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AND ITS PRACTICAL APPLICATIONS

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THE MODERN CENTRAL STATION.

Elsewhere in our pages will be found a full account of the present condition of the great Quarry Street station of the Commonwealth Edison Company of Chicago, of which there has been previous notice in our columns. The article is too rich in details to summarize and will repay careful study as showing the evolution of the great modern power station. Its importance to the art lies not so much in its being a very big station, which it is, or a very well planned station, which it also is, but in its being the manifestation of very large ideals in central-station practice and exemplifying in a very remarkable way the bigger concepts and the wider view of central-station practice. The Commonwealth Edison Company has for some years been a leader in many things, but in nothing more conspicuously than in the grasp of the larger electrical situation as it exists in the beginning of this the twentieth century. It is a notable thing even in these days of big stations to find a new station rising to 84,000 kw capacity in six gigantic units. It is a much more important thing to realize that still another station, several miles distant, of 120,000 kw is under construction, and a third alongside it of equal rating is already planned. These two colossal stations will have 20,000-kw turbo-generators as the units, and the first pair of these is expected to be in service before the close of the year now beginning.

The maximum load on the Commonwealth Edison plant last year was 182,600 kw, and the plans for larger load are now being carried out so successfully that the chances are good for load commensurate with the capacity of the new stations by the time their generators are ready to turn over. A great fundamental principle back of this huge development is that the electric central stations of a great city should be planned to take care of all the power output that the city requires for all the various purposes in which power is used, and that these stations and the distributing system should be so skilfully and economically planned that this power load must by economic necessity come to rely upon them. The view is a logical one and it has been consistently followed in the development of the Chicago central stations. The end has already justified the undertaking. It is not the lighting of a big city with incidental motor service that has been the ideal of the creators of the Commonwealth Edison Company, but rather the acquisition of the entire electric service of a great territory not limited by even the city limits, nor confined to any few classes of service. One of the interesting features of the situation is that the time has evidently come when the gathering under a single roof of the generating equipment of a great city has ceased to be a logical procedure, when the territory served has become so huge and the size of the individual plants so great that aggregation is an inconvenience and a loss rather than an advantage. The stations of the past have generally been of such size that there could be economic gain in increase of size. The time has evidently now come when the individual plants have already reached an output so great that further increase would make no material decrease of costs, and when it is of more importance to locate the next great plant in a position advantageous for the distribution as a whole than to have it adjacent to a previous plant. The time has come when great central-station properties are looked on as permanent. to be built up with the future in view and to be made ready to meet its requirements. It is this point of view and the full realization of the enormous possibility of electrical load with which coming decades are fraught that gives to the plant here considered its vital importance.

THE WORK OF THE REICHSANSTALT IN 1909.

As recently noted in the Digest, a synopsis of the report of the Physikalisch Technische Reichsanstalt, at Charlottenburg, has recently appeared in *Engineering*. The organization of the Reichsanstalt is dual, one part being devoted to physical and the other to technical or applied physical investigations. At times the two sets of investigations necessarily overlap, but the two official reports are kept separate in the same volume. In the department of photometry much attention has been paid to life tests of metallic-filament lamps. In the photometry of carbon-filament lamps the rotation of the lamps is not recommended, because at the speed of 180 r.p.m., necessary for obtaining a flickerless photometric illumination, the filaments are apt to be distorted by centrifugal force. With ordinary metallic filaments, however, employing many thread ascents and descents with correspondingly numerous positions of luminous symmetry in the horizontal plane, a much lower speed of rotation may be used advantageously. It is interesting to note that for a year past a tax has been paid on illumination in Germany, and that in the case of glow lamps this tax is levied on the watt consumption. This brings to memory the war tax which at one time was levied in England on windows and window glass and which had a distinct influence on the architecture of the period. The tax on light in Germany is not a heavy one, but it manifestly does not serve as a stimulus or incentive to the electric lighting industry. It would be interesting to know what the tax would amount to on some of our city electric signs, to say nothing of indoor illumination. In the department of magnetics an interesting fact is mentioned concerning certain samples of pure electrolytic iron. When deprived of occluded hydrogen by being heated in a vacuum these samples are said to lose almost all of their coercitive force, so that an iron free from hysteresis loss may finally be produced. It is very remarkable that a substance like hydrogen scattered through the mass of iron sheets should be able to affect the hysteresis, and the fact may have important potential practical bearings.

One cannot read the list of researches contained in the report, some of which are of a most practical character, without recognizing the enormous importance of the Reichsanstalt to the technical and manufacturing industries of Germany. Not only are manufacturers able readily and inexpensively to obtain certificates of reliability on all the material they buy and all the material they sell, but they are also able to keep themselves informed, through the work of the Reichsanstalt, on the latest developments in every line of production. Moreover, when difficulties occur with new processes or new lines of development they can often obtain a helping hand from the Reichsanstalt, which can initiate such researches by trained experts if the results are judged to be of sufficient importance to the industry at large. It is, therefore, no exaggeration to say that the Reichsanstalt is the center and basis of German specialized industry. The value to Germany of an institution like the Reichsanstalt, or to this country of our Bureau of Standards at Washington, is enormous, and is not to be expressed merely in terms of money paid for services rendered. Over and above all money values lie the stimulus to increased and improved productivity, the national prestige based on accurate knowledge of the facts of construction and production, and the encouragement of the engineers.

COMMUTATOR SEGMENT VOLTAGE IN DIRECT-CURRENT MACHINES.

As is well known, by many years of experience, the commutator is the most sensitive element of a direct-current machine and the weakest link in its chain of operation. It is wonderful how little trouble commutators give in practice considering how easily they may be put out of order, either mechanically or electrically. As a general rule all commutators spark at their brushes under normal loads. In most cases the sparking is insignificantly small, and in some cases it is almost microscopically small. It is only when the sparking exceeds a certain limit that it becomes serious and objectionable. Sparking may be considered serious (1) when it makes the commutator hot; (2) when it erodes or consumes either the commutator or brushes at an undue rate; and (3) when it approaches the limit at which an arc or flash-over on the commutator will occur between the brushes of opposite polarity. A machine may operate satisfactorily at its commutator under normal conditions, but may have so little margin of sparklessness that a slight accidental disturbance in the electric system, such as a momentary overvoltage or a momentary overload may cause the commutator to flash over, short-circuiting the mains, opening circuit-breakers and possibly injuring the machine. The theory of the commutator and its action is very complicated, and in its refinements exceeds the capabilities of modern analysis. But a working theory has been evolved after a great deal of experimental research carried on by a number of leaders in dynamo design.

One of the criteria of good commutation is found in the value of the average voltage between adjacent commutator segments under working conditions. If this segment voltage reaches a certain limit there will be a tendency to spark seriously; whereas, if the segment voltage is always kept well below this limit, quiet commutation may be assured. An article on the subject of segment voltage and its approximate measurement, by Mr. Theodore Hoock, has recently appeared in the *Elektrotechnische Zeitschrift,* as abstracted in the Digest. It is pointed out in this article that practical values for the segment voltage lie between 12 volts and 25 volts, and that it is ordinarily undesirable to exceed 30 volts or 35 volts. The ordinary shunt motor does not usually provide a greater speed range than 20 per cent on constant-potential mains. In such machines the segment voltage is readily capable of being kept within the required limits. When, however, a wide range of speed variation is called for by shunt-field weakening the tendency for the segment voltage to rise becomes very marked. In fact, the practical solution of speed variation with shunt motors in the ratio of 1:4 or 1:6 called for the introduction of compensating field poles intermediate between the main field poles. The article indicates how these compensating poles materially assist in keeping down the segment voltage at weak fields and high speeds.

TUNGSTENS VS. WELSBACHS FOR STREET LIGHTING.

A very valuable paper by Mr. Haydn T. Harrison was recently abstracted in the Digest, but no mere abstract could do justice to the thoroughness of Mr. Harrison's discussion or to its direct practical bearing on street lighting here as well as in England. London has been the great experimental station for trying out new lamps and new methods of lighting. The various boroughs have taken up the street-lighting matter with comparatively free hands and have tried very striking experiments. One of these, to which Mr. Harrison pays special attention, is of peculiar value to American engineers on account of its involving the substitution of tungsten incandescent lamps for Welsbach lamps on a fairly considerable scale. The light actually given by Welsbach street lamps has been the subject of much debate. The question is really one of upkeep so far as the illumination is concerned and of the relative prices obtainable for gas and electricity. New Welsbach street lamps commonly show up admirably, but it is the misfortune of the Welsbach mantle that it suffers acutely from the conditions of burning met on the street and falls off so seriously after a comparatively short term of service that it becomes necessary to replace mantles frequently if the illumination is to be kept where it is supposed to be.

The change to which reference has been made is in the borough of St. Marylebone. As a preliminary to any serious effort at the change the average candle-power of the gas lamps was tested by taking 100 lamps at random and measuring them carefully. The result showed for the single-burner consuming 4.25 cu. ft. of gas per hour an average of 50 cp. The double mantles of similar character showed 76.6 cp. A second investigation, conducted by Mr. Harrison himself, showed an average of 45 cp for the single mantles and 76 for the double. These facts are similar to those which have been ascertained in like investigations in this country, although from the figures it would appear that the London gas lamps are rather better kept up on the whole than those in American cities. From these data the tungsten outfit was designed. Each single gas lamp was replaced by two 35-watt tungsten lamps and each double lamp by two 55-watt lamps. The existing lamp-posts and lanterns belonging to the Borough Council, and being in good condition, it was decided to retain them, which was done with the addition of a suitable reflector. The cost of conversion of the posts for their electric equipment was little less than $15 each, and 200 posts a week were thus changed, the total number of gas lamps displaced being nearly 2000. On the strength of the results by these the Council has decided to change the nearly 1400 remaining gas lanterns to electric as soon as possible.

Not only did the new arrangement give improved results in illumination, but it proved to be actually cheaper than the gas service it replaced. In some instances where the double mantles previously used had seemed insufficient two 80-watt tungsten lamps were used instead of two 55-watt, with a corresponding great increase in illumination. The posts are distributed in the more important thoroughfares at seventy-six to the mile, and at sixty-five to the mile in the less important streets, and under the new conditions the average minimum direct illumination is stated by Mr. Harrison to be for the main thoroughfares 0.15 ft.-candle and in the streets of lesser importance one-third to one-half of this amount. This is a very satisfactory degree of illumination from any point of view, and it well shows the admirable results that can be obtained by the intelligent use of tungsten lamps. This Marylebone experiment ought to go far toward demonstrating the desirability of similar changes elsewhere. The cost of energy for this particular service was figured low, about 3 cents per unit, and at this price tungsten lamps were materially cheaper than the gas lamps; but if one were to make the comparison, not on the basis of cost per lamp, but on the basis of effective illumination, gas would have made but a poor showing even had the price of electricity been considerably higher than it was.

DESIGN OF HIGH-TENSION CABLES.

Much attention has recently been given to the design and selection of high-tension cables by electrical engineers, owing to the increasing need for high-tension underground cable networks. Papers on the subject have been read before both the British and American Institutes of Electrical Engineers. Three types of high-tension cable are now well recognized, namely: (1) Simple, single-conductor cables, comprising a cylindrical central conductor, usually of copper, an external concentric conductor, frequently of lead, and a concentric cylindrical layer of insulating material between them; (2) multiple-conductor cables in which two or more insulated conductors are associated under a single external cylindrical sheath, and (3) graded cables containing a plurality of concentric insulating layers of different materials arranged in such order and thickness as to reduce the intensity of the dielectric stress in the cable. It is now well understood that the intensity of the dielectric stress tends to a maximum at the inner wall of any cylindrical insulating layer and increases with the curvature, so that it is greater over a thin wire than over a thick wire, other conditions remaining the same. Up to 10 kilovolts of effective working stress between conductor and sheath the design of a single cable offers little difficulty, but troubles commence when a 20-kv cable is sought, and they multiply when a 40-kv cable is desired. The cost of such high-tension cables rises rapidly above the 10-kv limit.

An article on the elementary design of ungraded cables, by Dr. Paul Humann, has recently appeared in the *Elektrotechnische Zeitschrift* and is abstracted in the Digest. It gives the well-known theory of the dielectric strength of these cables in a slightly different form from that generally employed. In particular, it presents curves of the cable diameters for given tensions and conductor radii leading to the selection of a cable of minimum total cost for a given service. It would seem as though high-tension cables must be used to an increasing extent in cities, and there is a great demand for some fairly cheap insulating material of high dielectric strength, mechanical elasticity and chemical stability. Rubber is the best material known at present, but the price of this is very high. Varnished cambric and paper come next for consideration, but it should be possible to find a new material for the purpose as good as or even better than rubber. Curiously enough, nearly all the solids of high insulativity are rigid and non-elastic substances, such as sulphur, porcelain, glass and shellac. It has even been suggested that the property of insulativity depends upon, or is at least associated with, mechanical rigidity and brittleness: but the fact that rubber is both one of the best insulators known and also one of the most flexible of solids suggests the possibility of discovering artificial substitutes combining both qualities.

ELECTRICAL GROWTH IN 1910.

In no sense can 1910 be regarded as a year of great and spectacular activity in the industrial field; in fact, as the year closes the iron and steel trade might be said to be at a minimum of productive effort, with consequent severe restriction in other lines. The railroads have limited their purchases; no great enterprise, save Panama perhaps, has focused consumption or stimulated manufacturers; while even now capital is extremely cautious and slow as to its commitments in big "building for the future." Yet, on the whole, 1910 was not a bad year; in many respects it was a good year, and all the electrical industries enjoyed a steady advance much more sound and healthy than marked the notable expansion up to four or five years ago. It would be interesting, if it were possible, to know how far the electrical growth of these days is due specifically to the development from within each industry and how far it is due to supersession by other methods. For example, in street-railway work electricity now knows no rivalry, but the electric light still burns brighter every year because of the competition it meets and engenders. The electric motor is making good, but has many a rival among other powers. As for electric heating and cooking, it is simply marvelous that the art grows as it does in face of competition with cheapening gas.

	1909.	1910.
Electrical apparatus made	$275,000,000	$300,000,000
Electric railway earnings	475,000,000	520,000,000
Central-station sale of energy, etc.	250,000,000	300,000 000
Telephone earnings	250,000,000	275,000 000
Telegraph earnings	60,000,000	65,000,000
Isolated light and power plant earnings	75,000,000	100,000,000
Miscellaneous electric service	50,000,000	75,000,000
	$1,435,000,000	$1,635,000,000

It is usual for this journal to present annually its estimate of the public expenditure for electricity and electrical services. More often than not the figures are closely confirmed by census statistics and other data, but it is possible to go astray, and the table above should be taken only as an estimate of what are likely to be the approximate sums, bearing in mind that up to the beginning of 1908 the actual figures were available.

With regard to these figures it may be said that in a general way the growth of electricity is at the rate of about 20 per cent per annum over a period now reaching twenty-five years. It does not seem plausible that such a rate can be maintained, and, as the figures bulk up, it is most natural to look for a decline in the rate. Yet it is the fact that a great many electrical properties during 1910 show rates above 20 per cent, and these, too, the largest utilities. In the above table the gain in electrical manufacture has been taken at about 10 per cent; in electric railways at 10 per cent, which may be slightly low; in central station work at 20 per cent, which is about right; in telephony, nearly 20 per cent; in telegraphy, about 7 per cent; in isolated plant service, nearly 30 per cent, which may be excessive, but includes a lot of big power work, mines, battleships, etc.; in miscellaneous service, 50 per cent, which also may be high, but is likely to be correct. In other words, the largest single item of gain is taken at a low rate, and this would offset any excess in the smaller gains assumed at a higher rate. The progress in electrometallurgy and chemistry must not be overlooked; the advances made by the electric vehicle must not be forgotten; and there are a dozen or score of minor uses hardly dreamt of a year ago. On the whole, the *Electrical World* feels that it can stand by the total estimate given above, and is rather inclined to raise it to $1,750,000,000. But it is best to be on the safe side.

ELECTRIC LIGHTING.

It is pleasant to be able to record very material progress in electric lighting. To begin with, the material of lighting has been considerably improved. The tungsten lamp has, from the general experience of the central stations using it, been very substantially improved in quality as respects mechanical strength, an improvement in which the wire-drawn filament is beginning to play a considerable part. The result has been a very gratifying decrease in the breakage of lamps during shipment and in early burn-outs. It is hard to say from the data at hand whether the lamp shows much increase in average life, but the indications are rather favorable than otherwise. The normal standard efficiency has not been changed, nor does it seem likely to be. There has been, however, a very considerable change in the size of units available. The larger tungsten lamps of 150 watts, 250 watts, 300 watts and 400 watts are coming into use with very good results, particularly the two first sizes mentioned. A year ago engineers were going rather slowly in recommending these larger units, while now they do so without much hesitation. At the other end of the scale it is unfortunate that lamps taking as little as 15 watts and 20 watts at the ordinary voltage are being urged on central stations and consumers that otherwise would be fully content with the 25-watt and 40-watt units, which, if allowed to follow a natural course, would become the standards for interior illumination.

The tungsten lamps of voltage lower than 110, including the small, low-voltage sign lamps, are making some impression on special lines of lighting. The Hartford experiment, to which we have referred several times this year, seems to show the applicability of such small-voltage units to domestic lighting under conditions not generally considered altogether favorable. The reversion toward contract rates for these special classes of service, as shown in Hartford, and since then in a number of other places, is a very interesting development of high-efficiency lamp practice. The preliminary reports of this kind of service are on the whole rather encouraging than otherwise, and it may be that the combination of lower generating costs and increased lamp efficiency will tend to produce large increase of this class of central-station load. The electric sign business, which of late has been so considerable an item in the work of some central stations, seems to show no signs of declining. On the contrary, it seems to have come to stay, barring misuse esthetically that would lead to a reaction.

In street-lighting work there has been a very conspicuous movement toward more light and better light. This has been materially helped forward by the general use of the series tungsten lamps and the improvements in the types of arc now available for first-class lighting. The magnetite arc in the higher powers has made a strong impression on the art, and in the larger cities there are as well tendencies toward the installation of powerful flaming arcs for specially important situations. A good deal of recent progress can be put to the credit of the activity of merchants' associations, which have taken up the work of street illumination where the city has left it and have produced results, sometimes, it is true, rather flamboyant, but on the whole setting an example of first-class lighting that cannot fail to lead to better things. The luminous and flame arc in general have been very materially improved. They are not yet perfect, for the problems of lamp ventilation are very grave ones, and on lamp ventilation depends the final results attainable with these arcs, differing as they do widely from carbon arcs in that the products of combustion are solid instead of gaseous. The ordinary inclosed carbon arc must now be classed as obsolescent, and the production of the present large incandescent tungsten units will hasten its path toward oblivion, although it will probably hang on for a considerable period, just as the open arc has here and there survived even to the present time. But it must be admitted that the carbon arc has seen its best days, and a first-class luminous arc for alternating current would soon push most of the carbon arcs out of service. It is greatly to be regretted that the titanium arc for alternating current has fallen upon evil days and is no longer being installed to any considerable extent. It was a light of great promise on account of its admirable efficiency, and in some new modification may not improbably take a new lease of life. Another line of recent progress has been in the intensified carbon arc, of which the use for indoor lighting has very greatly increased during the past year. It seems satisfactorily to meet the color difficulty left outstanding by even the best incandescent lamps.

No new illuminants of any sensational characteristics have appeared during the year. The mercury arc and the Nernst lamp have been pursuing the even tenor of their way, the former in particular having made large inroads in the lighting of garages and industrial establishments. It is interesting to note here that the effect on the eye of the mercury-arc rays is not only harmless, notwithstanding early suspicion to the contrary, but workers under such light believe that it produces a beneficial effect on the eye even to such an extent as to warrant its being classed as a curative agent. From the central-station point of view the year has been a rather encouraging one, in spite of periods of dulness, and on the whole 1910 can be reported as a year of highly satisfactory progress in lighting matters.

ELECTROTECHNICAL PROGRESS IN 1910.

Electrical engineering is now so thoroughly incorporated with other branches of engineering that its advance is also a measure of the advance in engineering as a whole. For example, the largest single piece of engineering work in course of execution at the present time is that which is destined to sever the continents of North and South America, namely, the Panama Canal. Electrical engineering is to play a very considerable part in the operation of this canal. Similarly, in every important branch of engineering work electricity is continually assuming a more prominent share. On the other hand, electrical engineering is spreading in so many directions that no engineer can be familiar with all of its fields. Electrical engineers are specializing more and more. In fact, it may soon be necessary for students of electrical engineering to specialize before leaving the college or technical school. Specialization in electrical training, which has already commenced, though justifiable from the industrial standpoint, narrows the life opportunities of the engineer and threatens in time to detract from the standing of the profession at large with the public. During the past year very substantial electrotechnical progress has been witnessed. The central stations have tended to deliver larger powers with larger units than heretofore and have also tended to higher voltages. We now have generator units of 15 megawatts and the limit of capacity in a single unit is not yet reached. Improvements have also been made in transmission-line insulation for high voltage, so that the line insulator is ceasing to become the weakest link in the chain of a long-distance power-transmission system.

A notable event in the electrotechnical year was the conference of the International Electrotechnical Commission at Brussels. The success of this conference augurs well for the success of the commission in its future meetings. A distinct start was made at Brussels in the direction of international electrotechnical terminology and the selection of equivalent technical terms from different languages. Another direction in which a start was made at Brussels was in the standardization of electrical machinery by the recommendation that all machines, generators and motors alike, should be rated in watts. Decided progress was also made at the conference toward a working international electrotechnical notation in the provisional adoption of eight symbols as a nucleus for a future list. In time it is to be hoped that, say, twenty or thirty of the most important electrotechnical symbols may be standardized internationally. A larger number would probably be too irksome and a smaller number would probably lead to much confusion in the comparative technical literatures of different countries. The Brussels conference also undertook a very important duty, namely, that of deciding upon an international standardization of the direction of rotation of vectors in alternating-current vector diagrams. This promises to be a great boon to the whole world of electrical engineering.

The year has also witnessed the successful laying of the first ocean cable loaded with Pupin coils. This was laid across the Straits of Dover and has enabled London to be brought into telephonic union with Paris. The achievement is not only in the design, manufacture and laying of loaded cables, but also in the design and predetermination of telephone circuits. Improvements have also been made in transoceanic wireless telegraphy, whereby a regular wireless telegraph service over the Atlantic Ocean has been established. Incidentally, improvements in telephone relays have contributed to this result by increasing the sensitiveness of the wireless-telegraph receiver.

A research made during the year at the Bureau of Standards has shown that the temperature coefficient of resistivity in copper is proportional to the electrical conductivity of the sample within the range of variation met with in good commercial copper. This relation places the conductivity and the resistivity temperature coefficient upon a parity in their practical importance to the electrical engineer who uses ordinarily good copper conductors, but, at the same time, simplifies the task of measurement by requiring only one of these two quantities to be measured. The year has also witnessed an important step in American electrotechnical literature toward international legibility. To the trained engineers of all countries save Great Britain our electrotechnical publications are to a considerable extent sealed books, because of the antiquated and complicated pound-foot-inch units of measurement in which they deal and which can only be deciphered internationally by reference to troublesome tables of equivalents. During the past year an editing rule has been adopted by the American Institute of Electrical Engineers, the American Electrochemical Society and the Illuminating Engineering Society to add international numerical values, in parentheses, after each English value in all publications. This plan not only brings our electrical engineers into closer touch with our confrères abroad, from whom, in many directions, we have much to learn, but it also supplies automatically a valuable check and confirmation on numerical valuations of all kinds.

THE CENTRAL STATION SITUATION.

During the past year nothing especially suggestive of comment has occurred in the general central-station field. The tungsten lamp continues gradually to displace the inefficient carbon filament, which latter would be much more rapidly becoming a curiosity of the past were it not for the serious question of station income involved in the change from the old to the new. As a means of competition with gas, the tungsten is in many places making amends for its intrinsic commercial defect as a meter accelerator, and in the street-lighting field is showing what it can accomplish for the central station when given a fair show. The period of transition from the carbon to the tungsten filament would have been far less painful and less strung out if the central station industry, upon the advent of the latter, had, as a body, made a determined and persistent effort to raise the standard candle-power unit to the level of the 40-watt tungsten. By so doing it would have been placed on terms of lighting equality with the mantle candle-power of the gas industry, and little or no resistance would have been encountered from consumers; for the whole history of economics has shown that people upon the cheapening of a necessity or convenience, instead of reducing their expenditure for it proportionately, simply use enough more to balance the cheapening. Furthermore, the substitution of the higher candle-power would not result in over-illumination, since the human eye does not recognize an upper limit of illumination until the intensity of daylight is approached. In greater intensity of illumination much more progress has been made in exterior than in interior lighting. The progress in this respect has been satisfactory where new contracts for street lighting have been made during the year; and central stations owe much to the enterprise of merchants' associations in educating the public to the advantages of better street lighting. Every special installation of this kind is an object-lesson for better lighting of all streets, and merchants should everywhere be encouraged to organize "downtown" lighting associations. The increasing use of the flame arc in street lighting will further forward the good cause; and it is gratifying to note that when incandescents are applied to street lighting they are of much higher candle-power than the one-time street carbon incandescent. "More light for the same money" is more than a slogan for central stations, for it also stands for the brighter illumination which should displace the past relative gloom of artificial lighting.

The rate question still continues to be the subject of wide discussion, and the "best" rate systems are becoming increasingly numerous. This multiplication of systems appears in part to spring from lack of real comprehension of the basic principles of rate-making, or perhaps it should be said of discrimination as to their relative weights. It is remarkable that few, if any, of proposed systems add anything to the theory of rate-making as laid down by Hopkinson in 1892, though this is rather a tribute to the genius of the scientist who became a central-station engineer than a criticism of the ability of those who have since taken up the subject. While it would be desirable to have a single rate-system of authoritative source, it now seems that it is by a process of cut-and-try that the outlines of a permanent system will finally be fixed; and that in any event local prejudice, personal opinion, legislation, ordinances, public utility rulings and other considerations will govern final accordance with an ideal system. Several interesting experiments with partial flat-rate systems will be watched with much interest, and particularly those designed especially for small residence service. Even the heterodoxy of flat rates could be borne if it introduced the electric light into the small residences from which central-station service has heretofore been barred, and which vastly outnumber in almost every community the number of houses at present using electric light.

The tendency appears to be increasing toward the consolidation of central station properties in syndicates of national scope, and the merging of numbers of small companies into a single one, supplying from a central generating plant the service formerly given by each of the component companies. Perhaps the greatest progress of the year has been in the application of the idea of "new business" organizations and in the increasing perfection of detail in such organizations of older date. The growth of this development has been so rapid during the past few years that, from being the subject of reproach for weakness in business management, many of our more enterprising central stations rival in commercial methods old-established lines of business and in cases can even give pointers to the most up-to-date among these. The requirement of rational methods of accounting in the case of plants in States having public-service commissions has finally given to that important subject a serious status it formerly lacked, which change in spirit is doubtless partly due to the probable extension in the near future of public utility regulation, and this makes it a matter of good policy to get things into shipshape condition before the advent of the inquisitor. One undeniable boon which public-service commissions have conferred on plants coming under their supervision has been the requirement of a system of accounts which incidentally enables the central station to know the actual state of its business, to follow its progress intelligently, to discriminate between losing and profitable service, and to have facts on record that will enable formerly unsuspected loss to be turned into profit, if that be possible. Various matters relating to central-station details are treated under separate heads in the following pages. In general, the situation in its various aspects appears one full of promise for the enterprising central station.

PROGRESS IN ELECTRICAL SCIENCE.

Although it is quite possible, and indeed often happens, that during the space of a twelvemonth pure science in any given field may make very different progress from applied science, the one sometimes temporarily outstripping the other, yet in the long run the two are so closely connected that the progress of the one means the progress of the other. In the year just closed very satisfactory progress has been recorded in electrical science. The electronic theory has made notable strides through what seems to be the isolation of negative ions. Ordinarily, electrical workers do not deal with ions alone. When ions come, "they come not single spies, but in battalions." The single ion is believed to be so minute that about 1000 of them weigh collectively as much as an atom of hydrogen. Since the largest molecules of chemical substances are ultramicroscopically small, and the hydrogen atom must be a very small atom, the ion must be ultra-ultramicroscopic. Nevertheless, the electric forces capable of being developed by a single ion are relatively so strong that the addition of a single ion to a small mass of matter, such as a droplet of oil, is capable of changing the electrical properties of the mass in marked and easily recognized degree. In this sense the isolation of negative ions is believed to have been witnessed by more than one observer during the past year. This ionic negative charge is supposed to be the fundamental unit of negative electric charge. One can have multiples of this charge, but not subdivisions. A smaller charge than this fundamental unit is at present both inconceivable and unbelievable. Experiments have also been made tending to indicate that the positive ion may have been isolated. There is still much debate as to the existence and nature of positive ions. In this sense the old debate of the one-fluid versus the two-fluid theory of electricity has been resuscitated and given a new lease of life and energy in an entirely new sense that the original debaters would never have recognized.

Experimental researches have been continued with success in powerful magnetic fields and our knowledge concerning the magnetic properties of iron and iron alloys in these fields has been materially extended. Alternating magnetic fields have also been pushed to limits not previously explored and incidentally a perceptible physiological effect of such alternating fields upon the human senses has been announced. In the region of terrestrial magnetism much new material has been collected through the wandering cruises of the steamship *Carnegie*, that goes about to seek the dip and declination of the compass needle in all parts of Neptune's dominions. The modern steel ship is entirely unfitted for this work, and a large number of appreciable, but not very serious, discrepancies in the magnetic elements of the ocean charts have been brought to light in this way. Progress has also been made in deciphering the immense and complicated hieroglyphics of terrestrial magnetic observatory records by researches into the rate of propagation of magnetic storms. These magnetic storms are not only mysterious phenomena, but they also bring very manifest distresses to electric signaling over long distances, both wirelessly and by wires. Researches continued during the year into the properties of linear electric oscillators related to the aerials of wireless telegraphy have tended to confirm that particular previous theory of their action which defines the height of a single unloaded vertical wire with a good ground at the base as very nearly a quarter of the wavelength of emitted waves. There has been a good deal of debate over this question in the past. A recapitulation of the year's scientific records in electricity would not be complete without reference to the joint research of the National Laboratories of England, France, Germany and the United States, at the Bureau of Standards in Washington, over the internationally acceptable technique for the electrochemical equivalent of silver and the international value of the e.m.f. of the Weston cell. This joint research of scientific experts from the various national laboratories is an innovation of great importance that the past year may clearly claim as its own.

THE SMALLER CENTRAL STATION.

When it is recalled that of the 6000 central stations in this country more than 85 per cent are to be found serving communities of less than 5000 inhabitants the aggregate importance of the problems of the small electric-light company will be somewhat appreciated. In fighting the battles of competition with old illuminants, and educating the ultra-conservative public of these communities to the possibilities of electric-motor drive and heating appliances, the path of the small-town manager is beset with difficulties. But any one who has had an opportunity to study the smaller plants of this country, in whatever section, must be ready to testify that on the whole the future of electrical development in the small cities is in excellent hands. The electric-light manager of this character, we dare assert, will be found usually to be better informed, more progressive and public-spirited as a citizen, and a closer student of the details and advances of his complex business, from steam apparatus to customers' rates, than are any of the town's leading bankers, merchants, contractors or other business men in their own older established occupations. Increasing factors in this progressive personnel are the young technical graduates, often town boys or sons of the local plant owners, who return from academic studies and industrial experience, bringing the best ideas of modern practice to the aid of the home plant.

During recent years the small central station has shared in the phenomenal growth observed everywhere in the electrical industry. The number of lighting customers has customarily grown far more rapidly than the town's population, and motor loads, electric irons and other day-service devices have come to the aid of twenty-four-hour operation. There are few towns provided with an electric-light plant which could not support a properly campaigned day service from among the local printing offices, grain elevators, shops and factories and home heating apparatus. When twenty-four-hour service has been begun few managers regret the move, in spite of the interval of increased cost at the outset. Such continuous service is made more economical by transmission combinations, extending the lines of the company out to serve neighboring communities. The success of such systems is attested by the increasing number of these interurban transmission lines, the generating company either doing its own distributing or wholesaling to a local company for distribution. Under equitable price agreement, both arrangements have been found mutually profitable to company and customer. Where such lines penetrate good farming country rural customers along the route are found to be good consumers of electricity.

As noted recently in these columns, a remarkable boom in isolated lighting systems with gas engine and battery has resulted from a well-directed campaign of advertising to farmers. Such isolated installations cost from $500 to $800, and provide electricity for lighting, and for driving pumps, churns, separators, cutters, saws, etc. The lesson of this isolated-lighting plant movement, from the central-station viewpoint, would seem to be that the farmer, now become our most prosperous class, is anxious to get the benefits of electric service and is willing to pay well for it. In many instances when such farms are not too remote from electric plants, it should be possible to induce the owners to invest nearly an equal amount in transmission lines and apparatus, a number clubbing together when possible, and so obtain unlimited electric service without the inherent drawbacks of isolated operation with storage battery and gasoline engine. This opportunity for the small-town central station is beginning to be worked out successfully in several Middle West farm communities, where the farm owners bear part or all of the pole-line expense.

Combinations of the electric-plant functions with ice-making, steam heating and water pumping have also proven successful additions to central-station operation on account of the interesting complementary relations between the demands of these classes of service. Plants operated at a loss in small towns as simple electric stations have been known to become dividend-paying properties after auxiliary ice-making or steam-heating was added to utilize waste products to advantage. Internal-combustion engines using gas and oil as fuel have also shown attractive performances in small units, rendering good central-station service in places where exhaust steam is not of value, or the special fuels employed are unusually plentiful or cheap. The steam turbine and exhaust steam turbine do not show their best economies of performance under the non-condensing conditions prevalent in the small central station, but new types of European steam engines are attracting attention in this country, from showing operating results that give increased expectancy to the reciprocating type of steam-power machinery. The purchase of steam from the boilers of some local manufacturing plant has been found a successful expedient in many small stations, avoiding the stand-by costs of keeping plant boilers in service during light day loads. The central stations can reciprocate after darkness, supplying lighting and motor service when it is desired to operate some department of the factory overtime.

Rates do not occupy the attention of the small-town manager to so great an extent as in the case of his co-worker in the larger cities. The rates of the successful small station must be simple to understand and involve a low minimum charge. The lower scale of household expense in small communities makes a large minimum seem prohibitive, and several successful operators have learned that by conceding this initial point they profit well from the increased business and heavy bills during other periods of the year. The average small-town resident is suspicious of a rate schedule so complicated that he cannot understand it. However, the flat rate is steadily giving way to metered service in the small places, as it did a decade ago in the larger cities. Controlling devices for limiting current demands are not so important in small towns where the lighting superintendent carries in his head the number of lamps in Widow Johnson's dining-room and the location of every electric iron in town.

The story of the tungsten lamp's advent with many small stations is sometimes one of 100 per cent increase in illumination and 33 per cent decrease in bills, but the ornamental tungsten street lighting, recently become so popular everywhere, has provided a brand-new outlet for central-station energy. Sometimes this service is paid for by the merchants, property owners or city, and being long-hour business is often the subject of a profitable contract. Sign lamps may make the streets of the humblest village attractive after dark. The central-station man also has the tungsten lamp to thank for the powerful weapon it provides him in competing with gasoline and gas incandescent-mantle lighting systems. The gasoline-lighting problem is doubtless one of the hardest situations the electric-light man is called upon to confront, but the over-thrifty owner usually returns to the electric company's service after a few months' experience with the dimming mantles, excessive gasoline consumpion and tremendous fire hazard surrounding every such plant.

ELECTRIC ENERGY TRANSMISSION.

From an engineering standpoint electric power transmission has, aside from the operation of the Hydroelectric Power Commission of Ontario, been taking the rest cure of late, so that while there has been a considerable amount of new construction within the year just closed it has evolved, save in minor details, and this chiefly on the hydraulic side, comparatively little of novelty. The fact is that the apparatus and methods are just now pretty well standardized, which always implies a temporary cessation of improvement until the art takes a fresh start in perhaps some unexpected direction. There has been no increase in working voltage worth mentioning; the top figure of somewhere nearly 110,000 volts is maintained only in a very few plants, and the more ordinary figures of 50,000 to 70,000 are such as to call for little comment. In fact, we very much doubt whether the new constructions of the year show any material change in voltage as compared with the construction of last year. In fact, a plant actually working at 100,000 volts is at a point where, unless the necessary amount of energy to be transmitted is enormous or the distance is very great, ordinary mechanical considerations determine the size of the copper and further increase of voltage would mean taking considerable risks for very small gain in efficiency. Even in the few cases where the size of copper at 100,000 volts is such that considerable saving in cost would be secured by further rise of voltage, it still remains a question whether the extra insulation demanded would not in the long run cost more than the copper and whether, granting that the size of the copper could be reduced, it would not pay better to maintain the copper unreduced in total amount, but in the form of a duplicate line.

In general power-station design, granted the maintenance of any of the standard voltages, there is little occasion for novelty. In fact, for the ordinary design of a power station one could write something very like a prescription, given as symptoms the distance of transmission, the amount of energy, the available hydraulic head and the names of the bankers who underwrote the bonds. As the financial question is rather more often the amount of bonds that can be placed on the property than the determination of minimum fixed charges, the engineer has ordinarily comparatively little to do save pick out the necessary standard sizes and speeds of machines and select from suitable catalogs the largest amount of switchboard apparatus that his conscience will permit, since nothing makes a better appearance when the bondholders drop around than an elaborate and beautifully organized array of automatic switching apparatus. The brunt of the real work falls upon the unhappy constructing engineer, who has to stand as a buffer between the designing engineer and his backers, on the one hand, and a miscellaneous crew of contractors, on the other. It is small wonder, therefore, that the electric end of energy transmission is just now in a position of stable equilibrium and that the real engineering activity is most conspicuous in hydraulic work, of which the detailed operation—Heaven be praised!—cannot be conveniently standardized.

The most encouraging feature of electrical progress is the steady tendency toward the organization of large distributing networks, which, in the long run, must prove to be of great importance in the securing of cheap and reliable transmitted energy. Just how far even this will benefit the public, if the present tendency toward wholesaling energy is kept up, it is a little difficult to say. The natural and proper line of development is that pursued in some of the important Western networks, where a large territory is actually supplied practically at first hand from the transmitted energy. The normal process for a great electrical development is the constitution of what is virtually a single huge central-station organization covering a county or two instead of a town, and taking full advantage of all the resulting possibilities of efficient distribution. In fact, looking at the matter in the large way, the most useful and best-managed energy transmission systems are these which have grown up around ordinary central-station practice These matters aside, it seems that the line of progress marked out for the immediate future is rather the organization of efficient and widely ramifying networks than any particular change of methods and apparatus

The situation with respect to electric energy distribution in many regions is very illogical. There are small stations scattered here and there working from steam or water, or both, and hydroelectric transmission companies wholesaling energy to some stations and to a few private consumers in the same territory. There ought to be instead a physical merger of the properties into one coherent network under one systematic management, organized not as a raft on which to float securities, but as a conservative corporation to derive its profits from the sale of electric energy. There is comparatively little need for any radical changes on the engineering side of the work until the organization of such networks requires changes of method in order to meet the requirements of larger and longer transmissions than are now common. At present the best engineering in electric energy transmission appears to be that being done by the Canadian Hydroelectric Commission and the Southern Power Company, accounts of whose work have appeared in these columns from time to time. There are no very long-distance enterprises at the moment in sight, and hence there has been no occasion for changes in practice. Even the larger projects of railway electrification with their accompanying beautiful problems in transmission seem to have for the present subsided.

THE ELECTRIC VEHICLE.

While during the past year the electric vehicle has experienced no boom, it has made substantial progress, particularly in the way of establishing a firm basis for future development. The ill-advised spurt of ten years ago left an evil effect which persisted beyond all reason; but the lingering suspicion as to the actual merit of the electric vehicle may now be said to have disappeared from the minds of all whose opinion is worth considering. An evidence of the revival of confidence is given by the support accorded by the leading central-station men of the country to the recently founded Electric Vehicle Association of America, which promises to be a most important factor in rapidly advancing the interests of storage-battery vehicular traction. As long as the full confidence of central-station men was withheld the cause was seriously handicapped, for the public could not be expected to take a serious interest in a proposition not meeting the full approval of the very men to whom it should appeal through the profit involved in the increased sale of electricity Happily, this reluctance now appears finally overcome, and the association should find the central-station industry its strongest aid, as well as the most efficient agency, in the propaganda about to be started.

Through gradual improvement the transportable lead battery has been brought to a state justifying the claim that, with ordinary care, it now amply fulfils the practical requirements for vehicular service; and the new alkali battery has in service sustained to a high degree the claims made for it. There are thus now two distinct types of transportable storage batteries to be confidently counted on in developing an electric vehicle industry which, in a few years, should take a place among the more important branches of electrical application. That such a prediction of large development is warranted is shown by what has been already accomplished in cities where intelligent and well-organized effort has been made toward advancing the electric vehicle. We need only point to the examples of Cleveland and Rochester, Toledo and Washington, and among small cities, of Rockford, Ill. The first stage appears to be the cultivation of the pleasure vehicle, and success had been met in this field by avoiding competition with the gasoline touring car and concentrating on the superiority of the electric vehicle for urban service. In time relay stations will enable the latter to compete with the gasoline car, but the idea of such competition should at present be kept in the background. While the field for the pleasure vehicle is one of great profit in itself, both to the manufacturer and to the central station, it is, so far as relates to large cities and great manufacturing centers, secondary to the opportunity for the electric wagon and truck. It is in this branch that the electric vehicle will finally meet its greatest development, though necessarily progress will at first be relatively slower than in the introduction of the pleasure vehicle owing to the revolutionary nature of a change affecting an industry for centuries hitched to the horse and with which much capital and a large army of labor are associated.

As the electric vehicle has now been brought to a high state of technical development and passed entirely beyond the experimental stage, and its widespread use appears only a matter of future commercial exploitation, attention will be more and more concentrated on matters of detail that in the development period are naturally passed over. In his presidential address before the Electric Vehicle Association of America Mr. W. H. Blood referred to some of these, including the standardization of voltages, chassis and size of batteries, and the desirability of co-operation with the gasoline vehicle industry in the standardization of tires and wheel tread. It would also seem to be desirable to come to some consensus of opinion as to the charge range of the pleasure vehicle and of standard capacities for the electric wagon and truck. The electric truck is free of limitations in its competition with other means of vehicular transportation, but the pleasure vehicle is at a disadvantage when a general comparison is made with the gasoline car owing to the unrestricted touring range of the latter. While the future will undoubtedly witness the establishment of more or less complete systems of relay station charging, and perhaps even the development of a system whereby the owner of a vehicle can at each stage of a trip exchange a depleted battery for one fully charged, for the present it would seem a matter of good policy to standardize electric vehicles on the basis of single-charge mileage range under normal conditions. The charge range of the present-day pleasure vehicle is amply sufficient for city and neighborhood service, and a frank rating on the basis of mileage will do no harm, but, on the contrary, should do good by rendering the electrical proposition entirely definite to the prospective user and dissociating it in his mind from the long-range gasoline competitor.

The immediate work of the association, however, is educational, and, with the large monetary resources at its command, the merits of the electric vehicle should this year become known as never before to the public. In such a campaign the central-station industry should be a valuable auxiliary, if it can generally be brought to see that the interests of the electric vehicle are closely allied with its own interests, and that working for an electric-vehicle load is just as sound in policy as working for increased lighting or motor load. We believe that central-station men recognize in general the opportunity, and that with sufficient encouragement the central station can be made the strongest factor in the commercial exploitation of the electric vehicle. The relation between the association and this agency of exploitation should be as direct as possible, and might extend to the supply for local use of advertising copy and the compilation for distribution to central stations of an electric vehicle commercial manual similar to the Electrical Solicitor's Handbook issued by the National Electric Light Association.

DEVELOPMENTS IN ELECTRICAL MACHINERY.

No new types of electrical machines were placed on the American market in 1910, but standard apparatus was built in sizes which would have been considered impracticable, if not impossible, a few years earlier. Generators ranging in rating from 10,000 kw to 15,000 kw for operation at speeds of from 300 r.p.m. to 750 r.p.m. and synchronous converters rated as high as 3000 kw were placed in service during the past year. A difficulty which was encountered in operating certain of the early high-speed turbo-generators was caused by the excessive current delivered by the machines on short-circuit. The force produced by the short-circuit current distorted the armature windings and in some cases destroyed the generators when the windings were not sufficiently protected. Bracing the armature coils against the core minimized the damage occasioned by a short-circuit but did not lessen the current reproduced in the armature circuit. The immediate cause for the excessive current was the small value of the local magnetic leakage reactance of the armature coils, in which very few turns were used because of the high rotative speed. A later development, which tended to minimize damage by limiting the short-circuit current, consisted in inserting reactance in series in the generator leads. This scheme has proved thoroughly effective, but the design of proper reactive devices has been no small problem. A still later development consisted in passing the load current from the generator into the primary circuit of an "insulating transformer," the secondary of which was connected to the load circuit. This transformer was designed with the amount of magnetic leakage required for protecting the generator under short-circuit. According to the latest development, the protecting transformer is a two-to-one auto-transformer having the desired amount of leakage reactance and operating at extremely high efficiency. The generator is wound to deliver its load at one-half of the circuit voltage, while the auto-transformer is wound in such a way that it would be rated at one-half of the generator output if it were used as a one-to-one insulating transformer.

In the not far distant past, American engineers were discussing at great length the relative advantages of single-phase and three-phase transformers for polyphase service at a time when very few three-phase transformers were in use, and which type, in fact, was, in this country, distinctly non-orthodox. Conditions have so far changed that for the very large units the three-phase type may now be considered standard. Three-phase transformers are now being built in ratings as large as 14,000 kva, while 6000 kva is the rating of the largest single-phase unit thus far constructed. Although the standard high limit of transmission e.m.f. is still from 100,000 volts to 120,000 volts, yet an operating e.m.f. as high as 138,500 volts has been reached and testing transformers have been built for as high as 400,000 volts. In the transformer field an important improvement has been the increase in the maximum permissible size of self-cooling units from, say, the 800 kva of a few years ago to 2000 kva at the present time. This increase is attributable to the improved methods of causing the oil to circulate within the case and become exposed to the cooling effect of the exterior surface of extended area.

The polyphase induction motor remains the popular machine for general industrial service. Some departure from the earlier standard low-resistance, squirrel-cage form is to be noted in the increasing use of motors specially designed with reference to the service to be performed. Where formerly only so-called standard squirrel-cage motors would have been employed, use is now made of induction motors with coil-wound secondaries or with primaries arranged for multispeed operation. Few, indeed, are the services performed by the shunt-wound, direct-current motor in its various types that cannot be obtained by means of some form of the polyphase induction motor as now developed. Possibly the only exception is found in the adjustable-speed, direct-current motor, which has no successful rival in the polyphase induction type. A three-phase machine which offers inviting possibilities for development for adjustable-speed service is the polyphase commutator motor, which has not yet passed beyond the experimental stage in this country. It is not too much to look forward to the introduction of this type of machine in the near future. When that time arrives the highly successful variable-speed, constant-speed and adjustable-speed, direct-current motors will have worthy rivals in the single-phase commutator motor, the three-phase induction motor and the polyphase commutator motor.

INDUSTRIAL ELECTRIC POWER.

While there has been no shining installation of motors in industrial work in 1910 comparable with that laid down at Gary, Ind., in 1909, manufacturers report that the sale of small motors during the year has been larger in proportion to the total sales than ever before. That these motors have found their way to central-station circuits is evidenced by the increased earnings of electric light companies, which cannot be accounted for by any phenomenal increase in the number of incandescent lamps installed during the year. The movement toward the adoption of the electric motor as a source of power is very broad and far-reaching. Years of missionary work have had their effect and the universal experience is that one motor installation leads to another. It has been repeatedly shown that, taken on over-all merits and in detail, the electric motor drive not only equals but surpasses any other form of motive power. Heretofore the want of a well-defined plan of development for a load, which managers have now come to regard as their main business, has led to concentration on really casual work, because for the moment it appeared to be more profitable, certainly more showy, and in reality only added to the peak. For some unaccountable reason motor installations do not seem to leave great impressions on the minds of average solicitors. The motors usually lack human interest and are located in uninviting places; but these homely installations are continually grinding away and pouring income into the coffers of the electric light company. Just one taste of a good motor load is all the average manager needs to whet his appetite for more, and it is surprising to note how rapidly his vision broadens. Power customers no longer deal with men who are merely ordinary salesmen, good enough for selling a non-technical commodity, but unable to grasp clearly and point out just exactly where the motor surpasses an engine and why it does so. The supply of electricity is now regarded as being as much a business as the manufacture and sale of any other commodity, and the same business principles of development are being applied to it. Yet it is only within the last year or two that anything like a serious effort was made to push the use of electricity on commercial lines.

The first cost of electrical apparatus and machinery has always been a factor in the non-adoption of such apparatus in competition with gas and steam. Thoroughly technically and practically trained salesmen, animated by confident enthusiasm, have, however, largely overcome this objection by awakening interest in the mind of the manufacturer in the beneficial results to be obtained by motor drive and proving an actual saving possible. A minute study of the isolated plant problem, especially in the large cities, has revealed the fact that these are not so invulnerable to central-station attack as is generally supposed. Manufacturers of electrical apparatus with their well-equipped industrial engineering departments have done much to aid in the work of quickening the interest of the prospective buyer, and when working in conjunction with the central station the result is that complete and accurate information regarding the operating conditions of the particular plant is compiled and submitted to the heads of the firm, and these, being commercial men, realize the importance of cheap power, and, knowing the trend of future developments, make the best provision for the present. An unlimited amount of power available at any hour of the day or night by simply closing a switch is an advantage which cannot be overestimated. Where isolated plants are installed the generating equipment must almost equal the rating of the total motor installation, whereas the maximum demand on central station circuits for the entire installation is usually less than one-half the horse-power rating, and it is the maximum demand which influences rates. Contractors engaged in general municipal and other undertakings are also relying more and more upon electricity as a motive power, and the use of energy by them during the past year has been very great in some localities.

ELECTRIC HEATING.

The number of electrically heated devices in use at the present time is much greater than is generally supposed. The day for the general adoption of electricity for cooking seems much nearer now than it was a year ago, and with a satisfactory rate and improved apparatus substantial progress is not far distant. Among the more intelligent electric cooking utensils have found wide adoption despite the handicaps of a high rate. But the electrically heated devices do not fare so well in the hands of servants, and as in central-station practice the chances for waste are greatest in the boiler-room, so in domestic work the place for greatest losses is in the kitchen. It is, of course, necessary to get the attention of the mistress of the house in order to introduce electric cooking apparatus, but its reputation is made or unmade by the cook. This is the servant problem brought home to the central station. The 6-lb. electric flatiron is still the most popular heating device on the market. The manufacturers of these devices are now offering an electrical duplicate of every iron on the market at present heated by gas, coal or any other means. Next to the flatiron the electric toaster enjoys the widest sale, and the indications point to energetic toaster campaigns during the coming year. The toaster, like the flatiron, costs so little to operate and contributes so much to personal comfort and convenience that it is its own best advertisement. Strange as it may seem, the electric heating pad is the third most popular device and only because the manufacturer in this case, as in the two preceding instances, has produced an article which meets practical requirements. The use of percolators, chafing dishes, plate warmers and numerous other dining-room fixtures has increased amazingly and it is to these convenient, although small energy-consuming, devices that much of the popularity of electricity is due and that, for the present at least, managers must look to increase the residence load factor and income. Much of the domestic apparatus has been changed within recent months. Hermetically inclosed resistors are being adopted, the resistors being sealed within welded metal jackets, and the heaters can readily be removed for cleaning. Ranges are now made on which cooking can be done as quickly with electricity as with gas or coal, and the tendency is to pattern the devices after the gas range. Rates, however, are still the chief deterrent to the wide adoption of ranges, for in order to compete with artificial gas selling at $1 per 1000 cu. ft. electrical energy must be sold in the neighborhood of 3 cents per kw-hour. With such a rate it is possible to spot a town with electric ranges, and where lower rates prevail electric cooking has come into its own. With rates such as are offered in Ontario since the installation of the Hydroelectric Commission's service, electric heating and cooking should make rapid progress.

There are certain phases of the electric heating and cooking question, however, into which managers of central stations might delve deeply during the coming year with advantage if they have not already been brought face to face with the problems. Thus far the great majority of heating apparatus connected to central-station circuits have been of the small, portable variety which may be attached to existing lamp sockets. The use of such apparatus does not entail additional distribution expense to the central station and should be encouraged, since it not only increases the load factor of the system, but also brings in additional revenues and usually at the top rates. When the convenience of the apparatus is considered, expense, especially if it is not very great, is of minor importance. If it is desired to encourage the use of heating apparatus of this kind, and a schedule of rates similar to Hopkinson's is in force, the demand charge, or by whatever other name it may be called, can be abrogated, thus enabling all the energy consumed in a dwelling to be measured on a single meter and favoring the heating load by a minimum rate. Such systems are already in use in numerous localities. In the case of heavier cooking and heating apparatus, however, additional expense is involved both on the part of the central station and of the householder, who in addition seeks a reduced rate. Oftentimes the installation of a medium-size range does not call for heavier street circuits or larger transformers, although requiring heavier interior wiring. Where residential feeders have been installed, however, with an eye single to economizing on distribution and on load losses the installation of ranges will necessitate heavier copper and larger transformers.

Recently electric heaters have appeared on the market which, while consuming the same number of kw-hours, have the advantage of a greatly reduced maximum demand and an excellent load factor. In fact, by storing heat either in water or in an oven or cooker, it is proposed to give residence installations a load factor of 100 per cent with a consequent reduction in the price of energy—a consummation devoutly to be wished. Up to the present time the scheme has not progressed beyond the experimental stage, although it is fraught with great possibilities. The work has been confined to the storage of excess energy in water, rendering hot water available in the household at any time. When lamps or other devices are placed in circuit the water heater is switched out of circuit and vice versa. If this switching operation were performed automatically and without complication it would be quite an advance. Another form of heat storage is being tried, notably at Hartford, Conn., in connection with fireless cookers, and the progress made there is outlined elsewhere in this issue. Numerous other instances of heat storage in connection with fireless cookers and ovens may be cited, and work in this direction will doubtless be pursued energetically during the year.

In the industrial field electric heating continues to make haste slowly. Welders of all kinds which are automatic in their operation and do not require skilled labor offer advantages to manufacturers of great moment. For tempering high grades of steel the fuse-bath type of furnace deserves wider adoption than it has up to the present enjoyed. The printing, publishing and bookbinding trades continue to offer a wide field for the application of electrically heated apparatus; but in industrial work the general condition of the business of the country at large has a marked effect on the installation of new systems. The past year as a whole has not been an over-busy one in many industries, so that developments have been somewhat retarded, although many manufacturers have taken advantage of the lull and redesigned some of their apparatus.

Not all of the devices at present made meet the requirements of the user and a closer co-operation between maker and user is necessary before satisfactory devices are finally evolved. The same is true of some of the domestic cooking and heating apparatus offered for sale.

THE STORAGE BATTERY.

The past year has not been distinguished by any notable advances in storage batteries, if we except the notable progress made commercially by the Edison alkali cell. Recently the pasted plate has taken on new life, though it seemed at one time as if it was doomed to disappear as a commercial electrode, the Planté plate having been adopted coincidentally by several large American makers to the practical exclusion of the pasted plate. It appears, however, that the merits of pasted plates for "standby" batteries are meeting a deserved appreciation, and several large equipments have been lately installed in the lighting plants of the larger cities. For a reserve source of electrical supply in case of accident, such as lighting-station batteries on three-wire systems, and batteries across the exciter busbars of alternating-current plants, the pasted-plate battery is particularly suitable. It retains its charge well over a given period of time; it costs far less and occupies less space than the equivalent Planté plate battery, and is also cheaper to install by reason of its smaller weight and volume. Though not so durable as a Planté plate under continuous charge and discharge, the pasted plate may have even a longer life than the Planté where used only intermittently and occasionally.

An old friend, long lost sight of, has again come to the front—namely, storage-battery rail traction—and is receiving a cordial welcome. Several cross-town lines in New York City have operated several storage-battery cars for a considerable time and it is reported that the experience has been so satisfactory that all the horse cars in New York are to be displaced by cars of this type. They are very light, equipped with ball bearings, and chain drives are used between the motor and car axle. The schedule speed is low, about six and one-half miles per hour, including stops, but the cars give far better service than horse cars and they pay. There are many cases where battery-driven cars may be more suitable than trolley cars and better dividend earners, and a successful battery-driven car means that a new and considerable market is opened to the battery manufacturers.

After a long period of indifferent existence and critical trial the electric motor truck has proven to be a thoroughly commercial industrial vehicle and for most purposes far superior to the gasoline-engine truck. A considerable number of batteries have been used for these trucks during the past year and have helped to increase appreciably the volume of the battery business. The electric pleasure carriage has also grown in popularity and the number has increased greatly. The battery requirements for these vehicles have been the source of a large revenue for the battery manufacturers. The sparking-battery trade has remained practically stationary. This output is always a much larger proportion of the total battery production than is usually supposed, and a considerable variation in it has an important effect on the volume of yearly output. The widespread movement toward electric train lighting has greatly increased the demand for batteries for this purpose, and the trade in railroad-car batteries during the past year has been probably larger than ever before in the history of train lighting. These batteries are used both with axle-generator systems and for straight storage supply, in the latter case the battery being charged full at one terminal and discharging to the lamps throughout the run.

While the foregoing factors have contributed to increase the year's trade, the business in power-station and regulating batteries and auxiliaries has not been so active as in ordinary or normal periods. This is attributable to two main causes, namely, the financial situation and the increasing use of the steam turbine. During the past year electrical plants have had no money spent except for necessary repairs or equipment to handle load increases. The storage battery, being viewed by most operators as a refinement in power-plant design, is not contracted for except when good dividends and surpluses are the result of the year's operations, while its low cost makes the addition of a steam turbine in cases cheaper than an equivalent capacity in battery equipment, even based on very high discharge rates. Therefore, the steam turbine has recently been given preference in nearly every instance where increase in plant capacity has been necessary. Moreover, the flat consumption curve of the steam turbine, indicative of high economy on light and variable loads, and its almost instantaneous response to any change in load, have contributed to reduce the demand for regulating batteries. These considerations apply principally to the larger sizes of power plants where the capacity of the unit is 500 kw or over, as reciprocating engines are the prime movers commonly used in the smaller installations.

It has been freely predicted that the use of gas engines would greatly increase the demand for regulating batteries, as that prime mover has no overload capacity and works most economically at a certain fixed load. Up to the present time these predictions have not been justified—not because the regulating battery is unnecessary, but because the gas engine is not being adopted as a prime mover with the alacrity and unanimity that its advocates expected, nor will it be until the costs of gas-power plants are reduced. The total output of batteries, auxiliaries, plates and repair parts for 1910 is estimated to be in the neighborhood of $4,500,000

THE ELECTRIC RAILWAY.

Steady progress along conservative lines, rather than startling innovations, has characterized the developments in the electric railway field during the past year. Of most interest, from the point of view of novelty as seen by the general public, was the introduction of the storage-battery car for service where the cost of change from horse traction to slot-conduit electric traction seemed not to be justified by the advantages to be gained by the change. Storage-battery cars, which one year ago were looked upon as being in merely the experimental stage of development, have proved admirably adapted for the service to which they have been put, and they bid fair to drive the few remaining horse cars from the metropolitan traction field during the next few months. This result is attributable to developments in both the nickel-iron and the lead storage battery, the advent of the former in thoroughly serviceable type having hastened the improvements introduced in the latter. The past year has witnessed the terminal electrification of the Pennsylvania Railroad at New York City, the engineering features of which were along such well-established lines that little comment has been excited by the highly successful results obtained continuously from the beginning of service. However, the success has involved the proper operation of the locomotives, not all of the details of which have been of standard type. In certain of the mechanical features the locomotive represents a decided departure from electric railway practice in the direction toward steam railroad practice. Instead of abolishing the side-rod construction, which has at times been held to be a disadvantageous feature of the steam locomotive when compared with its electric rival, the designers have retained the side rods and adapted the electric motor to this type of construction. Experience with the new locomotives would seem to indicate that by mounting the driving motor in the cab well above the tracking mechanism, and providing constant torque throughout the revolution, the best features of both the steam and the electric locomotives have been retained, namely, smoothness of running and uniformity of tractive force in all positions.

Certain of the limitations encountered in direct-current motors built according to earlier standards have been removed by the application of commutating poles and redesigning the machines to take full advantage of the non-sparking conditions brought into existence thereby. During the past year complete lines of commutating-pole railway motors have been standardized. The need for the commutating pole is most urgent in motors built for high-voltage service, and the 1200-volt railway, which has proved well suited for interurban lines, owes its success to this auxiliary. However, the commutating pole is particularly adapted for use with motors subjected to highly fluctuating loads in which commutation rather than temperature rise is the feature which dictates the design limits. The frequent starting and stopping along city streets to which a railway motor is often subjected involve extremes of load fluctuations, and for this service the commutating-pole motor is quite as desirable as for high-voltage service. The 1200-volt, direct-current railway has proved thoroughly reliable, so that success can be predicted as the result of its selection with equally great assurance as is true with the 600-volt equipment. Almost all of the equipment now in 1200-volt, direct-current railway service is, in fact, neither more nor less than well-designed, doubly-insulated, 600-volt apparatus arranged for operation in series units of two at 1200 volts. The motors are designed for, and operate at, 600 volts, and they receive energy from 600-volt converters operated at normal e.m.f. The converters are connected in pairs joined in series to deliver 1200 volts, while the motors are not changed from the series to the parallel connection except in groups of two in series. However, each motor, as well as each converter, is insulated for the full line potential of 1200 volts. The flexibility of the arrangement has proved very advantageous for combined city and interurban service, since a trolley e.m.f. of 600 volts can be used whenever desired by placing the motors in the usual parallel position.

The outlook for the single-phase railway, in so far as any change has taken place during the present year, is brighter than it was one year ago. All of the compensated-series, single-phase equipments that have been installed have proved satisfactory, and in many instances substantial additions have been made to the equipments. The New York, New Haven & Hartford Railroad has greatly extended its single-phase service during the year, the new equipments including locomotives for both freight and passenger trains and multiple-unit cars for local passenger trains. The Rock Island & Southern Railway Company has installed single-phase equipments for both its freight and passenger service. In this connection it is worthy of note that items have appeared in these columns during the past year relating to recent single-phase railway installations in Sweden, Switzerland, Italy, Austria, England, France and Germany. A temporary setback to steam railroad electrification was caused by the decision not to equip the Chicago terminals for electrical operation. However, as time goes on the need for substituting electricity for steam will become more urgent, the cost involved in making the change will become less and the advantages to be gained thereby will increase, so that the change will be postponed for only a short time. In the meanwhile the continual discussion of the electrification problems will result finally in the substitution of electricity for steam in various neighborhoods. Pressure is already being brought to bear on the steam railroads in the Boston district. Philadelphia is beginning to look forward to electric traction service to New York, and the present decade will probably see the steam locomotive superseded by the electric locomotive in the Washington district, and possibly between Washington and Baltimore

TELEPHONY.

In the evolution of every new industry or service there is always what may be termed a "formative" period, during which there is usually a struggle for capital, the determination of methods of production, development of processes, the construction and rapid improvement of plant and the establishment of prices and selling methods. These and other factors incident to the novelty of the business are so various and engrossing that little opportunity is given for a survey and consideration of the industry as a whole. That the telephone business has passed beyond the formative period could not be better indicated than by the analytical consideration of the activities of the past year or two, which have resulted in improved systems of accounting, analysis and studies of costs, consolidation of smaller companies into larger ones, mergers to eliminate wasteful competition, revised methods of administration, extensive advertising and the efforts to educate patrons to the use of the telephone service and deter them from its abuse. Of all these, the recent advertising and publicity campaigns have probably been most evident to the general public. The time was when almost every news item was viewed with suspicion by telephone managers. This policy of secrecy, of course, led to the invention of all sorts of fabulous.

yet undenied, theories concerning the telephone business. But now, following the trend of the times, there is apparent a counteracting influence, which is rendered evident in a broad, open policy of publicity and education. From the standpoint of the telephone employee, one of the most interesting developments is the so-called functional or three-line system of organization. The logic of this system is invulnerable. According to this plan, the business of the telephone company is considered to involve three main functions—namely, the provision and care of plant, commercial relations with the public, and the handling of the traffic. These three departments, the commercial, traffic and plant, work co-ordinately in their respective fields throughout the territory to be operated. Such an organization is conducive to a development of the best there is in a rightly placed employee, as his superior officers, however far up the line, are in a position to understand and appreciate the particular kind of work with which he is engaged.

The contest between the automatic, manual and semi-automatic systems has recently received much consideration, due to the considerable publicity given to a paper presented to the European Telephone Conference by Mr. J. J. Carty which touched on the subject. There is much in Mr. Carty's contention that all systems are really semi-automatic, the variations of different systems lying chiefly in the relative sequence of manual and automatic operations rather than in their proportion. Again there is a difference between the proportion of manual operations performed by the user and by the company. It is interesting to note that improvements in automatic systems lie almost entirely along the lines of safeguarding the manual operations against either careless or wilful error. On the other hand, improvements in manual switchboards have been in the direction of relieving the operator from manual operations and in additional automatic signals to attract her attention to necessary manual operations. A type of manual switchboard recently introduced in the Middle West is so arranged that the operator is relieved of the manipulation of all keys in the normal call. As soon as a cord is plugged to a call the operator is automatically put in talking connection with that cord. As the connection is completed to the desired line the listening connection is severed, and the intermittent ringing of the desired station is automatically initiated, stopping only upon the response of the called station or the abandonment of the connection by the calling station. Furthermore, the calling station is made cognizant of the actual ringing, as a small fraction of the ringing current is diverted back toward that station. There are now several such switchboards in operation which are giving good satisfaction to both the public and the telephone company. There is one feature of the automatic systems as thus developed which is not attained in the manual systems—namely, the instantaneous disconnection, which is a very valuable feature where a number of calls must be made in rapid succession. The advantage of this convenience is all the more accentuated by the fact that the slow disconnection or recall is probably the one feature of modern manual switchboards most unsatisfactory to the users.

This year has seen the extension of the long-distance range from the Atlantic to Denver, and conversations from ocean to ocean seem now within the probabilities of the reasonably near future. This probability rests upon the combination of the so-called phantom, the Pupin coil, and the telephone repeater, which together have extended not only the conversational range, but also the commercial range. For many years the system of Jacobs lay dormant, as the art of line building and apparatus building had not advanced to a point where the conditions could be controlled and made unvarying within the necessary limits. Then, suddenly, it was discovered that we were just upon the edge of the requirements, from which point it has been such an easy step that there are hundreds of so-called phantom circuits in use to-day. The name "phantom" is quite characteristic of telephone parlance, being founded upon the fact that two physical circuits, both tangible, combine to form a third independently usable circuit without additional wires. In the carrying out of the system the two limbs of each physical line are so associated through transformer or repeating coils that they may be used in multiple as one side of another line. The phantom line resulting from the association of two physical circuits is in effect a circuit of double cross-section and is made available by transposing the two associated circuits with respect to each other. The most important consideration is the fact that the superimposed circuit represents almost no investment. Heretofore it has not been possible to obtain the combined benefits of Pupin coils and of phantoms, but there has now been invented a combination coil which provides for the loading of both the physical and phantom circuits. Thus far there may be some doubt as to the availability of the repeater for use upon such a circuit However, now that this instrument is known to work satisfactorily within certain very special limits, experience under actual operation should guide inventors in the direction of wider application.

ELECTROCHEMISTRY IN 1910.

The past year's story of the now firmly established and, we might almost say, old electrochemical industries, of aluminum, carborundum, artificial graphite, calcium carbide, phosphorus, caustic soda and chlorine, is simple No radically new development can be recorded, but rather a quiet, steady, effective commercial expansion into new fields of usefulness and along conservative lines. In the caustic and chlorine industry the case is somewhat different. The plant of the Hooker Electrochemical Company, using the well known Townsend process, which was destroyed by fire in the summer, was rebuilt with remarkable speed, so that the works are again in full and successful operation. A new diaphragm cell of German origin was installed by the Niagara Alkali Company, which also took up the old Roberts process of making hydrochloric acid from cathodic hydrogen and anodic chlorine. The old tendency of New England paper and pulp mills to become independent of Niagara and make their own chlorine and caustic was further emphasized by the success of the Whiting cell at the works of the Oxford Paper Company at Rumford, Maine. This is a mercury-cathode cell, the chief feature which distinguishes it from the classical Castner-Kellner cell being a periodical removal of the sodium amalgam to the caustic compartment instead of the continuous movement in the latter cell. Liquid chlorine is now being made by several companies. The largest use is in the recovery of tin from scrap for the manufacture of tin tetrachloride for use in the silk industry. This process is carried out on a large scale by the Goldschmidt Detinning Company at Chrome, N. J., and represents a new and complete departure from the old electrolytic detinning process.

In connection with the calcium carbide industry, the success of the calcium cyanamide works on the Canadian side of Niagara Falls deserves notice. In their process of fixation of atmospheric nitrogen, the nitrogen is first separated from the oxygen of the air by a comparatively simple chemical process, which represents a departure from the usual European method of liquefying the air and separating its constituents by fractional distillation. The nitrogen is then combined with calcium carbide at an elevated temperature, forming directly calcium cyanamide. This is sold as a fertilizer, either as produced or for mixture with other fertilizers, its fertilizing effect being due to the formation of urea from the cyanamide in the soil. This new fertilizer seems to have met with considerable favor. Perhaps of even greater interest is the projected 4000-hp plant to be erected by interests affiliated with the Southern Power Company in North Carolina for the production of nitrates by electric discharges through air. Both the Guye process and the Pauling process will be tried, the latter having been in commercial operation for several years in a plant at Innsbruck, Tyrole. This is the first undertaking of its kind in this country, since the much-discussed Bradley-Lovejoy plant at Niagara Falls stopped operation some years ago, before entering the commercial stage. The consideration which encouraged a trial was the availability of large amounts of power and the market for fertilizers in the South. While the manufacture of nitrates by arc discharges through air is also a case of fixation of atmospheric nitrogen, the process differs almost in every aspect from calcium cyanamide manufacture. In the manufacture of nitrates the raw material is simply air, and nothing is required but large amounts of electric power to combine a portion of the nitrogen and oxygen into nitrogen oxide; the resulting gas mixture is, however, so rich in air and so low in nitrogen oxide that a long and expensive process of concentrating the dilute gas mixture into a marketable product is required at the end of the process. On the other hand, in the manufacture of calcium cyanamide there is an initial expense, since the starting materials are calcium carbide and nitrogen (which must first be separated from the oxygen in the air). But in this case the electric furnace process yields in the form of cyanamide an almost directly marketable product.

In the applications of electrochemical methods to metallurgy, if we leave aside the distinctly electrochemical metals, aluminum, magnesium, etc., electrolytic copper refining remains of prime importance. In many years' working on the largest commercial scale the technics of electrolytic copper refining have been standardized in each of the large refineries to such an extent that radical changes can hardly be expected. Nothing new has been heard of the working of the Betts electrolytic lead refining process in the two American plants where it is in commercial operation. Quite a considerable activity is to be recorded in endeavors to improve the metallurgy of gold and zinc by electrochemical means, although definite results have not been reached in either case. In gold metallurgy a number of inventors and engineers are at work independently to devise an electro-amalgamation process, the idea being to improve the extraction efficiency of the amalgamating plate by making it a cathode. Considerable attention has recently been attracted to the Clancy modification of the cyanide process, which proposes the substitution of a cheap cyanamide solution, combined with electrolysis, for the more expensive cyanide solution as an effective solvent for precious metals.

In zinc metallurgy an improved dry chlorination process which has had several predecessors in this and other countries is to be tried in a new plant in Colorado, while quite a number of workers are actively engaged in developing electric-furnace methods for zinc smelting. The fundamental idea is, of course, the substitution of a large electric furnace unit for the small retort unit now in use. One electric zinc furnace, at least, has been in successful operation during the past year on a fairly large experimental scale in Upper Silesia, Germany, and it is interesting to note that this furnace was of American design. The largest new developments of electric furnaces are, however, to be expected in the metallurgy of iron and steel. The two 15-ton Héroult steel refining furnaces of the United States Steel Corporation, working in South Chicago in conjunction with the Bessemer converter and in Worcester in conjunction with the open-hearth have proven so successful that the Steel Corporation has secured complete control of the Héroult patents for steel melting and refining in this country. Very large installations are reported as under contemplation. The other problem of reducing pig iron from iron ore in the electric furnace is also approaching solution, the work being done independently, although along similar lines, in Shasta County, California, and in Sweden and Norway. The new Trollhattan electric pig-iron plant, which started operation on Nov. 15, is of special interest, as the work is being done under the auspices of the Jernkontoret, the official association of Swedish iron masters. The results obtained will, therefore, have an authoritative character. Nevertheless, in its newer applications to metallurgy, electrochemistry is still in its infancy; while there is concentrated activity on distinct promising problems, and gratifying evolution, almost everything in this branch is yet far from finality.

WIRELESS TELEGRAPHY AND TELEPHONY.

Progress in wireless signaling during the past year has been of an unusual nature, since it has consisted both of advances and setbacks. The federal government has shown unexpected activity in the prosecution of a number of firms which, the authorities allege, have been engaged in the development of wireless mainly as an auxiliary to their respective stock-selling agencies. Whether or not the government will be able to prove its cases is still an open matter; but if the charges which have been brought reflect the conditions which have existed it is high time that an art so necessary to the world's welfare should be relieved of connection with unsound financial methods. The unprogressive attitude which certain of the European governments have held with regard to wireless communication has greatly restrained its usefulness to the general public as a competitor of cable signaling. During the past year, however, there has been a change, and concessions have been granted for working over some important stretches of sea. South American countries, however, are likely to benefit before we do, on account of the great difficulties which have been encountered in satisfactorily arranging for transatlantic wireless transmission. The wireless patent situation in the United States has steadily been growing more complicated. Legal activity is beginning, however, and it is greatly to be hoped that when decisions are handed down on the dozen or so wireless patents which are now in suit much of the confusion which has been due to the patent situation will be cleared away.

In spite of the handicaps which are preventing ether communication from reaching its full degree of utility, it has, in the past year, given a good indication of what this may be. Half a dozen vessels, on which were 300 or more people, have been rescued by the use of wireless from positions in which the fates of the crew and passengers were at least very uncertain. However, other recent examples, such as that of the S. S. *Cincinnati,* have shown how crudely the wireless is applied. The *Cincinnati* had a rough passage, and on both continents friends of the ninety-six cabin passengers were much worried, since no word could be had from the ship. On her arrival, two days overdue, it was explained that she "was too far away to send wireless message." This shows regrettable limitations in installing, since it is not difficult to obtain apparatus by the use of which a ship may keep in touch with land during an entire passage. One of the most significant accomplishments of the year was the long-distance test carried on by the navy in the early summer, namely, 3000 miles daylight signaling from a 600-ft. tower. When the requirements of this test were stated some time ago wireless engineers in general considered the feat too great to be thought of in the "present state of the art." Nevertheless, the test was made to indicate he feasibiliy of the proposition, and the result was so satisfactory that work on the high-power government station, to be located near Washington and to have a daylight range of 3000 miles, has been begun. The record figures for long-distance communication have been pushed upward. Under exceptional conditions (at night in the fall or winter) a distance of 6500 miles has been attained, and 3000 miles by daylight is scarcely more than normal working for well-equipped stations. Notwithstanding this, "records" of much shorter distances continue to be announced from time to time. The group frequency of 1000 per second which had been quite thoroughly tried out by the end of 1909, has had a year of fairly general use, and is showing up well. The prediction that the 1000-spark per second frequency would be much more easily followed by the ear through the irregular rumblings of "atmospheric" than are the lower rates of discharge has been well verified by experience. The navy is now installing some sixty outfits in which this higher spark frequency is used.

The methods of theoretical engineering necessary in the design of wireless instruments are daily reaching more firm foundations. In the study of the quantities involved in electromagnetic wave signaling it has been necessary to invent both methods of making measurements and apparatus for carrying them out. Conceptions of new physical entities and their relations with the ordinarily used quantities have had to be worked out, and the connection between standard alternating-current practice and high-frequency alternating-current practice has been established by necessity. Thus the tools for intelligent work in wireless are being rapidly developed, and the cut-and-try methods gradually done away with. The more progressive workers in the field have left the "accepted standards," and by evolving new methods and apparatus therefor have reached new degrees of usefulness. It is stated that by the utilization of several novel principles the harmful effects of even the worst "static" or atmospheric interference may be completely done away with; and those who have witnessed demonstrations of the late methods and who understand their technology are indorsing this statement without qualification. The application of the method to commercial practice is expected within the next few months.

Wireless telephony in America has suffered from over-exploitation and under-accomplishment. Promises ranging from opera music at 200 miles to telephony between New York and Paris have been very lacking in fulfilment. The majority of workers in this branch of wireless signaling have either feared or been unable to break away from the arc-and-microphone types of sender, and the general lack of progress is probably the result of this. Even the patents on space telephony have been exceedingly few, and the entire development of the science is quiet. Occasionally a wireless telegraph operator is startled by picking a "Hello! Hello!" from the ether about him, but practically no activities are announced. It may be that development is going on without the fireworks which usually accompany work in this line, and that announcement of unusual progress may be made most unexpectedly. If this is not the case, it is to be regretted that the work has been put aside, for wireless telephony should be able to offer the solution of transmission over distances which are impossible with wires or cables.

PROGRESS IN PHOTOMETRY.

During the past the development of photometry as recorded in the technical press has been transitional, but in the year just closed there have been exhibited marked indications of a new era in photometry. Just as in an investigation it is necessary first to design, set up and test the requisite apparatus, to develop methods and determine corrections, so it might be said that photometry has been in the formative period, and is now approaching a state of development where it can be used with some degree of confidence in the factory and test-room and applied with excellent results to the solution of important scientific problems. The simple laws which lie at the foundation of photometry are known, and their limitations are recognized. Satisfactory photometer bars and screens have been devised, and auxiliary apparatus, such as sectored disks, rotators and integrating spheres, have been developed and studied. Photometric methods have been standardized and satisfactory working standards have been provided. The ultimate primary standard has not yet been found, but the investigation of primary standards is still being pursued. Now is the proper time for such investigation, after the more immediate demands for suitable working standards have been satisfied. It is encouraging to believe that before long the Illuminating Engineering Society will have established a nomenclature which should reduce greatly the confusion due to the present lack of uniformity. A preliminary report was presented to the society this year, but needed further consideration in certain respects before assuming its final form. It is to be hoped that its final form will be such as to make its recommendations acceptable abroad as well as at home, so that international as well as national agreement may be obtained.

One of the live questions in photometry at the present time, and one that must be settled before a wholly satisfactory status can be reached, is that of the comparison of light sources of different integral colors. This is not a new problem, but is one that has been elevated recently to a position of importance, partly, no doubt, because of the late developments in high-efficiency illuminants and partly because attention to this problem has only been possible after the more fundamental problems in homochromatic photometry have been solved. The flicker photometer, the commonest solution of the problem that has been offered, is quite old, but the careful, scientific investigation of the significance of its indications is just being undertaken. The more ardent supporters of the flicker photometer have made claims that are scarcely justified. Recent experiments have shown that at moderate intensities of illumination the results obtained by an observer with the flicker photometer are the same as those which would be obtained by the same observer by direct comparison in an ordinary photometer if the average of a large number of settings at different times is taken. With the flicker photometer, however, the error of a setting is very much less, probably because of the absence of the psychological element of an indeterminate criterion, which renders the direct comparison so difficult and uncertain. The flicker photometer, then, is no more or less than a quick means to a direct comparison, and hence would exhibit all the vagaries of the individual eye, so that the results of one observer might differ markedly from those of another with different color-sensibility. In the last analysis, however, this would appear to be the exact function which should be demanded of a photometer for the measurement of light-sources of different colors. If the instrument quickly and accurately gives the relative intensity of two light-sources, as an observer would obtain the relation by the more tedious and less exact method of direct comparison, it performs its legitimate function.

With the more exact knowledge regarding the flicker photometer that has been obtained during the past year we are in a better position to consider the question of the adoption of arbitrary standards for the comparison of differently colored light-sources. If each of the national laboratories should undertake to determine by the use of a standard flicker photometer, under standard conditions, the relative intensity of two such sources as the carbon and tungsten lamps, and should record the average of such determinations by a large number of persons with normal vision, in terms of the transmission coefficient of a suitable color screen such as would change the apparent color of the carbon lamp to that of the tungsten, then international agreement could be secured in heterochromatic photometry and the actual measurements in factories and testing laboratories would consist, through the employment of such calibrated color screens, in the actual comparison of light-sources of the same effective color. The promotion of this plan would come within the province of the research committee of the Illuminating Engineering Society, when that committee is appointed.

A résumé of the recent developments in photometry would be incomplete without brief mention of its application to the study of physical problems. Accurate photometry is a most valuable adjunct in the investigation of optical problems and has been used to that end with considerable success. With no other apparatus than an ordinary photometer and suitable electrical measuring instruments it has been possible to learn much about the radiating properties of metals. The influence of selectivity on the efficiency of metal-filament lamps has been shown in this way. The measurement of high temperatures in optical pyrometers is another illustration of the application of photometry in other physical measurements. The possibilities of its application are large and should be utilized now that the instruments and methods of photometry are well established.

ILLUMINATING ENGINEERING.

The most noteworthy event of the year in the illuminating engineering field was the giving of a course at Johns Hopkins University of thirty-six lectures by men best qualified to do so, the lecturers being selected by the Illuminating Engineering Society. This course marked the beginning of a new era in illuminating engineering and laid the foundation upon which the specifications for the profession will be based. Partly through the influence of the lectures and the annual convention held in Baltimore immediately preceding the lectures the activities of the Illuminating Engineering Society were greatly broadened during the year. Instead of dealing solely with lamps, and candle-power, and ft.-candles, the activities now embrace architecture, decoration, color effects, physiology, optics, commercial aspects of lighting, professional standing of the illuminating engineer, etc. The new year finds the society with a largely augmented membership and in a healthy condition, which promises growth in each of its many branches.

Among the numerous subjects to which attention has been directed during the past year perhaps none is of greater importance than the effect of quality and direction as well as the quantity of the light upon the eye. To an extent much greater than formerly the color of the light is being given consideration when deciding between rival illuminants. Attempts are being made to equal daylight in color quality by means of artificial light, and some go so far as to claim that the result has already been accomplished. While there can be no doubt as to the desirability of duplicating daylight for color-matching purposes, and a reliable reference standard for color work in photometry could well be one equaling daylight, yet opinions differ greatly concerning the most desirable color for general artificial illumination. Indeed, certain persons contend that the light from the tungsten lamp is too "white" and for many purposes the light from the carbon lamp is preferable. If one were permitted to judge intentions by the results considered satisfactory he would be justified in assuming that, previous to the last two years or so, the chief requirement in illuminating problems was the obtaining of a specific density of illumination upon the plane of reference quite independent of any other factor. At the present time it is appreciated that the prime requisite is to have the light source so hidden that the only light reaching the eye is that reflected from the object being viewed. The importance of the above features has received greatly increased recognition during the year just passed.

Improvements during 1910 in the methods of manufacture of tungsten lamps have to a considerable extent overcome the fragility of the filament. The wire-type or "drawn-wire" filament tungsten lamp is so far superior to the earlier type of tungsten lamp that the accidental breakage, which was a determining element in the average life of the earlier lamps, has been practically eliminated, the fragility of the later lamps being no greater than that of carbon-filament lamps. In the flaming-arc lamps marked improvements have been made in the direction of increased life of electrodes with accompanying reduction in cost of maintenance. An electrode life of 100 hours is now being obtained in regular service, while a life of 140 hours is to be expected in lamps now being developed. So-called intensified-arc lamps are being employed to a rapidly increasing extent for the lighting of stores and similar interiors where color matching is of importance. The possibility of extended developments along an entirely new line was pointed out during the year in connection with the production by Dr. Peter Cooper Hewitt of a light-transforming reflector by the use of which the missing red rays can be supplied to supplement the light from the mercury-vapor lamp. As a result of this work it may be expected that the mercury-vapor lamp will find a greatly broadened field for application in locations where previously it was considered unsuited because of the lack of red rays in the light. The soft, well-diffused, penetrating light from the lamp renders it well suited for many purposes, but hitherto it has been barred from use where correct color representation was of importance. The field of the lamp has, therefore, been closely circumscribed, for color is of importance in the great majority of locations, and the lack of red is painfully noticeable even where one does not consciously attribute any value to correctness of color representation. When equipped with a reflector which acts as a secondary source of light of the proper color, the mercury-vapor lamp should prove a worthy competitor of the numerous high-efficiency, high-candle-power lamps now in use.

PRIME MOVERS.

The progress in prime-mover engineering during the past year has been along the same general paths which have guided the developments of the preceding few years. Coal and fuel oil continue as the sources of heat energy according to relative economy, availability and other special conditions. The chief outlying problems regarding coal relate to the utilization of low-grade forms, including lignite, slack, culm and other similar residue. To this end two ways are open—transformation into producer gas or combustion in the furnaces of steam boilers, either by special furnace arrangements or by combination and treatment in such manner as to produce some form of artificial fuel. All of these methods have received some attention during the year, but the urgency of the coal situation is not yet sufficiently keen to stimulate a general and serious study of these problems. The use of peat as an industrial fuel falls into the same class of problem, and certain interesting results have been developed during the year both in Canada and in the United States. The most hopeful indications seem to point to the utilization of peat through the gas producer and gas engine. The plants thus far experimented with have been of small size, and caution must be exercised in extending such results to larger units. It does not appear that the cost of heat energy from peat can, under present conditions, be made sufficiently low to compete seriously with coal except at considerable distance from the coal fields. The best grades of peat have shown from 7000 to 10,000-lb.-Fahrenheit units per pound of dried product, and in small units one hp-hour has been developed at the engine for about two lb. of such fuel at the producer, with correspondingly more in the case of a partially dried product. Regarding the status of oil fuel, an important series of estimates has been made during the past few years, partly by the U. S. Geological Survey and partly by private interests, the results of which have recently been partly made public. These estimates deal with the ultimate capacity of the crude petroleum oil fields in the United States, both those under present development and those in prospective or probable areas. Limitations of space do not permit a statement or discussion of actual figures, but the important fact is clearly brought out that, in all human probability, at any reasonable rate of increase in the rate of consumption, the production will meet the demand for a future period many times the normal life of all standard types of present power plant equipment. The conclusion is that in locations where oil is more economical than coal at the present time it should apparently continue to remain so for years to come; and, in any event, so far as supply is concerned, boilers, furnaces, stacks, etc., may all be designed with definite reference to the use of oil fuel rather than with any reference to the likelihood of a forced return to coal during the normal life of the plant.

Continued attention remains focused on the boiler room as the scene of large economies yet open to conquest. The CO_2 recorder in various forms, as well as simpler forms of apparatus for flue gas analysis, are all attracting increasing attention, and their records, when properly interpreted, are contributing to the closer regulation of air supply and to the more exact fulfilment of the conditions of combustion. It has been recently pointed out, however, that in many cases the use of such CO_2 recorders has been disappointing because it has been assumed that such indications by themselves furnish a direct and definite determination of economy. This is not the case, and it should be understood that the CO_2 percentage is only one of the factors of a complex result depending on many interacting conditions. In a given pound of fuel it is sought, of course, to liberate the entire amount of heat energy potential in the fuel, and to reduce to a minimum the heat rejected or lost by way of the chimney, radiation, etc. The principal item of this waste heat is, of course, that by way of the chimney, which depends on the total weight of gas, the temperature and mean specific heat; and the CO_2 percentage is only one of the factors serving to determine this combination result. Further experimental data are much needed showing the relation between CO_2 and boiler economy under varying conditions of uptake temperature and other determining factors of the operative condition. More information is also needed regarding the economy of boilers under partial load and overload, and regarding the influence on economy of various departures in greater or less degree from the conditions for maximum economy. It has been demonstrated over and over again that under the best conditions boiler efficiencies of 80 per cent and better can be realized. With this fact in mind, every chief engineer should develop a most serious discontent regarding boilers which under approximately full load conditions fail to realize an efficiency of this order. Engineering progress in a broad sense calls not so much for the achievement of record results at isolated points and under specially favorable conditions, but rather for the raising of the general level of power-house boiler economy by from 5 to 10 per cent, a result which is demonstrably possible and which would realize a form of national conservation of the utmost importance, having in view the certain ultimate exhaustion of our present sources of heat energy.

The developments of the year in regard to prime movers fix the steam turbine still more definitely in its place as the typical form for electric generators, while for the direct mechanical drive of industrial works and for all types of direct drive where the speeds are relatively low the reciprocating engine still holds its place. All this is in exact accordance with what has been often repeated in these columns—that the choice between the highest types of steam turbine and of reciprocating engine is to be based on considerations of adaptation to the service required rather than on arguments of thermal economy under test conditions. Both types show economy in the same class, but the peculiar characteristics of the turbine have shown such definite adaptation to the demands of electric service that few engineers would to-day give serious consideration to reciprocating engines as the sole prime mover for large central station equipment. Attention still remains focused, however, on combinations of the two types—reciprocating engines for the high-pressure end of the steam cycle and turbines for the low-pressure end. This may be of peculiar value in connection with the extension of present existing stations, where, by the addition of low-pressure turbines, the output may be greatly augmented, while in certain cases the system may be properly considered for new installation. These combinations have given rise to special problems in connection with the design of mixed pressure turbines in order that either high or low-pressure steam may be used in such turbines to the best advantage. Recent tests have indicated that the economy of such combinations may be made superior to that of either type singly, operating under the same general conditions, and with an economy curve remarkably flat over a very wide range. One of the most notable of such installations is that in the Interborough station in New York City. The combination doubles the economic output of the original engine units and gives an extraordinary flat economy curve of value, rivalling or exceeding the best of results from turbines alone and showing a heat consumption about 77 per cent that for the engines alone and as originally installed.

A striking increase in the economy of small units has been realized in Germany, where compound engines of the so-called "semi-portable" type of 50 hp and upward are reported as developing energy at the rate of 1 to 1½ lb. of coal per 1 hp-hour and with an engine efficiency of 19 to 20 per cent. As described during the year in these columns, the cylinders are located in the steam dome and form one casting with it. The steam is superheated to a temperature of about 650 F. before entering the high-pressure cylinder of the engine and again reheated between the high and low-pressure cylinders. This superheating and reheating is effected by the waste gases from the boiler. The detailed arrangements of the combination may well be studied by American engineers as an interesting example of methods of reducing heat wastes and of raising the over-all plant economy of small installations. A similar simple non-condensing type is also reported as showing a corresponding improvement over the usual economy of its class. In the field of internal combustion prime movers but little definite progress has been made during the year looking toward the extended use of such types in large sizes for central station service. The unit of small or moderate size, on the other hand, is advancing steadily in general favor and seems destined rapidly to absorb a very considerable share of the field now occupied by the reciprocating steam engine and boiler. Such units may operate on liquid and gaseous fuels of various grades, and particularly on producer gas made from coal of all grades down to and including lignite and other fuel useless under present conditions for steam generation. Hopeful results have also been reached in California with producers using oil fuel, and a considerable number of such plants are likely to come into service during the next few years. The Diesel engine seems also to be gaining in favor for units of moderate size, and excellent results have been reported from this type, in one case covering a period of three years' service. For large central-station service, however, the internal combustion engine has still to demonstrate more clearly its superiority to the steam boiler-turbine combination, which is typical of this field of service. In the Gary plant, however, which contains thirty-three 3000-hp units, a large number of which are used for electric generator drive, excellent results have been realized, and the most encouraging reports have been made as to the general success of the engine as a prime-mover for such service. While the regulation for operation in parallel is naturally inferior to that with turbine drive, it is stated that in this respect the gas engines are in the same class with steam engines, and that no trouble from cross currents between generators has developed.

In the field of auxiliary equipment passing mention should at least be made of the centrifugal pump for boiler feed, of the rotary type of air pump and of the steam regenerator for reducing heat wastes due to irregular demands of the loads, all of which are attracting increasing attention and seem destined to take their place by right among the typical features of power-house equipment. The past year has witnessed the construction or installation of several items of power-house equipment, making notable advances in the output rating of such units. Mention may be made of the following: Steam boilers of 7000 kw operating rating each, and allowing at full load only 2.48 sq. ft. heating surface per kw-hour generated. The high rate of evaporation per square foot of heating surface in these boilers will be noted. An independent superheater of 8000-hp rating to use waste heat from billet furnaces. A 25,000-hp exhaust steam feed-water heater and purifier. A surface condenser of 25,000 sq. ft. cooling surface. A two-stage centrifugal pump for boiler feed of normal rating of 25,000 boiler horse-power, or 1600 gal. per minute, guaranteed to deliver against a total resistance of 300 lb per square inch. Such items, together with turbine units of 14,000 hp and over, indicate impressively the rapid advances in size which have marked the recent progress in power-plant engineering.

RURAL ELECTRICAL DISTRIBUTION.

Surveying the progress made in introducing and extending the use of electricity on farms in the United States during the year just closed, the observer may report some progress. This is especially true in the case of the isolated electric farm plants, which are now far less rare than in the past. Manufacturers of agricultural machinery, gas engines, gas producers, storage batteries, small dynamos and motors, and low-voltage lighting equipment are keenly interested in this development and are fostering it with zeal and intelligence. The subject is discussed in the agricultural journals and at meetings of agricultural societies and gas-engine builders. It is evident that for some years to come a large proportion of the electricity used on farms will come from private generating plants on the farmer's premises, since few farms can now obtain service from central stations or transmission lines. Several companies make 24-volt to 48-volt outfits, more or less complete, consisting of gasoline engine, dynamo, storage battery, switchboard, tungsten lamps, wiring and fixtures, and perhaps two or three small motors. A large number of these low-voltage sets have been sold during the year. More elaborate equipments include gas producers or are driven by steam engines or water-wheels, in the latter case the plant being frequently almost entirely automatic in operation. It is fair to assume that some of the private-plant owners, as the years go by, will be fair "prospects" for central-station service if the latter is available at a fair price. The use of electricity on farms is sure to be greatly increased with the progress of intensive cultivation, which is becoming an acute national need; and in the country, as in the city, the question of central-station service versus isolated plant must be fought out on its merits in each individual case. At present, in many cases, it is simply the private plant or nothing. and the makers of the apparatus used in these small installations are entitled to credit for the ingenuity and enterprise they exhibit in enabling the farmer to have the benefits of electricity at a moderate cost.

But while the private-plant men have been especially active, the central-station interests have been by no means idle. It is recognized that the subject of rural electrical distribution is really of great importance for the immediate future. One does not need to go so far as the enthusiast who figured that if each of the 5,737,372 farms in the country in 1900 had 50 hp in electric motors installed the manufacturers would be called upon to furnish 286,868,600 hp in motors, with generators of a corresponding rating, while the central stations would be required to furnish energy in amount far beyond anything imagined by the "popular-science" man who writes for the Sunday newspapers. Central-station companies in certain parts of the country are, however, beginning to give serious attention to the problem, and the number of farm customers is now considerable in some sections. There was a paper on "Electricity on the Farm and the Influence of Irrigation" at the St. Louis convention of the National Electric Light Association last May and another on "The Promise of Electrified Agriculture" at the Frontenac convention of the Edison Companies last September. Quite recently the new Commercial Section of the N. E. L. A. has appointed a committee of nine members to examine and report at the next convention on "Electricity in the Rural Districts," with a chairman who is general contract agent of one of the large suburban central-station companies of the Middle West, and during the present year this journal will present information on the subject gathered by its field editors

But how is the distant central station to supply the electricity needed for operating farm machinery and lighting houses. farms and outbuildings at a profit to itself and at a rate satisfactory to the consumer? Evidently the question is one of high-tension distribution with the use of small transformers on customers' premises. Expressions of opinion were asked as to operating experiences under these conditions in a recent "Question Box" discussion of the N. E. L. A. Answers were received from managers in California, Washington, Indiana. Virginia, New York and Colorado. The consensus of opinion seemed to be that from 6600-volt to 10,000-volt primary service is entirely practicable. But it was pointed out that the average farmer is a small consumer and that the cost of the transformer and the transformer losses must be considered in taking on the business. A central-station man who has given considerable study to the subject offers this suggestion: Where the central station is distributing 2300/4000-volt service along country highways, require the customer to purchase the transformer and pay for all secondary distributing lines on his farms; the energy to be measured on the primary side of the transformer, the company furnishing the meter, which, like the transformer, is to be installed on the highway, and the customer to pay for his lamp renewals. No maximum is to be demanded and a reasonable rate is to be made for energy furnished. Naturally, the farmer's motor business is off-peak load and his lighting requirements are small, because he and his household go to bed early. Consequently, the farmer's business is desirable because it does not add appreciably to the peak load.

Interurban railway companies have done considerable business in selling electricity to farmers, not so much for the income, which is usually small, as to accommodate men whose property is crossed by the railway. Usually the farmer furnishes his own line from the railway to his house and barns. using 550-volt direct current from the grounded railway circuit and burning his lamps in series-multiple The railway company supervises the installation and advises the farmer to have the work inspected by his insurance company before service is given. At the present time there are about fifty farmers and dairymen within a few miles of Elgin, Ill., who are using electricity in this manner. One development of the year to which reference must be made is the attention paid by central-station men to electric pumping for irrigation in humid regions. There has been a great deal of irrigation and incidental farm load developed by electric service companies in semi-arid regions in California, Washington, Oregon and Colorado, but only recently, apparently, has it occurred to Eastern electrical men to promote similar business in the East during the periods of drought which are experienced every summer in the Eastern and Central States. The Rochester (N. Y.) Railway & Light Company has installed electric pumping plants in fruit farms and market gardens near that city with most encouraging results, as mentioned in the N. E. L. A. paper to which reference has been made. Some work of a like character has been done on the outskirts of Chicago also. An enterprising market gardener living within four miles of the city boundary buys central-station energy not only to light his house and farm buildings, but also to operate a 5-hp centrifugal pump by which he lifts water from a river to irrigate his growing crops during prolonged dry periods, thereby getting ahead of his competitors in forcing his produce for the early home-grown market. He paid for the pumping installation and a portion of the cost of the line serving it. On the southern border of Chicago, where the land is low, there is a 600-acre farm where electricity from a central station operates a 15-hp, single-phase motor which drives a 12-in. vertical centrifugal pump used to draw the water off the land and discharge it into Calumet Lake. By the use of this electrical energy two crops of hay are grown yearly, making valuable land of what would otherwise be a useless marsh. These modern instances show the benefits of electric irrigation and drainage in localities where the possibilities of such development have been unsuspected hitherto. They are but glimpses of that expansion of the use of electricity on the farm which the future will surely show, particularly when the era of intensive farming arrives, as it surely will arrive from the pressure of economic forces that cannot much longer be resisted.

THE WATER-POWER SITUATION.

The policy of the government toward conservation generally, and particularly toward the treatment of water-powers on lands under government control, remains still undetermined and the subject of much discussion. We have several times considered this matter in its various aspects and pointed out both the dangers of no control at all on the part of the government and the risks of inefficiency in development that will be run by the promiscuous development of water privileges without a coherent plan of coöperation. As to the existence of a water-power trust, which is endeavoring to grasp all the hydraulic resources of the country, we have oftentimes expressed skepticism and see no reason to change that attitude. On the other hand, it must be admitted that there is a keen realization on all sides of the value of the power privileges of the country at large, and that there is danger that they may be pre-empted for speculative purposes in such wise as seriously to interfere with their development to the best public use. This is, in our opinion, however, not the result of the machinations of a water-power trust, either fully or partially organized, but of a general recognition of values and a general tendency, which is here, as everywhere, dangerous, toward a policy of obstruction aimed by many large financial groups at the independent development of anything.

It must be frankly admitted that it is an extremely difficult matter at the present time for persons unconnected with one of half a dozen financial groups to carry out any considerable enterprise in any field of activity. So complete has been the tacit alliance of various interests within the last ten years that in any operation requiring one or several million dollars capital it is almost impossible to secure the funds without dependence on one or another affiliated junta of capitalists. It is a perfectly general tendency which displays itself unquestionably in water-power development, but no more so than it would in the case of building a railway, or establishing a new packing-house, or starting a steamship line, or opening a big shoe factory Whether this situation is one that demands immediate and drastic remedies or not we leave to the exponents of the "dismal science" to decide.

As regards water-powers, it is important that they should be developed according to a definite plan, wherever the capital is obtained. It is equally important, in our opinion, that so far as possible they should be developed under pretty close public control on account of the quasi-public nature of the business. It makes little difference from whose strong-box the money for the work is obtained. It makes a great deal of difference whether there is governmental control sufficient to insure that the development shall not be grossly over-capitalized, shall be administered according to a systematic plan and shall furnish energy at equitable prices to all comers.

At present anything like effective conservation of the water-powers of the country and regulation of their development is impossible on account of an open quarrel between the general government and the States as to their respective rights in the matter. We had occasion not long ago to point out the need of action by the general government in the case of powers involving interstate rights. As in many other matters, such action is becoming of far-reaching importance, and it remains to be seen what Congress and the Supreme Court will do with the somewhat loose constitutional provisions under which action could be taken. In theory, State regulation of all matters regarding conservation ought to be more efficient than regulation by a central government which is supposedly not in close touch with local necessities. In practice, it has been over and over again demonstrated that local authorities are too easily reached by large financial interests with axes to grind, so that the guidance of such affairs by powers that care comparatively little for the feelings of local magnates is sometimes much to be desired. A few interested cattle men or lumber men may stave off policies of conservation until there is nothing left to conserve, if they can work directly upon State politics. It is the old question of good theory versus bad practice. Just at present it appears that the advocates of local authority and those of general authority are at a deadlock, which, in the interest of the people at large, should be broken as soon as possible in order that either one party or the other to the dispute may have opportunity to make good its protestations of belief in conservation. The water-powers of the country are too valuable to be thrown into the hands of promoters or pushed into hasty or improper development. It would do no harm for both the State governments and the general government to sit tight for a while and think the problem over.

PUBLIC-SERVICE REGULATION.

The attitude of the States toward public-utility corporations in 1910, as indicated in commission regulation, appears to have been modified. It is not exactly, as some would have us believe, a tempering of the wind to the shorn lamb. The subject of active public regulation of electric lighting corporations is generally associated in the public mind with the control of other classes of public-utility companies, and in most sections of the country the aspect of this subject that has ranked foremost in importance during the year is the steam-railroad rate situation. The overshadowing influence of this situation and the effect of its settlement upon the railways and the industries which are wholly or largely dependent for activity and prosperity upon railway purchases have helped to divert the public mind from serious attention to occurrences of a more purely local nature. In the meanwhile other influences have been at work. As corporate abuse was responsible in part for the public dissatisfaction which underlay the law enacted in New York State and encouraged similar threatened legislation in other States, so a reformative attitude on the part of the corporations has led to a more willing acceptance of the conditions desired by the companies. In an editorial in these columns in the first issue of January, 1909, the opinion was expressed that the movement for regulation probably never would have reached the full extreme to which it went in New York State if officials of companies not directly under attack had tried to meet the agitation half way and striven to secure legislation that would be reasonable. Since that time the intensity of the movement has receded and the corporations have progressed toward a common ground on which the issues between producer and consumer, that is to say, the bargain between seller and buyer, ought to be settled with fairness to all. The danger in reaction is that any regulative policies which States adopt will be rendered so weak that they will be of no real protection either to the public or to corporations. If that danger is recognized as one that should not be ignored in a thoughtful consideration of what the future may bring forth it must be realized that too weak a policy may leave an opening for abuse in management of which some may take advantage, and also for an intolerant attitude toward the public into which various corporations, forgetting the lessons of the last few years, may fall again. Where regulative commissions are to exist at all it will be to the ultimate interest of the companies to have their powers reasonable and fair to both the corporations and the public and to have the membership of such bodies made up of men who will administer their powers in this just spirit.

New commissions were created during 1910 in the States of New Jersey, Maryland and South Carolina. The Corporation Commission of Oklahoma has assumed, under authority of the general act under which the commission was created, jurisdiction over electrical corporations. The Maryland law follows closely the text of the original New York public-service commissions law, but it includes a specific provision for a court review, which was purposely omitted in the New York law. Although the New Jersey and South Carolina laws are not comparable, in the authority which they permit, with the earlier laws of Massachusetts, New York and Wisconsin, they are still steps in the irresistible movement for regulation which is passing through the country. The laws now in existence present wide extremes of the regulative policy of States; likewise the commissions which enforce these laws present in their membership extremes of character and ability. A strong commission can make a weak law an effective instrument, while a weak commission can make a strong law ineffective. More than one commissioner has assumed office with the notion that his duty would be to protect the public against the corporations, but experience has taught him, not only that it was his equal duty to protect the corporations against the public, but that no other policy would serve the public interest in certain cases. A rigid policy of protection of one interest without fair protection of the rights of the other interest will bring punishment upon itself through a later reactionary sentiment and legislation. With some States it will be a question of whether regulation is desired or the investment of outside capital is desired. Certainly there will be no substantial development in some localities unless, either by precise statute or the absence of statutory prohibition, or by commission or absence of commission, openings are allowed for profits in the promotion of new enterprises. Even under some of the most rigid of the commission laws avenues are left open for that profit without which substantially no speculative funds would be available for the promotion of new undertakings. In New York State the services of promoters have been recognized as valuable services for which securities might properly be issued. In the State of Wisconsin the law distinctly provides that discount on bonds shall be charged to capital account. This is done on the ground that such discount is part of the cost at which the capital is secured.

Another element in the situation the influence of which is sure to be felt during the coming year is the recent party change in political ascendency. Regulation has been a policy of the Republican party in the past, but its extension, so far as the national supervision of railways is concerned, will follow lines that can be seen less certainly now than before the upheaval which occurred in November. Long before the complexion of the House of Representatives will become Democratic, the State of New York has seen the accession to power of a new administration. As a result of the changes in Governor and Legislature in New York rumor has played havoc with the public-service commissions law of 1907 and with the retention in office of various members of the commissions by whom it is enforced. Where the rumors are so thick and arise with such apparent show of authority it seems certain that some changes will be attempted, although with what final result only the future can tell. By reason of its administration of the law and its unusual appreciation of the problems of small companies the New York Public Service Commission of the Second District has taken rank with the ablest and fairest commissions of the country. While the New York situation may change and no doubt an attempt will be made to introduce greater economy of methods we should regret to see a backward step taken. Regulation, if both wise and reasonable, is in the permanent best interest of the corporations. In New York, as well as in other States, a regulative policy will afford an outlet for radicalism and an argument against the far more dangerous, but often threatened, spread of municipal ownership.

New Jersey Public Service Corporation Pension and Benefit System for Employees.

A pension system, together with life insurance and sick or disability benefits, was put into effect by the Public Service Corporation of New Jersey and allied companies Jan. 1. The benefits will affect all the permanent employees of the street railway, gas and electric companies, including those acquired by the corporation during the last year. In no case will the men be asked to contribute any portion of their wages, as the expenses are to be borne wholly by the employing companies.

About 10,000 men will be affected by the company's action and the cost of the general scheme will, for the first few years, be at least $50,000 a year. Later it will be more. Provisions are made for pensions based on percentages of wages or salary, with the minimum fixed at $240 a year. As sick or accident benefits one dollar a day will be paid during disability, not exceeding ninety days in any one year, and the insurance money payable on the death of an employee will be $300.

Voluntary retirement at sixty-five years of age and after twenty-five years of continuous service and compulsory retirement at seventy after twenty years' service are provided for. The pension will amount to 1 per cent of the average annual salary paid the person retired for ten years previous to retirement, multiplied by the number of years of service. Thus a man who had received $1,200 a year and had worked thirty years would get 1 per cent of $1,200 multiplied by thirty, or $360 a year. All present employees will receive the insurance if they continue in the company's employ until death, but new employees will have to serve one year before they acquire insurance rights, and then such rights will be dependent upon continuous service thereafter. Pensioners will not be paid sick benefits, but retirement on pension will not deprive an employee of the insurance benefits.

The Public Service Corporation is believed to be the first utility company in the country to put into effect a complete pension, death and sick benefit scheme for its men without expense to the employees. The pension and benefit funds will be administered by a welfare committee, of which the second vice-president of the corporation will be the chairman. The other members of the committee will be the president, treasurer and general claim agent of the company.

Telephone-Rate Investigation in Chicago.

While admitting that the existing schedule of rates of the Chicago Telephone Company may be inequitable between the different classes of subscribers, the telephone sub-committee of the committee on gas, oil and electric light of the Chicago City Council in its report following a study of the company's business, dated Dec. 28, 1910, finds that the present rates yield sufficient revenue to pay all the operating expenses, taxes and depreciation, together with a return of 10 per cent on the present value of the plant, which is placed at $19,053,169. The investigation was in charge of Mr. William J. Hagenah, formerly expert for the Wisconsin commission, and was made under the direction of Aldermen W. J. Pringle, chairman; C. E. Merriam and T. K. Long, of the City Council.

The present investigation was ordered with a view to checking the results and conclusions obtained in a report on Chicago telephone rates, submitted in May, 1910, by D. C. & W. B. Jackson, engineers, and Arthur Young & Company, accountants. The earlier report dealt with the cost of maintaining each class of service and the revenue therefrom and found a net deficit of $908,533. Certain services cost more than the revenue derived from them, while others paid in excess of their pro rata share of operating expense. As the result of this investigation, the telephone company asked permission to increase certain of its charges so as to net about $1,200,000 additional income.

The later report, prepared by Mr. Hagenah, assumes a book value of the property of $23,406,126, from which is adduced its present value of $19,053,169, considering depreciation of plant equipment and appreciation of real estate. The replacement value of the property is placed at $22,115,764, of which $20,448,304 is subject to depreciation. Taking a condition factor of 77.5 per cent, the present value of this depreciable plant is given as $15,847,456. No consideration is apparently made of the going or organization value of the company in arriving at its present value of $19,053,169.

The total Chicago revenue is found to be $8,321,609.69, divided as follows:

Exchange earnings	$7,608,817.88
Toll earnings	588,827.50
Private-line earnings	12,447.62
Real estate revenue	30,730.99
Dividends and interest	49,188.84
Miscellaneous revenues	31,596.84
Total	$8,321,609.69

The operating expenses of the Chicago exchange were analyzed as follows:

General	$420,063.86
Rentals	357 413.49
Operating	2,444,200.74
Maintenance	1,492,756.17
Reconstruction	812,227.45
Miscellaneous	569,103.20
Total	$6,095,764.91

Besides finding that the gross corporate income is equal to 10 per cent of the present value of $19,053,169, or 8 per cent on the book value of $23,406,126, sufficient to pay the present 8 per cent rate of dividends, the investigators commented adversely on the instrument rental charges of $355,711 paid to the Bell interests, which they believed would be adequately represented by $135,000 at present market rates. The service charge of 2.87 per cent paid to the Western Electric Company on purchases for warehouse service was deemed to be an advantageous arrangement for the telephone company, saving it heavy warehouse costs. Mr. Hagenah gave it as his opinion, in the conclusion of the report, that any increase in rates is unwarranted at this time.

Good Year for Brooklyn Edison.

The year 1910 has been the most prosperous in the history of the Kings County Electric & Power Company and the Edison Electric Illuminating Company of Brooklyn. The former is the owning and financing company in control of the entire lighting industry of the Borough of Brooklyn, and the Edison company is the operating organization, which deals with the consumers. The broad-gage policies of the company in its dealings with the public, the efficiency of internal operation, and the alert and progressive methods used in securing and retaining business have produced a development within the year just past which exceeds all previous records. The increase in gross earnings during 1910 amounts to approximately $600,000.

The ratio of expenses to earnings has been improved and the net result correspondingly increased. After charging more than $525,000 to depreciation, the net divisible surplus for the year will be at least 9¾ per cent and possibly 10 per cent on the total capital stock of $10,000,000. During the year the Kings County company issued $2,500,000 of 6 per cent debenture bonds, the full interest of which has been included in the year's expenses. Expenditures for capital purposes are increasing in amount year by year, keeping pace with the growth of the borough and aiding particularly in the development of the outlying sections. Dividends have been continued on the Kings County stock at the rate of 8 per cent per annum. This rate has been paid continuously since its adoption, the disbursement of Dec. 1 last being the forty-third consecutive dividend.

Possibly the most noted development during the year was the institution of the profit-sharing and pension plan, which was announced in these columns last month. In this feature of welfare work the Brooklyn Edison company has taken the lead. It is the first of the large corporations in Brooklyn to establish such co-operative measures as between stockholder and employee. The directors of the company decided to share the prosperity of the company in a substantial manner with the employees, and on the first of the year each employee who has been with the company five full years was credited with a sum out of the divisible surplus of the company's operations for the year equal to 8 per cent upon his salary, or the same amount of dividend as the stockholders receive on their holdings. The employees who have been in the service of the company four years receive 6 per cent; three years, 4 per cent, and two years, 2 per cent of their year's salary. These dividends to employees are credited in their names in the Brooklyn Edison Investment Fund, an organization established during the year, in which the employees of the company invest their savings or a portion thereof in the securities of the company. There is now invested in this fund over $70,000, the property of about 750 of the company's employees. After three years the employee's profit-sharing investment becomes available for withdrawal in stock if he so desires. Before the expiration of the three-year limit, however, such profits as are credited to an employee may be withdrawn to make payments upon the purchase of a home, or in case of the death of the employee, or because of unusual necessity in the opinion of the committee having jurisdiction.

A system of pensions for aged and incapacitated employees who have been with the company ten years or longer has also been established. This is more liberal in its provisions than similar systems in effect in the large corporations in this country.

The lighting and industrial load connected to the company's mains, which is computed in "50-watt equivalents," during 1910 reached a total in excess of 2,000,000. It took from 1889, when the company began business, to 1907 to amass a business which amounted to the equivalent of 1,000,000 units. The connected load added in the past three years is, therefore, equal to that connected during the previous eighteen years. The additional connections during 1910 amount to the equivalent of about 300,000 lamps. The amount of electrical energy generated and consumed was greatly in excess of that for any previous year, and the amount of energy sold during the month of December just closed exceeds that for any previous month in the history of the company.

One of the factors in this very large increase in new business that has especial significance as bearing on the industrial growth of Brooklyn is the rate offered by the company for energy used by motors. It has not only caused many Brooklyn plants to change over from gas or steam equipment to electricity supplied by the Edison company, but has also aided in inducing a number of large enterprises to locate in Brooklyn

The Brooklyn Edison company, in connection with the city authorities, has accomplished much during the year calculated to aid in the growth and development of Brooklyn, and this particularly with respect to a notable increase in city lighting. An adequate system of street lighting is not only a vital necessity as far as convenience of citizens and the prevention of crime are concerned, but it is an excellent advertisement for a community. The number of city arcs has been increased in Brooklyn during the year to over 5000. The Manhattan Bridge has been illuminated. Fort Greene Park and Prospect Park have both been equipped for the first time with an adequate system of electric lighting. The posts used are artistic and were designed by the Municipal Art Commission. In Prospect Park 450 of these posts have already been installed and 300 more will follow, this equipment replacing 150 gasoline lamps. Each of the new posts carries an 85-watt tungsten lamp. The posts are placed on all drives and walks 100 ft. apart. This gives Prospect Park a modern illumination and places it on a par in this respect with Central Park in Manhattan and other first-class parks throughout the country. The city has also contracted with the Edison company for 400 hp to operate the flushing pumps for cleaning Gowanus Canal. This system wil be placed in operation early this year.

An interesting development that has taken place during the year is the inauguration in Brooklyn of merchants' decorative street lighting. The first installation of this kind has taken place within the last two months on Bedford Avenue, as noted in these columns at the time. The equipment consists of a number of artistic posts, each holding five 100-watt tungsten lamps surrounded by opal globes. The local merchants themselves contract and pay for this street illumination with the idea of increasing the attractiveness of their respective localities. The company has a number of contracts already under way for this type of lighting in different parts of the borough, and the indications are that it will spread during the coming year.

Among the customers who have discontinued the use of their private plants for Edison service may be mentioned: Steeplechase Park, Coney Island, 1200 hp; the New York Dock Company, 1200 hp; Gretsch Corporation, 440 hp; Shultz Bread Company, 250 hp; Clarendon Hotel, 1000 lamps and 100 hp; also about 125 other plants ranging in capacity from 5 hp to 200 hp Renewal contracts have also been signed for the supply of all lamps and motors to Luna Park, Dreamland, Brighton Beach and the Manhattan Beach Estates, Coney Island.

Dry dock No. 4 at the Brooklyn Navy Yard has been built entirely with energy supplied by the Brooklyn Edison company. This required a maximum of about 1000 hp. All the contractors for the Fourth Avenue subway have signed agreements with the Edison company for the supply of electricity and are using the energy in the construction of this great public improvement, for which the city has already appropriated $15,800,000.

A comprehensive plan to secure the electric equipment of unwired Brooklyn residences has also been inaugurated during the year and is meeting with gratifying results. This plan widely advertised by the company, consists of an offer to install electric equipment for any house owner in the Borough of Brooklyn, payment for which may be made in instalments with the lighting bills as they become due.

Two other notable features contributing to the total of 1910 achievements are the largely augmented sale and use of household cooking and heating appliances and the increasing popularity of the electric vehicle, some of the largest concerns in the borough, including the department stores and express companies, having adopted or extended the use of these vehicles during the year. Mr. W. W. Freeman is vice-president and general manager of the company, Mr. W. F. Wells the general superintendent, and Mr. T. I. Jones the general sales agent.

Central-Station Insurance.

At the St. Louis meeting of the National Electric Light Association statistics were presented by Mr. W. H. Blood, Jr. insurance expert of the association, tending to show that fire insurance premiums paid by the electric lighting companies of the country are fully twice as high as the low ratio of loss would warrant. Resolutions were adopted by the association asking for an investigation of the subject by the fire insurance companies and directing that copies of the resolution be furnished to member operating companies so that they might take up the matter with their brokers. A thorough campaign along these lines has recently been organized as fitting at this season of the year, and large numbers of copies of the resolution have been placed in the hands of the operating companies requesting them to bring the matter to the attention of their insurance brokers Letters have also been written from association headquarters to some 250 insurance companies calling their attention to the matter and inviting them to investigate the subject with a view to a reduction in rates commensurate with the premiums received and the risks involved. An extremely interesting report and analysis of the subject generally was presented at St Louis by Mr. Blood and has been reprinted in the annual proceedings of the association

Meeting of Boston A. I. E. E. Section.

At the regular monthly meeting of the Boston branch of the American Institute of Electrical Engineers, held on Dec. 21, Chairman J. F. Vaughan presiding, an illustrated talk on the Panama Canal was given by Mr. D. B. Rushmore, of the Power & Mining Department, General Electric Company. Mr. Rushmore gave a graphic account of recent impressions of the work on the Isthmus. In connection with electrical matters Mr. Rushmore deprecated the fact that the power of the Chagres River had not been utilized in the canal construction under the administrations of Messrs. Wallace and Stevens. He praised the power-house construction at each end of the canal. A typical plant, containing three 1500-kw steam turbo-generators run from fuel oil, is used on the driving of cableway machinery at Gatun. A considerable amount of auxiliary work is also handled by electricity. Rotary converters are used to supply energy to the cableway motors, as these machines are all of the direct-current type. Mr. Rushmore also briefly described an electrically driven concrete mixing plant in which the material cars are operated by three-phase motors equipped for automatic operation between mixers. Two overhead trolleys are used, and the cars are run without anyone riding upon them. Power is very successfully returned to the line when the cars run on a down grade.

All the ships passing through the canal locks are to be hauled by electric locomotives, two in front and two behind. All the equipment of the locks is operated by electricity, including gates, main and auxiliary valves. A hydroelectric plant will be installed on the side of the spillway of the Gatun dam to supply energy for operation, the present steam plant being held in reserve. The lock gates are about 85 ft. long and weigh about 750 tons. The conditions for the operation of electrical machinery in the Canal Zone are very severe on account of the heat and moisture. It was unfortunate that the dredging was not handled electrically. Mr. Rushmore stated that the only thing on the Isthmus which he felt could be done better by air than by electricity was the operation of various drills. All the other work could have been done better by electric power than by any other agency. Two more men are required with a steam shovel than with an electric shovel, and the steam engines used are inefficient in the extreme. Electrically driven centrifugal pumps are also used in pumping earth for waterworks excavation. The electric locomotives used in hauling the ships through the locks will probably be operated by alternating current. Before closing Mr. Rushmore paid a high tribute to the work of Colonel Goethals and Colonel Gorgas. The esprit de corps of the entire organization is, he said, most commendable.

Telephone Growth in Chicago.

For the year 1910 the Chicago Telephone Company reports the greatest growth in its history, the net gain in the number of telephone stations being 37,641. In the City of Chicago the total number of telephone stations connected to the exchanges of this company now amounts to nearly 240,000, and in the suburban district there is something over 60,000, giving a total of about 300,000 stations in the territory served by the company. Studies for the future indicate a growth of about 30,000 stations a year for the City of Chicago, but these figures may be exceeded, as the 5-cent measured rate service, with a minimum of $1.50 a month, is popular with customers and is an important factor in the extension of the company's service.

It is of interest to consider the amount of wire used for telephone conductors in some of the large office buildings of Chicago. For example, in the People's Gas Building there are 335 miles of conductors; in the Commercial National Bank Building, 216 miles; First National Bank Building, 190 miles; Monadnock Building, 95 miles. These figures indicate the amount of plant required in the work of a telephone company in a large city. The mileage of wire in the buildings mentioned and in similar large buildings, and, indeed, all the interior mileage, is omitted in the general statement of mileage of wire installed in conduits and on poles throughout the city, which at the close of the year 1910 reaches a total of 551,553 miles.

Practical Electricity on the Farm.

The practical uses of electricity on farms and in farm residences were discussed at the recent convention of the National Gas and Gasoline Engine Trades Association at Racine, Wis. A paper on this subject by Mr. C. H. Roth, of Roth Brothers & Company, Chicago, opened the discussion and presented recommendations for the equipment of a typical farm installation of gasoline engine, generator and storage battery, to supply lighting, together with a small amount of motor service, about the farmhouse, barn and yard.

Farm owners are coming to recognize the convenience and other advantages of electric lighting, said Mr. Roth. Like the telephone, the rural free delivery and the automobile, electric light will soon be considered almost a necessity on progressive, well-managed farms. Electricity has the advantage over other illuminants of making available power for motor service as well as lighting, after the generating plant is once installed or lines brought in from a central station. To the tungsten lamp is due the credit for the remarkable impetus given successful farm lighting within the last year. Without the economy of consumption of the new lamp the cost of adding a storage battery to an isolated plant was almost prohibitive, and without a battery the engine and generator were required to run all the time that any lamps were in use, while their rating had to be large enough to carry the total demand of the lamps connected or used simultaneously. The generating equipment now employed with a battery need be only one-half of the possible demand, as battery and generator can be used in parallel to supply unusual loads.

Mr. Roth described a typical farm installation intended to supply thirty-four 16-cp and 8-cp, 30-volt tungsten lamps, operated an average of two hours daily. Complete with wiring and fixtures such a 0.5-kw plant, driven by a 1-hp engine, would cost about $500. To charge the 16-cell storage battery provided, running an average of one hour each day, or three hours at three-day intervals, and assuming gasoline to cost 15 cents a gallon and oil 5 cents a day, the total cost to operate the plant would be about $75 a year, made up as follows: Gasoline, $18.25; battery maintenance, $10; maintenance of engine and dynamo, $8; lamp renewals, $6; interest on investment, $28.20. This represents a total cost of less than 20 cents a day. or about ½ cent per lamp per day.

Electricity on the farm guards against the fire risk from lanterns and matches, more dangerous in the country than elsewhere; enables lamps to be controlled from a distance, and permits the farmer to do his wood-sawing, churning, cream-separating, pumping, corn-shredding, ensilage-cutting, threshing, hoisting, conveying, vacuum cleaning, washing, ironing, cooking, heating soldering and branding irons, and a hundred other operations, with the aid of electricity. In closing, Mr. Roth repeated Edison's prediction that the farmer of the future will spend his time at the switchboard during most of the day.

Mr. T. Milton, of the Electric Storage Battery Company, Chicago, told of the remarkable success of his company in disposing of farm isolated plants since it has assembled and offered for sale complete gas-engine-driven outfits. As soon as gas-engine dealers and farmers become properly interested in the possibilities of farm lighting the storage-battery company desires to withdraw from the sale of complete plants, devoting its efforts to the storage-battery equipment only. Popular advertising has resulted in bringing in thousands of inquiries, and the small-plant sales in the Chicago office of the company alone have jumped from one or two a month to four complete outfits each day.

Mr. E. P. Edwards, of the General Electric Company, Schenectady, N. Y., gave the estimate that out of this country's population, 92,000,000, only 26,000,000 people have access to the service of electric supply companies, which latter figure appears rather low. The 6,000,000 farms, therefore, offer the greatest industrial opportunity of the time for supplying them with electricity, and the farmer needs only to be shown the advantages of electricity and its ability to help him in his work. Mr. Edwards suggested that work should be done through the agricultural colleges in fitting students with a good knowledge of machinery, just as they are instructed in the raising of crops and live stock. For farm installations he suggests a standard potential of 110 volts in preference to 30 volts, where motors are to be operated, heating appliances used or lamps employed at some distance from the plant.

Mr. P. S. Rose, of Madison, Wis., pointed out that the regents of agricultural colleges must be encouraged to take a more progressive stand consistent with the increasing use of electrical and mechanical appliances on the farms, and should instruct students in these subjects.

The Promise of an Electrified Agriculture.

At the annual meeting of the American Society of Agricultural Engineers, held at Lafayette, Ind., Dec. 27 and 28, Mr E. P. Edwards, of the General Electric Company, Schenectady, N. Y., read a paper on the subject of "The Promise of an Electrified Agriculture." The present decade, remarked Mr. Edwards, will be notable for its scientific agricultural development with the aid of electricity on the farm. As a class the farmer is a large user of power, but the sources from which he draws it are at present inefficient and uneconomical compared with industrial standards in other lines. As significant of the tremendous opportunities in the agricultural field, Mr. Edwards remarked that of the 29,000,000 persons engaged in gainful operation, reported by the 1900 census about 10,000,000 devote their energies to the farm. About 89 per cent of the horses and mules in this country are also at work on the farms. The farmers use more implements and a greater variety of mechanical devices than any other class, and it is important that they should be properly trained in the selection and use of this apparatus. No sharp line of division exists between farm and urban power needs, and mechanical and electrical power should benefit the farmer as well as the city man. But at present, in the farmer's ignorance of power apparatus and the machinery manufacturer's ignorance of farm methods and needs, neither seems to know just where this power should be applied.

Mr. Edwards spoke of the increased efficiency and economy of electric lighting since the advent of the tungsten lamp. For a few hundred dollars, he said, an isolated gasoline-engine-driven generator and storage battery can be purchased, and at the expense of a few hundred dollars more motors can be operated for running milking machines, cream-separators, churns, feed-grinders, threshing machines, hay-hoists, pumps, root-cutters, refrigerating outfits, corn-shellers, vacuum-cleaners, sewing machines, etc. Attention was called to the limitations of 30-volt direct-current plants where the operation of motors or heating appliances was desired, especially at any distance from the generating plant. Where isolated farm plants are being installed Mr. Edwards suggested that these be of the alternating-current type, employing a frequency common to the neighborhood central-station lighting plants, so that in case transmission lines were brought near the farm the isolated prime-mover apparatus could be discarded and energy obtained from the central-station service. In closing, the speaker referred to the utilization of high-potential electricity for stimulating plant growth directly, and for the production of nitrogenous compounds used as fertilizers.

In the discussion which followed Mr M. L. King, of Iowa State College, Ames, Ia., told of the use of electricity on several farms in northern Iowa, and Mr. O. H. Caldwell, of the *Electrical World*, described several central-station extension systems in central Illinois, from which electricity is being sold to farmers at the same low rates as in the neighboring towns. In reply to Mr. Edwards' remark that a single gasoline-engine outfit with electrical generator and motors was obviously better than half a dozen separate small engine outfits used for pumping, feed-grinding, threshing and other power purposes, Prof. J. B. Davidson, of the Iowa State College, at Ames, declared that a careful investigation of farm conditions had convinced him that electricity was suitable only for lighting on the farm and that motors with their connecting wiring were unsatisfactory for the portable work required. Gas-engine energy at 2 cents a hp-hour represented also a great saving, he said, over electrical energy at even 10 cents per kw-hour In his own experience he had found it cheaper to grind feed with gas-engine power than with electricity at 5 cents per kw-hour, a rate lower than service could be supplied to most farmers. Mr. Edwards mentioned the gas-electric tractor for farm use, with its four-wheel drive by motors at each axle, energized by a gasoline engine, and suggested that a unit of this kind might be of service for lighting duty, in connection with a storage battery to supply energy for small demands while the tractor outfit was employed at other work.

"Agricultural Engineering and the Demand for Agricultural Engineers" was discussed by Dr. Samuel Fortier, chief of irrigation investigations of the United States Department of Agriculture. In the sixty-seven land-grant colleges of this country, which have permanent equipments valued at $112,000,000 and total annual incomes amounting the $18,000,000. 24,930 of the 27,579 students are classified as follows:

Engineering	17,892
Agriculture	4,999
Household economy	1,443
Forestry	223
Veterinary science	215
Horticulture	158
Total	24,930

These figures show that the land-grant colleges are engineering rather than agricultural schools, and that they are training almost 60 per cent of the engineering students of the country Attention is chiefly given to training civil, mechanical and electrical engineers, while only two colleges out of the sixty-seven have established courses in agricultural engineering. The need and demand for the agricultural-engineering work indicate that the course should be divided into six sections:

1. Farm machinery and farm motors.
2. Farm structures, including rural architecture
3. Rural water supplies and sanitation.
4. Public roads.
5. Drainage.
6. Irrigation

This course should be supplemented by general instruction in the elements of a well-rounded education.

Each year more than $100,000,000 is expended for farm implements and machinery, and in the purchase of this great quantity of apparatus the best of judgment should be employed. Farm architecture also needs improvement and the simple problems of water supply and other farm chores should be made less laborious and more sanitary. The problem of good roads imperatively calls for solution when it is known that the average American farmer pays 23 cents to haul a ton a mile, although 10 cents should cover the cost on improved highways. The reclamation of waste areas through irrigation of unwatered lands and the drainage of swamps is another great and useful field for the engineer's knowledge and skill. At least 230,000,000 acres of waste swamp land await reclamation in the United States. Two-fifths of the area of this country is arid, and much of the remainder is subject to periodical droughts which make artificial watering necessary to farming operations

The land-grant colleges have long been catering to the demand of the industrial and municipal organizations for civil, mechanical and electrical engineers, said Dr. Fortier, and unless the curricula in these schools are changed the older branches of the engineering profession are sure to be overcrowded. Meanwhile progress in agriculture and the improvement of rural districts are being immeasurably retarded through the lack of competent agricultural engineers.

Gasoline Lighting Installation Causes Serious Explosion and Fire.

A gasoline explosion in a poolroom on the lower floor of the two-story building at 919 Pine Street, St. Louis, about 8:30 a. m. on Nov. 12, caused a fire which resulted in damage estimated at $50,000, principally to the school for the instruction of maintenance men, which had just been established on the upper floor by the Bell Telephone Company of St. Louis. The poolroom on the ground floor was occupied by a Greek and was lighted by gasoline, the latter being conducted to fixtures over the pool tables and elsewhere by tin pipes connected to a tank. By a leak or in some other manner there was an explosion of gasoline fumes. The gasoline caught fire and a large quantity of the burning fluid spread all over the building, and in an instant the whole interior was ablaze. The occupants of the building had to run for their lives.

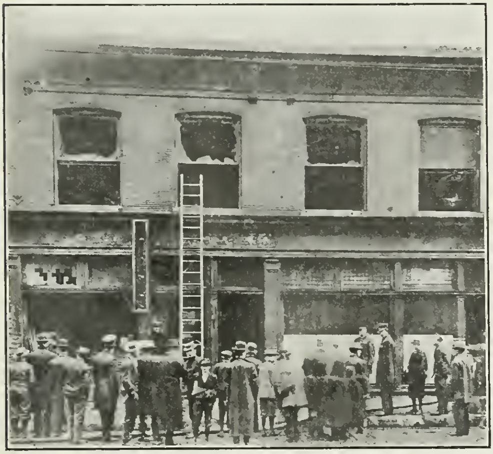


Fig. 1—Front View of Building.

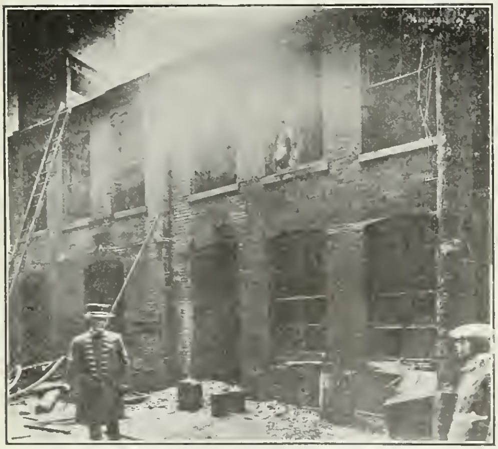


Fig. 2—Rear View of Building.

There appear to have been two explosions. A policeman who was passing heard a slight noise and saw smoke. He stepped up to the poolroom window and peered in. The next instant the plate-glass front was blown out and the 200-pound man was hurled into the middle of the street, sustaining painful but not dangerous injuries. The fire burned with great intensity owing to the gasoline, but the firemen saved the walls of the building. The accompanying illustrations are front and rear views of the building, after the fire, taken before the firemen had left. The rear view shows some cans, which are apparently gasoline cans.

On the second floor of the building, and extending into an adjoining building, was the school of instruction of the maintenance department of the Bell Telephone Company. Twenty young men who are learning the work of installing telephones had just reached the rooms and were preparing to start in on the duties of the day when the explosion came. They were forced to flee without their overcoats. The principal financial loss occurred here, because the telephone company had a large number of new telephones stored in this place.

Wisconsin Commission News.

The Gogebic & Iron Counties Railway & Light Company has been recently organized for the purpose of acquiring the stocks and bonds of the Gogebic & Iron Counties Railway & Light Company, of the State of Michigan, which company owns the electric light plant at Bessemer, Mich., and has an option contract on the property of the Twin City General Electric Company, comprising the street railway and electric light plants serving the cities of Ironwood, Mich., and Hurley, Wis. The new company plans also to acquire the property of the Ashland Power Company, which company owns the majority of the capital stock of the Ashland Light, Power & Street Railway Company and also owns land in Ashland County containing the Grand Canyon of Wisconsin, Copper Falls and Brownstone Falls. There is a total head on the Bad River, in this territory, of 150 ft.

It is the purpose of the company to improve the Copper Falls and Brownstone Falls property. The survey made in this connection showed that by the acquisition of another piece of property, known as Mellen Rapids, a total fall of 258 ft. could be made available. This property has been subsequently acquired, together with very liberal flowage rights. The company intends to improve these various water-powers and to connect them up with the White River Power Company's plant at White River, owned by the Ashland Light, Power & Street Railway Company, by transmission lines, and to connect the same to Ironwood and Bessemer, Mich., so as to distribute this power throughout the territory named and thereby serve the demand of the various mining companies along the Gogebic range for cheap electric energy.

The company has petitioned the commission for authority to issue stock and bonds as outlined below, which authority the commission has granted. The authorized issue consists of the following:

(1) Two thousand shares of preferred stock of the par value of $100 each, carrying a guaranteed dividend of 6 per cent per annum, being a total issue of $200,000. This stock is to be sold for money only and for not less than par value. (2) Five thousand shares of common stock of the par value of $100 each, being a total issue of $500,000. This stock must be sold for money only and for not less than par. (3) Gold mortgage bonds, to the sum of $1,344,400, par value, to bear interest at the rate of 5 per cent per annum and to be secured by a

mortgage or deed on all the property of the company. The bonds are to be sold for money only and for not less than 75 per cent of the par value.

The commission specified that the funds to be derived from the sale of the foregoing stock and bonds must be used for the following purposes:

(a) Purchasing bonds of the Ashland Power Company of the par value of $120,000. (b) Developing water-power on the Bad River, near Mellen, Wis., constructing the necessary buildings and installing the necessary machinery. (c) Constructing a transmission line from the power plant of the Ashland Light, Power & Street Railway Company at White River and at Brownstone Falls on Bad River, to the City of Hurley, Wis. (d) Purchasing the first-mortgage bonds of the Iron Counties Railway & Light Company, of the State of Michigan, of the par value of $458,300. (e) Purchasing 500 shares of 8 per cent preferred stock and 500 shares of the common stock of the Ashland Power Company. (f) Purchasing a reservoir system and building storage dams. (g) Providing the necessary working capital and to pay interest, incidentals and contingencies during construction. (h) Purchasing 3500 shares of the common stock of the Gogebic & Iron Counties Railway & Light Company, of the State of Michigan.

The Lancaster Electric Light Company petitioned the commission for authority to put into effect a minimum charge of $1. After investigating the conditions in Lancaster the commission allowed the company a minimum charge of 75 cents.

Maryland Commission News.

The Maryland Public Service Commission has withheld action on the application of the Park Heights and Mortimer Heights Water Companies to merge as a suburban water company. Necessary to the plan was the consent of the commission to an issue of $90,000 in bonds and $120,000 in stocks to cover the cost of the purchase of both properties and provide funds for subsequent extensions. The commissioners said that if it was impossible for the transaction to go through on the basis of anything less than the immediate issue of $90,000 of bonds and $120,000 of stock for the property as it stands then the application must certainly be denied. The commission did not sign an order to that effect and will not do so until the applicants have had sufficient time to present the matter in a revised form. The commission, after thoroughly investigating the financial situation and going into the assets of both companies, as well as into the revenue that it would be possible to derive from such a merger, gave a hint as to what it might consider a fair issue of bonds and stock. The opinion prepared by the commission was a long one and included the results of an investigation made by its chief engineer, Mr. Charles E. Phelps, who not only reported to the commission on the physical value of the property concerned, but made a study of it with a view to ascertaining its prospects after the merger had been effected.

Mr. George H. Bausman has asked the commission to inquire into a contract that he said was about to be made between the Consolidated Gas, Electric Light & Power Company and James L. Kernan for lighting his buildings on North Howard Street with electricity. It was alleged that the contract called for energy at 1 cent per kw-hour, whereas the actual cost was about 2 cents per kw-hour. Such rates, he said, were a discrimination. It was pointed out in the letter that Mr. Kernan had a private lighting plant. The company, it was said, desired to put all such plants out of commission and, in order to do so, rates were made below cost, and the public generally would have to pay the expense involved in suppressing private plants. Mr. Bausman says he is an engineer and the closing out of private plants would put him out of business.

The commission is investigating the subject of crowded street cars with a view to devising some method whereby the conditions may be relieved.

New York Commission News.

The Fulton County Gas & Electric Company, through its manager, Mr. J. E. Hodgson, has voluntarily reduced the price of gas in the Cities of Johnstown and Gloversville from $1.30 per 1000 cu. ft. to a sliding scale of prices commencing at $1.20 and running down to $1 per 1000 cu. ft

The application for permission to change the rates, when submitted to the Public Service Commission, Second District, was immediately granted. The reduction comes at this time without any request from the citizens of these cities, and no complaint as to price had been submitted to the Public Service Commission. The application was presented by G. W. Curran, Comptroller of the United Gas & Improvement Company, of Philadelphia, which controls the Fulton County company.

The Public Service Commission, Second District, has ordered a conference to be called of the general managers, district superintendents, train dispatchers and master mechanics of the several interurban railroads in the State, to be held at Syracuse on Jan. 19, for discussion of all questions in relation to the safety of operation of these railroad companies.

The attention of the commission has been called to a number of serious accidents on interurban railroads (nearly all outside of the State of New York, but involving conditions existing in this State), which accidents, as far as investigations have developed, were caused by defective methods of operation, defects in block signals or violations of rules or orders.

The electrical expert of the commission, Mr. Charles R Barnes, is preparing a program of subjects which will be assigned to various interurban electric railroad officials for discussion at this conference to the end that all necessary precautions shall be taken and improvements made to prevent such accidents as have occurred in other States.

The Hoosac River Electric Light & Power Company has been authorized to exercise a franchise granted by the Town of Pittstown for furnishing electricity for light, heat and power.

The commission has received a complaint from J. H. Van Duzer & Company, of Newburgh, directed against the toll charge made by the New York Telephone Company between Newburgh and Tuxedo Park. The complainant has no alternative but to pay the 25-cent charge between Newburgh and Tuxedo whether he secures the party desired or not. He is obliged to call by number and take his chances as to whether his correspondent can be reached by that number. The company has been asked to answer the complaint within twenty days.

At the close of business for 1910 the Public Service Commission, Second District, had had presented to it for action 2071 different matters. These included 1438 complaints which were handled informally by the commission and settled without the necessity of formal orders, 371 formal complaints and 262 applications from various corporations for authorization by the commission. During the year the commission disposed of and closed 1670 of the matters presented. During the three years of the commission's existence 5496 matters have been presented to it for action. In addition to daily sessions and consideration of disposition of cases the commission handled 554 hearings, covering a period of 106 days.

During the year the commission authorized capitalization to the amount of $151,048,108. In 1909 there was authorized $142,855,035.85; in 1908, $92,253,900; for the last six months of 1907, $17,730,745.49, a total for the three and a half years of the commission's existence of $403,887,789.34

During the present week the commission will hear the application of the Syracuse Rapid Transit Railway Company for authority to increase its capital stock from $4,000,000 to $5,750,000, the increase, $7,750,000, to be preferred stock, and for authority to issue and sell capital stock to pay outstanding notes amounting to $1,600,000; the application of the New York State Railways for authority to acquire capital stock of the Syracuse Rapid Transit Railway Company; and the application of the East Hampton Electric Light Company for authority to issue $14,000 in first-mortgage 6 per cent bonds.

The Public Service Commission, Second District, has entered an order, effective Feb. 1, 1911, prescribing rules and regulations to govern after that date the practice of gas and electrical corporations and exacting cash deposits from consumers. Correspondence received at the office of the commission has disclosed that many patrons of such corporations are ignorant of the provisions of law pursuant to which such deposits are exacted. Accordingly an inquiry was made by the commission into the practice, disclosing an entire absence of such proper rules upon the part of the corporations that the observance of them would inform the depositor as to his rights in the transaction and safeguard his interests. The order is designed to correct these conditions. The more important provisions of the order are as follows:

1. A detailed record shall be kept with respect to each deposit now on hand or hereafter received.

2. Upon each deposit shall be allowed and paid interest at the rate of 6 per cent per annum.

3. Each depositor upon ceasing to be a consumer shall have the right to withdraw his deposit and all accrued interest thereon upon certain terms and conditions.

4. Each corporation shall keep on hand for distribution to its customers printed circulars under its corporate or business name, such circulars to contain for the information of the depositors in full Section 63 of the Transportation Corporations Law, pursuant to which the companies obtain their rights in the matter, and shall also contain in full this order of the commission.

5. Each corporation shall on or before March 1, 1911, provide every consumer having a deposit with a copy of such circular and hereafter prior to exacting a deposit such corporations shall present a copy of said circular to the consumer or applicant for service of whom a deposit is demanded.

6. Also each corporation is required to provide reasonable ways and means whereby a depositor who in good faith makes application for the return of his deposit and is entitled to the return of same, but who is unable to produce the original certificate of deposit, may not for that reason be deprived of his rights.

AMERICAN ELECTRICAL ENGINEERS.

W. H. Powell.

William H. Powell was born in Leicester, England, Sept. 14, 1867, but was brought to this country by his parents when about three years old. His early life was spent in New Britain, Conn., where he received his primary education. After being graduated from high school he served as an apprentice in one of the local machine shops. While there an interest along engineering lines was awakened and he decided to make his career that of an engineer.

In 1886 he entered Cornell University, where he studied mechanical engineering under Dr. Thurston and electrical engineering under Prof. H. J. Ryan, and was graduated in 1890 with the degree of M.E. In conjunction with Mr. C. B. Humphrey, Mr. Powell made quite exhaustive studies of the efficiency of transformers, about which comparatively little was generally known at that time. The results of these investigations were embodied in their thesis, which was also presented in 1890 as a paper before the American Institute of Electrical Engineers.

Upon leaving college Mr. Powell entered the laboratory of the Westinghouse Electric & Manufacturing Company, where he took advantage of the opportunity to study closely the apparatus that came under his notice. After a few months Mr. Powell accepted a position as construction engineer with the North American Construction Company, in which position he was in charge of street railway work. While with this company he helped build the first Westinghouse electric road to be started, that at Greensburg, Pa. From this position he entered the New York district office of the Edison General Electric Company and became connected with the extended street railway work which was then being started. An opportunity to be associated with Prof. W. A. Anthony led Mr. Powell to accept employment with the Mather Electric Company, where he held the positions first of chief draftsman and then of superintendent. While with this company, under Prof. Anthony's direction, he designed the generator and motor equipment of one of the first 500-volt, direct-current, motor-driven manufacturing plants in the country, that of the Blatz Brewery in Milwaukee, which is still in operation with the original motors.

In 1894 Mr. Powell left the Mather company to become instructor in charge of the department of electrical engineering at Lehigh University and was one of those who helped to found the electrical engineering department of this university on a firm basis. He left the university after a year to become superintendent of the incandescent-lamp department of the Perkins Electric Switch Manufacturing Company.

W. H. Powell.

In 1896 Mr. Powell was made chief engineer of the Keystone Electric Company, of Erie, Pa. He held this position and that of consulting engineer of the company until 1902. During this period, in 1900-1901, he returned to Cornell and took up graduate work, receiving the degree of master in 1901. His research covered particularly the design of rotary converters. Mr. Powell's work in the university led to his election to the honorary society of Sigma Xi.

In 1902 Mr. Powell became connected with the Crocker-Wheeler Company, of Ampere, N. J., where he began his work in multiple-voltage speed control. The major portion of his work with this company was as an industrial engineer working out practical methods and increasing the scope of the applications of electrical power. In 1904 he entered the Allis-Chalmers Company as engineer in charge of the direct-current motor department of the Bullock Works. This position he held until 1907, when he was made general superintendent of the Cincinnati works. In 1908 he was advanced to the position of engineer in charge of the electrical department of the Allis-Chalmers Company, in which position he now has complete supervision of all the electrical work.

During his work Mr. Powell has taken out a large number of patents. These deal with switches, circuit-breakers, controllers of various kinds, including multi-voltage controllers, direct-current motors and details of construction of various electrical apparatus, including both direct-current and alternating-current generators.

Mr. Powell is a member of the American Society of Mechanical Engineers and a member of the American Institute of Electrical Engineers, being chairman of the Milwaukee branch of the latter and a member of the committees on sections and on electric lighting.

CURRENT NEWS AND NOTES.

Electric Mill Power in North Carolina.—In a State report recently issued 655 factories are reported as operating in North Carolina, with an aggregate capital of $50,000,000. Electric energy is used exclusively in 110 factories and partly in thirty-three factories.

Heavy Maximum Load.—During the year 1910 the maximum load on the system of the Commonwealth Edison Company, Chicago, reached 182,600 kw early in December. For the year 1909 the corresponding figure was 158,090 kw, showing the satisfactory increase of 15 per cent.

Electrical Section, Western Society of Engineers.—Officers for the Electrical Section of the Western Society of Engineers, Chicago, have been named as follows: Chairman, Garrett T. Seeley; vice-chairman, J. R. Cravath. The retiring chairman of the section, Mr. George H. Lukes, was made a member of the executive committee.

Minneapolis Electric Show.—As previously announced, the Northwestern Electric Show Association will hold its second annual electric show in the National Guard Armory, Minneapolis, on Jan. 26 to Feb. 4. Many attractive features are promised, including a high-frequency demonstration by Mr. H. T. Plumb. Mr. R. W. Clark, 15 South Fifth Street, Minneapolis, Minn., is general manager for the show.

Exchange Lectures.—The colleges of engineering of the University of Illinois, Urbana, Ill., and Purdue University, Lafayette, Ind., arrange each year a series of exchange lectures delivered by the members of the faculty of each institution. The first lecture delivered at the University of Illinois this year under this plan was by Prof. C. R. Moore, of Purdue, on "Power Manufacture and Its Dangers."

A Marked Improvement in Load Factor.—For the year 1910 the load factor of the Commonwealth Edison Company, Chicago, was a little over 41 per cent. In 1900 it was slightly under 29 per cent. This improvement accounts in a large degree for the prosperity of the company, as it is undoubtedly true that the load factor is the controlling element in the making or losing of money by an electric service corporation.

Christmas Turkeys for Central-Station Employees.—Before Christmas the Commonwealth Edison Company, of Chicago, distributed about 2100 turkeys as presents to all employees, whether married or single, men or women, who had been in the company's service over one year. The North Shore Electric Company, of the same city, also gave a turkey to each employee who had been with the company six months or more.

An Unsuspected Source of Gas Poisoning.—According to press dispatches from Paris, Professor Courmont, of Lyons, addressing the French Academy of Medicine at a recent meeting, said that unperceived escape of carbon monoxide from gas pipes and gas-heating apparatus is the cause of many deaths resulting from gradual poisoning of the blood. The French government is urged to take measures to meet this danger.

Franchise for Telharmonium.—The New York Cahill Telharmonic Company has applied for a franchise for furnishing music through the medium of electrical conductors throughout New York City The telharmonic system was described in our issues for March 10, 1906. Jan. 5, 1907, and April 28, 1910. The Bureau of Franchises has suggested that the initial term be twenty five years, with the privilege of renewal for a further term of twenty-five years.

Commonwealth Edison Branch, N. E. L. A.—The next meeting of the Commonwealth Edison branch of the National Electric Light Association in Chicago will be held at 8 p. m. on Jan. 10 at Recital Hall, in the Auditorium, on Wabash Avenue, near Congress Street. Mr. P. B. Juhnke will read a short paper on "Generating and Transmission Systems and Load Dispatcher's Office," and Mr. A. E. Evans will have a paper on "Substations and Distributing System."

The Moral Is Obvious.—A South Side woman in Chicago met her death during the Christmas holidays in an unusual manner. A wreath of holly was hung on a gas fixture in her bedroom. The gas cock was loose and turned very easily, as is often the case. During the night of Dec. 24 the wreath was jarred loose from its support and in falling it struck the handle of the valve, opening it and allowing the gas to pour into the room. On Christmas morning the woman was found dead

Pittsburgh, A. I. E. E. Meeting.—The December meeting of the Pittsburgh Section of the American Institute of Electrical Engineers was the best attended of the season, 125 persons being present. The subject was "Electric Lighting and Luminous Efficiency." Dr. E. P. Hyde presented a paper on "A Study of the Electric Incandescent Lamp," and Mr. F. R. Fortune one on "Luminous Efficiency as Affected by the Quality of the Light." Mr. C. F. Scott and others took part in the discussion.

Practical Way of Selecting Convention Topics.—Mr Thomas Crawford, of Clinton, Ia., president of the Iowa Electrical Association, is sending out return postcards to members asking them to indicate what subjects they wish discussed at the convention in Davenport next April. Further, they are requested to name members whom they would like to hear on any subject connected with the industry. This appears to be a sensible plan to make a convention program of more practical value

Columbia University Deutsches Haus.—As the result of the gift of $30,000 from Mr. Edward D. Adams for the purchase of a building for the purpose a "Deutsches Haus" is being established at Columbia University. The Deutsches Haus will contain a well-selected reference library and will serve as a bureau of information concerning schools and universities in both Germany and America. A gift of $100,000 has been obtained from an anonymous contributor as a permanent fund for the maintenance of the house

Sits on "Deadly" Third-Rail.—The Trenton *Times* gives an account of the experience of a six-year-old boy with what it calls "the deadly third-rail." The father was horrified to see the child playing between the rails of the West Jersey & Seashore Railroad at Pitman, N. J., and commanding him to stand perfectly still, ran to the station for help. The newspaper continues: "But the boy got tired of standing, and when his rescuers arrived he was sitting calmly and squarely on the third-rail with thousands of volts of electricity passing under him."

Tantalum Lamps for Street-Car Lighting.—The Chicago City Railway Company is equipping all the cars in its extensive system with 16-cp series-burning tantalum lamps, each taking 2.3 watts per candle and connected to the 550-volt circuit Twenty thousand of these lamps are already in place, and about 20,000 more will be needed, the lamps being purchased through the sales department of the Commonwealth Edison Company, which supplies the company with its electrical energy. The Chicago Railways Company, as previously mentioned, is also using tantalum lamps after an exhaustive series of tests.

Electric Club of Chicago.—The meeting of the Electric Club of Chicago on Dec. 28 was devoted largely to an informal debate of the question whether the club should secure a more centrally located meeting place and possibly permanent quarters. Some elaborate plans were discussed. It was decided to enlarge the house committee, of which Mr. A. A. Gray is chairman, by adding to it Messrs. James H .Delany, George P. Nichols, C. A. S. Howlett and W. E. Keily. Out-of-town visitors at the meeting were Messrs. Robert Kelly, Jr., Holophane Company, Newark, Ohio, and H. A. Otterson, Ridgway Dynamo & Engine Company, Ridgway, Pa.

Measuring the Coasting Time of Street Cars.—Several St. Louis street cars have been equipped with a special coasting meter, or clock, which registers the total time during which energy is not taken by the motors. If this preliminary equipment is successful these instruments will be installed on a number of the cars. Other devices designed to encourage the motorman in the economical use of energy in starting and running have been constructed to register the total time during which energy is taken. The St. Louis idea employs the reverse principle and has a solenoid arranged to release the clock movement when no energy is passing through the controller.

Central-Station Vehicle Service in Chicago.—With its varied activities and widely scattered stations, substations and departments, the Commonwealth Edison Company, of Chicago, requires a number of vehicles for the transportation of men and goods, as well as tools and supplies. The transportation department, organized three years ago, has shown a remarkable growth under the management of Mr. C. F. Clark. It now has in its charge twenty-eight electric delivery wagons, thirteen gasoline automobiles and 123 horses and 118 horse-drawn vehicles. A large garage is maintained, and the calls for vehicles from various departments amount to about 600 a month.

"Wireless" from Aeroplanes.—A newspaper dispatch from Paris dated Dec. 24 says that Mr. Farnam has concluded the first of a series of experiments with wireless telegraphy used in connection with an aeroplane. The aviator is reported to have sent dispatches for a distance of six miles from an aeroplane in the air, and he is reported as being confident of being able in time to telegraph in this manner for a distance of sixty miles or more. The value of a practicable combination of wireless telegraphy and aviation in military maneuvers would be very great, and it is said that Mr. Farman's experiments have made a deep impression on the military experts of France.

Detroit A. I. E. E. Section.—At a recent meeting of electrical engineers held at the Hotel Tuller, Detroit, Mich., plans were formulated for the organization of a local section of the American Institute of Electrical Engineers. A list of twenty-five names, the number requisite to secure a charter, was secured and forwarded to the headquarters in New York. Messrs. H. M. Brown, John R. Woolfenden and A. T. Barley were chosen as a temporary committee to act until the completion of the regular organization. There are thirty electrical engineers in Detroit and perhaps twice that number in neighboring cities, and an endeavor will be made to get them all enrolled and affiliated with the profession.

Indiana Engineering Society.—The annual meeting of the Indiana Engineering Society will be held at Indianapolis, Jan. 12-14, at which several reports and papers on electrical subjects will be presented. The committee on central-station light and power, consisting of Messrs. Frank R. Daniel, chairman; C. D. Emmons and Prof. C. F. Harding will report on illumination costs, economy of motor-driven apparatus and protection of underground piping from electrolytic action. Reports will be presented by the committee on electrical engineering, Messrs. C. A. Tripp, chairman, E. H. Bangs and Robert P. Woods; and by the committee on electric railways, Messrs. Robert P. Woods, chairman, R. N. Murry and Thomas B. McMath. Mr. Chas. A Tripp will read a paper on individual drives applied to textile mills, and the Williams hydroelectric plant at Bedford will be described by Mr. DeWitt V Moore.

National Independent Telephone Convention.—The annual convention of the National Independent Telephone Association, of which Mr. F. H. Woods is president, will be held at the Hotel Lasalle, Chicago, Jan. 17, 18 and 19. A number of important issues will be up for discussion, including the subjects of interchange of traffic with competing exchanges and regulation by State utility commissions, and a large attendance is expected at the meeting. The number of exhibitors this year will exceed that at any previous convention. The exhibits will be installed on the eighteenth floor of the hotel, while the convention sessions will be held on the floor above. The morning sessions are to be given over to discussions affecting the managerial and executive sides of the telephone business, while the afternoons will be devoted to technical discussions led by Mr. L. E. Hurtz, of Lincoln, Neb.

Electricity in the Modern Theater.—"We could not run this house without electricity," declared the manager of a large new theater recently. "I can scarcely enumerate the many ways in which we use electricity and we can only wonder how we ever got along without it." Not only is electricity used for the general illumination of the theater, but it is relied upon for stage effects of lighting, flame and fire, storm and crash, warmth and benignity, that are sometimes, with their easy or rapid gradations, fairly marvelous. The mechanisms of many important "acts" and illusions are entirely electrical; the call-boy has been superseded by electric signals from stage manager to dressing rooms, and heating and ventilation are controlled by electrical means. Even the scrubwomen are provided with baseboard attachments so that they can secure sufficient illumination in the portion of the building in which they are working without lighting the entire house.

Philadelphia N. E. L. A. Meeting.—The regular meeting of the Philadelphia Section of the National Electric Light Association was held Dec. 19 in the assembly room of the company building, 1000 Chestnut Street, with an attendance of 125 members and guests. Prizes were awarded to Messrs. W. H. Donley and J. J. Sessinger for securing the greatest number of new members during the season, and to Messrs. J. B. Seaman and W. L. Crist for the best suggestions relating to improvements in central-station management The suggestion of Mr. Seaman was to standardize the location of the house service and terminals for all makes of meters, and to adopt a standard coloring for terminals in order to facilitate their connection. The suggestion of Mr. Crist was the inclosure with each receipted bill of a slip expressing the company's thanks for the remittance and inviting continued patronage, a small advertisement being added. A revised constitution was adopted, which provides for the division of the section into branches, of which a meter department, an accounting department and a commercial department are already organized. Section meetings will be confined to a consideration of general topics. Two papers were presented at the meeting, one on "Business Getting," by Mr. J. E. Dougherty, and the other on "Refrigeration," by Mr. R. L. Lloyd. Dr. Spitzka will address the next regular meeting, to be held Jan. 16, on "The Effects of Electricity on the Human Body."

QUARRY STREET STATION COMPLETED.

The Latest Generating Plant of the Commonwealth Edison Company, with Continuous Rating of 84,000 Kw.

Two years ago an article was printed in the *Electrical World* describing and illustrating the initial equipment of the Quarry Street generating station of the Commonwealth Edison Company in Chicago. Since then the entire station has been completed and placed in operation, and the purpose of this article is to describe the finished plant. To make the article complete there will be brief reference to the general arrangement, as described previously, but the greater portion of the present account will be devoted to the more recent equipment and to the purely electrical features of the station which have been worked out for the complete installation.

Six generating units of 14,000 kw each, or 84,000 kw in all, are installed in this plant. Two of these constitute the initial equipment described in the preceding article. The four units added during the last two years have a combined rating of 56,000 kw. That this increase is demanded by the constant extension of the business of the Commonwealth Edison Company is shown by the fact that whereas in 1908 the maximum load on the company's system was 117,370 kw, the corresponding figure of two years later was 182,600 kw. During this period, also, the maximum rating of Fisk Street station, a near neighbor of the Quarry Street plant, was increased from 100,000 kw to 120,000 kw by the remodeling of four of the earlier generating units in that station. Furthermore, the company is now engaged in erecting a new station several miles distant from the Fisk and Quarry Street plants, to have a rating, when completed, of 120,000 kw, and to be followed by a duplicate station on the same plat of ground of a like rating. This new station is known as Northwest station, and when the two Northwest plants are completed they will add 240,000 kw to the generating capacity of the system. At that time the total rating of the four steam turbine generating stations of the company will be 444,000 kw. The initial equipment of the first Northwest station will be 40,000 kw in two units (the largest yet built), and it is expected that these 20,000-kw machines will be in service by the close of the year 1911.

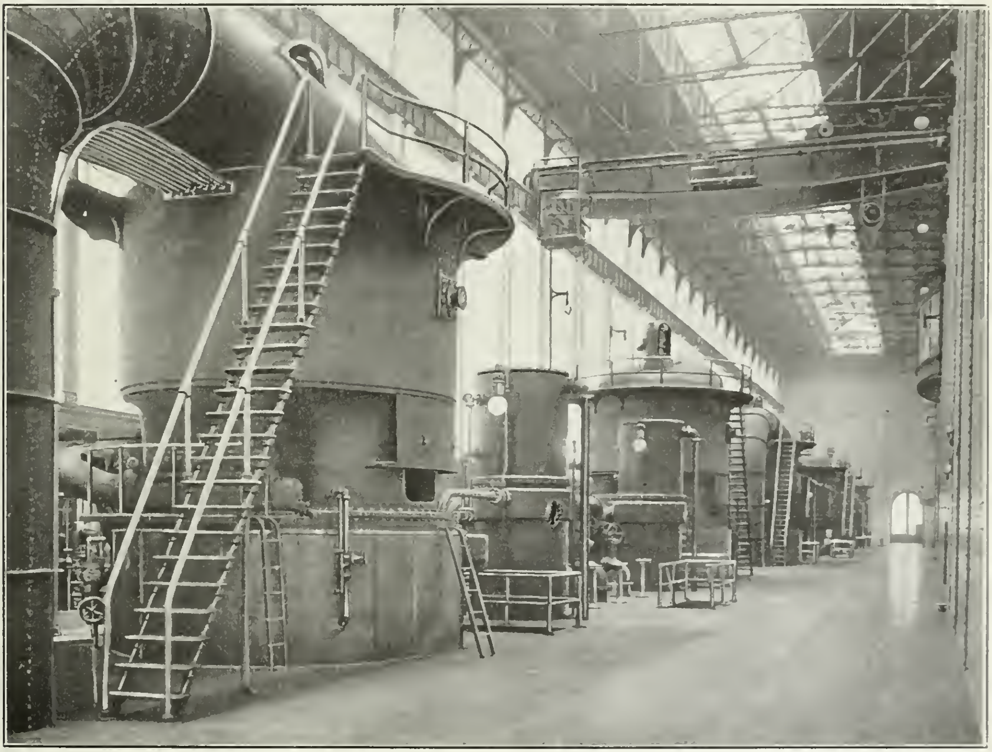


Fig. 1—View of Turbine Room Looking East.

GENERAL ARRANGEMENT.

Quarry Street station is located directly across the South Branch of the Chicago River from its older and somewhat larger neighbor, the Fisk Street station. Fig. 2 is a property plat of the two stations, showing their relative position and surroundings. The two plants are quite distinct, so that a breakdown in one would not cripple the other, but they are electrically connected by tie lines in two tunnels and they are operated together as one electrical generating system. A ferry service is maintained across the river at this point.

The building of the Quarry Street station is a massive one, less ornamental than the Fisk Street station, yet dignified and imposing. The exterior is of red pressed brick, and the boiler room is surmounted by eight steel stacks. The building is 462 ft. 10 in. long, east and west, and 207 ft. 10 in. wide, north and south. The distance from the ground to the roof over the turbine room and boiler room is about 80 ft.

The station arrangement is longitudinal; that is, the plant is divided into four parts placed side by side, and each extending the entire length of the building. Each of the four divisions, therefore, is 462 ft. long. The four parts consist, in order from north to south, of the train shed, 27 ft. 6 in. wide; the boiler room, 86 ft. 6 in. wide; the turbine room, 56 ft. 4 in. wide, and the switch house, 34 ft. wide. The train shed and the switch house are not as high as the central portion of the building, and in the case of the switch house there is a central pavilion for the operating gallery higher than the wings on either side, but still not reaching to the level of the roof of the turbine room. Fig. 3 is a good view of the exterior of the entire plant, taken from across the river, and showing the train-shed side. The principal entrance to the station is on the opposite side of the building and is shown in Fig. 4. Fig. 7 shows a cross-section and Fig. 8 a general arrangement plan of the whole station.

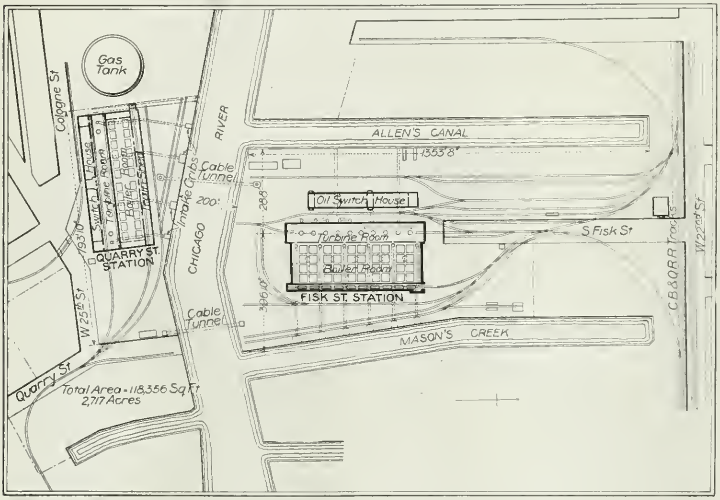


Fig. 2—Map of Property (Including Fisk Street Station).

Ample provision has been made for natural light and for ventilation. Skylights, monitors and side windows are used to admit the light and air, and window control is effected by electro-pneumatic means. The turbine room is finished in white-enameled brick, and owing to its length and the fact that it is over 60 ft. high it presents an impressive appearance. There is a visitors' gallery on the northern side of this room on the boiler-room level, and several doors open into it from the boiler room. A railroad track extends the whole length of the train shed and is used in the delivery of coal and the taking away of ashes. Another permanent railroad track is placed at the southern side of the turbine room.

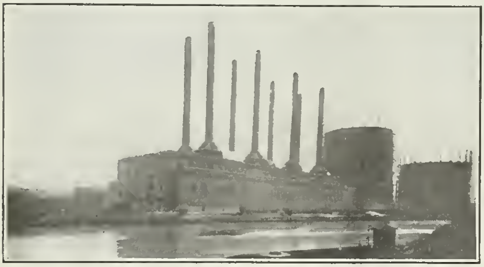


Fig. 3—View of Exterior from Riverside.

TRAIN SHED AND BOILER ROOM.

Coal is brought into the station in cars on the track in the train shed by means of the company's yard locomotives. Here, by means of overhead traveling cranes with grab buckets, the coal is dumped into hoppers beneath the track and in turn emptied into a longitudinal conveyor for each half of the station. Thus it is taken to crushers at each end of the train shed. Transverse conveyors carry the fuel to bunkers over the boilers, holding 150 tons for each individual boiler. The ash-handling system presents no novel features; it is similar to that at Fisk Street.

Arranged in two rows parallel to the turbine room are eight water-tube boilers for each generating unit, or forty-eight for the entire station. These boilers present a long and impressive perspective, as may be judged from Fig. 5. Each boiler has 5000 sq. ft. of heating surface, exclusive of the superheaters. The boilers are designed for 225-lb. gage pressure and for a maximum steaming capacity of 30,000 lb. per hour. The superheater is designed to give from 150 deg. Fahr. to 175 deg. Fahr. of superheat when the boiler is operated at 30,000 lb. of steam per hour. The automatic chain grates are 8.5 ft. x 11.5 ft. in the case of the boilers for the first two units and 9 ft. x 11.5 ft. in the case of all the other boilers.

The original boiler setting at Quarry Street represented a new departure in power-house design, as the furnace was placed under what is ordinarily the rear header of the boiler. This arrangement enables a decided improvement to be made in boiler efficiency, and with the long flame chamber, expanding in volume, it makes for more perfect combustion. However, on account of the comparatively high cost of maintenance of furnaces for the boilers with the horizontal pass the last six boilers to be installed in this station have been provided with standard settings, except that they were set at the same height as in the case of the "reverse" boilers which have just been mentioned. Thus the latest boilers installed also have a larger combustion chamber than is the case in ordinary practice.

Eight steel stacks, 12 ft. inside diameter and extending 250 ft. above the boiler-room floor, are provided. There are thus six boilers for each stack. The stacks are carried on steel structures over the boilers. A hand-power 5-ton crane is provided in the boiler room.

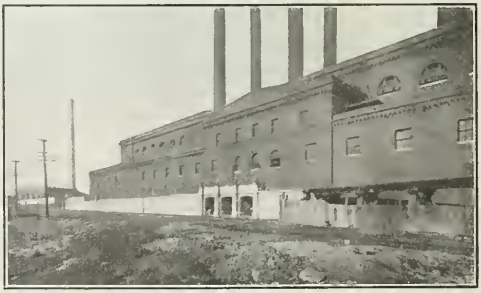


Fig. 4—Exterior from Switch-House Side, Showing Main Entrance.

TURBO-GENERATORS AND THEIR AUXILIARIES.

Extending down the center line of the turbine room is a row of six turbo-generator units with their auxiliaries. Each of these units has a continuous rating of 14,000 kw and is a complete and individual unit, each with its own auxiliaries. The distance from center to center of these machines is alternately 67 ft. and 74 ft. Each steam turbine has an independent steam header and connections to the eight boilers which supply the steam, making each unit independent on its steam side. These headers are carried in an absolutely straight line In addition there are cross-connections between adjacent sets.

Fig. 1 is a general view in the turbine room. As will be seen, the large ventilating ducts leading to the tops of the turbo-generators are a conspicuous feature of this plant. These ducts are connected to air chambers in the basement, provided with grated openings leading to the outside air, and as vanes are placed in the incased revolving-field cores of the generators air is drawn through these ducts to ventilate the generators. The heated air is forced downward and out through the laminations of the stationary armatures and rises to the top of the turbine room, where it escapes to the outer air by means of ventilating equipment, to which reference has already been made.

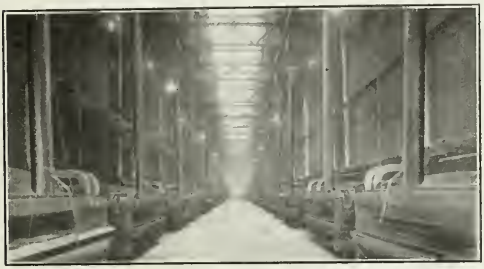


Fig. 5—View in Boiler Room Looking East.

The generating units consist of five-stage Curtis steam turbines direct-coupled by means of vertical shafts to three-phase, four-pole, revolving-field generators. These generators are of two types—9000 volts at 25 cycles and 12,000 volts at 60 cycles, as will be explained later. The speed of operation is 750 r.p.m. and 720 r.p.m. respectively, and the machines stand about 25 ft. above the floor. Including the condensers in the basement, the entire height of each unit is 33 ft., while the diameter is 15 ft.

The condensers are set in the basement so that the operating parts of the turbine are conveniently reached from the main turbine floor. Each condenser has 25,000 sq. ft. of surface. Each unit is equipped with a combined circulating and vacuum pump driven by a Corliss engine. The pump is of the volute type and has a rating of 25,000 gal. per minute. The steam cylinder of this machine is 20 in. in diameter and the air cylinder 28 in., with 24-in. stroke.

Each unit is also provided with a turbine-driven hot-well pump, which is set in a pit in the basement floor next to the condenser. Also each unit has an independent vertical feed-water heater and a centrifugal, turbine-driven, 4-in., three-stage boiler-feed pump. A spare boiler-feed pump is provided for each two units, this being of the reciprocating type. It may be of interest to state that this is probably the first station in the United States in which centrifugal boiler-feed pumps have been installed. These pumps are proving very successful. A view in the turbine room designed more particularly to show the auxiliaries is given in Fig. 6.

A double oiling system is provided for each unit. One of the systems supplies the oil to the step bearings, and this is operated at about 1200 lb. pressure. The other system supplies oil to the upper and intermediate bearings of the turbo-generator and to the governor. An oil filter is placed on the turbine-room floor directly in front of each unit. The pumps for each of the two oiling systems are arranged in duplicate. An oil accumulator is also provided for each unit for regulating the oil pressure on the step bearing.

A color scheme is used to designate the different kinds of piping employed in the station.

The water intake is from four cribs which have been built in the river to provide for the station's requirements. Four tunnels lead from these cribs to intake wells in the turbine-room basement directly under the circulating pumps. The discharge from the condensers is fed into a well for each unit. Each of these wells is connected to a common discharge tunnel, which empties into the river at a point west of the station. This discharge tunnel is circular in section and 9 ft. 8 in. in diameter.

A 90-ton electrically operated overhead traveling crane equipped with four motors spans the turbine room.

ELECTRICAL ARRANGEMENT.

As already stated, the electrical output of Quarry Street station is of two kinds—9000-volt, 25-cycle energy and 12,000-volt, 60-cycle energy. Four of the six generating units—those known as Nos. 1, 2, 3, and 4—are 9000-volt, 25-cycle machines and two, Nos. 5 and 6, are 12,000-volt, 60-cycle machines. A 5000-kw frequency changer placed on the first floor of the switch house, with an opening leading into the main turbine room, forms the link between the two systems. This frequency changer enables the station to take advantage of the diversity factor between the 25-cycle and 60-cycle systems, the unit being used to feed into one ór the other system as the conditions of load may require.

All energy from the 9000-volt, 25-cycle machines is delivered to the western end of the switch house, which contains the 9000-volt buses, switching equipment and outgoing lines. The two 12,000-volt, 60-cycle machines, together with the 60-cycle generator of the frequency changer, deliver all their energy to the newer, or eastern, section of the switch house, where the 12,000-volt buses, switching equipment and outgoing lines are located. At the present time the 9000-volt, 25-cycle part of the frequency changer is used ordinarily as a motor and drives the 12,000-volt, 60-cycle side as a generator. This arrangement may be reversed, however, when needed, as has been explained.

Referring to the diagram of general bus connections (Fig. 9), each generator, as shown, is connected through oil switches to an auxiliary bus and to a main bus. The main bus is sectionalized between units. Each unit has two line buses, and each line bus supplies four outgoing lines. Each line bus is connected to both the auxiliary bus and the main bus. This two-bus arrangement permits supplying energy from any unit to any group of lines.

The frequency changer, likewise, is equipped for eight outgoing lines, and these, with the eight lines from each generating unit, make up the total number of outgoing lines from the station, which is fifty-six. The 60-cycle side of the frequency changer has the same bus connections and outgoing-line equipment as is provided in the case of the generating units.

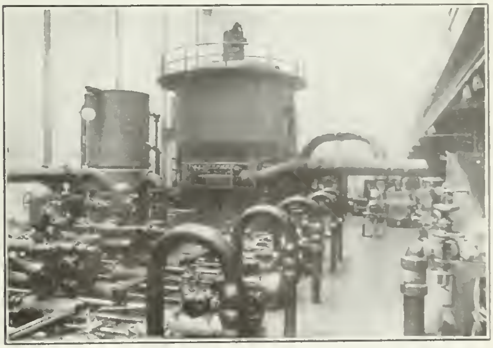


Fig. 6—View in Turbine Room, Showing One Unit and Auxiliaries.

SWITCH HOUSE EQUIPMENT.

In the basement of the switch house below the level of the turbine-room floor and next to the outside or southern wall is the high-tension cable vault. On the north side of the base-

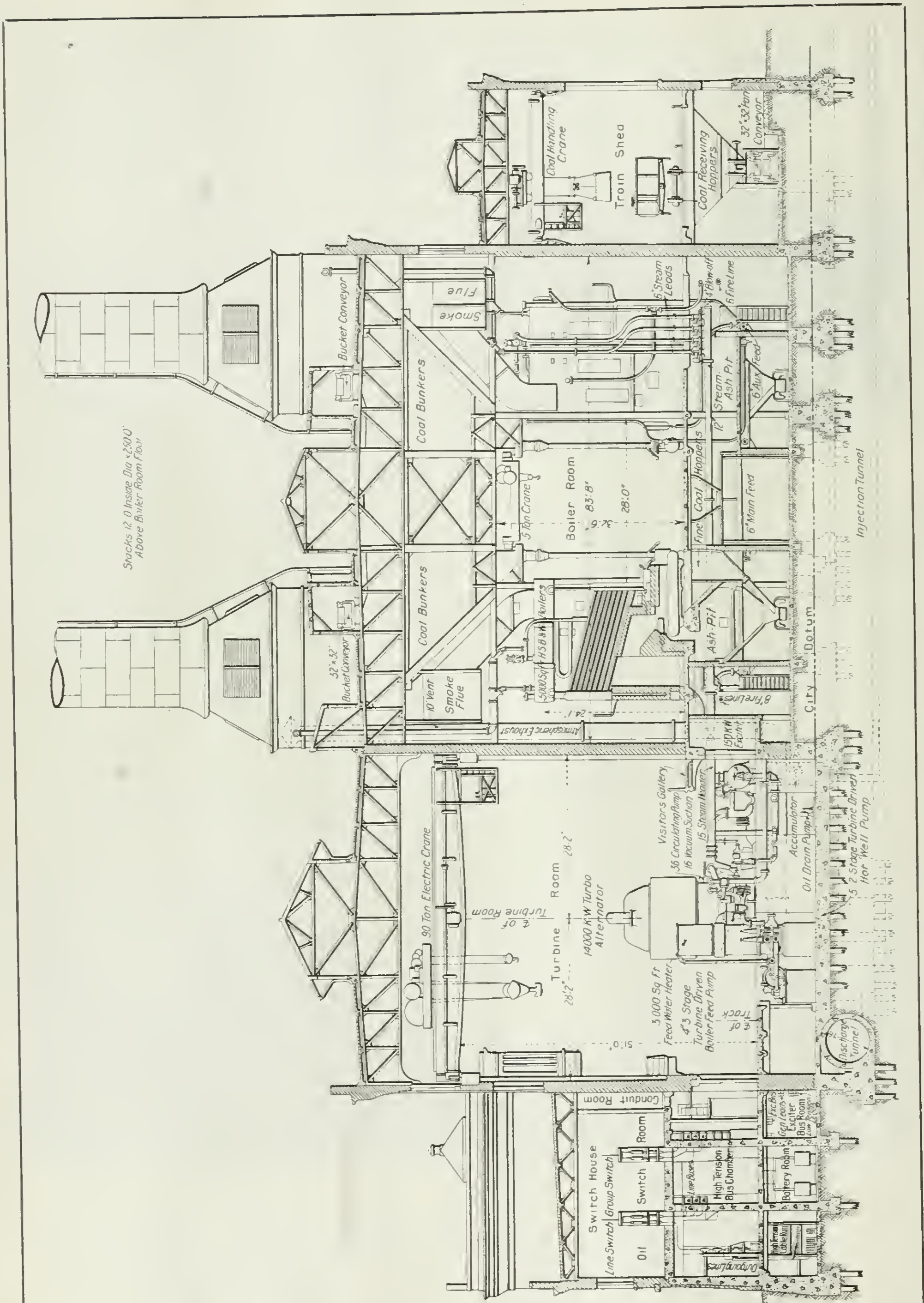


Fig. 7—Cross-Section of Quarry Street Station.

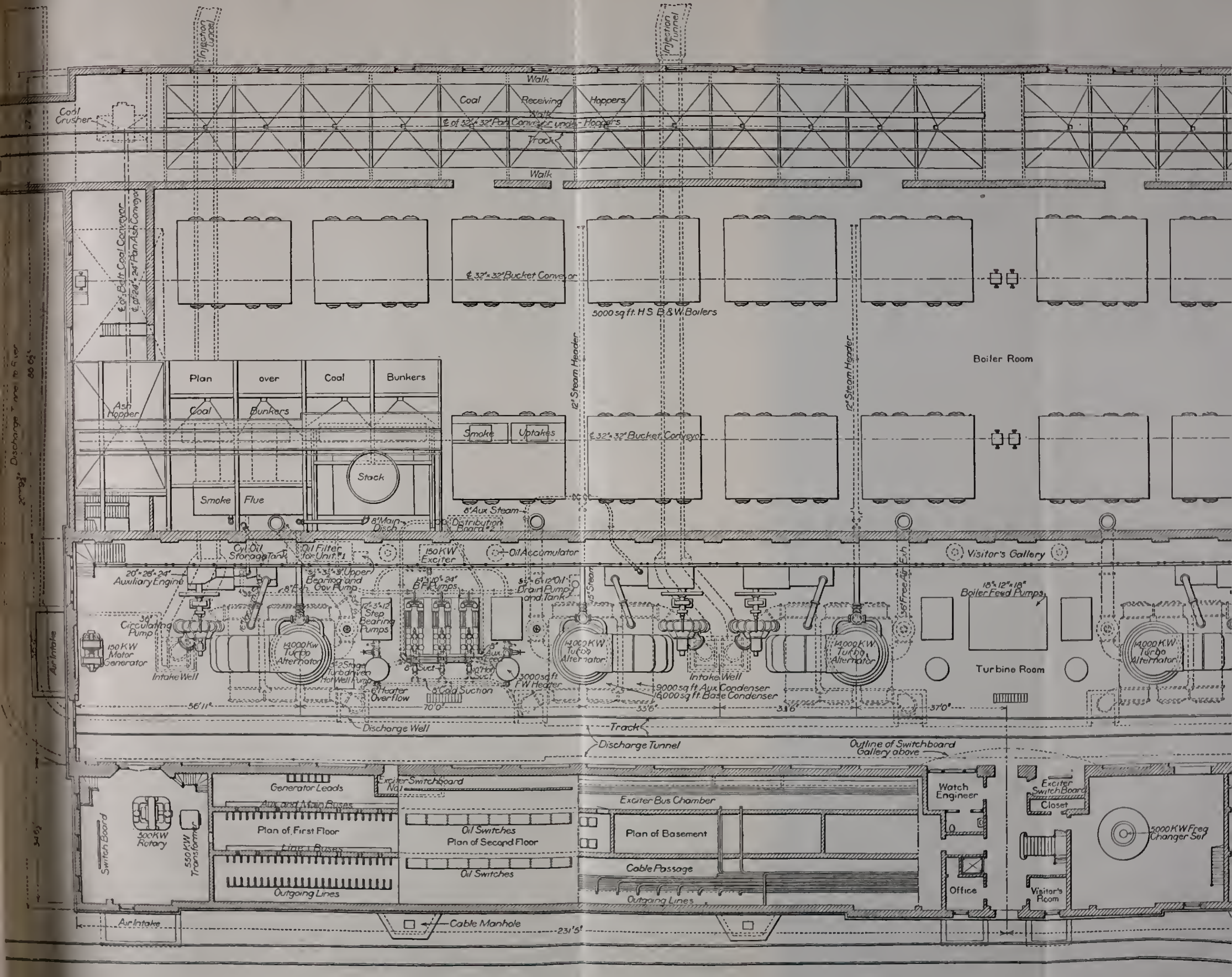
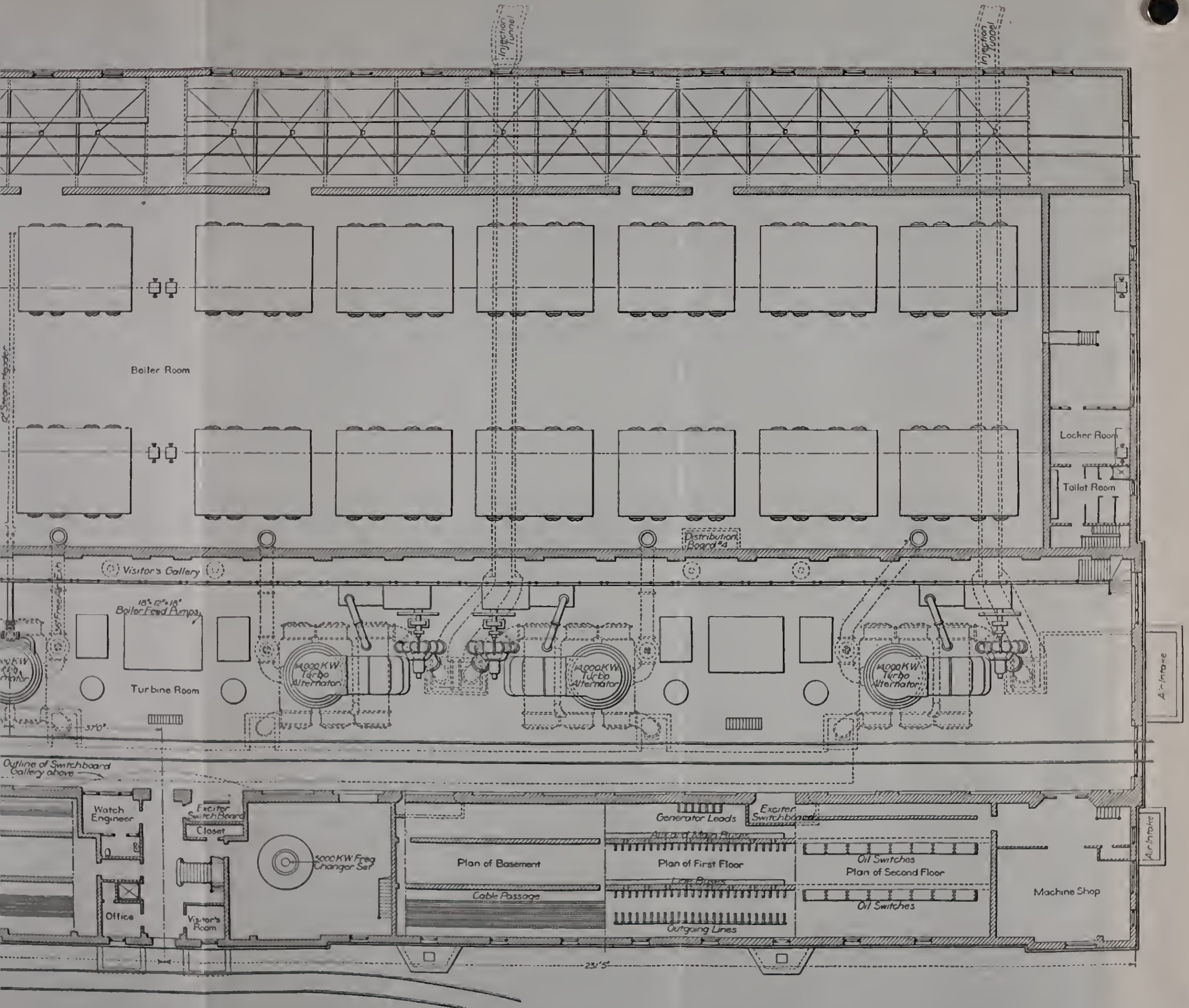


Fig. 8—Plan View Showing General Arrangement of the Quarry Street Station.



View Showing General Arrangement of the Quarry Street Station.

ment next the turbine-room wall is a passageway containing the cables for the excitation system and for light and power for the station. Between the two is a space occupied principally by two excitation storage batteries. Here also are the motor-driven ventilating fans, which heat and ventilate the switch house.

The western end of the basement forms the basement of the substation and contains the copper for the rotary-converter connections. The direct-current feeder cables start here, and the blower for the transformers is also placed in this basement. Here also is one of the air intakes connected with the ventilating ducts for the turbo-generators, as already mentioned. At the east end of the switch-house basement are located toilet-rooms, lockers, lavatories and shower baths for the turbine-room force.

The first floor of the switch house is on the level of the turbine-room floor. On this floor are located the high-tension bus compartments (Fig. 10), buses and the potential and current transformers connected to them. Here also are the terminal boards to which the secondaries of these transformers are connected. The potential transformers are rated at 200 watts each and are connected to the buses through the new S. & C. high-potential fuses designed to break in a special liquid.

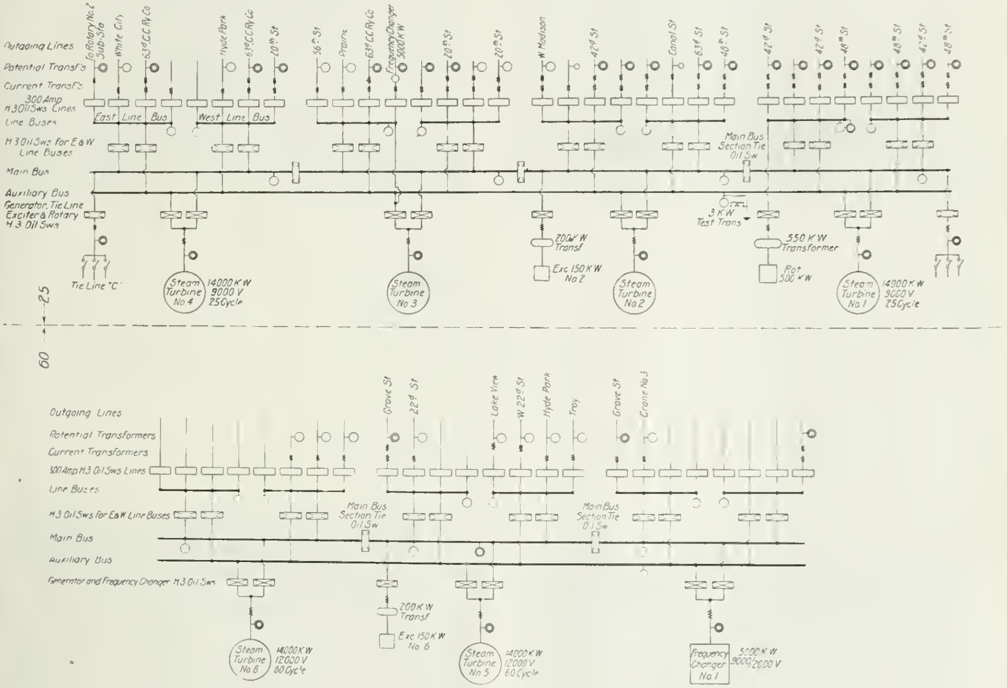


Fig. 9—Diagram of Turbine, Bus and Line Connections for 25-Cycle and 60-Cycle Systems.

Five alcoves project from the turbine room into the first floor of the switch house. These contain marble switchboards, two controlling the light and power distribution for the station building itself and three for excitation. There are also two light and power distribution boards in the north wall of the turbine room, so that in all there are four distribution switchboards and three excitation boards placed at intervals around the turbine room. The two distribution boards in the north wall of the turbine room control the local distribution of light and power in the boiler room. A view of one of the excitation switchboards in its alcove is shown in Fig. 11.

SUBSTATION.

The western end of the first floor of the switch house, as indicated in the general plan (Fig. 7), is devoted to the substation, which supplies the electrical energy for local consumption about the premises. The equipment includes two 500-kw rotary-converter outfits, one of these being a split-pole rotary and one a standard rotary with induction regulator. There is a seven-panel white marble switchboard in this substation. This board contains the controlling equipment for the two rotary converters, and feeders run from it to the four distribution switchboards which have been mentioned. No feeders from this substation are taken out of the building. However, there are three 220-volt, direct-current tie lines between this board and the West Twenty-second Street substation (the Fisk Street substation), with connections into Fisk Street. There are also lines connecting the tie lines just mentioned to Fisk Street station direct. As a further reserve there is a large storage battery in the West Twenty-second Street substation. Some details of the load carried by the Quarry Street local substation are given farther on in this article under the heading "Station Light and Power."

FREQUENCY CHANGER.

One interesting feature of the Quarry Street station is the 5000-kw frequency changers, which is of the vertical type. This machine is placed on the first floor of the switch house in a room opening into the turbine room. A picture of it is given in Fig. 13. The frequency changer is provided with a ventilating duct very similar to those used on the turbo-generators, and at the top is mounted the 125-kw exciter. The exciter is also used in starting the machine. The controlling panel for this frequency changer is shown at the right in the picture. A 30-ton hand-operated crane with electric hoist spans the room in which the frequency changer is placed.

The central pavilion of the switch house, on the first floor, also contains the watch engineer's office and other offices and rooms for visitors. The main entrance to the station, shown in Fig. 4, leads to this central pavilion.

At the eastern end of the first floor of the switch house, as shown in Fig. 7, is the machine shop for the station. Here there are lathes, drills, presses and various machine tools, all driven by direct-current motors.

OIL SWITCHES AND KINDRED APPARATUS.

On the second floor of the switch house are all of the high-tension oil switches, 112 in number. These are of the type known as H3, and Fig. 12 is a view of this floor of the switch house, looking east, showing a number of them. The oil switches shown in this picture are for the 12,000-volt, 60-cycle section. The line switches are shown at the right, and the generator and group switches at the left. The oil switches are of two sizes, rated at 300 amp and 1200 amp respectively. Each generating unit has eight 300-amp switches and eight 1200-amp switches. As shown in the picture, the switches are placed in two rows, the south row for the line switches and the north row for the generator switches and bus ties. The south row contains 300-amp switches and the north row those of the 1200-amp type. End switches on the north group for each unit are used for the tie lines and exciters.

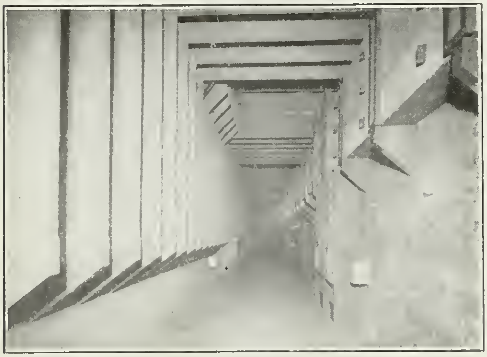


Fig. 10—Bus Compartments Situated on First Floor of Switch House.

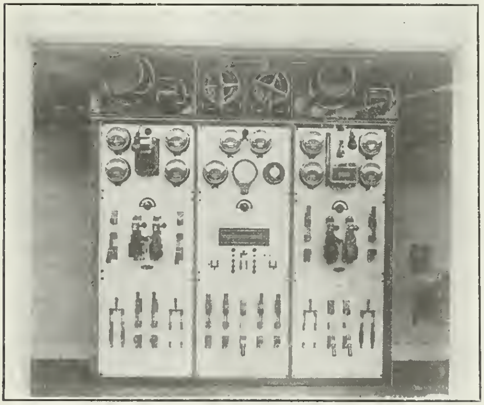


Fig. 11—Excitation Switchboard in Alcove.

At the bottom of the oil switches are located disconnecting switches of the lock-bolt type shown in Fig. 14. The lock bolt has been developed to meet the need for a disconnective which, when open, cannot fall shut, and when closed is locked firmly in that position to prevent blowing out in case of a heavy "short." By a special arrangement the operating rod cannot be released or inserted except when the switch is fully opened or fully closed—that is, when the lock is performing its function. The disconnecting switch permits the oil switch to be disconnected from the bus for repairs or for "killing" lines or buses through an air-gap.

The doors of the oil-switch compartments are made of wood and glass. Doors are provided on each of the two outward-facing sides of the compartments. The upper doors—that is, the doors leading to the oil-pot compartments—are suspended from hinges at the top, and are alternately fastened and left free to swing. The object of this arrangement is to prevent the gas from any explosion in an oil-switch compartment from affecting the adjoining compartments on that side. At the top of these hanging doors are small "cuckoo-clock" doors with helical hinges, which serve as an additional vent, or safety valve, for relieving the pressure in case of a violent opening, as by heavy short-circuits. All oil-switch doors are painted light gray, resulting in a brighter room and making it a safer place to work in. A strip of the compartments 1 ft. wide and just above the floor is painted very dark gray, so that it will not show stains resulting from cleaning the floors.

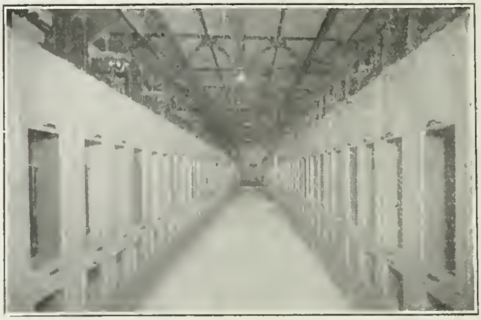


Fig. 12—View of Switch House. Second Floor, Showing Oil Switches in 60-Cycle Section.

North of the oil switches, along the turbine-room wall, is a passageway containing conduits leading to the operating gallery and containing instrument and control cables. Here also are terminal boards, to which the control wires of the oil switches are connected.

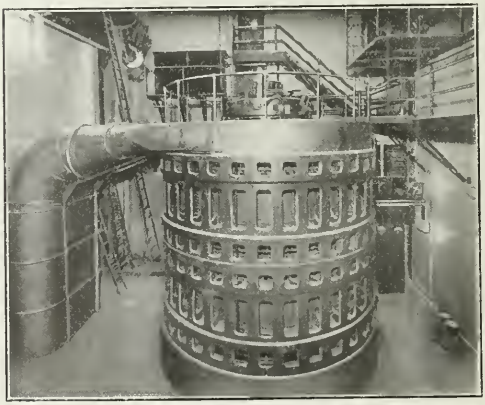


Fig. 13—Frequency Changer.

On the south side of this floor of the switch house are signal boards, grounding devices, high-tension test cabinets and also various accouterments, such as rubber gloves, etc., used for the safety of attendants in pulling disconnecting switches and making break-down tests. A signal board is provided for each unit.

On it are mounted lamp signals indicating what lines are in service. There are also provided intercommunicating signals connected to the operating gallery to inform the operator in the gallery whether the lock on the control of the oil switch has been set or whether the disconnecting switches have been opened or closed. The test cabinets are interconnected and are used for plugging-in leads to connect to lines or buses for break-down tests

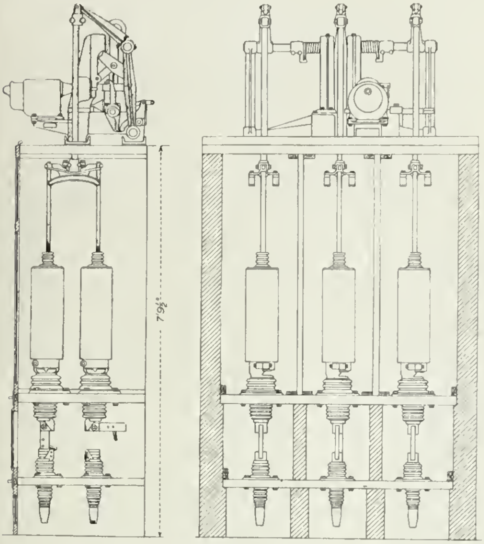


Fig. 14—Diagram of Oil-Switch Compartment, Showing Arrangement of Lock-Bolt Disconnecting Switch.

At the east end of this second floor is located a storeroom in which are kept spare parts, armature coils, etc., in great number and variety. In the corresponding room at the west end of this floor, above the substation, is the electrical repair shop. Motor-operated exhaust blowers are also placed in this room.

OPERATING SWITCHBOARD AND GALLERY

As has been stated, the central pavilion of the switch house is higher than the flanking wings. It provides for a third floor in the switch house, and on this third floor is the operating gallery from which the station is controlled and operated. Here also is the chief electrician's office, a room for testing and a sleeping room. The gallery is arranged with a curved glass front projecting into the turbine room, so that an unobstructed view of all the generating units may be obtained from it. In the general view of the turbine room, shown in Fig. 1, the projecting front of the operating gallery can be seen at the right

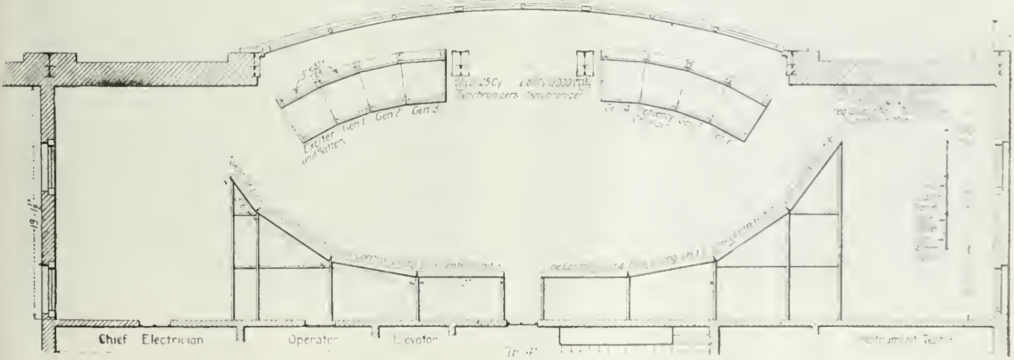


Fig. 15—Plan of Operating Gallery.

Fig. 15 is a plan of the operating gallery. The general arrangement consists of the use of benchboard generator panels on the north side of the gallery, or the side having the glass front projecting into the turbine room, and line-control panels on the south side of the gallery Both the generator panels and the line-control panels are divided into two sections, and the eastern end of the gallery is devoted to the switchboards for the 12,000-volt, 60-cycle generators and line control, the 9000-volt, 25-cycle generator and line panels being at the western end The switchboards are arranged in the curving position shown, and in the center of the gallery (from which position by this arrangement all the instruments on the various boards may be seen) is placed the operator's desk This desk is shown in the photograph (Fig. 16), which is a view of one-half of the operating gallery, looking west, and showing on the right the 9000-volt, 25-cycle generator panels and on the left the line control panels for the same voltage and frequency

The arrangement for the eastern half of the gallery is symmetrical with the western half, as indicated in the plan, Fig. 15 The western half of the gallery, shown in Fig. 16, contains the generator benchboards for units Nos 1, 2 and 3 and an exciter and battery benchboard. It also contains line-control boards for units Nos. 1, 2 and 3 and a control board for the Fisk Street tie lines. The eastern half of the gallery contains, on the north side, generator boards for units Nos. 4, 5 and 6, and also a combined frequency-changer and exciter benchboard On the south side of this half of the gallery the line-control boards are for units Nos. 4, 5 and 6, and there is also a line control board for the frequency changer The operating gallery is provided with a false floor of marble, and under this are placed all conduit lines leading to the switchboards The operating gallery is lighted by a large skylight

In addition to the switchboards mentioned there is a separate frequency-changer board at the eastern end of the gallery, consisting of two panels, one for the frequency changer proper and the other for fire alarm service and other instruments

At the central operator's desk are kept the load records, and three telephones are here provided. One telephone communicates directly with the load dispatcher at 139 Adams Street, one is an intercommunicating local instrument and one is connected to the Commonwealth Edison branch telephone exchange

The switchboard panels are all of black Monson slate, framed in gilded iron molding. As stated, the generator control panels are of the benchboard type with the instruments placed on the upper vertical portion and the control, the control signals and the miniature bus on the horizontal or bench portion of the board The apron of the bench, or the vertical part below it, carries the voltmeter switches and the main operating bus switches. A space is left between the upper vertical portion and the bench portion of the generator switchboards to enable the operator to look between them into the turbine room through the projecting glass front of the operating gallery.

Fig. 17 is a nearer view of four of the line-control panels. The panels shown in the illustration are for the 25-cycle system, but the 60-cycle panels are not materially different in construction. Referring to Fig. 17, the arrangement of instruments is as follows: Indicating instruments are placed at the top. Next come the relays. Below them is a line of control switches, operating the oil switches, and at the bottom are the watt-hour meters. All instruments are placed in a vertical line, and there are four of these lines to a panel and eight to a unit.

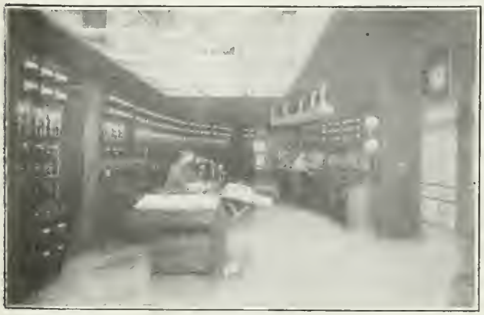


Fig. 16—View in Operating Gallery Looking West, Showing 25-Cycle Generator and Line Switchboards.

A rear view of some of the line panels is given in Fig. 18. Owing to the possible short-circuiting of terminals back of the switchboard by the dropping of tools used by meter testers and by such other troubles as are liable to be caused in working on line circuits, a connecting device has been applied to each instrument to avoid the necessity of removing instruments. This is styled a test-adapter and is used for cutting any defective instrument out of circuit and also for connecting an instrument or relay to a bus for testing. The buses are connected to terminals placed in front of the switchboard and also leading to a special panel on which is mounted a test meter.

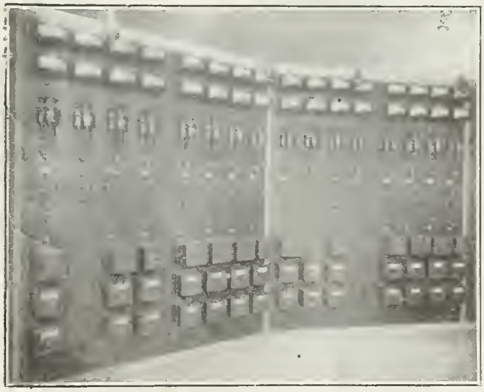


Fig. 17—View in Operating Gallery, Showing Line-Control Panels (Nearer View to Show Details).

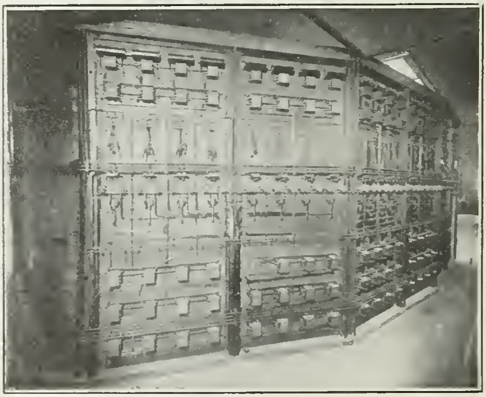


Fig. 18—View in Operating Gallery, Showing Rear View of Line-Control Panels.

EXCITATION.

There are two 150-kw, 125-volt motor-driven exciters and three 150-kw exciters driven by steam turbines. A motor-driven exciter is placed at each end of the turbine room and the steam-driven machines are located along the north wall of the turbine room. All of these exciters are interconnected between the excitation switchboards, making one excitation system, which, however, can be sectionalized. In addition there are two excitation batteries, each consisting of seventy cells provided with Exide plates. Fig. 19 shows the connections of the excitation system.

As previously remarked, there are three excitation switchboards of three panels each placed in alcoves off the turbine room. These are of white Italian marble, with ornamental iron frames. Fig. 11 shows one of these boards. The boards contain the various throw-over switches, generator-field switches and the indicating and integrating instruments for all exciters and batteries. The two outside panels carry the solenoid-operated switches and the meters for the field leads for the turbo-generators. There is thus one of these panels for each turbo-generator. Mounted on these outside panels, also, are the main switches for the exciters, connected to buses located on the back of the board. These buses are interconnected by cable. The middle panel in each board supports the instruments, end-cell indicators and main switches for the excitation batteries.

Above the excitation switchboards are placed the generator-field rheostats and the exciter-field rheostats. The former are motor-operated and the latter are controlled by ratchet-head switches. In front of these boards is a rolling shutter, electrically tripped, to serve in case of need as a fire curtain for protection. These shutters are controlled by gang switches placed at both ends of the turbine room.

NEUTRAL LEADS.

Along the south wall of the basement of the turbine room are placed the oil switches connecting the neutral leads of the 25-cycle and 60-cycle generators to the neutral bus. This bus is connected to the main ground bus by two neutral resistances of 2.5 ohms each. These two resistances consist of iron grids, and there is one at each end of the basement. Normally, the 60-cycle neutral bus is separate from the 25-cycle bus, but they can be connected together in the event of failure of either neutral resistance.

STATION LIGHT AND POWER.

The substation, which has been briefly described, supplies electrical energy for 107 arc lamps, 2900 incandescent lamps and forty-three motors having a total rating of 712 hp. It will be seen, therefore, that the load for the building itself is of no mean proportions. The feeders connecting the substation switchboard to the four distribution boards are 1,000,000-circ. mil. cables, and there are two 250-volt direct-current feeders leading to each board. One is enough to carry the load, the other being a reserve. On the distribution boards are placed the switches for the various motors and cut-out boxes. All motors are of the direct-current, 220-volt type and range in rating from 2 hp to 150 hp. They operate cranes, bilge pumps, ventilating fans, conveyors, coal crushers, coal unloaders, stokers, air compressor, fire pump, etc.

The cut-out cabinets control from twelve to twenty circuits each for arc and incandescent lighting. The general illumination of the turbine room and boiler room is by arc lamps. The yard lighting is also by arc lamps mounted on posts. The lighting of the remainder of the bulding and detail lighting is by incandescent lamps. Certain important incandescent lighting circuits are carried normally on the storage battery, and other lighting circuits are arranged to be thrown over by an emergency switch from the normal source of supply to the storage battery. Thus no emergency can arise when the station will remain in total darkness.

SAFETY AND FIRE PROTECTION.

Great precautions have been taken to insure the safety of the operating force, both in the steam and the electrical parts of the station. All the latest appliances available to this end have been installed, and there are devices of all sorts to insure the health, safety and comfort of employees. In the train shed and boiler room, at various convenient locations, are placed red lights indicating the location of push switches which in an emergency may be used for tripping the switches controlling the motors operating the conveyors. Thus, in case of accident, as of a man being caught in a coal conveyor, for instance, the mechanism can be stoped at once from any one of a number of easily accessible points.

Similarly the arrangements for fire protection are very complete, although the building and its contents would seem to be themselves practically fireproof. A special fire pump in the boiler-room basement is connected to a 150-hp motor and is arranged to be supplied with electricity by either of two 1,000,000-circ. mil feeders. This pump, which is of the centrifugal type, can deliver 1000 gal. of water a minute at 150-lb. pressure to a permanent piping system with plugs placed at convenient points about the building and property. An ample supply of hose on reels is accessible for the well-drilled fire brigade made up of station employees. The piping system has a further connection at the river by which a fireboat could force water through it. In addition, there is a similar connection on the street, to which fire engines could be attached. Fire-alarm boxes are placed in and about the building. The "pulling" of one of these boxes signals the operators on duty in the operating gallery and also makes a record at that place. The switchboard operator then, by remote control, causes a whistle to be blown in the boiler room, indicating the number of the box and the station fire department responds.

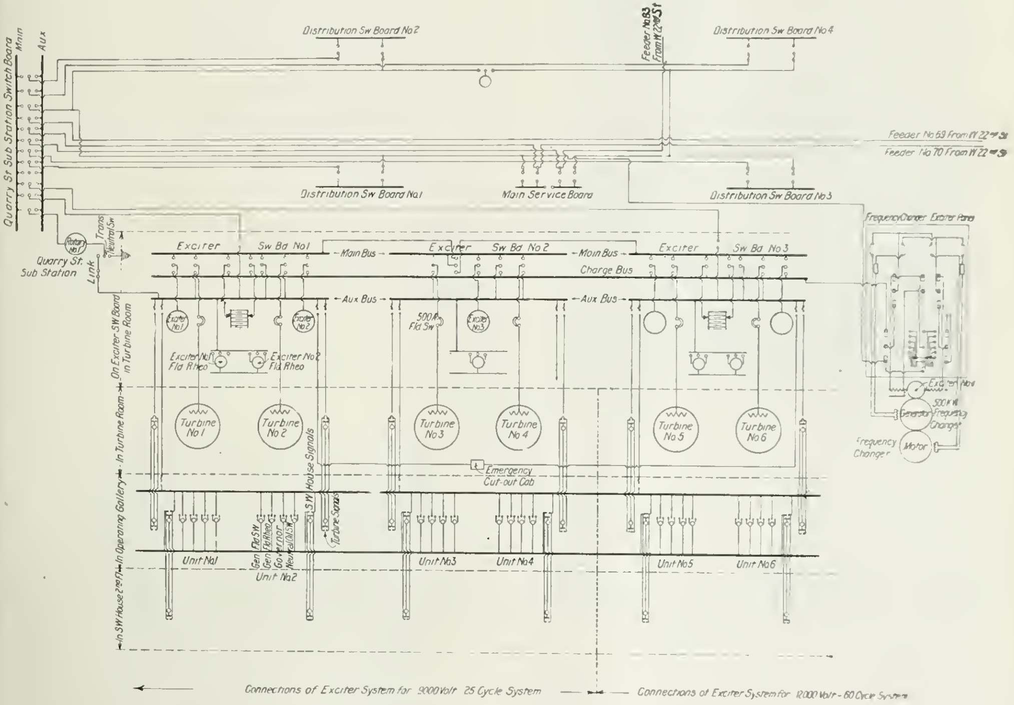


Fig. 19—Diagram of Exciter Bus Connections

SECTIONAL OPERATION.

The entire 25-cycle system of both Fisk and Quarry Street stations is sectionalized in such a way that it may be operated in one, two or three sections. The maximum load on any one section is limited to 60,000 kw. At night, at this time of the year, from shortly before midnight to about 6 a. m., the three sections are operated in parallel or as one section. At the hour last named the load is split into two sections as it nears the 60,000-kw limit, and about an hour later it is divided into three sections. The system is operated as three sections until about 9 p. m., then as two sections until a little before midnight when the two are combined into one as before.

No one portion of the city is exclusively supplied from any one section of the system. On the contrary, care is taken to prevent any given territorial area from being altogether dependent on any one of the three sections. This is a provision for safety in case of break-down and, furthermore, tie lines between the various substations are provided for emergency use.

When the 25-cycle system is operated in two or more sections, the four 25-cycle generating units at Quarry Street are at present connected two to one section and two to another, with tie lines connecting with corresponding sections at Fisk Street. Fisk and Quarry Street stations are so operated together that the load on the tie lines is a minimum. The switches on these tie lines are provided with overload relays so that a disturbance in either station will have little effect on the load of the other station

Sixty-cycle units are operated in one system There are only two of these units, both located at Quarry Street, and they have a combined rating of 28,000 kw, while at Fisk and Quarry Street together there are fourteen 25-cycle units, aggregating 176,000 kw The 60-cycle energy is transmitted to Edison substations and transformed down to 2300-4000 volts for distribution circuits The 12,000-4000-volt transformers by which this is accomplished were first installed in 1909 and are now carrying the long-hour load, with the substation frequency changers (9000 volts and 25 cycles to 4000 volts and 60 cycles) helping out on the peaks where needed. As the 60-cycle system expands the 12,000-volt transformers in substations will ultimately replace the frequency changers, some of which will then be used as synchronous compensators connected to the 2300-4000-volt bus to improve the power factor. Others, of the larger sizes, will probably remain to serve as links between the 25-cycle and 60-cycle systems.

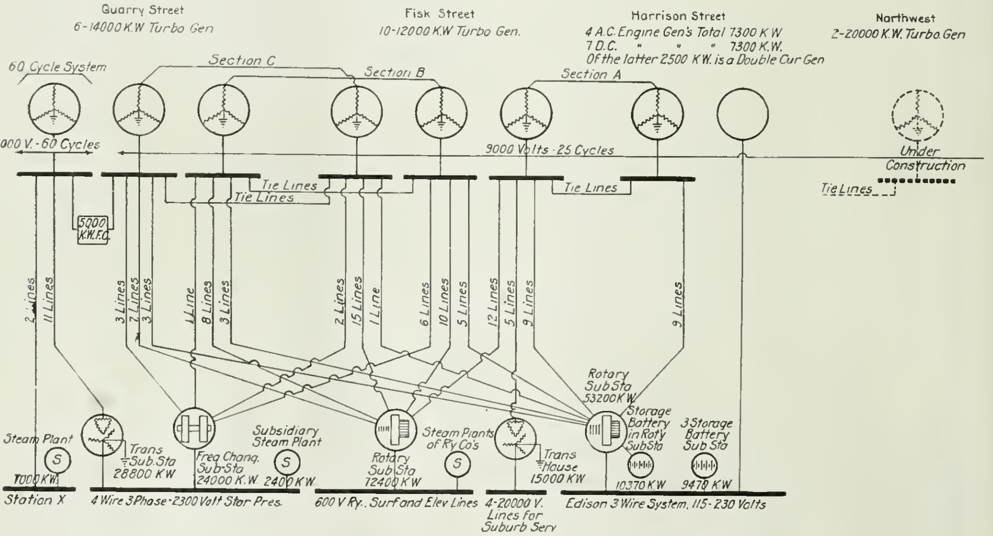


Fig. 20—Diagram of Component Parts of Commonwealth Edison System.

The 9000-volt, 25-cycle outgoing lines from both Fisk Street and Quarry Street supply (besides the frequency changers, as mentioned above) the rotary converters in the Edison and railway substations and also three 5000-kw step-up transformers at Fisk Street for 20,000-volt transmission lines. Fig. 20 is a drawing showing the component parts of the system. This drawing is an amplification of one of similar nature prepared for a paper read by Mr. R. F. Schuchardt, electrical engineer of the Commonwealth Edison Company, before the Chicago Section of the American Institute of Electrical Engineers on June 5, 1908, and entitled "Recent Developments in Protective Features of a Large High-Tension System." It is interesting to note that while the original drawing was prepared only two and a half years ago, it indicated the 84,000-kw Quarry Street station, now completed and described in the present article, as "under construction," whereas the diagram presented herewith shows the Northwest 120,000-kw station as "under construction," so rapidly does the business of the company expand

The general plan of operating the Fisk and Quarry Street stations is practically the same as that outlined in the *Electrical World* of May 27, 1909, in an article entitled "Practical Operation of Fisk Street and Quarry Street Stations in Chicago." Since that time, however, Quarry Street station has been placed in full operation, and both stations are now operated twenty-four hours a day.

ENGINEERS, ARCHITECTS AND CONTRACTORS.

Following is a list of the names of the engineers, architects and principal contractors for the Quarry Street station: Consulting mechanical engineers, Sargent & Lundy; electrical engineers, engineering department of Commonwealth Edison Company; architects, Shepley, Rutan & Coolidge; general contractors, Wells Brothers Company; boilers and stokers, Babcock & Wilcox Company; turbo-generators, exciters, high-tension switching equipment and control, General Electric Company; condensing equipment, Henry R. Worthington; boiler-feed pumps, Dean Brothers and Henry R. Worthington; overhead traveling cranes, Whiting Foundry & Equipment Company; coal and ash handling machinery, Mead-Morrison Manufacturing Company; boiler setting and lining of ash pits, H. A. Bishop; excitation batteries, Electric Storage Battery Company.

OVERLOAD BOILER OPERATION AT ST. LOUIS.

A series of tests recently made on the twelve new watertube boilers in the Ashley Street station of the Union Electric Light & Power Company, St. Louis, have shown that these 508-hp units can be operated at an output of 250 per cent of their normal rating. For several years it has been the practice of the St. Louis company, as it is now in several other places, to operate all boilers in service normally above their full rating, forcing them in times of peak load to the maximum output of the heat units in the coal that can be burned in the furnaces. The Union Electric Company has recently contracted for two new 4000-kw, horizontal, 60-cycle Curtis turbine-alternator units which will be installed in the Ashley Street station in March and June, 1911. By July, 1911, the last of the 5000-kw turbine units with which this station was originally equipped will have been replaced by a 12,000-kw turbine alternator.

UNDERGROUND INSTALLATION AT MIDDLETOWN, OHIO.

Middletown is in Southwest Ohio. It is an enterprising manufacturing town with flourishing steel, paper and tobacco industries. It is well located for manufacturing purposes, having three railroad lines to facilitate shipping. The population of this place is 13,400; when the new plant of the steel-rolling mill, now nearing completion, is put in operation the population is expected to increase by at least 1000.

A franchise was recently granted to the Middletown Gas & Electric Light Company to furnish electricity for light, heat and industrial purposes, provided that the company placed all its wires underground. It may be well to mention that there has been and is a competing electric light company in operation, using overhead distribution.

The Middletown Gas & Electric Light Company after a thorough canvass obtained many prospective consumers, largely on the merits and advantages of underground distribution, enough to represent a fair return for the capital invested. It was not necessary to offer lower rates to obtain consumers.

The station was located near the company's abandoned coal gas plant. This plant was abandoned when natural gas was brought into the town, but the plant is kept in reserve so that it can be started on short notice in case the natural-gas supply should fail. The electric power house was located here because gas engines are used as prime movers, and two large containers are kept filled with gas, which would run the gas engines for several days in case of accident cutting off the natural-gas supply.

The power station is a brick building having a slate roof, in which are placed sky-windows and vents; there are also a number of large windows, which furnish a flood of daylight and give the station-room a bright appearance.

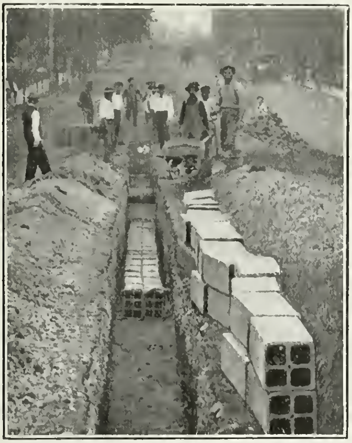


Fig. 1—Laying Out Clay Ducts.

At present only two units are installed; room is being provided for future growth. The units are 350-kw and 150-kw, three-phase, revolving-field alternators designed for 2300 volts, 60-cycle, directly connected by flexible couplings to a 400-hp and a 200-hp, four-cylinder and two-cylinder horizontal natural gas engine. The engines are started with compressed air, which is furnished by a 6-hp gas engine and pump; exhaust chambers, 4 ft. x 6 ft. x 5 ft., placed underground and built of concrete receive the exhaust from the engines; only two cylinders exhaust into one chamber; each chamber is provided with an outlet of an 8-in pipe leading straight through the roof of the building. Water for the jackets of the gas engines is taken from the city mains. The switchboard consists of two feeder panels and two generator panels. The switchboard is of standard type and on its face are mounted the usual instruments. It offers nothing of special interest.

A most important problem in connection with this plant was to lay out properly the distribution network. A careful study was made of the town and the main ducts were located in streets and alleys where business appeared most promising. The shortest possible routes were selected to a number of large consumers with whom contracts have been entered into These consumers demand a day load of approximately the output of the large generator.

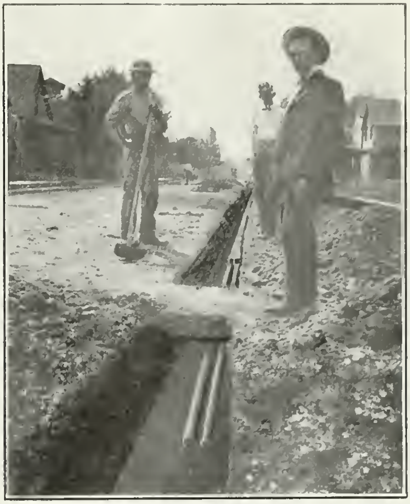


Fig. 2—Laying Out Fiber Ducts.

The underground conduit and cable system was laid out with a view to accommodating a city of 40,000 people. While this is not necessary at present, it was thought best after thorough consideration to adopt this far-sighted policy. On the main street twelve ducts were laid. Nearly all the other lines were six ducts and were mostly laid in alleys. At street intersections are manholes from which fiber laterals are run to transformer poles located in the backyards which adjoin the alleys, from which poles many houses can be reached with secondary overhead wires. By adopting this method of distribution the underground-cable system was confined to the use of primary cables, which greatly reduced the cost of the system.

The ducts are embedded on all sides with a 3-in. layer of concrete. The manholes were built of brick, 5 ft. x 5 ft x 5 ft. At present about 60,000 duct-feet of multiple clay and about 2000 duct-feet of fiber duct are installed. About 18,000 ft. of No. 2 and 8000 ft. of No. 6 three-conductor, 2300-volt, paper-insulated lead cables are laid and also about 1000 ft of No. 6 rubber-insulated lead cable for laterals. The rubber cable was used in terminating cables on poles, thus dispensing with the use of terminal heads. The end of the lead was served back, thoroughly taped, received a coat of P & B. paint and was connected directly to the transformer cut-outs

The gas engines were furnished and set up by the Bessemer Gas Engine Company. The generators and switchboard were furnished and installed by the General Electric Company The distribution system was designed by the Safety Insulated Wire & Cable Company, which also had the contract for installing the conduits and furnishing all the cables required

EXHAUST-STEAM TURBINE PLANT AT VIRGINIA, MINN.

An example of the benefit of the low-pressure steam turbine in a case where it was desired to increase the efficiency of a plant operated on steam pressures varying from 145 lb. to 80 lb. per square inch is afforded by the unique engine and turbine installation of the Virginia (Minn.) Electric Power & Water Company, which obtains its steam from a lumber-mill boiler plant 1500 ft. distant from the generating units.

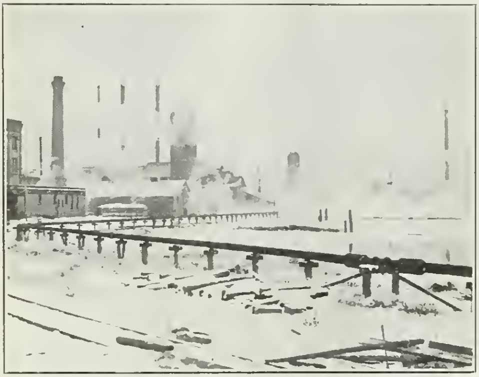


Fig. 1—Eight-Inch Steam-Pipe Line, 1500 Feet Long, from Lumber Mills in Background to Virginia Electric Company Plant.

The City of Virginia, with its population of 12,000, is in the center of the important Mesaba Range lumbering and iron-mining region, and the sawmill of the Virginia & Rainy Lake Lumber Company there is one of the largest plants in the Northwest. The great quantity of wood refuse from the "hogging" machines has always been in excess of the needs of the lumber company for its own boilers and power purposes, and this waste material is burned in huge screened cupolas or used as filling to reclaim parts of the plant property. The boiler house of the lumber mill is 1500 ft. distant from the electric company's generating station, but about three years ago an agreement was entered into by which the latter obtained steam for operating its engine-driven alternators and steam pumps through an 8-in. pipe line from the lumber plant's boilers.

The construction of this 1500-ft. pipe line, which has now been successfully operated for three years with the original engine installation, is shown in the accompanying illustration, Fig. 1. The 8-in. pipe is covered with a 2-in. coating of magnesia insulation, inclosing which is a covering of 0.25-in. painted canvas. At points where the pipe rests on rollers carried on wooden posts 2-in. saddles are strapped on to protect the canvas covering. At 200-ft. intervals expansion joints are inserted in the pipe line to allow for temperature changes. One of these is shown in the foreground of the picture. The entire pipe line is given a grade toward the electric company's plant of 2.5 in. for each 100 ft., and ends in a receiver tank from which a Crane automatic trap withdraws whatever condensation occurs. Even in the sustained severe winter temperature of from zero to —10 deg. Fahr. encountered in northern Minnesota, this trap draining the 1500 ft. of 8-in. line discharges less than 10 gal. of condensation water an hour, and the snow is said to lie on the canvas covering unmelted during cold winter weather.

Following the rapid growth of the population of Virginia about a year ago and the consequent increase in the electric lighting demand it was decided to increase the output of the station and to utilize more efficiently than in the simple, non-condensing engines the steam consumed by the plant. The steam pressure supplied from the lumber-mill boiler plant varies widely with the demands of its own engines, sometimes ranging from 80 lb. to 145 lb. per square inch at the head of the pipe line, so that the conditions seemed unfavorable for a high-pressure turbine installation at the electric company's plant 1500 ft. distant. It was accordingly decided to employ a high-pressure reciprocating engine as before, which would be less affected by the variations in steam pressure, allowing this to exhaust into a low-pressure steam turbine which could also utilize the exhaust of the water-pumping, air-compressor and fire-service pumping units in the station. During periods of light pumping load when the engine-driven units are shut down the turbine is arranged to take live steam as needed through a reducing valve.

The 350-kw low-pressure turbine-generator set installed is of the 2300-volt, 60-cycle Allis-Chalmers type, like the 300-kw engine-driven unit in parallel with which it operates during the peak-load period. In addition to these the plant equipment includes an auxiliary belted 200-kw General Electric alternator driven by one of the original G. H. Corliss engines built forty years ago. The steam-pump equipment for the water-works and fire service comprises a 30-hp compound air compressor for operating an air-lift well delivering 500 gal. per minute into a 275,000-gal. ground-level cistern, from which a 10-hp reciprocating pump raises it 80 ft. to a 100,000-gal. overhead tank. Two Underwriters' fire-protection pumps are also installed, but since these are operated only in case of emergency their exhaust steam does not become continuously useful for turbine operation. The arrangement of these various units is best shown by the accompanying sketch, in which the steam headers are shown by solid lines and the exhaust pipes by dotted lines. From the entry receiver and trap the steam is brought into an overhead header through a reducing pressure valve, branch headers supplying steam to the various pumping units, condenser circulating engine and main reciprocating engines. The exhaust from all the steam pumps is collected in a low-pressure line which is connected at one end to a steam-heating system serving the company's offices and nearby dwellings, and is closed at the other end by a relief-valve set to open at 1 lb. pressure above atmosphere. This exhaust header is also connected to the intermediate receiver, between the turbine and reciprocating engines, through an equalizing valve set at 0.5 lb. above atmosphere. The receiver, into which the two engines exhaust, is also connected to the atmosphere through a relief valve set to open at 1 lb. pressure. From the receiver the low-pressure steam passes through an oil separator and directly into the exhaust turbine. A 2.5-in. live-steam tap is also carried to the automatic valve on the turbine, which opens to admit high-pressure steam when the reciprocating

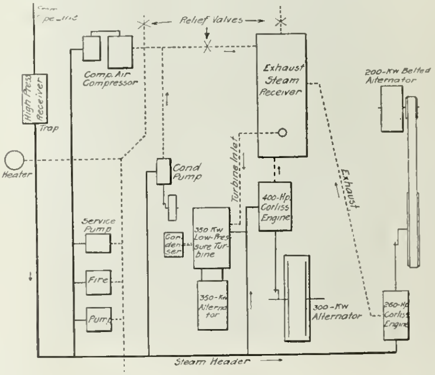


Fig. 2—Arrangement of Station Apparatus—Steam Lines Solid, Exhaust Lines Dotted.

units are not exhausting enough steam to carry the turbine load.

The turbo-generator is operated continuously during the twenty-four hours, having now been run without shut-down since March, 1909. The nature of the water-pumping load requires that the 30-hp air compressor and the 10-hp duplex pump shall also be run continuously, and these, together with the 10-hp engine driving the turbine condenser pump, supply sufficient exhaust steam to carry ordinary day electrical loads on the turbine. Not until the turbine load begins to exceed 100 kw is the live-steam valve called upon for the admission of steam from the pipe line. If the turbine demand falls below the steam quantity exhausted by the pumping units, the relief valve in the exhaust header opens to the atmosphere. The condenser vacuum is normally maintained very high, approximating 27 in., while during day-load operation a vacuum of 10 in. or 12 in. is held on the receiver. From the exhaust pipe a heating system is tapped off, aggregating 15,000 sq. ft. of radiating surface in the office of the Virginia Electric Power & Water Company and in nearby dwellings, all within 400 ft. The condensate from this system is returned to a small vacuum pump in the basement of the power plant. The differential setting of the relief valves in the reciprocating-unit exhaust pipes insures that steam will always be available for the heating-system line. The engine-driven unit is ordinarily operated from 4:30 p. m. to 11:30 p. m., during the heaviest lighting load on the station, being paralleled with the turbine-driven generator, which is run continuously throughout the twenty-four hours. In case of breakdown the auxiliary 200-kw engine-driven set can be started up, also exhausting into the receiver. The lumber-mill boiler plant from which the station now receives its steam will shortly be remodeled and the electric company has joined the lumber interests in building a steam tie line with another mill boiler house 600 ft. beyond the first, so that high-pressure steam will be carried a total distance of 2100 ft., or nearly half a mile from boilers to generating units. From the power station's exhaust steam it is then again conveyed 400 ft. further in the mains of the heating system.

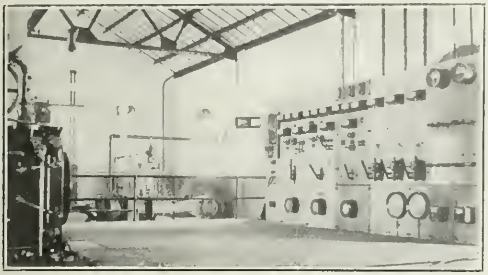


Fig. 3—Switchboard and Compound Air Compressor.

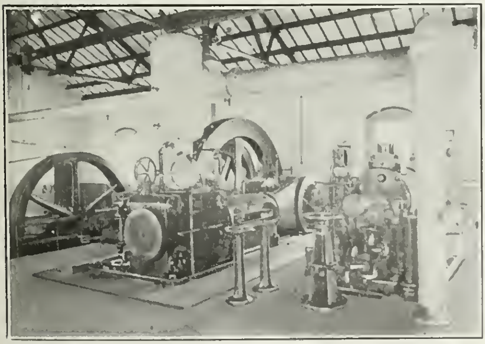


Fig. 4—Corliss Engine and Exhaust Steam Turbine.

The Virginia Electric Power & Water Company also has a modern and completely equipped office building unusual in plants serving a population of similar size. It has 600 lighting customers and a connected day load of 125 hp in small motors. Mr. O. H. Griggs is manager of the company and Mr. J. A. Kennedy is superintendent of the plant and designed the installation of the engine and turbine-driven equipment.

ELECTRIC FIRELESS COOKER DEVELOPMENT.

Successful and Epoch-Making Experiments on Central Station Supply.

In the popularization of central-station service by the Hartford Electric Light Company the management has long sought to develop off-peak business to the fullest possible extent. Special encouragement has been given to consumers to purchase electricity on a twenty-four-hour basis, and in both the lighting and power fields a large connected load has been secured which is spread over many hours of the day, and which consequently enables the company to make the best use of its plant and distribution system, while at the same time the community finds it advantageous to absorb energy on a distinctly large scale. As a result of this policy the company's income for the present year has reached the maximum of $8 per capita, with a tributary population of only about 115,000, and the prospect of a still larger utilization of electricity in the community is most attractive.

The company's work in developing residential lighting service has already been described in these columns (*Electrical World*, Sept. 1, 1910, page 489), and brief reference has been made to the efforts of President A. C. Dunham and his associates to place electric heating on a genuine commercial basis, in order to compete successfully with coal, gas and oil. Some months ago President Dunham began to experiment with the electric fireless cooker principle in the hope of producing an equipment which would compete successfully with existing agencies, and thus furnish a most desirable class of long-hour business for the company's circuits. The success with which these experiments have been crowned justifies the statement that a new epoch in the sale of electricity is close at hand for central stations desirous of extending their long-hour service, for the tests at Hartford show conclusively that with the electric fireless cooker a family of from three to five persons can be provided for with a minimum revenue of 3 cents per kw-hour, corresponding to a continuous consumption of 150 watts at a flat rate of $3 per month. Any consumption at this rate of $3 lasting less than twenty-four hours per day is a corresponding benefit to the central station, which can sell electric energy profitably for twenty-four-hour service on a large scale at even 1.5 cents per unit.

A net cost of current of $3 per month for a family of the above size for electric cooking is a figure of profound significance to the central-station industry. It means that the day of successful competition with coal, oil and gas is here: that the electric kitchen can be placed in families of even very moderate circumstances and maintained at a profit to the central station without increasing the actual cost of fuel for cooking; that the average householder can enjoy all the delights and advantages of electricity in the preparation of his food at little or no increase in expense over the present crude and wasteful apparatus for coal burning; and it means reductions in the cost of living through the use of the less expensive cuts of meat, the elimination of all insurance difficulties, and the saving of an entire room, if desired, in the modern apartment, at a cost of from $5 to $10 per month. Best of all for the central station, this business can be obtained by the long-hour use of its equipment in numerous installations taking from 50 watts to 150 watts each on rates of $2 or $3 per month. The distribution of this load throughout many hours of the day will mean only a nominal increase in plant capacity even when the community approaches the electric-cooking saturation point. It is unlikely that anything like the full rated capacity of the individual domestic cooking installations will be continuously required for twenty-four-hour service, although that is to be the privilege of the householder; but too much emphasis cannot be laid upon the fact that if the full rating of the equipment should be demanded the company will still receive its minimum income of about 3 cents per kw-hour so long as it maintains the flat rate above mentioned.

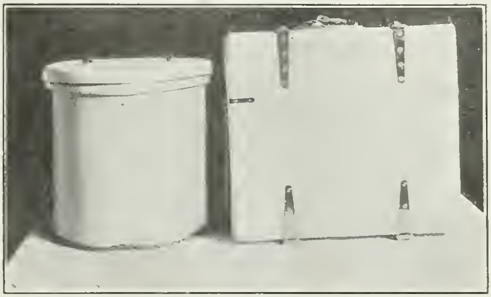


Fig. 1—A 50-Watt and a 100-Watt Fireless Cooker.

In June, 1910, the company began systematic experiments with the fireless cooker under the general direction of Mr. Dunham and the immediate personal supervision of Mr. R. D. Cutler. The initial experiment was the cooking of a pot of Boston baked beans by placing an ordinary 16-cp incandescent lamp inside and insulating the outfit from the external atmosphere. The experiment showed that the beans could be cooked in the best possible manner with a continuous expenditure of about 35 watts, the temperature being maintained at 250 deg. Fahr. with little difficulty. From the beanpot experiment the company extended its work, seeking to obtain the best insulating materials for the cooking device, and at every step careful records were made of the time required to perform a given task and the input in electrical energy which would sustain the required temperatures. The cookers made by the company for its tests have been steadily improved in mechanical features, facilities for cleaning, ease of accessibility, capacity and portability. About a dozen cookers have been built since June, and the company has now reached a point where arrangements are being negotiated for the manufacture of the device on a commercial scale. Early in 1911 the company plans to open an electric cooking school in the apartment equipped with electric devices which has been referred to in these columns, and an electric cookbook will shortly be written and published on the basis of experiments which have been under way during the past half-year. At present the company serves daily to a number of its employees a hearty lunch or dinner prepared entirely on the fireless cooker, and if the personal appearance of the men is any testimonial to the quality of the viands the question of consuming the product of the fireless cooker is permanently settled. A nominal charge of 25 cents per meal is made to cover the cost of food only.

Two sizes of cooker have resulted from the company's experiments, one being rated at 100 watts and the other at 50 watts. The tests have shown that 100 watts input will continuously maintain a temperature of 380 deg. Fahr., which is sufficient for roasting any kind of meat or baking any kind of bread. The present type of oven, designed to meet the needs of a family of four persons, consists of a box of fibrous material 19 in. wide, 17½ in. high and 18 in. deep, outside dimensions, containing two disk-heating elements 6½ in. in diameter, located at the top and bottom of an interior oven lined with glazed white fireclay and surrounded by asbestos or other suitable insulating packing. The interior oven is 12½ in. long, 8 in. high and 10½ in. wide, and has a capacity of two loaves of bread at once, set in appropriate baking pans. Each heating element is made up by the company in its laboratory and the resistance coil consists in each 50-watt unit of approximately 60 in. of Driver-Harris No. 33 nichrome wire. The wire is pressed mechanically against a fireite plate in a recess ¼ in. deep, the total thickness of the plate being ½ in. Each plate is countersunk to a depth of ¼ in. into the top and bottom of the fireclay oven and the two plates in the 100-watt cooker are electrically connected in parallel. The cooker is provided with a hinged cover with insulating material of the same kind as that used in the body of the cooker, and straps are provided with a harness clip on each, these locking the cover securely in position and preventing the escape of any noticeable amount of heat. The locked cover is not so tight, however, that steam cannot escape when liquids are boiled in the oven. The present cookers used by the company are designed to operate on a 60-volt circuit, which is used in the residences which the company supplies with tungsten lighting on a flat rate; but operation on higher voltages has been provided for.

The 50-watt cooker is cylindrical in shape, its outside diameter being 14 in. and the depth of the oven about 9 in. It consists of a 50-watt heating element of the type used in the larger cooker set into a glazed white stone jar 8 in. in diameter, which is surrounded with heat insulation, with an outside fibrous covering, and a top cover of the plunger type with felt washer, asbestos and fiber insulation. The top cover is 2 in. thick and is countersunk into the jar to permit retention of heat. In each type of cooker the fireite plate containing the heating element is sealed into the oven by retort cement. Current is supplied in each case through a flexible cord connection leading into the interior through a brass bushing in the side of the cooker near the bottom. The low energy consumption of each cooker enables it to be placed on any ordinary lamp socket without difficulty of any kind. From the first the effort has been made to produce a cooker which would be compact, portable and thoroughly sanitary. The heating element has been immersed in hot water without deterioration of the insulation. In general, the larger cooker is planned for baking, roasting and other relatively short-time service, the smaller outfit being used for stewing, boiling and other long-hour service. The company's rate for service for both cookers, used as many hours of the day and night as the consumer requires, is to be $3 per month for families of three to five people. The main object which the company has in mind is the popularization of electricity for cooking with resultant increase in revenue from current sales.

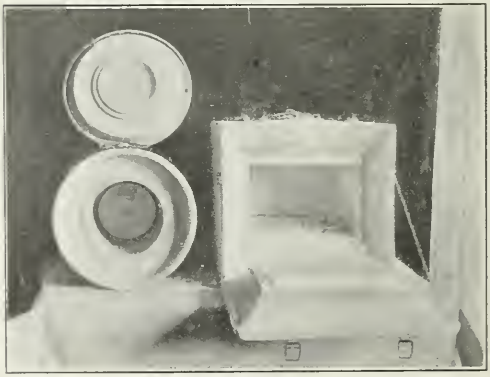


Fig. 2—Interior of Fireless Cooker.

The tests which the company has made are most suggestive, and a number of them are given below. Early in the development the company secured the services of an expert cook, a young woman well used to handling experimental problems in dietetics. The preparation of all meals is under her charge, and the success of the fireless cooker from the standpoint of the housewife has thus been taken into consideration by one familiar with feminine requirements and capable of seeing that they are met by the company's plans for electric cooking service.

TYPICAL FIRELESS COOKER TESTS.

Test 1.		
Baking powder biscuit	100 watts	50 min
Six cup custards	100 watts	50 min
Roast beef, 2½ lb.	100 watts	90 min
Stewed tomatoes in 100-watt oven after cooking meat	100 watts	15 min
Potatoes, cut in cubes, 35-watt cooker, 3 hours (not successful, higher heat would have been desirable.)		
Meal served to 4 persons		
Test 2		
Roast pork, 5 lb.	100 watts	3 hrs. 30 min
Apple sauce, on a 35-watt unit		3 hrs.
Six cup custards	100 watts	50 min.
Baked potatoes (slightly hard, longer time preferable),	100 watts	2 hrs. 30 min
Six persons served		
Test 3.		
Baked bluefish, 3 lb.	100 watts	1 hr. 40 min
Boiled potatoes (small quantity of water better)	35 watts	3 hrs.
Biscuit	100 watts	50 min
Three persons served		
Test 4		
Roast lamb, 4¾ lb.	100 watts	1 hr. 45 min.
Meat pie, from previous day's Irish stew	100 watts	1 hr. 15 min
Marble cake	100 watts	1 hr.
Tomato sauce	100 watts	15 min
Mashed turnips and potatoes	50 watts	3 hrs
Eight persons served		
Test 5.		
Baked pork chops	100 watts	1 hr. 45 min.
Spinach	50 watts	1 hr. 15 min.
Apple sauce	50 watts	50 min.
Five persons served.		

Tests show that 250 deg. can easily be maintained by the 50-watt cooker.

Ham, baked beans, cereals, corned beef, meat stews, etc., are usually put in the cooker at 8:30 p. m. and left all night. At 7 a. m. they are taken out, well done. Sponge cake can be baked in about one hour in the 100-watt cooker.

In connection with the experiments of the company much has been learned about the employment of systematic methods in preparing meals on the fireless cooker. On account of the small amount of energy required to handle the work without substantial expense for current it is necessary to allow a somewhat liberal time for cooking the various articles. Hence good planning in the use of the time brings its reward, and the preparation of foods requiring a shorter time to cook while the longer-cooking foods are in the oven reduces the amount of labor materially. Thus, in the preparation of one of the company's meals the potatoes were put into the cooker (50-watt size) at 9 a. m. and left until 12. Baking-powder biscuit were put into the 100-watt oven and cooked from 9:15 a. m. to 10:05 a. m.; sponge cake was prepared in the meantime and baked from about 10:05 a. m. to 11:05 a. m., and bluefish was put on at 11:05 a. m. and finished at about 12:40 p. m. It is expected that the company's electric cookbook will contain helpful suggestions along these lines. In the cooking school ten electric ovens are to be used for demonstration purposes.

In addition to the electric cooking problem Mr. Dunham has lately taken up the question of domestic water heating for washing and other applications. Apparatus has been developed to supply water on a percolator system to a 30-gal. kitchen boiler, the water being heated by a 200-watt unit before it enters the boiler and the heat being maintained at a high level by a 100-watt unit in the bottom of the tank. An average temperature of 150 deg. Fahr., with a maximum of 190 deg. Fahr., will be maintained in the boiler, and the heating unit on the percolator is to be equipped with an automatic float switch connection which will cut current off when water is not needed. The tank will be insulated to prevent the escape of heat in excess. The company will probably make a flat rate for this service which will enable it to be used by consumers generally, and it is possible that the heater may be utilized in connection with the warming of houses by hot-water circulation

OPERATION OF A TWO-PHASE DISTRIBUTION SYSTEM.

By Alden W. Welch

Where energy is transmitted over a three-phase, 25 cycle, 6600-volt circuit two-phase current is usually obtained by use of a frequency changer consisting of a three-phase, 25-cycle, 6600-volt motor, direct-connected to a two-phase, 60-cycle, 2700-volt generator. The two windings of the generator sometimes have a common connection, but more often the two phases are entirely independent of each other. At one time it was the practice to connect the two phases in series and run a common wire from their intersection, since by this method three wires were sufficient, while four were required for the operation of the two phases independently. The great disadvantage of this scheme is that if trouble occurs on one phase it will affect the operation of the other. A ground on one of the outside legs will produce a strain between the other outside leg and the ground equal to 1.41 times the volts per phase. The practice now is to transmit with four wires from independent phases and distribute with three wires from either one single-phase transformer having a split winding, if single phase is desired, or from two single-phase transformers having their windings connected for two-phase service.

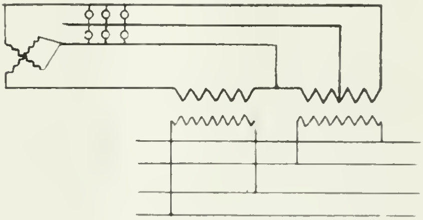


Fig. 1—Distribution Diagram.

When a number of customers in the same vicinity using both lamps and motors are to be served with energy, it is customary to make use of a four-wire, two-phase secondary In this case the secondary of the transformer on one phase is connected to a three-wire, 120-volt service which feeds the lamp circuits, while for the motor circuits a second transformer, connected for two-wire, 240 volts is used. One secondary terminal of this transformer is connected to one outside secondary terminal of the lighting transformer and the other terminal forms the fourth wire of the secondary circuit The wire running from the junction of the two transformers forms the common wire for the two-phase motors, the first and fourth wire being connected to the phase terminals of the motors. Reference to the diagram will immediately make clear this method of operation. This method should not be used where the motor and lighting loads are simultaneous. The usual condition met with

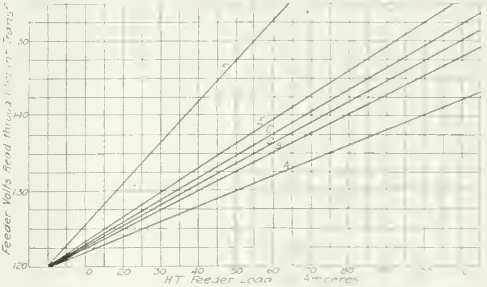


Fig. 2—Diagram Showing Pressure Condition in High Tension Feeders.

is that the motors are operated during the day, while the lamps burn only at night. This maintains a balanced condition on the secondary.

The voltage is controlled by either a hand-operated or an automatic regulator. The latter method has been tried with great success, and following is a brief description of such a regulator. The control part of this apparatus is a contact-making voltmeter which consists of a solenoid having a shunt winding and a series winding acting in opposition. Mounted on a support is a lever, on one end of which are two contact points and on the other end is a core which is free to move within the solenoid. The contact points on the movable lever control the energy used in the relay switch, which in turn controls the circuit for operating the motor of the regulator.

In series with the shunt winding is a non-inductive resistance having taps for various voltages. The resistance is of such value that a current of about 0.8 amp is carried in the shunt winding. The potential tap used for two-phase feeders is usually 120 volts. The series windings are divided into seven fine and two coarse adjustment windings, each of the coarse windings having about seven times the effect of a fine one.

In calibrating the contact-making voltmeter a spring on the lever is adjusted until the lever balances between the contacts with 120 volts on the shunt winding and no current in the series coils. In order that the contact-making voltmeter may compensate for the *IR* drop on the feeder at all loads, the number of series turns is adjusted to maintain normal voltage at a time when the feeder is carrying a heavy load at a power-factor of 90 per cent until the effect of the ampere-turns due to the current is equal and opposite to that produced by the shunt coils, the lever balancing between the relay contacts.

Any increase in load on the feeder naturally increases the ampere-turns in the series coil and causes it to draw the core downward, the lever making contact on the upper stud. This operates the relay switch, causing the motor to operate the regulator in a direction to increase the voltage until the pull exerted by the shunt coil balances that in the series coil. As the load decreases on the feeders the pull in the series coil decreases and the core is drawn upward, causing contact to be made on the lower stud. This energizes the relay in the lowering position and the regulator continues to lower the voltage until a balance is again restored to the solenoid windings.

For regulating the voltage of highly inductive circuits use is made of a compensating voltmeter. This instrument compensates for the inductance and *IR* drop, and is used for maintaining a predetermined voltage at the point of distribution irrespective of load or power-factor. The regulator should be connected between the feeder switch and the series transformer so that the ammeter will indicate the exact load carried by the feeder and not include that taken by the regulator. This is essential to good voltage regulation.

The following is the method for determining at what pressure a two-phase feeder should be operated when hand-operated or motor-operated regulators are used. The feeder is covered by testers. One is usually sufficient, but for feeders extending over a large area two or more testers are necessary in order to obtain satisfactory results. Pressure readings are taken by means of an alternating-current voltmeter at the cut-outs of certain customers, the aim being to obtain a general idea of the pressure conditions in all parts of the feeder. If the voltage is found to be nearly normal over the whole feeder, especially in the districts of heaviest load, a certain customer is selected on each phase, usually in the section of the heaviest load. These two locations are termed the balancing points and it is assumed that, conditions remaining the same, when the pressure is normal at these points the entire feeder is operating at satisfactory pressure.

At the balancing points, the station from which the feeder is being operated is called up by telephone and readings are obtained of the feeder load and feeder pressure as indicated by the station instruments. From the data obtained a curve is plotted, having feeder loads in amperes as abscissas and feeder pressures as ordinates. If 120 volts is considered normal pressure at the balancing points, and when that voltage is read the feeder is carrying 50 amp high tension, at 130 volts feeder pressure at the station, read through shunt transformers, the curve would start at 0 amp and 120 volts and pass through the point on the sheet representing 50 amp at 130 volts. Two similar curves, one for each phase, are drawn on the same sheet.

If the loads on the two phases are nearly equal and correspondingly distributed, the two points representing the respective loads on the two phases should be plotted and a curve drawn bisecting the space between these points. The curve so determined should be used for operating both phases. If the loads on the two phases are not evenly distributed, curves of both phases should be plotted on the same sheet. Under these conditions the two phases of the feeder would be regulated by different curves.

Curve *A* represents the previously mentioned condition when the conditions affecting the operation of the two phases are equal. Operating curves *B* and *C* do not coincide with each other, but the difference between them is so slight that curve *D* may be drawn bisecting the space between them. *D* now becomes the operating curve for the feeder, *B* and *C* being erased. With conditions on the feeder such that the phase curves assume the positions *E* and *F* it would be necessary to retain both curves and operate each phase by the curve corresponding to it. All the curves start at 120 volts, which represents normal pressure at the customer's cut-outs.

With a hand-regulated feeder the operator reads the load on each phase and by consulting the curves finds at what pressure the feeder should be operated. When the load changes he raises or lowers the pressure to correspond. When automatic regulators are installed the curve is used for setting the contact-making voltmeter to operate at normal voltage at the balancing points. A general test should be made over the feeder about once a month.

It has been suggested that small shunt transformers be installed at selected points on the feeder and pressure readings taken at the secondaries of these transformers instead of at the customer's cut-outs. By this method the actual pressure of the feeder at a given point would be obtained. With the present method the feeder pressure often appears to vary on the same phase within a few hundred feet. This is due to the load conditions on the various transformers. The writer recalls one case in which there were three customers on the three corners of a certain street fed by three individual transformers connected to the same phase. Two installations were being supplied with current at 120 volts, while the pressure at the third was 110 volts. An investigation showed that the low pressure was caused by the aged iron of the distributing transformer. The scheme of using the small independent transformers for reading the line voltage has much to commend it

REMOTE CONTROL OF MOTOR DRIVE IN CHICAGO GRAIN ELEVATOR.

The large grain elevator of the Interstate Elevator Company, at Fiftieth and Wallace Streets, Chicago, is equipped with and driven throughout by fifteen induction motors aggregating more than 500 hp. This elevator was formerly operated by steam, but was converted to electric drive at the time of elevating the Erie tracks near which it stands. Three-phase, 60-cycle energy at 6600 volts is obtained from the power plant of the Indiana Railroad Company, a quarter mile distant, which also lights the yards and subways of several railroads, including the Polk Street terminal.

The motor equipment of the elevator comprises fifteen motors, totaling 525 hp. A 75-hp motor, arranged with gears, friction clutches, cable drums and rheostatic control, is used to move railroad cars into place for loading and unloading. A 30-hp motor drives the shovel shaft, on which are mounted drums winding up ropes which drag large flat boards or shovels across the floors of the cars, pushing the grain into chutes at the doors. These shovel drums are arranged with friction clutches operated by counterweights, which allow the shovel boards to be carried back into position before winding begins. Small drums on the shovel shaft may also be used for adjusting the position of cars. There are three 50-hp motors driving the elevating bucket-belt conveyors and four 40-hp motors operating the oat clippers. Two 10-hp motors drive grain separators and a 30-hp motor is employed to operate the bleacher. The dust is blown from the dust house by two 15-hp motor-driven draft fans. A 30-hp motor-driven emergency fire pump is also provided, as the elevator building is separated by the railroad yards from the street and is inaccessible for fire protection.

The starting apparatus for all of the fifteen motors is concentrated in a switchboard installed in a brick building separated from the elevator structure by fire walls and steel doors. The transformers stepping down the transmission potential, 6600 volts, to the motor pressure, 440 volts, are mounted in a concrete compartment in the basement of the switch-house.

When one of the workmen out in the elevator structure desires to have a machine started he pushes the battery bell-button at the motor. This rings a bell on the switchboard and throws the corresponding indicating arrow on an annunciator. The switchboard attendant answers this signal to show that it is properly received by pushing a button on the switchboard which rings a battery bell at the motor. He then throws the motor switch into the starting position, holding it there until a two-ring signal is received from the man at the motor-driven machine, indicating that the motor has started properly and has reached a speed where it can be thrown over to the running position. This two-ring signal received, the starting switch is thrown over to the full running position and the switchboard attendant's duty ends.

To enable the man running the machine to shut down the motor when he is through operating it, the 220-volt trip-coil circuit of the circuit-breaker controlling this motor is carried in conduit to a push button mounted near the starting signal button at the motor. Depressing this button energizes the trip coils of the circuit-breaker, opening it and stopping the motor.

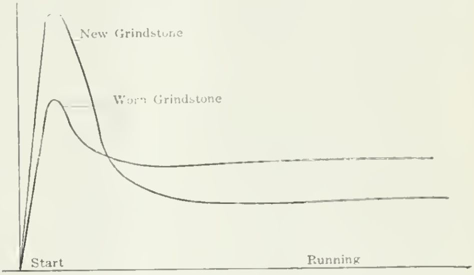
Several of the large motors in the elevator are on the upper stories and others are installed in the basement. All of these, however, are satisfactorily started and controlled by the method in use. This electrical equipment has been installed several years and has given the best of service. The necessity for isolating the starters from the elevator structure was in accordance with the Underwriters' requirements, as it was deemed hazardous to permit oil switches or sparks in the dust-laden air of the elevator. The car-shift motor with its rheostatic controller is installed in the switchroom, where it can be manipulated by the switchboard attendant.

VARYING STARTING AND RUNNING TORQUES DURING LIFE OF MOTOR-DRIVEN GRINDSTONE.

A peculiar problem is presented to the engineer who has to specify the size and characteristics of a motor to drive a grindstone. When new a large heavy grindstone will require a high starting torque to accelerate its great mass, but after it is under way the power required to do intermittent grinding will be comparatively small on account of the large flywheel effect of the rotating mass. The power of the motor, delivered continuously to the stone, is drawn upon only intermittently by the grinding tool, so that a smaller motor than otherwise necessary will be sufficient. But as the wheel wears the reverse of the above relation between starting and running torques takes place.

To accelerate the small, worn grindstone very much less starting effort is required, but this decrease of flywheel effect results in demanding a motor rating practically equivalent to the power intermittently used at the grinding tool. The choice of a motor to be permanently installed for grindstone drive must therefore involve the considerations of both high initial torque and good efficiency and power-factor on light loads.

In equipping the factory of the B. Herschel Manufacturing Company, Peoria, Ill., for electric drive from the lines of the Peoria Gas & Electric Company, eight 4500-lb. grindstones have been arranged for electric drive and fifteen others in the same plant will be similarly equipped. The Herschel company manufactures blades and teeth for agricultural machinery and uses a large number of these stones for finishing the grinding of its products. When new the 4500-lb. grindstones are 14 in wide and 6 ft. in diameter and are run at about 250 r.p.m. As they become worn the pulleys are changed four or five times, keeping the peripheral speed of the stone practically constant during service. When the stones reach a diameter of 14 in. they are discarded and new ones substituted. Upon investigation of the starting demand of a new stone it was found that during a period of ten seconds the power taken amounted to 30 kw. As the grindstone got under way the power to supply the friction and grinding load fell below 10 hp or 12 hp. An old stone, however, showed a power demand of at least 15 hp to drive it at rated speed while working. The motors finally chosen for the operation of these stones were 15-hp, 440-volt, 60-cycle, three-phase Westinghouse HF phase-wound machines, which develop a high initial starting torque well suited for this work. The eight grindstones at present driven by these motors are operating with entire satisfaction, and, as above noted, fifteen additional stones are to be similarly equipped



Starting and Running Torques of New and Worn Grindstones.

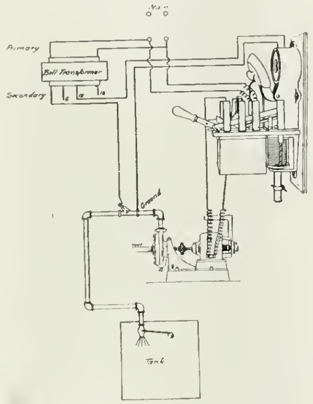
AMPERE-HOUR METERS FOR CONTROLLING ELECTROPLATING.

An interesting use of the amp-hour meter, developed principally for reading battery input and discharge, is the arrangement of such a meter with a scale marked in pounds of copper, ounces of silver, or units of any other plating metal, so that when the meter is placed in series with an electroplating bath the exact quantity of metal deposited can be read directly without examining the plated piece The amp-hour meter hand is arranged with a set-back attachment so that it can be started from zero at the beginning of each plating operation. Several large silver-plating concerns which have had amp-hour meters in service for a year or more report that with the large batches of work in their electroplating baths the reading of the meter has attained an accuracy over 99.5 per cent of the actual deposits by weight. A contact piece on a movable hand makes it possible to operate a circuit-breaker and stop the plating operation after a given weight of metal has been deposited.

LETTERS ON PRACTICAL SUBJECTS

REMOTE CONTROL OF WATER TANK.

The following scheme for controlling the water supply to a distant tank may be of interest. The equipment consisted of a 4-hp Wagner motor direct-connected to a three-stage Morris pump delivering water to a tank of 3000 gal. capacity three-quarters of a mile away, through a 2-in. feed pipe running overhead. The pipe line had a ball-cock stop valve in it and the intention was to connect to this installation a circuit-breaker, so that when the tank became full the ball-cock valve would close, the flow of water cease, the load drop off and the circuit-breaker open. This scheme, however, did not work out as well as was anticipated, due to the fluctuations in the main line from which the supply was taken. The following scheme was then tried. A 2-in. horizontal check valve was put in the discharge line with a spark plug in the cap, so that when the flap valve was open contact was made to the center part of the spark plug, thus closing the circuit of a small bell-ringing transformer. To one of the low-voltage leads of the transformer was connected a circuit-breaker rewound for 12 volts, and the other lead was grounded as shown in the engraving herewith. Now, when the tank became full the ball cock closed the discharge line and stopped the flow of water. The check flap thereupon dropped and opened the circuit of the 12-volt line, which released the circuit-breaker and thus opened the circuit. The plan worked well and the scheme can doubtless be applied for many other purposes



Remote Control of Tank.

Tuxedo, N. Y. H. Lake

* * *

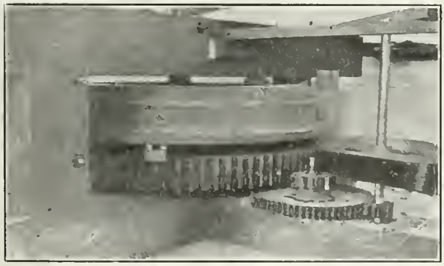
GREASE LUBRICATION.

In small or medium-size power stations where it is not profitable to install a gravity lubrication and filtering system the matter of satisfactorily oiling all the machinery bearings at a low cost for oil and labor often assumes proportions far beyond its seeming importance. Consequently the oiling system is usually found to be very crude in small plants, often neglected entirely by the designer and left entirely to the engineer and his squirt can. Persons who have ever had anything to do with running machinery, and especially fast-running electrical machinery, are well aware of the destruction caused by insufficient or neglected lubrication. The science of lubricating engineering has been developed to such an extent that there is no need of or excuse for either high friction cards or badly worn bearings, provided a little attention be given to the matter of lubrication by the owners or manager of the plant. The engineer cannot install a suitable lubricating plant all by himself, even though he is willing and anxious to do so. He must have the support and encouragement of his employers in order to add so much to the equipment of the station. But there are a number of things which the engineer can do upon his own responsibility which will greatly increase the efficiency of the lubrication at a very slight expense. He can obtain a supply of compression grease cups and apply them to bearings where there are open oil holes. The compression grease cup filled with some good grease is no mean lubricator, and for the small plant the compression grease cup leaves little to be desired. All that is necessary for applying compression grease cups is to tap a hole in the bearing, using a ¼-in. pipe tap for that purpose, then screw in the grease cup, and the whole thing is done except the filling of the cup with good grease and the periodical screwing down, a little at a time, of the cover of each cup. Right here is where the oiler usually goes wrong. He screws down the grease-cup covers too much and forces far too much grease into the bearings. If one would investigate the matter a little he would see what happens when the cover of a 2-in. grease cup is given ¼ in. of movement. The area of a 2-in. cup is 3.14 sq. in. and with sixteen threads to the inch the compression would be one-twenty-fifth of one-sixteenth, or 1/400 in. This advance of the cover would squeeze out 0.0078 cu. in. of grease. This makes quite a drop and enough to lubricate a good deal of shaft bearing, so that when an engineer is seen to screw down a cup cover a whole turn or even two turns at a time one may be certain that he is wasting good grease. Moreover, the grease will work out of the bearing and ornament beams or the floor to the detriment of the appearance of the station. It is remarkable how little grease is actually required thoroughly to lubricate a large shaft bearing. The great majority of bearings are over-lubricated, and the writer has investigated cases of excessive oil bills where it was found that the machinery would actually run safely and well on one-tenth of the lubricant applied and wasted in and around the journal bearings. True, there cannot be too much oil or grease applied to a bearing as far as proper lubrication is concerned—splash and submerged lubrication proves this—but there is a big difference between using and wasting a lubricant. The grease cup is very convenient for lubricating bearings which are located in obscure places hard to reach with an oil can. In cases of this kind it is very easy to pipe the oil hole to a convenient place and then add a coupling and a compression grease cup. Grease may be forced through very long pipes in this way, but care should be taken in the arrangement of the pipe, or else much grease may be wasted in certain cases. For instance, when a pipe extends upward a considerable distance above the level of the bearing, should a bearing thus connected become warm or hot enough to melt the grease in the connecting pipe there will be a flow of grease or oil of altogether too liberal a character, and the bearing is liable to be flooded with grease or oil until the contents of the pipe have been melted out so far back that the heat cannot reach more grease. To avoid a possible occurrence of this character the pipe connecting the grease cup with the bearing should lead downward as soon as it leaves the journal bearing for a distance as great as heat can be transmitted by the pipe. There is a limit of length for each size of pipe beyond which heat will not go, and that limit is where the heat in the grease pipe is lost by radiation into the atmosphere. After this length has been exceeded by a pipe leading downward, then the pipe may be led upward, quickly or gradually, until the cup is at the desired location. With the grease pipe arranged in this manner there will never be any loss or waste of lubricating material through undue melting of the grease. When two bearings are located close together the writer has occasionally arranged both to feed from a single grease cup, the pipes from the bearings being joined together into a third pipe leading to the grease cup. But where such an arrangement is used some means must be provided to prevent all the grease passing through one of the pipes while the other gets nothing. This may be done in more than one way. The writer finds it convenient to place a tee in each branch pipe and then thread a plug so it will reach to the bottom of the hole in the branch of the tee, thus nearly or quite closing the opening through the tee. An ordinary pipe plug will not answer for this, as it is too short to reach to the bottom. It is best to thread a bit of solid rod of the requisite diameter, then bend the end of the rod for a handle, or forge it flat like the end of a thumb-screw. This arrangement may be adjusted at will until each branch receives the precise amount of grease it is desired to send out, and a slight movement of the plugs will permit the proportion of grease sent to either bearing to be changed at will.

South Bend, Ind. James F. Hobart.

HOME-MADE 6 FT. BORING MILL.

The resourcefulness of the erecting engineer is proverbial, for all have some pretty tough problems to tackle that the "slip-stick" fellows in the design office overlook; problems that keep them from spending much time enjoying the scenery in the far-away places where they have to put machinery together and make it work. The construction of a 6-ft. boring mill with hammer and saw, and with what pieces of machinery could be scratched up in a mining town 3000 miles from the factory, should be of interest and the accompanying photograph shows how it worked. While installing a water-power plant in a British Columbia settlement to which the mail came once every two weeks, the writer discovered that the finishing of the case side-plates of the water-wheels had left insufficient room for the runner inside to clear the casing. This error had not been noticed in the factory erection department, but it was felt that at least 0.5 in. additional space would be required on either side. The next problem which presented itself was how to get that ½ in. taken off of the casings, which were nearly 6 ft. in diameter. Of course, they might have been shipped back to the nearest civilized machine shop, but that would have caused two months' delay at a time when we were already behind in our erection. So it was determined to take that ½ in. off in a boring mill of our own construction, and we set about finding material with which to build it. This search was a disheartening one after the first fifteen minutes, during which I visited the mine-plant headquarters and looked over their stock of machinery. But the next day I happened to run across an old gear wheel down the valley that had been taken from an abandoned shaft. It was 6 ft. in diameter and weighed several tons, but, convinced that it would make an ideal stage for my boring mill, we laboriously hauled it to the plant. Here we fixed it on a shaft borne between two horizontal timbers for a frame and rigged up some other small gears to drive it from a pulley belted to a steam-engine shaft. Hook bolts were also made to secure the turbine plate to the gear spokes, and the cutting tool was bolted into place on one of the uprights supporting the cross-pieces. Of course, the finished boring mill worked like a charm and after getting it together it was only a day or two before the side plates were completed and in their places, with as smooth a finish as ever came out of the factory itself.



Home-Made Boring Mill.

Chicago Ill. John R Reading.

A METHOD OF TESTING AN ELECTRIC MINE HOIST.

The object of this article will be to give a method of testing an electric hoist for the purpose of making analysis of the losses and of the power required to drive the equipment.

One of the special cases to which this method of testing is particularly adapted is in testing old hoists which have been changed over from steam to electric power and on which there are no available data.

Consider the case of a single cage, without a counterweight, the rope drum and hoist being driven by an induction motor. Assume that the depth of the shaft, the size or weight of the rope, rope speed and weight of the cage are not known. By connecting an indicating wattmeter in the circuit of the motor and taking four readings, noting the time between readings and number of revolutions of the drum, all of the above unknown quantities can be calculated. The writer has made several similar tests and has found that the results calculated from the tests do not vary more than 2 per cent from the correct values.

In order to illustrate how these tests are conducted and the accuracy of the computed values, the results and calculations of an actual test will be given.

Let L equal loss load in kilowatts, or the power lost due to the friction of the hoist drums, motor friction load and iron and copper losses in the motor; Ca equal the power necessary to lift the weight of the cage at its normal hoisting speed; R equal the power necessary to lift the weight of the rope which is suspended in the shaft. Four readings are then taken, the readings for convenience being designated as A, B, C and D. Reading A is taken when the cage is at the top of the shaft and just as it is starting down. Reading B is taken just before the cage arrives at the bottom of the shaft and before the power is shut off. Reading C is taken while the cage is running up and as soon as the controller is on the last notch, but not until the motor is up to speed. Care is taken in getting this reading to see that no power is registered on the wattmeter due to the acceleration of the equipment. Reading D is taken just before the cage arrives at the top.

These four readings can be expressed algebraically as follows:

$A =$ Starting down $= L - Ca$. $B =$ Arriving down $= L - Ca - R$; $C =$ Starting up $= L + Ca + R$; $D =$ Arriving up $= L + Ca$.

On one of the equipments tested the following values were obtained:

$$A = -10.2;\ B = -11.8;\ C = 19.4;\ D = 17.8$$

The values of A and B are given the negative sign because the motor was acting as an asynchronous generator and feeding energy back in the line.

Subtracting D from C gives $R = 1.6$ kw. or 2.14 hp.

The depth of this shaft was 450 ft. and the time between readings C and D was four and one-half minutes, so that the rope speed was 100 ft. per minute. Knowing the rope speed and the horse-power required to lift the rope from the bottom of the shaft the weight of the rope can be figured as follows:

$$\text{Rope weight} = \frac{2.14 \times 33.000}{100} = 707 \text{ lb}$$

707 lb. divided by 450 ft. = 1.57 lb. per foot. Upon referring to a steel rope table it was found that 1-in. rope weighs 1.50 lb per foot.

Adding A and D it is found that $2L = 7.6$, or $L = 3.8$ kw $= 5.1$ hp. Substituting this value of L in equation D, Ca is found to equal 12.7 kw = 17 hp, and the weight of the cage is

$$\frac{17 \times 33.000}{100} = 5600 \text{ lb.}$$

Although no two of the above four equations have the same value, it is interesting to note that the difference between equations A and B should be equal to the difference between equation C and D, and in each case this value is the rope kilowatt. Moreover, the difference between A and D is equal to the difference between B and C and is equal to twice the losses. If these checks do not hold true some mistakes have been made and other readings should be taken in order to determine the discrepancy.

The writer has also used this method for testing elevators and mine hoists on which the cage is counterweighted. In this case the equations are as follows:

$A = L - Ca + Cw + R$; $B = L - Ca + Cw - R$; $C = L + Ca - Cw + R$; $D = L + Ca - Cw - R$.

In the above equation Cw equals the power necessary to lift the counterweight at its rated speed. As it is neither necessary nor possible to determine the separate weights of the cage and the counterweight from the above equations, let $Ca - Cw =$ difference, or the power in kilowatts required to lift the difference between these weights.

A mine hoist upon which there were no available data was tested by this method and the values obtained for the various wattmeter readings were as follows:

$A = L - \text{Diff.} + R = 24$ kw; $B = L - \text{Diff.} - R = 8.8$ kw; $C = L + \text{Diff.} + R = 28.4$ kw; $D = L + \text{Diff.} - R = 13.2$ kw.

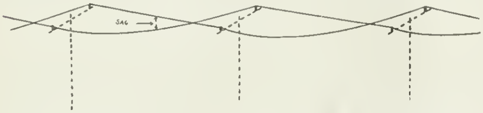
Solving, it is seen that $2R = 15.2$ kw, or $R = 7.6$ kw $= 10.1$ hp The rope speed was 500 ft. per minute, hence $(10.1 \times 33{,}000) \div 500 = 668$ lb. = weight of one rope. Subtracting B from D gives: Diff. = 2.2 kw = 2.93 hp. And $(33{,}000 \times 2.93) \div 500 = 193$; or the cage was found to weigh 193 lb. more than the counterweight. Additional counterweight of 1000 lb. was added and another test showed that the cage was about 800 lb. heavier than the counterweight. Adding B and C it is found that $2L$ equals 37.2 kw, or $L = 18.6$ kw $= 24.7$ hp.

It is evident that a condition might exist when in lowering the cage the motor would take energy from the line and after enough rope had become lowered in the shaft to overcome the friction the motor would become an asynchronous generator and put energy back in the line. Such cases are often met with and the wattmeter must be closely watched in order to give the values a negative sign in case the motor is acting as a generator. If the cage is over counterbalanced this condition may exist when the cage is running up the shaft.

Scranton, Pa. A. S. Biesecker

SIMPLE METHOD OF TRANSPOSING WIRES.

This scheme of transposing a pair of telephone wires at every pole of the transmission line along which they are carried is certainly so simple as to have deserved better attention from engineers who design lines and use instead the unsatisfactory double-groove transposition insulator or four-insulator construction. The method consists in rotating the circuit by crossing wires between poles, allowing the lower wire several feet more sag than the other. In a line carried on pins 3 ft. apart and hung in 600-ft. spans, 3 ft. difference in the sags of the crossing wires has proved an entirely satisfactory and permanent construction. The wires cannot swing together and make contact, for at the middle of the span, where the tendency to swing is greatest, the wires are correspondingly most widely separated. In a line of any length the unsymmetrical suspension of the wires is compensated since each wire occupies alternately the long and short sag position. The only provision to be made in using this construction is that the wires do not slip on the insulators or the latter rotate under the unbalancing action of the unequal spans, letting the wires get together.



Simple Method of Transposing Telephone Wires on Transmission Towers.

Cameron, Wis. P. F. Larned.

THE DISTINCTION BETWEEN TORQUE AND WORK.

Because of the fact that many writers and engineers erroneously express units of both work and torque in foot-pounds, a confusion sometimes exists regarding the distinction between the two. As will be shown, work is properly expressed in foot-pounds (ft.-lb.), while torque should be expressed in pounds-feet (lb.-ft.), or preferably in pounds at a given radius.

Work is the overcoming of resistance through a certain distance. It is measured by the product of the resistance into the distance through which it is overcome. It is also measured by the product of the moving force into the distance through which the force acts in overcoming the resistance. Therefore if, as suggested in Fig. 1, a weight of 50 lb. is raised through a distance of 100 ft. the work done is $50 \times 100 = 5000$ ft.-lb.

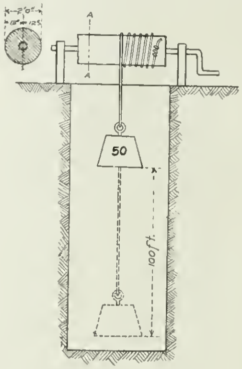


Fig. 1—An Example of Work and of Torque.

Torque is the measure of the tendency of a body to rotate. It is the measure of a turning or twisting effort. Torque may exist even if there be no motion. Thus, in Fig. 1, the torque at the circumference of the drum is 50 lb. whether the drum be moving or standing still. It is assumed that the hoisting rope has no weight. Torque is sometimes expressed as the product of the force introducing the tendency to rotate times the distance from the center of rotation to the point of application of the force. For instance, in Fig. 2 the torque tending to turn the cylinder in the brick wall would be $100 \times 12 =$ 1200 lb.-ft. (In some textbooks this would, inaccurately, be expressed as 1200 ft.-lb.) The cylinder cannot turn and no work could be done. Therefore, it is incorrect to express this tendency to rotate in foot-pounds, which is the unit of work. Probably the most preferable way of expressing the torque in this or in any example is in terms of pressure (or force) and radius. Thus: "100 lb. force at 12 ft. radius." Ordinarily the expression is given for unit or 1-ft. radius. Then, for the case of Fig. 2, the torque would be 1200 lb. at 1 ft. radius. Summing up, work should be expressed in foot-pounds

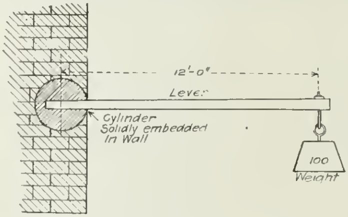


Fig. 2—An Example of Torque.

Torque, although it is, erroneously, sometimes expressed in foot-pounds, should always be expressen in pounds-feet, or preferably in pounds of force at a given radius. There can be torque where there is no work. Applying the principles outlined above to a motor under test for output, the power delivered being measured with a prony brake, Fig. 3, may be taken as an example. The torque is 10 lb. at 3 ft. radius, or 30 lb.-ft., or 30 lb. at 1 ft. radius. Since the motor pulley is turning at the rate of 1000 r.p.m. a point on its circumference travels $2 \pi r R = 2 \times 3.14 \times 1 \times 1000 = 6280$ ft. per minute. At its circumference the pulley is overcoming a resistance of 30 lb. Therefore it is doing work at the rate of $30 \times 6280 = 188{,}400$ ft.-lb. per minute. Since, when work is done at the rate of 33,000 ft.-lb. per minute, a horse-power is developed, the motor is delivering $188{,}400 \div 33{,}000 = 5.7$ hp. It should be noted that, though the torque at the circumference of the motor pulley was considered in the example, it is not necessary to take the torque at that point. The torque may be taken at any point if the radius to that point is used instead of he radius of the pulley. The formula for determining the horse-power output of a motor under test with a prony brake is

$$\text{hp} = 2 \times \pi T S \div 33{,}000,$$

where $\pi = 3.1416$, T = torque in pounds-feet and S is the speed of the motor in revolutions per minute. Substituting the values from the above example in this formula:

$$\text{hp} = 2 \times 3.14 \times 30 \times 1000 \div 33{,}000 = 5.7 \text{ hp.}$$

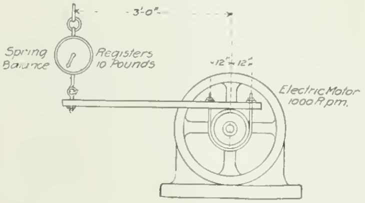


Fig. 3—Torque Registered with Prony Brake.

This is the same result secured by the former and longer method. In metric units work is expressed in kilogram-meters, so, conversely, troque should be expressed in meter-kilograms or in kilograms at a given radius in meters.

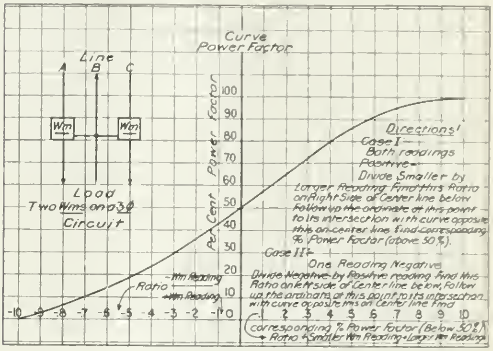
Pittsburgh, Pa FRANCIS BUNNELL

DETERMINING THE POWER FACTOR OF A THREE-PHASE CIRCUIT.

Among men employed by operating electric companies there are many who know that methods exist by which the power-factor of a three-phase circuit or installation may be determined, but comparatively few are able to apply them successfully. Many errors made in meter connections due to the effect of low power-factor on the registration of single phase watt-hour meters (or wattmeters) or separate elements of polyphase meters on three-phase circuits are directly traceable to the lack of knowledge of the points brought out in the accompanying illustrations. Figs. 1 and 2 are copies of instruction sheets furnished by one operating company to its employees where induction-motor installations are the rule. These sheets have been reproduced here with the hope that some seeker after knowledge will be benefited. Fig. 1 in the well-known power-factor curve for two single-phase meters on a polyphase circuit. It also gives a small diagram of simple connections in addition to a few words of instruction with reference to the use of the curve. As the figure stands it should be self-explanatory. Fig. 2 gives, first, a method of checking results obtained by employing the curve given in Fig. 1, as well as a diagram of the connections to be used in obtaining data for the check. This part of Fig. 2 should be easy to apply. The second part of Fig. 2 gives a detailed method of determining the correct connections of two single-phase meters, or one polyphase meter, on a three-phase circuit. If this part of Fig. 2 is employed with care errors in meter connections on three-phase circuits due to the power-factor being near 50 per cent should be a minimum.

To illustrate the use of the above instructions, an actual case will be taken: A 100-hp, three-phase, 440-volt induction motor was operating on 30 per cent full load or 40 hp (298 kw) at 60 per cent power-factor (afterward determined) when an order "came through" to place a polyphase meter on the installation. Immediately after the meter had been connected in circuit the following question was asked: "Should the light element add to or subtract from the heavy element, that is, is the power-factor above or below 50 per cent?" As the meter leads were incased in pipe, these could not be traced, therefore the instructions in the second figure pertaining to this point were applied. The connected load of the motor having been thrown off, it was found that one element of the meter gave a negative reading. Sufficient load was then put on to bring the motor to about 80 per cent of its full-load rating. Each element of the meter (taken separately) now read positively, but the element which on no-load gave a negative reading on 80 per cent load read lower than the heavy element. The meter had been correctly connected when installed. Later both methods given in the above figures to determine the power-factor of a three-phase circuit were applied and both gave approximately 60 per cent (at 30 per cent load), as previously stated.

Los Angeles, Cal. C. E. HOWELL



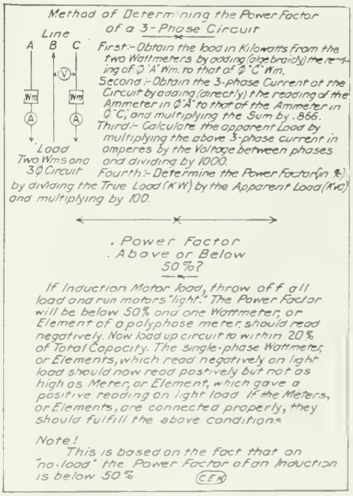
Directions!

Case I—
Both readings Positive—
Divide Smaller by Larger Reading Find this Ratio on Right Side of Center line below Follow up the ordinate at this point to its intersection with curve opposite this on center line find corresponding % Power Factor (above 50%).

Case II—
One Reading Negative
Divide Negative by Positive reading Find this Ratio on left side of Center line below, Follow up the ordinate at this point to its intersection with curve opposite this on Center line find corresponding % Power Factor (Below 50%)

+ Ratio + Smaller Wm Reading ÷ Larger Wm Reading

Fig. 1—Power-Factor Curve.


Line
A B C
V
Wm
Wm
A
A
Load
Two Wms and
3φ Circuit

Method of Determining the Power Factor of a 3-Phase Circuit

First:—Obtain the load in Kilowatts from the two Wattmeters by adding (algebraicly) the reading of φ "A" Wm. to that of φ "C" Wm.

Second:—Obtain the 3-phase Current of the Circuit by adding (directly) the reading of the Ammeter in φ "A" to that of the Ammeter in φ "C," and multiplying the Sum by .866.

Third:—Calculate the apparent Load by multiplying the above 3-phase current in amperes by the Voltage between phases and dividing by 1000.

Fourth:—Determine the Power Factor (in %) by dividing the True Load (K W) by the Apparent Load (Kva) and multiplying by 100.

Power Factor
Above or Below
50%?

If Induction Motor load, throw off all load and run motors "light." The Power Factor will be below 50% and one Wattmeter, or Element of a polyphase meter, should read negatively. Now load up circuit to within 20% of Total Capacity. The single-phase Wattmeter, or Elements, which read negatively on light load should now read positively but not as high as Meter, or Element, which gave a positive reading on light load. If the Meters, or Elements, are connected properly, they should fulfill the above conditions

Note!
This is based on the fact that on "no-load" the Power Factor of an Induction is below 50%

CEH

Fig. 2—Chart of Instructions.

QUESTIONS AND ANSWERS.

Have any data been published on the number of meters installed in average towns or is there any approximate average percentage of electric light customers to population in cities of different classes? F. B.

Considerable information concerning the probable number of meters in various towns and the approximate average percentage of electric light consumers to the population in cities of different classes has been given in our columns at various times. The reports given covered a total of fifty towns. From these reports it appears that the average number of meters per 100 of population is about eight. The average number of residence meters per 100 of population in Ohio seems to be about five.

Kindly advise me how to determine the power-factor of a three-phase line by the use of two wattmeters. W. P. T.

In measuring power in any three-phase circuit, it is essential to employ two single-phase wattmeters. That is to say, if the leads be marked *A*, *B* and *C*, one of the wattmeters could be connected with its current coil in lead *A* and its voltage coil across between this lead and lead *B*. The other wattmeter could be connected in lead *C* and with its voltage coil across between this lead and lead *B*. The sum of the readings of these two wattmeters would be the true power in the circuit. When the power-factor is less than 50 per cent, one of the wattmeters will give a negative reading, which means that under these conditions the true power is represented by the difference between the readings of the two wattmeters.

We have experienced excessive heating in the wires of a three-phase, 440-volt, 60-cycle motor circuit, each wire of which is contained in a separate iron conduit. The conduits were bonded together and grounded with no apparent decrease in the heating. Would the inductive effect in about 150 ft. of such conduit be great enough to cause a temperature rise? Would this method of distribution be considered good engineering practice in polyphase work? Could a 5-hp, 500-volt direct-current, series-wound, four-pole motor, be made to operate with any degree of success on a 220-volt, 60-cycle circuit as a repulsion motor? About what power might be expected under these circumstances? F. D. M.

It is very bad engineering practice to run the three wires of a three-phase circuit in separate iron conduits, and we fail to see how the installation could ever have passed the Underwriters' inspector. The Code is very explicit in stating that all the wires of the same alternating-current circuit must be placed in the same conduit. By making this change your heating will disappear, if the wires are large enough. The ordinary form of direct-current motor with projecting field poles is not suitable for use as a repulsion motor. A motor of the repulsion type should be provided with a continuous magnetic circuit. Unless the circuit is continuous the machine will require an excessive amount of current for magnetization, and hence the power-factor will be extremely low and the performance unsatisfactory, if, in fact, the machine can be operated at all. It is to be noted in this connection, however, that a machine provided with a continuous magnetic circuit, such as is usually the case with a repulsion motor, can be operated as a direct-current motor with even better results than are obtained from the ordinary direct-current machine.

It is desired to transform from three-phase current to single-phase through a three-phase transformer. If two of the windings of the secondary be joined as for star connection and the third winding reversed, what output will be obtained, and will such a system unbalance the three-phase line? M. B. L.

It is not practicable to transform from balanced polyphase to single-phase by means of stationary apparatus of any kind. The energy supplied from a balanced polyphase system is practically continuous, while the energy supplied in a single-phase system is fluctuating. On this account it is necessary to insert some energy-storing medium between the polyphase system and the single-phase system if the polyphase load is to remain balanced. Energy storage by stationary apparatus is extremely costly, on account of the fact that very little energy can be stored in a magnetic field or in an electrostatic field. The secondaries of three transformers the primaries of which are connected in star, when joined to a three-phase system, can be arranged to provide energy for a single-phase load, but the load on the polyphase system will necessarily be unbalanced. The best arrangement would be that in which two of the windings are joined in series to produce an electromotive force equal to 1.73 times that of one coil, and the third coil is entirely omitted. Evidently the load will then be taken off only two of the phases, and the third phase will be without load.

Two pieces of apparatus were connected in parallel on a 25-cycle circuit. One had a resistance of 50 ohms, a capacity of 0.00002 farad and an inductance of one henry. The other had a resistance of 20 ohms, an inductance of 0.5 henry and zero capacity. From the data given the impedance $Z = 126.3$ ohms and the angle of phase difference was computed to be 52 deg. 36 min. When the actual resistance of the circuit was obtained from the formula $R = 1 \div \left(\frac{1}{r} + \frac{1}{r_1} + \dots\dots\right) = 14.28$ ohms it differed widely from R when obtained from the formula $R = Z \cos \phi - 76.74$. Why should this be?

It is not possible to add together directly the reciprocal of the resistances of several alternating-current circuits placed in parallel in order to find the equivalent resistance of the resultant circuit. This fact can be best appreciated by dealing always with currents rather than electromotive forces when treating parallel circuits. That is to say, one should consider conductance rather than resistance in solving problems relating to parallel circuits. Take, for example, a circuit composed of one ohm resistance in series with one ohm reactance. The impedance of the circuit is 1.4 ohms, the angle of lag is 45 deg., and the power-factor is 70.7 per cent. The impedance of the circuit being 1.4 ohms, the admittance is 0.707 mho and the conductance is 70.7 per cent of the admittance, which is 0.5 mho. The reciprocal of the resistance, as you will note from the above, would have been 1 mho, while the conductance is only one-half of this amount. These facts are discussed at great length in Dr. C. P. Steinmetz's book on "Alternating Current Phenomena."

When a choke coil is placed in an alternating-current arc lamp circuit does it use up the voltage as the resistance does in a direct-current lamp or does it back up the electricity in the wire something like a dam backs up the water in a stream? We are contemplating purchasing an alternating-current arc lamp to be used on a 110-volt circuit and the arc operates at 70 volts with 4 amperes. If the 10 volts are lost in the choke coil and magnets, does the lamp take 110 times 4, or 440 watts, or does it take 80 times 4, or 320 watts? P. H. C.

The so-called choke coil placed in an alternating-current arc lamp circuit consumes voltage in a manner somewhat similar to the resistance used with a direct-current lamp, but the relations are quite different. The choke coil is so arranged that it produces about itself a considerable magnetic field. This field alternates with the current and produces in the conductor a counter voltage. It is this voltage which tends to reduce the current with the alternating-current lamp, just as does the lost voltage in the resistance used with the direct-current lamp. It is not possible to add directly the magnetic voltage across the choke coil to the voltage consumed by the lamp to obtain the apparent sum of the two on the circuit. For example, if the lamp consumes 70 volts and the choke coil consumes 70 volts, when the two are connected in series the total voltage required is slightly less than 100 volts. The choke coil is much more economical than the resistance device used with direct current. It is possible to use resistance with an alternating-current lamp just as is done with a direct-current lamp, but it is preferable to use a choke coil on account of the improved economy.

Central Station

Management, Policies and Commercial Methods

GOOD CENTRAL-STATION CUSTOMERS GET TUNGSTEN-LAMP CHRISTMAS PRESENTS.

A central-station manager in a small central Illinois city pleased his customers during the holiday season by presenting to those who called at the office to pay their lighting bills 40-watt tungsten lamps. All whose November monthly bills exceeded $3 received one lamp and those whose bills were above $5 two lamps.

ELECTRIC-LIGHT PLANT ADVERTISES THE TOWN.

Citizens of Eureka, Ill., take pride in the public spirit of the Eureka Electric Service Company, which has installed on the wall of its generating station near the railroad an electrically lighted sign bearing the name of the town. As a result travelers on through trains notice this evidence of Eureka's progressiveness and remark about it when the train stops and they peer through the windows to determine their progress in the night.

BOSTON EDISON SERVICE EXTENDED IN WALPOLE, MASS.

The Edison Electric Illuminating Company of Boston has recently completed the installation of a new transformer station in the town of Walpole, which, with the rearrangement of distribution circuits in the municipality, has resulted in a marked improvement in service. The present transformer capacity of the substation is 750 kw for commercial and 106 kw for street-lighting service. A duplicate transmission line has been built for 13,800-volt service between Boston and Walpole. The capacity of the circuits in Walpole has been practically quadrupled by their rearrangement. An inefficient generating plant has been shut down at Medfield and that municipality is now supplied through Walpole. Three times as much energy as formerly can now be delivered in the districts previously served by the old Medfield station. The street-lighting circuit of the company, extending southward from Walpole through Bellingham nearly to the Rhode Island line, contains ninety miles of wire and is one of the longest circuits of its kind in the world

ST. LOUIS UNION ELECTRIC COMPANY OCCUPIES NEW OFFICES.

On Dec. 12 the office staff of the Union Electric Light & Power Company, of St. Louis, moved from the old building at Tenth and St. Charles Streets into the company's new offices at the southwest corner of Twelfth and Locust Streets. The new building is a five-story structure faced with white tile and fronts 150 ft. on Twelfth Street and 100 ft. on Locust Street. The entire office and salesroom portion of the building is occupied by the Union Electric Company. On the first floor are the appliance showrooms, cashiers and lamp-renewal clerks. The offices of the executive department and sales department are on the second story, while the third is given over to the administrative and accounting offices. The engineers' quarters are on the fourth and fifth floors. The showrooms flank the lobby entrance to the Shubert Theater auditorium, which is in the building, affording an excellent opportunity to interest matinee and evening theater-goers in the electrical appliances of these attractively furnished rooms.

The appearance of the new Union Electric building after dark is especially prepossessing. Its shining white-tile walls loom brilliantly in the intense magnetite-arc illumination of Twelfth Street, the widest thoroughfare in the city, while every window is made a bright square of light by instructing the office employees to turn on all lamps, throw up the shades and leave the lamps to burn when they quit their work in the evening. An average power consumption of 1 watt per square foot of floor surface has been maintained in the office lighting, white walls and reflecting glassware combining to produce an illumination of 5 ft.-candles at the working plane. The brilliant appearance of this lighting from the outside will be further accentuated by outlining the building with tungsten lamps

A RED-LIGHT POLICE-SIGNAL SYSTEM AT LOS ANGELES, CAL.

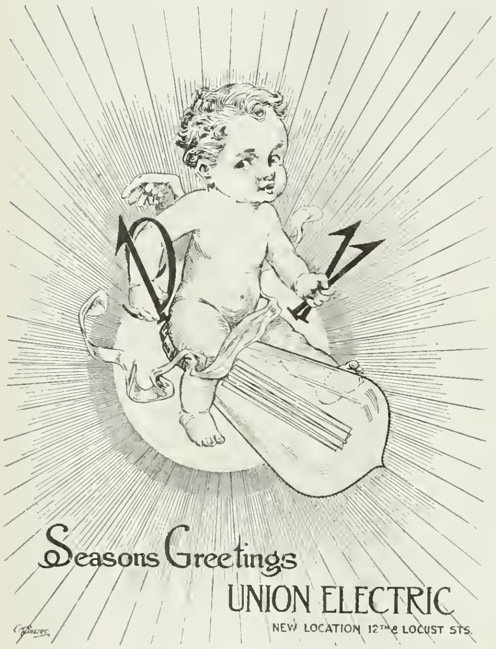
The City of Los Angeles contemplates the installation of a red-light street-signal system for the assistance of the police force in the prevention of crime. It is proposed to extend the lamps throughout the city in locations of about ten to the circuit, such circuits to be in clusters over a distributed area and not controlling a particular street. The lamps will be hung at the center of street intersections and in the vicinity of patrol boxes and will be placed from 10 ft. to 15 ft. above the regular street arcs, giving a total height from curb line of about 45 ft to 50 ft Red lamps at this distance cannot be mistaken and will eliminate the necessity of an officer going to the street where they might be situated. By this system the circuit cut in will show in the immediate vicinity of trouble, notifying officers working in such district Headquarters can then communicate with patrolmen on duty instantly, whereas present conditions may cause an hour's lapse between the patrol box calls. A similar system has recently been installed in Camden and Trenton, N. J.

BOSTON EDISON COMPANY TO ERECT LARGE ELECTRIC SIGNS.

The Edison Electric Illuminating Company of Boston has recently ordered two large electric signs which will combine moving and picturesque effects in drawing attention to the company's facilities. One sign will be located on a building in a busy section of the Back Bay and will be of the statue type, the figure being designed by Noble. The statue will represent "Progress," and the figure will be 16 ft high, apparently set in an incandescent lamp and provided with moving-cloud effects produced by a focusing arc lamp and screens revolved by motors The whole sign will be 26 ft high The second sign will be located on a manufacturing building in South Boston will be about 30 ft. long and with letters 4 ft. in height. There will be three lines of reading flashed on and then cut off, followed by a rapidly moving motor, belts, pulleys and an emery wheel. This machinery will remain visible while the figure of a man is outlined, and as a result of automatic arrangements the workman will apply an iron bar to the emery wheel and sparks will begin to fly. The "Progress" sign is being built by the American Sign Company and the industrial sign by Betts & Betts, of New York

SEASONABLE ADVERTISING AT ST. LOUIS.

At this particular season of the year there is something refreshing and welcome in tales, events, or, in fact, anything possessing what is generally known as human interest. At Christmas the feeling of good will toward men seems to pervade the very atmosphere, while at New Year the mingled feelings half of pain and half of rapture which come to the thoughtful are lost in the happy greetings and hearty good wishes which mark the old year's knell. It is natural, therefore, that advertising which is intended to appeal to buyers should also reflect the spirit of the times. The accompanying illustration shows the advertisement inserted in the St. Louis papers by the Union Electric Light & Power Company of that city on Jan. 1. There is a subtle charm which strikes one's fancy in the reproduction picturing the winsome New Year coming in astride a tungsten lamp. Certainly the design is appropriate and the advertisement seasonable.



Attractive New Year's Greeting Printed in St. Louis Papers, Jan. 1, 1911.

RESULTS OF BYLLESBY COMPANY'S FORTY-FIVE-DAY HOUSE-WIRING CAMPAIGN.

From Oct. 1 to Nov. 15, 1910, a forty-five-day house-wiring campaign was conducted in a number of cities where central-station plants are operated by H. M. Byllesby & Company, Chicago. In general, the conduct of this campaign was similar for all the cities, with slight modifications to meet local conditions. Newspaper advertising and solicitors were both used to advantage, and the work of wiring the houses was done on a cost basis, the company paying the contractor's profit. The most successful of these local campaigns, that in Mobile, Ala., a city of 51,000 population, where 660 new customers were added to the 5000 existing consumers, was recently described in the *Electrical World*. The fifteen cities in which the forty-five day house-wiring campaign was conducted have a total population of approximately 324,000. The total number of houses wired was 1415.

LARGE CENTRAL STATIONS TO EXCHANGE ADVERTISING IDEAS.

Arrangements have been completed between the publicity departments of ten or twelve of the largest central-station companies, operating in the principal cities of the country, by which a copy of every newspaper advertisement, booklet and piece of printed matter issued by each company will be mailed to the "copy" men of all the other companies. The interchange of ideas resulting from this scheme will be especially valuable in the non-competing field of the central station, enabling each company to benefit from the new-business arguments invented and employed by its contemporaries. This arrangement for interchanging advertising matter just completed has been the subject of correspondence between several of the companies interested, dating back almost a year

MERCHANTS GAVE POSTS; COMPANY, WIRING; AND CITY, LIGHTING.

Mendota, Ill., a little city of 4000, with 500 electric-light consumers, has installed thirty-seven tungsten-lamp pillars in its business section. The posts, which are of the curved type used at Aurora, Ill., are placed at 80-ft. intervals and each carries three 60-watt tungsten lamps. The bare pillars were paid for by the merchants, each of whom was assessed $12.50. The wiring and lamp equipment, including the setting of the posts, was furnished by the Mendota Electric Light Company, which received a ten-year contract for operating the system, the city paying for the downtown illumination as part of the general street lighting. The topmost lamps of the pillars burn all night, from dusk to dawn, and for them the company receives $2.50 per lamp per month. The lower lamps burn until midnight only, and cost $1.50 each per month. The electric company also took advantage of the street-lighting construction to put all its high-pressure lines and street mains underground in the business section

FARM CUSTOMERS OF EUREKA (ILL.) ELECTRIC SERVICE COMPANY.

Beside its 200 lighting customers in Eureka, Ill., the Eureka Electric Service Company also supplies electrical energy to seventy-five consumers in Roanoke and fifty in Metamora, towns nine miles north of Eureka. En route the single-phase, 6600-volt, 60-cycle transmission line furnishes the means for lighting and power to about twenty farm installations. The farmers are served in little groups of three or four from a single step-down transformer at the transmission line, 110-volt or 220-volt lines being run to the farm premises. The latter pressure is used only in a few instances where an unusually long service line is required in order to reach the farmhouse. Motors to operate cream separators, grain dumpers, churns, feed cutters, etc., are run from the single-phase, 60-cycle line, and a number of electric irons are in use on these farms.

The rate to farm customers is the same as in the towns, viz., 50 cents per month service charge, plus 10 cents per kw-hour. To customers having sufficient motor load to justify a special rate 5 cents per kw-hour is charged for all energy used in addition to a primary quantity in kw-hours equivalent to twenty-five times the hp-rating of the motor. Ten per cent discount is allowed for payment within fifteen days of rendering the bill. To farm and town customers alike the company rents or sells its motors, but furnishes its transformers for farm customers free of charge. Collections are made and meters read at three-month intervals, one trip being sufficient for both purposes. The farming element reached by the Eureka lines is of the most substantial class and collections involve no delay. The approximate date of the collector's visit is known in advance, and when he comes, reads the meter and computes the bill his money is usually awaiting him. The average income from these farm services varies from $2.50 to $4 a month. Country customers are good users of electricity. The present transmission line was built in June, 1910, when twenty-four-hour service was begun at the Eureka plant. The line passes within 100 ft. of one farmhouse where the owner has installed only recently a gas-engine-driven isolated lighting plant, furnishing service to two other farmers near by. Needless to say, this little group is pretty keenly disappointed that they did not wait for the urban conveniences on the way to reach them. The plant owner would be pleased to sell his outfit and obtain energy from the central-station lines if he could find a purchaser for his apparatus.

ELECTRICITY AT A STATE FAIR EXHIBIT

It is significant of the increasing attention paid to electricity by those engaged in agricultural pursuits that electric lighting and electric drive played a conspicuous part in the large exhibit of the International Harvester Company of America at the recent Illinois State Fair at Springfield, Ill. The main exhibit of this large company was in a tent, and a prominent feature was an electric power plant, neatly railed off and described as the "engine-room." The accompanying illustration gives a good idea of it.

Exhibit of Electrical Apparatus.

Two 25-hp gasoline engines, made by the Harvester company, were belted to two Fort Wayne 16-kw, 125-volt, direct-current dynamos, and there was a two-panel switchboard of blue Vermont marble. All wires leading to and from the board were carried in metal conduit under the ground. The entire "engine-room" was raised 14 in. from the ground, and the floor was covered with linoleum.

The lighting load included 690 green incandescent lamps used in decoration, some of them, as wired in festoons within the tent, being shown in the picture. There was also a double-faced flashing sign representing the monogram of the company and mounted on the central pole of the tent, as shown in the picture. The power load consisted of four motors. One of these, a 5-hp machine, was belted to a line of spreaders, hay tools and a corn-picking machine. There was also a motor of the same size belted to twine-making machines used in the manufacture of the twine used in grain binders. Another 5-hp motor was belted to a line of horizontal gas engines to show the latter in motion. The engines were connected in such a way that, although of different sizes, they all revolved at the same speed, making an attractive exhibit. A 1½-hp motor was used in the cream-separator exhibit.

Electricity was also furnished to operate the company's moving-picture show in a separate tent, one large arc lamp here taking 60 amp. Electric fans were also used about the exhibit and lamps attached to long flexible cords were employed to show the inside construction of the various types of agricultural machinery.

The company also made a "power-house-on-the-farm" exhibit, which consisted of a 4-hp gas engine belted to a line shaft. From this shaft were operated a 2-kw, 30-volt generator, as well as a corn-sheller, a feed-grinder, a cream-separator, a grindstone, an emery wheel, a pump, a fan mill, a circular saw and a washing machine. A 16-cell storage battery was also included in this exhibit. The lamps used here were 20-watt tungstens, and the battery was of service in connection with the night police lighting.

As a whole the exhibit attracted much attention, and it is probable that it will be repeated, with improvements, at other State fairs to be held during the present year. Mr. B. E. Avey, of Aurora, Ill., installed the electrical features of the exhibit.

RESULTS OF ST. LOUIS HOUSE-WIRING CAMPAIGN.

Several months ago a house-wiring campaign was planned by the officials of the Union Electric Light & Power Company, St. Louis, with the threefold purpose of getting unwired, incompletely fixtured and already wired houses connected to its lines.

For prospective consumers desiring their houses wired the company arranged with several contractors to have this work done at a low price, the amount of which, if desired, was assumed and paid by the electric company, the customer reimbursing it in twelve monthly instalments. In sending solicitors out to make these contracts for house wiring it was found very advantageous to have them provided with a fixed scale of prices for the work, so that the amount could be quickly determined without the delay of having another man estimate on the job. Such delays often result in the customer's changing his mind about the amount of investment he wishes to make. The company's agreement with the contractor stipulated a maximum charge of $18 for five outlets in a five-room house, with a proportionate advance for additional lamps if desired.

Where houses were wired but had no fixtures installed the company offered six fixtures complete for $12.63, also payable in twelve instalments.

To occupants of completely equipped houses near its lines, but not connected, the company offered to loan electric lamps, inspect the house wiring and make outside connections free of charge on sixty days' trial. If the consumer proved dissatisfied at the end of this period the company agreed to take back its lamps and disconnect its service, charging only for the energy used at its regular rates. If the sixty-day trial service satisfied the customer he paid for the lamps, renewable free of charge, and contracted for the service at the usual rate.

In planning the campaign just described the first step was a house-to-house canvass by men and women agents, who reported whether the houses they visited were unwired, unfixtured or wired, whether Union Electric service was used, and if this was satisfactory. In the case of present customers of the company the agents turned their attention to demonstrating appliances and heating apparatus, selling the devices, if possible, or leaving them on trial. From the results of this canvass white, blue and buff-colored cards were filled out, indicating whether the house visited was already a consumer of electricity or, if not a consumer, was wired or unwired. To 7000 of these card addresses of non-consumers of electricity five circular letters were mailed in succession explaining the wiring-at-cost and free-connection offers. Newspaper advertisements and car posters with return-postcard tablets were also used in the campaign to acquaint the public with the company's liberal proposals toward new consumers. Of the circular letters it was noticed that replies usually followed the third letter at least, while by the time the fifth was received the new customer was usually ready to sign a contract.

As a result of the sixty days' operation of this campaign Mr. L. F. Philo, contract agent for the Union Electric company, announces that 200 houses have been wired, seventy-five equipped with fixtures and 300 formerly unconnected wired residences secured for the company's service. The effect of the campaign has also been noticeable in increasing the average residence customer's consumption and in extending the outlying alternating-current distribution over a larger area. Following the present residence campaign the Union Electric company contemplates similar efforts among long-hour commercial users of lighting, such as drug stores, restaurants and cafés.

The St. Louis company has recently secured the services of an illuminating engineer, Mr. J. F. McGlesney, formerly of Chicago, whose expert assistance is offered without charge to those planning the lighting of rooms or buildings, including owners, architects and consulting engineers who do not make an especial study of lighting arrangements. The company's illuminating engineer co-operates with the architect or engineer, if one is employed, or will suggest to the customer interested the best means of improving his illumination or enhancing the effectiveness of the lighting.

CENTRAL-STATION RESULTS AT BROCKTON, MASS.

The return of the Edison Electric Illuminating Company of Brockton to the Massachusetts Gas and Electric Light Commission for the year ended June 30, 1910, indicates that the demand for central-station service in the Brockton district is increasing in a thoroughly satisfactory manner. The total income of the company in 1910 was $291,153, compared with $243,603 in 1909, or an increase of 19.5 per cent. The largest item of increased earnings was sales for motors, there being an income from this source in 1909 of $44,053, compared with $67,261 in 1910. The gain in motor-service earnings was nearly $2,000 per month, or 52.3 per cent over the previous year. The policy of the managers of the Brockton and Lowell companies (Lowell figures were printed in the issue of Nov. 3), Messrs. Stone & Webster, has been to institute a vigorous campaign for motor business within the past year or two, and the resulting expansion of this service has been remarkable. The total sales of the Brockton company for 1910 were 6,341,370 kw-hours and the average income per kw-hour was 4.6 cents. Of the foregoing output, which included street and commercial lighting as well as motor service and sales of electricity to other companies, 2,507,232 kw-hours were sold to motor consumers at an average return of 2.68 cents per kw-hour. A year ago the sales required the delivery of 1,247,079 kw-hours to consumers having motors and at an average return of 3.53 cents per kw-hour. The motor service development work has plainly resulted in substantial benefits to the community served, for the figures show that the average motor user pays nearly 0.9 cent less per unit this year than he did a year ago, while the company's output for motor service increased 1,260,000 kw-hours.

The commercial lighting income of the Brockton company increased in the past year from $141,680 to $154,069. The lighting rates were reduced from 20 cents to 16 2/3 cents per kw-hour and the company acquired the central-station service in the towns of Bridgewater and Stoughton, putting its prices into service in these small communities and transmitting electricity throughout the district from its turbine station at East Bridgewater. Other municipalities served by the company are Brockton, Whitman, East Bridgewater and Avon, the total population of the territory being about 85,000 at the present time. The average revenue from commercial lighting was 10 cents per kw-hour in 1909 and about 10.8 cents in the year just closed. The street-lighting income gained about $10,000 during the year, part of the increase, however, being due to the consolidation with the companies serving outlying communities.

The total connected load of the company on June 30 last was 6573 kw, the total number of customers being 2175. The connected load consisted of municipal arcs, 280 kw; municipal incandescents, 52 kw; commercial arcs, 557 kw; commercial incandescents, including miscellaneous company lamps, 3171 kw; commercial motors, 2513 kw. The average income from motor service per kilowatt of connected motor load was $26.70, or $19.80 per horse-power per year.

The company generated 8,079,038 kw-hours during the year and purchased no energy from outside sources. The major part of this output was delivered by the turbine station at East Bridgewater, which contains a steam generating plant of four 525-hp Babcock & Wilcox boilers and two 1500-kw vertical Curtis turbo-alternators operating at 900 r.p.m. and delivering energy to the outgoing lines at 13,200 volts, three-phase connections The old steam plant of the company in Brockton is used mainly as a substation, although upward of 2000 hp in steam equipment is held in reserve here in case of trouble at the turbine plant. The manufacturing cost at the station alone, figured for the entire output of the company, and not taking into account capitalization charges or any distribution, management, taxation or miscellaneous expenses, was $71,766 for the past year, the principal items being:

Fuel	$45,438
Oil and waste	669
Water	451
Wages at station	18,436
Station repairs	1,747
Steam equipment repairs	2,252
Electric equipment repairs	600
Miscellaneous tools	2,173
Net manufacturing cost	$71,766
(or 0.89 cent per kw-hour manufactured)	

The principal items of operating expense for the year were: Manufacturing cost, $71,766; distribution, $39,675; office expenses and management, $39,098, and taxes and miscellaneous expenses which brought the total expenditure to $175,814, or 2.87 cents per kw-hour sold. The company declared dividends of $61,208, or about 0.97 cent per kw-hour sold, leaving a margin of about 0.75 cent per kw-hour from the total receipts to meet interest, depreciation and contingent charges. These figures show conclusively that while the station cost of electrical production is of much technical interest, there is only a small margin left after legitimate expenditures or apportionments are made for the requirements of the surplus. The "man in the street," seeing from the return to the State that the company

CENTRAL-STATION FACTS AND FACTORS, BROCKTON, MASS., 1910.

Kw-hours delivered at station busbars	8,079,038
Kw-hours sold, total	6,341,370
Percentage of output sold	78.5
Kw-hours sold for electric motor service	2,507,232
Total income from operation	$291,153
Total income from electric lighting (commercial service)	$154,069
Total income from electric motor service	$67,261
Total investment in physical plant	$1,253,390
Kw rating of station equipment owned by company	5,061
Number commercial lighting customers	1,853
Estimated population of company's territory, 1910 (Brockton, 1910 census, 56,878, other towns, 1905 census, 24,304)	85,000
Total connected load in kilowatts	6,573
Average total earnings per kw-hour sold, cents	4.6
Average total earnings from motor-service sales, cents	2.68
Total cost of plant per kilowatt of station rating	$248
Gross yearly income per kilowatt of station equipment	$57.50
Gross yearly income per capita of population, approximately	$3.40
Ratio of connected load to station capacity	1.3 to 1
Yearly load factor (average divided by maximum of 2750 kw)	33.3 %
Watts station rating per capita	59.5
Number of consumers per capita	0.0256
Average income per kilowatt of motor load per year	$26.70
Average income per consumer	$134
Gross liabilities (capital, bonds, loans)	$1,232,800
Cost of plant more than capital and loans	$111,777
Total liabilities per kilowatt of station rating	$244
Investment per capita	$14.75
Number consumers per hundred population	2.5
Number of consumers	2,175

can produce electricity at its station for something under 1 cent per kw-hour with coal at $4.27 per ton, may well note that the actual cost of delivering a kw-hour to the customer is in this instance easily from three to four times the mere station cost, which does not take into account the necessary provision to keep the plant and system up to modern standards of practice, insurance, office expenses, the cost of transmitting and delivering energy over a wide area, administration, legal charges and the necessary bond interest, all of which must be met before a cent of dividends can be declared. In order to produce electricity for general uses in its territory the company maintains a plant and system representing an investment of $1,253,390, or $184 per horse-power of steam-generating capacity at the dynamo shaft. The principal items of the investment are: Steam plant, $276,921; land and buildings, $257,601; overhead lines, $251,224; electric plant, $211,171, and underground lines, $146,812.

Various data of the year's operation are summarized in the table on the preceding page.

Wiring and Illumination

BAD PRACTICE IN ELECTRICAL WORK.

By T. W. Poppe.

A bad practice that is daily growing, due no doubt to the keen competition in the electrical trade, is the manner of setting outlet and switchboxes in wooden paneling and wainscoting. Fig. 1 shows a questionable method of setting an outlet box in wooden paneling or wainscoting. This method is employed in many rush jobs when the cry is "Get the work done" and the demand is for a speedy finish.

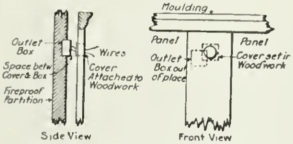


Fig. 1—Wrong Method of Installing Outlet Box in Wainscoting.

To gain speed in placing the boxes in position, the wireman, with the sanction of the man in charge of the work and often at his command, places the outlet box at the approximate point and places a small quantity of plaster of paris or cement around it to hold it in position. The mechanic whose duty it is to secure the panels in position cuts the proper size of hole, at the proper point, in the wooden paneling, removes the cover from the iron outlet box and fastens it to the rear of the wooden paneling. This causes the outlet to come in the exact position, but it leaves a bad condition when the paneling is permanently fastened in position. There is often a space large enough to allow any flame which might be caused by a short-circuit or ground in the outlet box to escape to the woodwork, which is usually well seasoned and dry and susceptible to the intense heat generated by a short-circuit or ground. Fig. 1 shows a box and cover placed in position as described.

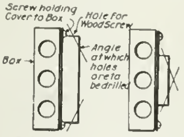
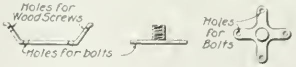

Screw holding Cover to Box
Hole for Wood Screw
Box
Angle at which holes are to be drilled
Switch Box
Outlet Box

Fig. 2—Methods of Fastening Outer Box.

To overcome this condition, meet the demands of the keen competition in the electrical trade and make a thoroughly fireproof job is a comparatively easy matter. Fig. 2 shows an outlet box changed slightly to meet the exigencies of the case. In wooden panels it is absolutely necessary that the outlet be in the exact position, as any deviation will break the symmetry of the paneling. The box as shown in Fig. 2 can be fastened, by means of the cover, directly to the panel, and as the cover is fastened to the box there will be no space to allow any flame to escape to the woodwork in the event of a short-circuit or ground.



Figs. 3 and 4—Fixture Stud and Support.

In Fig. 2, where thus marked, the holes are drilled in the cover diagonally so as to allow a wood screw being passed through the hole and into the wood. This will hold the cover securely in position, and the box being fastened to the cover will also be held securely. To provide for fixture support a stud (Fig. 4) is fastened to the box by using two pieces of band iron, 1/8 in. x 1/2 in., bent as shown in Fig. 3. The two pieces of band iron are placed at right angles to each other and the fixture stud fastened to them by means of stove bolts. The band iron and fixture stud now form practically one piece, which is then placed in position as shown in Fig. 5 and fastened to the cover of the outlet box, using the same wood screws which hold the cover to the panel.

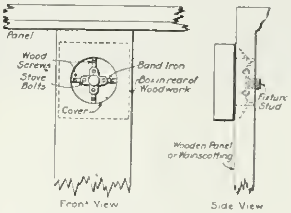


Fig. 5—Fixture Stud in Place.

Should rigid conduit be used in running to the outlet, some difficulty would be experienced in getting the conduit exact. This is a condition which can be easily overcome. Install the rigid conduit to within 1 ft. or so of the outlet, and when the carpenters are ready to install the paneling run from the rigid conduit to the outlet box with flexible conduit, using a combination coupling (Fig. 6) to connect the flexible conduit to the rigid conduit. The flexible conduit can be pushed from side to side or raised or lowered as the case might require.

In a building of any size these changes could be made with very little expense at any machine shop and the time saved would more than recompense a person for the little extra trouble and cost. One saving would be in not fastening the box to the wall with plaster of paris or cement. This consumes much time, as the plaster or cement must be prepared and in fastening the cover to the woodwork as described only four wood screws are required. These a mechanic can carry in his pocket and have ready at any time.

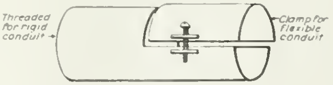


Fig. 6—Combination Coupling for Mixed Conduit Work.

EXTERIOR ILLUMINATION OF NEW YORK DEPARTMENT STORE.

The Gimbel store, at Broadway and Thirty-third Street, New York, the interior illumination of which was described in these columns at the time the store was opened to the public in September, during the past month was outlined with incandescent lamps for the holiday season. The accompanying illustration shows the brilliant appearance of the store at night. The decorative scheme consists in outlining the 216 windows with 4-cp lamps, and the erection of the circuits required the services of seventeen men who worked overtime to complete the task in less than a week. The building faces Greeley Square and adjoins Herald Square, so that the illumination is very noticeable and striking. The entire electrical equipment of this store is supplied with energy from the mains of the New York Edison Company.

Night View of Store Illumination.

* * *

THE USE OF CONSTANTS IN WIRING CALCULATIONS.

By Edwin C. Ashe.

Wiring and, for that matter, many other calculations that involve the use of several constants can be much simplified by resolving the constants into a factor which is itself a constant. It frequently occurs in industrial-plant and central-station work that, for wiring computations, the permissible voltage drop and the power-factor remain the same. These and other constants can be effectively incorporated into a multiplier. An example or two will best explain the method.

Consider the problem suggested in Fig. 1. A three-phase, 220-volt, 60-cycle, 20-hp motor is to be installed at a distance of 200 ft. from the supply mains. It is assumed that the power-factor is 70 per cent and that the permissible voltage drop in the branch circuit to the motor is 6 volts. What size wire should be used? The formula for determining the size of wire in circular mils for a three-phase circuit is:

$$\text{Circ. mil} = 11 \times d \times I \div e \qquad (1)$$

where 11 is a constant, d is the single distance in feet from the source of supply to the energy-consuming device, I is the current in amperes and e is the permissible voltage drop. All of the quantities in this equation are known except the current. It is, therefore, necessary to determine the current before the equation can be used. It should be noted that the equation gives an approximate result in that the constant 11 is not absolutely exact and that neither the inductance nor the capacity of the circuit is considered. It is, however, sufficiently accurate for estimating for short lines, and the error that it introduces is usually more than compensated for by the fact that in practical work a wire of a commercial size must be used. The difference in area between any two succeeding commercial wire sizes generally more than offsets the error in the equation.

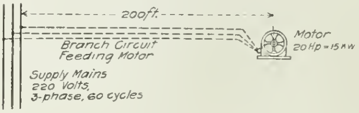

200 ft.
Branch Circuit Feeding Motor
Supply Mains 220 Volts, 3-phase, 60 cycles
Motor 20 Hp = 15 kw

Fig. 1—A Motor-Wiring Example.

The formula below gives the current in each of the wires of a balanced three-phase circuit.

$$I = W \div (1.73 \cos \theta) \qquad (2)$$

where I is the current in amperes, W is the power transmitted in watts, 1.73 is a constant, E is the voltage of the supply circuit and $\cos \theta$ is the power-factor of the circuit. For wiring calculations it may be assumed that the factors 1.73, E and $\cos \theta$ are always of the same value in an industrial plant where many motors are installed. These three factors can, therefore, be resolved into a constant thus:

$$I = W \div (1.73 \times 220 \times 0.7) = 3.75 \qquad (3)$$

or approximately:

$$I = 3.8 \text{ kw} \qquad (4)$$

It is apparent, then, that by multiplying the kilowatt capacity of the motor by the factor 3.8 the approximate full-load current in amperes flowing to the motor will result. The current for the motor of Fig. 1 will be $3.8 \times 15 = 57$ amp. It should be noted that the size of the branch wire to the motor required so that the voltage drop in them will not exceed a certain limit (6 volts is to be allowed in the example under consideration) can be determined directly as hereinafter explained. But it is necessary always to know the current that will flow in given leads so that conductors can be selected that are sufficiently large to carry this current without overheating. A conductor may be of sufficient area to convey energy to a device with a given voltage drop, but yet not large enough to do so without heating excessively. Therefore, after a conductor size has been determined with reference to drop it should always be checked to see that it is large enough safely to carry the current.

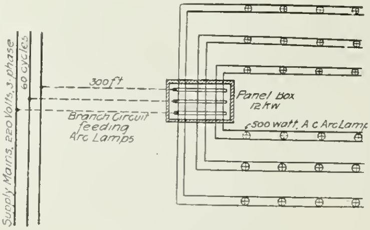

Supply Mains, 220 Volts, 3 phase, 60 cycles
300 ft
Branch Circuit feeding Arc Lamps
Panel box 12 kw
500 watt, A C Arc Lamp

Fig. 2—An Arc-Lighting Wiring Example

The value for current from equation (3) and the allowable voltage drops, 6 colts, can now be substituted in equation (1).

$$CM = \frac{11 \times d \times 3.75\,\text{kw}}{6} = \text{kw}\,d \times \frac{11 \times 3.75}{6} = 6.87\,\text{kw}\,d \qquad (5)$$

or approximately

$$CM = 6.9\,\text{kw}\,d \qquad (6)$$

The conductor area should be (on the voltage-drop basis) at least $6.9 \times 15 \times 200 = 20{,}700$ circ. mil. Referring to a wire table it will be found that the next largest commercial wire size is No. 6, which has an area of 25,250 circ mil. It will safely carry, with rubber insulation, 46 amp. But the motor of Fig. 1 takes 57 amp, so No. 4 wire, which will carry 65 amp, is the smallest that can be used.

Consider another example, involving a multiple arc-lighting installation, outlined in Fig. 2. It is assumed that the permissible drop in the branch to the panel box, the supply voltage and the power-factor remain the same as for the problem solved above. What size wire should be used for the branch conductors? Each arc lamp requires 500 watts (assumed) and as there are twenty-four arc lamps feeding from the panel box the total load is $24 \times 500 = 12{,}000$ watts, or 12 kw. The branch circuit to the panel box is three-phase, but the arc lamps are connected on single-phase circuits which are so arranged that the three-phase load is a balanced one.

The size of branch conductors which will provide a 6-volt drop with the above-outlined assumptions is from equation (6):

$$\text{Circ. mil} = 6.9 \times 12 \times 300 \times 24{,}840.$$

The full-load current will be, from equation (4): $I = 3.8 \times 12 = 45.6$ amp.

The conductor that most nearly corresponds to an area of 24,840 circ. mil is No. 6, which has an area of 26,250 circ. mil, and it safely carries with rubber insulation 46 amp. It is, therefore, large enough to convey the full-load current of 45.6 amp to the arc lamps and, therefore, No. 6 wire should be used.

From the examples it is evident that many of the wiring calculations necessary in central-station and industrial-plant practice can be made by using two constants which can be readily remembered. It may be desirable in some instances to use multipliers which will give current and conductor size values when the multipliers are multiplied into capacities expressed in horse-power instead of in kilowatts. But, as a rule, it is believed that the expressions involving kilowatt capacities will be found most convenient.

LETTERS TO THE EDITOR.

Municipal Plants and Rate Systems.

To the Editor of Electrical World:

Sir:—I have been reading with interest some recent articles bearing on rates governing the sale of electricity. Writing from a Western State where utility commissions are not common and where most of the plants are municipal property, the rate problem comes up with some new features, and I wish to make plain at this point that, while the chief object to be attained by using the revenues of the public tax to build lighting plants is to assure cheap and satisfactory service, this has been accomplished only in part. Rates for lighting purposes have been established and the average resident subscriber can buy electricity for 10 cents per kw-hour, with a minimum charge of 50 cents per month. With this common rate in effect municipal plants with capacities ranging from 75 kw to 500 kw have in service from 150 to 1500 meters. As the service is practically all lighting, the natural result is a very high peak load to which the municipal board usually points with considerable pride and hastens to explain that this patronage was procured chiefly by maintaining continuous service and a fair rate. And here is the straw that breaks the camel's back: Appended to this "fair rate," and treated by most boards as a necessary evil, is a motor rate of 6 cents per kw-hour, with 5 cents or possibly 4 cents offered as an inducement to some subscriber to use 50 hp—an exact reversal of the so-called "discriminating rate" extended to the large consumer by privately owned plants. A liberal application of the formulas that govern engineering practice will prove to any one concerned that when a company can for 10 cents per kw-hour deliver energy to a service that constitutes a part of its peak load only it can furnish energy to a service operating in daylight hours at a rate of 2 cents per kw-hour with equal profit. With this rate in force the writer is firm in the belief that the municipal board will find the load-curve running high in the daytime, and the necessity for a tax levy to liquidate the bonded indebtedness caused by the old rates entirely abolished.

Wamego, Kan. D. A. Course.

Line Poles Destroyed by Birds.

To the Editor of Electrical World:

Sir:—On the Sonora line of the Ferrocarril Sud-Pacifico de Mexico, running between Nogales and Guaymas, Sonora, we are greatly troubled from damage to telegraph poles by woodpeckers. These birds are most numerous between Hermosillo and Magdalena, a distance of 200 km. They make no distinction as to the class of wood, all being alike to them. In my office I have a sample of creosoted pole which has been in use for a little over two years, and which has a hole 5 in. high x 2½ in. wide; inside this opening there is a hole dug out something like 18 in. deep x 5 in. wide. The portion of the pole taken out is 7 in. in diameter and shows that the pole had been well treated with creosote. Some of our cedar poles have from four to five deep holes in them, and redwood about the same. We have taken out 250 of the bird-eaten poles and have about 200 more to remove. The kind we are substituting is a smaller pole burnettized, with a creosoted butt. These have not yet been touched, although we began rebuilding last March, stopping work during the rainy season. I should greatly appreciate any information from your readers as to the best method, aside from a shotgun, to get rid of these pests, as poles cost considerable money in this section of Mexico.

C. T. Day.

Assistant Superintendent of Telegraph, Ferrocarril de Sonora
Empalme, Sonora, Mexico.

Converter Substations.

To the Editor of Electrical World:

Sir:—The writer has just returned from a business trip to Europe and has read with interest the letter of Mr. A. R. Miller in your first issue of November, which came out just after the writer sailed.

Mr. Miller is correct in his statement that the substation design, shown in Fig. 1 of the writer's article, that appeared in your first issue of August resembles in many respects the arrangement of the stations of the Brooklyn Rapid Transit Company. This was stated in the writer's letter, which was published in your first issue of October, but the stations differ in the respects mentioned in that letter.

Mr. Miller is also correct in his statement that the engineers of the Boston Elevated Railway Company, as well as the writer, had visited the substations of the Brooklyn Rapid Transit Company. The writer, moreover, has also visited the converter substations in New York, Philadelphia, Baltimore, Washington, Buffalo, St. Louis, Louisville, Chicago, etc., and has naturally been influenced by all such visits.

Practically no converter substation of recent design fails to embody many ideas that have been of value in previous designs, and an engineer would be rather short-sighted who failed to utilize the results of others' experience and his own observations.

The writer does not see how his letter in your first issue of October could be construed as claiming originality for all or any of the features of particular merit in the arrangement of the substation in question, but it was spoken of as a suggested arrangement that embodied the ideas of the engineers of the Boston Elevated Railway Company as well as his own.

The writer does not wish to detract in any way from the credit due to Mr. Miller and his associates for the very satisfactory manner in which they have designed the converter substations of the B. R. T., but practically every point mentioned by Mr. Miller as having been copied from the designs of the B. R. T. was really taken from designs considerably antedating the stations of the B. R. T.

The relative location of circuit-breakers, air-blast transformers, rotaries and switchboard used by the B. R. T. is practically the same as was installed in Baltimore, Louisville, St. Louis and other cities eight or ten years ago, and it is the logical arrangement that would naturally suggest itself to any one familiar with the apparatus. Manufacturers' publications as well as articles in technical journals have shown this general arrangement for years

Relative to the arrangement of the wiring passing from underground cables through disconnecting switches and breaker to a bus above the breaker, this scheme is shown in Fig. 2 of the writer's article which illustrated the station of the Union Electric Light & Power Company, of St. Louis, installed about eight years ago. This sketch also shows feeder knife selector switches mounted above and pulled from in front of the feeder breakers and connecting to either of two duplicate sets of busbars on a gallery above the breakers.

The locating of a pedestal with the negative and equalizer switch on it near the rotary as well as the running of the negative and equalizer buses between the pedestals has been standard practice with direct-current railway generators for years.

In a similar manner each individual point of design mentioned in Mr. Miller's letter can be traced back to what might be called "ancient history," and it would be an extremely difficult matter to determine who was the originator and who was entitled to the credit for the arrangement.

Pittsburgh, Pa STEPHEN Q. HAYES

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Voltage Between Segments in Direct-Current Machines.—T. HOOCK.—When a direct-current machine is loaded the flux produced by the armature distorts the primary flux. The flux density at one rim of the pole is increased and the voltage difference between adjoining segments is correspondingly increased. In motors built for wide variations of load by means of field adjustment the high voltage between segments may cause an arc. Various numerical examples are given.—*Elek. Zeit.*, Dec. 15.

Changing the Number of Poles.—F. NIETHAMMER AND E. SIEGEL.—To change the speed of three-phase induction motors the frequency of the network may be varied. Such a change of the frequency can be easily obtained by changing the number of poles of the generator. The authors describe a new method of the Austrian-Siemens-Schuckert Company, in which only the field system is changed from four poles to two poles, while no change is made in the armature. Tests were made with such a generator driving an induction motor, which was found to operate to perfect satisfaction at 1200 r.p.m. with a four-pole arrangement of the generator and at 600 r.p.m. with the two-pole arrangement. Some details are given of an oscillographic study made in connection with these tests.—*Elek. u. Masch.* (Vienna), Dec. 4.

Circular Diagram of Induction Motor.—K. KRUG.—The author shows that Ossanna's exact circular diagram for the polyphase induction motor can be derived in a comparatively simple manner by the analytical method with the aid of the symbolic notation.—*Elek. u. Masch.* (Vienna), Dec. 4.

Commutator Motors for Three-Phase Currents.—A. SCHERBIUS.—The first part of an article on the design of commutator motors for three-phase circuits especially for use with reversing rolling mills and winding in mines. In the present instalment the author deals especially with the Deri system of brush displacement for regulation of the motor and discusses the advantages of this method over the use of an ordinary repulsion motor.—*Elek. u. Masch. Betriebe*, Nov. 25.

Induction Motors.—J. FISCHER-HINNEN.—A fully illustrated English translation of his German paper, recently abstracted in the Digest, on recent developments in induction-motor design, with special reference to arrangements of the starting resistance inside the motor itself.—Lond. *Elec. Review*, Dec. 16.

Eddy Currents.—A mathematical article on the eddy currents in solid conductors of rectangular cross-section embedded in rectangular slots, giving formulas for the current density, etc. —*Elek. u. Masch.* (Vienna), Nov. 13.

Lamps and Lighting.

Public Lighting in London.—A historical sketch of the development of public lighting in the City of London. It was not until about 1903, when the magazine lamp became a commercial success, that it was found feasible to advocate any material change in the open-type arc lamps, which had so far proved satisfactory for the public lighting of the city. In 1904 and 1905 flame-arc lamps were introduced. Then came the various experimental trials with high-pressure gas in several streets, but electric lighting came to the front again in 1908 and 1909. A description is given of the central-suspension system used in the Cheapside and Watling Street areas. The chief merit of this system lies in the advantageous position relative to cross streets in which it enables lamps of high candle-power to be placed at any desired height above the roadway. A 12.5-amp magazine flame lamp is used, its special feature being the Peard prismatic reflector. These reflectors consist of funnel-shaped glass dishes *A* (Fig. 1) screwed to a movable tabular stem *B* supported by a special fitting *C* attached to the bottom of the outer globe, which is of clear glass. Their function is to increase the candle-power of the lamps near the horizontal plane, thereby greatly adding to their effective power for street-lighting purposes; they also enlarge the visible area of the light source and screen the eye from the direct rays of the arc at all angles greater than 35 deg. below the horizontal. In

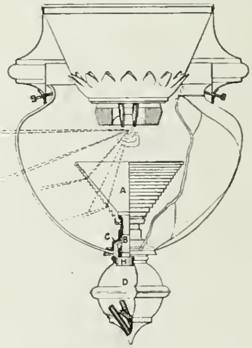
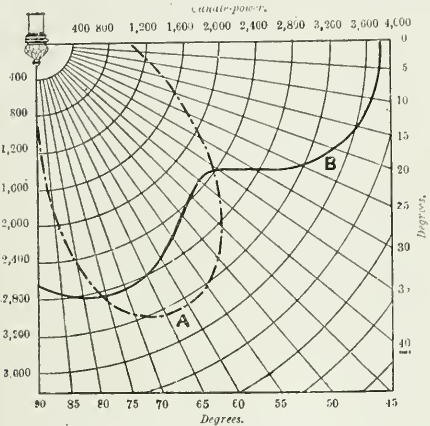


Fig. 1—Oriflamme Arc-Lamp Globe with Peard Prismatic Reflector.

addition they serve a very useful purpose in materially reducing the deposit on the globes, all carbon ends and dust passing through the reflectors into a detachable copper-ball fitting *D* below the globes. By the use of these reflectors and fittings an effective candle-power is obtained of 3500 at and somewhat below the horizontal plane, while the mean hemispherical candle-power is maintained above 2800 candles. The polar candle-power curves of the lamp are shown in Fig. 2, in which *A* refers to the use of an ordinary light opalescent globe and *B* to a clear outer globe with a Peard prismatic reflector. Notes are then given on central lighting by high standards on Farrington Street. The 12.5-amp Excello flame-arc lamp is used, the lamps being fitted with inner dioptric, deposit-free globes within very slightly opalescent spherical outer globes. The polar candle-power curve is given in Fig. 3. The article is to be concluded.—Lond. *Electrician*, Dec. 16.



A = With ordinary light opalescent outer globe.
B = With clear outer globe and a "Peard" Prismatic reflector.

Fig. 2—Polar Curves of 12.5-Amp Oriflamme Lamp.

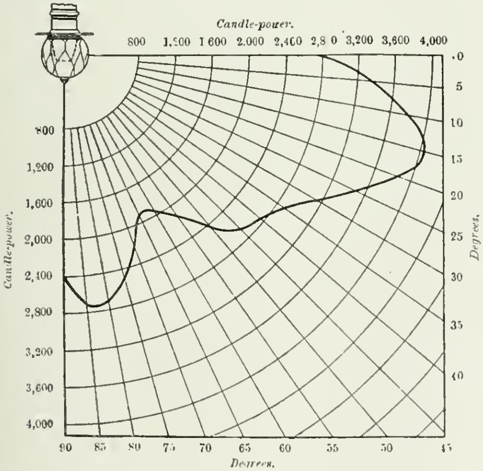


Fig. 3—Polar Curve of 12½-Amp Excello Arcs with Dioptric Inner and Semi-Opalescent Spherical Outer Globes.

Filter for Ultra-Violet Rays.—H. Lehmann.—A paper on an absorption filter for the production of pure ultra-violet rays from rays given out by the usual source of light. He employs nitrous dimethylanilin. This may be used as an aqueous solution or as a solid solution in gelatine. However, this material still permits green and red rays to pass. He, therefore, combines this material with Jena "blue uviol" glass, but even thus some red rays are still permitted to pass. To cut them out he employs a 20 per cent copper sulphate solution in water. For the whole combination he uses a vessel the walls of which are made of blue-uviol glass plates filled with copper sulphate solution, while one of the outer surfaces of the glass plates is covered with a solution of nitrous dimethylanilin in gelatine. This combination is absolutely non-transparent for sources of light with few ultra-violet rays, like ordinary incandescent lamps. But it permits the passage of ultra-violet rays to a greater degree than any other filter combination. It is especially useful for the study of photoluminescence. For demonstrating purposes, for instance, the ultra-violet rays coming from the filter may be projected on a linen cloth or paper, when a blue-white spot of light will appear. That this light is of secondary nature is proved by the fact that a white, dull porcelain plate substituted for the linen cloth or paper appears perfectly black. Porcelain is one of the few substances which show almost no fluorescence. The method may be used for testing the chemical purity of substances, the genuineness of gems, etc., as well as for physiological experiments.—*Phys. Zeit.* Nov. 15.

Three-Phase Arcs.—L. Crouch.—An illustrated description of the Mercanton-Righi three-phase arc lamp with four electrodes, three lower electrodes connected to the three phases being opposite to a larger upper electrode which is not connected to the circuit. There are six craters. The consumption of the fourth upper insulated electrode is very low. It is believed that these arcs are steady and satisfactory on traction circuits of 15 cycles per second.—Lond. *Elec. Review,* Dec. 9.

Arc Lamps.—In continuations of a long illustrated serial brief descriptions are given of various new magazine lamps in which when one pair of electrodes is finished another pair is put into operation automatically. The descriptions are mainly based on recent German patent specifications.—*Zeit. f. Beleucht.*, Nov. 20 and 30.

Vacuum-Tube Lighting.—D. McF. Moore.—A lecture giving a historical sketch of the development of the nitrogen and carbon-dioxide vacuum-tube lamps.—*Jour. Franklin Inst.* November.

Generation, Transmission and Distribution.

Combined Destructor and Electricty Works.—E. K. Scott.—The author points out that after the early exaggerated claims and unjustified criticisms the combined refuse destructor and central station is now proving its value. It is pointed out that some of the lowest fuel costs for electricity works are obtained where steam from refuse destructors is used, as, for example, at Hackney (the lowest in London), St. Helens and Partick. The number of kw-hours per ton over a whole year's working varies, of course, with different plants; fifty seems an average figure which any moderately well-managed combined plant might attain to, and ninety-seven has been reached on an eight-hour test. The author gives directions as to the site of the plant, quality of refuse, charging dust, arrangement of the building, exit of the gases, the heated-air supply, thermal storage, clinker and its uses, etc. To make a success of the combined station the refuse destructor should be in charge of the electrical engineer. By combining the two, one office and staff is sufficient. As hand stoking is absolutely necessary and good management of the fire and draft makes all the difference between success and partial failure, the stokers should be picked men and the number of them sufficient so that they are never pressed to get through their work.—Lond. *Elec. Review,* Dec. 9.

Electric Supply in England.—Statistical tables of 110 electric supply companies in Great Britain, giving details of equipment, rates,. etc.—Supplement to Lond. *Electrician*, Dec. 16.

Traction.

Vienna.—J. Seidener.—A report made to the Vienna Electrical Society pointing out the necessity of introducing electrical operation on the Vienna Stadtbahn, especially for the purpose of running trains at shorter intervals and removing the smoke nuisance and thus bringing the road into greater general favor. An account of the discussion which followed is also given—*Elek. u. Masch.* (Vienna), Dec. 11.

Electric Steering Gear for Ships.—K. Trowbridge.—The author gives brief illustrated sketches of the systems of the Union Elec. Ges., Pfatischer and Brown & Haigh. Direct-current compound-wound motors are most suitable. A comparatively large number of vessels have electrically controlled steam steering gear; a much smaller number have complete and independent but interchangeable electrical and steam steering gear, while a very few ships have purely electrical steering equipment.—Lond. *Elec. Review*, Dec. 16.

Rail Corrugation.—A. Busse.—His report to the International Congress in Brussels on the causes of rail corrugation. He concludes that the ultimate cause must be found in the steel itself.—*La Lumière Elec.*, Dec. 10.

Installations, Systems and Appliances.

Storage Battery Engineering.—J. Appleton.—A Franklin Institute paper in which the author first discusses the use of the storage battery for emergency or stand-by service in substations and to carry peaks of short duration due to acccidents on transmission lines caused by excavations, building operations, etc. For such purposes the requirements are maximum output of energy for short periods; maximum first cost and upkeep; minimum space requirements and weight. These batteries need have a life of only about 300 discharges, as the estimated number of discharges per year in this service would not exceed twenty or thirty. The author gives data on a storage battery designed especially for this purpose in comparison with other batteries. A battery installed in the Sixteenth Street substation of the New York Edison Company consists of 150 cells, each containing 131 plates. The output at various rates is 10,790 amp for one hour, 21,580 amp for twenty-one minutes, 32,370 amp for ten minutes and 43,160 amp for six minutes. In connection with this problem importance is placed on the design of end-cell switches which can carry such enormous currents and enable additional cells to be cut in during the discharge as the voltage of the cells drops. The author gives the following figures for the percentage of battery rating (figured on the one-hour discharge rate) to the maximum direct-current peak loads of the following companies: New York Edison, 25 per cent; Chicago Edison, 48 per cent; Brooklyn Edison, 36 per cent; Boston Edison, 36 per cent The author then briefly discusses the use of storage batteries in connection with purchased-energy contracts and the regulation by storage batteries of alternating-current generating plants. The storage-battery plant of the United States Steel Corporation at Gary is described in some detail. In connection with the regulation of fluctuating loads by means of storage batteries the author mentions a device to enable the storage battery equipment to take the quick fluctuations, relieving the generating machinery of them entirely, but throwing slowly into the generators fluctuations which are sustained for any length of time. For this purpose an automatic device has been developed for changing the average load on the generators with sustained changes in the demand. The device consists of a small motor actuating the booster regulator through reducing gear. The principle of its action is that on a discharge of the battery the motor is operated so that it revolves in a direction slowly to raise the load on the generators. On a charge of the battery the motor runs in the opposite direction, thus slowly relieving the generators of load. A battery equipped with the average adjuster will still take the rapid fluctuations, but will not hold the generators to a fixed average, the sustained changes being gradually transferred from the battery to the machines. To hold the generator load line below a fixed limit a simple stop has been designed to open the adjuster circuit when the generator load reaches a predetermined point. The generators can thus be made to work up to any desired limit, the battery taking all the quick fluctuations and also the sustained peaks above the limit.—*Jour. Franklin Inst.*, November.

Wires, Wiring and Conduits.

High-Tension Cables.—P. Humann.—In cable manufacture it is often the practice to use the same insulation thickness for cables with different copper thicknesses or even to increase the insulation thickness with increasing thickness of the copper conductor. This practice is wrong. To get the same degree of safety the insulation thickness should decrease with increasing copper diameter. This is illustrated in diagrams. If the voltage of operation E has a certain given value, and if the potential gradient e in the insulation layer next to the copper (where the potential gradient in the insulation is a maximum) has also a certain value, the radius of the copper conductor can be so chosen that the cable diameter becomes a minimum. For this purpose the radius must be made $= E \div e$ for single cables and $= \frac{2}{3} E \div e$ for three-phase cables.—*Elek. Zeit.*, Dec. 15.

High-Tension Insulators.—Kuhlmann.—A French translation of his recent German paper giving a critical illustrated review of modern high-tension insulators.—*L'Industrie Elec.*, Dec. 10.

Electrophysics and Magnetism.

Electric Stress at which Ionization Begins in Air.—A. Russell.—An abstract of a London Physical Society paper In the "Proceedings" of the American Institute of Electrical Engineers for July, 1910, J. B. Whitehead publishes the values of the electric stress at which ionization begins in air. The electrodes he used in his experiments consisted of a metallic tube and a cylindrical wire coaxial with it. Alternating pressures were employed, and the inner wires used had diameters varying in size from 0.089 cm to 0.475 cm. If A be the radius of the inner wire the author has found that the expression $32 + 13.4 \sqrt{A}$ gives all Whitehead's experimental results for the maximum electric stress in kilovolts per centimeter with a maximum inaccuracy of less than 1 per cent. The experiments show that the electric stress at which ionization occurs is independent of the metals used for the electrodes and of the inner radius of the outer tube. It depends merely on the radius of the inner wire. It is shown that Steinmetz's experimental results on the sparking distances between parallel rods are in substantial agreement with Whitehead's figures. An empirical formula is given which is based on experimental results recently published by Kowalski and Rappel for the sparking voltages between equal spherical electrodes. The results indicate that the electric stress at the moment of discharge has a minimum value when the distance between the electrodes is a certain function of their radius. The author lays great stress on the currents of electrified air which stream around the electrodes before the discharge takes place and the effects of which it is customary to neglect. These currents often modify very appreciably the values obtained for the disruptive stress at the moment of discharge. There is a striking similarity between the formula for the temperature gradient at the surface of a hot wire cooling in air and the empirical formula for the potential gradient at the surface of an electrified wire when ionization is taking place at its surface.—Lond. *Electrician*, Dec. 16

After-glow of Electric Discharge.—R. J. Strutt.—An abstract of a London Physical Society paper. It has long been known that when an electric discharge has passed at low pressure through certain gaseous mixtures a luminosity survives for some seconds after the discharge has been turned off. A greatly improved method of experimenting on the phenomenon was introduced by Dewar. A powerful air pump is used to draw a regulated current of gas through the vacuum tube. In this way a continuous removal of the gas from the region of discharge is effected, and the after-glow which it emits in passing through another vessel on its way to the pump can be examined continuously and at leisure. There has been considerable difference of opinion as to whether pure oxygen shows a glow or not. Under the conditions of the author's experiments the glow, if any, is certainly exceedingly faint. With air, on the other hand, a bright yellow glow is obtained, which is improved by enriching the air with oxygen. Pure nitrogen gives no glow whatever. Several previous experimenters have connected the glow with ozone, though generally without expressing any very definite view as to what part ozone played in its production. The chief evidence for this hitherto has been that the glow is obtained only where oxygen is present and that it is destroyed by heat. The following additional evidence was obtained: (1) The glow cannot survive passage through a tube cooled in liquid air. This is regarded as due to condensation of ozone. (2) It is destroyed by passage over oxides of copper, manganese and silver. Ozone, too, is known to be destroyed by these substances. (3) While the glowing gas oxidizes bright silver, the gas current beyond the point at which the glow has died out does not do so. Disappearance of the glow is simultaneous with disappearance of ozone from the gas. The glow is thus shown to involve consumption of ozone. It is, therefore, natural to regard it as a flame of low temperature, arising from the oxidation of some other body of ozone. The next experiments were made to determine the nature of this other body. A current of ozone from a vacuum tube fed with oxygen was allowed to mix, in a Y-shaped tube, with any other gas which it was desired to test on its way to the pump. Nitrogen or ordinary air added to the ozone gave no effect, but air which had been through an independent discharge, and had been deprived of its original glow by silver oxide, was found to glow again on mixing with ozone. Clearly, then, some body is produced in air by the discharge whose oxidation is responsible for the glow. This body proves to be nitric oxide. On leading a current of this gas into the ozone stream a very brilliant glow was obtained, of the characteristic yellow color. By suitable arrangements this glow can be produced in the form of a pointed flame with dark inner cone. The glow is not associated with a sensible rise of temperature. Condensing the ozone with liquid air, allowing it to re-evaporate and admitting nitric oxide to it, a yellow flash can be obtained long after the electric discharge is over. The glow is purely chemical in its origin. The main conclusion of the present paper is that the ordinary yellow after-glow is due to oxidation of nitric oxide by ozone.—Lond. *Electrician*, Dec. 16.

Magnetic Properties of Iron Alloys.—An account of the extended discussion which followed the paper of Hadfield and Hopkinson recently abstracted in the Digest.—Lond *Electrician*, Dec. 16.

Electrochemistry and Batteries.

Use of Refrigeration with Storage Batteries.—L. Jumau.—An abstract of a paper read before the Second International Congress on Refrigeration in Vienna. In certain processes for making storage-battery plates as well as in the operation of storage batteries the maintenance of low temperatures may be an advantage. It is a fact that the local action of sulphuric acid on the lead is reduced by lowering the temperature so that the batteries retain their charge for a longer time; on the other hand, the capacity of the battery suffers thereby. However, an advantageous influence of low temperatures is found in the formation of Planté plates with respect to the thickness of the peroxide layer obtained and, therefore, the surface capacity of the plate. Formation tests at different temperatures gave values of a surface capacity per square decimeter as follows: 0.274 amp-hour at 40 deg. C., 0.695 amp-hour at 27 deg. C., 0.905 amp-hour at 13 deg. C. An arrangement of cooling devices during the formation is therefore advisable in order to keep the temperature constantly low so as to get a uniform yearly product.—*Elek. u. Masch.* (Vienna), Dec. 11.

Units, Measurements and Instruments.

Reactance Power.—C. O. Mailloux.—A letter commenting on the recent proposals of Brunswick, Boucherot and Brylinski to find a suitable substitute for the term "puissance déwattée." He considers the corresponding English term "wattless power" to be even worse. From an international standpoint the translatability of the term is of importance. The following terms are considered most suitable: Puissance de réactance (reactance power); puissance de réaction; puissance réagissante; puissance réactive; puissance réactante. If the last term was selcted, the term puissance condensante could be formed for the case of a condensance or capacity. In this case "puissance réagissante" could be chosen as the most general term to comprise both puissance réactante and puissance condensante. (See also the letter of C. O. Mailloux in *Electrical World*, Nov. 24 (page 1244).—*L'Industrie Elec.*, Dec. 10.

Electrostatic Voltmeter.—R. Burrows,—A note on a new electrostatic voltmeter design. There are two fixed coaxial metallic cylinders, with the same number of evenly spaced openings cut out of the cylindrical surfaces of each (see *A* and *B*, Figs. 4 and 5). In the space between the metallic cylinders and coaxial with them is supported a cylinder of a dielectric substance, the specific inductive capacity of which is different from that of air. This dielectric cylinder has the same number of evenly spaced openings in its cylindrical surface as have the metallic ones (see *G*, Fig. 5). The vibration in capacity is effected by the rotation of the dielectric cylinder between the metallic ones. However, the so-called dielectric constant of any material, instead of being a constant, increases more or less with time of exposure to the electric field, in many cases there being a sudden initial yield. Consequently if a steady potential difference were applied between the fixed cylinders there would be a more or less slow creeping action of the pointer attached to the dielectric cylinder. The instrument would, therefore, be useless for measuring steady potential differences. However, it could be used for measuring alternating potential differences if a proper dielectric substance is chosen. Flint glass seems to be the best for this purpose. The fundamental formulas for an instrument of this kind are given.—Lond. *Electrician*, Dec. 16.

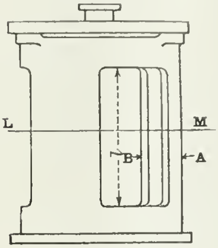


Fig. 4—Electrostatic Voltmeter.

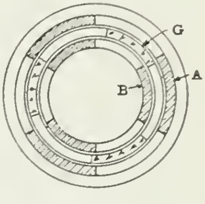


Fig. 5—Section Through L—M.

Oscillograph.—F. Emde.—A highly mathematical paper on the testing of oscillographs with respect to their inertia and damping effect.—*Elek. u. Masch.* (Vienna), Dec. 11.

Dielectric Constant.—M. P. Floquet.—A comparison of different methods of measuring the dielectric constant.—*Comptes Rendus*, Vol. 151, No. 11; *Jour. Franklin Inst.*, November.

Telegraphy, Telephony and Signals.

Telephone Cables.—W. A. J. O'Meara.—A paper read before the (British) Institution of Electrical Engineers on submarine cables for long-distance telephony. After describing early submarine cables, the author discusses the three methods of increasing the range of telephonic transmission: (1) heavier conductors, (2) "continuous loading," (3) "coil loading." The last-mentioned method was found by the British post office to be the most suitable and was adopted in the new Anglo-French cable. A description of this cable, its laying and the tests when completed are given. The arrangement of the Pupin coils in the cable is shown in Fig. 6. The two double coils required for the four conductors of the cable, each coil being of slightly less than 6 ohms resistance and having an inductance of 0.10 henry at 750 cycles per second, are inserted at intervals of 1 knot (1.15 miles or 1.85 km), but the two

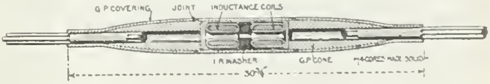


Fig. 6—Method of Sheathing Over Coils.

coils nearest the ends of the cable are inserted at a distance of only half a knot from the terminal apparatus, as experiments have shown that in this arrangement reflection losses are considerably reduced. Each double coil consists of two windings on the same iron core, and one winding is connected in series with each conductor. By this means the gradual change in permeability in the iron core, due to aging, will not affect the balance in the two limbs of the telephone circuit. Each coil is protected with a sheet of metal foil in order to exclude all possibility of the silk covering of the wires of the coils absorbing moisture from the cylindrical envelope of gutta-percha in which they are contained. The cores of the cable are connected to the envelope at its two ends by tapered solid gutta-percha joints. The diameter at the center of the envelope is 3 in. (76.2 mm) and at the cores where the joints terminate 1 in. (25.4 mm). An annular rubber distance-piece is inserted between the two coils of a set to give greater flexibility. The total length of the joint is 30.75 in. (781 mm). As the diameter of the cable at the points where the coils are inserted is increased, a larger number of sheathing wires are required at those points than over the conductors alone. This difficulty is overcome by starting a second layer of sheathing wires over the cores, about 27 ft. (8 m) from the center of the coil envelope and gradually working them into a single layer with those over the bulge. Finally they are terminated as a second layer again over the cores at a distance of about 27 ft. (8 m) from the center of the coil envelope. The attenuation constant of the loaded cable was found on test to be 0.0147. The paper is to be concluded in a subsequent issue.—Lond. *Electrician*, Dec. 16.

Wave Detectors.—H. Sutton and W. H. Eccles.—Sutton describes his work on a galena detector for practical work and suggests that the fall of resistance at the contact is due to the increase of mechanical pressure there through thermal expansion produced by the current. He compares the effect with the Trevelyan rocker experiment in which a hot fluted copper bar is placed on the edge of a block of lead and heats the contact, the sudden expansion of the lead throwing the bar up, the hot bar falling and touching the cooled lead, again heating it, the alternate heating and cooling of the lead keeping the bar rocking. The bar then gives out a musical note owing to the high rate of vibration. He found that a pair of galena contacts arranged in delicate flexible contact act the same as the hot copper-lead rocker. Eccles includes the fall of resistance at the contact in the "negative temperature coefficient of resistance of the contact" and remarks that since he has failed to find a useful oscillation detector constituted of a contact between substances possessing positive coefficients in the bulk one has always to deal in good detectors with bulk negative coefficients of resistance. For a certain effect he observed with the galena detector he gives the following explanation in preference to the "rocker" one of Sutton: The heat generated by the current at the constricted pathway across the contact warms the contiguous matter, thereby causing expansions which enlarge the area of contact. Consequently, the current density decreases, cooling follows, since there is other resistance in the circuit, and contraction re-establishes the former state of things. This cycle takes place very rapidly at a rate affected by the inductance and resistance of the telephone in the circuit.—Lond. *Electrician*, Dec. 16.

Submarine Cables.—C. Bright.—A continuation of his lectures before the Royal Naval War College on submarine cable laying and repairing. In the present instalment the author deals with jointing and splicing and the disposal of the cable sections aboard ship.—Lond. *Electrician*, Dec. 16

New Apparatus and Appliances

THE LIFE-TESTING AND ELECTRIC EQUIPMENT OF THE ENGINEERING DEPARTMENT OF THE NATIONAL ELECTRIC LAMP ASSOCIATION.

As early as 1903 the National Electric Lamp Association, at that time consisting of less than half a dozen member companies, undertook to determine the real performance of the lamps manufactured by its members and by outside companies. From 1906 to 1910 this work was carried on in the factory in Cleveland, Ohio, where Brush originally manufactured his arc-lighting machines, but with the growth of the association and the large increase of engineering research work it was found necessary to provide additional facilities.

In the new building, which is located on the site of the old factory, the lamp-life testing racks are placed in a room with walls entirely of glass, located on the roof, this location being chosen to provide ventilation to carry off the heat generated by so many incandescent lamps. In making plans for wiring, switching and transforming machinery it was estimated that the maximum demand would be 4000 amp at 120 volts, alternating current; 225 amp at 140 volts, direct current, and 25 amp at 280 volts, direct current. Energy is supplied by the Cleveland Electric Illuminating Company at 2300 volts, alternating current.

The transforming machinery at present consists of one 300-hp, 2300-volt, 60-cycle, three-phase synchronous motor connected directly to a single-phase, 120-volt alternating-current generator. The circuit is controlled by a Tirrill regulator with pressure wires running to the center of distribution on the racks. The regulator is adjusted so that the voltage at the racks shall be 120 volts. In addition to this there is a 30-kw, 140-volt direct-current generator, the voltage of which is controlled by a Tirrill regulator. This machine is used for supplying energy to storage batteries and to the direct-current lamps on test.

In order to have available for lamp testing every voltage which might be required in both alternating-current and direct current service a very simple and flexible plan was adopted. Fig. 1 shows the construction of the regular alternating-current racks on which are placed all standard-base lamps requiring a voltage of from 6 volts to 300 volts. *A* and *B* are the busbars, which consist of three strips of ⅛-in. copper ½ in. wide. *A* is connected to the rack at *C*, thereby grounding the framework, which is made of 1¾-in. angle iron, and to which the bars carrying the receptacles are fastened directly. *B* is connected to a ½-in. copper rod *E*, which is insulated from the rack frame *J* by a porcelain insulator to the left at *D*. The portion of the sketch bearing the numbers 222-223, etc., represents standardized ¾-kw auto-transformers with their three terminals connected at *F*, *M* and *N* respectively. The rod *E* is duplicated on the other side of the rack, the unidentified leads being the connections from the transformers on the other side with the strips on the back of the rack. *N* is one of the asbestos-covered leads from the auto-transformer which connects with a narrow strip *H* insulated from the channel *O* by means of a strap of hard fiber. *O* is a bar or strip of channel brass 1⅛ in. wide and ¾ in. deep. The brass is ⅛ in. thick. The bar *P* is not connected with the transformer, as the location of the support *J* would interfere with it, therefore the sockets are connected directly across the primary leads, giving 240 volts in this case. On the 120-volt rack the voltage on this bar would be 120 volts. As a range of from 0.5 volts to 300 volts was desired for alternating current and from 75 volts to 260 volts for direct current some very elastic system was necessary. The problem was solved by the use of auto-transformers having a rating of ¾ kw for alternating-current circuits and individual rheostats for direct-current circuits. Two large transformers were installed, one stepping up the voltage from 120 volts to 240 volts and one stepping it down from 120 volts to 60 volts and 30 volts, the latter having two steps for the two voltages. Auto-transformers are used throughout on account of their better regulation.

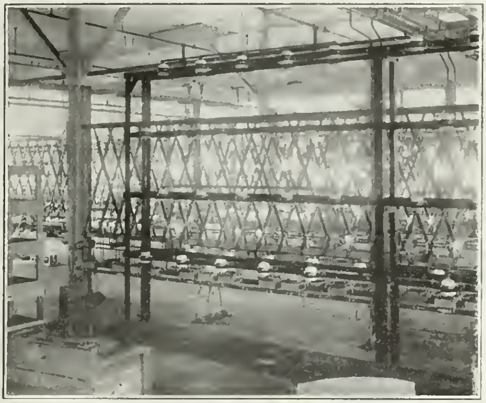


Fig. 1—Interior View of Lamp Testing Laboratory.

The lowest voltage is that used in miniature lamps. The installation for this style of lamp consists of three auto-transformers with 30-volt primaries and with secondaries of approximately 5 volts, 10 volts and 15 volts respectively. There are a number of taps brought out of the secondary windings from which it is possible to obtain voltages at ½-volt steps from 0.5 volt to 14.5 volts.

Passing from miniature to standard Edison bases, the next variation is obtained from seventy-five 30-volt primary transformers of standardized rating, to which there are connected 600 sockets. The ratio of transformation is such that voltages from 6 to 42 may be had in 1-volt steps. There are seventy-five 60-volt primary transformers, giving a range of from 54 volts to 90 volts in 1-volt steps. There are only 290 sockets available here, but the odd transformers are kept in reserve and may replace any in the racks if a particular voltage which is not at hand is desired. This same plan of substitution is carried out extensively on the 120-volt racks and saves considerable room. The three preceding sets of voltage ranges have been taken from the large step-down auto-transformer already mentioned, while the 120-volt racks, which are most numerous, are connected directly to the generator. There are 2000 sockets in this set with a range of from 90 volts to 180 volts to supply which there are used altogether 575 transformers. On the last set there are 1000 sockets with 275 transformers with 240-volt primaries, giving a secondary range of from 180 volts to 300 volts.

In addition to the multiple racks there are eighty street-series sockets operated from a separate transformer having a number of taps, which, together with a set of variable resistances, make it possible to obtain any current used in street series lamps.

An extra emergency multiple rack with 360 sockets is being installed which covers the entire range of voltages desired, one-quarter being run from the 30-volt circuit, one-quarter from the 60-volt, one quarter from 120-volt and the remainder from 240-volt.

For direct current there are 110 sockets for 280 volts and 210 for 140 volts, each outlet being equipped with an adjustable resistance by means of which the required voltage may be obtained. Energy for these circuits is obtained from the direct-current generators, already described, and is supplied at 140 volts and 280 volts.

All of the life-testing racks are of fireproof material throughout. Lamps put on these racks are placed on a circuit having a voltage which is determined by rating the lamps at a specific consumption of a certain number of watts per candle. For each lamp there is a record card giving all the necessary information concerning the lamp, and at certain predetermined periods the lamps are removed and photometered, this being carried on until they burn out.

In order to determine the actual time that the lamps are on test and also to insure that no sudden rise in voltage may occur or that the circuit may not be interrupted without a time record the greatest precautions have been made for mechanically recording the time and for means of calling attention to any excessive change in voltage should it occur.

A recording voltmeter is attached to the 120-volt racks in the test-room and whenever the voltage varies more than 1 volt above or below 120 a bell rings. In addition to this the record of the meter is carefully watched and the regulator is adjusted so that there shall be not more than about 0.2 volt variation under ordinary conditions. If the voltage increases to more than 123 volts the main circuit-breakers on the switchboard are automatically tripped. As an excess voltage on the lamps will materially decrease their life, it is necessary that all of these precautions shall be taken or otherwise the results of the tests will be of little value.

A clock operates a shaft to which are attached four electromagnetically controlled clutches. These electromagnets are placed in series with pilot lamps in different sections of the test-room and in case the circuit on these racks is opened the clutches are thrown out so that recording mechanism in the form of counters which indicate hours ceases to work. By referring to these counters the time during which energy has been supplied to the rack is easily obtained. This entire mechanism was devised and constructed by the engineering department.

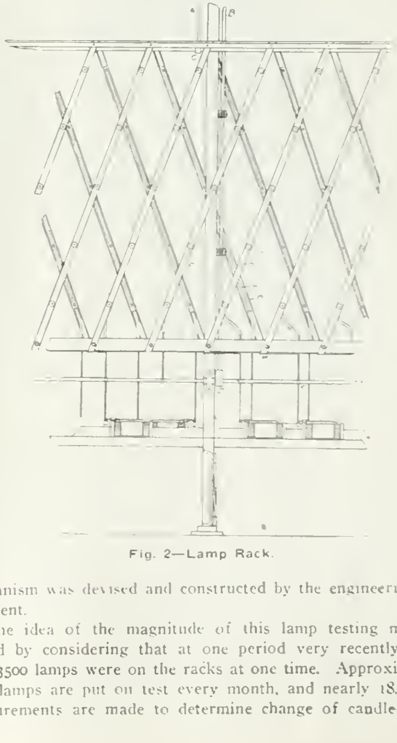


Fig. 2—Lamp Rack.

Some idea of the magnitude of this lamp testing may be gained by considering that at one period very recently more than 3500 lamps were on the racks at one time. Approximately 2300 lamps are put on test every month, and nearly 18,000 cp measurements are made to determine change of candle-power with life. Anyone who has seen the light given by these lamps at night may be able to appreciate slightly the energy consumed in making these tests and the expense incurred for the main object of determining the life and peformance of the lamps manufactured by the member companies of the National Electric Lamp Association.

PRIMARY BATTERY FOR USE WITH TUNGSTEN LAMPS.

Among the inherent defects of primary batteries which have rendered them more or less unsatisfactory for many purposes may be mentioned the rapid deterioration of the elements with time when not in use and the rapid falling off in the e.m.f. when the batteries are in service. These defects are attributable to the local action at the zinc electrode, together with the polarizing influence of the electrolyte upon the electrodes.

It is now claimed that these defects have been largely removed in a form of primary battery which is being placed upon the market by the American Ever Ready Company, 304 Hudson Street, New York.

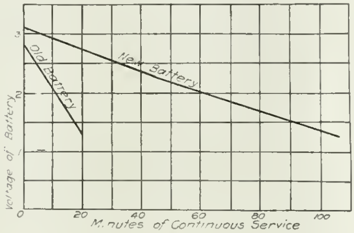


Fig. 1—Comparative Tests of Batteries, Size $2\frac{1}{4}$ x $1\frac{1}{4}$ x $\frac{5}{8}$ In.

In comparison with the usual type of primary battery the new battery embodies improvements in electrolyte, electrodes and insulating materials. In the usual form of battery use has always been made of manganese ore. In the new battery for the purpose of minimizing the polarization there has been substituted for manganese ore the manganese hydrate. To minimize local action around the zinc electrode use is ordinarily made of mercury. In the new form of battery there has been substituted therefor mercury sulphate. In place of the blotting paper separator generally used between the electrodes, in the new battery use is made of a special form of insulation asserted to be much superior for the purpose.

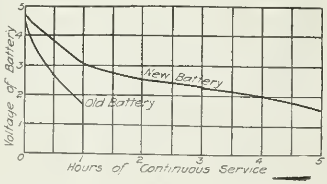


Fig. 2—Comparative Tests of Batteries, Size $2\frac{5}{8}$ x $2\frac{1}{2}$ x $\frac{7}{8}$ In.

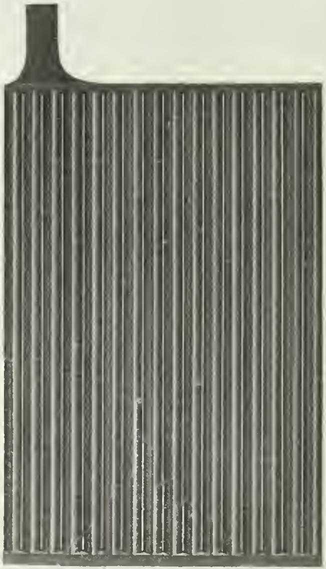
The active life of the battery that is now being placed upon the market is said to be four times as great as that of the usual primary battery, while the battery maintains a much higher and more uniform e.m.f. throughout its life. These facts are shown in the accompanying illustration representing service tests made upon the batteries.

Fig. 1 shows the results of a continuous-service test on an old-style zinc-carbon battery having dimensions of $2\frac{1}{4}$ in. x $1\frac{1}{4}$ in. x $\frac{5}{8}$ in. supplying energy to a certain tungsten lamp, and a similar test on a new battery having identical dimensions when supplying energy to a tungsten lamp of exactly the same style, kind and size. Fig. 2 gives an equivalent comparison of continuous tests on old-style and new batteries having dimensions of $2\frac{5}{8}$ in. x $2\frac{1}{2}$ in. x $\frac{7}{8}$ in.

ELECTRIC VEHICLE BATTERY.

The Electric Storage Battery Company, of Philadelphia, has recently developed for the market an electric vehicle battery which will be called the "Ironclad-Exide." It is said that long tests have already proven the dependability of the new battery, which was the invention of a Frenchman, the American rights for which were secured by the company about four years ago.

The positive plate of the battery, shown in the accompanying illustration, is so designed as to prevent the loss of active material. The plate consists of a metal-conducting top and bottom bar connected by vertical conducting rods. Each rod is surrounded by active material, which in turn is protected and held in place by a slotted hard-rubber tube. This tube carries a vertical rib on each side which takes the place of wood separators, used with the standard "Exide" type of positive plate, and makes the use of rubber separators unnecessary. A thin, flat wood separator spaces the positive from its negative. The negative plate is a modified "Exide" negative plate thickened and improved to enable it to withstand not so much the increased output as the greatly increased life of the new positive plate.

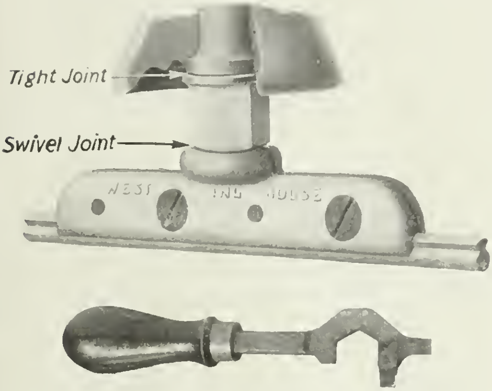


Storage-Battery Plate.

For the new battery the following points are claimed: It gives from two and one-half to three times as long life as the older type. Active material does not shed from the plates, which eliminates the necessity for cleaning the cells. It gives increased mileage and maintains this high feature during the greater part of its life. The battery can be installed in standard "Exide" battery jars so that vehicle users having "Exide" batteries can substitute the new batteries when requiring renewals.

TROLLEY CLAMP.

The Westinghouse Electric & Manufacturing Company has just placed upon the market a new trolley clamp that embodies several improvements. The swivel joint permits the boss to be screwed up tight to the stud, thereby keeping out moisture and preventing corrosion and wear of threads. The two side caps are absolute duplicates and thus the clamping pressure is uniform. Having only two countersunk holes in each side, the clamp is stronger than the clamping pressure, consequently more permanent. A few drops of solder in the swivel joint after the clamp is installed adapt it for feeding. The clamp can be installed with an ordinary screwdriver and a monkey-wrench or with a combined screwdriver and wrench especially designed for this service.



Trolley Clamp, with Combined Screwdriver and Wrench.

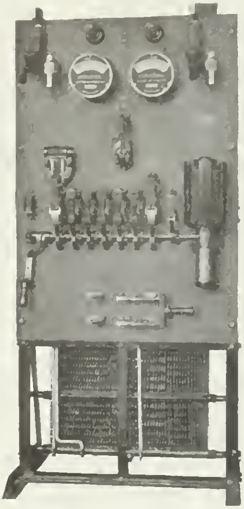
ELECTRIC DELIVERY WAGON WITH SHAFT DRIVE.

As will be noted from the accompanying illustration, the shaft method of driving which is employed with high-grade pleasure cars has been applied by the Waverly Company, Indianapolis, Ind., to a light delivery wagon. The motor shaft runs parallel with the rear wheel shaft and is connected thereto by means of herringbone gears. It is said that of all types of drive the herringbone gear possesses the highest efficiency. The model of wagon here illustrated is particularly suited for department stores, milliners, grocers, laundries and all that class of dealers who make quick deliveries. The motor is of such size and the battery carries such an amount of energy that the vehicle can cover from fifty to seventy-five miles on one charge, the speed maintained being from ten to fifteen miles per hour.

Electric Delivery Wagon.

LARGE AUTOMATIC FIRE-PUMP STARTER FOR CHICAGO CITY HALL.

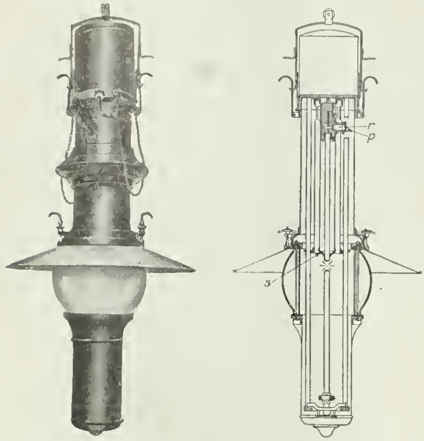
For controlling the 150-hp motor which will operate a fire pump delivering 750 gal. of water per minute to a fire-protection tank in the new Chicago City Hall a special Schureman-type automatic starter with hand attachment has been built by the Cutler-Hammer Manufacturing Company, Milwaukee. The starter is controlled from a float-type switch at the tank on the 320-ft. level and closes the motor circuit automatically to fill the tank as soon as the water level reaches a predetermined lower limit. In this way the quantity of water held in the tank is maintained at a prescribed amount. The accelerating switches are closed in proper succession by cams on the starting shaft, which is manipulated by a solenoid against the resistance of an adjustable dashpot. In the closed position the shaft is held by a locking magnet. In case of injury to the float mechanism a handle is provided by which the starting switches can be operated by hand. A double-throw switch is provided for connecting over to the terminals of the large storage battery placed in the building to guard against the possibility of interruption of the water-power transmission line of the Sanitary District of Chicago, which supplies the City Hall electric service. Pilot lamps are provided for showing the condition of the circuits. All of the parts are of brass or copper-plated, and when installed the starting panel will be inclosed in a protecting case.



Automatic Fire-Pump Starter.

ENCLOSED 70-HOUR FLAMING-ARC LAMPS.

The Excello Arc Lamp Company, of New York City, has brought out new alternating-current and direct-current long hour burning flaming-arc lamps intended for steel-mill and street-lighting service. Both types of lamp have vertical electrodes and by shutting off the supply of air after the fashion common to inclosed arc lamps of the ordinary type an electrode life of seventy hours is obtained on a single trimming. By the total inclosure of the arc, however, the problem of disposing of the fumes arising from the arc which cannot be disposed of by ordinary methods of ventilation confronted the manufacturer. The deposit is got rid of by a novel arrangement of the globe and burning chamber. Above the arc itself a long, chimney-like metal tube is arranged, which owing to its large radiating surface causes the lighter gases to condense inside it and in the upper and cooler portion of the lamp where the deposit accumulates and is easily brushed out when the lamps are retrimmed. Inside the outer opalescent globe there is a clear cylinder of glass surrounding the arc and open at the top and bottom. By referring to the engravings the construction of the lamp will be apparent. A constant circulation is thus set up and the ash or deposit is so completely got rid of that the loss of light after seventy hours' burning is insignificant. The mechanism of the direct-current lamp is of the differential pattern, while in the alternating-current lamp it is of the motor type. The mechanism is housed in the upper compartment of the lamp, where it is immune from the gases, deposit and heat of the arc. It is a trifle more rugged than the usual mechanism and the construction throughout is good. The electrodes are self-focusing; that is, the negative and positive electrodes both feed, thus maintaining the arc in a fixed position within the globe. The arc e.m.f. is about 40 volts to 45 volts and the current consumption is 8 amp. Special electrodes are employed, each 350 mm long. In the direct-current lamp the upper or negative electrode is 13 mm in diameter and the lower or positive electrode is 15 mm in diameter. In the alternating-current lamp both electrodes are 13 mm in diameter. The light distribution curve of the lamp is shown in Fig. 3. The lamps are easily retrimmed. The lower metallic section, including the globes and shade, is removed as one piece. After the lower electrode holder has been drawn down to its lowest position the upper electrode holder, which fits snugly in the metallic tube, may be reached by a key which passes through the valve opening *p* and the hole *r* to the set-screw clamping the electrode in place. The lower electrode is inserted in the usual manner and centered with the upper electrode. The specific consumption of the lamp per mean lower hemispherical candle-power is 0.35 watt.



Figs. 1 and 2—Excello Long-Hour-Burning Flaming-Arc Lamp.

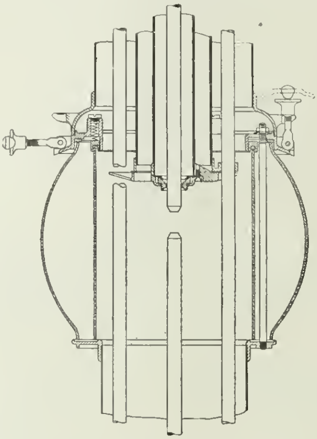


Fig. 4—Cross-Section of Arc Chambers.

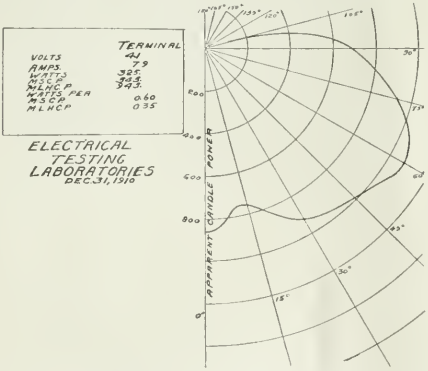
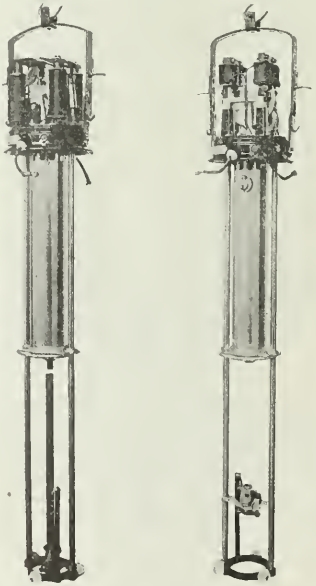


Fig. 3—Vertical Distribution of Light, Excello Seventy-Hour Flaming-Arc Lamp.



Figs. 5 and 6—Mechanism of Direct and Alternating-Current Lamps.

Industrial and Commercial News

The Week in Trade.

COMMERCIAL business during the last week of 1910 showed no improvement over that in the preceding weeks. Post-holiday quiet was apparent in all lines of trade and industry, and both commercial business and manufacturing activities felt the effect of the inventory-taking period. The wholesalers and jobbers were practically without orders during the week, which is not unusual, however, at the close of the year. Retailers did little business, although reductions and bargain sales did something to stimulate buying. The general reports of the holiday trade are satisfactory, although in many cases the volume did not come up to that of the previous year. The best reports came from the Western section of the country, where the benefits of the free marketing of agricultural products have been distinctly felt. Holiday trade in the industrial centers was to some extent restricted, due to the fact that a large percentage of the manufacturing plants are either operating at part time or have laid off a number of their employees. In the steel and iron districts this was especially noticeable, where the majority of mills are running at less than 50 per cent. of capacity. Reports from the South were especially good, owing to the early marketing of cotton at high average prices. The week added nothing of encouragement to the iron and steel industry. But few orders were placed and there were no developments which made more encouraging the outlook for 1911. There was much discussion as to whether prices will be cut on a so-called open market basis. The advocates of reductions and the standpatters seem to be fairly evenly divided, but the policy of the steel trade will not be known until after the conference that will be held in New York on Jan. 11. While some railway track supplies were contracted for during the past week, there were very few orders for rails. The recent orders of the Pennsylvania Railroad and the New York Central have not as yet been finally closed, owing to the disinclination of the mills to accept the specifications. Collections have been generally fair, especially in the West and South. In other sections there has been no improvement. Business failures for the week which ended Dec. 29, as reported by *Bradstreet's*, were 251, as compared with 271 the previous week, 257 in the corresponding week of 1909, 299 in 1908, 185 in 1907 and 220 in 1906.

The Copper Market.

PRACTICAL stagnation marked the closing week in the copper market for the year 1910. Prices were weak, and while the selling agencies continued to quote electrolytic at 13 cents, it was generally understood that what few sales were made were negotiated at something like 12⅝ cents or 12¾ cents At no time in the past several months has the demand for copper been quite so dull as during the past week. While the operators in the market believe, or at least assert, that there will be a revival in demand during January, there is no real basis upon which to predict such a hope. It is probable that the figures of the Copper Producers' Association will show a considerable increase of surplus stocks during the month of December and there is every reason to expect a similar increase during the month of January. The domestic demand is almost nothing at the present time and there is no life in the London market. During the week the report of the United States Geological Survey was made public, giving the official production of copper for the year 1909 from both domestic and foreign ores as 1,391,021,454 lb. This was the largest output in the history of the industry and exceeded that of the year 1908 by 253,059,046 lb. It is estimated that the production of copper in 1910 will amount to 1,448,000,000 lb. This enormous production, which is in excess of the consumption, is being continued at the present time in spite of the fact that quite a number of mines have endeavored to curtail their output. It must also be remembered that there are large stocks being carried in the warehouses of Europe which, while they do not figure in the official reports, are still at the disposal of consumers. The exports for December were not particularly large, amounting for the month to 28,794 tons The daily call on the Metal Exchange up to and including Dec. 30 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.00	12.15	....
December	12.00	12.15	12.07½
January	12.00	12.15	12.07½
February	12.00	12.15	12.07½
March	12.00	12.15	12.07½

The London market, Dec. 30, was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard Copper, spot	55	17	6	56	0	0
Standard Copper, futures	56	13	9	56	16	3

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.50c			11.70c		
London, spot	£62	0	0	£52	15	0
London, futures	65	18	9	53	7	6
Best selected	65	10	0	57	15	0

Industrial and Commercial Notes.

General Electric Company Sales.—An official of the General Electric Company states that the total sales made by that company during 1910 will amount to something more than $70,000,000. Orders booked will amount to about the same figure. The company therefore ends the year with just about the same amount of business on hand that it had at the beginning. In all of the plants of the company there are now employed about 35,000 men. During the year the company has spent in the neighborhood of $5,000,000 for plant extensions and improvements. This has mostly been in the nature of additions to the existing plants, although a large amount of new construction has been commenced at Erie, where foundries and machine shops are being built. A new lamp factory has also been built at Toledo. According to this official, the total addition to the floor space of the General Electric plants during 1910 was in the neighborhood of 1,400,000 sq. ft. While quite a number of large orders were taken during the year for heavy apparatus for lighting concerns, a larger percentage of the business was for the lighter classes of machinery than in any previous year. There has been a rapid development in the use of small motors in manufacturing concerns, and there has also been a very heavy increase in the department of household appliances. The busiest single department of the General Electric Company during the year was the lamp department With the exception of the year 1907, the year 1910 shows the largest business the General Electric has ever had. The plants, however, have not been operating at full capacity, because the numerous extensions and improvements made within the last few years have increased the capacity to about $100,000,000. This authority states that it is the opinion of many of the officials of the company that 1911 will not exceed 1910 in volume of business. In fact, many of the officers of the company expect some recession during the coming year

Crocker-Wheeler Company.—Both in gross business and in net profits the Crocker-Wheeler Company, Ampere, N. J., under the guidance of Dr. S. S. Wheeler, president, and Gano Dunn, vice-president and chief engineer, has exceeded in 1910 its record of 1909. As it closes its twenty-third year of independent existence it looks forward to increasing prosperity under the same management and upon the same lines of business policy. "The figures for the year are not yet obtainable," said an official of the company in discussing the year's business, "but they will undoubtedly show the largest volume of orders in the history of the company. With a complete line of induction motors, besides the Crocker-Wheeler direct-current motors which the company has been manufacturing since 1888, there is no motor-drive problem, large or small, which cannot receive expert handling by the engineers of the company. During the past year the company has continued to supply to the steel mills its Form 'W' rolling mill motor, which set the fashion in this particular line and which is used in large quantities throughout the steel industry. One of the principal achievements of the company in 1910 was the launching of its 'Remek' lighting transformers, which represent a radical advance in the art of transformer design. The company has continued to build generators of all capacities, both alternating current and direct current, and has already booked orders for important generating apparatus to be delivered during 1911. In the turbo-alternator field the Crocker-Wheeler Company is establishing itself as an important independent manufacturer of the electrical end of such equipments"

Lighting Companies Prosper More Than Tractions.—A representative of the largest electrical manufacturing concern in the country, who keeps in close touch with the conditions of the electrical industry, says that during the year 1910 the light and power companies have shown much greater prosperity than the traction companies. He says that 90 per cent of the orders for large generating apparatus have come from the light and power companies. This, he explains, is due to the fact that in many sections of the country the traction companies are not in the best of shape. He points to the fact that in New York, Philadelphia, San Francisco, Chicago, Cleveland, Toledo, Detroit and many other important cities the traction companies are having either financial or franchise difficulties. This has made the moneyed interests less favorable to traction securities than those of lighting companies. As he puts it: "The traction companies have a much harder row to hoe than the light and power companies. The public is in closer touch with the traction company and makes far greater demands on it than it does on other public service companies. There is a constant effort to increase the service; the hauls must constantly be made longer; improvement in equipment is perpetually demanded, and there is absolutely no chance of increasing the rate of the fare. Then, again, the municipalities always regard the traction companies as fair victims for taxation increases. It is a constant struggle for the managers of traction properties to keep their expenses down within a profitable range. The lighting companies do not have this difficulty. They are not in endless warfare with either the city officials or with the public. The demand for their service is always expanding, and there is very little clamor for reduction in rates. For these reasons the manufacturing companies have found during the past year that the lighting companies are much better customers and in much better condition to buy than the tractions."

Insulated Wire Trade in 1910.—It would be stretching a point to say that the insulated wire trade during the past year had been satisfactory. In discussing the matter a representative of one of the largest manufacturing concerns in the country said that while the total volume of business had probably been larger than that done in 1909 it had not been up to the expectations of the manufacturers, and the year closed under rather gloomy conditions. "The reason that trade was so unsatisfactory this year," said this authority, "is that it was so definitely bunched within the limits of a few months. In January and February orders were moderate, but probably as much as manufacturers could have expected. Beginning with March and running well up toward the end of July there was a great rush of orders. Business came to us in such volume that we began to think 1910 would be our record year. Then there was a slump, a heavy slump, and from Aug. 1 to the end of the year orders were few and small in size. The business for the last five months of the year was so light that it entirely offset the prosperity of the first half of the year. At the present time business is very dull. The figures for the year, however, are somewhat deceptive as far as the real earnings of the insulated wire companies are concerned. We have been badly handicapped by increases in manufacturing costs. During the early months of the year, when orders were coming in, crude rubber and yarns were very high, but owing to the competition of outside manufacturers we could increase our selling prices very little. The result was that during the period of our best business we operated on a narrower margin than ever before in our history. When crude rubber and yarn declined in the early fall business also went down to the zero mark and we got no benefit from the cheaper raw material. I would not venture a prophecy as to 1911. I think much depends upon what is done in Washington, but I do not consider the outlook at all optimistic."

Westinghouse Electric & Manufacturing Company.—Although the fiscal year of the Westinghouse Electric & Manufacturing Company does not end until March 31, it is expected that the current year will show the largest earnings and the best profits in the history of the organization. The earnings for the calendar year 1910 have been larger than ever before recorded. A representative of the company, in speaking of the business done last year, said that the average sales throughout the twelve months were almost $3,000,000 per month. These figures do not include the income from investments, royalties, etc. It is estimated that the gross earnings for 1910 will be between $34,000,000 and $35,000,000. The general character of the work done was in the lighter class of electrical apparatus. The busiest section of the manufacturing plant was the railway motor department. Almost throughout the entire year this department has been working overtime. There was also a heavy business done in transformers and in small commercial motors. Orders for large turbo-generator units were not as numerous as heretofore, although some good contracts were made. It is estimated that the factory cost of the business done will be between $28,000,000 and $29,000,000, leaving a net profit in the neighborhood of $6,000,000. In October the company was employing about 19,000 men, which is an increase of more than 6000 over the same period last year. During November and December orders were not so plentiful as in some of the previous months of the year, but a good volume of business was still contracted for.

Allis-Chalmers Company.—The record of the Allis-Chalmers Company for 1910, like that of many other manufacturing companies, shows a streak of fat and a streak of lean. The fiscal year of the company ends June 30, so that any estimate of the business done in the calendar year is largely guesswork. An official of the company made the statement that, according to the data now at hand, the business done in 1910 would be about the same as that done in 1909 This was about 80 per cent better than the business of 1908. During the past year, according to this authority, the electrical business done by the company was good, the orders for mining machinery and for power plant apparatus were satisfactory, the orders for flour mill machinery were enormous and there was a fair demand for gas engines and for steam turbines. The demand for reciprocating steam engines was very poor, and the general machinery demand was only moderate. Quite a number of good orders were taken for hydroelectric apparatus, but hardly as many of these were received as had been anticipated. Beginning with March 1, there was a fine run of orders and business was booming. This continued until toward the end of July, when there came a slump, from which there has been little recovery. The last five months of the year were extremely dull, and so far there is little prospect of improvement in 1911. During the past two or three months the plants of the company have been operated at less than 50 per cent of capacity.

Motor Vehicle Associations Consolidate in Boston.—The motor truck associations existing in Boston have been consolidated under the name of the Boston Commercial Motor Vehicle Association, and there will hereafter be but one association of dealers in this field in the city. Electrical interests are represented by Day Baker, of the General Vehicle Company, who is the secretary of the new association. Present members of the Boston Motor Truck Association and of the Commercial Motor Vehicle Association, of Boston, have been admitted to membership, and an eligibility clause has been adopted limiting future membership to actual dealers in commercial motor vehicles. The new association will not attempt to conduct a separate motor vehicle show during the present season, but will co-operate with the Boston Automobile Dealers' Association in the annual show to be held in Boston in March. The new association will endeavor to work for the establishment of motor truck ways in the major teaming thoroughfares of the city, following a thorough discussion of this matter a few days ago by a motor vehicle committee of the Boston Chamber of Commerce. This committee was appointed to consider means of reducing the congestion of Boston streets, and the power of electric and gasoline vehicles to accomplish this was discussed at some length at the public meeting.

Poulsen Wireless Company.—San Francisco capitalists have recently organized a company under the laws of Arizona, with $25,000,000 authorized capital, called the Poulsen Wireless Company, to exploit in the United States the wireless telegraph and telephone patents of Valdemar Poulsen, of Copenhagen. Beach Thompson is president of the new company. E. W. Hopkins, of the Hopkins estate; George A. Pope, of the Pope estate; Howard P. Veeder, formerly interested in the Stanislaus River Power Company, and a number of other prominent California capitalists are interested in the project. It is stated that the company will not be ready to enter the commercial field for some time. Its work at present will consist of a series of experiments and tests. Communication both by wireless telegraph and wireless telephone has been established between San Francisco and Stockholm.

Compressed Air for Anaconda Mines.—It is stated in Butte that the Anaconda Copper Mining Company will have its air-compressor plant in operation about Feb. 1. The electrical equipment which will operate this plant will be in readiness by that time. The energy is furnished by the Great Falls Water Power & Townsite Company, and is transmitted a distance of 130 miles. This transmission is made over two separate lines. Near the center of the transmission lines is a switching station equipped with oil switches and lightning arresters, by means of which a cross-over connection can be made and one-half of either line can be cut out while the remainder is in operation. Above the power-carrying lines are two galvanized steel strands grounded at each tower, which will serve as protectors against lightning. A 100,000-volt substation has been constructed on Anaconda Hill, from which the energy is to be distributed. The compressor plant consists of three Nordberg direct-connected variable capacity air compressors, each with a capacity of 7000 cu. ft. of free air per minute. When operated at full load the energy required to drive these compressors is 3000 hp. It is estimated that the substitution of air for steam by the Anaconda company will reduce the cost of producing copper 1½ cents per pound. The plant already completed is intended to serve only the Mountain View, High Ore and Diamond mines. If the result is as successful as is anticipated the other mines of the Anaconda company will be similarly equipped.

Hickory (N. C.) Hydroelectric Development.—Construction on the development of the hydroelectric plant of the Water Power Electric Company on the Catawba River at Hickory, N. C., is to begin next week and be pushed to completion. The chief engineers are Connell & Connell, of 90 West Street, New York City, and Louis R. Abel, who has had his office at 258 Broadway, has gone to Hickory as the resident engineer. Colonel Marcellus E. Thornton, who is the president of the company, and also president of the Thornton Light & Power Company at Hickory and of the Hickory Railway Company, has labored unceasingly during the last five or six years for this consummation. He was formerly president and general manager of the Main Jellico Mountain Coal Company, at Kensee, Ky., with a capital stock of $500,000, of which he owned considerably over a majority. This construction, it is thought, can be completed in fourteen or fifteen months. Two large industrial plants will be constructed during the same period, located near the dam and power house. It is estimated that 9000 hp will be developed.

Electrical Engineers' Equipment Company.—The Electrical Engineers' Equipment Company, of Chicago, manufacturers of high-tension power-house and line-construction specialties, has enlarged its facilities by leasing for its office and factory the building at 10 and 12 North Desplaines Street, Chicago, which will hereafter be the headquarters of the company. This building is three stories high and 50 ft. wide and contains approximately 12,000 sq. ft. of floor space. The machine shops and other manufacturing departments of the company, as well as the store house, will be concentrated here. The Electrical Engineers' Equipment Company is one of the newer companies in the electrical manufacturing business, but it has been successful. Percival Steele is president of the company, and A. D. Fonger is assistant manager.

Chicago Telephone Rates.—A reduction of from 8 per cent to 10 per cent in the rates for service charged by the Chicago Telephone Company is recommended in a report of experts employed by the City Council. Action on the report was postponed until the members of the Council, telephone company officials and others interested have a chance to be heard. The experts report that the telephone company is earning 10 per cent on its investment and is not entitled to earn more than 8 per cent. The investigation covered a period of six months and took in every branch of the service. The report is practically opposite to one made some time ago by the Arthur Young Company, public accountant, and D. C. & Wm. B. Jackson, engineers. This former report favored an increase in telephone rates.

To Use Storage-Battery Cars.—The Public Service Commission of the First District has set Jan. 10 as the date of a hearing upon the application of Frederick W. Whitridge, receiver of the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway Company, for permission to change the motive power on that line from horse cars to storage-battery cars. These cars have been experimentally in use on this line for some time. They are the cars built by the Third Avenue Railroad Company and equipped with batteries furnished by the Gould Storage Battery Company. A number of these cars are now running on the Twenty-eighth Street and Twenty-ninth Street line under an operating contract with the Third Avenue Railroad Company.

Developing Tungsten Properties.—Development work on the tungsten properties of the Blue Grouse Mountain, northeast of Spokane, Wash., is progressing rapidly. Buildings have been erected for the accommodation of a large number of workmen, and the work will be pushed forward as soon as the weather permits. The shaft is being sunk at a point where the three veins of ore join, about 40 ft. below the surface. The ore in these veins runs from 40 per cent to 70 per cent tungsten. The company has about thirty tons of ore sacked, which it is estimated will be worth from $300 to $500 a ton.

Henry L. Doherty & Company's Christmas.—The firm of Henry L. Doherty & Company made a Christmas present to each of its employees, from the highest officials to the office boy, of 20 per cent of the yearly salary. In addition to this the heads of departments and those holding important positions participated in the profits of the company for the year.

Financial.

The Week in Wall Street.

While actual transactions last week were a trifle better than the week previous, and while prices of stocks were a trifle stronger, market conditions taken as a whole were thoroughly discouraging. There is no confidence left even among the professional traders and the public has long since ceased to be a factor in the market. It is doubtful if a year ever closed more dismally than did 1910. In 1904 and 1907 the market was much more demoralized and prices were far lower, but the Street was at least cheered with some measure of activity. Traders in those years had positive opinions and were not afraid to back them with their money. To-day there is general uneasiness and few professionals are daring enough to make deals involving important amounts. Just at the present time the reason assigned for this condition is the general anxiety felt over the anti-corporation prosecutions. With two anti-trust suits involving enormous amounts of capital nearing decision in the Supreme Court, with the prosecution of the so-called Electrical Trust ready to begin, and with the question of railroad rates still hanging in the balance, speculators and investors alike may well be timid and nervous. It is the general opinion of the trades that upon the decisions now imminent hangs the fate during the early months of the new year. In the bond market during the past week there was some increase of activity and it begins to look as if a genuine investment demand were being developed. The money market advanced sharply during the week and call money rose at one point to 7 per cent, the highest rate since May. Rates Dec. 31 were: Call, 3¾@4 per cent; ninety days, 4½ per cent. The quotations in the table are those of the close Dec. 31.

NEW YORK.

	Dec. 23.	Dec. 31.	Shares sold.		Dec. 23.	Dec. 31.	Shares sold.
All. Ch.......	⅜	8*	300	Int. Met., pf.	54¼	53½	10,250
All. Ch., pfd.	30*	29	300	Mackay Cos..	92½*	92½*	——
Amal. Cop...	62⅝	61⅝	64,200	Mackay C.,pf.	76*	75¼*	100
Am. D. T...	20½*	20½*	——	Man. Elev...	139*	138⅛*	1,010
Am. Loco....	36½	38	2,625	Met. St. Ry..	15*	15*	——
Am. Loco.,pf.	105½*	108*	200	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & C.	80*	80*	——	Steel, Com...	72⅛	72⅛	288,978
Am. T. & T..	142½	140⅛	7,100	Steel, pfd....	116⅞	116⅝	6,380
B. R. T.....	75½	75¼	5,650	W. U. T....	73	72½	1,850
Gen. Elec....	155	151*	2,950	West'h, com.	65½	65½*	1,200
Int.-Met. ...	19½	19½	7,200	West'h, pfd..	122*	122*	——

PHILADELPHIA.

	Dec. 23.	Dec. 31.		Dec. 23.	Dec. 31.
Am. Rys...........	42½*	42*	Phila. Elec.........	16¼	16⅜
Elec. Co. of A......	11⅝*	11⅝*	Phila. R. T.........	18¼	18⅝
Elec. St. B'ty.......	48¾	48¼	Phila. Trac.........	84*	84
E. S. B'ty., pfd.....	30*	30*	Union Trac.........	43	43¼

CHICAGO.

	Dec. 23.	Dec. 31.		Dec. 23.	Dec. 31
Chi. City Ry........	170*	170*	Chi. Tel. Co.......	123	120
Chi. Rs., Ser. 1.....	92½*	92½*	Met. El. Co........	21*	23*
Chi. Rs., Ser. 2.....	25¼	25¼	Met. El., pfd......	65*	69
Com. Edison........	115½	113*	Nat'l Car..........	117	119*
Chi. Subways.......	4	4⅝	Nat'l Car, pfd. ...	117½*	117½*

BOSTON.

	Dec. 23.	Dec. 31.		Dec. 23.	Dec. 31.
Am. T. & T..........	142½	140¼	Mex. Tel..........	4*	4*
Cum. Tel...........	149*	145*	Mex. Tel., pfd......	6⅝	6*
Edison E., Ill.......	285	288	N. E. Tel..........	138	138
Gen. Elec...........	155*	152½	W. T. & T.........	16*	18*
Mass. E. Ry........	18¼*	18	W. T. & T., pfd....	90¼*	91¼*
Mass. E. Ry., pfd...	85½*	86			

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*Last price quoted.

Shares sold for five days, Dec. 26 to Dec. 31

Western States Gas & Electric Company.—The purpose of the recent organization of the Western States Gas & Electric Company, referred to in our issue of Dec. 8, is to take over the California properties recently acquired by H. M. Byllesby & Company, of Chicago. These include two large water-power developments and several water-power sites not yet developed. The principal local plants purchased consist of the electric and gas properties formerly owned by the Stockton Gas & Electric Corporation, at Stockton; the electric light and power business at Richmond, and the gas and electric properties at Eureka The American River Electric Company, which owns a large hydroelectric plant on the American River in Eldorado County and maintains a reserve steam turbine plant at Stockton, is included in the transaction. The Humboldt Gas & Electric Company, operating at Eureka, possesses a considerable water-power development in Trinity County, transmitting energy to Eureka, sixty-five miles away. The American River Electric Company's business includes service to Stockton, Placerville, Florin, Elk Grove, Sheldon, Gault, Lodi and Plymouth by means of long-distance transmission lines, which are also extensively utilized for supplying power for gold-mining and irrigation purposes. The Humboldt electric business includes service to the towns of Arcata, Alton, Ferndale, Field's Landing, Fortuna, Hydesville, Loleta and Rohnersville. Eureka and surrounding towns have a population of 22,000. They are located on Humboldt Bay, which affords one of the few good harbors on the Pacific Coast. Eureka will soon be connected with San Francisco by a railroad now under construction. Stockton, with its suburbs, has a population of 30,000, and, besides being one of the oldest cities in California, is a manufacturing center of importance. Richmond, a newer town of 12,000 people, lies on San Francisco Bay, south of Berkeley. It also is a manufacturing center and is the location of large new shops being built by the Pullman Car Company. All three cities have shown very rapid recent growth.

Commonwealth Power, Railway & Light Company.—The returns of the Commonwealth Power, Railway & Light Company, the holding concern organized a year ago by Hodenpyl, Walbridge & Co. and E. W. Clark & Co. to take over railway and light properties in Michigan, will be more favorable for the year 1910 than the best estimates made by the management. As the company has been in operation only for a year, comparisons must be made with the individual operations of the subsidiary companies in previous years. An estimate based upon the actual figures for the first ten months of the year shows gross $4,950,000, as compared with $4,350,000 for the separate companies during the previous year, and net $2,390,000, as compared with $2,105,000 in the previous year. The surplus after paying fixed charges will be $910,000, which is equal to 15.16 per cent on the outstanding preferred stock of the company. The Commonwealth Power, Railway & Light Company, while owning the stock and controlling the operation of these subsidiaries, has not issued any bonds of its own, owing to the objection of the Michigan Railroad Commission. All of the financing necessary during the year was done by the separate companies. The properties included in the combine are the developed and undeveloped water-powers on the Muskegon, Kalamazoo, Grand and Au Sable Rivers. The subsidiary companies control the electric light and power business of Grand Rapids, Saginaw, Bay City, Kalamazoo, Battle Creek, Jackson, Flint, Pontiac, Cadillac and a number of intermediate towns, and the railway business of Grand Rapids, Saginaw and Bay City. The gas business of some of these cities is also controlled. About a year ago work was commenced on a 12,000-hp hydroelectric development on the Au Sable River and the construction of transmission lines to Bay City, Saginaw and Flint. It is said that the dam has now been completed, and the installation of machinery will begin early in the new year.

Metropolitan Reorganization Plans.—The reorganization plan of the Metropolitan Street Railway Company, upon which a committee of bondholders, assisted by Stone & Webster, has been at work for many months, was presented to the Public Service Commission last week. The total present outstanding securities and obligations of the Metropolitan Street Railway system are about $136,000,000, which does not include the outstanding securities of some of the collateral companies. The new plan provides for an issue of new securities of the total amount of about $96,000,000, making a reduction of about $40,000,000. The fixed charges, representing the interest on the bonds which have been adjusted under the plan, have been reduced more than $1,000,000 per year. The plan also provides for participation on the part of the old stockholders by the payment of an assessment which is expected to furnish the new company with $10,000,000 in cash. It is said that if the Interborough-Metropolitan Company fails to meet its assessment on its stock of the Metropolitan Street Railway Company the property will probably be sold at foreclosure and will be bought in by Stone & Webster and operated by that well-known firm. The Interborough-Metropolitan has continually refused to confer with the reorganization committee and the committee has arranged with Stone & Webster to do the necessary financing in case the parent company refuses to participate.

United Properties Company.—The United Properties Company of California was incorporated Dec. 30 under the laws of Delaware with a capital stock of $200,000,000. The company is authorized to equip, construct and operate railroads, steamship lines, electric light and power plants and traction lines, provide water for domestic uses and irrigation and build and operate wharves, docks and warehouses. The operating offices will be in San Francisco and Oakland. The directors are Harry W. Davis, of Wilmington; F. M. Smith, W. S. Tevis, R. J. Hanford, Gavin McNab and W. R. Alberger, of San Francisco; C. B. Zabriskie, of New York, and Dennis Searles, of Oakland. It is said that the new corporation represents a merger of all the public utility companies of Berkeley and Oakland, including the ferry lines to San Francisco. Mr. Zabriskie is manager in New York of the Pacific Coast Borax Company, of which F. M. Smith is president. He declined to make any statement concerning the new company at the present time.

Southern Bell Telephone Bonds.—N. W. Harris & Company and Kidder, Peabody & Company are advertising for sale to the public at 96 and interest the $10,000,000 issue of the Southern Bell Telephone & Telegraph Company thirty-year first mortgage 5 per cent bonds. In the circular announcing the sale of these bonds the report of the company for 1910 (partially estimated) is stated as follows: Gross revenue, $6,000,000; operating expenses and taxes, including $1,820,000 maintenance charges, $4,300,000; net earnings, $1,700,000, leaving a surplus, after paying the interest on the new bond issue, of $1,200,000. It is stated in the circular that the territory served by the Southern Bell company includes the most rapidly growing portion of the Southern States, and that the total population served is estimated at over 12,000,000. On Oct. 31 the company was operating 14.782 miles of pole lines and had in service 250,000 miles of wire on poles and 167,000 miles of underground wire.

Third Avenue Bondholders Appeal.—The bondholders' committee of the Third Avenue Railroad Company has appealed to the Supreme Court of New York for a review of the reorganization plans which were rejected a short time ago by the Public Service Commission of the First District. The bondholders review in detail the proceedings before the commission, and show that three separate hearings, which stretched over a period of about two years, were held. The petition in their suit claims that the Public Service Commission law as construed and enforced by this commission is in violation of the constitutional rights guaranteed to the company. The ground upon which the reorganization plans were refused was that the proposed capitalization was in excess of the value of the property.

Cheap Telephone Bonds.—At the weekly auction of securities in New York, Dec. 28, 1910, $670,000 worth of 5 per cent first mortgage bonds of the National Telephone Corporation were sold for $3.350, or $5 per bond. The National Telephone Company is a West Virginia corporation and is operating at present under the control of federal receivers.. John A. Howard, who recently filed a petition in bankruptcy, was the promoter of the enterprise. A recent examination of the books of the company showed that from May 7, 1909, to July 5, 1910, the company earned a net profit of $12,822 and $187.863 was charged against it.

Hood River Electric Company Sold.—The Oregon & Washington Electric Corporation, of Portland, has purchased the Hood River (Ore.) Electric Light, Power & Water Company. It is said that the price paid for this property was $70,000, the purchaser assuming the bonded indebtedness amounting to about the same amount. The Oregon & Washington Corporation has been buying a number of plants in the Far Northwest and recently secured the Vancouver Electric Light & Power Company.

American Light & Traction Company.—The report of the American Light & Traction Company for 1910 will show larger earnings for the stockholders than in any previous year. The net earnings available for dividends will be approximately $3,735,000, or 15.34 per cent better than last year. The total gross earnings for the year, with December estimated, are $3,855,000, as compared with $3,345,440 in 1909. The officials of the company state that a conservative estimate of next year's earnings would place them at least 10 per cent above those of this year. The cash in hand in the company's treasury amounts to nearly $1,500,000, and the separate companies are said to have $1,000,000 in bank. There are also temporary investments of nearly $2,000,000, all of which shows that the company is amply supplied with working capital.

Standard Gas & Electric Company.—The earnings of the subsidiary companies of the Standard Gas & Electric Company, which was organized some months ago by H. M. Byllesby & Company, for the year 1910 show liberal increase in both gross and net over the previous year. During the month of October the Fort Smith (Ark.) Light & Traction Company showed a gain of more than 17 per cent; the Tacoma (Wash.) Gas Company showed a gain of 47 per cent; the Muskogee (Okla.) Gas & Electric Company a gain of 23.8 per cent; the Ottumwa (Ia.) Railway & Light Company a gain of 11.3 per cent; the Enid (Okla.) Electric & Gas Company a gain of 24.8 per cent; Mobile Electric Company, a gain of 10.9 per cent, and the Northern States Power Company a gain of 24.4 per cent.

Massillon Electric Company.—During the twelve months which ended Nov. 30 the earnings of the Massillon (Ohio) Electric & Gas Company were equal to 3.25 per cent on the $500,000 outstanding capital stock, as compared with 2.35 per cent the year previous. The net earnings for this period were equal to three times the amount required to pay the interest on the company's outstanding bonds. This company distributes energy for light and power to the City of Massillon and the neighboring towns of Canal Fulton and Navarre. It also owns the gas system at Massillon, but this plant has not been profitably operated since natural gas came into the field. The company serves a population of about 17,500. The total station capacity is 1000 kw. Henry L. Doherty is president of the company.

United Railways Investment Company.—The earnings of the United Railways Investment Company, which controls both the United Railroads of San Francisco and the Philadelphia Company, of Pittsburgh, showed a very large increase for the year 1910. The larger percentage of increase has been shown by the United Railroads of San Francisco. Not only have the gross receipts of this company grown to a considerable extent, but the operating expenses have been reduced, owing to the fact that the supply of power costs much less than it did a year ago. This is on account of the operation of the company's hydroelectric plants on the Stanislaus River. It is expected that the Investment company will in a short time resume dividends upon its preferred stock.

Niagara Falls Power Company Stock.—The Public Service Commission of the Second District of New York having authorized the Niagara Falls Power Company to issue common stock to the amount of $1,534,000, the financial condition of the company will be very much improved. The proceeds are to be used to liquidate the 10-year 6 per cent debentures, series "A," to the amount of $614,000; 6 per cent debentures, series "B," to the amount of $815,000, and 6 per cent debentures, series "C," to the amount of $105,000. The discharge of these outstanding obligations will relieve the company of an annual fixed charge of nearly $100,000. The company's earnings for 1910 are the largest in its history, and its business is being rapidly developed.

Cities Service Company.—Officials of the Cities Service Company state that the earnings of the subsidiary companies—the Denver Gas & Electric, the Empire District Electric and the Spokane Gas & Fuel companies—show at least 25 per cent gain in 1910 over the previous year. The largest percentages of gain were in the two electrical companies. The Empire District Electric Company has recently acquired a controlling interest in the Columbus (Kan.) Electric Company. In addition to this Henry L. Doherty & Company have acquired an interest in the Citizens' Gas, Electric & Heating Company, of Mount Vernon, Ill.

Twin City Rapid Transit Company.—The November earnings of the Twin City Rapid Transit Company, of Minneapolis, showed a loss of more than $8,000 in net, in spite of the fact that the gross earnings increased almost $40,000. This difference is explained as being due to the fact that the low water in the Mississippi River increased very largely the operating expenses. The road was forced during almost the entire month to rely upon its steam station for energy. The earnings of the company for the calendar year 1910 will be the largest in its history.

American Telephone & Telegraph Company.—T. C. Kingsbury, a member of the firm of N. W. Harris & Company, became a vice-president of the American Telephone & Telegraph Company on Jan. 1.

DIVIDENDS.

Associated Gas & Electric Company, preferred, quarterly, 1½ per cent, payable Jan. 15.

Bell Telephone Company of Pennsylvania, quarterly, 1½ per cent, payable Jan. 16.

Boston Suburban Electric Companies, preferred, quarterly, 1 per cent, payable Jan. 16.

Fort Smith (Ark.) Light & Traction Company, preferred, quarterly, 1¾ per cent, payable Jan. 15.

Manchester (N. H.) Traction, Light & Power Company, quarterly, 2 per cent, payable Jan. 16.

Minneapolis General Electric Company, preferred, semi-annual, 3 per cent; common, quarterly, 1¾ per cent, both payable Feb. 1.

National Carbon Company, quarterly, common, 1½ per cent, payable Jan. 14.

Northern States Power Company, preferred, quarterly, 1¾ per cent, payable Jan. 15.

Oklahoma Gas & Electric Company, preferred, quarterly, 1¾ per cent, payable Jan. 15.

Ottawa Light & Power Company, 1½ per cent, bonus, 2 per cent, payable Jan. 10.

Ottumwa (Iowa) Railway & Light Company, preferred, quarterly, 1¾ per cent, payable Jan. 15.

San Diego Consolidated Gas & Electric Company, quarterly, preferred, 1¾ per cent, payable Jan. 15.

Springfield (Ohio) & Xenia Railway Company, preferred, quarterly, 1¼ per cent, extra, ½ per cent, payable Jan. 5.

United Metals Selling Company, quarterly, 5 per cent, payable Jan. 15.

Youngstown & Ohio River Railroad Company, preferred, quarterly, ¾ per cent, payable Jan. 5.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses	Net Earnings	Charges	Surplus.
Chattanooga Railway & Light Company:					
November, 1910	$70,480	$36,326	$34,154	$24,120	$ 0,034
November, 1909	64,811	36,342	28,469	22,237	6,232
Cumberland Telephone & Telegraph Company:					
November, 1910	604,289	344,700	259,588	56,5[illegible]	203,07[illegible]
November, 1909	560,032	306,971	253,061	40,7[illegible]	212,310
Detroit United Railway Company:					
November, 1910	739,982	478,304	261,678	174,31[illegible]	102,308
November, 1909	676,482	440,750	235,73[illegible]	157,010	83,424
Nashville Railway & Light Company:					
November, 1910	158,739	85,848	72,891		
November, 1909	140,426	83,181	66,245		
Philadelphia Company:					
November, 1910	1,703,42[illegible]	1,002,653	700,760		
November, 1909	1,707,016	962,894	744,122		
Twin City Rapid Transit Company:					
November, 1910	619,140	319,732	299,417	137,912	161,504
November, 1909	580,795	273,044	307,751	140,251	167,500
United Railroads of San Francisco:					
November, 1910	633,618	350,465	283,153		
November, 1909	610,313	352,570	266,743		

General News

Construction News.

SAYRE, ALA.—Extensive improvements are contemplated to the property of the Sayre Mining Company, including the installation of an electric plant. The company has authorized a bond issue to the amount of $25,000 to provide funds for same.

SEWARD, ALASKA.—The Alaska Electric Company is reported to be contemplating the construction of a telephone line from Seward to the Innoko and Iditarod.

PARKER, ARIZ.—Plans are being considered by the Pacific Current Motor Company for the installation of what is known as the Price current motor on the Colorado River, at a point near Headgate Rock. The company proposes to supply water to irrigate land in this vicinity and to generate electricity to be used to operate pumps for irrigation purposes. W. H. Taggart, of Los Angeles, Cal., is secretary of the Pacific Current Motor Company.

EUREKA, CAL.—The quesion of establishing a municipal electric light plant and telephone sytem in Eureka is under consideration.

HUNTINGTON BEACH, CAL.—Preparations are being made by the Southern Pacific Railroad Company to equip its steam railroad to the Holly Sugar Company's factory for electrical operation. Representatives of the Associated Chambers of Commerce of Orange County are circulating a petition asking the Southern Pacific Company to equip its railway between Huntington Beach and Anaheim for electrical operation and to operate an interurban service between the two cities.

KERMAN, CAL.—Preparations are being made by the Vineland Telephone Company, recently incorporated, for the erection of a telephone line for the accommodation of the farmers in the Kerman district from the town to and beyond the river. The main line will be about six and a half miles long. It will have eight branches to the nearby ranches, covering ten miles or more. The company is capitalized at $25,000 and the incorporators are: J. C. Ashlin, Willfred Baker, R. S. Elliott, P. H. Carlsgard and N. O. P. Syongrounds.

MERIDIAN, CAL.—Surveys are being made by the Pacific Gas & Electric Company for the purpose of extending its transmission lines from Meridian to Colusa. When the line is completed the company will supply electricity for lamps and motors in Colusa. The company also proposes to supply electricity to the reclamation districts between Meridian and Colusa.

SAN FRANCISCO, CAL.—The Standard American Dredging Company, of San Francisco, Cal., has just placed an order with the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for a 700-hp alternating-current induction motor.

SAN FRANCISCO, CAL.—Plans have been completed by Alfred I. Coffey, city architect, for the power house and laundry building of the new San Francisco Hospital, located at Twenty-third Street and Potrero Avenue. The equipment of the power house will include four steam turbo-generators. Provision will be made for an additional turbine.

SAN JACINTO, CAL.—The Ramona Power Company has purchased a reservoir site below Idyllwild. The company has secured rights for power purposes to practically all the water in the north and south forks of Strawberry Creek. The water will be piped from a point as high as possible in the canyon in order to secure a maximum fall to the power house, to be located in San Jacinto Canyon, near the foot of the mountain. After passing through the power house the water will be returned to its natural source, where the water is already owned for irrigation purposes.

SUSANVILLE, CAL.—Work is progressing rapidly on the Cady & Bunnell power plant, located on the Bunnell property, about seven miles west of Susanville. The plant when completed will supply electricity for lamps in Susanville.

PALISADE, COL.—The Town Board has agreed to grant an electric light franchise to the Mutual Light, Power & Telephone Company, provided the promoters will agree to put up a cash bond to carry out the provisions of the proposed franchise. Owing to dissatisfaction with the service of the old Palisade Light & Power Company a new company has been organized by local citizens. The old plant was taken over for $7,000 by Hendrie & Bolthoff, of Denver, Col., who have recently been operating it. H. P. Waterman, secretary of the old company, has asked the Council not to grant the new franchise, and has promised to install a new plant and furnish a twenty-four-hour service, if given time to make the necessary changes.

BRIDGEPORT, CONN.—The directors of the United Illuminating Company, which operates electric plants in Bridgeport and New Haven, Conn., have voted to advise the stockholders to take over the plant and holdings of the Fairfield Electric Light Company, of Fairfield, Conn. It is expected that the transfer will be made at the annual meeting in March. The company recently secured the property of the Stratford Light Company, which gave the company the entire field between this city and New Haven.

NEW HAVEN, CONN.—The Connecticut Company has awarded contracts to the Gillett Construction Company and the Lord & Lake Company for the construction of a brick addition to its power house on Grand Avenue, New Haven. A 400-kw generator and other electrical equipment will be installed.

WINDSOR LOCKS, CONN.—The Northern Connecticut Light & Power Company has given notice that it will apply to the next Legislature for the right to extend its transmission lines, pipes, conduits, etc., in and through the highways of Windham and Middlesex Counties; also to construct dams, power plants and electrical systems over, under or through navigable waters and for the right to take by eminent domain lands necessary or convenient for the purposes of the company. It is understood that the company proposes to supply electricity to electric light and power companies in Middlesex County.

WASHINGTON, D. C.—Bids will be received until Jan. 10 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the Navy Yard, Mare Island, Cal., schedule 3170, one overhead traveling electric crane; schedule 3187, one 2-kw constant speed motor-generator and one 2-kw, open core wireless telegraph transformer.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of the District of Columbia, Washington, D. C., until Jan. 10, for the construction of a central steam-heating plant and boiler house at the M Street, High, Simons and Douglass Schools, Washington, D. C. Form of proposal and all necesary information may be obtained from the chief clerk, Engineer Department, Room 427, District Building.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Jan. 10 for furnishing at the various navy yards the following supplies:—Brooklyn, N. Y.—Schedule 3207, one set of speed gears, one set of motors with controlling appliances and one set of four distant controlling apparatus for above gears. Bids will also be received until Jan. 17 as follows: Puget Sound, Wash.—Schedule 3188, one special motor bead stock speed lathe. Newport, R. I.—Schedule 3236, one air compressor set. Schedule 3232, eighteen generator sets and 200 transformers, to be delivered at the various navy yards. Norfolk, Va.—Schedule 3243, electrical helm indicators, two steering telegraph sets. Proposals will also be received until Jan. 24: Schedule 3248, to be delivered at Norfolk, Va., vacuum drying and impregnating apparatus. Norfolk Va.—Schedule 3247, one electric deck winch.

ATLANTA, GA.—It is reported that contracts are now being awarded by the Georgia Power Company, through the Northern Construction Company, of Detroit, Mich., for the development of its Tallulah Falls property, where it is proposed to develop over 50,000 hp for transmission by electricity. The work includes the construction of a dam 50 ft. high and a 12-ft. tunnel, one and one-half miles long, to convey water to power house; 150 miles of transmission lines, to be carried on steel towers, carrying a voltage of 100,000. Three units will be installed at first, consisting of 8000-kw generators driven by 14,000-hp water wheels under a 600-ft. head. The ultimate development will include six units, same as above.

ROBERTA, GA.—Bids will be received by W. J. Marshall, R. F. D., Lizell, Ga., about Jan. 30, for the construction of an electric light plant for the town of Roberta.

CHICAGO, ILL.—Sealed proposals will be received by the City of Chicago until Jan. 19, at the office of the Commissioner of Public Works City Hall, 200 East Randolph Street, Chicago, Ill., for two 20,000,000-gal. centrifugal pumps and two 1000-hp, synchronous electric motors, together with piping, wiring, switchboard and other appurtenances at the Twenty-second Street pumping station, according to plans and specifications on file in the office of the Department of Public Works, Room 705, City Hall, Chicago, Ill. Proposals must be made out on blanks furnished by the above office. B. J. Mullaney is Commissioner of Public Works.

TAMPICO, ILL.—The Village Council has adopted a resolution to notify the Dixon, Rock Falls & Southwestern Railway Company that it must equip its railway for electrical operation or discontinue operating its car in the village and tear up its tracks. The company secured a franchise to operate an electric railway through the village, but so far the motive power has been furnished by a dummy steam engine. The road extends from Tampico to Hooppole, a distance of about fifteen miles.

WATAGA, ILL.—It is reported that the Galesburg & Great Eastern Railroad Company is contemplating equipping its railroad for electrical operation and extending it into Galesburg. A. J. Harms, of Chicago, Ill., is superintendent.

BEECH GROVE, IND.—Plans are being made by the Big Four Railroad for the construction of six additional shops at its plant at Beech Grove, which will include a combined steam and electric power house. The new shops will be equipped for electric motor drive throughout.

FRANKFORT, IND.—The plant and holdings of the Central Energy Company, of Frankfort, Ind., have been taken over by the Central Union Telephone Company, of Chicago, Ill.

HENRYVILLE, IND.—An independent telephone company has been organized in Henryville for the purpose of installing a new system in this place. The Cumberland Telephone Company now operates a telephone system here.

JEFFERSONVILLE, IND.—Owing to the Cumberland Telephone Company having raised its rates, steps have been taken to organize and install an independent telephone plant in this locality. The City Council, it is said, will grant a new company a franchise.

MARION, IND.—No bids were submitted for the $50,000 bond issue offered by the City of Marion, the proceeds to be used for the construction of an electric light plant. It is understood that the validity of the bonds is questioned. The city already owns a plant for street lighting and proposes to establish a plant to supply electricity for commercial purposes. The Marion Light & Heating Company, owned by the American Gas & Electric Company, now supplies electrical service in this city.

ADAIR, IA.—At an election held Dec. 20 the citizens voted in favor of the proposition to issue $10,000 in bonds, the proceeds to be used for the construction of an electric light plant. This will make the bond issue $30,000 for the water works and electric light plant. The Council is ready to receive proposals for the service of an engineer, and to let contracts for the entire work. J. J. Hayden is town clerk.

CENTERVILLE, IA.—Plans are being considered by the Centerville Light, Power & Traction Company for rebuilding its central heating system and the installation of a new 300-hp boiler.

HAMBURG, IA.—The citizens on Dec. 12 voted to grant a franchise to E. B. Hillman, of Hamburg, Ia., a franchise to construct and operate an electric light plant in Hamburg, Ia. Frank Blunk, of Hamburg, Ia., is engineer in charge.

KEOKUK, IA.—The Keokuk Electric Railway & Power Company is reported to be preparing plans for making extensive changes to its power plant in Keokuk. A. D. Ayres, of Keokuk, is manager.

MENLO, IA.—The Farmers' Mutual Telephone Company is contemplating the erection of toll lines to Guthrie Center, Greenfield, Stuart and Casey.

REDFIELD, IA.—The installation of an electric light plant in Redfield is reported to be under consideration.

ROCK VALLEY, IA.—The local telephone exchange has been purchased by E. S. Thayer, who has also petitioned the City Council for an electric light franchise in Rock Valley.

INDEPENDENCE, KAN.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Jan. 26 for the construction of United States post office, complete, including plumbing, gas piping, heating apparatus and electric conduits and wiring, in accordance with plans and specifications, copies of which may be obtained at the above office or from the custodian of site at Independence. James Knox Taylor is Supervising Architect.

MURRAY, KY.—The Murray Traction Company has begun work on the preliminary surveys for its proposed electric railway to extend from Murray to the Tennessee River, sixteen miles in length. Nathan Ryan, of Murray, is president of the company.

CROWLEY, LA.—The City Council has authorized the purchase of additional equipment for the municipal electric light plant, including one 110-hp engine, one 150-kw generator and one 75-kw generator. It is proposed to install a two-unit system and establish a twenty-four-hour service for lamps and motors.

DEXTER, MAINE.—It is reported that the Morrison Woolen Company has contracted with the Central Maine Power Company, of Dexter, Maine, to supply electricity to operate the Morrison mill on Center Street.

FARMINGTON, MAINE.—The new power plant of the Franklin Power Company, located at Cleveland Rips, on the Carrabassett River, four miles above North Anson, is completed and supplying electricity for lamps and motors in Farmington. The transmission line is seventeen miles in length. The plant has an output of 600 kw. Beginning with Jan. 1, the price of electricity will be reduced from 18 cents to 12½ cents per kw-hour.

PRESQUE ISLE, MAINE.—The Aroostook Valley Railroad Company is contemplating the construction of two extensions to its system, one to begin at Washington Station in Presque Isle and to extend across Woodland to New Sweden, and the other through Caribou to Limestone.

SALISBURY, MD.—The City Council has awarded the contract for street lighting to the Salisbury Light, Heat & Power Company for a term of three years. Under the terms of the contract the company is to furnish 16-cp incandescent lamps, with an all-night service, at the rate of 75 cents per lamp per month and arc lamps at $5 each per month, which is the same price the city is paying under the present contract.

BOSTON, MASS.—Orders have recently been placed by the Boston Elevated Railway, of Boston, Mass., with the Westinghouse Machine Company, of Pittsburgh, Pa., for seven stokers to replace some old equipment at its Charleston and Lincoln Wharf stations.

BURLINGTON, P. O. WOBURN, MASS.—The citizens have voted to enter into a contract with the Edison Electric Illuminating Company, of Boston, Mass., for the installation of twenty-five street lamps

LEOMINSTER, MASS.—The Selectmen and lighting committee have decided to change the present street arc lamps to tungsten lamps for street lighting. It is proposed to install 80-cp and 60-cp tungsten lamps and to enter into a new contract with the Leominster Electric Light & Power Company for lighting the streets of the town. Under the present contract the town pays $105 each per year for arc lamps with an all-night service and $75 per lamp per year for lamps burning until 1 o'clock.

LEOMINSTER, MASS.—The Leominster Electric Light & Power Company has announced a reduction in the price of electricity for lamps and motors, taking effect from Jan. 1, 1911. Under the new schedule the rate is reduced from 16 cents to 15 cents per kw-hour for the first 50 kw consumed each month and 12 cents per kw-hour for all used in excess of that amount. The price for electricity for motors has been reduced to 5 cents per kw-hour for the first 2000 kw consumed per month, and all in excess of that amount 2½ cents per kw-hour.

WORCESTER, MASS.—Mayor James Logan, of Worcester, has filed with the State Board of Gas and Electric Light Commissioners a formal complaint against the Worcester Electric Light Company, alleging exorbitant prices. He states that the company has refused to furnish the city with arc lamps for less than $86.25 each per year, which he believes is an exorbitant price.

IRONWOOD, MICH.—The Gogebic & Iron Counties Railway & Light Company has filed amendments to its charter increasing its capital stock from $100,000 to $700,000. The company is negotiating with the Twin City General Electric Company with a view of taking over the plant and holdings of the last-named company.

LANSING, MICH.—The Au Sable Electric Power Company has applied to the State Railroad Commission for permission to issue $450,000 in bonds, the proceeds to be used for the erection of an electric transmission line from its power plant on the Au Sable River to Saginaw, Flint, Owosso, Lansing and other cities of central Michigan.

MOUNT CLEMENS, MICH.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Feb. 6, 1911, for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office at Mount Clemens, Mich., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Mount Clemens, Mich., or at the above office. James Knox Taylor is Supervising Architect.

BRAHAM, MINN.—The Eastern Minnesota Power Company, of Pine City, Minn., has submitted a proposition to the citizens of Braham, asking them to subscribe to $5,000 in capital stock of the company and to install electric lamps. The company agrees to furnish and maintain twenty-five street lamps, with an all-night service, for $50 per month.

BRAINERD, MINN.—Work has commenced on the construction of the new electric plant, which is being erected by the Toltz Engineering Company, of St. Paul, Minn. It is expected to have plant in operation by March. Under the arrangements with the City of Brainerd the Toltz Engineering Company will supply electricity at the switchboard of the municipal electric plant. The city will continue to own and operate the distributing system. Since the municipal plant was burned out last April energy has been supplied from the railway shops of the Northern Pacific Railroad Company.

FERGUS FALLS, MINN.—The Edwards Telephone Company, recently organized, proposes to erect a telephone system in the Town of Friberg and adjoining townships in the central part of this county. August Splisgerber is president of the company and E. M. Nelson is secretary.

SHAKOPEE, MINN.—Plans are being prepared by the superintendent of the municipal electric light plant for the installation of an engine-driven pump in the power house, bids for which will be received until Jan. 10.

WORTHINGTON, MINN.—Plans are being considered for the construction of an electric railway to connect Albert Lea and Worthington, via Elmore, Blue Earth, East Chain, Fairmont and along the southern edge of Minnesota and northern Iowa. G. E. Doyle, of East Chain, and H. W. Knight, of Chicago, Ill., are interested in the project.

MARYVILLE, MO.—Plans are being prepared by the Missouri & Kansas Telephone Company for extensive improvements to its plant in Maryville, which will involve an expenditure of about $40,000.

WARSAW, MO.—S. O. Norris, of the Continental Power & Development Company, of Clinton, Mo., is reported to have purchased the Arnolds mill property and proposes to supply electricity for lamps and motors in Warsaw. It is understood that power for operating the plant will be secured from the Niangua River

ORLEANS, NEB.—The power house of the Orleans Electric Light & Power Company was badly damaged by an explosion on Dec. 18. Work on reconstruction of the plant will begin immediately.

MASON, NEV.—Negotiations are under way between Jules Labarthe, general manager of the Mason Valley Mines Company and the Truckee River General Electric Company whereby the last-named company will supply electricity to operate the mines of the Mason Valley Mines Company. Under the terms of the contract the Truckee River General Electric Company is to erect a new steel tower transmission line from its power plant at Virginia City to the smelter site, which will give the smelting company service from two independent sources, the site now being connected with the Yerington transmission line.

RENO. NEV.—Plans have been completed by the Truckee River General Electric Company for the construction of a new power plant near Verdi. The work will include the construction of a large dam across the Truckee River, and the erection of a power house, near Verdi, where about 3000 hp will be developed. Electricity generated at this plant will be used for the smelter at Mason City and Waubuska and also for the operation of mines at Yerington.

GIBBSBORO, N. J.—The installation of a municipal electric light plant in Gibbsboro is reported to be under consideration.

HARRISON, N. J.—The Town Council is considering the question of changing the street lighting system on Harrison Avenue. It is proposed to erect arches across the street at a distance of every 100 ft., and to place twelve Madga lamps on each arch. The system may also be erected along the turnpike road to the Hackensack Bridge, through Kearny, the arches to be erected every 200 ft.

MORRISTOWN, N. J.—The Pine Brook Electric Railroad Company has applied for a franchise to construct and operate an electric railway in Bloomfield Avenue, near Boonton.

CLOVIS, N. M.—Plans are being considered by W. D. McBee, of Clovis, and associates for the construction of an electric power plant and erection of a system of transmission lines to the farms in the vicinity of Melrose, N. M., to supply electricity to operate irrigating pumping plants. It is proposed to install motors and pumps at the different wells from which water is obtained. It is proposed to reclaim about 12,000 acres. The cost of the work is estimated at about $300,000.

SILVER CITY, N. M.—The Gila River Power Company has filed application with the Territorial Engineer for water in Gila River in the western part of Grant County. The company expects to develop about 15,000 hp.

BUFFALO, N. Y.—Plans have been completed for the construction and equipment of a power house for the International Bridge Company at Niagara Street and the Erie Canal, near the bridge entrance.

BUFFALO, N. Y.—The Niagara Gorge Railroad Company has recently installed a small substation in Lewiston, the equipment of which consists of a 300-kw General Electric rotary converter with two transformers.

BUFFALO, N. Y.—The Aldermanic Lamp Committee has entered into a new agreement with the Buffalo General Electric Company to supply electricity for lighting the city buildings at a flat rate of 4½ cents per kw-hour. The old rate was 6 cents. In school buildings where electricity is used to operate moving picture exhibits the price will be 9 cents per kw-hour.

MONROE, N. Y.—The Livingston-Niagara Power Company is reported to have been granted permission to exercise its franchises in the towns of Avon, Caledonia, Geneseo, Lima and York in Livingston County, and in the towns of Rush Mendon and Wheatland, in Monroe County. It is expected that the Lima-Honeoy Falls Trolley Company, which has recently changed hands, will come under the control of the new company.

NEW YORK, N. Y.—Bids will be received until Jan. 10 by Kingsley L. Martin, Commissioner of Bridges, for constructing elevator, stairs, drainage, ornamental and electrical work for the anchor piers of the Queensboro Bridge over the East River.

NEW YORK, N. Y.—Frederick W. Whittridge, receiver of the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway Company, has applied to the Public Service Commission, First District, for permission to change the motive power on the 110th Street crosstown line to storage battery power.

ROME, N. Y.—The Board of Public Works has awarded the contract for lighting the streets of the city for a term of five years to the Rome Electric Light & Power Company at $83 per arc lamp per year. Under the present contract the city pays $90 per lamp per year.

WILSON, N. Y.—The Ontario Railway Company, recently incorporated, is reported to have submitted a proposition to the Village Board of Trustees offering to build an electric railway from the village of Wilson to the Rome, Watertown & Ogdensburg Railroad, a distance of two miles.

BLACK MOUNTAIN, N. C.—C. E. Waddell, of Asheville, N. C., engineer, is reported to have been engaged by the Blue Ridge Association for Christian Conference to take charge of the construction of electric light plant, water works and grounds in connection with the erection of a summer school to be established by the association.

WINSTON-SALEM, N. C.—Plans are being made by the P. H. Hanes Knitting Company for the installation of 8600 spindles in its soft-yarn mill. The mill will be operated by electricity and will require about 400 hp.

MINOT, N. D.—Announcement has been made that the plant and holdings of the Minot Light & Telephone Company have been purchased by H. M. Byllesby & Company, of Chicago, Ill. The new owners will take over the plant Jan. 20, 1911.

OAKES, N. D.—The Council is considering a proposition submitted by E. Marshall, of St. Paul, Minn., and E. M. Pope, of Watertown, S. D., for the installation of an electric light plant in Oakes.

STANLEY, N. D.—Application has been made to the Council, by John I Moore, Minot, N. D., for a franchise to install an electric light plant in Stanley.

ALLIANCE, OHIO.—The Alliance-Akron Railroad Company has awarded the contract for grading its proposed electric railway between Alliance and Akron, a distance of twenty-six miles, to the McGinty Construction Company. Charles Keith is president.

COLUMBUS, OHIO.—Plans are being considered for the construction of a conduit to hold the wires owned by the State and the city. It is proposed to build a conduit from the prison on West Spring Street, east of Front Street, south to Broad, where it will be branched to the State institutions east and west of the river. It is proposed to supply electricity to the different State institutions from the power plant now being constructed at the Ohio Penitentiary. The State House will be the first to be connected.

GALLIPOLIS, OHIO.—The Kanauga Traction Company is planning to extend its railway to Addison in the spring. J. S. Howard is secretary.

HURON, OHIO.—The capital stock of the Huron Telephone Company has been increased from $10,000 to $40,000.

IRONTON, OHIO.—The capital stock of the Home Telephone Company has been increased from $50,000 to $120,000, the proceeds to be used to take over the plant of the Bell Company, in Ironton.

KENTON, OHIO.—The Kenton Gas & Electric Company has applied to the City Council for an extension of its franchise. In case the franchise is extended it is understood that the company will build a new plant at once, at a cost of $65,000.

LANCASTER, OHIO.—The contract for furnishing and installing additional compressor piping, etc., for light, heat and power plant at the Boys' Industrial School, Lancaster, Ohio, was awarded to the Laidlaw-Dun-Gordon Company, of Cincinnati, Ohio. F. C. Gerlach is superitendent.

ST. MARY'S, OHIO.—The St. Mary's Machine Company is reported to have secured the contract to install a gas-producing plant at the electric light plant, to cost about $18,500.

CANYON CITY, ORE.—Arrangements are being made by the Eastern Oregon Light & Power Company, of Baker City, Ore., for the installation of a power plant at Magoon Lake to furnish electricity for lamps and motors in the John Day Valley. W. C. Parrish, of Baker City, is superintendent of the company. The company also proposes to furnish electricity for operating pumps to supply water for irrigation purposes in Harney County.

FREEWATER, ORE.—The Pacific Power & Light Company is reported to be contemplating the erection of an electric transmission line to Gardena, a distance of about eight miles.

KLAMATH FALLS, ORE.—A movement has been started by George B. Frank, a local contractor, toward the establishment of a municipal electric light plant in Klamath Falls, Ore.

PORTLAND, ORE.—The Portland Railway, Light & Power Company has placed its new east side power station, known as station L, in operation. The plant has an output of 2720 hp. A 200-kw direct-current generator will be installed in the power house next spring.

PANAMA.—Sealed proposals will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Feb. 25, 1911, for furnishing machines, motors and limit switches to operate the Stoney Gate valves and cylindrical locks at Gatun, Pedro Miguel and Miraflores. Blanks and general information relating to circular (No. 614), may be obtained from the above office or at the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; 55 National Realty Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing officer.

LANCASTER, PA.—Sealed proposals will be received by the water committee at the office of the City Controller, City Hall, Lancaster, Pa., until Jan. 17, for an electrically driven centrifugal pump having a capacity of 10,000,000 gal. in twenty-four hours. Plans and specifications can be secured at the office of the superintendent of water works, Lancaster, Pa., for which a deposit of five dollars will be required. J. H. Rathfon is city controller.

POTTSTOWN, PA.—The Suburban Gas & Electric Company, of Pottstown, Pa., has recently ordered from the Westinghouse Machine Company, of Pittsburgh, Pa., one 625-kw high-pressure turbine, operating between 150 lb. steam pressure and a 28-in. vacuum. The Westinghouse Electric & Manufacturing Company will furnish a 2300-volt, 3-phase, 60-cycle, alternating-current generator to go with the turbine. The new equipment will supply electricity for light and power service.

SHICKSHINNY, PA.—Bids will be received by the borough of Shickshinny until January 10 for the installation of steam and electrical apparatus in connection with the proposed improvements to the municipal electric light plant. Specifications may be obtained upon application to the Borough Council, Shickshinny, Pa., or to Edgar Llewellyn, Pa., electrical engineer.

HOWARD, R. I.—Bids will be received until Jan. 9 by Charles Potter, secretary of Board of Charities and Corrections, for the installation of an electrical and plumbing system in the Reception Hospital, now under construction on the State Farm, Howard, R. I. Plans and specifications may be obtained from Martin & Hall, architects, 806 Union Trust Company, Providence, R. I.

CHARLESTON, S. C.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Jan. 13, for a conduit and wiring system and extension of present gas piping system at the United States custom house at Charleston, S. C., in accordance with plans and specifications, copies of which may be secured at the above office or at the office of the custodian of the building

DALLAS, S. D.—Arrangements are being made to form a company for the purpose of establishing an electric light plant in Dallas. The local business men have subscribed $6,250 toward the project. For further information address the secretary of the Boosters' Club.

ETOWAH, TENN.—T. F. Peck, secretary and general manager of the company that proposes to erect an electric light and power plant in Etowah, writes that bids for the construction of the proposed plant will be called for about April 1, 1911. The cost of the work is estimated at about $50,000.

OCOEE, TENN.—The Ocoee Construction Company, of Ocoee, Tenn., has placed an order with the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for four 3750-kva, 2300-volt, 3-phase, 60-cycle, 360-r.p.m. water-wheel type generators; four 3750-kva, 3-phase, oil-insulated water-cooled transformers; two 120-kw motor-generator sets and a fourteen-panel switchboard. The water wheels will be furnished by S. Morgan Smith Company, of York, Pa., and will have a maximum capacity of 5400 hp each. Electricity generated at the plant will be used to operate electric railways in and near Chattanooga. J. G. White & Company, of New York, N. Y., have charge of the engineering work.

AUSTIN, TEX.—Announcement has been made that the Southwestern Telephone Company will make extensive improvements and extensions in Texas and Arkansas during the next two years, which will involve an expenditure of about $3,000,000. A line will be built to Brownsville J. E. Farnsworth is general manager of the Southwestern Telephone Company.

FORT STOCKTON, TEX.—Arrangements are being made by Clay Brothers, of San Angelo, Tex., for the installation of an electric light plant and ice factory in Fort Stockton. They were recently granted a ten-year franchise by the Pecos County Commissioners.

GEORGETOWN, TEX.—The City Council is reported to have engaged F. H. Lancasshire, of Dallas, Tex., to prepare plans and specifications and as consulting engineer in connection with the reconstruction of the old plant of the Georgetown Water, Light & Power Company, for which bonds to the amount of $45,000 were recently voted for the purchase of the plant and reconstructing the same. R. E. Ward is Mayor.

HOUSTON, TEX.—Plans have been prepared by the Home Telephone Company for the erection of a telephone exchange building at Carolina Street and Rusk Avenue, to cost $30,000; the new equipment to be installed in the building will cost about $170,000.

PARIS, TEX.—F. H. Lancashire, of Dallas, Tex., has been engaged by the City Council to make investigations and make a detailed report in regard to improvements to the water pumping station and the construction of a municipal street lighting. E. H. McQuiston is Mayor.

ROCKPORT, TEX.—Plans are being made by the Rockport & Aransas Pass Railway Company, recently organized, for the construction of an interurban railway between Rockport and Aransas Pass. Electric or gasoline motors will be used. Charles F. Hoff, R. W. Newberry, S. A. Clevenger and Charles G. Johnson, of Rockport, are interested in the project.

SALT LAKE CITY, UTAH.—Proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Feb. 3, 1911, for the extension, remodeling, including plumbing, gas-piping, heating apparatus, electric conduits and wiring system, of the United States post office and court house at Salt Lake City, Utah, in accordance with plans and specifications, copies of which may be obtained from the custodian at Salt Lake City, or at the above office. James Knox Taylor is Supervising Architect.

BRATTLEBORO, VT.—At an election held Dec. 28 the citizens voted to authorize the town officials to enter into a contract with the Twin State Gas & Electric Company for a term of ten years. The proposition to install a municipal electric plant was defeated.

BLACKWOOD, VA.—Preparations are being made by the Blackwood Coal & Coke Company for extensive property development in the vicinity of Blackwood. The company will install mining and timber-cutting machinery, including a large band mill, power equipment, etc.

CAMAS, WASH.—Application has been made to the City Council by E. E. Goff, of Portland, Ore., for an electric light franchise in Camas, Wash. If the franchise is granted Mr. Goff proposes to establish a 500-hp power plant on the Washougal River, where a power site has already been secured.

PROSSER, WASH.—The Klickitat Irrigation & Power Company is reported to have applied to the Secretary of the Interior for approval of the Horse Heaven and Glade irrigation projects. The company proposes to utilize the water from the Big Klickitat River by the construction of a large reservoir, having a capacity of 240,000 acre ft. of water, to supply water to irrigate about 300,000 acres. The company also proposes to construct a large hydroelectric power plant to supply electricity to operate the pumps to pump additional water from the Columbia River The cost of the entire project is estimated at about $12,000,000. L. M. Price is chief engineer, and J. B. Early head of the contract department.

BRISTOL, WIS.—The Bristol Telephone Company has filed an amendment to its charter increasing its capital stock from $8,000 to $16,000.

EAST TROY, WIS.—The Milwaukee Electric Railway & Light Company has submitted a proposition to the Village Board to install an electric light system in East Troy.

WYOCENA, WIS.—The Columbia County Light & Power Company, which recently purchased the plant and holdings of the Duck Creek Light & Power Company, of Wyocena, Wis., has entered into a contract to supply electricity in Rio. The Columbia County company will make improvements to its plant including the installation of new machinery and erect transmission lines to Rio and Pardeeville. When the proposed improvements are completed the company will establish a twenty-four-hour service in Wyocena, Pardeeville and Rio. B. C. Keeley, manager of the Duck Creek Light & Power Company, will be manager of the new company, with an office in Pardeeville, Wis.

UPTON, WYO.—Preliminary plans are being prepared by [illegible] & McDonnell, of Kansas City, Mo., for an electric light plant and waterworks system for Upton, Wyo.

CORNWALL, ONT., CAN.—The construction of an electric railway between Hawkesbury and Cornwall is reported to be under consideration. Messrs. Moloney and P. F. Campbell are interested in the project

HAMILTON, ONT., CAN.—It is reported that the Hamilton, Caledonia & Port Dover Electric Railway Company is contemplating the construction of a power house at Caledonia. George I. Staunton, of Hamilton, Ont., Can., is interested in the company

HAMILTON, ONT., CAN.—Announcement has been made by the Imperial Traction Company, which is applying for a federal charter, that it proposes to begin work on construction of its proposed electric railway in the spring. The company proposes to build a network of railways covering western Ontario, to connect Hamilton, Guelph, Berlin, Stratford, St. Marys and London. It is also proposed to build branch lines to Niagara Falls and Sarnia. The capital stock of the company is placed at $6,000,000. The directors are: L. B. Howland, of Toronto, Ont. Roger Miller, of Ingersoll; George M. Reid, of London and S. R. Hay, of Listowel.

KINGSTON, ONT., CAN.—At a meeting of representatives of nine municipalities along the frontier between Napanee and Cornwall, held at Brockville, a union of municipalities was formed for the purpose of cooperating to secure power from the Hydro-Electric Power Commission for eastern Ontario. The towns represented above are Kingston, Napanee, Brockville, Athens, Lyn, Prescott, Cardinal, Iroquois and Morrisburg. It is estimated that about 53000 hp could be used by the municipalities represented.

REGINA, SASK., CAN.—Bids will be received until Jan. 17 by A. J. McPherson, City Commissioner, for furnishing and installing the following equipment: One 1500-kw steam turbo-generator set; one 5[illegible]-kw, direct-current generating unit; one 500-hp boiler, economizer, hand power traveling crane and a coal and ash conveyor. E. W. Bull is city electrician.

ANGUSTURA, SONORA, MEX.—Surveys are being made by the Richardson Construction Company for a large irrigation system in the valley of the Yaqui River, near Angustura, for irrigating about 5[illegible]0,000 acres of land owned by the Yaqui River Land & Irrigation Company. The system involves the construction of a reinforced-concrete dam, 180 ft. high, near Angustura. A large hydroelectric power plant will be installed in connection with the irrigation system. The cost of the entire work is estimated at $4,500,000.

OCAMPO, CHIHUAHUA, MEX.—H. C. Flipper, of El Paso, representing the Sierra Mining Company, has been granted a concession by the State of Chihuahua, for the installation of a hydroelectric power plant near Ocampo. The proposed plant will supply electricity for operating the machinery of the mining camps of the Sierra Mining Company

New Industrial Companies.

THE COON'S DE MARVEL COMPANY OF NEW YORK, of Rochester, N. Y., has been granted a charter with a capital stock of $100,000. The company proposes to manufacture electrical massage apparatus, etc. The incorporators are W. H. Coon, N. L. Coon and K. A. Holmes, all of Rochester, N. Y.

DEWEY & COMPANY, of Plano, Ill., have filed articles of incorporation, with a capital stock of $5,000, for the purpose of dealing in automobile electrical goods, vehicles, etc. The incorporators are H. M. Dewey, E. E. Gray and B. A. Kinney.

THE DOUBLE TURBINE COMPANY, of Boston, Mass., has been incorporated by Charles L. Purinton, Emma E. Mullen and Thomas C. Murphy. The company is capitalized at $50,000 and proposes to manufacture and deal in electrical machinery.

THE INTERNATIONAL CONTRACTING COMPANY, of Winnipeg, Man., Can., has been chartered with a capital stock of $5[illegible] by Robert I. Miller, E. W. Peters, S. H. Green, F. R. C[illegible]man and M. T. Hunter, all of Winnipeg.

THE JACOBSON ENGINEERING COMPANY, of Saratoga Springs, N. Y., has been incorporated with a capital stock of $[illegible] by Charles Jacobson, John E. Jacobson and James Bloomingdale, all of Saratoga Springs, N. Y.

THE P. J. O'ROURKE ELECTRICAL ENGINEERING COMPANY, of Brooklyn, N. Y., has filed articles of incorporation with a capital stock of $[illegible]5,[illegible] for the purpose of manufacturing and dealing in electrical machinery. The incorporators are P. J. O'Rourke, B. C. King and J. C. Totten, of Brooklyn, N. Y.

THE POST-BROWN ELECTRICAL MANUFACTURING COMPANY, of Los Angeles, Cal., has been incorporated by F. W. Post, E. A. Brown and A. K. Martell. The company is capitalized at $50,000.

THE PURE CARBON COMPANY, of Wellsville, N. Y., has been chartered with a capital stock of $100,000 by C. A. Farnum, W. J. Richardson, of Wellsville, N. Y., and R. A. Dempsey, of Bradford, Pa. The company proposes to manufacture carbon articles, etc.

THE RED CROSS GERM-PROOF TELEPHONE GLASS MOUTHPIECE COMPANY, of San Francisco, Cal., has been incorporated, with a capital stock of $500,000, by M. M. Morris, G. W. Merrill, H. H. Davis, G. E. Murphy and Maurice Summerfield.

THE SIERRA INCANDESCENT LAMP COMPANY, of Los Angeles, Cal., has been incorporated with a capital stock of $50,000. The directors are: W. H. Taylor, E. H. Fosdick and C. A. Barhydt.

THE WOODS ELECTRIC CAR COMPANY, of Los Angeles, Cal., has filed articles of incorporation with a capital stock of $10,000. The incorporators are R. S. Fend, E. D. Rogers and F. W. Plastine.

New Incorporations.

DAISY, KY.—The Daisy Telephone Company has been formed by Charles Franck, R. H. Madden and others. The company proposes to erect a telephone system throughout the county.

AKRON, OHIO.—The Brewster Telephone Company has been chartered, with a capital stock of $5,000, by B. T. Calaway, C. P. Bradford, Clay McClurg and W. H. Keller, all of Akron. The headquarters of the company are located at Brewster, Ohio, not a post office.

CANNELVILLE, OHIO.—The Cannelville Telephone Company has filed articles of incorporation with a capital stock of $10,000. The incorporators are: W. S. Pletcher, Allen Neal, W. W. Baughman and others. The company has recently purchased the Cannelville telephone exchange.

PHILO, OHIO.—The Connellville Telephone Company has been incorporated with a capital stock of $10,000 by John H. Swingle and others

CADDO, OKLA.—The Caddo Power Company has filed articles of incorporation with a capital stock of $6,000. The incorporators are J. D. Hartzog, D. M. Wilson and P. C. Tarver.

MANGUM, OKLA.—Articles of incorporation have been filed for the Mangum Electric Company with a capital stock of $200,000 by E. S. Bessy, L. Rutherford, of Oklahoma City, Okla., and John C. Keys, of Cleveland, Ohio.

WESTON, ORE.—The Weston Mountain Telephone Company has been incorporated with a capital stock of $2,500 by Charles M. Schneider, Lester C. Leach and Alvin S. Burrill.

CLEARFIELD, PA.—The Greene Heat, Light & Power Company has been granted a charter with a capital stock of $10,000. The directors are: A. J. Musser, of Clearfield, Pa., treasurer; John S. Fisher, of Indiana, Pa.; R. A. Shillingford, Ashury W. Lee and Howard J. Thompson, all of Clearfield, Pa.

HARLEYSVILLE, PA.—The Douglasville Telephone Company has been chartered, with a capital stock of $5,000. The company will operate a telephone in Douglas Township, with Sassamansville as the main place of business. Owen K. Schultz, of Barto, is treasurer.

HARRISBURG, PA.—Three new electric light companies have been granted charters by the Secretary of State as follows: The Lower Providence Electric Company, the Plymouth Electric Company, the West Norristown Electric Company. Each company is capitalized at $5,000 and the directors are: Herbert H. Ganser, of Norristown, Pa., treasurer; Daniel A. Bertolette and Montgomery Evans, all of Norristown, Pa

HARRISBURG, PA.—Charters have been granted by the Secretary of State to ten new companies as follows: The Edison Electric Company of Heidelberg; the Edison Electric Company of Hamburg; the Edison Electric Company of Womelsdorf; the Marion Township Electric Company; the Lower Heidelberg Township Electric Company; the Perry Township Electric Company; the Spring Township Electric Company; the West Reading Electric Company; the Wyomissing Electric Company; the Windsor Township Electric Company. Each company is capitalized at $5,000, and the directors are: George L. Roller, of Reading, Pa., treasurer; Walter A. Rigg and Harry H. Reigel, both of Reading, Pa.

HAZLETON, PA.—The Hazleton Power Company has been incorporated with a capital stock of $5,000. The directors are: A. B. Markle, C. B. Houch and C. J. Kirschner, all of Hazleton, Pa.

HAZLETON, PA.—Articles of incorporation have been filed for the Sugar Loaf Power Company with a capital stock of $5,000. The directors are: A. Markle, C. B. Houch and W. H. Lawall, all of Hazleton, Pa.

HAZLETON, PA.—The Butler Power Company has been chartered with a capital stock of $5,000. The directors are: C. J. Kirschner, of Hazleton, Pa., treasurer; A. Markle, C. B. Houck, and A. F. Harger, all of Hazleton, Pa.

HAZLETON, PA.—A charter has been granted to the Foster Power Company by the Secretary of State. The company is capitalized at $5,000 and the directors are: C. J. Kirschner, of Hazleton, Pa., treasurer; A. Markle, C. B. Houch and A. F. Harger, all of Hazleton, Pa.

PROSPECT, PA.—The Prospect Telephone Company has been granted a charter with a capital stock of $8,000. The incorporators are: Elmer Wehr, of Prospect, Pa., treasurer; J. G. Glenn, A. Bowers, and F. P. Critchlon, of Prospect, Pa.

BUMPUS MILLS, TENN.—The State Line Telephone Company has filed articles of incorporation with a capital stock of $5,000 to construct a telephone line from Bumpus Mills to Cadiz, Ky. The incorporators are: W. B. Pugh, D. Hargis, C. R. Crow and Edison T. Fentress.

FARWELL, TEX.—The Rock Island, Texico, Farwell & Southern Railway Company has been chartered with a capital stock of $200,000 to construct a seventy-five mile steam or electric railway from Farwell to a point on the south line of Cochran County, about five miles east of New Mexico. The incorporators are: M. T. Healy, S. H. Witten, D. A. Lurthicum, all of Farwell, Tex.; J. W. Shilders, K. K. Runnels, T. B. Martin and Thomas J. Allens, all of Texico, N. M.

CRIGLERSVILLE, VA.—Articles of incorporation have been filed for the Criglersville Mutual Telephone Company with a capital stock of $5,000. The officers are: W. A. Renalds, president; C. F. Ross, vice-president, both of Criglersville, and L. W. Crigler, of Madison, secretary

BLOOMER, WIS.—The Bloomer Electric Light & Power Company has been incorporated with a capital stock of $25,000 for the purpose of supplying this village with electricity for lamps and motors.

MISHICOT, WIS.—The Mishicot Telephone Company has been chartered with a capital stock of $2,600 by A. Hoist, August Rhode, P. Bomiller and others.

OSLO, WIS.—The Oslo Power & Light Company has been incorporated with a capital stock of $5,000 by A. O. Anderson, L. O. Larsen and Mabel F. Anderson. The company proposes to develop the water power at Oslo Falls. Post office address is Oslo, R. F. D., Cato, Wis.

GRAND FALLS, N. B., CAN.—The Grand Falls Power Company has been incorporated by Sir William Van Horne, H. S. Holt, president of the Royal Bank of Canada; George F. Underwood, vice-president of the International Paper Company, of New York, N. Y., and others. The company proposes to develop the water power of the Grand Falls.

HAMILTON, ONT., CAN.—The Imperial Traction Company has filed articles of incorporation for the purpose of constructing and operating an electric railway from Hamilton, extending through Guelph, Berlin, Stratford, St. Mary's, London, Ingersoll, Woodstock, Brantford and back to Hamilton, with branches to Niagara Falls and Sarnia.

TORONTO, ONT., CAN.—The Central Canada Power Company has filed articles of incorporation, with a capital stock of $10,000,000. R. H. Parmenter, A. J. Thomson, W. S. Moloch and N. B. Wormwith, of Toronto, Ont., Can., are reported to be interested in the company.

MONTREAL, QUE., CAN.—The National Hydroelectric Company has been incorporated, with a capital stock of $10,000,000.

Personal.

MR. M. E. TERBUSH, formerly with the contract department of the Commonwealth Edison Company, Chicago, is now in charge of the new-business department of the central station company in Wilmington, Del.

MR. LOUIS R. ABEL, 258 Broadway, N. Y., has accepted the position of resident engineer of the Water Power Electric Company, which has commenced the erection of a hydroelectric plant on the Catawba River at Hickory, N. C

COL. M. E. THORNTON, of Hickory, N. C., is on a visit to New York in the interest of the Water Power Electric Company, which has started work on the construction of its hydroelectric plant on the Catawba River at Hickory.

MR. ROBERT D. FERGUSON, until recently connected with the contract department of the Commonwealth Edison Company, Chicago, has resigned to accept the position of new-business agent of the Evansville Gas & Electric Company, Evansville, Ind. Mr. Ferguson was popular with his associates in Chicago, and before his departure a dinner was tendered to him by a number of his friends.

MR. EDWARD N. LAKE, for several years division engineer with the Board of Supervising Engineers, Chicago Traction, has resigned to accept a position as designing engineer with the Stone & Webster Engineering Corporation of Boston. The latter, as already noted in this journal, will design and erect a 30,000-kw generating and distributing system for the Boston Elevated Railway Company, and no doubt Mr. Lake will have something to do with this work.

MR. CLIFFORD S. MACCALLA, who has been with the Washington Water Power Company, Spokane, Wash., for the past seven years, has been appointed general manager, to succeed Mr. D. L. Huntington, who retains the presidency of the company. Mr. MacCalla was in charge of the construction of the Post Falls dam, a generating station, the steam relay station in Spokane and the Little Falls dam and generating station. He will assume charge of the construction of a hydraulic installation five miles above Little Falls.

Obituary.

WILLIAM DE FOREST BROWN, secretary and treasurer of the National India Rubber Company, of Bristol, R. I., lost his life by drowning while out duck shooting on Dec. 9. His canoe capsized, and the heavy clothing he wore prevented his saving himself by swimming. Mr Brown was born in Rehoboth, Mass., and spent almost his entire life in connection with the rubber-covered wire industry. For the past eighteen years he had been secretary of the National India Rubber Company, and six years ago he was also elected to the office of treasurer, succeeding Colonel Samuel P. Colt. Mr. Brown is survived by a widow and a grown daughter. A public funeral was held Dec. 12 in the Congregational Church at Rehoboth, after private services at the Brown home in Bristol.

MR. EDWIN J. JENNESS, general foreman for the Western Electric Company at the Hawthorne Works, Chicago, died in Phoenix, Ariz., on Dec. 28. Mr. Jenness had been ill for some time and he left Chicago last February in the hope of benefiting his health. He was born in Rye Branch, N. H., in 1865, and had been connected with the Western Electric Company for twenty years. He had charge of several departments at Hawthorne and was held in high esteem by his associates. He invented a number of improvements in shop practice, and owing to his executive and technical ability was considered one of the most valuable men employed by the company in the manufacturing end of its large business. Mr. Jenness, who was unmarried, was an associate member of the American Institute of Electrical Engineers.

Trade Publications.

BELTED ENGINES.—The Allis-Chalmers Company, Milwaukee, Wis., has issued Bulletin No. 1501 dealing with the Allis-Chalmers Reliance type of belted Corliss engine.

WATT-HOUR METERS FOR SWITCHBOARD SERVICE.—The General Electric Company has issued a new edition of its Bulletin No. 4662-A on watt-hour meters for switchboard service

THE 1200-VOLT DIRECT-CURRENT RAILWAY .—Bulletin No. 4794, issued by the General Electric Company, describes the 1200-volt lines of the Milwaukee Electric Railway & Light Company.

CARBON DIOXIDE RECORDERS.—The Precision Instrument Company, 49 Larned Street, W., Detroit, Mich., has issued an illustrated leaflet devoted to the Simmance-Abady carbon dioxide recorder, which is equipped with a sixty-day chart.

INCANDESCENT LAMPS.—The Franklin Electric Manufacturing Company, Hartford, Conn., is distributing mailing folders devoted to its incandescent lamps. Attention is called to the fact that each lamp sent out is thoroughly tested before being shipped.

ELECTRIC CRANES.—The constructive details of electric traveling cranes are well illustrated in catalog No. 25 of the Northern Engineering Works, Detroit, Mich. The catalog contains numerous illustrations showing industrial establishments in which the various types of traveling cranes are employed.

FRICTION CLUTCHES.—The Carlyle Johnson Machine Company, Manchester, Conn., has issued a bandsome catalog devoted to Johnson friction clutches. Especial mention is made of clutches for cut-off coupling work in connection with marine motors, for which a one-way clutch is particularly adapted.

WATT-HOUR METERS.—In bulletin No. 131 of the Federal Sign System, 205 La Salle Street, Chicago, Ill., a complete description is given of the Willis "straight-line" watt-hour meter. This instrument is a direct reading meter which can be used for either direct current or alternating current without readjustment or recalibration.

PRINTING ATTACHMENT.—The Minerallic Electric Company, 1004 West Van Buren Street, Chicago, Ill., has issued a new bulletin (No. 25) describing its portable printing attachment as well as the contact-making clock used in connection with it and several features recently added to the company's standard printing attachment.

FITTINGS FOR VACUUM CLEANERS.—The Keller Manufacturing Company, Philadelphia, Pa., has had printed for distribution a sheet containing outline illustrations of standard pipe fittings that may be used with vacuum cleaner pipe installations. While these fittings are standard, many are not used in ordinary piping work, and the trade names of the fittings are given in order to facilitate ordering the same.

LIGHTING SPECIALTIES.—The McGill Manufacturing Company, 36 Oak Street, Valparaiso, Ind., has issued a handsome catalog dealing with lamp guards, portable lamps, soldering specialties, etc. Among the new devices described is a reflector-guard which performs the double service of protecting lamps and reflecting light to any desired point. There is also shown a special metal cone shade for use in connection with wire guards.

ELECTRIC PYROMETERS.—Bulletin No. 130, of the Bristol Company, Waterbury, Conn., is a fifty-six-page illustrated catalog of electric pyrometers, and includes description and lists of both indicating and recording forms of such pyrometers, with explanation of the special patented features, as for instance, basic patents on means of compensating readings of thermoelectric pyrometers for changes in cold-end temperature. On pages 48 to 55 a list is given of more than 700 users of the Bristol pyrometers.

ELECTRIC MINE LOCOMOTIVES.—The General Electric Company has issued Bulletin No. 4790 illustrating and describing in considerable detail two-motor and three-motor mine locomotives of various ratings, arranged to operate either singly or in tandem. The bulletin describes also the gathering locomotive, which consists of a standard locomotive equipped with a motor-operated reel, to which is attached a flexible heavy insulated cable. The gathering locomotive can, therefore, be operated for some distance beyond the terminal of the trolley wire by merely slipping a hook fastened to one end of the cable over the trolley wire. The reel operates automatically and the locomotive is operated in the same manner as when the trolley is used.

ELECTRICAL HOUSE GOODS.—House Goods Bulletin No. 9[illegible], just issued by the Western Electric Company, lists in an attractive manner apparatus, appliances, tools and devices intended for everyday household use. Inter-phones for residences and office service, for private line telephone systems and for apartment house and vestibule use, all of Western Electric manufacture, are listed in many varieties. The booklet contains information and prices on telephone arms and brackets, annunciators, dry batteries, Edison cells, "Hawthorn" bell ringing transformers, battery supplies, pocket electrical instruments, bells and buzzers of many types, including the "Hawthorn"; burglar alarms, door and window springs and door openers, fire-alarm boxes and annunciators, electric heating devices, including irons, tea kettles, percolators, toasters, chafing dishes, water heaters, air heaters, warming pads and curling iron heaters; "Sunbeam" Mazda lamps, miniature lamps, Christmas tree outfits, Holophane reflectors, portable lamps for a variety of uses, "Hawthorn" Mazdaliers, including the folding type; lamp cords, sockets and receptacles, pendent switches, plugs and current taps, tubular flashlights and vest-pocket flashlights, time switches and door switches, [illegible] medical apparatus, including medical batteries, "Hawthorn" electrical massage vibrators and applicators; "Hawthorn" small power motors, sewing machine motors, buffing and grinding machines, washing machines and suction sweepers; "Hawthorn" desk and bracket fans, oscillating fans, ceiling fans and fan motor outfits; push buttons of cast bronze and stamped metal; "Hawthorn" floor treads, speaking tubes, whistles and mouthpieces; switches, telegraph apparatus, relays, arresters, toy battery motors, electrical toy outfits, "Hawthorn" watchmen's time detectors, wireless apparatus; high-tension insulators, "Hawthorn" incandescent lamp cord, call bell outfits, electric window tappers, electric alarm clocks, etc

BUSINESS NOTES.

THE CENTURY ELECTRIC COMPANY St. Louis, has appointed Mr Gus Sachs, 1810 Main Street, Dallas, Tex., as its sales agent for the State of Texas. Mr. Sachs is very well known in that territory, which is also true of the "Century" motors which he will handle.

THE HOYT ELECTRICAL INSTRUMENT COMPANY has found it advisable to close the sales office it has maintained at 161 Summer Street, Boston, Mass. Communications for the company should therefore be sent either to the New York office, 136 Liberty Street, or to the factory at Penacook, N. H.

STERNOID.—The Underwriters' Laboratories, Chicago, have approved "sternoid," made by the Dickinson Manufacturing Company, Springfield, Mass., as "a molding material baving suitable non-absorption, non-combustible and insulating qualities, for use in electrical fittings where considerable mechanical strength and durability are required"

RAILROAD STORAGE BATTERY ORDER.—The Harriman Lines have recently closed a standardization contract with the Willard Storage Battery Company, of Cleveland, Obio, for their requirements of train lighting batteries. This contract was awarded to the Willard Company after a thorough service test of all makes of storage batteries extending over a period of two years.

COLUMBIA INCANDESCENT LAMP COMPANY.—The branch office of the Columbia Incandescent Lamp Company in Dallas, Tex., has recently removed from the Prætorian Building to [illegible]13 Elm Street The change was made in order that the office might be located in the same building with the wareroom, thereby enabling the company to handle stock shipments with the greatest dispatch

W. N. MATTHEWS & BROTHER, EASTERN OFFICE.—Mr. Victor L. Crawford has been appointed Eastern representative of W. N. Matthews with offices in the Glackner Building, 227 Fulton Street. Mr Crawford was for a number of years connected with the St. Louis Union Electric Light & Power Company as contracting agent, and for several years has been with the Matthews company as a representative calling on the trade throughout the country.

MR. GEORGE. B. DUSINBERRE has been transferred to the New York office of the American Electric Fuse Company, formerly located at 116 Nassau Street, and now in the Hudson Terminal Buildings, 50 Church Street. Mr. Dusinberre was formerly in charge of the Cleveland office of the company, and takes the place in New York of W. E. McCurdy, who has resigned. In the new quarters a large stock will be carried of telephone protectors, magnet wire, motor starters, controllers, battery chargers, rheostats and ignition apparatus

SLOW-SPEED MOTORS.—Directing attention to its alternating-current motors for slow speeds, the Kimble Electric Company, of Chicago, says that it does not attempt to cover a large variety of motor speeds by the use of the same punchings. Special stampings are used for each speed, and they are designed to utilize the material to best advantage. This construction makes it possible to manufacture low-speed motors of good operating characteristics, high power-factor and efficiency and comparatively low no-load current at moderate prices.

THE KLAXON COMPANY, which has handled the Klaxon and Klaxonet warning signal sales, was succeeded Jan. 1 by the Lovell-McConnell Company, at Newark, N. J. W. O. Turner, who has been manager of the Klaxon Company, becomes secretary of the Lovell-McConnell Company, and will take entire charge of the sales and offices. The Lovell-McConnell Company's plant is housed in a building in many respects the most complete factory in the United States. Under the policy of the Lovell-McConnell Company all 1911 jobbers' contracts include an agreement to maintain sales list prices. This means that even if the jobber bought in thousand lots he could not sell a hundred, or ten, or five Klaxons at any less figure than they could be bought from the factory in the same quantities.

DODGE, DAY & ZIMMERMANN, engineers, of Philadelphia, have added to their organization Messrs. Walter Loring Webb and James M. Kennedy, both well known in the engineering world. Mr. Webb is the author of several engineering textbooks, including "The American Civil Engineer's Pocket-Book," "Economics of Railroad Construction" and "Problems in the Use and Adjustment of Engineering Instruments." As pioneers in the field of industrial engineering, Dodge, Day & Zimmermann have been prominent factors in advancing efficiency in industrial and public service enterprises. The principles of which they are exponents have received material impetus of late through the prominence given the subject of efficiency in the recent hearings before the Interstate Commerce Commission on the application of the railroads to increase freight rates.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Geo. S. Emery, 41 N. Royal St., Mobile, Ala.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next semi-annual meeting, New York City, April or May, 1911.

American Electro-Therapeutic Association. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York. Next meeting at Philadelphia, Pa., Sept. 5, 6 and 7, 1911.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Electric Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Street & Interurban Railway Engineering Association. Secretary, Norman Litchfield, Interborough Rapid Transit Company, New York.

American Street & Interurban Railway Association. Secretary H. C. Donecker, Engineering Societies Building, 29 West 39th St. New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark.

Association of Iron and Steel Electrical Engineers. Secretary, John Farrington, Steubenville, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Boston, Mass., June, 1911.

Association of Railway Electrical Engineers. Secretary, J. Andreucetti, Chicago & Northwestern Railway, Chicago. Next annual meeting, Chicago, November, 1911. Semi-annual meeting, Washington, 1911.

Association of Edison Illuminating Companies. Secretary, N. T. Wilcox, Lowell, Mass.

Canadian Electrical Association. Secretary, T. S. Young, 220 King St. West, Toronto, Can.

Canadian Street Railway Association. Secretary, Allen H. Royce, 48 King St. West, Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind. Annual meeting at Claypool Hotel, Indianapolis, Ind., Jan. 19, 1911.

Colorado Electric Light, Power & Railway Association. Acting Secretary, F. D. Morris, 323 Hagerman Building, Colorado Springs, Col.

Eastern States Independent Telephone Association of Pennsylvania, New Jersey, Maryland and Delaware. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

Electric Vehicle Association of America. Secretary, Harvey Robinson, 124 West 42d St., New York.

Electric Club, Chicago. Secretary, F. S. Hickok, 824 Marquette Building, Chicago. Meets every Wednesday noon, 303 Wabash Ave.

Electrical Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Next meeting, Albany, N. Y., Jan. 17, 1911.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursday of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Credit Association of Chicago. Secretary, Frederic P. Vose, Marquette Building, Chicago.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, Engineering Societies Building, 29 West 39th St., New York.

Engine Builders' Association of the United States. Secretary, C. H. Lembower, Reading, Pa.

Florida Electric Light & Power Association. Secretary, H. C. Adams, West Palm Beach, Fla. Next meeting, Jacksonville, Fla., April 4 and 5, 1911.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago. Annual convention, Chicago, 1911.

Independent Electrical Contractors' Association of Greater New York. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

Indiana Electric Light Association. Secretary, J. V. Zartman, Indianapolis, Ind.

Internal Combustion Engine Association. Secretary, Chas. Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

International Association of Municipal Electricians. Secretary, C. R. George, Houston, Tex. Next meeting, St. Paul, Minn., 1911.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

Iowa Electrical Association. Secretary, W. N. Keiser, Dubuque, Ia Next meeting, Davenport, Ia., April 19, 20 and 21, 1911.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Davenport, Ia., April, 1911.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Independence, Kan., Sept. 21 and 22, 1911.

Maine Electrical Association. Secretary, Walter S. Hyman, Waterville, Maine.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electric Association. Secretary, Herbert Silvester, Detroit, Mich.

Minnesota Electrical Association. Secretary, T. C. Gordon, Little Falls, Minn.

Mississippi Electric Association. Secretary, A. H. Jones, McComb City Light and Power Co., McComb City, Miss.

Missouri Electric, Gas, Street Railway & Water Association. Secretary, N. J. Cunningham. Next meeting, St. Louis. April, 1911.

National Arm, Pit & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National District Heating Association. Secretary, D. L. Gaskill, Greenville, Ohio.

National Electric Light Association, New England Section. Secretary-Treasurer, L. D. Gibbs, 39 Boylston Street, Boston, Mass.

National Electric Light Association, Pennsylvania Section. Secretary-Treasurer, Van Dusen Rickert, Pottsville, Pa.

National Electric Light Association, Nebraska Section. Secretary-Treasurer, S. J. Bell, David City, Neb.

National Electric Light Association, Georgia Section. Secretary-Treasurer, H. M. Corse, Columbus Railroad Company, Columbus, Ga.

National Electric Contractors' Association of the United States. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Niagara Falls, July 19, 1911.

National Electric Light Association. Executive Secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York.

National Electrical Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn. Next meeting, New York, March, 1911.

National Electrical Credit Association. Secretary, Frederic P. Vose, 343 Marquette Building, Chicago.

National Independent Telephone Association. Secretary, A. C. Davis.

Nebraska Electrical Association. Secretary, Frank McMaster, Beatrice, Neb.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New Orleans Electrical Contractors' Association. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

New York Electrical Society. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York.

Northwest Electric Light & Power Association. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting at Youngstown, May 18 and 19, 1911.

Oklahoma Public Utilities Association. Secretary, Galen Crow, Guthrie, Okla.

Order of Rejuvenated Sons of Jove. Mercury (Secretary), R. M Van Vleet, 1157 Monadnock Building, Chicago, Ill.

Pacific Coast Electric Vehicle Association. Secretary, A. H. Halloran, 604 Mission St., San Francisco, Cal.

Pennsylvania Electric Association. Secretary-Treasurer, Van Dusen Rickert, Pottsville, Pa.

Pennsylvania Street Railway Association. Secretary, Charles H. Smith, Lebanon, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings, second Saturday of each month.

Pittsburg Electric Booster Club. Recording Watt meter, O. R. Rombach, 919 Liberty Ave., Pittsburg, Pa. Meetings, fourth Monday of each month.

Railway Electric Supply Manufacturers' Association. President, A. C. Moore, Safety Car Heating & Lighting Co. Chicago.

Society for the Promotion of Engineering Education. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

Society of Wireless Telegraph Engineers. Secretary, E. D. Forbes, Box 63, Brant Rock, Mass. Monthly meeting, first Monday of each month.

Southwest Electric & Gas Association. Secretary, E. T. Moore, Dallas, Tex.

Street Railway Association of the State of New York. Secretary, C. G. Reel, Kingston, N. Y.

Underwriters' National Electrical Association. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1911.

Vermont Electrical Association. Secretary, A. B. Marsden, Manchester Center, Vt.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 145 Monroe St., Chicago, Ill.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Wireless Institute. Secretary, Alfred N. Goldsmith, College of the City of New York, New York.

Wisconsin Electrical Association. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis.

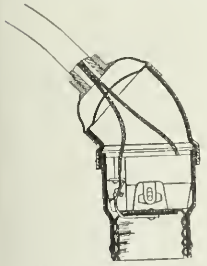
Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 26, 1910.

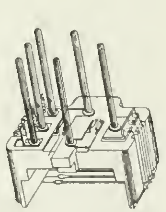
[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

13,186. ELECTRIC FURNACE FOR METALLURGICAL PURPOSES; P. Girod, Ugine, France. App. filed Aug. 5, 1909. A refractory hearth, a lower electrode, means for causing part of the metal to unite with the same and an upper electrode in contact with the slag, the lower electrode being partly formed by the metal to be treated and being cooled.

979,404. SELECTING DEVICE; F. G. Agrell, Stockholm, Sweden. App. filed Feb. 27, 1907. For making a large number of connections, by using the armatures of four electromagnets, three of which are in a triangular position and the selector being connected to three armatures by a universal joint so as to give seven positions, with three magnets and fourteen with four.



979,428. Electric Lamp Socket.



979,455.—Heater and Glower Renewal.

979,428. ELECTRIC-LAMP SOCKET; H. B. Chandler and J. A. Fleet, Portland, Maine. App. filed Aug. 28, 1908. For changing a straight socket into an angle socket by means of an angle piece between the two parts of the socket detachably secured to each part.

979,448. RAIL BOND. R. L. Dunivant, Fort Worth, Tex. App. filed Feb. 7, 1910. Conductors with bond disks carried by the ends of the bond engaging the under surface of the conductors and yielding means holding the disks in engagement with the conductors.

979,455. HEATER AND GLOWER RENEWAL FOR SECOND-CLASS CONDUCTOR LAMPS; O. Foell, A. Kusebauch and R. Neckman. Pittsburgh, Pa. App. filed Nov. 11, 1908. A lamp glower with base for terminals, a heater, a non-conducting support therefor, removably secured to the base for electrically connecting the heater to the terminals.

979,464. LIGHTNING ARRESTER; W. R. Garton, Chicago, Ill. App. filed Nov. 11, 1907. For preventing sneak currents and static discharges by means of separated conductors with an interposed body of a chloride and a capillary element leading from a moisture receptacle into proximity with but insulated from the conductor.

979,465. METHOD OF TREATING CARBON ELECTRODES; W. Gaston, New York, N. Y. App. filed March 9, 1910. Preventing cracking by saturating the hot carbon electrode as it comes from the baking furnace with a thick hydrocarbon solution.

979,467. TELEPHONE MOUTHPIECE; G. W. Gibberd and O. A. Elias, London, Eng. App. filed May 28, 1909. Disinfecting mouthpiece with a screwed sleeve between the mouthpiece and transmitter, radial perforations in the sleeve and an antiseptic ring surrounding the perforations.

979,475. PULL SOCKET FOR ELECTRIC LAMPS; G. W. Goodridge, Bridgeport, Conn. App. filed July 30, 1908. Switch block and spindle with ratchet on the spindle and sliding pawl and returning spring and two spring contacts making a double break.

979,485. ELECTROLYTIC CELL; D. S. Gartshorn, Boston, Mass., and Alan A. Claflin, Medford, Mass. App. filed Sept. 27, 1910. For preventing gas polarizing the electrode, the electrode consisting of a rotary cylinder on a horizontal axis with its circumference partly above, but partly dipping below a liquid electrolyte and a stationary electrode concentric to the cylinder and in proximity therewith beneath the electrolyte.

979,497. MEANS FOR ELECTROLYTIC MANUFACTURE OF SODIUM; P. L. Hulin, Grenoble, France. App. filed Oct. 27, 1908. Cathode consisting of spaced vertical rods hanging below a carrier detachably secured to a fixed support with a cylindrical anode surrounding it.

979,498. COMBINED BRAKE APPARATUS AND SWITCH MECHANISM; W. H. Hultgren, Philadelphia, Pa. App. filed June 21, 1907. For hoisting apparatus for the shipper sheave of an elevator including brakes controlled by the sheave and means for yieldingly holding the sheave in operative position when the brake is released.

979,514. PORTABLE WIRING DEVICE. I. S. Kray, Lancaster, Pa. App. filed Feb. 7, 1910. For stretching and holding wires taut by means of a telescoping standard carrying a head with wedge-shaped top pulleys on opposite sides and frictional gripping arm on the head.

979,515. ELECTRICAL HEATER; F. Kuhn, Detroit, Mich. App filed Aug. 19, 1909. A receptacle with a hollow member of lesser cross-sectional area than the receptacle and tapering with a tapering sleeve for engaging the hollow member and an electrical heater surrounding the sleeve.

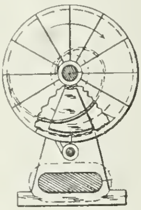
979,544. SHIELD FOR CIRCUIT CONDUCTORS. T. F. Murray, New York, N. Y. App. filed Feb. 2, 1910. The shield is in box form with openings for the pipe carrying the wires and with a removable cover and front wall with means for closing all the holes excepting the pipe hole.

979,556. BLOCK SIGNAL SYSTEM; G. S. Pilasterer, Nashville, Tenn. App. filed Feb. 23, 1909. A three-position signal with an actuating device for moving the signal from danger to an intermediate position and then to a third position with a manual latch preventing movement of the actuating device to set the signal to the third position and an electric lock for the latch.

979,569. TELEPHONE CALL RECORDER. H. K. Sandell, Chicago, Ill. App. filed Sept. 24, 1909. Telephone line with call register which is advanced by the movement of part of the 'phone when making a call, the breaking of a line current rendering the register advancing means effective.

979.570. TELEPHONE CALL RECORDER; H. K. Sandell, Chicago, Ill. App. filed May 23, 1910. Telephone line, call register with advancing means and spring resisting the advance with means for preventing overwinding of the spring, an escapement and an electromagnet operating it to permit the spring to turn back the register.

979,590. TELEPHONE SYSTEM; S. S. Stolp, Chicago, Ill. App. filed Nov. 27, 1908. Bell system for signaling with metallic conductors and grounded battery and grounded signaling devices which are disconnected when the conductors are connected to actuate the signaling device at the opposite ends.



079,603.—Dynamo-Electric Machine.

979,603. DYNAMO-ELECTRIC MACHINERY; D. W. Troy, Montgomery, Ala. App. filed Nov. 1, 1908. A field magnet with a pair of armature conductors movable together through the field, one of the conductors being more inclined than the other and longer than the field, and means for maintaining electrical connection between the conductors at points stationary with respect to the field.

979,608. INCANDESCENT ELECTRIC LAMP SOCKET; S. B. Van Ranst, Syracuse, N. Y. App. filed Oct. 5, 1910. A sleeve terminal, a spring arm fixed outside of the sleeve and extending into it whose free end engages the inner terminal of the lamp.

979,616. TELEPHONE SWITCHBOARD KEY; K. Weman, Buffalo, N. Y. App. filed March 1, 1909. Co-operating contact springs, a key lever having a slot and a separate tip in the slot and engaging the springs, the tip consisting of V-shaped halves.

979,635. ELECTRICITY METER; H. Aron, Charlottenburg, Germany. App. filed April 29, 1909. Bulk limit meter for overloads, including a rotary spindle driven by the current and means for giving it retrograde movement with a coupling for intermittently connecting and disconnecting the means for giving it the retrograde movement.

979,636. ELECTRICAL LAMP WIRE CONNECTIONS; S. Ashdown, Vancouver, B. C., Can. App. filed Jan. 11, 1910. Pendent cords for making more than one connection to the rosette by means of an egg-shaped body with grooves inserted between the wires.

979,637. ELECTRIC MOTOR; C. Backer, New York, N. Y. App. filed April 6, 1910. An electromagnet with oscillating armature connected to the crank of a shaft.

979,651. ELECTRIC CABLE CONNECTION; L. H. Church, Stamford, Conn. App. filed Feb. 3, 1910. A coupling sheath with slotted opening, with a wedge fitting the opening so as to bind a cable within the sheath.

979,652. GAS CONNECTION FOR OUTLET BOXES; L. H. Church, Stamford, Conn. App. filed March 11, 1910. Attaching arms with a central hub and slots in the sides, so that the walls of the hub are closed inward when the attaching arms are pressed downward.

979,663. ELECTRIC FURNACE; B. Guthrie, Pittsburgh, Pa., and J. P. Karch, Plainville, Conn. App. filed March 8, 1909. An electric furnace with a tiltable casing, a crucible therein, electrodes supporting it and means for retracting the electrodes to form an arc.

979,676. SWITCHING SYSTEM; G. T. Lademan, Milwaukee, Wis. App. filed Sept. 2, 1909. Railway telephone, with a substation set, a through line, two terminating lines, a signal receiver on the through line and one on each terminating line and a switch for connecting the substation set to either terminating line and changing the connection of the signal receiver of the selective line to include the local switches and a switch for connecting the set to the through line.

979,712. TROLLEY GUARD AND FINDER; H. R. Sherman, Hartford, Conn. App. filed June 10, 1909. A cradle on a trolley pole movable above the axis of the wheel, with flaring sides to form a trough when the wheel is in contact with the wire.

979,715. ELECTRIC PIANO PLAYER; W. H. Smith, Penge, London, Eng. App. filed Feb. 23, 1909. An automatic operator having an electromagnet, operating a striker with a high resistance in series and a low resistance in parallel and a cut-out in the low resistance, the time of operation of the cut-out with respect to the striker being varied.

979,750. LIFTING MAGNET; A. C. Eastwood, Cleveland, Ohio. App. filed July 17, 1908. For lifting iron and steel, the magnet having a pole piece depending from either end of the core and a magnetizing winding sending its flux through each of the pole pieces and core.

979,769. ELECTRIC SIGNALING BOX; A. Kempston, San Francisco, Cal. App. filed Feb. 23, 1909. Fire alarm for preventing interference of signals by holding a box in a position so that it will start its signal to the main office after another box has completed its round of signaling and thus hold the other boxes till it gets through with its signal.

979,840. INSULATOR BASE; W. T. Goddard, Victor, N. Y. App. filed Sept. 9, 1910. A conical insulator support consisting of two sections connected by a ball and socket joint for universal relative adjustment.

979,856. DEVICE FOR HOLDING KEYS IN FIRE ALARM BOXES; F. B. Holbrook, Rome, Ga. App. filed Aug. 2, 1910. Guard for fire alarm box with posts on the outside and a breakable guard held by the posts and a key having an aperture to receive the guard.

979,860. BONDING FISH PLATE; C. A. Huse, Williamsport, Pa., and James L. Miller, Lewisburg, Pa. App. filed Feb. 18, 1910. A cutting element carried by the rail engaging portion of the fish plate so as to cut into the under part of the thread and the upper part of the base of the rail.

979,868. ELECTRIC RAILWAY BRAKE; J. Mahoney, Wilkinsburg, Pa. App. filed April 20, 1908. The motors are caused to act as generators in braking with means for initially causing a rush of current through the brake and then restoring the brake circuit to normal braking condition.

979,804. ELECTRIC SWITCH; R. D. Snyder, Delta, Pa. App. filed May 12, 1910. A knife switch on a turn table base with a plurality of pairs of contacts arranged around the base.

979,899. LINE THREADING DEVICE; F. N. Steiglederm, Richmond, Va. App. filed March 12, 1910. For threading a cord or line through a pipe, by means of a traveler or piston with a reservoir for compressed air for forcing it through the pipe.

079,904. ELECTRIC SOLDERING IRON; A. H. & C. P. Waage, Chicago, Ill. App. filed Jan. 28, 1910. A heating element or cartridge with a core grooved at one end, a coil surrounding it, terminal wires overlying the groove and an extension from the coil consisting of turns of thin insulation.

979,905. ELECTRIC SEALING DEVICE; J. G. Wallman, Oakland, Cal. App. filed June 27, 1910. For sealing with wax by means of a tube with a cap supporting a seal removably secured to the lower portion of the tube, a casing, a drum in the casing and a current-conductor in the casing encircling the drum.

079,906. ELECTROLYTIC CELL; F. Weinberg, New York, N. Y. App. filed March 31, 1909. Preliminarily immerses an aluminum electrode in a phosphate solution independent of the electrolyte in which the electrode is used and then passes an alternating current through the same until the electrode is formed.

979,912. ELECTRIC IGNITION APPARATUS FOR INTERNAL COMBUSTION ENGINES; F. H. Alston, Birmingham, Eng. App. filed Jan. 24, 1910. Makes use of ball or roller bearing contacts instead of rubbing contacts for the parts of the igniting dynamo.

979,927. ELECTRIC LIGHT RECEPTACLE; H. D. Brown and L. W. Blyyer, Los Angeles, Cal. App. filed Oct. 6, 1909. For metallic signs in which a base has an aperture with notches in the edge, an electric light receptacle of insulating material, a metallic lock having a flange engaging the edges of the aperture for detachably locking by a rotary movement.

979,934. APPARATUS FOR SEPARATING MAGNETIC MATERIALS FROM OTHER MATERIALS OR FROM LIQUORS; A. E. Davis, Birmingham, Eng. App. filed Dec. 28, 1909. A magnetic separator with a tray which is magnetized, a supplemental tray inserted therein, a portion of the bottom of the latter being adapted to be magnetized by induction from the former.

979,940. TROLLEY STAND; C. M. Feist, Sioux City, Ia. App. filed April 13, 1910. A base, a rotatable cap arranged to produce an annular oil well, the top inclosing the bearing portions of the bottom.

979,977. ELECTRIC FIRE ALARM; E. Mahon, Fairfield, Ia. App. filed July 13, 1909. Electric fire alarm and a circuit closer operated by a float in a liquid.

979,986. TELEPHONE RELAY OR REPEATER; H. Morgan, Quinter, Kan. App. filed May 19, 1909. Two magnets with their cores opposite to two other magnets, the first two being supplied with incoming current and the last two supplying outgoing current, the magnets being in a casing and acting as a transformer for repeating.

979,999. APPARATUS FOR THE STERILIZATION OF WATER AND OTHER LIQUIDS; C. S. Piestrak, Paris, France. App. filed Aug. 29, 1910. Sterilizes by ozone, including a liquid inlet tube, a series of cones forming an injector with rings welded to the cones and holding them superposed and two electrodes concentrically arranged, the inner one being exhausted and an air passage between the electrodes communicating with the injector and the atmosphere.

980,024. TELEPHONE RECEIVER; W. H. Thompson, Wheeling, W. Va., and H. R. Stuart, Milwaukee, Wis. App. filed June 11, 1909. For telegraphone with solenoid coil receivers containing a plurality of solenoids with pole pieces extending from the magnet into proximity with each other and co-operating with the solenoids and independently adjustable.

980,032. ROTOR FOR HIGH-SPEED ELECTRICAL MACHINES; H. H. Wait, Chicago, Ill. App. filed March 11, 1907. A central supporting drum, windings around the drum, insulating material compressed outside of the windings, a metallic band compressing the material and a retaining ring around the band.

080,042. TELEPHONE TRANSMITTER; C. Adams-Randall, New York, N. Y. App. filed April 14, 1905. A diaphragm with independent electrodes insulated therefrom engaging electrodes which can be connected in series in whole or in part with a common battery.

980,090. SAFETY APPLIANCE FOR MOTORS; P. R. Forman, Chicago, Ill. App. filed Nov. 23, 1909. For protecting motor windings from undue rushes of current by means of a fuse of large capacity in the motor circuit, an auxiliary fuse of small capacity, also arranged in the motor circuit, a short-circuit for the auxiliary fuse and means operated by current in the motor circuit for breaking said short-circuit.

980,109. MOTOR CONTROL; D. L. Lindquist, Yonkers, N. Y. App. filed May 7, 1908. Alternating-current brake with an alternating motor starter for induction motors, including a speed-controlling device with opposing electromagnets and a brake magnet connected to effect the variation in the strength in one of said magnets.

980,118. TELEGRAPH APPARATUS; J. B. Odell, Chicago, Ill. App. filed Dec. 21, 1907. Selective apparatus for printing telegraphs using a type wheel and ratchet wheel with a shiftable connection between a selecting magnet, an armature, a push and pull pawl pivoted to the armature to feed the ratchet, with means for shifting the connector between the ratchet and wheel to permit the return of the wheel to normal position.

980,129. AUTOMATIC FEEDER REGULATOR; B. P. Rucker, Charlotte, N. C. App. filed April 1, 1910. For regulating the voltage of an alternating-current circuit to be used on single-phase or polyphase circuits, including a regulating transformer with a movable member, a voltmeter with an indicator and arms, one engaging the indicator when the voltage falls below normal and the other when it rises, and connections between the arms and transformers to regulate the voltage of the circuit by actuating the movable member, when one or the other of the arms engages the indicator.

980,153. MAGNETO ELECTRIC GENERATOR; T. S. Hemenway, Buffalo, N. Y. App. filed May 25, 1908. For party lines for ringing Central without ringing the party line signals. The drive shaft for the armature being longitudinally movable and operating a circuit interrupter.

980,156. STEERING MEANS FOR VESSELS; H. Hertzberg and M. J. Wohl, New York, N. Y. App. filed Dec. 12, 1908. Automatically steers and controls the operation by a compass which automatically and momentarily varies the speed of driving a plurality of propellors.

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DATA OF FOREIGN TRADE.

In our first issue of the year data were given as to the general increase in electrical business during 1910. Readers of these pages will already be familiar with the fact that the electrical export trade of the year has more than held its own in comparison, for it has been shown to be in a very healthy condition of growth and expansion. Indeed it is now said by the bureau of statistics of the Department of Commerce and Labor that our whole foreign commerce in 1910 is likely to exceed that of any preceding year, with imports making a new high record in the grand total. We are glad to note this, for no trade can be healthy or permanent that is not fully reciprocal. Another significant feature is that while our food exports fell off some 35 per cent, this is more than counterbalanced by a gain in exports of manufacturers, showing an advance of 65 per cent. There was also a gain of 60 per cent in exported raw materials. These gains are undoubtedly explained by the revival of trade abroad. All the reviews of the year tell of improved conditions, notably in England, Germany and Canada, and in the Dominion conditions begin to take on the aspect of a "boom."

Turning to the specific data of electrical exports, we are very glad to note again the rally that was the feature of the ten previous months accentuated in the November returns. It appears that the exports of electrical instruments and small apparatus for the month were $884,326 as compared with $584,210 in 1910. In heavy electrical machinery the amount rose from $470,687 to $612,007—not so marked a gain, but more notable in view of the fact that for a long time machinery demand was falling off and running behind. Now all the lost ground has been made up, with a bright outlook for the future. The two items taken together amount to $1,496,333 in November, 1910, as compared with $1,054,897 in 1909, or a gain of very nearly $500,000, at the rate of 33 per cent. The figures for the eleven months are equally good, if not better, the grand total being $15,528,304 against $11,884,533, an improvement for the period of $3,643,771. At this rate the total for the twelve months will reach $17,000,000, a handsome and respectable figure, but by no means even yet what it ought to be. Canada, Mexico and Brazil are good customers, and Japan buys well of the heavy class of stuff. Most European markets are barred by high duties, but it is not for the United States to "kick" on that score, for we are worse sinners. There are, however, many open or neutral markets, and in them much remains to be done in order to live up to the measure of opportunity.

THE CHICAGO DRAINAGE CANAL POWER PLANT.

Elsewhere in our columns will be found the first part of a very complete and interesting report on the hydroelectric development on the Chicago Drainage Canal. This plant has often been mentioned in the technical press, but the present paper gives a far clearer idea of the real importance of the project than anything which has yet appeared. The plant is in the proper sense of the word unique, at least from the hydraulic standpoint. It was a big engineering feat to plan and execute the turning of more than 750,000 cu. ft. of water per minute from one drainage area to another, in this case from the Gulf of St. Lawrence to the Gulf of Mexico. The power development, important and valuable as it is, is merely an incident to the herculean task of draining a city of more than 2,000,000 inhabitants into a watercourse which did not topographically belong to it and freeing it at the same time from the grave danger to health involved in taking water supply from a contaminated source. The Drainage Canal proper stretched twenty-eight miles, of which distance more than half was cut through solid limestone. At the end of this long run necessary to turn the drainage Gulfward, an extension, much of the way practically on a viaduct, was carried some miles further to gain an adequate hydraulic head for the installation of the power plant.

At the end of the power-house canal, too, there are important hydraulic works, including a lock and a gigantic spillway, but the power house itself is a beautifully straightforward piece of engineering equipped in an exceptionally simple and efficient manner. The head available is 34 ft., and consequently to employ direct-driven units of adequate size involves a somewhat complicated turbine plant. Each of the eight electrical units for which the plant was planned, of which six are now installed, involves the use of six 54-in. turbine runners on the same horizontal shaft. By this arrangement the speed of the big generators was carried up to 163 r.p.m. They are 6600-volt, three-phase, 60-cycle machines, and their connection to the transmission line is one the simplicity of which is worthy of particular commendation. Each of the six big units with its transformers constitutes a single generating unit and each is exactly alike in all its connections These units are connected only on the high-voltage side, and are in effect 44,000-volt units serving the transmission lines directly. By this plan of design the enormously complicated provisions sometimes made for an interchangeability never practically needed are avoided and the switching system is reduced to somewhere near reasonable dimensions. There are some small plants in which it may be necessary so to arrange the connections that any particular generator may be run on any particular transformer, but in such cases the cost of the switchboard and the intricacy of its connections are highly undesirable. With a plant of such capacity as the one here described and with big generating units there is no conceivable reason why the generator and its transformers should not be considered as one and treated as a whole, just as if it were an ordinary 110-volt generator, working directly upon the distribution system, the only difference being that as a matter of fact the high-voltage current actually generated requires an adequate switching apparatus.

The transmission system involves nothing unusual except the concurrent use of pin and suspension insulators. The two original circuits were aluminum cables carried on 50 000-volt pin insulators mounted upon steel towers. The additional third circuit is carried on suspension insulators as regards the two lower wires and on additional pin insulators for the pole top wire. The towers are set in concrete on a 350-ft. spacing, and the operation of the line from a practical standpoint has been eminently satisfactory. At the Chicago end of the line the load is, as is well known, used both for city work in lighting and power and for the supply of power to local consumers, including the operation of a number of suburban lighting and power systems. It would probably be somewhat difficult to untangle from the general cost of the project the financial items chargeable to the power development, but the result has certainly been the saving of a huge quantity of power which was far too valuable to waste and the installation of a transmission system which ought to be economical to maintain and operate

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MAGNETOMOTIVE FORCE IN NON-UNIFORM MAGNETIC PATHS.

The electric resistance of a simple cylindrical metallic wire of known uniform resistivity, length and diameter is one of the simplest computations in the whole range of electrical engineering. It is only necessary to multiply the resistivity by the wire's length and to divide by the wire's cross-sections, all in appropriate units, in order to obtain the solution of the problem. If, however, the metallic conductor instead of being a uniform cylinder is a prism of varying cross-section—say a wedge-shaped plate of metal—then, even though the dimensions of the plate and the uniform resistivity be given, the computation of the resistance of the strip between opposite edges is not so easy. It can be computed without much trouble in a few easy cases of simple geometrical forms. It can be computed with more or less difficulty in a few cases where the prism is a solid of revolution of certain relatively simple types. In a great many cases the problem cannot be solved by any known mathematical machinery, even although the prism has a known geometrical form. Moreover, if the resistivity of the prism instead of being uniform varies from point to point along the prism according to an assigned law, as, for example, when the prism is maintained at a certain temperature gradient between its two ends, the problem naturally becomes increased in complexity and is less likely of solution by arithmetic The latter case corresponds in magnetics to the problem of finding the reluctance of a wedge-shaped or keystone-shaped tooth in the core of a dynamo armature. If the reluctance of the tooth, as a whole, is known to a given magnetic flux passing the same, the drop of magnetic potential in the tooth, or the number of amp-turns necessary to send the assigned flux through the tooth, is deducible. The geometrical form of the tooth is comparatively simple, and if the reluctivity of the steel in the tooth were uniform the formula for the reluctance of a keystone-shaped tooth of given dimensions would be relatively simple. The difficulty is increased by the fact that the reluctivity varies from point to point along the tooth by reason of the changing flux density; and the relation between the reluctivity and the flux density is not immediately perceived, but has to be investigated independently for each quality and brand of steel. Consequently, the total reluctance of a tooth of given dimensions carrying a given total flux is not easily deduced arithmetically

The above problem is discussed in its generality by Mr. A. Miller Gray in an article on page 111. The problem is hampered and made unnecessarily difficult by the uncouth inch-units, which, unfortunately, are rendered necessary to the engineer by prevailing machine-shop practice in this country. To a European engineer the problem is placed on a simple basis of apprehension, a condition which places a handicap on English-speaking students in comparison with their foreign competitors. The article clearly shows that no ordinary rule of interpolation for a mean value of the flux density can be expected to give reliable results. A much more reliable result is obtained by the method presented in the article of summing up a series of ten equal segmental lengths or sections of the tooth in each of which the flux density is nearly uniform and for each of which the amp-turns per inch are obtainable from the magnetic data of the steel. This is the method of the integral calculus by the long series summation when no short-cut formula can be found. Although somewhat tedious, the method is quite satisfactory from the engineering standpoint.

A rigid formula for the tooth reluctance can, however, be found in this case by the rules of the integral calculus from the fact of the known relation between reluctivity and metallic flux density in steel. It is known that if the reluctivity is plotted rectangularly as ordinates against metallic flux densities as abscissas the curve is an ascending hyperbola except at very low flux densities. At densities below saturation no distinction need be made between the actual flux density and the metallic flux density; but at or above saturation the metallic flux density remains constant at its limiting value, while the actual flux density exceeds this by the amount of the superposed magnetizing force. The determining constants of the hyperbola are obtainable from the saturation curve of the steel employed; so that knowing the hyperbola and the dimensions of the booth the total reluctance can be computed, although the formula is not a simple one. In any case a very high degree of precision is not worth striving for, owing to other uncertainties in the magnetic circuit besides the tooth reluctances, and also because at high densities the flux does not keep within the limits of the tooth, but escapes laterally into the air or adjacent groove space, thereby vitiating to some extent the assumptions underlying the problem

SOME PECULIARITIES OF DIFFUSE REFLECTION.

A recent paper before the Illuminating Engineering Society reports the results of a study of the action of diffusely reflecting surfaces at various angles of incidence from the normal to 60 deg., the purpose being to find out how various wall papers of different coloring and texture behave under varying incidence. Many values have been accumulated on the coefficients of reflection of various substances at some specified angle of incidence, and there has been more or less investigation of the amount of specular reflection obtained from apparently diffusing surfaces. In the work here referred to there was a systematic study of the relation between the angle of incidence and coefficient of reflection for more than a score of surfaces which enables one to form a fairly clear idea of the variations to be expected in the performance of supposedly diffusing surfaces under various practical conditions. Obviously, the coefficient of diffuse reflection is certain to vary somewhat with the conditions of incidence, but it would be impossible to predict offhand whether this variation would be 5 per cent or 50 per cent, or how it would vary in papers differently finished.

Mr F. H. Gilpin, the author of the paper in question, gave values for twenty varieties of wall covering, varying in mean coefficient of reflection from about 6 per cent to 57 per cent, and for comparative purposes has added white blotting paper having a mean coefficient of 74 per cent. The results of the investigation are very curious, particularly in the relation of the color to the variations of coefficient at different angles of incidence. It is well known that the color of diffusely reflected light may vary considerably with the angle of incidence, owing to the modifying effect of the multiple reflection at a rough surface on the apparent color of the light Some textures, too, give a strongly colored component plus a faintly colored component rising from quasi specular reflection, and still other surfaces may be expected to show asymmetric reflection, though this is perhaps less common in papers than in textiles. As the result of these varying modifying causes, Mr. Gilpin found in some instances a coefficient at 60 deg incidence nearly or quite double that for normal incidence Cases of this kind were found chiefly among the relatively poor reflectors having a semi-glossy surface. One very remarkable instance was in the case of two cherry-red papers, one having an average coefficient of 6.2 per cent and the other of 9.5 per cent The first-mentioned showed a coefficient varying from 5.7 at 0 incidence to 6.6 at 60 deg. incidence, while the latter having at 0 incidence a coefficient of only 6.3, owed its higher average almost entirely to the large effect at the higher angles of incidence, reaching 13.7 per cent at 60 deg. Curiously enough, this variation was much less than appeared in a glossy varnished tile paper of a cream color, thus indicating the relatively great difference in the effect of the pigmentation at different reflecting angles.

Even coefficient of the white blotting paper referred to ranged from 71.1 per cent at 0 deg. to 80 per cent at 45 deg., falling off a little at a higher angle. All of the papers tested, save two that were nearly white, had coefficients below 45 per cent, showing, as similar tests have done before, the high absorption found in most of the things with which we choose to cover our walls. It seems hardly likely that the question of angle of incidence will enter materially into the computations of illuminating engineering, since it is much easier to get a really good reflector than to attempt to juggle with a bad one by varying the incidence. The source of light used in Mr Gilpin's experiments was an incandescent gas burner; the illuminant, however, probably had comparatively little effect on the results, since they run much like those derived from incandescent lamps. These experiments, like all others, lead to the same general results, that creams, buffs and yellows in various tones are on the whole good reflectors, while grays, greens, blues and reds are almost universally bad reflectors This is a necessary result of the comparatively low luminosities of light of these colors as compared with the full yellow but the average man, and particularly the average decorator does not seem to realize that it may be embarrassing to coat a wall with a color which absorbs most of the light incident upon it. One of the most interesting cases here brought out is that of a French gray with an average coefficient of only 26 per cent. Grays frequently look light on casual observation but they are almost always bad reflectors owing to the admixture of black, or red, or both, in the pigment. Even very meager traces of black and red cut down the reflecting power for ordinary light in a very notable manner, so that when such colors are used in decoration suitable provision must be made for a supply of light large enough to cover their shortcomings No sensible illuminating engineer would recommend a general abandonment of strong color in decoration, since decoration is a matter which goes much deeper than the mere lighting problem. However, he should never fail to point out that if deeper colors are employed the amount of light necessary for proper illumination in a room must be increased, sometimes by fully 50 per cent

Selden Automobile Patent Overthrown.

The United States Court of Appeals in New York City has reversed the decision rendered by Judge Hough, of the United States Circuit Court, Sept. 15, 1909, which sustained broadly the validity of the Selden patent and granted an injunction against the Ford Motor Company and others who had been sued for infringement of the patent. This decision is of the greatest importance to the automobile industry, as the Selden patent was the basis upon which the Association of Licensed Automobile Manufacturers, now including about 80 per cent of automobile firms, organized for the control of the industry. The brunt of the litigation against the Selden patent has been borne by the Ford Motor Company and John Wanamaker. It is announced that an endeavor will be made to appeal the decision to the United States Supreme Court, but whether such an appeal will be received is entirely at the discretion of that court, which rarely grants such a reopening of a patent case. In the decision, which was written by Judge Noyes, it was held that the Selden patent is based on the Brayton constant-pressure gas engine, which came into limited use in 1873, prior to the introduction of the Otto four-stroke cycle gas engine. The court admitted that the Selden patent was valid for a vehicle using the Brayton type of engine, but held that it did not apply to automobiles using gas engines of the Otto type. The opinion states that the carriage element of the automobile is not novel, and that the drive element was old in 1879; gas engines were also old at the time of the application for the Selden patent, and liquid hydrocarbon engines were in use, both of the compression and non-compression type, and the Otto engine came into use later and superseded the Brayton type. The court stated that had the inventor appreciated the superiority of the Otto over the Brayton engine and adapted that type to his combination his patent would cover the modern automobile. He made, however, a wrong choice, and the court held that it cannot, by placing any forced construction on the patent or by straining the doctrine of equivalents, make another choice for him at the expense of the defendants, who neither legally nor morally owe him anything.

The patent was applied for in 1879, and for over sixteen years the application lay in the Patent Office. The court in its opinion stated that the applicant took full advantage of the period of inactivity permitted by the rules and statutes, and that it is apparent that he delayed just as long as possible the issue of the patent. During this long period the automobile art made marked advances along different lines, and when, in 1895, the patent was granted it disclosed nothing new. For the monopoly granted by his patent the inventor had nothing to offer in return, and the public gained absolutely nothing from his invention, whatever it was. Since the inventor, however, followed strictly the statutes and rules of procedure, the courts cannot exact a greater amount of diligence from him; and when the patent was granted under the law it became entitled to the consideration accorded to any other patent, and even if it was useful only for tribute it must be viewed without prejudice and with absolute judicial impartiality. The decision was thus not based upon any Patent Office abuse associated with the issue of the patent or the manner in which it was subsequently exploited, but rested only on the fact that the patent was valid only for a combination in which the short-lived Brayton type of gas engine entered, and could not apply to a combination in which the Otto or modern type of gas engine is used.

A. I. E. E. Meetings.

The general subject of "Corona Phenomena" will be discussed at a meeting of the American Institute of Electrical Engineers to be held in the Engineering Societies Building, New York, on Jan. 13.

A paper by Prof. Harris J. Ryan entitled *Open Atmosphere and Dry Transformer Oil as High-Voltage Insulators* and one by Mr. E. L. West entitled *High-Voltage-Line Loss Test Made on the 100-kw, 60-Cycle, 180-Mile Transmission Line of the Central Colorado Power Company* will be presented for discussion.

MID-YEAR CONVENTION.

A special meeting of the Institute, to be designated as the Pittsfield-Schenectady mid-year convention, will be held on Feb. 14, 15 and 16. Among the papers to be presented will be the following:

Mechanical Forces in Magnetic Fields, by Dr. C. P. Steinmetz; *Problems in the Operation of Transformers*, by Mr F. C. Green; *Protection of Electrical Transmission Lines*, by Prof. E. E. F. Creighton; *Tests of Grounded Phase Protector on the 44,000-Volt System of the Southern Power Company*, by Messrs. C. I. Burkholder and R. H. Marvin; *Tests of Losses on High-Tension Lines*, by Mr. G. Faccioli; *The Temperature Gradient in Oil-Immersed Transformers*, by Mr. James Murray Weed; *Hysteresis and Eddy-Current Exponents for Silicon Steel*, by Mr. W. J. Wooldridge; *Commercial Problems of Transformer Design*, by Mr. R. H. Wilson; *Design, Construction and Test of an Artificial Transmission Line*, by Mr. J. H. Cunningham.

BOSTON AND LOS ANGELES MEETINGS.

A meeting of the Institute under the auspices of the Boston Section and with the co-operation of the Boston Society of Civil Engineers and the American Society of Mechanical Engineers will be held in Boston on Feb. 17. Mr. R. A. Philip will present a paper on certain phases of the general subject of economic limitations to aggregations of power systems.

A Pacific Coast meeting of the Institute will be held in Los Angeles during the month of April under the auspices of the telegraphy and telephony, railway and high-tension transmission committees.

Minneapolis Central Station Destroyed by Fire.

The Minneapolis General Electric Company, a Stone & Webster organization, operates two generating stations in Minneapolis and one at St. Croix Falls, Minn. The latter station, known more familiarly as the Taylor's Falls development, is forty miles from Minneapolis and will generate eventually 20,000 kw. Until the erection of this station in 1906 the entire generating system of the company was within the city limits of Minneapolis, and until December, 1907, the Main Street station, situated on the east bank of the Mississippi River at St. Anthony's Falls, across the river from the business district, carried the full load of the city. The Taylor's Falls station of the company was described in these columns July 6, 1907; the transmission line to Minneapolis was described in the issue of Sept. 7, 1907, and the distribution system within the City of Minneapolis in the Oct. 5, 1907, number.

The Main Street station is equipped with a 1500-kw Curtis turbo-generator, three reciprocating engines having an aggregate rating of 3100 hp, a 1000-kw motor driving line shafts or itself driven as a generator by the prime movers, and three water-wheels operating under a maximum head of 48 ft. and developing an aggregate of 2400 hp. In addition the company has two main substations, one on South Fifth Street with a steam plant of two units having an aggregate generating rating of 600 kw and 3050 kw in rotary converters feeding the underground, direct-current, three-wire system. Part of the energy is received from the Main Street station and part from St. Croix Falls through substation A located at the end of the high-tension transmission line at the city limits. This latter substation contains nine step-down transformers rated at 9000 kw. Service from the Main Street station is supplied at 2300 volts, two-phase, 60 cycles, 500 volts direct current, and to both alternating-current and direct-current arc circuits from the machines belted to the line shafts driven by the water-wheels or the 1000-kw motor from motor-generators and from constant-current transformers. In addition to its use as a motor or generator the 1000-kw machine on the line shaft is used as a synchronous condenser to control the power-factor of the system.

Early on the morning of Jan. 6 the Main Street station was destroyed by fire originating by all accounts from a short-circuit in the station. After the fire started there were a number of explosions which helped the general conflagration. The service was interrupted from 6:45 until 12:15 in the afternoon, when, after extraordinary efforts on the part of the company officials, there was a resumption of the 220-volt direct-current service, cables being spliced so that the energy could be fed from the various substations direct from the St. Croix Falls station. By connection with the Twin City Rapid Transit Company's station 500-volt direct current was available for motor users early the following morning. Service in the residence district was resumed on the following night, but owing to the total destruction of all the generating machinery in the station it was impossible to get the street lamps back into service. On the night of Jan. 8 several three-phase feeders were cut in so that on Monday service was restored with the exception of the street lighting. The boiler plant used in connection with the station was not destroyed, nor were the stacks affected.

During the morning of the fire the business section was in a state of commotion. Elevators in downtown office buildings were out of commission, lamps could not be lighted, residences were without electricity, newspapers, every one of which depends on electricity for driving presses and typesetting machines, were crippled, and the city was cut off from the outside world because the telegraph companies rely on the lighting company for energy to operate their quadruplex systems. The manager of the Minneapolis *Daily News* appealed to Mr. H. R. Kelley, engineer for the Studebaker Company, whose electric vehicle and commercial truck salesroom is opposite the newspaper office. Mr. Kelley suggested using storage batteries from some of the Studebaker electric trucks. Twenty minutes later 105 Exide cells from three commercial trucks were loaded onto a truck stationed outside the window of the composing room and leads were run to the linotype machine switches, delivering energy at 220 volts to the motors. By noon the regular service was restored and the printing-press motors were operated as usual in getting out the afternoon editions of the paper. Nicollet Avenue and other downtown streets which are ordinarily unusually brilliant owing to ornamental street-lighting standards are still in comparative darkness and the greater portion of the city is in a similar plight at night so far as public lighting is concerned.

The energy displayed by the lighting company in the face of the disaster was remarkable. Just as soon as it was safe to work near the ruins (the firemen were not withdrawn until the following morning) 200 men, reinforced shortly after by 100 more, were set to work bringing order out of chaos. A field restaurant was established and fires were built to keep the men warm as they clambered over the débris, through tangled masses of iron and over ice hummocks, splicing cables so that energy could be carried around the ruins to the stricken city.

Steps were immediately taken to rebuild the ruined station, either on the present or some other site. A loop station will also be erected in connection with this generating station so as to render it possible to switch the Taylor's Falls circuits from the main station in case of another catastrophe like that of Jan. 6. The loss is estimated at over $500,000 and is covered by insurance.

Telephone Rate Investigation in Chicago.

An interesting contribution to the discussion of rates for telephone service in Chicago now in progress between the City of Chicago and its advisers on one side and the Chicago Telephone Company on the other has been made by the company through President B. E. Sunny in its answer to the report of Mr. William J. Hagenah, expert for the city, summarized in these columns in the issue of Jan. 5, page 24.

The company objects to Mr. Hagenah's statement of the amount of the company's construction and real estate account. This figure is placed by Mr. Hagenah at $23,224,843.31, but the company takes exception to this estimate and says that in its judgment the property could not be duplicated for less than $5,000,000 in excess of that figure. It is pointed out that the investment per telephone station is only $110, as compared with an average investment of $147 per telephone station in the twenty-six Bell telephone companies scattered all over the United States.

Naturally the subject of depreciation receives much attention in the company's statement. On this subject Mr. Hagenah is quoted as follows: "The annual provision for this purpose [depreciation] is a proper operating expense, and to meet it the utility is entitled to charge rates sufficiently high to cover this requirement, in addition to the actual cost of operating the plant. To such annual charge should be credited a depreciation reserve, against which should be charged all replacements and renewals." Mr. Sunny says that while Mr. Hagenah may be theoretically in the right, it has not been until very recently, if the time has yet come, that there has been anyone or any telephone company with sufficient experience to frame final views on this subject. At no time has the Chicago Telephone Company been able to fix accurately the depreciation on its property so as to be able to set aside reserves in a definite sum and at a definite time to cover the loss. On this point the City of Chicago was cited as an example. It was stated that the General Electric Company has no reserve account to provide for depreciation; if the net earnings in any particular year warrant it, this latter company makes a direct credit to construction—a practice which Mr. Hagenah deprecates in his report. The Western Electric Company follows the same practice. Hatfield on "Modern Accounting" is quoted as saying that recognition of depreciation is relatively uncommon in the accounts of American corporations. This authority mentions the Allis-Chalmers Company as an exception, as in a "lean" year, 1906, it charged nearly $300,000 to depreciation. Mr Sunny adds that this amount was less than 1 per cent on the total plant value. He points out also that the People's Gas Light & Coke Company, of Chicago, had no depreciation reserve account up to about seven years ago, and that at the present time this account is but a small percentage on plant investment. The Commonwealth Edison Company is referred to as having a plant investment of almost $64,000,000 and a depreciation reserve account of only $2,700,000.

The Chicago Telephone Company does not wish to be understood as believing that a proper depreciation charge is not advisable and necessary. Its position to-day is that in the rearrangement of rates a proper amount must be allowed to take care of wear and tear on the property. At the same time it is explained that the item of depreciation has not pressed heavily upon the company up to this time for the reason that the property is practically new and most efficiently maintained. The company thinks that what the City of Chicago, and particularly the telephone-using public, wants to know is how much the plant of the company cost; furthermore, if it is a good plant, well cared for and in a condition to give first-class service. Considerations of this kind, it contends, must be taken into account for rate-making purposes rather than the question of depreciation.

In relation to the item of $147,400 in the expense account due to the charge by the American Bell Telephone Company for instruments and service, the company is confident that it is a proper item of expense, having been made under a binding contract and continued in the exercise of the best judgment of the company's directors and officers

Various items of operating expense which Mr. Hagenah seems to have failed to take into account are enumerated, as installation of meters at stations and the removal of conduits and cables out of the way of the proposed passenger subway in Chicago. A still larger item has reference to telephone competition. It is pointed out that the Chicago Telephone Company operates under municipal regulation in its fullest sense, and the prices to be charged for each class of service are fixed. The maximum income of the company is fixed by law. Having undertaken to regulate the affairs and rates of the Chicago Telephone Company, the city has virtually obligated itself to secure to the company an exclusive opportunity to furnish telephone service, if conducted satisfactorily under the provisions of the regulation. The city has failed in this obligation. The result is that the telephone company will soon be under dual rate regulation; that is, its rates will be regulated by the municipality and also by competition—a condition that does not exist in any other city in the world. The company has not been allowed to purchase the telephone plant of the Illinois Tunnel Company, and the latter is now building an opposition exchange. If this competition is successful it may reduce the net profits of the Chicago Telephone Company $700,000 a year. Adding other expenses due to competition, as interest and depreciation on unused plant, an allowance of $750,000 per annum may be required to offset competition. Possibly the total annual expense of the installation of meters, the changes due to the subway and of competition may amount to $1,170,000 per annum. However, it is not pretended that this is an accurate forecast.

In conclusion, Mr. Sunny, speaking for the telephone company, says that it is anxious that rates should be made which shall be fair to its subscribers and which will bring additional subscribers. These rates should be fair also to the 1500 stockholders of the company, to whom a corporation looks for additional capital to develop the service.

Hydroelectric Development at Bull River Falls, British Columbia.

At a point about thirteen miles west of Fernie, British Columbia, the Bull River Electric Power Company has constructed a 9000-ft. flume for utilizing a 273-ft. fall in the river at that point. The flume is constructed of wood and built upon a rock foundation, is 7.5 ft. deep by 30.5 ft. wide at the intake and reduced to 16 ft. wide after the first 1000 ft. of length. It is estimated that a flow of 462 cu. ft. per second is available. The company is now preparing to install the penstock, which is to be of steel, 9 ft. in diameter, and will rest upon bedrock the whole length, at an angle of 30 deg. The foot of the stock will rest upon a natural bedrock, and a T-shaped cross-pipe will be placed at the end of the stock in which the wheels will be placed. Three wheels of 4200 hp each will be utilized as the demand for power develops.

It is estimated that $300,000 will be required to install the generating plant and to erect 100 miles of poles and string the wires. It is the expectation to sell energy to the City of Fernie on the east, to Cranbrook on the west, and to many of the mining plants within the territory to be reached from its central position.

Employers' Liability Laws.

Among the states that are preparing to adopt employers' liability laws attention is being drawn particularly to Massachusetts and Washington. The commission created by the State of Massachusetts at the last meeting of its Legislature to investigate the subject of compensating workmen for injuries received in the course of their employment and to report to the next Legislature a plan for adoption has prepared a tentative draft of the bill. The proposed measure applies to employments wherein five persons or more are regularly engaged. Recovery is allowed in all cases, irrespective of negligence, except where injury is self-inflicted or due to intoxication or breach of statutory regulations. The proposed employers' liability law for Washington, which has been drafted by the special commission, has just been made public. One of the sections that are unusual is that creating a "first-aid" fund. This is entirely distinct from the "accident" fund, which comprises the money collected for the compensation of seriously injured workmen. The first-aid fund is to be contributed equally by the employers and the employees at a rate of 2 cents a man per working day for the man himself and a like amount for his employer. The fund will go to cover the cost of all emergency treatment of injured persons. The major part of the bill is devoted to the accumulation and disbursement of the accident fund. Every employer of labor at hazardous occupations in the State is obliged to pay into the fund a specified percentage of his payroll. In the case of powder mills this rate is 10 per cent. For some occupations the percentage is as low as 1.5 per cent, and the others fall somewhere between the two extremes. On the whole, the schedude of rates to be charged the various industries is said by the commissioners to be practically the same as that demanded by the casualty companies.

Boston Electric Show Developments.

Active consideration is being given by the Edison Electric Illuminating Company of Boston to the initial plans for the electrical show to be held under its auspices in Boston from Sept. 28 to Oct. 26, 1912. The company is working to make the show a genuine world exposition of electricity, and recently purchased full-page advertising space in the press of Paris, Berlin, Vienna and Rome, with a two-page insertion in English and Japanese in a prominent paper of Tokio. These advertisements point out that the company's intention is to make the show the most comprehensive, extensive and instructive exhibition of the development and present application of electrical machinery and appliances ever held, and they emphasize the special opportunities which will be afforded exhibitors from other countries to display their products. Attention is called to the fact that Boston is the center of the wealthiest and best purchasing community in the United States; that the New England States, from which the show will draw attendance, have a population of 7,128,065 people in an area of 61,973 sq. miles; that many of the greatest industries of the world—cotton, woolen, leather, rubber and boot and shoe manufacture, office furniture and confectionery production—are localized in New England; and that the large number of people who yearly come to that section on business will in 1912 be interested in the electric show.

The management of the show is already making a world-wide search for information concerning the use of electric light, heat and power in every trade, industry and application, and is especially desirous of learning about every unique, novel or exceptionally economical use of electric service that has been found practical anywhere. Mr. H. W. Moses, manager of the show, is devoting his entire time to its development, with headquarters at the Edison Building, 39 Bolyston Street, Boston.

St. Lawrence-Long Sault Dam Project.

Canadian interests opposed to the damming of the St. Lawrence River at the Long Sault Rapids below Cornwall, Ont., have again been aroused by the notice that a bill will be introduced on Jan. 9 at Washington, D. C., granting to the St. Lawrence Power Company authority to construct such works in the river as would meet their requirements. While, of course, the United States Congress can grant powers of operation and construction only on the American side of the river, it has been decided to send a delegation to Washington to make representations to the Harbors and Rivers Committee pointing out that works constructed in American waters might considerably interfere with navigation on the Canadian side, and that the danger of flooding large areas would be great. The delegation will be made up of members of the Montreal Board of Trade, Chamber of Commerce, Shipping Federation, Dominion Marine Association and other bodies interested in preserving existing conditions on the St. Lawrence. A detailed history of the St. Lawrence power project was given in these columns in 1910 on pages 552 and 1342 of Vol 56.

Consolidation of Electric Generating Properties in Canada.

The consolidation of a number of electrical properties in the Province of Ontario, Canada, has just been consummated by Messrs. Smith, Kerry & Chase, of Toronto. The holding company is known as the Electric Power Company, Ltd., and the companies controlled operate in that portion of the Province of Ontario lying east of Toronto, west of Kingston and north of Lake Ontario. This district embraces nearly all that section of Ontario not now supplied by the Hydroelectric Commission, which has confined its operations chiefly to the western section of the province.

The following Ontario public-utility companies are involved in the merger: Seymour Power & Electric Company, Ltd.; Peterborough Light & Power Company, Ltd.; Peterborough Radial Railway Company; Auburn Power Company of Peterborough, Ltd.; Trenton Electric & Water Company, Ltd.; Sidney Electric Power Company, Ltd.; Nipissing Power Company, Ltd.; Oshawa Electric Light Company, Ltd.; City Gas Company of Oshawa, Ltd.; Cobourg Utilities Corporation, Ltd.; Northumberland-Durham Power Company, Ltd., and Central Ontario Power Company, Ltd. Mr. J. G. G. Kerry, of Toronto, is president of the company; Mr. A. B. Colville is secretary, and Messrs. Smith, Kerry & Chase are the designing, contracting and operating engineers. The head office of the company is in Toronto and the offices of the general manager and general superintendent of the company are in Belleville.

The Electric Power Company controls a number of water-powers along the route of the Trent Valley Canal from Burleigh Falls to Trenton. Hydroelectric energy is being delivered at present from five points to seven substations over 130 miles of 44,000-volt transmission lines. The aggregate rating of the stations is 10,000 hp, and two other generating stations, having a combined equipment of 7500 hp, are now under construction. In the course of six months the length of transmission lines and the number of substations will be more than doubled by the completion of works now under construction. The ultimate development will reach in the neighborhood of 100,000 hp.

The district to be served will reach from Oshawa to Kingston and will cover an area of approximately 5000 sq. miles. The present population of this area is approximately 250,000, and in it are located such cities and towns as Peterborough, Kingston, Belleville, Oshawa, Lindsay, Cobourg, Port Hope, Bowmanville, Trenton, Campbellford, Napanee, Deseronto, Madoc and Picton. Besides the general distribution of electricity for lamps and motors in the various towns and cities in this district, the company has made contracts with many private consumers who will use large blocks of energy. Among these are the Canada Cement Company, whose entire mills near Belleville were changed over to electric drive on the first of the year, and the Northumberland Pulp Company, which has recently completed a mill at Campbellford, where about 2000 hp will be utilized. Generally speaking, the rates vary from $15 to $25 per hp-year for twenty-four-hour service according to the nature of the business carried on by the various customers and the distance of the consumer from the generating stations.

Substations are now being constructed at Oshawa, Port Hope, Cobourg, Bowmanville, Brighton, Colborne and other points in order to furnish the entire electric service in these various towns and supersede the old steam-driven and water-driven plants now in operation at these places. Substations for similar purposes are already in operation at Belleville, Trenton, Stirling and Madoc.

The water-powers on the Trent and Otonabee Rivers lie in three groups located as follows: Between Buckhorn Lake and Peterborough, a distance of twenty miles; between Healy Falls and Bradley Bay, a distance of ten miles; between Frankford and the Bay of Quinte, a distance of six miles. The Electric Power Company, having large holdings of water-rights in each of these three groups, will develop the various powers as the market warrants.

Electric Motor Control.

A patent was issued Dec. 20, 1910, to Mr. H. Ward Leonard on an application filed April 24, 1903, relating to a method of electric motor control depending upon the control and variation of a local source of energy, rather than through specific arrangements of the propelling motors. The application of the invention is to the operation of electric locomotives, reversible rolling mills mine hoists, warship turret-turning and similar work.

One of the principal features claimed in the patent is the employment of a source of energy divided into two secondary sources by means of transformers, the low-voltage windings of which are used in parallel to secure the maximum torque and in series to secure maximum speed. Each of these two windings supplies half of the maximum voltage and half of the maximum amperes, the total watt capacity, weight, size and cost of the energy transformers thereby being reduced, it is claimed, about one-half of that previously required. By dividing the supply windings into four secondary sources it is claimed the watt capacity of the transformers can be reduced to one-fourth of that of the motors controlled. By the invention a constant power can be employed with a torque variable inversely to speed. Other claims relate to a motor-control system in which the speed is controlled not only by variable voltage supply to the motor armature, but also by varying a separately excited field winding of the motor. Still another set of claims relate to a compound-wound motor having a variable voltage supply for its armature and a series-field winding, to obtain control over a certain range, and still another field winding, the current in which is weakened, to obtain higher speeds. The patent drawing illustrates the use of a high-tension single-phase source of energy and a locomotive carrying two transformers, the energy being supplied at variable voltage to the propelling motors.

Invention of Duplex Telephony.

Noting the newspaper statement of Jan. 3 to the effect that General Allen, chief signal service officer of the United States Army, has announced that multiplex telephony—that is, carrying on two or more telephone conversations at the same time over one circuit—is now practicable, Mr. Frank L. Perry, of Chicago, announces that he accomplished the feat of carrying on two telephone conversations over one circuit in his laboratory over two years ago. To prove his assertion Mr. Perry exhibits documentary evidence signed by Mr. Bion J. Arnold the consulting engineer, and Mr. Donald M. Carter, of the firm of Parker & Carter, patent lawyers in Chicago.

Under date of Nov. 6, 1908, Mr. Arnold wrote Mr. Perry a letter, which, as it is brief and may be of some interest to those interested in the development of this art, is quoted in full:

"It gives me pleasure to state that on the evening of Nov. 4 I witnessed what was to me a very interesting and remarkable feat in telephony at your home in the Erie Apartments, this city. At that time you connected four telephonic instruments to one circuit—first to a grounded one, and afterward to a metallic one—and Mrs. Perry and my daughter, and yourself and myself, talked simultaneously over these circuits, Mrs Perry and my daughter carrying on one conversation, and you and myself carrying on another over the one circuit, apparently without any interference. In other words, two conversations were carried on over the same wire without the parties to either conversation being disturbed by the other parties. I am not sufficiently versed in telephonic engineering to attempt to state what the importance of this achievement actually is, but to me it seems important, and the evening was certainly an interesting one."

Mr. Carter, in a statement dated Jan. 5, 1911, says that more than two years ago Mr. Perry exhibited to him an apparatus and system by means of which two telephonic conversations were transmitted simultaneously, without either interfering with the other, over a single-wire grounded circuit, and also over a single metallic circuit. Mr. Carter says: "I carefully examined this apparatus while it was in operation, and proved to my own satisfaction that Mr. Perry had successfully solved the problem of the simultaneous transmission of two telephonic conversations over the same circuit and without interfering with each other." Mr. Carter also relates that a short time afterward his partner, Mr. Francis W. Parker, visited Mr. Perry's laboratory and finally satisfied himself that two conversations were carried on simultaneously over the same circuit.

Mr. Perry also declares that men of the highest prominence in the telephone field examined his laboratory demonstrations over a year ago and were compelled to admit that the test conducted in the laboratory was apparently successful. For a number of years Mr. Perry was assistant business manager of the old *Western Electrician*, and he has a wide acquaintance among electrical men. Since his retirement from electrical journalism he has been giving—as, indeed, he had done for several years before that—a great deal of time to investigation of the properties and utilization of electrical waves.

Railway Converter Substations.

Before the January meeting of the Armour Institute of Technology Branch, A. I. E. E., Mr. Joseph H. Jacobson, engineer inspector for the board of supervising engineers, Chicago Traction, presented a paper on the design of railway converter substations, which was illustrated by photographs taken by the speaker and projected on a screen by means of a reflectoscope. Mr. Jacobson described the design features of the rotary substations of both the Chicago Railways Company and the Chicago City Railway Company, outlining the arrangement of apparatus, from the incoming high-tension lines to the 600-volt feeders leading to the trolley. A number of 2000-kw rotary converters are in use in the Chicago street-railway systems. It is the practice of this company to start its rotaries in three partial-potential steps from the alternating-current side, while those of the South Side system are arranged for starting in this manner or from the direct-current side, the latter being the standard practice in operation. Mr. Jacobson also presented figures showing the extremely large rating in electrical generating and converting apparatus devoted to the electric railway service of Chicago. The five converter substations of the South Side system (which purchases energy from the Commonwealth Edison Company) contain 50,000 kw in converters, together with 2240 kw-hours in storage batteries. The six rotary substations of the Chicago Railways Company contain twenty-three 2000-kw rotary converters and 12,700 kw in 600-volt generators feeding directly into the trolley system. The Consolidated system on the North Side and West Side has 68,000 kw in 600-volt railway generators, while the Calumet and South Chicago system has 8000 kw in rotary converters transforming the 20,000-volt energy purchased from the Commonwealth Edison Company.

Messages of Governors to Legislatures.

In their messages to the Legislatures which are now convening the Governors of several States discuss questions relating to public-utility corporations and commissions. Abstracts of the parts of the messages which affect electrical corporations follow:

GOVERNOR DIX, OF NEW YORK.

Governor Dix, of New York, stated that he was giving careful and special attention to the Public Service Commissions and hoped in the near future to address some recommendations to the Legislature on this subject.

A large part of the message was devoted to discussion and facts regarding the alarming rate at which the expenditures for current expenses of the State had increased in recent years, and to the need for economy in the future. Governor Dix said that during the last fiscal year the new Public Service Commission cost the State $897,372, and that for the ensuing year these commissions asked the State to appropriate $1,984,537. These sums are in addition to the very large sums charged by the Public Service Commission of the First District to the City of New York.

Governor Dix added that he did not refer to the facts regarding State expenses because he disapproved legitimate expenditures for hospitals, asylums, schools and regulative commissions, but to show the abnormal rate of increase in the expenditures for these purposes and to point out the absolute necessity of the most drastic retrenchment. He believed that such retrenchment could be made without impairing the efficiency of the State service, but declared that unnecessary boards and commissions should be abolished, useless employees removed and every demand for appropriation carefully scrutinized to the end that the expenditures of the State be brought within its income and that the total amount of appropriations be limited to the estimated amount of revenues.

The message contained a reference to the subject of conservation and proper development of the natural resources of the State. Governor Dix said that the proper utilization of the great water-powers which are now permitted to go to waste would bring to the State an annual revenue of many millions of dollars, as well as add greatly to the wealth of the people.

The total power used in manufacturing in the State in 1905 was 1,643,000 hp, of which 850,000 hp was produced by steam. To produce this 850,000 hp with coal throughout the year cost $85,000,000. To produce this amount of power by water and distribute it electrically would cost $25,000,000 per annum, thus saving, Governor Dix estimates, $60,000,000 per annum now paid to other States for the purchase of coal.

GOVERNOR FOSS, OF MASSACHUSETTS.

Governor Foss, of Massachusetts, said that on business principles he was not in favor of commissions as a means of transacting public business, unless they were appointed subject to recall, for he believed their tendency was not in accord with popular or representative government. He said that commissions had practically no check placed over them and that they multiplied unnecessary officers and clerks, and thereby increased the expense of carrying on the work of the different branches of the State's activities. He advised the abolition of the following commissions which relate to quasi-public corporations, namely, the Railroad Commission; the Gas and Electric Light Commission; the Boston Transit Commission, and the Highway Commission, which includes the supervision of the telephone and telegraph companies. In their place he recommended the creation of a Public Utilities Board, which should consolidate the functions of these commissions, with the stipulation that the tax-collecting function of the Highway Commission should revert to the State Treasurer's department.

This board, Governor Foss said, should be composed of five members, whose terms should be for ten years, subject to the recall of any member at any State election. The chairman should be a lawyer. This board should have the right to employ and hear counsel; its decisions should be in writing, with the vote of each member recorded, and it should have the power of initiative.

Governor Foss condemned holding companies as wholly indefensible and said that the old method of framing legislation desired by public-service corporations behind closed doors, through legislative agents and the lobby, should be entirely discontinued.

GOVERNOR DENEEN, OF ILLINOIS.

Governor Deneen said that authority should be given to the Railroad & Warehouse Commission, or to a commission appointed for this specific purpose, to gather and publish all facts regarding the cost of construction, maintenance and operation of public utility corporations, with power to require service adequate for the public needs and to fix rates which would be fair to the public, would assure to investors a reasonable return upon their investment and would offer inducements for the investment of private capital in public service corporations to stimulate their growth as the public needs might require.

If the employers' liability commission fails to reach an agreement Governor Deneen recommends that he be authorized to appoint another commission.

It is recommended that a law be passed prohibiting electric and gas companies from furnishing service without charge to public officials.

GOVERNOR POTHIER, OF RHODE ISLAND.

Governor Pothier, of Rhode Island, announced that he believed it would be to the interest of public-utility corporations, no less than for the benefit of the public, if there should be created a board of commissioners of public utilities to act as referee in the adjustment of all differences between such corporations and the public as to the character, quality and quantity of the service rendered and the rate exacted in return therefor. The recommendations of such a board for the improvement or extension of the service rendered should carry the power of enforcement subject only to reversal by the courts. The right should be given to investigate every cause of complaint either by the corporations or by the people, to examine and inspect equipment, determine the method used in fixing rates of compensation and whether the consumer received that to which he was entitled and for which he paid. Such a board would not only compel compliance with just public demands, but would protect the corporation in cases where the demands upon it were unjust or unreasonable.

Governor Pothier recommended that the Assembly enter upon a thorough and serious consideration of the matter, looking to the enactment of a law creating a State board of public utilities, with proper powers of supervision over the activities of all railroad, steamboat and other transportation companies, pipe-line, gas, electric light and power companies, telephone and telegraph companies, water-distributing companies and other public-service corporations operated by private interests.

GOVERNOR EBERHART, OF MINNESOTA

A department of waterways should be created, Governor Eberhard says, as part of a proposed Bureau of Public Domain. It should be in charge of at least one commissioner and, if devoted to the conservation and development of water resources, would earn its cost manyfold. The revenue resulting from a single water-power or the commercial advantage of a single waterway might warrant the support of such a department for a decade. This department should make a complete study of the subject and should submit a draft for a proposed revision of the laws of Minnesota on this topic.

A workmen's compensation act should be passed in accordance with the recommendation of the commission appointed by the last Legislature to report at this session.

The operation of electric railways should be subject to the Railroad and Warehouse Commission.

GOVERNOR OSBORN, OF MICHIGAN.

Governor Osborn stated that the water-powers of the State had passed almost entirely into the hands of private owners. The State should persist in a policy that had for its purpose the development of a special income from water-powers. Care would be taken, of course, to do nothing that would render over-difficult the general and successful development of the water-powers of the State. Such development could result only in a great increase in the taxable tangible values of the State.

Governor Osborn said that probably the surest way of bringing about practical justice to all concerned in industrial accidents would be the creation of a workingman's insurance fund, to be controlled and managed by the State Department of Insurance.

GOVERNOR PLAISTED, OF MAINE.

It was suggested by Governor Plaisted, of Maine, that the Legislature consider the advisability of establishing a public utilities commission. He said that the development of water-powers should be encouraged, but that true conservation lay in using them, not in letting them lie idle. The water-powers could be made valuable only by development by private enterprise and capital. The State would never, as a State, develop a single water-power, build a single storage dam or erect a single power station, but welcomed those who came in good faith to invest capital in making these powers an aid to industry. The speculator who asked privileges of the State simply that he might dispose of them at an enhanced value to those who actually desired to conduct business enterprises should receive no consideration, but the legitimate business man should be encouraged by liberal treatment. In granting charters, however, to companies desiring to develop water-power the Legislature should insist on certain restrictions The power should not be carried out of the State. Maine should be a great manufacturing State, not merely a power station.

GOVERNOR MARSHALL, OF INDIANA.

For the regulation of securities Governor Marshall, of Indiana, recommended revision of the corporation laws so that no corporation could issue a dollar's worth of stock without having a dollar in money or a dollar's worth of property go into the corporation to the satisfaction and approval of the State Board of Tax Commissioners. He recommended that all transportation lines be prevented from issuing bonds without the consent of the Railroad Commission, obtained by showing that the funds were to be actually used for corporate purposes and that the sale of such bonds for less than 95 be forbidden. He recommended that no bonds be issued by any other public utility without like consent from the State Board of Tax Commissioners, so that public utilities might not only be controlled, but ratably and reasonably taxed by this board, which should have exclusive powers of taxation over all public utilities.

A workmen's compensation act was suggested.

The repeal of every law which permits the condemnation of land by private persons or corporations for the erection of a dam across any of the streams was recommended. The streams should be preserved to the people so that the State might lease the water-power rights and regulate and limit the prices to be charged consumers.

After saying that the State had been passing through an era of public extravagance, Governor Marshall added that new boards of commissioners should be shunned.

GOVERNOR BASS, OF NEW HAMPSHIRE.

Governor Bass recommended the creation of a public service commission to take the place of the present Railroad Commission. It should have authority fully to regulate rates, service and capitalization of all public-service companies. For this most important and difficult service the highest grade of men should be secured. Appointments should be made for terms of substantial length to the end that the commissioners might be removed as far as possible from political influences.

A thorough investigation should be made by the State in order to ascertain how it may profitably guide, assist and control the development and use of water-power within its borders in the interest of the Commonwealth. An employers' liability act and workman's compensation act should be enacted.

GOVERNOR BALDWIN, OF CONNECTICUT.

The enactment of a bill in general conformity to the scheme reported by the special commission which favored the creation of a public-utilities commission in 1909 was recommended.

Governor Baldwin, however, referred to several provisions of the bill so reported as objectionable. In his judgment an annual salary of $7,500 for each commissioner was too large. As the State was small in territorial extent and the number of corporations within the jurisdiction of the commission not very great, he should regard it as likely that the time of the commissioners would by no means be fully occupied by their official duties. An annual salary of $5,000 would be sufficient. The bill as reported gave an appeal to the Superior Court. While Governor Baldwin thought this was a proper safeguard against possible injustice, he said it might be sufficient were it given only when the decision appealed from was not a unanimous one.

Governor Baldwin recommended the enactment of a bill making certain modifications, with respect to certain industries, in the present law as to an employer's liability. It might be thought proper to proceed further in the direction of framing a workingmen's compensation act.

The Chicago Electrical Show of 1911.

First of the year's electrical shows, and also the oldest established of the several annual exhibitions of that character given for the benefit of the public in American cities, the Electrical Trades Exposition in Chicago always attracts attention. This year's show, which was opened on Jan. 7 and will be closed on Jan. 21, is the sixth to be given under the same management and is held at the Coliseum, as in former years. There are about 100 exhibitors, filling the entire main floor of the building and its annex. The general scheme of decoration and illumination is dignified and pleasing, not as spectacular as the searchlight-and-ribbon effect of last year, but forming an artistic, if quiet, setting for the whole picture. An improvement has been made in the construction of the booths, not only in design, but in inclosing the lamps surmounting the posts in white-glass globes rather than in imitation art glass.

There are many popular features to attract the public, as good music, various spectacular exhibitions, the crackling of "wireless instruments," an estimating contest, souvenirs, the electric baking of bread to be given to the poor, and the fine government exhibit, to say nothing of the bustle, lights and animation of the whole scene; but to the electrical man probably the most striking feature of the exhibition is its diversity. Among the smaller articles not only of electrical use by the public, but also in the various industrial applications of electricity, few will be found missing in the Chicago Electrical Show. Furthermore, there are many appliances shown exclusively for the benefit of the central-station man and the electrical constructor. The number of new things is unusually large, and, as a whole, the display is a representative electrical show made by practical electrical men, quite up to date and high class. It may be added that the photographs used to illustrate the articles describing the show in this issue were taken on the first day before the installation work was quite completed, and do not do justice to the display.

ILLUMINATION AND DECORATION.

Looking upward the Electrical Show interior presents the appearance of a huge tent, with an opening in its top, 75 ft. above the floor level, through which is seen a similitude of brilliant blue sky, marked here and there by fleecy clouds. Pendent from the rim of this opening are huge streamers of gold and silver hangings, alternate ones being caught up by great illuminated gilt drums and green seals. From the border of electric lamps which accentuates the conventional designs of the tent top, great folds of green and white bunting are draped down to the balcony level, counterfeiting admirably the appearance of a tented inclosure. The balconies themselves are also draped in green and white, and their railings at intervals carry large gilt escutcheons with illuminated art-glass domes. The booths have been designed as leafy pergolas with frosted 60-watt tungsten lamps scattered among the autumn leaves on trellised umbrella structures. The rear walls of the booths are marked by white columns, surmounted by 250-watt tungsten lamps inclosed in 14-in. Alba glass globes, while the lower posts at the front carry 100-watt tungstens in 10-in Alba globes. The center of the exhibit floor is occupied by an illuminated column, 25 ft. in height, which forms a part of the paraphernalia for the estimating contest which is a feature of the show.

Indirect lighting from hidden channel reflectors bordering the 53-ft. x 204-ft. overhead opening provides the means of illuminating the sky canopy hung from the roof girders. The 300 60-watt tungsten lamps in this channel are placed at 2-ft intervals, reflectors of special curvature being employed to project part of the light produced out onto the middle part of the sky canopy. At the bulls'-eyes of the target-like decorative designs framing the openings are placed 60-watt clear tungstens. Each of the fifty drums in the streamers contains a 32-cp lamp. Among the booths are seventy 250-watt tungsten lamps on the taller columns and 165 100-watt lamps on the lower columns. Each booth is also lighted by six 60-watt frosted tungsten lamps on the trellises, making a total of nearly 100 watts in tungsten lamps directly available for illuminating the 125-ft. x 250-ft. floor space of the Coliseum. As this represents an expenditure of 3 watts per square foot, exclusive of all the decorative and exhibit lighting, one may be assured that the Electrical Show is well illuminated. The decorative effects of the show were designed and executed under the direction of D. H. Burnham & Company, the architects.

CENTRAL-STATION AND PUBLIC-SERVICE COMPANY EXHIBITS.

The practical uses of electricity for the business man are very handsomely illustrated in the extensive exhibit of the Commonwealth Edison Company, Chicago, whose display takes the form of a row of stores demonstrating the utility of various kinds of interior lighting, showcase and window illumination, electric signs and curb illumination. Six storerooms, complete in every detail from plate-glass windows to shelving, have been erected fronting 20 ft. on "Commonwealth Avenue," as the north aisle of the exhibit space, with its realistic curb, raised sidewalk and lamp-posts, has been named, the depth being 25 ft. There are seven lamp-posts bordering the curb, each bearing a single vertical 500-watt tungsten lamp inclosed in a frosted globe. The stores on Commonwealth Avenue represent various lines of business, the non-electrical goods being furnished by prominent Chicago merchants who cooperated with the Commonwealth Edison Company in arranging the exhibits. Careful attention has been given to the illumination of the "stores," which in each case conforms with the decorations and character of the display. The showcases are lighted by tungsten linolites. A number of attractive souvenirs, match safes, paper clips, booklets, etc., are distributed from the Commonwealth Avenue exhibit to prospective customers. In every detail the idea is most thoroughly and lavishly carried out. The plan for the Commonwealth Edison "street" exhibit is due to Mr. Dana H. Howard, advertising manager of the company, who superintended the construction of the exhibit, assisted by Messrs. O. R. Hogue, N. A. Robbins, W. P. Lyon and D. H. Nicholes.

The Cosmopolitan Electric Company, Chicago, exhibits industrial applications of the three-phase, 60-cycle energy which it distributes from its new generating station on the South Side of the city. A motor-driven automatic screw-machine driven by a ½-hp motor is in continuous operation and holds the attention of the crowds by the almost intelligent sequence of its movements. Mounted on a trestle platform above the floor of the exhibit is the hoisting gear of a five-ton alternating-current crane equipped with a 50-in. lifting magnet for handling iron and steel materials. A 15-hp adjustable-speed alternating-current motor is also arranged to drive a Sturtevant positive-pressure blower. Several new street-lighting standards for 250-watt and 500-watt tungsten lamps are shown. The exhibit is in charge of Messrs. Homer E. Niesz, general manager of the Cosmopolitan Electric Company, and James H. Delany, contract agent.

The North Shore Electric Company, which supplies electricity to the suburban area surrounding Chicago, has made a feature of a large map, 8 ft. x 10 ft., of its lines and territory, each town, village, generating station and substation being marked with a miniature frosted or colored 1-cp, 3-volt lamp operated four in series from the 11-volt secondaries of a sign transformer. The map is used to demonstrate the industrial advantages of factory sites near the lines of the company, where central-station electrical energy for lighting and motor service is available. The North Shore company also directs attention to its "house-wiring-at-cost" offer by which payment for the actual cost of the work is distributed over twenty-four equal monthly payments. Mr. John G. Larned, general contract agent, and his assistants represent the company at the show.

The Chicago Telephone Company demonstrates telephone-exchange operation by a large Western Electric multiple switchboard section attended by six operators, supervisor, etc., just as in an actual working exchange. The operation is carefully explained to the public by simply worded signs and by the attendants. From the booths of the American Telephone & Telegraph Company adjoining the Chicago Telephone Company's exhibit, free long-distance telephone calls are given to certain cities. Messrs. A. M. Ramsay, N. Anderson and O. W. Stitt represent the local company and Mr. Maurice Kenyon represents the long-distance company.

The new automatic-telephone service soon to be inaugurated in Chicago is demonstrated by the Subway Telephone Construction Company, which is building and will operate the automatic system of the Illinois Tunnel Company. A number of subscribers' telephone sets with dial-calling devices are mounted about the walls of the booth, and in a glass-covered cabinet is a section of the switching apparatus of the 10,000-line exchanges, such as are being installed in Chicago. This apparatus includes the primary line switches, the selector switches and the connector switches which complete the connection. The public is invited to familiarize itself with the use of these automatic telephones. Messrs. E. R. Neir and W. M. Curtis are in charge of the exhibit.

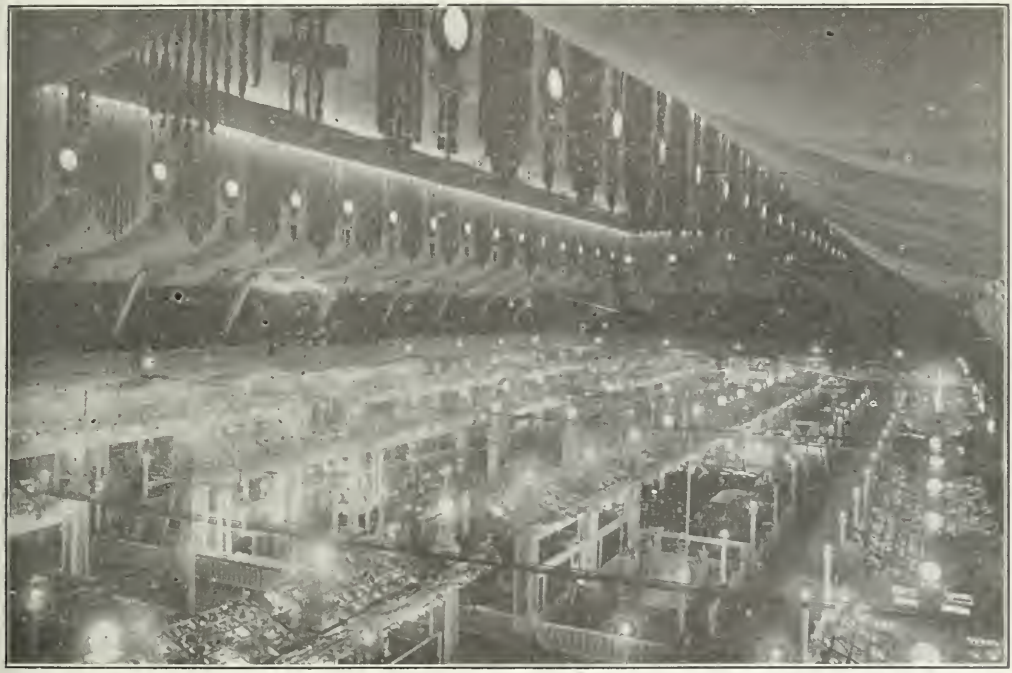


Fig. 1—General View.

SPECTACULAR AND EDUCATIONAL EXHIBITS.

"Cooking by wireless" is one of the sensational "stunts" at the Electrical Show which excite intense popular curiosity. This exhibit, arranged by Mr. C. H. Thordarson, of Chicago, occupies a large booth in the Coliseum annex. Standing before a large marble-topped table the attendant sets down a common frying-pan or other cooking container on the marble slab. The utensil quickly comes to cooking temperature, without wires or other source of heat being visible, and the food it contains is soon frying merrily. Water in a metal dish placed anywhere on the long marble slab can be brought to a boiling temperature in a minute. A small electric fan held near the slab starts to run, delivering a vigorous breeze, and a portable lamp, without connection plug or wires, quickly comes up to full candle-power. The demonstration is varied by a number of other interesting and mystifying experiments with this "wireless" transmission of energy. The explanation is, of course, a powerful alternating magnetic field under the slab. This field is produced by a double-circuit, open-path, laminated-core electromagnet energized by a current of approximately 100 amp taken from the 110-volt, 60-cycle alternating-current lines in the building. The electromagnet is mounted on a runway so that an assistant can move it to any part of the table to follow the demonstrator as the latter performs his experiments on the table top.

Amateur exhibits of home-made wireless telegraph and other electrical apparatus form one of the most interesting special features of the show. The Chicago Wireless Association, a club of amateurs mostly under twenty-one years of age, has in practical operation a 1/4-kw wireless outfit built by one of its members. The outfit is equipped with a set of copper-coated Leyden jars, an adjustable helix with inclosed spark gap, double and single tuning coils, closed-core transformer, improved disconnecting switch and silicon-perikon detectors

The association also exhibits several of its antenna-carrying kites, with which the range of transmission of a set "sending" half a mile with the ordinary aerial has been increased immediately to eight miles with the kite 1000 ft. in the air. This exhibit is in charge of Messrs. J. Walters and E. Mullner. Mr. H. C. Briggs also demonstrates a Tesla high-frequency outfit capable of delivering an 18-in. discharge, showing many of the interesting manifestations of electrical energy under these conditions of extreme frequency and potential.

The Crane Technical High School operates two stations, one a 2-kw closed-core transformer in the annex and the other a 1-kw open-core coil on the opposite balcony. These sets are equipped with glass-plate condensers, while tuning is done with adjustable loose-coupling coils and air condensers. Silicon detectors are used in receiving messages between the two stations. Messrs. F. Richards, J. B. Maypole, C. Ziska and B. Wallace represent the Crane school.

The Lane Technical High School boys exhibit a ¼-kw closed-core transformer, an adjustable variometer, a combination loose-coupler tuning coil, adjustable condensers and silicon detectors, all of amateur manufacture. Messrs. F. F W. Requa, H. C. Ford and J. Lowell are in charge.

Englewood High School, Chicago, although not a manual-training school, is represented by a club of young wireless enthusiasts who own a 5-kw, 35,000-volt transformer, a large oil-immersed condenser set, adjustable tuning coils, and silicon and ferron detectors. The club is developing a new type of directive aerial, comprising a nest of eight grounded copper cylinders having a section of their surfaces removed. The openings point in eight different directions, and inside the cylinders, insulated from them, are the copper-plate aerials, from each of which separate lines are run down to the receiving and transmitting apparatus. The screening action of the outer cylinders makes it possible to discover from which direction the incoming wireless impulse proceeds. Messrs. M. Lippman, G. Stough and J. Dunne are the officers of the club.

Fig. 2—View of "Commonwealth Avenue."

The interesting and educational exhibit of the United States government occupies the Coliseum annex. Of chief electrical interest is probably the standard wireless-telegraph equipment of a first-class battleship, exhibited in the southwest corner. This apparatus is complete with long-range sending coil, tuning devices, copper-coated Leyden jars, helix and spark-gap and navy-type detector. Near this booth are the models of warships, half a dozen in number, including miniature representations of battleships, cruisers, gunboats, torpedo boats and torpedo destroyers. A fine relief map of the Canal Zone and Panama Canal, modeled to the scale of 3 in. to the mile, presents a clear demonstration of the tremendous engineering work on the Isthmus. Two walls of the annex have been covered with more than 100 fine colored transparencies of Reclamation Service, army and navy scenes, some 2 ft. x 3 ft., and all illuminated by electric lamps concealed in the rear. Some of these pictures trace events in the Spanish and Philippine campaigns, and in racks near by are the guns and infantry arms used by the United States and other armies. A Colts-Maxim rapid-fire gun, a Colts-Gatling protected machine gun and a Springfield 3-in. field gun are also exhibited. Army experiments with aeroplanes and dirigible balloons are pictured. The Bureau of Engraving and Printing exhibits one of its hand-type engraving presses similar to those on which stamps, paper money and bond certificates are executed at Washington. The machine in service at Chicago is used for engraving souvenir cards and handkerchiefs, which are distributed to the throngs passing the exhibit.

SPECIAL FEATURES.

At the center of the exhibition floor is a graceful column, 25 ft. in height, its shaft and base being built up of huge spools wound with copper and iron wire. These alternately ruddy and silver-colored bands attract the interest and merit the attention of each purchaser of a ticket to the Electrical Show, for prizes aggregating $5,000 in value and headed by a $2,650 Woods electric automobile are to be distributed to the persons estimating most accurately the total linear length of wire wound on the curved surfaces of this column. The spools differ in diameter and in the size and number of layers of wire. No data are vouchsafed except those apparent from inspection of the column in position. Besides the important first prize of the automobile, which is exhibited in a special booth by itself, there is an additional $2,500 worth of other prizes, including an electric piano player, washing machines, kitchen outfits, dining-room sets, coffee percolators, chafing dishes, vacuum cleaners, electroliers, dome lamps, etc., to be given to those coming next nearest the correct length. Every purchaser of a paid admission to the show receives a ballot entitling him to an estimate.

Special days during the two weeks of the Electrical Show were arranged for as follows: Monday, Jan. 9, Souvenir Day, Puzzles; Tuesday, Jan. 10, Souvenir Day, belt buckles and match boxes; Wednesday, Jan. 11, Chicago Electric Club Day; Thursday, Jan. 12, Wireless Telegraph Day; Friday, Jan. 13, Illuminating Engineers' Day; Saturday, Jan. 14, Students' Day; Monday, Jan. 16, Souvenir Day; Tuesday, Jan. 17, Sons of Jove Day; Friday, Jan. 20, Benjamin Franklin Day, souvenirs, Telephone Day; Saturday, Jan. 21, Children's Day.

During the afternoons and evenings while the Electrical Show is in progress popular concerts of selected programs are rendered from the Coliseum balcony by Weber's Band, Mr. John C. Weber director, assisted by Miss Blanche B. Mehaffey, soprano soloist.

A feature of the 1911 show which is of interest to exhibitors is the arrangement for profit sharing. The net profits of the Electrical Show are to be shared equally between the Electrical Trades Exposition Company and the exhibitors after the show expenses, administration costs of the company for the year and a further sum of $2,000 have all been subtracted from the gross income from exhibition spaces and box-office receipts. The exhibitors' share of the profits will be divided among them in the proportions of their respective spaces. This arrangement does not imply, however, that the exhibitors may be held responsible for losses incurred by the show.

Chicago's sixth annual Electrical Show is held, as have been the exhibitions of preceding years, under the direction of the Electrical Trades Exposition Company, the officers of which are: President, Mr. Samuel Insull; first vice president, Mr. Ellsworth B. Overshiner; second vice-president, Mr. Louis A. Ferguson; secretary-treasurer, Mr. Stewart Spalding. Mr. Homer Niesz is general manager. The show is open daily, except Sunday, from 10 a. m. to 10:30 p. m.

In another place in this issue will be found a comprehensive account of the exhibits of manufacturers and dealers in electrical apparatus.

New York Commission News.

During the year ended Dec. 31, 1910, the New York Public Service Commission for the First District reports that it considered 2711 matters other than those relating to rapid transit. Of these 194 were formal cases and 2517 informal cases. Informal complaints against gas and electric companies, other than complaints as to meters, numbered 529, of which nine are undetermined. Of electric meters 637 were tested, all of which were "complaint" meters.

About one-half of the report is devoted to a review of the rapid-transit development of the year.

The report shows that 142 electrical companies have been organized for the purpose of furnishing service within the City of New York. Of this number twelve companies are now operating. The total gross capitalization of electric (including electrical subway) companies is $163,216,000. The total gross capitalization of gas and electric companies is $5,424,000. The grand total capitalization of all companies subject to the jurisdiction of the commission is $1,125,858,000. A combined report for the twenty-six gas and electrical companies, covering the calendar year 1909, shows some separate details relating to electric corporations. The capacity of the generating stations was 224,317 kw. There were sold 361,920,873 kw-hours, or an average of 991,564 kw-hours per day. The total includes intercompany sales amounting to 38,616,804 kw-hours. The operating electrical revenues were $23,642,816, as compared with $21,922,806 in the previous year. These figures include sales to other electrical companies of $563,826 and $522,717 respectively. The electrical operating ratio was 56.40 in 1909 as compared with 55.40 in 1908.

The total applications for the issue of securities from July 1, 1907, to Dec. 31, 1910, amounted to $361,138,940, of which the commission approved $82,458,400 and disapproved $208,829,300. The amount pending on Dec. 31, 1910, was $69,461,240.

Statistics presented in reference to the development of street railway travel in New York City show that there was an increase in the number of rides per capita from 228 in 1898 to 320.9 in 1910.

The Public Service Commission of the First District of New York held on Jan. 4 a hearing on the Long Acre Electric Light & Power Company's application for the approval of an issue of $10,000,000 stock and $50,000,000 bonds. Only detailed testimony as to the value and earning possibilities of the company was heard, and the hearing was adjourned to Jan. 16. The commission also heard a considerable amount of expert testimony on Jan. 4 upon the application of the Kings County Electric Light & Power Company for the approval of an issue of convertible debenture bonds amounting to $5,000,000. This hearing was adjourned to Jan. 18.

On Jan. 5 the commission again held an informal hearing upon the complaint made by the consumers in the Far Rockaway district against the Queens Borough Gas & Electric Company concerning the rates charged for electricity. This hearing was largely technical and was continued until Jan. 12.

The commission had ordered public hearings to begin Jan. 18 on the proposition of certain Staten Island capitalists to construct a subway tunnel underneath the Narrows between Fort Hamilton and St. George. If this tunnel were constructed it would connect with the Fourth Avenue (Brooklyn) subway.

On Jan. 9 there was a hearing before Commissioner Maltbie upon the application of the New York Edison Company for a modification of the order made by the commission some two years ago limiting the forms of contracts for electric lights

The New York Public Service Commission of the Second District has received a complaint from the town board of the Town of Cornwall, Orange County, directed against the Hudson Counties Gas & Electric Company, as to the efficiency of the incandescent electric lamp supply, voltage of the current supplied for light and the price of electricity sold and delivered in said town. The present charge for incandescent street lights is $20 per annum per 25-cp lamp. The town board believes this an excessive charge and the commission is asked to fix a just and reasonable rate. The complaint has been served upon the company and an answer required within twenty days.

Complaint has also been received from the Newburgh News Printing & Publishing Company, of Newburgh, and a large number of citizens of that city, alleging that the rates charged for gas, electric energy and steam-heat service in the City of Newburgh are excessive and unwarranted and asking the commission to make an investigation into the conditions complained of. The commission has no jurisdiction over steam-heating service, but will take up gas and electric energy prices

New Jersey Commission News.

The first report of the Board of Public Utility Commissioners of New Jersey says that the experience of the board has been that most of the things accomplished are done through negotiation with the companies and in compliance with recommendations rather than by the issue of orders. The recommendations of the board were generally adopted by the companies interested, and in no case where an order was issued was it necessary for the board to institute proceedings for the collection of a penalty for wilful default of compliance.

A section of the report relates to the organization of the utilities division. Arrangements have been made, by the courtesy of the Stevens Institute of Technology, for the installation at Hoboken of apparatus for testing the accuracy of gas meters and meter provers. Similar courtesy has been extended the board by Rutgers College at New Brunswick to enable it to install apparatus for determining the accuracy of electric meters. This apparatus is necessary to aid the board in carrying out the provision of the law which gives it power to require gas and electric lighting companies to furnish safe and adequate service. No appropriation was made by the Legislature for the purchase of such apparatus. The board is buying the necessary mechanical appliances and paying for them out of its appropriation. The report adds that the board is compelled to divert from its funds for this purpose moneys which might well be used for the employment of additional inspectors needed in the utilities division.

The provision of the law requiring the approval by the board of grants to public utilities has been criticised as an unwarranted interference with the principle of "home rule" in that it may prevent a municipality making such terms as it chooses with a public-utility corporation in return for a privilege granted. The board expresses the opinion that such criticisms are not well founded, that valuable franchises have been granted by local governing bodies without proper protection of the public interest and the result of this has given force to the demand for State regulation. If the franchise is to be submitted to a State board for its approval greater care is naturally exercised by those seeking it to have the terms of the grant of such a nature that they will pass the scrutiny, without adverse criticism, of an impartial tribunal. The board declares that the legitimate interests of both the public and the corporations are better protected by the policy of requiring local grants of privileges to public-utility corporations to be approved by a commission having at its command the services of expert advisers, with special knowledge of the subject of franchise grants to such corporations.

Reference is made to the fact that, with the aim of establishing uniform systems of accounting, conferences have been called with representatives of street railway, gas, electric light, telephone and water companies Numerous suggestions have been made to the board and this matter is now under consideration. The limited amount of the board's appropriation has restricted it in the employment of accountants whose advice would be of material assistance, and the problem of uniform accounting has not been solved as expeditiously as is desirable. The board hopes to settle this matter at an early date

The report states that serious questions have been raised which put the jurisdiction of the board, and the extent thereof, in doubt, and that these doubts should be set at rest by further legislation. One of the questions raised is that under the section providing for the approval of the issue of securities the function of the board is administrative and limited to determining whether the proposed issue is lawful and that, finding the proposed issue to be lawful, it must approve the issue to the amount, for the purposes and upon the terms proposed by the corporation.

The report suggests a further statutory enactment clearly declaring that it was not the legislative purpose to preclude the enforcement of the orders of the board by resort to the appropriate processes of the courts.

The board believes that it should have the right to adopt and fix, by general orders, standards of service supplied by electric lighting, street railway, water, telephone and other public-utility corporations subject to the jurisdiction of the board The board strongly urges that, in the consideration of any changes in the law, and particularly such changes as will tend to place additional duties, involving a consideration of technical problems, upon the board, a sufficient appropriation be allowed to provide for the employment of such technical assistance as will be required to make the law effective.

Massachusetts Commission News.

The Massachusetts Railroad Commission and the Boston Transit Commission, sitting as a joint board by order of the General Court of 1910, have submitted three reports to the Legislature of 1911 bearing upon subway extensions in the City of Boston. The board recommends the construction of a double-track subway under Winter and Summer Streets from Park Street to the South Station, continuing the Boston end of the Cambridge subway eastward in order to provide a trunk-line route from the western suburban district through the shopping center of Boston to the terminal of the Boston & Albany and New York, New Haven & Hartford Railroads. Its action is based upon a thorough investigation during the past year by Acting Chief Engineer E. S. Davis, of the Boston Transit Commission, of the engineering feasibility of the subway, and the estimated cost excluding land damages, with stations at Washington Street and at Atlantic Avenue, is $2,600,000. The length of the proposed subway is about three-quarters of a mile. The board also takes up in detail the question of a subway from the South Station to Andrew Square, Dorchester, and recommends the building of a double-track subway extension of the Park Street-South Station projected subway from the South Station under Dorchester Avenue and the Fort Point Channel to Andrew Square, where an underground terminal is planned, with elaborate transfer facilities between subway and surface cars. A station at Broadway and Dorchester Avenue would provide for rapid transit to South Boston. The estimated cost of this subway is $3,500,000. Regarding the proposed subway under the West End of Boston, or so-called West End Loop, the board states that it recommends no legislation in favor of the project, on the grounds that the district is already well served by surface cars; that no part of it is more than 750 ft. from some transportation line, and that a subway from Scollay Square westward would require the building of an elevated line through a district which would be injured by its construction and maintenance. Advocates of the West End Loop subway argued that the building of such a line would rejuvenate the district, but the board feels that transportation alone cannot restore the growth of a section of a city, and points out the absence of any large demand for access to the West End by costly subway routes.

The Massachusetts Legislature of 1911 convened at Boston on Jan. 4 with the prospect of an unusually busy session in connection with matters of interest to public-utility corporations. Governor-elect Eugene N. Foss was inaugurated on Jan 5 He delivered one of the most radical inaugural addresses since the days of Governor Ben Butler, recommending the abolition of the Railroad, Gas & Electric Light, Highway and Boston Transit Commissions and the establishment of a single public-utilities commission for the entire State, as outlined on page 92 of this issue. The proposition to abolish the existing public utility commissions of the State, representing as they do many years of special experience and generally fair-minded administration of public utility and public relations, will unquestionably meet with great opposition. Each of the four boards mentioned is almost overwhelmed with work, with the possible exception of the Boston Transit Commission, and there is little evidence in sight of any real gain in economy through such a reduction in the commission strength of the State.

The annual report of the Massachusetts Railroad Commission for the nine months ending June 30, 1910, has been submitted to the Legislature. The report shows that the gross assets of all the electric roads in the State are $185,456,188; the gross liabilities, $175,470,489; the surplus, $9,985,699, and the percentage of capital to surplus, 11.84. Seventy-eight companies made returns to the board. Of these thirty-five paid dividends ranging from 1.5 per cent to 10 per cent and forty-three declared or paid no dividends. Twelve companies paid 6 per cent or over. The dividends paid averaged 3.28 per cent on the total capital stock. The total capital investment, including capital stock and net debt, is $166,685,381, and the total average cost per mile of main track is $61,733. The total income of the companies from all sources during the nine months was $25,329,312, and the total expenditures, including dividends declared, for the period were $25,496,252, leaving a net deficit of $166,940 to be deducted from the surplus of previous years. The companies carried 469,330,784 passengers, ran 87,712,572 car-miles, and operated on 67.38 per cent of their earnings. The average earnings per car-mile were 27.39 cents, and the expenses of operation were 18.45 cents. The companies employed 18,839 persons, owned 7669 cars, and 17,586 electric motors. Only nine passengers were injured fatally. Regarding the legislative request for a report on the desirability of requiring street railway companies to convey the cars of other companies the board states that the public interests require additional legislation, making this compulsory under some conditions, but preferably under the supervision of the board.

The Massachusetts Highway Commission is still under discussion in connection with the change which it recommended in the telephone rates in the Boston & Suburban district last summer. A committee of the Massachusetts Real Estate Exchange recently made a casual investigation of the rates now in force and concluded that the effect of the change will be to give the New England Telephone & Telegraph Company a greater gross income pro rata when all subscribers are using service under the new rate than under the former system. In general, the result of the change in rates appears to have been entirely beneficial to many thousands of subscribers who have voluntarily accepted them, the actual bills being reduced in innumerable cases. The rates were based upon the most complete and scientific study of telephone conditions ever made in an area of the size of the Boston district, and the report of the consulting engineers to the commission, Messrs. D. C. & W. B Jackson, has been received with appreciation by the great majority of telephone users. The traffic distribution as determined by many weeks of expert analysis formed the principal basis of the zone system now in use, and this was the only logical basis upon which to form a service charge. Many special interests like real estate dealers are large consumers of telephone service throughout the entire metropolitan district, and it is inevitable that the commission's centralization of rates along the channels of maximum traffic should produce increased bills in such cases, since these form exceptional currents of traffic in relation to the normal streams of intercourse. The commission holds itself in readiness to profit by any experience which develops in the use of the new rates, and has repeatedly stated that it does not consider the rates necessarily a final solution of the problem.

Wisconsin Commission News.

The first section of the annual report of the Railway Commission for the fiscal year ending June 30, 1910, has been submitted to the Governor. The summaries show that there are now twenty-six electric railways—an increase of one—operating in the State, with a total mileage of 608.2 miles. The operating revenues for the year ending June 30, 1910, were $6,788,101.97, an increase of $770,181, or approximately 11.5 per cent. Total operating expenses increased from $4,068,554 for 1909 to $4,678,363 for 1910, an increase of $609,808, or 13 per cent. Net operating revenues increased $160,372, or about 8 per cent.

The number of utilities making report to the commission for the fiscal year aggregated 851, as against a total of 847 for the preceding year. Of this number 199 were electric utilities, an increase of twenty-seven over those reporting last year; thirty-five were gas utilities, an increase of two; 119 were water utilities, an increase of eight, and 506 were telephone utilities, a decrease of twenty-three. This latter decrease was due primarily to the exclusion of certain private mutual telephone lines previously listed as public utilities.

The report calls attention to the striking increase in the utility business for the year as indicated by the financial data filed by them. Comparing balance sheets and income accounts for the present and previous fiscal years, it is noted that the electric utilities have increased in operating revenues 20 per cent, in net income 29 per cent and in new construction for the year 145 per cent. Similarly the water utilities have increased their operating revenues 7 per cent, net income 13 per cent and construction for the year 24 per cent. Gas utilities have increased their operating revenues 8 per cent, net income 15 per cent and new construction for the year 22 per cent. Telephone companies have increased their operating revenues 11 per cent, net income 9 per cent and construction during the year 14 per cent. The total value of the property and plants of the electric utilities increased from $23,827,350 on June 30, 1909, to $32,281,419 on June 30, 1910.

The commission notes that during the year but two appeals have been taken to the Supreme Court from decisions of the commission. The report complains of a lack of compliance with the statute requiring uniform accounting systems on the part of the municipally operated plants. On the other hand, the report calls attention to the increasing number of informal complaints and revision of rates and the growing tendency on the part of the municipalities to submit their rate schedules to the commission for informal investigation and revision.

The commission has handled during the year fifty-seven formal and 144 informal utility cases, 3354 railroad cases, fifty-eight applications for stock and bond issues and sixteen applications for certificates of convenience and necessity.

The total issue of bonds, promissory notes and interest coupons authorized amounted to $244,573,225. Of these authorizations, $237,365,975 were to railway companies, $6,007,000 to electric railway, light and power companies, $222,750 to gas companies, $768,000 to water companies and $210,000 to companies doing a combined water and light business.

The stock issues authorized had a face value of $83,445,200, distributed as follows: To railway companies, $82,570,200; gas companies, $250,000; electric companies, $583,200; electric street interurban railway, light and power companies, $830,000; heating companies, $2,000.

The commission urges the necessity of a more comprehensive legislation with respect to the law in regard to the issuing of stocks and bonds by the public-service corporations of the State. The law as it now stands, by virtue of the construction recently put upon it by the Supreme Court, is of little value as a means of ascertaining many important facts relating to the past issue of securities which should be matters of record in connection with any new issues of securities. Besides a revision of the present law the commission urges a further strengthening of the law under which the Legislature should describe the purpose for which securities should be issued, defining the character and limiting the amount which should be reasonably required and leaving to the commission to ascertain whether the proposed purposes are within the terms of the statute and whether the character and amount proposed to be issued are reasonably required by the utility. It is emphasized that in order properly to safeguard investors and to fulfil the purposes of the stock and bond law the broadest possible powers of investigation should be vested in the commission.

The commission on Jan. 5 authorized the Madison Interurban Telephone Company to increase its rates for service to the extent of about 50 per cent for single business and residence urban telephones and quite materially in rural districts. The company operates a telephone system in Dane and adjoining counties, with a total of 984 subscribers. The company is capitalized at $75,000 and has outstanding bonds to the amount of $20,000. The property is valued at $90,000. The corporation in its petition asks for authority to increase its rates for the following purposes: To enable the company to earn a reasonable return upon the capital invested; to create a depreciation fund; to meet increased cost of operation and the increased cost of long-distance service; to meet the increased cost of materials and labor. The commission made an extended review of the affairs of the company and found the increase asked for warrantable and reasonable

The old rates were as follows: Business service, $1.25 per month; residence service, $1 per month; rural lines service, $1.25 per month. The rates asked for and allowed by the commission are as follows: Business service, $2.10 per month; residence service, $1.50 per month; rural lines service, $1.35 per month.

The commission denied the petition of J. C. Burns, of La Crosse, asking that the La Crosse Gas & Electric Company and the La Crosse Telephone Company be required to remove poles in a certain alley in the city to permit the extension of railway switch track. The petitioner based his action upon the fact that the permit given the railway company to extend its switch track was accorded by the municipality previous to the granting of rights to the utility companies to erect poles in the same locality. The telephone company secured its right from the State and the electric company its from the municipality. The commission found, however, that not until 1907 was power granted the cities to pass upon the location of tracks in public thoroughfares, and that in consequence the ordinance giving prior permission to the railway company was a nullity when enacted, and that therefore no right can be predicated upon it. No order was given, but the commission suggested that the parties to be benefited should meet the expense incident to the removal of all obstructions.

The commission has authorized the Chippewa Valley Railway, Light & Power Company to issue stocks and bonds as follows: (1) Three thousand shares of common stock of the par value of $100 each, being an issue of $300,000. The stock is to be issued for cash at the par value for the purpose of acquiring the property of the Chippewa Falls Water Works & Lighting Company, to pay its floating indebtedness incurred in making additions and extensions and for further additions and extensions. It is stipulated, however, that the stock may be issued in exchange at par for the property of the company, the value of which has been determined by the commission. (2) First-mortgage twenty-year gold bonds for $250,000, of the denomination of $1,000 each, bearing interest at the rate of 5 per cent per annum. The bonds are to be issued in accordance with the terms of a deed of trust issued to the Harris Trust & Savings Bank and Andrew Cooke, of Chicago, as trustees. The bonds are to be issued and sold for money only at not less than 75 per cent of their par value for the purpose of supplying funds for making extensions and additions to the property and for purchasing additional equipment.

The commission has ordered canceled the certificate issued to the Chippewa Valley Railway, Light & Power Company on Feb. 24, 1910, so far as it relates to $100,000 common stock.

Canadian Hydroelectric Commission News.

At a special meeting of the Seaforth (Ont.) Town Council on Dec. 23 an agreement was reached between the electric light company and the town whereby the company will sell to the town corporation its lines and poles at a value fixed by the commission, together with 75 per cent of that value for the cost of construction. The company agrees to run its plant as heretofore until the town is ready to distribute hydroelectric energy.

The injunction granted to Mr. G. P. Magann against the construction of the hydroelectric transmission towers adjoining his property on Dowling Avenue, in Parkdale (mention of which was made in the issue of Dec. 29, page 1513), will likely not cause any further delay in the supply of energy by the commission to Toronto. The commission on Dec. 31 applied to Hon. William Pugsley, Minister of Public Works, at Ottawa, for approval of its plans of construction of the towers, and it is understood that his approval will shortly be given subject to all the details being carried out to the satisfaction of the department's engineers.

CURRENT NEWS AND NOTES.

Theft of Electricity.—A St. Louis man has pleaded guilty to using electricity in his cutlery-grinding establishment without passing it through the meter. Although he used a "jumper" around the meter, he pleaded that he was guilty only of a "technical and thoughtless violation" of the law, but entered an unconditional plea of guilty nevertheless He was fined $25 and costs, the whole amounting to $40.

Full of Electricity.—According to an Indiana newspaper, a miner of Sullivan, Ind., "has found that he has so much electricity in his body that a watch carried in his pocket will not run. He has tried eight different watches, full jeweled, within the past few months and every one of them stopped within twenty-four hours. He has been told that he is a human storage battery and will have to depend on the town clock for his time, but was warned not to approach it too closely."

Indiana Water Power.—Governor Marshall, of Indiana, in his message to the Legislature which convened Jan. 5 recommended the repeal of every law which permits the condemnation of land by private persons or corporations for the erection of a dam across any Indiana stream. He holds that these streams should be preserved to the people in order that the State may lease the water-power rights and regulate and limit the prices to be charged consumers of electric current generated by such power.

Canadian Electric Power Projects.—Application has been made to the Canadian Parliament for the incorporation of the Western Canal Company, with power to construct a canal from the Rainy River below Fort Frances to a point on the river five miles below the Long Sault Rapids, and to develop electric power at this point. The Nepigon-Albany Canal & Transportation Company is applying for power to construct a continuous waterway from Nepigon Bay, on Lake Superior, to James Bay and for transportation and power rights.

Appeal to London from Winnipeg Power Decision.—On Dec. 27 the Court of Appeal at Winnipeg gave the Winnipeg Electric Railway Company leave to appeal to the Imperial Privy Council of England against the decision given by the Manitoba court in favor of the City of Winnipeg in the recent litigation concerning the right of the company to develop power outside the city limits for use in the city under its charter. The city corporation has also decided to appeal the recent decision of the court on certain points, the latter appeal going to the Supreme Court at Ottawa.

Boston Subways.—Two tunnel projects that would cost $6,100,000 were favored and one treated adversely in a report submitted to the Massachusetts Legislature by the Boston Transit Commission and the Board of Railroad Commissioners on Jan. 6. The two tunnel extensions advocated would establish a through line between Harvard Square, in Cambridge, and Andrew Square, in South Boston-Dorchester, by way of Beacon Hill, Park Street station and the South Station and other way stations, and the joint board suggests that the trains should make the full run.

Canadian Water-Power.—According to official estimates by the Department of the Interior, the available water-powers of the Dominion of Canada are capable of developing more than 25,000,000 hp, which if produced from coal would represent a consumption of more than 562,000,000 tons per annum. The Province of Quebec leads with an available water-power of more than 17,000,000 hp, its present development, however, being only 50,000; whereas Ontario, with a water-power of not much in excess of 3,000,000 hp, has a present development of more than 330,000 hp.

Multiplex Telephone Development.—Four patents dealing with multiplex telephony and telegraphy and issued to Major George Owen Squier, of the Signal Corps of the United States Army, on Jan. 3, 1911, have been dedicated by the inventor to the public for the free use of any person in the United States without the payment of any royalty. The invention relates to the simultaneous transmission of a plurality of messages over a single telephonic circuit without "cross-talk." Use is made of electric waves of such frequencies as to make possible the selection and complete independence of the various messages

Energy from Niagara Falls.—A legislative bill now pending is designed to authorize the Secretary of War to grant permits for diverting within New York State the waters of Niagara River above the falls for the creation of power to individuals, companies or corporations now actually producing power from these waters or from the Erie Canal. The daily diversion, it is provided, shall not exceed in the aggregate a rate of 20,000 cu. ft. a second. The bill eliminates limitation as to importing energy from the Canadian side. Following a hearing held on Jan. 6, the house committee deferred action.

Unsuspected Dangers from Gasoline Automobile Trucks.—The death of Dr. J. A. Hemsteger, a Chicago physician, on Jan. 6 after inhaling fumes exhausted from the engine of his gasoline automobile in the inclosed space of his private garage, calls attention to one of the little-suspected dangers of gasoline vehicles and trucks when allowed to stand indoors for any length of time with engines running. The physician was running the engine to clear the cylinders and muffler of carbon deposit, and after a few minutes noticed symptoms of nausea and dizziness. These disappeared after he came out into the outside air, but returned that evening, accompanied by severe suffering. The next day he died. Incomplete combustion in the engine cylinders, producing carbon monoxide, was doubtless responsible for the death through the enfeebling of the red blood corpuscles. Carbon monoxide forms a stable compound with the hemoglobin of the blood, depriving the red corpuscles of their normal function of transferring oxygen from the lungs to the muscular tissues. Unfortunately, also, this action is cumulative, and small quantities of monoxide taken into the system on successive occasions may have their poisonous effects added and produce serious results. The pollution of air around partly inclosed loading platforms by motor trucks with their engines running may, therefore, be expected to affect the health and activity of clerks and workmen to an unsuspected degree, and is only one of a number of disadvantages of such gasoline cars when compared with electric trucks.

Rejuvenation of Sons of Jove at Chicago.—By a change in the arrangements the rejuvenation and dinner of the Sons of Jove to be held during the Chicago Electrical Show will be held on Tuesday, Jan. 17, beginning at 6 p. m., at the Auditorium Hotel, instead of the time and place previously announced.

Copper in Greenland.—At the Josva and Lilian Mines in Greenland the first melting furnace was installed during last summer. A shipment of 500 tons of blister copper was received at Copenhagen, Denmark, in the last week of December. Previously all the ore was shipped to Denmark. Forty-six men are at present employed in the mills, among them several natives.

Talking Moving Pictures.—Dr. Arthur Korn, professor of physics at the University of Munich, whose experiments in long-distance photography attracted attention a few years ago, has exhibited before the Academy of Sciences of Munich an invention for synchronizing the phonograph and cinematograph by means of which the moving pictures appear to speak. It will be recalled that Edison gave a similar exhibition some months ago.

Electric-Bell Scarecrows.—It is said that electric bells rung intermittently form an excellent method of scaring away birds from grain fields and orchards. It is reported that an Austrian inventor has utilized this idea as the foundation for a patent in which is described a clock connected to a primary-battery circuit in such a manner as to ring a series of bells at frequent intervals for the purpose of keeping the birds unsettled and alarmed.

Technical Papers Combine.—Announcement is made of the consolidation of the *Electric Trunk Line Age* and the *Railway Electrical Engineer,* the official journal of the Association of Railway Electrical Engineers. The journal in its enlarged form continues to be the official organ of that organization Mr. C. L. de Muralt, of the firm of Muralt & Company, engineers, professor of electrical engineering at the University of Michigan and formerly editor of the *Electrical Trunk Line Age*, has been retained as editor.

Meeting of the Electric Vehicle Association of America.—The next regular monthly meeting of the Electric Vehicle Association of America will be held in the Engineering Societies Building on Jan. 17 at 8 o'clock. Mr. Bruce Ford, of the Electric Storage Battery Company, will present an illustrated paper on "The Ironclad Exide Battery" and among those listed to discuss the paper are Mr. W. P. Kennedy, of the Studebaker Automobile Company, and Mr. F. F. Sampson, of the New York Transportation Company.

Some Prophecy.—Newspapers continue to rush in where technical journals fear to tread. Thus a Chicago daily of recent date sagely observes: "Electricity seems to accomplish everything, but it is what it has done for transportation that interests most people. In that line the electrically propelled aeroplane will doubtless develop to supremacy for high-speed mail and perhaps passenger service. The electric gyroscope will furnish stability for this device and also for monorail high-speed trains electrically driven."

"Sticker" Telegrams.—The United States Supreme Court decided that a telegraph company must accept a telegram though it contains a "sticker" intended to fix additional liability on the company for delay in transmission. The court took the same position some time ago in a case against another telegraph company, but two new points were brought up in the present suit. One related to the effect of a rule of the company forbidding a sender from putting anything on the face of the blank form, except the message, date, name and address of the one to whom the message was to be sent. The court holds that the plaintiff had no knowledge of the rule, and that the rule contained in a tariff book of the company was intended for use and guidance of the company's agents and not for the public.

Pension System at Niagara Falls.—Announcement is made that the Niagara Falls Power Company, of Niagara Falls, N. Y., and the Canadian Niagara Power Company, of Niagara Falls, Ont., with their allied interests, have established a pension system which became effective on Jan. 1. All employees who have been continuously in the service of the companies for ten years are eligible. Men who reach the age of fifty years after a service of fifteen years may be retired on a pension which shall not be less than $20 a month or more than $100 a month.

Commission Form of Government for Springfield, Ill.—By a vote of 3699 to 3029 Springfield, Ill., has adopted the commission form of municipal government under the recent Illinois law permitting cities not exceeding 200,000 in population to make the change. By this law a Mayor and four commissioners exercise all legislative and executive powers for the city, and relations with public-service corporations undergo a marked change, as explained in the summary of the law given in the *Electrical World* of April 14, 1910, page 923.

Wisconsin Electrical Association.—The annual convention of the Wisconsin Electrical Association will be held Jan. 18 and 19, in Milwaukee, at the Hotel Pfister. The program will consist of papers and discussions on the following subjects: "Publicity Campaigns."—"Some Principles Established by the Wisconsin Railroad Commission."—"Electric Meter Testing."—"Ornamental Street Lighting."—"Insurance." —"Electric Railway Repair-Shop Practice." The matter of holding a banquet on Wednesday evening, Jan. 18, is now under consideration by the executive committee.

Meeting of the Wireless Institute.—A meeting of the Wireless Institute was held in Fayerweather Hall, Columbia University, New York, on Jan. 4, at which Mr. Kolster, of the Radio Telephone Company, read a paper on "Singing Spark Sets." After the presentation of the paper the election of officers was held and resulted as follows: President, Mr R. H. Marriott, of New York; vice-presidents, Messrs. Greeleaf W. Pickard, of Amesbury, Mass., and Fritz Loenwenstein, of New York; secretary-treasurer, Mr. Alfred N. Goldsmith, City College, New York, and directors, Messrs. Frank H. Fay and Sidney L. Williams, both of New York.

Alternating-Current Interurban Railway to Use Direct Current.—According to newspaper accounts the Warren & Jamestown Street Railway Company, of Warren, Pa., connecting that city with Jamestown, N. Y., has decided to supersede its present alternating-current single-phase system by the use of direct current, so far as car operation is concerned. It is said that the change will involve an expenditure of nearly $100,000, and that the work will be commenced soon. The alternating-current service proved undesirable, it is said, because the company was obliged to install transformers so that 550-volt energy might be used in the cities of Warren and Jamestown. This involved additional construction expense and is considered not to be so satisfactory as the straight direct-current system for car operation. The line is about twenty-two miles long, and alternating current will be retained for transmission, the power house being at Stoneham, Pa., while new substations will be erected, probably at Frewsburg and North Warren.

Illumination Effects at Commercial Vehicle Show.—At the National Commercial Motor-Vehicle Show to be held at the Coliseum, Chicago, Feb. 6 to 11, decorative features are promised in the illumination of the building. The 300-ft. x 175-ft. ceiling is to simulate stained glass and at 11-ft. centers will be studded with 500-watt tungsten lamps. Illuminated fountains, pillars and vases will complete the ornamental lighting of the show.

Electric Motor Trucks on Docks.—Fourteen longshoremen with hand trucks have been displaced at the Hoboken (N. J.) docks of the Hamburg-American Line by a three-wheeled electric platform truck of one-ton capacity, which has a low platform 5 ft. x 12 ft. without sides and can travel twenty-four miles a day on one charge at a rate of four and one-half miles an hour. Two similar one-ton trucks and two three-wheeled trucks with a carrying capacity of four tons are used for transferring castings and finished parts from one part of a factory in a large industrial plant to another and between factory buildings. They can be taken on freight elevators to any floor in the factory buildings.

Baltimore City Lighting.—The report of the Department of Lighting of the City of Baltimore, which has been prepared by Superintendent McCuen, shows that 684 lamps of all descriptions have been added to the service during the past year. There were 400 gasoline lamps discontinued owing to the changes to incandescent lamps and also for economy. Fifty overhead arcs were connected with the conduit system, and 139 lamps of all sorts were transferred. The total number of lamps now in Baltimore is 11,340, a net gain over 1909 of 200. The gas meters tested up to July 1, when the Public Service Commission took charge of this work, were 21,897, and the fees from these and 5937 electric meters were $2,784.10. Street signs to the number of 908 were put in position.

Meeting of the Brooklyn Company Section of the N. E. L. A.—A holiday social meeting of the Brooklyn Company Section of the N. E. L. A. was held in the auditorium of the Johnston Building, Brooklyn, on Jan. 9. The speakers of the evening were Mr. Henry L. Doherty and Mr. T. I. Jones. The former spoke on "Rates," outlining the elementary development of the various rate systems at present in vogue and pointing out the advantages of the Doherty system. Mr. Jones, who is the general sales agent of the Brooklyn Edison Company, spoke on the "Development of Our Business," which as pointed out in a previous issue was exceptionally good during the past year. A vaudeville performance was given after the meeting, followed by refreshments. The attendance was 485 and the meeting did not adjourn until after 12:30

Christmas Celebration by Toronto Section of the N. E. L. A.—The Toronto Section of the National Electric Light Association held a "Christmas tree festival" on Dec. 29 which proved to be a happy event. Following a vaudeville show by professional performers and a buffet lunch presents were distributed from a "Christmas tree," every one of the 150 members being appropriately remembered. Accompanying the gifts were cleverly arranged limericks that tersely portrayed the eccentricities of the various members. Mr. W. A. Martin, assistant general manager of the Toronto Electric Light Company, was presented with an automobile, he lately having purchased for the company a gas car, the toy being a slight hint that an electric carriage would be a far better advertiser than the gas machine. Tin watches were given to men who have a tendency toward tardiness. The chief power engineer received a whistle, and was requested to inform the assembly as to the amount of horse-power required to blow the toy. The sales manager, who has made a specialty of electric irons during the past season, was presented with a toy iron, while a member who has a tendency toward red-tapy things was given a blank form with an appropriate limerick. The illuminating engineer received a candle and the chief operator a magnet. The committee in charge of the arrangements included Messrs. R. F. Pack, L. V. Webber, E. E. Wheler, Charles Bawden, H. W. Martin, Mill Pellett and Eugene Creed. At the next regular monthly meeting, on Jan. 26, Mr. T. C. Martin, executive secretary of the National Electric Light Association, will deliver an address on "Organization."

Propose Large Water-Power for Muskogee, Okla.—Plans have been formulated by J. A. Norman and other business men of Muskogee, Okla., to dam the Grand River at two water-power sites ten miles north of the city, utilizing the energy thus generated to furnish light, drive factories and operate electric interurban railways. The Grand River is said to be capable of developing more than 100,000 hp at this point, and the dam proposed would be 40 ft. high and 1500 ft. long. A company with $1,500,000 is to be formed, according to the plans of Mr. Norman, who is styled by some "the father of Oklahoma statehood." Muskogee has enjoyed the highest rate of growth of any city in the country, jumping from a town of 4300, according to the 1900 census, to its 1910 population of 25,200. It lies in the midst of an important oil and natural-gas country and deposits of coal and marble are only forty miles distant. The Arkansas River is navigable to the mouth of the Grand River, which empties into it. If built the proposed dam would also create a reservoir for the water supply of Muskogee.

Janitors' Wiring Criticised.—A contributor to the *Chicago Daily News* signing himself "Electrical Engineer" points out that almost every janitor of an apartment building thinks he knows something about electricity and that the amateur wiring jobs done in consequence of this assumption of knowledge constitutes a real danger. Sometimes extra lamps are placed in basements, hallways or porches, and the wiring is often done by the janitor by means of lamp cord supported on nails, staples or anything but the proper insulating material. Another violation of the municipal regulations for wiring is the practice of many janitors of connecting up an alarm clock with a weight attachment to turn off the hall lamps late in the evening. These clocks are usually set on a wooden shelf near the meter board or distributing box, and the connections are frequently made with lamp cord or bell wire. This form of "jerry wiring" may easily constitute a fire hazard. Furthermore, a city ordinance in Chicago provides that in all apartment buildings more than two stories high the owner shall keep a lamp in use on each floor all night long.

Electric Club of Chicago.—At the meeting of the Electric Club of Chicago on Jan. 4 the death of Mr. Arthur O. Einstein, a member of the club, was announced, and Messrs. W. S. Taussig, P. R. Boole and F. S. Hickok were appointed a committee to take suitable action. It was voted that the dues for the remaining portion of the club year be remitted in the case of all new members sending in their applications before Feb. 1 After President F. P. Vose had extended a New Year's greeting to the members, Mr. A. J. Francis, of the Chicago office of the Fort Wayne Electric Works, read a brief paper on "Energy-Saving Devices." The speaker contended that apparatus resulting in economy of electrical energy is really to the advantage of the central-station company in that it makes customers pleased and in the end advances the interests of the electric service company also. Tungsten lamps, low-voltage transformers, bell-ringing transformers and compensating devices for use in connection with the arc lamps of moving-picture shows were mentioned as appliances of this description. Messrs. Arthur Bessey Smith, C. W. Bender, of Cleveland, and O. B. Duncan took part in the discussion. Afterward there was a meeting of the board of managers of the Electric Club, and Messrs. J. G. Pomeroy, Frank L. Perry and H. A Fife were appointed as a nominating committee to select a ticket to be voted on at the annual meeting on Feb. 1

ELECTRICITY FROM A DRAINAGE CANAL.

Extensive Hydroelectric Development of the Sanitary District of Chicago—I.

THE Drainage Canal of the Sanitary District of Chicago is an artificial channel thirty miles long connecting the South Branch of the Chicago River with the Desplaines River at a point below Lockport, and designed to discharge about 840,000 cu. ft. of Lake Michigan water each minute into the Desplaines River and so into the Illinois River, from which it finds its way through the Mississippi into the Gulf of Mexico. At the Desplaines end of the Drainage Canal this water has a fall of about 34 ft., providing a site for a hydroelectric generating station, the output of which is transmitted back to Chicago and used for municipal and commercial lighting and power purposes.

Until 1900 Chicago presented the peculiar anomaly of a city discharging its sewage into the great fresh-water lake at its door, and yet taking from that same lake all of its water for drinking purposes. In 1892 work was begun on the Drainage Canal by the Sanitary District of Chicago, a public body organized for the purpose of improving the condition of the water supply of the territory in and adjacent to the City of Chicago. When completed in 1900 this Drainage Canal reversed the direction of flow in the former stagnant South Branch of the Chicago River, which was the principal discharge channel of the city sewer system, thus sweeping all of the refuse that formerly decomposed in the river or found its way out to the lake down across the prairie in a diluting flood of clean Lake Michigan water, purifying itself before even the end of the artificial channel was reached. A complete system of intercepting sewers discharging into the new channel has since been completed, and elaborate plans have been formulated, and partly carried out, for constructing supplementary channels which shall free the lower end of Lake Michigan from all other contamination.

The main channel of the Drainage Canal, as first chartered, extended from the Chicago River at Robey Street to the controlling works opposite the City of Lockport, Ill., a distance of twenty-eight miles. For the first thirteen miles of this distance the canal is excavated through glacial drift and gravel, and measures 200 ft. wide at the water line and 24 ft. deep. The fifteen miles from Willow Springs to the controlling works represent a rectangular prism, 161 ft. x 24 ft., cut from the solid limestones of the Paleozoic age. In places the floor of the excavation is 35 ft. below the country surface, although the depth of the canal throughout its length is 24 ft.

The earth section has a slope of one in 40,000, while the smaller rock section is graded to one in 20,000, transporting the canal's average flow of 10,000 cu. ft. per second at a velocity of about 1.5 miles per hour. Throughout its entire length the Drainage Canal parallels the old Illinois & Michigan Canal, which gave the name and importance of Lockport to the little Illinois town near the present controlling works. For the last thirteen miles of its flow the Drainage Canal utilizes the valley of the Desplaines River, and the latter stream had to be provided with a new bed to replace that appropriated by the canal. The cost of excavating the main channel and the Desplaines diversion, exclusive of the price paid for the right of-way, etc., was over $23,000,000. The material moved aggregated nearly 30,000,000 cu. yd. of earth and glacial drift and 13,000,000 cu. yd. of rock.

At the southwestern terminus of the Drainage Canal, as first planned, is the Lockport controlling works, designed to keep the rate of flow through the canal constant, in accordance with the War Department's limits placed on the amount of water which may be diverted from Lake Michigan. These controlling works comprise seven sluice gates and a bear-trap dam. The sluice-gate openings are 30 ft. wide between masonry abutments and the gates have a vertical travel of 20 ft. The bear trap dam has an opening 160 ft. wide and can oscillate through a range of 12 ft. vertically. This great hinged barrier is raised and lowered by hydraulic pressure, virtually floating into posi-

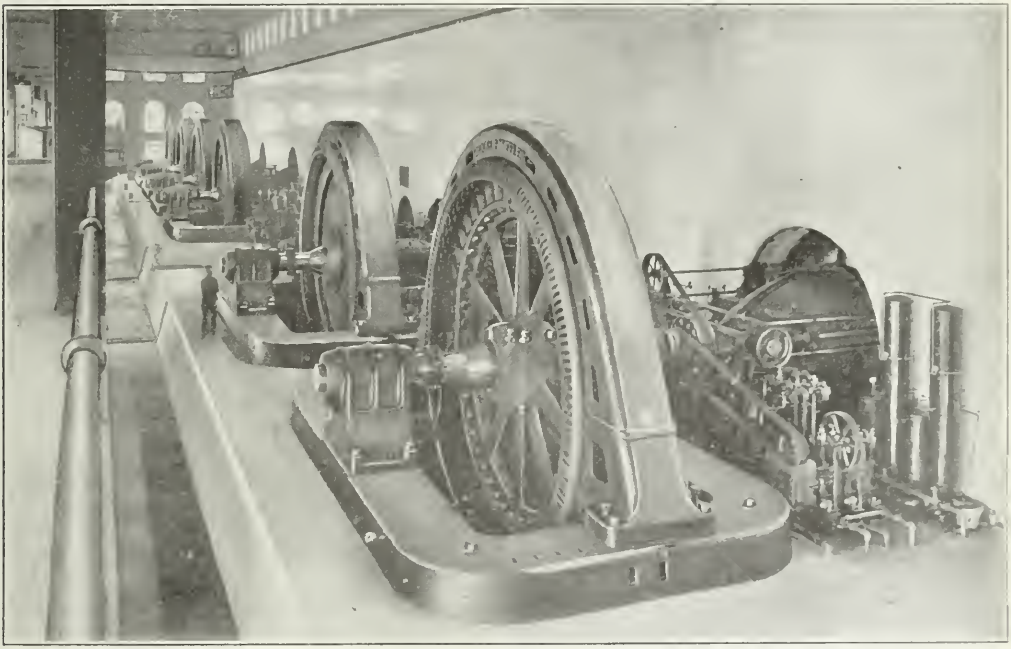


Fig. 1—Generator Room in Station of the Sanitary District of Chicago on Drainage Canal at Lockport, Ill.

tion when water is admitted beneath the leaves. The sluice-gates are operated by electric motors.

HYDROELECTRIC DEVELOPMENT.

With the original plan of the Drainage Canal completed to the Lockport controlling works, it became obvious that the potential energy of the large volume of water dropped each minute over the spillway of the controlling works was being wasted. In the next few miles below Lockport the bed of the Desplaines River drops away very rapidly, and by extending the canal a mile or two down stream it was realized that a head of 30 to 40 ft. could be secured, making about 40,000 hp available in the water delivered through the Drainage Canal. The discharge water of the power house at this point could then be utilized as the headrace of a second generating station at a lower level, and so the first amount of power might be duplicated.

Fig. 2—Terminal Station, Chicago.

The first of these interesting plans has been completed and in operation several years. The original canal was extended two miles down the middle of the broad Desplaines valley, between massive bulwarks of clay and stone spoil, faced with concrete, which carry the surface of the water high above the chimney tops of adjacent houses. This power extension of the original canal is at no place less than 160 ft. wide, and at its downstream terminus, two miles from the controlling works, is closed across by the generating station which operates under a mean head of 34 ft. Nearly 400,000 cu. yd. of material was used in the construction of these retaining walls.

The suspension of nearly 40,000,000 cu. ft. of water behind artificial retaining walls at a height of 40 ft. above the neighboring city of Joliet, Ill., backed by the contents of thirty miles of canal communicating with the whole of Lakes Michigan and Huron, was one of the results of this extension canal, and although all of the structures holding this immense body of water had been designed with a liberal factor of safety, it was decided to provide means for shutting off the extension canal in case trouble should ever develop below the natural excavated canal section.

The structure provided for this duty of closing the 184-ft. canal entry was the famous "butterfly dam," the only one of its kind in existence. This dam comprises a 184-ft. movable leaf, 30 ft. high, pivoted at its center, and which, normally held in position parallel to the canal banks, is arranged to be swung across the channel, closing it completely. The lower pivot, which in service sustains a pressure of 3,776,000 lb., is a 32-in. steel cylinder built in a steel frame which is sunk 40 ft. into the rock bottom of the channel. The upper pivot, which in service sustains a thrust of 1,800,000 lb., is carried on a brace span of truss construction, supported at its extremities on two concrete piers, 190 ft. apart, between which the movable leaf is free to swing. In its normal open position the butterfly dam thus leaves a navigable channel 80 ft. on each side of the piers.

To close the dam the leaf is first started by a motor-driven rack-and-pinion which throws it into the current. Six 6-ft. x 4-ft. valves or gates are inserted in each half of the leaf. To hasten the closing of the dam all of the gates on the counter-current side of the swing are opened, while those on the current side are closed. This presents a greater effective pressure on the one side than the other, and the leaf rapidly moves into place, where it is secured by closing an end-lock on the east abutment. To open the leaf the reverse gates are operated and the greater pressure accordingly applied to the other side, swinging the dam back to its central position. An underground tunnel is provided for the operator's use from a shaft in the west abutment to one in the north pier, where the control apparatus is located. The butterfly leaf weighs 710 tons, and 1080 tons of steel were used in the dam structure.

The two-mile stretch of extension canal between the controlling works and the power house is of irregular width, in no place less than 160 ft., and has a mean depth of 24 ft. The hydraulic works at the power-house end of the extension canal comprise a 34-ft. lock capable of taking vessels up to 20 ft. beam; a 48-ft. bear-trap gate spilling from the main channel; a 12-ft. bear-trap gate for clearing the power-house forebay, and the eight turbine penstocks through which water is admitted to the water-wheels driving the generators within the station.

The present canal lock, which complies with the legal requirements imposed by the Legislature, measures 130 ft. long between gates and 22 ft. wide between walls. Its maximum lift between levels is 40 ft., and with 12 ft. of water over its sills at the lower level the height of its gates is probably exceeded by no other lock. Both gates and valves are operated by electric motors from control boards in the lock-tender's cabin. These control panels, built by the Cutler-Hammer Company, report the operation of the gates or valves, together with their position, by the lighting of colored lamps. Duplicate head gates are provided, in case of accident. The regular gates are moved by motor-driven winches which wind up cables. The valves for emptying and filling the lock are of unique construction. They consist of a pair of huge concentric hollow cylinders, the inner one reaching up to the low-water level, with which it communicates, and the outer one extending to the high level, at which it is surrounded by water admitted through a conduit passage in the lock masonry. The tall outer cylinder rests on a fitted seat, which acts as the valve. When lifted by the motor this cylinder admits the flow of water under its lower end and over into the short cylinder, from which it discharges. The discharge ports in the lock are in the center of the side walls and are arranged so that eddies cannot be produced which will cause vessels to be lashed back and forth. The lock can be emptied in eight minutes.

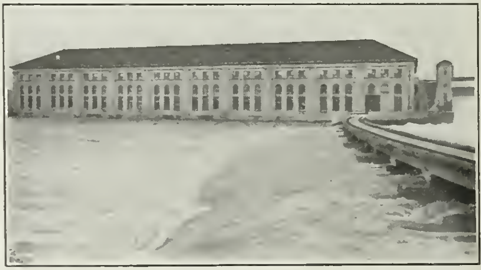


Fig. 3—Down-Stream Side of Power House; Spillway at Right.

At the east side of the present lock provision has been made for constructing a large ship lock which will take any vessel plying on the Lakes-to-the-Gulf waterway, of which the Drainage Canal forms the first link.

Next to the lock structure are the two movable bear-trap dams, from which vessels entering the lock are protected by a concrete fender-pier. The 48-ft. dam, which has a vertical ravel of 14 ft., spills water from the main canal, and is used n conjunction with the controlling works at Lockport, two miles back, to govern the amount of water flowing in the canal, ompensating for the different demands of the water-wheels with variations of load. A fall of about three feet is noted between the normal height of the water in the canal at the power house and the level of Lake Michigan. The main 48-ft. bear-trap dam at the lower plant, like the adjacent 12-ft. dam which is used for clearing the forebay, is hydraulically operated by varying the height of the water column in a "bucket" communicating with apertures inside the leaf, thus causing the dam virtually to float up to the required height.

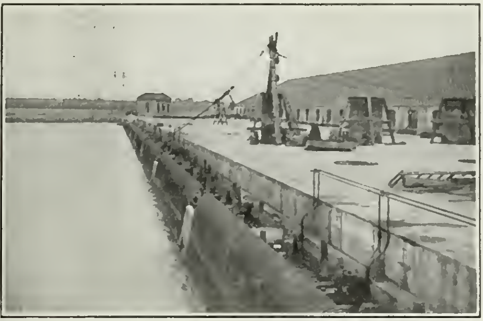


Fig. 4—Forebay and Rocks at Power House.

The forebay for the power house, which takes a triangular slice out of the canal extension along its west bank, is protected against ice and floating material by a skew fender-boom of massive concrete construction, pierced by fourteen submerged arched openings, each 19 ft. wide. The penstock entries to the turbine chambers are guarded by slanting racks of ⅜-in. x 3-in. steel bars placed at 3-in. intervals. Each of the nine penstock chambers is 32 ft. wide, 74 ft. long and 28 ft. high, and they are separated by reinforced-concrete walls 6 ft. thick, so that any chamber may be emptied without imperiling the adjacent ones under pressure. Each of the six completed main chambers contains a 6000-hp six-runner horizontal water-turbine set. Access to the bearings of these machines is given through vertical cylindrical wells or tubes extending from the penstock roof to the turbines, 20 ft. below. In the central penstock chamber are contained the water-wheels for the three exciter sets. The down-stream bulkhead of the penstocks forms the north wall of the power house.

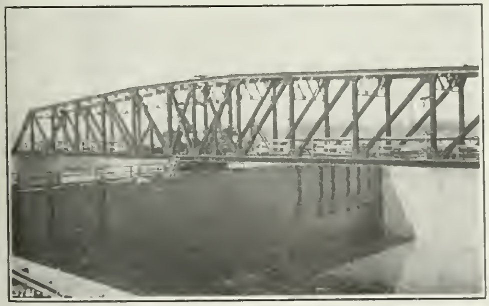


Fig. 5—Butterfly Dam Closed at Controlling Works.

POWER HOUSE.

The hydroelectric generating station of the Sanitary District is a concrete structure 385 ft. x 70 ft. in floor plan and 47 ft. high, measured to the eaves. The roof, of red tile, is supported by steel-truss construction without interior supports. The interior of the station is lined throughout with white-enameled brick, presenting an uncommonly handsome appearance.

The station has been designed for eight 4000-kw water-wheel-driven, alternating-current generator units, of which six have now been installed and are in operation. The three exciter units for serving these machines are also complete.

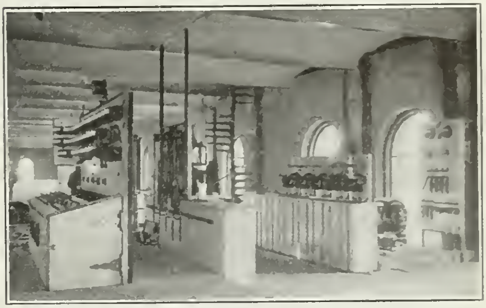


Fig. 6—Operating Switchboards, Power House.

The four alternators in the west half of the station are driven by 6000-hp Wellman-Seaver-Morgan water-wheels, each horizontal turbine shaft penetrating the north bulkhead wall and carrying six Jolly-McCormick 54-in. runners located in the penstock chambers before described. The turbine shafts are 12 in. in diameter and 71 ft. 5 in. in length, and are made in three sections, of open-hearth steel, nickel steel and annealed nickel steel respectively, corresponding to the increasing torque imposed as the shaft nears the generators. Alternators Nos 5 and 6 are driven by S. Morgan Smith water turbines built under specifications similar to those of the first four. These units all operate at a rated speed of 163 r.p.m. At 0.8 gate opening they use 100,000 cu. ft. of water per minute and develop 5360 hp. The draft tubes are molded in the concrete of the power-house foundations and discharge the tail water with a minimum of disturbance or loss of suction head.

The six 4000-kw, 6600-volt, 60-cycle, three-phase alternating-current generators were built by the Crocker-Wheeler Company, Ampere, N. J. The rotors measure 18 ft. in diameter and are connected directly to the turbine shafts revolving at 163 r.p.m. Nos. 1, 2, 3 and 6 have their armature conductors built of bar sections inserted in the partly open slots, while Nos. 4 and 5 have had this construction replaced by form-wound coils.

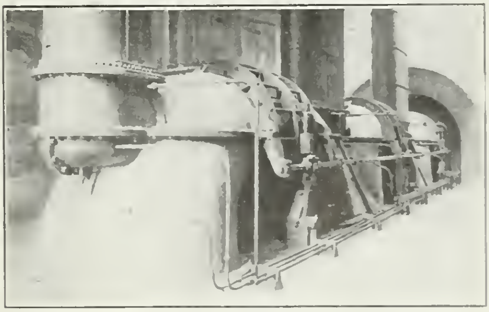


Fig. 7—Interior View of Submerged Turbine Chambers.

Three 350-kw, 250-volt direct-current exciter generators are provided. Two of these were built by the Crocker-Wheeler

Company and are driven by 600-hp Wellman-Seaver-Morgan turbines; the third is of Western Electric manufacture and is driven by a 600-hp S. Morgan Smith Company turbine. The exciter sets are mounted on the main generator floor, midway between the two four-unit sections of the main alternating-current equipment.

The 6000-hp turbines have their speed automatically controlled by Lombard oil governors which are being installed to replace the mechanical governors at first used. The three exciter turbines are controlled by mechanical governors, two being of the Lombard-Replogle type and one of the Woodward type.

The electrical equipment in the power house is ranged on three floors—the main generator floor and two balconies. On the first floor, besides the generating units, are the 6600-44,000-volt step-up transformers and the 6600-volt transfer buses. The first balcony carries the remote-control benchboard and switching apparatus, the high-tension transformer switches and, at the east end, the 44,000-volt electrolytic lightning arresters. On the top or second balcony are the main buses and the outgoing-line buses, the high-tension tie switches and the generator rheostats.

From the water-wheels to the 12,000-volt buses of the terminal station all apparatus of every kind is of well-known standard design and in every respect had passed through the experimental period. No special apparatus or complications of any kind were permitted to enter into the construction and design, therefore the matter of operation is simplified without sacrificing flexibility. A skeleton diagram of connections—from which instrument wiring has been eliminated, not being important, as each unit has its own system, rendering switching of instruments unnecessary—is shown. Each water-wheel generator and transformer bank is treated as a unit straight through to the high-tension bus. Every connection on each of the six units is identical and will be found in a relative location; in fact, there are six identical plants terminating at a given point. An operator learning one complete unit knows the entire system of connections and where to find them. This could be accomplished only by paralleling the generators at all times on the high-tension side, although it could be done on the low-tension side if necessary.

At the high-tension busbars the units are grouped in pairs and can be operated as such on separate circuits through to the terminal station, at which point the connections are carried through to the low-tension busbars in exactly the same manner as at the power house, permitting the entire plant to be operated as one or as three wholly separate plants, interruptions on one not affecting the others in any manner. To carry this plan through the entire system required the most careful preparatory work. The only complicated part of the operating system is on the duplicate 12,000-volt busbars, where the outgoing distributing circuits may be switched from either of two sections of busbars normally used on each section, but may, in case of necessity, be transferred to any particular section—a flexibility that probably will never be required. The ordinary operation is thus simple as compared with many of the large stations.

As before mentioned, the station design has followed the idea of taking each generator with its bank of transformers as a unit, although providing transfer connections on the 6600-volt side in case it becomes necessary to operate a generator with other than its own transformer group. The main 44,000-volt high-tension bus is arranged for sectionalizing into three parts, from each of which one of the outgoing transmission circuits (the third is now being strung) is fed.

From the generators the 6600-volt circuits are taken over 600,000-circ. mil conductors to the hinge clips of 450-amp double-throw hook switches, protected by oil-switch breaks, making it possible to feed from the generators directly into the 6600-volt buses or the step-up transfer banks, or both. From the 6600-volt buses, through Hartman hand-operated oil switches mounted on an enameled-brick partition at the center of the station, four 6600-volt circuits are taken off for transmitting energy to several nearby industrial plants. The 6600-volt buses are carried the length of the station in marble-slab channels, mounted on enameled-brick partitions, behind which the transformers are installed. Eighteen of these 1333-kw oil-insulated, water-cooled General Electric 6600-44,000-volt step-up transformers are now in place, grouped in six delta-connected 4000-kw banks, one corresponding to each generator. The high-tension leads from each transformer bank are carried through the ceiling to two General Electric type H motor-operated oil switches on the first balcony. These transformer switches are connected in series and serve as a double break for disconnecting the transformers from the main high-tension bus. The oil switches are enclosed in enameled-brick compartments, the walls of which are extended to protect the connecting buses and hook switches. From the transformer switches the lines again ascend to the main bus on the second balcony. This bus is made up of rod conductors carried on petticoat insulators between single-course

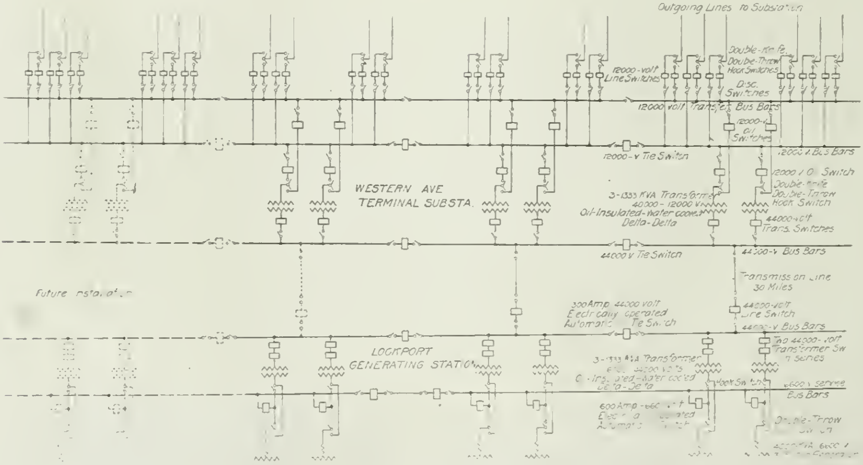

Outgoing Lines to Substation
Double-Knife Double-Throw Hook Switches
12000-volt Line Switches
Disc. Switches
12000 volt Transfer Bus Bars
12000-v Oil Switches
12000-v Tie Switch
12000 v Bus Bars
12000 v O. Switch
Double-Knife Double-Throw Hook Switch
WESTERN AVE TERMINAL SUBSTA.
3-1333 KVA Transformer 40000-12000 V. Oil-Insulated-Water cooled Delta-Delta
44000-volt Trans. Switches
44000 v Tie Switch
44000-v Bus Bars
Transmission Line 30 Miles
Future
300 Amp 44000 volt Electrically operated Automatic Tie Switch
44000-volt Line Switch
44000-v Bus Bars
Two 44000-volt Transformer Sw in series
LOCKPORT GENERATING STATION
3-1333 KVA Transformer
Oil-Insulated-Water cooled Delta-Delta
Hook Switch
6600 v service Bus Bars
600 Amp 6600 volt
Double-Throw Switch

Fig. 8—Diagram of Switching Arrangement of Power House, Transmission Lines and Terminal Station.

barriers of enameled brick, 2 ft. 6 in. high, erected on the concrete floor. This bus runs the length of the gallery, and at present is divided into three parts, by General Electric type H motor-operated sectionalizing oil switches, to each of which sections two of the transformer banks may be connected hrough the double-break oil switches, as before mentioned. In turn from each of these three sections similar remote-controlled oil switches connect to the three transmission circuits which will shortly be in operation into Chicago. These circuits are carried along the gallery on bus construction in double-tier barriers, similar to that employed with the main bus. At the east end of the gallery they rise through choke coils to the high-tension entries connecting to the pole line, and just within the station have discharge taps taken off to the 44,000-volt General Electric aluminum-cell electrolytic lightning arresters which are mounted below on the first gallery.

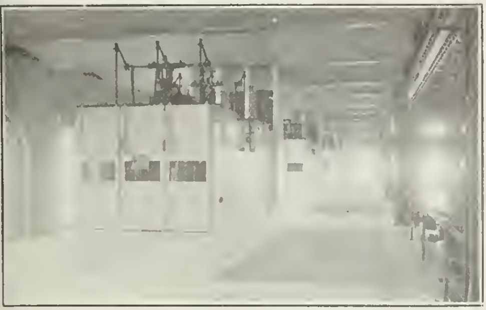


Fig. 9—Oil-Switch Gallery, Power House.

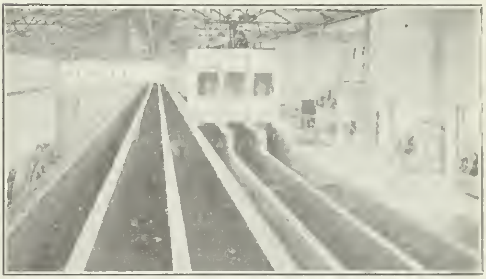


Fig. 11—44,000-Volt Busbar Compartments.

The control of the operating units is effected and all switching operations are performed from a remote-control benchboard on the first balcony, which commands a view of the entire generator room. This marble switchboard comprises six generator panels with Thomson ammeters, power-factor meters, indicating wattmeters and voltmeters, and General Electric totalizing kilowatt-hour meters. At the right are the three exciter panels, and at the left is a swinging bracket carrying a synchroscope, two Hartman reed-type frequency meters and Thomson frequency meters and voltmeters, which can be applied, through plug connections, to any circuit on the board.

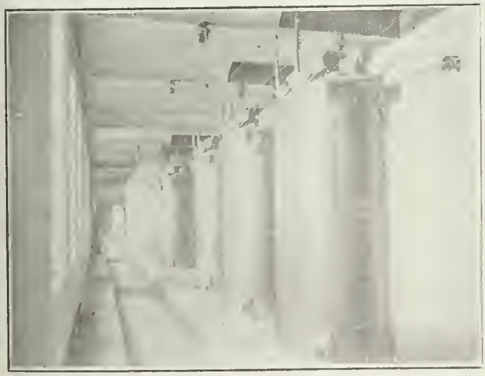


Fig. 10—Transformers in Power House.

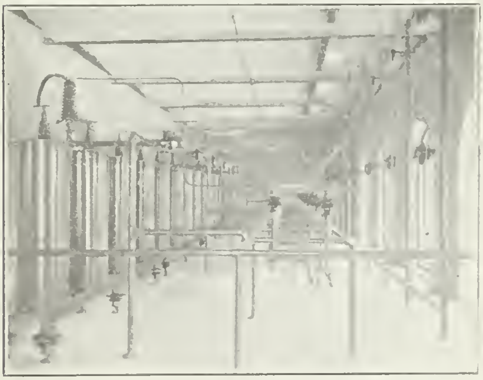


Fig. 12—44,000-Volt Electrolytic Arrester.

Behind the switchboard, on an enameled-brick pedestal, are the General Electric solenoid-operated exciter switches, and another pedestal carries the motor-operated generator-field switches. A Western Electric 250-125-volt, 10-kw balancer set is also provided, for the station lighting circuits. The Cutler-Hammer remote-controlled generator and exciter field-rheostats are mounted on the second balcony, just above the control apparatus above enumerated.

Of course, the principal output of this generating station is transmitted to Chicago over the steel-tower transmission line paralleling the Drainage Canal, but several small blocks of 6600-volt power are distributed to nearby industrial establishments and for city lighting at Joliet and Lockport, respectively three and two miles distant. This 6600-volt energy is tapped from the transfer bus through Hartman oil switches mounted on an enameled-brick partition in the center of the transformer groups, and the separate circuits are cabled up through the gallery structure to overhead lines in the top balcony, where they are connected to the 6600-volt transmission lines. These circuits are protected by General Electric 6600-volt star-connected electrolytic lightning arresters, comprising three separate piles of aluminum disks inclosed in a single enveloping tank and having their neutral or bottom point grounded.

The generator floor of the power house is served by a 40-ton Whiting crane, and a narrow-gage railway track runs the length of the station close to the south wall behind the transformer banks.

The power house was put into operation December 28, 1907 and with the dams and lock cost, complete, $800,000 exclusive of electrical machinery. The operating staff comprises a force of eighteen men, all neatly uniformed, who work on eight-hour shifts. Besides the superintendent and his assistant there are four operators, four assistant operators, four oilers and four generator tenders

ELECTRICAL PROPERTIES OF COMPOUND WIRES—III.

By Frank F. Fowle.

A SERIES of determinations of resistance and inductance was made by the Electrical Testing Laboratories, New York, for a manufacturer of composite wire, which will be considered in some detail. These tests covered ohmic resistance, effective resistance to alternating currents of low frequency, inductive reactance and impedance. The mean diameter of each sample was determined from several measurements and the core diameter and the shell thickness were determined approximately. The lengths tested were 60 ft. of No. 6 and No. 9 B. & S. gage and 50 ft. of Nos. 8, 10, 12 and 14 B. & S.

The measured ohmic resistance to direct currents is given in Table XIV, in ohms per 1000 ft. at 26 deg. C. (78.8 deg. Fahr.). The corresponding resistance of solid copper of equal size, at the same temperature, was calculated as follows: Matthiessen's meter-gram standard of 0.14173 ohm for pure annealed copper at 0 deg. C. is equivalent to 9.591 ohms per mil-foot, or a mile-ohm of 809.3 lb. Taking the average temperature coefficient as 0.0042 per 1 deg. C., from 0 deg. C., and the conductivity of hard-drawn copper as 98 per cent for Nos. 6, 8 and 9 and 97 per cent for Nos. 10, 12 and 14, the resistance of a hard-drawn solid wire of copper at 26 deg. C. was calculated for equal mean diameters of copper-clad.

TABLE XIV.—CONDUCTANCE RATIOS OF COPPER-CLAD STEEL TO HARD-DRAWN COPPER, FROM MEASUREMENT.

B. & S. Gage.	Mean Diameter (Inches).	OHMS PER 1000 FT.		Conductance Ratio of Copper-Clad.
		Copper-Clad.	Copper.	
6	0.162	0.9383	0.4136	0.4408
8	0.128	1.742	0.6626	0.3803
9	0.115	1.850	0.8208	0.4437
10	0.104	2.280	1.014	0.4447
12	0.080	3.740	1.714	0.4582
14	0.067	5.560	2.443	0.4394
			Average	0.4345

This copper-clad wire is rated to have an average conductance ratio of 40 per cent, with an allowable variation between the limits of 35 per cent and 45 per cent in any coil. The actual average shown in Table XIV is about 3.5 per cent above the rating. The observed temperature coefficient, taking an average value per 1 deg. C., from zero, varied between 0.0016 and 0.0035 with a mean of 0.0021.

The measurements of core diameter and shell thickness are checked with the over-all mean diameters in Table XV, with the view of showing their precision and later calculating the conductance ratio of the steel in the core.

TABLE XV.—PHYSICAL DIMENSIONS OF COPPER-CLAD STEEL WIRES.

B. & S. Gage.	MEASURED.		OVER-ALL DIAMETER, r_2		CALCULATED.	
	Core Diameter. $2r_1$	Shell Thickness $r_2 - r$	Calculated.	Measured.	$\frac{r_1^2}{r_2^2}$	$\frac{r_2}{r_1}$
6	0.13	0.016	0.162	0.162	0.644	1.246
8	0.10	0.014	0.128	0.128	0.610	1.280
9	0.09	0.012	0.114	0.115	0.612	1.278
10	0.08	0.012	0.104	0.104	0.592	1.300
12	0.05	0.015	0.080	0.080		
14	0.04	0.018	0.076	0.067		
				Average	0.615	1.276

The last two columns of Table XV are calculated from the mean measured over-all diameter and the core diameter. The maximum possible error in the core diameter, as given, is large and in the case of No. 6 B. & S. wire it amounts to about ± 3 per cent; for smaller sizes the error is probably still larger.

The conductance ratio of the steel in the core may be calculated from

$$\frac{\rho_c}{\rho_1} = 1 - \frac{1 - n}{A_1} \qquad (87)$$

The application of this formula gives results as follows:

B. & S.	$\frac{\rho_c}{\rho_1}$
6	0.132
9	0.095
10	0.062

The formula when applied to the No. 8 gage sample shows a slightly negative conductance ratio for the steel, which, of course, cannot exist; the result is probably ascribable to some defect in the copper shell which impaired its conductivity. The result upon which most reliance can probably be placed is that obtained from the No. 6 B. & S. sample, because it has the largest diameter and is therefore most readily measured with fair precision. Even here, however, an error of 3 per cent in the core diameter will produce a final error of about 40 per cent in the conductance ratio of the steel, as computed by this method.

TABLE XVI.—RATIO OF APPARENT TO OHMIC RESISTANCE, FOR COPPER-CLAD STEEL WIRE.

Current in Amperes.	RATIO OF APPARENT TO OHMIC RESISTANCE.		
	25 Cycles.	40 Cycles.	60 Cycles.
NO. 6 B. & S. GAGE.			
5	1.013	1.013	1.013
10	1.015		
20	1.018	1.022	1.029
35	1.043		
NO. 8 B. & S. GAGE.			
5	1.003	1.003	1.003
10	1.009		
20	1.022	1.026	1.028
25	1.035		
NO. 9 B. & S. GAGE.			
5	1.005	1.005	1.005
10	1.006		
15	1.009	1.009	1.009
20	1.012		
NO. 10 B. & S. GAGE.			
5	1.004	1.004	1.004
10	1.005		
15	1.006	1.006	1.006
20	1.007		
NO. 12 B. & S. GAGE.			
4	1.000	1.000	1.000
8	1.001		
12			
16	1.005		
NO. 14 B. & S. GAGE.			
3	1.000	1.000	1.000
6	1.002		
9	1.006		
12	1.006	1.006	1.006

Admittedly the method is not one that would be chosen for such work, but no substitute is here available. It is apparently the case, however, that the conductance ratio of the steel diminishes with decreasing wire sizes. The average ratio for No. 6 and No. 9 is 0.113 and the average for Nos. 6, 9 and 10 is 0.096.

There is considerable difficulty in making an accurate measurement of the core diameter, because the core does not retain an accurate cylindrical form, but varies therefrom in a slightly irregular manner. The conductance ratios for the wire as a whole, given in Table XIV, go to show that within this range of sizes the proportions of steel and copper remain fairly uniform and are not substantially altered by the drawing process. It does not appear whether all these samples of wire were drawn from the same billet, or even whether the steel came from the same heat, but presumably there was some diversity in this respect.

TABLE XVII.—INDUCTIVE REACTANCE OF COPPER-CLAD STEEL WIRES PER 1000 FT. WITH 12-IN. SPACING.

Current in Amperes.	INDUCTIVE REACTANCE IN OHMS PER 1,000 FEET OF CONDUCTOR.		
	25 Cycles.	40 Cycles.	60 Cycles.
	NO. 6 B. & S. GAGE.		
5	0.060	0.097	0.146
10	0.062		
20	0.070	0.108	0.158
35	0.080		
	NO. 8 B. & S. GAGE.		
5	0.066	0.110	0.167
10	0.074		
20	0.092	0.150	0.209
25	0.100		
	NO. 9 B. & S. GAGE.		
5	0.060	0.098	0.140
10	0.064		
15	0.068	0.104	0.154
20	0.072		
	NO. 10 B. & S. GAGE.		
5	0.056	0.096	0.142
10	0.060		
15	0.062	0.104	0.166
20	0.064		
	NO. 12 B. & S. GAGE.		
4	0.056	0.088	0.138
8	0.058		
12	0.060	0.097	0.142
16	0.062		
	NO. 14 B. & S. GAGE.		
3	0.050	0.089	0.130
6	0.054		
9	0.056		
12	0.058	0.096	0.142

The ratio of apparent resistance to ohmic resistance, with alternating currents, is given in Table XVI. The measurements of apparent resistance were made at 25 cycles, 40 cycles and 60 cycles. The ratio is independent of the frequency, under 60 cycles, for No. 9 B. & S. and sizes smaller: for No. 8 and No. 6 the ratio is independent of frequency at low current densities, but increases very slightly with increasing frequency when the current density is high. For all sizes the ratio increases with increasing current density, but at a faster rate in the large sizes than in the small. The increase in the ratio with increasing current density, at constant frequency, indicates an increasing permeability of steel.

The measurements of inductive reactance were made on rectangular loops with separations of 12 in., 18 in. and 24 in. Four current values and three frequencies were employed, as indicated by Table XVI. The total number of measurements is too great to permit presentation here in brief tabulated form, but the results obtained with a 12-in. separation are presented in Table XVII. The inductance of a single conductor of radius r_2 and parallel to its return conductor or mate at a distance *d*, excluding the internal inductance of the conductor itself, is given by

$$L_0 = 2\,\mu_0 \log \frac{d}{r_2} \tag{88}$$

The multiplication factor to convert this into henries per 1000 ft. of conductor is 0.00007018.

The value of μ_0 for air may be taken as unity and hence per 1000 ft.,

$$L_0' = 0.0001404 \log \frac{d}{r_2} \tag{89}$$

By computing from Table XVII the corresponding values of inductance, and deducting therefrom the proper values of L_0', the remainders will be the values of inductance within the conductor and the values of permeability of steel can then be found. The value of permeability thus found is, of course, the apparent value, and is moreover an average value, the flux density being non-uniform.

Considering first the No. 6 B. & S. sample by itself, the following set of values holds simultaneously:

$$\left.\begin{aligned}
\frac{\rho_c}{\rho_1} &= 0.132\\
n &= -0.441\\
n_1 &= 0.614\\
n_2 &= 0.386\\
\frac{r_2}{r_1} &= 1.246\\
A_1 &= 0.644\\
A_2 &= 0.356\\
l_1 &= 0.193\\
l_2 &= 0.807\\
L_{12} &= 0.0186\,\mu_1 + 0.165\,\mu_2
\end{aligned}\right\} \tag{90}$$

The internal inductance in henries per 1000 ft. of No. 6 conductor is given from the last expression above by

$$L_{12}' = 0.000000567\,\mu_1 + 0.00000503 \tag{91}$$

The results of calculating the apparent average permeability from (91), and from those results the corresponding total flux and the average flux density, are given for No. 6 wire, at 25 cycles, in Table XVIII.

The maximum flux density reaches twice the average values given in Table XVIII. The low permeabilities are such as might be expected with low flux densities. Apparently the minimum value of permeability will be about 100. The values of permeability deduced from other measurements on the sample of No. 6 wire are shown in Table XIX.

The values of apparent permeability given in Table XIX show an increase with higher current and flux densities and in general a decrease with higher frequencies.

Taking up now the sample of No. 9 B. & S. gage, the inductance formula will be determined by the following set of simultaneous values:

$$\left.\begin{aligned} \frac{\rho_c}{\rho_1} &= 0.095 \\ n &= 0.444 \\ n_1 &= 0.583 \\ n_2 &= 0.417 \\ \frac{r_2}{r_1} &= 1.278 \\ A_1 &= 0.612 \\ A_2 &= 0.388 \\ I_1 &= 0.131 \\ I_2 &= 0.869 \\ L_{12} &= 0.00858\,\mu_1 + 0.172\,\mu_2 \end{aligned}\right\} \qquad (92)$$

TABLE XVIII.—PERMEABILITY AND FLUX VALUES IN CORE OF NO. 6 B. & S. COPPER-CLAD STEEL WIRE.

Amperes at 25 Cycles.	Permeability. μ.	Total Flux in c. g. s. Lines, per Centimeter of Length. φ	Average Flux Density, per Square Centimeter. B.
5	127	12.3	74 2
10	150	29.0	175 0
20	240	96.6	561.0
35	352	238.0	1,440.0

TABLE XIX.—PERMEABILITY OF STEEL CORE IN NO. 6 B. & S. COPPER-CLAD STEEL WIRE.

Separation in Inches.	Current in Amperes.	PERMEABILITY.		
		25 Cycles.	40 Cycles.	60 Cycles.
12	5	127	134	137
	10	150		
	20	240	211	193
	35	352		
18	5	140		
	10	173		
	20	241		
	35	353		
24	5	165	158	151
	10	210		
	20	288	235	198
	35	389		

The inductance in henries per 1000 ft of conductor is expressed by

$$L_{12}' = 0.000000262\,\mu_1 + 0.00000524 \qquad (93)$$

The calculated values of permeability for the sample of No. 9 B. & S. wire are given in Table XX.

TABLE XX.—PERMEABILITY OF STEEL CORE IN NO. 9 B. & S. COPPER-CLAD STEEL WIRE.

Separation in Inches.	Current in Amperes.	PERMEABILITY.		
		25 Cycles.	40 Cycles.	60 Cycles.
12	5	138	168	97.3
	10	235		
	15	332	259	239.0
	20	429		
18	5	92		
	10	214		
	15	335		
	20	432		
24	5	122	159	139.0
	10	219		
	15	365	265	260.0
	20	462		

A comparison of the values of permeability in Table XX with those in Table XIX exhibits first the fact that the permeability is subject to considerable variation commercially—that is, it can be foretold only approximately, or within certain limits. The current and flux densities in the sample of No. 9 wire were higher than in the sample of No. 6, and this probably accounts for the greater permeabilities at currents of 15 amp or more.

The current density in the core is apparently a fair index to the probable value of the permeability. It is not a difficult matter, however, to calculate in any case the approximate flux density in the core and therefrom estimate the probable permeability. The latter method is logically the proper one to use.

One of the noteworthy features of these measurements is exhibited by the fact that for constant separation the total inductance diminishes slightly with decreasing wire sizes. This is not the case with solid copper wires, for which the inductance per 1000 ft. of conductor is

$$L_c' = 0.00001524 + 0.0001404 \log \frac{d}{r} \qquad (94)$$

That part of the inductance internal to the wire remains constant, while the external part increases with diminishing wire sizes. In the samples of copper-clad steel wire here considered the decrease of core inductance more than equaled the increase in the external inductance, with the result of a net decrease in the total. This is attributable to a diminishing conductance ratio of steel to copper with diminishing wire sizes, as shown above for No. 6, No. 9 and No. 10 B. & S. copper-clad.

As regards these inductance formulas in general, it should be observed that they do not apply to conductors composed of magnetic metals when spaced near to each other in comparison with their radii. As Maxwell has pointed out, in that case the induced magnetism will disturb the external field and the previous reasoning is not applicable. In the present case, a separation of 12 in. between No. 6 B. & S. wires is equal to 92.3 times the diameter of the steel core, from which it may be concluded that the induced magnetism and resultant distortion of field is quite negligible.

The fluctuations of permeability will give rise, with alternating currents, to pulsations of inductance and resistance. The core inductance, which is directly proportional to the permeability, will increase with increasing current and the maximum instantaneous inductance will exist at the time of maximum instantaneous current, except as modified by the lag due to hysteresis. Rising core inductance will correspondingly decrease the core admittance and thus increase the total apparent resistance, by decreasing the proportion of total current in the core. The compound effect of these phenomena is somewhat complicated, because a diminishing proportion of core current tends to neutralize the effect of rising permeability by decreasing the core inductance. The measurements of effective impedance show, however, maximum values with maximum currents, and it may be inferred that the net effect of rising current is greater impedance.

The predetermination of the inductance of a copper-clad steel wire may be in some doubt, owing to uncertainties in the conductance ratio of the steel cofe to the copper shell and in the permeability of the steel. The several parts of the whole inductance of the No. 6 sample, when the permeability (μ) is 127, are as follows, in henries per 1000 ft. of conductor with 12-in. separation:

	Per Cent.
Core inductance = 0.000072 =	19
Shell inductance = 0.000005 =	1
Exterior inductance = 0.000305 =	80
Total inductance = 0.000382 =	100

When the permeability reaches a value of $\mu = 352$, the whole internal inductance amounts to 40 per cent of the total. When the separation is 24 in. and $\mu = 165$, the whole internal inductance equals 22 per cent of the total. The total internal inductance is composed in very large part of the core inductance, because of the high permeability, whereas the permeability of the shell is unity.

The inductive reactance of such wires to alternating currents is therefore not predeterminable with high precision, but this statement is not true of impedance at low frequencies. If the impedance is expressed in the general form

$$z = r + j\,x \qquad (95)$$

then the impedance of a No. 6 copper-clad steel wire, such as has been considered, could be expressed at 60 cycles and 24-in. separation, with $\mu = 198$, as

$$z = 0.951 + j\,0.175 \qquad (96)$$

$$= 0.967\,e^{ja} \qquad (97)$$

where

$$e^{ja} = \cos a + j \sin a \qquad (98)$$

and

$$a = 10.4 \text{ deg.} \qquad (99)$$

Under the same conditions the impedance of a solid copper wire would be:

$$z = 0.414 + j\,0.137 \qquad (100)$$

$$= 0.436\,e^{ja} \qquad (101)$$

where

$$a = 18.3 \text{ deg.} \qquad (102)$$

The true conductance ratio of copper-clad to copper in this case is 0.441, while the admittance ratio for alternating currents is 0.451, or about 2.5 per cent in excess of the former. It becomes apparent that copper-clad wires the conductance ratio of which does not exceed approximately 50 per cent, in alternating-current circuits at 60 cycles or less, will have an admittance ratio to copper of only a little more than the conductance ratio and perhaps not exceeding it substantially at all. The power-factor in such copper-clad circuits will be slightly benefited, in comparison with copper, but the power losses, size for size under equal conditions, will, of course, be materially greater.

MAGNETOMOTIVE FORCE IN NON-UNIFORM MAGNETIC PATHS.

By A. Miller Gray.

The problem to be solved below is to find the m.m.f. necessary to send a given magnetic flux through a length of magnetic circuit L (Fig. 1) in which the area of the circuit and, therefore, the flux density in the circuit vary uniformly between the two points A and B. The particular problem is to calculate the ampere-turns necessary to send a given flux through the teeth of a direct-current machine.

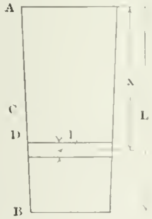


Fig. 1—Dimensions of Magnetic Table.

Fig. 2 shows the relation between flux density and ampere-turns per inch when the magnetic circuit is one with uniform flux density. Various methods have been suggested for the solution of the special problem, namely:

First—The flux density is assumed to be uniform and equal to the flux density at C; that is, to the mean value between A and B.

Second—The flux density is assumed uniform and equal to the flux density at D, where D is a point at two-thirds of the depth between A and B.

Third—Calculate the ampere-turns necessary if the flux density were uniform and of a value equal to that at A, B and C respectively. To find the correct average value for the complete circuit use Simpson's rule in the following way:

$$AT = \frac{AT_a + 4\,AT_c + AT_b}{6}$$

The following method is more accurate than any of the above methods, and is also easily applied.

Referring to Fig. 1, let B_a = flux density at the tip of the tooth, that is, the minimum density; B_b = flux density at the bottom of the tooth, that is, the maximum flux density. Let

$$k = B_b \div B_a.$$

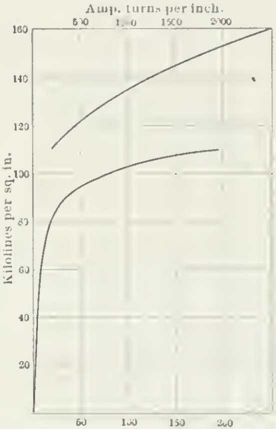


Fig. 2—Magnetization Curve.

Divide the tooth into a large number of small lengths l. Find the average flux density for each of these small lengths; for example, the average flux density at x, Fig. 1, is $B_a k x \div L$. Find now the value of ampere-turns per inch for each of these small distances by the use of Fig. 2, and then find the average value for the whole tooth.

For example, let $k = 1.4$.

Divide the tooth into ten equal lengths, then for a value of B_b = 140,000 lines per square inch the average density at each of the ten parts is as given in Table I. There are also given in this table the corresponding values of ampere-turns per inch taken from Fig. 2. The average value of ampere-turns for the whole tooth is 487.6.

TABLE I.—MAGNETIZING FORCE.

Lines per Square Inch.	Ampere-Turns per Inch.
138,000	1,110
134,000	910
130,000	740
126,000	600
122,000	470
118,000	360
114,000	270
110,000	190
106,000	130
102,000	96
Average	487.6

This work has been done by using Fig. 2 as a basis, and the results have been plotted in Fig. 3, which curve may, therefore, be used directly to determine the ampere-turns necessary for a tooth when the maximum tooth density and also the value of k are known.

It is obvious that the same method may be applied for the determination of the iron loss in the tooth part of an armature when the value of *k* is so large as to make it difficult to determine what value of flux density to use when applying the core-loss curve.

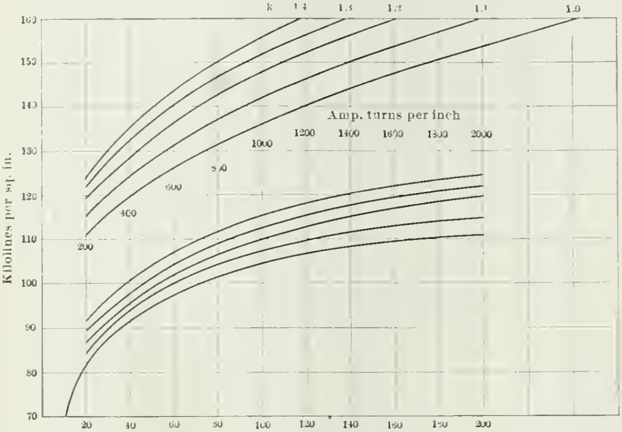


Fig. 3—Magnetization Curves for Various Proportions of Magnetic Paths.

In Table II is given a comparison of the results obtained by the four different methods applied to a definite problem. As might be expected, the first method is fairly accurate when both the maximum and the minimum densities are on the straight part of the curve, that is, when the densities are either very high or very low; but the method is inaccurate when working at densities around the knee of the saturation curve.

TABLE II.—COMPARISON OF METHODS OF COMPUTATION.

Flux Density.	k	Ampere-Turns per Inch by Various Methods.			
		Method 1	Method 2	Method 3.	New Method.
160,000	1.4	900	1,450	1,060	1,170
150,000	1.4	600	1,000	712	790
140,000	1.4	340	630	447	500
130,000	1.4	150	360	232	300
120,000	1.4	77	150	124	140
110,000	1.4	41	72	62	72
100,000	1.4	23	38	30	39
90,000	1.4	14	20	16	16

AUTOMATIC CONTROL OF TEMPERATURE.

By Albert A. Somerville.

In scientific and commercial work it is often desirable to maintain a constant temperature in a room for a considerable length of time. The simplest automatic controlling device is, of course, the most desirable—that is, the most inexpensive, the most efficient and the easiest adjustable device. These devices differ in the case of different heat sources.

Considering coal furnaces, the simplest arrangement is probably that of an air drum located in the place to be heated, and this air drum is connected by a tube for operating a system of levers in the furnace-room. Increased pressure due to heating causes the levers to close the dampers and thereby shut off the draft. The opposite effect is produced by contraction of the air due to cooling—that is, the dampers are opened, increasing the draft. It can be adjusted to any temperature and is fairly consistent. The mistake commonly made when a room becomes too warm is that of opening the windows or doors to allow it to cool. In this case, if the air drum is located in the same room, it is also cooled and the furnace draft opened accordingly, so that the amount of heat received is increased and must be remedied by a readjustment of the automatic control.

Where gas is used as a fuel the amount of flow is sometimes regulated by a float which partly closes the outlet. The height of this float varies with the expansion of a liquid or the flow may be regulated by the expansion of lever arms. The greatest objection to these methods is that sometimes the gas is entirely cut off and the flame extinguished, and later, when the outlet is opened, the gas escapes without undergoing combustion. To avoid this danger a pilot flame must be kept continually burning.

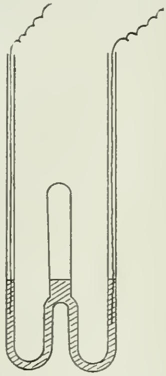
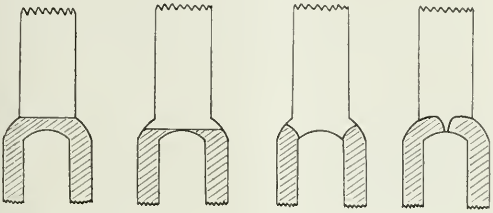


Fig. 1—Mercury Interrupter.

Where electrical energy is used as the heat source a choice can be made of a greater number of contrivances which may be used. The most direct method is to use such a heating coil that a change in temperature will cause a change in resistance which will vary the current. This method is allowable only when the outside temperature is constant. Lever arms operated somewhat like the thermoblink used for making and breaking contact in electric signs may be used where the current is not large enough to cause trouble due to sparking. A thermo-couple may be used to operate a galvanometer which swings a long boom or arm, closing or breaking the heating circuit. A relay requires fine adjustment, and when a secondary circuit is used it frequently entails a lot of trouble keeping it in working order. Therefore, if the make-and-break attachment can be confined to the primary or heating circuit it is much simpler to operate. This can be done if good contacts can be made and sparking prevented in breaking the contact. Contact may be made between two solids, a solid and a liquid or two columns of liquid, such as mercury. In the latter method there is the least sparking, an oil being used to quench the spark. One instrument of that kind is constructed on the order of a gas thermometer (Fig. 1). The lower arms are filled with mercury to the level indicated. The center bulb is sealed and contains air. Wires extend into the two arms, the mercury making connection between the two wires, which closes the heating circuit. As the temperature rises the air expands in the bulb and drives the mercury down until it finally breaks into two columns, thus breaking the heating circuit.

From the cohesion of mercury there will be a sudden break, which, however, will cause hardly any sparking if the surface is covered with oil. When cooling allows the two columns to unite they will form a big conductor of mercury and the heat effect produced in the mercury itself is very small. The sensitiveness depends on the size of the air bulb. The temperature at which it will break the contact depends on the height of the mercury in the bulb at room temperature, and it is easily adjusted to any temperature desired.

The use of oil, which is liable to form into globules with the air, is not necessary if clean mercury is used in a clean glass tube. The surface tension of clean mercury is a very important factor. As an experiment the instrument may be put into a glass beaker filled with water and an incandescent lamp used as a heater connected in series with the instrument. When the water is heated by the lamp to a certain temperature the gas in the bulb expands enough to drive the mercury down and break the contact. As evidence that the heating is stopped the light of the lamp is also extinguished. When the water is cooled off and the air in the bulb is sufficiently contracted to allow the mercury to rise and make contact again, the lamp lights up and at the same time commences to heat the water.

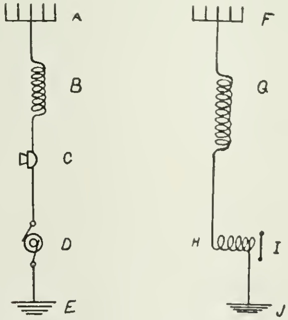

Figs. 2 to 5—Various Stages of Make-and-Break.

Figs. 2 to 5, inclusive, show the make-and-break in various stages. Fig. 3 shows the flat surface of the mercury just a short time before break. When it suddenly breaks the surface tension quickly pulls the two columns apart, as in Fig. 4, so there is very little or no sparking. When it cools the two columns come together as in Fig. 5 and on making contact have the appearance indicated in Fig. 2. It will handle a current of several amperes. The sensibility for variation in temperature depends on the size of the gas bulb.

A SIMPLE WIRELESS TELEPHONE.

By John L. Hogan, Jr.

An apparatus for wireless telephony is usually considered an excellent example of a mass of complications. In this connection it is interesting that wireless telephony by true electromagnetic radiation may be accomplished with the aid of very simple apparatus. In a recent test made with such instruments instead of involved "oscillators," etc., speech was transmitted two and one-quarter miles with a power expenditure of less than 100 watts. Although the apparatus used is not so sensitive as that of more modern design, still the small power needed indicates the method to be perfectly practicable.



Figs. 1 and 2—Transmitting and Receiving Antenna Circuits.

The arrangement of the transmitting apparatus is shown in Fig. 1. In this sketch *A* represents the antenna; that is, an elevated system of conductors arranged to radiate electromagnetic waves. *B* is a low-resistance coil of wire so designed that the whole or any part of it may be put into circuit and the resultant inductance of the antenna system thereby varied to make its natural wave-length that which is to be transmitted *C* represents a carbon microphone transmitter, which carries a current of 4 amp or 5 amp without undue heating. *D* is a high-frequency alternator driven at 28,200 r.p.m. by a steam turbine. At this speed the alternator produces current at 70,000 cycles, corresponding to a wave-length of 4250 m. Fig. 4 shows the general appearance of the machine. Returning to Fig. 1, *E* is an earth connection.

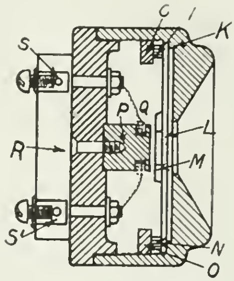


Fig. 3—Details of Responding Device.

With the transmitting apparatus in operation, the system radiates sustained electromagnetic waves of a constant frequency (that at which the alternator is running and to which the antenna system is made resonant) and of a uniform amplitude, the value of which depends upon the resistance of the microphone transmitter *C*. When this transmitter is spoken into the movement of the diaphragm by the second waves changes its resistance in accordance with the voice vibrations, and so impresses identical variations in the amplitude of the radiated waves. Thus any continuously acting receiving apparatus which is capable of giving responses proportional to the amplitudes of the received waves will reproduce the speech which operates the transmitter, provided, of course, that the receiver is within effective range of the sender

Fig. 2 is a diagram of the receiving system used Here the antenna wires are represented by *F* and the variable tuning inductance by *G*. *J* is the earth connection. *H* is a coil having supported before it a mica diaphragm *I*, carrying a ring cut out of sheet copper or silver. *H* and *I* together form the mechanism which responds to the received waves and so reproduces the transmitted speech.

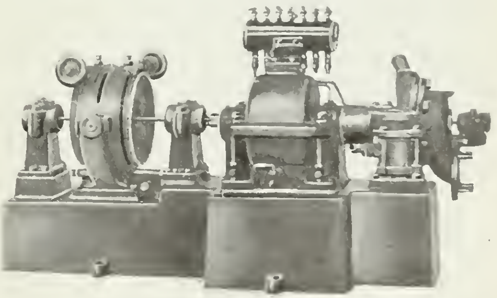


Fig. 4—High-Frequency Generator.

The construction of the responding device is shown in detail by Fig. 3. Here *K* is a hard rubber shell in which the diaphragm *L* is placed. This diaphragm may be of mica and have shellacked to it a copper or silver ring *M*, or the diaphragm may consist of a simple copper or silver disk. Experiment showed that a silver ring mounted on a mica diaphragm was a little more than twice as sensitive as a plain copper diaphragm. The diaphragm is clamped in place by screwing down upon it the rings *O* and *N*. A hard-rubber back *R* supports an ivory core *P* and screws into the shell *K*. A coil *Q* of fine enameled copper wire is wound in a channel around the core *P*, and its terminals are fastened to binding posts *S* and *S'*.

In the operation of this "dynamometer telephone," high-frequency currents passing through the coil excite inverse currents in the diaphragm-ring *M*. There is, therefore, an attraction between the coil and diaphragm, and this attraction remains constant for a single value of high-frequency current. As the amount of radiated current varies, that of the received current must do likewise, and the value of attraction between the coil and diaphragm of the dynamometer telephone will change correspondingly. Therefore the dynamometer telephone is a continuously acting receiver which gives responses proportional to the amplitudes of the received waves, and as such is capable of reproducing wireless speech.

In the speech-transmission test complete sentences were passed from sender to receiver over two and a quarter miles with the small power consumption noted above. The articulation and intensity at the receiver were sufficiently good to make speech intelligible; and in order to get transmission it was not necessary to invoke the aid of the usual "one, two, three, four, five, six." Different persons' voices were recognizable, and on the whole, in spite of the extreme simplicity of the apparatus used, the results were very satisfactory.

Central Station

Management, Policies and Commercial Methods

INDUCTION RADIATORS FOR ST. LOUIS 60-CYCLE SYSTEM.

One of the largest single-company orders ever placed with manufacturers of induction-type potential regulators has been given by the Union Electric Light & Power Company, St. Louis, Mo., which is equipping all of its 60-cycle distribution centers with automatic induction regulators to replace the old hand-operated regulators formerly installed on its feeders. Fifty-one of the relay-controlled, 100-amp, 2300-volt induction regulators have been ordered. These are compensated to keep the feeder-end voltages constant and are capable of producing 10 per cent buck or boost of the generator pressure.

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ELECTRIC PUMPING AT WAUPACA, WIS.

The City of Waupaca, Wis., has for several years operated an interesting installation for the electric pumping of its city water. The city owns a small water power on the Waupaca River, where formerly it operated water-wheel-driven pumps taking water from the river. Later a different source of water supply was desired, and a 75-kw, 500-volt direct-current dynamo was installed, driven by the water-wheels. Power is transmitted at 500 volts to a small brick pump-house, about a mile distant, where water is taken from drive wells. This pump-house contains a 5-hp Northern vertical-shaft, 500-volt direct-current motor, direct-connected to a vertical-shaft Byron Jackson three-stage centrifugal pump with a rated capacity of 600 gal. per minute. This pumps to an elevated reservoir as many hours per day as necessary to supply the needs of the town The whole water-pumping plant is operated by one man.

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MOTORS REPLACE WATER-WHEEL-DRIVEN PUMPS AT PEORIA, ILL.

The auxiliary water supply of Peoria, Ill., is obtained from a number of wells in which the water rises to within 20 ft. of the surface. Vertical-shaft centrifugal pumps are placed at this level, lifting the water to the intakes of the high-pressure pumping units. Water-wheels utilizing the pressure of the pipe line were formerly arranged at the top of the shafts to drive the centrifugal pumps, but since the demand on the main pumping engines has increased it has been found necessary to deliver their entire pumpage into the mains directly, without diverting part to the operation of the lift pumps. Motors have accordingly been used to replace the water-wheels and drive the centrifugal pumps. There are eight of these pump motors, averaging 35 hp, forming an excellent twenty-four-hour load for the Peoria Gas & Electric Company, which supplies the energy to operate them.

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BOSTON EDISON EDUCATIONAL PLANS.

The lecture committee of the Boston Edison Employees' Club decided to recommend an electrical lecture course at the Franklin Union, Boston, in connection with the instruction work of the winter season, and arrangements were made with the Union for the holding of morning classes for those whose work is in the evening. The course will cover magnetism, battery, resistance measurement, generator, motor and instrument practice with lectures. For the benefit of those seeking more advanced work a university extension course will be given by Professors Harrison W. Smith and W. E. Wickenden, of the Massachusetts Institute of Technology. The latter course is designed to introduce the study of the utilization of electricity for power purposes, beginning with a brief discussion of measuring instruments and later taking up the action and application of direct currents and alternating currents. Evening classes at the Union started on Jan. 2 and morning classes on Jan. 3, 1911. The university extension course will start on Jan. 24. President Edgar has offered in the name of the company to those who take either of the two courses to refund the fees in case 70 per cent or over of the lectures and shopwork classes are attended. Mr. J. L. Boyle is chairman of the lecture committee.

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CLEANING TUNGSTEN LAMPS AND REFLECTORS.

It is well known among central-station companies that it is difficult to get consumers to clean their lamps and reflectors frequently enough to get the best service. Certain difficulties have developed in connection with the cleaning of tungsten lamps and glassware which were not present with carbon lamps and are worthy of serious consideration. The consumer who uses tungsten lamps has usually been impressed, either by experience or by the injunction of others, with the idea that the tungsten lamp is very fragile and should not be handled. He takes these instructions literally and never cleans the lamps or reflectors for fear of breaking them. The result is that some installations which were very creditable in the early days of tungsten lighting have now depreciated to a point where they are anything but creditable. Besides the fear of breaking the tungsten lamps another thing deters many users from cleaning reflectors thoroughly. The majority of the shade holders which have been installed with reflectors on tungsten lamps have probably been of a new patented type which, although excellent in mechanical design, is unfamiliar to the average user. In other words, the user does not know how to remove the reflectors as he did in the case of the old standard line of shade holders with thumb screws for attaching the shade. This tends to prevent users from taking down glassware for cleaning.

Some central-station companies have gone so far as to do a certain amount of cleaning of tungsten lamps and reflectors for customers. However, this cannot be considered a permanent solution of the question, because it would be prohibitive in cost if carried out on too large a scale. The real solution lies in a campaign of education among consumers to show them how to clean lamps and glassware with the least danger of breaking. Probably the best plan is to teach them to clean lamps as far as possible while they are burning. This also applies to the reflectors or glassware. It is not possible to give a piece of glassware as thorough a cleaning when in place over a lamp as if it were taken down and put in soapsuds, but it is possible to get off so much of the dirt with the aid of a damp cloth and a stiff-bristle brush (the latter for cleaning cracks or prisms) that a thorough cleaning can be put off until such time as the lamp burns out, when the reflector can be taken down and thoroughly washed.

TRANSFORMATION POST-CARDS TO AID HOUSE-WIRING CAMPAIGN.

The Union Electric Light & Power Company, of St. Louis, makes use of a novel post-card to call attention to the campaign for wiring old houses in which it is now engaged. The picture side of the card originally shows a cross-section through a dwelling, with the occupants engaged in household duties and several electricians busily occupied in wiring electric light outlets. Passing a moist cloth or sponge across the card brings down a developer which is applied along the top edge, and, presto! the picture changes to a view of the inside of an attractively furnished living-room lighted by tungsten lamps. Beneath the developed picture is the inscription, "Electric service assures perfect illumination and prevents eye-strain." The address side of the post-card bears a coupon to be mailed to the central-station company requesting its representative to call at a certain hour to explain the sixty-day trial lighting offer and estimate covering wiring and fixtures.

CO-OPERATIVE ELECTRICAL POWER SUPPLY.

The fundamental reason why the central-station business has prospered within the last twenty years is plainly economic in character. The concentration of power generation into hands capable of utilizing to the utmost the reliable and efficient performance of modern equipment and the co-ordination of distribution systems formerly unrelated into flexible networks providing for the maximum spread of electrical energy with a minimum investment in physical plant have been based upon the profound truth that economy of production for resulting service over great areas is vitally dependent upon centralization. In the last analysis the central station is an integration of numerous isolated plants, and by its location within striking distance of the electrical center of gravity of scattered groups of consumers, by its ability to take advantage of the diversity factors in varying installations and its opportunities to manufacture its product on a wholesale basis, it can generally deliver service at competitive points more cheaply than less efficient small groups of equipment can supply points in their immediate vicinity. In a very modern sense the large central stations of to-day are carrying coals to Newcastle at a lower cost to the consumer than the latter can bring about on his own premises if he is honest enough to figure the real expense of production.

Evidence that the industrial waste of duplicate steam power-plant installations in the same neighborhood is coming to be appreciated is afforded by a recently completed station for mill service at Woonsocket, R. I., which has been built on a community-of-interest plan by neighboring yarn and spinning establishments. The necessity of an adequate power supply led the manufacturers to form a power company with a centralized plant for electrical service, the capacity of the initial equipment being 1200 kw. The engineering details of the plant illustrate little that is novel, but it is significant that the textile establishments concerned recognized the limitations of single and separated plants and decided to pool their power interests. This sort of co-operation affords possibilities of much good to central-station companies face to face with the difficult problem of securing long-term mill power contracts, for if the elimination of a few small scattered equipments in favor of a larger main source of supply works out as it normally should, it will be easier in the long run to convince the mill man that service from the system which is most highly organized for efficient production and distribution is the best and thus the least expensive for him to utilize.

The benefits of a combination plant include savings in labor cost and fuel consumption per unit of output, concentration of responsibility for a more reliable service than two smaller installations would normally supply, the establishment of distribution facilities on a lower plane of first costs than are ordinarily required with separated sources of electrical supply, and economy in capital application resulting from a reduction in the margin of excess generating capacity made possible by centralization. The idle capacity, in other words, which is necessary in single plants to handle emergencies can be considerably reduced as the size of main plant increases. The amount of these benefits in a specific case naturally varies with local conditions, but there is no question that with reasonably good management a single plant serving two mills formerly dependent upon separate generating stations and distributing systems is readily capable of saving its owners several thousand dollars per year. In many cases central-station service intelligently applied may be expected to carry the economies of production and distribution still further.

TNE NEW ELECTRIC COMMERCIAL-VEHICLE GARAGE IN ST. LOUIS.

The Union Electric Light & Power Company, of St. Louis, has opened an electric garage exclusively for trucks, as noted in the *Electrical World* of Dec. 1, 1910. It is a model in every detail, and its size, location and cost show plainly the opinion of at least one central station as to the future of the electric truck. A brief description and the accompanying illustrations will be of interest.

The garage is located in the heart of the business center, a map issued by the company showing that 95 per cent of all freight terminals and important business houses are situated within a radius of one and one-quarter miles. The garage fronts 70 ft. on the main east-and-west artery of St. Louis, nineteen blocks from the river. It is 175 ft. deep and the peak of the roof rises 50 ft. above the floor. There is not a pillar or obstruction of any kind in the building. The roof is equipped with eight large skylights, insuring an abundance of light and ventilation.

Inside of the garage, along both sides and across the front, adjacent to the walls, there is a trench constructed of concrete closed over at the top by iron plates, and this trench contains all piping and wiring. The concrete forming the trench is carried up above the floor level 6 in., serving the double purpose of keeping water on the floor from running into the trench and acting as a check for the wheels of the vehicles to run against, preventing careless drivers from backing or running wagons into the walls.

The various charging circuits are carried from the garage switchboard to cast-iron plug boxes in grooves molded in the concrete walls of the trench. After the wires were installed complete, these grooves were closed in by strips of transite or asbestos board, held in position by cement. The various circuits are therefore separated in fireproof and practically non-conductive material, at the same time permitting access at any point at small expense and in a manner permitting easy repairs.

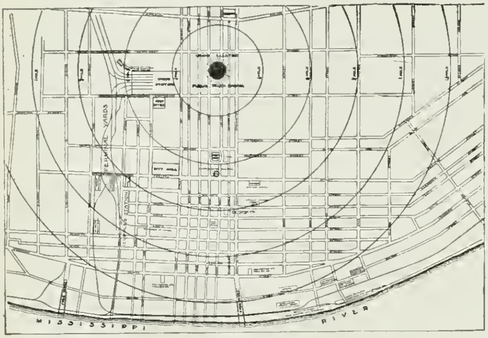


Fig. 1—Map Issued by Union Electric Light & Power Company of St. Louis.

Energy for charging each vehicle is controlled at a switchboard supplied from the Edison three-wire system at a pressure of approximately 120 volts on each side of the system. Charging plug circuits are arranged on either side of the system so as to secure a practical balance under almost any conceivable arrangement of wagons in the garage. The individual circuits are controlled by a single-pole double-throw switch in series with an inclosed fuse of suitable capacity. On the same leg of the circuit controlled by the fuses and switch is connected in series a carbon compression-type rheostat permitting an infinite range of readjustment within its capacity. The single-pole double-throw switches are arranged so that when they are thrown down the circuit is connected directly across the busbars with no instruments in circuit other than the general busbar instruments and any instruments which happen to be on the vehicle. When thrown up each of these switches connects its charging circuit in series with an ammeter and closes auxiliary contacts which give a voltage reading across the terminals of the battery. The attendant is, therefore, in a position to go over all vehicles being charged at frequent intervals without undue labor, which greatly contributes to the systematic and proper charging of the vehicles and the recording of readings at regular and necessary intervals, which in turn assures the vehicle being cut off of charge at the proper time.

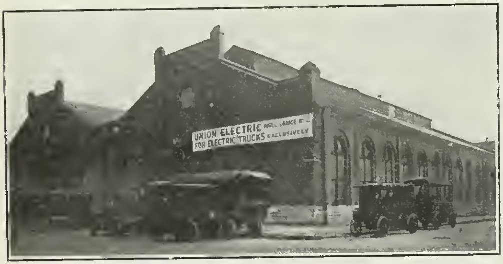


Fig. 2—Exterior of Garage.

Charging outlets are located at regular intervals on the wall, and each outlet has its own receptacle for a plug. Outlets constituting a second set are suspended from the girders of the roof and are so constructed that they automatically rise to the roof when not in use.

A roomy office opens off the main floor immediately adjacent to the board. A battery-room, 21 ft. x 50 ft., opens off the opposite side of the garage, and next to this is the store-room and repair shop, of equal size. In these two rooms particular attention has been paid to ventilation and light. The Union company is the St. Louis distributor of a well-known make of battery and will consequently be in a position to give this important feature of the business efficient attention.

In the repair shop all repairs of a simple nature will be undertaken, but free use will be made of the extensive machine shops of the company when extensive repairs are necessary. In this way a truck owner will have at his disposal high-class labor and machinery that no ordinary garage could afford.

One important feature is the space available for enlargement should it be necessary. Immediately adjoining the garage on the west is a space 66 ft. front by 100 ft. deep, and on the east there is a lot 143 ft. front by 170 ft. deep, both of which are owned by the company and will be converted into a huge garage if the present one meets with the success it deserves.

The Union company is not new to the garage business. Four years ago it opened an electric pleasure-car garage and instituted an extensive educational campaign. Its efforts in this direction have been crowned with success, for in that time the number of cars in service in the city has increased from eleven to about 300, the number of sales agencies from one to fourteen and the number of electric garages from one to ten. If it can do for the truck what it has done for the pleasure car St. Louis will have indeed a notable record in the annals of the electric vehicle.

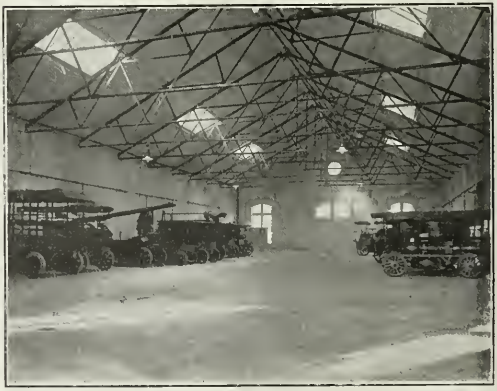


Fig. 3—Interior of Garage.

CENTRAL-STATION EMPLOYEES AS PUBLIC SERVANTS.

Mr. Arthur S. Huey, vice-president of H. M. Byllesby & Company, in charge of operation of the numerous public-service corporations managed by that organization, has addressed a circular letter to its employees reminding them of their own duties as public servants in the communities in which their companies operate.

The circulars are not unlike many others which have been issued by public utility companies and have been noted in these pages from time to time. The trend of all of them is to instil into the minds of the recipients the advantage to the company and to the individuals of practicing courtesy.

"As members of the Byllesby organization," reads the circular, "you are public servants in the true meaning of the term.

"It is particularly important that every officer, every head of department and every employee, of whatever capacity, should realize this fact and regulate his conduct accordingly.

"Each one of us owes his employment to the public.

"In all municipalities where we manage electric, gas and street railway utilities the people have selected our organization to perform essential service, or have consented to such an arrangement.

"The operation of a public utility is in the most positive sense a public trust, and is so regarded by H. M. Byllesby & Company.

"Under these circumstances you must realize that you can do your full duty to your employer only by doing your full duty to the people of the municipality where you are occupied.

"The employee who serves our company best is the employee who serves the public best.

"This applies in all departments of the operating organization—equally to the managers, the stokers at the gas works, the trainmen on their cars, the engineers at the power houses, the men in the offices and to those engaged in construction and other outside duties.

"To a great extent our organization is judged by the manners of its employees. Therefore, you must cultivate genuine courtesy and must exercise patience and forbearance on all occasions.

"Those details of the service which the public have a right to know, while perfectly familiar to yourself, are often not understood by the men and women with whom you come in contact.

"Part of your duty is to reply to inquiries for information politely and comprehensively. If you are unable to supply the information yourself the inquirer should be personally conducted (whenever possible) to the person in authority who can.

"You are never too busy to furnish the public with proper information, nor to be courteous in manner as well as in words. In using the telephone it is especially easy to be gruff and abrupt and to turn friends into enemies.

"Courtesy and decent treatment are due fully as much to those of small financial means as to the largest prospective patron.

"The possession of a habit of cheerful courtesy, springing from an honest desire to please, is an invaluable asset to the person who would advance himself in popularity and material welfare. It is worth more than capital and at times takes precedence of ability.

"But all of your good manners and willingness to make agreeable the points of contact between company and patron are of little consequence unless they originate in a deep-seated consciousness of your obligations in the public service.

"The men in the mechanical and in some of the other departments seldom or never meet the public in an official way. Their work lies in helping to back up our reputation with satisfactory actual performance.

"The standard of the service should be guarded as scrupulously as the standard of the food supplied on your table. Interruptions to the service should be made a matter akin to the honor of every man upon whom the service depends.

"In all departments promises to patrons and public should be carefully considered before they are made, in the light of the fact that disappointment and dissatisfaction go hand in hand.

"These words are addressed to *you*, not necessarily because you have been negligent, but to impress upon you the importance and dignity of your occupation, and to assist you in understanding what we expect from the members of our organization."

DAMAGES FOR INJURY FROM CONCEALED WIRES.

The Kansas City Court of Appeals has decided that where a foreman receives notice of the existence of an electrical danger, at a point where servants of the foreman's company are working, and knows that this arises from a defective wire, he must, irrespective of any other matter in which he is engaged, take instant action to seek out the danger and remove it. To permit the servants to work in that vicinity with knowledge of their peril is negligence.

In the case in which this conclusion was reached it appeared that the plaintiff, who recovered a verdict of $500, was employed by the defendant company in removing débris. It was wet and muddy in the place where he was working, and in reaching down after a plank he came in contact with a concealed live wire, resulting in serious injury.

A witness named Hipshire testified that a short time before the accident happened, in going over the premises, he felt a shock of electricity at the point where he was working, but he could not say at exactly what point he felt the shock. Hipshire, upon receiving this shock, informed the foreman of it Other witnesses on behalf of the plaintiff, as well as the plaintiff himself, testified that they had not seen the wire, although they were working within 10 ft. of where the plaintiff was at work, and although they had been around there a half a day or more. In the opinion of the court, the foreman, having had notice that electricity was escaping, should have taken immediate measures to prevent accident To quote from the opinion, it was said: "In such a case time of notice is not a question of moments, hardly of seconds To permit any time to elapse, or even to have permitted the men to work at all in that vicinity with knowledge of the presence of a deadly peril, involved in the presence of a loose current of electricity, was gross negligence."

Wiring and Illumination

DEVICE FOR TESTING METALLIC FILAMENTS.

Attempts have long been made in the metallic-filament lamp industry to devise a convenient process of filament testing As the filaments combined in a given lamp have to be quite homogeneous, the resistance of each should be determined with great accuracy. Many manufacturers determine the resistance of the filament by connecting its terminals to a measuring instrument. The Wheatstone bridge, which is generally

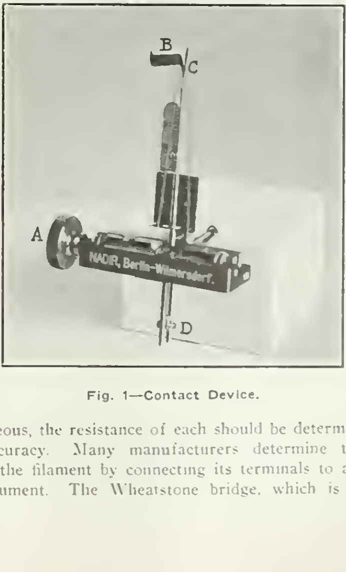


Fig. 1—Contact Device.

employed in this connection, is not rapid enough to allow all the filaments of a given lot to be examined and hence tests have to be limited to a few samples chosen at random, which obviously cannot warrant the uniform quality of all the filaments. Moreover, the connecting up of the ends of such brittle filaments necessarily entails difficulties and the unavoidable breakage results in a very troublesome waste of material.

The firm of Nadir in Berlin-Wilmersdorf, Germany, has brought out a testing apparatus for metallic filaments which would seem to avoid these drawbacks. The most interesting part of the apparatus is the contact device represented in Fig. 1. This device will make a reliable contact with filaments of any thickness (down to a minimum diameter of 0.01 mm) without any risk of breakage. The operation is purely mechanical and requires no special skill; moreover, the opening and closing of the contact tongs occurs quite smoothly without any shock.

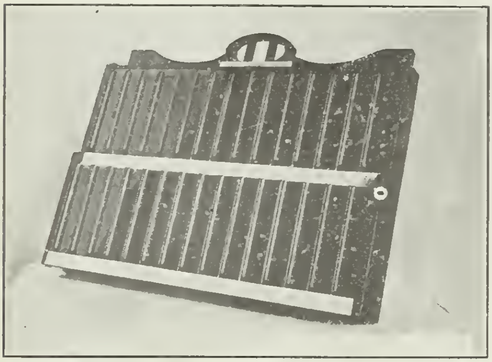


Fig. 2—Sorting Case.

The filament to be tested is placed on the transversal arm *b*, from which it drops into the notch *c*; its ends are thus made of their own accord to penetrate into the contact tongs, which are closed by turning the button *d* in a backward direction. The button *d* is fixed to a shaft comprising three eccentrics, the first and last of which serve to open and close the contact tongs, whereas the central one actuates a screen intended to prevent any vibrations of the filament.

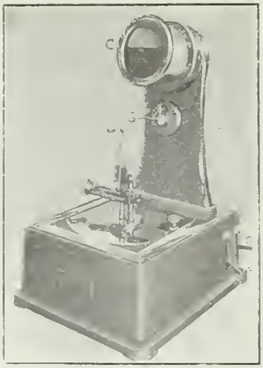


Fig. 3—Device for Testing Lamp Filaments.

The two contact tongs are insulated from one another, and each is connected to the contact rod *a* communicating with a resistance-measuring instrument. In order to withdraw the filament tested, the button *b* is turned round in an opposite direction, so as to open the contact tongs, after which the filament is deposited either directly in the sorting cases (Fig. 2) or on a numbered plate.

In Fig. 3 is shown the apparatus in a readily transportable form combining an instrument for resistance measurements, a battery and the contact device above described.

After adjusting the index of the contact device to the required length of filament, the latter is placed in the position above described and the needle of the checking instrument is brought into play by shifting the two levers *D* and *E*. The button *G* allows any one of the three scales of the instrument to be chosen. In order to reduce the deflection of the needle, its position of rest can be fixed by a stop to a division sufficiently advanced for leaving only a short distance to be traversed, which arrangement greatly increases the rapidity of measurements. A precision resistance of 20 ohms allows the accuracy of the instrument to be checked previous to each series of tests.

The measuring principle consists of applying to the circuit a constant e. m. f., supplied by a small battery which is located in the base of the apparatus. Two special terminals allow the instrument to be connected to any outside battery when desired

ILLUMINATING ENGINEERING ACTIVITY IN GREAT BRITAIN.

Quite a number of recent events in London have been of considerable interest to those concerned with illuminating engineering. First among these may be noted the opening meeting of the Institution of Electrical Engineers on Nov. 11, when the new president, Mr. Ferranti, delivered his address The address was of a very imaginative character, a picture being drawn of the future supply of electrical energy all over Great Britain by immense central stations capable of distributing electricity at less than 0.25 cent per kw-hour. Incidentally it was suggested that by the fixation of nitrogen from the atmosphere gigantic crops might be raised, and even the ultimate subjugation of the British climate was regarded as within the power of electricity.

What was, however, also a great attraction at the opening meeting was the opportunity presented to many engineers of seeing the new home of the Institution, on the Victoria Embankment, for the first time. The Institution has now a building of its own and has spent a considerable amount of money in embellishing it. The scheme of lighting adopted was also interesting. The lecture theater walls are of unpolished mahogany and the lighting is supplied mainly by inverted means, a series of 220 25-watt tungsten lamps being concealed at the base of a white frieze so that the room is surrounded by a girdle of soft light. In addition the center part of the ceiling consists of glass through which daylight is received during the day. By night, however, the light from four quartz-tube mercury-vapor lamps streams through this glass, giving the impression of moonlight.

The scheme of lighting is thus somewhat original and gave rise to much discussion. The absence of glare was regarded as a matter for congratulation, but there were certain features in the interior which did not escape criticism. It has been suggested by some that the general effect of the lighting is somewhat flat, and that the extremely uniform illumination attained over the floor area is not wholly desirable, since it gives the eye no rest. There is no central point to which the eyes of the audience are instinctively turned. It is suggested that special illumination of the president's desk ought to be provided so that those present would find it natural to concentrate their attention in that direction.

Some interesting particulars were also given of tests of the illumination, which were presumably carried out with the lumeter instrument previously referred to in our issue for

Nov. 17, 1910, page 1189. The illumination over the floor area is of the order of 2 ft.-candles. Figures were also given for the surface brightness of the illuminated frieze. This varied from about 5 ft.-candles at the center to nearly 10 at the ends (where there is mutual reflection between the adjacent bright surfaces)—a very moderate brightness compared with that of most illuminants. The walls of the theater are stated to have a surface brightness of about 0.3 ft.-candle. Measurements of the illumination on the lecture tables in the library show that the present illumination is only about 1 ft.-candle, but it is anticipated that arrangements will be made to provide more light soon, and the lighting fixtures in this room are still incomplete. For example, special methods of illuminating the shelves of books are still contemplated.

The question has often been raised whether it is possible to add together the illumination from two widely different colored sources and obtain a consistent result. Now in this case the actual illumination, due to both mercury-vapor lamps and metallic-filament incandescent lamps, came to just above 2 ft.-candles. The illumination at the same spot due to the metallic-filament lamps alone was 1.6 ft.-candles, and the illumination due to the mercury-vapor lamps only was 0.5 ft.-candle. Considering the difference in color, this adds up very closely to the actual combined illumination. However, the illumination is, of course, fairly high. It does not follow that equally good agreement would have been obtained with very weakly illuminated surfaces.

Some additional particulars of other measurements with the lumeter instrument were given in a recent paper before the Physical Society by Mr. J. S. Dow. The illumination in a number of the "tubes" and tramcars of London was studied and there appeared to be remarkable variety in the results. In some cases from 2 to 3 ft.-candle horizontal illumination was provided; in others results more like 0.2 or even 0.1 ft.-candle were sometimes met with. One feature of this instrument is the ease with which it can be applied to illumination in a vertical or inclined plane. For example, Mr. Dow, in the paper mentioned above, showed that it was very easy to examine the illumination on the blackboards in schoolrooms (which often varied in a surprising manner), the brightness of placards, time-tables, etc., and the distribution of illumination over hoardings containing advertisements. It was pointed out that an advertisement in itself is valuable only when it is clearly seen. From the advertising standpoint adequate illumination is, therefore, very valuable.

One interesting example of the results of measurements by daylight and artificial light was related. One evening some measurements of the brightness of tree-trunks in the park were made and the dark bark had, by daylight, an apparent brightness of about 2 ft.-candles, even though it was evening and the twilight was coming on. Subsequently the author went into a brightly lighted tea shop and the effect was that of coming from the twilight into a brilliantly lighted interior. Nevertheless, the illumination on the tables, bright as it appeared to be, was actually less than the brightness of the dark tree-trunks. It may be added that even the illuminated white frieze at the Institution of Electrical Engineers, by which the theater is actually lighted, is not so bright as many dark tree trunks and sooty buildings are when receiving daylight illumination. The eye would never credit this, presumably because the great expanse of sky overhead, having a brightness of hundreds of foot-candles, causes all moderately bright objects to appear dark in comparison.

At a subsequent meeting of the Institution of Electrical Engineers there was again much discussion on illuminating engineering lines. This was the occasion of a paper by Mr. Haydn T. Harrison on "Street Lighting by Modern Electric Lamps." The paper contained a considerable number of data comparing the performances of gas and electric lamps and the polar candle-power curves of different illuminants. The author endeavored to show that the conditions of good street lighting are best secured by a number of small units spaced near together rather than by isolated sources, far apart, of great concentrated brilliancy. The paper was also useful in showing how customary it is becoming to equip street lamps with some form of prismatic or other globe in order to modify the natural curve of light distribution.

It is interesting to note that Mr. Harrison did not entirely approve of the method suggested by Mr. J. Abady and embodied in the street-lighting specification of the Westminster and City Council, according to which the candle-power of a lamp is determined as the mean of the values at 20 deg and 50 deg. It was pointed out that a lamp might comply with the specification and yet have a very poor kind of curve for street lighting purposes.

The discussion revealed a great advance in the view that there is too much glare in modern street lighting, and it seems pretty clear that in the future there will be increasing attention paid to this point in addition to the provision of a certain convenient illumination. It was pointed out that most street lighting involves a compromise between the avoidance of glare and the provision of good and uniform illumination. The very rays which are emitted at small angles to the horizontal and are therefore most effective for illuminating the parts of the pavement most removed from the lamp are also those which are most apt to shine out into the eyes of pedestrians and produce an impression of glare.

Another point was the general recognition of the need for some form of specification for street lighting which would meet with general acceptance. Mr. L. Gaster referred to the recent decision of the German Institution of Electrical Engineers to take measurements in a horizontal plane 1 m above the ground in the cases of both interior and outside lighting, and pointed out that this had been referred to the Institution of Gas Engineers in Germany with a view to joint agreement on a common method of testing. Several speakers, including Mr. C. P. Sparkes, suggested the desirability of a committee to deal with a specification for street lighting, apart from the illuminants employed, and Mr. J. S. Dow pointed out that the Illuminating Engineering Society, which had always taken an attitude of impartiality toward this subject, could give material assistance in this direction.

Another suggestion from Mr. Gaster was that the cost of improved street lighting should be partly defrayed from the contributions of motor-car taxation, which are understood to be allotted to road improvement. Nowadays it is the speed of the traffic in London more than anything else which determines the need for good illumination, and the matter is one of considerable importance to motorists and others driving rapidly It is therefore only reasonable to expect a contribution from them to the expenses of adequate lighting.

The Illuminating Engineering Society in London held its opening meeting on Nov. 8, at which time it was explained by the president that arrangements had been made for the two opening meetings to be devoted to discussions on gas lighting and electric lighting respectively, the idea being to obtain a summary of progress in these directions and subsequently to proceed to practical examples. The honorary secretary also read a brief report of progress during the vacation, making special reference to the presence of delegates at the Congres International des Maladies Professionnelles, when the question of factory illumination came into consideration, as commented upon in our issue for Nov. 10, 1910.

A paper on "The Present Status and Recent Advances in Gas Lighting" was then read by Mr. F. W. Goodenough, of the Gas, Light & Coke Company, and a very interesting discussion in which many prominent gas engineers took part, followed One point which received special attention was the ability of consumers to adjust their own burners, and Mr. Carpenter, of the South Metropolitan Gas Company, mentioned that a new burner had been introduced by his company with complete success. This is adjusted once and for all for a certain quality of gas and needs no further attention as regards regulation of air supply

At the next meeting of the society a paper of a similar nature is to be read by Prof. E. W. Marchant, of Liverpool University, dealing with recent progress in electric lighting. The Illuminating Engineering Society is thus setting to work to deal with all illuminants in an impartial manner and is already doing good work by affording opportunities for representatives of both gas and electric lighting to meet on friendly terms and exchange views in a way they otherwise would not find an opportunity of doing. This point was specially emphasized by Mr. F. W. Goodenough at the commencement of his paper.

It was further stated by the president that a subsequent meeting would be devoted to library illumination.

RECENT TELEPHONE PATENTS.

REPEATER SYSTEM.

Among the various classes of telephone circuits probably none have displayed greater ingenuity upon the part of inventors than repeater circuits. If a repeater is to be used practically, it must be two-way; that is to say it must be capable of being introduced in a two-wire metallic circuit and reinforcing received currents from either direction with equal facility. Furthermore the reinforced currents must be transmitted in such a manner as not to reflect back into the repeater as if they were arriving currents, thus causing singing or confusion. It is evident that a two-way repeater must be differentially connected with respect to its own reinforced currents.

A typical repeater circuit is that recently patented by Mr. N. G. Worth, of Columbus, Ohio, and shown diagrammatically in Fig. 1. Assume the line to be W, W_3, W_2, W_4 It will be seen that with the introduction of the repeater a short-circuit has been introduced to divide absolutely the line into two sections so that there will be no possibility of mutual interference of the two sections due to direct conduction of talking currents from one to the other.

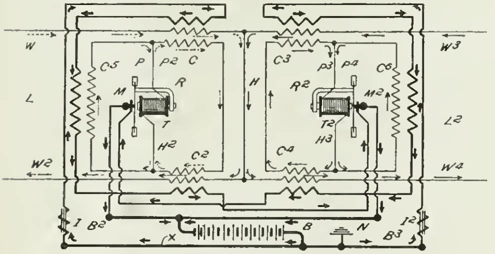


Fig. 1—Telephone Repeater System.

Assume now a talking current arriving from W, W_2. This will pass through the secondaries of C, C_2 and thereby induce co-acting currents in the tertiaries. These currents divide between coil C_5 and receiver part R. At the same time currents are induced in primaries C, C_2, C_5, but whether or not balanced they are of no effect as they have no inductive relation to the outgoing line section.

Repeater R acts sending current fluctuations from its transmitter M. This is in a circuit including primaries of coils C_3, C_4, C_6. In coils C_3 and C_4 currents are set up in the secondaries, which currents are sent out on line W_3, W_4. At the same time currents are set up in the tertiaries of C_3 and C_4, which co-act and the combined effect of which must be equal and opposite to current set up in the secondary of C_6. Under this condition and under this one alone will receiver part R_2 remain inert and therefore incapable of sending out reflected reinforcements toward W, W_3. Similarly repeating may be traced in the opposite direction.

NEW APPARATUS.

Fig. 2 shows in section and in elevation a desk-stand head used with a desk stand patented by Mr. W. Leaver, of Chicago, and assigned to the Kellogg company. The transmitter casing is drawn back as a lug. The sectional view shows at a glance how the flexible hinge is arranged.

Another patent assigned to the same company is that of Mr. A. H. Weiss for a sheet-metal wall set. All parts save the transmitter are mounted upon the base plate, the sides and cover of the box being integral and hinged to swing out of the way. The core is cut away to clear the bell posts, but a filler corresponding is secured to the base. A hook is arranged to limit the swing of the cover after the manner of a desk leaf slide. This prevents the transmitter from striking the wall if the cover be released.

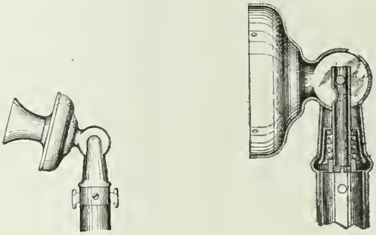


Fig. 2—Leaver Desk-Stand Head.

Mr. W. E. Butler has patented a rotating pole changer driven by a constant-current motor operated off the exchange storage battery. The pole-changing commutator is included in the circuit of the primary of a transformer fed from the same battery. The transformer steps up the potential to the required voltage for ringing.

ELECTROMAGNETIC RECEIVER SYSTEM.

A common-battery system using an electromagnetic receiver in distinction to the usual permanently magnetized receiver has been invented by Mr. F. X. Staub, of Fort Wayne, Ind., his patent having been assigned to the Corwin Telephone Manufacturing Company. The novelty of the present arrangement lies rather in a non-inductive shunt about the receiver than in the use of the receiver itself.

COMBINED TELEPHONE AND SERVICE SYSTEM.

A combination signal and telephone system is patented by Mr. H. G. Webster, of Chicago, under the above title and assigned by him to the Kellogg Switchboard & Supply Company The circuits are all so arranged that the two limbs of the telephone subscriber's line, even during a conversation, are in balance and thus a neutral point may be maintained at all times. To this end the line relay is double-wound, one winding in each limb of the line. Again, an offsetting resistance is included in the tip cord strand to balance the supervisory relay in the ring strand. Lastly, the battery is grounded at its middle. The signal circuit is introduced upon the line limbs in multiple through split balanced coils and it is carried off at the subscribers' stations similarly. The signal relays are double-wound, one winding connected to each line leg. These relays are sensitive only to direct currents flowing in both their windings in the same direction. They, therefore, respond to the signal currents and fail upon the telephone currents.

PARTY-LINE SYSTEMS.

In a party-line system invented by Mr. O. T. Lademan, of Milwaukee, special-station instrument circuits are used. When the receiver is lifted from the hook its circuit alone is closed across the line, the induction coil and transmitter being left dead. When it is desired to transmit the receiver circuit is modified by the introduction of impedance, while the transmitter circuit is closed and the induction-coil secondary is thrown practically across the line. There is thus maximum receiving efficiency coupled with minimum effect of the receiver in reducing outgoing currents.

Mr. E. Gould, of Spring Valley, Minn., has endeavored to prevent "listening-in" on party lines. He provides keys at each telephone, one for conversations forward and one for those in the other direction. Each key cuts off the non-wanted direction. Thus any one between two conversing stations must cut them apart in order to listen.

Mr. J. A. Hall, of Oakland, Cal., has invented an antiseptic cap for transmitter mouthpieces. A cylindrical holder clamped to the mouthpiece by rearwardly projecting resilient fingers carries a ring of absorbent material at its front part. The ring surrounds the cylinder, the latter being perforated at this point. A sheet cover fits over the absorbent ring to protect it and to prevent evaporation of the antiseptic solution with which it is saturated.

COMBINED TELEPHONE AND ALARM SYSTEM.

A combined common-battery telephone system and alarm system has been patented by W. W. Dean, his patent being assigned to the Consolidated Fire Alarm Company. In applying the alarm system, two relays are introduced at the central office, one on each side of each subscriber's line. If these act in unison they counteract each other. If, however, one fails while the other acts the alarm-recording device is used to operate. At the subscriber's station the code wheel of the alarm box causes simultaneous grounding of both line limbs. When the telephone calls the signals are over a metallic circuit and both alarm control relays operate in unison. When the alarm code wheel is tripped only that control relay operates which is upon the battery side of the line. The other fails, as it is connected between two earth connections.

REVERTING BUSY TEST.

In some instances where it is desired to do away with a code letter or word for selective party line stations, a different line number is assigned to each station and the jacks of the various numbers grouped together on one line are all interconnected. In case one such station calls another upon the same line, it is evident that there should be something to notify the operator of the relation of the called and calling stations. It is usual to cause a special busy tone to be audible to the operator during the testing period provided she be testing upon a line already connected to the same cord pair which is being used for testing. Thus if the answering plug be connected to the same line being tested the tone will be introduced.

This has been used for some time upon three-wire switchboards, but Messrs. D. A. Lawver and C. C. Bradbury have just obtained a patent for its application to a two-wire switchboard according to their circuit scheme. They have assigned their patent to the Kellogg Company.

LETTERS TO THE EDITOR.

Operating Costs of Illuminants.

To the Editor of Electrical World:

Sir:—In your edition of Dec. 29 is a brief account of the paper by Messrs. Bryant and Hake before the Chicago Section of the Illuminating Engineering Society on the comparative operating costs of different illuminants. Of course, until this paper is published and something is known of the manner in which tests were made it cannot be a subject of much discussion; but even at the present time it might be well to call attention to the fact that since interest and depreciation were not included in the cost figures the latter are necessarily of little value.

In many cases where electrical energy is figured at a low rate, such as 1 cent or 2 cents per kw-hour, interest and depreciation become items of great importance. Assume, for example, a mercury-vapor lamp costing $34, consuming 192 watts and operating 1000 hours a year with energy at 1 cent per kw-hour. Interest on the investment at 6 per cent is $2.04 per year. The depreciation can be found by deducting the price of the tube (a renewal part and hence taken care of under maintenance) from the cost of the lamp and figuring on the remainder at the proper rate. Allowing $10 as the cost of the tube and taking 10 per cent as the rate of depreciation, the annual depreciation is found to be $2.40. Assuming 4000 hours as the life of the tube, the maintenance comes to $2.50 per year, while the cost of energy is 192 kw-hours at 1 cent, or $1.92.

Summarizing the above, there are: Interest and depreciation $4.44; maintenance and energy, $4.42. Thus it is found that interest and depreciation are actually greater than maintenance and energy and, therefore, it follows that the omission of interest and depreciation would show in this case less than half the actual cost of operation.

Boston, Mass. J. S. Codman

A Standard of Light for Color Values.

To the Editor of Electrical World:

Sir:—Referring to the editorial in your issue of Dec. 22 entitled "What Is Daylight?" I beg to call attention to my paper entitled "A Standard for Color Values," which was presented, March 17, 1910, before the Illuminating Engineering Society.

The abundant evidence in this paper, together with the still greater volume which has accrued since its presentation, is, I believe, sufficient to settle thoroughly the matter in so far as rendering it justifiable for all scientific societies to define the spectrum of average daylight by stating that it is the same as that from pure carbon dioxide gas when traversed by electric current in a vacuum tube. In the paper above referred to I made a proposition to this effect, and favorable action was taken in that the council of the society was requested further to investigate and act on the matter. I also made similar proposals at various times during the past ten years, and specifically did so in my paper presented before the American Institute of Electrical Engineers on April 26, 1907.

It is a fortunate scientific coincidence that it is possible to settle such an important problem in so simple a manner. Not only have many of the highest European authorities, but also the United States Bureau of Standards, stated that the white "Moore light" is as near an average daylight as it can be hoped ever to decide upon. Dr. H. E. Ives presented a paper comparatively recently before the Illuminating Engineering Society in which he reported on a study of all illuminants from a purely scientific standpoint, and came to the same conclusion. It is a most remarkable statement that of the thousands of color experts who are now using the "Moore light" not one has yet been found who has not agreed that its color values give entire satisfaction.

Newark, N. J. D. McFarlan Moore

Voltage-Wave Distortion and Life of Incandescent Lamps.

To the Editor of Electrical World:

Sir:—In his reply in your issue of Dec. 15 to my letter calling attention to certain obscure points in his article regarding the change of life of lamps on peaked as compared with sine wave-form, Professor Kinsloe seems to have taken a peculiar point of view regarding where the burden of proof in a question like this lies.

When, a few years ago, a certain professor of physics in this country announced that he had discovered a small change of the mass of a body with its temperature, the scientific world did not immediately start elaborate experiments to prove that the mass of a body does not change with its temperature, but rather waited for the professor to bring forth more conclusive evidence as to the change which he thought he had detected. This was a perfectly logical attitude, because it was inherently improbable that such an effect as he claimed to have observed would have escaped the attention of the innumerable scientific workers who had for years been making careful weighings, and no one of whom had ever detected any trace of a similar effect. Eventually it was shown that the supposed effect of heat on the mass of the body was really due to the effect on the balance of rising currents of heated air.

Similarly, in the present instance, it should be remembered that the life-testing of lamps is no new thing; that it has been carried on as a regular commercial proposition for many years, and that, in spite of the many experiments which have been made, never before has there been detected a positive effect of the sort which Professor Kinsloe claims to have discovered. Previous workers in this field have not been lacking in powers of observation or in facilities for making exact life tests of lamps. Moreover, experiments which have been made to detect an effect of this sort have invariably given results of a negative character. Therefore, it seems quite clear that the burden of proof rests entirely on the experimenter who would prove the existence of such an effect as Professor Kinsloe claims to have found.

In my previous letter I referred to certain tests as being inconclusive, and because of this admission Professor Kinsloe refuses to accept these results as satisfactory evidence to prove the fallacy of his own results. In speaking of these tests as inconclusive I meant that they were inconclusive as far as proving the existence of a positive effect was concerned. As a matter of fact I consider that these tests were far more conclusive than any which Professor Kinsloe has presented in his paper, the conclusion being that within the limits of error of the life-testing of lamps there is no difference shown between the effect of alternating current and that of direct current. By what process of reasoning it is possible to conclude that lamps which show the same candle-power and life at a given voltage on either alternating current or direct current should show a considerably lower candle-power and shorter life on peaked wave than they do on sine wave Professor Kinsloe does not attempt to indicate. However, this process of reasoning is very important, since without some logical connection, and in view of the known facts, the burden of proof rests upon him and the proof can be considered complete only when supported by evidence of the most convincing character.

Returning now to some other statements in Professor Kinsloe's letter, I notice that he raises the question as to whether lamps burned on a given effective voltage will consume exactly the same amount of energy on either wave-form. The answer to this question is contained in Professor Kinsloe's own article. By taking the data from his curves I find that his values for the watts of the lamps in the two groups, as figured by multiplying the watts per candle by the candle-power, are substantially the same. Moreover, Professor Kinsloe has in his somewhat unusual method of measuring watts assumed that the affirmative answer is given to his question. To carry out his own course of reasoning he should have shown experimentally that this would be true before attempting to measure the watts of a lamp by ammeter and voltmeter.

Professor Kinsloe also raises the question as to whether a lamp will give the same candle-power when burned at the same effective voltage on the two wave-forms, and challenges me to give an answer to the question. Although this question had been answered entirely to my satisfaction by many previous experiments, a set of measurements were made at the Electrical Testing Laboratories to cover definitely the points which Professor Kinsloe has raised. Using a harmonic generator set, a sine wave of 60 cycles frequency was obtained and also a triple-frequency harmonic of approximately one-third the amplitude of the fundamental. This harmonic was impressed upon the sine wave in such a way as to make a much more pronounced peak than Professor Kinsloe had in his tests. Various lamps were measured with the sine wave, with the peaked wave and with a re-entrant top wave produced by reversing the phase of the triple harmonic. The lamps measured comprised not only carbon and "gem" lamps, but also a 20-watt tungsten lamp, which has the finest filament which is produced commercially to-day, as well as a regular 60-watt tungsten lamp having a coarser filament. The voltage on these lamps was adjusted to the same value with a Weston alternating-current-direct-current voltmeter containing no iron. A wattmeter was also included in the circuit. The results are summarized in the following table:

Type of Lamp.	Volts.	SINE WAVE, 60 CYCLES		RE ENTRANT TOP WAVE		PEAKED WAVE.	
		Wattmeter Reading.	Candle-Power	Wattmeter Reading.	Candle-Power.	Wattmeter Reading.	Candle-Power.
16-cp carbon......	110	35.23	16.0	35.23	16.0	35.23	16.0
20-cp "gem"	110	27.76	13.5	27.76	13.5	27.76	13.5
20-watt tungsten...	110	13.38	11.77	13.38	11.7	13.38	11.75
60-watt tungsten...	110	33.05	42.05	33.05	42.5	33.05	42.44

The results of this test are directly at variance with the results of the initial measurements of the lamps as shown by Professor Kinsloe. He found, for instance, that changing a carbon lamp from sine to peaked wave reduced its candle-power from 17.1 to 15.8. A similar effect was found in the other tests. The life curve was in each case consistent with the initial measurements. The initial measurements, however, were evidently greatly in error since he should have got the same candle-power on either wave-form. It follows clearly enough that whatever error was made in the initial measurements has been carried throughout the tests.

It is clear that, whatever may have been the reason for the shorter life of lamps on peaked wave which Professor Kinsloe observed, the erroneous character of the measurements which he adduces in support of his conclusions makes it necessary, in view of all other information regarding the performance of lamps, to conclude that the reduction in life was in itself a result of some faulty experimental arrangement similar in character to that which vitiated all of his electrical or photometrical measurements.

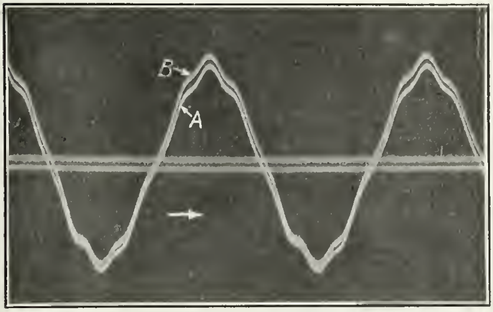
New York. Clayton H. Sharp

To the Editor of Electrical World:

Sir:—Referring to Professor Kinsloe's article in your issue of Nov. 17, to Dr. Sharp's letter of Dec. 8, to Professor Kinsloe's reply of Dec. 15, and also to your editorial of Nov. 17, one point seems to have been overlooked, namely, the statement in the original article, repeated in Professor Kinsloe's reply, reading as follows:

"No effort was made to obtain voltage regulation, but it must be borne in mind that the two waves were obtained from the same alternator and the tests were conducted simultaneously, so that any fluctuation in one wave was accompanied by a similar variation in the other."

The writer believes that this statement is not correct. The saturated iron reactance which causes the peaked wave also causes the regulation on the distorted circuit to be much poorer than the regulation on the machine. Without knowledge of just what arrangements were employed, it cannot be stated how much the regulation of the distorted circuit would be affected, but it might be twice as bad as that on the machine—possibly less, possibly more. Shortly after the first reading of Professor Kinsloe's article the possible effect of wave-form in connection with temperature variation was made the subject of experiment in the General Electric standardizing laboratory to determine whether there was any large variation of resistance in "Mazda" lamps during a voltage cycle. None was apparent, as will be seen by reference to the accompanying illustration, where A is the impressed e.m.f. and B is the current. A 25-watt lamp and 25-cycle circuit were chosen to get the largest possible change of temperature and resistance during a cycle. Finding no large change, we knew that the lamp behaved like a resistance and that testing on various wave-shapes at the same watts consumption is the same as testing at the same effective voltage. It is also shown that there is no large change of temperature in the filament throughout the cycle. Similar curves have been found by Dr. Sharp, establishing the fact that the power-factor of the lamp is practically unity. (See page 1538, A. I. E. E. *Proceedings*, September, 1910.)



Voltage and Current Waves, 25-Watt Lamp, 25 Cycles.

The fact that has already been commented on—namely, the higher watts per candle on the peaked wave that Professor Kinsloe found in his test—seems evidence that some error was made. If there is variation in the cyclic change of temperature caused by the varying wave-form, the result would probably be less watts per candle-power on the peaked wave and not more, as the candle-power varies faster than the temperature.

To know that the candle-power was the same on any wave-shape eleven 40-watt "Mazda" lamps were tried in the General Electric research laboratory on various circuits, with the following result:

Direct-current, 38.2 cp; sine wave, 38.1 cp; peaked-wave machine ("crest factor," 1.51), 38.4 cp; wave distorted by saturated reactance ("crest factor," 1.70), 38.2 cp. Crest factor 1.70 was obtained from Professor Kinsloe's Fig. 3 by measurement, although it is stated in his report to be 1.58. These data are given simply to corroborate data which Dr. Sharp will undoubtedly be able to give in answer to the question, "Can Dr. Sharp state positively that even the same lamp will give exactly the same candle-power when burned at the same effective voltage on the two wave-forms?"

The research laboratory, since these preliminary tests were made, has started some more complete tests, which will be reported later. I am simply submitting this brief comment not to show that the life of lamps may not be affected by wave-form—for it may be—but to add testimony to the fact that parts of the report as given out will not bear careful analysis until supported by more facts

Schenectady, N. Y. L. T. Robinson

Wattless Power.

To the Editor of Electrical World:

Sir:—I have read with considerable interest Mr. Hanchett's letter on "Wattless Power" appearing in your issue of Dec. 15, but, it must be confessed, without entire assent. I agree with him heartily that the term "wattless power" is most unfortunate, being, as it is, a pure contradiction in terms. Mr. Hanchett's remarks, however, on power equations in general and his insistence on the word "simultaneous" would seem unnecessary. He is aware, of course, that the ordinary expression for electric power ($EI \cos\theta$) is got from the multiplication of the simultaneous, instantaneous values of voltage and current, and, so far as I know, no one has ever quarreled with the principle he supports so strenuously.

Mr. Hanchett's statement that E is always equal to RI "although E may not be the terminal voltage" seems to me to constitute a very curious example of reasoning in a circle. The E of which he speaks is nothing more than a quantity defined as being equal to RI, and it is definable in no other way. With this borne in mind, the statement is true—one might almost say obvious. However, the error goes deeper than this for, if we follow Mr. Hanchett's nomenclature, we are under the necessity of distinguishing between two quantities—one the accepted value E which appears in our power equations and is indicated by our voltmeters; the other that component of the first E which is spent in overcoming resistance, and which does not admit of direct measurement except for steady currents.

The case is exactly analogous if we say that the tractive effort of a locomotive is equal to the train resistance at all times. Here obviously the statement is untrue if the speed of the train is varying, unless we redefine the tractive effort and distinguish between the quantity so defined and the true tractive effort, which is the force applied to the train. There is more than a superficial resemblance between the electric and mechanical cases, as Clerk Maxwell showed when he demonstrated that an electrical system conforms to the laws governing all dynamic systems. The standard equations for an electrical and mechanical system are respectively:

$$F = M\frac{dv}{dt} + f(v)$$

$$E = L\frac{di}{dt} + Ri$$

Just as the term $M\frac{dv}{dt}$ represents that part of the applied force which is spent in imparting kinetic energy of motion to the system, so $L\frac{dt}{di}$ represents that part of the impressed electric force spent in imparting kinetic energy to the electrical system, i.e., storing energy in the magnetic field. The term $f(v)$ represents the dissipative function, just as RI represents that part of the electric force spent in dissipating energy in the form of heat. From the foregoing it seems to me that Mr. Hanchett's position is rendered untenable and quite meaningless.

As to statement that Ohm's law is always true as originally conceived, I wish to enter an emphatic dissent. Ohm's law as originally stated meant that the resistance is a geometrical constant of the circuit, whereas we know that it is also a function of the temperature and of the frequency. Moreover, the law is a purely empirical one, and Ohm must have meant E to designate the terminal voltage, as this is the only value of E admitting of direct experimental determination. Finally, Ohm's law is not even approximately true for electrical conduction through highly rarefied gases, as Sir J. J. Thompson has shown.

Pittsburgh, Pa. John R. Carson

To the Editor of Electrical World:

Sir:—I have read with interest Mr. Mailloux's second communication in your issue of Dec. 29, 1910, which replies specifically to my communication on the subject of "Wattless Power," printed in your issue of Dec. 15, 1910. I do not think that Mr. Mailloux's ideas therein expressed as to the use of abstruse mathematical conceptions are at all at variance with my own. I am ready to concede at once not only the desirability of such things as these, but their absolute necessity.

It must be remembered, however, that the crux of this controversy is not whether we shall abandon figments of the imagination in developing our explanations of facts, but rather what appropriate name we shall bestow upon the something which is indicating its presence upon our instruments, heating our apparatus and occupying its capacity, and interfering with our regulation. It is a tangible phenomenon which everyone can see.

The name which we select should first of all be of scientific accuracy; but inasmuch as this name once established must be intelligently used not only by mathematicians and scientists, but by practical men, it seems to the writer eminently fitting that we should select that scientifically accurate name which creates the least confusion.

It was for this reason that the writer advanced the argument that "wattless power," "fictive watts," or any name conveying the power idea, was disconcerting and confusing to the practical mind, and that the phenomena could be adequately expressed to the satisfaction of both the scientist and the practical man by the word "reactions."

The specific cases can be handled by the qualifying adjective "current" or "voltage." It is a most fortunate fact that these words of our nomenclature convey no power idea. It is impossible to conceive of power expressed in current unless the volts are mentioned and vice versa; and as this is precisely what occurs in the case of so-called wattless phenomena, volts or current in either case being largely absent owing to the difference in phase, the term "current-reaction" or "voltage-reaction" not only accurately describes what is taking place, but is intelligible to everyone who has given the subject sufficient study to be able to manage competently the apparatus in which these reactions are found. There can be no possible objection to the reversal of the term as Mr. Mailloux suggests. "Reaction currents" and "reaction voltages" are equally understandable and convenient.

The consulting engineer in conferring with his clients must explain why, if he advise an alternating-current system, he must buy a 1000-kw generator, whereas if he use a direct-current system 800 kw will suffice. It is easy for him to explain that in the alternating-current machine there will be an additional current reaction which requires the larger size and that this reaction does not appear in the direct-current machine. It takes but little of the real power, but occupies the current capacity of the machine. All of this is lucid. As he hopes to be understood let him not talk of wattless power and power-factor in endeavoring to convince his client that he must expend more money. Why should not this scientifically accurate explanation become a legitimate standard method of expression?

Referring to Ohm's law Mr. Mailloux cites the names of many eminent authorities who have suggested that it be modified in explaining alternating-current phenomena. These men I have always considered my teachers and references of last resort, and I do not hesitate to class Mr. Mailloux himself among them.

It sometimes happens that the pupil is materially assisted by his denser conception in selecting from many correct explanations that which is conspicuously clear to the numerically larger class that he represents. Fortified by this reflection, I venture to point out that to modify Ohm's law to fit alternating-current phenomena suggests that alternating current is a different physical entity, whereas it is nothing but a periodically varying direct current.

We do not think of modifying Ohm's law in the case of the direct-current motor armature. We simply evaluate and deduct the back e.m.f. from the impressed, and using the net result as the e.m.f. apply Ohm's law and obtain the resistance of the armature. It seems to the writer that it is a scientifically correct and easily understood method to proceed in the same way in alternating-current explanation, namely, to evaluate all of the e.m.fs. which the circuit contains, both impressed and induced, and vectorially combine them into a resultant to which Ohm's law will respond, thereby strengthening rather than discrediting the fundamental proposition.

It matters not that Dr. Ohm did not have in mind the intricate alternating-current phenomena when he framed his famous law. He was far-seeing enough to state it in such a way that the proposition was basic no matter what the future might bring forth.

It would seem that the interests of electrical science will be best conserved by promoting the permanency of our fundamental units and formulas. "Wattless watts" and "Ohm's law fails" have done much damage, which can be avoided by materially abridged methods which sacrifice no scientific accuracy.

New York. George T. Hanchett.

To the Editor of Electrical World:

Sir:—In your issue of Dec. 29, 1910, Mr. C. O. Mailloux makes some interesting remarks on "Scientific Abstractions in Relation to Scientific Realities."

It is doubtless safe to say that we know more about things than the beginnings of knowledge. Yet not to inquire into the meaning of words and to seek what things they hide is to become a dupe to such words. To forbid such inquiry would be, as Poincaré says, to adore a metaphysical idol "like savage peoples who prostrate themselves before a statue of wood without daring to look at what is within."

Mr. Mailloux marvels at the possibility of dealing with linear "forces." But what is "force"? The idea is, according to Professor Crew, even older than that of "mass" or of "energy" and "from many points of view one of the most complex and puzzling of physical quantities." Lagrange and his school define force as "that which tends to move a body"; but according to the school of Newton and Galileo force is the "time-rate of change-of-momentum." Here the force acting on a body is not the "push" or "pull" it exerts, but a "vector-product" of a scalar "mass" by a vector "acceleration" whose components are

$$X = \frac{md^2x}{dt^2} \qquad Y = \frac{md^2y}{dt^2} \qquad Z = \frac{md^2z}{dt^2}$$

Now suppose a criminal suspended on a rope attached to a rigid tree limb. While his feet find support there is no downward "pull" on the rope. On removing such support both man and rope show signs of distress. Does the criminal choke because the "force" in the rope and that due to "gravity" ***tend*** to tear him asunder? Such would be the view of those who define force in anthropomorphic terms; for to them force is that which tends to produce motion—there need be no motion. Mathematical physicists, however, would argue that the criminal must *drop* toward Hades or *rise* toward Heaven before we can calculate the force of 150 lb. of crime!

But how can we define force when we do not know what "mass" is? Shall we agree with Poincaré and say masses are mere coefficients which we find convenient to introduce intc our equations?

We must admit that many of the concepts of science are, as Mr. Mailloux puts it, mere "figments of the imagination." Yet to say this unqualifiedly is to confuse science with poetry. Tc my mind science is a product of "reason" the aim of which is consistency or logical sequence; a "figment of imagination," on the other hand, is formed according to no particular order of sequence.

Mr. Mailloux speaks of the "force factors" which enter intc the complete formulation of Ohm's law. With reference tc the "retainer" there are stored, restored and dissipated energies but if we speak of their "force factors" why not of their "mas factors" and "acceleration factors"? What is the force facto in a three-phase, twenty-five-mile circuit delivering 15,000 kv at 25 cycles per second? We know little and care less abou the metaphysics of the phenomenon. We are more intereste in the voltage that must be impressed at the other end t deliver the "goods."

The difficulties attending the use of Newtonian mechanic have led to the system of Energetics. Experience has show that this system is an improvement on the older one, as i involves less of the inconceivable. Of course, even here w find concepts which "do not materialize." In thermodynamics we struggle with $\int \frac{dQ}{T}$, that "ghostly quantity." But these are mental concepts which find at least some counterpart in nature. The imagination has a legitimate place in science if properly checked. There are "voltage reactions" and "reaction volts" if you refer to the mathematical expressions or graphic conventions. Hunt as you will you cannot find them in the wire. We are so in the habit of dealing with symbols of things in nature that we seek an ontological background for every abstraction or generalization into which we are led. If you must go high-flying, keep your eye on terra firma; otherwise let's do our theorizing with our feet on the ground.

Philadelphia Pa. B. Spencer Greenfield.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Single-Phase Motors for Mine Locomotives.—R. Richter.—An illustrated paper describing a method of building single-phase commutation motors of relatively large rating in such a compact way as is necessary for mine locomotives. In the motor of the Maffei-Schwartzkopff Company there are no resistance connections between armature winding and commutator and neither excitation transformers nor choking coils are required. The excitation winding *d* in Fig. 1 is not connected in series with the armature *c*, but in series with the primary *o* of the adjustable transformer from the secondary of which the variable voltage is impressed on the armature. The compensation winding is indicated at *b*. The ratio of exciting current to armature current is, therefore, proportional to the secondary-to-primary transformation ratio of the transformer and also proportional to the voltage impressed on the armature, since the number of primary windings of the transformer is constant. In the moment of starting the e.m.f. impressed on the armature is small and therefore the exciting current is also small, but it increases with increasing armature voltage and with increasing speed of the motor. The arrangement of the windings is shown in Fig. 2 for two poles. The stator is uniformly slotted. One of the five slots per pole carries the exciting winding. The other slots carry the compensation winding. The position of the armature windings short-circuited by the brushes is also indicated in the illustration. Some data are given of motors built on these principles, their arrangement in the locomotive and results of tests.—*Elek. Zeit.*, Dec. 22.

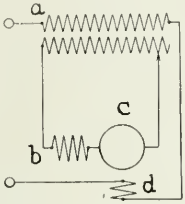


Fig. 1—Single-Phase Commutator Motor.

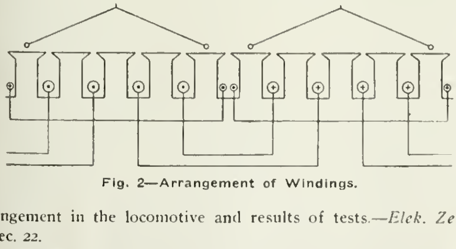


Fig. 2—Arrangement of Windings.

Aluminum Field Coils.—A note on a recent British patent (2711, Dec. 15, 1910) of the Specialfabrik für Aluminium-Spulen und Leitungen Ges., of Berlin. Coils of bare aluminum wire are plunged, when hot, into a cold bath of sodium hydroxide or sodium carbonate solution. The liquid penetrates into the coils and on drying a strong insulating layer of aluminum oxide is formed on the wires. The carbonate solution is preferable, as it removes any grease remaining from the drawing process.—Lond. *Elec. Eng'ing*, Dec. 22.

Totally Inclosed Motors.—P. Amsler.—A translation in abstract of his recent German paper on the cooling of a totally inclosed motor by means of an air current which when it has become heated by its passage through the machine is led into the base of the machine, where it is cooled by pipes through which water flows. The cold air current is then passed again through the machine.—Lond. *Electrician*, Dec. 23.

Commutating Poles.—A note on a recent British patent (27,968, Dec. 15, 1910) of Miles Walker (British Westinghouse Company). Automatic regulation of the commutating pole flux is obtained by connecting the exciting windings between two brushes close together in the neutral zone, one slightly in advance of the other. Wider brushes, and therefore a shorter commutator, can be employed.—Lond. *Elec Eng'ing*, Dec. 22.

Leakage Field of Three-Phase Transformers.—W. Rogowski—The first part of a mathematical paper on the theory of the leakage flux of three-phase transformers. The paper is to be concluded.—*Elek. Zeit.*, Dec. 22.

Lamps and Lighting.

Recent Progress in Electric Lighting.—E. W. Marchant.—A paper presented before the (British) Illuminating Engineering Society. The author first considers recent developments in incandescent lamps and gives particulars of experiments on the effect of repeated switching on and off of metallic-filament lamps, the effect of vibration on the life of lamps, etc. With respect to the effect of repeated switching on, twenty lamps, supplied by several makers, were subjected to a test. The lamps were divided into two groups and each one was adjusted to have an initial specific consumption approximating 1.4 watts per candle-power: this adjustment was effected by introducing resistance into the circuit of each individual lamp. One set of twelve lamps was connected in circuit with an automatic switch driven by a small fan motor at such a speed that a cam switched on the light for fifty seconds and switched it off for ten seconds. The reason for this choice of time was that it appeared that ten seconds was enough to allow the filament to become practically cold and thus to give the maximum contraction and expansion of the thread. As far as the experiments have gone the effect of switching does not appear to be serious; the lamps that have been burning continuously have

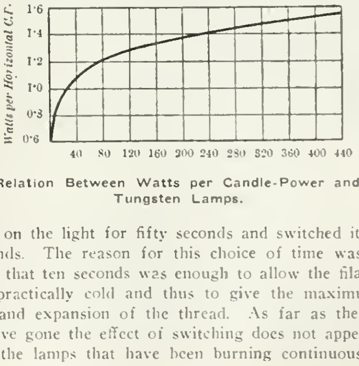


Fig. 3—Relation Between Watts per Candle-Power and Life of Tungsten Lamps.

given out to the same extent as those that have been subjected to the continuous switching off and on. The number of switchings to which so far each lamp has been subjected is 25,000 approximately, and all the lamps except two are still burning. Fig. 3 gives the relation between the effective life of tungsten-filament lamps (as defined on the 80 per cent of initial candle-power basis) and initial watts per candle-power. The effective life is roughly proportional to the 3.65th power of the initial watts per candle-power, a law which corresponds with that found for carbon-filament lamps. It is probable that metallic-filament lamps are much more injuriously affected by the sudden shocks they receive when their globes are being cleaned than by any ordinary vibration to which they may be subjected. One may sum up the position as far as metallic-filament lamps are concerned by saying that at present there is no difficulty in obtaining a 230-volt metallic-filament lamp of about 25 cp which will give one horizontal candle-power for 1.2 watts and will operate at near this consumption for over 1000 hours, probably for a much longer period under ordinary conditions. Improvements of illumination are next discussed. With respect to arc lamps the author discusses methods of changing the distribution of the light so as to give more uniform illumination over a large area. The following results are given of tests of lamps made by the author with a spherical photometer.:

Type of Lamp.	Volts.	Amperes.	Mean Hemi-spherical Candle-Power.	Candle-Power per Watt.
Inclosed-flame lamp (clear globe) .	58.0	8.45	2,200	4.5
Opal globe....	57.8	8.5	1,430	3.0
Open-flame arc (slightly obscured globe)........	40.0	7.0	1,040	3.72
Slightly inclosed arc (ordinary carbon)	86.0	8.5	1,150	1.6
Midget singly inclosed arc lamp..... ..	77.0	3.2	245	1.0

Finally mercury-vapor lamps with globes of fused quartz or silica are discussed. The test of one of these lamps gave 1.73 cp (mean hemispherical) per watt. The lamp consumed 688 watts at 230 volts and gave a mean hemispherical candle-power of 1190. An account is given of the extended discussion which followed. G. W. O. Howe referred to the peculiar blackening of certain metallic-filament lamps. From the shadowgraph resulting in such cases it appears that the deposit is the result of a discharge from a certain small part of the filament. More curious, however, is the fact that in the author's tests the deposit consisted mainly, if not entirely, of copper. The leading-in wires contained a certain amount of copper and the conclusion is reached that the liberation of the copper particles results from the heating of the wire through conduction from the filament.—Lond. *Electrician*, Dec. 23.

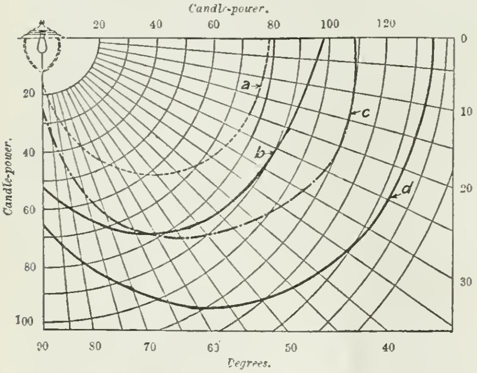


Fig. 4—Polar Candle-Power Curves of Street Lamps.

Public Lighting in London.—The conclusion of the long illustrated review of recent improvements of the public lighting system of the City of London. A description is given of the use of the bracket system in Paternoster Row. Fig. 4 shows the polar candle-power curve of the metallic-filament lamps employed, the dotted lines *a* and *c* being for the 75-cp and 100-cp lamps respectively, the tests being on the isolated lamps without fittings or reflectors. The full lines *b* and *d* show the measured candle-power of the complete fitting containing these lamps and demonstrate the improvement due to proper arrangement of the reflectors, shades and globes. Fig. 5 shows the polar candle-power curve of the three-lamp, centrally suspended, high-candle-power fitting in Watling Street, containing three 100-cp metallic-filament lamps. The improvement in the lighting in the three areas dealt with in the article amounts to an increase of 63 per cent in candle-power.—Lond. *Electrician*, Dec. 23.

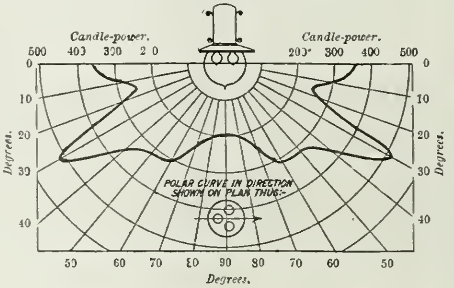


Fig. 5—Polar Candle-Power Curve of Three-Lamp Unit.

Tungsten Lamp.—A note on a recent British patent (14,116, Dec. 8, 1910) of the Wolfram Lampen A. G. for a process for decarbonizing metallic filaments by raising them to incandescence in an atmosphere of methane gas (CH_4) at a pressure of a few millimeters.—Lond. *Elec. Eng'ing*, Dec. 15.

Spherical Photometer.—R. Ulbricht and E. Dyhr.—A paper in which several possible sources of error of the spherical photometer are investigated in detail, especially the color of the paint of the sphere, the color of the window for measuring, etc. It is shown that with proper construction and maintenance the spherical photometer is a very reliable instrument. However, the recent proposal of Sumpner to use the cube form instead of the sphere should not be followed since it would introduce errors which cannot be controlled.—*Elek. Zeit.*, Dec. 22.

Electric Lighting of Railway Station.—An illustrated description of the lighting installation at the Squirrel's Heath and Gidea Park station of the Great Eastern Railway in Great Britain. A small paraffine engine is used in connection with a low-pressure generator, a battery and metallic-filament lamps. —Lond. *Electrician*, Dec. 16.

Arc Lamps.—The conclusion of the long illustrated serial on new arc lamps. In the present instalment arrangements for keeping the globes clear are described.—*Zeit. f. Beleucht.*, Dec. 20.

Installations, Systems and Appliances.

Continuity of Electric Supply.—An editorial with reference to a recent breakdown at Glasgow. Prime movers, steam plant, generators and transformers have become highly reliable. Switchgear is more vulnerable. In the network of mains, owing to the sectioning that is now usual, defects are generally restricted to a small area and the systematic testing of mains naturally reduces trouble in this direction to a minimum. One of the greatest safeguards in electricity supply would seem to be linked up of two or more stations in support of each other; yet such a course is not without its risks, as is rendered evident by the breakdown at Glasgow. In that instance a fault arose in the trunk main connecting two stations, with the result that a serious drop in pressure occurred on the extra-high-tension mains and the motor-generators and rotaries in the substations were shut down. Something must be done in the direction of the protection of feeders. The most obvious precaution is that such important links as the feeders between stations should be duplicated, but this simple precaution is not enough. There must be automatic protection in addition. One of the difficulties here is that the automatic devices will be required to act only at long intervals. It is also worth considering whether switchgear should not be more completely sectioned, so that if an interruption occurs the supply may be resumed with the least possible delay.—Lond. *Electrician*, Dec. 16.

Electric Heating and Cooking.—A. J. Cridge.—A paper read before the Yorkshire Section of the (British) Institution of Electrical Engineers on various applications of electric heating and cooking, and an account of the extended discussion which followed.—Lond. *Elec. Rev.*, Dec. 23.

Wires, Wiring and Conduits.

Calculation of Overhead Wires.—M. and R. Weil.—The French government has recently issued new regulations concerning overhead wires. The authors deal with those parts of the regulations which relate to the minimum height of the wire above ground. This height changes with changing temperature or with an accidental overload due to wind or rain. The authors give the fundamental equations for determining the tension and sag of the wire as functions of the temperature and the overload. They calculate the maximum tension, discuss effects of variations of the load and give a numerical example with diagrams. A modification of Blondel's graphical method is also given.—*La Lumière Elec.*, Dec. 17.

Grading of Dielectrics.—W. C. Smith.—A brief explanation of the principle of arranging the insulation in form of a series of layers of different dielectrics so that the different materials occupy the best possible position. The fundamental formulas of grading are given.—*Gen. Elec. Review*, January.

Reinforced Concrete Poles.—An illustrated article on the construction of poles from reinforced concrete, with special reference to the Gallia system, for which relative inexpensiveness is claimed, no special machinery being required.—*La Lumière Elec.*, Dec. 17.

Electrophysics and Magnetism.

Magnetic Hysteresis at Low Temperature.—R. Beattie and H. Gerrard.—An article in which the authors describe experiments showing the effect of temperature on both "rotational" and "alternational" hysteresis in iron, steel, nickel and cobalt. Liquid air was used for producing the low temperatures required. In the rotating field the torque method was used and in the alternating field the loops were determined ballistically. In the case of rotational hysteresis a marked increase in the loss was found at low temperature. An increase, though somewhat smaller in amount, was also found in alternational hysteresis, whereas the experiments of Fleming and Dewar (1896), which were confined to iron and steel, showed either no alteration or indefinite results. The increase appears to be due generally to increased coercive force.—Lond. *Electrician*, Dec. 23.

Modification in Magnetic Fields of Lines of the Light Emitted by the Electric Spark.—G. A. Hemsalech.—An account of tests in which he finds that magnetic fields modify the intensity of light. In sunlight such fields may produce a diminution of light, showing thus an apparent absorption of light coming from the photosphere and a reinforcement of certain lines in the solar spots.—*Comptes Rendus*, Nov. 21, 1910; abstracted in *Amer. Jour of Science*, January.

Electrochemistry and Batteries.

Life of Primary Batteries.—J. G. Lucas.—A note on a paper giving the results of some extensive investigations on the ordinary types of signaling batteries used by the British post office and other telephone administrations. In dealing with the porous-cup Leclanché type of cell he showed that the textbooks are very much out of date on this question, and that modern telephone requirements can be met much more economically by modifying the subdivision of the manganese dioxide and carbon in the porous cups. In the case of even such small current discharge rates as 40 milliamperes the result of the modifications is to decrease the total working costs to at least one-seventh, while at discharge rates higher than 40 milliamperes the decrease in costs is much greater. The agglomerate form of Leclanché battery, the author pointed out, is an expensive type, and the possible advantages which might be derived by its use are not commensurate with this expense. In connection with the use of dry cells as at present designed the investigations went to show that the chief difficulties and expense lie in the fact that for discharges which must necessarily be spread over several months full use cannot be made of the chemical energy vested in the materials used in these cells, owing to the sudden rise, after a time, in the internal resistance Details are given of experimental cells, the behavior of which indicates that the difficulties are not insuperable. As the free ammonia gas evolved from Leclanché cells is found seriously to affect the metalwork of telephones and to act deleteriously upon secondary cells, he has made satisfactory experiments with an electrolyte of manganese chloride instead of the usual ammonium chloride solution. He points out the practicability of sealing up the battery compartments in connection with cells charged with manganese chloride solutions, and the consequent reduction in loss by evaporation as compared with ammonium chloride solutions. In comparing the costs and efficiencies of the various batteries for subscribers' speaking purposes he stated that even experts in determining telephonic transmission efficiencies are unable to perceive any loss due to the resistance of the usual two-cell speaking battery rising from 0.5 ohm to 4 ohms, and that even at 6 ohms internal resistance the loss is only just appreciable to experts. This had an extremely important bearing upon the question of the most economical type of battery to be used for subscribers' speaking sets, and the author gave information relating to a modified type which would, apparently, result in the total working costs being reduced by one-half, as compared with the existing agglomerate battery, and nearly to one-third as compared with dry cells.—Lond. *Electrician*, Dec. 23.

Action of Light Upon an Electric Cell.—H. Pelabon.—If two rods, one of pure antimony and the other of an alloy of antimony and selenium, are plunged into a hydrochloric acid solution of antimony trichloride there is obtained a cell in which the pure antimony acts as the negative pole. This cell has curious properties. If it is kept in darkness its e.m.f., on open circuit, attains a constant value in a few days, provided that the temperature remains constant. Upon suddenly illuminating the positive pole the e.m.f., originally E_0, increases at once to a much higher value, E_1, and then, the illumination being maintained, it diminishes, and in the course of about twenty minutes reaches the original value E_0, which remains constant under these conditions. Then when the illumination is cut off the e.m.f. diminishes to a value of E_2, when it increases slowly and in about an hour reaches the original value E_0, which is maintained continuously in darkness. The same phenomenon is observed, whatever may be the proportion of selenium in the positive electrode, but alloys low in selenium appear to be the most sensitive. Tellurium and sulphur when alloyed with antimony do not exhibit this behavior. The nature of the metal influences enormously the delicacy of this phenomenon. Almost all the metals with their selenides give cells which are sensitive to light.—*Comptes Rendus*, Vol. 151, page 641; abstracted in *Amer. Jour. of Science*, January.

Fixation of Atmospheric Nitrogen.—J. Zenneck.—A lecture in which the author gives a brief review of the different processes for the fixation of atmospheric nitrogen. To compare the efficiency of the processes two features are to be taken into account: First, the amount of oxide produced per kw-hour; second, the concentration of the nitric oxide in the gas mixture. There are great electrical difficulties to be overcome in testing. In the plant of the Badische company the turbines are directly coupled with large three-phase alternators Their terminals are connected by three thick copper conductors with the furnace house. A thinner conductor connects their neutral point with the earth in the furnace. Each of the three main conductors is connected with one terminal of an arc furnace, the other arc terminal being earthed. An induction coil is used in series with each arc. This is necessary on account of the peculiarities of the arc. The size of these induction coils is many times that of such coils employed in engineering practice. They are so well designed that the phase difference between current and e.m.f. is very nearly 90 deg. In the immediate neighborhood of the furnace electrodes the e.m.f. is several thousand volts. The operation is, therefore, dangerous. Care must be taken in switching a furnace to the line to prevent a dangerous rise of voltage. Starters such as are used with motors can be used only in a restricted way and are employed only with very large furnaces. In this case several induction coils are connected in parallel and are switched on one after the other. Moreover, it seems that the conditions of current and voltage at the furnace differ considerably from those in ordinary electrical engineering practice. This fact causes great complications in making measurements. For instance, two precise instruments, both calibrated by the Reichsanstalt and agreeing exactly together under ordinary conditions, showed differences of 4 per cent when used at the furnace. Ordinary commercial instruments which are usually accurate within 1 per cent or 2 per cent showed differences of 12 per cent or more. Even the connections of the instrument are difficult, since the conductor carries from 200 amp to 300 amp and is charged to several thousand volts against earth. All this is of importance for determining the furnace efficiency. Since ordinary electrical measuring instruments give wrong results the author concludes that the figures of efficiency which have been published should be met "with unlimited skepticism" if the data published do not show that the electrical energy has been accurately measured.—*Phys. Zeit.*, Dec. 15.

Units, Measurements and Instruments.

International Value of E.M.F. of the Weston Standard Cell.—E. Warburg.—An official statement of the Reichsanstalt to the effect that beginning with Jan. 1, 1911, the value 1.0183 international volts at 20 deg. C. is to be used by the Reichsanstalt as the e.m.f. of the Weston standard cell made according to the rules of the London International Conference (with an excess of solid cadmium sulphate). Heretofore the value 1.0186 international volts at 20 deg. C. was used in Germany. The difference is, however, less than 0.0003 volt. This is partly due to the fact that the mercurous sulphate of the new standard cells gives a somewhat smaller e.m.f. than that used in the former standard cells of the Reichsanstalt.—*Elek. Zeit.*, Dec. 22.

Cast-Iron Permanent Magnets.—An article on a method developed by a British company for making cast-iron magnets. The iron casting, after being machined to the required dimensions, is heated in a gas furnace until the casting can just be handled without causing distortion. At this point the casting is plunged into a "chemical bath," from which it is transferred to running water which removes superfluous chemicals and leaves the iron clear and suitable for enameling. The only remaining process is to magnetize the casting by means of coils of wire suitably arranged according to the shape of the casting. In regard to the strength of field the cast-iron permanent magnets are inferior to steel to the extent of 10 per cent or 15 per cent, but the retentivity has been proved to be equal to that of the best steel. The magnetic qualities of a good quality of black cast iron treated in this way are given in Fig. 6, which shows the *B-H* curve, and in Fig. 7, which gives the hysteresis loop. The treated magnets can be cast to any shape with fixing lugs and machined before hardening, thus obviating magnet clamps and expensive grinding and boring machinery. The saving in cost by using cast-iron permanent magnets is claimed to be at least 50 per cent even for the most intricate forms.—Lond. *Electrician*, Dec. 23.

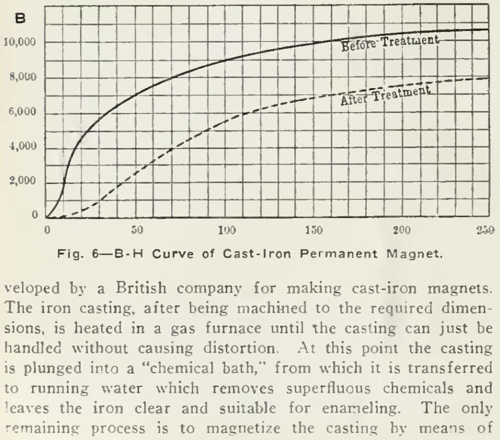


Fig. 6—B-H Curve of Cast-Iron Permanent Magnet.

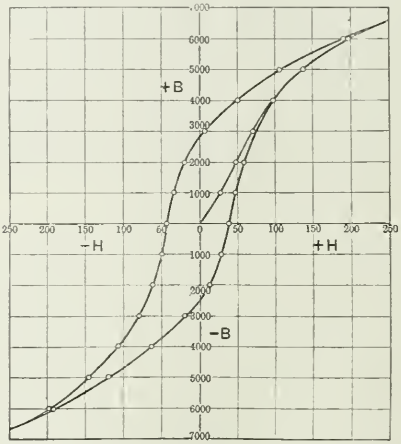


Fig. 7—B-H Loop for Cast-Iron Permanent Magnet.

Testing of Impulse Water-Wheels.—W. R. Eckart.—A note on a paper read before the (British) Institution of Mechanical Engineers which points out the importance of a knowledge of the quantity of water used in generating energy in hydroelectric stations. In this way the exact efficiency of the plant can be determined, and the provision of extensions on the hydraulic side can be undertaken in good time. The reason why this is not done more often is the expense involved and the unreliability of the methods available. The author then describes a Pitot tube apparatus which has been employed for the work and the preliminary work which must be undertaken to fit it for the purpose. As a result of these and other tests he has reached the conclusion that the use of the Pitot tube and a contraction gage for the determination of the discharge from large nozzles is not only practicable but accurate within the limits of experimental work. Moreover, the apparatus is inexpensive and portable. In the discussion which followed H. S. Hele-Shaw said that there ought to be no difficulty in governing by operating the needle by the governor, and this is an easier way than deflecting the nozzle itself. Mark Robinson also pointed out that it would be easy to arrange for a secondary governor which would slowly move the needle after the deflecting nozzle had made any rapid action that might be necessary. G. Broughall thought that owing to the erosive action of high-velocity water a hardened steel nozzle would be better and cheaper than one of bronze. Deflecting the needle was used for governing on account of its rapidity of action. It was probable that to obtain control of the adjustment of the needle would throw heavy strains on the pipe line. P. Pitman pointed out that no hard-and-fast rule could be given for the best width of bucket to employ for a given size of jet. In his opinion nozzles should not be more than 5 in. in diameter, as against the 8.75 in. given by Eckart. The speed can best be controlled in plants where economy of water is not a consideration. The speaker said that he had used deflectors operated by the governor, though this arrangement is not suitable on large plants owing to the high stresses thereby set up. W. R. Eckart pointed out that hoods which have been used on the Pacific Coast have given rise to many pipe-line troubles. For this reason the deflecting nozzle is preferred.—Lond. *Electrician*, Dec. 23.

High-Voltage Battery.—H. Hoerig.—An illustrated description of a high-voltage battery for statical work, especially for use with an electrometer. It is a combination of twenty batteries, each consisting of 121 copper, distilled water, zinc cells. The battery containers are made from paraffine. Great care is taken in the insulation of the conductors and of the switching apparatus. The hard rubber used is covered with paraffine and is protected whenever necessary against light. Detailed descriptions and drawings are given of the mechanical arrangements.—*Phys. Zeit.*, Dec. 15.

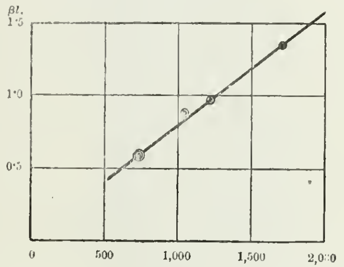


Fig. 8—Test of Cable.

Exhibition of Instruments.—The first part of an illustrated account of the recent annual exhibition of the British Physical Society describing various laboratory and testing instruments, primary batteries, an inclosed form of capillary electrometer, etc. The article is to be continued.—Lond. *Electrician*, Dec. 23.

Alternating-Current Instruments.—R. Ziegenberg.—In a continuation of his long illustrated serial the author deals with various alternating-current instruments operating on the hot-wire principle and gives details of recent improvements taken chiefly from German patent specifications.—*Zeit. f. Beleucht.*, Dec. 20.

Telegraphy, Telephony and Signals.

Long-Distance Telephone Cables.—W. A. J. O'Meara.—In the conclusion of his paper on the new loaded telephone cable between England and France the author describes the laying of the cable. A description is given of some tests of L. B. Turner on the loaded cable made to determine by direct measurement the transmitted and received currents. The high-frequency current used in the tests was supplied from the Central Post Office, London, over a pair of telephone wires. Fig. 8 gives the relation between the mean values for frequency and for βl (where $l^{\beta l}$ = ratio of transmitted and received currents). The length of loop under test, l, was 40 knots. These results are compared with the value of β indirectly obtained by speech tests in the following way: That single frequency which best represents the voice, so far as volume of sound is concerned, is about 800 periods per second. From the diagram it is found for this frequency that $\beta l = 0.63$; that is, $\beta = 0.0158$. Assuming 800 periods per second to be the simple equivalent voice frequency, the value of β per second as found by speech-test comparisons with standard cable is $\beta = 0.0169$. The paper was discussed at length and the discussion is to be continued at a later meeting.—Lond. *Electrician*, Dec. 23.

Transmitters and Receivers for Wireless Telegraphy.—J. A. Fleming.—A note on a recent lecture on improvements in transmitters and receivers. The author referred first to his oscillation valve detector in which use is made of an incandescent lamp containing a metal plate of some convenient form. Owing to the unidirectional conductivity in a bulb when the filament is glowing electricity can flow from the filament to the plate, but not in the reverse direction. Fortunately this property holds equally for high-frequency oscillations, and thus the device can be used as a detector in wireless telegraphy. In the latest form of valve use is made of a tungsten filament instead of a carbon filament. Owing to the form of the curve connecting potential with current in the vacuous space it is possible to increase the sensitiveness very materially by applying to this detector a constant e.m.f. on which the e.m.f. of the oscillations was superimposed. Passing on to the oscillations and methods of producing them the author laid stress upon the fact that the effect varies with the method of production. Thus if the spark gap is subjected to an air blast the secondary current is increased. This is due to the fact that the ordinary spark consists of an arc discharge and a spark discharge superimposed. The former lowers the voltage available for charging the condenser and therefore it is desirable to remove it. This is done by means of the air blast. In order to see just what happens it is necessary to count the sparks produced and a photographic spark counter is used for this purpose. Records reproduced showed that much greater regularity was obtained with the air blast than without it. The author finally described a new form of discharger which he has recently designed. This is of the quenched-spark type, and consists essentially of two steel plates one above the other; the lower one is stationary, and the upper one in rotation. The plates, which are very perfectly surfaced and spaced 0.25 mm (0.01 in.) apart, are immersed in oil, and as there is a small hole in the center of the bottom plate a continuous circulation of the oil takes place when the upper plate is in rotation. This form of spark discharger gives exceedingly uniform results, and it has been used by the lecturer for the purpose of measuring condenser losses.—Lond. *Electrician*, Dec. 23.

Telegraph Receiver.—The telegraph receiver shown in Fig. 9 contains an electromagnet M with excitation windings W. The chamber A includes the poles, and is divided by the membrane E into two compartments. B are coils placed on the pole shoes and through these coils passes the line current in ordinary telegraphy or the local current in wireless telegraphy. The changes in the magnetism of the poles produce vibrations on the membrane. Illuminating gas passes through the chamber A and leaves at the points D_1 and D_2, where small flames are burning. When nothing is transmitted over the line the flames burn quietly, but when some message is transmitted the membrane oscillates and the gas pressure varies in the two compartments of the chamber. This causes differences in the brightness of the two flames indicating the message transmitted. The apparatus may also be used as a relay by permitting the flames to act on selenium cells.—*Elek. Zeit.*, Dec. 8.

Time Signals.—Brenot and P. Jegou.—Two articles on the transmission of time signals by wireless telegraphy, with special reference to the system used on the Eiffel Tower.—*La Lumière Elec.*, Dec. 17.

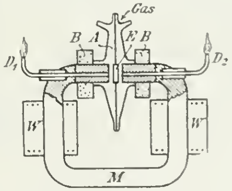


Fig. 9—Telegraph Receiver.

Miscellaneous.

Institute of Technology.—P. Kalisch.—An illustrated description of the new Institute of Technology in Breslau, Germany, giving notes on the electrical laboratory, the chemical laboratory and the metallurgical laboratory. The latter is the most important one on account of the large metallurgical interests of the province of Silesia and is well equipped for electrometallurgical work.—*Elek. Zeit.*, Dec. 22.

Book Review.

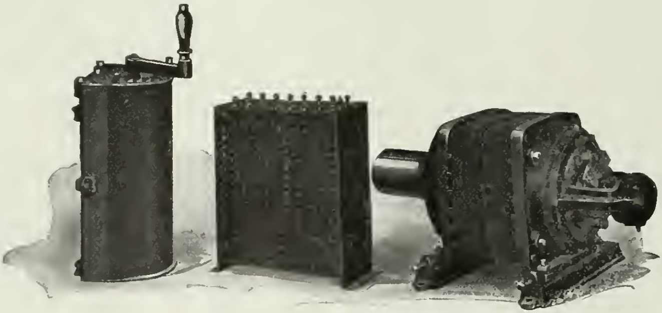
Steam Power-Plant Piping Systems. By William L. Morris, M. E. New York: McGraw-Hill Book Company. 505 pages, 389 illus., Price, $5.

In this work the author urges the leaving of all piping detail to the contractor, the engineer's part being simply to indicate the piping, much as is done with the structural-steel diagram of a building, and to furnish layout of steam users, condensers, etc., and building blue-prints. The idea will certainly be productive of better layouts of piping details and should be adopted by any engineering concern that has not a draftsman familiar with the layout of good pipe work. However, the power-plant engineer should be, in effect, a master pipe-fitter himself if he is to serve his clients to the full extent which they have a right to expect. All large engineering firms handling big power stations have usually a force of excellent pipe draftsmen and an engineer who specializes on this work, but the man who undertakes ordinary industrial power-plant work should be thoroughly familiar with every minute detail of piping layouts. Aside from sound judgment in the selection of boilers, engines, electric equipment and buildings, the bulk of his work will be the connection of these, and his clients have the right to expect this to be done at no such additional expense to themselves as an extra price tacked on the piping contract for detailing pipe work. This book will go far to assist power-plant engineers in getting a sound basis for proper pipe layouts, though, like all books written conscientiously out of the experience of the author alone, it is very limited in the variety of good piping schemes actually discussed. As the author remarks, many will disagree with him and can doubtless present other and better schemes that have come within the ken of their own experience. But in no subject in the whole range of engineering is there such wide difference of opinion and such an amazing extent of argument as over the fascinating problem of how to boil water and put the steam of it into an engine. Possibly the largest and most experienced pipe-fitter in the world is the Standard Oil Company, which uses screwed fittings up to extraordinary sizes in all its power plants and boiler houses and avoids flanged work like a plague. Yet flanged work is designed almost to the exclusion of screwed fittings by a great many power-plant designing firms of the first rank. The same differences of opinion range down through water-tube versus fire-tube boilers, open-feed versus closed-feed water heaters, barometric versus dry vacuum condensers, etc. The engineer can have neither too wide experience nor too extensive reading to be efficient in power-plant design. Mr. Morris' book treats of the piping to and from every detail of the multitudinous apparatus of the power house. With the sole exception of pipe covering, all the connections required to engines, boilers, economizers, pumps, auxiliary engines, condensers, blow-offs, drips, oil apparatus, etc., are described in separate chapters with a profusion of illustrative diagrams. While many will not agree with the author's rejection of well-known details nor approve of his own substitutes therefor, the book sets forth what he has found by his own experience to work well in practice and will be a valuable component in the library of any engineer engaged in power-plant work.

New Apparatus and Appliances

VARIABLE-SPEED POLYPHASE MOTOR.

Illustrated herewith is the new variable-speed polyphase motor, with controller and rheostat, manufactured by the Kimble Electric Company, of Chicago. This motor is exhibited for the first time at the Chicago Electrical Show of Jan. 7-21, 1911. For speed variation the Kimble company employs rheostatic control. In a phase-wound motor the energy from the main circuit is supplied to the stator and current is induced in the rotor. If the rotor current is passed through a rheostat the motor will operate at reduced speed. By cutting out the rheostat, step by step, the speed can be brought up through any desired range. Motors made by this company will operate on any point of the rheostat with equal resistance in each phase of the rotor, resulting in quiet operation, with a minimum of heat in the rotor windings. The general rule is to operate the phases unsymmetrically for the sake of cheapness of construction in the controller. The stator used in the variable-speed motors is the same as is used for the constant-speed induction motor; the difference between the two types is in the rotor, which is a wound rotor and equipped with slip rings.


Polyphase Phase-Wound, Variable-Speed Motor, Rheostat and Controller.

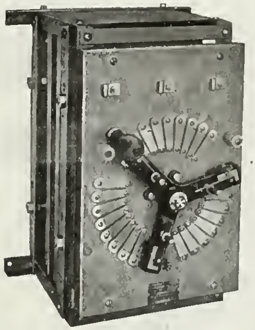
The controllers are of the drum type and are of substantial construction. The core is composed of eight pieces of solid cast bronze mounted on a center shaft to which is attached the controller handle. This method confines any slight arcing to the contact fingers, which can be replaced at low cost. Eight forward speeds and four reverse speeds are provided and the controller permits speed reduction to from 60 per cent to 75 per cent of the maximum.

The amount of resistance used in the rheostat at each controller point determines the speed of the motor at that point for a constant load. If the load is always the same the rheostat can be calculated accurately to give the desired speed range. However, if the load is variable, the speed no longer depends wholly upon the controller setting, but is affected also by variations in the load itself. In other words, a certain amount of load on the motor is necessary to make the control effective. For this reason the proper rheostat to be used depends very much upon the nature of the work to be done by the motor. To meet varied requirements the Kimble company is prepared to adjust the rheostat in a manner to suit each individual case.

The rheostat itself is housed in an iron cage. The resistor is composed of special resistance wire of ample size. There are no soldered joints, one wire being used throughout. There are no grids which may be broken by jarring or temperature changes.

ALTERNATING-CURRENT MOTOR SPEED REGULATORS.

The induction motor was formerly used for service requiring constant speed only, but the wide distribution of alternating current has caused its adoption for service where speed regulation is desired. The slip-ring motor is well adapted for speed regulation, as it is possible to accomplish the desired variation by means of an adjustable resistance in the secondary circuit.



Motor-Speed Regulator.

The Cutler-Hammer Manufacturing Company, of Milwaukee, has recently standardized a line of speed regulators for slip-ring motors. The face-plate type illustrated herewith is made in several styles and types, and in sizes for motors of from 0.25 hp to 50 hp. This apparatus is compact, the resistors being self-contained and connected, when installed, in the secondary circuit. The segments are of hard-drawn copper, readily replaced or interchanged without interference with the connections inside.

The three sets of resistors are delta-connected, so that equal values of resistance are inserted in the three phases of the secondary, thereby insuring a balanced condition. The standard apparatus is designed to reduce the speed by 50 per cent at full-load torque.

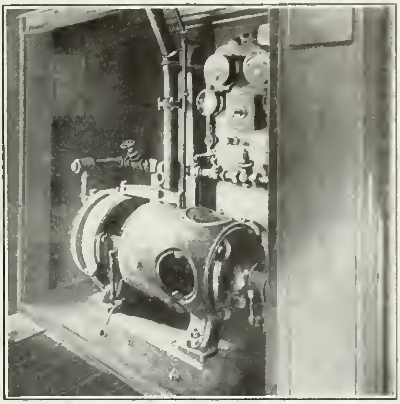
In the small regulators use is made of German silver wire, which insures accurate speed control with no speed variation due to heat, the German silver wire having a zero temperature-resistance coefficient. Non-inductive grid resistors are used with the larger sizes.

CURTIS TURBINES FOR TRAIN LIGHTING.

Curtis turbo-generators are now being installed on a locomotive or in a baggage car to meet the most exacting demands of train-lighting service. These sets, consisting of a Curtis turbine direct-connected to an electric generator, form compact, sturdy units, so simple in construction that they require practically no attention. At the present time, when the railroads are making every effort to insure the greatest degree of safety to their passengers, these sets are meeting with favor, as their use eliminates all danger from fire or explosion due to the leakage of illuminating gas in case of an accident. The superior quality of the light, due to the excellent voltage regulation of the turbine, is a feature to be greatly appreciated by the passengers. Each car is brilliantly illuminated with an absolutely steady light.

This service permits the use of cooking and heating utensils in buffet and dining cars, and of electric toilet articles in drawing-room and sleeping cars. For suburban service no auxiliary equipment is required, and the turbine affords an exceedingly simple and very economical equipment, dispensing with batteries, boosters and regulators.

Over 300 Curtis turbines are now in use on steam railroads, and many roads have adopted this system as a standard equipment for train lighting. There are sixty-seven of these turbines now in service on the Chicago, Burlington & Quincy Railroad, forty-two on the Great Northern, forty-two on the Northern Pacific, forty-three on the Chicago, Milwaukee & St. Paul and a smaller number on a large number of other roads.



Train-Lighting Turbo-Generator.

TUNGSTEN INCANDESCENT LAMP WITH DRAWN-WIRE FILAMENT.

Mr. C. W. Bender, of the National Electric Lamp Association of Cleveland, was present at the meeting of the Electric Club of Chicago on Jan. 4, and in the course of discussion on the subject of "Energy-Saving Devices" he mentioned the new Zokul wire lamp. The name "Zokul" is applied to incandescent electric lamps having a tungsten filament of drawn wire. These filaments are drawn through diamond dies and the lamps containing them are now available in only the 15-watt, 25-watt, 30-watt and 40-watt sizes, designed to burn on 30-volt and 60-volt circuits, principally for train lighting. The 110-volt, 220-volt and series Zokul lamps are not quite ready for the market, although it is expected that they will be in a few months. Experience with these drawn-wire lamps on low-voltage circuits has been very satisfactory, according to Mr Bender. The filaments are about five times as strong as squirted tungsten filaments. They have a life of 1500 hours or more. In the experimental 110-volt lamps of this type it is found that after burning 1500 hours nearly the entire length of the filament is ductile. However, small sections of the filament are found to be still fragile, and when the entire filament is made as strong as nearly all of it is now the commercial Zokul lamp will be ready for the market.

Mr. Bender expressed himself as opposed to low-voltage lamps for commercial or residence lighting. He said this practice involves the additional expense of a transformer, and is not generally to be commended for ordinary lighting situations. He thought that customers who have been using carbon lamps are willing generally to spend about the same money for lighting providing they can get a greater amount of illumination in return for it by the use of the modern lamps. Speaking of the ordinary tungsten, or Mazda, lamps, he said their life has been found to range from 2100 hours to 2000 hours or more. Within three or four months it is hoped that the electric industry will have at its disposal a tungsten lamp with a filament which it will not be possible to break in any ordinary service

INSULATION AND CAPACITY TESTING SET.

The Thompson-Levering Company, Philadelphia, Pa., has recently put on the market a new type of insulation and capacity testing set composed of three units, a galvanometer, test box and tripod. The gavanometer is of the highly sensitive suspension type, with any "sensibility" up to 1600 megohms and any coil resistance from 30 ohms to 2000 ohms. The magnet is of carefully aged and hardened steel, and the instrument is designed to give a deflection proportional to the current throughout the entire scale. The galvanometer system in its entirety is visible through a removable glass window, facilitating balancing of the coil and ease of replacing the upper or lower suspensions when required. During transit the coil is clamped, so that it will withstand severe handling, and is so arranged that when it is set up it can be instantly released. The telescope and scale are insulated from the magnet and are supplied with a leveling screw. The telescope lens system consists of an acromatic objective lens and acromatic Ramsden eye-piece. The objective is corrected for flatness of field and the eye-piece consists of two lenses, acromatic eye and single field, which combination gives the highest results obtainable. The scale is a reproduction of a standard millimeter scale and is well lighted and easily read.

The test box, which is a feature of the apparatus, has a standard condenser, a standard resistor having a resistance of 100,000 ohms, and the Ayrton shunt, complete in the one case, thus doing away with the separate units and the cord connections and master switch. The only leads from the test box are the galvanometer leads, the cable leads and the battery leads. The test box is made of oak and has a hard-rubber top, with high insulation pillars, upon which are mounted the individual units, and it is supplied with removable legs, of round polished rubber rod, 8 in. long, to insulate it from earth when in use. The two switches are the main test switch, with studs marked "Cable" 0.1 megohm and 0.1 mf, and the shunt switch with the values of 1, 0.1, 0.01, 0.001. The standard 0.1 megohm is wound with manganin wire, and is said to be accurate to within 1/25 of 1 per cent. The 0.1-mf standard mica condenser is used in place of the old style 0.3-mf condenser, as it is easier to use and does not give an excessive kick. It is claimed to be accurate to within ¼ of 1 per cent. The Ayrton shunt coils are wound with manganin wire and accurate to 1/25 of 1 per cent.

The insulation and capacity key is situated on the left side of the special short-circuit key and is in convenient position to be operated by the index finger of the tester. This key makes contact on ample silver points and has a charge, insulate and discharge point. The insulation and capacity switch consists of a single-pole, double-throw, finger-type, actuated-rocker switch, with knife-blade spring contacts, and the short-circuit key is constructed so that the right end has a knife-blade contact and the left end a spring contact, made on silver points. The spring is so arranged that the operator, pressing the left side, automatically releases the right-end contact and completes the circuit on the left-hand side, giving the tester the advantage of having on the right hand a permanent short-circuit when desired. When a momentary short-circuit is required the left-hand side can be tapped and the short-circuit tapping of the galvanometer may be made momentarily at the desire of the engineer.

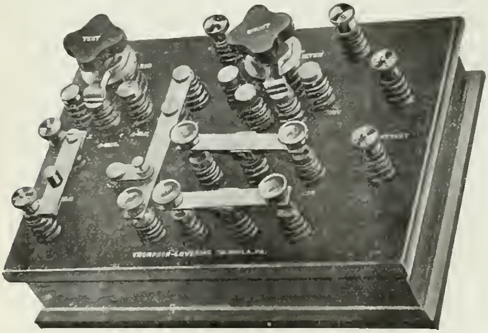


Fig. 1—Test Box of Insulation and Capacity Testing Outfit.

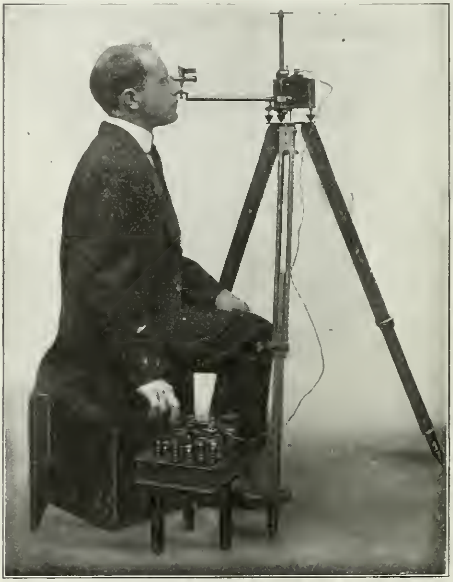


Fig. 2—Insulation and Capacity Testing Outfit Arranged for Field Work.

Large and substantial cable posts are provided with switch attached, so that the cable can be quickly short-circuited by closing the switch across the posts. The binding posts are all of the knurled-head clamp type.

The insulation throughout the entire set is of the corrugated pillar form, as shown, and is continued below the under side of the rubber plate. The set, consisting of the galvanometer and test box, is placed in an oak case, which is provided with a heavy carrying strap and is of convenient form to be carried in one hand, allowing the tester to carry the tripod in the other. The height of the box is such that when the galvanometer is set on the tripod and adjusted for field work the testman, sitting on the case, finds the different units in proportion, so that he may make his tests conveniently and rapidly.

TELEPHONE DISPATCHING SYSTEM.

Ninety-nine miles of the Illinois Central Railroad between Paducah and Central City have lately been equipped with telephone circuits for handling train orders. Already the telegraph has been supplanted for dispatching trains on more than 2000 miles of this road. On the new circuit sixteen way-station subscriber sets have been installed in addition to twenty-one regular telephone stations. These way stations are placed along the line in booths or buildings located at sidings or points where it is not necessary to station regular operators. Some of these stations were previously used as block telegraph offices. These sets, which are somewhat similar in appearance to the standard magneto telephone set, are for use in connection with hand sets equipped with plugs and cords. Each subscriber's set is equipped with a jack to enable connection to be made by means of a hand telephone. The hand sets are numbered and one is furnished to each freight train conductor when his train is ready to start out on a run. A receipt is taken from the conductor when the set is delivered and the set is turned in when the conductor completes his run. To get into communication with the dispatcher the conductor goes into the booth, or station, throws a switch which connects the telephone to the line and inserts the plug into the jack, thereby placing his receiver across the line. To speak to the dispatcher it is necessary to press a button on the hand set which closes the transmitter circuit. Owing to the simple method of operation and the fact that the hand sets are always turned over to the conductors in good condition, there is very little possibility of the equipments not being in good operating condition at all times This constitutes an effective method of keeping in touch with freight trains at all points along the road. The telephone apparatus was furnished by the Western Electric Company.

EXHIBITS AT THE CHICAGO ELECTRICAL SHOW.

THE general features of the Chicago Electrical Show, which opened on Jan. 7 in the Coliseum and will close on Jan. 21, are described elsewhere in this issue. That article includes accounts of the operating and purely educational exhibits, the illumination and general arrangement. Herewith are presented brief accounts of the various exhibits of manufacturers and dealers. All told, there are over 100 exhibits. Many new things are shown, and an effort has been made in the following list to call especial attention to the novelties. As it is impracticable to classify the exhibits under group headings, owing to their great variety and the fact that many of the exhibitors have more than one class of goods, the descriptive notes are arranged alphabetically by the name of the exhibitor, as follows:

Addressograph Company, Chicago, has an exhibit of card-index addressing machines by which advertising matter, etc., may be addressed. All the machines shown are motor-driven. Messrs. W. K. Page, C. D. Worthington, D. W. Hall and C. T. Shart represent the company

Allis-Chalmers Company, Milwaukee, has an instructive exhibit of machinery and transformers near the main entrance. The display includes one centrifugal pump and three lighting transformers for 2200 volts primary, rated respectively at 7½ kw, 10 kw and 20 kw. There are also a 5-hp, 220-volt, three-phase, 60-cycle, 1150-r.p.m. induction motor and a 5-hp direct-current motor designed for 1050 r.p.m. In addition there are three electrically driven air compressors. One is driven by a three-phase, 60-cycle, 220-volt alternating-current motor; one is a portable machine with hose and nozzle for inflating automobile tires, and the third is a stationary air-compressor outfit. The last named is shown in operation connected to hollow flagstaffs, to which are attached small silken flags. By means of an electrically operated valve and an extra contact on the governor of the air compressor air is intermittently applied to the flags through perforations in the flagstaffs. The arrangement of this spectacular feature is such that the air from the tank connected to the compressor blows the flags in a horizontal position when the compressor is not operating. As soon as the air pressure is reduced to a predetermined point the governor automatically throws the air-compressor motor in circuit and at the same time cuts off the air from the flags. The compressor is then operated until the air in the tank is increased to the proper pressure, at which point the governor throws out the compressor and again applies the air to the flags. This makes a novel and interesting effect. Messrs. S. R. Kerr, A D. Waring, J. W. Gardner, C. M. Howe, A. W. Burns, James Ashworth, W. M Miller and C Jurgens represent the company.

American Ironing Machine Company, Chicago, has a 48-in. Simplex ironer, motor-driven and designed for large residence work: a 37-in. machine, not only motor-driven but electrically heated, intended for medium-sized homes, and a 24-in. Simplex Junior, electrically heated, designed for small families. In addition, a combination skirt board for fancy ironing, arranged to be used with electric flatirons, is exhibited. The machines are shown in operation by Mr. G. A Renner and Mrs. Currie.

American Ozone Company, Niagara Falls, N. Y., exhibits Ozosure water sterilizers and clarifying filters. Sterilization is effected by ozone, and the apparatus may be attached to any lighting circuit. Treated water is delivered by simply opening a faucet and is said to be free from all harmful germs. The filters are designed for use with the sterilizers when muddy water is to be treated. Messrs. E. C. Spurge and J. F. Butler represent the company

American School of Correspondence, Chicago, shows electrical and other educational publications which it produces. Mr. M. L. Brantingham represents it.

American Steel & Wire Company, Chicago, has a prominent display of bare and insulated wires and cables in various forms, both copper and steel wire being shown. The exhibit includes copper wire from No. 40 magnet wire (the size of a hair) up to an armored submarine cable. Wire rope and rail bonds are also shown in great variety. Mr. B. H. Ryder, of the electrical department of the company, is in charge of the exhibit.

American Telegraph Typewriter Company, New York, exhibits a new telegraph typewriter invented by Dr. George A. Cardwell. The machine is used to send messages for a distance over telegraph or telephone wires and to print them on typewriters, both at the sending and receiving stations, thus dispensing with the services of a trained telegraph operator At the Coliseum the messages are sent and received from the exhibit to the Rector Building downtown, using the connection furnished by the Chicago Telephone Company Mr. H A. Babb represents the company.

Anderson Carriage Company, Detroit, shows its new direct-shaft-drive Detroit electric automobile. These handsome pleasure vehicles are equipped with a new type of control lever which greatly facilitates their operation. Messrs Price, Walsh, Reed and Wagner represent the company

Apex Appliance Company, Chicago, displays an electric washing machine for laundry purposes as well as washing machines operated by hand. The Apex washer has an oscillating motion and is driven by a 1/8-hp motor. The wringer is operated from the same shaft, and the machine is made entirely of metal. Messrs. C. W. Swanson, Edwin Golbeck and Charles Ericson represent the company.

G. W. Armstrong Company, Chicago, exhibits the various specialties which it handles, including its absolute-cut-out arc-lamp hanger, the Green Seal dry batteries, flashlights and electrical novelties, Dossert solderless connectors and Kuhlman transformers. Messrs. G. W. Armstrong, H. Caird, R. L. Thayer and R. K. Fast represent the company.

Artcraft Institute (Domestic Science Department), Chicago, has an attractive display of various electric appliances for household use, of which practical demonstration is given. This booth also constitutes a rest-room provided for members of the Chicago Women's Club. Mrs. T. V. Morse, Mr. C. J Morse, Mr. V. A. House, Mrs. B. M. Steere and Miss Glenna Lynch are in charge

Automatic Enunciator Company, Chicago, displays its loud-speaking telephonic enunciators designed for "paging" in hotels and clubs and also for use in railroad stations, announcing the names of streets in street cars, etc. Six horns are shown, each containing a "reproducer" by which the announcement is made. It is said that 30,000 reproducers can be connected to one transmitter. Messrs. Herman Kiper, Louis Cole, F. B. Ijams and P. P. Hinckley represent the company.

Babcock Electric Carriage Company, Buffalo, displays two of its pleasure vehicles. One is a coupé equipped with a thirty-six-cell lead battery or a fifty-cell Edison battery. The other is a roadster with forty-two cells of lead battery, each having fifteen plates, and it is said that it can be easily driven 100 miles on one charge. The vehicle may also be equipped with sixty cells of Edison battery. It is recommended as a delivery wagon for central-station companies. Mr. J. T. Fisher represents the company.

Birtman Electric Company, Chicago, displays new suction cleaners, pedestal vibrators and hair driers, portable vibrators and hair driers, and Radio or beauty lamps. All these devices are known as Bee products, and all are equipped with universal motors made by the Birtman company, which is represented by Messrs. A H. Apfel, F. A. English, A. J. Sanders and H. R. Butz.

Fig. 1—Exhibit of North Shore Electric Company.

Bissel Motor Company, Toledo, attracts the attention of the housewives as well as of electrical men by its exhibit of electric sewing-machine motors, both the household and manufacturing types being shown. The new industrial sewing-machine motor is shown partially cut away to reveal its mechanism. Messrs. E. J. Fisher and Frank Fisher represent the company.

Cadillac Electric Manufacturing Company, Cadillac, Mich., exhibits its Cadillac combination electric stove and toaster. The demonstration here consists of popping corn and the product is given away to eager bystanders. Mr. H. D Payne represents the company.

Chicago Electric Meter Company, Chicago, exhibits three types of printing attachments for watt-hour meters in actual service. One is the new portable attachment, demonstrated for the first time. Messrs. H. S. Sines, C. I. Hall and C. C. Lovejoy represent the company.

Chicago Fuse Manufacturing Company, Chicago, exhibits conduit outlet boxes, sectional switch boxes, inclosed fuses, inclosed fuse blocks, fuse wire and fuse links. These goods are all sold under the name Union. Messrs. W. W. Merrill, Arthur S. Merrill, C. T. McDonald, G. E. Harland, Felix Trautman, Walter D. Dana, George C. Reid and Joseph Pearson represent the company

Chicago Pneumatic Tool Company, Chicago, has on exhibition an extensive line of portable electric drills, grinders, hoists, pneumatic hammers and pneumatic drills. Messrs. C. B. Coates, Charles H. Schumacher, E. Aplin, A. M. Andresen, Paul Jahn, A. E. Conrow and P. H. Gilliland represent the company.

Crane Company, Chicago, exhibits various steam fittings and accessories, as gate valves, emergency valves, steam traps, pipe joints and the like. One cast-steel gate valve is motor operated with near and remote control, and there is an emergency valve with electric release. Another operating feature of the exhibit is composed of Cranetilt steam traps, demonstrating an economical method of handling condensation under all conditions. Messrs. F. C. Sabin and J. A. Minwegan represent the company.

Cutler-Hammer Manufacturing Company, Milwaukee, restricts its conspicuous exhibit to a complete line of electric heating appliances. In addition to electric irons, stoves, curling-iron heaters, radiators, chafing dishes, coffee percolators, tea kettles, etc., there is displayed for the first time the new adjustable-disk stove, wherein the heat can be regulated to any degree desired. A prominent feature of the exhibit is the line of "instantaneous" water heaters with carbon units, by which a continuous flow of hot water can be obtained in from fifteen to twenty seconds after electricity is turned on. These heaters are designed for bath, lavatory, bar, therapeutic and kitchen attachments. Portable instantaneous water heaters are also shown. Mr. George B. Katzenstein is in charge of the exhibit.

Dayton Electromobile Company, Dayton, Ohio, exhibits the Dayton electric automobile through the Centaur Motor Company. The vehicle is equipped with either handle or wheel-steering gear, and with either chain or safety drive. Exide or Edison batteries are used, and solid or pneumatic tires are optional. Messrs. A. M. Robbins, Harry B. Wood and J. Owen Lee represent the company.

J. R. Deane & Company, Chicago, exhibits electric motors, motor starters and speed regulators. A 7½-hp interpole motor and a new oscillating fan made by the Peerless Electric Company, of Warren, Ohio, are shown, as well as direct-current motor starters, a field rheostat, speed regulators and single-phase and three-phase motor starters made by the Independent Electric Manufacturing Company, of Milwaukee. The apparatus shown is all recent, for the Independent company is a comparatively new one and the Peerless interpole and oscillating-fan motors are of late design. The exhibits are in charge of Messrs. James R. Deane, F. L. Merrill, J. B. Estabrook and William H. Gaulke.

Domestic Equipment Company, Chicago, displays its Domestic electric washing and wringing machine, as well as an Oscillator hand-driven washer. The tub of the electrically driven machine is springless and is equipped with positive drive. No wood is used in the tub, and the wringer is quickly reversible and easily controlled. Messrs. David J. Kennedy, Richard J. Killick, S. M. St. Clair and Miss E. Howard represent the company.

Driver-Harris Wire Company, Harrison, N. J., exhibits resistance alloys in the form of round and flat wires. Nichrome is shown glowing at working temperature in the open air to demonstrate its non-oxidizable properties and usefulness for all types of heater work. The resistance of this alloy is said to be sixty times that of copper, and it is asserted that it can be worked unprotected at temperatures ranging up to 1800 deg. Fahr. Climax, a nickel-steel alloy; Advance, a copper-nickel alloy, and Monel metal are also shown. Messrs. Elwood Duble, Jr., and Harry G. Harrington represent the company.

Duntley Manufacturing Company, Chicago, has a handsomely decorated booth and exhibits vacuum cleaners, air washers and air purifiers, as well as a new automatic printing-press feeder. Messrs. W. W. Bishop, H. D. Payne and A. R. Nelson represent the company.

Edison Storage Battery Company, Orange, N. J., shows Edison storage batteries and appliances to be used therewith. There are batteries for supplying energy to electric trucks and pleasure vehicles, as well as for the electric lighting of gasoline automobiles and the igniters for gas engines. Also there are batteries intended for isolated residence lighting, for table lighting in restaurants and for train lighting and signal work as well as for use in "wireless" service. Messrs. W. W. Wheatly, Lucien Wheatly, E. V. Titus, H. G. Thompson and C. B. Frayer represent the company.

Electric Storage Battery Company, Philadelphia, has on exhibition a comprehensive display of storage batteries and accessories, including the Chloride accumulator for use in all classes of service. A feature is a farm-lighting plant, including a dynamo, battery and switchboard. For the first time, also, the company's new Ironclad Exide plate for electric vehicle use is exhibited. Messrs. Godfrey H. Atkin, T. Milton, T. A. Cressey, R. I. Baird, P. G. Downton, J. Rosholt and H. M. Beck represent the company.

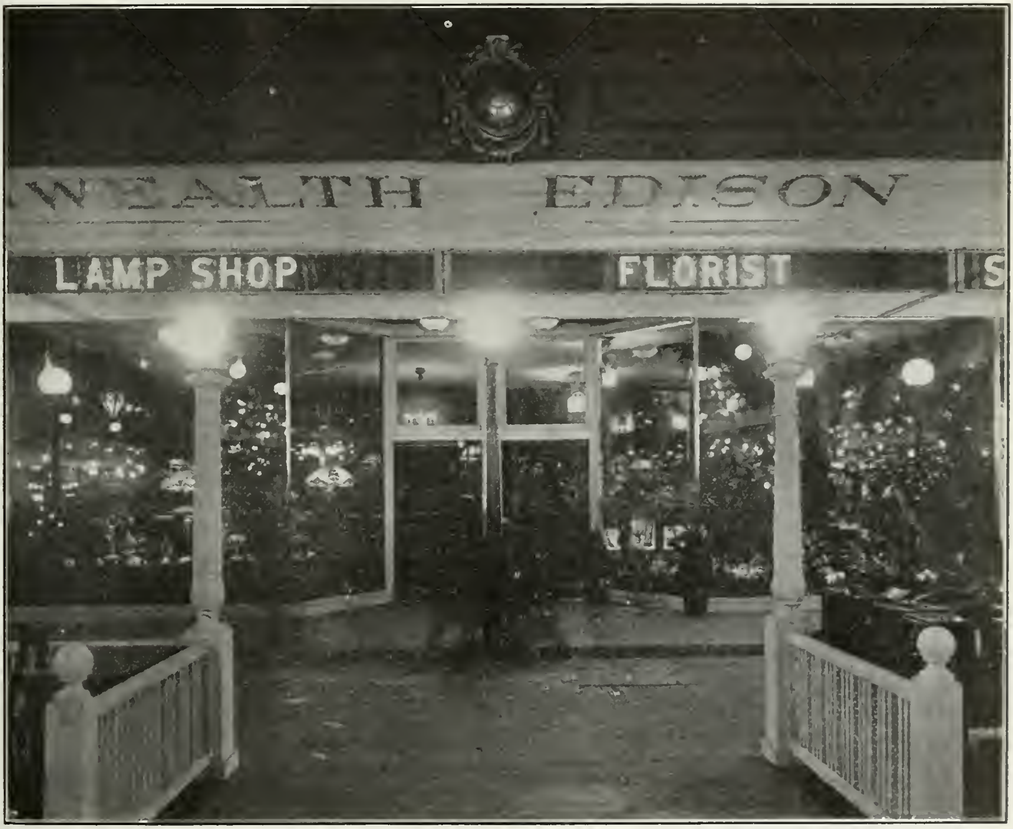


Fig. 2—View Showing Two Stores on "Commonwealth Avenue."

Electrical Testing Laboratories, New York, which have had educational exhibits at the show for several seasons, this year demonstrate some of their methods of testing paper, embracing chemical and mechanical examinations, and tests for determining the suitability of all classes of paper for various uses. Devices are shown for testing the tensile strength, bursting strength, thickness and folding endurance of paper. In addition lantern projections of paper fibers as viewed under the microscope were shown, together with methods of preparing samples for the various tests The exhibit is of special interest to electrical men and others interested in the purchase of paper on an economical and scientific basis.

Electrical World, New York, has a larger and more centrally located booth than in previous years. Samples of the *Electrical World* and electrical books are shown. Messrs. H. T. Matthew, O. H. Caldwell, R. B. Withrow, J. R. Cravath and W. E. Keily represent the paper.

Empire Vacuum Company, New York, shows Imperial and Gem vacuum cleaners. The former, equipped with a ⅕-hp motor, weighs 48 lb., and is intended for use in large residences, hotels, churches, etc. The Gem has a 1/6-hp motor, weighs 35 lb., and is designed for use in small houses and apartments. To prove that these vacuum cleaners hold all the dust, the company uses soda upon the rug for demonstration purposes. A length of hose runs from the exhaust side of the machine to a jar filled with vinegar. If any of the soda taken into the machine came out of it and went into the vinegar there would instantly be effervescence, and the absence of this is pointed to as a proof that the machine contains all the dust sucked into it. Messrs. C. Q. Adams and P. J. Whiteside represent the company.

C. G. Everson & Company, Chicago, display some handsome novelty portable lamps as well as their usual line of water-filtering apparatus. Messrs. R. B. Everson and Paul Trotter represent the company.

Excello Arc Lamp Company, New York, makes an exhibit of its flaming-arc lamps in the space of G. W. Armstrong Company. A feature is the long-burning lamp, never shown before at an exposition. Mr G. W Armstrong is in charge.

Farrington Auto Company, Chicago, exhibits a Columbus electric coupé and a chassis. Mr. W. H. Farrington is in charge.

Federal Electric Company, Chicago, has a varied exhibit of its products, including standard electric signs, the Willis direct-reading watt-hour meters, Federal ozone machines, kitchen cabinets, Dimalite sockets, insulating joints and fixtures. Messrs. John F. Gilchrist, J. M. Gilchrist, J. H. Goehst, L. G. Shepard, F. G. Willing and Paul Judson represent the company.

Flexlume Sign Company, Buffalo, N. Y., shows its prismatic day-and-night signs and various styles of lettering. The original designs and color changes shown are features of this exhibit. Messrs. W. R. Wiley and D. F. Wiley represent the company.

Fort Wayne Electric Works, Fort Wayne, Ind., has an interesting assortment of small motors, meters, transformers, fan motors, etc. An electric motor-driven rock drill is shown, as well as vertical motors and buffers and grinding motors. Messrs. A. L. Pond, A. J. Francis, A. E. Stevens and G. B. Fairbanks represent the company.

Fig. 3—A Corner View, Showing Ceiling Decorations.

General Electric Company, Schenectady, N. Y., has a large and varied exhibit, as usual. Arc lamps of various kinds, including vertical-feed flaming-arc lamps, as well as intensified arcs and luminous magnetic arcs, are shown. There is also an extensive display of Mazda and other incandescent lamps, and an extensive line of electrically heated household appliances, such as coffee percolators, chafing dishes, etc. One section is devoted to house, store, factory and street lighting, and a moving-picture rectifier connected to a lens spotlight for theatrical purposes is shown in operation. A distinct feature is an automobile lighting equipment, consisting of an especially constructed dashboard with head, side and tail lamps. The lamps have an attachment which enables them to be used interchangeably either on electric machines or gas cars equipped with storage battery. The new C. V. C. motors are shown, as well as a complete line of small motors and fans for household use. Messrs. J. D. A. Cross, W H. Colman, Frank H. Gale, N. R. Birge, F. G. Vaughen and others represent the company.

Hamler-Eddy Smoke Recorder Company, Chicago, has a much larger exhibit of its interesting instruments than last year. Four of the automatic smoke recorders are shown, and one is connected to the Coliseum chimney and records the smoke produced. Mr. R. L. Eddy, the inventor of this instrument, is in charge of the exhibit.

Hoskins Manufacturing Company, Detroit, displays a variety of electrical furnaces. One, of the muffle type, is designed for hardening high-speed steel parts at temperatures reaching 2500 deg. Fahr. Another furnace is of the crucible type for high-melting-point alloys, and in this temperatures as high as 3600 deg. Fahr. may be attained. Small muffle furnaces for treating carbon steels are also shown, as well as pyrometers reading up to 2500 deg. Fahr. and a line of electric soldering irons and toast stoves. All furnaces are shown in operation. A conspicuous feature of the exhibit is a switchboard arranged to show a flash test of nickel-chromium wire. Messrs. H. R. Badger, A. G. Melcher, W. V. Young and Mr. Busse represent the company.

Houston Manufacturing Company, Rockford, Ill., exhibits stationary vacuum cleaners, which are shown in two sizes. Mr. F. K. Houston and others represent the company.

Hughes Electric Heating Company, Chicago, makes a display of electric ranges and "hot plates" in various styles and sizes. New appliances exhibited for the first time are the electric kitchen range No. 40, which has four "burners" and a baking oven, 18 in. x 18 in. x 12 in. in inside dimensions; also one-burner, two-burner and three-burner hot plates, corresponding in design and appearance to the ordinary gas hot plates. Mr George A. Hughes and others represent the company.

Hurley Machine Company, Chicago, displays its Thor electric laundry machines for the home. In addition to its regular line, the company shows one of its models made in white metal and enamel. This machine is connected with hot and cold water, and also to drain pipes. It is now exhibited for the first time. Messrs. Neil C. Hurley, W. J. Conlon, W J. Haynie, J. E. Erickson, S. N. Cotterman, F. B. Widger, E J. Riedy and W. A. Murfey represent the company.

Ideal Electric Company, Chicago, is one of the automobile exhibitors. It shows a four-passenger electric brougham. This handsome vehicle has Exide batteries and Westinghouse motor and controller. Edison batteries may be used without any change of chassis or body. Messrs. Bruce Borland, U. B. Grannis and C. J. Holdrege represent the company.

Illinois Appliance Company, Chicago, exhibits its adaptable lamp changer, the Waage electric soldering tool and the Bendyke electric vibrator. All three of these devices are demonstrated by Messrs. H. H. Woods, J. G. White and others, who represent the company.

International Correspondence Schools, Scranton, Pa., exhibit their educational publications, with special reference to the electrical engineering courses. The teaching of languages by the phonographic method is demonstrated. Messrs. C. C. Marson, D. D. Meahan, C. E. Freelove, W. M. George, Fay Crabs and C. M. Gott represent the company.

Janette Manufacturing Company, Chicago, shows electrically driven air compressors for use in saloon bars and also in garages. Automatic pressure regulators are also a feature of the exhibit. Messrs. I. H. Silverstone and John T. Janette represent the company.

Judd Laundry Machine Company, Chicago, displays electric washing machines of the oscillating type and wringers. Three machines are shown, and they are demonstrated by Messrs. H. D. Judd, W. E. Starr and others.

Keller Manufacturing Company, Philadelphia, exhibits its Keller-Duplex vacuum cleaner for permanent installation and the Keller-Santo vacuum cleaner for household use. The company says of the former that it is the only stationary vacuum cleaner approved by the underwriters for operation on ordinary lighting circuits. Messrs. Thiele, Hazard, Nyberg, North, Ballou and Scott represent the company.

Kimble Electric Company, Chicago, displays single-phase variable-speed alternating-current motors, operating job-printing press and ventilating fans and blowers. An interesting feature of the exhibit is the line of polyphase motors from ¼ hp to 7½ hp, both constant speed and variable speed, the latter being shown for the first time. These motors are phase-wound and of the slip-ring type, equipped with a drum type of controller, permitting of eight forward speeds and four reverse speeds. Messrs. J. K. Bass, Austin Kimble, R. P. Warner, G. L. Holzheimer, H. A. Seaton, R. O. Gilburg and Ray High represent the company

Kinetic Engineering Company, Philadelphia, exhibits an electrically driven organ blower. The Kinetic blower is composed of several fans mounted on a shaft contained in a windtight box and direct-connected to an electric motor. The rotation of these fans develops air pressures, and these pressures are added together step by step until the final pressure is sufficient to operate the organ. Messrs. J. G. Bierck, E. N. Johnson and W. W. Ricker represent the company.

A. W. Kratz, Chicago, displays his electrically driven washing machines. Two sizes of the "1900" machines are exhibited and also the new "Kratz Electric" washer, which is a rotary machine. Messrs. A. W. Kratz and Fred J. Kratz are in charge of the exhibit.

Macbeth-Evans Gas Company, Pittsburgh, has a handsome and conspicuous exhibit, larger than that of last year, which also attracted much attention. For the first time the company shows tungsten "arcs" incased in complete spheres made in two parts of the special Alba glass. These globes are made in standard sizes, and they are used for all of the tungsten lamps mounted on posts throughout the Coliseum. The pergola over the booth is supported by columns made of the white Alba glass in cylindrical form and illuminated from within, giving a fine effect. A new feature of the exhibit is an Alba shade designed specially as a reflector for 500-watt tungsten lamps. The special Iridile luster glass is also shown for the first time and there is a general line of electrical glassware. Messrs. F. K. Pinckney, A. Jampolis, A. W. Boulton, W. G. Banning and W. Williams represent the company.

Machado & Roller, New York, are making an exhibit of Roller-Smith instruments and circuit-breakers, as well as H. & B. resonance-type frequency meters and Columbia watt-hour meters, including new shunted-type direct-current watt-hour meters and single-phase and polyphase induction-type alternating-current meters. Messrs. Harry I. Shire and W H. Sinks represent the company.

Mailometer Company, Detroit, Mich., shows an envelope sealer and stamper which, it is said, may be operated by an office boy to seal, stamp and count 150 letters a minute. Mr. E. B. Terry and J. S. Brown represent the company.

Manhattan Electrical Supply Company, Chicago, shows a varied line of electrical supplies and specialties—in fact, a sort of miniature supply store. Electric heating appliances and "wireless" material are conspicuous. Messrs. Clarke Methot and Albert Holland represent the company.

McCrum-Howell Company, Chicago, devotes its booth to the Richmond vacuum-cleaning machine, both of the stationary and portable types. Two sizes of the stationary machines are shown in operation, one of 1 hp, the other of 2 hp. The portable machine is also demonstrated, this machine having a suction fan, whereas the stationary machines are provided with pumps. The booth is artistically decorated to suggest a home interior, as the setting for the machines,. and the exhibit is a conspicuous one. Mr. F. C. Allen represents the company.

Millar Electric Company, Chicago, shows electric heating devices, including toasters and flatirons. The heating units used are of original design and the toaster is quite different from other types. The heating unit is placed horizontally between two triangular uprights. The lower part is wound to deliver a greater volume of heat than the upper part, .and the two parts are adjusted so to secure an evenly toasted piece of bread. Messrs. R. M. Millar, Francis Granger and R. L. Tobin represent the company.

Minerallac Electric Company, Chicago, exhibits samples of Minerallac insulating compound. A conspicuous feature in the booth of this company is a break-down test on a "pancake" of Minerallac subjected to a potential of 40,000 volts The company also exhibits cable clips, bushings and other specialties of particular interest to central-station men. Messrs H. S. Sines, C. I. Hall and C. C. Lovejoy represent the company.

National Carbon Company, Cleveland, has an educational exhibit showing the wide variety of carbon products These include dry cells for all general work, Columbia batteries for telephones, igniters for motor-boat and engine ignition, wet and closed-circuit batteries for signal work, flashlights, arc-lamp carbons, electrodes of various sizes and shapes, brushes for generators and motors, and various specialties. Messrs. R. A Crider, L. F. Stowe, E. H. King and E. E. Turner represent the company.

National Electric Lamp Association, Cleveland (Engineering Department), has, as usual, a large and instructive exhibit of incandescent lamps. The features may be itemized as follows: (1) A display of Mazda train-lighting lamps; (2) the Holophane tree, a large statuary bronze fixture about 9 ft. high, upon which are shown burning different sizes of Mazda-Holophane units with satin-finish reflectors. (3) a glass-inclosed metal display rack showing about forty of the different types of Mazda miniature lamps; (4) a small "peek-a-boo" case in which the relative color values of the carbon and Mazda lamps are compared; (5) large 500-watt Mazda lamps with reflector sockets; (6) the new multiple clusters using Mazda lamps and metal porcelain-finish reflectors In addition the regular line of 110-volt and 220-volt tungsten and tantalum lamps is exhibited on attractive display racks A miniature photometer shows relative amounts of light received from a carbon lamp and from a Mazda lamp of the same wattage, giving a rough idea of the apparatus used in lamp photometery. There is also an arrangement of mirrors within the box-like frame which surrounds a Mazda-Holophane unit, showing the general method of obtaining distribution curves on the different lighting units. Messrs. J. R. Crouse, S. E. Doane, G. C. Webster, C. W. Bender, N. H Boynton, W. W. Dodd, Ralph Beman, C. P. Soderberg and H. J. Raymond represent the company.

Henry Newgard & Company, Chicago, in addition to being electrical contractors, are manufacturers of switchboards and their exhibit consists of an interesting display of high-grade panel boards, steel cut-out cabinets and other electrical specialties of their own manufacture. Armature winding is exemplified also. Messrs. Henry Newgard, Martin Newgard, Chester Johnson, Fred Smith and H. B. Harvey represent the company.

Nuway Service & Sales Company, Chicago, shows its portable electric suction cleaner. The machine includes a centrifugal fan direct-connected to a universal motor. It is incased in a mahogany box 4½ in. square. The company also exhibits the Atwood vacuum cleaners, manufactured in Rockford, Ill. It is represented by Messrs. A. W. Nohe, I. A. Nohe, W. M. Stewart, C. A. Stewart, T C. Phillips, S B Atwood and James Atwood.

Ohio Electric Car Company, Toledo, has an electric automobile exhibit in charge of Mr. Irving O. Slater

Pelouze Electric Heater Company, Chicago, exhibits for the first time its new Pelouze toaster-stove and griddle, also electric flatirons, disk stoves, chafing wishes, percolators, water cups, tea kettles, broilers, fry pans, etc. Messrs. William Nelson Pelouze, A. A. Guardia and Clark Ross represent the company.

Perfection Vacuum Cleaner Company, Chicago, shows vacuum cleaners both of the installed and portable types. The installed machines are intended for residences, apartment buildings and office buildings, while the portable cleaners are more applicable for hotels and office buildings where there is elevator service. Messrs. Harvey Wallace, O. F. Becker, C J Becker and J. L. Wallace represent the company

Periodicals.—In addition to the *Electrical World, Electric City, Electrical Record, Electrical Review and Western Electrician, Electrocraft* and *Popular Electricity* are exhibitors

Philadelphia Storage Battery Company, Philadelphia, exhibits batteries for commercial and pleasure automobiles, as well as sparking and lighting batteries for gasoline cars and batteries for electric launches. Mr. Carl Klemp represents the company.

Rider-Ericsson Engine Company, New York, exhibits its Reeco electric house pump. This is a new departure in electric pumps, as the outfit may be used either for short suction or deep-well pumping. Where the level of the water is more than 25 ft. below the top of the ground, the deep-well head is substituted for the pump supplied for low heads and a brass deep-well cylinder is lowered in the well. The motor, mounted on a frame, is arranged to drive either type. Mr. H. B. Houghtaling represents the company.

Rosenfield Manufacturing Company, New York, shows the Magic electric suction cleaner. The principal feature of this machine is that it weighs but 10 lb. and runs on wheels. This is a simple cleaner, said to consume only 100 watts, but to do satisfactory work for the purposes for which it is recommended. Mr. W. W. Rosenfield represents the company.

Sefton Manufacturing Company, Chicago, exhibits corrugated paper shipping cases and folding cartons for packing incandescent lamps. The company displays for the first time its automatic standard wrapper. Messrs. W. H. Fairchild and R. E. Ferguson represent the company.

Simplex Electric Heating Company, Cambridge, Mass., has an entirely new demonstration this year, consisting of the baking of bread in quantities by electricity. The baking is done by H. H. Kohlsaat & Company and the bread baked is donated to the United Charities of Chicago by the Simplex Company, Kohlsaat & Company and the Commonwealth Edison Company. The operation attracts a great deal of attention. The type of oven used is adaptable for hotel, bakery or restaurant use. Beside this prominent feature there are numerous electric cooking appliances, such as broilers, toasters, etc., especially adapted for hotel and restaurant use. A general line of electric heating and cooking appliances, including flatirons, dining-room sets, heating pads, etc., completes the exhibit. Messrs. H. R. Hixson, H. F. Holland, W. F. Hruby, J. N Macalister, H. B. Fyfe and E. R. Jacobs represent the company.

Stamping Washer Works, Chicago. show the Home Queen stamping washing machines, which are electrically driven. Two sets of pedals are used, stamping on a floating board which carries the clothes and is sustained by springs and the buoyancy of the water. Half of the pedals rise as the others fall, giving the stamping effect. Messrs. M. D. Coffin and M. J. Martin represent the company.

Stolz Electrophone Company, Chicago, demonstrates telephonic hearing devices intended for the use of persons partially deaf. Mr. Charles Viggers is in charge of the booth.

Studebaker Automobile Company, South Bend, Ind., has a conspicuous and centrally located display of electric vehicles. There are two pleasure cars, a victoria and a coupé, a delivery wagon and a platform truck. The last named is of the type used by Gimbel Brothers, of New York. Messrs. Curtis, Kelley, Westerdale, Hooper, Levy, Keith, Cobb and Daniels represent the company.

Swedish-American Telephone Company, Chicago, has a complete line of magneto telephone apparatus. A feature is a new combination electric clock and telephone that requires no master clock or controlling devices at the central office. The Radio telephone holder is also conspicuously displayed. Messrs. E. B. Overshiner, A. V. Overshiner, W. E. McCormick and Fred Seeley represent the company.

The Electric Company, Chicago, displays its electrically operated piano played in a sound-proof booth. Mr. G. A. Pond represents the company.

Ralph Temple Automobile Company, Chicago, exhibits Baker shaft drive electric cars. The display includes a chassis equipped with the shaft drive, a car "in the white," showing the woods employed, and two de luxe coupés, one upholstered in whipcord and the other in leather. Messrs. Robert S. Givins and J. M. Bush represent the company.

Thordarson Electric Manufacturing Company, Chicago, has an interesting exhibit of bell-ringing transformers, spark coils, high-potential transformers and laboratory apparatus. The showing is one which is of interest both to the electrical man and the layman. Messrs. C. H. Thordarson and A. R. Johnson represent the company.

Toledo Electric Welder Company, Cincinnati, Ohio, has three electric welding machines on exhibition, all in operation. One small welder, designed for welding wires ¼ in. in diameter or less, is used in welding souvenir samples of brass to iron. This machine is of aluminum to make it as light as possible. A larger machine is used in butt welding, and the third is the spot welder or electric "riveter," which is used to demonstrate the electric method of riveting without the use of rivets. This interesting machine is called a "spot welder" because it welds two pieces of sheet metal in one spot about the size of a rivet where the electricity is localized between the upper and lower dies. The company also has sample boards showing all kinds of electrically welded "stunts," as automobile wheel rims, baseball masks, wire chairs, horse bits, etc. Messrs. Neil Macneale, F. Warren, A. M. Searles and A. M. Anderson represent the company.

Union Light & Supply Company, Chicago, exhibits Just tungsten lamps imported from Germany, as well as the Shaler "electro-pad," manufactured by the C. A. Shaler Company, of Waupun, Wis., and the Acme heater, made by the Electrical Specialties Company, of Colorado Springs. Messrs. J. F. A. Comstedt, Frederick A. Watkins, M. A. Hartigan and A. M. Miltenberg represent the company.

Van Manufacturing Company, Braddock, Pa., has an electric flatiron known as the "Three-in-One" iron. By inserting different weights the iron may be made to weigh 5 lb., 6 lb. and 7 lb., thereby simplifying the carrying in stock of irons of different weights. Mr. D. O. McAllister represents the company.

Vulcan Electric Heating Company, Chicago, makes an exhibit of its electric soldering, branding and curling irons. The display is one calculated to attract popular interest as well as that of electrical men. Messrs. F. J. Holmes, M. Y. Steen, A. G. Sutcliffe, S. W. Richards, L. Sisskind and H. L. Wuerffel represent the company.

Westinghouse Companies, East Pittsburgh.—The Westinghouse space contains exhibits by the Westinghouse Electric & Manufacturing Company, the Westinghouse Lamp Company and the Cooper Hewitt Electric Company. The feature of the Westinghouse Electric exhibit is a new adjustable-speed alternating-current mill-type motor designed for severe intermittent, varying-speed reversing duty, such as the operation of cranes, elevators, roller-lift bridges, etc. Cooking and heating devices, meters, transformers, rectifiers, 1911 fan motors and ventilating motors are also shown. The company's small general-utility motor and electric cooking devices are demonstrated. Messrs. T. P. Gaylord, W. R. Pinckard, A. L. Millard, M. MacNeill, R. W. Everson, F. A. Servis, J. W. Robinson, H. L. Garbutt, C. W. Regester and others represent the company. The Lamp company exhibits complete lines of 110-volt wire-type tungsten lamps ranging in size from 25 watts to 500 watts and of 220-volt wire-type lamps ranging in sizes from 45 watts to 500 watts. Street-series tungsten lamps are shown in different sizes, ranging from 50 watts to 250 watts. Messrs. J. M. Schilling, A. N. Brown, C. R. Wood and others represent the company. The Cooper Hewitt company displays direct-current and alternating-current mercury-vapor lamps. These are mounted to show the operating mechanism. Mr. Irving B. Cary represents the company. The entire exhibit is in charge of Mr. W. Barnes, Jr.

Woods Motor Vehicle Company, Chicago, in addition to supplying the electric coupé which is the chief prize in the estimating contest and which is prominently displayed in a central position, has a four passenger coupé in its own exhibit. Both of these vehicles are handsomely finished and attract much attention. Messrs. Carl J. Metzger, R. Herrington, F. J. Newman, Thomas Clements and L. E. Burr represent the company

Industrial and Commercial News

THE WEEK IN TRADE.

THERE was no improvement in trade conditions during the first week of the new year. In fact, there was no reason to anticipate any improvement. Weather conditions and trade conditions have remained about the same. Wholesalers and jobbers have been engaged in stock-taking, and have received but few orders. While retail sales during the holiday season were fairly liberal, there is no evidence that they were sufficient to deplete stocks. In the industrial world the situation is rather discouraging. In the iron and steel industry the mills are still operating at less than 50 per cent of capacity, and the question is left open as to whether prices will be reduced within the next two months. The discussion of price reduction is causing buyers to hesitate and makes a temporary lull in demand. The best lines in the iron and steel industry are wire and structural materials. There have been no orders placed for steel rails of any importance, and, as far as any one knows, no orders are in prospect. Within the past week, however, some quite important orders for locomotives were made, the Southern Pacific having ordered 190 locomotives from the Baldwin Company. This is one of the largest single orders ever placed. Several other roads have also placed orders for locomotives, of which the American Locomotive Company has received its full share. It is evident that almost all leaders in the commercial industry are inclined to be conservative. As quoted in our issue of last week, one of the leading authorities in the electrical industry expressed the opinion that the business done in 1911 would not be as great as that done in 1910. While such expressions are not freely given, it is undoubtedly true that a great many of the best judges of business have this feeling. Collections are fair because the Western country is more or less prosperous. Business failures for the week which ended Jan. 5 were 281, as against 251 the previous week, 271 in the same week in 1910, 329 in 1909, 435 in 1908 and 283 in 1907.

THE COPPER MARKET.

CONSUMERS of copper placed a few small orders last week for limited amounts of metal, February and March delivery. These sales were almost entirely for electrolytic, and while this grade is still quoted at 13 by the selling agencies it is well known that no actual transactions have been pulled off at these figures. The actual prices received ranged from 12.55 to 12.75, and the further off the delivery the better the price. An attempt was made to advance the price of copper when the slight demand was developed, but it failed. The demand from consumers was so feeble that it would not stand any advance in price. The margin between the American and the European selling prices has been so narrow that there has been little inducement to speculators, and in consequence there has been little activity in the foreign market. The figures of the Copper Producers' Association, which were made public Jan. 9, brought little real comfort to the market. While they showed that the stock of copper on hand Jan. 1 was 122,030,125 lb., a decrease of 8,358,874 lb. from Dec. 1, and which compared with 141,766,111, Jan. 1, 1910, it also disclosed the fact that the production during December had been 123,339,219 lb., as compared with 119,353,463 lb. in November. It was evident, therefore, that if there was any curtailment policy in force among the producers it was showing no effect upon the production figures. The domestic deliveries were reported as 43,594,018 lb. and the foreign deliveries were reported as 88,104,075 lb. The Metal Exchange figures for copper exports during December were 31,526 tons, which was the largest month except September for the year. The total exports for the year were 298,233 tons, as compared with 302,530 in 1909. The exports for the first week in January were 8437 tons. The daily call on the Metal Exchange Jan. 9 quoted standard copper as per accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.00	12.15	.....
January	12.00	12.15	12.07½
February	12.00	12.15	12.07½
March	12.00	12.15	12.07½
April	12.00	12.15	12.07½

The London market Jan. 9 was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	56	12	6	56	6	3
Standard copper, futures	57	8	9	57	3	9

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.15c	12.07½c
London, spot	£56 15 0	£56 2 6
London, futures	57 12 6	56 17 6
Best selected	60 0 0	59 15 0

INDUSTRIAL AND COMMERCIAL NOTES.

Platinum Market of 1910.—During the year 1910 there was very little change in the platinum market except a steady increase in prices and a steady increase in demand. At the end of the year the demand was far in excess of the supply, and platinum had advanced during the year up to $39 per pound. This is almost the top notch for platinum prices. The supply during the year never seemed to be up to requirements. The dental industry kept up its enormous demand, and the electrical industry also required a large amount. The result was that there was more platinum wanted than there was output from Russian mines. In discussing this condition one of the best informed platinum men in America, Cyrus Osborne Baker, said: "I do not believe that there has been any curtailment in Russia in order to advance prices. Prices have gone forward simply because the demand has been larger than the supply. I hardly expect that the demand for platinum during the coming year will be as large as it was in 1910, but I think that it will be large enough to take up more than all of the output that is offered from Russia."

New England Telephone & Telegraph Company.—A special telephone service has recently been put into operation by the New England Telephone & Telegraph Company which is intended to meet the needs of business men who telephone a great deal between two certain points. The service has proved a great success, for it not only saves in tolls but it has many other advantages. This service is available for any half hour or more daily except between 8 a. m. and 12 noon. Any business man who telegraphs once or twice daily to the same person, office or factory will find it greatly to his advantage to secure these special rates. The service is particularly valuable to those whose regular calls cover a long distance, from twenty-five to one hundred miles. It allows the use of a private line for thirty minutes daily for about the regular charge of ten minutes. There is no delay in making connections and there is no interruption. The company furnishes special trunk lines and special telephones at each end, and the regular service is not affected in any way.

New President of Allis-Chalmers Company.—W. H. Whiteside has retired from the presidency of the Allis-Chalmers Company, which position he has occupied since 1905, and has been succeeded by D. W. Call. For the past six years Mr. Call has been assistant to the president of the American Steel Foundries Company, with his headquarters in New York City. Although going to Milwaukee from the East, Mr. Call has always considered the West his home, and the greater part of his business career has been passed in that section. Mr. Call was born on a farm near Cleveland, Ohio, and is of Scotch descent. At the age of seventeen he commenced his business life in Cleveland, and for twenty-three years has had an active career in connection with large manufacturing corporations, both in this country and in the Dominion of Canada.

Convention of Byllesby Men at Chicago.—More than 200 managers and employees of H. M. Byllesby & Company and their thirty-eight affiliated public-service companies operating in fifty-five communities in this country are expected to attend the second annual convention of the Byllesby forces at Chicago, Jan. 17 to 20, inclusive. The sessions of the four days will be held at the Congress Hotel, and will be given over to the reading and discussion of technical papers by members of the organization. A formal banquet will be given in the Gold Room of the Congress on the last evening of the convention. The dates of the meeting, Jan. 17 to 20, have been chosen to coincide with those of the Chicago Electrical Show, so that the out-of-town managers can inspect the latest developments of the industry while in Chicago.

Telephones in Pennsylvania Railroad Terminal.—The Pennsylvania Railroad is installing a telephone system of controlling train movements at its Philadelphia terminal. This is believed to be the first installation of a complete telephone dispatching system within the limits of a terminal. This system is unique, being in some measure a telephone train wire having intercommunicating features only between certain points. Dispatchers' offices are located at "S" tower, which is a telegraph office at Thirty-second Street, and at "A" tower, at Seventeenth Street. At the latter point three calling equipments are provided, which enables any one of the three operators to call any station, while at "S" but one calling equipment is provided. The various way stations, of which there are fifteen, can call automatically either "S" or "A," but there is no provision for calling the other way stations. Accordingly both dispatchers' offices are equipped with selectors, as are the regular way stations. Under ordinary operating conditions the dispatchers at "A" will call the various way stations, but in cases of emergency the "A" tower will be cut out and the train movements controlled from "S." The complete equipment of telephone and selector apparatus was supplied by the Western Electric Company.

Western Electric Company's Year.—The Western Electric Company last year changed its fiscal year to end Dec. 31, instead of Nov. 30. For the thirteen months ended Dec. 31, 1910, its sales will be approximately $66,000,000, as compared with $45,000,000 for the twelve months of last year. These sales compare with $69,000,000 for the year 1906, which was the largest year in the history of the company. The increase over the past year has been well distributed over the various lines of merchandise which the company handles, such as telephone, cable, motors, generators and electric light supplies, and the increase in the business has been well distributed throughout the United States. The company has approximately twenty houses throughout the United States, through which it distributes its electric manufactures and supplies. The company during the past year has continued its policy of concentrating the manufacturing at Hawthorne, and several millions of dollars have been spent there in new buildings. The latter part of 1910 more new buildings, to cost $1,000,000, have been authorized, which will still further increase the capacity of the plant. The company now employs altogether upward of 24,000 men.

United Wireless Telegraph Company.—The United Wireless Telegraph Company reports that, in spite of prosecutions and other troubles, it has steadily developed its system of wireless stations, and that at the present time it has almost 500 in operation. Within the last few weeks a new station has been established at Ceiba, Spanish Honduras, which is intended to take care of a large volume of business that is being given to the company by the United Fruit Company. There has also been a station established at Daytona, Fla., which is intended to look after the Cuban and Gulf trade. There have been within the last few months fifteen stations established in South America along the Amazon and Paraguay Rivers. These new stations practically give to the United Wireless the chief position in the wireless business in South America. In addition to this line of development there have been a number of new stations established on the Great Lakes and in the Northwest. Several points in Alaska have been connected up, and there have also been a number of new stations placed on the Pacific coast of the United States.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Hickory, N. C.; Oklahoma City, Okla.; Spokane, Wash.; Montgomery, Ala.; Pardeeville, Wis.; Waupaca, Wis.; Viola, Wis.; Portsmouth, N. H.; Red Bluff, Cal.; Lawrence, Kan.; Oregon, Mo.; Durant, Okla.; Beatrice, Neb.; Tofield, Ont., Can.; Hamilton, Ont., Can.; Prairie du Sac, Wis.; Ely, Nev.; Fairbury, Neb.; White City, Kan.; North Baltimore, Ohio, and Cottage Grove, Ore.

Lighting Legislation in Massachusetts.—The Massachusetts Gas Commission has made a report recommending that a bill be enacted providing that a corporation engaged in manufacturing or selling electric energy for light, heat and power shall not, without authority of the general court, transfer its franchises, lease its works or contract with any person, association or corporation to carry on its works except in accordance with the laws that are now already in effect. These laws limit increases of capitalization and restrict the cost of extensions.

Aluminum Trade of the Year.—The demand for aluminum during the year 1910 was considerably in excess of that in 1909. The Aluminum Company of America, which practically has a monopoly of the business in this country, reports that it has been fairly busy throughout the entire year. The demand for aluminum wire for transmission purposes has not been particularly heavy, but this line has kept up fairly well with the other demands for aluminum. Very few large installations were made during the year, and the best orders for transmission wire that came in were from Canada. The aluminum business has gradually expanded in the way of novelties and household utensils. This branch of the industry has been particularly pushed by the Aluminum Company of America. Although the patents which governed the manufacture of aluminum expired in the spring of 1909, there have been as yet no important competitors in the manufacturing field. The prices have remained about the same for the last three or four years, and vary from about 23 cents to 25 cents per pound.

Value of the Storage Battery Cars.—Frederick W. Whitridge, receiver and general manager of the Third Avenue Railroad Company, in his recent report to the bondholders says: "I have made many experiments to find a self-propelling car, and have now had built in our own shops twenty-five cars which we have equipped with batteries furnished by the Gould Storage Battery Company. So far these cars have worked in a perfectly satisfactory manner. As a substitute for horse cars I have been using them now for three months on the 110th Street line. While this line was operated with horse cars it produced 75 cents to $1 per day per car, and now it is averaging between $40 and $50 a day. I do not feel justified in spending any larger sum on these cars until they have been through the winter and we have had a longer period for testing them, but if they are as successful as it now appears I propose to replace all of the horse cars on the Third Avenue system with this character of storage battery cars."

Connecticut River Company.—At a meeting of the stockholders of the Connecticut River Company held recently at Hartford it was voted to accept the amendment to the company's charter obtained from the Connecticut Legislature, giving the company the right to make improvements on the Connecticut River at Windsor Locks. These improvements will consist of a dam and an electric power plant. Twelve hundred shares of stock were voted in favor of the acceptance and 738 against it. The minority vote consisted largely of the holdings of the Northern Connecticut Securities Company, which owns the 600 shares of stock recently bought from the Connecticut River Banking Company, the 50 shares bought from the Ætna Insurance Company, and some other smaller purchases.

Electric Power Plant for Ely Camp.—It is said that work will begin early in the spring on a hydroelectric plant to furnish energy for the Giroux Reduction Works in Ely, Nev. The plant will be built by the Telluride Power Company and is expected to develop 3000 hp. It will be constructed on Cleveland Creek, about twenty miles east of Ely, and a transmission line will run over the Schell Creek Range to the Giroux plant. For a number of years the utilization of the water powers on Cleveland Creek has been contemplated, and the Giroux Mining Company has controlled the rights. A dam will be constructed, and a regular flow of water will be maintained for the generating plant.

Watt-Hour Meters for the Philippines.—The Sangamo Electric Company, Springfield, Ill., has just made a large shipment of integrating mercury flotation watt-hour meters to Manila, Philippine Islands. Owing to the long shipping distance involved it was important that a type of meter be selected that would withstand rough usage without injury and the mercury flotation type was judged to be particularly well adapted to meet the conditions.

Twin City Light & Traction Company.—The Twin City Light & Traction Company, of Chehalis, Wash., will expend during the coming year about $100,000 for improvements, which will include the new power house to be built and equipped with modern machinery. Heller, Sinclair & Anderson, bankers, of Philadelphia, are the financial backers of this company.

Mexican Electrical Order.—The Westinghouse Electric & Manufacturing Company has just received an order for one 100-kva, three-phase, 60-cycle, 480-volt, 900-r.p.m. belted-type generator, a two-panel switchboard and several induction motors, to be shipped to the Mina Mexico Company, Tonichi, Sonora, Mexico.

Financial.

The Week in Wall Street.

ALTHOUGH the New York stock market has shown considerable improvement in price since the first of the year, it would be hard to imagine a market that was more discouraging and really more stagnant. The fact that the market has been largely oversold makes any little activity on the part of professional traders result in an advance of quoted prices. There are no stocks being offered, there is no short interest, and any disposition to purchase that is shown by speculators results in stronger prices. The entire situation in Wall Street is one of extreme discouragement. A member of a prominent firm last week declared that his concern, which is operating at an enormous expense, had not received in outside commissions within the past two months enough to pay its electric light bills. The bank troubles which occurred last week have had little effect upon Wall Street, because they were immediately taken in hand by very powerful financial interests and the public was entirely protected. There was a disposition shown to prevent the public from losing any money on account of unwise or unlawful bank operations, and this in itself is something of a guarantee. Wall Street is in a condition where even those who are generally optimists are not now prophesying any immediate return of business. There is no reason to fear any market demoralization or any serious panic, but there is every reason to expect prolonged stagnation and small business. The money market has not shown very much improvement, but rates are still unusually cheap. This is largely because there is no speculative demand for money, and the investment demand is not sufficient to absorb the surpluses that the larger banks have accumulated. The re-investment of dividends and other similar activities which generally occur shortly after the beginning of the new year have caused some little activity in the bond market. The investment in bonds has certainly improved, but there is no doubt that the character of the bonds is being more closely scrutinized than ever before. Money was quoted Jan. 9: Call, 3¼@3¾ per cent; 90 days, 3½@3¾ per cent. The quotations in the table are those of the close of Jan. 9.

NEW YORK.

	Dec. 31.	Jan. 9.	Shares Sold.		Dec. 31.	Jan. 9.	Shares Sold.
All. Ch.....	8*	8¼*	520	Int. Met., pfd	53½	54½	9,850
All. Ch., pfd.	29	28⅛*	300	Mackay Cos.	92½*	92⅞*	100
Amal. Cop...	61⅝	64¼	61,500	Mackay C.,pf.	75¼*	75¾	400
Am. D. T...	20½*	20½*	———	Man. Elev...	138⅛*	140	1,150
Am. Loco....	38½	40	1,830	Met. St. Ry..	15*	15*	———
Am. Loco.,pf.	108*	108½*	215	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	80*	83¾*	600	Steel, com...	72⅛	74⅞	422,790
Am. T. & T..	140⅛	141½	7,726	Steel, pfd....	116⅝	118⅜	6,060
B. R. T.....	75¼	76⅜	9,696	W. U. T....	72½	74¾	8,765
Gen. Elec...	151*	151½	2,300	West'h, com.	65½*	66½*	800
Int. Met. ...	19½	19¾	9,500	West'h, pfd..	122*	123*	100

PHILADELPHIA.

	Dec. 31.	Jan. 9.		Dec. 31.	Jan. 9.
Am. Rys...........	42*	42	Phila. Elec.........	16⅜	16½
Elec. Co. of A....	11⅝*	11⅞	Phila. R. T.........	18⅝	19¾
Elec. St. B'ty......	48¼	50¼	Phila. Trac.........	84	84½
E. S. B'ty., pfd....	30*	30*	Union Trac.........	43¼	45¼

CHICAGO.

	Dec. 31.	Jan. 9.		Dec. 31.	Jan. 9.
Chi. City Ry........	170*	170*	Chi. Tel. Co........	120	120
Chi. Rs., Ser. 1....	92½*	92½*	Met. El. Co.........	23*	22*
Chi. Rs., Ser. 2....	25¼	25	Met. El., pfd.......	69	69*
Com. Edison.......	113*	115	Nat'l Car..........	119*	119*
Chi. Subways......	4⅝	4½	Nat'l Car., pfd.....	117½*	117½*

BOSTON.

	Dec. 31.	Jan. 9.		Dec. 31.	Jan. 9
Am. T. & T..........	140¼	141⅞	Mex. Tel...........	4*	6
Cum. Tel...........	145*	149¾	Mex. Tel., pfd......	6*	6*
Edison E., Ill......	288	290	N. E. Tel..........	138	138
Gen. Elec..........	152½	152¼	W. T. & T.........	18*	18*
Mass. E. Ry........	18	18*	W. T. & T., pfd....	91¼*	91½
Mass. E. Ry., pfd...	86	84¼			

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*Last price quoted.
Shares sold for five days, Jan. 3 to Jan. 7.

Financial Notes.

Milwaukee Electric Railway & Light Company.—The earnings of the Milwaukee Electric Railway & Light Company for 1910 showed a considerable increase over those of 1909. This property is one of the most important of the North America Company's utility holdings. Recently Vice-President J. D. Mortimer, of the Milwaukee company, said, regarding the utility situation there, that Milwaukee, from the standpoint of natural advantages and resources, is as favorable a situation as any other city in the West. There are many sites advantageously located and available for new industries where real estate is comparatively cheap, and there are exceptionally good facilities for both railroad and water transportation. Mr. Mortimer said further that the sale of electric energy in Milwaukee is being actively pushed and the new schedule of rates which has recently been put in force is so low that there is no longer any inducement for the installation of private power plants and their operation has ceased to be economical. The power lines of the Milwaukee company are being extended in all existing manufacturing districts and the company is ready to supply energy to all customers. In a circular sent out by the company, signed by Mr. Mortimer, he advises all manufacturing concerns looking for new locations to investigate thoroughly the advantages of Milwaukee before locating elsewhere.

Columbia Gas & Electric Company, Cincinnati.—President A. S. White, of the Columbia Gas & Electric Company, of Cincinnati, Ohio, has arranged for the sale of $2,000,000 of the $3,500,000 East Ohio Gas 5 per cent bonds at 92, which will net $1,840,000 for the company. These bonds were secured through the sale of the Cleveland artificial gas property to the East Ohio Gas Company. The deal was ratified at a special meeting of the board of directors on Dec. 21. The sale was made to a New York and Boston syndicate, and the arrangement by which an English syndicate was expected to take $2,000,000 Columbia Gas & Electric bonds, referred to in our issue of Nov. 3, has been abandoned, the new deal being considered better. The money will be paid into the Knickerbocker Trust Company, of New York, as trustee of the bonds of the Columbia company, and the trustee will advertise the retirement of $2,000,000 of Columbia bonds. This will afford an opportunity of turning in $1,400,000 bonds that have been used as collateral for loans. The floating debt of $800,000, nearly all secured by the company's bonds, will be paid and a good working capital will remain in the treasury. Through the retirement of bonds the bonded indebtedness of the company will be reduced $2,000,000

Yosemite Power Company.—The Yosemite Power Company was incorporated in California late in December by John Hays Hammond with an authorized capital of $10,000,000. The new company will absorb the Tuolumne Electric Light & Power Company, of Sonora, and the Tuolumne River Power Company. The former of these is controlled by Mr. Hammond and the latter, an undeveloped property, by Charles D. Shaw, of Maine. Jointly these two companies own and control practically all of the upper Tuolumne watershed, together with valuable reservoir and water rights on the south and middle forks of the Tuolumne River. The combined properties have an estimated capacity of 100,000 hp and are located but little more than 100 miles from San Francisco, which is said to be Mr. Hammond's objective point of distribution.

Public Service Electric Company.—Articles of incorporation were filed in Trenton last week for the Public Service Electric Company. The capital stock authorized was $1,000,000 and the company is a subsidiary of the Public Service Corporation of New Jersey and will take over control of a number of the lighting and power companies. The Public Service Gas Company also filed a certificate of incorporation with $200,000 capital. The latter concern will take over the management of certain of the Public Service Corporation's gas properties. The organization of these companies is in accordance with the policy of the big corporation, announced some time ago, of segregating under separate companies its various interests

Toledo Railways & Light Company.—Negotiations between the Toledo Railways & Light Company and the City of Toledo for the renewal or extension of the franchise of the company have now reached that stage where the city solicitor has been requested to draft a franchise ordinance embodying all matters except those relating to the question of rate of fare and the valuation of the property. It is not expected that there will be any differences of opinion that will delay the granting of a new franchise. The city has already through its own expert accountants examined and audited the operations of the company, with a view to the present negotiations, and the minor matters will be settled later.

Columbus (Ohio) Railway & Light Company.—It is unofficially announced that the stockholders of the Columbus Railway & Light Company will be assessed $10 a share to pay for the last year's improvements and for the cost of the strike which ran for several months in Columbus. Such a 10 per cent assessment would produce $500,000

West Virginia Electric Combination.—W. W. Raub, of Pittsburgh, is reported to be working on a plan to merge electric railways and lighting plants in Allegheny County, Maryland, and in Somerset County, Pennsylvania. Capitalists of New York and London are to finance the enterprise. The South Penn Railways and Light Company has been incorporated for the purpose, and among those mentioned in connection with the deal are John Hartshorne, Rodman W. Hicks and George K. Preston. It is proposed to connect the Cumberland & Westernport Electric Railway with the Pennsylvania and Maryland Electric Railway and make a through line from Cumberland over the mountains to Meyersdale, Garrett and other points in Pennsylvania, including Berlin, Somerset and Johnstown. An extension to Keyser, W. Va., and another to Hyndman, Pa., are said to be contemplated. Edwin S. Johnson, of Pittsburgh, is said to be making a survey for the connecting link. It is proposed to build a large power plant to provide current, the cost thereof to be $450,000, and options on a tract of coal land are said to have been obtained.

New York Edison Company Stock.—It is reported in financial circles that the New York Edison Company at its next annual meeting, which will probably be held a short time before the annual meeting of the Consolidated Gas Company, which occurs Jan. 23, will increase the rate of its dividend from 1½ per cent to 2 per cent quarterly. This would place the stock on an 8 per cent basis. In 1910 6 per cent was paid on approximately $50,400,000 of stock. This added something more than $3,000,000 to the income account of the Consolidated Gas Company. The New York Edison Company earned in 1910 about $17,800,000 gross, as compared with $16,550,000 in 1909. After all charges, including interest and a large amortization or depreciation allowance had been paid, the company had available for dividends approximately $5,000,000, which was equivalent to about 10 per cent on its capitalization. The stockholders of the Consolidated Gas Company are of the opinion that there should be some annual disposition of the large earnings and surplus of the Edison company.

United Illuminating Company of New Haven.—The stockholders of the United Iluminating Company, of New Haven. Conn., have authorized an issue of new stock to the amount of $500,000. The present capitalization of the company is $1,500,000, and the new stock will bring the capitalization up to $2,000,000. The directors voted to issue $300,000 of the new stock to the stockholders of record of Dec. 28. The other $200,000 will remain in the treasury, to be used at such times as the directors may determine. The stockholders at their meeting also approved the purchase of the Fairchild Light & Power Company, a small concern in the territory served by the United Illuminating Company.

Northern Ohio Power Company.—The Northern Ohio Power Company, of Columbus, has been incorporated to build a traction and power outfit which will operate near Akron, Ohio. This company will also probably build a transmission line to Toledo.

DIVIDENDS.

American Light & Traction Company, preferred, quarterly, 1½ per cent; common, quarterly, 2½ per cent; common stock dividend, 2½ per cent, all payable Feb. 1.

Boston Elevated Railroad Company, semi-annual, 3 per cent, payable Feb. 15.

Cuyahoga Telephone Company, preferred, quarterly, 1½ per cent, payable Jan. 31.

Milwaukee Electric Railway & Lighting Company, preferred, quarterly, 1½ per cent, payable Jan. 31.

Railway & Light Securities Company, semi-annual, preferred, 3 per cent; common, 2 per cent, both payable Feb. 1.

Seattle Electric Company, quarterly, common, 1¾ per cent, payable Jan. 16.

Standard Underground Cable Company, quarterly, 3 per cent, extra 3 per cent, special 5 per cent, all payable Jan. 11.

United States Rubber Company, quarterly, first preferred, 2 per cent; second preferred, 1½ per cent, both payable Jan. 31.

J. G. White & Company, preferred, quarterly, 1½ per cent, payable Feb. 1.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
Aurora, Elgin & Chicago Railroad Company—					
November, 1910	$132,507	$74,422	$58,085	$36,602	$21,483
November 1909	122,788	69,525	53,263	29,585	19,288
Bangor (Me.) Railway & Electric Company—					
November, 1910	46,346	18,587	27,579	13,928	13,831
November, 1909	45,427	18,336	27,091	12,979	14,112
Blackstone Valley Gas & Electric Company—					
November, 1910	97,798	46,680	51,118	30,168	20,950
November 1909	101,818	45,139	56,679	29,604	27,075
Columbus (Ga.) Electric Company—					
November, 1910	46,241	16,129	30,112	17,357	12,755
November, 1909	36,078	17,321	18,757	13,000	5,757
Dallas (Tex.) Electric Corporation—					
November, 1910	127,042	94,828	52,214	24,028	28,186
November, 1909	121,215	68,780	52,435	27,471	24,964
Edison Electric Illuminating Company of Brockton—					
November, 1910	31,899	15,187	16,712	4,900	11,812
November, 1909	28,288	12,943	15,345	3,996	11,349
El Paso (Tex.) Electric Company—					
November, 1910	59,985	33,437	26,548	8,224	18,324
November, 1909	56,069	31,302	24,767	8,397	16,370
Galveston-Houston Electric Company—					
November, 1910	118,251	69,923	48,328	26,026	22,302
November 1909	109,058	61,246	47,812	22,985	24,827
Jacksonville (Fla.) Electric Company—					
November, 1910	48,904	26,961	21,943	9,498	12,445
November, 1909	45,611	23,053	22,558	9,481	13,077
Lake Shore Electric Railway Company—					
November, 1910	91,802	50,792	41,010	34,669	6,341
November, 1909	90,705	48,984	41,984	35,393	6,328
Lowell (Mass.) Electric Light Corporation—					
November, 1910	43,690	23,134	20,556	4,340	16,216
November 1909	35,042	16,653	18,389	4,161	14,228
Minneapolis General Electric Company—					
November, 1910	124,972	46,089	78,883	31,753	47,130
November 1909	105,362	39,726	65,636	31,670	33,966
Northern Ohio Traction & Light Company—					
November, 1910	189,705	110,718	78,987	43,366	35,620
November, 1909	175,742	99,972	75,770	43,399	32,370
Northern Texas Electric Company—					
November, 1910	119,263	63,309	55,954	23,878	32,076
November, 1909	105,253	57,097	48,156	16,189	31,967
Pensacola (Fla.) Electric Company—					
November, 1910	24,427	14,328	10,099	5,067	5,032
November, 1909	21,176	12,362	8,814	4,509	4,305
Portland (Me.) Electric Company—					
November, 1910	44,458	18,578	25,880	10,048	15,832
November, 1909	36,898	11,864	25,034	9,194	15,840
Puget Sound Electric Railway Company—					
November, 1910	150,274	106,037	44,237	38,775	5,462
November, 1909	139,018	97,508	41,510	34,091	7,410
Savannah Electric Company—					
November, 1910	56,863	39,346	17,517	17,435	82
November 1909	51,088	33,516	17,572	17,555	17
Seattle Electric Company—					
November, 1910	469,334	256,618	212,716	106,026	106,690
November 1909	451,533	265,088	186,445	104,184	82,261
Sierra Pacific Electric Company—					
November, 1910	47,710	16,489	31,221	6,889	24,332
November, 1909	46,377	15,522	30,855	5,914	24,941
Tampa (Fla.) Electric Company—					
November, 1910	43,248	22,980	20,268	6,212	14,056
November, 1909	52,900	28,584	24,316	4,594	19,722

General News

Construction News.

MONTGOMERY, ALA.—Plans are being prepared by the Montgomery Light & Water Power Company for extensive improvements and extensions to both its electric and gas systems, which will involve an expenditure of about $350,000. The plans include enlarging the electric generating station at Tallassee, at a cost of $250,000. Two additional turbines, each having a rating of 3000 kw, will be installed with accessories, and new transmission cables will be erected.

CONWAY, ARK.—The local electric light plant is reported to have been seriously damaged by an explosion.

ALAMEDA, CAL.—Following the announcement of the absorption of the Pacific Gas & Electric Company by the Great Western Power Company, the Council committee has decided to return the certified check of the Great Western Power Company and call off negotiations for the purchase of electricity from the company for a day service in connection with the municipal electric plant. There is considerable opposition to the proposed scheme to purchase power from an outside company, as it was feared that it would prove an entering wedge for corporations wishing to compete with the municipal plant. It is said that the reduction of 40 per cent in fuel oil will enable the municipal plant to supply the service as cheaply as it can be purchased.

CHICO, CAL.—Announcement has been made that the Fleisbhacker Brothers have purchased a half interest in the Sacramento Valley Power Company. It is understood that the company will be reincorporated with a capital stock of $2,000,000, and bonds for an equal amount will be issued.

FORBESTOWN, CAL.—Plans are being considered for the installation of a new electric plant on the property of the Garibaldi Mining Company early this year. The plant will supply electricity to operate the machinery in the mines of the Forbestown district.

FRESNO, CAL.—Announcement has been made that extensive improvements will be made to the local telephone system, which will include an extension of the service to the northwest of the city, and possibly to the Kearney Boulevard tract. It is also proposed to install more underground cables in the downtown district.

FRESNO, CAL.—It is reported that orders will soon be placed by the San Joaquin Light & Power Company for steel pipe lines and transformers for eight substations in the distributing system of the company through the valley. The pipe line is to be used for bringing the water power to two units of 5000 hp each, soon to be installed in the Crane Valley plant. It is expected to have 20,000 hp available at the Crane Valley plant by early summer. A. G. Wishon is general manager.

GREENVILLE, CAL.—The Indian Valley Light & Power Company is reported to be contemplating extending its system to Taylorsville, Crescent and Seneca. The power plant will also be enlarged.

LAWNDALE, CAL.—The Lawndale Improvement Association is planning to install a street lighting system. It is proposed to erect eighty electric street lamps.

LOS ANGELES, CAL.—The Board of Public Works has directed that bids be asked for the installation and maintenance of 350 new street arc lamps, to be erected at the rate of not less than thirty each month. It is stipulated that none of the new lamps shall be placed south of Manchester Avenue.

LOS ANGELES, CAL.—The Los Angeles-Pacific Electric Railway Company has awarded the contract for the construction of the proposed ten-mile extension of its railway from Hollywood to Lankershim and from Lankershim to Kester, a distance of five miles, to Palmer, McBride & Quayle for $400,000.

MODESTO, CAL.—The contract for supplying electricity for the coming year for municipal lighting and operating the water-works pumping station has been awarded to the La Grange Water & Power Company, of La Grange, Cal.

RED BLUFF, CAL.—Notice of appropriation of 8000 miners' in. of water of Deer Creek has been filed by A. G. Simpson, of Chico, Cal. A power plant will be erected at a point about fifteen miles east of Vina. The water will be carried in a ditch 20 ft. across the top, 14 ft. at the bottom and 6 ft. deep.

REDONDO BEACH, CAL.—The large power plant of the Pacific Light & Power Company has been completed. The plant has a generating capacity of 65,000 hp, and will supply electricity for operating the systems of the Pacific Electric and Los Angeles Railway companies, and will also supply energy to the Pacific Light & Power Company.

SAN FRANCISCO, CAL.—The Yosemite Power Company, recently incorporated with a capital stock of $10,000,000 by John Hays Hammond and associates, it is reported, will absorb the properties of the Tuolumne Light & Power Company and the Tuolumne River Power Company, both of which are controlled by John Hays Hammond. The two companies jointly own and control practically all of the upper Tuolumne River watershed, along with the valuable reservoir and water rights on the south and middle forks of the Tuolumne River. The directors are: John Coffey Hays, of Visalia, Cal.; Lester R. Wiley, of Bangor, Maine, and Albert Raymond, of Berkeley, Cal.

SAN RAFAEL, CAL.—A franchise has been granted to George D. Shearer to construct and operate an electric railway in San Rafael. It is understood that the railway will be built during this year.

TIBURON, CAL.—The contract for the construction of a power plant at the naval coaling station, Tiburon, Cal., has been awarded to Snare & Triest, of New York, N. Y., for $25,900.

WILLOWS, CAL.—The Board of Supervisors has granted the Sacramento Valley Power Company a franchise to erect and operate an electric transmission line in Glenn County. C. R. Wickes, agent of the company, will also apply for a franchise in Willows at the next meeting of the Board of Trustees.

WILLOWS, CAL.—The Board of Supervisors has recently sold a franchise to C. R. Wickes, granting him the privilege to erect transmission lines for the distribution of electricity throughout the county. Electricity will be purchased from the Sacramento Valley Power Company, and already many hundred horse-power has been contracted for.

HAZARDVILLE, CONN.—The A. D. Bridge Sons Company has purchased a new generator. As soon as the machine is installed the company will operate its own electric lighting plant.

NEW HAVEN, CONN.—The stockholders of the United Illuminating Company, which operates in New Haven and Bridgeport and in towns adjoining both cities, have ratified the purchase of the property of the Fairfield Electric Light Company, of Fairfield, Conn. The capital stock of the company has been increased by $500,000, making a total of 2,000,000.

NEW LONDON, CONN.—The New London & East Lynn Electric Company, it is said, will apply to the next Legislature for permission to construct an electric railway from Niantic to the Connecticut River, to connect with a new drawbridge, now being constructed by the State of Connecticut.

PUTNAM, CONN.—The stockholders of the Putnam Light & Power Company on Dec. 28 voted to authorize the directors to increase the capital stock of the company from $50,000 to $100,000 and to issue bonds not to exceed $150,000, the proceeds to be used to take up outstanding indebtedness and for improvements and extensions to its system.

WASHINGTON, D. C.—The contract for wiring the State, War and Navy Building, Washington, D. C., has been awarded to the Keller Pike Company, of Philadelphia, Pa., for $23,200.

WASHINGTON, D. C.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Jan. 20, for furnishing and installing lighting fixtures in the United States buildings at Goldsboro, N. C.; Henderson, N. C.; Council Bluffs, Ia.; Danville, Ill.; Jackson, Tenn., and Sioux City, Ia. Plans and specifications may be obtained at the above office. James Knox Taylor is Supervising Architect.

FAIRBURN, GA.—The question of issuing $14,000 in bonds, the proceeds to be used for the installation of an electric light plant, will soon be submitted to a vote of the people.

FORT SCREVEN, GA.—Sealed proposals will be received at the office of the Constructing Quartermaster, Fort Screven, Ga., until Jan. 30, 1911, for construction and installation of an electric light system at Fort Screven, Ga. Further information will be furnished on application. A deposit of $15 will be required for plans and specifications.

MILLEDGEVILLE, GA.—Sealed bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Feb. 8, 1911, for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States postoffice at Milledgeville, Ga., in accordance with plans and specifications, copies of which may be obtained at the above office, or from the custodian of the site at Milledgeville, Ga.

BOISE CITY, IDAHO.—The Boise Power, Light & Traction Company, recently incorporated with a capital stock of $1,000,000, is making preparations for the construction of a large power plant on the Payette River, above Horseshoe Bend, and for the erection of transmission lines through the southern part of Idaho. The proposed plant will develop about 5000 hp and will cost $500,000. A. L. Woodhouse is general superintendent.

KOOSHIA, IDAHO.—Application has been made to the Town Council by F. J. Engelhorn for a franchise to supply electricity for lamps and motors in Kooshia. Mr. Engelhorn is planning to extend his transmission lines to Stiles and Kamiah.

ST. MARIES, IDAHO.—The residents of the district southwest of St. Maries are planning to organize a telephone company for the purpose of constructing a telephone line from that section to this city. F. A. Johnston is interested in the project.

WENDELL, IDAHO.—Plans are being considered for the construction of an electric railway between Wendell and Hagerman during the coming year.

CARLYLE, ILL.—The directors of the Citizens' Telephone & Telegraph Company have voted to accept the offer of H. C. C. Beckemeyer, of Carlyle, to purchase the stock of the company and guarantee the bonded indebtedness, making the consideration $34,000.

CHICAGO, ILL.—The Interstate Independent Telephone & Telegraph Company, which was recently placed in the hands of receivers, is contemplating extensions to its system in the southern and central part of the State. F. A. Dolph is receiver.

COMPTON, ILL.—Improvements are being made to the local electric light plant by the Oregon Power Company, preparatory to the erection of a transmission line from the main plant at Oregon to the plant here for the purpose of supplying electricity in this city.

EAST ST. LOUIS, ILL.—The City Council has granted the East St. Louis Light & Power Company additional franchise privileges which will give the company the right to extend its system in the fast growing sections of Lansdowne and East Lansdowne to supply electricity for lamps and motors.

ELGIN, ILL.—A large Westinghouse generator is being installed in the Rinehimer mills to supply electricity for operating and lighting the mills. The company has recently installed a new set of boilers. When the plant is completed the service now supplied by the Aurora, Elgin & Chicago Railroad Company will be discontinued.

KILBOURNE, ILL.—Negotiations are under way between the Village Board and the owners of the electric plants at Petersburg and Havana, Ill., with a view of having a transmission line erected from one of those plants to supply electricity in Kilbourne.

MATTOON, ILL.—Arrangements have been made by the property owners and business men on Broadway from the Illinois Central lines to Nineteenth Street with the Central Illinois Public Service Company for the installation of ornamental lamp standards and cluster lamps for street lighting.

MT. VERNON, ILL.—Henry L. Doherty & Company, of New York, N. Y., are reported to have purchased the plants and holdings of the Citizens' Gas, Electric & Heating Company in Mt. Vernon from the Trowbridge-Niver Company, of Chicago, Ill.

PEORIA, ILL.—The Moss Avenue Improvement Association has been organized for the purpose of securing an ornamental street lighting system for that thoroughfare. Edward N. Armstrong is president.

STREATOR, ILL.—It is reported that the Illinois Valley Gas & Electric Company is contemplating the construction of a large power plant to cost about $250,000.

COLUMBUS, IND.—The boilers in the municipal electric light plant have been condemned by the inspectors of the insurance company in which the plant is insured, which will necessitate the installation of new boilers. A. H. Mahan is superintendent.

FARMLAND, IND.—The town of Farmland has entered into a contract with the Citizens' Water & Light Company, of Westchester, Ind., to supply electricity for lighting the streets of the village and for commercial purposes. Thirty-eight street lamps will be installed. A transmission line will be erected at once from Winchester to Farmland. Residents living along the line will also be supplied with electrical service.

GAS CITY, IND.—The municipal electric light plant and water works pumping station was destroyed by fire Jan. 6, leaving the city without water and electrical service. Arrangements will be made with the Marion Light & Heating Company to erect a transmission line and furnish electricity for lamps and motors and for operating the pumping station. The city will be without water until new machinery is installed. An entire new plant will have to be built, and it has not yet been decided whether to rebuild or not. The old plant was built about thirteen years ago at a cost of about $37,000.

GOSHEN, IND.—The new steam auxiliary plant of the Hawks Electric Company, has been completed and placed in operation. The plant will be used for emergencies and during the low water periods. The equipment consists of a 625 turbo-generator set and two 300-hp Bass vertical water-tube boilers.

HENRYVILLE, IND.—The Henryville Telephone Company, recently organized, is reported to be in the market for material for a new telephone sytem. George Bellinger is president of the company.

MARION, IND.—The City Council has granted the Marion Light & Heating Company a franchise to supply electricity for power purposes in Marion for a period of thirty-five years, and has also entered into a contract with the company to supply a day service for six months. The day service will be supplied by the transmission lines used by the municipal plant at night. The company will erect new transmission lines throughout the city for the distribution of electricity for motors. S. H. Smith is manager.

MITCHELL, IND.—The municipal electric light plant has been purchased by S. D. Rowland for a consideration of $7,103. Mr. Rowland was granted a franchise to construct and operate a water system, work on which will begin at once. The electric plant was installed by the city about twelve years ago and has been a losing proposition.

MUNCIE, IND.—Steps have been taken by the City Council for the installation of an ornamental street lighting system. The city electrical inspector has been authorized to secure information regarding the lamp standard sytem which is now in use in many cities.

SEYMOUR, IND.—The plant and holdings of the Seymour Gas & Electric Light Company were purchased recently by Frank R. Grover, William Claney and Theodore Durst, all of Chicago, Ill., at a sheriff's sale, for $20,000. The parties represented a reorganized company of the stockholders of the old company, which also purchased the electric light franchise which was granted to the Seymour Public Utilities Company about a year ago. It is understood that improvements will be made to the plant and system.

WAWAKA, IND.—The People's Mutual Telephone Company, recently incorporated, is reported to be in the market for material and equipment for the construction of a telephone sytem. The directors are: John Reidenbach, Braden Franks and William Weaver.

SANBORN, IA.—It is reported that W. D. Bowan, of Charles City, and others have been granted a franchise to supply electricity for lamps in Sanborn.

LAWRENCE, KAN.—Verne Long and Roy Porterfield, students in the engineering school of the University of Kansas, are reported to be preparing plans for the installation of an electric lighting system in a farming community near Madison. The proposed plant will be located six and one-half miles south of Madison. It is expected to have the plant completed by next summer. Power for operating the plant will be obtained from the Verdigris River.

SYLVIA, KAN.—It is reported that a contract has been let for the construction of an electric light plant to replace the old plant, which was destroyed by fire.

WHITE CITY, KAN.—Plans and specifications are being prepared by Burns & McDonnell, of Kansas City, Mo., consulting engineers, for the installation of a municipal electric light plant and water-works system in White City, to cost approximately $25,000.

BOWLING GREEN, KY.—Sealed bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Jan. 21 for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office and court house at Bowling Green, Ky. James Knox Taylor is Supervising Architect.

FRANKFORT, KY.—The City Council is reported to have granted a franchise to E. M. Wallace, manager of the Capitol Lumber Company, to construct and operate an electric light plant in Frankfort, Ky.

MIDWAY, KY.—The City Council is considering the question of granting a franchise to E. M. Wallace, manager of the Capitol Lumber Company, of Frankfort, Ky., to supply electricity for lamps in Midway It is proposed to extend a transmission line from Frankfort, Ky., a distance of fourteen miles, to supply the service. Mr. Wallace was recently granted an electric light franchise by the City Council in Frankfort, Ky.

RICHMOND, KY.—The capital stock of the Richmond Electric & Power Company has been increased to $90,000. J. Hale Dean and L. B Hennington are interested in the company.

ALEXANDRIA, LA.—The City of Alexandria is reported to be negotiating for the purchase of the property of the Alexandria Electric Street Railway Company. If the city takes over the railway it will be operated in connection with the municipal electric light and power plant. If the deal is consummated the proposition will be submitted to a vote of the people.

MANSFIELD, LA.—Preparations are being made by the Southern Telephone Company for improvements and extensions to its local system which will involve an expenditure of about $10,000.

PRESQUE ISLE, MAINE.—Arrangements are being made by the Maine & New Brunswick Electrical Power Company to erect a transmission line from its plant at Aroostook Falls to Limestone, Van Buren and St. Leonards, running near Grand Falls, to supply electricity for lamps and motors to these towns and also to supply power for the construction work in connection with a power plant on St. Johns River, at Grand Falls, which, it is understood, will soon be built.

ANNAPOLIS, MD.—Bids will be received by the Board of County Commissioners of Anne Arundel County, Annapolis, Md., until Jan. 17, 1911, for lighting certain streets or roads of Brooklyn, Curtis Bay and vicinity, and the vicinity of Linthicum Heights, with either arc or incandescent electric lamps, for the terms of one, two, five or ten years. The number of lamps to be supplied will not be less than fifty arc lamps or an equivalent in incandescent lamps. S. O. Tilghman is clerk.

BOSTON, MASS.—The contract for installing electrical system in Curtis Hall, Jamaica Plain, has been awarded to Edwin C. Lewis for $4,471.

GLOUCESTER, MASS.—The City Council has granted the Gloucester Electric Company permission to lay underground conduits on Western Avenue to Kent Circle.

HAVERHILL, MASS.—William W. Roberts, city clerk, acting under the direction of the Municipal Council, has filed a petition with the State Legislature asking for legislation permitting municipalities to construct and operate plants to supply heat, light and power for municipal use and for use of inhabitants, without being compelled to buy any existing plants.

SPRINGFIELD, MASS.—Mayor Edward H. Lathrop in his inaugural address strongly advocated municipal ownership of the gas and electric lighting systems now owned by separate corporations.

WESTBORO, MASS.—Negotiations have been closed whereby the Marlboro Electric Company, of Marlboro, Mass., has leased the property of the Westboro Gas & Electric Company. The local plant will be operated as an independent company. Electricity for operating the local system will be supplied by the Marlboro Electric Company, which receives its power from the plant of the Connecticut River Power Company.

HILLSDALE, MICH.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Feb. 3, for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States post office at Hillsdale, Mich., in accordance with plans and specifications, copies of which may be obtained at the above office, or from the custodian of the site at Hillsdale, Mich. James Knox Taylor is Supervising Architect.

HOLLY, MICH.—The plant of the Holly Electric Light & Power Company, of Holly, Mich., was recently destroyed by fire. The plant was equipped with engine and hydraulic turbine-driven units, having an output of 200 kw.

IRONWOOD, MICH.—The Gogebic & Iron Counties Railway & Light Company, which has an option of the property of the Twin City General Electric Company, consisting of the street railway and electric lighting systems in the cities of Ironwood, Mich., and Hurley, Wis., also plans to acquire the property of the Ashland Power Company, which owns the majority of the capital stock of the Ashland Light, Power & Street Railway, of Ashland, Wis., and land in Ashland County containing the Grand Canyon of Wisconsin, Copper Falls and Brownstone Falls. In this territory on the Bad River there is a total head of 150 ft. The company proposes to improve the Copper Falls and Brownstone Falls property and connect them up with the plant of the White River Power Company at White River, owned by the Ashland Light, Power & Street Railway Company, and with the plants at Ironwood and Bessemer, Mich., for the purpose of supplying electricity throughout the entire territory and for the various mining companies along the Gogebic Range. The Gogebic & Iron Counties Railway & Light Company has applied to the Wisconsin Commission for authority to issue capital stock and bonds for the purpose of taking over the various properties.

LUDINGTON, MICH.—F. R. McMullen & Company and W. F. Mayhon, both of Chicago, Ill., are reported to have leased the Hamlin Lake dam and the plant of the Interurban Electric Light & Power Company to the Cartier Lumber Company, of Ludington, Mich., for a term of fifty years. The contract calls for the erection of a new concrete dam to be completed by June 1. The new company will supply electricity for lamps and motors in Hamlin, Hart and Pentwater. It is said that the company also contemplates the construction of an electric line along the lake shore from Muskegon to Ludington and Manistee.

MUSKEGON, MICH.—The City Council has engaged F. F. Van Tuye, of Detroit, Mich., consulting engineer, to prepare plans and specifications for a municipal electric light plant, the cost not to exceed $75,000.

PONTIAC, MICH.—The order confirming the sale of the property of the Oakland County Telephone Company, including the physical property and franchise, to the Michigan State Telephone Company has been signed by Judge Smith. The price paid for the property was $66,731.

PONTIAC, MICH.—Negotiations have been closed by the Eastern Michigan Edison Company for the purchase of seventeen acres of land near Pontiac, on which it proposes to erect a large power plant. When completed the plant will supply electricity in Pontiac, Mount Clemens, Royal Oak, Utica and Rochester for commercial purposes.

THOMPSONVILLE, MICH.—Plans are being considered by the National Wood Dish Company for the construction of an extension to its plant. New machinery will be installed, including power equipment.

MINNEAPOLIS, MINN.—The directors of the Minneapolis General Electric Company have called a meeting of the stockholders to be held Jan. 16 to vote on the proposition to increase the capital stock of the company by $875,000, the proceeds to be used to finance extensions and additions to its system.

MINNEAPOLIS, MINN.—The main power plant of the Minneapolis General Electric Company was destroyed by an explosion and fire on Jan. 6, causing a loss of about $750,000 and putting a great portion of the electric service throughout the city out of commission. The company is making arrangements to secure electricity from its plants at Taylor's Falls.

MOOREHEAD, MINN.—The Moorehead & Fargo Street Railway Company is reported to be contemplating the extension of its railway to Dilworth.

ST. PAUL, MINN.—The City Council has awarded the contract for lighting the streets of the city for the ensuing year as follows: To the St. Paul Gas Company for supplying electricity for ornamental street lamps at $75 each per year, a reduction of $15 from the present price; also for arc lamps served by overhead wires at $75 per lamp per year, a reduction of $5 per lamp; arc lamps with underground service at $90 each per year. The contract for gas lighting was awarded to the Patterson Street Lighting Company. The reduction in the cost of electric lamps will be about $9,000 from the present contract.

SANTIAGO, MINN.—The Santiago-Blue Hill Telephone Company is erecting a branch telephone line to Glenorado

GLASGOW, MO.—The suit brought against the City of Glasgow to establish the validity of the bond issue of about $30,000, the proceeds to be used for the installation of water works, electric lights and sewerage system, has been decided in favor of the city. The proposition was voted on more than a year ago, but the legality of the bond issue was taken to the Supreme Court, which has declared the bond issue legal.

KANSAS CITY, MO.—The City Council has granted the Intercity Viaduct & Freight Railway Company a thirty-year franchise for an electric switching system in the North End. The company is a subsidiary of the Intercity Viaduct Company, which owns the viaduct connecting Kansas City, Kan., and Kansas City, Mo. The viaduct is a mile long and cost nearly $1,000,000.

OREGON, MO.—It is reported that the City of Oregon would like to receive prices on the following equipment for the municipal water and light plant: One direct-connected unit, consisting of a 120-hp to 150-hp engine and a 2200-volt, 60-cycle alternator, one 150-hp high-pressure boiler and accessories. For further information address Norton R. Martin, superintendent electric light and water works plant.

PALMYRA, MO.—The Hannibal & Northern Missouri Railroad Company has been granted a franchise by the City Council to construct a railway, to be operated by electricity or other power, on certain streets in Palmyra. The company proposes to build a railway to extend from Palmyra to Shelby, the same to be in operation by June 1914

SPRINGFIELD, MO.—Plans are being considered for the construction of a large hydroelectric power plant on the White River, near Springfield, Mo. A committee composed of H. M. Smith, cashier of the Merchants' National Bank; C. H. Cole, president of the United Iron Works, and Senator F. M. McDavid, chairman, has been appointed to look into the matter. A. J. Zwart, of St. Louis, Mo., is interested in the project. The cost of the proposed plant is estimated at about $1,000,000.

KALISPELL, MONT.—Arrangements are being made for the construction of an electric railway from Columbia Falls to Polsen, down the east side of the Flathead Lake and River, work on which will begin about March 1.

TROY, MONT.—The County Board has granted R. E. Porterfield a franchise to install an electric light system in Troy.

BEATRICE, NEB.—The Commercial Club is reported to be considering the proposition of installing an electric light plant in connection with the new water works system, for which bonds were recently voted. A resolution has been adopted authorizing the City Council to make a thirty days' test of the wells north of the city, and if a sufficient supply of water can be procured to proceed with the construction of an electric light plant for the city.

FAIRBURY, NEB.—Burns & McDonnell, of Kansas City, Mo., consulting engineers, have prepared plans for the construction of an electric light plant and water-works system in Fairbury, Neb., for which bonds to the amount of $40,000 have been issued.

HOLDREGE, NEB.—Bids will be received until Feb. 2 at the office of the Supervising Architect, Treasury Department, Washington, D. C. for construction, including plumbing, gas piping, heating apparatus and electric conduits and wiring of the United States post office at Holdrege, Neb., in accordance with plans and specifications, copies of which may be obtained at the above office or from the custodian of the site at Holdrege, Neb. James Knox Taylor is Supervising Architect.

NEBRASKA CITY, NEB.—The Burlington Railroad has installed an electric block system from its passenger station to the east side of the river. It is understood that the company expects to extend the system to Lincoln and to the south lines in the spring.

ELY, NEV.—It is reported that work will begin in the spring on the construction of a large hydroelectric power plant to supply electricity to operate the reduction works of the Giroux Consolidated Company in this district. The plant will be erected by the Telluride Power Company and will be located on Cleveland Creek, about twenty miles east of Ely, where between 2000 and 3000 hp will be developed.

FALLON, NEV.—The City Council is negotiating with the United States government officials in regard to utilizing the water power in a canal about six miles from Fallon in connection with the construction of the proposed municipal electric light plant. There is a 26-ft. drop in the canal carrying 50 second ft. of water, and it is proposed to purchase or lease the power house at that point and transmit electricity to this city. C. J. Noble is city clerk.

PITTSFIELD, N. H.—The streets of the town were lighted by electricity for the first time on Dec. 28, the service being supplied by the Pittsfield Light & Power Company, recently organized. The contract is for a term of five years, under which both arc and 32-cp tungsten lamps will be supplied. The equipment of the power house includes a 150-hp boiler, an engine having a rating of 125 hp, an 85-kw alternating-current generator and a 3½-kw exciter, together with switchboard and transformers. The primary circuits will carry 2200 volts, which will be stepped down to 110 volts for residential lighting. Charles F. Gardner is manager, and Guy F. Harden is superintendent.

PORTSMOUTH, N. H.—Arrangements are being made to install an electric plant on Appledore Island on the Isles of Shoals. The proposed plant will supply electricity and heat for the large hotel and other buildings on the island. Henry W. Morse is manager.

NEWARK, N. J.—The Public Service Electric Company, a subsidiary of the Public Service Corporation of New Jersey, has filed a certificate with the Secretary of State, showing that it has just issued $1,000,000 in capital stock for cash at par value.

NEWARK, N. J.—D. B. Dunham & Sons, of Rahway, N. J., are erecting a five-story building, 100 ft. square, at Central Avenue and Fourth Street, Newark, N. J., which will be equipped with wood-work machines, blacksmith tools, drill presses and machine tool equipment. A steam heating plant and a large automobile elevator are being installed. The plant will be equipped for electric motor drive. Electricity for operating the plant will be supplied by the Public Service Corporation of New Jersey. The company manufactures automobile bodies.

CARTHAGE, N. M.—Messrs. Stackhouse & Brown, of Carthage, N. M., have submitted a proposition to the federal government to extend an electric transmission line from their power plant at Carthage to the site of the proposed Elephant Butte Dam and to supply electricity for carrying on the construction work there and to provide electricity for lighting the construction camp. The proposed line will be seventy-five miles in length. A power plant will be erected for this special purpose and to provide electrical power for the Kelly and Mogollon mining districts.

FARMINGTON, N. M.—Investigations are being made by J. A. Clay, general manager of the Durango Electric Company and San Juan Water & Power Company, in Farmington, with a view of extending the electric transmission lines of the companies to this locality to supply electricity to operate the irrigating pumping plants and for other purposes. It is reported that it is proposed to take over the Farmington electric light plant.

LAS CRUCES, N. M.—The Las Cruces Electric Light & Ice Company has extended its electric lighting system to the town of Mesilla Park.

LAS CRUCES, N. M.—At a recent meeting of the Elephant Butte Water Users' Association, held in Las Cruces, President H. B. Holt officially reported that the federal government has embraced in its plans for the construction of the large dam and land reclamation enterprise in the upper valley of the Rio Grande the installation of a hydroelectric plant, which will utilize the maximum amount of power afforded by the water storage reservoir. Electricity generated at the plant will be transmitted throughout the valley for use of the farmers.

ROSWELL, N. M.—Sealed bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Feb. 2, 1911, for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring of the United States post office and court house at Roswell, N. M., in accordance with drawings and specifications, copies of which may be secured from the custodian of site at New Roswell, N. M., or at the above office. James Knox Taylor is supervising architect.

SILVER CITY, N. M.—The Gila River Power Company has been granted permission by the Territorial Engineer to divert water from the Gila River in the western portion of Grant County. The company proposes to reclaim about 50,000 acres of land by irrigation and to supply electricity for transportation purposes to the Mogollon mining section and to other points in the county. The company is capitalized at $6,000,000. Thomas Lyons, manager of the Gila Farm Company, of Gila, N. M.; William D. Murray, president of the Silver City National Bank, of Silver City, N. M., and John R. Bartlett, of New York, N. Y., are said to be directors.

ALBANY, N. Y.—The State Trustees of Public Buildings have awarded the contract for the construction of the power house for the Capitol Building and the State Education Building to the Ford Construction Company, of Rochester, N. Y., for $346,287.

BROOKLYN, N. Y.—The contract for installing four electric elevators in the Kings County Hospital has been awarded to the Maintenance Company, 5456 Franklin Street, New York, N. Y., for $13,800.

BUFFALO, N. Y.—A resolution was introduced at a recent meeting of the Board of Aldermen asking Francis G. Ward, Commissioner of Public Works, to furnish estimates of the cost of installing ornamental electric lamps in the district bounded by Tupper, Michigan, Buffalo River, Main Street and Delaware Avenue, similar to those erected in Genesee Street.

DUNKIRK, N. Y.—The Public Service Commission, Second District, has granted the petition of the Dunkirk Power & Heating Company, of Dunkirk, N. Y., to consolidate with the Dunkirk Distributing Company, and to increase its capital stock to $50,000. The company will supply electricity and heat.

EASTHAMPTON, N. Y.—The Easthampton Electric Light Company has applied to the Public Service Commission, Second District, for permission to issue $14,000 in bonds, the proceeds to be used for enlargement of its power house and extensions to its system.

GLOVERSVILLE, N. Y.—The Fulton County Gas & Electric Company has reduced the price of gas in the cities of Gloversville and Johnstown from $1.30 per 1000 cubic feet to a sliding scale, commencing at $1.20 and running down to $1 per 1000 cubic feet. The reduction was voluntary on part of the company.

NEW YORK, N. Y.—The Public Service Commission has granted the application of the Bronx Gas & Electric Company for permission to issue $154,000 in bonds, under a mortgage made July 1, 1910, to the Knickerbocker Trust Company, the bonds to be sold at not less than 95.

NEW YORK, N. Y.—The contract for furnishing 500 lamp standards for tungsten lamps for lighting the parks of the city of New York was awarded to the Elmer P. Morris Company, 90 West Street, New York, N. Y. About half of these posts are of a new type and will be used for the lighting of the transverse roads through Central Park, and the balance for regular installations.

SCHAGHTICOKE, N. Y.—The Hoosac River Electric Light & Power Company has been authorized by the Public Service Commission, Second District, to exercise a franchise granted by the town of Pittstown, N. Y., to supply electricity for lamps and motors in that place.

WEST POINT, N. Y.—Sealed proposals will be received at the office of the Quartermaster, West Point, N. Y., until Jan. 30, 1911, for furnishing and installing a complete central energy telephone system, as per drawings and specifications on file in the above office. Proposals from manufacturers of telephone apparatus and cables only will be considered. Forms for proposals will be furnished on application.

HICKORY, N. C.—The Water Power Electric Company is reported to have engaged Connell & Connell, 90 West Street, New York, N. Y., as chief engineers, in connection with the construction of a hydroelectric power plant, which will develop about 9000 hp. Louis R. Abel, 258 Broadway, New York, N. Y., will be resident engineer.

SPRAY, N. C.—The Fine Arts Gingham Manufacturing Company, recently organized with a capital stock of $300,000, is planning to erect a new plant at Meadow Summit, near Spray. About 10,000 spindles and 400 looms will be installed. The mill will be equipped for electric motor drive.

WINSTON-SALEM, N. C.—It is reported that the North Carolina Traction Company, which was organized for the purpose of building an interurban electric railway from Winston-Salem to Floyd, Va., has decided to award contracts for the construction of the road during this month. The proposed railway will be ninety-two miles in length. Bonds to the amount of $2,000,000 are said to have been authorized.

MANDAN, N. D.—The installation of a municipal electric light plant is reported to be under consideration.

MINTO, N. D.—The question of establishing a municipal electric light plant in Minto is reported to be under consideration.

AKRON, OHIO.—Director of Public Service J. W. Gauthier has notified the City Council that all the city's lighting contracts expire in 1912 and advises that it is time that the subject be given some consideration. He states that either gas or electric lamps should be stipulated in the new contracts, but prefers electric lamps. He believes that a more advantageous price can be obtained for the electric lighting service than the city is now paying.

ANDOVER, OHIO.—The Andover Electric Telephone Company has filed amendments to its charter increasing its capital stock from $6,000 to $10,000.

DEFIANCE, OHIO.—The city has entered into a contract with the Defiance Gas & Electric Company to light the streets of the city for a period of ten years. Under the terms of the contract the company is to supply arc lamps at the rate of $70 each per year and electricity for commercial lighting at the rate of 9 cents per kw-hour with a discount of 10 per cent for prompt payment.

ELYRIA, OHIO.—Negotiations are under way looking to the consolidation of the independent telephone companies of this county. It is proposed to organize a company with a capital stock of $600,000 to take over all the systems, the stockholders to be given three shares of stock in the new company for each share of the old company stock held by them.

LATHROP, OHIO.—It is reported that the Black Diamond Coal & Coke Company, of Columbus, Ohio, is planning to rebuild its tipple and power house at Lathrop, which was recently destroyed by fire.

NORTH BALTIMORE, OHIO.—The North Baltimore Service Company, recently incorporated with a capital stock of $30,000, proposes to establish an electric plant and gas plant to supply gas and electricity for light, heat and power in North Baltimore. The incorporators are: Arthur J. Darton, Ralph S. Holbrook, Joseph Steinem and Claude R. Banker.

DILL, OKLA.—The capital stock of the Dill Farmers' Telephone Company has been increased to $5,000. The company contemplates making improvements to its system.

DURANT, OKLA.—The City Council has authorized plans to be prepared for the construction of a municipal electric light plant, with sufficient output to supply electricity for 100 arc lamps and for commercial lighting for the city. The proposed plant will be located in the rear of the city hall. Bonds to the amount of $20,000 have been voted for same.

OKLAHOMA CITY, OKLA.—It is reported that preparations are being made by the Oklahoma Street Railway Company for the erection of an addition to its Belle Isle power plant, increasing the output from 2500 to 5000 hp. The company also proposes to enlarge its substations at Olie Avenue and Second Street.

STILWELL, OKLA.—The City Council has awarded the contract for the construction of the electric light plant to the Southwestern Engineering Company, of Oklahoma City, Okla., for which bonds to the amount of $5,000 were recently voted.

COTTAGE GROVE, ORE.—The Cottage Grove Electric Company has submitted a proposition to the Council offering to make extensions and improvements to its system, involving an expenditure of $12,000, providing a twenty-year franchise is given it from the expiration of its present franchise.

HOOD RIVER, ORE.—The Oregon & Washington Electric Corporation is reported to have purchased the plant and holdings of the Hood River Electric Light & Power Company. It is said that the price paid for the property was $70,000, the purchaser to assume the bonded indebtedness amounting to as much more.

LAKEVIEW, ORE.—The California & Oregon Light, Heat & Power Company is contemplating establishing a day service during the coming year. N. P. Jensen is superintendent.

LEBANON, ORE.—The City Council has granted the Albany & Interurban Railway Company a franchise in this city. The railway will extend from Albany to Sweet Home via Lebanon, thence to Holly and down to Brownsville.

SALEM, ORE.—It is reported that J. J. Hill has closed negotiations for the purchase of the Salem, Falls City & Western Railroad. It is understood that the railway will be equipped for electrical operation and will be operated in connection with the Oregon electric railway.

SUTHERLIN, ORE.—Plans are being made for the construction of an electric railway down the valley. A power site has been located. The project also includes opening up large coal and timber properties. M. M. Valerius, of Sutherlin, and G. E. Fosbrooke, of St. Paul, are interested in the project.

PHILADELPHIA, PA.—The Pennsylvania Equipment Company, West End Trust Building, Philadelphia, Pa., is reported to be in the market for a 20-ton, 40-ft. span overhead electric traveling crane.

PITTSBURGH, PA.—Arrangements are being made by the Pittsburgh Railways Company for the erection of a new substation, 67 ft. x 68 ft., at Forbes and Craft Streets, Pittsburgh,

PUNXSUTAWNEY, PA.—The new power plant of the Jefferson Electric Heat & Light Company is nearly completed and will soon be put in operation. A new street lighting system has been installed, which will be put in service as soon as the plant is started. It is understood that the company will supply electricity to operate the silk mill of the United Textile Company.

SCRANTON, PA.—The Wayne & Lackawanna, the Wallen-Paupack and the Wayne & Pike Telephone Companies have been consolidated under the name of the Paupack Telephone Company. The new company is capitalized at $50,000 and contemplates making improvements and extending the service. The officers are Dr. L. P. Cooke, of Hawley, president; Franklin A. Peet, of Hamlin, vice-president; J. T. McFarland, of Lake Ariel, secretary, and E. P. Jones, of Lake Ariel, treasurer.

STEELTON, PA.—Plans are being considered by the Steelton Light, Heat & Power Company for the erection of an electric plant within the next six months. At present the company purchases energy from the York Haven Company.

TITUSVILLE, PA.—The Titusville Electric Traction Company is reported to be contemplating extensions to its system. If the proposed extensions are made, additional power equipment will be required. The generating station is located at Fieldmore Springs, near Titusville, Pa. W. J. Smith, president and general manager, has charge of the purchasing department.

BELLE FOURCHE, S. D.—The Belle Fourche Electric Light, Heat & Power Company is reported to be contemplating the erection of a new transformer station and the installation of two more transformers next spring.

BRYANT, S. D.—The Electrical Engineering Company, of Minneapolis, Minn., has secured the contract for the installation of the municipal electric light plant, at $3,000.

FLANDREAU, S. D.—The St. Paul Railroad Company is reported to have completed arrangements for the construction of an electric railway to Ortonville, Minn.

GANN VALLEY, S. D.—The local telephone company is contemplating the construction of an exchange building in Gann Valley.

HENRY, S. D.—The Council is reported to have awarded the contract for the installation of an electric light plant to the E. M. Pope Manufacturing Company.

IRENE, S. D.—Jensen Brothers have been granted a franchise to install and operate an electric light plant in Irene.

RAPID CITY, S. D.—The Dakota Power Company has taken over the plant and holdings of the Rapid City Power Company. It is understood that the price paid for the property is $150,000. When the merger of the plants is completed the company will have an output of 7500 hp.

WHITEWOOD, S. D.—The Whitewood Electric Light & Power Company has commenced work on the erection of a transmission line to connect with the system of the Consolidated Power & Light Company.

JOHNSON CITY, TENN.—The Watauga Electric Company has recently installed a 700-hp steam turbine in its electric plant in Johnson City. The plant supplies electricity for lamps and motors throughout the city and also for operating the cars of the Johnson City Traction Company. A. Smith is secretary and manager.

BURNET, TEX.—The Smart telephone system, which covers Burnet County and many towns in other counties, has been purchased by G. P. Lester, of San Angelo, Tex. The purchase price is said to have been $5,000.

HEARNE, TEX.—At an election held Dec. 14 the citizens voted in favor of the proposition to issue bonds for the construction of water works and electric light improvements.

PROVO, UTAH.—Preparations are being made by the Telluride Power Company, of Provo, Utah, for the construction of a large hydroelectric power plant near the confluence of the Malad and Snake rivers and the erection of an electric transmission line to run east and west across the southern part of Idaho. The plant will develop about 10,000 hp and will involve an expenditure of several millions of dollars.

BRATTLEBORO, VT.—The question of installing an ornamental street lighting system on Main Street, from the Brattleboro House to the library, is under consideration. It is proposed to erect ornamental lamp standards each carrying three, four or five 100-watt tungsten lamps. The town recently entered into a contract with the Twin State Gas & Electric Company for street lighting for a term of ten years. The contract calls for 100-watt incandescent tungsten lamps.

NORFOLK, VA.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 4 for a 60-ton electric traveling crane in building No. 23 at the Navy Yard, Norfolk, Va. Specifications can be obtained on application to the bureau or to the commandant of the navy yard named. The cost of the work is estimated at $12,500. R. C. Hollyday is chief of bureau.

ABERDEEN, WASH.—The Citizens' Lighting & Power Company, recently incorporated, has applied to the City Council for a franchise to construct and operate an electric light and power plant. The company also proposes to build an electric railway.

GLACIER, WASH.—The Watt Development is being organized to take over the power rights owned by H. C. Evans on Hood River.

GRANGER, WASH.—Transmission lines are being erected in Granger by the Pacific Power & Light Company for the purpose of supplying electricity for lamps in this town.

NORTH YAKIMA, WASH.—Plans have been completed by the Pacific Power & Light Company for enlarging and improving the hydroelectric plant at Priest Rapids. It is proposed to widen, deepen and cement the bottom of the main canal, which supplies water to the White Bluffs and Hanford ranchers. The company also proposes to make the large canal at Priest Rapids a ship canal, providing the government will supply the locks.

PE ELL, WASH.—Application has been made to the Town Council by H. W. Welles for a franchise to install a telephone system in Pe Ell. Mr. Welles also proposes to extend the system to McCormick, Walville, Doty and Dryad.

SEATTLE, WASH.—The City Council is reported to have revoked the franchise of the Seattle, Renton & Southern Railway Company, which operates a railway from Seattle to Renton.

SOUTH BEND, WASH.—J. D. Creary is reported to have applied to the City Council for a franchise to construct and operate an electric interurban railway in South Bend. The proposed railway will extend from this city to Raymond. It is expected that work will begin in the spring.

SPOKANE, WASH.—Bids will be received by the Board of Public Works until Jan. 21, 1911, for the uncompleted portion of the plumbing, heating, electric wiring and painting of the isolation hospital. Plans and specifications and information for same may be obtained in the office of Preusse & Zittel, supervising architects, Jamieson Building, Spokane, Wash., and at the office of the Board of Public Works. J. C. Argall is secretary.

SPOKANE, WASH.—The Washington Water Power Company is planning extensive changes to its transmission system in Opportunity, which will include the erection of a new power plant and the removal of the high-tension transmission lines from Dishman, and the erection of a new transmission line to run directly south to the new station and thence on to Chester from the main power line, which extends along the Northern Pacific Railroad.

SPOKANE, WASH.—Bids will be received by the City of Spokane, Wash., until Jan. 20, for the following machinery and equipment: Two 14-in. single suction, horizontal shaft, two-stage centrifugal pumps, with necessary priming fixtures; one 900-hp, 2200-volt, 60-cycle, 3-phase induction motor; one cast-iron base plate; two 450-hp flexible couplings; one switchboard panel, 65 in. x 24½ in., ⅜ in. bevel, mounted 25 in. from the floor, with all necessary wiring and the following apparatus: One ammeter, 400-amp; one automatic oil switch, one set brass bars, two current transformers, one card holder, one name plate, one set starting resistance and all necessary connecting cables between switchboard and motor and between motor and starter, valves, pipe connections. Also one 3,000,000-gal., two-stage, horizontal shaft pump, with necessary priming fixtures; one induction motor of the wound rotor type, with necessary starter and switching devices; one switchboard complete, with necessary connecting cables between the motor starter and switchboard. Plans and specifications are on file in the office of the Board of Public Works, Spokane, Wash. John Gifford is city purchasing agent.

VANCOUVER, WASH.—Important water rights in Canyon Creek have been filed on by J. L. Charlton, of Vancouver, Wash. It is said that a company will soon be organized to furnish electrical service in this vicinity. An electric railway will be built from Yacolt to Vancouver, and possibly up along the north bank of the Columbia River to White Salmon. H. W. Arnold, representing Eastern capitalists, is promoter.

AFFINITY, W. VA.—The Pemberton Coal & Coke Company, of Affinity, W. Va., is reported to have placed an order with the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for a 150-kw engine-driven generator, and a large motor generator set. Auxiliary apparatus will be purchased as needed.

BLUEFIELD, W. VA.—Arrangements are being made by the Norfolk & Western Railroad Company for the construction of an addition to its local power house. C. S. Churchill, of Roanoke, Va., is chief engineer.

MARTINSBURG, W. VA.—Extensive improvements and additions are being made to the plant of the Martinsburg Power Company, which, when completed, will increase the output of the plant to 2500 hp. The new equipment will include one 1000-hp boiler, manufactured by the Edgemont Iron Company, of Edgemont, Del., and one 1000-hp steam turbo-generator set. The boiler will be equipped with a Welzel mechanical stoker. The 350-hp engine now in the power house will be held for use in emergencies.

COMBINED LOCKS, WIS.—The Combined Locks Paper Company has awarded the contract for the construction of a steel and concrete dam to the O'Keefe Orbison Engineering & Construction Company, of Appleton, Wis. The proposed dam will be 645 ft. long and carry a head of 19 ft. of water, and will cost from $90,000 to $100,000.

FREMONT, WIS.—A telephone company has been organized by George Dobbins and others to build a telephone exchange in Fremont and erect telephone lines to connect with the Poysippi and Weyauwega exchanges.

GRAND RAPIDS, WIS.—The Arpin Lumber Company, of Grand Rapids, Wis., expects to have its large power dam, located about six miles from Conderay, on the Chippewa River, completed next spring. As yet, it has not been determined whether a hydroelectric plant will be installed or not.

HATFIELD, WIS.—The report that the La Crosse Water Power Company is to sell its dam and power plant in Hatfield to the Minneapolis, St. Paul, Rochester & Dubuque Traction Company is denied by the officials of both companies. M. W. Savage, president of the traction company, states that the company will build its own plant.

HUDSON, WIS.—B. W. Ultman is reported to have purchased flowage rights on the Kinnickinic River and proposes to construct a dam and erect a power plant.

KAUKAUNA, WIS.—At a special election held recently the citizens voted in favor of the proposition to purchase the electric plant of the Kaukauna Gas & Electric Company, to be owned and operated by the municipality.

MADISON, WIS.—J. E. Jones, secretary of the Chicago & Wisconsin Valley Street Railways Company, states that work on construction of its proposed railway will begin in April, 1911, between Madison and Portage. The company has taken offices in the Washington Building, Madison, Wis.

MARINETTE, WIS.—It is reported that plans are under way for the development of the water-power of Chappie Falls, on the Menominee River, four miles north of Marinette. It is estimated that about 6000 hp can be developed, which will be transmitted to Marinette by electricity.

PARDEEVILLE, WIS.—Plans are being prepared by the Columbia Electric Light & Power Company, of Pardeeville, Wis., for the installation of an electric power plant at Rio, Wis., the equipment of which will include a 150-hp return tubular boiler, one 125-hp Corliss or four-valve engine, one 100-kw, 3-phase, 60-cycle, alternating-current generator, feed water heater, pump, switchboard, etc.

PRAIRIE DU SAC, WIS.—Surveys are being made by the Wisconsin River Power Company for its proposed dam to be erected across the Wisconsin River near Prairie du Sac. According to the present plans, the dam will be 1500 ft. long, with 1000 ft. spillway, with a head of 25 ft., capable of developing 26,000 hp. Transmission lines will be erected to Milwaukee and Madison and also to North Freedom to supply electricity for the mines in that section. R. G. Walter has charge of the work.

VIOLA, WIS.—It is understood that this village will be in the market in about sixty days for equipment for the proposed municipal electric plant. The work will include the construction of a dam across the Kickapoo River. The plant will be driven by hydraulic turbines. C. R. Thomson, of Richland Center, Wis., engineer, has charge of the work.

WATERTOWN, WIS.—Bids will be received at the office of the Supervising Architect, Washington, D. C., until Feb. 7, for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office at Watertown, Wis., plans and specifications for which may be obtained at the above office or from the custodian of site at Watertown, Wis. James Knox Taylor is Supervising Architect.

WAUPACA, WIS.—Plans are being considered by the City Council for the installation of an independent power plant. It is proposed to install the plant in the basement of the new high school, the equipment to consist of one or more high speed engines, direct-connected to generators, motors and other electrical and mechanical apparatus.

EDMONTON, ALTA., CAN.—Tenders will be received by John Stocks, Deputy Minister of Public Works, until Jan. 23 for all telephone material required during the coming year for extensions and repairs in this Province.

EDMONTON, ALTA., CAN.—The consulting engineers have reported on two propositions for civic power development to the north of the city. The development at Grand Rapids, 192 miles north, would cost about $3,000,000, making the cost about $30 per horse-power in Edmonton, while the development at Athabasca Landing, 105 miles north, would cost $2,000,000, making the cost per horse-power $20 per year. The city has both propositions under consideration.

PINCHER CREEK, ALTA., CAN.—The City Council is negotiating with the Pincher Creek Electric Light Company for the purchase of its plant, to be owned and operated by the municipality. Smith, Kerry & Chase, of Winnipeg, Man., and Toronto, Ont. consulting engineers, are now appraising the plant.

FERNIE, B. C., CAN.—Arrangements are being made to supply electricity for operating the municipal electric plant from the generating plant of the Bull River Power Company located on Bull River.

FERNIE, B. C., CAN.—The British Columbia Electric Company, of Vancouver, has filed application for 500 miners' inches of water from the Elk River, near Fernie, and for several smaller rights on other streams. It is said that the company proposes to develop the power for transmission by electricity to the towns in the Crow's Nest Pass country.

VANCOUVER, B. C., CAN.—Investigations are being made into the local telephone conditions. The installation of an automatic system in addition to the present plant has been suggested.

VANCOUVER, B. C., CAN.—The British Columbia Hydraulic Power Company, 415 Winch Building, Vancouver, B. C., has filed application for 300 cu. ft. of water per second from Nanaimo Falls, to be utilized to generate electricity.

VANCOUVER, B. C., CAN.—It is reported that the Canadian Pacific Railroad Company is planning to construct an electric railway connecting Vancouver, B. C., with Seattle, Wash., and Portland, Ore., for which, it is said, surveys are now being made.

YMIR, B. C., CAN.—It is reported that the provincial government is planning to erect a telephone line from Ymir to Waneta and also to Nelson as soon as the weather permits in the spring. For further information address R. A. Ibbottson, of Ymir, B. C.

BRANDON, MAN., CAN.—A syndicate of capitalists from Vancouver, B. C., is negotiating with the City Council for a franchise to establish a street railway sytem in Brandon.

WINNIPEG, MAN., CAN.—It is stated that the Canadian Pacific Railroad Company proposes to install 2000 miles of telegraphone wires along its system, principally in western Canada.

WINNIPEG, MAN., CAN.—The contract for the installation of a 500-kw generator set in the municipal electric plant was awarded to Seamans Brothers, of Toronto, Ont., for $16,410.

WINNIPEG, MAN., CAN.—The City of Winnipeg has voted to appropriate $80,000 for the installation of underground conduits in the city this year, work on which will begin in May. H. N. Ruttan is city engineer.

AMHERST, N. S., CAN.—Arrangements are being made by the Canada Electric Company, of Amherst, for increasing the output of its plant this spring. The city has agreed to double the amount of power it is now using. The cost of the work is estimated at about $13,000.

BOWMANVILLE, ONT., CAN.—The ratepayers have passed a by-law granting a franchise to the Seymour Electric Light & Power Company, Ltd., to erect an electric light and power plant in Bowmanville.

FORT WILLIAM, ONT., CAN.—The by-law to appropriate $67,000 for improvements and extension to the municipal electric street railway system has been passed.

HAMILTON, ONT., CAN.—Plans are being made by the Dominion Power & Transmission Company for extension and improvements to its plant, which will involve an expenditure of about $350,000, of which $100,000 will be expended on the erection of a new substation in Hamilton. The company will also purchase new street cars at a cost of about $30,000, orders for which have been placed with the Preston Car & Coach Company, of Preston, Ont.

HAMILTON, ONT., CAN.—George Lynch Staunton, K.C., acting for several Hamilton capitalists, has secured a Provincial charter for an electric railway extending from Hamilton to Port Dover. The cost of the proposed railway is estimated at about $1,000,000. It is expected that the cars will be taken up the "mountain" by the Hamilton & Barton Incline Railway, or an arrangement made with the Brantford & Hamilton Electric Railway to use its line running out westward as far as Ancaster.

KINGSTON, ONT., CAN.—The citizens on Jan. 2 voted in favor of the by-law to make improvements to the municipal electric light plant. C. C. Folger is manager.

PORCUPINE, ONT., CAN.—A. E. Wallberg is constructing an electrical power plant on the Metagami River and will supply electricity for lamps and motors to the surrounding country.

RAINY RIVER, ONT., CAN.—Application has been made to the Dominion Parliament for a charter for the Western Canada Company, with powers to construct canals in this vicinity, to be utilized to generate electricity.

TOFIELD, ONT., CAN.—Application has been made to the town officials by Charles E. Taylor, manager of the Tofield Coal Mines Company, for a franchise to construct and operate an electric light plant to supply electricity for lamps and motors in Tofield and the surrounding country. Work will begin on construction of the plant as soon as the franchise is granted.

TORONTO, ONT., CAN.—Justice Middleton on Jan. 4 dismissed the application of the town of Dundas for an injunction restraining the Cataract Power Company from erecting wires across the Des Jardines Canal. Justice Middleton held that the wires would not interfere with the navigation of the canal.

TORONTO, ONT., CAN.—The Electric Power Company, recently incorporated under a Dominion charter, has taken over the following companies: The Seymour Power & Electric Company, of Campbellford, Ont.; the Peterborough Light & Power Company, of Peterborough, Ont.; the Trenton Water & Electric Company, of Trenton, Ont.; the Sydney Electric Power Company; the Nipissing Power Company, of Toronto, Ont.; the Oshawa Electric Light Company, of Oshawa, Ont.; the gas company, of Oshawa; the Cobourg Utilities Corporation, of Cobourg, Ont.; the Northumberland & Durham Power Company, of Cobourg, Ont., and the Central Ontario Power Company, of Peterborough, Ont.

MONTREAL, QUE., CAN.—The Shawinigan Water & Power Company, it is reported, will apply to the Quebec Legislature for permission to increase its capital stock if necessary up to an amount not exceeding $20,000,000.

MONTREAL, QUE., CAN.—It is reported that the directors of the Saraguay Electric & Water Company have authorized Charles Brandeis, civil and electrical engineer, 4 Phillips Place, Montreal, to prepare plans for the erection of a new power-house, equipment, etc. Steam turbines will be installed in units of 3000 hp each. Contracts will be placed about the first of February. The cost of the plant is estimated at about $225,000.

REGINA, SASK., CAN.—Tenders will be received by the City of Regina until Jan. 31, 1911, for furnishing and installing the following equipment: One 1500-kw steam turbo-generator set, one 500-kw direct-current generating unit, two 500-hp boilers, one fuel economizer, one hand-power traveling crane and one coal and ash conveyor. This is an extension of date for receiving proposals from Jan. 17, as published in our issue of Jan. 5. Specifications and further information will be furnished on application to A. J. McPherson, city commissioner, or E. W. Bull, city electrician.

SONORA, MEX.—The Kellogg Switchboard & Supply Company, of San Francisco, Cal., has closed a contract with the Compania Telefonica de Sonora, S. A., of Sonora, Mex., for telephone equipment for the City of Hermosillo. H. C. Goldrick is local manager, and Charles W. Forbes is general manager of the company, which has taken over the government concession for the entire system of telephone lines in the State of Sonora.

New Industrial Companies.

THE AMERICAN SUCTION CLEANER COMPANY, of New York, N. Y., has been chartered with a capital stock of $25,000 to manufacture cleaning machinery, etc. The incorporators are: E. N Burns, J. Devine and E. F. Sause, all of New York, N. Y.

THE ATLANTIC ELECTRIC SUPPLY COMPANY, of Greenville, S. C., has been incorporated with a capital stock of $10,000 by D. A. Henning, H. L. Fuller and E. C. De Bruhl.

THE CONTINENTAL CONSTRUCTION & SUPPLY COMPANY, of Wichita, Kan., has been organized for the purpose of doing a general contracting business, making a specialty of refrigerating plants, electric lighting plants, dealing in all kinds of pumping machinery and automatic electric water systems for cisterns and wells. Ira Judson Foster, formerly with the Kansas Gas & Electric Company, is general manager.

THE DOWDALL MANUFACTURING COMPANY, of Borough of Queens, N. Y., has been incorporated by John F. Linton, James F. Dowdall, both of Glen Morris, N. Y., and Benjamin F. Hamm, 522 West 145th Street, New York, N. Y. The company is capitalized at $10,000 and proposes to manufacture and sell electric pressing irons, etc.

THE INSTANTANEOUS ELECTRIC HEATER COMPANY, of Boston, Mass., has been chartered with a capital stock of $10,000. The directors are: J. S. Dondero, president; William H. Barter, of Winthrop, treasurer, and J. M. Starr.

THE KELLER MANUFACTURING COMPANY has filed articles of incorporation under the laws of the State of Maine for the purpose of dealing in vacuum-cleaning machines. The company is capitalized at $1,250,000.

THE LAPORTE METER COMPANY, of Laporte, Ind., has filed articles of incorporation with a capital stock of $150,000 for the purpose of manufacturing gas and electric meters and meter provers and other devices used in the distribution of gas and electricity for heating, lamps and other purposes. The directors are: V. P. Wilkins, Emmitt Scott and E. H. Scott.

THE MARION MOTORS SOUTHERN COMPANY, of Greensboro, N. C., has been incorporated by H. L. Hopkins and A. Fairbrothers & Bros. The company is capitalized at $25,000 and proposes to manufacture motors, power generators of various kinds, also carriages, wagons, boats, etc.

THE MOTOR SAFETY CRANK COMPANY, of New York, N. Y., has been incorporated by Mason G. Worthin, 164 West Eighty-fifth Street, Forester A. Linn, 1133 Broadway, and George Reif, 226 West Ninety seventh Street, all of New York, N. Y. The company is capitalized at $50,000 and proposes to manufacture motors, engines and accessories.

THE PERU ELECTRIC COMPANY, of Peru, Ind., has been incorporated with a capital stock of $100,000 by W. H. Zimmerman, J. H. Miller, John Kramer, C. R. Hughes and C. H. Brownell. The company proposes to erect and equip a large factory for the manufacture of electrical devices and supplies.

THE RAILWAY ADD BULLETIN COMPANY, of Fort Wayne, Ind has been incorporated by William C. Millet, Mark E. Bates and Thomas J. O. Dowd. The company is capitalized at $10,000 and proposes to manufacture advertising devices and electrical advertising cabinets for use in railway and interurban staions and to sell or lease space in such cabinets; also manufacturing, selling and leasing electrical bulletin cabinets for use in railway and interurban stations operated by electricity. The principal place of business will be located in Fort Wayne, Ind.

THE RUTAN AUTO COMPANY, of Port Jervis, N. Y., has been incorporated by P. C. Rutan, J. S. Rutan and J. A. Rutan, all of Port Jervis, N. Y. The company is capitalized at $45,000 and proposes to manufacture and deal in automobiles, engines, motors, etc.

THE UNITED STATES POLICE & FIRE SIGNAL COMPANY, of Pittsburgh, Pa., has been incorporated with a capital stock of $5,000. The directors are: Edward Lewis, Ross and Diamond Streets, Pittsburgh, Pa., treasurer; Thomas A. McQuaide, Thomas Richards, Alfred K. Dement and George N. Munro, Jr., all of Pittsburgh, Pa.

New Incorporations.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the United Properties Company of California, under the laws of the State of Delaware, for the purpose of effecting a merger of all the public utilities companies of Oakley and Berkeley, Cal., including the ferry line that connects those places with San Francisco. The company is capitalized at $200,000,000, and the incorporators are F. M Smith, W. S. Levis, R. G. Hanford, Galvin McNab, C. B. Zabriske, W. R. Alberger and Dennis Searles. The operating offices will be in San Francisco and Oakland.

SANTA ROSA, CAL.—The Sonoma Valley Water, Light & Heat Company has been incorporated with a capital stock of $100,000 by E. M and Edna Hoen, of Sacramento, Cal.: L. L., L. C. and Mabel Lewis, of El Verano, Cal.

INDIANAPOLIS, IND.—Articles of incorporation have been filed for the Southern Indiana Power Company with a capital stock of $800,000. The company proposes to construct power stations in the coal fields of Indiana for the purpose of supplying electricity for lamps and motors in the coal field communities, and also to transmit electricity a distance from the coal fields. It is proposed to locate the first plant near Bedford, Ind., at the mouth of a coal mine in the hillside. Other plants will be erected as business develops. The incorporators are: Frederick E. Matson, E. E. Gates, Gustav H. Mueller and T. N. Stillwell, all of Indianapolis, Ind. The headquarters of the company will be located in Indianapolis, Ind.

PORTLAND, MAINE.—The Public Service Company has been incorporated with a capital stock of $800,000 to construct and operate railways, telegraph and telephone sytems, gas, steam, coal plants, etc. G. F Duncan is president and E. Woodman treasurer, both of Portland, Ore

RIDGEWAY, N. C.—The North Carolina-Virginia Railway Company has been chartered with a maximum capital stock of $6,000, to construct a six-mile railway from Ridgeway to the North Carolina State line. The officers of the company are: E. C. Wing, of New York, N. Y., president, and George Demarest, of Brooklyn, N. Y., secretary and treasurer.

HITCHCOCK, S. D.—Articles of incorporation have been filed for the County Line Telephone Company by Andrew Olson, C J. Gross, E Stitt and Paul P. Stahl. The company is capitalized at $25,000.

PIERRE, S. D.—The Great Eastern Telephone Company has been granted a charter by the Secretary of State with a capital stock of $100,000. The incorporators are: Frank B. Rowe, Febian Crelton and August Chochnet.

DUG SPUR, VA.—The Burk's Fork Telephone Company has been incorporated with a capital stock of $5,000. The incorporators are W. S. Cox, president; J. A. Goad, secretary and treasurer, and E K Mabry, all of Dug Spur.

VANCOUVER, WASH.—The Oregon-Washington Corporation has filed articles of incorporation with the Secretary of State with a capital stock of $5,000,000 to take over the plant and holdings of the Vancouver Water Company, the Vancouver Gas Company, the Vancouver Railway Company, the Hillsboro Water & Light Company, the Forest Grove lighting system and other properties in Oregon and Washington. The incorporators are: A. Welch, of Portland, Ore.; E. W. Mall, Henry Fleischhauer, R. M. Boykin, C. M. Berryman and A. J Pitkin, all of Portland, Ore. and Isaac Anderson, of Tacoma, Wash.

MATOAKA, W. VA.—Articles of incorporation have been filed for the Matoaka Electric Power Company by William De L. Walbridge, Herbert R. Mackay and Henry B. Walbridge, 1 Broadway, New York, N. Y.; John H. Parrott, of Roanoke, Va., and James C. Stras, of Matoaka, W. Va.

CLAY, WIS.—The Viking Telephone Company has been incorporated with a capital stock of $1,000 by J. Johnson and N. G. Nelson.

Personal.

MR. WILLIAM B. BOYD, chief engineer of the Toronto Power Company, of Niagara Falls, Ont., and Toronto, has been elected a member of the Institution of Electrical Engineers of Great Britain.

MR. WILLS MACLACHLAN, formerly electrical superintendent of the government grain elevator at Port Colborne, Ontario, Canada, has been appointed electrical engineer for the city of London, England.

MR. D. F. COLLIN, recently with the Bell Telephone Company, Kansas, as business manager, has joined the W. K. Palmer Company, engineer, of the same city and will have charge of its business department.

MR. J. C. BELL, who was division superintendent of the Eastern Pennsylvania Railways Company at Lansford, Pa., has been made division superintendent, with headquarters at the main office of the company in Pottsville.

MR. W. C. JENKINS is the author of an article entitled "Chicago's Marvelous Electrical Development," beginning in the January issue of the *National Magazine*. The generation and sale of electricity by the Commonwealth Edison Company are described.

MR. C. F. CRANE has been appointed superintendent of railways of the Eastern Pennsylvania Railways Company, one of the J. G. White & Company properties, with headquarters at Pottsville, Pa. Mr. Crane was formerly general passenger and claim agent of the company.

MR. CHARLES L. BENJAMIN, of the Cutler-Hammer Manufacturing Company, Milwaukee, contributed an interesting article on the varied and extensive electrical manufactures of Milwaukee to the New Year's souvenir issue of the *Evening Wisconsin*, of that city.

MR. CARL BENDEKE, who was formerly connected with the engineering department of the New York Edison Company, and more recently with the Ontario Power Company, of Niagara Falls, has been appointed electrical engineer at the Patent Office, Christiania, Norway.

MR. SAM A. HOBSON, who for many years past has been actively and prominently identified with the Wesco Supply Company in St. Louis, resigned this connection to join the Fort Wayne Electric Works, whose St. Louis office he is now managing at 1311 Chemical Building, that city.

MR. M. B. CHASE has resigned his position in the detail and supply sales department of the Westinghouse Electric & Manufacturing Company, Boston office, to accept the position of New York manager for the Sangamo Electric Company, of Springfield, Ill., which has opened offices in the Hudson Terminal Building, 50 Church Street.

MR. VAN DUSEN RICKERT, purchasing agent for the Eastern Pennsylvania Railway Company, of Pottsville, Pa., which controls the Eastern Pennsylvania Light, Heat & Power Company, of which he is general agent, has also been made claim adjuster, effective Jan. 1. Mr. Rickert is also secretary-treasurer of the Pennsylvania Electric Association.

MR. RALPH H. RICE has been promoted to be division engineer in charge of electrical transmission and distribution for the Board of Supervising Engineers, Chicago Traction. Mr. Rice was formerly assistant division engineer, and his promotion follows the resignation of Mr. Edward N. Lake. Mr. Rice, who is a graduate of Armour Institute of Technology, was formerly employed by the Arnold Company.

MR. WILLIAM MACKENZIE, president of the Toronto Railway Company and the Electrical Development Company, as well as chairman of the board of the Rio de Janeiro, Sao Paulo and numerous other public utility corporations, was among those knighted by King George V of England on the occasion of the distribution of New Year honors. Sir William Mackenzie's partner was also similarly honored and will hereafter bear the title of Sir Donald Mann.

MR. ALTON S. MILLER, president of the Union Electric Light & Power Company, St. Louis, is contesting, in the interest of the traveling public, a railroad abuse. Mr. Miller secured a reservation on a Pullman between Philadelphia and Belmar, N. J., last summer, for which he refused to pay because he had been obliged to stand up all the way. The case is now before a St. Louis court, and Mr. Miller says he will, if necessary, carry it up to the United States Supreme Court.

MR. MALCOLM CARRINGTON has been appointed assistant manager of the Chicago office of the Westinghouse Electric & Manufacturing Company, of which Mr. T. P. Gaylord is manager. Mr. Carrington has been with the Westinghouse company for a number of years, and for the last three or four years was assistant manager of the railway and lighting department in the home office at East Pittsburgh. He graduated from Lehigh University with the degree of E.E. in 1896, and after that spent some time with operating companies in Richmond, Va.

MR. A. B. INGRAM, vice-chairman of the Ontario Railway and Municipal Board, of Toronto, is on a ten days' tour of United States cities, where he will study the various pay-as-you-enter types of cars in use. Mr. Ingram was accompanied by Mr. J. F. H. Wyse, consulting engineer to the board, and Mr. E. L. Cousins, railway expert for the city. On the return of Mr. Ingram, the Ontario Railway and Municipal Board will go into the local situation at Toronto again, and with the information gathered from the tour will give judgment determining the type of street car to be used in Toronto. The Toronto Railway Company is now operating under an order of the board that practically only compels it to place a pay or fare box on the back platform of a car to make it qualify for service.

MR. H. A. BENEDICT, electrical engineer of the United Traction Company, Albany, was the guest of honor at a dinner given at the Ten Eyck in that city, on the evening of Dec. 31, by some of his associates in Central New York. Mr. Benedict left the United Traction Company on Jan. 1 to assume his new duties as superintendent of equipment of the Public Service Railway Company, Newark, N. J. Among those present were the following: Messrs. J. P. Barnes, electrical engineer, Syracuse Rapid Transit Company; W. J. Harvie, chief engiener, Utica & Mohawk Valley Railway Company; F. J. Doyle, master mechanic, Schenectady Railway Company; E. S. Fassett, general manager, United Traction Company; Chas. H. Smith, general superintendent, United Traction Company; M. C. Carpenter, master mechanic, United Traction Company; H. N. Ransom, C. F. Scott, and C. E. Barry, General Electric Company.

Obituary.

MR. S. MAYS BALL, Atlanta correspondent of this journal, died Dec. 11 in that city after an illness of only a few days. Mr. Ball was a graduate of the University of Alabama, and in recent years had acquired a wide reputation throughout the South through his literary work. He contributed largely to magazines and newspapers on industrial and other subjects, among his latest work being a series of articles in a northern magazine on the prohibition question in Georgia, Mississippi, Alabama, North and South Carolina.

MR. ARTHUR O. EINSTEIN, until recently prominently connected with the Crescent Company, Chicago, and a well known electrical business man of that city, died in St. Louis, Jan. 3, of heart disease superinduced by inflammatory rheumatism from which he had suffered for six months. Mr. Einstein was born in St. Louis in 1876, and began his career in the electrical field as city salesman for the Commercial Electrical Supply Company, of St. Louis. Later he served as salesman in St. Louis for the Electrical Appliance Company and then came to Chicago as city sales manager for the Manhattan Electrical Supply Company. Several years ago he established a manufacturers' agency under his own name, which was later merged into the Crescent Company, dealer in electrical specialties, which he formed with Messrs. J. H. McGill and F. R. Bryant. Six months ago, at the beginning of his illness, Mr. Einstein withdrew from the Crescent Company and returned to St. Louis. Mr. Einstein was unmarried and is survived by two sisters and by three brothers, one of whom, Mr. A. C. Einstein, is president of the King Electric Company and the Suburban Electric Light & Power Company, St. Louis. Mr. Einstein was a member of the Electric Club of Chicago and the Sons of Jove.

Trade Publications.

CONCRETE MIXERS.—The Ransome Concrete Machinery Company, Dunellen, N. J., has issued a well-printed 96-page catalog devoted to concrete mixers suitable for operation either by steam engines or electric motors.

ELECTRICAL GLASSWARE.—The Macbeth-Evans Glass Company, of Pittsburgh, has issued a handsome pamphlet illustrating the globes made of Alba glass for street lighting. Full-page illustrations showing night views of street lighting in Chicago, Minneapolis, Indianapolis, Boston and other cities are shown. A number of designs of cast-iron, pressed-copper, concrete and reinforced-concrete lamp posts for ornamental street lighting are also illustrated.

PERPETUAL CALENDAR.—The American Sheet & Tin Plate Company, Pittsburgh, Pa., manufacturer of transformer steel, has issued an all-metal perpetual calendar made entirely of the company's product. The back is made of 28 gage galvanized sheet, 14 in. x 20 in., and the calendar plates are made of 34 gage enameling stock, finished in black with dates in aluminum. The calendar is lithographed in four colors and is fitted with a bright chain hanger. It is issued for general distribution to every sheet metal shop, supply house and user of sheet and tin mill products in the country interested enough to ask for it.

CALENDAR.—The Western Electric Company has just prepared for distribution an attractive 1911 wall calendar. The calendar, finished in two colors, is of pleasing design, with figures large enough to be seen across a room, and not too large for the office wall. The company's symbol, a map of the United States within a circle, comprises the upper part of the calendar. A separate legend is provided for each of the twelve months, illustrating some phase of the company's manufacturing and selling program. Illustrations showing an arc lamp, ventilating fan, motor and inter-phone, typifying the essentials of modern business—light, ventilation, power and communication—are prominently featured.

G. I. LAMPS.—"I Am Glad To See You, G. I.," is the cordial salutation with which a circular, just issued by the General Incandescent Lamp Company, of Cleveland, begins. The folder contains a little story in which are summarized the advantages of G. I. lamps, and on the last page is a list of forty-two representatives of the G. I. Company.

BUSINESS NOTES.

THE CHICAGO FUSE WIRE & MANUFACTURING COMPANY, Chicago, changed its name on Dec. 31 to the Chicago Fuse Manufacturing Company.

THE FAIRMOUNT ELECTRIC & MANUFACTURING COMPANY has moved its office and plant to its new building at 2203 and 2205 Pearl Street, Philadelphia, Pa.

CATALOGS WANTED.—The Massachusetts Electrical Construction Company, Springfield, Mass., has opened an office at 318 Main Street, in that city, and would like to receive catalogs, price lists, discount sheets, etc., relating to electrical apparatus, fittings, supplies, etc.

MINERALLAC ELECTRIC COMPAUY.—The Minerallac Electric Company, of Chicago, has moved into its new building, and its present address is 400 South Hoyne Street. In its new quarters the company has 10,000 sq. ft. of floor space in a two-story and basement building and is well equipped to meet the demands of its growing business.

THE CUTTER ELECTRICAL AND MANUFACTURING COMPANY has opened a new sales office at 1418 Ford Building, Detroit, Mich., which is in charge of C. E. Wise, formerly of the Chicago office.

THE ROBB ENGINEERING COMPANY has purchased the Robb-Mumford Boiler Works at South Framingham, Mass. The present management and manufacturing organization will be continued. The Robb Engineering Company has also a plant at Amherst, Nova Scotia.

THE ELMER P. MORRIS COMPANY, of 88 West Street, has been awarded contract for furnishing 500 posts for tungsten park lighting of the City of New York. About half of these are of a new type and will be used for the lighting of the transverse roads through Central Park, the balance being for regular installations.

MORGAN SMITH WATER TURBINES.—The contract has been placed with the S. Morgan Smith Company, York, Pa., through its Boston office, for a water-wheel unit to be installed at Aroostook Falls, New Brunswick, for the Maine & New Brunswick Electrical Power Company. This unit will develop 2400 hp. under a head of 72 ft. A. R. Gould, Presque Isle, Maine, is managing director.

THE ALBERGER PUMP COMPANY, 140 Cedar Street, New York, has recently closed a contract with the United States Navy Department for eleven 54-in. and seven 15-in. vertical-shaft, centrifugal pumps with complete electrical equipment for the New York, Puget Sound and Pearl Harbor dry docks. The order, the company states, does not impair its facilities or capacity for turning out all its normal business in good time.

THE CENTRAL STATION DEVELOPMENT COMPANY, Cleveland, Ohio, has added another valuable department to its organization. This department is devoted exclusively to the education of central station solicitors —training them and imparting such information as will bring their efficiency up to the highest point, thus increasing their value as solicitors and new-business men for central stations. This department is conducted along the lines which have made the men of the National Cash Register Company famous as business getters.

THE GILL SELECTOR.—The Baltimore & Ohio Railroad has just installed a telephone train-dispatching equipment made by the United States Electric Company, of New York, between Grafton, W. Va., and Salem. The circuit is 35.8 miles long and there are twelve stations on the line, the dispatcher being located at Grafton. The Gill selector, made by the United States Electric Company, 284 Pearl Street, New York, is installed at each of these stations and the signal bell is rung by the main line current, the source of power being at the dispatcher's office. This circuit covers a busy section of single track road and telephone dispatching is expected to expedite train movement over the division.

ANDERSON ELECTRIC CAR COMPANY.—The Anderson Carriage Company, Detroit, Mich., has changed its corporate name to the Anderson Electric Car Company. This change of corporate name constitutes a further evidence of the evolution that is all the time taking place in the mode of individual transit. Practically the same board of directors and officials is still in charge of the company's affairs. Mr. W. C. Anderson has acted as president and general manager since its organization in Port Huron, in 1888. Mr. W. M. Locke is still treasurer and has successfully handled the finances of the company during the many years of his incumbency. The board of directors has been increased to nine members. The additional directorate includes G. M. Bacon, G. D. Fairgrieve and W. H. McFarland, of Detroit, and F. E. Price, of Chicago.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED, JAN. 2, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

979,970. METHOD OF ELECTRIC WELDING; L. S. Lachman, New York, N. Y. App. filed Oct. 17, 1906. For welding handles to plates by providing the blade with a reduced portion and the shank with the lug overlapping the reduced portion, fitting them together and passing a current therethrough.

980,183. SYNCHRONOUS DYNAMO-ELECTRIC MACHINE; J. Bache-Wiig, Edgewood Park, Pa. App. filed Feb. 3, 1910. Polar projections with transverse peripheral slots and conducting bars in the slots forming a closed circuit winding, the bars near the edges of the projection being of lower resistance than those near the centers.

980,200. SECTION BREAKER AND INSULATOR; W. T. Carns and T. L. Brown, Red Jacket, W. Va. App. filed May 6, 1909. Includes a knife switch on a base attachable to the ends of the line wire, the blade of the switch holding the ends together and relieving the insulating material from strain.

980,214. WATER LEVEL REGULATOR; J. E. De Bisschop, New Britain, Conn. App. filed May 2, 1910. Contact arm operated by a float ball, and controlled by a second float ball operative during high water conditions.

980,221. ELECTRIC SWITCH; A. C. Eastwood, Cleveland, O. App. filed Sept. 27, 1906. Power actuated switch with solenoid and plunger and stationary laminated contact on the frame engaging the switch member near its connection with the plunger.

980,256. VILLAGE TELEPHONE POLICE CALL; G. W. Herrick, St. Marys, Pa. App. filed March 20, 1908. A telephone circuit with line wires and signalling means including an electric circuit independent of the telephone circuit, a relay therefor, a hook for the telephone forming a terminal for one of the line wires and a shunt circuit connected to the line wires and passing through the relay with terminals bridged by the hook.

980,256. ELECTRIC INDUCTION SMELTING FURNACE; K. A. F. Hiorth, Christiania, Norway. App. filed May 18, 1910. Annular furnace groove with a hollow magnet core inside the furnace and a primary winding between the core and groove.

980,265. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed Dec. 17, 1908. An alternating current-source, a direct-current source, an alternating-current work circuit, a motor generator connected between the sources with means for varying the field of the direct-current end of the generator with variations of speed.

980,286. COIL RETAINING MEANS; P. Kennedy, New York, N. Y., and Jos. A. Misland, Bayonne, N. J. App. filed May 15, 1909. Secures conductors in slots by metallic wedge with metallic projections at intervals

980,302. CONTROLLING DEVICE FOR ALTERNATING CURRENT MOTORS; D. L. Lindquist, Yonkers, N. Y. App. filed May 26, 1905. For induction motors with resistance in the secondary circuit and opposing magnets for decreasing the resistance controlled by the resultant of the primary and secondary voltage of the motor.

980,338. HAULAGE LOCOMOTIVE; J. M. Roan, Dante, Va. App. filed Dec. 30, 1908. For mines with a motor, a reel carrying a haulage cable, a second reel and means for transmitting motion from the motor to either or both reels.

980,344. TROLLEY; F. B. Russell, Elmira, N. Y. App. filed May 16, 1910. A trolley fork with bearings in its arms, a tubular lubricant receptacle passing through the wheels and fixed to the bearings with an oil supply duct leading thereto.

980,345. FURNACE; M. Ruthenburg, Lockport, N. Y. App. filed Nov. 9, 1907. A removable hearth and a wedge for adjustably supporting the hearth.

980,356. MULTIPLEX TELEPHONY AND TELEGRAPHY; G. O. Squier, United States Army. App. filed Nov. 5, 1910. Makes use of ultra-sound electromagnetic wave frequencies for transmitting telephone and telegraph messages so that all harmful effects to the battery telephone apparatus are removed since the effects of these frequencies are too minute to produce disturbances and cannot be heard by the ear. The high frequencies are transmitted along the skin of the wire and the battery telephone currents through the body of the wire so that the same wire is used to carry both kinds of current.

980,357. MULTIPLEX TELEPHONY AND TELEGRAPHY; G. O. Squier, United States Army. App. filed Nov. 5, 1910. Uses a pair of line wires with battery telephone sets bridged across the wires, a high-frequency generator in series in the line and a receiver for high frequency oscillations in series with the line.

980,358. MULTIPLEX TELEPHONY AND TELEGRAPHY; G. O. Squier, United States Army. App. filed Nov. 5, 1910. Low frequency signaling instrument connected to the line, a high-frequency circuit with a silent earth connection and a receiver circuit for detector for electric waves in the high-frequency circuit.

980,359. MULTIPLEX TELEPHONY AND TELEGRAPHY. G. O. Squier, United States Army. App. filed Nov. 5, 1910. A line, a plurality of earth circuits extending therefrom, a plurality of transmitter or receiver circuits in series in each of the earth circuits, each transmitter circuit impressing different but ultra sound frequencies on the line and each receiver circuit tuned to the frequency of one transmitter.

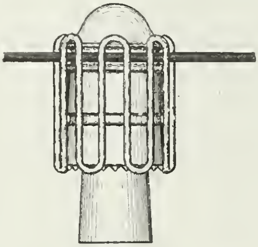
980,364. PROCESS OF SEPARATING MERCURY FROM POOR ORES BY ELECTROLYSIS; Bela Szilard, Paris, France. App. filed June 22, 1910. Treats finely divided ore with a liquidating agent including a solution of salt and calcium sulfid and then electrolysis.

980,369. MANUFACTURE OF STEEL; W. R. Walker, New York, N. Y. App. filed Jan. 2, 1909. A movable ladle containing the alloy additions is maintained hot to keep the alloy melted by electricity.

980,380. ELECTRIC SIGNALING APPARATUS; R. A. Wilbite, Indianapolis, Ind. App. filed Jan. 6, 1910. Continues to ring after closing and is operated by the window. Details.

980,417. AUTOMATIC EXCHANGE SELECTOR; H. B. Holmes, Park Ridge, and E. B. Craft, Chicago, Ill. App. filed March 8, 1906. Selector with bank of fixed contacts in parallel rows, group of brushes and wipers connected in multiple, the brushes on a movable common support and means for advancing them into mechanical relation with the fixed terminals and for giving them a movement to carry the selected brush along the corresponding row of terminals.

980,420. BIMETALLIC RIVET; D. S. Hulfish, Chicago, Ill. App. filed March 14, 1907. For making wire for use with electrical contacts of small dimensions, wireless detectors and the like.



980,495.—Wire Retainer and Insulator Guard.

980,432. TROLLEY WHEEL; J. L. Perkins, C. W. Putnam and C. M. Munson, Holyoke, Mass. App. filed Feb. 26, 1910. Details in the construction of cast-iron trolley wheels.

980,438. LAMP SOCKET; H. E. Reeve, New York, N. Y. App. filed May 12, 1908. The base and sleeve telescope into each other and snap together, two parts of the edges of the base being bent over, forming catches, and the sleeve having shoulders for the catches.

980,465. AUTOMATIC ADJUSTABLE HOLDER FOR TELEPHONE INSTRUMENTS; F. S. Weyrs, Philadelphia, Pa. App. filed April 19, 1909. A base plate with sustaining posts, a grooved block pivoted to the post, the block supporting the receiver and the rotation of the block acting upon the switch hook to control the switch.

980,475. MOTOR CONTROLLED SWITCH; A. J. Barlow, Tottenham, England. App. filed Dec. 4, 1909. Drum switch to which an auxiliary motor is geared directly with contacts on the switch for starting and stopping the motor after the switch has been operated.

980,495. WIRE RETAINER AND INSULATOR GUARD; G. W. Crawford, Jr., Morgantown, Ind. App. filed April 25, 1910. For taking up slack without disturbing the connection with the insulator and to act as a guard to prevent breaking the insulator by making it of cylindrical zig-zag form.

980,526. ELECTRIC RAILWAY SYSTEM; C. A. Huse, Williamsport, Pa., and Spencer M. Bowman, New York, N. Y. App. filed Feb. 3, 1910. For doing away with the third rail, the motor receiving its current from switch-boxes at intervals along the road bed, which are made alive as the car passes thereover.

980,540. SYSTEM OF ELECTRIC TRACTION; O. E. Longsdorf, Crafton, Pa. App. filed July 23, 1909. The live conductor is spaced into sections successively energized by magnets on the cars. Details.

980,541. DEVICE FOR CONTROLLING ELECTRIC CIRCUITS; P. Lorillard, Tuxedo Park, N. Y. App. filed Jan. 29, 1907. For controlling switches or pole changers in a certain order by means of stops and connections between the switch and the stop for moving the stop concurrently with the movement of the switch.

980,557. LOCKING MECHANISM FOR ROTARY SNAP ELECTRIC SWITCHES; J. G. Peterson, Hartford, Ct. App. filed Sept. 2, 1910. The carrier plate with projecting lugs supports the movable switch poles and has slots into which lugs project from the ratchet plate to guide the ratchet in a straight line transversely of the spindle when it is moved by a cam fixed to the spindle.

980,559. ELECTRIC SWITCH; C. D. Platt, Bridgeport, Conn. App. filed May 31, 1910. Electric switch with a movable contact, stationary contacts coöperating therewith having oppositely disposed interengaging bosses and perforations with binding screws passing through them.

980,613. TELEPHONE SYSTEM; W. W. Dean, Elyria, O. App. filed July 31, 1909. Talking circuit and receiver in which the receiver coil and inductorium are combined, the coil in the line bridge of the inductorium also serving as a receiver winding.

980,619. LOCKING DEVICE FOR THE RECEIVER ARMS OF TELEPHONES; W. R. Ewing, Mars, and Chas. P. Ewing, Renfrew, Pa. App. filed April 29, 1910. A locking device for holding the arm when the receiver is removed, which arm is released by central.

980,620. AUTOMATIC ELECTRIC SWITCHING MECHANISM; J. J. Fanning, Cantley, Quebec, Canada. App. filed Feb. 17, 1910. For operating a switch on the track from the car platform by means of electro-magnets in the roadbed energized by depressing a trolley wheel on the platform.

980,627. METHOD OF CLEANING METALS, H. E. Genet, New York, N. Y. App. filed Sept. 16, 1910. Immerses the metal in sodium hydroxid containing an anode of aluminum with which the metal is brought into contact.

980,639. ARC LAMP; C. A. Hughes, Terre Haute, Ind. App. filed July 5, 1910. For moving picture machines with spaced pairs of parallel bars, vertical rack bars carrying electrodes and means for moving the bars vertically, transversely and laterally to adjust the electrodes.

980,703. INCANDESCENT LAMP; E. Thomson, Swampscott, Mass. App. filed Oct. 12, 1908. For tungsten filaments, a set of which are mounted upon the carrier, which carrier is spring supported at the ends so as to avoid the transmission of shock to the filaments.

980,707. MOTOR CONTROL; J. F. Tritle, Schenectady, N. Y. App. filed July 15, 1908. Electric motor of the induction type with resistances in circuit and electromagnetically actuated switches which short-circuit portions of the resistances and establish parallel connections between portions of the resistances before short circuiting them, together with a control system controlling the circuits of the windings of the switches.

980,709. RAILWAY SIGNALING SYSTEM; R. P. Tuttle, New York, N. Y. App. filed July 29, 1909. Signaling system for single track railways divided into sections subdivided into blocks. At the end of each section an operator governs all the signals of the section.

980,763. ELECTRIC FURNACE FOR THE CONTINUOUS EXTRACTION OF ZINC FROM ITS ORES; E. F. Cute and P. R. Pierron, Lyons, France. App. filed Aug. 13, 1908. A closed retort of ring form, and two oppositely arranged electrodes in the axes of the retort with a condenser in connection with the retort formed by a vertical cylinder in which an electrode is arranged.

980,770. WIRE CONNECTOR; A. Freier, Boston, Mass. App. filed Jan. 18, 1909. A seamless drawn tube whose cross section is like the figure 8, into which the ends of the wires are inserted and the tube twisted.

980,781. ELECTRIC MELTING FURNACE; K. A. F. Hiorth, Christiania, Norway. App. filed July 28, 1909. The secondary of the transformer for the furnace is subdivided and the bath of the furnace forms part of the secondary windings and is of greater resistance.

980,805. ELECTRIC LAMP HOLDING SOCKET; H. W. Lawrence, Denver, Col. App. filed July 24, 1908. The base is made of a series of concentric chambers, one of smaller diameter than the other, with slots and contact switch, and the screw shell supported in the bottom of the larger recess.

980,812. AUTOMATIC ELECTRIC CIRCUIT BREAKER; W. F. Meter and W. L. Rideout, Oshkosh, Wis. App. filed March 30, 1908. The pivoted hammer strikes the movable contact to open the switch and is controlled by an electro-magnet.

980,830. BATTERY AND HOLDER; G. L. Patterson, New York, N Y. App. filed May 26, 1908. One of the terminals is located concentrically with relation to the other, the central terminal screw threaded to receive the threaded central terminal of the battery cell, with a laterally projecting connector for connecting the terminal with a terminal of another set.

980,843. MOUNTING CONDUCTORS; K. Schroter, Berlin, Germany. App. filed May 20, 1910. Applies a protective coating to the structure near the filament and permanently mounts the filament and passes current through it to expel material therefrom and remove the coating.

980,844. VOLTAGE REGULATION OF DYNAMO-ELECTRIC ALTERNATING CURRENT MACHINERY; M. Seidner, Budapest, Austria-Hungary. App. filed July 29, 1910. A closed circuit of regulating resistance with generator and field coil therefor and connections from the field coil to the generator and to the regulating resistance and a source of alternating current connected to the resistance.

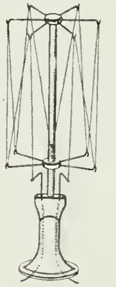
980,857. PARTY LINE TELEPHONE EXCHANGE; C. A. Anderson, Salina, Kansas. App. filed Feb. 28, 1910. A series of local stations, a central office, a party line connecting the stations to the office with devices for sending operating impulses from the office to the stations and a generator for signaling impulses, station selecting keys and connections so that the depression of one key connects the devices to the line and the release disconnects them and connects the generator

980,863. ELECTRIC SWITCH; G. A. Burnham, Saugus, Mass. App. filed April 25, 1910. Electric switch in oil with insulating plate so that the connections may be made above the plate.

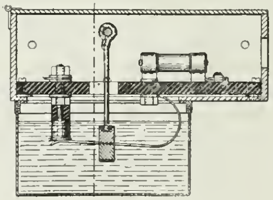
980,865. CONTROLLER REGULATOR; C. P. Ebersole, Keokuk, Ia. App. filed July 8, 1905. A controller with alternating inclined waves and stops, a hood thereon, and a dog with jointed connection with the hood.

980,866. CONTROLLER REGULATOR; C. P. Ebersole, Keokuk, Ia. App. filed Oct. 11, 1908. For street car controllers with a removable top carrying the stationary and movable member.

980,883. TELEPHONE EXCHANGE; N. E. Norstrom, Chicago, Ill. App. filed Feb. 24, 1909. A device sends impulses alternately in opposite directions over a party line and the impulses are broken up in one direction into short impulses and automatic means prevents selected impulses from being broken up.



980,843.—Mounting of Conductors.



980,863.—Electric Switch.

980,884. LIGHTNING ARRESTER; N. E. Norstrom, Chicago, Ill. App. filed Oct. 14, 1905. For telephone lines, including a carbon block, a spring with one end connected to a fixed support, a third carbon block connected to the other end of the spring and a ground for the third block.

980,885. CABLE BOX; N. E. Norstrom, Chicago, Ill. App. filed March 22, 1907. A carbon plate lightning arrester with a ground connection, a spring supporting the plate and line terminals adjacent to the plate.

980,886. TELEPHONE EXCHANGE; S. A. Nurstrom, Chicago, Ill. App. filed Nov. 13, 1905. Party line conductors and a device for sending impulses over the line with a condenser connected in a bridge of the conductors and automatically operating means for breaking the bridge when an impulse is being sent.

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CORONA LOSS FROM HIGH-TENSION AERIAL WIRES.

Until within recent years it was believed that if an energy transmission line were well insulated the only loss of energy occurring in its use was due to I^2R loss. Consequently, the panacea for all conditions of line loss was to raise the voltage of transmission so as to diminish the current strength I and thus diminish the loss by I^2R. When, however, the voltage of transmission on underground conductors reached 10 kv it was found that, even with well-insulated cables, there was a source of loss additional to I^2R, namely, E^2G watts, where E is the voltage applied to the cable and G a virtual conductance due to dielectric hysteresis. In other words, a well-insulated cable would apparently behave as though it leaked when operated at high alternating voltages owing to a hysteretic lag in the electric flux permeating the insulator, with respect to the impressed cyclic pressure. In the case of aerial lines, however, this hysteretic loss disappeared, the air being, for practical purposes, a perfectly elastic insulator.

Working pressures continued to rise on overhead long-distance transmission lines, and after reaching 40 kv a new source of loss made its appearance. This took the form of a dissipation leakage into the air, not by ordinary conduction or by hysteresis, but by a brush discharge, or corona, wherein the air particles carried away electric charge from the surface of the wires. Up to a certain critical voltage the air surrounding the high-pressure wires insulated practically perfectly. Above this critical voltage the surrounding air broke down electrically and carried away an electric current from the wire by a sort of convection, aided by brush discharges from the surface of the wire. Owing to unwarranted generalization, it was for a time held by some that this effect put a definite limit to high-tension voltages. Later, however, it was found that the value of the critical voltage depends on the size of the wire. A thin wire breaks down the air surrounding it at a lower voltage than a thick wire. When the breakdown occurs in the dark a halo, or corona, is seen to envelop the wire and a faint hissing sound may also be heard—the characteristic murmur of a brush discharge.

In 1904 Prof. H. J. Ryan read a paper before the American Institute of Electrical Engineers on an elaborate laboratory research on the subject of "The Conductivity of the Atmosphere at High Voltages," which has become a classic. His experiments showed the influence of the diameter of the conductor; that the corona developed over a high-voltage wire above a certain critical voltage only, and that it might develop at the peak of an alternating-current voltage wave, but not during the remainder of the wave if the peak exceeded the critical voltage. They also showed that at atmospheric temperatures and pressures not departing greatly from the normal the critical voltage varied inversely as the absolute temperature and directly as the pressure of the air approximately. A formula was arrived at for determining the critical voltage of corona from the size of the wire and distance of the wires apart, as well as the temperature and pressure of the air. The results of this and other experimental researches on high-tension corona was to show that a very considerable loss of power could take place into the air surrounding a wire above the critical corona voltage. The danger of such a loss was increased on wires passing through high altitudes and over mountains, owing to the reduction in the pressure of the atmosphere surrounding them. The only way to avoid this loss consistent with the necessary high voltage for long-distance transmission would be to use wires of relatively large diameter and to suspend them relatively far apart on the pole cross-arms. Actual measurements of the loss by corona or overhead wires have shown, during the last few years, that they may occur at a voltage considerably lower than that predicted by the above-mentioned formula. Discrepancies of 30 per cent or 40 per cent revealed themselves in this way between the results in the laboratory and results out of doors on actual lines.

At the last meeting of the American Institute of Electrical Engineers Professor Ryan read a new paper on the subject setting forth the theory of the loss by corona, on the one hand, and dealing with the reasons for the discrepancy between laboratory tests and transmission-line tests, on the other hand. This discrepancy it attributed to a combination of a number of elements, such as dirt on the wires, free ions in the neighboring air, radioactive emanations, moisture in the air, etc. It is also partly accounted for by brush discharges, or partial corona formation, in advance of the full corona developed as in the laboratory. Taking all of these influences into account, a reduction-factor of 0.72 is offered in the paper as an average factor for reducing the critical voltage of corona formation in the laboratory to that for the initial stage of well-marked loss of power in actual overhead lines by brush discharge. The greater part of the paper is devoted to an explanation of the phenomena of corona and corona loss of power by reference to the electronic theory. It must be admitted that the theory of electrons fits the observed facts satisfactorily as they are presented in the laboratory. The observed facts in actual overhead lines are so complicated by dirt and irregularities, either on the wires or in the air between them, that the underlying theory becomes concealed.

GENERAL SOLUTION OF OSCILLATION TRANSFORMER PROBLEMS.

A comprehensive general solution for a group of related problems concerning oscillation transformers used in wireless telegraphy is given in an article by Mr. John Stone Stone on page 175 of this issue. In many respects the method employed for attacking the problem resembles that used with problems relating to the so-called "general alternating-current transformer" or "general alternating-current commutator motor." The equations derived from the general alternating-current transformer are applicable to the series transformer, the shunt transformer, the auto-transformer, the constant-current transformer, the induction motor and the induction frequency converter. In a similar manner the equations for the general alternating-current commutator motor are applicable to the single-phase and polyphase series motors, shunt motors, compound motors, repulsion motors, "conduction motors" and "induction motors" of all types. Mr. Stone assumes that the general oscillation transformer consists of two inductive circuits interconnected both by induction and by conduction, and each containing a condenser. Having developed the circuit equation for the general case there is at hand an equation applicable to any form that the general transformer may assume. In applying the general equation to a specific case it is necessary to assign definite values to the "constants" of the circuits. It is in the determination of these constants that difficulty may arise. The author has anticipated this difficulty by describing methods for testing an oscillation transformer of the general type. Although the method described allows one to determine the constants of the transformer tested, great care would be necessary in applying the values thus ascertained to a transformer of the more simplified type in view of the fact that any change in the mechanical arrangement which affects the type alters immediately the constants of even that portion of the circuits which has not been directly changed.

COEFFICIENTS OF REFLECTION.

A point of special interest in the paper presented before the New York Section of the Illuminating Engineering Society last week by Mr. Paul F. Bauder, of which an abstract appears elsewhere, lies in the colorimeter readings obtained with various incandescent lamps illuminating both white and colored surfaces. The data are too elaborate to abstract here, but the thing about them that immediately strikes the attention is that no incandescent lamp, not even a tungsten lamp, gives anywhere near daylight values of color, at least if one takes the standard of the Ives colorimeter as representing daylight. Of unmodified lamps the intensified arc lamp and the carbon-dioxide tube come nearest to daylight, and both these differ greatly in color from any of the gas or electric illuminants in ordinary use. Unquestionably the colors of any of these illuminants can be modified by additive or subtractive processes so as to come much nearer the so-called white than they now do, as with the fluorescent screen of Dr. Cooper Hewitt, the composite gas and electric illumination which was recently proposed and the bluish globes which have been used with Nernst lamps and might be equally well applied to tungsten lamps. This last device is a curious reversion to a practice once not uncommon in the use of kerosene lamps. Some thirty years ago light-blue chimneys for ordinary kerosene lamps were considerably exploited and their effect in modifying the color was both striking and agreeable.

Mr. Bauder investigated at some length the effect of colored wall finish on the color value of the light reflected and found, as might be expected, that a marked effect was produced, yet not enough to afford anything like a complete color correction. It is by no means certain that such a correction, even if very easily obtainable, would always be desirable or agreeable. The glow of a late afternoon sun is perhaps quite as pleasant as the bluish light of a north sky. This is a matter concerning which tastes differ and will undoubtedly continue to differ. From the data given in the paper it is clear enough that in so far as it is desirable to reproduce the tone of daylight it can best be done by illuminants either in themselves substantially white or so combined as to secure the same result. Diffusing wall surfaces are evidently not sufficient to secure the desired result, and suitable screening, although it would doubtless be effective, is open to some criticism on the score of efficiency, since the rays which must necessarily be repressed in order to obtain a color balance are those of high luminosity

THE EYE AND ARTIFICIAL LIGHT.

A paper by Dr. Nelson M. Black before the New York Section of the Illuminating Engineering Society, an abstract of which appears elsewhere, gives so dispassionate and reasonable a view of dangers to the eye from artificial illumination that it is particularly to be commended. It was Josh Billings, we believe, who remarked: "If there iz ennything I hate it iz a cuss who knows a hull lot of things that ain't so." There is no doubt whatever that since the introduction of brilliant lamps within the last half century there has been more trouble with the eyes, or at least more definitely recognized trouble, than before artificial light was practically available for long-continued work. Man lives and works under artificial light as he did not a century ago, and it is not surprising that he should in a measure pay a penalty for so doing. On the other hand, there has been a vast deal of rather wild hypothesis based on slender experimental data current of late, and it is positively refreshing to find a discussion like Dr. Black's, which frankly admits the things of which ophthalmologists are ignorant and puts forward, not *ex cathedra* statements, but tentative theories backed up by a good deal of ophthalmological evidence. The particular feature of Dr. Black's paper is the stress which he lays upon the injury done to the eye by too bright light. It is a curious fact that too great brilliancy of the visual rays is a factor in ocular damage from artificial light which has been neglected of late in favor of interesting and curious, but not altogether convincing, theories about the malign influence of infra-red and ultra-violet radiations. Now, there is absolutely no question that both these forms of radiation, when received in sufficient amount, may be harmful, but on the other hand it is only under rather extraordinary conditions that it is possible to get enough of such radiations in artificial illumination to do any particular mischief. When ultra-violet rays injure the eye at all it is a superficial injury akin to sunburn and only under very unusual circumstances of long duration. As for the infra-red and red rays, their heating effect is great and it is quite conceivable that when received in sufficient amount injury to the eye would result. Yet only in very rare instances is there enough of this heat effect to cause trouble, and cases of injury that can fairly be attributed to it are very rare.

The theory that the red end of the spectrum is injurious dates back at least some forty years, and found its finest demonstration in the blue-glass craze which ascribed to the light filtered through cobalt glass curative properties that were almost miraculous. Obviously, since cobalt glass lets through the violet and ultra-violet rays, any beneficial result derived from it must have been due, not to adding violet radiation, of which the glass is incapable, but to cutting off the inimical red. The late General Pleasanton, originator of the blue-glass cure, relates with the utmost sincerity his bringing home from the service a decrepit army mule, purblind and afflicted with rheumatism When the sunshine that streamed through his stable window had been filtered through blue glass his sight was restored and his rheumatism disappeared. This is only one of the extraordinary cures reputed to have been produced by blue glass. Looking at the matter now in the light of cold reason, one does not argue, one simply grins. It was one of the many delusions of pseudo-medicine, like Bishop Berkeley's tar water and Perkin's "Metallic Tractors." At the present time interest is shifted to the other end of the spectrum, and we find in current literature long screeds regarding the dangers of the ultra-violet only to be averted by the use of somebody's particular variety of protective glass. Now, for one case where infra-red or ultra-violet can get at the human eye in sufficient quantity to do damage, there are thousands where one may be seriously affected by too great intensity of the visible spectrum, and Dr. Black sums up some of the evidence regarding this really very important matter.

The substance of it is that physiologists are practically agreed that seeing is in virtue of some photochemical reaction in the retina. Whether there is only one visual substance, the so-called visual purple, as Dr. Edridge-Green has held, or several visual substances, according to the well-known theories of Hering, is unknown; but it is quite certain that prolonged and intense light puts the retina out of action concurrently with and probably because of its decomposition of the photochemical substance or substances. The retina may be compared to a color sensitive plate in which the maximum photochemical effect is produced, not in the deep blue, as with the salts of silver ordinarily used in photography, but in the yellow, as when ordinary plates are treated with a suitable sensitizing bath. When the access of light is powerful enough to decompose the visual purple or other sensitizing substance faster than it can be regenerated, the part of the retina affected is put out of business, sometimes even permanently, as in the case of eclipse blindness to which Dr. Black refers. Even where the action is not so intense as to produce so serious an effect there is trouble in a minor degree, showing in a good many disagreeable ways only too familiar to those who have been unlucky enough to be thus exposed.

Incidentally, as Dr. Black shows, a good deal of strain is due to conscious and unconscious efforts to exclude the light from the eye chiefly by reflex action of the lids and iris. These are unpleasantly familiar phenomena and are the result of failure to keep bright light out of the eye. They are due in a sense to particular radiations, but these radiations are those very ones to which the eye is most sensitive and which produce the most potent effect on whatever photochemical substances are present in the retina. No amount of cutting off either the red or violet rays as such will make it safe to look at the sun or powerful electric arc for any considerable period or to work with the blaze of a Welsbach mantle or a tungsten lamp shining at short range fully into the eye Precautions such as the use of diffusing globes and shades shielding the eye from too much light also serve to cut off and diffuse the invisible rays which may have a specific injurious action on the organ of vision. It must not be supposed that even the extreme ultra-violet rays are necessarily harmful, since at the last Ophthalmological Congress at Naples a paper was read indicating that under proper precautions they are not without therapeutic value, and for that matter therapeutic results of apparently some value have been obtained by carefully regulated exposure of the eye at short range to the light from an incandescent lamp All this, however, is beside the main question and involves matters which the ophthalmologists will have to fight out among themselves. From a practical standpoint, however, Dr Black has done an extremely good thing in laying stress on the really common source of trouble from artificial illumination—that is overexposure of the retina to too intense direct light When this is avoided complaints of injury from artificial illumination will become comparatively scarce.

Convention of the N. E. L. A.

It has been officially announced that the next convention of the National Electric Light Association will be held in New York City, May 29 to June 3. The sessions will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, all of the large auditoriums being available for the purpose during the week of the convention. There will be no official exhibition in connection with the convention this year, and as yet no hotel has been designated as the official headquarters

Ohio Electric Light Association.

The executive committee of the Ohio Electric Light Association held its annual meeting at the Chittenden Hotel in Columbus, Ohio, on Jan. 11, at which Cedar Point, Ohio, was selected as the place for the next annual convention, with headquarters at the Hotel Breakers, the time to be Tuesday to Friday, July 25 to 28, 1911. The excellent entertainment and large attendance at the convention of 1910 induced the committee to return to this point for its 1911 convention. The convention this year will be even more elaborate in the way of program and entertainment than that of 1910, which was one of the most successful State electrical conventions ever held in the United States. Following is the preliminary program:

Report of the committees on motor application, on electrical transmission and on meters; *Ornamental Street Lighting*, by Mr. O. H. Hutchings, of the Dayton Lighting Company; *Mercury-Arc Rectifiers, Their Installation and Care*, by Mr. J. T. Kermode, of the Cleveland Illuminating Company; *Systematic Central-Station Records*, by Mr. O. B. Reemelin, of the Dayton Lighting Company; *Motor-Driven Refrigeration*, by Mr. W. C. Anderson, of the Canton Electric Company; *Development of a Central Station in Small Cities*, by Mr. S. M. Rust, of the Greenville Electric Light & Power Company; *Pumping Water for Municipalities and for Irrigation by Electricity*, by Mr. B. H. Gardner, of the Dayton Lighting Company; *The Use of Tungsten Lamps in Sign and Outline Lighting*, by Mr. W. B. Gowdy, East Liverpool Traction & Light Company. There will also be a report by the secretary of an investigation of insurance rates charged in Ohio, both fire and liability. The report will state the money this insurance is costing and the losses for the past five years.

The association will publish its souvenir program as in the past. Three banquets will be given by the association on the three nights of the convention to all in attendance, and the entertainment for the ladies will be on a liberal scale. Mrs. Clara Turpen Grimes, the soloist who gave so much enjoyment to all attending the 1910 convention, has consented to return for 1911.

The committee on general arrangements consists of Messrs. E. A. Beckstein, Sandusky, Ohio; T. D. Buckwell, Toledo, Ohio, and W. J. Hanley, Cleveland, Ohio. Further information may be obtained by addressing the secretary, Mr. D. L. Gaskill, Greenville, Ohio.

National District Heating Association.

The executive committee of the National District Heating Association at a recent meeting named Pittsburgh as the place for the third convention of that association, which will be held on June 6, 7 and 8, with headquarters at Fort Pitt Hotel.

The hotel management has made special rates for the occasion and has provided for the meetings and exhibits to be held in the banquet hall of the hotel, which is considered the best room for such a meeting in the United States.

It is anticipated that the program for the convention will be an unusually attractive one to those engaged in heating, whether isolated or district, as the questions to be considered will be in some measure general to the heating business. The subjects so far announced are as follows: "Radiators and Their Treatment"; report of the committee on data, which will include rates and other data pertaining to the heating business; report of the committee on meters; report of the committee on radiation; results of measuring station load by the Venturi and General Electric meters; heating franchises, and five other papers, the subjects of which will be announced later.

The entertainment will be arranged for both gentlemen and ladies attending the convention, and the manufacturers and other members of Pittsburgh have given assurance that it will be enjoyable in every respect.

This convention follows the National Electric Light convention, which will be held in New York City, and it is expected that many of those in attendance at the national convention will attend the heating convention upon their return from New York City.

Further information may be obtained from the secretary, Mr D L Gaskill, at Greenville, Ohio.

Annual Meeting of the Illuminating Engineering Society.

At the annual meeting of the Illuminating Engineering Society, which was held in New York on Jan. 13, it was announced that the following officers had been elected by letter ballot of the whole membership: President, Dr. A. E. Kennelly, Harvard University; vice-presidents: Dr. H. E. Ives, National Electric Lamp Association, Cleveland, to represent the Chicago Section; Mr. T. H. Piser, Welsbach Company, Boston, to represent the New England Section, and Mr. J. T. Maxwell, Philadelphia Electric Company, to represent the Philadelphia Section; directors: Messrs. F. N. Morton, United Gas Improvement Company, Philadelphia; John C. D. Clark, People's Gas Light & Coke Company, Chicago, and Arthur Williams, New York Edison Company; secretary, Mr. P. S. Millar, Electrical Testing Laboratories, New York; treasurer, Mr. V. R. Lansingh, Holophane Company, New York.

Secretary Millar presented the annual report of the council to the membership. The report showed that the membership had increased from 1045 to 1530 during the year 1910. The number of new members elected during the year was 650; there were seventy-six resignations, eighty-two cancellations and seven removals by death. Of the total membership, 60 per cent represent the electrical industry, 20 per cent the gas industry, the remaining 20 per cent representing the reflector manufacturers, consulting engineers, contractors, etc.

An analysis of the 186 papers thus far printed in the society's *Transactions* showed that there were two dealing with acetylene lighting, six with architecture, fourteen with calculations, one with daylight, sixteen with electric lighting, nine with fixtures, sixteen with gas lighting, fifty-two with illuminating enneering, one with illuminating oils, two with pedagogy, sixteeen with photometry, eight with physics, seven with practical research, nine with units and standards, fifteen with street lighting and twelve with vision.

Mention was made of the highly successful results from the lecture course on illuminating engineering at Johns Hopkins University and the annual convention at Baltimore in October. During the year increased interest in the society has been shown by architects, fixture designers, decorators, etc., and it is hoped that they will engage actively in the affairs of the society.

At the dinner, which was served at the Machinery Club immediately preceding the meeting, the guests at the speakers' table included President W. W. Freeman, of the National Electric Light Association; President Hyde, Past-presidents Marks and Sharp, Secretary Millar, Past-treasurer Elliott and Treasurer-elect Lansingh, of the Illuminating Engineering Society. President-elect Kennelly was prevented from being present on account of a lecture which he was delivering in Philadelphia during the evening. Mr. Lansingh, as senior vice-president, assumed charge of affairs for the incoming administration.

Illumination Club of St. Paul.

At a meeting held in the offices of Reed & Stem, architects, St. Paul, Minn., on Thursday evening, Jan. 5, an organization was formed which will be known as the Illumination Club of St. Paul. The object of the organization is the advancement of illuminating engineering and the study of all subjects connected with illumination in any form. In addition to the presentation and discussion of papers it is planned that the club shall be a medium of exchange for general illuminating engineering information and data. The secretary will endeavor to collect from manufacturers and others all available data on various light sources and accessories, and this will be kept for reference by the members. The usefulness of the organization will be extended in other directions if the membership increases according to present indications. A program has been prepared for six meetings, from January to June of this year, and a tentative program has been outlined for the season of 1911-1912. Until further notice these meetings will be held on the second Monday of each month, in the offices of Reed & Stem, 601 Endicott Building. The subject for the next meeting, which will be held on Monday, Feb. 13, is street lighting, and the paper of the evening will be given by Mr. Earle D. Jackson, consulting engineer, St. Paul.

At the meeting on Jan. 5 Mr. Arthur L. Abbot presented a paper on "Some Notes and Data on Illuminating Engineering." Officers were elected as follows: Chairman, Mr. Arthur L. Abbot; secretary, Mr. Clovis M. Converse, 303 North Snelling Avenue, St. Paul, Minn.

Illinois Contractors' Association.

The Illinois Electrical Contractors' Association met at the Hotel La Salle, Chicago, Saturday, Jan. 14, about seventy of the total membership of ninety-eight contractors being present at the sessions. At the morning business meeting matters of handling time and material work, details of estimating, experience on costs, etc., were discussed in executive session, and in the afternoon a "revival" meeting was held, during the course of which nearly fifty contractors recounted their "experiences" in handling the complicated business of equipping human habitations for electricity. Only members of the state and national contractors' associations were present at these sessions.

In the evening the association banquet was held in the Palm Room of the hotel, with Mr. C. R. Kreider, of Kohler Brothers, Chicago, as toastmaster. Mr. Joseph R. Strong, of New York City, spoke on the subject of "The National Association," and Mr. E. Cleary, of Detroit, discussed "Electrical Contracting as a Business." The evening's entertainment was closed with extemporaneous remarks from members of the association, and by professional entertainers imported from the current vaudeville bills at the local theaters. The entertainment committee comprised Messrs. A. S. Schulman, E. Freeman, J. N. Pierce and M. N. Blumenthal.

National Electric Light Association Urges Appointment of Federal Water-Power Commission.

The executive committee of the National Electric Light Association has forwarded to Washington a resolution urgently recommending the authorization and appointment of a committee to consider the subject of federal water-power. The resolution calls attention to the fact that the condition of the laws and regulations relating to the public lands of the United States government is so complicated, unsatisfactory and unsettled that the financing and commercial development of new enterprises in connection with public lands are rendered practically impossible; and that the immediate development of the idle water-powers of the nation is of importance to the whole people in that it brings to immediate use an indestructible natural resource that would be otherwise lost or idle and conserves coal, oil, gas and other fuels that are limited in amount and not subject to replacement. After pointing out that the National Electric Light Association is particularly interested in the situation pertaining to public lands of the United States in connection with the development of water-powers, and that much of the difference of opinion upon the subject of water-powers arises from the difficulty of obtaining a clear comprehension of all the facts, the following recommendation is urged:

"That a competent commission, composed of members of the Senate and House of Representatives of the United States, together with other persons familiar with the financial and other practical aspects of the situation, be appointed with full authority to collect the evidence and for that purpose to hold full and complete open hearings in different sections of the country.

"That such commission be appointed at as early a date as possible to the end that its meetings may be held between the adjournment of the present session of Congress and the reassembling of the new Congress, in the hope that it will report upon such reassembling and Congress be thereby enabled to take prompt action in the enactment of such laws as will permit the development of the natural resources of the country in such a manner as shall render them of the greatest possible use to all of the people."

Telephone Rate Investigation in Chicago.

The Chicago City Council committee on gas, oil and electric light held several hearings last week in relation to the proposed revision of telephone rates. Mr. William J. Hagenah appeared as the expert adviser of the committee, and the Chicago Telephone Company was represented by several of its officers. In addition to matters in dispute to which reference has been made previously in these columns several new features of the discussion were taken up. One related to the cost of underground conduit installed by the company. In Mr. Hagenah's report a valuation of $2,677,425 is placed on the company's underground conduits. This is $718,645 below the figures shown by the company's records, and the discrepancy brought about a spirited discussion in which Mr. J. G. Wray, chief engineer of the company, criticised Mr. Hagenah's methods of determining the value of the company's property. Mr. Wray contended that the unit costs used by Mr. Hagenah were too low and do not represent the actual cost of the conduit construction. In reply, Mr. Hagenah said: "We based our unit costs on the records of the last twelve years. We were unable to get the records prior to that time. Of course, the books show the total amounts expended prior to 1898, but the single records have been destroyed."

At another hearing Mr. Hagenah declared that up to 1907 the company made an annual charge for depreciation, the amount standing on the books at that time for this purpose being $3,767,233. Then by a new system of book-keeping, according to Mr. Hagenah, as reported, the depreciation account was wiped out, and the surplus account was credited with the amount, a stock dividend of $4,500,000 being declared at the same time. The explanation of this made by the company is that the old depreciation account had accumulated between 1889 and 1907 under the old franchise. In 1907 a new franchise was secured, fixing the rates, and for that reason it was thought fair to divide up the old depreciation account among the stockholders and begin afresh.

Another item discussed was the contract under which the Chicago Telephone Company is said to have paid the American Telephone & Telegraph Company $422,326 in 1909. Inasmuch as the parent company owns over half of the stock of the Chicago company, Mr. Hagenah charges that this contract is a device of the majority stockholders to secure larger dividends than the other stockholders. Mr. Sunny, the president of the Chicago company, said that the association of the local company with the parent Bell company was of very great value to the former, and in his opinion the payment under the contract was not excessive. He is reported to have added that in his judgment if the competing telephone company in Chicago could enter into such a contract, substituting itself for the Chicago Telephone Company, it would be willing to pay $10,000,000 for the privilege.

Tungsten Lamps in Germany.

Consul William T. Fee, of Bremen, has made a report to the Bureau of Manufactures on the commercial status of the tungsten lamp in Germany. It is stated that while the lamp manufacturers are not under strict association rules regarding the output, sale, etc., of their product the prices to the dealer and jobber are held to a certain established point for Germany, but the markets in other countries are open. The prices to the consumer upheld by the union dealers' agreement are as follows: 16-watt lamp, 55 cents; 32-watt lamp, 60 cents; 50-watt lamp, 60 cents, and 100-watt lamp, $1.27. In addition there is a government tax of 5 cents for the 16-watt lamp, 10 cents for the 32-watt and 50-watt lamp, and 15 cents for the 100-watt lamp. There is a customs duty on incandescent lamps which for a 32-watt lamp is about 1 cent. It is stated that the 16-watt tungsten is not giving satisfaction, as the life is too short and the percentage of breakage is high. It is very little used, the 32-watt lamp being the popular unit. One company claims a life of 2200 hours for its lamps, but 1000 hours to 1400 hours is considered a good average life. It is stated that the percentage of breakages of tungstens in shipment from Bremen to Berlin, about 200 miles, is below 2 per cent. The broken lamps received by dealers are immediately returned to the manufacturer, together with the packing case, which does not form a part of the sale. With the next order for lamps good lamps equal in number to the broken ones are shipped without charge. The German export trade in incandescent lamps increased from $2,000,000 in 1907 to $4,780,000 in 1908 and to $7,857,000 in 1909.

Hydroelectric Prospects in Maine.

State-wide rumors of the formation of a hydroelectric power trust in Maine under the name of the Moosehead Power Company have occupied considerable space in the New England papers within the past few days. As a result of the stories spread abroad, President Henry I. Harriman, of the Connecticut River Transmission Company, who maintains headquarters at Boston under the engineering and promoting organization of Chase & Harriman, has given out a brief interview concerning the intentions of the Moosehead Power Company, which is being organized by himself and his associates. Mr. Harriman states that criticisms of the company's plans are as yet decidedly ahead of time, since the bill giving it a charter has not as yet been introduced into the Maine Legislature. When the bill is presented to the legislative committee through counsel the aims of the company will be set forth specifically, and the public will then have real grounds upon which to establish its opinion. Mr. Harriman denied that the Standard Oil Company is in any way interested in the project. He said that the Moosehead Power Company owns flowage rights on the Kennebec River, from the Forks northward to Moosehead Lake, and that it proposes to build a plant with an ultimate capacity of 100,000 hp. Contrary to the popular impression that the State of Maine is to become a mere power plant for New York and Massachusetts factories, it is not proposed to transmit energy outside the State, but to sell it to manufacturers within the commonwealth. Mr. Harriman said that it is intended to form a company to sell energy in bulk and in no sense to inaugurate an electric lighting business. He announced that he is entirely willing to see a public-service commission established in Maine and to have a line of demarcation drawn between his company as a wholesaler and local distributing companies in the way it has been done in Massachusetts under the decisions of the Massachusetts Gas and Electric Light Commission in Fitchburg and Worcester. The development will take a large amount of capital into Maine, and the utilization of resources will be a great benefit to industries. Mr. Harriman said that it is not intended to raise the waters of Moosehead Lake materially, but that the storage facilities to be established by the company on the Kennebec River will be of material benefit to all existing powers on the stream.

Public-Utility Taxation in Boston.

Figures recently made public by the Boston Board of Assessors show that the public-service corporations operating in the City of Boston proper are among the heaviest annual contributors to the running expenses of the municipality. The Edison Electric Illuminating Company paid a tax of $270,046; the Boston Consolidated Gas Company, $233,241; the West End Street Railway Company, $125,271; Boston Elevated Railway Company, $118,757, and New England Telephone & Telegraph Company, $59,111. These companies contributed to the public treasury approximately $1.30 per capita for the population of Boston proper for the year 1910, excluding a vast amount of additional taxation which had to be met in the municipalities surrounding the business area of the Boston district and also excluding various State assessments. The largest personal tax outside the contested portion of the Welch trust estate is paid by the Boston Edison Company, which has a personal assessment of $73,246, based on an appraisal of $12,000,000 on machinery used in plant operation. The assessment on the plant is greater by $1,000,000 than in 1909. The tax of the Boston Edison Company is the third largest of all corporation assessments in the city.

California Legislature to Consider Public-Utility Measures.

At a Republican conference of members of the California State Legislature recently held in San Francisco the committee on public utilities made several recommendations and outlined a measure to bring before the Legislature, which convened in Sacramento on Jan. 2.

A change of the constitution is suggested whereby franchises shall not be granted for a term of years, but shall continue until the State or county or municipality granting the same shall elect to take over the property used in supplying such public service and engage in the business thereof, the several counties and municipal corporations in the State to be authorized to engage in any business to or for which a franchise may be given.

Ex-Governor George C. Pardee submitted the draft of a bill providing for the appointment of a State Board of Control, to consist of the Governor, the State Engineer and three salaried members appointed by the Governor. This board is to grant permits for the use for electric and power purposes of waters not already appropriated. The bill provides that the State board's electric and power permits shall not be for a longer period than twenty-five years. One section abrogates all appropriations of water which have not been put or which are no longer put to some beneficial use. All appropriations are to be subject to the right of the State to fix rates for which electricity and power shall be sold or distributed. Actual construction work must begin within three months after the board's approval of an application for appropriation and be completed within five years. On completion a license for the diversion and use of a fixed amount of water for a definite time is to be granted the applicant.

The license gives a right to no water in excess of the capacity of the works and will be limited to the water actually required for generating electricity or power. Surplus waters can be stored during floods or high water or when not required for irrigation. Besides $10 for filing an application and $100 for a license an appropriator must make annual payments to the board as follows: For first 100 hp, no charge; next 900 hp, 15 cents for each horse-power; second 1000 hp, 5 cents for each horse-power; above 2000 hp, 2½ cents for each horse-power.

Annual detailed reports must be made to the board. The bill provides that if an appropriator engages in any combination in restraint of trade or to raise or keep up rates his license shall be forfeited. The provisions of the act do not apply to municipal corporations or irrigation districts.

New York Automobile Show.

The eleventh national automobile show given under the auspices of the Association of Licensed Automobile Manufacturers was opened in New York City on Jan. 7. The applicants for exhibition space were so numerous that it was necessary to divide the show into two parts, and even then it was necessary to rebuild and enlarge the three galleries about the amphitheater of Madison Square Garden where the show is held. Last week's exhibit included only gasoline pleasure vehicles and accessories, while the exhibition this week, beginning Jan. 16, is devoted to commercial vehicles and electric pleasure cars, as well as motorcycles and accessories.

Counting the two weeks there are 101 exhibitors of complete motor cars, sixty-nine of whom show pleasure cars and thirty-two commercial vehicles. The exhibitors represent about 80 per cent of the total output of cars in the country. In addition there are 578 accessory and motorcycle exhibits, making a total of 679 exhibits. The four-cylinder water-cooled engine predominates in the gasoline vehicles. The cylinders are cast in pairs with integral water jackets and cylinder heads and in most of the cars a centrifugal pump is used for water circulation. The high-tension magneto is employed in a great majority of the cars for ignition purposes.

Just as in previous shows the gasoline pleasure vehicle overshadowed the electric pleasure vehicle, so in the show this week, from which the gasoline pleasure vehicle is excluded and where the electric pleasure and commercial vehicles are combined, the gasoline commercial vehicle overshadows the combined electric exhibits. It is plainly evident that the commercial gasoline vehicle has become a very strong competitor in the field which has always been looked upon as the one for which the electric vehicle is pre-eminently fitted. The gasoline vehicles on exhibition range in size from a 600-lb. package delivery wagon to a 10-ton truck. All of the manufacturers of electric vehicles, however, are not represented at the show, there being five manufacturers exhibiting in the commercial class and only three in the pleasure class. The former are the General Vehicle Company, the Lansden Company, Pittsburgh Motor Vehicle Company, the Studebaker Automobile Company and the Ward Motor Vehicle Company, while the latter are the Anderson Carriage Company, the Hupp-Yeats Electric Car Company and the Waverley Company. Of the dozen or more commercial electric vehicles shown all are fitted with chain drive and all have a single motor with the exception of two trucks, which are fitted with two motors. The lightest electric commercial vehicle on exhibition is a 700-lb. delivery wagon which the General Vehicle Company, of Long Island City, has placed on the market to fill the demand expressed at the recent convention of the Electric Vehicle Association of America for light-weight wagons for package delivery for retail as well as general department store work. The vehicles as a whole do not differ from those shown at last year's exhibition.

Electric Club at Chicago Electrical Show.

A well-attended luncheon of the Electric Club of Chicago was held on Jan. 11 in the Coliseum during the Electrical Show by the courtesy of Mr. Homer E. Niesz, who is manager of the Electrical Show as well as vice-president of the club. Some of the bread served at the tables was baked in the electric ovens of the Simplex Electric Heating Company at the show. Mr. H. H. Cudmore, president of the Electrical League of Cleveland, was the principal speaker as the result of an interchange of courtesies between the Cleveland and Chicago clubs, Mr Vose, the president of the latter organization, having previously addressed the Cleveland League. Mr. Cudmore said that the organization in Cleveland is conducted on lines similar to those followed by the Electric Club of Chicago. Meetings are held twice a month, although it is expected that the plan of holding weekly meetings, as in Chicago, will be adopted at some future time. One feature of the Cleveland meetings is the "harmony" singing, which has proved an enjoyable diversion and has served to bring the men closer together.

Mr. Cudmore spoke particularly of the plan of co-operative newspaper advertising adopted by the electrical interests of Cleveland, and he caused to be distributed sample pages of the newspaper publishing these advertisements. An arrangement was made some months ago, as noted in these columns, with the Cleveland *News*, an afternoon paper, by which on every Saturday there is published what is called "The People's Electrical Page." In the center of this page there is a collection of items of electrical information of general interest, and surrounding it are advertisements of electrical manufacturers, dealers, contractors and central-station interests. The idea is that the electrical advertising of Cleveland is thus massed in one broadside, as it were, and is, therefore, more effective. The work is in charge of Mr. M. E. Turner, of the Cleveland Electric Illuminating Company, who is also an officer of the league. Mr Cudmore closed with a cordial invitation to the members of the Electric Club of Chicago to visit the Electrical League of Cleveland.

Mr. J. S. Badger, general manager and chief engineer of the Brisbane Tramways, of Brisbane, Australia, who has been spending some time in the United States investigating the management of street railways in American cities, was a visitor and spoke briefly by invitation. He said that all the trunk railroads and many of the street-railway and electric light plants in Australia are owned by the government or by municipalities. He believes, however, that the electrical industry does not reach its highest development under government ownership. Public ownership has many good features, but it is undoubtedly true that private enterprise supplies that initiative which makes for the greatest degree of enterprise and development. Mr. Badger spoke of the remarkable progress in street-railway service in Chicago since he visited that city some fifteen years ago. The street-railway systems of Australia are small compared with those of the United States, and the speaker gracefully expressed a sense of obligation for being permitted to study freely many examples of American development.

Messrs. George. H. Porter and Thomas C. Ringgold spoke briefly. The treasurer's statement was submitted, showing that on Jan. 1 the Electric Club of Chicago had $3,222.35 in its treasury.

Annual Dinner of St. Louis League of Electrical Interests.

The second annual meeting of the League of Electrical Interests of St. Louis was held at the Missouri Athletic Club on Jan. 10 and was an enjoyable affair. It was also the occasion of the annual dinner of the society, and several unusual "stunts" were presented. The invitations were sent out in blueprint form and recipients were told that the "feeder" would be of 100,000,000 circ. mils, with resistance nil. The souvenir menu was also provided with a blueprint cover with a clever design, and the sheets were tied together by silk-covered lamp cord. Three hundred members were present and puzzled themselves in endeavoring to discover what "impregnating compound," "glazed porcelains," "transformer oil" and other electrical terms meant in the way of things to eat and drink.

The dinner was followed by lantern-slide cartoons of many present, the bright light of publicity being thus thrown on the counterfeit presentments of the speakers while they were addressing the assemblage. There were also several vaudeville acts by professional performers. Capt. Robert McCulloch, the retiring president, occupied the chair. Mr. H. H. Humphrey, consulting engineer, was elected president of the league for the ensuing year and Mr. F. D. Beardslee, commercial engineer of the Union Electric Light & Power Company, was elected secretary and treasurer, succeeding Mr. Walter Robbins. A number of out-of-town guests were present, including Messrs. W. A. Bixbey and N. J. Cunningham, of Springfield, Mo.; F. E. Murray, of Louisiana, Mo.; H. B. Shaw, of Columbia, Mo., and R. J. Irvine, of Marshall, Mo

Operating Details of Chicago Commonwealth Stations.

A larger hall having been found necessary for the monthly meetings of the Commonwealth Edison Branch (Chicago) of the National Electric Light Association, the meeting on Jan. 10 was held in Recital Hall, with an attendance of fully 300. It was decided to adopt a distinctive badge of membership. Two other branches, those in Brooklyn and Philadelphia, have also adopted badges. The Chicago badge will consist of the N. E. L. A. bronze button in the center, encircled by the words, "Commonwealth Edison Company Branch," on a background of red, white and blue. It is believed that the badges of the different branches will be particularly useful at the annual conventions of the whole association. It was announced that the evening of Jan. 20 will be "N. E. L. A." night at the Chicago Electrical Show, and that free tickets will be given to the members of the branch by the courtesy of the Commonwealth Edison Company. The Chicago branch is growing satisfactorily, and it now has 762 members.

Two papers were read at the meeting. The first was by Mr. P. B. Juhnke, whose subject was "Generating and Transmission Systems and Load Dispatcher's Office." Mr. A. E. Evans followed with a paper on "Substations and Distributing System." These papers are part of the series of descriptions of the work of the various departments of the Commonwealth Edison Company, which is the feature of the season's program of the branch. Both papers were illustrated by lantern slides. Mr. Juhnke described the generating stations in outline. He made a number of interesting statements, such as the fact that the total quantity of water in a boiler at Fisk Street is boiled over about once in two hours at full load. The speaker also remarked that the direct current generated as such amounts to only 2 per cent of the total amount of electricity generated. Mr. Juhnke paid considerable attention to the transmission lines and load-dispatching system. There are fifty-three substations and nearly all have two incoming lines, so that one will be available if the other breaks down. The technical control of the immense system of the Commonwealth Edison Company is centered in the load dispatcher's office. Here there is a wall diagram showing every 9000-volt, 12,000-volt and 20,000-volt switch on the system Plugs of different colors are used to indicate the character and condition of these switches, and not one of them is opened or closed without an order from the load dispatcher. There is also an elaborate system of charts and records. No apparatus connected with the generating, transmission and distributing systems can be touched for repair or removal without a permit from the load dispatcher, and the average number of such "load dispatcher's permits" in force at any one time is about fifty.

Mr. Evans described the various types of substations and the apparatus, as transformers, rotary converters, storage batteries, frequency changers, etc., installed in them. The largest rotary converters are of 2000 kw rating and are both of the vertical and horizontal types. The storage batteries of the various substations have a total rating of about 20,000 kw. The various substations designed for particular classes of service, as railway load, industrial plants and commercial service, were described.

In the discussion Mr. Edwin Jowett, of the Fisk Street station, made the interesting statement that 10 per cent of the water in the South Branch of the Chicago River passes through the condensers of that great electrical generating plant. If there were any way of utilizing the heat wasted in the condenser discharge it would be possible to operate five plants of the size of the Fisk Street station. Mr. John F. Gilchrist remarked that the heating of the water in the South Branch of the Chicago River by the Fisk Street and Quarry Street stations actually was of appreciable benefit to the Economy Light & Power Company on the Desplaines River at Joliet and no doubt to the Sanitary District on the Drainage Canal at Lockport in the operation of their hydroelectric plants. Since the two great steam plants have been in full operation the heated water they discharge into the river has had the effect of ameliorating very largely ice troubles at the water-power stations mentioned. "Thus," said Mr. Gilchrist, smilingly, and referring to the Sanitary District, "we are actually warming the water used by a competitor, so that it may operate its plant more effectively in winter."

Others taking part in the discussion were Messrs. W. J. Weyker, W. Goodykoontz, G. C. Spencer, U. Davis and D. D. Higgins. An orchestra, composed of company talent, gave some music before the meeting was declared adjourned

Cedarmen in Convention Report Decrease in Pole Stocks.

A large decrease in white-cedar pole stocks from the 20-ft lengths up was reported at the fifteenth annual session of the Northwestern Cedarmen's Association, held at the Hotel Radisson, Minneapolis, Jan. 10 and 11. Twenty cedar producers were represented at the convention and the stock report of present poles on hand showed a decrease of nearly 40 per cent, or 800,000 pieces, compared with the stock of a year ago. All sizes are thus cut down to a point where, with reasonable trade for the next few months, the old stocks will be pretty well cleaned up before the new stock is in shipping condition.

The estimated production for the present season indicates a total of about 600,000 pieces from the 20-ft. lengths up. If this estimate is correct the available supply will still show a shrinkage of 200,000 poles. In any event a sharp decrease in stocks on hand during the coming season is predicted by the pole men.

Posts show a decrease of 38 per cent. The input of posts during the present season will come close to 10,000,000. The stocks of 4-in. and 5-in., 7-ft. posts are low and these sizes are selling at list price and better.

A few changes have been made in the present pole specifications, but these are comparatively unimportant.

Poles 4 in. x 25 ft. have been included with standard telephone and telegraph poles and will take the same specifications. Circumferential measurements are 12 in. for dry and seasoned 4-in. tops and 12.5 in. for green stock. The top measurement for 20-ft. poles will be the same as in the longer sizes. Hereafter the measurement for crook in 20-ft. poles will be taken from a point 4 ft. from the butt instead of from butt to top as formerly.

President T. M. Partridge opened the convention with an address, and reports were heard from the officers and committee members. The association banquet was held at the Hotel Radisson Tuesday evening, fifty being present.

The Wednesday morning session was devoted chiefly to discussion of protection from forest fires and the framing of a bill to be presented to the Legislature prohibiting insurance companies from canceling policies on ten days' notice in times of danger from fires. The bill will ask for ninety days' notice.

The officers of the Northwestern Cedarmen's Association elected for the ensuing year were: President, Mr. T. M. Partridge; vice-president, Mr. E. C. Norton, Escanaba, Mich.; treasurer, Mr. W. B. Thomas, Manistee, Mich.; secretary, Mr. H. H. McKinney, Minneapolis; directors, Mr. J. W. Benham, Chicago, and H. S. Gilkey, Minneapolis

Discussion on Luminous Efficiency at Chicago.

On the evening of Jan. 13 the members of the Chicago Section of the Illuminating Engineering Society were the guests of the Electrical Show management and took dinner at the Coliseum restaurant. The evening's discussion was on the subject of Dr. Herbert E. Ives' paper on "Luminous Efficiency," presented before the Philadelphia Section Jan. 21, 1910. Preliminary to the discussion an abstract of the paper was read by Mr. A. L. Eustice. Dr. Ives' paper is a classical compilation of the results obtained by himself and other investigators from studies of the luminous portions of the spectra of various illuminants, in which the superior value of certain wave-lengths in producing light as a physiological sensation is pointed out. After indicating the consequent necessity of some equivalent measure, such as "reduced luminous efficiency," a term which the author coins, he concludes that absolute luminous efficiency, measured in percentage of utilized energy at the wave-length most efficient in a physiological sense, is still a quantity for future investigation and suggests that the "lumens-per-watt" of the illuminating engineer is exact and satisfactory as far as it goes. Dr. Ives also advocated a simpler terminology as being necessary to advance the understanding of the subject.

Mr. James R. Cravath opened the discussion, calling attention to the difficulty of arriving at an accurate determination of the "mechanical equivalent of light" in lumen-hours or candle-hours per watt-hour, although the mechanical equivalent of heat is a well-known quantity. For the comparison of modern illuminants, however, such determination is not absolutely required. Mr. Cravath then reviewed the table of luminous efficiency of various light sources compiled in the paper under discussion and remarked on the very low efficiencies of the best electrical artificial illuminants. This table follows:

Source	Spherical Candles per Watt.	Lumens per Watt	Per Cent Reduced Luminous Efficiency.
Ideal yellow-green source	50.00	625.0	100.0
Firefly			96.5
Black body at 6000 deg.	7.50	95.0	15.6
Carbon filament ("4-watt")	0.21	2.6	0.43
Tungsten filament	0.63	7.9	1.3
Direct-current arc	1.10	13.8	2.2
Yellow flame arc	3.00	37.8	6.0
Quartz mercury arc	3.40	42.8	6.8

Dr. Morton G. Lloyd declared that the term "mechanical equivalent of light" is meaningless without including modifications, since light iself is not energy and hence cannot be compared by a simple numerical ratio with the electrical energy which produces it. A better expression, thought Dr. Lloyd, would be "mechanical equivalent of radiation," since radiation expresses the idea of energy. The same reasons led him to conclude that "luminous efficiency" is also meaningless without modifications. The speaker remarked that unfortunately many able scientists do not give proper consideration to the physiological aspects of light production. For example, the sensation produced in the eye does not vary directly as the incident light, the color of lights of equivalent intensities having an important bearing on the degree of brightness which the eye perceives. The first-mentioned principle indicates that, in a physiological sense, illumination does not obey absolutely the familiar inverse-square law. In the balanced photometer screen, when illuminations of equal intensities are compared, this difficulty does not enter. The unequal visual sensations produced by differently colored lights of equivalent intensities can be shown by balancing the sources at one pair of positions and then doubling the distance of each source, with the result that the balance will no longer continue.

Mr. G. C. Keech remarked on the admirable color qualities of daylight as suited to the human eye, although Dr. W. C. Bauer, of Northwestern University, who was present, observed that the quality of daylight is at no time really constant for any hour of the day or day of the year. Prof. E. H. Freeman, of Armour Institute, declared that an agreement must be reached on the matter of nomenclature, deciding whether "light" is to be considered in its physiological or purely physical aspect.

The subject to be discussed at the next meeting of the Chicago Section of the Illuminating Engineering Society, "Illumination Problems in Small Cities," is expected to be of special help to central-station managers in the smaller towns, where the expert services of illuminating engineers are not available. The author of this paper has not yet been selected, but the discussion will tell of the work done by small-station managers in improving their local lighting conditions.

Fixture Design and Glare.

The regular monthly meeting of the New England Section of the Illuminating Engineering Society was held at the Edison Building, Boston, on Jan. 9. Chairman C. O. Baker presided. Papers were read by Mr. David Crownfield, chief fixture designer of the Pettingell-Andrews Company, Boston, on "The Illuminating Engineer and the Fixture Designer," and by Dr. Percy W. Cobb, of the physical laboratory of the National Electric Lamp Association, on "Physical Points Bearing on Glare."

Mr. Crownfield emphasized the point that the fixture designer has had little to do in the past with the location of outlets, but that a proper treatment of illumination problems demands a change from this condition. The problems of artificial lighting are extremely elusive, and personal skill in the selection of apparatus and methods is of paramount importance. The standards are constantly rising, and the introduction of highly artistic shades adapted to the special treatment of diverse lighting needs renders the location of the outlet an important part of the solution in each case. It is a mistake to suppose that all is well when the illuminating engineer has flooded a given area with light. The temperament of the fixture designer naturally tends toward the artistic side of the illuminating problem. Both the artistic and scientific sides of the question must be taken into account for a proper result, including a reasonable cost of lighting and the use of artistic light carriers and fixtures.

The principal considerations affecting the illumination of any interior room or area are: First, the use of the room; second, the selection of the kind of lamp best suited to the use of the room; third, the proper quantity of light required for such use as the room may be put to, either specialized or general; fourth, the location of the outlets at such points that the light will best perform its office; fifth, the satisfaction of certain esthetic requirements which are inherent in every lighting problem, and, sixth, the selection of a fixture of such a type and nature that it will properly perform its office as a light carrier and also be designed along lines which will be esthetically satisfactory with regard to its environments. The use of the room is profoundly important in its relation to illumination, and a wide range of requirements is manifested, covering those of public and semi-public buildings, such as banks, art galleries, apartments, clubs, churches, theaters and private residences and commercial buildings in general. In considering the kind of light desired cost is important, together with consideration of the necessity of changing the light-giving medium for special requirements. In library, theater, home, church and hospital lighting cost should not be the prime factor. The important point is quality of light or its effect on color. Strict color requirements in certain installations of necessity limit the use of mercury-vapor lamps, glower lamps and other specialized illuminants. Adaptability of the height of the lamp to its surroundings is most important. Where the conditions require that the illuminating equipment should exemplify specific style and standards of taste care should be taken not to multiply styles in a single room. The quality of light should ever be the dominant factor.

Quantity of light must be considered with respect to the entire range of conditions demanded by the installation. The work of the society will tend to arouse an interest in good illumination on the part of the public as time passes. Mr. Crownfield said that, in his opinion, the single unit, high-wattage lamp is objectionable for most interior work except within its limited sphere, which lies in foundries, depots, post offices, packing-rooms, stores and other large areas where more or less rough work is done under conditions requiring a bright general illumination. Ballrooms, opera houses, salons and theaters require a wide range of illumination between a high brilliancy and clear relief of special objects of interest. The limit of brilliancy is the point of obtrusiveness where illumination becomes intense. Mr. Crownfield said that the lighting should never be the dominant feature of a room. The limit of dimness should be where people are aware of each other's presence, but not of mutual individuality. Without in any sense disparaging scientific research into lighting problems, Mr. Crownfield stated that it is often helpful to consider lighting on a scale as follows: Dim, low diffused, good general illumination, reading light, strong reading light, brilliant and finally intense illumination. Outlets should never be equipped to furnish a permanently dim light, except in hospital wards, libraries, clubs and in halls and corridors of private houses and hotels. A dim lighting effect is also desirable in church auditoriums where altars are used, with provision for high light in certain altar applications. Brilliant lighting is required in ballrooms, hotel lobbies, dining-rooms, hospital operating-rooms, gymnasia and other places where people go to be seen. A good reading light is desirable in the waiting-rooms of stations, theaters, libraries, at the entrances of court houses and in lecture halls. Mr. Crownfield criticised the tendency toward extreme brilliancy in the lighting of amusement entrances, notably picture shows.

The importance of studying the effect of lighting on the colors of walls and ceilings was emphasized. Depth of illumination may be added to any space by the proper location of outlets In banks, governmental and municipal buildings considerable uniformity in outlet location is desirable, with special treatment of the larger spaces by chandelier fixtures harmonizing with the minor brackets. Usually from five to seven outlet groups are required. Particular care must be paid to architectural harmony under present-day conditions. Outlets in churches should be arranged to bring out the architectural features of the buildings, at the same time avoiding any direct glare from illuminants so far as possible. The Colonial style of church is cheerful and can be lighted with good effect artificially by placing outlets in the ceiling for chandelier service and adding a line of brackets one each side under the gallery against the wall between the windows. Romanesque and Gothic churches should be lighted by outlets on beams or columns, with special lamps behind the sanctuary arch or over the chancel space. In clubs and also in residences there should be enough outlets to enable the lighting to be brilliant on occasion. The lighting of private houses is often defective on this score. A 40-watt lamp should be the maximum limit of any residential outlet. In living-rooms one center outlet with from two to six side outlets and a floor plug should be provided. In bedrooms there should never be less than two lamps beside the dressing-case and preferably one over it also. In closing Mr. Crownfield exhibited drawings in color of recent artistic fixture designs.

Following Mr. Crownfield's paper a short discussion on indirect lighting was held. The case was cited of a room 13 ft. square which had recently been equipped with four 60-watt outlets and inverted prismatic shades. The illuminating engineer who handled the work claimed that a person with ordinary eyesight could read easily with two outlets in service, and that another with poor eyes could read in comfort with four outlets in circuit. Most of the speakers criticised the use of indirect lighting for reading. Mr. Crownfield stated that it has a tendency to annihilate all the ceiling color and that better diffusion would be obtained by a reading lamp. Replying to a question he stated that the most artistic fixtures known were designed in the Bourbon and Georgian periods, and that it is perfectly proper to make the fixture the highest decorative note in the room. Mr. W. H. Blood, Jr., Boston, said that many contract agents think that their duties are contained in selling quantity of light, which, as a rule, means glare, and that few realize the importance of the artistic side of illumination. He considered indirect illumination of the type discussed almost a barbarism. It gives an unpleasant feeling in a room and, while it is used to some degree around Chicago and elsewhere, it is dull. Some bright spots are needed. The depressing effect of indirect illumination has frequently given rise to severe headaches, and it is extremely difficult to make indirect lighting artistic. Dr. Louis Bell, Boston, stated that the use of four 60-watt outlets in a room 13 ft. square gives an extraordinary illumination. He commented on the low efficiency of indirect lighting. Mr. Preston S. Millar, New York, spoke of the acceptance of indirect lighting on the Pacific Coast, where most of the criticisms have been aimed against the poorly installed systems. He thought that the indirect method has a certain small field of its own.

Dr. Cobb presented an exhaustive paper on the physical aspects of glare, discussing the structure of the eye in relation to disturbances from side light. He did not consider that general illumination is ever carried too high, and in nature it is only in certain rare cases, as with sunlight on snow in high altitudes, that serious intensities are encountered. The relative over-brightness of a part of the field of vision on the retina may contribute to confusion of vision. Dr. Cobb brought out the point that, as a rule, the human observer prefers to have the upper portion of his field of vision dark in comparison with the rest of the field. He described the muscular adjustment of the eye to meet the conditions imposed by varying disturbances at different angles of vision. A light source in the field of vision is like a loud sound, severe pain or sharp stimulus to the skin. Too high a brilliancy of isolated foci may produce retinal irritation. The incandescent carbon filament is too bright to maintain in the direct field of view. Dr. Cobb said that the praise often given the kerosene lamp as an illuminant arises from the fact that there is usually nothing bare visible, the mechanical structure and heat of such a lamp compelling a reasonable distance between it and the reader's head. He discussed the adaptation of the eye to strong light and pointed out that exposure to high illumination causes a loss in sensitiveness. Dr. Cobb reviewed mathematically the relations existing between the brightness of walls and the light upon work being performed, stating that as long as the details of the work are clear the light on walls should not exceed that on the work itself. He further described researches in Germany and the United States on the subject of visual acuity, emphasizing the relation of visual acuity to variations in intensity of side light. Tests show that an angle of about 25 deg. is the maximum at which visual acuity is substantially affected by the introduction of a disturbing side light. The experiments of Sweet and Millar in America were briefly touched upon, and the effect of scattered light within the eye discussed briefly. So far as scattered light reduces visual acuity it does not appear inimical to the eye itself. The reduction of visual acuity appears to be greater when the rays of light from a side source fall upon the blind spot in the retina than when side light falls upon the illuminated section of the retina.

Air and Oil as Dielectrics.

In a paper that in many respects was supplementary to his paper on "The Conductivity of the Atmosphere at High Voltage," which was presented in 1904, Prof. Harris J. Ryan, of Leland Stanford, Jr., University, California, described the formation of corona in air and the rupturing of oil by dielectric stress at a meeting of the Amercan Institute of Electrical Engineers held in New York on Jan. 13.

Tests have shown that initial corona is dependent not only on the application of a certain minimum stress, but also upon a certain minimum distance through which such stress must be applied. This distance, designated as the "striking distance," is shorter for smaller diameters and longer for the larger diameters. Below the "striking distance" the stresses required to produce corona or spark-discharges are increased above the value required for the critical striking distance. The critical stress value is reached at 76,000 volts per inch within a zone of 0.07 in. from the surface of the conductor. When uniformly distributed, 76 kv per inch is the critical stress required to rupture air in bulk, but a larger stress is required to rupture thin films. This fact points strongly toward some dynamic action that requires a critical minimum combination of stress and distance through which to bring about rupture wherein any foreshortening of distance must be compensated for by an increase in stress.

Professor Ryan presented evidence to show that electric stress is merely one of several factors of importance in the production of corona and spark discharge in air or in gases generally. He discussed in detail the theory of ionization by collision, and thereby accounted for the great dielectric strength of thin envelopes of air.

On the basis of the ionization theory, Professor Ryan showed that ionization and the travel of ions under electric stresses are the cause of failure of the open atmosphere as an insulator and they are the cause of corona formation. All ordinary failures of the atmosphere under stress are developed through ionization by collision which can be started under usual high-voltage electric stresses through the presence of some natural or antecedent supply of ions. Variation in the supply of natural ions in open air is the cause of the erratic variation of critical loss-voltages; such variations have little effect upon the values of the part-corona voltage that has increased the atmosphere loss by the small amount equal to the loss caused by the inevitable ion-convection current. The figure of the electric field about the high-voltage conductors determines the facility with which the migrating ions will concentrate the electric stress near the surface of the conductor and thus render the resulting corona irregular at all stages, causing it to be started and to be maintained at correspondingly lower voltages. The turbulent elements introduced by variations in the amount of natural ionization have so small an effect upon the corona-forming pressures and the field irregularity factor above referred to is so nearly constant over a wide range of conditions that the rational formula as developed should be found dependable to a reasonable extent. The term *"dielectric strength"* as applied to the oper atmosphere, from the inherent nature of things, can have no definite meaning. The rupturing strength of the normal atmosphere rests upon two factors only, (1) quantity of ionization produced by the rupturing voltage, (2) the distance between the electrodes. The rupturing gradient varies from 300 kv per inch (120 kv per centimeter) at lowest ionization to 3 kv per inch (1.2 kv per centimeter) at highest ionization with no indication that the limits at either end of this range have as yet been found.

In discussing the phenomena in oil, Professor Ryan stated that the failure of the oil as an insulator is due to ions liberated by the electric stress from the supply of free ions in the metals of the electrodes. The electric stress required to detach ions from metals to the oil is much lower than the corresponding stress for a gas. The further conclusion follows necessarily that a compressed gas must, in regard to *insulating quality alone*, be superior to oil.

In a communication from Mr. E. L. West, general manager of the Central Colorado Power Company, it was stated that the corona loss on the line of this company is much higher with the receiver load off than with it on. He found that with nothing whatever connected to the line a station voltage of 77 kv (effective sine wave) applied at Shoshone caused part-corona to start on the line conductors over the passes, and that as the voltage increased the corona loss increased with almost the same rapidity that it would if it had been started simultaneously over the entire 181 miles (291 km) of line and attained a value, due to corona alone, of 16 kw per mile (10 kw per kilometer) at a station e.m.f. at Shoshone of 105 kv.

Discussion.

Prof. M. I. Pupin expressed the opinion that the engineer who proposes to study the phenomena which accompany high-potential transmission cannot make progress without employing the ionization theory. He said that Professor Ryan had done wonderfully well in applying the theory to corona phenomena. Probably the average electrical engineer is not as familiar with the electron theory as he should be, and every effort should be made to familiarize engineers with this most useful tool.

Mr. Ralph D. Mershon called attention to the fact that the term "striking distance" was used by Professor Ryan to refer to the depth of a certain zone within which a limiting stress existed, rather than the arcing distance between needle points as ordinarily considered. He outlined a theory of stress accumulation based essentially on logarithmic functions which agreed satisfactorily with the relations reported by Professor Ryan from experimental observations.

Mr. G. Faccioli explained in detail the significance of results of corona observations reported by him and Mr. Moody in 1909. He attributed the discrepancies between the values observed under test and the values indicated by theoretical formulas to the presence of bodies in the immediate neighborhood of the electrodes and to the influence of the leads attached to the electrodes. He stated that the formation of corona is accelerated when a small piece of insulating material is placed on the surface of a cylindrical electrode. This condition is identical with that found in high-tension transmission lines where the line wires are attached to the insulators.

Dr. C. P. Steinmetz stated that the paper by Professor Ryan represents a correlation in convenient form of the vast amount of experience which has been collected since 1904, when the first classic paper of the kind was presented by Professor Ryan. Dr. Steinmetz said that the chief disadvantage of the ionic theory resides in the fact that many of the predictions based on it prove incorrect; afterward, however, the theory is so modified as to cover the facts discovered. Such results may appeal to the physicist who merely makes a correction in a curve or formula, but the engineer must be sure of his predeterminations before they are embodied in the construction of a transmission line. The breaking down of the air by the formation of corona requires not only a certain voltage gradient, but also a sufficient distance—that is, a certain total voltage. The fact that the electricity during discharge follows narrow channels of flow can be explained on the basis of the unstable conductivity of the dielectric. That is, the current tends immediately to increase along any narrow path where it may first form, due to the fact that the presence of the current itself increases the conductivity locally.

In a written communication to the discussion Prof. J. B. Whitehead discussed certain features of the ionic theory and presented evidence to show that the presence of a greater or less number of ions has no influence on the voltage at which corona starts. For example, absolutely no difference in the voltage at which corona starts is observed when the discharging wire is subjected to a copious supply of Roentgen rays, although the rays furnish one of the most powerful ionizing agents known.

Mr. Erich Housmann in a written communication called attention to the fact that the critical voltage at which energy loss begins varies almost exactly with the density of air, and hence in higher altitudes the critical voltage will be lower. The corona loss is proportional to the square of the excess voltage over the critical value. When the distant end of a transmission line is open-circuited the voltage at every point on the line increases, and when the potential over a considerable portion of the circuit exceeds the critical value a loss of energy ensues. In view of these facts it is possible for the conditions to be such that an ammeter at the station may indicate approximately the same value of current when the distant end of a transmission line is open-circuited as when connected to the full load.

Prof. Samuel Sheldon attributed to the differences in the chemical constituents of air the fact that the behavior of air with reference to its increase in dielectric strength with increase in gas pressure is erratic, and reaches a turning point or "hump" at from 150 lb. to 200 lb. per square inch. The initiation of the hump probably accompanies the initial ionization of the nitrogen of the air.

In a written communication Mr. J. E. Noeggerath showed that the phenomena in mercury-vapor lamps serve to support the views of Professor Ryan relative to corona phenomena, especially that concerning the high voltage required to start the ions, the continuation of ionization at voltages lower than at starting, the starting of ionization at lower voltages when a supply of ions is present and high stresses near the electrodes with low-voltage gradient between them. A practical conclusion which may be derived from the last-mentioned phenomenon is that when the critical transmission voltage is reached an increase in e.m.f. involves either a large increase in the distance between wires or a reduction in the ratio between the maximum and the effective voltage—that is, the adoption of direct current for transmission.

* * *

Artificial Illumination and the Eye.

At a meeting of the New York Section of the Illuminating Engineering Society held on Jan. 12 three papers were read and discussed. Artificial illumination as a factor in the production of ocular discomfort was treated in a paper by Dr. Nelson M. Black, Milwaukee, Wis. Dr. Percy W. Cobb, physiologist of the National Electric Lamp Association, Cleveland, Ohio, presented a paper dealing with physiological points bearing on glare. Mr. Paul Bauder, of the National Electric Lamp Association, read a paper in which reflection coefficients were discussed in detail.

Dr. Black described fully the different parts of the eye, paying particular attention to the rods, the cones and the pigmentary layer. In the external segments of the rods is the light-sensitive pigment known as visual purple, which contains an unstable substance, readily decomposed by the mechanical or chemical effects of the ether waves. The rapidity of decomposition depends upon the color of the light and upon its intensity, while provision exists in the retina for the constant regeneration of the visual purple, the restoration process taking place rapidly in dim light or darkness.

The eye is able to adapt itself to an enormous range of intensity of illumination, but the length of time the eye may be used with comfort is greater with the weaker illumination. The sensation of glare is produced when, for example, a person passes quickly from a dark room to a brilliantly lighted one, on account of the time that must elapse before the visual apparatus properly adjusts itself to the light intensity to which the eye is subjected. In view of the fact that exposure of the unprotected eyes to the light having a spectrum including wave-lengths extending far into the ultra-violet produces serious and often lasting injuries, the violet and ultra-violet rays have been considered the cause of all eye troubles extant. However, by reason of the absorption of rays having wave-lengths of less than 295 microns by the cornea and of less than 400 microns by the lens, practically no ultra-violet rays reach the retina, and hence the ill effects upon the eye are probably superficial. Moreover, the glass envelope used with most illuminants absorbs the ultra-violet rays, and therefore the eye is not usually subjected to even the superficial injury.

Dr. Black expressed the opinion that at least a part of the ocular discomfort observed from the use of the eyes under artificial light results from the irritating effect of the luminous or visible radiations of such illumination upon the unprotected retinal elements. The visual purple, which is an essential factor to vision and is the protective agent to the retinal elements against light, is used up by the improper application of illuminants having spectra with relatively more radiations which decompose this photochemic substance more rapidly than sunlight. This irritating effect is probably greater because insufficient time has elapsed for evolutionary changes to adapt the eye to modern artificial illumination.

Dr. Cobb, in his paper on glare, called attention to an important purely mathematical proposition, namely, that the image of any object seen against the face of a lens, prism or other refracting system is just as bright as the object from which it is formed. There is, it is true, always a small loss of light in passing through a layer of glass, but this is nearly constant about 10 per cent. The fact that an incandescent filament seen through a prismatic reflector appears to consist of innumerable filaments does not mean that the apparent candle-power per square inch, as far as the eye is concerned, is reduced. This quantity is reduced in such a case about as much as it would be in viewing the filament through a sheet of clear glass. That is, the eye is, in effect, looking at a filament a hundred times as large as the actual filament and (less by an insignificant fraction) exactly as bright in terms of candle-power per apparent square inch. Only when such reflectors are so far away that the eye is unable to distinguish their individual surfaces, and the media of the eye can themselves perform the necessary diffusion, is there any reduction in intrinsic brilliancy significant for the protection of the eyes. In the case of frosted or sand-blasted glass the individual refracting surfaces are very minute, the individual images very small, and diffusion is here complete even at close range.

Dr. Cobb claimed that scattered light in the eye from a side light-source is a large factor in reducing visual acuity and that there are probably two effects relative to the sensitiveness of the retina itself, one called forth by the extent of retinal surface stimulated by the side-light, and transient; the other the result of high intrinsic brilliancy of the side light-source and persistent (to a degree) after the side-light has ceased to act for a fraction of an hour. Obscuration of vision by scattered light in the eye of itself need be no more harmful to the eyes than looking out of a window into a fog. If, however, one can distinguish a definite change in the retinal state under side-illumination of the eye which may persist after the light is cut off, the possibility is not far to a practical application of this distinction. Although under practical conditions the actual reduction of visual acuity by this feature of glare is not so great as to cause in itself serious embarrassment of vision, yet it can be looked upon as a symptom by means of which the physiological diagnosis of a system of illumination may possibly be made in a scientific way, instead of the method of trying it out under actual conditions, so wasteful of time, capital and human eyesight.

Mr. Bauder gave much information relating to the reflection and absorption coefficients of various materials. In a certain room 10 ft. long, 10 ft. wide x 10 ft. high the following average values were found for the illumination obtained from various lamps as affected by the color of the walls—the ceiling and floor being white. The values are expressed in per cent, with 100 taken as the values obtained with white floor walls and ceiling.

PERCENTAGE ILLUMINATION WITH DIFFERENT COLORS OF WALLS

Lamps.	Red.	Green.	Blue
3.1-watt carbon	53.39	48.57	43.90
2.5-watt carbon	50.85	49.35	44.55
2.0-watt tantalum	49.27	49.60	46.11
1.25-watt tungsten	47.20	51.08	50.38

As showing the extent to which the efficiency of a lighting equipment may be decreased by the use of improper globes, the author presented the following table of absorption percentages with various styles of glass:

ABSORPTION BY DIFFERENT GLASSWARE.

	Per cent.
Clear glass	5 12
Light sand blast	10–20
Alabaster	10–20
Canary colored	15–20
Light blue alabaster	15–25
Heavy blue alabaster	15–30
Ribbed glass	15–30
Opaling glass	15–10
Ground glass	20–30
Medium opalescent	25–40
Heavy opalescent	30–60
Flame glass	30–60
Signal green	80–90
Ruby glass	85–90
Cobalt blue	90–95

Mr. Bauder stated that for certain locations it is desirable to direct the light at once, without wall or ceiling reflection, upon the work at hand, and in order to accomplish this result steel reflectors of various surface finishes have been adopted. A considerable loss occurs, as the efficiency of reflection varies from 60 to 65 according to the type of reflector but the results from a correct illumination standpoint are apparently warranted.

A great deal has been and is being done by incandescent lamp and reflector manufacturers to increase the lighting efficiencies of the various styles of reflector, and the possibilities for manufacturers of interior decorations, such as art glass, wall hangings, etc., include a field of immense dimensions.

Discussion.

Dr. J. E. Weeks remarked that the existence of visual purple has been acknowledged for some time. The destruction of the purple is accelerated under conditions of glare where the pupillary contraction cannot take place with sufficient rapidity. The most comfortable method of illuminating a room consists in hiding the source of light and illuminating merely the object which is to be viewed. Light from lamps at the side is particularly disagreeable. He expressed the opinion that the assembly rooms of the State Senate at Albany are very poorly lighted, largely on account of the fact that lamps are exposed directly to view along the side of the room.

Dr. H. H. Seabrook said that most of the damage to the visual organs is caused by the chemical rays. He called particular attention to the importance of considering not only the amount of light used in illuminating objects, but also the direction of the light.

Mr. W. H. Gardiner called attention to the fact that the trouble to the eyes known as cataract is quite prevalent in Labrador; where the eyes are frequently subjected to so-called snow blindness.

Mr. A. J. Sweet discussed in detail the factors upon which glare may be said to depend. There are two distinct phenomena to which the name glare may be applied. According to one of these, the glare is proportional to the discomfort produced, while according to the other the glare varies with the depression of visual function. The depression of perception varies with the amount of flux, while the comfort depends upon the specific brilliancy of the light source. Tests have shown that when the visual angle of separation between an external light and the object illuminated exceeds about 26 deg. the amount of flux obtained from the external source has no effect upon the ability to see the object viewed. This particular form of glare is quite independent of that to which ocular discomfort may be attributed.

Prof. S. W. Ashe stated that it is not proper to compare illuminants on the single basis of the amount of flux produced, but the effect of each illuminant on the visual acuity must be taken into consideration. Of lamps giving equal amounts of flux, that having a low specific brilliancy or placed beyond the range of direct view is far preferable to one having a high brilliancy and placed where it can easily be seen.

Mr. Norman Macbeth, in discussing the effect of different illuminants upon colored fabrics, stated that materials which seemed to match perfectly when illuminated by light from one source may appear quite different when viewed under light from a different source. Color selectivity depends not only upon the material, but also upon the chemical composition of the dyes used in coloring the material

Mr. Bassett Jones, Jr., remarked that in many localities the amount of light flux produced is of relatively minor importance in comparison with other features of the illuminating equipment, such as the harmony of the fixtures with the architectural treatment of the room and the effect of the color of the light upon the decorations employed

Mr. E. L. Elliott remarked that the facts mentioned by Mr. Jones are properly considered when it is remembered that there is an art of illumination as well as a science of illumination. Both of these must be combined and receive the proper weight before correct results can be obtained

Messages of Governors to Legislatures.

Abstracts of the annual messages of a number of Governors to State Legislatures were published in these columns last week. The following additional excerpts of messages relate to the recommendations regarding public utilities

GOVERNOR SPRY, OF UTAH.

Governor Spry repeated the recommendation made by him two years ago for the creation of a Public Utilities Commission.

GOVERNOR M'GOVERN, OF WISCONSIN

Governor McGovern, of Wisconsin, stated that the stock and bond law enacted in 1907 has been so construed by the Supreme Court as to limit the scope of the inquiry which the Railroad Commission might institute where public service corporations desired to issue stock and bonds or other evidences of indebtedness, for money only, to an ascertainment of the legal capacity or competency of corporations to issue these securities. So construed, this law was of little value. It did not authorize the disclosure of important facts relating to past issues of securities which should be in possession of the commission before new issues were authorized. On the other hand, it might result in the issue of a large volume of corporate securities the validity of which the State would have to recognize in future litigation concerning rate regulation. The law should be amended without delay. Instead of permitting the corporations to determine the amount and character of the securities they wished to issue the Legislature should do this and prescribe the purposes which justified such issues, leaving to the commission authority to ascertain in any given case whether the proposed purposes were within the terms of the statute and whether the proposed issue in character and amount was reasonably required to accomplish such purposes.

Governor McGovern said that of all the plans for workingmen's compensation thus far put in operation the German system was the best. He suggested the enactment of a statute which would do in Wisconsin what the German law had accomplished

Only about a half dozen States in the Union were as richly endowed with water-powers as Wisconsin The utilization of the water-powers should be brought with the jurisdiction of the Railroad Commission, to be regulated and controlled in the interest of all the people, the same as other public utilities. It did not seem unfair or unreasonable to secure to the public a share in the advantages which came from the use of this natural resource. The compensation for water power privileges should not, of course, be so large as to discourage development

GOVERNOR HAY, OF WASHINGTON

Governor Hay recommended the abolition of the Railroad Commission, the Tax Commission and the office of Insurance Commissioner and the creation of a Public Service Commission. The Public Service Commission would undertake the duties now carried on by the Railroad Commission in reference to transportation, telegraph and telephone companies with the added powers of supervision and regulative control over light, power, gas, water and irrigation companies or corporations doing business in the State.

Washington must face the issue of State or federal control of natural resources. National conservation as advocated by its most ardent advocates was designed less to benefit the consumer of the products of those resources than as a new means of obtaining increased revenue for the national treasury. The extra tax represented in the federal royalty would fall upon the citizens of the localities where coal mines and water-power were developed. The State would be inexcusably derelict if it failed to protest against such a proposition and at the same time failed to make immediate provisions for exercising its own prerogatives in controlling, administering and preserving its natural resources.

Governor Hay commended to the serious consideration of the Legislature a draft of a bill on the subject of workingmen's compensation and hoped that favorable action at this session would result.

GOVERNOR WILSON, OF NEW JERSEY.

Governor Wilson urged the imperative obligation to effect such changes in the law of the State as would henceforth effectually prevent the abuse of the privileges of incorporation which had in recent years brought so much discredit upon the State. It would be necessary to regulate and restrict the issue of securities, to enforce regulations with regard to bona fide capital, examining very rigorously the basis of capitalization, and to prescribe methods by which the public should be safeguarded against fraud, deception, extortion and every abuse of its confidence.

While there was a Public Utilities Commission in New Jersey it had hardly more than the powers of inquiry and advice. It was understood by everybody who knew anything of the common interest that it must have complete regulative powers: the power to regulate rates; the power to learn and make public everything that should furnish a basis for the public judgment with regard to the soundness, the efficiency, the economy of the business: the power, in brief, to adjust such service at every point and in every respect, whether of equipment or changes or methods of financing or means of service, to the general interest of the communities affected. Such regulation, based on thorough and authoritative inquiry, would go far toward disclosing and establishing those debatable values upon which so many questions of taxation turned. Values could not be taxed fairly until they had been ascertained and established. The great matter of conservation seemed to Governor Wilson like a part of the same subject. There should be systematic compensation for injured workmen, which would give them their rights by automatic operation of law.

Massachusetts Commission News.

The Worcester Electric Light Company has appealed to the Massachusetts Gas and Electric Light Commission against the Board of Aldermen of the City of Worcester, which recently granted a franchise to Mr. A. S. Lowell, a prominent merchant, to transmit electricity across Foster Street for distribution in the immediate neighborhood of his power plant. The commission will give a hearing on the case in the near future.

The Railroad Commission gave a hearing on Jan. 12 upon the petition of the Selectmen of Attleboro for increased service and fare reductions by the inauguration of workingmen's tickets on the Interstate Consolidated Street Railway Company. President F. H. Dewey and General Manager Henry C. Page, of Worcester, appeared for the company, and submitted figures showing that the cars were not seriously overcrowded even in the morning and night rush hours when the maximum factory traffic was handled, and that two and three extra cars were often run to meet the demands for increased service. President Dewey discussed the fare situation at some length, and stated that if the company granted workingmen's tickets between 5 and 7 a. m. and 5 and 7 p. m. at a rate of 3.5 cents per ride, as requested by the petitioners, the loss would easily amount to $12,000 a year—a sum which the company could ill afford to spare in view of its moderate earnings of from 4 per cent to 5 per cent dividends and the requirements of maintenance. Mr. Dewey closed by stating that the existing facilities provide a ride of from eight to twelve miles on a 5-cent fare with a free transfer, which is unusually reasonable for a street railway serving such a territory. The commission took the case under advisement

Wisconsin Commission News.

Governor McGovern has appointed Mr. David Harlowe, of Milwaukee, to be a member of the Wisconsin Railroad Commission in place of Prof. B. H. Meyer, who recently resigned to accept a place on the Interstate Commerce Commission at Washington. Mr. Harlowe is a railroad-rate expert by education and business training, being at present the traffic manager for the Allis-Chalmers Company, and one of the best posted men on railroad matters in the State.

The Supreme Court has upheld the "indeterminate permit" feature of the public-utilities law. It was contended in the Kenosha case that a certificate of public convenience and necessity from the Rate Commission need not accompany a franchise secured from the City Council. One lighting company had surrendered its franchise and taken an indeterminate permit. Ten days later an electric railway company secured a lighting franchise from the Council, but made no application to the commission for a certificate of convenience and necessity. In quo warranto proceedings the lighting company prevented the railway company from carrying out the provisions of its franchise and the railway company appealed on the ground that the law was void.

The special committee appointed by the Legislature to consider the water-power question has completed its investigations and formulated its report. The bill which the majority members of the committee will file with the Governor will place the control of the water-powers with the Rate Commission. The terms of the bill provide that all future water-power franchises shall, under the terms of the act, come within the control of the commission, while franchises already given under legislative authority are to terminate within three years unless the holders of the franchise place their powers under the commission control. The franchises under the control of the commission are to be made indeterminate. The control of the commission in the case of new powers is to extend to the location of the dam from which the power is to be obtained. In case of existing water-powers where the full power is not now developed by existing power it is left with the commission to say whether new water-power sites on the stream can be utilized, and if so, where the dam shall be located. When water-power franchises come under its control, as the bill provides that the commission shall have the power to issue orders regulating the flowage, controlling the use of the power, and to decide practically all questions in regard to its operation. In cases of leases of the power, the control of the contract rates for its use is left with the commission.

The commission has authorized the Madison Gas & Electric Company to issue $727,000 par value of thirty-year gold bonds of the denomination of $1,000 each. These bonds are to bear interest at the rate of 6 per cent per annum, and the issue is to be under the terms of a mortgage or trust deed given to the Bankers' Trust Company, of New York. Of the issue, $400,000 is to be held for the purpose of acquiring by purchase or exchange or of paying or redeeming the first mortgage bonds, dated April 1, 1896, and now outstanding to the amount of $400,000, such exchange to be at par. Bonds to the value of $27,000 are to be used in exchange and liquidation, par for par, of an equal amount of outstanding obligations of the company now owing to the American Light & Traction Company and incurred by reason of extensions and additions made to the plant of the company. Bonds to the value of $100,000 are to be issued and sold for cash at not less than par value for the purpose of reimbursing the company for money actually expended for making extensions and additions to the property.

New York Commission News.

The Public Service Commission, Second District, has authorized the Corning Gas & Electric Company to exercise a franchise granted by the Village of Painted Post, Steuben County, for the purpose of furnishing electricity for light, heat and power. The East Hampton Electric Light Company has been authorized to issue $13,500 par value first mortgage 6 per cent bonds, the proceeds to be used for equipment and improvement of its plant and distributing system.

The Syracuse Rapid Transit Railway Company has been authorized to issue its preferred capital stock to the amount of $1,750,000, to be disposed of at not less than par and the proceeds to be used to pay and discharge the principal of promissory notes of the Syracuse Rapid Transit Company to the amount of $1,660,000. The remaining $90,000 is to be used for additions, extensions and betterments. The authorization is upon the express condition that the corporation shall credit to its fixed capital account the sum of $57,189, which the commission found charged to capital account, but not properly the subject of capitalization.

The Chasm Power Company, of Chateaugay, N. Y., was ordered to show cause before Jan. 16 why an order should not be made requiring the company to place its street-lighting and distributing system in a safe condition. Investigation by the commission of the company's plant followed a fatal accident recently to a telephone lineman, who came in contact with the wires of the company. The investigation disclosed that the method employed by the company of operating its street incandescent-lighting system was very poor, inasmuch as when the lights are cut out, the circuit at any lamp remains alive on account of a permanent connection at a distant end of the circuit. These wires, being constantly alive, afford a dangerous operating condition, which the commission seeks to remedy.

At a hearing before Commissioner Maltbie of the Public Service Commission of the First District of New York, Jan. 16, on the application of the Long Acre Light & Power Company for permission to issue $10,000,000 worth of stock and $50,000,000 of bonds, two points were settled by decision of the commission. The New York Edison Company, interposing, claimed that the Long Acre company had invalidated its franchise by non-operation. The attorneys of the Long Acre company made a motion that the New York Edison Company be prohibited from taking part in the hearings and also moved that all evidence as to the validity of the Long Acre franchise be stricken from the records. In the session of Jan. 16 Commissioner Maltbie decided both of these motions adversely to the Long Acre company. He said that it was the opinion of the commission that the New York Edison Company had a right to be heard and also he declared that the Long Acre company must produce evidence to show that its original franchise had not lapsed on account of failure to be exercised. With regard to the last motion, the attorneys for the Long Acre company asked time to prepare briefs and furnish evidence as to the validity of its franchise. The next hearing was therefore set for Jan. 31.

During the past week there were two hearings upon the complaint of consumers in the Far Rockaway section of New York against the rate charged by the Queens Borough Gas & Electric Company for electrical energy. The time at these hearings was occupied with the technical testimony of expert accountants and the engineers. The company claims that it is now charging as low a rate for energy as can be done and earn a fair return upon the money invested.

Maryland Public Service Commission News.

The Maryland Publice Service Commission last week filed with Governor Crothers its first report. The commission reports that its jurisdiction covers 220 corporations, with bond and stock issues aggregating $1,772,578,699. Reference is made to delays in organization, which was finally effected on June 1, when a full board, consisting of Mr. James M. Ambler (chairman), Mr. Philip H. Laird and Dr. Joshua W. Hering, met for the first time. Owing to a suit brought questioning the legality of the payment of salaries in excess of $3,000 to employees of the commission the State comptroller will not honor requisitions for amounts in excess of $3,000, and the engineering department cannot be organized unless better salaries are paid.

Three pending investigations are mentioned as involving great labor and study. One of these relates to rates for common carriers by water, filed by the Merchants and Manufacturers' Association; another to rates for telephone service, based on a schedule by the Chesapeake & Potomac Telephone Company, and the third to a complaint against the Consolidated Gas, Electric Light & Power Company relative to its charges for gas and electricity.

Referring to this latter, the commission says that on June 16, 1910, the commission was advised by the Mayor of Baltimore, through a gentleman connected with the city solicitor's office, that the complaint against the Consolidated Gas, Electric Light & Power Company, of Baltimore City, under section 36 of the Public Service Commission law, would be ready for filing by the first of July. The complaint has not yet been filed. The understanding is that it will be presented early in the present year. Because of its large fixed charges, the commission thought it advisable to reserve its funds as much as possible in order that money might be available for making physical valuations of corporate properties, if such course was deemed necessary.

Mr. Charles E. Phelps, chief engineer of the commission, has worked out a plan for the organization of his department. It provides for a transportation division, with a civil engineer in charge; an accident division, a testing division and a statistical division, with a superintendent in charge. Since the commission was organized eighty-four cases have been entered upon its regular docket and forty-nine upon its correspondent docket. Thirty-four of the regular cases have been decided after hearings, twenty-three have been settled either by withdrawal or by compliance on the part of the corporations, and twenty-four remain open. The commission found that it had no jurisdiction in three cases. Thirty-two of the correspondence cases were settled, thirteen remain open, and four were carried to the regular docket. The commission demands a uniform system of accounts as a necessary aid to it in its work.

The report states in conclusion that it is gratifying to the commission to record the fact that so far the great majority of the corporations of the State have met the commission in a friendly spirit. Changes and adjustments to new conditions will entail upon them extra work and some annoyance at the outset, but it is believed that in a short time the spirit of co-operation will prevail generally, with better and cheaper service for the public and reasonable and just profits for the corporations.

The commission has approved an application for the consolidation of the Park Heights and the Mortimer Heights Water Company. The new company is authorized to issue $100,000 worth of stock and $75,000 worth of 6 per cent bonds.

The Washington, Westminster & Gettysburg Railroad Company last week filed with the Public Service Commission an application to allow it to construct a railway from Brentwood, Md., passing through Prince George's, Montgomery, Howard, Frederick and Carroll Counties to the Pennsylvania line, and then to Gettysburg. In order to pay for the right-of-way and for the construction the company asks the approval of the commission to issue $100,000 of stock and in addition $35,000 of bonds and $6,000 of preferred stock at 6 per cent for each mile constructed. The application will be heard on Jan. 25.

Mr. Philip D. Laird, a member of the Public Service Commission, was in Easton last week with the chief engineer to the commission, Mr. Charles E. Phelps, to investigate the Easton Light & Fuel Company. Complaints were filed against the price, quality and quantity of the company's gas and electricity by the people of Easton. The company denied the truth of the allegations and asked for an investigation. Throngs of people attended the hearings, which are still being continued, and much interest is being manifested by the residents as to the outcome of the complaints.

At a suggestion from the commission the Fire Board of Baltimore has ordered the removal of all gas gages from the engine and truck houses of Baltimore. They were placed in these places by Superintendent of Lamps and Lighting McCuen for the purpose of keeping record of the gas pressure in the different sections of the city. Mr. McCuen contends that these gages are absolutely necessary for the protection of the consumers, and manifested considerable surprise when the commission suggested their removal. Chief Engineer Phelps, of the commission, explained that the gages had been ordered removed by the commission on his recommendation. He said that in place of these gages, many of which have long been out of order and few of which were ever consulted, the commission proposes to keep one stationary gage at the City Hall and to use portable gages to test the pressure from time to time in other sections of the city.

Holding that a corporation has no right to abandon or refuse to place at the disposal of the public such utilities as it may have, which, if put into operation, would be for the public convenience, the commission last week handed down a decision in the case of the Old Frederick Road Improvement Association against the United Railways & Electric Companies, of Baltimore. The latter was ordered to establish satisfactory connections between the present terminus of its Catonsville line at Stoddards and its Ellicott City line at a point one-half mile away. The commission in passing on the matter pointed out the great inconvenience caused by the abandonment of the trackage. The commission was further asked to reduce the fare on the Ellicott City line and also order certain changes in the routing of the cars operated over it, but declined to do so on the ground that the facts set forth do not warrant such action. It, however, accepts the proposition of the company to grant walking transfers from eastbound Ellicott City cars to eastbound Towson cars. The establishment of transfer privileges between these two lines was one of the things asked for by the Improvement Association and the company voluntarily granted it.

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Canadian Hydroelectric Commission News.

On Jan. 13 Hon. Adam Beck, chairman of the commission, announced that the loop connecting St. Mary's and London had been completed and power turned on. The completion of this section gives a double transmission circuit through all the municipalities north and west of Dundas and should obviate any further trouble in obtaining a continuous service. The line from Niagara Falls to Dundas has already a double circuit, so that the whole line from the Falls to St. Mary's, the present terminus of the commission's main line, is now equipped with a double circuit.

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Georgia Hydroelectric Development.

Work has been begun on a hydroelectric system in north Georgia which ultimately will develop 155,000 hp. There are four sites, two on the Chattahoochee River, one on the Tullulah River and another on the Etowa River. The first to be developed is at Tullulah Falls, where a dam 384 ft. long and 112 ft. high is being constructed. About 60,000 hp is available here, and the power house will contain six 8000-kw turbines. Transmission to Atlanta, ninety miles distant, will be at 100,000 volts, to be reduced to 2300 volts for distribution.

CURRENT NEWS AND NOTES.

Interior Conduit in Colorado.—In Colorado during the six months ending Dec. 31, 1910, slightly over $60,000 worth of iron conduit was installed.

Lightning Rods in Germany.—Prussian regulations require that before lightning rods can be erected permission must be obtained from the local police authorities and the work must be inspected and approved. All lightning rods placed upon government buildings must be inspected by an expert electrician at least once a year to determine continuity of circuit and electrical ground resistance.

Mme. Curie and the French Institute.—Notwithstanding that the senior organization of the Institute of France—the forty immortals—has protested against the admittance of Mme. Curie to membership in the Académie des Sciences, the latter body has placed that distinguished scientific worker at the head of a list of six upon whom a vote will be taken on Jan. 23. Among the six are MM. Branley and Broca, known for their work in connection with wireless phenomena.

International Association of Municipal Electricians.—The *Proceedings* of the fifteenth annual convention of the International Association of Municipal Electricians held at Rochester, N. Y., Sept. 6 to 9, 1910, have been issued in book form. The association represents the municipal electrical departments of American and Canadian cities. Mr. H C. Bundy, of Watertown, N. Y., is president, and Mr. Clarence R. George, of Houston, Tex., is secretary. This year's convention will be held at St. Paul, Minn.

Wireless Consolidation in Germany.—According to a newspaper telegram the Marconi and Telefunken interests in Germany have been merged, thus putting an end to the competition and serious difficulties which have hitherto been caused by Marconi's refusal to co-operate with the Telefunken systems or to handle their messages. The trouble has been acute in respect to communcation between ships at sea and between ships and the shore, as the Hamburg-American and the North German Lloyd steamers are the only vessels of the German mercantile fleet that are equipped with the Marconi apparatus.

Terminal Electrification Agitation in Chicago.—The new president of the Illinois Central Railroad, Mr. Charles H. Markham, late of Pittsburgh, has entered upon the discharge of his duties, and one of the first things that confronted him in Chicago was the demand for the electrification of the Illinois Central Railroad terminal to help to abolish the smoke nuisance. Naturally, the new president was not able to give any definite assurances to the various petitioners that waited on him, but begged for time and promised to consider the problem with an unbiased mind. He must have been impressed, however, by the fact that there is a real public demand for the remedy of a long-standing grievance.

Electric Furnaces.—As has previously been noted in these columns, the Canadian government has for some years been investigating the subject of smelting iron ore by means of electricity and the latest result of this investigation has been recently published in a bulletin issued by the Department of Mines. When the investigation was first started in 1904 there were in existence but four electric furnaces for the smelting or handling of iron ore. In 1910 there were 114 furnaces, of which sixty-seven were in operation, eleven not working and thirty-six in course of erection. Of these furnaces thirty were in Germany, twenty-three in France, twelve in Italy, ten in Austria and ten in the United States. Seventy-seven of them were of the arc type, fifty-five were induction furnaces and two a combination of arc and resistance furnaces. A great increase in the output rating of the furnaces is noted, the largest at present in operation having a rated output of 15 metric tons per day.

Congress of Technology.—In order to celebrate the fiftieth anniversary of its establishment the Massachusetts Institute of Technology will hold a congress of technology on April 10 and 11, 1911.

Telephones Displace Telegraph on Canadian Pacific.—Because it insures greater safety and operates at higher efficiency, the Canadian Pacific Railway, which already has 2254 miles of single-track road equipped with telephones for train dispatching, will during the coming year install the telephone on another 2000 miles of road to replace the telegraph in the operation of trains.

Jovian Rejuvenation in New York.—A rejuvenation and dinner will be held by the Sons of Jove at Reisenweber's, Fifty-eighth Street and Eighth Avenue, New York, on Jan. 30. The dinner will take place at 6:30 and the rejuvenation at 8. Mr. George Weiderman, electrical contractor, New York, is the local Neptune; Mr. T. I. Jones, of the Brooklyn Edison Company, is Statesman, and Mr. J. F. Becker, of the United Electric Light & Power Company, is Assistant Statesman.

Wireless for Canadian Passenger Steamships.—A law recently enacted at Ottawa provides that every seagoing and coasting passenger ship of over 400 tons gross tonnage registered in Canada, and every seagoing and coasting freight ship having a gross tonnage of over 1200 tons, shall be equipped with apparatus for wireless telegraphy. Failure to comply with the law subjects the offending owner to a fine ranging from $100 to $1,000, or to a term of imprisonment not exceeding twelve months, or both.

Canadian Society of Civil Engineers.—The Canadian Society of Civil Engineers will meet at the Royal Alexandra Hotel, Winnipeg, Jan. 24 to 27. Mr. C. B. Smith, of the engineering firm of Smith, Kerry & Chace, of Toronto, will read a paper on the municipal electric light plant of Winnipeg, and a description of the Calgary Power Company's station now building at Horseshoe Falls on the Bow River, forty-five miles northwest of Calgary, in Alberta, Canada, a brief account of which appeared in the Dec. 29, 1910, issue, will also be given.

Central-Station Returns to Labor and Capital.—In a recent address Mr. Samuel Insull, president of the Commonwealth Edison Company, Chicago, pointed out the interesting fact that the amount paid out yearly for labor by his company was just about equal to the wages of capital in the shape of bond interest and dividends on stock. He said that probably a similar proportion would be found to obtain in all companies supplying electricity. "In other words," said Mr. Insull, "the capitalist puts his money into the business and takes his pay in one-half of the profits, giving to labor the other half of the profits."

Niagara Power.—At a recent hearing in Washington on proposed legislation relating to the diversion of water at Niagara Falls, Gen. F. V. Greene advocated freedom of importation of Canadian water-power. Mr. Frederick L. Lovelace, secretary of the Niagara Falls Power Company, said his concern had been greatly injured by restrictions in the Burton law. He said his company would make no serious objection to open competition for the water of Niagara River. Mr. G. A. B. Scovell, of Lewiston, N. Y., believed in eliminating any restrictions on the obtaining of power from the Canadian side and pointed out that already all the power permitted to be used on this side is being utilized and that more than 100,000 hp is coming from two corporations on the Canadian shore.

Microphone Action in Lamp Filaments.—Noticing peculiar musical notes in an operator's head-set while certain supervisory switchboard lamps were lighted, Mr. William S. Paca, general manager of the Oil City (Pa.) telephone exchange, traced the source of the sounds to one of the cord lamps on the calling side. This lamp seemed to have a distinct microphonic action in picking up any sounds or vibrations of the desk position. In *Telephony*, Dec. 24, Mr. Paca describes his further experiments with this lamp, which seem to prove that ordinary loose contacts had no part in the microphone phenomenon, as the lamp had been in service a long time and was frequently handled. The needle of a galvanometer in series with the lamp swung in a way similar to the effect of a granulated carbon transmitter when agitated. When mounted on a transmitter diaphragm spoken words could be occasionally reproduced by the microphonic lamp. Mr. Paca concludes that the seat of the phenomenon is in the hydrocarbon paste of the filament itself. Several other switchboard lamps were found to share the effect.

Western Society of Engineers' Banquet.—The Western Society of Engineers held its forty-first annual meeting and dinner at the Red Room of the La Salle Hotel, Chicago, the evening of Jan. 11. The result of the election of officers for 1911 was announced as follows: President, Mr. O. P. Chamberlain; first vice-president, Mr. W. C. Armstrong; second vice-president, Mr. C. R. Dart; third vice-president, Prof. I. O. Baker; treasurer, Mr. Albert Reichmann; trustee, Mr. Ernest McCulloch. The secretary announced the membership at the close of 1910 to be 1124. Mr. R. H. Rice, of the board of supervising engineers, Chicago Traction, was awarded the Chanute medal for the best electrical engineering paper, on "Low-Tension Feeder Systems for Street Railways." Among the speakers of the evening was Prof. Charles E. Merriam, of the University of Chicago, one of Chicago's aldermen and chairman of the commission which for the past two years has been investigating city methods and expenditures. He brought out the importance of true engineering in conducting municipal affairs, as contrasted with political chicanery.

Colorado Electric Club.—The annual meeting of the Colorado Electric Club was held Thursday noon, Jan. 12, in connection with the weekly luncheon. Adjustable paper hats were distributed as favors and a florist presented each member with a carnation. A new Jovian beverage was served, and the lunch was a very successful affair, with music and toasts. Following the lunch the annual financial statement was given. The membership is now 308, and the average attendance during 1910 was ninety-four. Forty-three speakers entertained at weekly lunches last year. The present balance on hand in cash and other assets is $2,300. In appreciation of the unusual services of Mr. C. F. Oehlmann, the retiring secretary, who has done much toward organizing the club, he was presented through Mr. Greenwald as chairman, in behalf of the club, with a handsome Morris chair. Resolutions of sympathy were passed on the death of Senator Hughes, whose last public appearance was before the Electric Club. The meeting then proceeded to the election of eleven directors, as follows, who comprise also the chairmen of the various committees: Messrs. C. F. Oehlmann, illuminating engineer of the Denver Gas & Electric Company; J. F. Dostal, superintendent of electrical department of the Denver Gas & Electric Company; this year's Jupiter, H. T. Wolfenden, Denver representative of the Allis-Chalmers Company; J. F. Greenwald, publicity manager of the Colorado Telephone Company; B. S. Manuel, sales manager with the Westinghouse Electric & Manufacturing Company; W. Matthews, superintendent of overhead equipment with the Denver City Tramway; W. P. Carstarphen, president of the Carstarphen Electric Company; C. F. Stannard, secretary of the Denver Gas & Electric Company; Gen. Irving T. Hale, manager of the General Electric Company in Denver; W. F. Brown, of the Colorado Telephone Company, and J. F. Reardon, city electrician of Denver, for one-year term.

National Telephone Convention Postponed.—The National Independent Telephone Association announces that its annual convention, which is to be held in the Hotel La Salle, Chicago, has been postponed from Jan. 17-19 to Feb. 8-10.

Telephones in Winnipeg, Man.—During 1910 the number of telephones in the City of Winnipeg, Man., increased by 3437, making the total number of telephones there 16,161, which is said to mean a larger number per capita than in any other city in Canada. The telephone system is owned and operated by the government.

Missouri Electric, Gas, Street Railway and Water Works Association.—At a recent meeting of the executive committee of the Missouri Electric, Gas, Street Railway and Water Works Association in St. Louis it was arranged to hold the annual convention of the association in St. Louis on April 13, 14 and 15. Mr. R. J. Irvine, of Marshall, Mo., is president of the association.

C. E. A. Commercial Committee.—President Coate, of the Canadian Electrical Association, has appointed a commercial committee as suggested at the Muskoka convention of that body. The committee consists of: Mr. Eugene Creed, Toronto Electric Light Company, chairman; Mr. C. J. McNab, Montreal Light, Heat & Power Company; Mr. J. H. Larmouth, Electric Power Company, Belleville, Ont., and Mr. W. H. McIntyre, Ottawa Electric Company.

Boston Dinner of A. I. E. E.—The Boston Section of the American Institute of Electrical Engineers, in co-operation with the Boston Society of Civil Engineers and the American Society of Mechanical Engineers, will hold a dinner at Hotel Somerset, Boston, on Tuesday evening, Jan. 31. The guest of honor will be Prof. Elihu Thomson, past-president of the A. I. E. E. The object of the dinner is to facilitate arrangements for a joint engineering societies building in Boston.

Chicago Subway Project.—During the course of the telephone-rate investigation in Chicago Mr. B. E. Sunny, president of the Chicago Telephone Company, informed a committee of aldermen that Mr. B. J. Arnold, chief subway engineer of Chicago, would be ready to submit his report to the City Council about March 15. The building of the passenger subway in "downtown" streets will entail an additional expense on the telephone company for removing its underground circuits.

Proposed Revision of Electric-Light Rates in Chicago.—The chairman of the Aldermanic committee in charge of the matter declares that an investigation into the advisability of revising the rates of the Commonwealth Edison Company of Chicago should be begun in a few months. The present rate agreement with the city expires on July 12, 1912, and experience has shown that a year or more is not too long for an adequate investigation of the many aspects of rate schedules of public-utility corporations.

Employers' Liability in New Jersey.—It is reported that Senator Walter E. Edge will introduce in the New Jersey Legislature during the present week an employers' liability bill, prepared by the commission appointed by Governor Fort, and embodying various radical changes in the system of making compensation for personal injuries. Besides amending the present law, the bill will provide an elective compensation scheme to be put into operation by an agreement between employer and employee as a substitute for the right of recovery by action at law. In its modification of the present law the new measure would abolish contributory negligence as a defense for an action for personal injury, and would make wilful negligence only a defense. The bill defines wilful negligence as deliberate action or deliberate omission to act, operating as the approximate cause of injury, or conduct evincing reckless indifference to safety, or intoxication. The existing defense of assumption of risk on the part of an employee and fellow-servant is abolished. It is said that the schedule of compensation in the bill is more liberal than that allowed in any other state whose laws have a similar provision, in England or by the United States Steel Corporation, whose vice-president was one of the framers of the bill.

Medical Service by Wireless.—The captain of a freight steamer, the *Herman Frasch*, of New York, credits wireless telegraphy with saving his life. On Jan. 4 while at sea off Sabine Pass, Gulf of Mexico, Captain McGray was taken ill after eating canned salmon and his condition soon became critical. There being no doctor aboard, a wireless message was sent at random describing the symptoms and asking for medical advice. Shortly after a reply was received from the surgeon of the Ward steamer *Yucatan*, then in the harbor of Progreso, Yucatan, 800 miles distant, giving a prescription and details of treatment. The instructions thus received were followed and Captain McGray recovered.

Street-Lighting Controversy in Jersey City.—For some time there has been a controversy between the Street and Water Board of Jersey City, N. J., and the Public Service Electric Corporation on the subject of the substitution of 4-amp luminous arcs for 9.6-amp open arcs for street lighting. The city claims that the 4-amp luminous arc is not the equivalent of the 9.6-amp open arc, and has refused to pay the bills rendered since the substitution of the new lamp. Up to the present bills aggregating about $50,000 are held up. The claim has been made that instead of charging $75 per lamp per year, which is the price for lighting with the open-arc light, only $43.50 per lamp per year should be paid for lighting with the luminous arc.

Chicago Section of American Electrochemical Society.—The Chicago Section of the American Electrochemical Society will hold a meeting on the evening of Jan. 20 at the rooms of the Western Society of Engineers, devoted to a consideration of methods of treating iron and steel by the electric furnace. There will be four speakers. Mr. James Lyman, of the General Electric Company, will discuss *Electric Furnaces for the Manufacture of Iron and Steel.* He will be followed by Mr. F. T. Snyder, of the Metallurgical Engineering Company, on *Reliability of Electric Furnaces for Commercial Work.* Prof. C. F. Burgess, of the University of Wisconsin, on *Electrolytic Refining as a Step in the Production of Steel,* and Mr. Charles G. Osborne, of the Illinois Steel Company, on *Some Experiences with the Electric Furnace at South Chicago.* Members of the American Chemical Society and other engineers will be the guests of the local society for the evening.

Overhead Line Construction.—The overhead line construction committee of the National Electric Light Association, acting in co-operation with committees of the Maintenance of Way Association, the American Street and Interurban Railway Association and the American Institute of Electrical Engineers and a representative of the American Telephone & Telegraph Company, has prepared for general acceptance a set of specifications for overhead work. The specifications apply to overhead electric light and trolley line crossings (except trolley contact) over railroad rights-of-way, and the tracks and lines of wires situated thereon, and also to overhead electric lighting and transmission wires of over 5000 volts constant potential crossing or constructed over telephone, telegraph or other similar lines. The committee, of which Mr. Farley Osgood, of the Public Service Corporation, Newark, N. J., is chairman, has requested that all persons interested in such specifications communicate to the chairman any suggestions that they may care to make.

ELECTRICITY FROM A DRAINAGE CANAL—II.

Transmission Line, Terminal Station, Substations and Distribution System of the Sanitary District of Chicago.

THE main transmission line of the Sanitary District of Chicago follows the east bank of the Drainage Canal from the generating station, a mile and a half below Lockport, to the Western Avenue terminal station, thirty miles away, where the transmission potential of 44,000 volts is stepped down to the city distribution pressure of 12,000 volts.

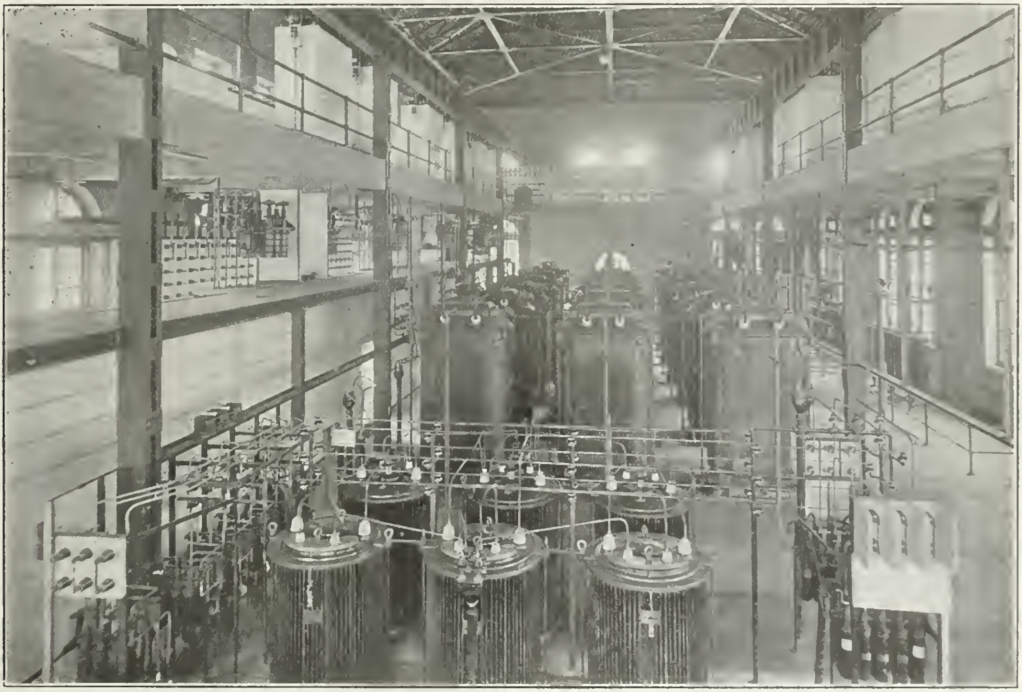


Fig. 1—Interior of Western Avenue Terminal Station.

As first constructed, the transmission line comprised two circuits of nineteen-strand aluminum conductor, equivalent in carrying capacity to No. 000 copper. These circuits were carried upon 50,000-volt Locke petticoat-type insulators mounted on steel poles or towers especially designed by the Sanitary District's engineers for this installation and built by the Aeromotor Company, Chicago. These poles are of bridge construction, measure 60 ft. over all, and are set 6 ft. into concrete, which is rounded above the surface of the surrounding ground to provide run-off for any water that may collect at the base. The lower cross arm, also of steel lattice-work construction, measures 18 ft. across and the upper cross-arm 12 ft. When first erected the two circuits were installed in the usual manner on these cross-arms, and a ground wire, clamped at the peak of each pole, was carried throughout the length of the line.

In order to secure additional carrying capacity for the increasing load of the Sanitary District's plant the original arrangement of the transmission wires on the poles has been modified by the addition of two suspension-type insulators hung from the lower cross-arm at points midway between the original petticoat-insulator pins. Mounting an additional petticoat type insulator at the peak of the poles will thus make available nine insulated wires, or three separate circuits. The last wire, taking the position of the original ground wire, is now being strung. During the past summer, however, the transmission line has been operated with the pole peak ground wire in position and with the original line wire on each side of the upper cross-arm grounded at every fourth tower. This arrangement was undertaken as an experiment to substantiate the claims of those who advocate the use of ground wires and claim that sufficient protection above the line conductors will actually prevent lightning disturbances. Although the past summer was not so noteworthy for electrical storms as were several preceding seasons, when great difficulty was experienced in keeping the lines in operation, especially satisfactory results have been obtained from the protected circuit, only three "minimum" or two-minute outages having occurred during the lightning season. The circuit on the south side of the pole line, formed by the lines carried on the two petticoat and one suspension insulator on the lower arm, has been equipped with the Nicholson type of grounded-ring protection, and the experience with this construction during the past season has duplicated that in New York State in showing a great reduction in the number of insulators broken.

At each of the numerous railroad crossings the petticoat insulators are replaced by strain insulators in each direction, employing also suspension-type and pin insulators at each such junction to hold the jumper rigid. The steel towers are erected to 350-ft. intervals, and throughout eighteen miles of the line were set in holes blasted in the solid rock and afterward filled with concrete. The vertical shafts of these towers measure 42 in. square at the base and 14 in. at the top, and each tower complete weighs 4000 lb.

Following the line of transmission, an underground four-conductor telephone cable has been laid between the terminal station and the Lockport power house, providing two separate telephone circuits between these stations for use in dispatching. At half-mile intervals these telephone circuits are brought up to junction boxes at the surface of the ground, where the line patrolmen, or troublemen, can obtain communication with the dispatcher or the generating station by inserting the plug of the lineman's telephone set which is carried as part of the equipment. This telephone line is, of course, entirely free from noise or inductive effects of any kind, and is extremely useful during construction work or times of line trouble. All trouble calls on the transmission line are handled from the Western Avenue station, where two shifts of troublemen are maintained who are provided with high-speed motor boats for quickly reaching the scene of the interruption.

WESTERN AVENUE TERMINAL STATION.

The Western Avenue terminal station of the Sanitary District's transmisison line, where the incoming 44,000-volt energy is reduced to a pressure of 12,000 volts for distribution within the city limits, is located on the south bank of the Drainage Canal near the Western Avenue bridge. The building is an attractively designed structure of concrete blocks with red tile roof. In floor plan it measures 124 ft. long and 70 ft. wide, and it is 42 ft. to the eaves of the roof. Besides housing the step-down transformers this station contains the distributing equipment for the 12,000-volt circuits and a 2300-volt substation for supplying energy for lamps and motors to neighboring consumers.

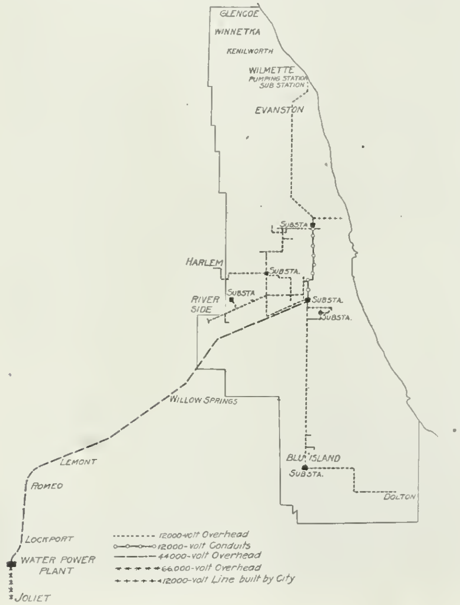


Fig. 2—Map Showing Transmission Lines and Substations.

From towers equipped with strain insulators for taking up the dead-end pull of the transmission line the 44,000-volt wires are led into the station through hooded entries at the second floor or gallery level. At this point provision is made, by an arrangement of cross-connecting switches, for quickly utilizing as a transmission delta any three of the six completed conductors which may remain unaffected in case of trouble. Taps from the high-tension buses lead through the concrete floor of the gallery to the 44,000-volt General Electric aluminum-cell lightning arresters. After traversing the choke coils the station energy is led through type H General Electric transformer switches and through series transformers operating the trip relays on these switches. Six banks, 4000 kw each, of General Electric oil-insulated, water-cooled transformers have already been installed in the Western Avenue station for handling the three transmission circuits, the third of which is about completed. Two 4000-kw banks are thus provided for each circuit, and the high-tension buses are further equipped with General Electric type H motor-operated oil switches for tying together the high-tension sides of adjacent pairs of transformers. This arrangement is also duplicated in both the main and transfer buses on the low-tension side of the transformers. All of the 44,000-volt conductors in the station, which are carried on the insulators mounted on pipe construction, are painted red as a danger warning to workmen.

The 12,000-volt leads from the transformer banks are taken to the hinge terminals of double-knife, double-throw disconnecting switches, made by the Delta-Star Electric Company. The upper terminals of these switches communicate with the main station buses through type H General Electric motor-controlled oil switches, and from these main buses, through type E Westinghouse solenoid-controlled oil switches and thence through double-knife, double-throw disconnecting switches similar to those above described, with the respective outgoing commercial circuits. The lower clips of the transformer-bank, double-knife, double-throw switches are connected through Hartman electrically-operated oil switches to the transfer bus, and thence through another group of Hartman hand-operated switches to the lower clips of the feeder line double-knife switches. This arrangement of the double-knife, double-pole switches makes it possible to transfer a circuit from the main to the transfer bus, or vice versa, without interrupting the flow of energy to the feeder. The sectionalizing switches in the main 12,000-volt buses, like those in the 44,000-volt buses, are General Electric type H, equipped with time-limit relays.

There are twenty outgoing circuits, each feeding separate parts of the city, to which energy is transmitted by the Sanitary District.

For measuring the energy used by the city an ingenious modification has been made in the main 12,000-volt station buses. Throughout part of their length two of the phases of these buses are formed of duplicate copper sections, separated from each other by 1 in. or more of fiber insulation, but connected together through the primary winding of a 600-amp series transformer. The transformer-bank buses feed into the upper conductors of these buses, while the city service is taken off the lower conductors; thus the energy required by the city traverses the series transformer winding. In circuit with the secondary of this transformer are connected a Westinghouse graphic recording wattmeter for securing a diagram of the demand curve of the city service and a watt-hour meter for totalizing the energy consumed.

The control of the transformer switches on both the 44,000-volt and the 12,000-volt sides is centered in a benchboard located on the operating gallery at the south end of the station. This board is arranged with ammeters and power-factor meters, indicating the condition of the transmission circuits, and also with totalizing watt-hour meters for measuring the aggregate energy transmitted. The low-tension switchboard for controlling the distribution feeder circuits comprises ten panels with two circuits to each panel. Indicating wattmeters and power-factor meters are provided, and connections are arranged to meter buses back of the board by which a Westinghouse graphic recording wattmeter and a General Electric recording voltmeter can be applied to measure the power or voltage of any circuit.

As before explained, six banks of three step-down transformers have already been installed in the Western Avenue terminal station. The complete plans call for the installation of eight such banks, the last of which will be added when the additional transmission circuit is completed on the second pole line, which will later be erected, connecting the substation with the generating power house at Lockport.

At the north end of the Western Avenue station an 1800-kw bank of oil-insulated, water-cooled transformers, stepping down from 12,000 volts to 2300 volts, has been provided for supplying energy for the motor and lamp requirements of adjacent customers. Also at this end of the building are two centrifugal pumps for furnishing cooling water for transformers and two motor-generator sets for furnishing direct current for station lighting and oil-switch operation. These pumps and direct-current generators are direct-connected to 440-volt, three-phase induction motors. There is also being installed in the north end of the station a 200-kw synchronous motor-generator set, delivering direct current at 550 volts. The primary purpose of this set is the operation of a large motor-driven eight-track rolling-lift bridge about 500 ft. distant. This interesting bridge was described in the *Electrical World* of April 14, 1910. But as there is little or no navigation on this portion of the Drainage Canal the bridge will likely be seldom operated for a number of years to come. However, running idle, the motor-generator set will perform an important service in the station by taking a leading current with its fields over-excited, thus partly offsetting the lagging-current demand of the large industrial service supplied by the Sanitary District and so increasing the efficiency of the transmission line.

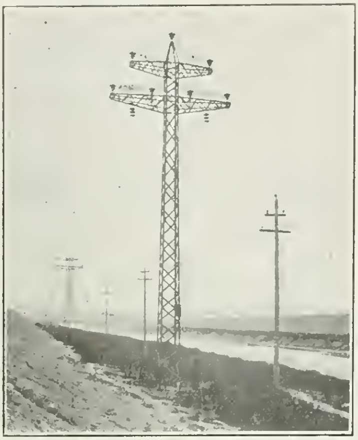


Fig. 3—Reconstructed Insulator Arrangement for Three Transmission Circuits.

Just north of the terminal station, on the canal bank, is a low concrete building, 10 ft. x 50 ft., which houses the sixty-cell battery which supplies energy for actuating the remote-controlled switches in the station. This battery is controlled from a panel on the small switchboard from which the transformer cooling-water pumps and the motor-generator sets are manipulated. A 20-ton electric traveling crane built by the Case Manufacturing Company spans the station over the transformers.

DISTRIBUTION OF HYDROELECTRIC ENERGY.

From the Western Avenue terminal station, where the transmitted potential of 44,000 volts is reduced to 12,000 volts for transmission within the city limits, twenty 12,000-volt circuits are led out on underground and overhead lines to the various substations belonging to the Sanitary District, the City of Chicago and several large consumers who purchase 12,000-volt energy directly.

The substations owned and operated by the Sanitary District of Chicago at which the incoming 12,000-volt energy is again stepped down to 2300 volts for local distribution, together with the present connected loads they serve, are as follows:

Ashland Avenue and Thirty-sixth Street, 2560 kw; Kinzie Street and Austin Avenue, 611 kw; Leavitt Street and Fullerton Avenue, 1097 kw; Twelfth Street and Forty-seventh Avenue, 1740 kw; Western Avenue and Canal, 2540 kw.

The last-named station is contained within the terminal station itself, and is referred to in preceding paragraphs. The construction of the other 12,000-2300-volt substations is in general nearly uniform, following the standard exemplified in the Ashland Avenue substation, exterior and interior views of which are reproduced herewith. The exterior of this one-story structure is of yellow pressed brick and the interior is lined with white enameled brick, a partition of the same material extending along one side of the room and inclosing the high-tension bus compartments and oil switches. This station contains a bank of three 200-kw oil-insulated, self-cooling transformers for reducing the city transmission pressure of 12,000 volts to the local distribution pressure, 2300 volts. The oil switches for both 12,000-volt and 2300-volt circuits are hand-operated.

In addition to the Sanitary District substations above noted Drainage Canal hydroelectric energy is also supplied to the Halsted Street, Wood Street, Rice & Lincoln, H. N. May, Emerald Avenue, Wentworth Avenue and R. A. Waller street-lighting plants of the City of Chicago; to the constant-current transformer arc-lighting substations in Humboldt, Douglass, Garfield and Lincoln Parks, Chicago, and to the substations in the neighboring villages of Cicero, Berwyn, Blue Island, Dolton, Morgan Park and Lyons.

As the Sanitary District of Chicago is a public body, organized and supported by the taxpayers who compose the population of the City of Chicago and an outlying fringe of territory, the trustees of its board have naturally taken the view that its electrical output should so far as possible be utilized for the public benefit of this population, and large use has accordingly been made of this energy for municipal lighting and pumping purposes. It was the hope of Mr. R. R. McCormick, former president of the Sanitary District, that at some time in the future not only should all the city lighting in Chicago be furnished by the Lockport plant during hours of darkness, but that by day the same source should be used to pump the city's water supply. Of course, when the system was first put into operation municipal needs were not at once equal to the output of the plant, so the Sanitary District officials had to choose between the three possible courses of (1) allowing large blocks of generating capacity to rest idle during many hours of the day; (2) selling energy to an outside distributing company at a low figure from which a small return would be realized on the public's investment, or (3) organizing a sales department for aggressively undertaking the distribution of its output to commercial consumers. The last-named plan was followed, and the Sanitary District board secured the services of an experienced sales engineer and began acquiring commercial load, which in three years has grown to a total connected value of nearly 20,000 hp in lamps and motors. The total municipal load is meanwhile 13,357 hp.

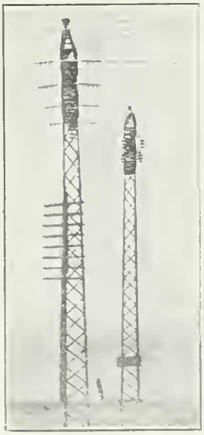


Fig. 4—Strain Tower at Railroad Crossing.

There are now 204 commercial consumers in Chicago. Some of the largest of these are the McCormick works of the International Harvester Company, with a connected load of 1985 hp in motors; the Simonds Manufacturing Company, 1263 hp;

Forest Park Amusement Company, 1200 hp; Chicago Reduction Company, garbage destructors, 675 hp (twenty-four-hour load); Liquid Carbonic Company, 600 hp; Aermotor Company, 600 hp; Marsh & Bingham, 500 hp; American Spiral Pipe Company, 461 hp; L. Wolf Manufacturing Company, 362 hp. Other large consumers outside of the city limits are the Joliet works of the Illinois Steel Company, with a connected load of 2620 hp in motors; the United States Crushed Stone Company, McCook, Ill., 1800 hp, and the Illinois State Penitentiary at Joliet, 705 hp. The Joliet load is furnished directly from the generating-station 6600-volt buses. The steel company's demand continues throughout the twenty-four hours of the day.

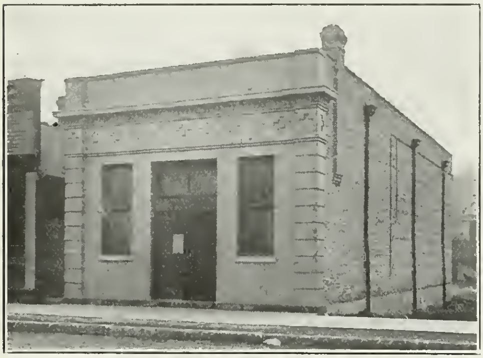


Fig. 5—Typical Distributing Substation.

The rates for industrial motor service are based on a maximum-demand system, the customer's demand being measured by a Wright demand meter or estimated by multiplying his total connected horse-power in motors by the following percentage factors:

Under 10 hp, one motor only, 85 per cent; under 10 hp, more than one motor, 75 per cent; 10 hp to 50 hp, 65 per cent; over 50 hp, 55 per cent.

For the first thirty hours' use of the maximum, as above determined, the charge is 9 cents per kw-hour.

For the second thirty hours' use of maximum, 4 cents per kw-hour.

For all over the first sixty hours' use of maximum, 2½ cents per kw-hour.

Where the 4-cent and 2½-cent portions of bills aggregate or exceed $50 prompt-payment discounts are allowed on this part, ranging from 10 per cent for $50 and 40 per cent for $300 to 60 per cent for $1,000.

In the villages of Blue Island, Berwyn and Lockport the Sanitary District has taken over the existing distribution systems and serves residence and business customers with lighting and motor service. The district has 537 consumers in Blue Island, 203 in Berwyn and 196 in Lockport. All of these consumers use electricity through meters, which are read monthly by the district's representative and bills rendered from the Chicago office in the American Trust Building. For this class of service a rate of 10 cents per kw-hour is charged for the first twenty kw-hours used, 7 cents per kw-hour for the next 100 kw-hours and 6 cents per kw-hour for all used thereafter. The minimum bill is $1 for each residence or store. Should payment of his bill be delayed, after ten days from its date the consumer is held liable for the consumption rendered at 11 cents per kw-hour for lighting and 7 cents per kw-hour for motors. The regular rate for energy for motors when registered by a separate meter is 6 cents per kw-hour, with a monthly minimum of $1 per horse-power. Residents of Dolton are served with Drainage Canal energy at a flat rate by the local municipality, which purchases its supply from the Sanitary District.

As before noted, the sale of electrical energy to municipalities for public use is one of the most logical and increasingly important aspects of the Sanitary District's electrical department. Electric pumping is already done in a number of nearby places with Drainage Canal power, and installations of very large sewage pumping and flushing units are now being erected. Through the new North or Evanston Channel connecting with the North Branch of the Chicago River, a rinsing flow of 40,000 cu. ft. of lake water per minute will be produced by four 150-hp motor-driven horizontal screw pumps at Wilmette, lifting the water 3 ft. above lake level to provide the flowage head for discharging through the nine miles of 720-sq. ft. section canal. The 440-volt, three-phase, 60-cycle motors will be energized over a 12,000-volt transmission line from the Western Avenue terminal station. Since this energy will be supplied in part by the fall at Lockport of the water pumped at Wilmette, a curious closed circuit of electrical and hydraulic power will be presented when the pumping station is in operation. A 750-hp motor is also being installed as an experiment to replace one of the engine-driven pumps in the Thirty-ninth Street sewage pumping station, which delivers through the Thirty-ninth Street conduit the contents of the intercepting lake-shore sewer which collects the flow of the various street drains that formerly emptied into the lake along the south shore.

The District is supplying energy for water-works pumping purposes at Lockport, Dolton (40 hp), Blue Island (200 hp) and Morgan Park (120 hp), besides operating the sprinkling pumps at Lincoln Park, in Chicago, where 375 hp in centrifugal pumps is installed. For this twenty-four-hour service to municipalities the Sanitary District receives $26.40 per hp-year.

The rate for twelve-hour lighting service is $15 per hp-year to municipalities. Besides the park and street lighting in Chicago, the District lights Cicero, Berwyn, Blue Island, Dolton, Morgan Park and Lyons. In Chicago the District has taken over the operation of the city's thirteen generating stations and substations for its street-lighting system, and is replacing the former engine-driven constant-current arc-lamp generators by motor-driven sets; also installing regulator-type transformers for energizing additional lamps. Along with this transfer of the city's plant properties goes the operation of its transmission and distribution circuits, which thus become available for use by the Sanitary District in serving its commercial motor-service customers during daylight hours if necessary. This agreement for joint use of lines will be the means of saving much expensive construction, which in the past has been necessarily duplicated by the two publicly owned systems.

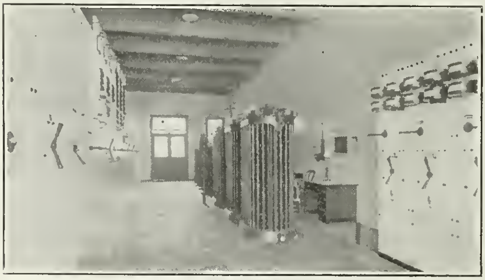


Fig. 6—Interior at Ashland Avenue Substation.

One of the most important results of Sanitary District energy for municipal lighting in Chicago will be the addition of 10,000 arc lamps to the city's existing equipment of 12,200 lamps. The city has long been desirous of making its lighting facilities more nearly adequate, but is near the constitutional limit of its bonded indebtedness. Under the new agreement with the Sanitary District the latter will furnish and install the additional 10,000 450-watt lamps, posts, conduits, etc., complete, with additional substations, for which outlay the city will repay the district in equal annual instalments, with interest, ending in 1918. The 10,000 new lamps are to be located at the rate of 500 a month. Fifty lamps will be installed on each circuit, thirty to sixty circuits being supplied from a substation. Under the agreement the city will pay at the rate of $15 per hp-year for the energy to operate the 22,000 lamps, taken during an average period of eleven hours per day, ranging from eight and one-half hours in summer to fourteen hours in winter. The new City Hall and County Building, representing a connected load of 30,000 16-cp lamps and 2500 hp in motors, will use Drainage Canal energy. The substation in the basement will contain a 4000-amp, 250-volt storage battery capable of carrying the entire electrical load of the buildings in case of interruption to the transmission system.

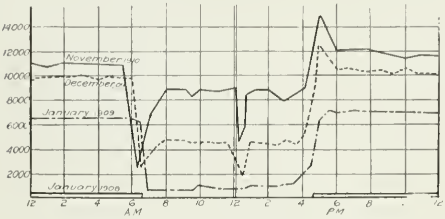


Fig. 7—Daily Load Curve for Three Years of Operation.

Besides its ninety miles of 44,000-volt circuits erected on thirty miles of steel towers the electrical department of the district operates 100 miles of single-circuit, 12,000-volt overhead lines, twenty-five miles of 12,000-volt underground circuit, twenty miles of 4000-2300-volt overhead lines and seven miles of 4000-2300-volt underground circuits. As indicative of the increasing electrical service of the Sanitary District to the community the following table shows the growth of the connected load by six month periods:

	June 30, 1909.	Dec. 31, 1909	June 30, 1910.
Municipal	11,950 hp	12,673	12,966
Commercial	12,698 hp	14,773	22,872

The affairs of the Sanitary District are controlled by a board of nine trustees elected by the people, three being chosen each year. The present president of the board is Mr. Thomas A. Smyth, recently elected. The electrical development has been carried out, however, during the presidency of Mr. Robert R. McCormick, who took a marked and intelligent interest in it. Mr. George M. Wisner is chief engineer of the Sanitary District and Mr. Edward B. Ellicott is electrical engineer. Mr. Ellicott is entitled to commendation for the ability and zeal he has displayed in designing and conducting the electrical work of the district in the face of numerous difficulties.

NOTE ON THE OSCILLATION TRANSFORMER.

By John Stone Stone.

In the evolution of wireless telegraphy a large variety of oscillation transformers have come into use, while the theory of only one form of them, the oldest and best known form, has been exhaustively studied. This particular form of the oscillation transformer consists of two oscillation circuits in mutual inductive relation to one another, as shown in Fig. 1. In what follows it will be shown that the theory of this particular oscillation transformer is the key to that of a number of other forms of oscillation transformers in which the two oscillation circuits are coupled together not merely by mutual inductance, but by having a common branch. It will be assumed that the resistance of the common branch is negligible compared to its reactance, this being a condition always realized in such transformers, as the principal dissipation of energy always takes place in the oscillation circuits at points outside the coils of the transformer *per se*.

In the oscillation transformer of Fig. 1 let the resistance, inductance and capacity of the first circuit be R_1, L_1 and C_1 respectively, while the corresponding constants of the second circuit are R_2, L_2 and C_2 respectively, and let M_{12} be the mutual inductance between the two circuits. The circuital equations will then be:

$$\left(\frac{d}{dt}+2a_1+p_1^2\int(\quad)\,dt\right)i_1 \pm \mu_1\frac{d}{dt}i_2=0$$

$$\left(\frac{d}{dt}+2a_2+p_2^2\int(\quad)\,dt\right)i_2 \pm \mu_2\frac{d}{dt}i_1=0$$

where i_1 and i_2 are the currents in the first and second circuits, respectively, and where

$$2a_1=\frac{R_1}{L_1},\qquad p_1^2=\frac{1}{C_1L_1},\qquad \mu_1=\frac{M_{12}}{L_1}$$

$$2a_2=\frac{R_2}{L_2},\qquad p_2^2=\frac{1}{C_2L_2},\qquad \mu_2=\frac{M_{12}}{L_2}$$

In the case of the transformer of Fig. 2 let R_1, L_1 and C_1 be the resistance, inductance and capacity, respectively, of the first branch; let R_2, L_2 and C_2 be the corresponding constants of the second branch; let L be the inductance of the common branch; let M_1 be the mutual inductance between the common and the first branch; let M_2 be the mutual inductance between the common and the second branch and let M_{12} be the mutual inductance between the first and second branches. The circuital equations will be

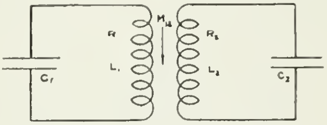


Fig. 1—Simple Oscillation Transformer.

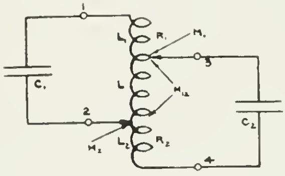


Fig. 2—General Oscillation Transformer.

$$\left(\frac{d}{dt}+\frac{R_1}{L_1}+\frac{1}{C_1L_1}\int(\quad)\,dt\right)i_1+\frac{L+M_1}{L_1}\frac{d}{dt}i-\frac{M_{12}}{L_1}\frac{d}{dt}i_2=0$$

$$\left(\frac{d}{dt}+\frac{R_2}{L_2}+\frac{1}{C_2L_2}\int(\quad)\,dt\right)i_2-\frac{L+M_2}{L_2}\frac{d}{dt}i-\frac{M_{12}}{L_2}\frac{d}{dt}i_1=0$$

and

$$i_1=i+i_2$$

which give

$$\left(\frac{d}{dt}+\frac{R_1}{L_1+L+M_1}+\frac{1}{C_1(L_1+L+M_1)}\int(\quad)\,dt\right)i_1-\frac{M_{12}+L+M_1}{L_2+L+M_2}\frac{d}{dt}i_1=0$$

and

$$\left(\frac{d}{dt}+\frac{R_2}{L_2+L-M_2}+\frac{1}{C_2(L_2+L+M_2)}\int(\quad)\,dt\right)i_2-\frac{M_{12}+L+M_2}{L_2+L+M_2}\frac{d}{dt}i_1=0$$

Comparing these expressions with the corresponding expressions for the oscillation transformer of Fig. 1 it is evident that the oscillation transformer of Fig. 2 is the equivalent of an oscillation transformer of the form shown in Fig. 1 in which the constants are such that

$$2a_1 = \frac{R_1}{L_1 + L + M_1}$$

$$2a_2 = \frac{R_2}{L_2 + L + M_2}$$

$$p_1^2 = \frac{1}{C_1\,(L_1 + L + M_1)}$$

$$p_2^2 = \frac{1}{C_2\,(L_2 + L + M_2)}$$

$$\mu_1 = \frac{M_{12} + L + M_1}{L_1 + L + M_1}$$

$$\mu_2 = \frac{M_{12} + L + M_2}{L_2 + L + M_2}$$

This correspondence not only makes all the work which has been done on the subject of the theory of the well-known oscillation transformer of Fig. 1 applicable to oscillation transformers of the type shown in Fig. 2 and available for predicating and interpreting the performance of such transformers, but it also makes such work available in the case of the transformers shown in Figs. 3, 4, 5 and 6, all of which, as well as that of Fig. 7, are but special forms of the transformer of Fig. 2.

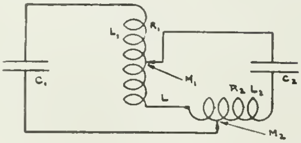


Fig. 3—Special Oscillation Transformer.

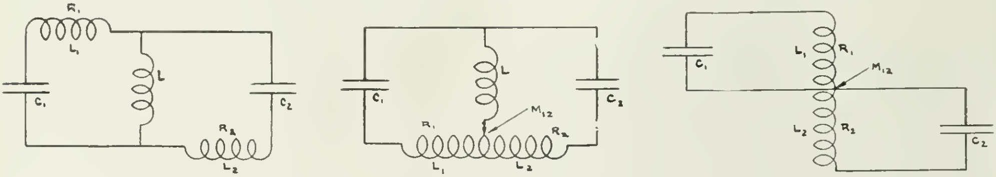
The case of Fig. 3 is obtained from that of Fig. 2 by the suppression of the mutual inductance between the first and second branches.

The case of Fig. 4 is obtained by the suppression of the mutual inductance between the first and second branch and also that between the second and the common branch.

The case of Fig. 5 is obtained by suppressing all of the mutual inductances.

The case of Fig. 6 is obtained by the suppression of the mutual inductances between the common branch and each of the other branches.

Finally, the case of Fig. 7, which is the same as that of Fig. 1, is obtained by the suppression of the common branch.



Figs. 5, 6 and 7—Special Types of the General Oscillation Transformer.

The most important mathematical function in connection with an oscillation transformer is its coupling coefficient, which may now be defined as

$$\sqrt{\mu_1\mu_2} = \sqrt{\frac{(M_{12} + L + M_1)\,(M_{12} + L + M_2)}{(L_1 + L + M_1)\,(L_2 + L + M_2)}}$$

In the case of the oscillation transformer of Fig. 1 this coefficient reduces to the familiar function

$$\frac{M_{12}}{\sqrt{L_1L_2}}$$

In order to determine the coupling coefficient in the case of such an oscillation transformer as that shown in Fig. 2 it becomes necessary to determine the values of L, L_1, L_2, M_1, M_2 and M_{12}. Such oscillation transformers are usually constructed of a continuous spiral of wire, no provision being made for opening the circuit of the coil at points along its length. For this reason an indirect method is necessarily pursued in obtaining the value of certain of the constants, a good method being as follows, reference being had to Fig. 2:

(1) Disconnect the condensers C_1 and C_2 by opening the circuits at 1, 2, 3 and 4.

(2) Ascertain L_1 by measuring the inductance across the terminals 1 and 3, the terminals 2 and 4 being disconnected.

(3) Ascertain L by measuring the inductance across the terminals 2 and 3, the terminals 1 and 4 being disconnected.

(4) Ascertain L_2 by measuring the inductance across the terminals 2 and 4, the terminals 1 and 3 being disconnected.

(5) Ascertain the inductance $\lambda_1 \equiv L_1 + L + 2M_1$ by measuring across the terminals 1 and 2, the terminals 3 and 4 being disconnected.

(6) Ascertain the inductance $\lambda_2 \equiv L_2 + L + 2M_2$ by measuring across the terminals 3 and 4, the terminals 1 and 2 being disconnected.

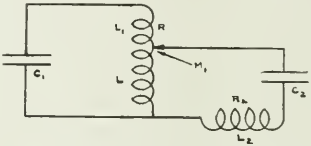


Fig. 4—Special Oscillation Transformer.

(7) Ascertain the inductance $\lambda_3 \equiv L_1 + L + L_2 + 2M_1 + 2M_2 + 2M_{12}$ by measuring across the terminals 1 and 4, the terminals 2 and 3 being disconnected.

By the foregoing process the inductances L_1, L and L_2 are ascertained directly, while from the last three measurements the mutual inductances are found to be

$$M_1 = \frac{\lambda_1 - L_1 - L}{2}$$

$$M_2 = \frac{\lambda_2 - L_2 - L}{2}$$

and

$$M_{12} = \frac{\lambda_3 - \lambda_1 - \lambda_2 + L}{2}$$

In determining the inductances L, L_1, L_2, λ_1, λ_2 and λ_3, no matter what method be used, great care should be exercised to prevent the capacity of the "dead ends" or unused portions of the coil from prejudicing the results. In this connection it is to be noted that in its reaction on the portion of the coil in use the apparent capacity of such a "dead end" or open-circuited portion of the coil may be enormously greater than its real or electrostatic capacity. This matter of the reaction upon the used portion of a helix due to an unused portion is a very interesting if somewhat intricate subject. Suffice it here to point out that in making the inductance measurements in question the safest procedure is to determine the fundamental natural rate of vibration of the helix as a whole when isolated and then make use of currents of a considerably lower frequency in determining the inductances.

To determine the fundamental natural rate of vibration of a helix it is sufficient to treat it as if it were an aerial or radiating conductor whose fundamental natural rate of vibration was to be observed. One end of the helix is left open while the other is connected to the upper ball of a spark-gap, the lower ball being connected to earth. The helix is now charged to a high potential and permitted to discharge to earth, while a wave meter, calibrated to short wave lengths, is brought into the neighborhood of the helix, but not into contact with it nor into close inductive coupling with it. In this way the frequency of the fundamental natural vibrations of the helix when isolated is determined.

The method of determining the constants in the case of the oscillation transformer of Fig. 2 is given above at considerable length as this is the most difficult case. A similar but somewhat simplified procedure will answer in the case of all the other oscillation transformers shown.

IMPROVEMENT IN ELECTROPLATING.

In most of the technical works where there is a department for so-called galvanizing—the number is daily increasing—there are besides the ordinary articles which may be hung in the bath in the usual way large quantities of smaller ones which must be coated with nickel, brass or zinc, so that they will not only look well and wear well, but also not cost too much. This is especially the case in factories where gilt buttons, buckles, etc., are made in large quantities, and also in the manufacture of lamps, parts of bicycles and sewing machines. Here there are used electroplating sieves made of woven-metal wire in which the articles to be plated are laid and which are hung in the bath. Apart from the fact that only comparatively small articles can be handled in this manner, handsome and durable work is not always the result. The larger part of the current is taken up by the sieve itself, which soon becomes thickly coated. The articles in the sieve, however, are shielded along certain lines by its wires and receive less metal in these places. In order to get a good coating the current must be strong and the operation prolonged. Otherwise sometimes as much as nine-tenths of the plating metal is deposited on the sieve or basket.

In order to do away with this difficulty a new sieve or basket has been placed on the market in Germany by the Langbein-Pfaunhauser Works by the use of which up to 660 lb. of small articles per day may be well coated; there is also a smaller type which handles only about 330 lb. per day. The articles to be plated are placed in the machine, about 50 lb. at a time, and left in the bath under the influence of the current about twenty to thirty minutes, without any attention being necessary.

ENVELOPE OR THIN PLATES FOR STORAGE BATTERIES.

By Stockton H. Mortimer.

The demand for an increased specific output in the lead storage battery has brought out in the last few years a number of interesting patents and improvements which tend to increase the watt-hour output per pound of complete battery by decreasing the weight of the grid or support. Two methods are conspicuous among these and show the tendency of development, namely, the envelope type, in which an effort is made to confine the active material to the support by a porous covering and the standard grid of reduced thickness with no artificial means of retaining the material other than the proper construction of the grid itself.

It is the intention of this article to discuss the features that are characteristic and of particular interest in these types, showing in a general way the advantages gained and the faults developed, with only such references to individual makes as are necessary to clearness.

One type of envelope plate is made of a number of ladder-like strips fastened together at the top and bottom, filled with lead oxide and coated with liquid celluloid, spaces being left between the strips to allow for circulation of the electrolyte. The celluloid when hard is slit into a number of horizontal strips to give the electrolyte access to the active material. This plate gives good results in laboratory tests, but fails in service on account of the active material forcing off the weakened celluloid coating.

Other types are made with the active material in strips or rods over conducting cores, and the cores are fastened into end pieces which serve as sides or ends for the plates. In one type the envelope is a porous tube of clay; in another, of the same general type, rubber washers are slipped over rods of active material and reinforcing strips are placed across the plate at intervals to correct the natural tendency to buckle. When these types are used in severe service or do not receive experienced care buckling occurs and the tubes are either split or forced open, which allows the material to escape from the envelope. The advantages claimed for these types are an increase in output per pound, an increase in their life and a decrease in the labor in washing out the cells, for it is evident that so long as the envelopes remain unbroken no sediment can collect in the bottom of the jars. The inherent faults are the weakness of the envelope and the tendency to buckle. As the grid is not designed to support the active material, but only to act as a conductor of the current, the life of the plate is entirely dependent on the life of the envelope, and any failure of this covering results in the rapid deterioration of the cell.

During charge and discharge the conductors and the active material expand, but this action is not equal in all parts of the plate, being greatest near the edges and less vigorous toward the center of the plate. This sets up a strain in the plate which would cause it to buckle if means were not taken to prevent it This condition is innate in all plates, but can be overcome by proper design of the grid.

The envelope type made of a number of narrow strips in each plate is particularly affected by this unequal expansion, for the outside members are more strongly acted on than the central members, with a consequent tendency to distortion of the individual strips, causing the envelopes to open and expose the active material to the direct action of the electrolyte.

In the other class are those plates which depend on the proper construction of the grid to hold the active material and to so distribute the current as to prevent unequal expansion This result can be obtained by designing the grid so that the resistance is equalized between the lug, the center and the edges of the plate. This is obtained to a remarkable degree in those plates having diagonal or diamond lattices. Thin-plate construction requires a grid having members that cross each other in the spaces occupied by the active material, so that the material is locked between the bars even when the thickness is reduced to the point beyond which no advantageous results are obtained. Grids the members of which do not cross on being reduced to a corresponding thickness are practically a conducting sheet with a series of openings extending through the sheet so that the grid acts merely as a support and does not tend to hold the material in place

The fault in the unprotected type is the loss of the active material during service. This loss is very slow in properly constructed plates and can almost be neglected in the best types of thin plates where the jars have deep sediment spaces In many of these batteries the sediment need not be removed during their entire life, although the total mileage is greater than that obtained from a thick-plate battery in the same size cells. The thin plates have been on the market for several years and from the beginning showed such increased specific output that to a great extent they have displaced the heavier types even in the largest trucks. They have a greater total mileage, are more economical than the thick plates and are being installed in most of the new trucks, which is the criterion of reliability in battery service.

The envelope type, being in the experimental stage, is the most interesting type, and, therefore, has been treated at some length in this article. Theoretically it should give a large output per pound and a long life, but in order to obtain these results it is necessary for the envelope to be very thin and the core light. These conditions have not been obtained in practice without sacrificing either the life or the specific output of the plate, and all efforts so far have served to show that these conflicting conditions cannot combine in commercial plates. Envelope plates have been used abroad to some extent and experimentally in this country, but the weaknesses developed by local conditions have shown that they are not equal to the more rugged type of uncovered plates.

ELECTRICITY IN AERODROMES.

The yachtsman who has had to steer his boat into a narrow channel or slip knows how difficult, if not impossible, it is to do so without scraping the sides of the vessel when a strong wind is blowing at any considerable angle to the opening of the channel. The difficulty of squarely entering an opening in the face of transverse air currents is all the more serious with an aerial craft, which must also allow for variations in its height above the ground. Particularly is this true in the case of a dirigible balloon of the Zeppelin type which exposes a large surface to catch side winds even after the balloon has partly entered its shelter. Consequently, the designer of a practical aerodrome for dirigible balloons must reckon with the wind problem liable to influence his plans. Such provisions have been made at recently erected and proposed structures. In the early ones erected at Metz and at Tegel each end is closed with a huge pair of doors which slide into compartments extending sidewise of the building at its ends, thus exposing the balloon to the side winds the moment it projects beyond the building. In the more recent aerodrome erected at Strassburg this sliding door construction was abandoned at the importuning of the Zeppelin company, the ends being closed by folding doors opening out only a little beyond the lines of the sides, thus protecting the craft from side winds while leaving or entering. In each case the doors are operated by electric motors, which is also the case with the bellows-type doors on the aerodrome at Friedrichshafen.

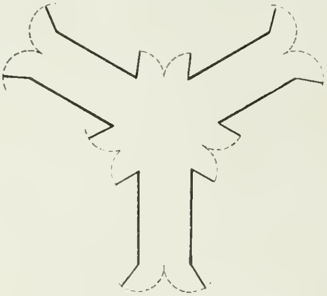


Fig. 1—Y-Shaped Aerodrome.

However, with any wind beyond a mild breeze the security afforded even by wide doors will vary with the direction of the wind. If the aerodrome were planned like a round-house so that the dirigible could leave through a door facing the wind, the risk would be reduced to a minimum. Upon this thought some recent designs are based, as, for instance, the polygonal type patented by Hans Kirchner for the Gesellschaft Harkort at Duisburg, which involves motor-driven equipment for bringing the dirigible to face the desired opening. The same firm has also designed a Y-shaped aerodrome having exit doors at the junction and also at the ends of the wings. In this type of building the balloon can be moved from one wing to another, or can be turned around by such maneuvering.

Still more radical in design is the type of aerodrome proposed by the structural steel works of August Kloenne at Dortmund, where the whole building is to be revolved to the desired position. The structure in this case is placed on trucks running on a circular track. To reduce the friction on this track, the structure is erected on a round float 32 m in outside diameter. The building, which is shown in Fig. 2, is 150 m long and 20 m wide. By raising the float with compressed air supplied by a motor-driven compressor the trucks are partly relieved of the weight and the building can easily be rotated by a 50-hp electric motor. The weight of the building alone is about 900 tons.

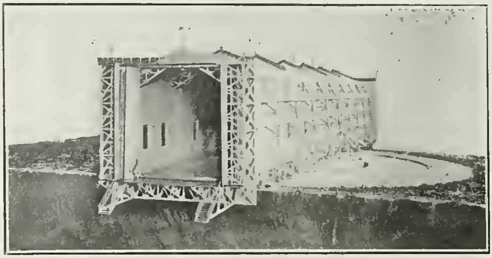


Fig. 2—Electrically Rotated Aerodrome for Dirigible Balloons.

The risk of gas leakage makes incandescent electric lamps the only safe means for lighting such structures. The use of electric power for opening and closing the doors, for moving the dirigibles while in their housings and for turning the whole structure offers a new field in which some interesting problems still remain to be solved.

ELECTRIC FURNACES IN SWEDEN.

Experiments for melting iron ore by means of electricity were first made in Sweden in 1906 at Domnarfort and have since been going on continually with different kinds of furnaces. An experimental furnace used at Domnarfort has recently been removed to make place for new improved ones. Ten furnaces will be built for one company, the Stora Kopparbergs Bergslags Aktiebolag, the first one being under erection now. This indicates that the manufacture of pig iron in electric furnaces is permanently established in Sweden. The new power station at Bullerforsen, which has a rating of 24,000 hp, is to furnish the energy until a new station which it is planned to erect at Forstivfvud shall be finished. One furnace will be ready in February this year and is designed for an annual production of 12,000 tons of pig iron. It will cost about $11,000 and will use about 4000 hp.

One experimental furnace is being erected at Trollhättan by the Järnkontoret which is designed for an annual output of 7000 tons and will require 2500 hp.

At the Högaräs works ten furnaces will be built, the first one being nearly ready. Each one of these furnaces will have a yearly production of 10,000 tons to 12,000 tons.

The above-mentioned plans for refining iron ore involve a yearly production of approximately 250,000 tons. This will increase the total output considerably, although some of the old furnaces will be abandoned. Of great economical value will be the utilization of water-power for generating the electrical energy instead of buying coal from other countries. Plans in regard to new and still larger installations are under consideration and will probably be heard from in the near future.

MIXED-PRESSURE TURBINES AT RACINE, WIS.

The Racine (Wis.) plant of the Milwaukee Electric Railway & Light Company at present consists of four engine units. Three of these are belted, and it is intended to dispense with them as a result of the reconstruction and additions now in progress. The fourth direct-connected unit is a 1500-kw General Electric generator driven by a cross-compound horizontal Fulton engine. A similar Fulton engine, which is direct-connected to a 1500-kw Westinghouse generator, is now being installed. Both are direct-current 500-volt machines. To receive the exhaust of these engines two horizontal 1250-kw mixed-pressure Curtis turbines, driving 60-cycle, 2300-volt alternators, will be installed. One of the present belted engines drives both a 500-kw, 60-cycle alternator and a 500-kw, 600-volt railway generator on the same shaft. This unit will later be used as a motor-generator set between the turbines and the engines when the reconstruction is completed.

A new building of steel and masonry construction with concrete roof is being built to house the turbines just described. This building will be extended over the existing machinery, replacing the present building, which is not fireproof and is not high enough to permit the use of a traveling crane. For the present the boiler equipment will not be changed, but the building is so designed that the modern structure may be later extended to the boiler-room. At present there are four Stirling boilers of an average capacity of 300 hp each and two Standard boilers of approximately the same size. The condensing apparatus for these turbines consists, for each machine, of a 4500-sq. ft. Prescott surface condenser with rotative dry-vacuum pump and single-stage centrifugal hot-well pump. The circulating pumps for these condensers are of the 14-in., two-rotor Worthington type, each driven by a 50-hp induction motor. The 30-in. Hoppes separator in this plant is common to both turbines.

Central Station

Management, Policies and Commercial Methods

FREE PORCH LIGHTING.

By order of the city authorities the municipal plant of Greenwood, S. C., will supply electricity without charge to 40-watt tungsten lamp installations on front porches. The conditions are that the owners or tenants of the houses will properly install and maintain a rigid pendent fixture 18 in. long, so located on the porch that the lamp will also light the sidewalk. It must not be placed behind vines or shrubbery and must be kept burning from 6 p. m. to 7 a. m. The municipal plant furnishes fixtures and lamps at actual cost.

ITEMS OF COST OF ISOLATED-PLANT OPERATION.

Where isolated plants are operated for furnishing electricity for lighting and motor service to buildings, factories, etc., proper account is seldom taken of the many items of expense which enter into the final cost of producing a kw-hour at the terminals of the consuming device. The Commonwealth Edison Company of Chicago has prepared an attractive circular entitled, "Do You Know What It Costs You?" the feature of which is a tabulation of the various items which are properly included in the cost of isolated-plant operation. This list, with blanks, in which it is suggested that the plant owner or operator insert his figures, is as follows: Salary of engineers; salary of firemen; salary of electricians; fuel; removal of ashes; water; oil; repairs to boilers; repairs to engines and dynamos; lamps; carbons; tool account; miscellaneous expenses and supplies, waste, packing, etc.; general expense; depreciation (10 per cent to 15 per cent); interest on investment; taxes; insurance; rental value of space; damages resulting from heat and vibration; risk to employees and the public through accidents and boiler explosions; Edison throw-over service; total.

The total obtained by summing up these items will usually cause considerable surprise to the unsuspecting owner of the isolated plant. This total cost, of course, makes no reference to the superior convenience of central-station service, its ready availability at all times, especially when extra or night work is to be done in one department, and the cleanliness of central-station operation from both the consumers' and the municipal viewpoint. The fourth page of the circular concludes with a list of twenty large Chicago consumers now using central-station service for both lighting and motors who formerly employed isolated plants. These loads recently connected to the central-station lines aggregate 15,000 hp in motors and the equivalent of nearly 50,000 16-cp lamps.

ELECTRIC PUMPING AT WALLA WALLA, WASH.

The Pacific Power & Light Company, through Mr. W. B. Foshay, general manager, has made a proposition to supply electric energy for irrigation purposes which has been accepted by a large number of farmers in the vicinity of Walla Walla, Wash. It was originally intended that an energy-transmission line should be built four miles into the country, but the plan has been received with so much favor that the line will be greatly extended. The first line will be completed by April 1 and will supply about sixty-five pumping plants, and it is expected that by July 1 this number will be increased to at least 100. The pump motors will be from 3 hp up to 40 hp or 50 hp, according to the number of acres of land a consumer will have under cultivation. The Pacific Power & Light Company is building the line and will furnish meters and transformers, the consumer furnishing a time switch and the pumping equipment. The business will be all off-peak, the time switch cutting off the supply for four hours during the evening peak.

A PRINTER'S SAVING BY REPLACING GAS ENGINE WITH MOTORS.

The Advent Publishing Company, doing newspaper and jo printing at Mendota, Ill., formerly employed a 4-hp gasoline engine to operate its presses. Gasoline for the engine cost $17 to $22 a month, in addition to which there were heavy charges for repairs and maintenance of the engine. No account was kept of the items of labor or attendance, but the manager of the shop estimated that during the time the engine was installed his actual outlays in supplies and repairs had averaged $33 a month. The difficulty of getting expert attendance, as well as the time lost during breakdowns, made the operation of the isolated plant a source of great annoyance and expense.

Mr. C. F. Lathrop, manager of the Mendota Electric Light Company, proposed to the printer that by substituting several small motors for the clumsy and inefficient engine and shaft drive all trouble would be entirely avoided and the cost of operation would not at the utmost exceed that by the engine. In the meanwhile additional presses and machines were added, so that when motor drive was installed a 5-hp motor was put in to run two cylinder presses, a 1-hp motor to drive three job presses on the second floor and a ½-hp motor to operate the typesetting machine. The monthly bills of the printing establishment have since averaged from $9 to $12, under a sliding-scale rate schedule in which the equivalent of 8.5 cents is charged for energy consumed up to 25 kw-hours, the rate decreasing to 5 cents a kw-hour for all used over 200 kw-hours. The resulting low cost of electric drive has surprised both the central-station man and the printer, the latter having dismantled his gas engine and disposed of it. This excellent showing of electric service has in part been due to the substitution of direct motor drives for the inefficient shafting formerly carried through the shop, and to the elimination of the long-hour runs of the gas-engine outfit to drive only the typesetting machine, now run by a ½-hp motor.

BOSTON EDISON COMPANY SPREADING ELECTRIC COOKING GOSPEL.

The Edison Electric Illuminating Company of Boston has recently been giving special publicity to the use of electricity in cooking, citing the order of the Secretary of the Navy for the establishment of electric cooking on battleships as the most significant recent advance in the art. All the suburban district offices of the company have been supplied with lithographed quotations from the specifications as clipped by permission from a confidential copy of the contracts for building battleships Nos. 34 and 35, which are on file in the Bureau of Construction and Repair of the Navy Department, showing in detail the equipment of the galley outfit and electrical auxiliaries to be installed. The company points out that the contracts for these battleships call for complete electrical equipment for every purpose in the "kitchens," including two electric ranges, warming ovens, bake ovens, urns, grinders, slicers, mixers, washers and other apparatus. The company recognized the importance of the adoption of electricity for battleship cooking as soon as it was announced, and sent a representative to Washington on a flying trip for the purpose of getting in close touch with the details. Much interest in the subject has been aroused by the company's lithographic reproductions.

ADVERTISING BY ELECTRICITY.

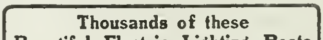
An electric advertising campaign has been started in Baltimore, commencing with an address recently by Mr. O. P. Anderson before the Baltimore Section of the National Electric Light Association in the physical laboratory of Johns Hopkins University on "The Design and Construction of Electric Signs." Later, upon the invitation of President Francis Lawton, Jr., Mr. Anderson addressed the Advertising Club of Baltimore at its mid-day luncheon in the Merchants' Club and chose as his theme "Advertising by Electricity." Mr. Anderson, who is an illuminating engineer of one of the lamp manufacturing companies, pointed out in his lecture before the Baltimore Section, N. E. L. A., that several cities of the United States are making commercial progress because the merchants of these cities believe in what he termed "co-operative illumination." He mentioned New York, Minneapolis, Chicago, Cleveland, Columbus, St. Louis and Buffalo as examples of cities that are growing larger by becoming brighter. He also pointed out that Baltimore Street, the main business thoroughfare of the Monumental City, has become a greater business street since the additional illumination has been installed.

The Consolidated Gas, Electric Light & Power Company, of Baltimore, is now actively engaged in promoting facilities by which Baltimore may take its place in the front rank in the matter of illumination. Already arrangements have been made to bring two sign concerns to Baltimore which will sell, install and maintain their signs as well as solicit business. Many merchants have already signified their intention to install signs, and the fact that they can be paid for in twelve monthly instalments and maintained during that time is an excellent inducement.

The city government has become interested in the campaign, and if an ordinance which has just been drafted by City Solicitor Poe meets the approval of the City Council, it will not be necessary for a man who desires to place an electric sign in front of his premises for advertising purposes to have an ordinance passed through the Council. All that will be necessary will be to appear before the Board of Estimates and present an application. This will save firms the expense of engaging a lawyer to draw up an ordinance and the delay necessary to have it passed through the Council. The Consolidated Gas, Electric Light & Power Company appeared before the board last week and requested it to suspend the rule requiring that permits for electric signs more than 6 ft. in length be incorporated in special ordinances. The company explained that there was much time lost in the passing of these special ordinances, and as the city had expressed its willingness to co-operate with the merchants and the company in making Baltimore brighter, there was no good reason why this rule should not be suspended. The board is considering the request.

ADVERTISING SPECIAL LIGHTING IN OUTLYING DISTRICTS.

In making its vigorous campaign for special ornamental street lighting designed to attract business to various neighborhoods in outlying districts, the Commonwealth Edison Company of Chicago has done some newspaper advertising. A reproduction of such an advertisement is shown herewith. These "ads" are not printed in the big downtown dailies, but rather in the vicinity papers of the outlying residence districts, each of which has one or more business streets. The sample given herewith appeared in a paper published in Woodlawn.



Thousands of these Beautiful Electric Lighting Posts On Chicago Streets

THE MERCHANTS in various parts of our city, realizing the value of well-lighted thoroughfares, have had one or more of these electric lighted columns, installed in front of their stores for a distance, in some cases, of a mile or more.

The effect is magical, resulting in an increase of business beyond all expectations.

The cost to each merchant is very small.

Visit some of these streets and be convinced that this is what is required to stimulate trade in your neighborhood.

Ogden Avenue and 12th Street
Milwaukee Avenue
Blue Island Avenue
Lincoln Avenue
N. Clark Street
W. Chicago Avenue
Michigan Avenue, Roseland

Then call Randolph 1280 and our representative will call and explain our plan fully.

Commonwealth Edison Company
139 ADAMS STREET

Advertisement in Chicago Local Paper.

Four-light or five-light posts equipped with 60-watt or 100-watt tungsten lamps are used, and about 1600 of these posts have been placed in various neighborhoods in Chicago. The installation of these systems is generally handled by business men's associations in the various districts. The posts are of iron and painted black, and usually one is placed in front of the store of each subscribing merchant. The lighting service is from dusk until 10 p. m. for six nights a week and from dusk until midnight for one night a week, the rate for each subscribing merchant being $1.50 per post per week for four 60-watt lamps. In order to get this rate it is necessary that there shall be twenty-five or more subscribers in each district. The company makes the complete installation and maintains it. The contract period is two years.

CENTRAL-STATION RESULTS AT FITCHBURG, MASS.

The return of the Fitchburg Gas & Electric Light Company to the State for the year ended June 30, 1910, shows that electricity is being popularized to an increasing degree in the northern Worcester County manufacturing city served by the organization. The company is one of the Tenney organizations and has an electric and gas department under the supervision of a local manager, who is responsible to the headquarters offices of the associated companies at Boston. The gross income of the company's electrical department for the year was $153,370, an increase of about 12.5 per cent over 1909. Of this revenue commercial lighting service furnished the larger portion, or $60,230, and the revenue from energy used by motors was $55,291. There was a gain of about $8,200 in commercial lighting over 1909, and the gain from industrial loads was about $5,100. The company's income from street lighting was $35,205 in 1910, compared with $33,666 in the preceding year.

The operating expenses of the company for 1910 were $100,595, compared with $87,085 the year before. The principal items of operating expense this year were: Net cost of manufacture at station, $47,711; distribution, $15,791; office expenses and management, $19,066; taxes, $10,399; miscellaneous, including insurance, legal, etc., $7,628. The balance to profit and loss for the present year was $52,775, compared with $49,523 the year before.

The cost of the physical plant of the electrical department to June 30, 1910, was $574,926. The company increased the plant investment by about $21,600 during the year. The larger items of plant cost for 1910 were: Underground lines, $161,001; steam-plant equipment, $142,904; land, $95,325; electric plant equipment, $82,799, and overhead lines, $50,511. The company expended $8,400 on additional overhead-line construction in the fiscal year 1910. Practically no change was made in the steam and electric generating plant equipment.

The company generated 4,461,580 kw-hours in 1910, compared with 4,006,157 kw-hours the year previous. Its gross income per kw-hour sold was 4.25 cents. For street lighting the company supplied 710,800 kw-hours; for commercial lighting by meter, 483,928 kw-hours; for general commercial lighting, 2,904,139 kw-hours, and for electric motor service, 2,401,440 kw-hours. The average income per kw-hour sold to motor users was 2.3 cents. The company sold or accounted for 3,978,987 kw-hours, leaving 482,593 units unaccounted for. The maximum load was 1650 kw and the maximum load on the day of least output was 320 kw. During the year the company burned 5443 tons of coal and 1573 tons of coke, besides a small amount of other fuel. The average cost of the coal per ton was $4.31 and of the coke $3.50. The station capacity was 2000 kw. The company's connected load was 2675 kw, including electric motors, 1538 kw, and commercial lighting, 982 kw. On June 30 last the company owned 2408 poles, and operated a total length in wire of 786,723 ft., divided as follows: Municipal wire, 356,985 ft.; commercial primary lighting wire, 123,103 ft.; secondary, 124,703 ft.; power primaries, 142,840 ft.; motor secondaries, 39,092 ft. The station service was handled by three engine-driven alternating-current generators delivering current to the distribution system at 2300 volts. There was an increase of about 96,000 ft. in the length of overhead wire in the year.

A summary of the company's operations, including various unit figures, is given in the accompanying table:

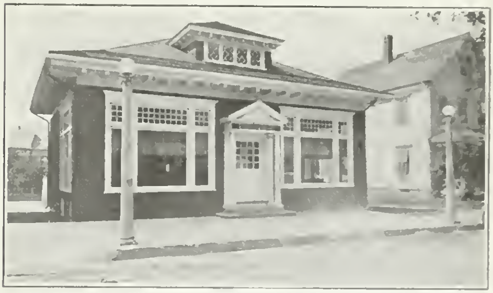
ANNUAL RETURNS OF THE FITCHBURG GAS & ELECTRIC LIGHT COMPANY.

Kilowatt capacity of station, rated	2[illegible]
Total population of district served, Census of 1910	[illegible]7,826
Gross yearly income per kilowatt station capacity	$76.68
Per cent income expended for operation, excluding interest and depreciation	65 per cent
Investment in electric plant and property	$574,926
Yearly operating expenses per $100 invested	$17.50
Average income per consumer	$1[illegible]8
Total connected load per kilowatt station capacity	1.[illegible]37 kw
Connected load in motors per kilowatt station capacity	.76[illegible] kw
Kw hours accounted for per 100 kw hours generated	89
Yearly load factor	[illegible]8 per cent
Gross yearly income per capita	$4.05
Investment per capita in electric plant	$1[illegible].20
Watts station capacity per capita	[illegible]
Number consumers per 100 population	2.56
Number residence consumers per 100 population	2.[illegible]
Number of residences, Oct. 1, 1910	4,528
Number of residence consumers, Oct. 1, 1910	890

Wiring and Illumination

SPECTACULAR LIGHTING AT REVERE, MASS.

Revere, Mass., a suburb of Boston, possesses numerous seaside resorts, where, as at other places of the same kind along the Atlantic seaboard, electricity is very largely employed for spectacular lighting in addition to regular uses. Electrical energy is supplied from the mains of the Suburban Gas & Electric Company, which has recently erected a new office building in the town for the convenience of its patrons. As shown in the accompanying engraving, the bungalow style of architecture has been adopted and the building is provided with attractive outdoor illumination in the shape of reinforced-concrete posts fitted with 60-watt tungsten lamps fed from a 104-volt circuit


Office of Suburban Gas & Electric Company at Revere, Mass.

A special summer lighting installation is on the Revere Beach boulevard, where the company supplies energy to about 200 flaming arcs located inside the amusement concessions. The street itself is lighted by twenty-two arches, each arch having fifty-two lamps of 8 cp each, the span across the boulevard being 43 ft. and the height of the arch centers 22 ft. In subagencies the company uses a sign shaped like an incandescent lamp to call attention to the place. From fifty to 100 lamps of 8 cp, frosted, are used in these signs, according to whether both sides are available for display purposes or not. A large billboard sign of the company's erection is illuminated nightly by incandescent lamps near the Boston & Maine Railroad.

At Wonderland Park, Revere, the company has a summer lighting load of about 2000 kw maximum. This is a large amusement resort where a striking amount of outline lighting is done. The company has had the business for five years. Service is supplied by four 50-kw transformers which step down the potential from 13,200 volts at the line side of the property to 130 volts and 230 volts for lamps and motors. Three-phase, four-wire service with a grounded neutral is installed on the secondary side of the transformers. The season lasts from May 30 to Labor Day, and the load is carried nightly until midnight. A brick substation, 40 ft. x 25 ft., handles the switching and transformer installation, and the park guarantees a minimum consumption during the season of 750,000 kw-hours.

SPECIAL LIGHTING AT WATERVILLE, MAINE, FOR BRIDGE-OPENING CELEBRATION.

During a celebration at Waterville, Maine, some time ago the lighting and railway companies combined to make the place attractive by night for two weeks. The occasion was the opening of a bridge by the Lewiston, Augusta & Waterville Street Railway Company. The Waterville & Fairfield Street Railway Company furnished the electricity to light festoons stretched across the street and the Central Maine Power Company supplied the energy for three-quarters of a mile of festoons arranged on the buildings. The lamps used were rated at 4 cp and 8 cp, and the illuminated zone was capped at each end by a luminous-arc lamp. The accompanying illustration is a view of the street at the time of the bridge opening.

Special Illumination at Waterville, Me.

GLARE AS AN AID TO STAGE ILLUSIONS.

Those who were familiar with the plans for amusing visitors in and about the grounds of the World's Columbian Exposition at Chicago will recall the Mackaye Spectatorium, which was wrecked by fire while yet unfinished. One of its novel features was the curtain, which was not to be of cloth or other opaque material, but of brightly lighted vapor. The plan was to have a film of vapor rise at the footlights and to project rays of light edgewise through this so as brightly to illuminate it, thereby screening the stage from the view of the audience.

While the trial of this clever arrangement on such a magnificent scale was unfortunately prevented by a disastrous fire, a little of the same sort of screening is often used in connection with the theaters which have been multiplying at such a remarkable rate during the last few years. Fortunately, the mist or vapor which Mackaye proposed to use in his venture is generally absent, but to make up for this some of the light beams are often turned directly toward the audience so as to effect by their glare part of what Mackaye sought to accomplish with his light-diffusing film of vapor.

The effect of this glare in reducing the visual acuteness is being utilized by a pantomime comedian who has just been appearing in vaudeville at the Plaza Theater, in Chicago. His using the glare effect there is all the more pronounced and successful as the little playhouse is lighted largely by indirect methods so as to screen carefully the observer's eyes from direct light rays. The curtain rises on a stage setting of black cloth at back and sides, with the comedian and his paraphernalia dimly illuminated by diffused light from the auditorium of the theater and by a little direct light from a crescent moon hung against the rear drapery. This hazy stage setting readily lends itself to the mystifying and often "spooky" pantomime in which the comedian conjures birds and even large musical instruments out of the darkness and breathes life into a figure which he has just glued together out of the stuffed limbs and members.

When other performers have presented similar tricks they have usually depended upon rapid sleight-of-hand work in the passing of objects through secret flaps in their elaborate stage setting or the similar substitution of live persons for dummy figures. The present manipulator varies this by working with a very simple stage setting and in a light which would be barely ample for disclosing the methods of his tricks if his audience were accorded the full use of their eyes. To avoid the latter he works behind a row of fifteen incandescent lamps of about 8 cp, each supported some 3 ft. above the stage floor on a little standard and each fitted with a metal half shade. By reversing the usual practice and turning the shades so as to throw the light into the eyes of the spectators he reduces their visual acuity just enough to hide the mechanism of his tricks, while still allowing them to enjoy them. Consequently the audience sees the dummy while it is being assembled, but does not see the drapery part when an assistant substitutes himself for the stuffed figure. Nor does it see the wires and rods by which various other paraphernalia are manipulated; hence the effect is pleasantly mystifying. No argument should be needed by illuminating engineers to prove the mistake of having lamps shine directly into the eyes other than the success of this vaudeville artist in thereby keeping his audience from seeing a part of what otherwise would be clearly visible to them.

TUNGSTEN STREET LIGHTING IN BOSTON.

The Edison Electric Illuminating Company, of Boston, Mass., has in the neighborhood of 1000 40-cp tungsten lamps in city street-lighting service, which have displaced gas and naphtha lamps. As pointed out in the Sept. 1 number, a departure from ordinary practice was made by the company in connection with

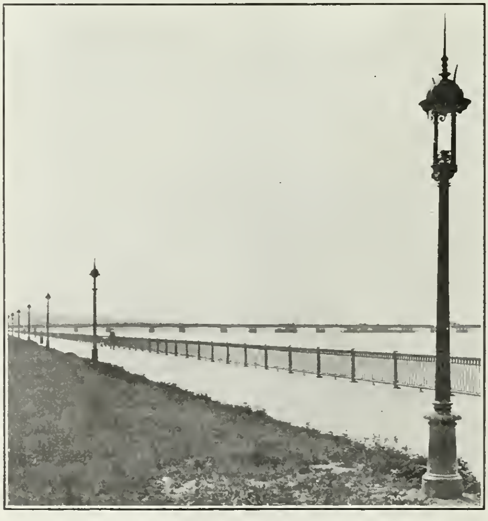


Fig. 1—Lighting of Charles River Basin Promenade.

the lighting of the Charles River Basin, West Boston and Harvard bridges, the Basin Promenade and Back Street being illuminated by multiple-series tungsten lamps ranging in size from 60 cp to 100 cp. The lamps are connected in series across the underground, three-wire direct-current network, and are hung about 11 ft. above the walks. Multiple lamps could not be used on the bridges because of the vibration, and high-tension series circuits were out of the question owing to the installation of the lamps on iron posts. To protect the lamp from weather and breakage a clear outer globe is provided. The installation on Back Street, a narrow thoroughfare at the rear of the Beacon Street residential estates, consists of 60-cp tungsten lamps fed from multiple-series circuits and carried on ornamental iron posts, as shown in the engraving herewith. The installation has transformed what was a poorly lighted street with flickering gas lamps to a brilliantly lighted thoroughfare. For 60-cp, 80-cp and 100-cp lamps the company receives $12, $14 and $18 per year as fixed charges plus 3 mills, 4 mills and 5 mills respectively per lamp-hour as running costs.

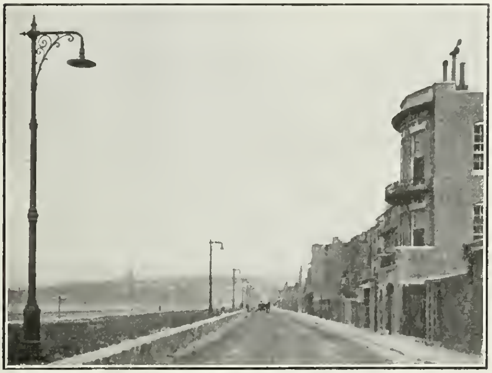


Fig. 2—Lighting of Back Street, Boston.

RECENT TELEPHONE PATENTS.

NEW AND IMPROVED APPARATUS.

A patent granted to Mr. B. W. Sweet, of Cleveland, Ohio, describes an improved desk stand wherein all working parts of the circuit are confined to the hollow stem of the stand. He shortens up the hook-switch springs so that they occupy the top part of the stem and below this is stowed a specially shaped induction coil designed to withstand the longitudinal strain caused by the frequent setting down of the stand. By including the induction coil in the stand a two-strand cord is sufficient. This reduces cord costs. This patent has been assigned to the Century Telephone Construction Company.

The patent granted to Mr. C. J. Erickson, of Chicago, relates to a harmonic signaling type of ringer. The exposed ends of the magnet cores are each provided with a slot, which supports the non-magnetic cross bar. This is accomplished by punching button holes in the cross bar, through which the cores are inserted. When the cores are assembled they are thrown outward so that the slots engage the cross pieces to clamp the whole securely in position. The cross piece carries at its center and at right angles to itself a slip of flat spring, which is securely clamped to it. The ends of the slip spring are then clamped by screws to the legs of a U-piece or yoke which spans the cross piece and which carries the bell hammer and rod. Thus there is provided a flexible torsional spring mounting, to which the armature of the ringer is attached from below.

In a switchboard switching key invented by Mr. K Weman, of Buffalo, the key lever is carried upon a pin which is clamped between the escutcheon plate and the horizontal element of an angle plate. The middle part of the angle is cut away at the bend, thus forming a space within which the lever may swing. The bottom of the vertical member of the angle carries the upturned switch springs, the actuating members of which carry small rollers which confront the block upon the lever This block is made of a piece of sheet metal formed into a tube of diamond-shaped cross-section, one edge of the tube being set into a cross slot in the bottom of the lever. Mr. Weman has assigned his patent for this key to the Ericsson Manufacturing Company.

Two patents granted to Mr. H.K. Sandell, of Chicago, describe a service counter for automatically counting messages. The counter is in view of the user and responds to every upward thrust of the hook switch lever. If the current flowing in the line circuit be constantly maintained the counter is restored or stepped back as the lever is again depressed. If, however, the current be stopped even for a very brief interval before the lever is depressed the count will be left recorded. The result is accomplished by a limit magnet, which once released will not restore. In the improved system the operator has the means of setting back the counter and the mechanism is safeguarded against operation by ringing current.

Upon incoming calls or upon attempts of the subscriber to recall the operator no count occurs as the line current is unbroken. Upon an outward call the break of current occurs during the operation of the cutoff relay.

Messrs. W. H. Thompson, of Wheeling, W. Va., and H. R Stuart, of Milwaukee, have patented a receiver for telegraphones. This instrument is duplex, having two diaphragms lying side by side in the same plane. Instead of the usual ear pieces, the diaphragm caps have central tubular apertures which lead to the two ears of the user. The receiver is of the solenoid type, each diaphragm carrying a cylindrical pole piece which projects into the corresponding receiver coil. Each receiver coil is connected upon an independent circuit to one of the reproducer magnets of the telegraphone. A single polarizing magnet serves for both receiver units.

Most multiple contact transmitters of the present day obtain their contact by the use of granules of carbon. In the transmitter patented by Mr. C. Adams-Randall, of New York City, no granules are used. There are instead a number of contact blocks symmetrically spaced upon the diaphragm, but insulated from it and from each other. Confronting each of these and in flexible contact with it is a carbon block. Multiple or series contacts are obtained as desired by connecting these single contacts together.

Messrs. G. W. Gibherd and O. A. Elias, of London, England, have produced and patented a disinfecting device in the form of a sleeve designed to be mounted between the transmitter proper and the mouthpiece. The walls of the sleeve have radial perforations and a disinfectant container surrounds the sleeve.

For rural lines it is sometimes advisable to provide a station disconnecting device for use in time of storm. Such a device forms the subject of a patent granted to Mr. P H Harner, of Dooms, Va. Two sheets of fire-resisting insulating material are hinged together on one edge. One sheet, the base plate, carries the line wire and ground terminals and also the plates of a saw-tooth lightning arrester. These plates are so shaped as to form receptacles for contact wedges mounted upon the cover plate, to which wedges the telephone wires are connected. When the cover is turned down the saw-tooth arrester is left in working position while the telephone is disconnected.

WIRELESS TRANSMITTER.

As a transmitter for wireless telephone signals Mr H G Matthews, of Gloucester, England, arranges a hoop carrying bundles of magnetic wire, the wires laid parallel and at right angles to the plane of the hoops. The whole is surrounded by a ringlike coil of wire placed parallel to the hoop.

RECEIVER HOLDER.

A receiver holder for desk sets is the subject of the patent of Messrs. J. G. Harris and A. Mancuso, of Philadelphia. This comprises a clamp bracket carrying a swinging arm at the end of which is the receiver. The arm can swing forward of its pivot, against a stop, to the listening position, or behind its pivot when it bears upon and holds down the switch hook.

AUTOMATIC SYSTEM SWITCH.

Mr. C. H. North, of Cleveland, Ohio, has patented a switch for automatic systems, having assigned his patent to the North Electric Company. In this switch the contacts are arranged in vertical rows upon a cylindrical surface. Rotary motion selects the proper vertical row and then the spindle is elevated to select the proper terminal. The novelty in the invention lies chiefly in the construction of the switch, especially in the reduction of all electromagnets to a single interchangeable unit adaptable to all needs.

LETTERS TO THE EDITOR.

Regenerative Electric Traction.

To the Editor of Electrical World:

Sir:—I have noted the quotations from the A. I. E. E. standardization rules appended to my letter in your issue of Dec. 29. I was aware of the fact that the term "adjustable-speed motor" had been proposed to be used to denote shunt-wound motors capable of speed regulation by means of field control, but I did not think that it had been adopted, for I have noticed several motor manufacturers still using the term "variable-speed motors" to denote this form of direct-current apparatus. Moreover, the fact that you contrasted the term "adjustable-speed motor" with "shunt-wound motor" instead of "constant-speed motor" led me to believe that you referred to some new development in the regenerative field.

As far as I know all the development in that field during the last ten years has been on the basis of the "adjustable-field" motor. Mr. Robert Lundell described shunt-field regulation in his regenerative patents and used it in his experiments. He also described an equivalent in the form of independent field excitation capable of regulation. He recognized the difficulties of obtaining a wide range of speed variation by field control on account of the limited space generally allowed for the traction motor. Mr. Lundell therefore combined the adjustable-speed principle with series paralleling, as a matter of fact even *double* series paralleling.

In 1902 an equipment was completed on these lines and installed and tested at Newcastle-on-Tyne. An average saving of energy of 25 per cent was found to be effected by this regenerative equipment. Mr. Raworth, making simplicity a first consideration, endeavored to use the adjustable-speed motor without any series paralleling. He found, however, after a few years that the speed variation obtainable in this way was insufficient and the saving negligible under average conditions, and he was compelled to adopt the principle of series paralleling which he had originally denounced.

A lesson brought home by the Newcastle test was the fact that, though armature resistances were practically dispensed with in this regenerative equipment, a saving during acceleration and running on intermediate notches was not discernible in the gross energy consumption. Mr. H. F. Parshall strikingly explained this discrepancy by remarking that the shunt circuit uses up (at the low average loads) what is saved during the acceleration periods by the absence of armature resistances. Besides this drawback of the shunt characteristic when applied to traction there are others, all of which have led to the original adoption of the series characteristic for traction purposes.

As I have said before, the shunt characteristic is essential to regeneration, but to my mind there is no objection of any weight against a combination which allows of the use of series characteristic during propulsion and of shunt characteristic during retardation. This combination can be so arranged that the standard series parallel equipment is retained complete and independent for propulsion. Consequently, the objection generally raised against any radical innovation, namely, that of possible lack of service reliability, is removed. The equipment is in that respect as perfect as any.

By using a series-parallel equipment capable of speed variation by field regulation, which kind of equipment was introduced a few years ago in Germany and found satisfactory, a saving can be obtained during the accelerating periods, which saving will amply compensate for the comparatively small loss in regenerative efficiency that would result from abandoning the complication of the *double* series-parallel principle and the adoption of the single series-parallel system. The result would be an equipment of maximum efficiency and service reliability and minimum complication.

Davenport, Ia. J. Gustaf V. Lang.

Voltage-Wave Distortion and Life of Incandescent Lamps.

To the Editor of Electrical World:

Sir:—With further reference to the criticisms made by Dr. C. H. Sharp and Mr. L. T. Robinson on Jan. 12 through the columns of the *Electrical World* of the writer's paper on the effects of alternating pressure wave-form on the life of incandescent lamps, which was first published in the June, 1910, *Bulletin* of the Engineering Experiment Station of the Pennsylvania State College, attention should be called to a number of statements made by both Dr. Sharp and Mr. Robinson which are not supported by the best information obtainable bearing on the question under discussion.

The writer is well aware that the burden of proof of claims made by him must rest upon the party who made these claims and he does not intend to disregard the obligation, but this fact in no way prevents his challenging evidence against him when the evidence thus offered is misleading or incorrect. At the present time work is being carried on which, it is hoped, will make it possible to answer directly certain criticisms which for the present cannot be contradicted by direct proof, and in the meantime it is the purpose of this letter simply to point out certain conflicting proofs offered by Dr. Sharp and Mr. Robinson as well as to direct attention to the work of others which may bear upon the case in question.

In the third paragraph of Mr. Robinson's letter he implies that the difference in life of lamps on the two waves is in part attributable to difference in regulation of the two waves. It is true that over any considerable range of voltage variation the saturated iron core used to obtain the peaked wave would have resulted in a poorer regulation of the peaked wave. However, throughout the tests described a recording voltmeter was kept on the alternator and the records show the greatest variation in voltage which occurred. An investigation of the variation of the peaked voltage corresponding to this slight change in alternator voltage showed the difference to be inappreciable. It may be positively stated that no effect worth considering could have resulted from this cause.

Mr. Robinson would lead one to believe that there is almost no change in resistance or temperature of tungsten filaments during a voltage cycle and offers as proof of his inference a test made by Dr. Sharp of a similar lamp on the same frequency (25-watt tungsten lamp on a circuit of 25 cycles). Dr. Sharp in the *Proceedings* of the A. I. E. E., September, 1910, page 1538, in describing this test states that he finds the variation of a tungsten-lamp filament's resistance during a cycle to be such that the minimum resistance is 10 per cent lower than the maximum resistance and that he calculated the power-factor to be 0.99975. It thus seems that Mr. Robinson would try to prove that there is almost no change in resistance or temperature during a cycle and that the power-factor is practically unity by means of a test which Dr. Sharp gives to show that the temperature does vary and that the power-factor is less than unity, the current leading the e.m.f. by a small amount. Nor can the variation pointed out by Dr. Sharp be considered insignificant, as will be shown later.

The statement made by Mr. Robinson that "there is no large change of temperature in the filament throughout the cycle" in the case of a lamp on a 25-cycle current seems almost absurd. He surely knows that when a lamp is supplied with current at 25 cycles the resulting flicker is plainly visible to the naked eye, and he must also know that this flicker is due to temperature fluctuation.

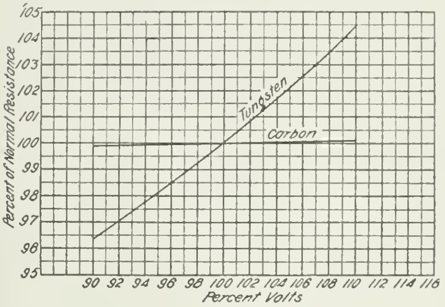


Fig. 1—Variation of Resistance with Voltage.

Returning now to Dr. Sharp's letter, it may be said that the writer cannot, until his tests now under way shall have been completed, attempt to substantiate his claims by further original proof, but it is possible at this time to point to evidence furnished by Dr. Sharp himself which is at variance with his present statements, and it is also possible to present other evidence which is against Dr. Sharp's last-obtained results.

Dr. Sharp in both of his communications to the *Electrical World,* as well as in a personal talk with the writer, objects to the measurement of power supplied to a lamp by means of a voltmeter and an ammeter. The writer fully agrees with his critic in his belief that the absolutely exact value of the true power supplied to a lamp should be measured by a wattmeter. He also agrees that lamps do have a power-factor very slightly less than unity, but, as has been before stated, the makers of the lamps tested at the Pennsylvania State College used a voltmeter and an ammeter in rating these lamps, and for that reason similar instruments were used in connection with the tests; if a lamp has a power-factor which is less than unity, then this power-factor is undoubtedly affected by the shape of the current wave.

From a letter written by Dr. Sharp, part of which will be quoted later, it would seem clear that Dr. Sharp agrees with the above statement, but notwithstanding this the results of tests given by Dr. Sharp in his last letter to the *Electrical World* show that on a sine wave, on a peaked wave and on a re-entrant wave, each of 60 cycles and 110 effective volts, the power supplied to the same lamp as measured by a wattmeter was identically the same in the case of each wave, Dr. Sharp's readings checking to at least four significant figures, thereby showing an agreement within one-tenth of 1 per cent.

If we refer now to a paper by Mr. John W. Howell in the *Proceedings* of the A. I. E. E., June, 1910, page 819, and compare the results given by Dr. Sharp in his letter, which forms part of a discussion of Mr. Howell's paper, *Proceedings,* A. I. E. E., September, 1910, page 1538, and if we assume both to be correct, we obtain additional information bearing on the point in question. Reference has already been made to Dr. Sharp's letter in the *Proceedings,* and it was pointed out that he found the resistance of a lamp filament to have a minimum value which was 10 per cent below the maximum resistance during a cycle when a 25-watt, 110-volt tungsten lamp was used on a circuit of 25 cycles (presumably at its rated voltage); the wave of e.m.f. being *extremely peaked.*

Dr. Sharp states that the peaked wave was selected so that the effect (similar to electrostatic capacity) might be exaggerated, and also that a frequency of 25 cycles was chosen as being as likely as any to give a maximum effect. These statements imply two things: First, that the fluctuations in the resistance and the power-factor vary as functions of the form of the e.m.f. wave, and, second, that the fluctuations in resistance and power factor probably vary with the frequency. Accepting Dr. Sharp's results and assuming that under the conditions specified by him the minimum resistance of a lamp is 10 per cent lower than the maximum resistance during a cycle, let us compare the results with those contained in Mr. Howell's paper, to which reference has already been made.

Let us assume that the resistance of the lamp tested by Dr. Sharp varied from 105 per cent of normal to a minimum of 94.5 per cent of normal, the latter value being 10 per cent lower than the maximum. Referring to Fig. 4 of Mr. Howell's paper, reproduced herewith, page 824 of the June *Proceedings,* we find that this variation in the resistance corresponds to a variation in voltage of from approximately 85 per cent of the normal voltage to 111 per cent of the normal voltage; and, further, from Fig. 7 of Mr. Howell's paper, reproduced herewith, we find that the above-named variation in voltage corresponds to a variation in candle-power of from approximately 65 per cent of the normal to approximately 130 per cent of normal. From the above it will be seen that if Mr. Howell's work is correct and if Dr. Sharp's work is also correct, then in the case of the lamps tested by Dr. Sharp the candle-power varied twice during each cycle from 65 per cent to 130 per cent of its normal value.

Mr. Howell's paper also gives some information concerning the life of the lamp. In the case of the lamp just considered, Fig. 7 of Mr. Howell's paper shows that at such times as the candle-power was 130 per cent of normal the disintegration of its filament was about four times its normal rate. While it cannot be accurately determined from Fig. 7 what the disintegration is when the candle-power is 65 per cent of normal, yet it cannot be less than zero. Hence, if we may fairly assume, and it is believed we may, that during one-eighth of a cycle the disintegration of the filament of the lamp tested by Dr. Sharp varied constantly from four times normal down to the normal rate, and during the next one-eighth cycle it varied constantly from the normal rate down to zero, etc., we find that under the assumption stated the average disintegration during the whole cycle would be 150 per cent of normal.

Under the above-named conditions, which appear to be entirely fair to Dr. Sharp's argument, if the resistance of a tungsten filament under the influence of a peaked wave of e.m.f. varies approximately 10 per cent, as Dr. Sharp claims it does, and if Mr. Howell's work may be relied upon, we find that the disintegration is 150 per cent of what it would have been if the resistance had remained unchanged throughout the cycle.

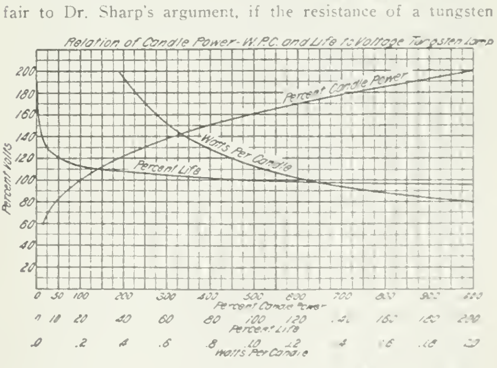


Fig. 2—Variation of Life, Candle-Power and Specific Consumption with Voltage.

There is every reason to believe that had the wave used by Dr. Sharp been sinusoidal there would have been much less than 10 per cent variation in the resistance, and the changes in temperature and candle-power would have been far less than they were with the peaked wave used by Dr. Sharp in his test.

Further reference may be made to the April 20, 1907, issue of the *Electrical World*, page 803, where an abstract, accompanied by curves, is given of a paper by Dr. Sahulka, printed originally in the organ of the Austrian Electrical Engineering Association. The tests here reported showed that in the case of certain incandescent-lamp filaments the resistance varied 2.1 per cent throughout the cycle, but this change of 2.1 per cent in resistance corresponds to a maximum change from the mean value in candle-power of 23 per cent. If we may assume that the filament used by Dr. Sharp in his test was similar to that upon which the tests recorded in the *Electrical World* were made, it would seem that, since the resistance varied 10 per cent with the wave used by Dr. Sharp, the candle-power variation could certainly not have been less than 50 per cent.

The question as to a probable error in the measurement of *initial* candle-power reported by the writer is being carefully investigated and a thorough search is being made for any possible influence or condition which could have introduced an error into these readings. It is quite evident, however, that except as an error of this kind would bear upon the initial candle-power reading the results of the life tests already published would not be affected, and it is certainly far from correct to assume that even had an error of this kind existed this was responsible for the greatly reduced life of the lamps on the peaked wave.

Finally, Dr. Sharp has repeatedly placed great emphasis upon his claim that numerous tests of an entirely similar nature to those performed by the writer have been made and that records of these tests are available. If Dr. Sharp, through the columns of the *Electrical World*, will state where these references occur he will be rendering no little service to the men who are deeply interested in this subject and who are at present experimenting along these lines.

State College, Pa. Charles L. Kinsloe.

Wattless Power.

To the Editor of Electrical World:

Sir:—The letter by Mr. Hanchett in your issue of Jan. 12 on the subject of "wattless power," "fictive watts" and "tangible phenomena" indicates that our divergence on the subject discussed is not great, now that Mr. Hanchett concedes the desirability and necessity of "abstractions."

In regard to the wattless "reactions," I am glad to say that I had already anticipated his views to a considerable extent in another communication, to which it now seems expedient to direct attention.

After I sent my first communication, printed in your issue of Nov. 24, 1910 (pages 1244 and 1245), I also sent a letter, in French, to the editor of *l'Industrie Electrique*, which has since appeared in that journal in its issue of Dec. 10, 1910 (No. 455, pages 531 and 532). In both of these letters it was made quite apparent that I objected to the adjective "wattless" under any and all circumstances. In the French letter, however, I went a little further and discussed more substitutes for "wattless power" than I did in the English letter. The English equivalents of the substitutes which I suggested are the following: *Reactance* power, *reaction* power, *reacting* power, *reactive* power and *reactant* power. The expression *reactive* power had been suggested already by M. Brylinski in a previous communication to *l'Industrie Electrique*, and I indorsed it strongly, although I preferred *reacting power*. There is a portion of that French letter which ought to please Mr. Hanchett. I suggested using the expression *reacting power* for the *general case*, involving, as I pointed out, two *specific* kinds of "reaction," namely, one due to *reactance* and the other to *condensance* or capacity, and then using the terms *condensant* power and *reactant* power to designate the two different kinds of reaction-power. We could also, in English, use, instead of these adjectival forms, the corresponding substantival forms with a hyphen, giving *reaction*-power, *reactance*-power and *condensance*-power. Of course, the same combination would apply to watts, amperes and volts as well in either case. I am inclined to prefer the substantival forms to the others, but we could get along with either. They are all satisfactory enough from the point of view of *translatability* and *exportability*. It will be seen, therefore, that I have gone still further than "current-reactions" and "reaction-currents" by proposing a nomenclature which enables the particular *kind* of reaction to be "specified" when desired. This has been done without disregarding Mr. Hanchett's requirements that the terms used should be suitable for both practical and scientific men. The practical man who wants to consider only the "resultant" reaction can use the *general* "reaction" terms. The scientific man who wants to consider the "component" reactions can use the specific terms.

Now, as to "tangible phenomena" and their interpretation I am not yet convinced that we can improve matters by shortening the terminology. The term "reaction" may be a convenient heading or title under which very important, far-reaching. "tangible" phenomena may be convenienty *catalogued*, but that does not mean that the phenomena themselves are thereby really *explained*, no matter how "tangible" they are. It so happens, for instance, that the "tangible" current indicated by an ammeter placed in an alternating-current circuit containing, considerable reactance has a portion which is so "intangible" that it does not appear at all in the indications of a wattmeter, it being in that respect "tangibly wattless." Now, the power which the wattmeter measures is one of the most tangible phenomena in that case. It includes all the factors of electrical energy, whereas the current includes only one. When we look at a phase-indicator we find tangible evidence that the current indicated by the ammeter is not altogether "tangible," and we know that although the ammeter may tell the whole truth about the resistance-heating effects of the current it is more or less "off" in regard to the "power" involved. We have to apply to its readings a sort of "coefficient of mendacity," otherwise known as the "power-factor," in order to get at the real truth in regard to the "tangible" power, which is, after all, the most important consideration. Try as we may, we cannot do away with this correcting factor, if we wish to account for all the tangible phenomena and reconcile them with each other. We must, therefore, go further than merely to catalogue the reactions. We must *segregate* them and consider them in detail. When we do this we find, much to our surprise, that many seemingly abstract and abstruse things like "power-factor" become quite "tangible."

In regard to the interpretation of Ohm's law, Mr. Hanchett gives me entirely too much undeserved credit, as he did to Ohm himself. The full discussion would occupy too much space, but a brief reference may be made to some of the points mentioned by Mr. Hanchett. The suggestion that we regard alternating currents as periodically varying direct currents is not at all objectionable, but the suggestion that we take a vectorial resultant of all the e.m.fs. does not help matters much, because it lands us in a mire of *spurious or fictitious resistances* having the remarkable property that they do not cause any ohmic loss of energy in a way which causes heat (Joule effect). This resistance would be of a kind which causes IR drop, but no I^2R loss. The modern generalizations avoid this contradiction by taking into account separately the different kinds of "reactions" which variable currents produce in the presence of reactance and condensance. Ohm only considered and formulated the relations for the *particular case* where all other "reactions" than the resistance or dissipative reactions are absent.

I find in your issue of Jan. 12 two more communications on "wattless power," one from Mr. B. Spencer Greenfield and another from Mr. John R. Carson.

Mr. Greenfield's statement that I *marvel* at the possibility of dealing with "linear forces" is a bit out of phase with the facts. My statement made it sufficiently clear, I think, that I regard it all as quite natural, and that, if I "marveled" at all, it was at those who "strain at gnats and swallow camels." I note with interest the two different definitions of force which are given by Mr. Greenfield. It is a pity that, after going to so much trouble to present the case in such an impressive manner, he should have neglected to tell us which of the two he preferred himself. It may be very difficult indeed to define force, especially if we must give up mass as another of our cherished delusions. But, until we find something better, we must use *some* definition, provisionally or tentatively. The first one spoken of, which is certainly older than Lagrange, and perhaps even much older than d'Alembert, is the one most generally accepted. The most satisfactory form of this definition is to be found in Professor Holman's classical book on "Matter, Energy, Force and Work" as follows (page 41): "*Force.* That action of energy by which it produces a tendency to change in state of motion of bodies." This is the definition which I have used in my lectures for the last ten years. The metaphysics of this definition are given quite fully in the book.

The second definition given by Mr. Greenfield would be older still than the first one if it really dated from Newton or Galileo; but in reality it is altogether *ex post facto*, so far as they are concerned, because it is purely a modern—indeed, very modern—*academic* definition, setting forth what we *now consider* must have been *meant* by Newton. It is doubtful if Newton himself would recognize his "child" when "thus clothed in "quaternion garb." There is no doubt that, practically, Newton considered forces to be agencies causing *linear* attraction or repulsion, and pulling or pushing effects, even though he *measured* them in terms of "fluxions" of momentum.

Even if it be true that mass is another figment of the imagination, or another cherished delusion, we need not on that account give up the foregoing definition of force, for the very good reason disclosed in my previous letter—namely, that the practical results which we can obtain by the use of the *hypothesis* of mass are just as real and useful and tangible as if mass were really a fact instead of an "abstraction" or a "coefficient."

Mr. Greenfield's criticism of my use of the term "force-factor" is based upon his misunderstanding of the term. He will find a definition of the *kind* of "force-factor" which I mean in the introduction to the American edition of Latour's "Induction Motor." After reading what I said there on the subject he will understand that his "mass-factors" and "acceleration-factors" are merely *particular kinds* of "force-factor." In my lectures on electric train movement I have, in fact, for many years habitually described them as such.

The reasoning about the "reactions" which cannot be found "in the wire" is similar to the reasoning about the assets of a corporation which cannot be found "in the bank." The wire and the bank both show a differential or net result only. The reactions and the assets can both be "located" if we look for them in the right way, as well as in the right place, using our "reason" as much as our perceptive faculties, or, in other words, using all our *sense* as well as our *senses*. They may be "there," even though we do not "see" them at first glance

Regarding Mr. Carson's communication, I may say that I agree with him on every point. He did not, however, make the most of his argument about the complex character of the "reactions" involved, for the simple reason that his "standard equations" are not the most general forms. The most general form of electrodynamic equation comprises one more term, making three quantities, on the right-hand side, representing three kinds of reactions, namely, inductance, capacity and resistance reactions, which, in the case of line-transmission "reactions," are not negligible, and make the problem of separating the reactions a much more difficult and complicated one

New York. C. O. Mailloux

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Starting Synchronous Motors and Converters.—O. Steels.—After some introductory notes on some points of the theory of starting synchronous motors and converters the author discusses the practical methods of starting operation in substations. Substations with induction motor direct-current generator sets are first discussed, then substations with synchronous motors and finally substations with converters. The author deals especially with the practical use of the synchronoscope in starting.—*La Revue Elec.*, Dec. 15.

Windings.—G. E. Miller.—A continuation of his long illustrated serial on the windings of dynamo-electric machinery. In the present instalment the author describes the method of determining the proper shape of a common form of armature coil, namely, a diamond-shaped coil.—*Elec. Journal*, January.

Induction Motor.—J. Fischer-Hinnen.—An English translation with illustrations of his recent German paper on probable developments of asynchronous motors. The original paper was abstracted at some length in the Digest.—Lond. *Electrician*, Dec. 30.

Lamps and Lighting.

Firefly.—H. E. Ives.—An account of a further experimental investigation in which the spectrum of the firefly radiation was studied from the ultra-violet at 0.2 μ to the infra-red at 1.5 μ. Photography was employed for the ultra-violet and visible regions, the extinction of phosphorescence for the infra-red The only radiation found is the band at 0.57 μ previously investigated. Apparently none of the same order of magnitude exists elsewhere in the region studied. The abdominal skin of the insect being shown to be transparent certainly as far as 3 μ, there remains for investigation the interval from 1.5 μ to 3 μ; all beyond 3 μ is called "body heat." That all beyond 3 μ is merely low-temperature radiation still, of course, lacks experimental proof. The light of the firefly was investigated for the properties of true phosphorescence and found to respond to none of the characteristic tests, such as dependence upon previous exposure to light or excitation by long waves. The light appears to be under the control of the insect. The results of the present investigation render still more probable the belief that the firefly produces only visible radiation of high efficiency. There is no evidence that the light is due to anything other than a true production of light by some biochemical process, which, as Langley remarks, "we know nothing to prevent our imitating successfully."—*Phys Review*, December.

Generation, Transmission and Distribution.

Direct-Current, High-Tension Series Transmission.—The Compagnie de l'Industrie Électrique et Mecanique, of Geneva, is at present increasing the equipment of the transmission line between Moutiers and Lyons, which is worked on the well-known Thury system. The original station at Moutiers contains five generating sets, each with an output of 1600 hp. Each set consists of two double machines coupled to a turbine and supplies a constant current of 75 amp at 14,400 volts. The total rating of the generating station is 8000 hp, of which 6400 hp at 57,000 volts is transmitted to Lyons—that is, a distance of 110 miles—over two wires 0.36 in. in diameter. A three-phase line runs parallel to the direct-current system. At Lyons the line current drives eight 725-hp motors, six of which work generators for supplying energy to the Lyons tramways.

The other two drive alternators in another substation. The excellent results which have been obtained from this line during its four years' working, from the point of view of simplicity, regularity, safety and ease of upkeep, have determined the supply company to carry out the following extensions: The erection of a new station at Bridoire (Savoy) which will contain four 2000-hp generators supplying a current of 150 amp at 9125 volts; the erection during 1911 of a station at Bozel (Savoy) of three 4000-hp machines supplying 150 amp at 18,250 volts; the installation at the Vaulx-en-Velin substation at Lyons of five motors of the same type as the generators, each with a rating of 1730 hp. The present line and apparatus will also be modified to make it capable of taking 150 amp. The total rating of the new system will be 28,000 hp and the three stations coupled in series will transmit 150 amp at a pressure of 127,000 volts. This voltage will, however, not be attained under normal working conditions, as owing to the lack of water all the sets will not be able to work together on full load.—Lond. *Electrician,* Dec. 30.

Gas-Power.—E. D. Dreyfus.—A paper on some pertinent features relating to gas-power. The author gives data on natural gas, by-product gas and producer gas, and discusses the relative costs of gas plants and steam plants. He then discusses briefly the types of gas engines and their regulation, also the types of gas producers and maintenance cost. Gas-power in this country to-day is estimated to represent an aggregate of over 475,484 hp, involving the following types in the order of their approximate importance: Blast-furnace gas, 31 per cent; natural gas, 43 per cent; producer gas, 22 per cent; illuminating gas, 3 per cent; coke-oven gas, 1 per cent; distillate, oil and gasoline, 0.1 per cent.—*Elec. Journal,* January.

Electricity in Textile Mills.—L. Crouch.—The first part of an article on recent developments in the electrification of textile mills, giving notes of four groups of American textile mills representing a total rating of 17,000 kw, driving some 528,000 spindles and 19,400 looms. The present instalment deals with the Pacific mills in Lawrence, Mass. The article is to be concluded. In another article the electric equipment of the Ray mills of Stalybridge is described.—Lond. *Elec. Review,* Dec. 23.

Water-Power in Austria.—H. Duell.—The first part of a paper on the utilization of the water-powers in the Austrian Alps, where 1,500,000 hp are available for development. In the present instalment the author deals especially with the water-powers of northern Tyrol and gives details of projects with estimates of cost.—*Elek. u. Masch.* (Vienna), Dec. 18.

Power Station.—Simonsen.—The conclusion of his extended paper on the new Reisholz power plant of the Rhenish-Westphalian electricity works. In the present instalment the author deals with the particular method of the water supply from the Rhine River to the condensers and with the arrangement of the switchboard.—*Elek. Zeit.,* Dec. 22.

Traction.

Paris.—A. Reisset.—A profusely illustrated description of the Nord-Sud underground railway of Paris. It is operated by a three-wire system at 2×600 volts. An overhead wire forms the positive outer (+ 600 volts); a third-rail, the negative outer (— 600 volts). The rails form the neutral wire.—*La Lumière Elec.,* Dec. 24.

Installations, Systems and Appliances.

New Tariff.—A. Soulier.—A discussion of the recent proposal of Prof. Riccardo Arno, who wants the consumer to pay not only for the real power $ei \cos \theta$, but also at a lower rate for the "wattless power." He proposes to use a meter which measures $ei \cos \theta$ plus the nth part of the difference between apparent power ei and real power $ei \cos \theta$, where n is a conveniently chosen figure (for instance, 3). The "complex charge" measured by the instrument is, therefore,

$$P = ei \cos \theta + \frac{ei - ei \cos \theta}{n} = \frac{ei}{n}[1 + (n - 1) \cos \theta]$$

This complex charge can be measured very easily by a simple adjustment of an ordinary electrodynamic meter. A phase difference is produced between the flux of the shunt circuit and the potential difference at the terminals of the circuit. For instance, for $n = 3$ Arno produces a phase difference $\theta = 5°$. In induction meters, in which θ is usually 90°, Arno makes $\theta = 95°$. The instrument thus becomes practically an exact integrator of the "complex charge" for values of the power-factor between unity and 0.8. The fairness of such a tariff is pointed out, although the difficulty is recognized of making the customer see the justice of a meter which is made to read wrong so as to indicate more than the real power.—*L'Industrie Elec.,* Dec. 25.

Control of Electric Winding and Hoisting Engines.—E. Rosenberg.—A paper read before the Manchester Section of the (British) Institution of Electrical Engineers. The author discusses the general features of the different systems of electric winding in mines and especially the control apparatus. He deals with the Ward-Leonard system, the rheostatic control of direct-current motors, the rheostatic control of induction motors, the use of the direct-current motor as a dynamic brake and the use of induction motors with direct-current excitation as dynamic brakes. In the latter case it is impossible to employ at the same time the combined effort of the brake and the motor, say, working with a counter current, and it requires some special switching arrangement for stator as well as rotor. The author finally deals with the eddy-current brake. Such brakes behave differently if copper disks or cast-iron armatures are employed. In the formr case the torque increases with speed, reaches a maximum and then falls again. On the other hand, with eddy-current brakes with cast-iron armatures the torque always increases with increase in speed. An account of the discussion whch followed is also given. W. Cramp mentioned the use of an induction motor with a variable number of poles. The only objection to the use of the induction motor as a brake seems to be that without counter current it is applicable only for speeds a little over synchronism. If it were so arranged as to have the number of poles changed it might be used as a brake down to the speed corresponding to the largest possible number of poles; or if the winding of the motor were arranged so that it could be connected in cascade, this would enable perfect control to be obtained when running as a motor with a very wide range of regenerative braking. Rosenberg thought the chief objection to this scheme with large directly coupled winding motors to be the great number of poles required and the deterioration in performance which such an arrangement of stator and rotor coils would give even at full speed.—Lond. *Electrician,* Dec. 30.

Switchboard.—H. W. Clothier.—The conclusion of his paper presented before the Newcastle Section of the (British) Institution of Electrical Engineers on switchgear and the isolation of faults on energy-supply systems. In the present instalment the following subjects are dealt with: Leakage protection, protective gear arrangements generally, generator protection, busbar protection, feeder protection, trunk main and high-tension feeder protection, combined balance and overload protection on high-tension networks, tail-end protection, transformer protection, elimination of potential transformers for protective systems, simplest equipment of automatic panel, protection from shocks and fire, and armored switchgear.—Lond. *Electrician,* Dec. 30.

Determination of the Steps of Starters.—H. Zallud.—A description of a simple method for determining the number of steps of starters for shunt motors and of rotor starters. He uses a logarithmic paper, very little calculation being required with his method.—*Elek. u. Masch.* (Vienna), Dec. 25.

Low-Tension Switches.—Henry.—An illustrated description of recent improvements in the design and construction of low-tension switches and circuit breakers.—*L'Industrie Elec.,* Dec. 25.

Electrophysics and Magnetism.

Discharge of Electricity Through Gases.—R. F. Earhart.—An account of an experimental investigation of the effect of temperature on the discharge of electricity through gases. Potentials required to produce luminous discharge from 22 deg. to 600 deg. depend merely on the mass of gas between the electrodes. Potentials required to maintain a discharge in air do not fall below 345 volts until temperatures approaching 1000 deg C. are reached. The minimum energy required to ionize a gas by collision depends to a very slight extent upon the temperature of the gas for temperature less than 1000 deg.—*Phys. Review*, December.

Resonance Without Damping.—F. Emde.—When an oscillation system without any damping gets into resonance with an external periodic force the amplitudes of the forced oscillations become infinitely large. The author proves this by first giving the equations for a small amount of damping and then passing over to the limiting case in which the damping is zero.—*Elek. u. Masch.* (Vienna), Dec. 25.

Analogies Between Mechanical and Electrical Phenomena.—K. Wessely.—A mathematical article in which the author first shows how to overcome a certain difficulty in deriving the transformer equation from Lagrange's mechanical equations of motion and then describes mechanical analogies of two generators working in parallel and of three generators working in parallel.—*Elek. u. Masch.* (Vienna), Dec. 18.

Principle of Relativity.—S. J. Barnett.—An account of experiments on the question of the motion of the ether in a steady electromagnetic field. The result appears to favor decidedly the principle of relativity.—*Phys. Review*, December.

Units, Measurements and Instruments.

Units of Thermal Resistance and Conductance.—C. Hering.—The author supplements his former article by further discussion of his new units of the thermal ohm and mho and by a table of conversion factors connecting these with other units. A table of the resistivities and conductivities of various refractory materials in these new units is added with a numerical example on the heat conduction through furnace walls.—*Met. and Chem. Eng'ing*, January.

Direct-Current Transformer.—At the recent exhibition of the (London) Physical Society of instruments and apparatus a transformer for the production of high-frequency alternating current from 100-volt or 250-volt direct current of Leslie Miller was shown. This instrument has been primarily devised for cautery work, for lighting low-voltage lamps, etc. By connecting the transformer to direct-current supply mains a comparatively large secondary current can be obtained from only a small primary current. Thus, on a 200-volt continuous-current circuit with a consumption of 0.5 amp a secondary current of 0.8 amp can be obtained for a cautery. The arrangement is shown in Fig. 1. In the main circuit *a* is the electromagnet, *b* a resistance, *cd* hammer and screw of break. The shunt circuit comprises part of resistance *b*, the condenser *c*, and the primary windings of the transformer *fg*. The instrument comprises a small electromagnet, wound with fine wire, having a light armature pivoted in front of its poles and arranged so that it "makes and breaks" the primary current in the same way as the armature of an electric bell. Connected between the contact points are a condenser of 3 mfd or 4 mfd capacity and the primary winding of a small alternating-current transformer. The electrical energy in the shunt circuit is thereby transformed to a low pressure and a current of the required magnitude is obtained. The secondary current is adjusted by altering the position of the iron core of the transformer. An efficiency as high as 80 per cent is claimed.—Lond. *Electrician*, Dec. 30.

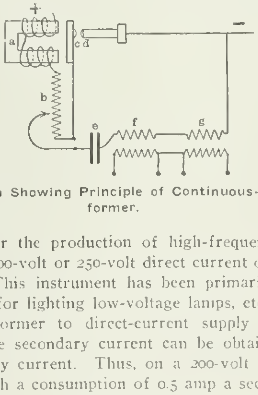


Fig. 1—Diagram Showing Principle of Continuous-Current Transformer.

Cooling Curves.—At the recent exhibition of the London Physical Society there was shown a recalescence curve-tracer of H. Brearley, of Firth College, Sheffield, which is a semi-automatic device for taking, by the aid of thermo-couples, cooling curves. The specimen is heated in a small tubular furnace connected in series with a regulating rheostat and the electric supply main. The thermo-couple, placed in the specimen, has its cold junction joined through a series resistance to an Ayrton-Mather galvanometer, of the Cambridge Company, the sensitiveness of which can be regulated. The light from a Nernst lamp is reflected by the galvanometer mirror on to the scale, which is part of the Brearley apparatus proper; the scale is graduated in millimeters and fixed 1 m from the galvanometer. The apparatus consists of a drum and a sliding carriage supporting two pointers, mounted the one above the other; the upper pointer is fixed, the lower one carries the depressible pen. An electromagnet on the carriage presses the pen against the drum once every second. The observer, who sits in front of the instrument and turns a handwheel at the end of a long horizontal screw, makes the fixed pointer follow the light spot on the scale. The pointer thus marks the position of the reflected ray every second. The armature of the sliding carriage is energized from a storage battery through the intermediation of a clock which causes the pen to be attracted once every second. The drum is turned through a rack and-pinion device; it makes one revolution in ten minutes, and the card has a length of 360 mm, so that a very large scale is secured for a range of probably a few hundred degrees Centigrade.—Lond. *Eng'ing*, Dec. 30.

High-Voltage Transformer.—A note on a transformer of German make for raising the e.m.f. from 1040 volts or 2080 volts to 500,000 volts. There are two low-tension coils, each designed for 1040 volts. On each of the two cores there are twenty-eight high tension coils, each consisting of 377 turns, so that the e.m.f. per turn is 24 volts. The 500,000-volt sparks between the secondary electrodes bridge an air-gap of 1.3 m (4¼ ft.).—*Jour. du Four Elec.*, Dec. 1.

Calorimetry.—W. P. White.—The author describes in detail a calorimetric system in which all conditions affecting the calorimeter temperature are, as far as possible, definite and measured, and in which as a result errors once serious are made negligible, computation is often simplified and an increase in effective thermometric accuracy can be secured. The apparatus was designed for the determination of specific heats especially at high temperatures, by the mixing method. Descriptions are given of two calorimeters designed for effectiveness in stirring. For the electric furnace the type with internal platinum winding is employed. It permits the attainment of a higher temperature and diminishes the slag between coil and chamber, thus increasing the rapidity and the exactness with which a constant temperature may be reached and maintained. For measuring the calorimeter temperature copper-constantan thermo-elements are used, and for the furnaces platinum rhodium elements, while the potentiometer installation has been further developed, especially with respect to equipotential leakage shields to protect against leakage in the potentiometer system.—*Phys. Review*, December.

Calorimetry Calibration.—The results of accurate tests of the two calorimeters mentioned in the preceding abstract by the electrical method. The electrical method is accurate and convenient if an adequate storage battery and an accurate signal clock are available. An automatic switch, which starts and stops the heating current in obedience to electric signals from a chronometer, is an advantageous substitute for a chronograph. The chief result of these tests is that the average accidental error of a complete calorimetric determination has been reduced to about one part in 30,000. The average accidental temperature error was brought below 0.00025 deg. This is practically a perfect performance for the multiple thermo-element used as a thermometer.—*Phys. Review*, December.

Thermo-Pile.—B. J. Spence.—The author has designed a very sensitive thermo-pile by employing alloys of bismuth and 5 per cent tin and bismuth and 3 per cent antimony. A single pair of junctions of these alloys gives a thermo-electromotive force of 120×10^{-6} volt per degree difference of temperature over a wide range of average temperatures—that is, between hot and cold junctions. The arrangement is described in detail. This peculiar type of thermo-pile has overcome to some extent the usual objections applied to thermo-piles in general, namely, lack of sensibility and sluggishness. It has a sensibility superior to the best bolometers and lacks the annoying unsteadiness of the bolometer due chiefly to batteries. It possesses a slow drift, which likewise is common to the bolometer, and is more sluggish than the bolometer.—*Phys. Review*, December.

Telegraphy, Telephony and Signals.

Microphones and Long-Distance Telephony.—Béla Gáti.—The author gives a review of former investigations made by others and more recent ones made by him on the current waves in microphones. The simplest way of studying the problem is to produce in front of the microphone a single tone and to measure the pulsatory current set up in the secondary coil of the telephone transformer. The best sound producer for such purposes is that due to Stern. In the author's experiments he used the barretter for measuring the current. The results of tests of a number of microphones of Hungarian make are given in diagrams in which the abscissas represent the number of oscillations of the sound waves, and the ordinates the strength of the current measured in millionths of an ampere with the barretter in the secondary circuit, when there is electric resonance. It is found that the microphones of a central battery system are the best, for while the fundamental tone of microphones used in other systems is low (about 600), that of the common battery microphone is in the neighborhood of 800. Considering that the number of vibrations of the ordinary vowel sound *a* long exceeds 900 (exclusive of the harmonics, the frequency of which is higher), it would be supposed that a microphone was better when it had a high fundamental tone, so that it would better render the higher sounds. To raise the fundamental tone of the microphone and to arrange it to carry a high current without heating use may be made of the arrangement designed by the Swedish engineers Egner and Holmstrom, whose microphone is shown in Fig. 2. The diaphragm is large and is tightly stretched by the device shown. A higher fundamental tone is thus obtained. When speaking into this instrument the higher tones of the voice remain sufficiently clear to be understood, even over a long line. It is thus possible to reach much greater distances by this aid than heretofore. However, as the principle of diaphragm tension is well known and could not, therefore, be patented, the inventors had recourse to the theory of points of junction of the diaphragm, and on the strength of this the patent was obtained. The cooling of the microphone is good. The inventors claim that they use a high current (1 amp), which increases the good results. At present more than 5,000,000 microphones are in use in the world, and the number will be 10,000,000 in a few years. It is desirable to improve the existing microphones so that they can carry one or more amperes. The necessary improvement can be effected by rather simple means, namely, by using a cooled microphone. This, in fact, serves fairly well for distances up to 2500 km (1500 miles) on a 4-mm (0.16-in.) copper wire, not only on a clear line, but also where outside disturbances take place. Some fundamental points of long-distance telephony are then discussed and wave forms are reproduced of the vowel *a* taken by oscillographic means. Like other apparatus, the long-distance high-current microphone has its drawbacks. The strong current in the line sets up a considerable induction in the neighboring circuits, so that the voice can also be heard in these latter lines. At the transmitting end the current passes through the receiver so that the speaker's voice is heard very loudly. This gives a somewhat disagreeable effect, at least at first. A remedy can no doubt be found for this, however. In any case the passage of the outgoing current through the resistance of the receiver causes a considerable lowering of the tension, which should be avoided. Another use to which the high-current microphone might be put is to operate a typewriting machine, using the characteristic waves for each letter of the alphabet. Marconi has already proposed this idea. The new microphone has also been tried for submarine bell signaling, and it should greatly increase the range of such signals.—Lond. *Electrician*, Dec. 30.

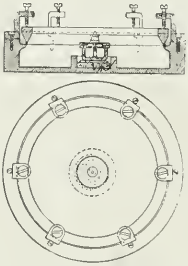


Fig. 2—Egner and Holmstrom's Long-Distance Microphone.

Wireless Telegraphy.—Brenot.—An illustrated article on the use of wireless telegraphy for the determination of differences of longitude.—*La Lumière Elec.*, Dec. 24.

Wireless Telephony.—C. O. White.—An illustrated description of the new commercial wireless telephone system of Dubilier.—Lond. *Electrician*, Dec. 30.

Electrochemistry and Batteries.

Electric Steel Furnace.—J. Harden.—An illustrated description of a new electric furnace for steel making and refining. It is a combination of an arc and a resistance furnace. For operation with three-phase currents three electrodes are used at the top which heat the bath, but the bath is also heated by the Joulean heat of currents passing through the bath between pole plates such as are used in the Roechling-Rodenhauser furnace.—*Met. and Chem. Eng'ing*, January.

Cyanamide.—An article by J. W. Beckman in which he points out that the term cyanamide is now used in three different senses, but that its use should be restricted to the chemical compound H_2CN_2, while the commercial fertilizers may be called lime-nitrogen and lime-nitrogen compound, etc. The same issue contains a long paper by J. C. Clancy on his process of using cyanamide with electrolysis in the metallurgy of gold. —*Met. and Chem. Eng'ing*, January.

Electromagnetic Separation.—E. Oppen.—A paper discussing the use of electromagnetic separation in foundries, especially for cleaning the molding sand, for separating metallic iron from cupola slag and for the recovery of iron in general. Various designs of separators of German make are described and illustrated.—*Stahl und Eisen*, Nov. 9.—Some details of the design of separators are discussed in two letters by G. Rietkotter and E. Oppen in *Stahl und Eisen*, Dec. 7.

Miscellaneous.

Asbestos.—H. R. Edgecomb.—A discussion of the production and uses of asbestos under the following heads: Origin, varieties, physical characteristics, geographical distribution, production, mining, preparation, general uses and uses for electrical insulation and its limitations.—*Elec. Journal*, January.

Swiss Electrical Society.—An account of the annual meeting held in November in Schaffhausen of the Association of Swiss Electricity Works and of the Swiss Electrical Society. There was a discussion on the revision of the factory laws in Switzerland, a report of the testing bureau of the society, and also reports of various committees.—*Elek. Zeit.*, Dec. 22.

Book Reviews.

Notes on the Graphics of Machine Forces. By Robert C. H. Heck. New York: D. Van Nostrand Company. 42 pages, 39 illus. Price, $1.

The author has selected a number of ordinary mechanisms, such as journal friction, belt transmission, chain and rope resistances, in order to show the utility of graphics in dealing with problems connected with them. The suggestiveness of the work is a valuable feature

Elementary Mechanics. Including Hydrostatics and Pneumatics. By Sir Oliver Lodge. New York: D. Van Nostrand Company. 308 pages, 107 illus. Price, $1.50.

The first edition of this elementary manual from the pen of its distinguished author appeared in 1895 and was followed by a "new edition" in 1897. The present one is identical with the revised edition of 1897. The subjects are expounded in a clear and thorough manner, and the student who has mastered the treatise will find that he has an excellent preparation for the study of physics and analytical mechanics. The numerical examples appended to the chapters and the examination papers at the end of the volume are a commendable feature of the work.

Cable Fault Localization Graphs in Practice. By Edward Raymond Barker. London: H. Alabaster, Gatehouse & Company. 68 pages, 24 illus. Price, 25 shillings.

The location of faults in submarine cables has long been the subject of study by the author and this last publication consists largely of a reprint of a series of articles which appeared in the *Electrical Review*, London. The present book gives results of experience with the author's calculation-board and discusses a large number of graphs taken from actual practice.

Die Transformatoren. By Dr. Gustav Benischke. Braunschweig: Friedrich Vieweg & Son. 220 pages, 228 illus. Price, 10 marks.

The volume is devoted to the theory and practice of transformers in alternating-current engineering. The modes of operation, construction, testing and designing of transformers are considered from the engineering standpoint and particularly in relation to transformers operating on lighting mains. Some excellent illustrations of types of transformers in current German use are appended, some of them indicating the methods of construction and assembling.

The engineering theory of the subject is discussed mathematically, but the mathematical treatment is not very difficult The chapters relate successively to the introduction, the mode of transformer operation, their construction, their heating and loading, their connections and special applications, tests, and design. The volume will be of special interest to students of electrical engineering acquainted with the German language and to practising engineers interested in German methods of transformer construction and testing.

Motorman's Practical Air-Brake Instructor By George R. Denehie. Chicago: Frederick J. Drake. 280 pages, 151 illus. Price, $1.50.

Although the title of this book confines the scope to air brakes other forms of brakes, such as electric and hand brakes, have also been allotted a space in proportion to their importance. The book is mainly devoted to the description of the construction and operation of different systems of power brakes, the explanations being accompanied by well-chosen illustrations, a large number of which are printed in colors. At the end of each section is given a list of questions and answers intended to clinch the important points covered in the body of the section. The subject of braking is treated in a general way and instructions are given for the operation and care of braking apparatus.

New Apparatus and Appliances

PORTABLE PRINTING ATTACHMENT.

The Minerallac Electric Company, 1004 West Van Buren Street, Chicago, has developed a new form of the Chicago printing attachment which is portable. The new outfit has been developed to meet the demands for a self-contained instrument for testing purposes to determine load factor for different periods, demand at different hours of the day and other information of this kind. The complete set consists of one of the company's standard type C printing attachments, one contact-making clock and one battery of dry cells, all assembled and protected in a neat oak carrying case. With this form of attachment a test on a customer's line is a simple matter, all that is required being the connecting of the three binding posts on the top of the attachment to the watt-hour meter register.

QUARTZ-TUBE MERCURY-VAPOR LAMP.

Constructive details of a form of quartz-tube mercury-vapor lamp recently placed on the market by the Brush Electrical Engineering Company, 37 Strand, W. C., London, England, are shown in the accompanying illustrations. Use is made of quartz rather than glass on account of the high temperature reached by the mercury vapor, namely, 3000 deg. Fahr. The specific light output increases at a rapid rate with increase in the temperature and at the temperature maintained in the quartz-tube mercury-vapor lamp reaches about 4 cp per watt. The light is deficient in respect to certain of the rays—but to a less extent than is that from the lower-temperature glass-tube mercury-vapor lamp—and hence the lamp is not suitable for use where color matching is of prime importance. It gives forth much violet and ultra-violet light, but these rays are

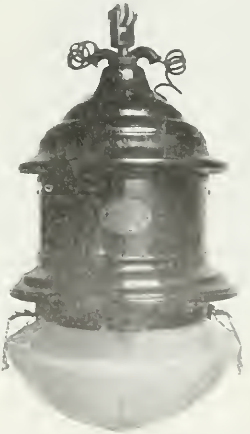


Fig. 1—Exterior View of Quartz-Tube Mercury-Vapor Lamp.

properly subdued by means of the opal glass globe which surrounds the mercury-vapor tube. The lamp is especially well suited for the lighting of outdoor areas and industrial premises where the color of the light is of less importance than its quantity and distribution. The lamp here illustrated is made in two sizes, giving from 1800 cp to 2500 cp at either 110 volts or 220 volts. The lamp is so constructed that the quartz tube can be renewed at any time. A useful life of 1000 hours is guaranteed for each tube whether installed initially in a lamp or subsequently for renewal.

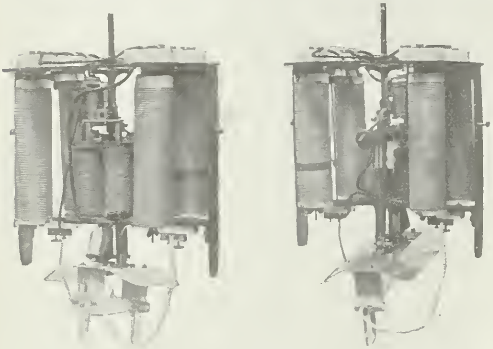


Fig. 2—Quartz-Tube Mercury-Vapor Lamps with Casings and Globes Removed.

AN INTERRUPTER FOR RAILROAD TELEPHONE WORK.

A circuit interrupter designed especially for railway telephone service has been placed on the market by the Western Electric Company. This interrupter is especially adapted for use in block towers where the operators are so busy that they do not have the time to call other stations by means of a hand generator. It is also especially adapted for use on yard lines where several telephones are connected to the same pair of wires.

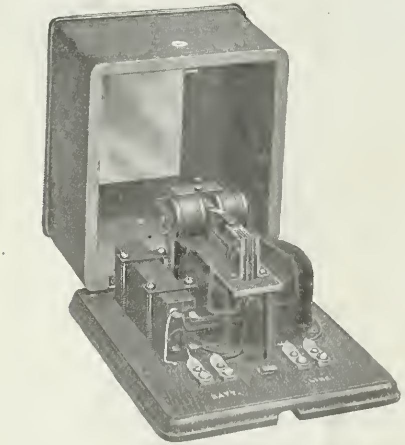


Fig. 1—Open View, Showing Mechanism.

The interrupter, a view of which is shown in Fig. 1, is intended to be mounted normally upon the wall in a vertical position in the same manner as a telephone set. The set is inclosed in a neat, well-constructed oak cabinet provided with a hinged cover. This cover is provided with a glass window through which the operator of the mechanism can be observed when the cover is closed. The mechanism is mounted upon the base of the cabinet and is readily accessible for adjustment, test and inspection.

The interrupter is operated by means of a key or push button which closes a battery circuit containing from four to eight dry cells. The number of cells necessary depends upon the number of bells it is desired to ring. Five dry cells will operate effectively fourteen 1000-ohm ringers or sixteen 2500-ohm ringers on a line of 500 ohms resistance, an equivalent of about a thirty-mile metallic circuit of No. 12 copper wire.

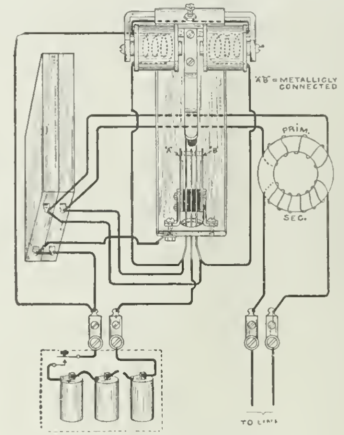


Fig. 2—Circuit Diagram.

The interrupter is so adjusted that it responds at once when the key is pressed, thereby closing the battery circuit. This arrangement insures a very economical energy consumption, as the interrupter is only in action when the battery circuit is closed. The mechanism is practically noiseless and sparkless. All circuit contacts are of platinum. Although the mechanism is very sensitive, it is built in a substantial manner which insures long service and low maintenance.

The circuit diagram illustrated in Fig. 2 shows the simplicity of the circuit and the ease with which it can be connected.

FLAMING-ARC LAMPS FOR WHARF LIGHTING.

The capital invested in the modern ocean greyhound is so great, the maintenance so large and the time of actual service before the vessel is considered obsolete so small that in order to obtain any return on the investment the time spent in port must be a minimum. For that reason stevedores, longshoremen and coal shovelers work day and night unloading and loading the vessel with freight and fuel. This night work requires good artificial lighting, and for single-story piers and those of two stories having ceilings of sufficient height the flaming-arc lamp, because of its economical operation, great brilliancy and penetrating power, has proved a very satisfactory illuminant for lighting these large semi-open areas. An excellent example of this class of illumination is afforded by the new pier of the Fabre Steamship Company at the foot of Thirty-first Street, Brooklyn, N. Y. This pier is the largest in or about New York, being 1476 ft. long, 150 ft. wide and 35 ft. high. Being only one story high, it is lighted during the day by means of skylights and whatever light comes in through the open doors. In fall and winter it becomes necessary to turn on the arc lamps as early as 4 o'clock. The present lighting system, which has been in operation about three months, consists of 24 Western Electric Hawthorn flaming-arc lamps, 22 of which are hung inside the building and the other two outside the building, one at either entrance. The lamps are hung in two parallel rows and about 120 ft. apart, the distance between the rows being 50 ft. Electrical energy is taken from a 2200-volt, three-phase, 60-cycle circuit of the Brooklyn Edison Company, brought into the building near the front entrance and stepped down to 115 volts by a transformer. From the transformer a circuit is run the length of the building. The entire lighting system is controlled by five boxes, so wired that three of them control four lamps each and two of them six lamps each, the lamps being connected two in series. The pier is long enough to berth and load three vessels at once, in which case all of the lamps would have to be burning. This seldom happens, however, a dozen lamps being a fair average load. One of the obstacles met with in lighting the pier is the elevated platform shown in the photograph. It was thought at first that this platform, which extends the length of the pier and is used for the convenience of passengers, would throw such a heavy shadow as to make the proposed plan of hanging the lamps impracticable. It has been found, however, that while this platform is over 8 ft. wide and but slightly below the level of the lamps the latter throw such a penetrating light as almost to overcome all shadows.

View of Pier Illuminated with Flaming-Arc Lamps.

The Fabre Steamship Company operates a line of ships between Naples, Marseilles and New York, and carries principally olive oil, olives, wines, raisins, nuts and grapes. The last three are extremely bulky and when unloaded are often piled almost ceiling high. If any other illuminant but flaming arcs was used it would not be possible to hang it high enough to render it impossible for the cargo to cut off a great deal of the light.

INDUCTION WATT-HOUR METER.

The accompanying illustrations show the latest form of watt-hour meters, represented in the type C meters built by the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa. The meter operates on the induction principle, the driving torque of the meter resulting from a shifting magnetic field acting on an aluminum disk. The shifting field is produced by the line current in a low-resistance series coil and current in a highly inductive shunt coil connected across the line. The coils are mounted on a laminated iron magnetic circuit of special design.

The design of the electromagnetic circuit is shown in Fig. 1. It will be noted that the circuit is closed on itself and therefore self-shielding, making the meter independent of stray fields. The arrangement is also such that most of the flux produced by the voltage coil passes through the gaps *FF*, only a leakage component across the gaps *ADC*, while *ABC* combines with the series flux to produce rotation. This feature renders the meter accurate over a wide voltage range by reducing the effect of varying permeability of the iron at varying voltage and also prevents shunt-field damping at high voltage, a serious defect in some types of meters. The light-load adjustment loops pass through the gaps *FF* and produce sufficient unbalance between the two limbs of the voltage flux to cause a friction-compensating torque. Owing to this position of the no-load adjustment loops, however, this adjustment is entirely independent of current.

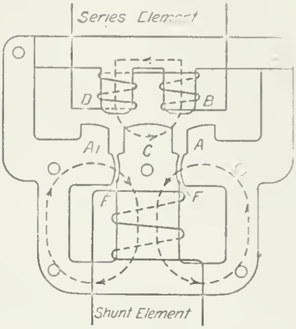


Fig. 1—Electro-Magnetic Circuit of Induction Watt-Hour Meter.

A feature of the meter is the micrometer light-load adjustment. The position of the micrometer screws at the bottom of the meter element, as shown in Fig. 2, makes them very accessible. The micrometer feature makes possible very accurate adjustments. It is claimed that the combination of freedom from current effect, possibility of micrometer adjustment and accessibility make an ideal light-load device, free from creeping and having maximum accuracy.

The positive full-load adjustment is another notable feature. The two retarding magnets are mounted on a heavy brass U-strap, the ends of which slide in machined ways in the mounting frame. This arrangement makes it impossible to twist the magnets out of alignment in tightening the clamping screws. Two clamping screws at each end of the U render the adjustment permanent in spite of shocks and jars. For mounting a highly polished and specially hardened steel ball working between two cup jewels is used. As it is impossible to make the center of gravity of the moving element

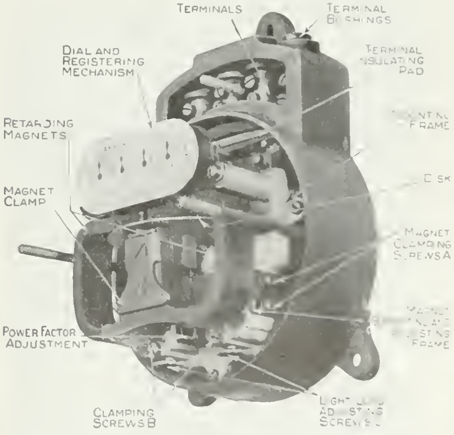


Fig. 2—Induction Watt-Hour Meter.

correspond exactly with the center of the bearing, the shaft has a very slight gyratory motion which gives a rolling action to the ball. This produces considerably less friction than the boring action of the jewel and pivot and, by presenting constantly new bearing surfaces, is stated to assure an extremely long jewel life and permanent light-load accuracy.

Permanence of full-load accuracy is assured by the special aging treatment given to the retarding magnets and by the protection afforded by an iron shield between the permanent magnets and the electromagnet, which prevents any bad effects from the heavy fields produced by overloads. The entire meter element is carried on a cast-iron mounting frame so that it can be removed from the case as a unit without disturbing any adjustment. This allows adequate inspection in case of trouble and makes all parts accessible for repairs.

The full-load torque of the meter is 42 millimetergrams per phase and the weight of the moving element is only 15 grams per phase. This gives the high ratio of torque to weight of 2.8. The lightness of the moving element further insures long life of bearing jewels. The shunt coil loss is from 1.4 watts to 1.8 watts per phase at normal voltage, and the series coils produce a drop of 0.4 volt at full load.

Every meter has a guaranteed accuracy within 2 per cent. at from 2 per cent of full load to 50 per cent overload. This permanence of the meters is stated to be so reliable that these limits can be depended on even after shipment. No adjustment is necessary at installation nor need the case be opened to remove supporting wedges or release the movement. For this reason separately sealed terminal chambers are provided for making connections, retaining the orignal seals on the meter element. This not only preserves the guarantee of accuracy, but prevents dust entering the meter at installation The meter is built in all forms demanded by common needs.

RECTIFIERS CHARGING BATTERIES OF FIRE-ALARM SYSTEM.

The mercury-arc rectifier shown in Fig. 1 has been installed for charging the storage batteries which operate the fire-alarm system of the City of Sandusky, Ohio. The battery consists of four sets of fifteen cells each, chloride accumulator, and, with the present system, fifty fire-alarm boxes can be pulled at once.

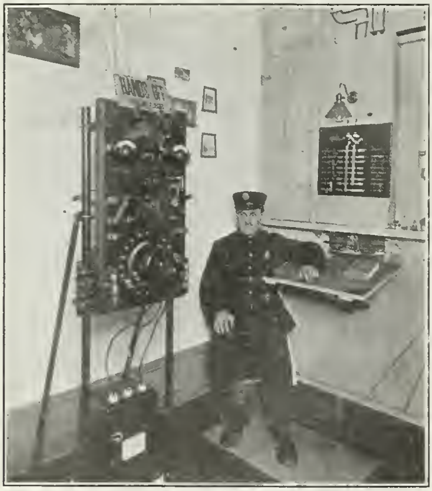


Fig. 1—Mercury-Arc Rectifier Panel.

Previous to the installation of the rectifier a gravity battery consisting of 108 cells operated the fire-alarm system. The new installation effects a saving of $300 per year, as cell renewals when gravity batteries were used were a large item of expense. The first cost of the new equipment, including rectifier, battery and distributing board installed complete, was $589, while the cost of energy for its operation is about $1.40 per month at a 10-cent-per-kw-hour rate.

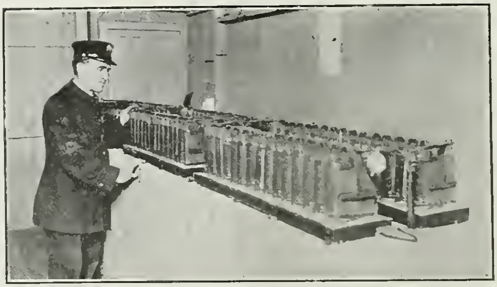


Fig. 2—Storage Battery.

This equipment is operating very satisfactorily and during the six months it has been in operation absolutely no trouble of any kind has been experienced with it. The rectifier panel was furnished by the General Electric Company, Schenectady, N. Y.

LIFE OF ELECTRICAL APPARATUS.

Electrical apparatus is generally considered to be less rugged than some other classes of machinery, but the accompanying illustration and description show through what severe ordeals it may sometimes pass without serious damage. The illustration shows two Bullock motors taken from the ruins of the Los Angeles Times Building. After the explosion and fire which recently destroyed this building these motors were removed from the basement, where they were lying in 5 ft. of water. The presses to which they were attached were completely destroyed and had no value except as scrap iron. The motors, however, were not badly damaged and were practically the only article of value saved from the ruins. In the adjustment of losses made by the Fire Underwriters' Association 99 per cent of the total insurance was allowed, the 1 per cent saving being based almost entirely on the value of the motors. The insulation of these was rendered useless, but the commutators, brush holders, bearings and frames of the machines were in perfect condition.

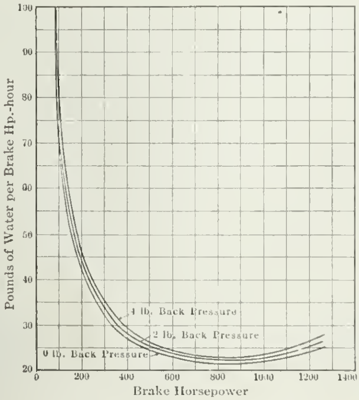
Motors Taken from the Ruins of the Los Angeles Times Building.

The motors attracted considerable attention and excited much comment because of the fact that they were the only pieces of machinery saved from the ruins. The larger motor is a 60-hp, 500-volt, 400-r.p.m. machine, while the smaller is a 10-hp, 450-r.p.m. machine. They are now being rewound in the shops of the manufacturer, the Allis-Chalmers Company, and will be used to drive new presses in the new building which is soon to be erected.

NEW NON-CONDENSING LIGHT AND STEAM-HEAT PLANT.

Nowadays a popular subject for discussion in connection with the design of power stations is the much-debated one of turbines vs. reciprocating engines. An example of the adoption of the latter in preference to the former is afforded by a central lighting and heating plant recently erected in Milwaukee. In this case it was considered that since the exhaust was to be used for heating and therefore the engine must exhaust against a back pressure, and it was impossible to run the engines condensing, the reciprocating type was undoubtedly better from all viewpoints than the turbine.

In this case there is a heating load in winter and atmospheric exhaust in summer because of the impracticability of obtaining sufficient water for condensing purposes. The new station is that of the Wells Power Company, of Milwaukee, Wis. It is situated in the basement of what is known as the Stevenson Building, at the corner of Mason and Milwaukee Streets, and is run in parallel with the old station in the Wells Building, a few blocks distant. These two plants supply energy within an area of about two and one-half miles in the center of the business section of Milwaukee. Electricity for lamps and motors is distributed on a three-wire direct-current system and exhaust steam for heating is sold throughout this territory. In order to prevent the heating load from outgrowing the lighting load it is the policy of the power company to accept no heating contracts without the accompanying lighting contracts.



Steam Consumption per Brake Horse-Power, 24-in. x 40-in. x 36-in. Vertical Cross-Compound Engine.

The main units for the new station, which was designed by and erected under the supervision of Messrs. D. C. & Wm. B. Jackson, engineers, of Chicago and Boston, are two 700-hp Allis-Chalmers cross-compound vertical Corliss non-condensing engines, direct-connected to 250-volt, direct-current Bullock generators of 500-kw rating each. These engines run at a speed of 100 r.p.m. and, with steam at 150-lb. pressure and exhausting against 2-lb. back pressure, will deliver an indicated horse-power on 20 lb. of steam. The accompanying curve, which shows the water rate under various conditions of back pressure, indicates the excellent economy of the units. The close proximity of the three curves is particularly noteworthy, indicating as it does but little change in economy from winter to summer conditions.

These machines are run non-condensing throughout the year, it having been decided that owing to the location of the station in the heart of the city and its elevation, the problem of obtaining condensing water in sufficient quantities offers too great an obstacle to the installation of condensers. Accordingly, as soon as the heating load drops off the engine exhaust is discharged to the atmosphere. Despite the unfavorable conditions the all-the-year-round consumption of these engines is remarkably good, averaging 20 lb. of steam per indicated hp-hour. By running the main units at or near their most economical point and taking up the fluctuations in load on the smaller engines in the old station, it has been possible to keep the general operating efficiency of the company's two plants at a very good figure. At the present time the designers of the new plant, Messrs. Jackson, are supervising the operation of the station

RECENT IMPROVED DESIGNS OF MAGNETOS FOR IGNITION SERVICE.

Several interesting departures in magneto design from the familiar rotating-bobbin type which has so long remained standard were exhibited at the annual convention of the National Gas and Gasoline Engine Trades Association, held at Racine, Wis., Dec. 12-15. In several of these oscillating armatures have replaced the older rotating forms, while in others the armature coils have been made stationary, avoiding moving contacts and insulation problems.

A new oscillating-armature type recently brought out by the Bosch Magneto Company, New York, is shown in the diagrammatic sketch, Fig. 1. The general arrangement is similar to the standard magneto form, but the armature is designed to be rotated through an arc of about 30 deg. by a cam trip on the half-speed shaft, being returned swiftly to its neutral position when released by a pair of heavy helical springs. Besides the momentary high potential developed due to the high speed of the armature's return the armature has a double winding, a primary consisting of a few turns of heavy wire and a secondary of many turns of fine wire. At the instant of the arma-

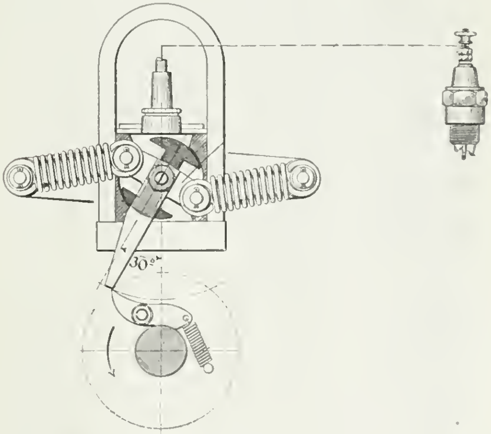


Fig. 1—Bosch Oscillating-Armature Magneto with Spring Return.

ture's return a contact breaker is arranged to open the primary circuit, thus producing a relatively high-potential transformer action in the secondary winding. The secondary terminals are led directly to the spark-plug gap.

An oscillating-bobbin magneto with spring return was also exhibited in the convention hall by the Webster Electric Company, Tiffin, Ohio. In this machine the field structure is modified into the ring type, straight-bar magnets being used. In all of these oscillating-armature magnetos the armature is moved only during the instant of delivering its spark, energy being collected from the half-speed shaft, however, during a large portion of the revolution, preserved in the springs and then suddenly released at a high rate of work when the cam disengages and the armature is snapped back. The quality of the spark produced is thus entirely independent of the speed of the engine.

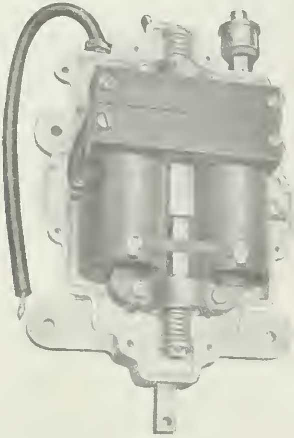


Fig. 2—Witherbee Oscillating Magneto.

An oscillating-type magneto in which the field structure and coils are both stationary, a magnetic short-circuiting keeper being the only moving element, was exhibited by the Witherbee Igniter Company, Springfield, Mass., and is shown in Fig. 2. This magneto comprises a group of bar magnets, whose magnetic path is always closed through the two cores of the armature coils, being permanently yoked by a cross-piece of soft-iron laminations. A movable short-circuiting yoke is also applied between the cores directly below the permanent magnets, thus acting, when closed, to shunt the lines of force away from the longer path formed by the winding cores. The short-circuiting yoke or armature is operated by a driving bar whose motion is imparted by some half-speed part of the engine. The bar is also provided with a latch mechanism allowing the short-circuiting yoke to be lifted and suddenly returned by springs into contact with the cores under the magnets. The height of the lift is adjustable to correspond with the service required of the generator. The action of the momentary withdrawal of the short-circuiting yoke is thus to send a magnetic impulse through the cores of the windings, inducing in the latter a high-tension e.m.f. which is applied directly to the spark plug. The magneto operates, of course, only at the instant its output is required, and for its drive requires only any half-speed reciprocating motion.

A new rotating-armature magneto of the inductor-generator type was exhibited by the Pfanstiehl Electrical Laboratory, North Chicago, Ill., in which the armature winding is stationary, being mounted on a ring inclosing the rotating iron armature at its middle point. The magnetic circuit of the horseshoe permanent magnets terminates in four half-length pole-pieces set at 90-deg. intervals, one pair opposing each half of the rotating bobbin and being so arranged that the flux from pole to pole is first set up in one direction and then, at the next 90-deg. position, in the opposite direction along the axis of the bobbin. This alternating flux traversing the stationary armature coil at the middle point of the bobbin sets up in it an alternating e.m.f.

SOME SPECIAL FEATURES OF THE CHICAGO ELECTRICAL SHOW.

The first week of the sixth annual Chicago Electrical Show closed with a large attendance. On one day of the week, Thursday, it was asserted that 17,000 people visited the Coliseum. The week was also marked by the meetings of several electrical and allied engineering bodies under the Electrical Show roof, through the courtesy of the management. The Chicago Electric Club's regular Wednesday luncheon was held in the Coliseum restaurant Jan. 11, and on Friday the Chicago Section of the Illuminating Engineering Society met in one of the Coliseum lecture halls. The Electrical Show continues until Saturday evening, Jan. 21.

The unique estimating contest, the first prize in which is a $2,500 Woods Victoria electric brougham, continues to hold the attention and interest of every purchaser of a paid admission to the Electrical Show. The electric automobile will be awarded to the estimator coming nearest to the exact total length of the wire on the column at the center of the exhibition floor, while twelve other prizes, ranging from an electric piano player and an electric washing machine down to electric heating devices and electric irons, will be distributed among the contestants next in order of success. The column on which the bare and insulated iron and copper cable and wire is wound measures 25 ft. 3 in. to the eagle surmounting the corona of electric lamps at its cap. It is built up of four tapered spools, the lower one wound with iron wire, the next with copper, then iron and again copper, presenting alternate shining bands of color on the shaft, as the bare wire forms the outer layer in each case.

Fig. 1—Roof Decoration, Open Tent and Sky.

The following helpful data have been prepared and are distributed to later contestants for the prizes: Bottom coil, 4 ft. 11 in., at base; wound with one layer of No. 6 B. & S. gage, rubber-covered copper cable and one layer of No. 8 wire-gage, bare galvanized-iron wire. Second coil, 2 ft. 8.5 in at base; wound with one layer No. 8 rubber-covered cable and one layer of No. 10 bare iron wire. Third coil, one layer

No. 14 duplex rubber-covered copper wire and one layer No. 12 bare wire. Top coil, 2 ft. 3.25 in. diameter; one layer No. 12 rubber-covered copper wire and one layer No. 14 bare copper wire. Each holder of a paid admission receives a ballot entitling him to estimate on the length of wire on the column.

With the spirit of estimating contests abroad, the Chicago Telephone Company also conducted a contest to which every visitor to the show was admitted, the one estimating most correctly the total number of telephones in its Chicago territory Saturday, Jan. 14, to receive one year's telephone service free of charge.

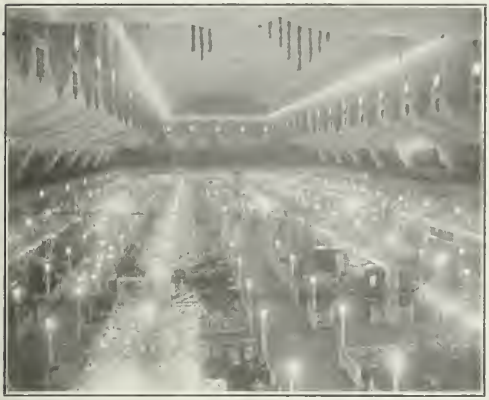


Fig. 2—General View of the Electrical Show.

During the first week the operator of the "wireless kitchen" in the Coliseum Annex introduced several new thrills into his répertoire, one of which was to fry eggs in a frying pan resting on a cake of ice on the marble-topped table. As has been already explained, an alternating-current electromagnet was mounted under the table top, its powerful field being used to induce eddy currents in any closed conductor brought over it. The electromagnet used from 70 amp to 100 amp of 60-cycle, 110-volt current, and delivered several kilowatts to the frying pan, cooking eggs in ninety seconds through 2 in. or 3 in. of ice or other non-magnetic medium intervening. During the performances a 60-watt series tungsten-filament lamp in series with a coil of a number of turns was also brought up to full candle-power through the 264-page Jan. 5 issue of the *Electrical World* laid on top of several 1-in. slabs of slate.

For visitors to the storerooms on "Commonwealth Avenue," the exhibit of the Commonwealth Edison Company, a number of special souvenirs and booklets have been provided. "How to Avoid Using Matches" is the legend on the envelopes containing matchsafes in the form of tungsten lamps, the answer on the box being, of course, "Use Electricity." Handsome paper-clips were also provided for distribution among merchants and store owners who visit the exhibit. Several specially prepared booklets directed at this class relate to the use of electricity for window lighting and ornamental street lighting. One striking folder shows that there are 2190 hours of darkness between dusk and midnight during the year, and that if only one person per minute passes along the street the electrically lighted window will be viewed by 131,400 prospective customers in the course of the year. At the lamp-shop exhibit the handsomely executed booklet describing the downtown Electric Shop is also distributed to visitors.

Novel souvenirs distributed from the central-station exhibit of the Cosmopolitan Electric Company, Chicago, are tiny brass barrels turned out by the motor-driven automatic screw machine operating in this booth. These little barrels, measuring 13/16 in. over all, are fitted with accurately turned screw heads and when handed out each barrel contains a little folder, tightly rolled, referring to the use of central-station energy for motors. "This little barrel," reads the folder, "shows what may be done by automatic motor-driven machinery at a nominal cost. If made by hand it would cost twice its weight in gold." The Cosmopolitan company also exhibits the hoist carriage of a five-ton motor-driven crane, with a 40-in. electric lifting magnet used to handle bars of pig iron, and a motor-driven blower used to hold a rubber ball in the air over a blast nozzle.

Electric baking of bread to be given to charity is one of the interesting and creditable undertakings participated in by the Simplex Electric Heating Company, the Commonwealth Edison Company and H. H. Kohlsaat & Company, a Chicago firm of bakers. Eighty standard 1-lb. loaves are produced at a baking, demonstrating the adaptability of electric heat for baking on this large scale. The large Simplex electric oven consumes 10 kw at full heat, but after being brought to baking temperature is ordinarily operated at half heat. The oven can be heated ready for baking in thirty minutes. Cast-grid resistance elements in the lower part of the oven produce the heat, which is conveyed to the pan shelves through hot-air ducts. Electric foot-warmers are used under the bowl stands to raise the dough for breadmaking. Besides the 500 standard loaves baked each week and given to charity a quantity of rolls are handed out to persons passing the booth. The cost of operating this electric-baking exhibit, including space rental, labor, etc., is shared equally by the three companies named.

Among out-of-town electrical visitors to the Chicago Electrical Show last week were Mr. H. B. Woodill, of the Woodill & Hulse Electric Company, Los Angeles, Cal., a prominent contractor and supply dealer of the Pacific Coast; Mr. G. M. Sanborn, of the Sanborn Electric Company, Indianapolis, former president of the National Electric Contractors' Association; Mr. O. M. Rau, electrical engineer of the Milwaukee Electric Railway & Light Company; Mr. H. E. Rice, manager of the Philadelphia Electrical Exhibition; Mr. Frank B. Rae, of *Selling Electricity*, New York; Mr. J. F. Roche, secretary and treasurer of the Billings (Mont.) Water-Power Company; Mr. L. M. Brown, of the Memphis Electric Company, Memphis, Tenn.; Mr. Robert S. Hale, superintendent of the sales department of the Edison Electric Illuminating Company of Boston, and Mr. W. B. Donkin, contract agent of the Allegheny County Light Company, Pittsburgh, Pa.

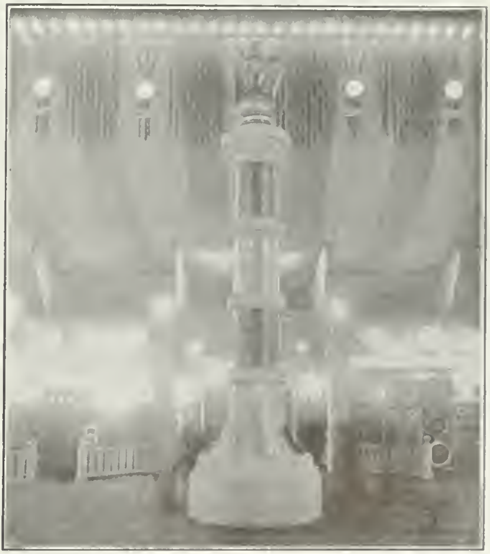


Fig. 3—Column of Copper and Iron-Wire Reels, Estimating Contest, Chicago Electrical Show, 1911.

Industrial and Commercial News

THE WEEK IN TRADE.

BETTER conditions in commercial trade were quite apparent during the past week. The post-holiday quiet has almost disappeared, and retailers are enjoying a fair measure of success in their clearance bargain sales. Wholesalers and jobbers are also reporting a better outlook for spring business. The salesmen sent out shortly after the first of the year are beginning to send in orders, and while these as a rule are smaller than usual, their variety and number seem to indicate that many stocks are depleted. The buying of the country merchants is still marked by the conservatism that has been apparent for the last eight months. In the industrial world there is little change. The textile manufacturers are apparently unwilling to expand, owing to the uncertain conditions of trade and high price of raw cotton. In the iron and steel trade there is a better feeling, but actual developments show little change. It has now practically been determined that there will be no price cutting, and many manufacturers believe that the positive settlement of this point will cause orders to come in which have heretofore been held up in hopes of better terms. It is expected that the railroads will figure in the demand, as it is well known that the majority of them are in need of equipment and rails. During the past week it is stated that orders for 220 locomotives were placed, and the Pennsylvania Railroad made contracts for 1000 steel cars to fill in missing numbers. The same railroad company's order for 150,000 tons of rails has finally been accepted by the mills. The New York Central Railroad's specifications have not yet been accepted, but it is believed that they will soon be adjusted on a satisfactory basis. There were also placed during the week orders for 20,000 tons of rails from various roads, and it is stated that contracts for 53,000 tons are pending. In the structural material line prospects seem to be fairly good, and a big tonnage is expected from the Eastern territory, especially from the neighborhood of Philadelphia. Collections are irregular, but are not so unsatisfactory as to cause any general complaint. From parts of the Northeast and East payments are slow, and from the South and Southwest they are generally very good. Business failures for the week which ended Jan. 12, as reported by *Bradstreet's,* were 353 as against 282 for the previous week, 291 for the same week in 1910, 319 in 1909, 431 in 1908 and 234 in 1907.

THE COPPER MARKET.

COPPER experienced another very depressing week, and all efforts to advance prices were futile. Many trade circulars were distributed during the period to show how much the apparent consumption of copper exceeded the production in 1910, but in spite of these circulars prices steadily declined, both here and abroad. While the figures that are being used to bolster up the market are correct, they do not mean in any way that the actual consumption of copper is equal to the production. The shifting of accounts may deceive the casual observer, but does not deceive the student of the copper market. The actual melting of copper is the consumption and not the alleged deliveries either for domestic purposes or to the foreign account. It is intimated that domestic consumers are now storing copper in their yards, with the agreement that the metal is not to be paid for until required for actual use. Whether the price for such copper is fixed at the time of delivery or at the time of consumption does not appear. According to the latest statistics published, the world's production of copper in 1910 was about 865,000 tons. The distribution of exports for 1910 showed a large increase in shipments to the Continent as compared with England. Germany was the heaviest taker of copper, where 22,000 tons alone went into warehouse to facilitate trading in copper certificates on the German Exchange. The total shipments of American copper to Germany were 80,843 tons, as compared with 64,403 tons in the previous year. There was an increase in the exports to France, and also to Holland and Italy, but there was a decrease in the exports to England of about 27,000 tons Prices on the Metal Exchange during the past week have been weak and, while there has been no change in the quoted figures, it is pretty generally understood that what few sales have been made have been at concessions. Exports for January, up to and including Jan. 16, were 16,444 tons. The daily call on the Metal Exchange Jan. 16 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.00	12.10	....
January	12.00	12.10	12.05
February	12.00	12.10	12.05
March	12.00	12.10	12.05
April	12.00	12.10	12.05

The London market, Jan. 16 was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	55	8	9	55	8	9
Standard copper, futures	56	5	0	56	6	3

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.15c			12.05c		
London, spot	£56	15	0	£55	7	6
London, futures	57	12	6	56	2	6
Best selected	60	5	0	59	10	0

INDUSTRIAL AND COMMERCIAL NOTES.

Georgia Power Company.—Plans for the hydroelectric development in northern Georgia which are being made by the Georgia Power Company are now in definite shape. This company, as was stated in our issues of Nov. 17 and 24, 1910, was formed by the consolidation of the Northern Georgia Electric Company, the Etowah Power Company and some smaller concerns. It has been authorized by the Railroad Commission of Georgia to issue $20,000,000 in stocks and bonds for the purpose of carrying out this work. The construction work will be done by the Northern Construction Company, of Michigan, of which C. Elmer Smith, of York, Pa., is president; A. W. McLimont, vice-president; C. O. Lentz, 71 Broadway, New York, chief engineer, and A. L. Kenyon, construction engineer. Almost all of the available water-power sites in northern Georgia have been acquired by Detroit interests, and these interests are the organizers of the Georgia Power Company. The company has at the present time four available sites: At Etowah, on the Etowah River; at Tallulah Falls, on the Tallulah River; at Neunan and at Buford, on the Chattahoochee River. When all of these sites are developed it is estimated that 155,000 hp will be generated. The first development that will be undertaken, and, in fact, construction work has already been commenced upon it, is at Tallulah Falls. At this point a dam 384 ft. long and 112 ft. high will be constructed. It is expected at this point to develop about 60,000 hp. The present plans for the generating station contemplate six 8000-kw turbines. A 100,000-volt transmission line of heavy copper wire will be constructed to Atlanta, ninety miles distant, where a substation will also be built. Secondary power will be distributed around the outskirts of Atlanta at 2300 volts. There are many large factories and cotton mills which are practically under contract, and the promoters of this enterprise are confident that they will have a market for all of the energy they can generate. The plant at Tallulah Falls is expected to be in operation within eighteen months.

Electrical Interests in Chicago Association of Commerce.—The comprehensive ways and means committee of the influential Chicago Association of Commerce has been selected for the year 1911. The sub-committee representing electrical goods, electric lighting, gas fixtures and wire is made up as follows: Thomas I. Stacey, Electric Appliance Company, chairman; F. A. Ketcham, Western Electric Company; G. M. Beardslee, Beardslee Chandelier Manufacturing Company; James M. Gilchrist, Federal Electric Company, and Charles H. Roth, Roth Brothers & Company.

New Plant at Minneapolis.—R. A. Phillips and Walter Goodenough, engineers, representing Stone & Webster, of Boston, have announced from Minneapolis that a new central station of steel and concrete will be erected at once for the Minneapolis General Electric Company. The cost of this will be about $750,000. C. Y. Ferris, personal representative of Stone & Webster, is in Minneapolis to direct the construction of this new plant

Lehigh Valley Extending Telephone System.—The success of the telephone train-dispatching circuits recently installed on the Lehigh Valley Railroad has led to extensions of this new method of handling train movements. A telephone line has just been cut into service between Packerton and Bernice, Pa., the dispatcher being located at Wilkes-Barre. The telegraph will soon be supplanted also between Wilkes-Barre and Sayre, adding about ninety miles more. The new circuit just placed in operation is known as the eastern end of the Wyoming division. It connects with about twenty-five way stations and is approximately 140 miles long. This train wire is divided into three sections, each radiating from Wilkes-Barre. The signaling equipment is so arranged that when a dispatcher calls any station signaling impulses are sent out over that particular section only. One section, which is known as the Mountain Cut-Off, has a special arrangement whereby in the event of any trouble on the train wire it is possible to connect it into the main line, thus fitting the circuit on either side of the trouble and enabling the dispatcher still to get every station. The complete equipment of telephone and selector apparatus has been furnished by the Western Electric Company. The Lehigh Valley plans eventually to use the telephone exclusively for the important work of dispatching trains.

Garwood Electric Company.—The power station which the Garwood Electric Company has furnished for the new Whitehall Building at 17 Battery Place, New York, is now all installed, a portion of it is in operation and the balance will be in operation as soon as the steam engines are ready for service. This installation, which is one of the largest isolated plants which have recently been built in New York, consists of three 300-kw, 225-volt, 100 r.p.m. generators and one 150-kw, 225-volt, 110 r.p.m. generator, direct-connected to Corliss engines built by the Providence Engineering Company. There are also one 5-kw and two 15-kw balancer sets, to be used in connection with the three-wire system. These generators are of the Garwood Electric Company's new type. The new Whitehall Building, it is said, will be the largest office building in the world. It will operate thirty-four elevators and approximately 5000 electric lights of 16-cp efficiency. The installation for which the Garwood company has furnished the generators will provide all of the energy used by the building, including motor, lighting and ventilator service. A few tenants have already entered the building, but it will not be entirely ready for service before March 1.

Chicago Advertising Association.—"Round Tablers" is the name of a newly organized group of advertising men who meet every Friday noon in the rooms of the Chicago Advertising Association for the purpose of promoting a systematic study of trade publicity. Addresses are delivered by invited speakers, after which a wide-open discussion follows. During the month of December the following subjects were taken up: "Large Space in Advertising," R. R. Shuman; "Style in Advertising," A. B. Jensen; "Cultivating the Dealer," S. DeWitt Clough; "Planning a Campaign," Frederick A. Farrar. Stenographic reports of the meetings are taken and a transcript is furnished each member of the organization. The officers for the ensuing three months are: Chairman, A. N. Fox; vice-chairman, Frederick A. Farrar; secretary, G. G. Place.

Rockingham Power Company.—It is probable that construction work will be commenced upon the plant of the Rockingham Power Company, at Blewitts Falls, on the Yadkin River, N. C., some time in February. This property was bid in by the reorganization committee at the foreclosure sale Nov. 24, 1910. It is now held in the name of E. Clifford Potter, treasurer of the Colonial Securities Company, of Boston. The new owners are formulating a financial plan for the organization of a new company, and are also having expert examinations made of the property by engineers before entirely determining upon the amount of work that will be done. A considerable amount of construction work has already been put into this plant, but it is not yet entirely determined as to what will be necessary to complete it. Under the original plans it was expected to develop about 30,000 hp.

Western Power & Irrigation Company.—The Western Power & Irrigation Company, of Oklahoma City, which was recently organized with a capital of $500,000, proposes to begin work at once upon a hydroelectric plant on the Washita River. At this development a concrete dam will be built, and it is expected that 650 hp will be generated. The energy will be transmitted to Mountain View, Okla., for the municipal plant and also supplied to farmers along the way for irrigation purposes. William L. Church, president of the Ambursen Hydraulic Construction Company, of Boston, has been retained as consulting engineer. The company also owns several other valuable water sites.

Chicago Telephone Company.—In its contest against the proposed reduction in rates for telephone service the Chicago Telephone Company has engaged former Assistant Corporation Counsel Hoyne. Mr. Hoyne appeared for the City of Chicago in framing the present telephone ordinance. General Engineer Wray, of the Chicago Telephone Company, has informed the Council committee that its experts' report is mixed up on valuations and errs in basing the cost of construction on the last ten years' work. The increase in labor, material etc., has recently been so great that it is claimed that the cost of construction work is considerably underestimated.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Cedar Rapids, Ia.; Lexington, Ky.; Koppel, Pa.; Mountain View, Okla.; Portland, Ore; Minneapolis, Minn.; Chicago, Ill.; Mountain Home, Idaho; Etna, Pa.; Greensboro, N. C.; Hamburg, Ark.; Crystal City, Tex.; Austin, Tex.; Ukiah, Cal.; El Centro, Cal.; Medford, Ore.; Knightsville, Ind.; Marble Falls, Tex.; Saybrook, Ill.; Atlantic, Ia.; Douglas, Ariz., and Clifton, Ariz.

Foreign Trade Publicity.—The Bureau of Manufactures of the Department of Commerce and Labor at Washington is establishing a file of the names of American manufacturers and traders, for use in distributing the valuable information which reaches it from time to time in regard to foreign trade. Those who desire to avail themselves of the facilities thus offered for extending their trade abroad should send to the bureau their names and advise it as to the class of business in which they are engaged.

Aluminum Company of America.—The Aluminum Company of America (controlled by the Mellon family, of Pittsburgh) has purchased 3500 acres of land, including Bernhart's Island, in the St. Lawrence River below Prescott, Ont., and proposes installing a plant capable of developing 300,000 hp. In the event of permission being given by the Canadian government, the company is reported to be prepared to expend $40,000,000 on the power development.

Financial.

THE WEEK IN WALL STREET.

THERE was an improvement in the stock market in price during the past week, and there was some little increase in the amount of trading. This betterment was not particularly encouraging, however, as there was very little evidence that any others than professionals were taking part in the market, and outside orders seemed to be entirely lacking. The many narrow swings that characterized the market but emphasized the fact heretofore referred to that there is very

NEW YORK

	Jan. 9.	Jan. 16.	Shares Sold.		Jan. 9.	Jan. 16.	Shares Sold.
All. Ch.	8¼*	8	200	Int. Met., pfd	54½	53⅞	3,506
All. Ch., pfd.	28⅛*	28*	300	Mackay Cos.	92⅞*	92⅞*	——
Amal. Cop.	64¼	63½	55,510	Mackay C., pf.	75¾	75⅞	506
Am. D. T.	20½*	20½*	——	Man. Elev.	140	140*	325
Am. Loco.	40	40	3,725	Met. St. Ry.	15*	15*	——
Am. Loco., pf.	108½*	110	200	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & C.	83¾*	85	100	Steel, com.	74⅞	76	524,475
Am. T. & T.	141½	142¼	13,948	Steel, pfd.	118⅜	118¾*	7,385
B. R. T.	76⅜	77⅛	26,310	W. U. T.	74¾	74¼	4,000
Gen. Elec.	151½	151*	3,550	West'h, com.	66½*	67*	1,350
Int. Met.	19¾	19⅞	4,525	West'h. pfd.	123*	116*	120

PHILADELPHIA.

	Jan. 9.	Jan. 16.		Jan. 9.	Jan. 16
Am. Rys.	42	43½	Phila. Elec.	16½	16⅜
Elec. Co. of A.	11⅞	12½*	Phila. R. T.	19¾	19⅞
Elec. St. B'ty.	50¼	50½	Phila. Trac.	84½	85
E. S. B'ty., pfd.	30*	30*	Union Trac.	45¼	46¼

CHICAGO.

	Jan. 9.	Jan. 16.		Jan. 9.	Jan. 16
Chi. City Ry.	170*	185*	Chi. Tel. Co.	120	[illegible]
Chi. Rs., Ser. 1	92½*	92½*	Met. El. Co.	22*	22*
Chi. Rs., Ser. 2	25	23½*	Met. El., pfd.	69*	68
Com. Edison	115	113½*	Nat'l Car.	119*	117*
Chi. Subways	4½	4¼*	Nat'l Car., pfd.	117½*	117½*

BOSTON.

	Jan. 9.	Jan. 16.		Jan. 9.	Jan. 16
Am. T. & T.	141⅞	142¼	Mex. Tel.	6	6*
Cum. Tel.	149¾	147*	Mex. Tel., pfd.	6*	6*
Edison E., Ill.	290	290	N. E. Tel.	138	137½
Gen. Elec.	152¼	151	W. T. & T.	18*	17*
Mass. E. Ry.	18*	18*	W. T. & T., pfd.	91½*	91½*
Mass. E. Ry., pfd.	84¼	84½			

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*Last price quoted.

Shares sold for five days, Jan. 9 to Jan. 14.

little stock for sale. It might not be entirely incorrect to say that the market is oversold, although if such an expression should create the impression that there is any considerable short interest in the market it would be erroneous. There is no doubt some short interest in stocks, much of which has been sold at lower prices than are at present quoted. In order to realize upon such deals, it seems to be the policy of a great number of professional traders to put an extreme bearish construction upon every piece of news that comes into the financial world. The fact that the City of New York has been compelled to fix its rate of interest at 4½ per cent on its new loan and the fact that the directors of the Pennsylvania Railroad were contemplating an issue of $100,000,000 of additional stock were emphasized and enlarged during the past week for depressing effects. Prices, however, did not recede and at the close of the week were several points higher on most of the active issues than at the opening. The market is in this interesting condition that if any outside activity can be stimulated there will be an upward movement. It is not likely that there will be any sharp decline, for the reason stated above, that the long accounts now being carried are extremely light. The banking condition is entirely satisfactory. This is more thoroughly emphasized by the fact that with the closing of several important institutions, and the necessity for helping several others, there was no flurry in the money market. It is now a common expression in Wall Street that the depositors of no regularly organized New York bank will ever be allowed to lose money as long as present banking interests dominate and are able to furnish protection. Quotations for money Jan. 16 were: Call, 2¾ @ 3 per cent; 90 days, 3½ @ 3¾ per cent. The quotations in the table are those of the close Jan. 16.

FINANCIAL NOTES.

Electric Combine Near Pittsburgh.—Negotiations are now being carried on with a view to the consolidation of a dozen or fifteen electric companies in the Beaver and Upper Ohio River Valleys, near Pittsburgh. It is stated that the interests at work upon this combination have already secured the Beaver County Light Company, New Brighton, Pa. This concern is building a dam at Beaver Dam which will generate a large amount of energy. The combination, it is stated, was formed by W. Caryl Ely and Van Horn Ely, of Buffalo, who have partly financed the deal with the Girard Trust Company, of Philadelphia; E. T. Stotesbury, of Drexel & Company, and J. G. White & Company. The statement that these parties were acquiring the properties in the interests of the General Electric Company was semi-officially denied at the offices of the latter company. It was officially stated that negotiations were pending, but that it would probably be two weeks before any definite announcement could be made.

Kentucky Electric Company.—The stockholders of the Kentucky Electric Company, of Louisville, have voted to reincorporate under the laws of Delaware and to increase the capital stock from $600,000 to $3,000,000. The company has also completed plans for the construction of a large power house on the Ohio River water front between Second and Third Streets. Several months ago a movement was on foot for the consolidation of this company with the Louisville Lighting Company, having a capital of $3,000,000, and the George G. Fetter Lighting & Heating Company, with a capital of $200,000. After long negotiations with the city authorities this plan was abandoned because no new franchise could be secured which was satisfactory to the stockholders of the three companies. The present franchise of the Louisville Lighting Company is perpetual and practically all of the stock of that company belongs to the Louisville Gas Company.

Hudson River Power Company.—The Boston bondholders' committee of the Hudson River Power Company has now on deposit $8,374,000 of bonds. The committee, together with several New York Trust Companies, is objecting to the allowances sought by the receivers and to the counsel fees. This matter will probably have to be adjudicated in court. The Windsor Trust Company, of New York, has sent out a circular letter to the bond depositors, stating that over 75 per cent of the bonds have been deposited and will be turned over to the Boston committee. After these bonds are turned over the other bondholders' committees will go out of business.

Chattanooga Railway & Light Company.—The gross and net earnings of the Chattanooga Railway & Light Company for 1910 were substantially higher than those for the previous year. The last official report which has been made public was for the twelve months ended Sept. 30, which showed that the gross earnings were $850,619, as compared with $763,478 for the previous year, and the net earnings for the same period increased $77,585. The surplus at the end of that twelve months amounted to $125,516. This company owns and operates the entire street railway and electric lighting business of Chattanooga and vicinity, and serves a population of about 75,000. Recently extensive building operations have been carried on by the company, and transmission lines are being extended to outlying districts.

Rockford Electric Company.—First and refunding-mortgage 5 per cent gold bonds of the Rockford (Ill.) Electric Company to the amount of $550,00 are advertised for sale in the daily newspapers. The advertisement states that the Rockford company controls the entire commercial electric light, electric power and steam-heating business in the City of Rockford under long-time franchises. The city has a population of about 45,000 and is well known for its diversified manufacturing interests. The amount of these bonds outstanding is $1,232,000, and they are a first mortgage on the entire property of the company, subject only to $28,000 in Rockford Edison 5's on the electric properties. The bonds are offered for sale at 96½.

Stone & Webster Engineering Corporation.—A report has been filed with the Secretary of the State of Massachusetts by the Stone & Webster Engineering Corporation, of Boston, showing its financial condition on Nov. 30, 1910. This report shows real estate, $480,402, and other assets sufficient to bring up the total to $1,231,553. The company has $500,000 of liabilities and its balance sheet shows profit and loss of $82,640. During the year the Stone & Webster properties have shown remarkable improvement in earnings. Without exception, all of the properties operated by this firm ended the year 1910 with records of largely advanced earnings and very much better physical condition.

American Telephone Bonds.—There has been considerable activity in the collateral trust bonds of the American Telephone & Telegraph Company in the Boston market during the past few weeks. It is said that between $2,500,000 and $3,000,000 of these bonds have changed hands since the first of the year in that market. It is understood that the Massachusetts savings banks have been the principal buyers. There is some mystery as to where this amount of bonds came from, but the general impression is that the greater part were sent from Europe for sale in Boston. The important feature in these transactions is the fact that savings banks are buying these bonds at a figure which nets an interest of about 4¾ per cent.

Winnipeg Electric Railway Company.—It has been announced that the Winnipeg Electric Railway Company will begin work at once upon a subsidiary steam power house in Winnipeg which will cost $500,000. Recently a decision prohibited the company from furnishing power to the City of Winnipeg from its hydroelectric station at Lac du Bonnet, and an appeal against this decision has been taken to the Privy Council. The determination to construct the steam power station was made in order to put the company in a position to continue active operations no matter what the decision as to the hydroelectric station may be.

Wisconsin Telephone Company.—The Wiscosin Telephone Company for the year 1910 shows a gain of 4400 subscribers, the largest increase in the company's business since its organization. Approximately 1000 of these subscribers were obtained within the last two months of the year, when a campaign for new business was actively inaugurated. The company expects to continue this sort of missionary work throughout 1911.

Suburban Electric Light Company, of California.—The Pacific Gas & Electric Company, of California, has succeeded in acquiring control of the Suburban Electric Light Company, of San Leandro, Cal. This company has supplied energy to quite a number of small towns in its locality. It has outstanding $503,350 capital stock and $250,000 bonds.

Westinghouse Machine Company.—It has been announced that practically all of the holders of the extension notes of the Westinghouse Machine Company have already assented to the plan recently indorsed by the creditors' committee for refinancing. This plan was described in our issue of Dec. 8, 1910

Electric Boat Company.—The regular dividends of the Electric Boat Company were not declared for the last quarter of 1910. This is the second consecutive quarter at which the preferred dividend has been passed. The regular annual distribution on the common stock from Jan. 1, 1907, to Jan. 1, 1909, was 2 per cent. The quarterly 2 per cent dividend on the preferred stock has been paid from 1903 up to July 1, 1910. The officials of the company say that the conditions of the company's affairs have not materially changed since October, when President Isaac L. Rice said: "The company has a large amount of business on hand and the outlook is excellent; and this has required the use at present of all the capital and earnings. It was the consensus of opinion among the directors that under the circumstances it would be wise to suspend dividends for the present." The failure to declare the quarterly preferred dividend and annual common dividend has provided the company with approximately $205,000 working capital.

Consolidated Gas Company.—It seems to be practically settled, at least it is the unanimous opinion in financial districts, that the Consolidated Gas Company will purchase the Brooklyn Union Gas Company. In 1910 the Consolidated earned about 8 per cent on $100,000,000 capital stock and the Brooklyn Union 11.2 per cent on $18,000,000 capital stock. Both companies own wholly or in part various other companies. The Consolidated owns or controls practically all of the gas and electric light companies in Manhattan and the Bronx, together with the Astoria Light, Heat & Power Company. The Brooklyn Union owns only gas companies, but owns them outright. During the past year the Consolidated has acquired the last few shares of the New York Edison Company's stock. The surplus earnings in 1910 applicable to dividends amount to about $8,100,000 for the Consolidated and $2,100,000 for the Brooklyn Union.

Receivers for Telephone Companies.—Charles E. Wilson, general manager of the Keystone Telephone Company, of Philadelphia, has been appointed receiver for the Continental Telephone & Telegraph Company, against which bankruptcy proceedings were brought last summer. This company was incorporated in New Jersey in 1909 with a nominal capital of $50,000,000, and shortly after its incorporation authorized a bond issue of $25,000,000. The company in acquiring independent telephone properties incurred obligations amounting to more than $2,000,000 In Pittsburgh William Flynn and Joshua G. Splane have been appointed receivers for the Pittsburgh & Allegheny Telephone Company, which was one of the largest independent concerns in that section. The company has issued $2,000,000 of preferred and a like amount of common stock, together with bonds amounting to $1,400,000.

Mahoning & Shenango Railway & Light Company.—The earnings of the Mahoning & Shenango Railway & Light Company, of New Castle, Pa., and Youngstown, Ohio, showed a large gain in 1910 over those of the previous year. Definite figures for the calendar year are not as yet obtainable, but the increase in surplus for the twelve months which ended Sept. 30 was $117,604. The Mahoning & Shenango Railway & Light Company's system comprises 145 miles of electric railway in the valleys of the Mahoning and Shenango Rivers and also includes the electric lighting systems of Youngstown, New Castle and Sharon, as well as various smaller places. The population of the territory served is rapidly increasing and there is a great amount of natural resources as yet undeveloped. The franchises of the company are either perpetual or will extend well beyond maturity of all the bonds, which is Jan. 1, 1916 The limited franchises of the company have recently been renewed for twenty-five years.

Pacific Telephone & Telegraph Company.—Bond & Goodwin, of Boston, have bought $5,000,000 of two-year 5 per cent coupon notes of the Pacific Telephone & Telegraph Company This company is one of the largest subsidiaries of the American Telephone & Telegraph Company and operates over a large territory on the Pacific Coast. It is said that the Boston firm has resold this issue at private sale, largely to interests in New York, New England and the West The notes were issued to provide for new construction.

Boston & Worcester Electric Company.—It is reported that James H. Parks, representing a syndicate of American and foreign investors, has secured an option sufficient to control the Boston & Worcester Electric Company. This option, it is understood, is to run a sufficient period to permit an expert engineer to make a definite appraisal of the value of the property.

DIVIDENDS.

Brooklyn City Railroad Company, quarterly, 2 per cent, payable Jan. 16.

Commonwealth Gas & Electric Companies, quarterly, 1¼ per cent, payable Jan. 16.

Connecticut Railway & Lighting Company, quarterly, preferred, 1½ per cent, common, 1½ per cent, both payable Feb. 11.

Consolidated Traction Company of New Jersey, semi-annual, 2 per cent, payable Jan. 15.

Electric Bond & Share Company, preferred, quarterly, 1¼ per cent, payable Feb. 1, common, quarterly, 2 per cent, payable Jan. 16.

Electric Company of America, semi-annual, 3½ per cent, payable Feb. 3.

Guanajuato Power & Electric Company, preferred, 1½ per cent, payable Feb. 1.

Havana Electric Railway Company, quarterly, preferred, 1½ per cent, common, 1½ per cent, both payable Feb. 11.

Mexican Lighting & Power Company, Ltd., 1 per cent, payable Jan. 20.

Mexican Tramways Company, quarterly, 1¾ per cent, payable Feb. 1.

Pacific Coast Power Company, semi-annual, 2 per cent on common, ½ per cent extra, 3 per cent preferred, all payable Jan. 16.

Public Service Investment Company, Boston, preferred, quarterly, 1½ per cent, common, semi-annual, 1½ per cent, both payable Feb. 1.

Railways Company General, quarterly, 1 per cent, payable Feb. 1.

Rio de Janeiro Tramways, Light & Power Company quarterly, 1¼ per cent, payable Feb. 1.

United Traction Company, of Pittsburgh, semi-annual, preferred, 2½ per cent, payable Jan. 20.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
Associated Bell Companies—					
11 months ended Nov. 30, 1910	$150,244,013	$104,247,770	[illegible]	[illegible]	[illegible]
11 months ended Nov. 30, 1909	135,151,170	91,229,184	43,921,986	[illegible]	[illegible]
Cape Breton Electric Company, Ltd.—					
November, 1910	29,403	14,639	14,764	6,066	8,698
November, 1909	26,535	13,776	12,759	6,175	6,584
Edison Electric Illuminating Company of Boston—					
December, 1910	542,463	204,928	337,535		
December, 1909	505,249	202,436	302,813		
Electric Light & Power Company, of Abington and Rockland—					
November, 1910	9,539	[illegible]	[illegible]	53	2,496
November, 1909	9,143	[illegible]	[illegible]	[illegible]	[illegible]
Houghton County Electric Light Company—					
November, 1910	20,018	[illegible]	[illegible]	[illegible]	[illegible]
November, 1909	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Keystone Telephone Company—					
December, 1910	96,851	47,439	49,412	[illegible]	24,803
December, 1909	94,790	[illegible]	[illegible]	[illegible]	[illegible]
Kings County Electric Light & Power Company					
December, 1910	[illegible]	[illegible]	[illegible]		[illegible]
December, 1909	[illegible]	[illegible]	[illegible]		88,041
Long Island Railroad Company					
November, 1910	[illegible]	[illegible]	[illegible]	[illegible]	93,452
November, 1909	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Paducah (Ky.) Traction & Light Company					
November, 1910	21,523	11,650	9,873	7,840	2,033
November, 1909	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
United Railways of St. Louis—					
November, 1910	[illegible]	[illegible]	[illegible]	232,151	[illegible]
November, 1909	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

General News

Construction News.

CLIFTON, ARIZ.—Plans are being considered by the Twin Peaks Mining Company for the construction of a power plant at York Station, from which electricity will be transmitted to its works to operate the machinery in its mines and reduction plant.

DOUGLAS, ARIZ.—It is reported that preparations are being made by the Copper Queen Mining Company, of Douglas, for the installation of two turbo-generators to supply electricity for operating machinery in its mines.

PRESCOTT, ARIZ.—The Climax Mining Company is reported to be contemplating extensive improvements to its property, including the erection of a hydroelectric power plant and a large ore-reduction plant, at Prescott, Ariz., where a ten-stamp crushing mill was recently erected.

EUREKA SPRINGS, ARK.—Owing to its plant being operated at a loss, the Eureka Springs Electric Company announce that the day service will be discontinued after Feb. 1, 1911.

FORDYCE, ARK.—The plant and holdings of the Fordyce Light & Water Company have been purchased by J. S. Morgan, owner of the Eldorado water and light plants, of Eldorado, Ark.

HAMBURG, ARK.—It is reported that arrangements are being made by the Missouri & Arkansas Lumber Company for rebuilding its plant, which was destroyed by fire some time ago. The company will be in the market for power and operating machinery.

ALAMEDA, CAL.—The City Council is considering the question of building a new power station and will probably call an election to vote on the proposition to issue bonds for same. The cost of the building is estimated at $50,000.

BAKERSFIELD, CAL.—Preparations are being made by the San Joaquin Light & Power Company to suppply electricity to the Midway oil fields. A large part of the material for the construction work has been purchased.

EL CENTRO, CAL.—Plans are being prepared by W. F. Holt and associates for the construction of a large steam-driven electric generating plant to cost about $250,000. The proposed plant will supply electricity for the entire Imperial Valley.

EUREKA, CAL.—The plant and holdings of the Humboldt Gas & Electric Company, of Eureka, Cal., have been purchased by M. H. Byllesby & Co., of Chicago, Ill. The property will be turned over to and will be controlled by the Western States Gas & Electric Company, a company recently organized with a capital stock of $15,000,000, which operates a number of plants on the Pacific Coast.

JACKSON, CAL.—John L. Henry is reported to have been granted a fifty-year franchise by the Board of Supervisors to erect and operate an electric system. It is understood that Mr. Henry proposes to supply electricity in the town of Plymouth.

PLACERVILLE, CAL.—Notice of appropriation of 5000 in. of water in Silver Lake has been filed with the County Recorder by Thomas G. Patton. The water will be diverted by means of a dam, ditch and flume and will be utilized for domestic, mining, irrigation and for generating electricity.

SAN DIEGO, CAL.—The San Diego Electric Railway Company has awarded the contract for the construction of an intake for its power plant at San Diego to Charles W. Carbaley, of Los Angeles, Cal. The work will consist of two 5-ft. conduits leading from the bay at the foot of E Street to the power house, which will be located at Arctic Street and E Street.

UKIAH, CAL.—Preparations are being made by the Snow Mountain Water & Power Company for extensive improvements and extensions to its system. W. S. Graham has been appointed general superintendent of the company, with headquarters at Ukiah.

VISALIA, CAL.—The Visalia Electric Railroad Company is contemplating an extension of its railway during this year which will connect Lemon Cove and Three Rivers. About eleven miles of track will be built.

WATSONVILLE, CAL.—It is reported that investigations are being made with a view of the rehabilitation of the Watsonville Electric Transportation Company, which formerly operated an electric railway between Watsonville and Port Watsonville, with a view of extending the railway farther back into the valley.

CARBONDALE, COL.—The Board of Trustees has granted the Aspen Light Company a franchise to supply electricity for lamps and motors in Carbondale for a period of twenty years. Under the terms of the franchise the company is to supply electricity at the rate of 20 cents per kw-hour, with a minimum charge of $2. A twenty-four-hour service will be established. The company, it is said, is to be capitalized at $25,000.

FOWLER, COL.—The City Council has granted the Pueblo & Suburban Traction & Lighting Company, of Pueblo, Col., a ten-year franchise to supply electricity for lamps and motors in Fowler. It is expected that transmission lines will be extended to Fowler at once.

MONTROSE, COL.—The Uncompahgre & Gunnison Valley Company is reported to have awarded the contract for the engineering work in connection with its proposed electric railway, twenty-nine miles in length, to connect Montrose and Delta, to M. L. Paret, of Kansas City, Mo. J. M. Pepper, of Montrose, Col., is interested in the project.

GEORGETOWN, CONN.—The installation of a distributing system for street-lighting service in Georgetown is nearly completed. Electricity for operating the system will be supplied by the Connecticut Company. Incandescent street lamps are to be used.

GREENWICH, CONN.—The Housatonic Electric Lighting Company is reported to have appropriated $100,000 for the construction of a gas-producing and distributing plant in Greenwich, Conn.

PUTNAM, CONN.—The Putnam Light & Power Company will petition the State Legislature for permission to extend its system in the Town of Woodstock for the purpose of supplying electricity for lamps and motors.

ROCKVILLE, CONN.—The Rockville-Willimantic Lighting Company has adopted a new schedule of rates for electricity for lamps, to take effect from Jan. 1, 1911. The rate in Rockville, Stafford and Willimantic will be 16 cents per kw-hour for the first 100 kw-hours and 13 cents per kw-hour for all over 100 kw-hours, with a discount of 1 cent per kw-hour for prompt payment. The minimum charge will be $1 per month, as at present.

WINDSOR LOCKS, CONN.—The stockholders of the Connecticut River Company have voted to accept the amendment to its charter obtained from the Legislature giving the company the right to construct additional dams and to erect and maintain a power station.

WASHINGTON, D. C.—A commission agent in an European country informs an American consul that he desires to correspond with manufacturers of electrical wire and of iron gas fittings and connections. For further information address Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C., referring to file No. 6104.

WASHINGTON, D. C.—A report from an American consul in Latin America gives particulars of the organization of a new company which proposes to construct a large hydroelectric plant and which will soon be in the market for machinery and equipment for same. For further information address the Bureau of Manufactures, Department of Commerce and Labor, Washington, D. C., referring to file No. 6106.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Jan. 31, for material to be delivered at navy yards as follows: Brooklyn, N. Y.—Schedule 3261, 195 non-watertight bells and buzzers, 400 dry cells, 150 electrose insulators, 15 electric soldering irons and 400 lb. rubber insulating tape; schedule 3268, one induction motor. Boston, Mass.—Schedule 3261, 22 soldering irons, 300 lb. rubber insulating tape and miscellaneous electrical supplies. Annapolis, Md.—Schedule 3259, three induction motors.

JACKSONVILLE, FLA.—Arrangements are being made by the Board of Trustees to take over the commercial lighting and power business of the Jacksonville Electric Company as provided in the recent franchise granted the company to use the streets of the city for a street car system. At a recent inventory the valuation of the transformers, poles, wires, etc., used for its commercial lighting and power service was estimated at $22,892.

AUGUSTA, GA.—The Augusta-Aiken Railway & Electric Company has placed orders with the General Electric Company for one 2750-kw turbo-generator with station equipment, one 500-kw motor generator set with step-down transformers, and one 300-kw motor generator set with step-down transformers.

EAST POINT, GA.—The Atlanta Utility Works, of East Point, Ga., is reported to be in the market for one 5-hp, three 10-hp and one 20-hp, 220-volt, 60-cycle induction motors. For further information address W. W. Rushton, secretary and treasurer.

LAGRANGE, GA.—The Gainesboro Telephone & Telegraph Company is reported to be contemplating increasing its capital stock by $280,000 J. C. Bass is president.

CLARKS FORK, IDAHO.—The MacGillis & Gibbs Lumber Company, of Milwaukee, Wis., and Spokane, Wash., has established an office in Clarks Fork, where, it is said, a large timber-cutting plant will be erected. The plant will be equipped for electrical operation.

MOUNTAIN HOME, IDAHO.—The Thousand Springs Power Company is reported to have decided to install a power plant and erect a transmission line five miles in length along the Snake River to a point below Brown's flats, where a pumping plant will be installed. The proposed plans call for an expenditure of about $300,000 and the irrigation of several thousand acres of land in Southern Idaho. Dr. R. G. Roberts, of Mountain Home, is the Idaho representative of the company.

BELVIDERE, ILL.—The Common Council has granted the Public Service Operating Company a new franchise in Belvidere The company has a ten-year contract for street lighting in this city. A. J. Stahl is president of the company.

BLOOMINGTON, ILL.—The Bloomington & Normal Railway & Light Company has filed an amendment to its charter increasing its capital stock from $600,000 to $900,000.

CHAMPAIGN, ILL.—It is reported that the Illinois Traction System is negotiating for the purchase of the Wabash, Chester & Western Railroad, which extends from Mount Vernon to Chester, a distance of fifty miles. Surveys have been completed by the McKinley interests nearly the entire distance between Cairo and East St. Louis. The railway is in operation between Cairo and Mounds, and it is understood that the promoters intend to resume construction work as soon as the weather will permit.

CHICAGO, ILL.—It is reported that plans are being considered by the Corn Products Refining Company, 26 Broadway, New York, N. Y., for large extensions to its Argo works, in the suburbs of Chicago, Ill., during the coming year. The company will purchase a large amount of power equipment and special machinery.

COLLINSVILLE, ILL.—The Collinsville Electric Light Company is reported to have awarded the contract for the construction of its new power house to Thomas Sauer. It is expected that the City of Collinsville will install additional arc lamps to the street lighting system when improvements to the plant are completed.

DECATUR, ILL.—The Wabash Railroad Company is reported to have made arrangements to secure electricity for operating its shops in Decatur from the Decatur Railway & Light Company, a subsidiary of the Illinois Traction Company, the contract calling for 1400 hp. It is understood that the electrical equipment and engines now in use at the local shops will be transferred to the railroad company's plant at Moberly, Mo.

MOMENCE, ILL.—The W. B. Harpole & Son Electric Light Company has purchased a 200-kw, 2300-volt, three-phase, 60-cycle Westinghouse alternator, a 7½-kw exciter and complete switchboard equipment for recent extensions found necessary to its lighting system.

PORT BYRON, ILL.—Extensive improvements are contemplated by the Crescent Telephone Company to its Port Byron system, which will include the erection of new poles and wires and remodeling the exchange building.

SAYBROOK, ILL.—R. C. Cooper, owner of the electric-light plant, recently burned, is reported to be contemplating the installation of a new plant to supply electricity in Saybrook, Arrowsmith and Gibson City.

BLUFFTON, IND.—The City Council has placed contracts for additional equipment for the municipal electric-light plant, involving an expenditure of about $10,000. The equipment will consist of a 450-hp engine manufactured by the Harrisburg Foundry & Machine Company, of Harrisburg, Pa.; generator and other electrical equipment to be supplied by the Fort Wayne Electric Works, of Fort Wayne, Ind. The city will rent the equipment for two years, with option of purchase at the expiration of that period. At that time the city will make the last payment upon the municipal lighting plant.

EVANSVILLE, IND.—Preparations are being made by the Evansville Railways Company for an extension of its railway system from Mount Vernon to New Harmony, a distance of fifteen miles.

EVANSVILLE, IND.—J. A. Brown, who is building a new industrial town on the Kentucky side of the Ohio River, opposite Evansville, Ind., to be known as "Mortalies," it is reported, will build a railway to connect with Evansville, cars to be transported across the river by ferry. It is said that work will begin on construction of the proposed road in February.

GAS CITY, IND.—It is reported that the Gas City municipal water and electric light plant, recently destroyed by fire, will be rebult by the city. The loss is estimated at $40,000.

GREENSBURG, IND.—The Citizens' Telephone Company is asking for bids for the installation of an automatic switchboard.

KNIGHTSVILLE, IND.—Plans are being considered by the Town Board for the installation of an electric-light system; electricity for operating the system to be supplied by the Terre Haute, Indianapolis & Eastern Traction Company. The traction company is preparing a franchise, which will be submitted at the next meeting of the Town Board.

LEBANON, IND.—The capital stock of the Citizens' Electric Light Company has been increased by $50,000, the proceeds to be used for improvements and extensions to its system. Charles C. McReynolds is president of the company, and C. E. Layton is secretary.

RUSHVILLE, IND.—Extensive improvements are being made to the municipal electric-light plant and water-works system, which will involve an expenditure of about $13,000 and include the installation of three Heine safety water-tube boilers, with a rating of 210 hp each, equipped with chain stokers, and the erection of a brick chimney 125 ft. in height.

ATLANTIC, IA.—Plans are being prepared by the W. K. Palmer Company, engineers, 717-720 Dwight Building, Kansas City, Mo., for a new pumping and electric-light plant for Atlantic, for which bonds to the amount of $50,000 have been voted.

CEDAR RAPIDS, IA.—Plans are being prepared by the Cedar Rapids & Iowa City Railway & Light Company for the construction of two new power houses during the coming year. One will be located at Iowa City and the other at North Liberty.

CHARLES CITY, IA.—The Charles City & Western Railway Company is reported to be contemplating building about twenty miles of new track during 1911. C. W. Hart is president.

RED OAK, IA.—The Iowa Telephone Company has purchased the telephone system of the Montgomery County Telephone Company at Red Oak. Steps have been taken to consolidate the two companies.

ROCK VALLEY, IA.—At an election held Jan. 9 the citizens voted to grant an electric-light franchise to Star Thayer, engineer.

MANHATTAN, KAN.—Plans are being made by the Manhattan City & Intercurban Railway Company for an extension of its railway from Manhattan to Fort Riley, fifteen miles in length, during the coming year. Joseph T. West, of Manhattan, is purchasing agent.

LEXINGTON, KY.—The Lexington & Interurban Railways Company has decided to build its power house in Lexington, Ky., instead of at Valley View on the Kentucky River.

LOUISVILLE, KY.—Plans have been approved by the stockholders of the Kentucky Electric Company, of Louisville, Ky., for extensive improvements and extensions to the plant and properties of the company during the year 1911 which will involve an expenditure of about $1,000,000. It is proposed to reincorporate the company and increase the capital stock from $600,000 to $3,000,000. The work includes the construction of a new generating station on Water Street between Second Street and Third Avenue. Upon completion of the new plant the present power house will be used as an auxiliary station. The company also proposes to supply steam heat in connection with the new plant. R. E. Hughes is president of the company.

OPELOUSAS, LA.—Plans are being considered for improvements and extensions to the municipal electric light plant, including the installation of additional machinery. Armas Durio is superintendent.

AUGUSTA, MAINE.—Announcement has been made by the Kennebec Light & Heat Company of a reduction in the rates of electricity, to take effect from Jan. 1, 1911. Under the new schedule the price will be reduced to 9 cents per kw-hour, with discounts of 5 per cent, 10 per cent and 15 per cent for prompt payment. The company in the last three and one-half years has voluntarily reduced its lighting rate from 43 per cent to 49 per cent, and has at the same time made many improvements to its service.

NEW BRUNSWICK, MAINE.—The Maine & New Brunswick Electrical Power Company has placed a contract with the S. Morgan Smith Company, through its Boston (Mass.) office, for a water-wheel unit to be installed at its Aroostook Falls plant. This unit will develop 2400 hp under a 72-ft. head. A. R. Gould, of Presque Isle, Maine, is managing director.

PITTSFIELD, MAINE.—The residents of Barnstead Parade are considering the question of lighting the town with electricity. A committee has been appointed to see if the Pittsfield Electric Light & Power Company would extend its transmission lines to that village and supply electricity there. C. F. Gardiner is manager of the Pittsfield Light & Power Company.

CUMBERLAND, MD.—It is reported that surveys are being made for the proposed electric railway between Meyersdale, Pa., and Frostburg, Md., connecting with the Cumberland & Westernport Electric Railway in Cumberland and the Pennsylvania & Maryland lines operating through the Meyersdale field. The railway will eventualy connect Johnstown, Pa. and Cumberland, Md.

OWINGS MILLS, MD.—Bids will be received by Frank W. Keating, superintendent Maryland Asylum and Training School for Feeble-Minded, until Feb. 1, 1911, for plumbing, electric equipment, heating and power equipment in connection with buildings to be erected and alterations in connection with present buildings, inclusive of increase of present power plant, installation of additional boilers, etc., and construction of sewage disposal system, in accordance with plans and specifications prepared by Ellicott & Emmart, architects, and by Charles L. Reeder, consulting engineer, copies of which may be secured at the office of the engineer, 910 Equitable Building, Baltimore, Md.

BOSTON, MASS.—Announcement has been made by Superintendent of Streets Rourke that he has rejected all bids recently submitted to him for street lighting and would call for new bids. Bids were called for a smaller type of lamps, and the Rising Sun Street Lighting Company and the Boston Consolidated Gas Company, which hold the present contract, refused to bid. The Edison Electric Company, Ramsdell & Company and William A. Rumpf submitted bids.

CHICOPEE, MASS.—In the annual report of the municipal electric light plant submitted by J. H. Forsythe, superintendent, the installation of new boilers to be equipped with smoke-consuming devices was recommended.

FORGE VILLAGE, MASS.—The Lowell & Fitchburg Street Railway Company, which formerly secured electricity for operating its cars from the Boston & Northern Street Railway Company, is now taking the service from the Lowell Electric Light Corporation, which has necessitated the installation of two new transformers in the substation located in Forge Village owned by the Lowell & Fitchburg Street Railway Company.

HOLYOKE, MASS.—The annual report of the Gas and Electric Department, submitted by W. H. Snow, manager, shows an increase in the output of both the gas and electric plants. The gain in the gas plant was 5.22 per cent and in the electrical plant 28.7 per cent. Additions to the electric plant in the past year consisted of the installation of four 400-hp boilers, a 2500-kw turbo-generator set, with necessary pumps, con densers, etc., increasing the output of the station to about 8000 hp. The business of the plant will warrant reducing the price of street arc lamps from $60 each per year to $45, beginning with the new fiscal year, and a reduction in the price of the street incandescent lamps proportionately.

MONTAGUE, MASS.—The Montague Electric Light & Power Company has recently purchased a large gasoline engine to operate its plant during the low-water periods.

DETROIT, MICH.—It is reported that Benjamin Douglas, Ford Building, Detroit, Mich., would like to receive estimates on a gravel plant, to be located near Detroit, with an output of 600 cu. yd. per ten-hour day. Estimates are also wanted on a steam or an electrical power plant to operate the same.

DETROIT, MICH.—Preparations are being made by the Detroit Sulphite Fiber & Paper Company, of Detroit, Mich., for the erection of an addition to its manufacturing plant, plans for which are being prepared by Albert Danielson, of Kalamazoo, Mich. The plant will be equipped for electrical operation throughout.

MARQUETTE, MICH.—Bids are being asked by the City of Marquette, Mich., for the construction of a dam at Silver Lake, twenty-four miles north of the city, in connection with the municipal electric-light plant. Plans and specifications can be seen at the office of Charles Retallic, superintendent.

STANDISH, MICH.—The local electric light plant is reported to have been purchased by Guy H. Winterstee and Bruce W. Garton. The new owners took possession of the plant Jan. 1, 1911.

CHISHOLM, MINN.—Sealed proposals will be received by the Board of Education until Jan. 24 for the construction, complete, including plumbing, heating and ventilating and electrical work, of a school building to be erected by the City of Chisholm. Separate proposals will be required as follows: (1) General contract; (2) plumbing; (3) heating and ventilating; (4) electrical work. Plans and specifications may be obtained from C. E. Bell, Tyrie & Chapman, architects, 320 Auditorium Building, Minneapolis, Minn., for which a deposit of $50 will be required for each set, of which $40 will be refunded upon return of the plans. Plans and specifications are on file at the office of the Board of Education, Chisholm, Minn.; at the office of the architects and also at the Builders' Exchanges in Minneapolis, St. Paul and Duluth, Minn. B. R. de Lorimer is clerk of board.

MINNEAPOLIS, MINN.—Arrangements are being made by the Minneapolis General Electric Company for the erection of an electric plant to replace the one recently destroyed by fire. In the meantime a turbine and transformers will be installed temporarily on the ground in front of the ruins. The new station will be of steel and concrete construction and will cost about $750,000.

ST. PAUL, MINN.—Sealed proposals will be received at the office of the Chief Quartermaster, St. Paul, Minn., until Jan. 23 for electric-light supplies, plumbing supplies, hardware, etc., as per schedule, which together with information will be furnished on application. Major D. W. Arnold is quartermaster.

THIEF RIVER FALLS, MINN.—The City Council is considering the question of installing a municipal telephone system in Thief River Falls.

TOWER, MINN.—It is reported that the proposition to issue from $10,000 to $15,000 for the installation of a power plant at Pike River Falls to supply energy for the municipal electric plant will be submitted to a vote in February.

CHESTER, MONT.—Application has been made to the Council by L. D. Pugsley, president of the First State Bank of Chester, for a franchise to install and operate an electric light system in Chester.

COLUMBIA FALLS, MONT.—Plans are being made by James A. Talbot, of Butte, Mont., and associates for the construction of an electric railway to extend from Columbia Falls to Polson, work on which will begin in March.

CHADRON, NEB.—Messrs. Kass & Klingaman, who recently purchased the electric light plant of the Chadron Electric Light & Power Company, have been granted a twenty-year franchise by the City Council It is understood that the new owners propose to make improvements to the system and install new machinery.

ATHENIA, N. J.—Sealed bids will be received at the office of the Secretary of Agriculture, Department of Agriculture, Washington, D. C., until Feb. 3, 1911, for furnishing and installing a storage battery at the United States Animal Quarantine Station, Athenia, N. J. James Wilson is Secretary of Agriculture.

BAYONNE, N. J.—The Bayonne Launch Company, recently incorporated with a capital stock of $10,000, is erecting a building 40 ft. x 6[illegible] ft. at the foot of Thirty-sixth Street and New York Bay, which will be equipped with modern wood-working machinery, operated by electricity. L. R. Schellenberger is secretary.

HOBOKEN, N. J.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Feb. 6, for an electric push button mail lift in the United States Post Office, Hoboken, N. J., in accordance with plans and specifications, copies of which may be obtained from the above office.

NEWARK, N. J.—The Gillette Safety Razor Company, of Boston, Mass., which purchased a tract of land on Frelinghuysen and Evergreen Avenues, Newark, N. J., is planning to erect a factory for the manufacture of frames for safety razors and safety razor blades at a cost of about $2[illegible]. A 500-hp plant will also be installed.

PASSAIC, N. J.—The question of building a municipal electric-light plant in Passaic is under consideration.

HOPE, N. M.—The Hope Community Irrigation Company is planning to construct a large irrigation system and install pumping machinery on its land near Hope. About 20,000 acres will be reclaimed. C. M. Botts, W. P. Riley, H. M. Gage and W. J. Lewis are interested in the company.

BOLTON LANDING, N. Y.—A deal has been consummated between the Bolton Light & Power Company and Henry C. Knoblauch, president of the company, whereby the company becomes the owner of the electric-light plant and distributing system, which have been owned and operated by Mr. Knoblauch individually.

BUFFALO, N. Y.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Jan. 31, for an electric push button freight lift in the United States Post Office at Buffalo, N. Y., in accordance with plans and specifications, copies of which may be secured at the above office or at the office of the custodian of the building. James Knox Taylor is Supervising Architect.

CORNING, N. Y.—The Public Service Commission, Second District, has authorized the Corning Gas & Electric Company, of Corning, N. Y., to exercise a franchise granted by the village of Painted Post to supply electricity for lamps and motors in that village.

EAST HAMPTON, N. Y.—The Public Service Commission, Second District, has authorized the East Hampton Electric Light Company to issue $13,500 in bonds, the proceeds to be used for equipment and improvements to its plant and distributing system.

NEW YORK, N. Y.—Judge Lacombe, of the United States Circuit Court, has authorized Frederick W. Whitridge, receiver of the Union Railway Company, to enter into a contract with the City of New York to construct as an extension service line an electric railway, operated by an overhead trolley, along St. Ann's Avenue from Third Avenue to the Southern Boulevard.

ROCHESTER, N. Y.—Plans are being considered by the Rochester, Corning & Elmira Traction Company for the construction of an extension of its railway from Rochester to Danville, a distance of ninety miles, during the coming year.

SYRACUSE, N. Y.—Surveys are being made by the Syracuse & South Bay Electric Railroad Company for an extension of its railway from Syracuse to Watertown, a distance of about seventy-three miles.

SYRACUSE, N. Y.—The Syracuse Rapid Transit Company has been granted permission by the Public Service Commission, Second District, to issue capital stock to the amount of $1,750,000, the proceeds to be used to take up the promissory notes of the Syracuse Rapid Transit Company, amounting to $1,660,000, the remaining $90,000 to be used for extension and improvements to its property.

GREENSBORO, N. C.—Preparations are being made for the construction of a 10,000-hp auxiliary steam power plant in connection with the interurban electric railway. W. S. Lee, of Charlotte, N. C., is vice-president.

TROY, N. C.—The Smitherman Cotton Mills are now operating by electricity, which is obtained from the hydroelectric plant of the Smitherman Power Company, located at Little Whitney Falls, on Little River, six miles south of Troy.

FORT RANSOM, N. D.—The organization of a company to build an electric railway to connect Fort Ransom and Enderlin is under consideration.

STANLEY, N. D.—The City Council has granted a franchise to J. I. Moore, of Minot, N. D., to install and operate an electric-light plant in Stanley.

CANTON, OHIO.—The Illinois Central Electric Railway Company is planning to build an extension from Norris to Farmington, a distance of six and one-half miles, during the year 1911. George W. Chandler is chief engineer.

CINCINNATI, OHIO.—Mayor Schwab at a recent meeting of the Board of Control suggested that provisions be made for lighting the streets of Hyde Park, Avondale, Clifton and Evanston with electric lamps instead of gas lamps, as at present, and advised investigations be made as to cost, etc.

CLEVELAND, OHIO.—The Forest City Engineering Company, of Cleveland, is reported to have prepared plans for the erection of a four-story building to be erected at Clark Avenue and West Fortieth Street, Cleveland, for the Schultze-Ruck Delfs Shoe Company. A gas engine with a rating of 60 hp will be purchased and probably a generator to supply electricity for lighting.

STEUBENVILLE, OHIO.—Plans are being considered by the Tri-State Traction Company for extending its railway to Weirton.

ARDMORE, OKLA.—The Pioneer Telephone & Telegraph Company, of Oklahoma City, has taken over the management of the Chickashaw Telephone Company with principal exchange in Ardmore. It is understood that extensive improvements and extensions will be made in the Chickashaw plant. J. M. Noble is general manager of the Pioneer company.

MOUNTAIN VIEW, OKLA.—The Western Power & Irrigation Company, recently organized with a capital stock of $500,000, proposes to develop various water-powers. The first plant will be erected on the Washita River, where 650 hp will be developed, work on construction of which will soon begin. Electricity generated at the plant will be supplied to the municipality of Mountain View and to farmers for pumping water for irrigation purposes. It is understood that contracts have been placed for construction of dam, machinery and equipment. C. T. Berryman is president; W. Holton Key, vice-president, and R. W. Poindexter, secretary. William L. Church, president of the Amhursen Hydraulic Construction Company, Boston, Mass., is consulting engineer. The main office of the company is located in the State National Bank Building, Oklahoma City, Okla.

BAKER CITY, ORE.—Arrangements are being made by the Baker Interurban Railway Company for the construction of its proposed electric railway to connect Baker City, North Powder and Eagle Valley, 100 miles in length, work on which will begin early in the spring. Anthony Mohr is promoter.

KLAMATH FALLS, ORE.—The Siskiyou Electric Power & Light Company, of Yreka, Cal., represented by A. C. Hough, attorney, has submitted a proposition to the City Council asking for a fifty-year franchise to erect transmission lines in Klamath Falls to supply electricity for lamps and motors to compete with the C. S. and R. S. Moore Company, which owns the local system. The Siskiyou company proposes to supply the service from its Falls Creek plant.

MEDFORD, ORE.—Preparations are being made by the Rogue River Electric Company for the construction of its new plant at Prospect, on Rogue River, next spring. The present plant located at Gold Bay, ten miles from Medford, has been found inadequate to supply the demands of the cities in the valley. High-tension transmission lines, carrying 66,000 volts, will be erected from the proposed plant to the cities in the Rogue River Valley, including Grant's Pass, Medford and Ashland.

PORTLAND, ORE.—It is reported that contracts have been placed by the Mt. Hood Railway & Power Company for electrical equipment for its new power house in Portland, consisting of four units having a rating of 3000 kw each. Preparations are being made by the company for the installation of two additional power plants.

PORTLAND, ORE.—Preliminary work is being done by the Portland Railway, Light & Power Company on the Upper Clackmas River, three miles above the Cazadero power station, where the company proposes to erect a large generating plant at a cost of $1,400,000. The work will include the construction of a gravity type concrete dam, 160 ft. in height and 750 ft. long across, with a head of about 135 ft. The power house will be located immediately below the dam.

PORTLAND, ORE.—Plans are being prepared by the Pacific Power & Light Company for extensive improvements and extensions to its systems throughout the Pacific Northwest, which will involve an expenditure of about $1,500,000. The company proposes to extend its transmission lines in connection with the irrigation system in the Columbia, Yakima and Walla Walla valleys to supply electricity to operate the pumps for irrigating purposes. The company already has a heavy irrigation pumping load and expects to double it by the end of the present year. It already has under way an extension of seventy miles of 66,000-volt transmission line from Kennewick to the Hanford Irrigation & Power Company's power house at Priest Rapids, on the Columbia River, and will erect about fifty miles of 6600-volt distributing system extending from the Milwaukee crossing on the Columbia River at Beverly to Hanford, Wash. Distributing lines are being erected from the high-tension lines at Sunnyside and Toppenish, and about twenty miles of high-tension and distributing lines are being erected from Freewater westward, serving a large irrigated district in that vicinity. The company is rebuilding the White River plant south of The Dalles at a cost of about $50,000; erecting a new substation at Walla Walla to cost about $50,000, and proposes to install a 1000-hp generator at the Walla Walla River plant and new substations at Touchet, Toppenish, North Yakima, Richland, Hanford, White Bluffs, Benton City and Beverly. Plans are also being considered to increase the output of the plant at The Dalles.

VALE, ORE.—Surveys have been completed by the Farmers' Electric Railway Company for its proposed electric railway to connect Vale and Malheur Canyon, sixteen miles in length. It is expected that the railway will eventually be extended to Ontario, Ore. G. W. Thomas, of Ontario, Ore., is president.

PANAMA.—Sealed proposals will be received at the office of the assistant purchasing officer, Panama Railroad Company, 24 State Street, New York, N. Y., until Feb. 1, 1911, for furnishing eight four-ton electric cargo handling cranes. Drawing and specifications may be obtained upon application to the above office. Major Wendell L. Simpson is assistant purchasing officer.

PANAMA.—Sealed bids will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until March 30, 1911, for furnishing material and erecting emergency dams at the canal locks and for furnishing and delivering certain tools, equipment and spare and repair parts. Blanks and general information relating to this circular (No. 616) may be obtained at the above office or from the offices of the assistant purchasing agents at 24 State Street, New York, N. Y.; 55 National Realty Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is General Purchasing Officer.

BEAVER FALLS, PA.—The Commercial Water Company is reported to be making preparations for the construction of a dam across Dry Run and erecting a pumping station for distributing the water thus impounded. It is possible that a hydroelectric plant may be installed. At present the city obtains electrical service from the Valley Electric Company, of New Brighton, Pa.

CONNEAUTVILLE, PA.—The installation of an electric light plant in Conneautville is under consideration. Application for a franchse to construct and operate an electric plant has been made to the Council.

ETNA, PA.—The Borough Council has instructed the borough clerk to advertise for proposals for the construction of a municipal electric-light plant. Provision was made to call off the building of the proposed plant in case the borough should be annexed to Pittsburgh. Post office address, Etna, R. F. D., Allegheny, Pa.

FRANKFORD, PA.—Application will be made Jan. 27 for a charter for a street railway, to be known as the Northeastern Street Railway Company, by George B. Atlee, Mayer Schamberg, Morris Ebert, W. L. Allen, Wilson Woelpper and others. The company proposes to construct an electric railway from Frankford Avenue and Bridge Street, in Frankford, Philadelphia, to the county line, or Poquessing Creek, passing through Bustleton, Somerton and Byberry.

HOMER CITY, PA.—Steps have been taken for establishing an electric-light plant in Homer City provided a franchise can be secured from the City Council. A company has been formed by J. A. Stokes, of the Blairsville Machine Works; W. P. Graff, cashier of the First National Bank, and C. A. Simons, superintendent of the Columbia Plate Glass Company, all of Blairsville. The company has purchased a site in Homer City, on which it expects to erect an electric plant and an artificial ice plant.

JOHNSTOWN, PA.—The Johnstown & Altoona Railway Company is planning to build an extension of its railway from South Fork to Altoona, calling for the construction of thirty-two miles of track.

KOPPEL, PA.—The Orenstein-Arthur Koppel Company is reported to have taken bids for the erection of the new buildings for its works at Koppel, Pa., including a wood-working shop, machine shop, erection shop and heavy car shop. A separate power plant will be installed and there will be an outside crane runway, 40 ft. x 275 ft. The chief engineer of the company, Machesney Building, Pittsburgh, Pa., will have charge of the construction of the plant.

MANCHESTER, PA.—The Borough Council has granted the Manchester Electric Light Company a franchise to erect and operate an electric light plant in Manchester.

McKEESPORT, PA.—Plans are contemplated by the Pittsburgh, McKeesport & Westmoreland Railway Company for the construction of an extension of its railway from Blackburn to Herminie, a distance of three miles, during 1911.

PHILADELPHIA, PA.—Charles E. Wilson has been appointed receiver of the Continental Telephone & Telegraph Company in a suit brought by John E. Stevenson, a stockholder and creditor. The company was incorporated in 1909 with a capital stock of $50,000,000. Shortly after it was incorporated bonds to the amount of $25,000,000 were authorized. The only asset the company is said to have is the liability of the subscribers to the bond issue.

PITTSBURGH, PA.—William Flinn and Joshua G. Splane, both of Pittsburgh, have been appointed receivers for the Pittsburgh & Allegheny Telephone Company. The company has outstanding $4,000,000 in capital stock and bonds with a face value of $1,400,000.

BATESBURG, S. C.—The capital stock of the Delmar Telephone Company has been increased from $3,000 to $5,000.

CHARLESTON, S. C.—The City Council is reported to have authorized preliminary plans and estimates prepared for the construction of a municipal electric-light and pumping plant.

WATERTOWN, S. D.—It is reported that an electric light plant will be installed in Watertown at a cost of $200,000 before spring.

JACKSON, TENN.—Two propositions have been submitted to the City Council for improvements to the street-lighting system. One is an offer from the Jackson Railway & Light Company to purchase the equipment now owned and operated by the city for $2,000 and to furnish 150 arc lamps, such as are used at the present time, at the rate of $65 each per year. The other proposition is to remodel the municipal electric plant and purchase new machinery at a cost of about $16,000. It is estimated that the cost of operating the new plant would be about $6,000 per year. The plan submitted by the Jackson Railway & Light Company would cost over $9,000 per year.

KNOXVILLE, TENN.—The county courts of Blount and Monroe counties have granted the Tellico Power Company franchises to erect transmission lines from its plant at Tellico Plains along the pikes and highways into Knoxville. The company has already secured a franchise in Knox County. The plant when completed will have an output of about 6000 hp, which will be transmitted to Knoxville, where it will be used for operating factories, industrial plants, etc. John C. Knight, of Knoxville, is president of the company.

NASHVILLE, TENN.—The Nashville Railway & Light Company is contemplating extensions to its system this year which will call for the construction of about five miles of new track.

AUSTIN, TEX.—It is reported that important improvements and extensions will be made to the property of the Austin Street Railway Company, which was recently reorganized with a capital stock of $1,250,000. The new incorporators are: R. C. Story, of Boston, Mass.; William G. Bell and W. H. Folts, of Austin. The work includes the erection of a new power plant, the purchase of new rolling stock and other improvements to the service.

CLEBURNE, TEX.—It is understood that extensive improvements and extensions will be made to the system of the Cleburne Street Railway Company during the year. The officers of the company are: Daniel Hewitt, president and general manager; A. M Morgan, vice-president, and P. C. Coon, secretary and treasurer.

CRYSTAL CITY, TEX.—Arrangements are being made by Dr. E. S. Link, of Crystal City, for the construction of a furniture factory. An electric power plant will be installed to furnish electricity for operating the plant and for the irrigating pumps in this section.

FALFURRIAS, TEX.—The local electric-light and power plant, water-works system and ice plant, owned by E. C. Lasater, of Falfurrias, is reported to have been purchased by G. W. Smith, of Cleveland, Ohio. It is understood that the new owner will make extensions and improvements to the systems.

FORT WORTH, TEX.—The City Council is considerinng the question of issuing $50,000 in bonds, the proceeds to be used for extensions and improvements to the munincipal electric light plant. The proposition will soon be submitted to a vote of the people.

HAMLIN, TEX.—The Hamlin Street Railway Company has been granted a franchise to extend its railway to the Central Nazarene University.

HASKELL, TEX.—Plans are being made by the Haskell Traction Company for the construction of an extension of its railway from Haskell to Rule, a distance of eleven miles, during 1911.

HOUSTON, TEX.—The Brown-Woods Electric Company, of Houston, has filed amendments to its charter, increasing its capital stock from $10,000 to $15,000.

LEAGUE, TEX.—The Galveston-Houston Electric Railway Company has awarded the contract for the construction of the power plant at League to the Stone & Webster Engineering Corporation, of Boston, Mass., to cost about $100,000. Contracts for machinery and equipment have already been placed.

MARBLE FALLS, TEX.—Charles Alexander and associates, who are erecting a dam across the Colorado River at Marble Falls and installing a hydroelectric plant, are reported to have prepared plans for the erection of another dam across the river near here, and a third one is contemplated, the latter to be located at Austin. Hydroelectric plants will be installed at each of the proposed dams. It is stated that contracts have been entered into to supply the cities of San Antonio, Waco and several smaller towns, situated within a radius of 100 miles of Marble Falls, with electricity for lamps and motors. Mr. Alexander is said to be now negotiating with the Municipal Commission of Austin to supply electricity in that city.

UVALDE, TEX.—The Uvalde & Leona Valley Interurban Railroad Company, which operates a railway between Uvalde and Sansom, contemplates extending the road to Batesville, a distance of twenty-five miles. The company now operates a gasoline motor car, and if the extension is made it is expected the railway will be equipped for electrical operation, which would necessitate the construction of a power plant and other improvements.

WEIMAR, TEX.—It is reported that the local electric light plant has been taken over by the Weimar Water, Light, Ice & Cold Storage Company, recently organized. It is understood that the new company will enlarge the plant and install new machinery. The company will also install water-works system, ice factory and cold-storage plant. William H. Hillje is president of the company.

LOGAN, UTAH.—The City Council has decided to increase the price for electric lamps of 16 cp from ten cents per lamp per month to fifteen cents per month, the new rate to take effect from Jan. 1, 1911. The municipal plant has been in operation between six and seven years and has yet been quite self-supporting.

RUTLAND, VT.—Plans are being considered by the Rutland Railway, Light & Power Company for building an extension from Poultney, Vt., to Granville, N. Y., nine miles in length, during the coming year.

CENTRALIA, WASH.—The Twin City Light & Traction Company is reported to be contemplating extensive improvements to its system during the coming year which will involve an expenditure of about $100,000 and include the erection and equipment of a new power house.

COUPEVILLE, WASH.—It is reported that the Whidby Island Light & Power Company will soon begin work on the installation of an electric light plant and water-works system.

NORTHPORT, WASH.—Work has been commenced by the J. G. White Company on the development of 30,000 acres of upper Columbia River land, purchased recently by the company for $1,500,000. It is proposed to develop the water-power and erect a hydroelectric power plant and to build a sawmill and box factory.

SEATTLE, WASH.—The City Council has passed an ordinance authorizing bonds for public improvements, including the installation of cluster lamps on Westlake Avenue.

SEATTLE, WASH.—Plans are being made by the Seattle Electric Company for equipping the Madison Street line from Broadway east for electrical operation, which will be ready for operation in the near future. The company also proposes to erect a new cable house, to be located at Madison Street and Tenth Avenue, which will be operated by electricity.

SPOKANE, WASH.—The report submitted to the Council power plant committee on Jan. 4 by City Engineer Macartney and W. E. Moore, hydraulic engineer, states that the city cannot, as a business proposition, build a power plant to supply electricity for the up-river pumping station and for street lamps only, but must go into the wholesale and retail business in order to make the plant pay. It also states that if the city decides to build its own plant now is the time to take the necessary steps. It also further states that the city should decide at once what it proposes to do to reduce rates for electrical service, whether to contract with some company after bids are submitted or to bring in another company to supply electricity for lamps and motors on a long-term contract, and eventually purchase the company's plant. It is stated that the present City Council will turn over to the commissioners elected March 7 under the new charter the question of building the municipal power plant for Spokane.

TACOMA, WASH.—The Island Railway & Navigation Company has applied to the City Commissioners for a franchise to build an electric railway on Sixth Avenue from Proctor Street, Tacoma, to the Narrows, a distance of three miles.

VANCOUVER, WASH.—The Oregon-Washington Corporation, recently incorporated with a capital stock of $5,000,000, has taken over the plant and holdings of the Vancouver Water Works Company, the Vancouver Traction Company and the Vancouver Gas Company. It is understood that B. M. Atkins, the present manager of the Vancouver Traction Company, will have charge of the Vancouver holdings for the company.

YACOLT, WASH.—Arrangements are being made by the City of Yacolt for the construction of a dam and pipe line at Big Tree Creek, which will be used to convey water to this city. The City Council has passed an ordinance granting the Yacolt Light & Power Company a franchise for joint use of the dam, where the city takes its water supply, to be used in connection with its power plant.

HUNTINGTON, W. VA.—The J. F. Johnson Company is reported to be making arrangements to construct a saw mill and power plant in Huntington.

WHEELING, W. VA.—The Pan Handle Traction Company is planning to extend its system from Wheeling to Glennova, a distance of three miles, during the coming year.

WHEELING, W. VA.—The power house of the Lorain Coal & Dock Company, located four miles east of Blaine, Ohio, was destroyed by an explosion, causing a loss of about $10,000.

BARABOO, WIS.—A company has been organized under the name of the Merchants' Power & Light Company to establish an electric plant in Baraboo. It is proposed to utilize the water-power from the dam under the Oak Street Bridge to generate electricity for a day service for motors and possibly for lamps. James Dickie, George McArthur, Sr., and George McArthur, Jr., are interested in the company.

BAYFIELD, WIS.—It is reported that plans have been prepared for the erection of a new boiler house in connection with the municipal electric light and pumping plant in Bayfield.

KAUKAUNA, WIS.—The Thilmany Pulp & Paper Company is reported to be preparing to construct a new factory which with equipment will cost about $250,000. The mill will be equipped for electric motor drive throughout.

MILWAUKEE, WIS.—It is stated that bids will be received for the construction of a new factory for the Hummel & Downing Company in Milwaukee, including power and coal-handling plant.

MILWAUKEE, WIS.—The Bradley Knitting Company is enlarging its factory and doubling its power equipment. The plant when completed will have an output of 225 kw and will supply electricity to light and operate its factory. The company utilizes the exhaust steam for heating by the vacuum system.

NEW LISBON, WIS.—At an election held recently the proposition to install a municipal electric-light plant was carried.

NORTH MILWAUKEE, WIS.—Plans have been prepared by the Home Brewing Company for the erection of new buildings, including power plant, refrigerating system, etc., to be erected in North Milwaukee

SHERIDAN, WYO.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Jan. 27 for furnishing and installing light fixtures in the United States public building at Sheridan, Wyo. James Knox Taylor is Supervising Architect

PENTICTON, B. C., CAN.—At an election held Dec. 27 the rate payers voted in favor of the by-law to appropriate $71,000 for the installation of a municipal electric light plant for the town. Power for operating the plant will probably be obtained from Ellis Creek, a report having been prepared by F. H. Latim, municipal engineer. It is expected that work on construction of the proposed plant will begin this month.

WINNIPEG, MAN.—The consulting board of power engineers has recommended to the Board of Control that cable conduits be installed on Main Street and Portage Avenue, at a cost of $55,000, this year.

WINNIPEG, MAN., CAN.—The Winnipeg Electric Railway Company has been granted a permit by the city to erect a new power plant on Mill Street to cost about $72,000. The proposed new plant will have an output of 12,000 hp and when completed will involve an expenditure of about $500,000. Wilford Philips is general manager and chief engineer.

BRANTFORD, ONT., CAN.—Application is being made for the incorporation of the Lake Erie & Northern Railway Company to construct and operate an electric railway from Port Dover, Simcoe, Waterford, Brantford, Paris, Glenmorris, Ayr and Galt and also to supply electricity for lamps and motors. The cost of the proposed railway from Brantford to Port Dover is estimated at $800,000, and work will begin on construction of the road if the various municipalities through which it will pass will guarantee the interest on the bonds of the company. From Brantford to Galt, in order to secure connection with the Canadian Pacific Railway at the latter place, the Grand Valley Railway will be rebuilt, or an entirely new road constructed. The incorporators are: Lloyd Harris, M. P.; W. S. Brewster, W. P. Kellett and John Muir, of Brantford.

HESPELER, ONT., CAN.—The by-law to appropriate $4,000 for extensions of the electric street-lighting system was carried at the election held recently.

LISTOWELL, ONT., CAN.—At an election held Jan. 2 the by-law to raise $5,000 to complete the electric light system was carried.

NORTH TORONTO, ONT., CAN.—At an election held Jan. 2 the by-law to appropriate $18,000 for an electric light plant was carried. E. A. James, of Eglinton, Ont., is engineer in charge.

OTTAWA, ONT., CAN.—Announcement has been made that the rates charged for electricity for lamps from the municipal electric plant will be reduced from 10 per cent to 15 per cent.

PRESCOTT, ONT., CAN.—The Aluminum Company of America, controlled by the Mellon family, of Pittsburgh, Pa., is reported to have purchased 3500 acres of land, including Bernhart's Island, in the St. Lawrence River, below Prescott, where it proposes to construct a plant to develop 300,000 hp. It is said that if permission is secured to erect a plant the company is prepared to expend $40,000,000 on the project.

STRATHROY, ONT., CAN.—The rate-payers, on Jan. 1, voted in favor of the by-law authorizing an expenditure of $6,000 for improvements to the municipal electric light plant and water-works system.

TORONTO, ONT., CAN.—The City Council has entered into an agreement with the Toronto Electric Light Company to extend the street lighting contract, which expired Dec. 31, for two months, at which time the city expects to be in a position to put the municipal electric lighting system in operation, electricity for which will be supplied by the Hydro-Electric Power Commission. The city pays the company $69 per arc lamp per year.

TORONTO, ONT., CAN.—Announcement has been made that the loop connecting St. Mary's and London has been completed and power turned on. The completion of this section gives a double transmission circuit through all the municipalities north and west of Dundas. The line from Niagara Falls to Dundas already has a double circuit, which gives the entire line from the Falls to St. Mary's, the present terminus of the Hydro-Electric Power Commission's main line, a double circuit.

MONTREAL, QUE., CAN.—The Shawinigan Water & Power Company is reported to have purchased a large tract of land in Maisonneuve, Montreal, in connection with the enlargement of its terminal station. J. E. Alfred is president of the company.

MONTREAL, QUE., CAN.—The Montreal & Southern Counties Railway Company is contemplating building an extension to the new "country club," St. Lambert, calling for two miles of track and the construction of an extension to connect Chambly Basin, Chambly Canton and Richelieu, a distance of thirteen miles, during the coming year.

VALLEYFIELD, QUE., CAN.—It is reported that the Montreal Cotton Company has purchased the plant of the Valleyfield Electric Company for a consideration of $80,000.

GUANAJUATO, MEX.—It is reported that arrangements are being made by a French syndicate, represented by E. Brunel, French consular representative at Irapuato, Mex., for the construction of an extensive system of interurban electric railways in the State of Guanajuato. It is understood that the syndicate is negotiating for the purchase of the street railway system in the State of Guanajuato, an offer of $500,000 in Mexican currency having been made to Governor Obegan Gonzales, principal owner of the property. The syndicate is reported to have already acquired the concession for the construction of the Morelia & Tacambaro Railway, for which the grade is partly finished. Mr. Brunel and associates propose to construct an electric railway system to connect the cities of Leon, Guanajuato and Irapuato. More than sixty miles of track will be built, exclusive of the street railway systems in the three cities, which the syndicate is arranging to control. The syndicate pledges itself to expend not less than $4,000,000 in gold in connection with the project.

New Industrial Companies.

THE DIXIE ELECTRIC COMPANY, of Montgomery, Ala., has been incorporated with a capital stock of $12,000 by Clarence N. Jones, Hopson Owen and W. H. Crump. The company proposes to manufacture and deal in electrical supplies.

THE ELECTRIC APPLIANCE COMPANY, of Toledo, Ohio, has been chartered by Mark Knabenshue, M. V. Girkins, Wesley S. Thurston, Jr.; George E. Seney and Francis E. Smith. The company is capitalized at $10,000 and proposes to deal in and sell all kinds of electrical appliances and machinery.

THE ENTERPRISE ELECTRIC FIXTURE COMPANY, of Cleveland, Ohio, has been chartered with a capital stock of $10,000 by A. Oppenheimer, Edward Younger and others.

THE FALK-McMAHON WIRELESS COMPANY, of New Orleans, La., has been organized by Hilbert Falk and others. The company proposes to establish a plant to manufacture a patented wireless telegraph machine invented by Mr. Falk.

THE E. A. FOY COMPANY, of Cincinnati, Ohio, has been chartered by E. A. Foy, Mary A. Foy, William R. Foy, R. E. Heekin and C. T. Burdge. The company is capitalized at $75,000 and proposes to manufacture lightning rods and electrical appliances.

THE GAS & ELECTRIC FURNACE COMPANY, of Denver, Col., has filed articles of incorporation with a capital stock of $200,000. The incorporators are: W. W. Linninger, J. C. Pelton and C. C. Donaldson, all of Denver, Col.

THE GRAVITY RAILWAY SIGNAL COMPANY, of Richmond, Va., has been incorporated with a capital stock of $500,000 to manufacture automatic electrical or mechanical railway signals. The officers are: W. H. Woody, Jr., president; C. G. Burton, vice-president, and William H. Campbell, secretary and treasurer.

THE LA POINTE ELECTRICAL COMPANY, of Hoboken, N. J., has been incorporated with a capital stock of $25,000 by F. A. La Pointe, G. Fallon and J. J. Fallon, all of Hoboken, N. J. The company proposes to deal in electrical supplies.

THE MODERN ELECTRIC COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $5,000 by S. J. Deutsch, F. Bernstein and S. J. Rothschilds.

THE MOTOR CAR MANUFACTURING COMPANY, of Indianapolis, Ind., has been incorporated by William C. Teasdale, Jr.; F. C. Dorn and G. O. Simons. The company is capitalized at $75,000 and proposes to manufacture automobiles and other power-propelling vehicles parts and supplies.

THE NATIONAL ELECTRIC COMPANY, of Baltimore, Md., has filed articles of incorporation with a capital stock of $2,500 for the purpose of doing an electrical engineering business. The incorporators are: Charles B. Mills, 1811 Ashburton Street; B. B. Shreeves, 130 Law Building; Charles Schmidt and William P. Schmidt, all of Baltimore, Md.

THE PEORIA ELECTRIC FIXTURE COMPANY, of Peoria, Ill., has filed articles of incorporation with a capital stock of $2,400. The company proposes to manufacture and deal in electric fixtures, supplies, etc. The incorporators are: E. J. Abercool, John L. Palmer and A. G. Walsh.

New Incorporations.

VAN BUREN, MAINE.—Articles of incorporation have been filed for the Van Buren Light & Power Company with a capital stock of $50,000. The company proposes to supply electricity for lamps, heat and motors in the towns of Van Buren and Hamlin. Levito V. Thibadeau is president, and Joseph Martin, treasurer, both of Van Buren.

LEE'S SUMMIT, MO.—The Lee's Summit Light, Power, Ice & Storage Company has been incorporated with a capital stock of $20,000 by Charles N. Hanks, L. H. Morris, John H. Cook and others.

ST. LOUIS, MO.—The Ozark Power & Water Company has been incorporated with a capital stock of $5,000 by R. W. Morrison, Chester E. Berg and Frank Mottbusch.

PLYMOUTH, N. C.—The Plymouth Light & Ice Company has been chartered with a capital stock of 25,000 by A. L. Owens, C. L. Owens and Clarence Latham.

WARRENTON, N. C.—The Warrenton Electric Light Company has been chartered with a capital stock of $25,000 to construct and operate an electric light plant in Warrenton, N. C. The incorporators are: W. L. Rogers, J. W. White, H. J. Bradley, Frank Seus and R. J. Jones.

COLUMBUS, OHIO.—The Columbus Electric Company has been chartered with a capital stock of $125,000 by W. S. Smith, W. F. Felton, T. W. Wolfrey, J. M. Davis and E. B. Taylor.

AUBURN, PA.—The Auburn Electric Light, Heat & Power Company has been granted a charter with a capital stock of $15,000. The directors are: F. J. Voss, of Auburn, Pa., treasurer; W. D. Burch, of Selinsgrove, Pa., and Horace H. Binkley, of Auburn, Pa.

Personal.

MR. SAMUEL INSULL returned to Chicago on Jan. 14 after a holiday trip to England.

MR. ANGUS S. HIBBARD, vice-president and general manager of the Chicago Telephone Company, has been elected president of the Wisconsin Society of Chicago.

MR. HENRY P. RUST read a paper on January [illegible] at the Brooklyn Engineers' Club having for its subject the Feather River hydroelectric plant of the Great Western Power Company.

MR. C. L. CROSBY, formerly manager for Crosby, Craft & Company, Cleveland, Ohio, which firm was dissolved Dec. 31, 1910, has accepted a position as district sales manager for Machado & Roller, with headquarters in the Oliver Building, Pittsburgh.

MR. W. A. LADUE has been appointed division superintendent of the Hudson division of the Public Service Electric Company, of Newark, N. J., succeeding Mr. H. D. King, who was connected with the company for ten years. Mr. Ladue will be stationed at Hoboken, N. J.

MR. W. R. PUTNAM has resigned as superintendent of the Menominee & Marinette Light & Traction Company, of Marinette, Wis., effective Feb. 15. Mr. Putnam has been with the company since February, 1909, having been formerly manager of the Red Wing Gas, Light & Power Company, of Red Wing, Minn.

MR. RALPH HAWKINS, formerly superintendent of the Ogdensburg Electric Light & Power Company, has been appointed general manager of the Patchogue Electric Light Company. Mr. Jesse C. Mills, formerly general manager, was presented upon retirement from that position with a handsome gold watch by the board of directors.

MR. AUSTIN E. GIBSON has been appointed local manager of the light and traction properties of the Michigan United Railways at Owosso and Corunna, Mich. Mr. Gibson was at one time operating engineer of the Mexican Light & Power Company and was also in charge of the electrical work of a number of copper companies in Arizona.

MR. G. N. LEMMON, who formerly represented Sanderson & Porter, of New York, in construction and power-house work for the Youngstown & Shenango Railway & Light Company and was later made superintendent of overhead lines of the company, has been appointed electrical engineer of the Michigan United Railways, with headquarters at Jackson, Mich.

MR. R. N. DICKINSON, formerly engineer on the staff of the general superintendent of the Public Service Electric Company, of Newark, N. J., has been appointed assistant superintendent of the Hudson division of the company. Mr. Dickinson, who will be stationed at Jersey City, succeeds Mr. W. A. Ladue, whose promotion is noted elsewhere in this column.

MR. N. M. ARGABRITE, manager of the Public Service Operating Company, of Belvidere, Ill., has resigned his position with that company to enter the service of the American Gas & Electric Company, of New York City. Mr. T. C. McKeen, who has filled the position of assistant manager under Mr. Argabrite, will succeed to the position of manager at Belvidere, Ill.

MR. C. H. BROWARD has been retained as superintendent of the new 24,000-hp hydroelectric plant on the Ocmulgee River, Georgia. This plant belongs to the system of the Central Georgia Power Company, of which Mr. J. J. Cagney, of Macon, Ga., is general manager. Mr. Broward has been connected with the Southern Power Company system, having had supervision of two of its large hydroelectric developments.

DR. EDWIN F. NORTHRUP showed a large collection of unique instruments and lantern slides at the Brooklyn Academy of Arts and Sciences Jan. 9 and lectured upon the subject of "New Devices for Electrical Measurements." Several of the instruments were shown in operation, among others the Vreeland oscillator and the Brooks deflection potentiometer and an autographic temperature recorder.

MR. W. S. GRAHAM, formerly Surveyor-General of California and member of the engineering corps during the construction of the Southern Pacific Railroad, has been appointed general superintendent of the Snow Mountain Water & Power Company, with headquarters at Ukiah, Cal. The company is planning extensive improvements to its system, and these will be under the direction of the newly appointed superintendent.

MR. LEWIS S. CURT, of the export department of the Federal Electric Company, was appointed a member of the foreign trade committee of the Chicago Association of Commerce at a recent meeting of the board of directors. This committee is organized for the purpose of increasing the commerce of Chicago with foreign markets, and Mr. Curt was selected for membership on account of his experience in connection with Spanish-American export trade.

MR. H. THURSTON OWENS has been appointed associate editor of the *American Gas Light Journal*, 42 Pine Street, New York City. Mr. Owens, who has been connected with the lighting industry for the past ten years and has been a frequent contributor to the technical press, is a member of the American Gas Institute, National Commercial Gas Association, New York Electrical Society, Illuminating Engineering Society and a corresponding member of the British Illuminating Engineering Society.

MR. THOMAS A. EDISON was elected an honorary member of the Engineers' Club of New York last week, and at the same time the same distinction was conferred on Rear-Admiral Melville, who attained his seventieth year on Jan. 10. The only other honorary members of the club are Andrew Carnegie and John Fritz, the Nestor of the steel industry in America. Both Mr. Edison and Admiral Melville have been members of the club for many years. The official letter to Mr. Edison speaks of his achievements as an inventor and his great contributions to engineering and industry.

PROF. DUGALD C. JACKSON has been retained by the British government as telephone expert in connection with the appraisal of the property of the National Telephone Company, which is to be purchased by the English Post Office Department at the expiration of the company's thirty-one-year license on Dec. 31, 1911. Professor Jackson, as a member of the firm of D. C. & W. B. Jackson, consulting engineers, Boston and Chicago, sailed for England on the Lusitania Jan. 18 for a week's preliminary conference with the British Post Office officials in connection with the valuation of the telephone property of the National company, which includes over 1500 exchanges and over 500,000 subscribers, the capitalization of the system being about $60,000,000. The purchase of the telephone system by the government will involve a valuation of the equipment with special reference to its availability for service as a part of the royal system of telephones which after next year will cover practically all the telephone service in the British Isles.

Obituary.

MR. WILLIAM H. BROWNE died in Brooklyn, N. Y., Jan. 14, of exhaustion due to cancer. Mr. Browne was born at Troy, N. Y., Dec. 3, 1849, and in 1888, shortly after entering the electrical field, became connected with the construction of the Richmond (Va.) electric railway, the first commercial road in this country. Shortly afterward he became associated with the Westinghouse interests in New York City, and as general manager of the United Electric Light & Power Company was in charge when the first alternating current system (2000 volts) was installed for lighting purposes. From New York Mr. Brown went to Montreal, Que., where he took charge of the Royal Electric Company. In 1897 the Chambly Manufacturing Company, under Mr. Browne's direction, began the development of hydraulic power on the Richelieu River at Chambly Rapids to furnish power for Montreal. The following year he completed the works of the Cataract Power Company at Hamilton, Ont. He later turned over to the Canadian General Electric Company the manufacturing business of the Royal Electric Company, which had been built up under his management. The consolidation of the Chambly Manufacturing Company, the Royal Electric Company and the Montreal Gas Company, under the name of the Montreal Light, Heat & Power Company, Mr. Browne's last work in Canada, completed the largest industrial organization in the Dominion. On Jan. 31, 1902, he resigned his position as head of the new company to become general manager and treasurer of the Stanley Instrument Company at Great Barrington, Mass. Five years later the Stanley works were merged with the General Electric Company and Mr. Browne opened offices in New York as a consulting engineer. When taken ill he was engaged in carrying out the hydroelectric development of the Rockingham Power Company in North Carolina. Mr. Browne was a widower and leaves five children—Mrs. A. P. Ryan, Mrs. W. Harry Sefton, Miss Mary Browne, W. H. Browne, Jr., and Maurice J. Browne, all of New York. He was a member of the American Institute of Electrical Engineers, of the St. Lawrence, Montreal and Catholic clubs, and was a past grand master of the Knights of Columbus.

Trade Publications.

FUSES AND CUT-OUTS.—The D & W Fuse Company, Providence, R. I., has issued Catalog No. 12 of its well-known non-arcing fuses and safety devices for lighting, heating, motor, railway, signal, telephone and telegraph circuits.

ELECTRICALLY HEATED APPARATUS.—The Manhattan Electrical Supply Company, New York, has isued a circular giving excellent illustrations, with descriptions, of a long line of electric cooking and other heating apparatus.

VENTILATION AND HEALTH.—Warren Webster & Company, Camden, N. J., have reprinted in pamphlet form Mr. W. G. Snow's lecture on "Ventilation in Its Relation to Health," delivered in the course on sanitary science and public health at Cornell University, May 24, 1910.

COAL-WASHING INSTALLATIONS.—The Link-Belt Company, Philadelphia, Pa., one of whose specialties is a modern method of treating and handling coal, to the end that the quality of the various grades may be improved, has issued a pamphlet describing the progress in constructing a recent installation of coal washeries at Dunkirk, Kan.

ELECTRIC HEATING PAD.—The H. W. Johns-Manville Company, New York, has issued a booklet entitled "Heat as the Family Doctor," enumerating various ills which may be cured by hot applications. The point emphasized is the necessity of a permanent and uniform heat, which can, of course, only be obtained from an electric heating pad. A list of "J-M Electrotherm" apparatus is included.

WATT-HOUR METERS.—The Sangamo Electric Company, Springfield, Ill., is distributing a series of bulletins showing the various elements of its mercury flotation ampere-hour and watt-hour integrating meters. The detailed drawings which illustrate the non-spillable mercury chamber should prove of interest to meter superintendents and constitute an interesting contribution to meter literature.

GARBAGE DESTRUCTOR.—The Power Specialty Company, New York, manager of the Destructor Company, has issued a pamphlet containing descriptions and tests of the Milwaukee garbage destructor, West New Brighton (N. Y.) destructor and the destructor at Westmount, Quebec, Canada. A list of installations of Heenan or Meldrum destructors, the steam from which is used for generating electricity for pumps, is appended.

STORAGE BATTERY.—The "Ironclad-Exide" battery for vehicles is described in a booklet issued by the Electric Storage Battery Company, of Philadelphia. In this battery the positive plate consists of metal top and bottom bars connected by vertical conducting rods. Each rod is surrounded with active material, which is protected and held firmly in place by a slotted hard-rubber tube. Each tube carries a vertical rib on each side, and these ribs take the place of the ribs of the wood separators as well as the perforated rubber-sheet separators used with the Exide type of positive plate. A thin flat-wood separator is placed between the positive and negative plates in the new battery. The negative plate is a modified Exide plate somewhat thickened to give it increased capacity.

BUSINESS NOTES.

THE MOLONEY ELECTRIC COMPANY, of St. Louis, Mo., is reported to be making arrangements for establishing a branch factory at Windsor, Ont., for its Canadian trade. The company is said to have orders amounting to $500,000 on hand.

CATALOGS WANTED.—The E. S. Downs Company, electrical engineer and contractor, Newark, N. J., has opened an office in the Firemen's Building in that city and would like to receive catalogs, price-lists, discount sheets, etc., relating to electrical apparatus, fittings, supplies, etc.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, has opened a St. Louis office and warerooms at 1120 Pine Street, which will be in charge of Mr. W. L. Cummiskey, who for some years was with the Jandus Electric Company and until recently its Western manager, with headquarters at Chicago.

THE HABIRSHAW WIRE COMPANY, New York, has received orders for rubber-covered wire that will be used throughout the new Vanderbilt Hotel, Thirty-fourth Street and Park Avenue, New York; the Bankers' Trust Company Building, Wall Street, New York, and the new building of the Harris Trust Company, Chicago.

THE KILBOURNE & CLARK COMPANY, one of the oldest established electrical machinery and engineering firms on the Pacific Coast, with headquarters at Seattle, Wash., has disposed of its business to George B. Adair & Son Company. Mr. Frederick G. Simpson, formerly secretary and chief engineer of the Kilbourne & Clark Company, has been appointed general manager and chief engineer of the Kilbourne & Clark Manufacturing Company, with factory and principal offices at Seattle, Wash. The plant of the Kilbourne & Clark Manufacturing Company manufactures rotary converters and transformers for wireless telegraph purposes, storage batteries and switchboards.

GIROD ELECTRIC FURNACES.—C. W. Leavitt & Company, 307 Church Street, New York, which company represents in this country the Girod electric furnace, state that the furnace of this type installed by the Simonds Manufacturing Company at Chicago is being transferred to that company's new and modern plant at Lockport, N. Y., where it will be utilized for refining the high grade of steel required for saws, machine knives, files, etc. At a plant in Ugine, France, six Girod electric furnaces are now in operation, and a new 8000-kw furnace is being installed. The Girod furnaces are also used by the Cockerill Company in Seraing, Belgium, and by the Krupp Company, of Eston, which is now installing a 12½-ton furnace of this type, to be operated with three-phase currents.

THE DEARBORN DRUG & CHEMICAL COMPANY has established a branch office and warehouse in Manila, P. I., with F. O. Smote in charge, under the supervision of E. C. Brown, manager of the foreign department of the Dearborn company. Mr. Smote has been connected with mining since his graduation in chemistry from the University of Illinois in 1891, and Mr. Brown has spent most of the past two years in Japan, China and the Philippines investigating steam plant and railroad conditions in the interests of Dearborn products and has established selling connections in Tokyo, Tientsin, Honolulu and Shanghai. The Dearborn company during the past two years has worked up a considerable business in connection with feed-water treatment and lubricants in the Philippines.

THE PAUL STEWART COMPANY has been organized in Cincinnati to deal in electrical apparatus, engines, boilers, etc. The company has purchased five acres of ground at Red Bank, on the Pennsylvania Railroad, on which the first building, a steel and concrete structure, 100 ft. by 54 ft., to be used as a shop and warehouse, has already been erected. The Cincinnati office will he in the First National Bank Building. Mr. Paul Stewart, who has for the past ten years been connected with the John A. Stewart Electric Company, is president of the company; Mr. George W. Gano, a pioneer of the electrical field dating from the days of the Thomson-Houston Company, is vice-president and treasurer, and Mr. Colter Rule, for the past year secretary of the Interurban News Distributing Company, is secretary.

SANGAMO NEW YORK OFFICE.—The increasing business of the Sangamo Electric Company, Springfield, Ill., has necessitated opening an office in New York City, which has been placed in charge of Mr. M. B. Chase, previously in the Boston office of the Westinghouse Electric & Manufacturing Company. The Sangamo products now embrace a complete line of alternating-current and direct-current watt-hour meters, ampere hour meters for stationary battery and vehicle work, portable and switchboard type of graphic recorders. A complete line of indicating instruments, both portable and switchboard forms, has been designed and will be offered for sale within a few months. The New York office will be fully equipped from both an engineering and sales standpoint, so that a large part of the work, especially that for devices to meet special conditions, formerly referred to the factory will be handled direct from New York. A new factory is practically completed at Springfield, which will enable the Sangamo company to take care of its very rapidly increasing business.

ANDRAE BUILDING, MILWAUKEE, DESTROYED BY FIRE.—The large six-story building at 118-120 Sycamore Street Milwaukee, occupied by the electrical supply and machinery stock of the Julius Andrae & Sons Company, was completely destroyed by fire on Saturday evening, Jan. 7. The fire started in the machine shop on the third floor, and the destruction of the building and its contents was rapid and spectacular. The Andrae company valued its stock, comprising electrical supplies and machinery of all kinds, at $150,000, while the loss on the building, of which it was the tenant, will reach $50,000. These losses are covered by insurance. Immediately following the fire new quarters were opened by the company near the site of the destroyed building, and the company was only interrupted a day or two in filling orders. Mr. Julius Andrae, a pioneer in the electrical supply field, recently celebrated the fiftieth anniversary of his business, which is now conducted by his three sons. As the company lost many of its records, it will appreciate it if manufacturers will forward catalogs and trade literature to replace the burned collection. company will be largely in connection with electric lighting, transaction and industrial power work.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JAN. 10, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

980,912. CLUSTER LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Dec. 28, 1907. A plural lamp holding device with insulating base, center contacts, threaded shells, a plate with grooves to receive the shells for locking them in position.

980,913. CLUSTER LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed April 14, 1908. A supporting member, an insulating base extending beyond the support, a plate on the upper side, a bayonet connection between the plate and support and lamp holder and contact carried by the vase.

980,921. LOADED PHANTOM CIRCUIT; G. A. Campbell and T. Shaw, Brooklyn, N. Y. App. filed Feb. 12, 1910. Two-line circuits associated to furnish a phantom or third circuit and a loading coil for the phantom circuit, comprising sectional windings in both component lines, the admittances between each sectional winding and the other elements of the coil being symmetrically distributed.

980,926. TWO-BUTTON PENDENT SWITCH; F. C. De Reamer, Schenectady, N. Y. App. filed Oct. 2, 1907. Two-button drop switch with body of insulation having a slot and lips binding posts secured to upper end of the body, and a sheet of insulation having slits in its ends to form tongues adapted to engage the lips.

980,940. ELECTRIC INDUCTION FURNACE; C. Grunwald, Bredeney, Germany. App. filed April 20, 1909. An auxiliary winding for counteracting the repelling effect of the primary winding upon the melting bath, with means for preventing the current in the auxiliary winding from influencing the equilibrium of the bath.

980,945. ELECTRICAL BINDING POST; W. Hector, Chicago, Ill. App. filed Feb. 27, 1908. Sheet metal blank with solid filling and binding posts.

980,979. ELECTRICAL REGENERATIVE CONTROL APPARATUS AND SYSTEM; J. C. Macfarlane and H. Burge, Arc Works, Chelmsford, England. App. filed Feb. 7, 1910. A motor generator with a pair of motors in series with each other and with the generator and a reversible shunt for controlling the field of the generator together with constant excitation upon the pair of motors and auxiliary shunt winding connecting the pair and one supply main.

980,986. ALTERNATING-CURRENT ELECTRIC MOTOR; H. S. Meyer, Bremen, Germany. App. filed Aug. 22, 1906. A rotor with laminations having slots carrying a distributed winding and bars of magnetic material in the laminations below the slots and short-circuited.

981,004. ELECTROPLATING APPARATUS; M. Reid, Cleveland, Ohio. App. filed Feb. 19, 1906. A central anode surrounded by a cage, a cathode surrounding the anode and extending from the lower portion of the tank as high as the anode.

981,012. ELECTRIC CONTACT; A. Schweiger, Itzling-Salzburg, Austria-Hungary. App. filed April 8, 1909. Insulator with two current conductors and two electrically conducting arms suspended from the current supplying conductors so as to be in electrical connection therewith and two upwardly extending projections integral with the arms carrying an insulator which receives the free ends of the wires, which are inclosed by a tube secured to the insulator.

981,015. PHANTOMED LOADED CIRCUIT; T. Shaw, Hackensack, N. J. App. filed Feb. 12, 1910. Line circuits forming a third or phantom circuit with a loading coil in each component, each coil having a core and winding thereon symmetrically arranged to minimize the magnetic leakage resulting from operating currents in the phantom circuit.

981,020. FIRE ALARM; F. D. Smenner, Fort Wayne, Ind. App. filed Sept. 9, 1908. Controlled by a weighed cord and weighed triggers.

981,027. CONNECTOR FOR ELECTRIC CONDUCTORS; G. E. Stevens Lynn, Mass. App. filed April 1, 1908. Socket terminal having elongated groove strips with springs pressing them together.

981,038. RENEWABLE FUSE FOR ELECTRIC CIRCUITS; J. A. Volk, Jr., South Norwalk, Conn. App. filed April 20, [illegible]. A non-conducting fuse body with end plates detachably secured thereto and having central holes and caps with screws engaging the holes.

981,057. ROTOR COIL RETAINER; A. J. Brown and R. B. Williamson, Milwaukee, Wis. App. filed April 8, 1910. A member with projecting poles and coils thereon bracing members for supporting adjacent sides of the coils and tie rods for fastening them together.

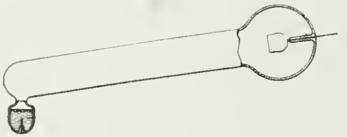
981,059. ROTARY CONVERTER; J. L. Burnham, Schenectady, N. Y. App. filed March 28, 1908. An armature with commutator and brushes, connections for supplying current to and from the armature, a field with poles surrounding the armature. Field magnet windings on the frame and connections for shifting the line of effective magnetization circumferentially with respect to the field by a variation in the relative current strengths in the windings.

981,063. SWITCH FOR ELECTRIC CIRCUITS; H. W. Cheney, Norwood, Ohio. App. filed Nov. 29, 1907. Circuit breaker with a reciprocating arm for opening and closing the contacts, one fixed and the other on a rotating drum within which a coil conductor is arranged which acts as a blow-out magnet.

981,074. SPLIT-KNOB INSULATOR; H. H. Dupont, Indianapolis, Ind. App. filed April 14, 1910. An insulator with two interlocking members for clamping the wires between them, which members are triangular in cross-section with wire grooves at each corner.

981,092. MAGNETIC SEPARATOR; A. Kuhn, Marchegg, Austria-Hungary. App. filed May 27, 1909. A drum having magnetic elements of Z-shape around the circumference and carried by non-magnetic spiders with annular retaining rings for the magnetic elements.

981,102. ELECTROLYTIC DEVICE FOR GENERATING PURE OXYGEN AND HYDROGEN; Wasquehal, France. App. filed Sept. 17, 1909. Electrodes with extensions having holes to form canals and a settling tank with means for draining off the impurities.



981,328.—Method of Operating Vapor Electric Devices.

981,118. SAFETY APPLIANCE FOR ENGINE GOVERNORS; H. R. Rockwell, Mount Vernon, Ill. App. filed May 31, 1910. For stopping the engine by means of an electric circuit brought into action by the governor at a certain speed.

981,120. TELEPHONE AND TELEGRAPH SYSTEM; H. O. Rugh, Sandwich, Ill. App. filed June 26, 1908. For simultaneous telegraphy and telephony, two-line wires and selecting calling means, telephone instruments, telegraph instruments and means for preventing interference.

981,121. AUTOMATIC ARC LAMP; E. Sailer, Rochester, N. Y. App filed Nov. 3, 1905. Carbon feeding devices with rotatable extensions, an operating handle on each extension, one of the handles being movable axially relative to the other, a spring normally operated to hold the handles in co-operative relation and a detent arranged to engage the handle with a plunger adjacent to the handles co-operating with the detent.

981,129. PROCESS OF FORMING INSULATING TUBES; W. R. Seigle, Nashua, New Hampshire. App. filed Dec. 20, 1909. The method of forming tubes, which consists in distributing finely divided liquefiable hydrocarbon over a sheet of asbestos fiber, rolling the sheet into a tubular spiral, inclosing the hydrocarbon between its layers and heating the tubular body, liquefying and distributing the hydrocarbon in the mass.

981,134. ROTARY CONVERTER; C. P. Steinmetz, Schenectady, N. Y. App. filed March 20, 1909. The armature has a commutator and collector rings, main field poles, windings for varying the flux in the main poles so as to vary the relative voltages at the commutator and collector rings and unwound commutating poles at the points of commutation of the current flowing through the commutator.

981,141. MEANS FOR PRODUCING A VACUUM; P. H. Thomas, East Orange, N. J. App. filed Jan. 23, 1904. For exhausting a lamp by the action of vaporization by means of auxiliary expelling means which supplies an additional more easily volatizable liquid into the chamber prior to exhaustion.

981,155. LIQUID HEATER; H. E. Bandow, Chicago, Ill. App. filed Oct. 3, 1910. Heater with a reservoir and draw-off valve and an electrical heating unit in the base of the heater.

981,196. ELECTROPLATING APPARATUS; S. S. Jacobsen, Beaver, Pa. App. filed Feb. 15, 1910. A tank with right and left feeding screws below the solution for feeding the work through the tank and electrical connections to the screws.

981,197. SYSTEM OF ELECTRICAL DISTRIBUTION; J. W. Jepson, New York, N. Y. App. filed Aug. 29, 1905. A load circuit, a generator and storage battery for supplying the same and a booster to assist charging the battery with an automatic voltage regulator for the generator and circuit controllers therefor.

981,198. SYSTEM ELECTRICAL DISTRIBUTION; J. W. Jepson, New York, N. Y. App. filed April 30, 1906. A consumption circuit, a generator and storage battery connected therewith with a booster for charging the battery and a regulator for the generator voltage.

981,229. OPERATING MEANS FOR VAPOR ELECTRIC DEVICES; P. H. Thomas, East Orange, N. J. App. filed Feb. 10, 1904. A chamber contains a vaporizable liquid and is heated during normal operation of the mercury vapor apparatus and a second receptacle of large heat-radiating capacity is connected therewith, together with means for maintaining a difference in pressure between the two.

981,235. ELECTRIC METER; H. N. Atwood, Lynn, Mass. App. filed Aug. 20, 1908. An inverted cup-shaped mercury receptacle with an armature therein, a magnet with poles in operative relation with the sides and a second magnet with poles in operative relation with the top of the armature.

981,236. ELECTRIC METER; H. N. Atwood, Lynn, Mass. App. filed Aug. 20, 1908. A mercury meter with two disk-shaped members, an armature on a shaft in the mercury, magnets co-operating with the armature, the parts being supported on a back with means for indicating the movement of the shaft.

981,240. REFLECTOR SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Nov. 3, 1906. A lamp receiver and center contact, an insulating base at right angles, binding posts in recesses and a movable cover for closing access to the binding posts.

981,241. WEATHERPROOF PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed April 8, 1907. A molded structure formed of insulating material and comprising a base and a one-piece portion formed with a pair of lamp-receiving recesses with their axes coincident and parallel with the support to which the base is secured.

981,242. ELECTRIC LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Feb. 17, 1908. An electric lamp socket having a casing with lateral hollow extension, a cap for the top of the casing with cut-away portion in alignment with the extensions and locking means for securing them together.

981,244. ELECTRIC WATER HEATER; H. A. Burns, Oakland, Cal. App. filed Sept. 3, 1910. A cup-shaped member with inner and outer casings and a coil of wire between the casings with a tube secured to the inner casing and conducting wire within the tube.

981,248. ELECTRIC ARC LAMP; J. T. H. Dempster, Schenectady, N. Y. App. filed May 31, 1902. Electrodes vertically arranged and a draft tube surrounding the upper electrode with its lower end on a level with the lower electrode.

981,256. *X*-RAY APPARATUS; W. S. Fullerton, St. Paul, Minn. App. filed May 25, 1908. A tubular standard with sliding head and counterweight, a tube holder, a lever pivoted upon the head and a sliding ring connected to the lever.

981,309. RAILWAY BOND WIRES; J. B. Richardson and T. W. Meich, Somerville, N. J. App. filed Aug. 17, 1910. Adjacent rails and a fish-plate are connected by two bond wires, one at each end of the fish-plate.

981,328. METHOD OF OPERATING VAPOR ELECTRIC DEVICES; P. H. Thomas, Montclair, N. J. App. filed March 31, 1905. Prevents excessive pressure by generating vapor at the negative electrode and cooling it at a distance from the electrode.

981,334. ELECTRIC HEATING IRON; H. Vanderpool, Turtle Creek, Pa. App. filed March 19, 1910. A removable resistance unit arranged for insertion in the interior of the iron, with means for securing it therein and switch mechanism for establishing varying currents through the resistance unit.

981,371. ELECTROLYTIC CELL; F. H. Briggs, Elyria, Ohio. App. filed June 22, 1910. A cathode electrode formed of suitable conducting material with slanting sides which terminate in a point and are closed at the bottom.

981,399. TELEPHONE TRUNKING SYSTEM; A. H. Dyson, Chicago, Ill. App. filed Jan. 22, 1907. Telephone lines, selecting switches, a common control therefor, a pair of relays with each line and an energizing circuit for the control.

981,406. MULTIPLEX TELEGRAPHY; R. A. Fessenden, Washington, D. C. App. filed Jan. 4, 1906. Transmits alternating currents over a line and causes them to interact with local alternating currents by passing them through the coil of an electromagnetic indicating mechanism supplied with local current.

981,447. ILLUMINATING INSTRUMENT; H. T. Martin and J. F. Golden, Baltimore, Md. App. filed Dec. 27, 1909. For inspecting the mouth by means of a casing containing an electric lamp and conducting connections within the casing pressing against the lamp to hold the same in position in the tube.

981,452. ELECTRIC SWITCH; P. T. McNally, Mandan, N. D. App. filed Dec. 21, 1909. A snap switch with an insulating base member, standards carried thereby, and carrying contacts and a main switch spindle provided with arms to co-operate with said contacts.

981,481. ELECTRIC HEATER; M. H. Shoenberg, San Francisco, Cal. App. filed Nov. 7, 1910. A receptacle with a faucet and an electric heater with tubular passage extending therethrough, forming a direct connection to the faucet.

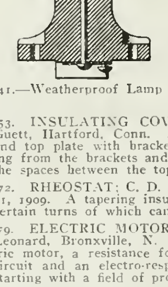
981,497. METHOD OF REMOVING DELETERIOUS GASES; P. H. Thomas, East Orange, N. J. App. filed Jan. 23 1904. For vapor lamps in which foreign gases are driven out by the convective action of vapor raised to a very high pressure within the chamber, the return of the gases being prevented by maintaining an internal pressure and outward velocity of the vapor from the chamber and closing the chamber at the proper time.

981,498. VACUUM APPARATUS; P. H. Thomas, Montclair, N. J. App. filed Jan. 23, 1904. Instead of placing the mercury in the vessel to be exhausted, he locates it in a separate receptacle below the vessel to which it is connected by a neck which can be sealed off when the operation is complete. The vessels are heated and a mechanical pump exhausts the bulb.

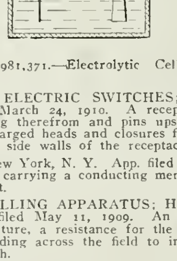
981,503. VACUUM DISCHARGE GAP FOR PRODUCING ELECTRICAL OSCILLATION; H. F. Waite, Harrison, N. Y. App. filed May 10, 1910. Spark gap with exhaust chambers having solid and liquid electrodes and series connections uniting the solid electrodes.

981,535. TROLLEY POLE; F. L. Cross, Annapolis, Md. App. filed July 6, 1909. A hollow trolley pole, flexible laterally with a main portion on edge in the vertical plane of the car.

981,545. MOTOR LEAD CONNECTION FOR STREET CARS; H. Etheridge, Zelienople, Pa. App. filed May 13, 1909. Provides a lead connection between the conduits and the motors to obtain flexibility, the leads being arranged over the top of the motors.



981,241.—Weatherproof Lamp Socket.



981,371.—Electrolytic Cell.

981,553. INSULATING COVER FOR ELECTRIC SWITCHES; M. Guett, Hartford, Conn. App. filed March 24, 1910. A receptacle and top plate with brackets extending therefrom and pins upstanding from the brackets and having enlarged heads and closures filling the spaces between the top plate and side walls of the receptacle.

981,572. RHEOSTAT; C. D. Kestner, New York, N. Y. App. filed Dec. 31, 1909. A tapering insulating core carrying a conducting member, certain turns of which can be cut out.

981,579. ELECTRIC MOTOR CONTROLLING APPARATUS; H. W. Leonard, Bronxville, N. Y. App. filed May 11, 1909. An electric motor, a resistance for the armature, a resistance for the field circuit and an electro-responsive winding across the field to insure starting with a field of proper strength.

981,586. LAMP HOLDER; T. B. Monosmith, Bay City, Mich. App. filed June 1, 1909. Exploring search lamp with a tubular member receiving a lamp socket and clamps for the cord, the clamps having tenons formed in the tubular member.

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THE ELECTRONIC THEORY AND CORONA LOSS FROM TRANSMISSION LINES.

In the discussion before the American Institute of Electrical Engineers of the recent important paper by Prof. Harris J. Ryan on high-tension corona, much was talked about electrons and the electronic theory. In fact, so much was said about electrons that the subjects of corona and corona loss from high-tension conductors became somewhat overshadowed thereby. In the passage of electric discharges through gases the phenomena are so complex and hard to account for that the physicist has been glad to entertain any theories that offered promises of simplification. The electronic theory is the most promising one and has done more to explain the subject than any other yet proposed, but the matter is so complex that, even with the aid of a promising theory, very little progress has been made arithmetically in solving actual problems of spark discharge. The conflicting views of the theory set forth in the A. I. E. E. discussion indicate its present nebulous character.

According to the electronic theory there are two kinds of electricity, positive and negative. Each is composed of definite and seemingly indivisible charges—the electron charges. It is supposed that electricity is made up of similar parts, each part—the electron—being indivisible, or an electric atom. Not only are all electric charges composed of aggregations of electrons, but the atoms of matter are imagined to consist of organized groups of electrons, each chemical elementary substance having its atoms all composed of like electronic groups. The positive electron is hard to identify and is supposed to be a relatively large and slowly moving entity, but negative electrons are identifiable, isolatable, extremely minute and very mobile. It is supposed that the internal forces that bind together the numerous electrons in a chemical atom are electromagnetic forces, and likewise the chemical forces that bind atoms into molecules. According to this view, all matter is but organized associations of minute electric charges, and all chemistry is but the classification of the results of the electric forces connecting these charges. It is assumed, on the same theory, that if we understood the electronic organization of hydrogen and oxygen atoms we should be able to predicate the mutual chemical affinity of these atoms, and to predict the amount of heat liberated by their union into molecules of water. Up to the present time, however, it does not appear that any single chemical formula has been explained, much less predicted, by the electronic theory.

Nevertheless, there are seeming corroborations and confirmations of the electronic theory in view. If, for instance, we accept the electronic theory of the structure of matter, then the property of inertia in matter is accounted for. It is merely a particular case of electromagnetic inertia, as witnessed in electric circuits. In the electronic theory of discharge through gases gaseous molecules at ordinary temperature are to be regarded like solar systems perhaps, each with a positive electron nucleus, like the sun, and an attendant swarm of negative electron satellites. The electric force which connects the negative electrons elastically with the central positive sun is relatively so strong that no satellite electron can escape. Such solar systems are neither positive nor negative, as a whole, but neutral and electrically balanced. In free air, at ordinary temperatures, there are, however, a few casual negative electrons or disengaged satellites flying about loose. These may have been separated from their proper solar systems by the operation of specially powerful forces or ionizing forces, such as ultraviolet light, radio-activity, etc. These negative electrons are virtually minute unattached negatively electrified pith-balls. In any electrostatic field they are urged with great speed along the lines of the electric force, and may acquire thereby great velocities. Granted a sufficiently powerful electric field and a sufficiently great distance for the same to act in, the electron velocities attained will be sufficient to smash any regular solar-system atom with which the electron may subsequently collide. The disrupted satellites then form new free electrons, which in their turn may be urged to disrupt yet more atoms, until the region will be filled with free negative electrons, which is the same as saying that the region becomes conducting and that a discharge will occur through it.

The picture thus suggested to the mind may be a substantially correct presentation of the facts, and yet the complexity of the action may be so great that no quantitative help is derivable from it. The theory is not sufficiently far developed to enable us to solve problems arithmetically. The only help that the engineer can yet obtain from the electronic theory, in relation to high-tension corona loss, is qualitative help in grasping the origin and nature of the phenomena. In order to arrive at numerical relations he has to depend on the results of observations and on empirical formulas deduced therefrom. From a numerical point of view he would be as well off without any electronic theory. Nevertheless, it seems very likely that further quantitative advance from empirical to rational formulas will have to be made along the electronic theory, which is, therefore, to be developed and fostered, not discarded and ignored.

THE DETROIT TUNNEL SUBSTATION.

Elsewhere in our columns will be found a somewhat extended account of the very ingenious substation equipment used in the Detroit River Tunnel railway installation. The conditions in this plant are very peculiar, owing to the fact that it is operated by electrical energy purchased from the system of the Detroit Edison Company. On general principles a first-class central station should be able, and is able, to deliver power at a figure economically comparable with anything that is likely to be done by a local power plant save of the largest size. With powerful locomotives to deal with, however, on the somewhat severe service of the tunnel, it becomes necessary in thus purchasing power to take measures to equalize the load as far as possible, so as to avoid, in the first place, sudden peaks which might interfere with the general service of the supply company and also to avoid the high maximum demand which large peaks entail. To meet these requirements an extremely well-planned combination of motor-generators, storage battery and regulating devices was installed, so that the first 800 amp comes from the motor-generators and then the battery comes into play to take the peaks up to a little more than 8000 amp, after which a reserve of about 800 amp more may be drawn from the motor-generators as a last resort.

The motor-generator sets themselves are worth a little comment. The chief machines are a pair of 1000-kw synchronous motor-generator sets. Each set is a two-bearing unit on a common base, and is provided with a direct-connected exciter. The extraordinary feature of these machines is the very high efficiency, reaching a little over 95 per cent at full load and 92 per cent at half load. This efficiency is so high as to leave little margin for improvement, even if it were feasible to use synchronous converters for the peculiar requirements of the situation. In addition, a 50-kw reversely operated motor-generator set is provided, allowing high-voltage three-phase currents for lighting and incidental purposes to be generated from the main storage battery if necessary. Reference should be had to the article itself for the very interesting regulating devices, too intricate to summarize here. Their actual effect is to keep the load on the batteries as a regulator at all times when severe demands for current appear, save when by chance the capacity of the battery might be somewhat exceeded. In normal operation the regulating apparatus and battery preserve practically constant load on the supply lines. Only by the use of such devices can a central-supply station safely take on a relatively large railway load, but with them it becomes both feasible and economical so to do; and the chances are that as time goes on there will be more and more of this unification of current supply in a given territory, now that the engineering difficulties of the problem have been so successfully met.

UNUSUAL CURRENT RELATIONS IN CONDENSIVE AND INDUCTIVE CIRCUITS.

In dealing with simple direct-current circuits the action of Ohm's law in regard to the effect of resistances in series or in parallel is usually so clear that the behavior of the indications of the voltmeters and ammeters in the circuit is easily understood. When, however, we deal with alternating-current circuits, where Ohm's law applies in a two-dimensional sense instead of in a purely numerical sense, the actions in the circuit may be very puzzling at first sight. For instance, we may take a single-phase generator supplying current to a single condenser. The two terminals of the generator armature are to be connected through an ammeter with the two terminals of the condenser. A certain current strength will, of course, be indicated on the ammeter dial as flowing through the generator and condenser. If, now, a choking coil be connected in shunt to the condenser, the generator will be able to send a current through the choking coil as well as the current through the condenser, so that, at first thought, the current through the ammeter should be increased. Actually, however, the current may be diminished and, if the choking coil be carefully adjusted to the condenser, the current supplied by the generator to the two devices together may be very small.

The case described in the article on page 232, by Mr. Alfred Still, may be explained on somewhat similar lines. As shown in the article, a certain variable-ratio transformer takes a somewhat large lagging current for excitation. When condensers are connected to the secondary terminals a leading charging current is superposed upon the lagging current of excitation. The vector sum of a leading and a lagging current may be smaller than either of the two components. Up to a certain point, therefore, the addition of leading current diminishes instead of increases the resultant primary current. The explanation given by Mr. Still seems to be entirely adequate, but the phenomenon is probably no more wonderful than occurs in every-day practice with a rotary condenser or synchronous machine operated on an alternating-current system partly as a synchronous motor and partly as a power-factor improver. Thus, such a machine may be receiving, say, 100 kva from the line. It may be delivering nearly 70 kw as a motor and at the same time nearly 70 kw of reactive power to the system, or apparently nearly 140 kw in all.

Both the test results and the analysis thereof by Mr. Still have been kept in their simplest form by maintaining the voltage impressed on the condensive circuit at a constant value. If the voltage impressed on the primary circuit of the transformer of high magnetic leakage had been kept constant, then the secondary e.m.f. would have increased steadily with each addition to the condensive secondary load, the effect upon the primary current being cumulative to a certain extent. Thus each cable coil condenser connected to the secondary circuit would not only receive more current than the value taken by each coil already in circuit, but the latter coils would receive an increased current. This effect is attributable to the fact that the leading current drawn through the highly inductive reactance of the transformer coils raises the terminal e.m.f. of the circuits considered as a transmission system. The phenomena here considered are closely related to the so-called resonance phenomena when the leading component of the primary current equals the lagging component, but the resonance effect is rendered inconspicuous by reason of the presence of the power component to overcome the losses in the transformer core and coils.

PERFORMANCE TESTS OF SERIES TRANSFORMERS.

As is true of the so-called constant-potential or shunt transformer, the secondary current of a series transformer differs from the product of the primary current and the transformation ratio by an amount equivalent to the requirements for magnetizing the core. In a shunt transformer the exact ratio of the primary to the secondary current is of relatively small importance compared with the exactness of the voltage ratio, while in a series transformer the current ratio is of considerably more importance than is the voltage ratio. For this reason the series transformer is frequently referred to as a current transformer, but the phenomena in this transformer differ only in magnitude from those in a so-called voltage transformer. Elsewhere in this issue appears an article by Mr. H. S. Baker in which is described a method for determining the current ratio of a series transformer by opposing the m.m.f. of the primary current against that of the secondary current when the two currents are passed around a special test core. The relative values of the opposing m.m.fs. are varied by changing the ratio of turns on the test core. The adjustment cannot be so made that the resultant m.m.f. reduces to zero, because there is a certain time-phase displacement between the primary and secondary currents; but the ratio of turns on the test core when the resultant m.m.f. has its minimum value can well be taken as the current ratio of the series transformer under the conditions existing during the test. The chief feature of the method described resides in the scheme employed for determining when the adjustments made give the minimum resultant m.m.f. on the test core. The e.m.f. produced by the flux due to this m.m.f. is indirectly observed both in value and in relative time-phase position by impressing it upon the voltage coil of a wattmeter the current coil of which is subjected to currents of definite values displaced relatively by known time-phase angles. For this purpose use is made of a source of three-phase e.m.f. for the current coil of the wattmeter. In order for the wattmeter to record a deflection it is essential for the currents in its two coils to be of absolutely the same frequency, which fact points to the necessity for supplying the current to the series transformer from the three-phase source and for maintaining the three-phase e.m.f. constant throughout the tests. When proper precautions are taken the method should give good results. Being of the opposition variety, it should possess a considerable degree of accuracy when skilfully applied

AUTOMATIC CONTROL OF TEMPERATURE.

The machinery of the solar system for heating the surface of the earth by the radiation of the sun is about the worst conceivable by the mind of thinking man, either from the standpoint of efficiency or from that of uniformity. It is saliently evident that the concept of warming animals, or of keeping their temperatures uniform, at the surface of the earth was not prominent in creative thought when the conditions of our partcular and insignificant little solar system were being forged in the giant smithy of Nature. Our own little heating machines for artificially warming inhabitable interiors are wasteful enough, and variable enough, to satisfy a profound pessimist; but they are models of efficiency and of regularity by comparison with solar radiation, from the standpoint of those who profess to believe that the sun was created for the purpose of giving life and warmth to man. We are only beginning to reconcile the exigencies of ventilation and of heating in our dwellings so as to combine warmth efficiency with hygiene. But for keeping the temperatures of our laboratories constant we already possess some fairly satisfactory devices.

A particular form of electric thermostat was described on page 112 of the *Electrical World* for Jan. 12, 1911, by Prof. A. A. Somerville. There are certain difficulties met with in all electrically controlled thermostats, and principal among these is the burning of the contacts at the automatic controlling switch Once these contacts get out of order the apparatus becomes unreliable and is apt to behave as though under the control of an intoxicated individual. Great care is, therefore, needed for insuring the maintenance of the contacting surfaces in effective condition. In the apparatus described in the article the contacting surfaces are both of liquid mercury. In the presence of air and under unfavorable conditions such mercury contacting surfaces might soon become dirty and unreliable, but under the conditions described in the article the contacts may evidently be kept in proper operative condition for an indefinite period. As mentioned in the article, the sensitiveness of this thermostat to casual changes of air-temperature depends in large measure upon the dimensions of the air-bulb. Large, thin-walled bulbs promptly bring their contained air close to the temperature of the external air, with corresponding change in the pressure or volume of the contents, whereas small, stout-walled bulbs are more sluggish in their action

N. E. L. A. Growth.

With the new year the National Electric Light Association has taken another leap forward in membership and on Jan. 21 it crossed the 6500 line. This is a gross gain of over 1500 since the St. Louis convention and a net gain of about 1250. The Canadian Electrical Association voted last week to affiliate with the N. E. L. A. body and this will also bring a large accession; while new company sections are being formed in Pittsburgh, Allegheny City, Scranton, Connellsville, Pa., and other cities. Mr. H. H. Scott, the chairman of the membership committee, estimates that 7000 members will be enrolled by the end of the month and that the number may easily be 8000 by the next annual convention in June. The membership fifteen months ago was slightly over 3000. A number of smaller central-station companies are included in the new membership.

Oklahoma Decision on Regulation of Rates.

The Supreme Court of the State of Oklahoma has handed down a decision in a case involving the regulation of the rates of a telephone company which includes an interesting discussion of all the elements that enter into a proper determination of rates for telephonic service and incidentally of service supplied by any public utility company. The opinion, which is of such length that it cannot be here printed in full, is one of much interest, in this respect resembling the opinion of the Supreme Court in the case of the Knoxville Water Works Company, which is frequently quoted, and the several precedent-making opinions of the Wisconsin Railway Commission relating to the valuation of public service properties, etc., which are also quoted.

The case was an appeal from the Corporation Commission of Oklahoma, which had issued an order against an increase made by the Pioneer Telephone & Telegraph Company in the schedule of rates for Enid, Okla. The opinion states that the basis of calculations as to reasonableness of the rates to be charged by public service corporations is a fair valuation of the property used by the corporation in rendering service to the public, and the opinion then proceeds to establish in detail what constitutes fair valuation. It was held that when the present value of a telephone exchange plant is being ascertained for the purpose of determining what amount the company is entitled to earn as a fair return upon its investment, and such value is ascertained by determining what amount it would cost to reproduce the plant, a reasonable amount for interest on the capital invested in the equipment of the plant during the period of construction should be allowed. In estimating the cost of reproducing the plant a deduction for depreciation of the physical properties from age and use should be made from the estimated cost of reproduction or replacement new. Consideration should not be confined to the valuation of the bare physical plant, but where the exchange has a large patronage sufficient to pay operating expenses, fixed charges and some profits, and when such patronage has been built up by an expenditure of labor and money for a period of time during which the plant was operated at a loss, these points should be considered and a reasonable amount allowed to make good the depreciation of the plant and replace the deteriorated portions when they become so impaired that they can no longer be made usable by repair. Rates are not excessive, oppressive or unreasonable to the public that yield only sufficient revenue to pay operating expenses and fixed charges, including a reasonable amount for depreciation and a return, as in the present case, of less than the legal rate of interest on the value of the properties used in rendering the service.

In the valuation of the property the court added a sum equal to 20 per cent of the value of the physical property of the company, this addition representing a "going concern" value. In discussing what rate a public service corporation may be permitted to earn without constituting an unreasonable charge for the service rendered, it was stated that this is in a great measure determined by the character and amount of the investment, the return that other investments of similar character and amount in the same community yield and the prevailing rate of interest. Investments in telephone properties in Oklahoma cannot be regarded as investments of such high grade as state or federal bonds or as in communities where the demand for telephone service is established or more definitely ascertainable than where it is subject to the varying changes of a rapidly developing country.

In conclusion the court ordered that the schedule rates established by the company and ruled against by the commission shall be the rates hereafter charged; if, however, subsequent experience in the operation of the exchange at Enid develops that these rates operate oppressively upon the public, or fail to render a reasonable return upon the property, either party has a remedy for relief by application to the commission.

Wisconsin Electrical Contractors' Association.

The two half-day sessions of the Wisconsin Electrical Contractors' Association held at the Republican Hotel, Milwaukee, Jan. 17 and 18, were devoted to the discussion of business topics of particular interest to electrical contractors. The Wisconsin association comprises 20 members, all of whom, with one exception, were present at Milwaukee. For the next year officers were elected as follows: President, R. J. Nickles, Madison; vice-president, George Pohlman, Milwaukee; treasurer, George Knoerr, Milwaukee; secretary, Albert Petermann, Milwaukee (re-elected). Mr. F. W. Pittman, of Lacrosse, was elected to the board of directors, the other members of which are Messrs. G. E. Rohn, of Milwaukee, and A. C. Langstadt, of Appleton. The association holds two meetings each year. The summer meeting of 1911 will commence at Oshkosh some time in August, from which point the contractors will charter a vessel for four days, following the plan of preceding years, for a cruise up the Wolf River, stopping at night to disembark for sleeping. All the meetings and meals will be held on board the boat during the trip.

Wood Preservers' Association.

The seventh annual meeting of the Wood Preservers' Association was held in the Auditorium Hotel, Chicago, on Jan. 17, 18 and 19. President Walter Buehler, of St. Louis, was in the chair, and Mr. F. J. Angier, of Chicago, the secretary, performed the duties of his office. The attendance was about 100, composed principally of railroad men or commercial men interested in methods of wood preservation.

The discussions were technical to the art of wood preservation and were brought out by the following papers: *What Railroads Have Done for Forestry,* by Mr. E. A. Sterling, of Philadelphia; *Impurities in Zinc Chloride,* by Mr. C. M. Taylor, of Port Reading, N. J.; *Piling of Timber,* by Mr. J. H. Waterman, of Galesburg, Ill.; *General Review of Timber Treating in This Country,* by Mr. Walter Buehler, of St. Louis; *Results with Treated Ties Along the South Atlantic Coast,* by Mr. William A. Fisher, of Wilmington, N. C.; *The Covering of Retorts,* by Mr. R. W. Yarbrough, of Texarkana, Tex.; *Plants in the North and in the South,* by Mr. Andrew Gibson, of Brainerd, Minn.; *Grouping Timbers for Treatment,* by Mr. W. F. Goltra, of Cleveland, Ohio; *Penetrations from Different Amounts of Preservatives,* by Mr. R. L. Allardyce, of Texarkana, Tex.; *Prolonging the Life of Railway Cross Ties,* by Mr. F. J. Angier, of Chicago; *Treatment of Sawed and Hewn Ties,* by Mr. H. J. Whitmore, of Denison, Tex.; *Depths of Penetration with Different Amounts of Preservatives,* by Mr. David Allerton, of Madison, Ill.; *Benefits of the Annual Meetings,* by Mr. William Townsley, Jr., of Cleveland; *Withdrawal of Creosote from Wood by Subsequent Vacuum,* by Mr. C. E. Chanute, of Chicago, and *General Review of Timber Treating in this Country,* by Mr. John T. Logan, of Texarkana, Tex.

This list of papers indicates the varied aspects of the art of wood preservation. It is the province of the Wood Preservers' Association to maintain a high standard of professional procedure in the work. One point brought out which may be of some importance to electrical men interested in the preservation of poles is that creosote penetrates farther into wood than the discoloration of the wood would indicate.

Officers were elected as follows: President, Mr. John T. Logan, Texarkana, Tex.; vice-presidents, Andrew Gibson, of Brainerd, Minn.; Mr. R. J. Calder, of Galveston, Tex., and D. Burkhalter, of Bradford, Pa.; secretary-treasurer, Mr. F. J. Angier, 1033 First National Bank Building, Chicago. The next annual meeting will be held in Chicago on Jan. 16 to 18, 1912.

Electric Power Club.

The midwinter meeting of the recently organized Electric Power Club was held at the University Club in Chicago on the evening of Jan. 17. The gentlement present, to the number of about thirty-five, sat down to a dinner and afterward there were several speeches. President Hobart delivered an address of welcome and Mr. James Burke, of Erie, Pa., performed the duties of toastmaster. Dr. R. A. Millikan, professor of physics in the University of Chicago, spoke on the "Atomic Theory of Electricity"; Mr. Charles A. Brown, of Brown & Williams, patent lawyers, Chicago, on "The Relation of Patents to Pooling Agreements," and Mr. Frederic P. Vose, of Vose & Page, lawyers, Chicago, on "The American Attitude Toward Law."

The Electric Power Club is an organization of national scope, having for its object not only the social commingling of its members, but also, in a general way, the standardizing of electrical apparatus from an engineering point of view. At its meetings papers are presented on technical subjects and also on the technical problems of electrical manufacturing. Mr. C. A. Hobart, of Cincinnati, is president of the club; Mr. E. R. Harding, of Chicago, is treasurer, and Mr. Charles A. Roth, of Chicago, is secretary.

Meeting of the Indiana Engineering Society.

The fourteenth annual meeting of the Indiana Engineering Society was held in the Denison Hotel, Indianapolis, Jan. 12 to 14, the registration reaching eighty-five. Ten new members were admitted to membership. The meeting was called to order by E. E. Watts, of Princeton, who deplored the fact that public money is being wasted by incompetent engineers and recommended an amendment to the present law fixing adequate compensation for engineers on public work. He thought engineers should pass an examination for registration by a State board and only men thus qualified should be permitted to take employment on public works.

In his report as chairman of the committee on mechanical engineering Mr. O. B. Zimmerman said there is a lack of technical instruction in secondary schools which accounts for the primary studies in the curricula of technical schools. An interesting talk was given at the morning session of the concluding day by Mr. Frank R. Daniels, of Indianapolis, on "The Prevention of Electrolysis." He said corrosive action of the kind which has done much damage to underground pipes can be checked and practically eliminated by careful study of conditions and the application of modern principles of insulation and conduction. Because of the large losses suffered by electric lines from theft, the roads are adopting the welded rail bond, as more satisfactory than the type that can be removed and sold for the copper of which it is made. Mr. Charles A. Tripp, of Indianapolis, made a brief report of the year's advances in electric construction, saying that while no new inventions had been brought out the advance in electrical equipment had been in some respects remarkable. Mr. Tripp followed his report by reading a paper on the application of "Individual Electric Drives to Textile Machinery." He said there was a growing tendency of engineers to abandon the shaft and pulley for separate motors regardless of the difference in the cost of placing and operation.

The following officers were elected for the ensuing year: President, Mr. Daniel T. Luten, Indianapolis; vice-president, Mr. Malvard A. Howe, Terre Haute; secretary, Mr. Charles Brossmann.

Byllesby Convention in Chicago.

The second annual convention of the employees of H. M. Byllesby & Company and affiliated public service companies was held in the Congress Hotel, Chicago, Jan. 12-20. The registered attendance was 286, 128 of this number being from the home office in Chicago and 158 from the various affiliated companies scattered throughout the country, these latter operating electric service, street railway, gas, power-transmission and telephone utilities in eighty-two municipalities throughout the West and South.

The meeting was opened by an address by Mr. H. M. Byllesby, president of the parent company, who in the course of his speech gave some interesting statistics showing the magnitude and extent of the work carried on under the direction of the company of which he is the head. A year ago the company was operating in forty different municipalities, while at present its activities embrace eighty-two different municipalities in this country, which are spread broadly from the Canadian border on the north to the Gulf of Mexico on the south and from Illinois to the Pacific Ocean on the west. The employees directly on the pay rolls of H. M. Byllesby & Company are 138 and those permanently and directly in the field in the various local companies aggregate 2400, making a total of 2538 regular employees. In addition, during the last twelve months an average of 2000 men have been at work in the field on construction, making a grand total of 4538 individuals employed and corresponding to about 23,000 individuals whose livelihood depended upon the interests represented at the meeting.

As compared with the Commonwealth Edison Company, which has 125,000 consumers, the interests represented have 129,146 consumers. The Byllesby company on Dec. 31, 1910, had $157,000 more cash in hand and $700,000 less liabilities. According to the report of the firm which audited the accounts of the company, during the past year its worldly wealth was increased by the sum of $758,356.53, and it was certified that the company on Dec. 31, 1910, had a capital and assets beyond all liabilities of $4,230,000. During the year 1909 the sale of securities was between $12,000,000 and $13,000,000, while in the past year it was between $22,500,000 and $23,000,000.

Mr. Byllesby called attention to the action of a prominent public service commission in one of the States in which the company operates largely, which has prepared a bill to submit to its State Legislature whereby public service corporations are authorized, after having capitalized at market value in stocks and bonds for the actual cash cost of their properties, to add thereto 100 per cent of "profit-sharing stock," thus recognizing the value of encouraging industry and enterprise. Mr Byllesby considers that this is one of the most remarkable steps in advance that have taken place in the public service business in the thirty years during which he has been connected with it Mr F. H. Tidnan, manager of the Oklahoma Gas & Electric Company and chairman of the convention, responded in appropriate terms to Mr. Byllesby's address.

During the four days' convention fifteen papers were presented, among which were the following having a direct electrical bearing: "Ornamental Curb Lighting," by Mr. B. W. Cowperthwait, of Faribault, Minn.; "Effective Illumination," by Mr. A. Larney, of Oklahoma City; "Central Station Economics," by Mr. Eugene Holcomb, of St. Paul, Minn.; "Unusual Engineering Design and Construction," by Mr. W. R. Thompson, of Chicago; "Construction of Hydroelectric Plants Relative to Economy in Operation," by Mr. J. M. Link, of Chicago; "Electric Versus Horse-Drawn Wagons," by Mr. F. H. Tidnan, of Oklahoma City; "The Effect of High-Efficiency Lamps on the Central-Station Industry," by Mr. Alex F. Douglas; "District System of Meter Reading," by Mr. T. K. Jackson, of Mobile.

On Wednesday afternoon Mr. Samuel Insull, president of the Commonwealth Edison Company, gave an address on modern methods of conducting central-station business, and later in the same day Mr. Byllesby gave some interesting reminiscences of the days of electric lighting in the early eighties, when the speaker was a member of the staff of Mr. T. A. Edison.

On the recommendation of a committee of which Mr. Harold Almert, of Chicago, is chairman it was decided to start a monthly technical and commercial paper to serve as a medium of communication between the various companies and interests affiliated with H. M. Byllesby & Company. It was also decided to collect information on industrial power for a data book to be furnished to all representatives of the companies interested in the various States, which will show the characteristics of various industrial plants using electric drive supplied with electrial energy by the various affiliated companies. The book will contain information about load-factors, connected load, power required to drive various types of machinery, etc.

On Tuesday afternoon, Jan. 17, Mr. and Mrs. Byllesby gave a reception at the Drexel Boulevard home to the delegates of the convention. Opportunity was also offered to visit the Chicago Electrical Show. Thursday evening there was a theater party. There were also excursions to the Fisk Street power house and Division Street gas works. On Friday evening a banquet was given at the Congress Hotel, at which speeches were made by Mr. Samuel Insull; Mr. Frank H. Jones, vice-president of the Continental & Commercial Trust & Savings Bank, of Chicago; Rev. Dr. Herman Page, of the St. Paul Protestant Episcopal Church, Chicago; Mr. E. S. Kiser, of the Chicago *Record-Herald,* and Mr. J. R. McKee, of the General Electric Company.

Mr. T. J. Jackson, president and general manager of the Mobile Electric Company, was elected chairman to preside at the opening of the next convention, which will be held in Chicago next January; Mr. E. M. Emery, of Mobile, was appointed secretary of the convention, and Mr. R. J. Graf, of Chicago, treasurer.

The officers of H. M. Byllesby & Company are as follows: President, Mr. H. M. Byllesby; vice-president, in charge of operation, Mr. A. S. Huey; vice-president and chief engineer, Mr. O. E. Osthoff; vice-presidents, Messrs. J. S. Cummins, of Chicago, and C. E. Groesbeck, of Portland, Ore., in charge of Pacific Coast interests; treasurer, in charge of auditing, Mr. J. J. O'Brien; secretary, Mr. R. J. Graf; assistant treasurer, Mr R. E. Wilsey.

Electricity in Iron and Steel Making.

A symposium on the subject of the manufacture of iron and steel by electric furnace methods held under the auspices of the Chicago Section of the American Electrochemical Society, Jan. 20, brought out a record attendance of interested chemists and engineers which taxed the assembly hall of the Western Society of Engineers in the Monadnock Block, Chicago, where the meeting was held.

Mr. James Lyman, district engineer for the General Electric Company, opened the subject by describing the construction, use and advantages of various types of electric furnaces. Present steel-making methods have been refined almost to their ultimate limit, said Mr. Lyman, and, although the quality and output have been increased all along the processes, such reduction methods requiring fuel combustion have the disadvantages of being difficult to handle and may produce non-homogeneous material and introduce impurities into the product unless great care is taken. The electric furnace, however, working without fuel, permits reactions to be carried on in a neutral atmosphere without the addition of impurities, and allows higher temperatures, greater fluidity of flux and metal, and closer control of furnace processes, making possible the production of hitherto unknown steels and alloys. The cost of electricity for steel-making processes, when obtained from water-power or blast-furnace gas sources, is quite comparable to the cost of high-grade fuel in the older processes. A large proportion of fuel in the ordinary furnace is used to produce and maintain smelting temperature, only a small fraction of this quantity being actually needed for the reducing reactions. In 1904 only four electric furnaces were in use in Europe, while to-day more than 100, ranging in capacity from 100 lb. to 15 tons, are in service here and abroad.

Electric furnaces are of two kinds, the arc furnace, in which the heating current is led into the furnace by electrodes, and the induction furnace, in which the metal to be heated forms the single-turn secondary of a transformer. Induction furnaces are limited to refining operations, and at commercial frequencies may have very low power-factors. In a Frick induction furnace, described by Mr. Lyman, energy is obtained from a frequency changer delivering 5 cycles to 15 cycles per second, single-phase, for securing a higher power-factor. This furnace consumes 660 kw-hours per ton per melt and has a heat efficiency of 65 per cent. A three-phase Rodenhauser furnace was also described, in which the metal pool included three annular troughs about the three legs of the furnace magnetic core. In these induction furnaces forced draft is applied between the metal walls and the core and primary windings, keeping the latter at normal machinery temperatures, not exceeding 70 deg. Stray fields in these induction furnaces produce a stirring action in the molten metal which improves the quality of the steel produced.

Arc furnaces possess the advantage of higher power-factors at commercial frequencies and are available for smelting processes. A 25-ton Frick arc furnace, taking 2000 kw, shows an efficiency of 80 per cent. Like a Swedish furnace also mentioned by Mr. Lyman, the gases from the furnace top are returned by a blower to tuyeres at the combustion zone. The electrodes are mounted at the sides of the combustion chamber, as in the Héroult furnace. In the Girod arc furnace a large upper electrode forms one terminal, the other being made up of numerous small conductor rods embedded in the furnace floor. In the Keller arc furnace the electrodes are dropped through hatches into the molten mass, being arranged with boom gear for renewing the terminals as they become destroyed. The Stassano furnace employs an arc between electrodes in the wall directly over the metal bath. Ordinary open-hearth efficiency is placed at about 25 per cent to 30 per cent, while the over-all efficiency of gas-engine transformers and electric furnaces is 15 per cent (the engines having a thermal efficiency of only 20 per cent, which reduces the excellent efficiencies of the other apparatus). Electric furnaces, said Mr. Lyman, make possible superior castings since they permit more accurate alloy ratios and a greater fluidity before pouring.

Mr. F. T. Snyder, of the Metallurgic Engineering Company, discussed the reliability of electric furnaces for commercial work. The years of experience with the electric furnace in the aluminum, calcium-carbide, carborundum and other industries, he said, have demonstrated its reliability in commercial use, besides developing complete lines of supplies and parts which are now available on the market for the steel industry. To illustrate the practical simplicity of electric furnace working, Mr. Snyder told of a furnace in the West which has been operated for several years by Chinese labor supervised by a white superintendent. While coal and other fuels are rising in values, the cost of electricity is lowering, indicating that the electric furnace is the furnace of the future. It will also have an important use in enabling manufacturers to produce high-grade steel castings from scrap, taking the place of certain forgings.

Prof. C. F. Burgess, of the University of Wisconsin, spoke of the possibility of electrolytic refining as a step in the production of steel. Although the electrolytic refining of copper, gold, silver and lead has played a most important part in the metallurgy of these metals, it has hitherto been impossible to deposit iron satisfactorily, due to the coating assuming a dark, rough, powdery quality before any useful thickness is deposited. Professor Burgess then exhibited an iron cathode which he had succeeded in depositing after several years' experimenting, during which time about 3 tons have been refined and 1000 alloys tested. The cathode shown, without doubt the largest piece of electrolytic iron in the world, was 2 in. thick and weighed 75 lb. This was deposited from a mixed solution of ferrous sulphate and ammonium chloride containing 40 gr of iron to the liter, and using a current density of from 6 amp to 10 amp per square foot at a potential difference of 1 volt. The current efficiency was nearly 100 per cent under these conditions, 1 kw-hour refining about 2 lb. of iron. The iron deposited from double refining, using a high-grade material as anode, can be produced of a purity of 99.7 per cent. This iron is quite brittle, due to occlusion of hydrogen, and can be easily shattered by a sledge-hammer for breaking up and charging into an electric furnace. Such electrolytic iron can be produced at $55 a ton commercially, said Professor Burgess, comparing well with high-grade Swedish iron.

Mr. Charles G. Osborne, superintendent of special steels for the Illinois Steel Company, told of the experiences with the 15-ton Héroult furnace at South Chicago. The current is led into three furnaces by three huge electrodes, 24 in. in diameter and 14 ft. long, placed at the apices of a triangle 5 ft. on a side. The adjustment of these electrodes is done both by hand regulation and automatically. In series with current transformers in each furnace lead are relay coils whose attraction is opposed by springs. If the electrode current varies, destroying this balance, one of two opposed dogs is clutched into an oscillating rack wheel, turning a switch arm to operate the electrode-hoist motor in one direction or the other, as required, and adjusting the electrode within 1/8 in. The furnace pressure varies between 80 volts and 110 volts. In some sample runs, of which records were shown, the current was on for forty-four minutes, then thirty-seven minutes later the furnace was tapped, the entire "heat" lasting eighty-one minutes. The heats were repeated at approximately 100-minute intervals. The South Chicago furnace has been worked on probably the greatest variety of products of any steel furnace in the world, and has been run at times on such unpromising material as cold stove plates and "wire-whiskers." The steel produced has shown a greater freedom from oxidization and higher ductility and tensile strength than has been the case with similar open-hearth steels.

Wisconsin Electrical Association at Milwaukee.

The Wisconsin Electrical Association, comprising representatives from the electric lighting and electric railway properties of the State, was called to order Wednesday morning, Jan. 18, at the Hotel Pfister, Milwaukee, by Vice-president George B. Wheeler, of Eau Claire, in the absence of President Clement C. Smith, who was detained from the sessions by illness. Nearly 100 members, including operating men and supply salesmen, were present. The secretary's report was presented by Secretary J. S. Allen, of Lake Geneva, and showed the association to be in a flourishing condition with more than $1,000 deposited to its credit in the bank and all bills paid.

Mr. Ernest Gonzenbach, of Sheboygan, read a paper on "Publicity Campaigns," in which he advocated carefully prepared advertising directed to the ultimate consumer of public-utility service. The good will of customers should be cultivated directly, he said, without resorting to political middlemen for favors. The speaker discussed newspapers, company publications, billboards and street-car cards for advertising purposes, and pointed out that in any case the material used must be exceedingly well-written and pungent to be attention-compelling and successful. He advocated the use of space in those newspapers of largest circulation regardless of editorial policy or journalistic class, observing that with their larger number the less well-to-do readers are quite as good public-service customers as the so-called better class of citizens. When the newspaper's editorial policy is appreciative of the company it is well enough to use advertising space, said Mr. Gonzenbach, but the reasons are far greater for doing so if the paper is antagonistic, as carefully prepared rebuttals should then be employed to counteract unfavorable statements in the reading columns. Street-car advertising should supplement the use of billboards, especially where the electric light company operates both utilities. The best advertising space in the cars should be retained for this purpose. Before closing Mr. Gonzenbach deplored those public-service managers who to secure peace at any cost submit to imposition from customers or interests. Such peace, without honor, and at the cost of self-respect, will never bring prosperity, said the speaker. The public admires a plucky fighter, and if it can be convinced that the corporation's position is sound and is undergoing attack from unworthy motives the offending elected representative will be thoroughly discredited and the contest result to the company's advantage.

Mr. W. H. Winslow, of Superior, spoke of the necessity for care in the preparation of advertising matter, and Mr. Glenn Marston, of Chicago, urged that newspaper advertising should be undertaken only with the view of securing direct results from readers, avoiding any purpose of tribute. He advocated the use of copy prepared by experts who understand public sentiment, tell their story directly and avoid technicalities. Mr. Marston recommended a policy of absolute frankness in public-service management.

At the opening of the afternoon session a brief address was made by Mr. T. F. Grover, former president of the association, now of Terre Haute, Ind., and telegrams of congratulation to the convention were read from Messrs. H. J. Gille, Minneapolis, Minn.; J. H. Harding, Los Angeles; D. C. Jackson, Boston, and Harold Almert, Chicago, all of whom were formerly identified with the association. Mr. A. W. Brady, president of the American Electric Railway Association, also telegraphed extending the national association's greetings and asking the co-operation of the Wisconsin men.

Mr. Edwin S. Mack, of the law firm of Miller, Mack & Fairchild, Milwaukee, then presented an instructive and carefully prepared discussion of the "Principles Established by the Decisions of the Wisconsin Railroad Commission." A full enumeration of these interesting points will be given later in these columns. Following Mr. Mack, State Senator G. B. Hudnall, of the Wisconsin Legislature, was introduced to the convention as "the father of the public-utility commission law of Wisconsin," and remarked that the success of the act had been due to the high personnel of the commission and to the co-operation of the companies themselves.

A new constitution for the Wisconsin association was presented by Mr. Irving P. Lord, of Waupaca, chairman of the constitution committee, and was ratified by the convention after brief discussion. The committee on affiliation with the National Electric Light Association, consisting of Messrs. P. H. Korst, of Janesville; L. L. Tessier, of De Pere, and W. R. Putnam, of Marinette, reported advising against such affiliation owing to the difference in eligibility rules and the resulting possible exclusion of valuable members from the local association. Co-operation in every way with the national association was recommended by the committee.

The association dinner was held on Wednesday evening in the Red Room of the Hotel Pfister. Acting-president G. B. Wheeler introduced as toastmaster Mr. C. N. Duffy, of Milwaukee. This well-equipped gentlemen, between appropriate introductory remarks of his own, called upon Messrs. F. G. Bolles, Milwaukee; C. M. Axford, Chicago; I. P. Lord, Waupaca; Professor Breckenridge, of Yale University; Oliver C Fuller, banker, Milwaukee, and Prof. Shailer Matthews, of the University of Chicago, all of whom responded in humorous vein. The address of Professor Matthews, however, included also a more serious and contemplative view of the changes that are going on in industrial conditions and their significance. The increasing personal consideration granted employees, the responsibilities of capital and wealth, and the hopeful signs for the future of business and industry directed by trained men were some of the subjects discussed in this talk by the head of the Chicago University divinity school and editor of *The World To-Day.*

Thursday morning's session was opened by Mr. A. J. Goedjen, superintendent of tests for the Milwaukee Electric Railway & Light Company, with a paper on "Meters and Meter Testing." Mr. Goedjen's paper was discussed by Messrs. J. M. Canby, meter expert of the Wisconsin commission; I. P. Lord, E. Gonzenbach, Prof. C. M. Jansky, of the University of Wisconsin; Mr. McNaughton and H. G. Nutting, of Fort Atkinson. A complete abstract of paper and discussion will be given in a later issue.

Mr. Frank A. Cannon, secretary of the Citizens' Association of Milwaukee, appeared before the association to enlist its sanction and co-operation for an electrical show to be held at the Auditorium in Milwaukee next January following the Chicago show.

Mr. C. M. Axford, of Chicago, read a paper on "Ornamental Street Lighting," discussing electricity as an advertising medium. Good street lighting, said the speaker, advertises the town and automatically increases the use of electricity. Mr. Axford urged that ornamental fixtures should be chosen of uniform design throughout a given city, and suggested improving the advertising value of sign displays by keeping all lighting units below a level of, say, 15 ft. above the street surface, while signs are erected at a height of from 20 ft. to 30 ft. He also pointed out the lower cost of installation and operation of high-efficiency arc-lamp illuminants to produce the same intensities and distribution given by tungsten-pillar installations. Mr. W. H. Winslow, of Superior, declared that the special street illumination in his city rather than discouraging merchants from window lighting has been the cause of intensive illuminations, since otherwise the windows appeared dark contrasted with the bright lighting outside. Good window lighting, he said, in turn reacts to produce high intensities in store interiors and in residences. Messrs. M. C. Ewing, of Wausau; R. M. Kimball, of Kenosha, and C. N. Duffy, of Milwaukee, also recounted their own companies' experiences with special lighting.

At the afternoon session Mr. W. J. Kelsh, master mechanic and chief engineer of the Eastern Wisconsin Railway & Light Company and the Wisconsin Electric Railway Company, Oshkosh, read a paper on "Electric Railway Repair Shop Practice," detailing some of the methods and economies employed by his companies. The subject of the paper was discussed by Messrs. J. P. Pulliam, of Oshkosh; W. H. Stevenson, of Chicago; J. C. Justensen, of Wausau, and Mr. Mullet, of Milwaukee.

Mr. C. N. Duffy, comptroller of the Milwaukee Electric Railway & Light Company, discussed the subject of "Insurance," recounting the experience and policy of the Milwaukee company. After referring to the excessive insurance rates generally charged on central-station and electric-railway properties in spite of modern construction methods, Mr. Duffy pointed out that the subject of insurance affects railway properties more than electric lighting companies on account of the former's large proportion of perishable properties in car stocks. In 1908 the Milwaukee company expended $15,000 in carrying out changes in its car barns recommended by the insurance inspectors, including the institution of fire drills, approved storage of oils and paints, cleaning of pits and concealed spaces, lowering of trolleys in car houses, provision of waste cans, extinguishers and sprinklers, etc. These changes, at a cost of $15,000, secured a reduction in rate from $1.40 to $1 per hundred, involving a yearly saving on $2,000,000 of the difference between $28,000 and $20,000 for the Milwaukee city lines car-barn property. The placing of this insurance is divided among all of the Milwaukee agencies, following a policy established by Mr. Beggs a number of years ago. No insurance is carried on the fireproof Public Service Building or the two power plants of the company. The Milwaukee company has instituted a fire-insurance reserve of $500,000, the 5 per cent annual interest on which, $25,000, goes back to the fund. Five-eighths of 1 per cent of the gross earnings of the company is also credited to the fund in monthly instalments, after paying the current insurance premiums. The ability of the company to carry its own insurance risk if necessary probably exerted a potent influence in obtaining the reduction which the insurance companies finally consented to give. Mr. Duffy advocated the display of consideration and reasonableness by both electric companies and insurance agents in securing the desired decrease in rates on electric properties.

Mr. A. K. Ellis, of Appleton, explained how, by the expenditure of several hundred dollars in carrying out recommendations, his company had secured a rate reduction from $1.84 to $1.50. Mr. R. N. Kimball, of Kenosha, said that in the case of the first fire his company sustained under classified insurance rates the company was forced to share the loss with the insurance people. Later he insisted on a blanket rate, without classifications, and when the second fire occurred the adjustment was a satisfactory and simple matter. Mr. F. A. Hecker, of Antigo, told of a reduction from $2.50 to 80 cents secured by rebuilding the plant. Mr. Douglass, commercial engineer of the Milwaukee company, deplored the often too literal interpretation of insurance rulings without individual judgment, citing a case where a 500-volt motor in the center of a foundry where molten metal was poured was required to be inclosed in a brick compartment for "fire-protection" reasons. Houses containing the most modern wiring construction obtain the same insurance rate as those equipped with gasoline-lighting systems, if the latter have been "approved."

President-Elect George B. Wheeler.

Mr. John I. Beggs, president and general manager of the Milwaukee Electric Railway & Light Company, was called upon for a brief address, and urged co-operation between public-utility corporations. Such mutual assistance, he said, is especially needed by the smaller companies which cannot afford to employ specialists in their technical, accounting and operating departments. Mr. Beggs spoke of the fair treatment received by the companies from the Wisconsin commission in spite of public clamor, and declared that proper principles resolutely adhered to would in the end win out. Mr. Beggs was warmly applauded.

A special committee on street lighting was appointed, consisting of Messrs. Winslow, Ewing and Axford. The selection of officers made by the nominating committee, Messrs. Gonzenbach, Vallier and B. G. Broad, was unanimously approved by the convention, and these officers were declared elected: President, Mr. George B. Wheeler, Eau Claire; first vice-president, Mr. Irving P. Lord, Waupaca; second vice-president, Mr. R. N. Kimball, Kenosha; secretary-treasurer, Mr. George Allison, Milwaukee.

Mr. George B. Wheeler, president-elect, is a graduate of Bowdoin College, Illinois. After engaging in journalism for a number of years he entered the electric railway field in 1891 as general manager of the Eau Claire (Wis.) Street Railway, Light & Power Company. Subsequently he was receiver of the property in the United States Court, and after the reorganization he was elected secretary and general manager of the property, which has since been succeeded by the Chippewa Valley Railway, Light & Power Company. This company now owns all the water-power on the Menomonie River and a valuable water-power on the Chippewa River, and supplies all the electricity used in Eau Claire, Chippewa Falls, Menomonie and Bloomer, Wis.; Red Wing, Minn., and numerous small towns.

Arc Lamp Practice.—Electric Meters.

The regular January meeting of the Boston Edison Section of the National Electric Light Association was held at the Edison Building, Boston, on the evening of Jan. 17, with Mr. R. E. Curtis in the chair. Papers were read by Mr. C. H. Ingalls, head of the meter division, on "Electric Meters," and by Mr. J. C. Norcross, assistant to the superintendent of installations, on "Arc Lamp Practice." Following the two papers of the evening the section adjourned to the Boston Edison Company's meter and lamp shops, where the various types of equipment mentioned in the papers were exhibited, with apparatus for testing and maintenance.

The paper by Mr. Norcross reviewed the evolution of the arc lamp in considerable detail, ranging from early types used by the Boston Edison Company to the present types of magnetite and flaming arcs used on the streets of Boston, with additional references to lamps adapted to indoor service.

Mr. Ingalls emphasized the importance of a high degree of accuracy in meters, pointing out that the desire of all companies of standing to deal fairly with every customer alone demands the use of an instrument of precision. He touched upon the importance of the meter in relation to central station income, showing that in round numbers every per cent loss due to meter inaccuracy is the equivalent of about 5 per cent of the total generating expense, or about 7 per cent of the total distributing expense. A gain in meter accuracy of only 1 per cent would pay for the expense of maintaining a first-class meter department. Bills of $1,000 a month are frequently recorded on a single meter. In selecting meters Mr. Ingalls said that the weight of the rotating element should be small and the torque relatively large. If a commutator is used, it should be of small diameter, to cause minimum friction. He described the principal types of meters now in general service and emphasized the importance of careful installation. Jewel wear and commutator troubles are the principal factors that affect the accuracy of meters. In some meters the weight on the jewel is several ounces, and on account of the small bearing surface the pressure actually exerted is in reality at the rate of some tons per square inch. The safe length of life of a sapphire jewel is within limits a function of the weight and number of revolutions of the rotating element of the meter, and as the friction of the commutator is similarly governed it is customary in some cases to base the period of time between tests on the time required for any meter to run from 800,000 to 1,000,000 revolutions for commutator meters and to about 2,000,000 for induction meters. Under this system the test times vary from two months to a maximum of twelve months for commutator meters, and from twelve to twenty-four months for induction meters.

Mr. Ingalls described the methods of testing employed in the Boston Edison Company's meter division, taking up gear ratio determinations, meter constants, disk rotations, comparisons with standards, stop-watch tests, single tests and multiple tests of meters in banks. The Boston Edison system of testing is based on a method of determining the rate of rotation of the disk and comparing that rate with the computed rate based on the actual energy in watts that is being measured by the meters. The laboratory is equipped for testing meters in series with a master meter, with a sounder connection which facilitates the adjustment of the disk speeds. For portable testing the company has developed a load box of one-fifth the weight of commercial devices. This box has been run as high as 80 amp at 220 volts, or about 18 kw, and weighs complete about 6¼ lb. By using a standardized resistance as a load box the company is enabled to omit the ammeter in testing a direct-current meter on the system. For testing the 600-amp to 2000-amp street railway meters now used by the company on the system of the Boston Suburban Electric Companies a special form of Wheatstone bridge has been designed. This obviates the need of carrying large and heavy batteries and permits the use of a direct-current rotating standard with satisfactory results. On an average the company's meters are found at the end of their assigned period less than 2 per cent slow on full load and less than 5 per cent slow on 10 per cent load. Tendencies are always toward the slowing of the meter on account of its ageing and friction increases. The tests of the Massachusetts Gas & Electric Light Commission on Boston Edison meters for the past eight years show an average accuracy of the meters to be 1.00078, or only eight-ten-thousandths of 1 per cent fast, the tests being the average of readings at one-fifth, one-half and full load. In only four cases the meter fell outside the State limit of 5 per cent, and in each case this was due to light load errors. In the past year the company tested 36,500 meters, and it now has installed on its system 42,300 meters. By the use of cupped diamond bearings a life has already been secured of over 50,000,000 revolutions, with the bearings still apparently as good as new.

Meeting of Electric Vehicle Association of America.

The regular monthly meeting of the Electric Vehicle Association of America held in the Engineering Societies Building, New York, Jan. 17, proved to be the best attended meeting thus far held by the infant organization, about 300 being present. The topic for the evening was an illustrated lecture on the "Ironclad Exide" battery, by Mr. Bruce Ford, of the Electric Storage Battery Company, of Philadelphia. The lecturer confined himself chiefly to a description of the battery rather than to data on its performance and added little to what has already been published. Briefly stated, the "Ironclad Exide" battery is of the lead-sulphuric-acid type and its principal feature of novelty resides in the construction of the positive plate, the negative being similar to the present Exide plate. only a trifle thicker. The grid of the positive plate is composed of a number of parallel vertical metal rods, united at their tops and bottoms integrally to top and bottom frames, the top being supplied with the usual conducting lug. Each vertical rod forms a core surrounded by a cylindrical pencil of peroxide of lead active material, which in turn is inclosed by a hard rubber tube supplied with a multiplicity of fine horizontal laminations to provide access for the electrolyte to the active material and passages for the flow of current during the charge and discharge of the plate. The tube fits snugly upon the active material and is furnished with two oppositely disposed vertical ribs which serve to stiffen and strengthen the laminated tube and act as separators. Improvements have also been made in the methods of mounting and connecting the plates.

The characteristics of the cell in discharge are similar to those of other types of lead batteries, the potential at a normal four-hour rate starting above 2 volts and maintaining a fairly uniform value throughout the discharge until toward the end, when it drops more rapidly. At 1.75 volts the cell is practically discharged. During charge its characteristics are similar to those of other lead batteries. While its capacity decreases at a less than constant rate of charge with increase of discharge rate, its capacity becomes greater at an increasing rate as the discharge rate becomes less. The battery is rated initially at four and one-half hours at a current corresponding to the four-hour rate of an Exide battery of the same size. The capacity is claimed to be 12.5 per cent more. The weight is about the same as that of an Exide battery of corresponding size. The chief claims made for the battery are its durability, decreased maintenance expense, a life from two to three times that of the Exide battery and a mileage life of over three times that of the latter.

The discussion following the presentation of the paper brought out a number of points regarding the construction and performance of the battery hitherto unpublished. Mr. W. P. Kennedy, of the Studebaker Automobile Company, New York, asked if the quantity of electrolyte had been increased or whether a greater area of the positive plate had been exposed, and he also desired to know if the shielding of the positive active material by means of the rubber tube had any tendency to postpone sulphation of the positive plate. The questioner also understood that the cost of the battery was somewhat higher than the cost of a battery of equivalent type and of equivalent capacity and asked for information regarding the economy to be effected by the use of the new cell.

Mr. Ford in answering the questions said that the quantity of electrolyte used in the "Ironclad" was about the same as that used in the standard Exide battery. The positive plate, being composed of a series of pencils, exposes a greater surface than the standard plate, but inasmuch as some of the surface is covered with the rubber tube and the electrolyte has not the same access to it that it would have if the tube were not present the actual exposed surface would be about the same. Regarding sulphation, he said that, although the company could not absolutely prove it, he thought that the battery would be as free from sulphation as any battery can be whose life and activity depend upon the principle of sulphation and not on the disease of sulphation.

Regarding the question of cost, Mr. Charles Blizard, of the Electric Storage Battery Company, said that the "Ironclad" would add an increased cost of about 40 per cent to the battery. In the matter of renewals, including labor for installing a complete battery, the increase would be about 60 per cent. The cost of operation of the new battery as compared with the lead, disregarding entirely the saving to be effected by the fact that the cleaning of the "Ironclad" can be eliminated, is about 25 per cent. The figures given do not take into consideration the increased mileage obtainable from the new battery, but the cost is reduced considerably when these figures are given weight.

Mr. F. F. Sampson, of the New York Transportation Company, asked a number of questions regarding the efficiency of the new battery, the necessity for cleaning it, the life of the wood separator, the length of time the battery would maintain its increased capacity, whether the battery could be charged at a higher rate than the present Exide cell and what would be the effect of a high discharge rate. Mr. Ford in answering the questions said that the efficiency of the "Ironclad" was about the same as that of the standard Exide cell. The new battery, he said, will practically never require cleaning. The web body of the wood separator is thicker than the web of the rubber separator, and therefore it is more substantial and less liable to crack than the old separator. When in the cell it is kept away from the positive active material, which corrodes the present separator, and with the new method of mounting the wood separator it is expected that it will be much more durable and have a life at least equal to the life of the plate. Under good operating conditions the "Ironclad" plate has about two and one-half times the life of the Exide plate. The battery is of the same dimensions as the Exide cell of corresponding size, so that the rate of charge would be logically the same, but if discharged at the four-hour rate instead of the four and one-half-hour rate it will require a longer time to charge in order to compensate for the extra capacity if the ampere-hour discharge is considered. As to the effect of a high discharge rate, the speaker said that a lead battery cannot be harmed by such treatment because the action of a lead battery in that respect is self-compensating.

Mr. L. Ruprecht, of the General Vehicle Company, New York, asked whether the height of the ribs in the new cell would be the same as in the Exide cell, to which Mr. Ford answered in the affirmative. Replying to a question of Mr Cheesboro regarding the watt-hour capacity per pound, Mr. Ford said that this was about nine and one-third initially, and may be worked up from 30 per cent to 35 per cent higher, thus approximating 12 watt-hours or a little more. Replying to a question asking information as to the method of fastening the strap to the connectors, Mr. Ford said that the little lugs on the ends of the copper connectors are raised to pass over the pillar strap, and that the pillar strap is then burned down just enough to maintain the fit.

Mr. Lloyd, of the General Vehicle Company, Long Island City, said that his company addressed itself to the subject of getting satisfactory batteries for its wagons, and, of course, had to depend upon the standard plates, the medium plate and thin plate, and finally adopted a fairly thin plate. He hoped that there would be something in the new battery which will appeal to all the vehicle manufacturers and which will become standard, so that different batteries will not exist all over the country. He did not think that the "Ironclad" had any greater capacity than the thin-plate battery used by his company, nor was its internal resistance any lower or the efficiency any higher. If the "Ironclad" battery had a longer life it would appeal to his company, but if the cost is such that it just about equals his company's estimated cost of renewal for batteries to carry it over the same period he was not satisfied as to the economy of using the new battery. The battery is not any less liable to misuse than the old form of standard lead plate, and Mr. Lloyd complimented the manufacturer on the product, as he realized the great difficulty of manufacturing the rod and developing it and the rubber tube. He said that if the rods did not swell or buckle he did not see why the battery should not last a long while under ordinary circumstances. Mr. Lloyd gave some figures comparing the battery used by his company with the "Ironclad," basing his comparison on the figures brought out in the paper and discussion. He expressed the opinion that the capacity of the battery should be based on a six-hour discharge rate rather than on a four-hour basis.

Mr. Pender asked concerning the advantages of the new thin connecting strap over the older strap and the reasons for making the change. Mr. Ford pointed out that the advantages were twofold—first, that the new strap was flexible and, second, that it had a higher conductivity because it was made of copper instead of alloy. The straps were made of a size to decrease the weight of the battery per kilowatt. Moreover, inasmuch as the "Ironclad" plate is not rigid a flexible strap is necessary.

Mr. Lloyd, again taking up the question of the rate of charge and discharge, said that his company used a lower rate per plate discharge than that recommended in the paper, but for the complete cell used substantially the same rate and ran six hours, while the Exide ran four hours. This is accomplished by placing 50 per cent more plate in the battery. Mr. Ford in his reply stated that if 50 per cent more plate is placed in the same size jar the four-hour rate of each plate would become 5.61. The six positive plates would have on a six-hour basis a total of 147.6 amp-hours instead of 112 in the size of jar mentioned. He was under the impression that on the basis of each initial rating the plates mentioned by Mr. Lloyd actually gave more than their initial capacity. Mr. Lloyd said that, on the contrary, the initial capacity was very much less. His company places thirteen thin plates in an ordinary nine-plate jar.

Mr. Erskine asked Mr. Ford if the new battery would resist the action of foreign material, such as salt or saltpeter, any better than the old. Mr. Ford did not think it would, and very much preferred not to answer the question at that time.

Mr. Bartlett interrogated Mr. Ford on the life of the new plates as related to the number of charges. He wished to find out if a pleasure vehicle, for instance, ran fifteen miles and was then charged, then ran twenty miles and was charged again, and afterward ran ten miles more and was charged, whether he would be drawing from his bank account in proportion to the number of charges, or whether the plate fails by some other action and disintegration of the active material. Mr. Ford said that the overcharge would not affect the new plate as much as it would the old plate, and suggested that if care were exercised not to charge the battery fully, but to place in about as much as was taken out, reserving normal charges for biweekly or weekly inspections, better results would be obtained.

Mr. Lloyd expressed the hope for great improvement in the lead battery, and said that both the Edison and lead batteries are now doing good work, intimating that the Edison battery was to be still further improved. Whatever difference of opinion there might be as to which of the two is better, he said that the industry should feel encouraged that the storage battery manufacturers were doing so much work for the electric vehicle business. Mr. Morrisse requested information on connecting and disconnecting the new connectors, and Mr. Ford said that for this purpose his company had developed a little shearing device which would shear off the strap where it was burned and that it can be easily replaced by the aid of a soldering iron.

Mr. Rice gave his experience in giving vehicle batteries partial charges at the noon hour while the operator was at lunch, but Mr. Ford was of the opinion that this procedure was a little dangerous because it was apt to be overdone. If, however, only a very small charge is given no deleterious effect should result. Mr. Lamont gave some information on the use of the ampere-hour meter on charging circuits.

It has been suggested to hold the next monthly meeting in Chicago at the time of the Chicago automobile show.

Some Principles Established by the Wisconsin Commission.

Before the convention of the Wisconsin Electrical Association at Milwaukee, Jan. 18, Mr. Edwin S. Mack, of the law firm of Miller, Mack & Fairchild, Milwaukee, presented a review of some of the principles established by the Wisconsin Railroad Commission affecting the electric lighting, railway and other public utilities of the State.

The commission has now been in service more than five years, during three years of which it has had jurisdiction over electric light companies. Its decisions and opinions occupy five printed volumes, in addition to its annual reports. Besides work of a routine character, such as the answering of questions and acting as general counsel and mentor to utilities, the duties of the commission are of two kinds: (1) The setting of standards of service, and (2) the adjustment of disputed cases and service and rate complaints.

Good service to the public is exacted by the commission, and if, upon investigation of a case, it finds an increase of rates necessary to enable good service to be rendered the commission is disposed to order such an increase. The adjustment of rate cases involves study of many factors. From the gross earnings the operating expenses including the taxes must be subtracted, while the rate of depreciation due to age and wear, the reasonableness of return, the correct principal on which to base return and the percentages allowable for interest and profit must all be determined. In addition to this costs must be properly proportioned among the various classes of service so that each of these classes shall pay its share.

The figures for the gross earnings and operating expenses are usually obtained from the company's books, verified by examination and study of the property in operation.

In considering the principal to be taken as the basis of return it is pointed out that different principles apply from those applicable to property with an open market value. The principal may be taken as the funded debt or bond issue, plus the capital stock and investments. If necessary to appraise the tangible property, (1) its original cost including additions may be considered, or (2) cost of reproduction new, or (3) present value—that is, reproduction value minus depreciation. Added into this, of course, is the "service" value, engineering, etc., necessary to make of the integral parts an efficient mechanism.

The "actual total investment" is generally taken as the basis for rate-making, when it can be shown that the expenditures have all been prudent compared with the present value of the investment and that ordinary business sagacity has been employed. When excessive or imprudent investments, not commensurate with the value of service to the customer, have been made a corresponding reduction will be ordered in the principal amount. Mr. Mack said that all values, whether gifts, surplus earnings, or new capital, are considered by the commission as actual parts of the investment. The sale of bonds is recognized by the commission as the modern method of raising capital, and matters of bond discounts are viewed as proper items of cost.

"Cost of going value," that is, the expenditure or deficit involved before the business reaches a profitable condition, with organization perfected, customers connected and harmonious operation throughout its mechanism, is also regarded as an item of the investment. The "cost of going value" as computed by the commission is shown by the diagram accompanying, which traces the elements of the example company's business during the first year, given over to construction; the second year, when partial operation began, and the following years, during which the business expanded normally, the income finally exceeding the expenses and netting a profit.

Interest at the rate of 6 per cent or 7 per cent will be allowed on going value, the higher figure where the service is good and it can be shown that the plant was not built ahead of public needs or in an excessively expensive or unwise manner, that there are no present prospects of profits, or that the past management has not been incompetent. Obviously, according to the commission's doctrine, public utilities cannot retrieve errors or losses as private businesses can. Of course, when a good return has been earned continuously from the beginning of work no cost of going value will be considered or allowed by the commission.

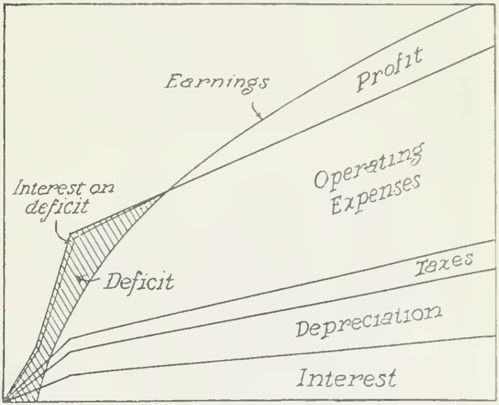

Diagram Showing Wisconsin Commission Method of Computing "Cost of Going Value."

When the investment in the property is not ascertainable or it becomes necessary to check or approximate such investment recourse is had to the appraisal of the elements of the property by the valuation staff of the commission. This staff was originally formed for the Tax Commission's service, on the Michigan plan, but now serves that commission and the Railroad Commission jointly.

Added to the sum of the costs of the elements of the plant as appraised, a general allowance of 10 per cent to 12 per cent is usually made for the expenses of combining the plants in "harmonious operation." Of the usual 12 per cent allowance, which applied to all but store supplies and paving, 5 per cent is credited to engineering, 4 per cent to interest during construction and 3 per cent to legal expenses, commissions and contingencies. The Wisconsin Commission usually places this total at 10 per cent to 12 per cent, although many engineers figure 15 per cent to 20 per cent for these expenses. In addition to this percentage stores and supplies, as part of the working capital, have been allowed up to 1.5 per cent in some cases. The depreciation factors for getting present values are obtained from curve sheets issued by the commission showing various rates of depreciation applicable to elements suffering from different degrees of wear and obsolescence.

The commission has refused to place a capital value on "successful good judgment" employed in locating a site, allowing only for the amount of money actually expended in acquiring the site. Allowance is made for non-operating property held for reserve or emergency use, but not for discarded equipment, or equipment held beyond plant requirements.

"Good will" as an element of public utility value is not recognized by the commission, which takes the point of view that this intangible asset applying to a private competitive business does not hold in a public monopoly. Franchises the commission recognizes as having value, but declares that this value cannot properly be considered for rate-making purposes. The commission carefully distinguishes the elements of interest and profit, decreeing for the first a reasonable rate of return on the investment, beyond which the surplus becomes profit. The commission frequently allows 8 per cent, chiefly for electrical industries, while water companies are restricted to 7 per cent and sometimes 6 per cent. Municipal plants are limited to 4 per cent.

In Wisconsin there has been a tendency to lose sight of the parts of a business, in consideration of the whole, although this is, of course, contrary to cost distribution methods. The cost of service is generally held to control the rate to be charged, although this has been modified in the case of small customers to enable them to be served at a cost which shall not be prohibitive. So far as possible, short-hour consumers pay an amount on the fixed costs proportional to their demand, and an amount on the variable costs proportional to their consumption or hours' use.

Massachusetts Legislative Notes.

Speaker Walker, of the House, has appointed a special legislative committee to consider the recommendations of Governor Foss regarding the abolition of existing State commissions and the creation of a single public-utility board. House Chairman Grafton D. Cushing will preside over the committee's deliberations and a thorough discussion of the Massachusetts policies of corporate regulation is anticipated at its sessions. A large number of bills of interest to public-service corporations have been introduced into the Legislature. Among these are bills to prohibit or regulate charges for the furnishing of gas or electric meters; a bill making it unlawful to employ in any public telephone office or exchange between 10 p. m. and 6 a. m. a woman or girl under the age of twenty-five; a bill permitting municipalities to construct municipal lighting plants upon vote of their citizens, without the existing safeguards, and a bill requiring stock of gas and electric light companies sold at auction to be disposed of in the City of Boston to the highest bidder. Two bills have been introduced reducing the hours of labor of street and elevated-railway employees by one hour per day, with restriction of the number of hours in which a day's work is to be performed; the property interests of the West End of Boston, represented by Mr. E. D. Codman, have filed a bill for the construction of a subway under the West End from Park Street to Cambridge Street; and the Boston & Eastern Electric Railroad Company has filed a petition for legislation requiring the Railroad Commission to issue to it a certificate of public convenience and necessity, so that it can proceed to build a high-speed electric interurban railway between Boston, Lynn and Salem.

New York Commission News.

The Public Service Commission, Second District, has notified all telephone corporations within its jurisdiction that the practice of offering trial service installations is regarded by the commission as unlawful and that the company engaging in the same is subject to the forfeiture and penalties prescribed by the Public Service Commissions law. It has been brought to the attention of the commission that certain telephone corporations have heretofore been in the habit of making what is called trial-service installations, the result of such trial installations clearly giving the new subscriber free service from a telephone corporation during a certain period of time, in many cases as long as six months. The commission calls attention to the requirements of the Public Service Commissions law that no telegraph corporation or telephone corporation subject to the provisions of the law shall directly or indirectly give any free or reduced service or any free pass or frank for the transmission of messages between points in the State except to its officers, employees, agents, pensioners, surgeons, physicians, attorneys-at-law and their families, or to persons or corporations exclusively engaged in charitable and eleemosynary work, and ministers of religion, officers and employees of other telegraph corporations and telephone corporations and street-railroad corporations; and the further provision that no telephone corporation shall directly or indirectly or by any special rate, rebate, drawback or other device or method charge, demand, collect or receive from any person or corporation a greater or less compensation for any service rendered or to be rendered than it charges or receives from any other person or corporation for doing a like and contemporaneous service.

The Ithaca-Auburn Power Company has been authorized to execute and issue a first-lien trust mortgage upon all its property and rights acquired and to be acquired to secure the payment of its thirty-year 5 per cent bonds to the amount of $750,000 and to issue its common capital stock for cash at not less than the par value of $50,000. The company is authorized to issue at once bonds to the amount of $433,000, to be sold at not less than 85 and the proceeds used for the acquisition of certain property from Mr. H. C. Mandeville, of Ithaca, for $100,000; for the acquisition of material for and the construction and installation of an additional steam plant, $95,000; for the construction of its distribution line and third-rail system for the New York, Auburn & Lansing Railroad Company, $201,000. None of the stock or bonds are to be issued until certain agreements with Mr. H. C. Mandeville, the Remington Salt Company and the Ithaca Street Railway Company have been entered into and satisfactory proofs submitted to the commission.

The commission has dismissed the complaint of the trustees of the village of Salamanca against the Salamanca Gas Company as to price of natural gas for fuel and light in that village. The village has consented to the dismissal of the complaint on the company agreeing to extend its existing distribution mains within the village limits to a distance not to exceed 200 ft. upon the application of a property owner who shall agree to make the service connection and purchase gas under the rules and regulations of the company; and further that the prices charged for natural gas to consumers within the village shall at no time exceed the prices then being charged to consumers in the City of Buffalo by the Buffalo Natural Gas Company. The present rate in Salamanca is 30 cents per 1000 cu. ft.

The Public Service Commission, Second District, has authorized the Westchester Lighting Company to issue under its first mortgage dated Dec. 1, 1900, to the Colonial Trust Company its fifty-year 5 per cent bonds to the amount of $2,824,000. The bonds are to be sold for par and the proceeds used to pay off and discharge the remaining bonded debt of the New York Suburban Gas Company, amounting to $343,000, which company was merged into the Westchester Lighting Company on Dec. 1, 1900, and to pay off and discharge the indebtedness of the petitioners to the Consolidated Gas Company on certain notes. Further petition is to be made by the company later on, at which time the question of crediting the capital account of the company with the replacements which have been made will receive consideration from the commission.

The Murray Electric Light & Power Company, of Monticello, has been ordered to show cause why it should not put its plant and overhead-line system in safe condition. The Monticello Telephone Company complains that at the present time sagging wires and other defectively constructed and maintained electrical equipment are a constant source of danger to life and property, that telephones are being burned out and fires have been started in buildings in that place by reason of the unsafe condition of the wires.

Maryland Commission News.

The Public Service Commission, following a lengthy investigation, has ordered the Easton Light & Fuel Company, of Easton, Md., to make a number of substantial improvements to its plant. The officials of the company are also ordered to report to the commission on Feb. 1 next, and every two weeks thereafter, regarding the progress of the installation. The order which was passed last week is the first of its kind that the commission has framed since it was created last year. The order is the direct result of a complaint filed several months ago by the Mayor and City Council of Easton and a number of citizens of the town. The complaint alleged that the gas and electric service furnished by the Easton Light & Fuel Company was of a poor quality and relief was asked for. Last week Commissioner Laird and Chief Engineer Phelps of the commission went to Easton and made a direct investigation. Commissioner Laird heard a quantity of oral testimony and Mr. Phelps made a careful examination of both the gas and electric plants of the company. The commission decided not to act on the complaints concerning the electrical service at this time, deeming that it would be better to secure an improvement in the quality and service of the gas furnished to the patrons at once. The commission's orders regarding the improvements were based on a report filed by Engineer Phelps. The order says that the commission has decided from the report of the chief engineer and from the evidence submitted that public convenience requires immediate improvement in the physical conditions of the works and an improvement in the methods of manufacturing the gas as supplied to patrons. The company was ordered to make the improvements suggested by Mr. Phelps. The first of these is that the plant shall have a thorough and immediate cleaning up. A number of technical recommendations were also made by the chief engineer.

Positive assurances were given last week by Mayor Mahool that on or about the first of next month the City of Baltimore will be in a position to lay before the commission its formal complaint against the general commercial rates charged by the Consolidated Gas, Electric Light & Power Company for gas and electric service and its application for the adoption of the London sliding scale plan in the future regulation of the company's rates. The commission was advised as far back as last June that such a complaint would be filed, and it was announced at its offices last week that the commission was prepared to receive the city's case. As soon as the complaint is filed a copy of it will be served on the company and the case will proceed without any delay.

In accordance with an order issued some time ago the Chesapeake & Potomac Telephone Company last week filed with the Utilities Commission a report showing that it owns in the State of Maryland property having a book value of $8,338,554 and an estimated value of $8,452,600. These figures, according to the report, do not include the value of the company's easements, which the city officials, for the purpose of taxation, fixed last year at $594,067. Using the company's estimated values, its property located in Baltimore is no less than $5,415,000, while its holdings in Maryland outside of the City of Baltimore are worth $2,922,000. To this is added a list of miscellaneous property, such as stores and supplies, teams, tools, furniture, fixtures and the like, allotted to both Baltimore and Maryland, which has a value of $115,000, making up the total of $8,452,000. In itemizing its property the company estimates the value of its land and buildings in Baltimore City at $811,000 and its city exchange equipment at $1,204,000, while its country exchange equipment is set down as $150,000. The values of other items are: Subscribers' equipment, city, $777,000, country, $263,000; underground conduits, city, $860,000, country, $97,000; poles and lines, city, $180,000, country, $1,143,000; underground cables, city, $939,000, country, $104,000; interior blocks and distributing wires, city, $170,000, country, $108,000; aerial wires, city, copper, $177,000, country, copper, $522,000, iron, $137,000; aerial cable, city, $273,000, country, $274,000; rights of way, city, $30,000, country, $61,000. The information contained in the report was requested by the Public Service Commission for the purpose of enabling it to determine the reasonableness of the new schedule of rates which the company is seeking permission to put into effect.

Massachusetts Commission News.

After an exhaustive investigation extending through several months the Massachusetts Gas & Electric Light Commission has reached the conclusion that it is at present inadvisable to recommend legislation on behalf of granting the right of eminent domain to electric power transmission companies within the State. The granting of eminent-domain rights was opposed in many quarters, notably by the Massachusetts Electric Lighting Association. In brief, the commission recognizes the necessity of constructing transmission lines on private rights-of-way. It is convinced of the importance of encouraging the entrance of cheap energy, but nevertheless feels that the framing of a bill which shall be constitutional and practical is a matter of great difficulty. It points out that any authoriuty to condemn land for private rights-of-way must be granted under adequate safeguards for the protection of the rights of the communities and individuals over whose territory such lines must pass, and that the public character of the undertaking should be clearly established as a condition precedent to any exercise of the right. The commission admits that the time may not be distant when the proper development of electrical distribution will require the exercise of eminent domain, but it feels that the need is not so urgent as to justify it in proposing a bill for that purpose at the present time. It therefore recommends that such legislation be postponed until experience more clearly demonstrates the need to exercise the right and discloses the character and intent of the public interests involved. A number of subordinate matters are treated in the report, which recommends legislation amending various sections of the Revised Laws bearing upon the marking of poles and wires, the location of lines across and under public ways, the location of wires belonging to street and electric railway companies, the marking of poles carrying dangerous potentials, the approval of interurban electric line regulations by the board and the recommendation that the board may grant a location for a line for the transmission of electrical energy which must pass through one or more cities or towns to connect its proposed terminals in case of the refusal or neglect of the municipal authorities through whose city or town the line is to pass to grant a location therefor, to provide for the confirmation of locations for electric lines in public ways which have been expressly granted by the proper authorities and are in actual use by the grantees, and to provide for the establishment of underground districts and for requiring the placing of all wires in such districts below the surface.

The commission has approved the issue by the Lynn Gas & Electric Company of 1800 shares of new capital stock at the price of $235 per share, as determined by the directors. The proceeds of 120 shares are to be devoted to the payment and cancellation of bonds of the par value of $10,000 issued by the Marblehead Gas & Electric Light Company and other indebtedness of that company amounting to $18,200, the payment of all these bonds and debt having been assumed by the Lynn company in connection with its purchase of the former; the proceeds of 540 shares are to be applied to obligations of the Lynn company on account of plant improvements; the proceeds of 180 shares are to be applied to the meeting of obligations incurred in the improvement of the Marblehead plant, and the proceeds of 960 shares are to be applied to further plant additions. The Fall River Gas Works Company has applied to the board for authority to issue 1150 shares of additional stock at $225 per share to meet the cost of plant enlargements. The Worcester Gas Light Company has petitioned the board for authority to issue 2000 shares of new stock at the price of $200 per share, to meet the cost of plant additions and improvements. The Haverhill Gas Company, a Stone & Webster organization, has petitioned the commission for authority to issue 5000 shares of common and 4000 shares of preferred stock of the par value of $100 each, at the price of $100 per share, for the acquisition of the property of the Haverhill Gas Light Company. The preferred stock is to be 5 per cent cumulative and preferred in liquidation.

The Massachusetts Highway Commission has submitted its annual report to the Legislature covering the year ended Nov. 30, 1910. An exhaustive discussion of the recent telephone investigations and recommendations of the board in regard to rates is included, with the usual statistics of operation from telephone, telegraph and cable companies in the State, which are now under the commission's supervision. The figures filed by the board from the returns of the companies show that the number of telephone subscribers has increased from 218,642 in 1909 to 243,779 in 1910 in Massachusetts; the number of operators from 3423 to 3566; the number of pay stations from 6653 to 7159; gross receipts from $9,999,459 to $11,088,885; net earnings from $2,633,020 to $3,115,251; the underground-cable installation from 7,288,549 ft. to 7,750,912 ft.; overhead iron wire from 40,315 miles to 51,165 miles, and the copper wire from 132,695 miles to 164,832 miles. The demand for telephone service is increasing at a very rapid rate in the State. Reviewing its action upon the rates of the New England Telephone & Telegraph Company the board shows that the old rates were disproportionate and unequal; that a reduction of revenue is fair to the company; that subscribers receiving service should be compelled to pay for the amount of service received, and that the new rates will benefit the subscribers, distribute the charges more equitably and through the use of the zone system be fair to the company and the consumer alike. The main effort was to secure equalization of rates, and the commission points out that the changes recommended were essentially readjustments rather than reductions. The commission feels that the rates compare favorably with those elsewhere, the measured business rate being in general higher in other cities. The toll rates are especially favorable at Boston. The commission recognizes that sufficient time must elapse to allow the new rates to be understood in view of the large number of subscribers affected. Already over 34,215 old subscribers, out of a total of about 75,000, have voluntarily changed to the new rates, which the commission feels is a good indication that they are favorable to the vast majority, since a total of 52,073 subscribers have expressed themselves in favor of the new rates. Over 6751 new subscribers to the new rates have been signed. The commission states that it considers the recommended rates more or less tentative, and purposes to continue its studies of the telephone situation, being open to further changes so far as they may be found necessary or desirable.

Wisconsin Commission News.

As a result of service inspections six electric light and gas companies in the State have been notified by the commission that they must immediately comply with the rules of the commission regarding service, according to the standards adopted by the commission, or legal proceedings will be taken against them. The companies are the Mineral Point Electric Light Company, Eagle River Light & Water Company, Dodgeville Electric Light & Power Company, Mauston Service Company and the Janesville Electric Company Penalty for failure to comply with the order of the commission in this respect is fixed by statute at $100 to $1,000.

The Eleva Farmers' Telephone Company petitioned the commission for authority to put into effect a rate of $11 per year for party-line service and a rate of $14 per year for business and single-line service. Upon an investigation of the financial affairs of the company the commission allowed the rate for party-line service, but deducted $1 from the proposed rate for business and single-party service.

The commission has received a request from the Black River Falls municipal plant for an investigation of the situation in Black River Falls with special reference to the advisability of establishing a day service. The commission is requested also to recommend a schedule of rates for lamps and motors.

The Washburn City Council and the Washburn Electric Light Company have agreed to submit to the commission for its recommendation two propositions made by the company to the city concerning the rates for the lighting of the streets in the City of Washburn. Because of the fact that the city and company could not agree upon a rate for such service the streets of the city have been unlighted for more than a year. The company proposes two schedules as follows: To furnish fifty 100-watt tungsten lamps, burning 2190 hours per year, for $1,137 per year, provided the city contract for a period of ten years; or to furnish electricity for any number of lamps the city may wish to install at the following rates: Two hours' use per day, 10 cents per kw-hour; four hours' use, 9 cents; five hours' use, 8.4 cents; six hours' use, 8 cents.

Upon request of the Brodhead Electric Company the commission has analyzed the affairs of the company and recommended the following schedule of rates:

Flat Rates.

Forty cents per active lamp per month for lamps burning to midnight or later.

Twenty cents per active lamp per month for all others.

Meter Rates.

Ten cents per kw-hour for the first thirty hours' use per month of the active connected load.

Eight cents per kw-hour for excess.

Motor-Service Rates.

Seven cents per kw-hour per month for the first thirty hours' use per month of the active connected load

Five cents per kw-hour for all excess.

The commission suggests a minimum bill of 50 cents per month for all consumers on a meter basis and $1 per horsepower per month for motors connected, with a 5 per cent discount on all bills for prompt payment.

AMERICAN ELECTRICAL ENGINEERS—No. XXVII.

L. C. Marburg.

Louis Christian Marburg was born March 8, 1876, at Wiesbaden, Germany, where his father, an American citizen, was residing at the time. He was graduated from the Gymnasium at Wiesbaden in 1894 and the same year entered the works of Sulzer Brothers, of Winterthur, Switzerland, the well-known engine builders. Commencing in one of the plants as an apprentice and successively passing through the different departments of the large factory, he soon learned the rudiments of the practical side of the profession he expected to follow and became acquainted with the shop methods of an establishment standing, according to the opinion of many European engineers, at the head of the manufacturing industry abroad. After a year's experience of this character he became connected with the Allgemeine Elektricitäts Gesellschaft, of Berlin, where he was employed as an assistant in electrical installation work of various kinds.

In the fall of 1895 Mr. Marburg entered the Technical High School of Charlottenburg, choosing as his particular study the course in electrical engineering, and a year later went to the Technical High School of Hanover and finally to that of Darmstadt. Among the professors at these colleges at the time were Riedler, Kohlrausch, Kittler, Guthermuth and others prominent in scientific and practical work. During his various college vacations he was employed in the experimental departments of Siemens & Halske, of Berlin, assisting in the testing of standard machines and in a good deal of research work carried on by the company.

In 1898 Mr. Marburg came to America and at once secured a position with the Sprague Electric Company, becoming in this manner connected with the pioneer work of Mr. Frank J.

Sprague in installing the multiple-unit system on the South Side Elevated Railway in Chicago. In 1900 he went to Schenectady, where he remained for over four years, being attached to the railway department of the General Electric Company, and assisting at first in the design of railway motors and later devoting his time mainly to power-station design. Among the large amount of work of this character carried on by the General Electric Company at that time were the stations of the Fonda, Johnstown & Gloversville Railway and the Schenectady substation of the Schenectady Railway Company.

In 1904 Mr. Marburg joined the Allis-Chalmers Company, remaining with it in the electrical department at Cincinnati for about one year and a half, looking after the sale of power plant and car equipment and supervising the design of a number of installations put in by the Bullock Company, which previously had been absorbed by the Milwaukee company. In 1905 he was transferred to Milwaukee to join the Allis-Chalmers Company contracting department, which contracted for and supervised the installation of complete power-plant and railway equipments. Soon after this he was appointed engineer of the department and placed in charge of its engineering work.

L. C. Marburg.

Among the power-plant designs originating during this period under his supervision are the stations of the Toledo, Port Clinton & Lake Side Railway; the Sandusky, Norwalk & Mansfield Railway; the Indianapolis, New Castle & Toledo Railway; the electrical parts of the high-pressure fire-service stations in New York, and a number of other steam-driven and water-power stations in various parts of the country. In 1907, when the department was discontinued, Mr. Marburg was appointed mechanical engineer of the gas and mill-engine department, in which position he was in close contact for more than a year with the Allis-Chalmers Company's interesting gas-engine installations at the Illinois Steel Company's plant at South Chicago, the Indiana Steel Company's plant at Gary, etc. To the question of parallel operation of gas-engine-driven alternators he devoted a great deal of attention, making a special study of it during a trip abroad. In 1908 Mr. Marburg was placed in charge of electric hoisting work, another subject to which he had devoted a great deal of time during a European trip.

Mr. Marburg is now secretary and treasurer of Marburg Brothers, engineers and importers, New York, a corporation formed during the past year to import various specialties from Europe and to represent European inventors in the exploitation of their patents in this country.

For some time Mr. Marburg was among the special contributors to the *Elektrische Kraftbetriebe und Bahnen*, of Berlin. A number of patents have been issued in Mr. Marburg's name covering various electrical improvements in connection with power distribution.

Mr. Marburg is a member of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, New York Electrical Society, Verein Deutscher Ingenieure of Germany, and the Electrical Society of Berlin. He is also a member of the Engineers' Club of New York and the University Club of Milwaukee.

* * *

CURRENT NEWS AND NOTES.

Commission Plan of Government for Illinois Cities.—Decatur, Ottawa and Dixon, by a special election in each case, have been added to the list of Illinois cities adopting the commission form of government made permissible by a recent law of the Illinois Legislature.

Expensive Coal for Municipal Plant.—The *Illinois State Register* charges irregularities in the conduct of the city finances of Springfield, Ill., among others, that an item of $1,164.48 due for coal for the municipal lighting plant in January, 1908, was paid three times; first on Feb. 29, 1908, next on April 14, 1908, and again on Jan. 2, 1909. The coal company declares that the last check was the only one which passed into its hands.

City Electrical Inspector for Milwaukee.—Alderman Koch, of the Milwaukee City Council, has introduced an ordinance, now passed to its third reading, providing for a city electrical inspector and three assistants to supervise all wiring and apparatus installed, enforcing the National Electrical Code standard. Wiring supervision in Milwaukee is now handled by the Underwriters' inspector, who works independently of the city ordinances. The new city inspector will be appointed for a term of four years.

Fatal Boiler Explosion at Rushville, Mo.—A boiler explosion in the electric-light plant at Rushville, Mo., on Jan 14 is reported to have wrecked the station, killing two men who were in the boiler-room. Pieces of machinery were blown through the home of Mr. C. L. Smith, owner of the electric plant, partially demolishing the residence. The force of the explosion shook the whole town and broke many windows. The Rushville plant has been established six years and the boiler which exploded has been in use during that period.

Illinois Electric Railways Association.—Temporary organization of the Illinois Electric Railways Association was effected at a meeting of representatives of about twenty Illinois electric railway companies in Chicago on Jan. 10. Mr H. E. Chubbock, Illinois Traction System, Peoria, was elected temporary president and Mr. C. E. Flanner, auditor of the Aurora, Elgin & Chicago Railroad Company, Chicago, temporary secretary. Various committees were appointed and the meeting adjourned until Feb. 17, when a permanent organization will undoubtedly be effected. Representatives of the Central Electric Railway Association of Ohio and Indiana were present to ask the new association to affiliate itself with the older organization, but this matter was referred to a committee without definite action.

Marine Electrical Association.—The regular quarterly meeting of the Maine Electrical Association will be held at Augusta, Maine, Friday, Jan. 27. Mr. W. S. Wyman, Waterville, is secretary.

The Wisconsin State Telephone Association.—The Wisconsin State Telephone Association will hold its annual meeting and convention at Madison, Wis., on Feb. 1 and 2. Provision will be made for the display of commercial apparatus and material. Mr. P. J. Weirich, Monroe, Wis., is secretary.

A Porter's Philanthropy.—James H. Tilghman, a colored porter in charge of the clubroom of the Chicago Telephone Company, has given $1,000 to the fund for a Y. M. C. A. building for negroes in Chicago. This is the largest gift from a negro and is believed to represent practically all the savings of the donor, who is advanced in years.

Hydroelectric Development in Finland.—An English syndicate has filed application with the Finnish Senate for a concession to use the waters of the Sarina Lake for electrical generating purposes. The concessionnaires purpose to electrify the Finnish railways and to supply St. Petersburg and Helsingfors with electrical energy. The generating station will be erected at Kuurmanjoki and will have a capacity of 168,000 hp.

Proposed Extension of "Eminent Domain" in California.—To enable the City of Los Angeles to condemn the plants of private water and water-power companies and acquire them for public use, Senator L. R. Hewitt, of the California Legislature, is preparing to introduce a bill amending the law of eminent domain for that purpose. If the bill becomes a law the city may go into the courts and secure an appraisement of a reasonable price to be paid for the private plants, and may then acquire them upon payment of the fixed price.

Excursion of the Boston Section of N. E. L. A.—On the afternoon of Jan. 14 the Boston Edison Section of the National Electric Light Association met at the Edison Library and visited the United States Navy Yard at Charlestown, where courtesies were extended by the government. Four officers were detailed to show the party the most interesting features of the yard, including the chain and rope shops, power plant and electrically driven dry-dock pumping plant, the boat shop and the battleship *New Jersey*, which is at present undergoing repairs. Many points of interest ordinarily missed by visitors were pointed out and the section voted the excursion one of the most successful in its history.

Gas Fatalities in Chicago.—An unusually large number of accidents due to the escape of illuminating gas have been reported from Chicago within the last two or three weeks. In every case the accident would not have occurred if electricity had been used. In addition to instances which have been mentioned previously in this journal, the case is related of a woman who walked in her sleep and turned on the gas in her room without lighting it, being overcome by the fumes. The woman was rescued in time to save her life. Another instance was that of a peddler who was found dead in his home beside his wife, who was unconscious. Gas escaping from a stove, and unsuspected, was the cause of this accident. Both victims were discovered sitting in chairs.

Chicago Stockyards Fire.—During the inquest held over the victims of the disastrous fire in the refrigerating plant of Morris & Company, Chicago Union Stockyards, on Dec. 22, testimony was given to show that the electrical wiring in the building was not maintained up to a proper standard. There was some suspicion that the fire might have been of electrical origin, but the coroner's jury in its verdict says that it is unable to determine definitely the cause. No reference is made in the findings of the jury to the electrical equipment, except that it is recommended that a thorough re-inspection of the stockyards be made by the city building and electrical departments and any violations of the ordinances be corrected immediately.

Sons of Jove Initiation in Chicago.—Taking advantage of the occasion of the Chicago Electrical Show, the Sons of Jove gave a dinner, followed by a rejuvenation, at the Auditorium Hotel, Chicago, on Jan. 17. Messrs. Frederic P. Vose and A. A. Gray were the toastmasters at the dinner, the former introducing the proceedings with a thoughtful speech on the deeper significance of Jovianism that made a lasting impression. Brief remarks were made after dinner was over by Messrs. F. S. Hunting, of Fort Wayne; W. N. Matthews, of St. Louis; David Aitken, of Cleveland; Glenn C. Webster, of Cleveland; W. H. Colman, George S. Searing, R. M. Van Vleet, George H. Porter, W. A. Stacy, Frank L. Perry, M. L. Womack, James C. Pomeroy and P. R. Boole, of Chicago. A class of forty-two candidates was initiated with dignified ceremony and a message was sent to Mr. J. F. Dostal, of Denver, the reigning Jupiter, who was unable to be present. Mr. Dostal and Mr. J. Robert Crouse, of Cleveland, past Jupiter, sent messages of regret.

Officers Nominated for Electric Club of Chicago.—At the meeting of the Electric Club of Chicago on Jan. 18 a vote of thanks was extended to the McGraw Publishing Company, publisher of the *Electrical World*, for supplying to the club, with its compliments, 1000 copies of a pamphlet containing the constitution and by-laws and list of members. The question of recommending a system of co-operative daily newspaper advertising in Chicago, such as obtains in Cleveland, was referred to the board of managers for future action. The nominating committee, through Mr. F. S. Hickok, made its report and the following gentlemen were placed in nomination and will undoubtedly be elected at the annual meeting of Feb. 1, as there is no sign of an opposition ticket: President, Homer E. Niesz, Cosmopolitan Electric Company; vice-president, Charles A. Howe, Holophane Company; treasurer, Otis B. Duncan, the J. Lang Electric Company; secretary, N. F. Obright, Sanitary District; board of managers, John W. Mabbs, chief engineer Board of Trade; H. A. Mott, Chicago Telephone Company; A. L. Millard, Westinghouse Electric & Manufacturing Company; George H. Jones, Commonwealth Edison Company, and W. R. Bonham, Sterling Electrical Manufacturing Company. Mr. H. D. Critchfield, of the Automatic Electric Company, gave an address on the automatic telephone exchange service in Chicago.

Peculiar Central-Station Accident at Plymouth, Mass.—A curious shut-down lasting about ten minutes was recently experienced by the Plymouth (Mass.) Electric Light Company. On the back of the main switchboard at the Leyden Street plant are several oil switches of the type which have the terminals brought out of the top of the switch through porcelain insulators and then connected with the busbar, machine or line through a right and left brass coupling which makes a bare brass connection 3 in. long in the top of the switch. This connection passes through the porcelain at the top of the switch for about 1½ in. and the brass coupling is covered by a paper sleeve which is slipped on over the wire and which fits down tightly over the porcelain. A short-circuit took place on a switch of this type, the switch being connected to a machine which was not in operation. The short-circuit occurred on the bus side of the switch, which was alive. Sand was thrown on the switch to extinguish a fire which started in the paper sleeve, and a mouse was found between the two connections, apparently electrocuted. It appeared probable that the mouse had formed a cross connection with its tail or claws between the opposite poles of the switch and it was evident that in some way the paper sleeves had become worked up enough to expose the circuit to the mouse's body. The insulation of the wire leading to the busbars did not burn, as it was of the fireproof type.

Terminal Electrification in Chicago.—In its annual report the executive committee of the Chicago Association of Commerce relates the efforts made by the association, through a committee of engineers of prominence, to make a study of the feasibility of electrifying the steam-railroad terminals in Chicago. It is promised that the investigation shall continue during the year 1911 and that a conservative analysis of the whole subject will be undertaken.

New Element Has Diamagnetic Properties.—Celtium is the name of a newly discovered element reported by Mr. Urbain to the French Academy of Sciences. The new element was isolated during attempts to obtain another comparatively new material, lutenium, which Mr. Urbain is reported to have discovered two years ago. Celtium is a product of the gadolinite earths and is said to have diamagnetic properties three or four times those of lutetium.

N. E. L. A. Hotel Committee.—For the accommodation of members who expect to attend the next convention of the National Electric Light Association, which, as announced in these columns last week, will be held in New York City, May 29 to June 3, a hotel committee, headed by Mr. F. H. Smith, of the United Electric Light & Power Company, New York City, has been formed. This committee will undertake to make definite hotel reservations for members and their guests on application.

More Than Fifty-seven Varieties.—A manufacturer of small alternating-current motors displayed a card at the recent Chicago Electrical Show stating that he had 1288 different types from which selection might be made. This large number is due to the different sizes, speeds, voltages, phases and frequencies, the varying characteristics interlacing in such a manner as to increase the number of "types" in geometrical ratio. This manufacturer makes motors from 1/6 hp to 10 hp. The number of varieties where larger motors are made would be much greater, of course.

Patent Litigation.—Mr. Frank Keiper, of the New York Bar, in discussing in a recent paper the subject of patent rights, said that not more than one-third of the patents litigated are held to be valid and infringed, the other two-thirds failing to be sustained. He also believes that where one patent is sustained as valid and infringed fully fifteen patent suits are filed and dismissed for want of prosecution, owing to the trouble or expense, or both, of getting the case to a final issue. This showing, he adds, is very discouraging and indicates that a patent condition exists which needs an extraordinary remedy.

Rate Controversy in Indianapolis.—Alleged discrimination in electric light rates is a subject being agitated in Indianapolis (Ind.) and has led to the holding of meetings by consumers and refusals to pay a rate exceeding that paid by what are claimed to be favored consumers. It is urged that the State of Indiana shall file a claim for $35,000, representing the difference between the rate charged the State for lighting the State House and other public buildings and that charged other patrons by the same company. The Indianapolis Board of Public Works has ordered the lighting companies to file a schedule of rates, and it is proposed that patrons shall refuse to pay their lighting bills until the companies file a scedule of rates and shall go into court if the supply is shut off.

N. E. L. A. Philadelphia Section Meeting.—At a meeting of the Philadelphia Electric Company Section of the National Electric Light Association held on Jan. 16, 1911, Mr. G. Bertram Regar, of the Welsbach Company, presented a paper on incandescent gas lighting which proved of much interest to the electrical men. Among the speakers of the evening were Mr. W. W. Freeman, president of the National Electric Light Association, and Mr. T. C. Martin, the general secretary; Mr. R. S. Orr, vice-president of the Pennsylvania Electric Association; Mr. E. A. Baily, chairman of the Brooklyn Company Section of the N. E. L. A., and Mr. M. S. Seelman, Jr., editor of the N. E. L. A. "Question Box." The meeting developed into an N. E. L. A. rally and was of special interest to the section. There were in attendance 181 guests and members.

One Hundred and Ten Thousand Volt Plant in Germany.—The first transmission line in Europe utilizing an e.m.f. as high as 110,000 volts will be built at Gröba, Germany, by the Aktiengesellschaft Lauchhammer. This company owns a large number of iron and steel works, some of which are to be furnished with electrical energy from the new power station. Three turbo-generators, each one of 5000 kw, will be installed at first, with space provided for two of the same size to be installed later. Four three-phase, oil-cooled transformers will step up the generator voltage from 5500 volts to 110,000 volts. The energy will be transmitted by overhead lines a distance of about thirty-five miles. When completed the station will have a total output of 50,000 hp. The transformer and switchboard installations are to be made by the Siemens-Schuckert Werke in Berlin.

Navigability of the Desplaines River.—Many interesting historical facts are brought out in the suit of the United States government against the Economy Light & Power Company, of Joliet, Ill., to restrain the latter from obstructing the navigation of the Desplaines River by constructing a water-power dam at Dresden Heights. The Supreme Court of Illinois has decided that the Desplaines River is not to be considered as navigable, as the rights of the water-power company go back to the time before the water of the Chicago Drainage Canal was turned into it. The government has taken the opposite position, however, and testimony is being taken in Chicago. One witness was Mr. Reuben G. Thwaites, of Madison, Wis., for twenty-four years secretary of the Wisconsin Historical Society, who testified that historical documents show that nearly a century ago boats capable of carrying six tons of merchandise and a crew of five men were able to navigate the Desplaines River without difficulty.

Electric Iron and Steel Works in Norway.—The Arendals Power Company of Norway, which for many years has owned the large waterfalls Böilefossen, will take up the electrical manufacture of iron, having acquired a considerable area of land for that purpose. The company has increased its capital to $1,000,000. Stock will be issued to the amount of $550,000 and $500,000 will be obtained from banks. The Böilefossen waterfalls at average flow will develop 30,000 hp, and with some hydraulic development will give an additional 12,000 hp. The company also owns practically the whole mining district about the City of Arendal. Recently it acquired the right to use the patents owned by the Swedish Electro-metal Company for producing iron and steel by means of electricity. The methods involved in these patents have been thoroughly tested at Trollhättan in Sweden and at Hardanger in Norway. The new works will be ready for operation in January, 1913.

Telephone Rate Investigation in Chicago.—The investigation of the telephone rate question in Chicago was continued last week by the City Council committee on gas, oil and electric light. The Chicago Telephone Company continued to resist the conclusions of Mr. Hagenah, the city's expert. Many alleged erroneous deductions in the Hagenah report were pointed out by the representatives of the company. For one thing, it was declared that no provision had been made to give the employees of the company an increase in pay during the next five years, notwithstanding the increasing cost of labor. The apportionment of charges to be made for toll service between the local company and the long-distance company was also discussed. It was asserted that of a long-distance charge amounting to $5, the local company gets about 12 cents, and the Aldermen wonder whether that is enough. The question of a reasonable dividend, whether 7, 8 or 10 per cent, and the rate of depreciation, whether 5½ per cent. as recommended by Mr. Hagenah, or 7 or 8 per cent, as desired by the company, was discussed. The committee itself is not a unit in considering the rate question, and no conclusion had been reached at the end of the week.

Tests of Meters.—Of 7713 tests of electric meters reported to the New York Public Service Commission, Second District, during November, 1910, 6188 meters, or 80.23 per cent, were accurate; 402, or 5.21 per cent, were fast, and 1123, or 14.56 per cent, were slow.

Empire State Association to Meet.—An informal meeting of the Empire State Gas & Electric Association will be held on Feb. 1 at Binghamton, N. Y. No specific subjects for discussion have been assigned in advance of the meeting, but topics of interest will be taken up.

Perpetual Franchises in Indiana.—A bill has been introduced in the Legislature providing that no public-service company shall assert a perpetual franchise. The bill is understood to be aimed to prevent the Indianapolis Water Company and the Central Union Telephone Company from asserting a perpetual franchise.

Mme. Curie Defeated.—The French Academy of Sciences has elected M. Edouard Branly to a vacancy in that body by thirty votes against twenty-eight for Mme. Curie, who was a candidate for the chair, which was formerly occupied by her husband. M. Branly discovered the coherer which led to the development of wireless telegraphy.

Baltimore A. I. E. E. Section.—At a meeting on Friday, Jan. 20, of the Baltimore section of the American Institute of Electrical Engineers, Dr. J. B. Whitehead, of Johns Hopkins University, presented a paper on "The Influence of the Magnetic Field on Vision," and Mr. A. S. Loizeaux another on "The Characteristics and Operation of Relays for Tripping Coils."

Change in the Value of the International Volt.—The Bureau of Standards, Washington, D. C., has issued in Circular No. 29 a statement that since Jan. 1, 1911, the bureau has been using as the e.m.f. of the Weston normal cell 1.01830 international volts at 20 deg. C. The change made is equivalent to an increase of about 0.08 per cent in the value of the international volt. Detailed explanations are given as to the reasons for making the change.

Industrial Safety Association.—Steps are being taken toward the formation of a National Industrial Safety Association along the lines of national engineering societies. Among the objects of the association will be to support a propaganda concerning the means of safety, by illustrated lectures and talks in industrial works, and to collect models and photographs. Further information may be obtained by addressing the association, Engineering Societies Building, 29 West Thirty-ninth Street, New York.

Meeting of New York Electrical Society.—Dr. Percival Lowell will be the speaker at a meeting of the New York Electrical Society, to be held in the Engineering Societies Building, New York, on Feb. 2, 1911. The subject will be "World Evolution." The lecture will be profusely illustrated by lantern slides. The lecture should prove of considerable general interest. Invitations to attend the meeting are being extended to friends of the members of the society and to members of kindred organizations.

Proposed Texas Legislation.—Among bills introduced in the Texas Legislature is one ordering an investigation of "electrical trusts," under which term are included the Western Union and Bell Telephone Companies, electrical property syndicates not having headquarters in the State and outside electrical manufacturing companies selling their product in the State. Another provides for a public service commission and still another confers authority on municipalities to regulate public utility rates, provided that no rate shall be fixed which will not yield a return of at least 10 per cent per annum on the physical valuation of a property.

Colorado Electric Club.—At the Thursday luncheon last week of the Colorado Electric Club Mr. W. P. Carstarphen, Jr., of the Carstarphen Electric Company, assumed the presidency for the ensuing year and gave an interesting address outlining the purpose of the organization. He emphasized the educational as well as the social features and proposed a greater participation by members in weekly addresses. The speaker of the day was Mr. H. H. Rice, who was introduced by Mr. Greenawalt, and as a subject took "Concrete and Its Use in Building Construction." The address was followed by comments from representatives among club members of the Portland cement manufacturers. A short statement on the reduction of fire-waste incident to the more general use of reinforced concrete was made by Mr. W. J. Canada, of the Rocky Mountain Fire Underwriters' Association.

Contractors and Central-Station Competition.—The electrical contractors and dealers of Baltimore have protested to the president of the Consolidated Gas, Electric Light & Power Company against the policy of that company with respect to electrical retail trade. It was stated that this policy tends to discourage the electrical dealers from pushing the sale of electrical devices. In reply Mr. Herbert A. Wagner, vice-president and head of the electrical department, said that the company had gone into the business of wiring houses, selling electrical appliances and constructing electric signs for the reason that the Baltimore jobbers do not do these things on a sufficiently large scale to increase appreciably the sale of electric energy. "But one-third of the business originated by its advertising campaign is done by the jobbers," Mr. Wagner said. "Having an established price per lamp in each classification, the jobber knows just what our price will be for a given house. When the owner comes to him to have it wired, if it so happens that the jobber can cut under our price and make a profit he will do it. The result is that the jobbers get the cream of the business anyway. We have tried to get jobbers to unite and do the electrical business of Baltimore in a broad way, but it seems to be impossible."

Mr. F. R. Upton Entertained in Budapest.—Mr. and Mrs. Etienne de Fodor gave a dinner at the Grand Hotel Hungaria in Budapest on Jan. 5 in honor of Mr. and Mrs Francis R. Upton, of Orange, N. J. Mr. Upton, who is accompanied by his wife and two daughters, went abroad for a two-months recreation trip and diverged from the route originally laid out to pay a visit to Messrs. de Fodor and Francis Jehl, who thirty years ago were colleagues of Mr. Upton in the Edison laboratory. Mr. de Fodor related an anecdote concerning Martin Force, who was an all-around handy man at the Menlo Park laboratory and was sent to help Mr. Batchelor to fit up the Edison lamp factory at Ivry-sur-Seine. On several occasions Mr. Batchelor tried to impress upon "Mart," as he was called, the necessity of being polite and obliging in his intercourse with Frenchmen. On one occasion Mr. Batchelor spoke to him of the use of the term "s'il vous plait" and asked how he would act if, for instance—pointing to an open door—a young lady should politely request him to close it. "Do it yourself s'il vous plait," blurted out Mart. After this time Mart was given up as incorrigible. On Jan. 6 Mr. Upton visited the large substation of the Budapest General Electric Company and was very much impressed with its extremely modern character and congratulated Mr. de Fodor upon his work. In the evening the party were taken to the Kings Theater to witness a Hungarian light opera and the following day they left for Vienna.

STORAGE-BATTERY SUBSTATION FOR DETROIT RIVER TUNNEL ELECTRIC RAILWAY INSTALLATION.

ONE of the most interesting features of the equipment installed for supplying energy to the electric locomotives operated through the Detroit River tunnel between Detroit, Mich., and Windsor, Ontario, is the substation which receives the energy at 4400 volts, three-phase, from the system of the Detroit Edison Company and delivers 650-volt direct-current energy to the electrical installation of the Michigan Central Railroad, the locomotives of which were described in our issue dated June 17, 1909.

The energy is purchased on a maximum-demand as well as a kw-hour basis, which makes it necessary for economical operation to eliminate as far as possible excessive peaks from the incoming lines. A storage battery has been installed to take care of the fluctuations of load, and the regulation devices are such that the first 800 amp are taken from motor-generator sets; then the battery takes care of the load from 800 amp up to 8360 amp: that is, the battery takes 7560 amp. Anything above this figure is again taken from the motor-generators. The maximum load is 9100 amp. When this load is being carried the motor-generator sets would be delivering 1540 amp (their full-load rating) and the battery would be supplying 7560 amp.

The more important items of apparatus installed for traction purposes only are two horizontal 1000-kw, 514-r.p.m. synchronous motor-generator sets; one 50-kw motor-generator set, and a storage battery with a present eight-hour discharge rating of 630 amp.

Each large motor-generator set consists of a General Electric three-phase, fourteen-pole, 1060-kw, 4400-volt synchronous motor directly connected to a 1000-kw, eight-pole, 650-volt direct-current generator The pair of machines forming a two-bearing set are mounted on a common base and run at a speed of 514 r.p.m. The shaft is extended at the motor end to accommodate a direct-connected exciter. Tests show that the synchronous motors of these sets will come up to synchronism in about forty-five seconds on the 35 per cent tap of the auto-transformer starter. The guarantees provide that these machines shall operate continuously with a temperature rise not exceeding 35 deg. C. at unity power-factor and that they shall carry an overload of 50 per cent for two hours with a temperature rise not exceeding 55 deg. C. The efficiencies are as follows:

Half Load	Three-fourths Load	Full Load	
91.0	93.0	94.0	Guaranteed
92.0	94.1	95.3	Tested

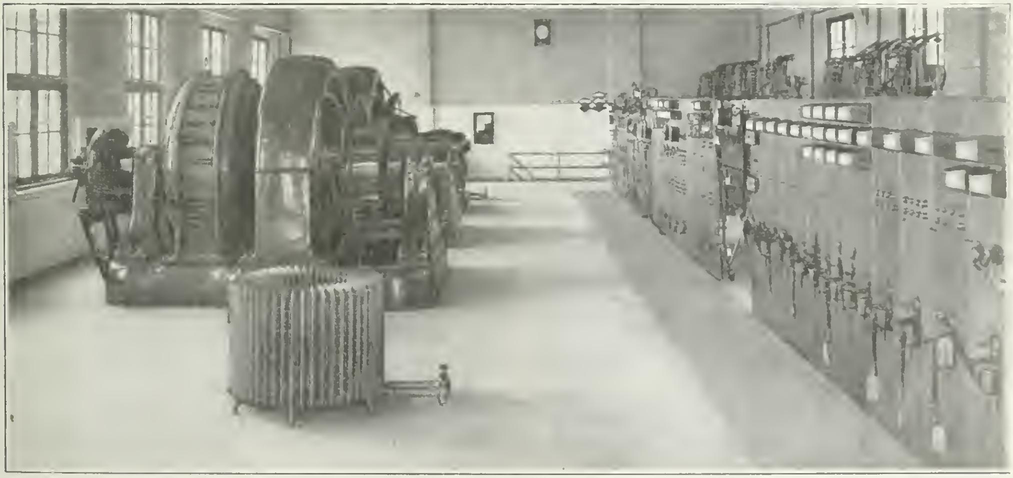

Fig. 1—Interior of Converter Station.

The direct-current machines are shunt-wound units designed to operate in parallel with the storage battery. They have commutating poles and also auxiliary shunt-field windings which are separately excited from the storage-battery booster and play an important part in the scheme for regulating the load. The auxiliary winding is of such strength that when the generator is operating under normal load at 650 volts the voltage can be raised to 700 or reduced to 575, so that it can be used for either charging or discharging the battery. These motor-generator sets are seen in the general view of the interior of the station, Fig. 1.

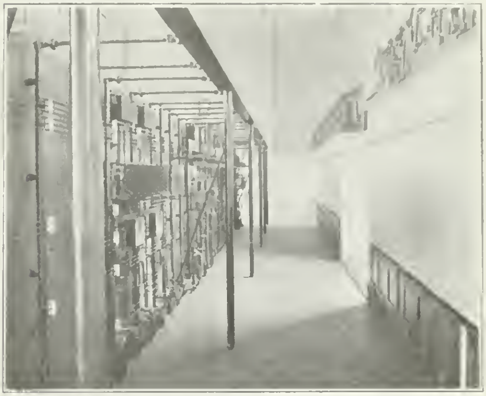

Fig. 2—Rear of Main Switchboard.

The 50-kw motor-generator set consists of a 75-hp, 650-volt shunt-wound direct-current motor directly connected to a 50-

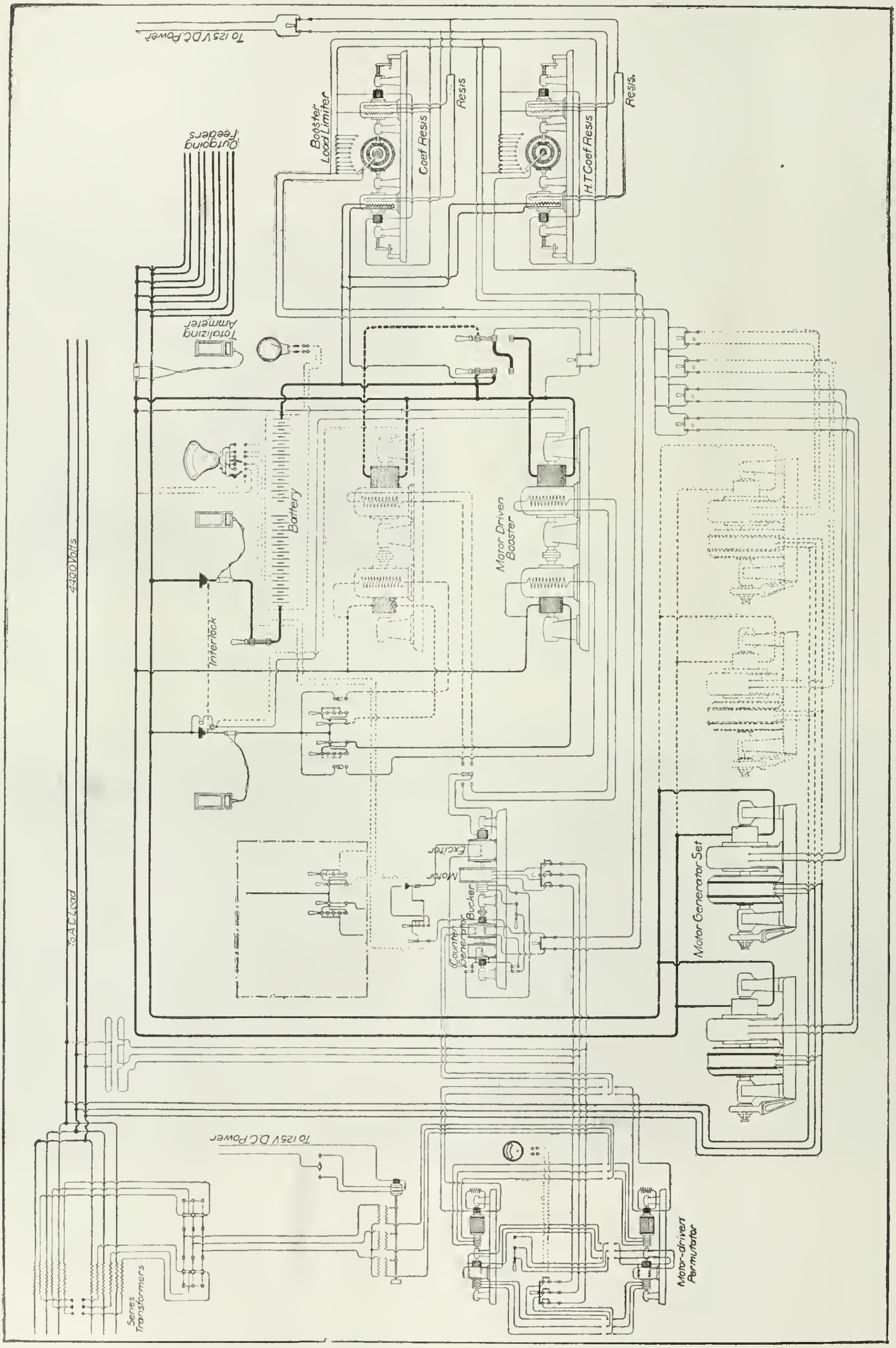

Fig. 3—General Arrangement of Circuits Connected to the Storage Battery.

kw, 4400-volt, three-phase generator. The two machines are mounted on a common base and form a three-bearing set. This unit is installed to provide a small amount of 4400-volt alternating current by driving the set from the main storage battery in case of total shut-down of the Detroit Edison Company's lines. In this manner one-half of the tunnel lighting, a small amount of pumping, signal lamps and signal track transformers can be operated, while the railway load would be carried on the main battery.

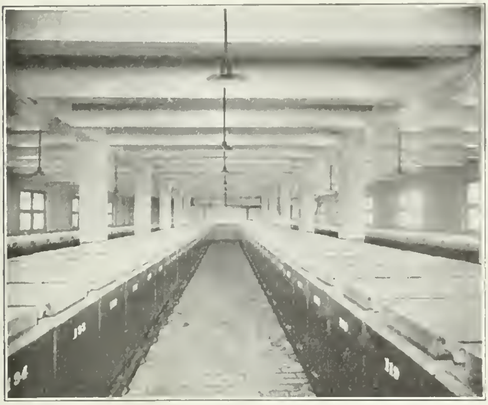

Fig. 4—Battery Room.

The battery consists of 312 Gould cells in fifty-nine plate tanks. Each plate element is 18.5 in. square and has a discharge rating varying from 630 × 8 amp-hours to 2520 × 1 amp-hours, and is capable of withstanding momentary discharges as high as 800 amp.

In connection with the battery use is made of a motor-driven booster, an exciter set for the booster and a small rectifier set for obtaining current for regulating purposes, which varies according to the ampere times the power-factor on the incoming supply. One floor of the battery house is shown in Fig. 4, while the exciter set, the motor-driven booster and the small regulating rectifier set are illustrated respectively in Figs. 5, 6 and 7. The load requirements are such that, taken in connection with the relatively low average demand, a practically instantaneous response to load changes must be obtained from the battery and booster, and to accomplish this result a special Gould high-voltage exciter has been provided, which upon the change of load occurring impresses an abnormal voltage on the booster field circuit. This voltage is maintained until the proper current flows through the booster field circuit to cause the booster to respond and so compel the battery to charge or discharge in accordance with the load changes.

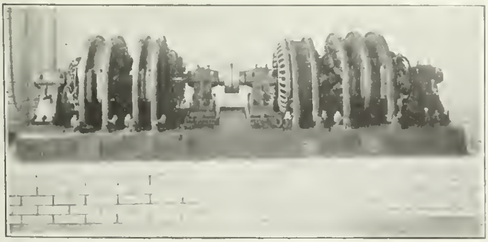

Fig. 5—Counter E.m.f. Generator, Bucker, Motor and Exciter.

To reduce the size of the battery required to accomplish the work and also the size of the booster necessary, it is desirable to have the station voltage changed inversely according to the demand on the station; that is, to have a high station voltage when the load is light and a low station voltage when the load is heavy. It is, however, not desirable that the variations in station voltage should occur at times other than times of maximums and minimums. To accomplish this a load-limit device, shown in Fig. 8, has been installed, which changes the excitation of the direct-current end of the motor-generator sets either when the booster voltage output rating is reached or when the booster current rating is reached, but at all other times permits normal excitation of the motor-generator set. This causes the motor-generator set voltage to be increased when the booster voltage reaches the limit in a charge direction or when the booster current reaches the limit in a charge direction, and decreases the voltage of the motor-generator set when either the booster voltage or current rating in a discharge direction is exceeded.

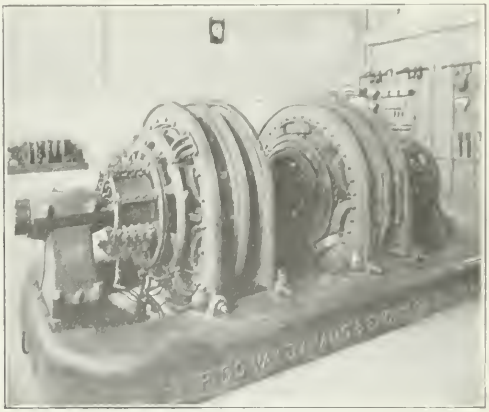

Fig. 6—Booster Set.

Inasmuch as the energy is purchased on a kw-hour basis, it is desirable that when the voltage is decreased on the motor-generator sets the current be increased, and to accomplish this a booster load-limit device has been installed. In the event of a load carrying beyond the capacity of the battery and booster this apparatus automatically shifts the excess load from it to the motor-generator set, thus preventing the opening of the battery circuit-breaker and the consequent transference of the total load to the motor-generator set, which would result in the opening of the motor-generator circuit-breakers. This load-limit device is actuated by the battery discharge current and the battery charge current and by the booster voltage in a charge direction and in a discharge direction. When the bat-

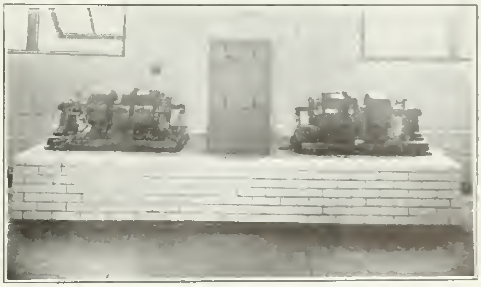

Fig. 7—Rectifier and Permutator Set.

tery is discharging and this load-limit device is actuated additional load is thrown on the motor-generator sets, and when the battery is charging and the load-limit device is actuated the load is removed from the motor-generator sets, but this device, like the load-limit control of the motor-generator sets, does not come into operation until certain limits have been reached. At all other times the regulating apparatus and the battery preserve practically constant load on the lines of the Detroit Edison Company.

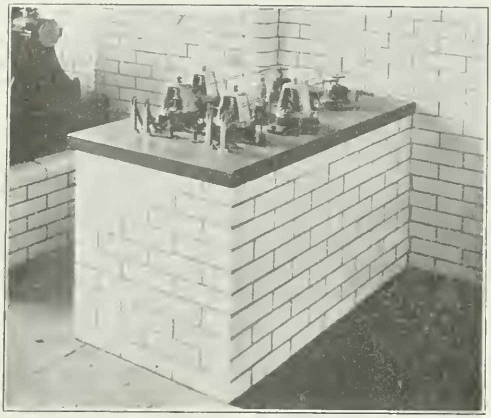

Fig. 8—Quadruple Load-Limit Device.

It is thought that the following details of the apparatus may be of interest: In the incoming lines from the Detroit Edison Company series transformers are inserted and from these series transformers current is led to a small rectifier set which consists of a synchronous motor and a small permutator. The synchronous motor drives the permutator in synchronism with the voltage, but in a reverse direction to the direction of the field set up by the current from the series transformers. This results in a field which is fixed in space so long as the power-factor is unchanged. The permutator is provided with two sets of brushes, one practically at 90 electrical space degrees to the other, one set being connected to the field circuit of the counter machine and the other set connected to a by-pass circuit. The brushes are so set that with the normal current flowing from one set of brushes through the field circuit of the counter machine no current flows through the by-pass circuit when the power on the incoming lines from the Detroit Edison Company is at 100 per cent power-factor. When set in this way a change in power-factor on the incoming lines without a shift of current will cause the current supply from the permutator to the field circuit of the counter machine to be reduced and the current to flow in the by-pass circuit, and by proper adjustment of the resistance of the two paths the current flowing through the counter machine field circuit is at all times proportional to the current times the power-factor on the incoming lines from the Detroit Edison Company.

From the counter machine armature a circuit extends to and includes one field circuit of the exciter and the armature of the bucker, this bucker being a machine designed to generate constant voltage irrespective of the direction and amount of current through its armature and provided to furnish a constant opposing force for the regulation to work against. The voltage of this bucker is equal to the voltage of the counter machine when the normal load is on the incoming lines, and any change in load on the incoming lines will cause current to flow from the counter machine or to the counter machine through the exciter field circuit, depending on whether the load is increased or decreased. From the exciter armature a circuit extends to the booster field circuit and includes a reverse series winding on the exciter. This winding cuts down the exciter voltage when current flows to the booster field circuit, thus permitting an abnormal voltage to be obtained from the exciter and applied to the booster field circuit as long as required, or until current begins to flow through the booster field circuit, when this voltage is cut down in proportion to the current flow to the booster field circuit. The wiring details of this apparatus are shown in Fig. 3.

In this plant the time required to reverse the booster from 80 volts in one direction to 80 volts in the other direction, with normal voltage applied to its terminals, is approximately four and one-half seconds. By using the differential exciter an e.m.f. as high as 300 volts can be impressed on the booster field circuit, which is wound for approximately 20 volts. The result is that the response of the booster is enormously quickened, and this excess voltage is cut down exactly as desired, so that at no time does an excessive or abnormal current flow through the booster field circuit. Means are provided whereby the average load supplied by the Detroit Edison Company can be changed at will to accommodate this system to different schedule conditions. Means are also provided whereby the regulation can be changed from 7½ per cent to 33⅓ per cent; that is to say, the incoming power from the Detroit Edison Company can be kept constant within the limits of plus or minus 7½ per cent or can be permitted to vary plus or minus 33⅓ per cent from any desired average.

UNUSUAL CURRENT RELATIONS IN CONDENSIVE AND INDUCTIVE CIRCUITS.

By Alfred Still.

Although the somewhat unexpected effects from the presence of both inductance and capacity in an alternating-current circuit are discussed in textbooks and may be assumed to be generally understood, the writer believes that the explanation of some results obtained under actual working conditions may be of sufficient interest to warrant publication of this article.

The diagram in Fig. 1 shows the arrangement of some apparatus used for the purpose of making high-voltage insulation tests on electric cables. This apparatus consists of an alternator *G* supplying energy to a variable-ratio transformer which in turn provides energy for the primary of a step-up transformer. The coils of a cable to be tested for insulation are connected in parallel across the secondary terminals of the step-up transformer; the actual arrangement consists of a water tank in which the coils under test are immersed, the free ends being connected to one terminal of the step-up transformer through a common insulated conductor, while the tank itself is connected to the other terminal of the transformer. It follows that the current indicated by the ammeter A_2 is largely a capacity current, the value of which will be proportional to the number of (similar) coils connected in parallel under test.

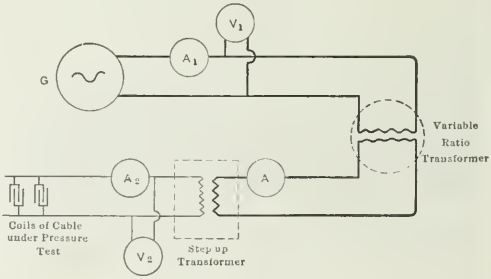
V1
A1
G
Variable Ratio Transformer
A2
A
Coils of Cable under Pressure Test
V2
Step up Transformer

Fig. 1—Actual Test Connections.

In regard to phase, this current will be in advance of the impressed voltage by nearly a quarter of a cycle and the current will be practically "wattless." If the magnetizing currents of the transformers were so small as to be practically negligible then the three ammeters A_2, A and A_1 would all give indications proportional to the total electrostatic capacity of the cables under test. Observations taken while varying the number of similar coils of cable connected up to the testing transformer, and noting the readings of the three ammeters, showed that, although the readings on ammeters A and A_2 were substantially proportional to the load—that is, to the number of coils under test—the ammeter A_1 in the primary circuit of the variable ratio transformer showed a *decrease* in the current as the number of coils was increased from 1 to 5, after which it showed an increase with the addition of further coils.

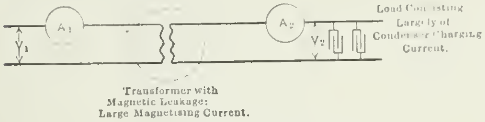
A₁
V₁
A₂
V₂
Load Consisting Largely of Condenser Charging Current.
Transformer with Magnetic Leakage: Large Magnetising Current.

Fig. 2—Equivalent Test Connections.

When carrying out these tests the frequency of the supply current and the test pressure were kept as nearly constant as possible, but owing to slight variations not only in these quantities, but also in the transformation ratio of the variable ratio transformer, the readings actually obtained are not given; they are not essential and would be of little value unless accompanied by somewhat lengthy explanations.

The peculiar changes of current as indicated by ammeter A_1 (Fig. 1) are due to the fact that the variable-ratio transformer, being constructed with an air-gap between the fixed and movable portions of the iron cores, has necessarily a large "wattless" magnetizing current.

In the case of the step-up transformer—which had a closed iron circuit—the magnetizing current was very small; and this accounts for the readings of both ammeters A and A_2 being approximately proportional to the number of coils of cable under test.

For the purpose of drawing a simple diagram of current vectors the step-up transformer may be omitted and the arrangement of the testing plant would then be as indicated in Fig. 2. The condition is that of an imperfect transformer, having a large wattless magnetizing current, connected on the secondary side to a circuit of very great electrostatic capacity as compared with its resistance and inductance.

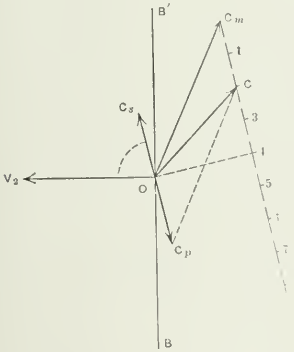

Fig. 3—Vector Diagram of Three-Phase Relation.

In the vector diagram of Fig. 3 let the vertical line BB' represent by its direction the time phase of the magnetic flux passing through the secondary windings of the variable-ratio transformer. The induced volts in the secondary will be OV_2, lagging exactly ninety time degrees behind the magnetism. The magnetizing current in the primary circuit—if entirely "wattless"—would be in time phase with the magnetic flux; but owing to the presence of iron in the magnetic circuit the phase of the actual primary current, even with no load on the secondary, will be somewhat in advance of the magnetism, as indicated by the vector OC_m, which represents the total primary current when the secondary circuit is open, or that component of the total primary current which must always be present so long as the voltage V_2 is maintained at the secondary terminals.

On account of the nature of the load the time phase of the current taken from the secondary windings of the transformer will be very nearly one-quarter period in advance of the secondary e.m.f., and the vector OC_s, drawn very nearly ninety time degrees in advance of the vector OV_2, may represent such a current.

Consider now what takes place in the primary circuit. It is clear that the secondary current must be balanced by an exactly equal but opposite component of the total primary current[1] in order that the *resultant* amp-turns required to maintain the magnetic flux shall remain as before. Therefore, OC_p may be drawn exactly equal in length but opposite in direction to OC_s, to represent this balancing component of the primary current, and by compounding OC_p and OC_m in the usual way, OC is obtained for the total current in the primary circuit when the current OC_s is taken from the secondary terminals. It will be observed that OC is *smaller* than OC_m for this particular value of the secondary current, and this reduction in the primary current when a small secondary current is taken from the transformer is clearly due to the peculiar time-phase relation between the leading secondary current (on the capacity load) and the lagging primary magnetizing current (due to the air-gap in the iron core of the transformer). The numerical values chosen for the construction of the diagram (Fig. 3) are 5 for the magnetizing current and 2 for the "load" current. It will be seen that as the secondary current is increased (by connecting up more coils of cable in the testing tank) the primary current will continue to fall until $C_s = 4$, which brings the resultant OC in time-quadrature to OC_s; but with a further increase of the secondary current the primary current will also rise.

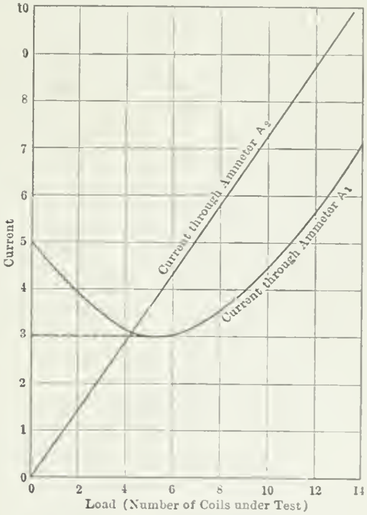

Fig. 4—Variation of Currents with Loads.

In Fig. 4 the numerical values of the secondary current and the total primary current have been plotted for increasing values of the secondary load, from open secondary circuit up to a total load of fourteen coils of cable; and the manner in which the primary current falls from 5 amp on open circuit to a minimum of 3 amp with five coils under test, after which it grows at an increasingly rapid rate, is very clearly indicated on the diagram. It may be mentioned that, although the actual readings taken under working conditions are not plotted, the average of the observed results very closely follows the theoretical curve which has been drawn.

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[1] For the purpose of simplifying the diagram a transformation ratio of 1:1 has been assumed.

CURRENT-RATIO AND PHASE-ANGLE TEST OF SERIES TRANSFORMERS.

By H. S. Baker.

The method here described for determining the current-ratio and phase angle of series transformers consists in bucking a known multiple of the primary amperes against another known multiple of the secondary amperes and reading the vector difference upon a wattmeter. The only apparatus required consists of a wattmeter of the moving-coil type, an ammeter, a laminated iron ring upon which may be wound various numbers of turns of wire, and a lamp bank. There must also be available a source of polyphase e.m.f., a source of heavy current and switches, as shown in Fig. 1.

The procedure of test is as follows: The apparatus is connected as shown in Fig. 1. The test ring shown has one primary turn, with secondary turns, shown in full line wound approximately uniformly around the ring. The tertiary winding, shown in dotted line, is also wound approximately uniformly around ring. This tertiary winding feeds through the switch *B* directly into the moving coil of the wattmeter.

Voltage taps are taken off at the secondary terminals of the transformer under test and connected through the switch *C* to the moving coil of the wattmeter through the regular meter resistance shown. The series coil of the wattmeter is supplied with 5 amp, which may be taken from either of two e.m.f. phases through the switch *A*, and may be reversed at will by means of the switch *D*.

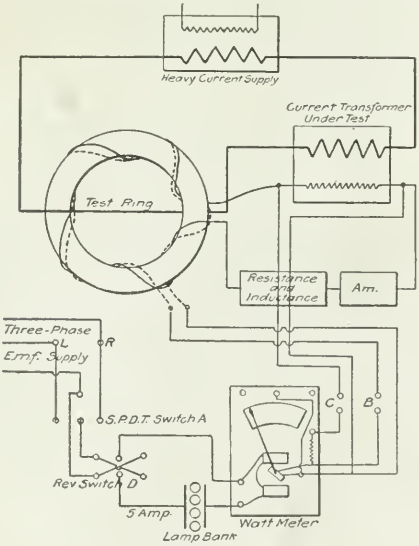


Fig. 1—Diagram of Connections.

Current is supplied through the heavy current circuits as shown. Care should be taken that the primary and secondary amperes are bucking in the test ring and not adding. The switches *A* and *B* are closed to the right and the switch *D* closed in the direction giving a plus deflection on the wattmeter. If *D* is to the right the reading may be designated plus and if to the left minus. The switch *A* is then closed to the left and another reading taken.

The above two readings represent components of tertiary amperes along directions of the two e.m.fs. used. The series secondary terminal voltage may now be read as follows:

Close the switches *A* and *C* to the right and the switch *D* in the direction to give a plus deflection of the wattmeter. Read the wattmeter and then throw switch *A* to the left and repeat the reading. These two readings represent components of secondary terminal volts along the same two directions.

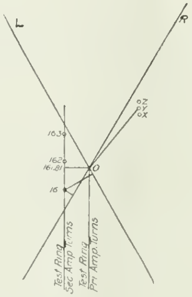


Fig. 2—Diagram for Interpolating Test Results.

The above four readings were as follows in the case of a series transformer marked 400 to 5 amp, a test ring with two primary turns being used:

Ring Secondary Turns.	Secondary Amperes.	Tertiary Current.		Secondary Volts.	
		R.	L.	R	L.
161	3.6	—89	—22	+4.0	+1.3
162	3.6	—22	+46	+4.4	+1.6
163	3.6	+47	+118	+4.9	+2.0

Fig. 2 is a diagram in which the above readings are plotted for 161, 162 and 163 turns. The lines *OR* and *OL* are 60 deg. apart, representing two sides of the three-phase e.m.f. supply shown in Fig. 1. *OL* was assigned the e.m.f. phase which leads *OR* in order to give the diagram correct rotation. The point 161 was determined by measuring along *OR* a distance (see table) of minus 89 and erecting a perpendicular to *OR*, then measuring along *OL* a distance of minus 22 and erecting a perpendicular to *OL*.

The intersection of these perpendiculars gives the point 161, and the vector *O* — 161 is the only line having projections along *OR* and *OL* of the values of minus 89 and minus 22. This vector thus represents the current flowing in the tertiary winding when 3.6 amp are in the secondary of the transformer under test, and when 161 to 2 is the ratio of the turns on the test ring. Similarly, the points 162 and 163 are plotted from the corresponding readings.

It will be seen that adding one turn to the secondary of the test ring changes its secondary amp-turns in magnitude but not in phase, and in going from 161 to 162 the point has passed *O*. At the interpolated point 161.81 the vector *O* — 161.81 is at right angles to the secondary amp-turns of the test ring. This is the vector difference between the primary and secondary amp-turns of the test ring. At this point the test ring secondary and primary amp-turns are of closely equal magnitude because their vector difference is approximately perpendicular to both. We know then that the vector ratio of currents is 2 to 161.81, or the current ratio is in error by 1.81 ÷ 160, or 1.13 per cent.

The phase difference between the primary and secondary amperes is determined by measuring the distance *O* — 161.81

and dividing it by 161.81 times the distance 161 — 162, which operation gives the tangent of the angle of secondary current lead.

The voltage delivered by the transformer under test is determined by plotting the voltage points x, y and z from the above voltage readings and interpolating between x and y in the same ratio as the point 161.81 is between the points 161 and 162. The voltage at this interpolated point will be found to be 4.4 volts. The secondary amperes were taken as 3.6. The following data are then obtained for this point:

Secondary Amperes	Secondary Volts.	Ratio.	Phase Lead
3.60	4.4	$\frac{161.81}{2}$	$\frac{0.89}{161.81}$

Other points taken on this same test were as follows:

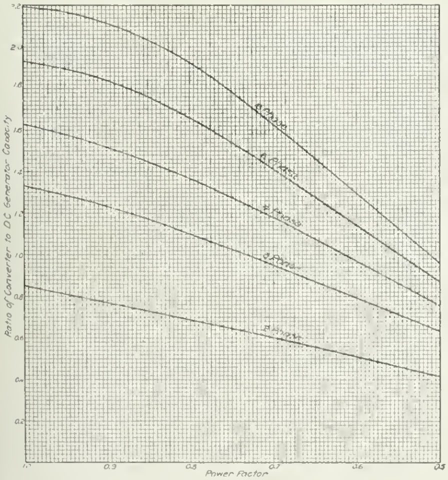
1.64		$\frac{162.22}{2}$	$\frac{1.33}{162.22}$
1.45		$\frac{162.53}{2}$	$\frac{1.57}{162.53}$

The above test of three points on the ratio curve was carried out and plotted by convenient means in forty minutes and forms a method at once available and effective.

COMPARATIVE CAPACITIES OF ROTARY CONVERTERS.

By W. L. Durand.

Anyone accustomed to electrical machinery must have noticed the decided difference in size between an alternating-current or direct-current generator and a rotary converter of the same capacity. The reason for this is not apparent unless a study be made of the different manner in which the two machines reach their limit of capacity as a result of the heating effect.



Variation of Output Rating of Converters of Different Number of Phases (Collector Rings), with Change in Power-Factor.

In a rotary converter the commutated continuous and alternating currents are, taken as a whole, in phase opposition to one another. At any load, therefore, it is to be expected that the effective resultant current should be less than the corresponding alternating-current or direct-current values. This is true of all but the single-phase rotary. It thus follows that the capacities of all but the single-phase rotary must be greater than their corresponding generator capacities.

In the *Sibley Journal of Engineering* for June, 1897, Dr. Charles P. Steinmetz gives an analytical treatment of the heating effect in a rotary converter when the power-factor equals unity, resulting in the derivation of the following equation:

$$\rho = \frac{8}{n^2 \sin^2 \frac{\pi}{n}} + 1 - \frac{16}{\pi^2}$$

where ρ is the ratio of the aggregate heating effects of a converter lead to the same direct-current load and n is the number of phases, or rather the number of collector rings.

As the heating effects are inversely proportional to the squares of corresponding capacities, capacity is, therefore, inversely proportional to the square roots of the heating effects, thus:

$$\frac{\text{converter capacity}}{\text{direct-current generator capacity}} = \frac{1}{\sqrt{\rho}}$$

Substituting numerical values for n in the above equation we obtain the following table:

n	2	3	4	6	12
ρ	1.3788	0.5641	0.3789	0.2677	0.2079
Capacity	0.8518	1.331	1.625	1.932	2.193

From this table it is clear that a decided economy results from the use of a rotary with a large number of phases, as the capacity is much greater than that of a machine with a smaller number of phases. The most common type of transmission line is three-phase, but in nearly every case where a rotary is used it will be found to be a six-phase machine. The reason for this becomes evident when it is seen that a six-phase rotary has a capacity nearly 50 per cent greater than that of a three-phase machine.

The ratio of the current heating effects produced in the armature winding of a rotary will be proportional to the squares of the respective currents; that is $\left(\frac{i}{\frac{I}{2}}\right)^2$ where i is the alternating current and I the direct current.

Prof. H. J. Ryan has shown that it is possible to derive an equation that shall also take account of varying power-factor. In brief, this is accomplished by integrating and averaging $\left(\frac{i}{\frac{I}{2}}\right)^2 d\omega$ between the limits of $\pm \frac{\pi}{n} + \cos^{-1} P$, where ω is the displacement of armature section from the section wherein the working alternating current and the continuous current are in phase opposition, as follows:

$$\rho = \frac{8}{P^2 n^2 \sin^2 \frac{\pi}{n}} + 1$$
$$- \frac{8}{\pi^2 \sin \frac{\pi}{n}} \left\{ \frac{\sqrt{1 - P^2}}{P} \left[\cos\left(\cos^{-1} P - \frac{\pi}{n}\right) \right. \right.$$
$$\left. - \cos\left(\cos^{-1} P + \frac{\pi}{n}\right) \right] + \sin\left(\cos^{-1} P + \frac{\pi}{n}\right)$$
$$\left. - \sin\left(\cos^{-1} P - \frac{\pi}{n}\right) \right\}$$

As this equation is rather long and complicated, much time will be saved by using the accompanying curves, which have been plotted for values of n from two to twelve, and for values of P from 1.00 to 0.50. If the curves be examined it will be seen that a slight decrease in the power-factor from unity will not make any great difference in the capacity, but if the power-factor drops off in any marked degree there is a decided falling off, especially in the higher phase rotaries. As most rotaries in use are of the six-phase type, it is clearly evident that it is of great importance to keep the power-factor as near unity as possible when the machine is running near its rated capacity.

HYDROELECTRIC DEVELOPMENT IN WURTTEMBERG, GERMANY.

A series of works on a large scale has been proposed for the utilization of the water-power of the rivers Würm, Enz and Nagold in the Kingdom of Württemberg. It is intended to build central stations to deliver electric current for power and light to towns and villages within a radius of thirty miles and more. The project originates with Messrs. E. Schleicher, of Stuttgart, and L. Kürsteiner, of St. Gallen, two engineers who have constructed important waterworks in Austria and Switzerland. The program for the construction of the concentrated waterworks is (1) preparation of a great collecting basin in the Valley of the Würm, between the towns of Würm and Mühlhausen; (2) utilization of the fall between the Stausee and the junction of the Würm with the Nagold, a maximum of 103 m (337.8 ft.), for a high-pressure plant with a large steam plant as reserve. Both plants can be used in a power station at the so-called Kupferhammer, where the Würm empties into the Nagold, in the Pforzheim "Gemarkung" or district. The Valley of the Würm, from the Village of Würm upstream as far as Mühlhausen, is almost uninhabited and but little cultivated, but is very well suited as the site of a dam. The upper dam wall for the reservoir is 322 m (1086 ft.) long on top and 22 m (72.2 ft.) at the bottom. The embankment will contain 225,000 cu. m (7,945,875 cu. ft.). The rain basin of the Würm which contributes to the dam has an area of about 400 sq. km (154.4 sq. miles). The dam will impound about 36,000,000 cu. m to 37,000,000 cu. m (1,268,640,000 cu. ft. to 1,306,655,000 cu. ft) and is sufficient to permit storing up the entire annual rainfall. The daily capacity of the Würm power station is, on work days, 96,000 hp-hours, the yearly capacity being 31,000,000 hp-hours. Experience shows that the daily demand of the combined power and light plants, including electric railway service, is at most seven to eight hours. It is intended, in consideration of the fact that the Würm power station has to take care of the maximum demands of the Enz-Nagold plants, to fix the maximum capacity at 20,000 hp. For this there will be necessary five groups of machines of 4000 hp each, one serving as a reserve.

The water of the Enz will be stored up by a solid dam and that of the Nagold by a "safety" dam. The water of the Enz will be carried by a race in a southeasterly direction under the heights of Büchenbronn and over the Nagold through a pipe at a height above all danger from floods, for the purpose of uniting it with that of the Nagold, which will be reached at about the boundary between Baden and Württemberg. The waters of the Enz and the Nagold will be carried in common by a race in three sections of each 3000 m (11,808 ft.) in length to the Wasserschloss and the high-pressure pipe line at Kupferhammer. The effective power of the low-pressure plant will be 4500 hp, but with very low water may drop to only 1500 hp. In order to eke out the power when the water is low there will be a reserve steam plant having two steam turbo-generators each of 1500 hp, which will be installed directly alongside of the power station of the hydraulic plant. The total maximum daily capacity of the two plants (Würm and Enz-Nagold) will be 24,500 hp. The combined cost of carrying out the two projects will be about 18,000,000 kronen ($3,600,000). It is stated that offers have already been made for concessions to take over the project.

Central Station

Management, Policies and Commercial Methods

DEPRECIATION.

Two papers on "Depreciation" were presented last year at the annual meeting of the Mississippi Electric Association, the *Proceedings* of which have just appeared in printed form, and from which the accompanying table is compiled. The first column appears in the paper by Mr. S. W. Greenland, and the second column in the paper by Mr. Jack Abbott. The columns give the estimated number of years of life.

Buildings	50	50
Boilers	12–20	—
Engines	20	15–20
Generators	12–25	15
Condensers	15	10–15
Pumps	15–20	12–15
Piping	21	—
Switchboards	20	—
Transformers	10	15–20
Meters	20	15
Poles	12	10–15
Cross arms	—	5-10

HOUSE-WIRING CAMPAIGN.

Mr. C. B. Yonts, manager of the sales department of the Illinois Traction Company, writes in reference to the house-wiring campaigns conducted in the interest of the Byllesby properties and noted in our issue of Jan. 5 that a similar campaign was conducted in 1909 by the Illinois Traction System in connection with the central stations operated by it, and that the greatest objection found to the plan was that the business taken in three months was so much greater than expected that it necessitated the doubling of the force in the construction and meter departments, and when the rush work was over the extra men had to be laid off. In 1910 it was decided to try the plan for the entire year, and this was found more successful than the old way, inasmuch as orders could be taken and connected the same week, which is of great importance to the salesman in securing the signature of his next prospect; and there was steady work instead of a congestion for two or three months. A smaller force of men operating in five cities with a total population of 100,000 wired 869 old houses in nine months; 500 electric irons and thirty-one electric signs were sold, sixty-five show windows rewired, the interior illumination was changed in a number of business houses, while the missionary work done cannot be estimated. In this way the efficiency of the sales department was also brought up, as it was found that the men give their undivided attention to the work when they know that it is permanent.

GROUNDING THE SECONDARY.

At the annual meeting of the Mississippi Electric Association last year, the report of which has just appeared in printed form, Mr. R. P. Strong, of New Orleans, presented a paper entitled "Grounding of Electrical Secondaries," which gives a very complete discussion of the subject. A number of specific cases are mentioned in which death and fires resulted from unprotected secondaries. An interesting comparison of grounded and ungrounded secondaries was furnished by a severe storm on Sept. 20, 1909. This resulted in a number of fires and the loss of several lives from electrical causes in New Orleans, while in the neighboring town of Houma, where the secondaries are grounded at the transformers, there was not a single trouble of this nature during the same storm, although the primaries became crossed with secondaries in so many places that the plant was forced finally to shut down. The paper reprints a letter from the Mobile Electric Company, which says that a very distinct advantage has been gained by grounding the secondaries, as before this was done there had been a number of serious accidents; furthermore, no increase in operating troubles has been found to accompany the grounding. Mr. Strong strongly recommended the grounding of all alternating-current systems, preferably to sub-surface piping systems. He recommended that where a secondary system is grounded the interior-wiring system connected thereto should previously be carefully tested and cleared of any grounds, as otherwise the grounding of an outside line might complete a short-circuit and cause a more or less serious burn-out on the inside wiring. He believes it is the duty of every central station to ground all secondaries as a protection to life and property. The item of expense, he said, can have no bearing except in favor of grounding, as the courts have repeatedly decided that lighting companies are liable for damage caused by abnormal pressures on low-tension systems. When one considers, he adds, the many thousands of people who daily come in contact with current-carrying parts of the secondary circuit while they are standing upon grounded surfaces or in contact with grounded objects, and are protected from sudden death only by a few layers of cotton insulation, the question is not so much why the secondaries are not grounded, but how central-station men, knowing their responsibility, are able to proceed in peace in the pursuit of happiness.

MINIMUM RATE IN INDIANA.

The city authorities of Muncie, Ind., have begun an investigation of the franchises of public-service corporations doing business in that city to learn which, if any, has a right to impose a "minimum charge" on customers. The investigation follows an announcement by the Muncie Gas Company that a "minimum charge" of 50 cents on each connection would be levied in the future, regardless of the amount of gas consumed.

LAUNDRY SHIRT CARDS AS ADVERTISING MEDIUMS.

The stiffening cardboards inserted in shirts returned from the laundry are made effective advertising mediums by the Indiana & Michigan Electric Company, South Bend, Ind. The central-station company supplies these cardboards, measuring 8 in. x 15 in., to the laundry free of cost. The cards are of good quality board and each week differ in color and in the running inscriptions advertising the use of electricity and electrical appliances. The laundry using the cards serves the best class of people in the city, so that the electric company is assured of its advertisements reaching the homes which, if not already customers, are likely to become users of electricity. Electric toasters, stoves, irons, etc., are also advertised on the laundry cards now and then, with the idea of reminding present consumers of the convenience of these appliances.

LABOR-SAVING DEVICES AND THE SERVANT PROBLEM.

The committee on household economics of the New Jersey Federation of Women's Clubs in order to prove that the installation of modern labor-saving devices in the home will solve the servant problem is at present equipping a home in Colonia, N. J., with apparatus for eliminating to a great extent the drudgery of housework. Speaking of the proposed scheme, Mrs. F. A. Pattison, president of the federation, is quoted, in part, as follows: "Realizing that we could talk, discuss and write papers on the subject until doomsday without any real results, we determined to demonstrate visibly the practical value of the proposition. One result, important, if not the chief, will be the solution of the servant-girl problem by eliminating from the servant class the present undesirables and those woefully ignorant of their duties. It will introduce the specialized servant. The installation of these mechanical devices will also reduce the number of servants in the large establishments of the wealthier class, and for those whose ménage is more modest and where one maid is sufficient the work of three can be obtained, precious time be saved and cleanliness be supreme." Mrs. Pattison is convinced that electricity will prove in the future the salvation of the housekeeper. The organization proposes to make housework the fashion, and when its little home is running will arrange for pilgrimages from all over New Jersey, from New York and from Pennsylvania.

USEFUL WORK IN SHOP PRACTICE.

In a pamphlet issued by the Cosmopolitan Electric Company, of Chicago, to further the sale of electricity for electric drive the argument of the economy which often may be obtained by the use of electric motors in manufacturing establishments is put in a forceful way, as may be seen by the following extracts:

"The celebrated remark of Mr. Roosevelt, i.e., 'the shots that hit are the shots that count,' applies with at least as much force to shop practice as to gun practice, for the power applied at the point of contact between the tool and the work alone earns money. All else is waste at your expense.

"The expression 'the tool and the work' must not be construed as having reference solely to machine-shop equipment. It is here used in the broadest possible sense to indicate the relation, for instance, between the lumber and the saw, the grain and the millstone, the rock and the crusher, the load and the elevator platform, the train and the locomotive drawbar. Any intermediate devices, either for the generation of power or its transmission to the point of contact between 'the tool and the work,' are wasteful; and as it is from actual work accomplished that you make your profits, it must be apparent that the measure of your commercial success is directly affected by the degree to which you eliminate waste.

"Assuming the monthly cost of your home-generated power to be any amount that your knowledge of conditions in your boiler, engine and transmission equipment may indicate to be approximately correct, did it ever occur to you that a great deal more than half of this sum is wasted?

"If you doubt it, the proof is easy to obtain for yourself. Run your entire plant for a full day on Sunday, all individual machine belts on loose pulleys or with clutches out, and weigh the coal. Figure cost of fuel, multiply by twenty-five (number of working days per month) and compare result with your normal monthly cost of coal. The difference between the two amounts is the value of power actually used in useful work. Compare this difference with your present total monthly cost and the result will set you thinking."

FLAT-RATE WINDOW LIGHTING IN MASSACHUSETTS.

In a number of Massachusetts cities the local lighting companies have added to their incomes by means of window-lighting propositions with tungsten lamps covering the hours from sunset to midnight. In a majority of cases time switches are employed, and all are placed on a flat-rate basis. In Lowell the Lowell Electric Light Corporation charges $1.50 per 100-watt tungsten lamp per month, net. The company also rents tungsten lamps with shades and holders at the rate of 18 cents net per lamp per month, which plan appeals to small merchants who would otherwise find the first cost of the outfits burdensome. The lighting company cleans the fixtures at regular intervals. Fig. 1 shows a typical flat-rate window in Lowell.

At Haverhill, Mass., the Haverhill Electric Company has over seventy-five customers using in the neighborhood of 1150 lamps on its flat-rate sign and window-lighting plan. The flat rate for tungsten lamps for window lighting is 50 cents, 65 cents, 95 cents, $1.50 and $3.65 per 20-cp, 32-cp, 48-cp, 80-cp and 200-cp lamp respectively per month. This service includes free renewals of all lamps that are burned out or blackened so as to lower the candle-power materially. Time switches are sold at cost or rented for $1.25 per month. A window lighted with 40-watt tungstens on a flat rate in Haverhill is shown in Fig. 2.

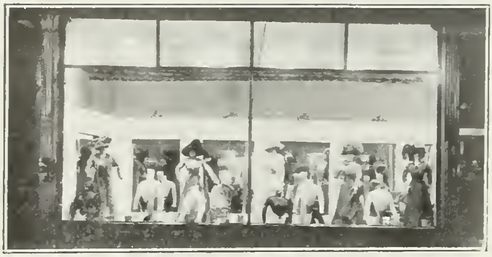


Fig. 1—Flat-Rate Window Lighting at Lowell, Mass.

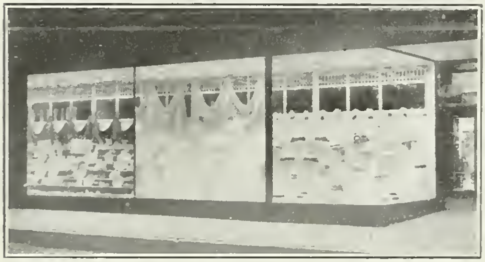


Fig. 2—Flat-Rate Window Lighting at Haverhill, Mass.

The Fitchburg Gas & Electric Light Company has a connected load of over 30 kw in flat-rate window lighting. The prices for this service are the same as given for Haverhill.

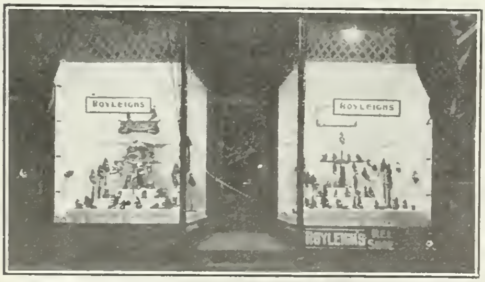


Fig. 3—Flat-Rate Window Lighting at Fitchburg, Mass.

The window illumination of a typical shoe store (Fig. 3) on a flat-rate basis costs the merchant $62.40 per annum, including lamp renewals and switching service incident to the proposition. In the case of a typical haberdashery the yearly cost amounts to $78 per annum. The first installation is lighted by eight 40-watt tungstens at each window and the second by ten 40-watt lamps.

ELECTRIC LIGHTING RATES IN GERMANY.

The following information relating to German central-station rates is given in a recent consular report by Mr. William T. Fee, United States consul at Bremen, which contains data for twelve of the largest cities in Germany:

In the majority of cities there is a meter rent averaging from 25 cents to 50 cents a month. In few cities is the flat rate in vogue, Bremen being about the only city of any importance where it is used. In most other cases there is "special time," generally from about 4 to 8 o'clock in the evening, depending on the season of the year, when the rate is much higher than at other hours. It is the time of the maximum demand and is charged for accordingly. Bremen now charges the highest price for electric current of all cities in Germany, but a reduction is promised after the electric plant is operated by water-power from a dam in the River Weser now under construction.

Rates are not in proportion to the maximum number of lights that can or may be used in an installation. Lights for elevators in buildings are given at power rates, which run from 2 cents to 5 cents per kw-hour. When an installation is made a fee is charged by the lighting company for inspecting the installation, lamps, etc. The charges are based upon the number of units and average about 3 cents to 6 cents a lamp.

Below are given in detail the hours when consumers in one of the twelve cities must pay 12 cents per kw-hour for current. At other hours it costs only 4 cents. This rate is fairly indicative of the charges in other cities of Germany.

Month.	Hours.	Month.	Hours.
January	4.30 to 9 p. m.	August	7.30 to 9 p. m.
February	5.30 to 9 p. m.	September	6.30 to 9 p: m.
March	6.30 to 9 p. m.	October	5.30 to 9 p. m.
April	7.30 to 9 p. m.	November	4.30 to 9 p. m.
May	7.30 to 9 p. m.	December	4.00 to 9 p. m.
June and July	Straight rate of 12 cents at all times.		

Another of the twelve cities has a system of rebates on annual consumption, on a money basis. The plant is leased by the city to a lighting company. It is one of the few cities in Germany that do not directly operate their own lighting plants.

Annual Consumption.	Per Cent. Discount.
$500 to $1,225	2
$1,225 to $2,500	5
$2,500 to $5,000	7½
$5,000 and over	10

Again in the case of one of the other cities the rate of discount is based on monthly consumption of energy used either in residences or factories:

Monthly Consumption.	Per Cent. Discount.
Under 100 kw-hours	12½
Minimum of 100 kw-hours	11¼
Minimum of 300 kw-hours	10
Minimum of 500 kw-hours	9½
Minimum of 1,000 kw-hours	8¾

The following prices are charged per kw-hour for electrical energy for lighting purposes in the twelve largest cities in Germany:

Hamburg—14.3 cents; up to 10 per cent rebate on value of amount used.

Hanover—9.5 cents.

Bremen—16.7 cents; price reduced to 12.9 cents for rest of year after 3000 kw-hours have been used or after an amount of energy equivalent to the use of the consumer's entire installation for 400 hours has been recorded; after both conditions fulfilled price reduced to 5.7 cents.

Berlin—9.5 cents. A discount is given on yearly values used —i.e., 5 per cent on first 10,000, increasing the rebate 2½ per cent for each additional 10,000 up to 50,000, after which the increase is 2½ per cent for each additional 25,000. For municipal power and lighting purposes a much lower rate is given.

Magdeburg—11.9 cents; reduced to 9.5 cents for amount used above 1000 kw-hours.

Frankfort—11.9 cents; is reduced 2.4 cents for each 10,000 kw-hours used.

Dresden—11.9 cents; with 3 per cent to 20 per cent rebate on value of amount used.

Breslau—7 cents for openways and stairways; 11.9 cents for dwellings and factories.

Cologne—11.9 cents, average from 4:30 to 9 p. m.; all other hours 4 cents per kw-hour.

Chemnitz—11.9 cents. The rate is lower for amounts above 100 kw-hours.

Munich—14.3 cents; rebate from 1 per cent to 13 per cent on value of amount used from 1000 kw-hours to 50,000 kw-hours.

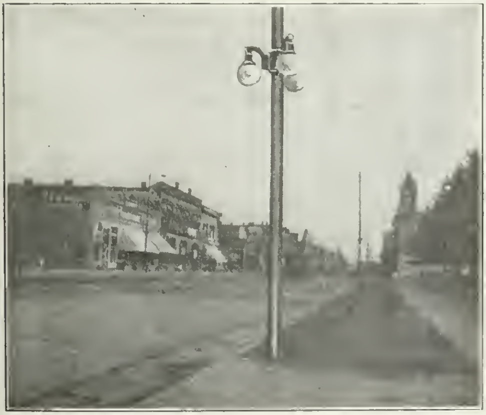
Leipzig—14.3 cents from 4 to 8 p. m.: all other hours 5 cents per kw-hour.

Wiring and Illumination

TUNGSTEN CLUSTERS MOUNTED ON TROLLEY POLES.

By W. B. Foshay.

There has always been a strong feeling that it is not at all practical to use the multiple type of tungsten lamp except where it is not subjected to vibration or sudden jarring. For that matter, it is still considered necessary by many to employ shock-absorbers with lamps of this type when used in places where they are subjected to more or less vibration. In the case of installing cluster or bracket lamps on trolley poles it has become the rule to specify some shock-absorbing device when multiple tungsten lamps are to be installed.



Tungsten Cluster on Trolley Pole.

The city of Walla Walla, Wash., is considering the installation of three-cluster brackets, to be mounted on the trolley poles already installed on the main street of that city, and as a demonstration the local lighting company has installed six clusters of this kind. The brackets are made in two parts and are bolted together on the pole, making a fine appearance. It was necessary that an economical method of installation be devised, as the city is limited as to the amount it can spend for lighting. The feed wires were therefore installed overhead, a single braided duplex twin conductor being strung on the top of the iron trolley poles. The lamps in the fixtures are fed by means of wires run down inside of the poles to the point where brackets are mounted, and then brought out through the side of pole and around to the three sockets, the fixtures being of such a design as to allow the wiring to be entirely concealed. The brackets are so mounted that two lamps are over the sidewalk and one over the street.

The lamps used in this demonstration are the 60-watt multiple tungsten type. The outer globes are 12-inch opalescent balls. During 872 hours that the demonstration has been under way four lamps have burned out and one was broken through the breaking of the outer globe. The jar of the post caused one of the globes to fall, but the lamp in this case was not injured. The filament of none of the eighteen lamps had been affected by the vibration caused from the operation of the trolley cars. In this installation the sockets are screwed directly to the hood of the shade holder and no shock-absorbing device has been installed. The city is figuring on installing 136 of these clusters, and if this is done the entire number will be installed in the same manner as the six under experiment.

The writer has always had more faith than even the manufacturers themselves in the use of tungsten lamps on drop cords and in the old type of fixtures, where the lamp is not in a vertical position. Since the fall of 1907 he has had lamps used under these conditions in his own home and has been able to get a life of from 1100 to, in one case, 3000 hours. It is interesting to note that the latter was one of the first lamps commercially manufactured in this country, and was in daily service from December, 1907, to September, 1910, and for over five months on a drop cord.

The price made the city, including installation, maintenance and renewals, is $36 per cluster per year on a three-year contract, $33 on a five-year contract and $30 on a ten-year contract for all clusters on trolley poles. Where poles are put in also the price, on a ten-year basis only, is $34.50 per year. There will be six poles to a block, and the lamps will burn from dusk to midnight, except that the lamps on one pole at each corner, or at least one to the block, will burn all night.

WIRING OF A NEW YORK LOFT BUILDING.

By John P. Morrissey.

In the recent upheaval of the manufacturing and business interests of New York to get away from the downtown district a number of office and loft buildings have been erected and very quickly occupied along Fourth Avenue. In the shadow of the Metropolitan Tower is the nineteen-story loft building at 334 Fourth Avenue on the southwest corner of Twenty-fifth Street. The building throughout is of the highest grade in its construction and equipment. There are four electric passenger elevators and three electric freight elevators, which were manufactured and installed by the A. B. See Elevator Company. The elevator installation is of the electric traction type, operating at 400 ft. per minute, lifting 2500 lb., with motors on the roof. For the tenant occupying the first floor and basement there is an electric sidewalk lift running between the sidewalk and the basement. The owner has installed for his own use an electric sidewalk lift, which travels from the boiler-room level to the sidewalk.

The electric equipment in the building is of the highest type and grade. The energy is taken from the street service to the service board in the sub-basement from the underground mains of the New York Edison Company, and is carried to the main switchboard, also in the sub-basement, where it is distributed. Provisions are made on this switchboard for controlling the output of a future power plant. The service board is set in a vault off the boiler-room on the Twenty-fifth Street side, where the service enters. It is a panel of polished, marbleized slate having mounted upon it two service switches and proper busbars and fuse posts to divide the service into three-wire, 220-110-volt circuits for lamps and two-wire, 220 volts for motor circuits. This division at this point eliminates the possibility of the drop in the motor feeders, which is at times great, due to sudden motor loads in a building of this type, from affecting the voltage of the lamps. The service board is inclosed in a wooden cabinet lined with sheet iron and having doors arranged so that the switches will be accessible in case of fire. The service feeders are run in iron conduit exposed on the ceiling. These service conduits are exceptionally large because the cables had to be arranged so that alternating current could be used in the building. The feeders that run to the switchboard from the service board are lead-covered and are composed of two 1,400,000-circ. mil cables for each of the three legs of the lighting feeder and two 1,400,000-circ. mil cables for each of the two legs of the motor feeder.

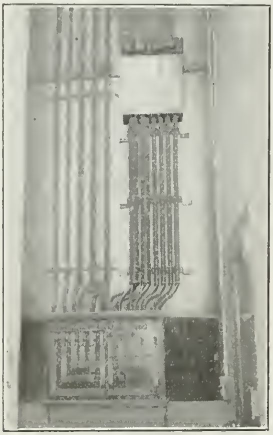


Fig. 1—Service Entrance and Pull Box.

The switchboard is situated in the engine-room. A private generating plant is contemplated and all arrangements have been made for its future installation. The feeder section of the switchboard has been set with respect to the future engine and generator layout. The switchboard is made of 1½ in. polished marbleized slate set on an angle-iron frame embedded in the floor and securely braced to the walls. All switches, meter connections and other metal on the face of the board are of finished, polished copper. Each of the switches and meters has a name-plate. The switches are connected to the respective feeders at the back of the board by round copper rods running vertically from the switch lugs to the top of the board, where they are held in place by a slab of marbleized slate, which is supported on angle irons bolted to the switchboard frame. Connectors are used to tie the feeder cables to the rods. The rods are covered with circular loom for their entire length. The connections between the meters and the switches are made with flat copper busbars, in many cases laminated. Each feeder has its own switch, three-pole for lamp circuits and two-pole for motor circuits. The meters that have been placed on the switchboards are for owner's lamps, superintendent's apartment lamps and owner's motor circuits. All other motor and lamp circuits are metered at the panels on different floors. The sides, top and bottom of the switchboard are covered with an electro-bronzed iron grille, one end having a door in it.

Above the switchboard a large pull box has been installed to which all feeders run from their respective riser shafts, motors and outlets. All crossing of cables has been done in this box. The feeders enter on the sides and front of the box, while from the bottom of the box the feeders are carried in conduit to a point above their respective lugs at the top of the board. This makes a very neat arrangement and a very safe one electrically. A section of the bottom of the pull box is removable so that the inside is accessible for future changes or additions. From this pull box the feeders run in conduit hung on the ceiling of the engine and boiler-rooms to their respective riser shafts and up to the distribution boxes, motors on roof and on different floors and in the engine-room. To avoid running conduits and cables across the tops of the boilers and among the steam mains to the north riser shaft a 14-in cast-iron pipe was installed in the unexcavated ground, starting at the engine-room and ending in the rear of the boiler-room, in which all feeder conduits are installed. Pull boxes were placed at each end of this cast-iron pipe, thereby doing away with the numerous bends of conduit at each end.

The conduit used throughout the entire building is "Galvaduct" and "Sherarduct," manufactured by the Safety-Amorite Conduit Company and the National Metal Molding Company respectively. All conduit and pull boxes have been painted where they are exposed to agree with the surrounding finish. Where long runs of feeders have been made the feeders are anchored in anchor boxes, made the same as pull boxes and so placed that the feeders were supported at the proper length as required by the law. The anchor boxes for the south shaft are placed directly below the distribution boxes on the floors on which they occur. They are 6 in. deeper than the distribution boxes so that the cables do not pass through the distribution boxes. On the north shaft these boxes are so placed that the conduits run up alongside of the distribution boxes, as the space provided would not permit the conduits to run behind the distribution boxes as in the south shaft.

The distribution boxes are unusually large, as they are made to receive the center of distribution panel for lamp and motor service at the top, which also includes the meter loops for both, the compartment and panel for meters, and the branch circuit panel for circuit switches. Besides these different panels a gutter space for the cables and wires adds to its size. The distribution boxes are 9 in. deep in order to accommodate the meters. The feeder and meter panels are placed on the back of the distribution box with a ½-in. air space between the panels and distribution box. The branch-circuit panel, being

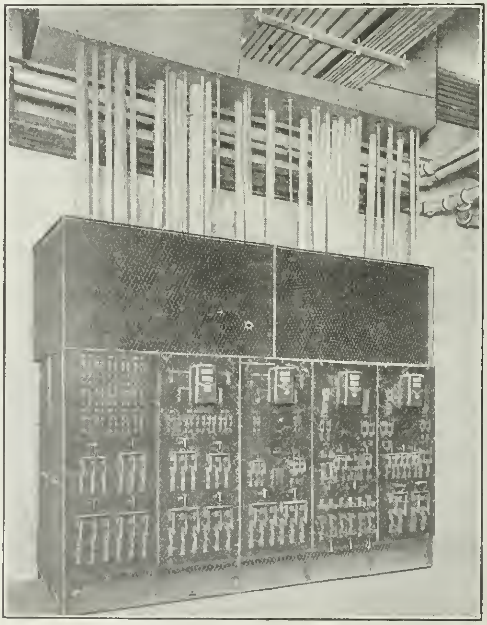


Fig. 2—Central Switchboard and Pull Box.

only 5 in. deep, is set on band-iron brackets, which leaves a clear air space of 4 in. between this panel and the back of the distribution box. This space behind the panel is used for running the cables and wires. All large conduits are run in the rear of the bottom and top of the distribution boxes, and the small branch-circuit conduits in front of the bottom and top of the distribution boxes, thereby avoiding all unnecessary crossing of cables and wires. Out of the top of each distribution box is a 1.25-in. elbow with a bushing arranged so as to finish flush with the plaster. This is installed for any future motor wiring and avoids all cutting when the wire is installed. On all sides of the distribution box a ¾-in. angle iron is installed and bolted to the distribution box so that the trims could be properly fastened and securely held in place. The panels for the feeder buses, meters and branch-circuit switches are made of 1-in. polished, marbleized slate entirely inclosed on all sides with a ¼-in. polished, marbleized slate lining. Polished copper busbars have been installed on the feeder panel for lamps and motors with lugs on both ends. The incoming feeders connect to one end and the outgoing feeders, which loop to the panels of the other distribution box in the manner described, to the other end. Set on top of the feeder buses is a strip of marbleized slate on which are set the lamp and motor buses, lugs and fuses for the meter loops in the respective panels. The meter loops are run from their respective lugs through the meter compartment, thence to the lugs on the lighting panels, which are connected to the busbars that feed the branch-circuit switches. The switches are arranged on either side of the buses and are placed so that the fuses are dead when the switches are open. Each panel is provided with a few extra switches for future use. Each section of the distribution box is provided with a door properly lined, and each branch-circuit panel is provided with a lamp receptacle for lighting same. All metal on the panel is polished copper. A polished-copper frame holding a plate glass under which is a small drawing showing the outlets and wiring and the number of the switch controlling each outlet is on the door of the branch-circuit panels. The branch circuits are connected to the panel so that two two-wire meters may be installed instead of one three-wire meter for lamp circuits. By this arrangement one panel may be used for two tenants, a front northeast and a rear northwest on the north panel and a front southeast and a rear southwest on the south panel.

The wiring scheme from the service to the outlets is held to the simplest system. The service runs from the service board to the switchboard as hereinbefore described, then the lamp and motor feeders run from the switchboard to the distribution boxes, looping through each distribution box until a set is fed that the feeder has been designed for. Meter loops are then taken off as described and connected to their proper panels. The feeders are designed for a 3 per cent drop between switchboard and any lamp at full load and a 2-volt difference between any two lamps. The motor feeders for tenants are run one to each riser shaft, where it runs to a center of distribution on the ninth floor, from which mains are run, one up to the roof and the other down to the basement. The other motor feeders are run to their respective motors in the engine and boiler-rooms, also to the elevator and fan motors on the roof. A motor feeder is run up to a center of distribution on the tenth floor, where mains are run, one up to the roof and the other down to the basement, the mains looping through a small panel on each floor which contains a 50-amp, two-pole knife switch. These switches are for future wiring for ventilating fans which may have to be installed as demanded by the factory laws of the State. Proper brackets have been hung from the ceiling at court windows for the fans. The motors in the engine-room are used entirely for pumping purposes; that is, house, fire, sprinkler and sump pumps. There are also some motor circuits for engine and boiler-room ventilating fans, also to the ash lift in the vault off the boiler-room. The starting apparatus for the various pumps is arranged for automatic operation by tank switches and also for hand starting by double-throw switches.

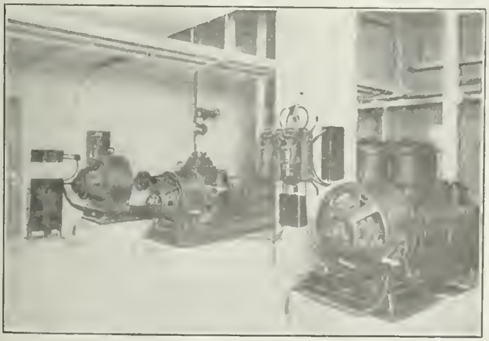


Fig. 3—Motor-Driven Pumps in Basement.

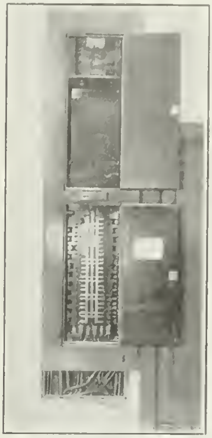


Fig. 4—Distribution Panel, Motor Box and Anchor Compartment.

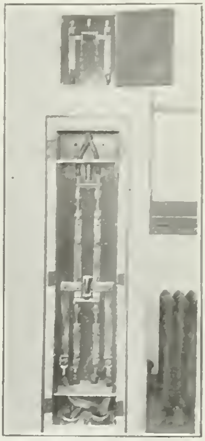


Fig. 5—A Center of Distribution.

The owner has a three-wire lamp feeder going up to the panel in the south hall of the nineteenth floor, from which all the lamps in the machine-rooms, deck houses and public toilets are fed. On the nineteenth floor the superintendent's apartment has been laid out and the three-wire lamp feeder is run from the switchboard to a panel located in the hall of the apartment from which all the apartment lighting is controlled. The stair-lighting circuits are arranged on separate feeders, there being two three-wire feeders for the south stairs and one three-wire feeder for the west stairs. These feeders run from the switchboard up to their respective panels on the tenth floor, where two-wire branches are run to each set of outlets, one set going down from the tenth floor to the first floor with an outlet on each landing and the other set going up from the tenth floor to the roof with an outlet on each landing. The outlets are on the walls and are set 10 ft. above the landings and are controlled by lock switches directly below them set 4 ft. above the landing. The first-floor passenger and freight-elevator entrances are lighted by ceiling outlets arranged in the paneling in the ceiling. Each outlet is controlled by a lock switch set in the marble. In this gang of lock switches a switch is provided for the lamps in the elevator cars. The circuits that feed these outlets are run from the main switchboard. This arrangement of running branches and feeders from the main switchboard to the different panels and outlets in the owner's portion of the building gives the engineer entire control of same. The outlets in the engine and boiler-rooms are arranged in the ceiling and on the walls with respect to the present and future machinery and boilers. They are all controlled from the switchboard.

The lamp outlets on all floors are arranged one to the bay, each outlet of 660-watt capacity and controlled by a two-pole knife switch on the panel board. The conduit is run ¾ in. to the first outlet from the distribution box and ½ in. between the first and second outlets. Two duplex wires are pulled into the ¾-in. conduit to the first outlet, one duplex wire stopping and the other duplex continuing on through the ½-in. conduit to the second outlet, where it terminates. This arrangement was followed so as to cut down the number of conduits going into the top of the distribution box, as each panel controls an average of twenty-six circuits throughout the building. During the building construction the outlets and conduits between outlets, with a length of conduit started toward the distribution box, were installed on the forms that were put in place to construct the concrete arches. After the concrete had been poured and set the forms were removed and the conduit ends picked up and continued back to the distribution boxes. This method of installation was found to be very satisfactory, as the cutting of the concrete, after it has set, is very laborious and cannot be done in a satisfactory manner. The wire used throughout the job is the best copper, 98 per cent conductivity, with an insulating compound of 30 per cent Para rubber of the best quality, this being protected by a moisture-repellant covering composed of two grades of cotton.

The local switches throughout the building are of the Metropolitan detachable pattern. All switches on the stairs, in the halls and in the public toilets are of the lock type, and all switches in the tenants' property are of the push type.

A conduit system has been installed for the public telephone cables. A 2-in. conduit is run from the terminal board in the engine-room to each riser shaft, one at a column on the north wall and the other in the partition of the toilet-rooms west of the south electric riser shaft, looping through a box on each floor. Each box has a brass cover with properly bushed holes for future extensions. A similar arrangement has been installed for the ticker, telegraph and other miscellaneous wires. That is, a 2-in. conduit is run at the same points and connected in the same manner.

An intercommunicating telephone system has been installed for the working force of the building and telephones have been connected at the following points: Engine-room, passenger elevator hall, first floor; freight elevator hall, first floor; passenger elevator machine-room on the roof; freight elevator machine-room on the roof, and in the superintendent's apartments on the nineteenth floor. The electric bell system in this building is not extensive, but necessary. A push has been installed at each entrance connected to a bell and annunciator in the engine-room. A push at the Fourth Avenue entrance is connected to a bell in the superintendent's apartments on the nineteenth floor. At each sidewalk lift a push has been installed at the street level connected with its respective bell. In each elevator a push has been installed which rings a bell and registers on the annunciator in the engine-room, thus giving the elevator operator a means of calling the engineer in time of trouble. A push has been installed at the entrance of the superintendent's apartments connected to a bell in the apartment. The batteries for the bell and telephone system are composed of Sampson No. 3 cells of a proper number to operate the respective system. They are set in hardwood boxes placed on the wall of the engine-room. Each system has two sets of batteries so as to have a reserve set to operate with. The pushes are of the sliding-contact, platinum-tipped type except the outside pushes, which are waterproof.

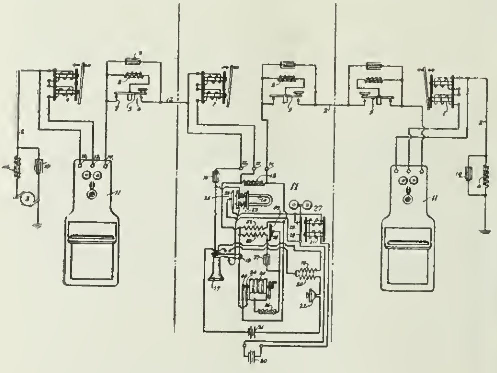
In addition to all the precautions that have been taken against the spread of fire, a fire-alarm system has been installed. On both stairways at the floor landings there is a station of the break-glass pattern, which is connected with the city fire-alarm system. Stations have also been located on the lower floor. Preparation has been made for a watchman's supervision system. An outlet has been set on each stairway at the floor landing so that a flush-type magneto-key station may be installed and the master clock arranged for in the superintendent's apartments. Stations have also been located on the lower floor.

The building was designed and the construction supervised by Messrs. George B. Post & Sons, architects. Messrs. Pattison Brothers were the consulting engineers, the Andrew J. Robinson Company was the builder and the L. K. Comstock Company the electrical contractor.

RECENT TELEPHONE PATENTS.

COMPOSITE SYSTEM.

In Fig. 1 is shown a composite system suitable for railway work which has been patented by Mr. O. M. Leich, of Genoa, Ill., his patent having been assigned to the Cracraft-Leich Electric Company. It is essential with such systems that the telephone apparatus provide a continuous path for telegraph currents whether or not in use. Similarly the operation of the telegraph keys must not open the line to telephone currents. In addition, the telegraph circuit must contain enough impedance to prevent sudden current changes which will disturb the telephone system. In the system shown the telegraph circuit may be traced from the grounded generator through the telegraph relay, through the coil cut in between the right-hand binding posts of the telephone through the telegraph key, etc. It must, of course, be assumed that the telegraph key is normally closed instead of open, as shown. It will also be seen that the telephone tap to the left-hand binding post of the set meets a condenser. The operation of any telegraph key, in dropping it against the back stop, opens the circuit simultaneously, short-circuiting the key coil so as to take up the inductive "kick."



Composite Telephone and Telegraph System.

The telephone instrument is shown with a high-frequency interrupter for telephone signal purposes. Currents produced by this and the hand generator in co-operation will follow the telephone circuit and not interfere with the telegraph. These as well as the telephone currents are obstructed by the retardation coils but pass freely through condensers.

LETTERS TO THE EDITOR.

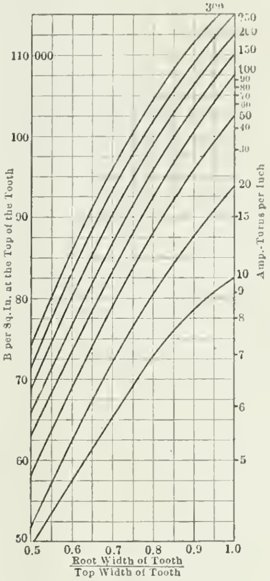
Magnetomotive Force in Non-Uniform Magnetic Paths.

To the Editor of Electrical World:

Sir:—I have read with much interest the article in your issue of Jan. 12 by Mr. A. Miller Gray describing a method of calculating the ampere-turns required for the armature teeth of direct-current machines, which the author designates as a "new method."

In the latter part of 1904, when confronted with the task of working out a system for the calculating department of the

Johnson-Lundell Electric Traction Company, of London, I felt dissatisfied with the methods given in the handbooks for the determination of the ampere-turns needed for the teeth, and I directed my assistant, Mr. Allan Berlin, now connected with the Swedish Patent Office, to work out a set of curves similar to those now given by Mr. Gray. We first obtained a magnetization curve of the particular iron we used for armature disks and then, choosing a certain ratio between top and root of the tooth, we marked on the magnetization curve a series of top densities and corresponding root densities and integrated the areas, thus obtaining the average ampere-turns. We plotted the results in a manner similar to that of Mr. Gray except that we used the top density instead of the root density as a basis, and also drew ampere-turn curves on the ratio of root to top as abscissa and the top density as ordinate. I happen to have a duplicate of this latter curve, which I inclose.



Curves for Amp-Turns for Teeth.

At about the same time we worked out these curves Mr. Henry M. Hobart published his book on motor construction, in which the leakage at high densities was emphasized and some corrections suggested, based on experimental data, if I am not mistaken. We then were thinking of recalculating our curves applying the corrections suggested by Mr. Hobart, but on further consideration we decided that owing to the numerous uncertainties in determining the correct ampere-turns for other parts of the circuit due to inaccuracies of air-gap, pole-tip distribution, variation of permeability of iron, etc., an attempt at great accuracy at this one particular point would be wasted.

These curves, once worked out, greatly facilitate calculations. They also furnish more correct and safer figures than the other methods. When the ratio of top to bottom (as used by Mr. Gray) is large, as, say, 1.6 to 1.7, which sometimes occurs, the ordinary methods give results that are too low to be safe. The magnetic leakage at high densities makes the results obtained from the curves still safer

Davenport, Ia. J. GUSTAF V. LANG.

Permanent Cast-Iron Magnets.

To the Editor of Electrical World:

SIR:—I note in the Digest in your issue of Jan. 12 the late arrival of our esteemed English friends in developing and describing a method for making cast-iron permanent magnets. Approximately twelve years ago the late Prof. H. A. Rowland, of Johns Hopkins University, experimented extensively and successfully in making permanent cast-iron magnets. For over ten years practically all the galvanometer magnets used by one of our leading manufacturers of electrical instruments were made according to the Rowland method, which is precisely that described by our English friends, except that the "chemical bath" instead of being a mystery may contain anything, as salt, sulphuric acid or copper sulphate, which renders the water an electrolyte, this being assumed to abstract heat from the casting rapidly. Pure cold water serves first rate.

Princeton, N. J. E. F. NORTHRUP.

General Pleasanton and the Army Mule.

To the Editor of Electrical World:

SIR:—The editorial in your issue of Jan 19 on excessive illumination as a cause of eye-strain is surely excellent and sounds a much-needed warning. But isn't it just a little severe on General Pleasanton and the "blue-glass cure"? On your discussion, in so far as it is based upon editorial acquaintance with the general's mule admittedly more intimate than mine, I make no comment; but Prof. Niels R. Finsen, certainly an authority on all branches of light-therapy, said in 1903 that "the general was absolutely on the right track, however short a distance he went." As Dr. Finsen cured several hundred cases of lupus by light-treatments, prior to his lamented death, and practically stopped the ravages of that awful disfigurement, his opinion is entitled to respect, as you would be the first to admit.

New York. T. J. JOHNSTON

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Rotary Converter.—L. DREYFUS.—A paper in which the author describes the complete diagram of the polyphase rotary converter for changing polyphase alternating current into direct current. The diagram is given in such a form that it includes all possible uses of the machine. The author first discusses the ohmic voltage drop and the copper losses of the alternating-current side; secondly, the ohmic voltage drop and the copper losses in the direct-current side; thirdly, the armature reaction, and finally describes the vector diagram. The problem is reduced to the general theory of synchronous machines.—*Elek. Zeit.*, Jan. 5.

Prevention of Induced Currents in Shafts and Bearings.—A note on a recent British patent (7463, Dec. 29, 1910) of the Felten & Guilleaume Lahmeyerwerke A.-G. In order to neutralize the e.m.fs. induced in shafts and bearings by the fluxes which pass through these parts a winding is arranged on the stator in such a way that an e.m.f. is induced in it by the influence of the same field fluctuations which produce the shaft voltage. The winding is short-circuited and counteracts the field fluctuations which induce currents in the shaft.—Lond *Elec. Eng'ing*, Jan. 5.

Mercury-Vapor Rectifiers for Large Outputs.—BELA B. SCHAEFER.—The output of the ordinary mercury-vapor rectifier is limited by the use of glass tubes and the difficulty of maintaining the vacuum. The chief features of the author's improvements are the use of a steel tube instead of a glass tube and the method of making it air-tight by means of asbestos and mercury. The steel tube has a diameter of 170 mm (6¾ in.). The vacuum can be maintained quite successfully. The arrangement of the electrodes and their details of construction are described at some length and oscillographic diagrams are given of the currents and voltages. The efficiency of the mercury-vapor rectifier is mainly determined by the voltage drop in the vapor space. This is about 15 volts and is practically independent of the current and of the voltage. For this reason the efficiency is the higher the higher the voltage of the circuit and is almost independent of the load. Fig. 1 shows the efficiency as a function of the voltage, the losses including those in the exciter, but not those in the transformer, which is used for dividing the voltage into two halves. Fig. 2 gives in curve *a* the efficiency of the mercury-vapor rectifier for varying sizes, all losses being included. For comparison with this curve *a* for the mercury-vapor rectifier the corresponding efficiency curve *b* for rotary converters with the same normal rating and for an e.m.f. of 220 volts is given. The efficiency of the mercury-vapor rectifier is considerably higher. As there are no moving parts the wear and tear is small. There is little expense for attendance and the apparatus works without noise.—*Elek. Zeit.*, Jan. 5.

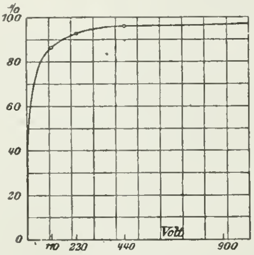


Fig. 1—Efficiency Curve.

The Best Thickness of Iron Sheets.—E. Jasse.—The author shows that the best thickness for iron sheets of electromagnetic apparatus can be easily calculated approximately as follows. The rule is that the iron losses become a minimum when the ratio of 80 per cent of the hysteresis loss to the eddy-current loss equals the ratio of the thickness of the iron sheets to the thickness of the paper.—*Elek. Zeit.*, Dec. 29.

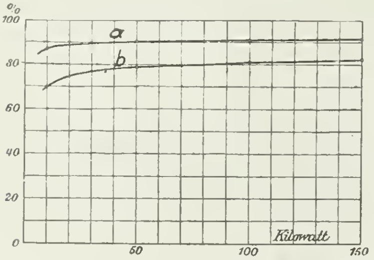


Fig. 2—Efficiency Curves of Rectifier and Converter.

Stray Flux of Induction Motor.—W. Rogowski.—The conclusion of his mathematical paper. The value of the leakage coefficient is expressed by the magnetic energy of the no-load and the leakage fluxes and on this basis the influence of the slot dimensions and of the saturation of the teeth is discussed. A numerical example is added.—*Elek. Zeit.*, Dec. 29.

Lamps and Lighting.

Quartz-Tube Mercury-Vapor Lamp.—An illustrated description of the "quartzlite" lamp, which is the latest form of Bastian lamp and contains a tube of quartz. As the current density is high this tube is quite short, even for circuits of from 100 volts to 250 volts. "The spectrum is further improved by the use of tantalum for the metal electrode." One result of using quartz is that a large proportion of ultra-violet light is transmitted, and as this may have a harmful effect on the skin it is essential that an outer glass globe should be used. The rated candle-power of the standard 3.5-amp lamp varies from 1800 to 2500, according to the pressure of the circuit. The process of switching on the lamp allows the current to pass through the shunt-tilting solenoids, which tip up the burner so as to cause the mercury momentarily to connect the electrodes. The solenoids being thereby put out of action the burner is allowed to fall to its original position, an arc being formed between the positive electrode and the retreating mercury. At the moment that the two electrodes of the burner are connected by the stream of mercury a small electromagnet in series with the burner opens the shunt circuit and thereby disconnects the tilting coils. Immediately, however, that the main circuit is interrupted the cut-out switch falls by gravity, so that the tilting circuit is ready to operate again. A metallic reflector is placed over the burner. Fig. 3 herewith shows the distribution of candle-power in a quartzlite lamp, rated at from 3 amp to 3.5 amp at 220 volts. The test was carried out at the National Physical Laboratory. The lamp was fitted with an opal globe. The mean hemispherical candle-power was calculated to be 1220, the maximum vertical illumination being 2700 candles. In a further test, when a frosted globe was used, the mean hemispherical candle-power was found to be 1480, so that the lamp gives more than 2 cp per watt. The distribution of light with the frosted globe is shown in Fig. 4.—Lond. *Electrician*, Jan. 6.

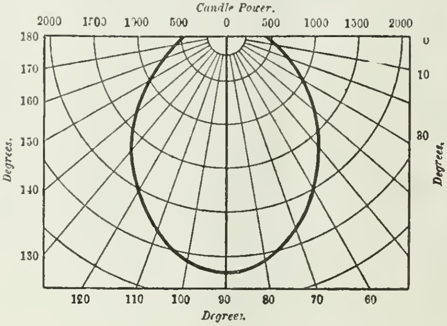


Fig. 3—Distribution of Light with Opal Globe.

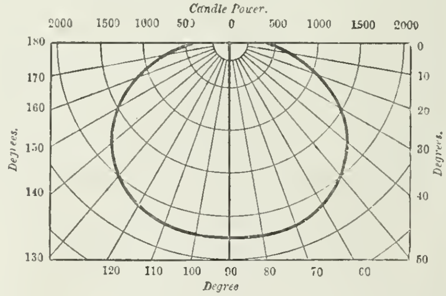


Fig. 4—Distribution of Light with Frosted Globe.

Neon Tube Lamp.—G. Claude.—A French Academy paper on further improvements of the neon tube lamp. Additions of foreign gases to the neon gas in the tube must be carefully avoided, since a few per cent only of nitrogen is sufficient to reduce the luminous output very essentially. The author makes use of the observation of Dewar that at exceedingly low temperatures (liquid air) charcoal absorbs gases rapidly; but neon is absorbed to a smaller degree than other gases. The light of the neon tube is rich in red rays and thus forms the counterpart of the mercury-vapor lamp. The author's neon tube has a length of 6 m (19½ ft.) between electrodes and a diameter of 45 mm (1¾ in.). The potential difference at the terminals of the tube is 1000 volts and is almost independent of the current, decreasing from 1100 volts to 980 volts when the current is raised from 0.1 amp to 1 amp. With a potential difference of 1000 volts and a current of 0.94 amp the effective power is 850 watts, the power-factor being 0.9. The tube gives 220 cp per meter (or 67 cp per foot) or 1320 cp for its total length, corresponding to a specific consumption of 0.64 watt per candle-power. This does not include the losses in inductance coil and transformer. If these are included the specific consumption is 0.8 watt per candle-power. But the author hopes to reduce this to 0.5 watt per candle-power. In an editorial note J. Blondin states that the neon tube lamp has passed the laboratory stage and that several neon tubes have recently been employed successfully side by side with nitrogen-vapor tubes for exterior illumination at the Paris Automobile Show.—*La Revue Elec.*, Dec. 30.

Generation, Transmission and Distribution.

Three-Phase Induction Motors in Mining.—P. Herd.—A paper in which the author discusses in a general manner some of the characteristics of three-phase induction motors and the bearing these characteristics should have in determining the rating and speed of motors to be installed. The subject is discussed under the following heads: No-load current; three-phase motors operating on unbalanced circuits; voltage variation; variation of frequency; choice of rating and speed of motors. In mining and metallurgical practice steam-mill, tube-mill, tailings-wheel or tailings-pump motors operate for twenty-eight and one-half days per month on an average, representing 342 days per year, so that the importance of installing high-efficiency motors to drive them is obvious. The author gives a numerical example showing that the expenditure of some more money on the first cost of the motor may result in a much greater yearly saving in the cost of energy consumed. The author emphasizes the necessity of installing the most efficient motors obtainable and the relatively unimportant bearing the question of low first cost should have in determining the type of motor to be installed to operate machines that will be in service for the long periods that obtain in mining practice.—*Trans. South African Inst. Elec. Eng.*, November, 1910.

Electric Winding.—An account of the extended discussion which followed the recent paper of Wilson before the Newcastle Section of the (British) Institution of Electrical Engineers. T. C. Futers objected to many electric winders on account of the complications and criticised at some length the Koepe pulley and the Ilgner system. On the whole he thought it better to retain steam winders and utilize the exhaust in a low-pressure turbine. M. Kirby gave the following figures for the cost of steam winding from actual practice in England: In one case the gross cost is 4.868 cents per ton per 1000 ft and in another case 5.48 cents. H. A. Couves said that there is a large demand for electric winders of small output; many collieries in northern England are working at from 700 tons to 800 tons per day, winding from 600 ft. to 700 ft. Colliery companies have been well advised not to put in electric winders if energy must be generated privately, but the case is different where a public supply is available. Many old steam winders still working ought to have been scrapped long since; the installation of electric winders in their place would not be expensive, as most of them could be run as three-phase geared machines. Schuil referred to the use of buffer storage batteries for equalizing the load and to the power-factor of induction motors at starting. W. C. Mountain gave figures showing that in many cases electric winding cannot compete with steam winding. There are cases, however, where electric winding, especially for small duties, can effect considerable saving.—Lond. *Elec. Eng'ing*, Jan. 5.

Transmission Systems for Agricultural Districts.—C. Schmidt.—A discussion of the most favorable voltage and other points in the design of transmission systems for agricultural districts. The author emphasizes that for such transmission systems small consumers are of great importance and their easy connection at a later date should be taken into consideration in the first design. It must be possible without high cost of the distribution network to operate several electric plows simultaneously and besides this to permit another high load on the same circuit. Further, it must be possible to connect small consumers without great expense. The author shows how such considerations influence the choice of voltage, etc.—*Elek. Zeit.*, Dec. 29.

Traction.

Fifty-Cycle Single-Phase Traction.—P. Mueller.—An illustrated description of the street-railway system of San Avold in Lorraine, Germany, which connects the town with a railroad station at a distance of 2.6 km (1½ miles). The road has considerable grades and curves. This is the first road in Germany which is operated by single-phase currents with the frequency of 50 cycles. Three-phase energy at 5000 volts and 50 cycles is bought at the price of 1.75 cents per kw-hour and one phase of the three-phase circuit is utilized for traction. Two transformer stations are arranged along the road. The motors are six-pole repulsion motors of the Bergmann Company. The electric equipment and the construction of the motors are described in some detail, and the advantage of the possibility of connecting a tramway directly to an existing three-phase transmission system is pointed out.—*Elek. Zeit.*, Jan. 5.

Single-Phase Locomotive.—An illustrated description of a 2000-hp, 15,000-volt, single-phase locomotive of the Oerlikon Company which is claimed to be "the locomotive of the least specific weight." The driving equipment when supplied with single-phase current at 15,000 volts and a frequency of between 13 cycles and 17 cycles per second can exert a power of 2000 hp continuously with a speed of twenty-six and one-quarter miles (42 km) per hour and a tractive effort of 13 tons at the road wheels. The speed can be regulated from nothing up to forty-three and three-quarter miles (70 km) per hour The tractive effort at starting may become a maximum of 15 tons. The axle pressure is 15 tons, the total weight of the locomotive 88 tons, the adhesive weight 88 tons, or six and seven-tenths times the normal tractive effort. The total length is 50 ft (15 m). Should the speed at which the normal tractive effort is reached become too near the maximum speed the latter can be increased by modifying the secondary transformer winding so that 3000 hp can be exerted for an hour at a speed of thirty-seven and one-half miles (60 km) per hour. The locomotive can also be operated with three-phase currents and with direct current. The motors are of the twelve-pole compensated-series type with compensating field coils.—Lond. *Electrician*, Jan. 6.

British Traction Statistics.—The annual statistical tables giving details of equipment and operation of 138 British tramways and light railways receiving energy from combined lighting and traction power houses, forty-eight tramways and light railways with power houses for traction only and sixteen electric railways in operation.—Supplement to Lond. *Electrician*, Jan. 6.

Electric Transmission on Shipboard.—F. Niethammer and E. Siegel.—An article on systems combining oil or gas line engines with electric transmission for the propulsion of ships. The authors discuss briefly the many different methods of reversal of direction and speed regulation both for direct current and alternating current.—*Elek. Kraftbet. u. Bahnen*, Dec. 4.

Installations, Systems and Appliances.

Switchgear for Mines.—G. Stevenson.—A note on a paper read before the Mining Institute of Scotland The author dealt first with the details of the switches used for underground work and considered the design of three-phase equipment in particular, as this system is considered to be preferable for employment in mines. Knife-blade switches with an air-break were first used, a pattern which had the double disadvantage of occupying a great deal of space and giving rise to dangerous arcing. They were, therefore, soon abandoned and replaced by oil-break switches, which still hold the field. To this simple switch have been added a multiplicity of automatic features, the use of which is not to be commended for mining work. Two overload trips are in general quite sufficient for the purpose, except where the neutral point of the system is earthed, when an extra one becomes necessary for adequate protection. The cardinal points in the lay-out of mining switchgear are safety, reliability and simplicity, and these can all be obtained by using oil-immersed iron-clad switchgear. As regards the switchgear to be used on the surface the same conditions should be fulfilled by it as by that underground. Well-designed boards built of substantial slate panels, mounted in an iron framework and arranged so as to keep all "live" metal away from the front of the board, make quite a satisfactory equipment. Each item of equipment should be inclosed in a separate and self-contained fireproof cell constructed of molded stone. In conclusion the author said sufficient attention had not been given in the past, in collieries generally, to the question of switchgear, with the result that low initial cost has been a deterrent factor. But the urgent necessity of raising the standard of the equipment is now being recognized.—Lond. *Electrician*, Jan. 6.

Protective Gear.—K. Faye-Hansen and G. Harlow.—A paper read before the Manchester Section of the (British) Institution of Electrical Engineers on the Merz-Price protective gear and other discriminative apparatus for alternating-current circuits.—Lond. *Electrician*, Jan. 6.

Wires, Wiring and Conduits.

Cables.—F. Fernie.—The continuation of his long illustrated serial on electric cables. In the present instalment the author deals with fault localization on three-wire and three-phase networks, the conditions which should be fulfilled to obtain satisfactory practical operation being stated The procedure which should be followed in fault localization is also given in a general way.—Lond. *Electrician*, Jan. 6.

Bare Neutral Wire.—E. W. Weinbeer.—The Peschel system of wiring in which slotted steel tubes (joined together by simple overlapping) without insulation are used for the protection of rubber-insulated wires is used to a considerable extent in Germany and it has become usual in recent years to use the tube for the return circuit. Since the joints are simply produced by overlapping the tubes the question of the voltage drop is of importance. The author gives the results of tests in practice in which such tubes were used as earthed neutral wires or as return circuits and shows that the voltage drop is in all cases far below the maximum permissible limit. For this reason the use of the Peschel tubes as neutral wire or return conductor offers no difficulties.—*Elek. Zeit.*, Dec. 29.

Calculation of Overhead Lines.—A. Blondel.—An easy method of calculating overhead transmission lines by means of a single diagram was described by Blondel at the "White Coal Congress" in 1902. His work has later been extended by him and others. In the present article the principal parts of the original paper by Blondel, together with the diagram, are reproduced.—*La Lumière Elec.*, Dec. 31.

Electrophysics and Magnetism.

Stretching of a Conductor by Its Current.—C. Hering.—A paper in which the author gives reasons why one should expect a current to develop an axial force in its conductor tending to straighten and stretch it. Some experiments are described which are directly explained by the conception of the lengthening of the circuit by the current, while the older notion of an increase of the area inclosed by the circuit due to the current is not in accordance with these experiments. The following conclusions are drawn: In a conductor free from all external influences a current exerts a stretching force, due to its magnetic effect, which is independent of the direction of the current or of the length of the conductor and is presumably proportional to the square of the current and inversely proportional to the cross-section; it continues to act, no matter to what length the conductor has been stretched by it, and is therefore not of the nature of a strain; it is affected by neighboring currents and becomes less as these neighboring currents neutralize the magnetic effect of the current, being zero in a perfectly non-inductive circuit; when it produces motion a counter e.m.f. is produced; when such motion is reversed by a stronger opposing mechanical force a direct e.m.f. is produced.—*Jour. Franklin Inst.*, January.

Radiation.—T. Royes.—A note on experimental determinations of the reflective power of lamp-black and platinum-black. The results are interesting, as they have a bearing on the laws of radiation. Kurlbaum's determinations of the constant in the Stefan radiation law were not corrected for the reflective power of platinum-black. If this correction is made Kurlbaum's value, 7.061×10^{-15}, is to be corrected to 7.10×10^{-15} ergs per centimeter square × fourth power of temperature degrees. Planck's value for the elementary quantity of electricity is consequently increased in the same ratio and becomes 4.624×10^{-10} electrostatic unit.—*Phil. Mag.*, January.

Magnetic Properties of Silicon-Iron Alloys.—S. Guggenheim.—His complete paper with illustrations on the magnetic properties of silicon-iron alloys and their uses in electrical engineering. An abstract of this paper has already been noticed in the Digest.—*Elek. Kraftbet. u. Bahnen*, Sept. 24.

Magnetism.—D. Owen.—The author continues his summary of the late Professor Curie's work on magnetism. The results arrived at for a number of bodies are given, including water, sulphur, phosphorus, bismuth, oxygen, ferrous sulphate and ferromagnetic bodies. Langevin's theory is considered and reference made to Weiss' work.—Lond. *Electrician*, Jan. 6.

Electrochemistry and Batteries.

Primary Cells for Telephone Purposes.—J. G. Lucas.—A long abstract with illustrations of his recent paper before the Institute of British Post Office Electrical Engineers on experiments carried out by the author and A. Fraser on primary batteries used in telephoning. The main conclusion arrived at is that by the substitution of powdered manganese dioxide for the comparatively large granules of manganese dioxide usually employed the ordinary porous-pot Leclanché cell is enormously improved, so much so that there is little doubt that cells so constructed will largely displace all other patterns, both wet and dry. Fig. 5 gives the results of discharging two No. 1 Leclanché porous-pot cells, exactly similar in every respect, except that in one the manganese dioxide is powdered and in the other merely granulated. The weights of material were identical and in both cases the cells were discharged for five hours a day and six days a week. A maximum drop of 33 per cent in the voltage was allowed in this test. The results of other tests are also given in diagrams. Some of the tests refer to dry cells. The author attributes the larger number of amp-hours obtainable in the case of the Siemens than in the Fuller dry cell to the fact that the Siemens depolarizer is more finely powdered and thus forms a more compact mass, so that the gases escape more slowly and carry off less moisture; the cell, therefore, does not dry up so quickly. The occasional bursting of the Siemens cells may be due partly

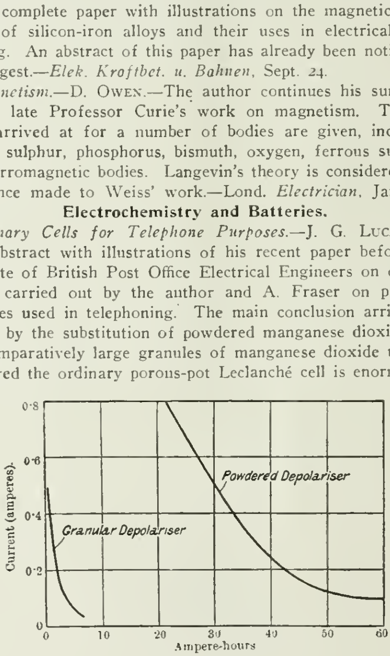


Fig. 5—Diagram Showing Effective Ampere-Hours of Two Leclanché Cells.

to this cause and partly to the formation of crystalline bodies within the zinc canister. Up to a certain point the effective amp-hours of the dry cells actually rise with increased current; this is due to the rise in resistance (caused by drying up) making it necessary to discard the cell after it has been in use for a certain period, and at the low discharge rates the amp-hours developed in that period are, of course, less. The superiority of the Siemens cell is also shown; it has a far longer life than the Fuller on the lower discharge rates. The paper also gives some particulars with regard to the substitution of manganese chloride for ammonium chloride as the electrolyte in the wet Leclanche cell. The author has made this charge to prevent the evolution of ammonia gas. The absence of this gas renders it unnecessary to ventilate the boxes of subscribers' batteries and therefore diminishes evaporation and "creeping," so that a considerable saving in maintenance costs is expected.—Lond. *Elec. Eng'ing*, Jan. 5.

Changes on Concentration at Electrodes.—T. R. Rosebrugh and W. Lash Miller.—A long mathematical paper giving the complete theory of the changes of concentration at the electrode brought about by diffusion and by chemical reaction.—*Jour. Phys. Chemistry*, December.

Units, Measurements and Instruments.

Magnetic Testing.—J. G. Gray and A. D. Ross.—An article discussing certain precautions which must be taken in the determination of the magnetic properties of materials. It is well known that the magnetic properties of a test specimen depend on their previous magnetic history. But it is not generally known that purely thermal treatment, such as that involved in the process of annealing a specimen, no matter what temperature is reached in the process, develops in the specimen a peculiar state which renders additional precautions necessary. This is called a "sensitive state" of the material. A magnetization curve yielded by the specimen following upon any change, or cycle of changes, in the temperature is not what may be called the *true* magnetization curve of the material. Fig. 6 shows the results obtained on testing at room temperature by the magnetometric method a specimen of hard steel which had been heated to 900 deg. C. and allowed to cool slowly. Previous to being heated the specimen had been rendered neutral, and during the process of heating and cooling had been exposed to no magnetizing forces. On submitting the specimen in the condition brought about by the thermal treatment described to the action of a magnetizing field which increased gradually from 0 to +9 c.g.s. units, then diminished gradually from +9 c.g.s. units to −9 c.g.s. units, and finally increased in like manner from −9 c.g.s. units to +9 c.g.s. units, the intensity of magnetization followed the curve *O A B C D E*. It will be seen that the point *E* does not coincide with the point *A*, and that the vertical distance of *A* above *O* is much greater than the vertical distance of *C* below *O*. The specimen was now thoroughly demagnetized, and the process repeated, when the curve *O A' B' C' D' E'* was obtained. It is important to notice that the point *E'* coincides with *A'*; the curve is now closed. An inspection of the figure shows that the hysteresis loop is now symmetrical. Cyclic alteration of the magnetizing force between limits $H = \pm 9$ c.g.s. units resulted in the curve being repeated over and over again. *O A'* is the true magnetization curve for the specimen in the annealed condition; it is this curve, and not the curve *O A*, that is characteristic of the magnetic properties of the material. But it is not necessary to anneal at 900 deg. C., since even a moderate alteration in temperature is sufficient to bring about the sensitive state to a marked degree. Once the "sensitive state" has been induced in a specimen it cannot be got rid of except by submitting the specimen to the demagnetizing process. A further series of experiments showed that the "sensitive states" induced by equal augmentations or diminutions of the temperature are of widely different amounts, depending on the position of the temperature ranges on the temperature scale. The effect of these facts on the methods of magnetic testing is pointed out.—*Phil. Mag.*, January.

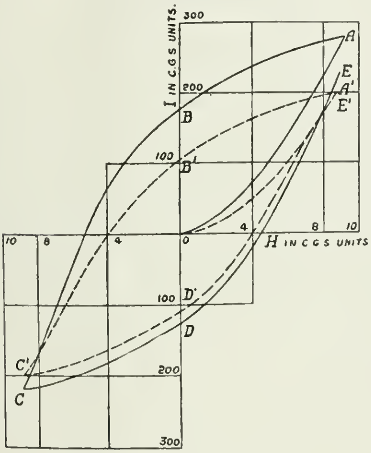


Fig. 6—Magnetization Curves.

Method of Measuring Magnetic Fluxes.—H. Zahn.—An article criticising some points in the recent paper of Peukert in which it was proposed to measure magnetic fluxes by means of the Hall effect. The present author points out two different sources of error of this method and shows how to overcome them. However, he thinks that the method is inferior to those usually employed.—*Elek. Zeit.*, Dec. 29.

Electrostatic Voltmeter.—G. W. Walker.—An abstract of a British Royal Society paper on an electrostatic voltmeter for recording the atmospheric potential. The instrument is the result of some experiments made at the Eskdalemuir observatory with the object of obtaining a simple and efficient voltmeter for the continuous photographic registration of the electrical potential at a fixed point in the atmosphere. Experience has shown that occasionally the instrument is required to register up to fully ± 1000 volts. Satisfactory results have been obtained by means of a Dolezalek electrometer. The usual sensitiveness is greatly reduced by using a phosphor-bronze suspension, while the needle is loaded to prevent tilting. A fixed difference of potential is applied between the quadrants by means of one or two standard cadmium cells, while the potential to be measured is applied to the needle. The needle can now carry 1000 volts with perfect safety and stability, while the scale value on the paper is constant to within a few per cent over a range from −900 volts to +900 volts. Trial has been made of a voltmeter (built in the workshop) similar in general design to that of Dolezalek, but in which the fixed difference of potential between the quadrants was provided by making the quadrants alternately of copper and zinc soldered together and not insulated. Uniformity of scale value has been obtained from about −500 volts to +500 volts, but for higher potentials only approximate uniformity is secured. This defect rises from want of mechanical perfection of the quadrants and needle, and should disappear in an instrument made with the same accuracy as that of Dolezalek. At present, also, the damping of the needle during very rapid changes of potential is insufficient. Reference was made to certain points in the manipulation of sulphur for insulating which have been found essential to secure good results.—Lond. *Electrician*, Jan. 6.

Carbondioxide Recorder.—In an article on the recent exhibition of the London Physical Society a description is given of a new CO_2 recorder of a British company. The arrangement is shown in Fig. 7 A sample of the products of combustion is drawn from the flue through the recorder by means of a water aspirator *G* (the inlet of the water from the cistern being at *H*, the outlet of the gas-water to drain at *J*) The gas is first cleaned by being passed through a soot filter *A*, and is then led through a temperature equalizer *C* to the first *(D)* of two meters D and E. After passing through this the CO_2 is absorbed in a chamber F, the remaining body of gas being measured by the second meter E. The two meters are connected by differential gearing to the mechanism driving the recording pen, so that the difference in volume of the gas due to the absorption of the CO_2 is recorded. After a certain definite volume of flue gas has passed through the first meter, the pen is made to drop to its initial position, from which it again starts to record. To insure that the gas is at the same temperature in passing through the two meters, it is passed through a temperature equalizer before entering each meter. These two equalizers, C_1 and C_2, consist of series of water-cooled pipes. As many as twenty-five analyses can be obtained per hour; the number can be varied by controlling the amount of gas. One of these recorders installed by the Cambridge Electric Supply Company resulted in a saving of forty-nine tons of coal in November last.—Lond. *Electrician*, Jan. 6.

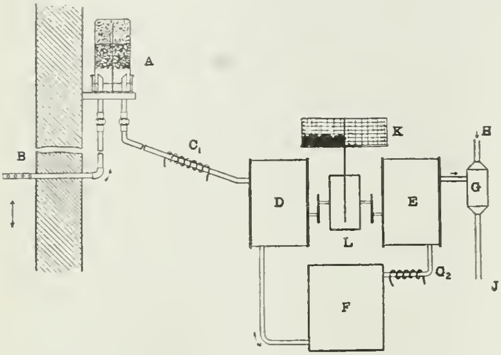


Fig. 7—Diagram Showing Principle of Bi-Meter CO_2 Recorder.

Thermoelectric Pyrometer.—In thermoelectric pyrometry the "cold" end of the couples in the pyrometer head are liable to be subjected to very variable temperatures, introducing errors in the readings. In an article on the recent exhibition of the London Physical Society a description is given of a method of a British company for overcoming this difficulty, employing compensating leads made of copper and copper-nickel alloy and having the same thermo-e.m.f. as the platinum-rhodium couple. These are run in opposition to the couple in the head of the pyrometer, thus removing the cold junction to the galvanometer and securing a greater accuracy by reason of more constant temperature.—Lond. *Electrician*, Jan. 6.

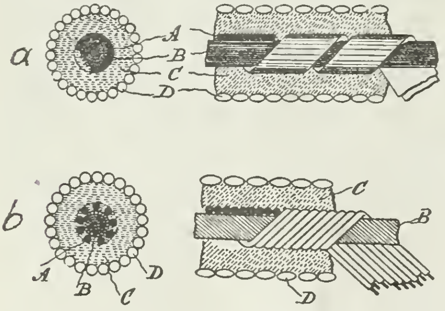


Fig. 8—The Cuntz Electric Cable.

Electrostatic Alternating-Current Instruments.—R. Ziegenberg.—The conclusion of his long illustrated serial on modern alternating-current instruments. In tne present instalment various electrostatic instruments made by German companies are described.—*Zeit. f. Beleucht.*, Dec. 30.

Telegraphy, Telephony and Signals.

Telephone Cable.—A description of a telephone cable devised by Mr. J. H. Cuntz in which capacity is counteracted by uniformly and continuously distributed inductance. The inductance is secured by winding the conductor in the form of a long helix about a supporting core, which in most practical cases would be made of thin iron wires. Two forms of the cable are shown in Fig. 8. In the upper diagrams *a* the conductor *A* is flat or ribbon-shaped so as to be compact and fit closely around the core *B*; while in the lower diagrams *b* the conductor is composed of a number of wires in parallel in order to give greater security against parting of the conductor and to provide a simple and commercially practicable method of manufacture. *C* and *D* in both figures indicate respectively insulation and covering, and sheathing.—*Stevens Indicator*, January.

Wireless Telegraphy.—P. Brenot.—The author describes various new measuring instruments for use in wireless telegraphy, especially for measuring the frequency and for measuring resistances.—*La Lumière Elec.*, Dec. 31.

Coupled Oscillation Circuits.—J. S. Stone.—A mathematical paper on the calculation of the frequencies and damping coefficients of two coupled oscillation circuits.—*La Lumière Elec.*, Dec. 31.

Book Reviews.

Engineering Mathematics. By Charles Proteus Steinmetz, Ph.D. New York: McGraw-Hill Book Company. 292 pages. 93 illus. Price, $3.

In the present work Dr. Steinmetz has given numerous excellent suggestions concerning methods for applying mathematics in engineering problems. Contrary to what one might be led to believe from the title, the book deals to only a limited extent with mathematics as such, but largely with the application to engineering of those branches of mathematics which are best suited for the purpose. A prominent feature of the book resides in the numerical examples taken from engineering problems, almost wholly electrical. Each example given is intended to show not the mathematical significance of the equation involved, but the method by which the engineering problem can be solved. In many cases the solution obtained gives only approximately accurate results, and it is in the treatment of such solutions that the book is most valuable.

The author lays proper stress on the importance of selecting the mathematical tool in accordance with the work to be done; that is, the problem to be solved. He shows, for example, the absurdity of attempting to predetermine within a fraction of 1 per cent the field current of a generator when the exciting currents of generators constructed under the best possible conditions to identical specifications vary by several per cent. It is pointed out that lack of absolute accuracy in engineering calculations does not involve error, but means merely the elimination of refinements that cannot be realized in the engineering equipment. The book affords a happy medium for the instruction of both the mathematician who sees in engineering problems merely possibilities of displaying his ability to create complications out of simpilicity and the practising engineer who prefers to guess at the whole result rather than bother with the details by cumbersome mathematical analysis.

The book contains seven chapters and two appendices. The first chapter deals with the "general number," or with strictly numerical determinations; Chapter II is devoted to the potential series and exponential function; the trigonometric series are treated in Chapter III, and maxima and minima in Chapter IV; methods of approximations, empirical curves and numerical calculations occupy Chapters V, VI and VII. The theory of functions and tables of functions are given in the appendices. The subject matter, which formed the basis of a course of lectures to electrical engineering students, is well arranged for use by seniors and juniors in engineering colleges and by others who are already familiar with trigonometry, analytic geometry and calculus.

Leçons d'Électrotechnique Générale. By P. Janet. Paris: Gauthier-Villars. Vols. 1 and 2. 732 pages, 337 illus. Price, 24 francs.

These volumes constitute a text-book, for colleges and technical schools, on the principles of direct and alternating currents and of the principal types of machinery operating with the same. The theory of the subject is presented to the student briefly in its physical form and is then developed mathematically toward the purpose in view, which is the analysis of the principles and mode of action of the various mechanisms considered. As a text-book the work is one of the best and most nearly complete which have appeared in the French language. It is supported by an unusually full bibliography, to which the reader is referred for the extension, support or collateral treatment of the matters considered in the text. The work is particularly strong on the side of direct-current and alternating-current dynamo machinery and their modes of operation.

Hendricks' Commercial Register of the United States. Nineteenth annual edition. New York: Samuel E. Hendricks Company. 1342 pages, large 8vo. Price, $10.

The current annual issue of this valuable commercial directory contains over 350,000 names and addresses under more than 35,000 business classifications. The index occupies just 100 pages, or 13 pages more than in the previous edition. The additional pages for the entire volume are 124, and, as 114 pages of matter that appeared the previous year are omitted from this edition, the total gain of pages is 238. A valuable feature of the book is the information accompanying many of the entries stating the specialty of the manufacturer. The electrical industry is well represented, and machinery in general has no less than 2000 classifications. For the purchasing agent of any manufacturing company the book is indispensable, and it is useful to every one who has occasion from time to time to seek the addresses of firms engaged in specific lines of manufacturing.

New Apparatus and Appliances

INSTRUMENT STANDARDIZATION AT THE ENGINEERING DEPARTMENT OF THE NATIONAL ELECTRIC LAMP ASSOCIATION.

In its research and testing work the engineering department of the National Electric Lamp Association requires the use of a large number of electrical instruments which must be calibrated with the greatest possible precision. In the testing section alone there are some 18,000 photometer readings taken every month on lamps which are sent to the association by the member companies to be tested; and, in addition to this, there are made here approximately seventy-five photometric standards a month, which are sent out to the member companies for use in rating their lamps. When one considers that the millions of lamps manufactured each year by these companies are photometered by using photometric standards which are made by the engineering department it will be realized that the accuracy of the instruments used for this work must be of the best.

The calibration-room, from which all of the standardization is carried on, is situated in the basement of the new Engineering building at the corner of Hough Avenue and East Forty-fifth Street, Cleveland, Ohio. In order to minimize the vibrations transmitted from machines in the building a concrete pier, 6 ft. x 12 ft., was sunk into the earth, upon which was placed the table supporting the standard instruments. This table is constructed of solid oak and the top is made of a slab of slate 11½ ft. long, 5½ ft. wide and 2 1/16 in. thick. All of the switching apparatus is connected permanently to this board and the instruments rest directly upon it.

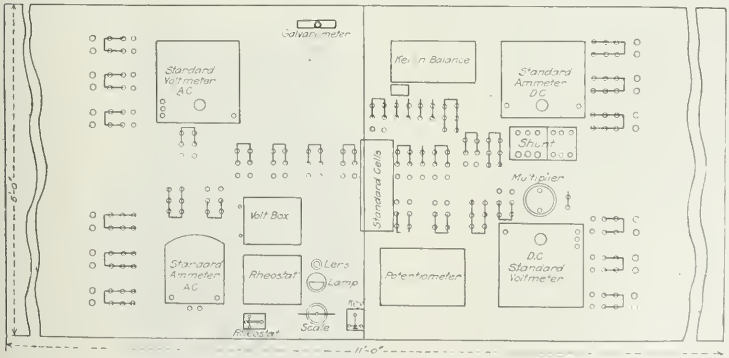


Fig. 1—Arrangement of Testing Apparatus.

Connecting this table to a plug board there are six pairs of leads by means of which it is possible to connect the standard instruments to any other apparatus throughout the building. From this plug board, which has sixty plug connections, there are nine pairs leading to the "pit" or dynamo-room. The connections are made by means of taper plugs and sockets and any desired form of current may be obtained on the different lines. Through this board alternating current of any practical frequency at 30 volts, 60 volts, 120 volts and 240 volts pressure may be obtained, while almost any desired direct-current voltage and amperage is obtainable from storage cells and from generators.

In addition to the nine pairs of supply leads there are four pairs of leads connected to a test table, four pairs to the photometer-room plug board, four pairs to the plug on the third floor of the building, one pair to the lamp-testing racks, one instrument-checking pair and one pair to two-lamp banks for loading purposes. By means of the leads to the lamp-testing racks it is possible to tell instantly the voltage on the main busbar, and by means of those connecting with the photometer board two or more sets of instruments may be calibrated simultaneously. The checking circuit connects with the photometer-room and the rotating-mirror photometer and has five outlets on the third floor for instruments located there.

The instruments which are used for standards are all of modern and approved type. They consist of a Weston standard direct-current voltmeter with a 15-volt, 75 volt and 150-volt scale and with a multiplier extending the range to 300 volts. For current measurement there is used a Weston standard millivoltmeter with a set of standard shunts which give a range of from zero to 0.5 amp, 2 amp, 5 amp or 20 amp.

For purposes requiring the greatest possible accuracy a Leeds & Northrup potentiometer with a range of from 0 volt to 1.5 volt is used, and by means of an external volt-box ranges of from 15 volts, 150 volts and 1500 volts may be obtained. On a 150-volt range readings may be taken to 0.01 volt and on the 1.5-volt range to 0.0001 volt. A standard Leeds & Northrup Wheatstone bridge and galvanometer are used for resistance measurements. This set is placed on the standardization table in order to insure accurate results.

Three Weston standard cells are kept in the calibration-room. One of these was checked by the Bureau of Standards, another at the laboratories of the Weston Electric Instrument Company, while the third was tested at the Electrical Testing Laboratories. By this means it is possible to insure the greatest reliability for these cells, and it has proved a very satisfactory system. The cells are packed solidly in a box and the terminals are connected to mercury cups, which are sealed when not in use, so that the cells are never in danger of an accidental short-circuit.

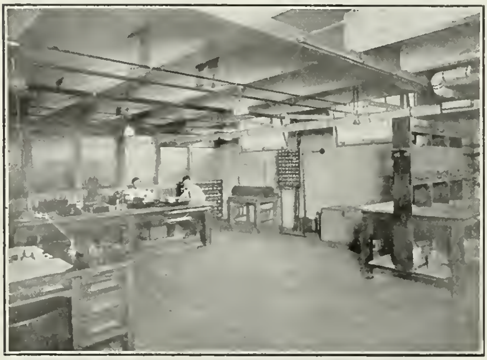


Fig. 2—View of Laboratory.

For alternating-current work there is a Siemens & Halske standard alternating-current ammeter with a range of from 0 amp to 2.5 amp and 5 amp, and a Weston standard oil-insulated voltmeter, with scales of 150 volts to 300 volts. For current measurements there is a Kelvin balance of 10-amp capacity, which is used to check the potentiometer.

In making the most accurate calibrations temperature measurements are made of the table, the instruments and the room. In checking alternating-current instruments a precision of from 0.2 per cent to 0.5 per cent is obtained, while on direct current a precision of from 0.1 per cent to 0.2 per cent is possible. In addition to the standardizing table there is a testing table on which all heavy work, such as transformer and motor testing, is carried on. During the past few months there have been tested 760 transformers of ¾-kw rating, which are used on the lamp-life testing racks.

An interesting feature of the wiring system is the telephone checking circuit. This telephone circuit is equipped with two switchboard operators' sets which enable two men to communicate with each other while checking instruments in their working positions in different parts of the building. The entire checking system of the building is wired with No. 4 and No. 8 stranded copper, so that the line drop for voltmeter work is negligible.

The main idea which is carried through the work is that of precision. All the instruments used throughout the building are checked every week and calibrated monthly. The laboratory standard instruments are checked weekly against current-checking lamps and at less frequent intervals against the standard photometer. The association appreciates the necessity for the most accurate work possible, and with this in view every facility which will in any way improve this work of standardization is thoroughly investigated.

CLOSING OF CHICAGO ELECTRICAL SHOW.

The Chicago Electrical Show of 1911 closed its doors Saturday evening, Jan. 21, after the most successful two-weeks' exhibition in the history of the Electrical Trades Exposition Company, under whose auspices it, like the preceding five annual expositions, was held. The total attendance during the thirteen days exceeded that of previous years, pleasant weather during the latter week swelling the numbers who thronged the Coliseum and annex. The 1911 show was also notable by reason of the comparatively large amount of business, in both present and prospective orders, reported done by exhibitors from their exhibit booths. A feature of this business was in the better class of sales, electric automobile dealers and manufacturers of the more expensive household devices being especially successful. Friday, Jan. 20, was Wisconsin day, when the members of the Wisconsin Electrical Association in convention at Milwaukee the preceding days visited the Chicago Electrical Show in a body as guests of Manager Homer E. Niesz.

SPEED-CONTROLLING DEVICES FOR SERVICE REQUIRING CONSTANT TORQUE.

For the control of series, shunt or compound-wound direct-current motors driving machinery the nature of whose work is such that a constant torque must be developed by the motor, the controlling device must be of rugged construction. The General Electric speed-controlling rheostats are designed for this service and embody features which add to the convenience and reliability of their operation. The contact segments are of liberal size and so designed that they may be very easily and quickly removed. For protection from failure of the circuit and the consequent danger of power being again thrown on the line without resistance in series with the motor armature, the rheostats are provided with a no-voltage release attachment. Upon

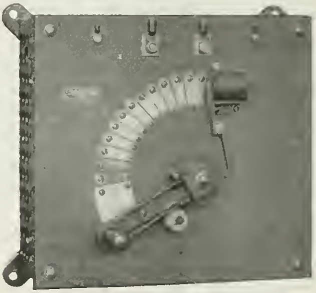


Fig. 1—Rheostat with Renewable Segments.

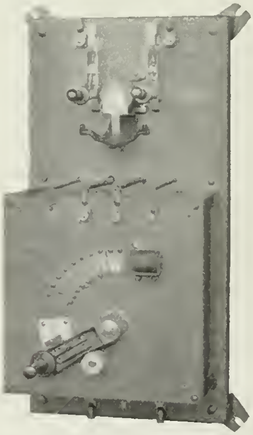


Fig. 2—Motor-Starting Panel Complete with Rheostat.

failure of the circuit, the retaining magnet is demagnetized, releasing the switch arm, and a spring instantly returns it to the "off" position. The no-voltage release coil is connected directly across the line in series with a resistance and is thus independent of the current of the motor field and will protect any motor with which the rheostat may be used. The resistance units are of non-fragile design and thoroughly ventilated. Where additional protection is desired rheostats possessing the features of those just described and in addition an over-load release coil are obtainable, and where the service is not so severe the same type of rheostat may be used, minus the renewable segments. In the larger sizes the circuit is made and broken on an easily renewed auxiliary button. The controllers are mounted on a slate base in connection with a double-pole circuit-breaker, presenting a compact and attractive appearance and affording ease of installation.

OIL SWITCH FOR SWITCHBOARD OR WALL MOUNTING.

The switches illustrated herewith are of the vertical up-break type, a construction which is desirable because of the fact that the maximum depth of oil is secured at the point of rupture of the circuit. The oil tank is made of cast iron and constitutes the main frame of the switch. It has a cast-iron cover which is held in place by hinged bolts and thumb-screws and which holds a felt packing ring tightly in place so that practically no dust can get in or oil escape from the case. The level of the oil in the case is shown by an indicator on the outside, and provision is made for drawing off the oil by means of a drain pipe.

The working parts of the switch, including the stationary and bridging contacts, are made in a unit which is conveniently removable from the tank without disturbing the leads or connections. An inter-lock is provided so that the switch unit cannot be removed from or inserted in the tank unless the contacts are in the "open" position. The contacts are so arranged that a rubbing action takes place when they are brought together, tending to keep them clean and to squeeze out the film of oil between them. Auxiliary removable arcing contacts are provided which break after the main contacts have spread by approximately ¼ in.

When the automatic tripping feature is applied, three tripping coils, for the three-pole automatic switch, are arranged for connection to three series transformers which are furnished with the switch. The two-pole switches are provided with one series transformer and the four-pole switch with two. The tripping mechanism is rugged in construction and at the same time sensitive to over-load conditions and positive in its action. The switches are calibrated for from 80 per cent to 160 per cent of the rated current of the switch.

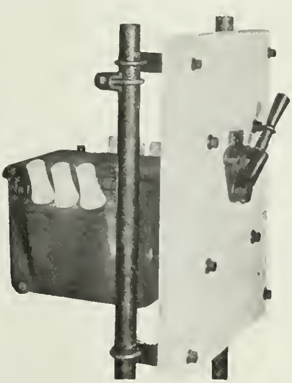


Fig. 1—Oil Switch Assembled.

The advantageous features claimed for the switch are as follows: The switch unit can be removed and taken to an adjacent bench where an inspection and all necessary adjustments can be made with good light. The switch units of any one size are interchangeable, so that an extra switch unit can be placed in the case while one which has been in operation is removed, if this procedure is desirable. With these oil switches the arc is drawn at a point of greater depth of oil than the usual construction permits. This arrangement avoids the throwing of oil when the switch is open under a heavy over-load or short-circuit and affords a good breaking capacity with minimum disturbance. The tripping coils and automatic features of the switch are entirely inclosed and protected within the case, while at the same time they are easily accessible for inspection.

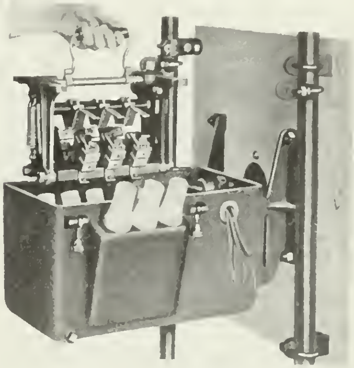
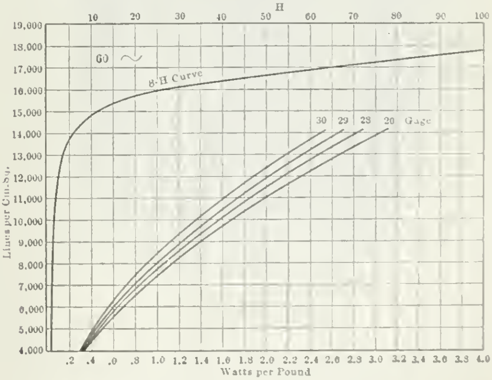


Fig. 2—Oil Switch with Contact Device Removed.

These switches have been placed on the market by the Allis-Chalmers Company for currents up to 300 amp and e.m.f. up to 3300 volts, both with and without automatic tripping devices.

CORE LOSS DATA.

The Follansbee Brothers Company, Follansbee, W. Va., the steel plant of which makes a specialty of sheet metal for electrical purposes, has issued a curve sheet, reproduced herewith, giving core loss data. As will be noted, the sheet is for 60 cycles, and includes a B-H curve and four curves giving the "core loss" for sheets of four different gages.



Magnetization and Core Loss Curves.

A 400,000-VOLT TESTING TRANSFORMER.

The R. Thomas & Sons Company, of East Liverpool, Ohio, has recently installed in its Lisbon (Ohio) insulator manufacturing plant a testing set of large rating to be used for testing transmission line insulators, high-voltage tubes and bushings, etc. The transformer was built by the General Electric Company at Pittsfield, Mass., Mr. J. J. Frank having immediate supervision of the design and construction. It is of 250 kw rating designed for 400,000 volts, 60 cycles. The primary is wound for 2300 volts, and is divided into two coils, the terminals of which are brought to a double-pole, double-throw switch in such a way that they may be connected either in series or in parallel so that with 2300 volts impressed either 200,000 volts or 400,000 volts may be obtained on the secondary.

The transformer may be operated at a much higher voltage than its rating calls for. It was operated continuously for one-half hour at 650,000 volts prior to shipment from Pittsfield.

The middle points of both the high-tension and the low-tension windings are permanently grounded. Provision is made for changing the low-voltage ground connection whenever the coils are changed from series to multiple or vice versa.

The low-tension winding is placed directly on the core and is surrounded by the high-tension winding in the form of a large number of separately insulated circular disk coils. Use is made of a bare conductor wound one turn per layer and placed between the salvaged edge of the intervening insulation. After being taped the coils are impregnated with insulating compound. The arrangement is shown in Fig. 1. The high-tension winding is supported by porcelain insulators, and between the high-tension and low-tension windings are cylinder insulators with flanged ends. The high-tension transformer leads are of the oil-filled type.

The completed transformer is shown in Fig. 2. It has a height to top of leads of 16.8 ft., occupies a floor area of 5.6 ft. x 10 ft. and weighs 20,000 lb. The case contains 2270 gals. of oil. The iron loss of the transformer is 84,000 watts and the copper loss at full load is 1270 watts, so that the efficiency at an output of 250 kw is 96.3 per cent. The copper loss is only 0.51 per cent. The reactance drop is 5.4 per cent, which is, therefore, practically identical with the impedance percentage of the transformer. The exciting current is equal to 7.18 per cent of the full-load current of the transformer.

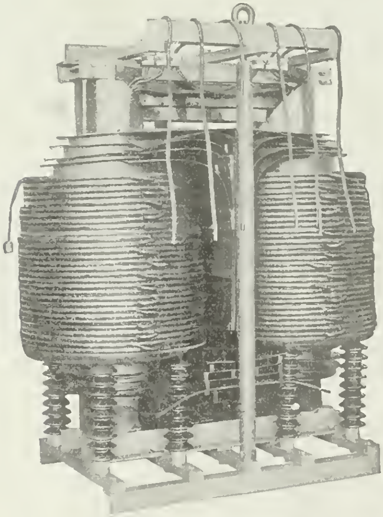


Fig. 1—Interior of 400,000-Volt Transformer.

In order that this transformer might be supplied with power up to its full rated load, should occasion arise, the R. Thomas & Sons Company has installed a new 250-hp Hamilton Corliss engine. This engine is equipped with an extra-heavy flywheel in order that there might be as little variation in speed as possible when sudden loads were thrown on caused by the breakdown of insulators at high voltages and by arcs over strings of suspension insulators under test. The main engine shaft also carries two belt pulleys, from one of which the factory machinery is driven, the other driving the jack-shaft to which are belted the generator used for test purposes and the generator for lighting the plant.

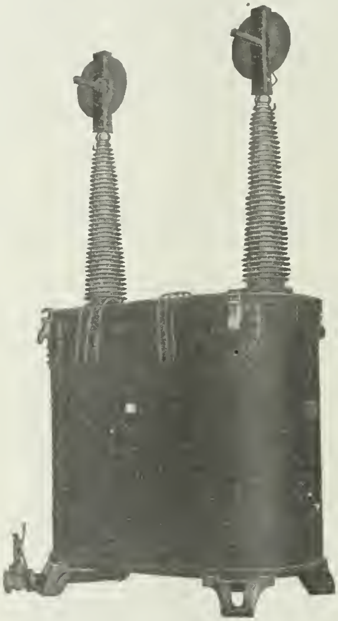


Fig. 2—View of Assembled Transformer, Showing Oil-Filled Heads.

The test generator is a Western Electric 200-kw, three-phase, 60-cycle, 2300-volt, 600 r.p.m. star-connected machine running single phase. The exciter is directly connected and is a 250-volt, 7.5-kw machine. The generator room panel and also the control switchboard were supplied with the generator by the Western Electric Company.

The method of controlling the voltage for testing purposes is entirely by the rheostats in the alternator and exciter field circuits.

On the generator panel is mounted a double-pole, single-throw oil switch with series-trip mechanism. There is also mounted on this panel and operated in connection with the oil switch a contact maker for closing a signal circuit connected to a lamp on the control switchboard, which is placed conveniently near both the transformer and the test-room. This lamp indicates the opening and closing of the switch in the generator room. A push button provided on the control board and connected with a bell in the generator room gives signals for starting and stopping the machine.

Mounted on the control board are an alternating-current voltmeter permanently connected through its transformer to the mains and an alterating-current ammeter connected permanently to the mains through a series transformer and supplied with a short-circuiting switch and a direct-current voltmeter connected to the exciter circuit.

For fine and accurate readings there has been provided a portable voltmeter so arranged with a special transformer having taps connected to a high-voltage plug switch mounted in the table of the control board that the voltmeter reading will be 100 when the generator volts are 515, 1150, 1725 or 2300, depending on the hole in which the switch plug is placed. It will be noted that this arrangement gives a great range of accurate readings. Consequently, for any desired test voltage a good reading may be obtained on one or another of these scales, bearing in mind at the same time that by means of the double-pole, double-throw switch above mentioned the ratio of the transformation may be made either 174 to 1 or 87 to 1.

The 2300-volt mains pass through the control board by means of a double-pole, single-throw oil switch. Two lighting circuits are so arranged in connection with this switch that one circuit of white lamps is closed when the oil switch is open and the other of red lamps is closed when the oil switch is closed. Both of these circuits indicate in the rain test-room and in the commercial test-room. The exciter and alternator field circuit rheostats and the alternator field switch are also mounted on this board. The board is so situated that the operator can observe any tests being conducted in either the rain or the commercial test-room.

The rain test-room is used for all experimental high-voltage testing and is fitted up conveniently to make not only the ordinary rain and dry tests on high-voltage line insulators but also tests on tubes, bushings, wall entrances, roof outlets, etc., and can be fitted to do any kind of high-voltage testing that occasion requires. These various tests cover a range of voltage up to and including 500,000.

NEGATIVE RESISTANCE FOR AMPLIFYING TELEPHONIC CURRENTS.

The use of negative resistance for amplifying or reinforcing telephone currents was first suggested by Béla Gáti in United States Patent No. 684,506, dated Oct. 15, 1901. Mr. Gáti specified a circuit for voice currents containing an arc lamp connected in series with a battery and two induction coils, the negative resistance of the lamp to be utilized to amplify the fluctuations in current thus produced. An increase in the current passing through the arc lamp causes its resistance to fall, thus further increasing the current passing through the circuit. A drop in the current passing through the circuit is likewise intensified, owing to the arc lamp increasing in resistance. The induction coils are connected to the two-line sections and act as input and output coils alternately, according to the direction in which speech is being transmitted over the line.

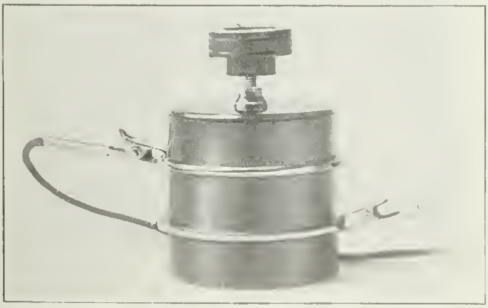


Fig. 1—Telephone Current Amplifyer.

Various modifications of this principle are described in a second patent for a telephone repeater issued to Béla Gáti (No. 799,554) dated Sept. 12, 1905. This basic principle of passing the voice currents through a battery to form direct-current fluctuations and then causing the fluctuations to affect and be amplified by a current-operated variable resistance is further exemplified in a patent issued to Weintraub and Latour (No. 921,930) dated May 18, 1909. This patent refers to the well-known negative resistance character of the mercury-vapor lamp, and particularly relates to means of utilizing the tube at a potential somewhat less than that necessary to maintain an arc, the inventors finding that in this condition it is extraordinarily sensitive to current variations.

A negative resistance telephone repeater is the subject of a United States patent (No. 979,012) issued Dec. 20, 1910, to Charles D. Lindridge, 37 Congress Avenue, Providence, R. I. The inventor finds that the sensitiveness of the negative resistance may be increased by bringing its conductance and the potential of current subjected to it within certain critical ranges of adjustment. A silicon-steel contact is mentioned in the specification as an example of negative resistance, and a repeater circuit is described using series-multiple contacts. Various features are incorporated in the patent which, the inventor says, are desirable for use in conjunction with the negative resistance, such, for example, as substitute resistances for use with the series-multiple contacts, adapted to maintain a constant normal potential of current across each contact.

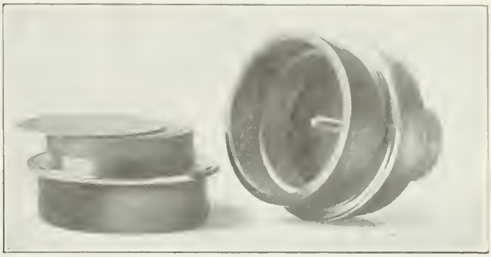


Fig. 2—Interior of Telephone Device.

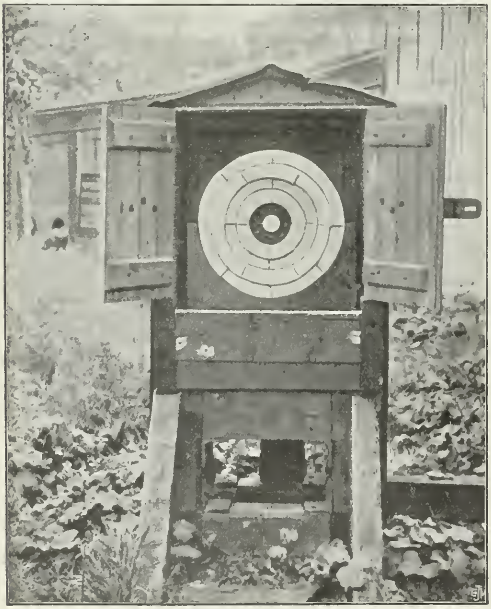
A negative resistance may readily be adjusted so that it automatically maintains a constant potential of current across it when the current passing through it varies within certain limits, but difficulty is experienced in making the potential across it vary inversely with the current passing through it. It is necessary that the potential of current across it vary in this manner, otherwise it cannot amplify current variations. Recent investigations which have been carried on by Mr. Lindridge lead him to believe that this difficulty of adjustment is owing to the resistance of the conducting paths between the electrodes being insufficiently uniform. If any want of uniformity exists in the resistance of these conducting paths current is very readily shunted from the high-resistance paths to the paths of low resistance. This, owing to the negative character of the resistance, has the effect both of increasing the resistance of the high-resistance paths and of making the resistance of the shunt paths drop still further. The result is that an almost inappreciable drop in resistance of one of the conducting paths between the electrodes instantly causes the resistance to break down as a whole and to lose its negative character.

Mr. Lindridge has been led to believe that the requirements of a negative resistance for amplifying current variations are that the resistance of each conducting path between the electrodes be high, that the contact or conducting surface of the electrodes be large and, particularly, that the resistance of all the conducting paths between the electrodes be uniform. This applies to both the contact and the mercury-vapor-tube types of negative resistance. With the idea of providing a negative resistance fulfilling these requirements Mr. Lindridge has recently designed the one of the contact type shown in Figs. 1 and 2. A disk of silicon 2 in. in diameter and ¼ in. thick is supported in a casing and connects with a metal ring extending around the outer edge of the case. This ring is grooved so that a test clip may readily be attached. Immediately above the polished surface of the silicon a steel diaphragm rests, insulated from the silicon by a thin mica ring. This diaphragm connects with a second metal ring extending around the outer edge of the case. By means of the screw at the top of the case the steel diaphragm may be slightly "crowned" or pressed down to come in contact with the silicon at the center. This idea of crowning a steel diaphragm is utilized in order to prevent the electrodes from bearing against each other with greater or less pressure at the edges on one side than on the other. With the negative resistance shown the greatest pressure between the electrodes is naturally at the center and the least pressure is exerted farthest away from the center, where the electrodes come in contact. But with a very thin insulating mica ring between the electrodes this difference in pressure is inappreciable. Fig. 1 shows the negative resistance complete as it appears when in circuit. Fig. 2 shows the top of the case removed.

AUTOMATIC ELECTRIC TARGETS.

In the accompanying illustration is shown a type of automatic electric target which has been used by the Belgian army for the past three years. The target, which is the invention of Captain Bremer of the Ninth Regiment, shows the marksman the result of his shot on an indicator which is connected by cable to the target proper.

The target proper is made up of a variable number of steel plates, each of which is supported by an iron shank capable of turning around an axis. When a ball hits one of the plates the latter turns toward the rear a sufficient distance to establish contact electrically and then returns to its former position.



Automatic Electric Target.

The electric indicator is the same in form as the target, the subdivisions of which are reproduced on it. As soon as a ball strikes the target a bell rings and the index of the indicator corresponding to the plate hit appears in sight, so that the marksman can immediately observe which plate has been struck. In comparison with the usual form of target the Bremer arrangement is advantageous in doing away with markers and thereby avoiding the dangers inherent to their employment, in minimizing the time consumed in shooting practice, in rendering the shooting at targets a source of pleasure and instruction, and in reducing the cost of maintaining a shooting range.

At the Brussels national shooting range and at the town ranges of Ostend, Namur, La Louvière and Binche use is made of a so-called annotator which automatically prints the points struck on the target. At the shooting range of Beverloo and Brasschaet large targets with white disks equipped with portable indicators are employed.

One of the most interesting forms of device is the disappearing automatic electric target comprising two silhouette busts placed 10 ft. apart from center to center. In order to bring one of the silhouettes into play it is necessary merely to press one of the two push-buttons with which the indicator near the marksman is equipped. Immediately the silhouette rises, remains in view for a time that may be regulated at will and then disappears automatically.

The above-described targets are being placed on the American market by Emile Maertens, 21 Eddy Street, Providence, R. I.

THE TELEPHONE ON ELECTRIC RAILWAYS.

An excellent example of how an efficient system of communication will quicken train service and aid generally in handling the business of the road is afforded by the New Hampshire Electric Railways on the lines operating around Haverhill, Lawrence, Lowell, Nashua, Hampton Beach, Salisbury Beach and intermediate points. This railway system uses the telephone in connection with its train dispatching to connect the repair shop with the various car houses, to connect the power house with the rotary stations and for general purposes, such as reporting defects in cars, track and overhead lines and ordering supplies for the various car houses. The telephone system is divided into two general sections corresponding to the divisions of the road, namely, the eastern and western divisions. The eastern division covers about sixty miles of road and is equipped with twenty-eight telephones. The western division is forty-

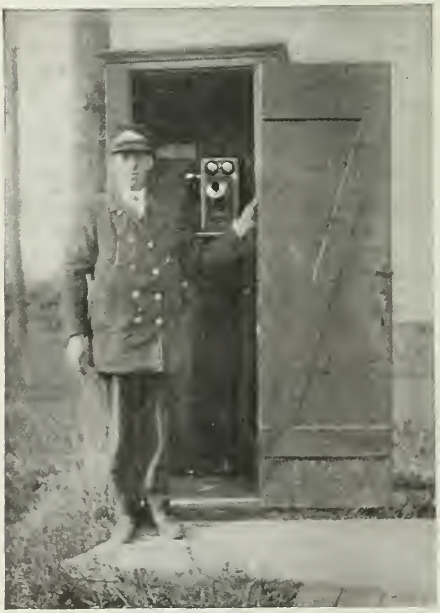


Fig. 1—Telephone Equipment at Siding.

seven miles in length and is equipped with thirty telephone stations in addition to those in use at Canobie Lake Park. There are also two other telephone circuits, one connecting the car house at Salem with the machine shop and the houses of the master mechanic and superintendent, the other a circuit paralleling the high-tension transmission line which supplies the energy for the road. Electrical energy is generated at Portsmouth, N. H., and transmitted at 13,200 volts, alternating current, to substations at Dover, Stratham, Plaistow, Amesbury, Salem, Methuen, Pelham and Hampton, where it is converted to 600 volts direct current. The telephone line paralleling the transmission line is fifty-five miles in length and is equipped with telephones at each rotary station. The high-tension patrolman always carries a portable telephone and by cutting into the line can connect with any point desired. The dispatchers at Salem and Amesbury can keep in constant touch with the power house at Portsmouth and each of the rotary stations. In case of a breakdown on the high-tension circuit, if a rotary station gets damaged during heavy storms, the heads of the departments can be notified at once and the necessary steps taken to clear the trouble immediately. The dispatcher for the western division is located at the Salem car house and from this point controls all the cars on this division. The telephone equipment here consists of a switchboard of thirty-line capacity, with trunk lines running to pony switchboards located at Haverhill and the Pelham car houses. At each siding and at other important points along the line there is a telephone booth in which are installed a telephone set, a lightning arrester and a triplicate copying machine. This machine makes three copies of each order, one of which goes to the conductor, another to the motorman, and the third winds up within the machine, which is locked. The switchboards and telephone apparatus of the entire system were furnished by the Western Electric Company.

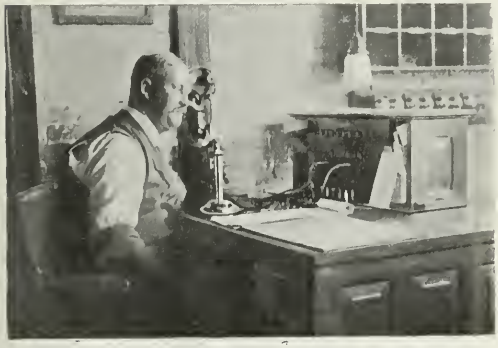


Fig. 2—Train Dispatcher at Salem Car House.

ELECTRICITY ON A PLANTATION.

On the eastern slope of the Alleghany Mountains in Virginia is located a tract of rolling upland consisting of about 11,000 acres owned by Mr. Thomas F. Ryan, the well-known American financier. The property is at Oak Ridge, Nelson County, on the Southern Railroad between Charlotteville and Lynchburg. Recently this large plantation was equipped with a complete electrical system for lighting all buildings on the place and to supply electric energy to drive the farm machinery, to operate the dairy, the flour and grist mill and to manufacture ice and do the other endless chores pertaining to farm work. Without this modern power system it would require a considerable number of men and horses to do the work about this large plantation. Now the working energy of eighty horses – of 500 men—is confined in one power-room, where it can be instantly dispatched in any amount desired to do the hard work about the farm and the many farm buildings.

The main power house, located near the barn buildings, is of stone construction, with concrete floors, and is amply large enough to house the power-generating machinery and the refrigerating apparatus and leave space enough for the milkrooms and the milk-handling machinery. In the power-room is a 60-kw, three-phase, 2300-volt General Electric generator, direct-connected to a 100-hp, three-cylinder Nash gas engine. The Nash engine operates on gas produced in the building from a gas-producer plant utilizing anthracite pea coal. This gas-driven generator supplies ample current for all the electricity used to light the many buildings on the plantation, gives energy to the many motors driving the farm machinery and provides for the operating of special heating devices, fan motors, etc. Compressed air is used for starting the gas engine, a 1-hp motor operating the air compressor. Fastened to the ceiling in the power-room is a small exciter, belted to the main shaft

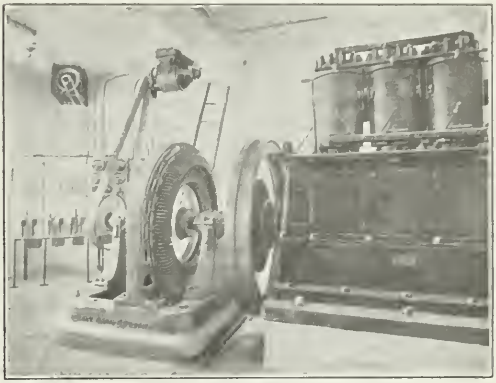


Fig. 1—Interior of Power House Gas Engine Driving Generator

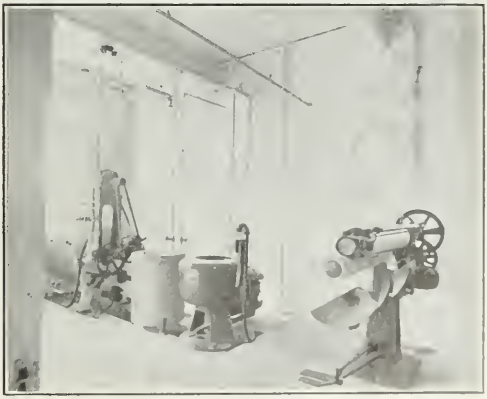


Fig. 2—Laundry.

To the left of the engine and generator are located the necessary switchboard panels. Three 10-kw transformers are placed in the loft of the power house for stepping the voltage down to 220 volts for the motor circuits, with a 110-volt tap for lighting circuits. Standard marine wiring is used throughout and all wires are laid in conduit.

A portion of the power-house building is devoted to refrigeration and the manufacture of artificial ice. A ton of ice is made every day, and in addition to this the plant maintains low temperatures in four cold-storage rooms—one for meats, one for the perishable fruit products of the estate, another for milk and still another for milk products, such as cream and butter. A 15-hp General Electric motor drives the ammonia gas compressor in this refrigerating plant, while a smaller motor, of 1½ hp, operates the brine-circulating pump.

Another interesting installation in the power house is a 25-hp low-pressure boiler which generates the steam used for heating the power house, supplies pressure to the small steam turbines which operate the cream separator and the bottle washer and gives a surplus supply of live steam for sterilizing the cans and bottles and the dairy machinery.

The dairy barn, which houses sixty imported Guernsey cows, is a model of its kind, with every convenience for caring for the stock and every sanitary arrangement necessary to preserve the health of the cattle and to assure a large supply of sanitary milk.

The milking is still being done by hand, although a vacuum milking system, driven by an electric motor, is being talked of The milk is carried on an elevated cableway across the intervening space between the dairy barn and the power-house building and deposited in the milk-receiving vat located in the loft. The milk-handling room is finished in white plaster with a concrete floor. A 3-hp motor drives a countershaft from which are belted the pasteurizers, pump, etc. As the milk descends from the receiving loft by gravity it is strained and cooled. Part is then sterilized or pasteurized for shipment and the remainder is put through a De Laval separator, driven by a tiny steam turbine, the cream being carried away to the ripening room, where it is cured and soured by a special process. In this apartment a 3-hp motor drives the churn and other machinery.

In connection with the milkroom is a washroom where a 2-hp motor drives a countershaft from which is belted a machine for washing cans. This machine washes the can inside and out in one process. A bottle washer is driven by a small steam turbine. Every can, bottle and pail, as well as the parts of the separator and other machinery, are thoroughly sterilized with live steam as soon as the washing is done. Live steam is also used to sterilize the floors and walls of the milkrooms after the rooms have been thoroughly washed and flushed. The dairy attendants are provided with a washroom, which is also equipped with suitable lockers and shower baths.

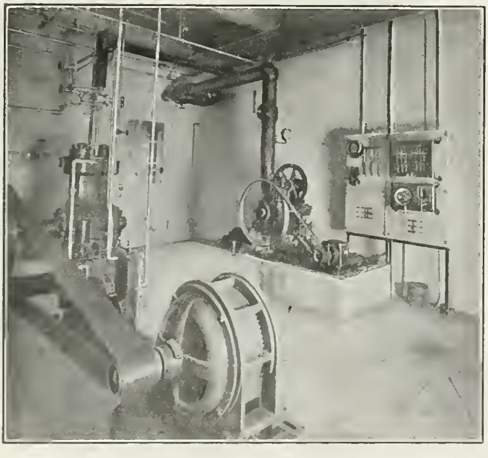


Fig. 3—Refrigerating Apparatus.

A novel feature of the dairy work is an up-to-date laundry where the white uniforms and other clothing of the dairymen are laundered. A 2-hp motor drives the washing machine. Another motor, rated at ½ hp, whirls the centrifugal dryer and the mangle is operated by a ½-hp motor. The drum of this mangle is heated by electricity. Electric flatirons are also used.

Besides the blooded cattle on the plantation there are nearly 200 thoroughbred horses. To supply all these animals with ground feed a small flour mill is maintained with a capacity of 50 bbl. of flour a day, where a large portion of the grain produced in that section is made into flour and the waste utilized for cattle feed. This flour mill is driven by a large electric motor.

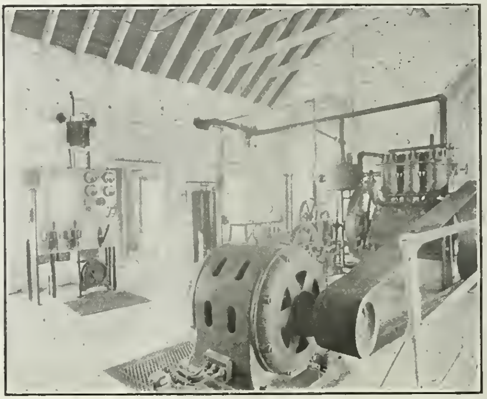


Fig. 4—Auxiliary Power Plant.

Electricity plays no insignificant part in adding to the comfort of those who enjoy the hospitality of the Ryan homestead. The energy for lamps for the main residence is furnished by a storage battery located in the basement which is charged from the main power plant. Every room in the large mansion is provided with an abundance of electric light and electricity is also extensively used about the building for heating and other purposes. There are electric dish warmers in the kitchen, electric heaters in the chambers and electric cooking devices for special service.

In order that the electric service need not cease even if the main power plant should meet with some unlooked-for accident, an auxiliary plant is located about 300 yd. from the main power station, which has been arranged for parallel operation with the main plant. In this auxiliary power house, which was the initial electrical equipment on the estate, is located a 50-hp gas-producer plant similar in operation to the one in the main power house. A 45-hp, three-cylinder Nash engine is belted to a 37½-kw alternating-current General Electric generator. This plant, though somewhat smaller, is operated nearly the same as the main plant and is held in readiness to be instantly started up in case of an emergency.

A mile away is still another gas-producer plant where a 37-hp gas engine is direct-connected to a powerful pump which forces water into a large reservoir with a capacity of 365,000 gal. This reservoir is located on a hill, so that the water system for the entire place is operated by gravity, giving an abundant supply of water as well as ample fire protection.

This electrical plant has been in successful operation for nearly a year, and the foreman of Mr. Ryan's plantation speaks in the warmest terms of its conveniences, flexibility and safety The apparatus was installed by Westerberg & Williams, o New York City, and the electrical equipment is almost entirel General Electric apparatus. Already plans are under way fo extensive improvements of the electrical apparatus and ultimately electricity will be employed wherever power is require about the plantation.

Industrial and Commercial News

The Week in Trade.

While there has undoubtedly been some increase in commercial business since the first of the year, this increase has not been all that was anticipated, nor have the promises for future business been as bright as were looked for. Jobbers and wholesalers in large commercial centers say that their salesmen are sending in better orders for dry goods, hardware and other staples than were sent in at any period during last fall. Orders, however, are not up to those that were received in the early months of 1910, and indicate that retailers are buying sparingly and with great discrimination. It is evident that the majority of retail merchants prefer to buy frequently rather than to make large orders and lay in heavy stocks. It is known that present stocks in retail hands are very light, but merchants as a rule are willing to let them continue in this state rather than take chances on carrying over a line of unsalable goods. In the industrial world there is no improvement in either woolen or cotton textiles. Mills are running on part time and manufacturing very conservatively. The iron and steel business has been somewhat improved by a definite settlement of the price question. Quite a number of orders have been received, which had been held up until it was positively determined that no reduction in prices would be made. These orders, however, are not as large as had been anticipated. But few new domestic orders have been received for steel rails, although it was reported last week that 25,500 tons had been sold in Argentina and Mexico. All of the plants of the United States Steel Corporation are in operation, although but a few of them are working more than 50 per cent of capacity. Some orders for steel cars were received during the past week, but these were mostly to fill in missing numbers and very few orders for additional equipment were placed. Structural contracts for building work are light. Taking the situation altogether, the West and South seem to be in a much better buying condition than the East. In other words, the agricultural centers are better supplied with money than the industrial centers. Collections continue to be very irregular. In many points they are slow, in the South they are fair, but in no section can they really be rated as good. Business failures for the week ending Jan. 19, as reported by *Bradstreet's*, were 302, as against 353 the previous week, 375 for the same week in 1910, 307 in 1909, 408 in 1908 and 252 in 1907.

The Copper Market.

During the past week the most interesting development in the copper market was the fact that there was a drop in the price of electrolytic by the Amalgamated and United Metal Selling Companies from 13 to 12½ cents, thirty days delivery. For quite a number of months these interests have been holding electrolytic copper at 13 cents, and in spite of independents underselling this price, there have been no considerable sales reported at less than the basic figure. It was apparent that the biggest copper interests in the market had pegged electrolytic at 13 cents, and the fact that they have now been compelled to lower this figure indicates that the copper market is not so strong as some of its advocates are proclaiming. The question as to what constitutes the real surplus supply of copper was brought forcibly to the front last week through a statement in the *Journal of Commerce*. This statement declares that the stocks of copper now on hand amount to 805,000,000 lb. Such a surplus stock is sufficient to create practically a crisis in the copper trade. Among the copper-selling agencies this statement was immediately denied. It was declared that the present stocks are not so great as to invite a crisis, and it was said that the stocks now on hand were approximately about one-half of the figure claimed. A statement from the producers calculated roughly that in the world there was at the present time about 400,000,000 lb. of copper. This absolute conflict of opinion between good authorities makes the copper market such an uncertain quantity that neither speculators nor investors are anxious to buy. There is no question that sales since the first of the year have been light, and although there has been somewhat more activity within the last week than there was previously, the total for the month of January is not at all satisfactory. The melters, who are the great buyers of copper, are not disposed to lay in heavy stocks at the present time. They are only buying to fill immediate needs, and in the present condition of business these immediate needs do not call for large purchases. Exports continue to be fair, but not large. For the month of January, including Jan. 23, exports were 22,005 tons. The imports are running at about the same figure that they have for the last few months. At the daily call on the Metal Exchange Jan. 23, standard copper was quoted as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.00	12.10	....
January	12.00	12.10	12.05
February	12.00	12.10	12.05
March	12.00	12.10	12.05
April	12.00	12.10	12.05

The London market Jan 23 was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	55	7	6	55	7	6
Standard copper, futures	56	5	0	56	5	0

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.30c			12.05c		
London, spot	£56	15	0	£55	7	6
London, futures	57	12	6	56	2	6
Best selected	60	5	0	59	10	0

Industrial and Commercial Notes.

Brooklyn Edison Buys New Equipment.—The Edison Electric Illuminating Company of Brooklyn placed an order last week with the Westinghouse Electric & Manufacturing Company for five 1000-kw, three-phase, 275-volt direct-current rotary converters, equipped with synchronous regulators for varying direct-current work. These regulators run 15 per cent above and 15 per cent below. It also ordered fifteen 400-kw air-blast transformers, 6600-volt frequency changes. The company is in the market for considerable apparatus, including three 2000-kw motor generator sets. There is also to be made a large order for apparatus for induction regulators, switchboards, etc. Orders for the majority of this apparatus, as indicated above, have not yet been placed. When the entire purchases are completed the apparatus will be distributed among the various substations in Brooklyn.

Interest in Storage-Battery Cars.—Since the operation of the Twenty-eighth & Twenty-ninth Street Crosstown Railway by storage-battery cars a very general interest in this system has been awakened in all parts of the country. The Gould Storage Battery Company, which equipped these cars, is in daily receipt of inquiries from small traction companies in all parts of the country, and the prospect is that if the cars prove entirely successful a large number of lines will be equipped with storage batteries. A representative of the Gould company says that, while no large orders have as yet been taken, there seems to be a very heavy business in sight. The storage-battery business is, however, very satisfactory at the present time, although the majority of orders are for small plants and lighting installations.

Electric Tramways and Power Plants in Turkey.—The American embassy at Constantinople furnishes the particulars of an adjudication concerning a concession of electric tramways in the City of Adrianople and the establishment of electric power in the Vilayet of Adrianople; also a concession for electric tramways in the City of Adana and the establishment of electric power in the Vilayet of Adana, which the Minister of Commerce and Public Works has sent to the embassy. These publications can be obtained by application to the Bureau of Manufactures, file No. 6116.

Electric Fan Business.—A representative of the General Electric Company is responsible for the statement that the electric fan business promises to be larger in 1911 than ever before in the history of the industry. Already, he says, orders are being received in such numbers that the fan departments not only of the General Electric Company but of almost all manufacturing concerns are running full time. This heavy demand is unusual at this early season of the year and shows the enormous development in the use of fans in all parts of the country.

Long Acre Electric Light & Power Company.—It has been announced that a syndicate of Boston capitalists, headed by ex-Senator James F. Shaw, has purchased the franchise and property of the Long Acre Light & Power Company. This company now has an application before the Public Service Commission of the First District of New York for permission to issue $10,000,000 in stock and $50,000,000 in bonds. The application was once turned down, and after a hearing in court the Public Service Commission was ordered by the Court of Appeals to reopen the case. The Boston syndicate has been negotiating for the purchase of this franchise and property for some time, and has been represented by Samuel Untermyer, its attorney. Mr. Shaw is an ex-president of the American Street & Interurban Railway Association, and has been connected with traction and lighting propositions since 1893. No definite information concerning the transfer of the property to the Boston syndicate could be obtained at the offices of the Long Acre company, 165 Broadway. Mr. Shaw is quoted as saying: "My syndicate will proceed immediately with the development of electric light and power. The company contemplates the expenditure of at least $10,000,000 in the initial plant. Under the plan proposed our engineers figure that we can sell energy at a lower price to the consumer than is now charged by the New York Edison Company." The Long Acre company was incorporated in April, 1903, for the purpose of manufacturing, distributing and selling energy for light, heat and power. The area of supply as defined in the original certificate of incorporation was bounded by Fifty-ninth Street, Fifth Avenue, Thirty-third Street and the Hudson River in the Borough of Manhattan. This area was extended by an amended certificate in June, 1907, to include all of the Boroughs of Manhattan and the Bronx. The franchise under which it operates was originally granted to the American Electric Manufacturing Company by the Board of Aldermen in May, 1887. This franchise passed through several hands, and finally came into the possession of the Long Acre company. At the hearing before the Public Service Commission early in the present month, attorneys for the New York Edison Company claimed that the franchise under which the Long Acre company proposed to operate had lapsed on account of non-use. This question is still undetermined by the commission and will be taken up at the hearing set for Jan. 31. Mr. Shaw was elected president of the Long Acre company last week.

Western Electric Company's Business.—In the issue of Jan. 12 the *Electrical World* published an estimate, from official sources, that the business of the Western Electric Company for the thirteen months ended Dec. 31 would amount to approximately $66,000,000. It is now officially given out that the gross sales for this period will be about $68,000,000. The difference is accounted for by the abnormally heavy bookings in December. The last month of any big manufacturing company is always swelled by a number of clean-up orders. The Western Electric has recently opened three new branch houses, one in Buffalo, another in Portland, Ore., a third in Milwaukee, giving it twenty-three branch houses in different parts of the United States. At present pay-rolls contain 24,000 names. The company is engaged in important plant developments at its big Hawthorne works which will cost during 1911 close to $1,000,000. This work has all been financed, however, and the company is in the best financial condition of any time in the last five years. In speaking of the outlook for 1911 an official of the company says: "The current year promises well and I am confident we shall show a healthy gain over 1910, but, of course, anything like the $16,000,000, or 35 per cent, increase over the 1909 twelve months cannot reasonably be expected. It would seem fair, however, to expect that gross sales this year will touch the former high record of $69,000,000. Western Electric has been buying its copper in hand-to-mouth quantities and will probably continue to do so for some time."

Additions to Chicago Drainage Canal Power House.—Work is under way for the addition of a seventh 4000-kw generating unit in the hydroelectric station of the Sanitary District on the Chicago Drainage Canal at Lockport, Ill. The turbine waterwheel will be furnished by the Wellman-Seaver-Morgan Company, of Cleveland, and the W. A. Jackson Company, of Chicago, will furnish and install the oil switches. The contract for the generator itself has not been awarded. The same is true in the case of the transformers, but the committee in charge of the matter for the Sanitary District trustees had recommended originally that the transformer order be placed with the Moloney Electric Company, of St. Louis, although later the matter of awarding the transformer contract was postponed. There will be six transformers, each rated at 1333 kw. Three of these will be step-up transformers placed in the power house, wound for 6600 volts on the primary side and 44,000 volts on the secondary side. In the Western Avenue terminal station in Chicago there will be three step-down transformers, reducing the voltage from the transmission-line potential to 12,000, 9000 or 6600 volts, according to the connections used on the secondary side.

New York Telephone Company.—A definite offer has been submitted to the Board of Estimate of New York City by the New York Telephone Company under which it proposes to increase its annual franchise fee for the exclusive right to provide telephone service. This offer is to take the place of one made in 1906. The company offers to pay $122,000 per year during the first period of five years, $134,000 during the second period, $152,000 during the third period, $176,000 during the fourth period and $200,000 thereafter. Under the original offer the company agreed to furnish service for the city's own use at 50 per cent reduction from schedule rates. It now claims that it cannot do more than continue to furnish such service at 25 per cent reduction. The company also revokes its offer to adjust its rates so as to limit its net earnings to approximately 10 per cent, "as jurisdiction over these matters has since been placed in the hands of the Public Service Commission of the Second District."

Allis-Chalmers Selling Abroad.—While the foreign sales of the Allis-Chalmers Company during the past few months have not been up to the high standard set last year they still have been very good. Japan is buying more freely than any other country and several large orders have recently been taken from that country. One of the most important of these is a steam and electric flour mill of 500-barrel-per-day capacity which the Allis-Chalmers Company, through the American Trading Company, has furnished complete. This installation includes a generating plant and individual motors for the entire mill. Another large order which the Allis-Chalmers Company has recently taken is for the Taihaku Sugar Company on the island of Formosa. This mill will install a 500-kw reciprocating engine-driven generator set with individual motors throughout. It will be one of the largest sugar mills in the world, turning out 700 tons per day. The output will be sold mainly in Japan and Manchuria.

Illinois Traction Association.—Plans are under way for the organization of the electric railways of the State of Illinois into an association for the purpose of presenting a united front in the competition for business with the steam roads. A preliminary organization has been formed under the name of the Illinois Electric Railway Association. The prospectus of this organization announces that it is proposed to connect all interurban lines in Illinois eventually, to fix uniform rates, to issue uniform interchangeable mileage books, to make a concerted combination for freight traffic and to improve the interurban service throughout the entire State by the adoption of standard equipment.

Syracuse Railway Consolidation.—The control of the Buffalo, Lockport & Rochester Electric Railroad Company has been formally taken over by the Beebe Electric Railway interests of Syracuse. The fact that a syndicate represented by C. D. Beebe had purchased the railroad was published in our issue of Dec. 22, 1910. Last week new officers were elected for the Buffalo, Lockport & Rochester Company as follows: President, C. D. Beebe, of Syracuse; first vice-president and general manager, J. M. Campbell, of Rochester; second vice-president, F. A. Dudley, of Buffalo; secretary and treasurer, H. C. Beatty, of Syracuse.

Moore Light-Western Electric Company.—An arrangement has been made between the Moore Light Company, of Newark, and the Western Electric Company whereby the latter will act as sales agent for the former. This arrangement is similar to that existing between the Western Electric Company and the Beck Lamp Company. There is no question of ownership or control, the larger company simply acting as sales agent in pushing the product of the Moore Light Company.

Telephone Building in Buffalo.—It is reported that negotiations are under way by the New York Telephone Company for the purchase of a site at the corner of Church and Franklin Streets, in Buffalo, on which the company purposes to erect a twenty-story building to be used partly as the headquarters of its Buffalo exchange system.

Wireless in Alaska.—The southern coast of Alaska will be brought into closer touch with the outside world by two additional wireless stations which the Navy Department will soon establish on the southern coast. These stations will be located in Unalaska, one of the Aleutian Islands, and at Kodiak, which is at the southern end of the Alaska peninsula. The United States Navy Department already maintains wireless stations in Alaska at Sitka and Cordova, and the army maintains stations at Nome and St. Michaels. These two new stations, while they belong to the Navy Department, will be open to commercial business on all ordinary occasions. It is said that if the stations work satisfactorily there will be an effort made in the spring to open communication between them and the Hawaiian Islands.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Independence, Ia.; La Salle, Ill.; Atlanta, Ga.; Leavenworth, Kan.; Glen Ellyn, Ill.; Troy, Ala.; Yale, Mich.: Grand Island, Neb.; Boone, Ia.; Mammoth Springs, Ark.: Virginia, Ill.; Canton, Pa.; Durand, Mich.; Tipton, Ind.; Elsinore, Cal.; College Park, Ga.; Fort Worth, Tex.; Needles, Cal.; Tacoma, Wash.; Toronto, Ont., Can.; Wheeling, W. Va.: Memphis, Tenn.; Knightstown, Ind.; Madisonville, Ohio; Ellicott City, Md.; South Fork, Pa.; Mount Olive, Ill., and London, Ont., Can.

Financial.

THE WEEK IN WALL STREET.

SPECULATORS who have been working for higher prices in Wall street made some little headway last week. Although there was no evidence that there was any buying from outside, there was stimulated among the professionals quite an active buying interest, which was especially developed only on the soft spots. This sort of activity does not mean much, except that professional traders are in some measure beginning to be convinced that the market will eventually become active and that prices will be higher. This class of traders only buys with a view to selling at better figures, and it is always an encouraging feature when the professional trader, who is the smartest dealer in the market, believes that prices will go higher. During the past week there were several matters which came to the front indicating a better situation in Wall Street. The improved foreign trade statement helped matters along, as the foreign trade statement is always considered an index to the general prosperity of the country. The Aldrich plan for remodeling our currency and banking system was favorably received by the Street. This also had something to do with encouraging those who make a business of trading on the Stock Exchange. Then, again, the bank statements showed that there had been a remarkable accumulation of funds in the local banks. These statements were not sufficient in themselves to create any great amount of enthusiasm, but when taken in connection with the fact that several large bond issues were offered during the week, and were readily absorbed, they seemed to indicate that the money situation is entirely satisfactory. As a matter of fact, the lack of speculation in Wall Street for many months past has not been due to any difficulty in acquiring money. Reports from the iron and steel trade were not particularly encouraging, but they indicated that the majority of mills were operating at about 50 per cent of capacity. Sales were not heavy, but expenses were, as a rule, trimmed to meet the volume of business, and there is no reason to believe that the United States Steel Corporation will fail to earn considerably more in each quarter than its dividend requirements. Several good bond issues were absorbed during the week, showing that while investors are very timid about getting into the stock market, they are not unwilling to take hold of good bonds when offered at reasonable prices. The money market during the week was extremely easy. As a rule rates for call loans were less than 2¾ per cent. Quotations Jan. 23 were: Call, 2½@2¾ per cent; 90 days, 3¼@3½ per cent The quotations in the table are those of the close Jan. 23.

NEW YORK.

	Jan. 16.	Jan. 23.	Shares Sold.		Jan. 16.	Jan. 23.	Shares Sold.
All. Ch......	8	8*	1,100	Int. Met., pfd.	53⅞	51¼	6,950
All. Ch., pfd.	28*	29	———	Mackay Cos.	92⅞*	92½*	600
Amal. Cop...	63½	63⅝	74,120	Mackay C., pf	75⅞	75¼	420
Am. D. T...	20½*	20½*	———	Man. Elev...	140*	138	295
Am. Loco...	40	40⅛*	3,900	Met. St. Ry.	15*	15*	———
Am. Loco.,pf.	110	110⅜	200	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	85	83½*	610	Steel, com..	76	77⅛	484,600
Am. T. & T..	142¼	143½	22,983	Steel, pfd....	118¾*	119	9,174
B. R. T.....	77⅛	76⅝	28,620	W. U. T....	74¼	74½	17,160
Gen. Elec....	151*	151½	1,400	West'h, com.	67*	67	1,900
Int. Met....	19⅛	18¾	4,500	West'h, pfd..	116*	119*	100

PHILADELPHIA.

	Jan. 16.	Jan. 23.		Jan. 16.	Jan. 23.
Am. Rys...........	43½	45	Phila. Elec.........	16⅜	16⅛
Elec. Co. of A......	12½*	12⅛	Phila. R. T........	19⅞	20¼
Elec. St. B'ty......	50½	53	Phila. Trac........	85	86½
E. S. B'ty., pfd.....	30*	30*	Union Trac.........	46⅛	47¾

CHICAGO.

	Jan. 16.	Jan. 23.		Jan. 16.	Jan. 23.
Chi. City Ry.......	185*	185*	Chi. Tel. Co........	120*	118
Chi. Rs., Ser. 1.....	93½*	93	Met. El. Co.........	22*	21
Chi. Rs., Ser. 2....	23½*	25	Met. El., pfd.......	68	67½*
Com. Edison........	113½*	113	Nat'l Car...........	117*	117*
Chi. Subways.......	4¼*	4⅛	Nat'l Car., pfd.. ..	117½*	118*

BOSTON.

	Jan. 16.	Jan. 23.		Jan. 16.	Jan. 23.
Am. T. & T........	142¼	143⅝	Mex. Tel...........	6*	6*
Cum. Tel..........	147*	146½*	Mex. Tel., pfd.....	6*	6*
Edison E., Ill......	290	288	N. E. Tel..........	137½	138⅛
Gen. Elec..........	151	151	W. T. & T.........	17*	18½
Mass. E. Ry........	18*	18	W. T. & T., pfd....	91½*	89
Mass. E. Ry., pfd...	84⅛	85½			

*Last price quoted.
Shares sold for five days, Jan. 16 to Jan. 21.

FINANCIAL NOTES.

Chicago Suburban Light & Power Company.—The Chicago Suburban Light & Power Company, operating in Oak Park and Auburn, western suburbs of Chicago, was acquired recently by interests friendly to the North Shore Electric Company of Chicago. An issue of $2,000,000 of 5½ per cent five-year gold debentures of the Chicago Suburban Light & Power Company, the principal and interest guaranteed by the North Shore Electric Company, is now offered for sale. The entire isue of the company's first-mortgage twenty-year 5 per cent bonds, $2,500,000 in amount, is pledged with the Illinois Trust & Savings Bank of Chicago as collateral security for these debentures. The company will be managed in close harmony with the North Shore Company and the Commonwealth Edison Company, and it is said that the net income available for interest charges on the debentures is three times the requirements. The bonds are offered at 98, yielding nearly 6 per cent.

National Carbon and Two Stock Exchanges.—Chicago newspapers report that the shares of the National Carbon Company have been stricken from the unlisted department of the Chicago Stock Exchange. This action was taken, it is said, because of the failure of the officers of the company to notify the Exchange of an extra dividend of 15 per cent declared on the common stock on Oct. 28 last. It is said that the books of the company were closed at 1 p. m. on the date mentioned without any notification to the Northern Trust Company of Chicago, the transfer agent of the National Carbon Company, or to the Chicago Stock Exchange as to the reason for ordering the books closed. It is also asserted that a similar indifference to the Boston Stock Exchange, where the shares are traded, was exhibited by the company

Westchester Lighting Company.—The Public Service Commission of the Second District of New York has authorized the Westchester Lighting Company to issue under its first mortgage bonds dated Dec. 1, 1900, an additional amount totaling $2,824,000. The proceeds of these bonds, which are to be sold at par, will be used to discharge the remaining bonded debts of the New York Suburban Gas Company, amounting to $343,000—this company having been merged into the Westchester Lighting Company—and to pay off the floating indebtedness that is now due a number of small creditors. It is claimed that the business of the company during the past year has been very satisfactory, and that by the end of 1911 all floating indebtedness will be liquidated

Pennsylvania Electric Railway Merger.—Negotiations have about been perfected for the consolidation of trolley and power properties in the neighborhood of Lancaster, Pa This consolidation has been brought about by a syndicate of Philadelphia capitalists. The properties to be merged are the Lancaster & York Furnace Street Railway, Lancaster & South Side Railway and the Coleman Water & Power Company A traffic agreement has also been made with the Conestoga Traction Company

Dover (N. J.) Electric Light Company.—The Public Utilities Commission of New Jersey has granted permission for the consolidation of the Dover Electric Light Company with the Rockaway Electric Light & Improvement Company The Dover company has controlled the smaller company for some time and now the two are to be merged, the combined company to be known as the Dover Electric Light Company

New Subway Bids Submitted.—The Bradley Contracting Company has made a formal offer to the Public Service Commission of the First District to construct the main lines laid out under what is known as the Triborough system, and also to equip and operate these lines after they have been completed. The new bid of the Bradley company is the sum total of the lowest bids received by the Public Service Commission for the construction of this work when bids were received in October, 1910. The Bradley company's bid has not as yet been considered technically by the commission, but the fact that such a bid has been received has caused a halt in the consideration of the Interborough's offer, which was made some weeks ago.

Consolidated Gas Company.—The annual report of the Consolidated Gas Company, of New York, which was made public Jan. 23, shows that the total net earnings of the company for 1910 were $3,046,448, which compares with $2,749,568 in the previous year. The total net income of the company from all sources amounted to $7,851,446. The interest charges were $434,967, leaving a surplus for dividends of $7,416,479. This amount is equal to about 7.43 per cent on the capital stock and is taken as a positive indication that the company can earn a fair dividend on its stock with gas at the 80-cent rate. For this reason it is practically certain that the gas company will carry no further the opposition, in the courts, to the 80-cent rate.

Chester Valley Electric Company.—Application has been made at Harrisburg, Pa., for a charter for the Chester Valley Electric Company by a group of Philadelphia and New York capitalists who have acquired a number of electric light and power plants in Chester County, Pa., and who intend to extend their holdings. The capital will ultimately be $1,000,000, and there will be a bond issue of $750,000. The proceeds of the bonds will be used for defraying the cost of constructing a larger power plant on Brandywine Creek near Coatesville. The officers of the company are: President, A. B. Beadle, of New York; secretary and treasurer, W. W. Levering, of Philadelphia.

Public Utility Bonds Offered.—Among the important offerings of bonds last week were: An issue of $2,721,000 consolidated and refunding mortgage 5 per cent bonds of the Seattle Electric Company by Harris, Forbes & Company, of New York, and Lee, Higginson & Company, of Boston, at 98½; $1,653,000 5 per cent first mortgage bonds by Clark, Dodge & Company, New York, and E. W. Clark & Company, Philadelphia, at 95. William A. Read & Company, of Chicago, has advertised an issue of the Boston & Northern Street Railway Company 4 per cent first mortgage bonds at 92¾. The subscription for all of these bonds has been fairly satisfactory.

Lincoln Gas & Electric Company.—The earnings of the Lincoln (Neb.) Gas & Electric Company for 1910 showed a very satisfactory gain over those of the previous year. The gross amounted to $390,185, as compared with $363,589 in 1909. The net earnings were $133,611, an increase of about $5,000. The surplus increased about the same amount. This company has a perpetual franchise for the supply of gas and electricity. It has over 65 miles of mains, 7000 gas meters and 1900 electric meters. The annual output of energy is about 3,150,000 kw. The property is operated by the Doherty Operating Company.

American Telephone & Telegraph Bonds.—It is said that all of the $10,000,000 of American Telephone & Telegraph Company 4 per cent collateral trust bonds which were recently offered for sale by N. W. Harris & Co. have been disposed of. There are still a good many of the bonds in Wall Street, and the supply is not likely to run short for some time. The original syndicate, however, is out from under the market. Quite a large number of these bonds went abroad.

Mohawk Hydroelectric Company.—Pingree, McKinney & Company, of Boston, have purchased $500,000 first mortgage 6 per cent bonds of the Mohawk Hydroelectric Company, of Ephratah, N. Y. These bonds are a part of an authorized issue of $932,000 and run for thirty years. The company will supply energy for light and power to the local companies in Johnstown and Gloversville, N. Y. William Barclay Parsons, of New York, is president of the company.

Westinghouse Machine Company.—The plan adopted some weeks ago by the creditors' committee of the Westinghouse Machine Company and submitted to the noteholders by circular letter has been approved and the consents of 95 per cent of the outstanding creditors have been received. This financial plan was outlined in our issue of Dec. 8, but the proposed mortgage has not yet been authorized by the stockholders.

Triumph Electric Company.—Directors of the Triumph Electric Company, of Cincinnati, have declared a dividend of 1½ per cent on preferred stock for the past quarter, which was paid Jan. 16. The officers report an improvement since the first of the year, with numerous inquiries for machinery. The ice machine branch is also receiving many inquiries with prospects for a good business.

Philadelphia Company Financing.—A special meeting of the stockholders of the Philadelphia Company, of Pittsburg, has been called for April 4 to vote on the proposed increase in the capital stock of the company by $1,400,000. The proceeds of this increase in stock will be used for the purpose of exchanging convertible notes aggregating $1,400,000 which are now outstanding.

Montreal Light, Heat & Power Company.—It has been announced that the Montreal Light, Heat & Power Company, instead of increasing its dividend from 7 to 8 per cent, has during the past few months granted concessions to consumers amounting in value to over $350,000 a year. This would amount to little more than 2 per cent on the company's capital stock.

DIVIDENDS.

Cambridge (Mass.) Electric Light Company, quarterly, 2½ per cent, payable Feb. 1.

Cincinnati Northern Traction Company, annual, 3 per cent, payable March 1.

Cities Service Company, monthly, preferred, ½ per cent; common, ¼ per cent, both payable Feb. 1.

Commonwealth Edison Company, quarterly, 1½ per cent, payable Feb. 1.

East St. Louis & Suburban Company, preferred, quarterly, 1¼ per cent, payable Feb. 1.

Edison Electric Illuminating Company of Boston, quarterly, $3 per share, payable Feb. 1.

Jacksonville (Fla.) Electric Company, semi-annual, 3½ per cent, payable Feb. 1.

Kellogg Switchboard Company, quarterly, 2 per cent, payable Feb. 1.

Lowell (Mass.) Electric Light Corporation, quarterly, $2 per share, payable Feb. 1.

McCrum-Howell Company, preferred, quarterly, 1¾ per cent, payable Feb. 1.

Metropolitan West Side Elevated Railroad Company, Chicago, quarterly, ¾ per cent, payable March 1.

Michigan State Telephone Company, quarterly, 1¾ per cent, payable March 1.

Montreal Light, Heat & Power Company, quarterly, 2 per cent, payable Feb. 15.

North American Company, quarterly, 1¼ per cent, payable April 1.

Omaha Electric Light & Power Company, preferred, semi-annual, 2½ per cent, payable Feb. 1.

Pacific Gas & Electric Company, preferred, quarterly, 1½ per cent, payable Feb. 15.

Pacific Power & Light Company, preferred, quarterly, 1¾ per cent, payable Feb. 1.

Washington Water Power Company, quarterly, 2 per cent, payable April. 1.

Western Telephone & Telegraph Company, preferred, semi-annual, 2½ per cent, payable Feb. 1.

REPORTS OF EARNINGS.

Period.			Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
ELECTRICAL SECURITIES CORPORATION.							
1 yr.,	Dec.	'10	$390,084	$196,854	$193,230	......	......
1 "	Oct.	'09	368,501	217,600	150,901	......	......
KANSAS CITY RAILWAY & LIGHT COMPANY.							
1m.,	Dec.	'10	$684,385	$417,682	$266,703	$191,069	$75,633
1 "	"	'09	622,049	377,571	244,478	172,062	72,416
7 "	"	'10	4,513,590	2,701,178	1,812,412	1,323,245	489,167
7 "	"	'09	4,173,690	2,396,205	1,777,492	1,209,122	568,370
MONTREAL STREET RAILWAY COMPANY.							
1m.,	Dec.	'10	$377,274	$235,209	$142,065	$37,642	$104,423
1 "	"	'09	337,563	212,006	125,556	34,480	91,076
3 "	"	'10	1,130,060	668,041	461,659	101,635	360,006
3 "	"	'09	1,026,441	586,879	439,562	96,345	343,217
NORTHERN OHIO TRACTION & LIGHT COMPANY.							
1 yr.,	Dec.	'10	$2,437,426	$1,348,963	$1,088,463	$521,069	$567,394
1 "	"	'09	2,117,641	1,190,057	987,584	524,065	463,519

General News

Construction News.

FLORENCE, ALA.—The Muscle Shoals Hydro-Electric Power Company is endeavoring to complete arrangements for its hydroelectric development. The present plans include the construction of three dams to create thirty miles of slack-water navigation, superseding the present narrow and tortuous canal of nine locks. It is proposed to build three locks, each with a lift of 25 ft., to provide navigation over the shoals and make power available. The cost of widening and deepening the present canal is estimated at $7,400,000; the cost of the three dams is estimated at $12,000,000. Congress has been asked to appropriate $9,000,000; the power company proposes to expend $3,000,000 on the three dams and an additional $10,000,000 for construction and maintenance of power plants. The officers of the company are: Frank Washburn, president; J. W. Worthington, vice-president, and W. H. Lindsey, secretary. The offices of the company are at Montgomery, Ala.

TROY, ALA.—Plans are being considered for enlarging the electric light and water plant, which will include the installation of a 150-hp boiler, one 250-kw, 3-phase, 60-cycle generator, direct-connected to steam unit; one electrically driven pump, having a capacity of 2500 gal. per hour. A. B. Campbell is superintendent.

MAMMOTH SPRINGS, ARK.—The Mammoth Springs Electric Company is contemplating the installation of a 1000-kw generator and erecting twenty-eight miles of high-tension transmission lines, carrying 33,000 volts. Preparations are being made by the company to furnish electricity for lamps and motors in five towns. E. C. Bellamy is secretary and manager.

ALAMEDA, CAL.—Electricity for operating the drawbridges across the tidal canal at Park and High Streets and at Fruitvale Avenue will be furnished by the municipal electric light plant. Funds have been provided for the erection of a transmission line from the power house to the bridges, which will cost about $5,000.

ALHAMBRA, CAL.—The Pacific Light & Power Corporation has been awarded the contract for installing and maintaining 350 tungsten street lamps in Alhambra for a term of five years.

CASSEL, CAL.—J. A. Whitehead and C. Whitehead have purchased a site on Hot Creek in Cassel, on which it is understood that a power plant will be erected.

ELSINORE, CAL.—The Consolidated Reservoir & Power Company is pushing development work in the mountains northeast of Banning on streams tributary to the Whitewater River, and it is expected that the company will be able to supply electricity to the ranchers in the Moreno and Perris Valleys within a couple of months. It is probable that the transmission line will be first extended to Moreno and thence to the Perris Valley and on to Elsinore, where the company is interested in a power project. The company, it is said, will erect a number of power houses at various elevations in the canyon.

GERMANTOWN, CAL.—An irrigation system is being developed by Charles D. Shaw in Germantown, embracing 640 acres, work on which is already under way. The pumping plants will be operated by electricity.

GREENVILLE, CAL.—A. R. Bidwell has decided to transfer the Greenville water-works system to the Round Valley Corporation and to float a bond issue, to secure funds for the development of this body of water for power and irrigation purposes. It is estimated that 1000 hp can be developed. It is said that a bond issue of from $100,000 to $200,000 will be placed on the market.

LOS ANGELES, CAL.—A resolution has been submitted to the City Council requesting that it will submit the proposition at the election to be held March 6 as to whether the city shall distribute electricity generated by the Owen. River aqueduct for lighting the city and to private consumers or dispose of all or part of it to private corporations for distribution.

LOS ANGELES, CAL.—Sealed proposals will be received at the office of the United States Reclamation Service, Los Angeles, Cal., until Feb. 15 for furnishing centrifugal pumps for the Salt River project in Arizona. Proposals will also be received at the same time and place for motors, transformers and switchboards for centrifugal pumps for the Salt River project. For particulars address United States Reclamation Service, Los Angeles, Cal.; Phœnix, Ariz., or Washington, D. C. F. H. Newell is director.

LONG BEACH, CAL.—Permits have been granted to the Southern California Edison Company for the erection of three buildings in connection with its new power plant in Long Beach, at a cost of $155,000.

NEEDLES, CAL.—The plant and holdings of the Needles Light & Power Company have been purchased by E. H. Rose, of Los Angeles, Cal., who, it is said, will enlarge and improve the plant. It is proposed to duplicate the equipment of the present plant and to operate the gas plant in connection with the electric plant.

SANTA BARBARA, CAL.—Initial steps have been taken for the installation of ornamental cluster lamps in the business district of the town. It is expected that the property owners will install lamps and standards and that the system will be extended in the near future.

SELMA, CAL.—The Fowler Independent Telephone Company has increased its capital stock from $7,500 to $30,000.

WILLOWS, CAL.—The Town Trustees have refused to accept the bid of the Northern California Power Company to furnish arc lamps for lighting the streets of the town at the rate of $72 each per year, under a five-year contract. As a new company will be operating in Willows within four months, it is thought that a lower rate can be obtained. The residents living in the outlying districts are making urgent demands for street lamps.

WILLOWS, CAL.—The Superior California Power Company has awarded the contract for the erection of its transmission line from a point some distance above Orland to Willows and beyond to the Sierra Construction Company, work on which will begin at once. Two transmission lines will be erected by the Superior California Company, each about thirty miles long, one extending from Orland to Willows and the other along the river. There will be about 100 miles of main and lateral lines, which will supply electricity to the towns and farms along the route for lamps and motors and also for operating pumps for irrigating purposes. Electricity for operating the system will be taken from the main lines of the Northern California Power Company. C. R. Wickes, of Willows, who has secured the franchises for the lines, is at the head of the Superior California Power Company.

ERIE, COL.—Plans are being considered for enlarging the municipal electric-light plant about May 1, 1911. The equipment will consist of a new boiler, larger generator and installation of a heating plant. H. O. Barraclough.

GROTON, CONN.—Plans are being considered to increase the output of the municipal electric light plant during the coming year. T. A. Graves is superintendent.

JEWETT CITY, CONN.—The municipal electric light plant was closed down Dec. 1, 1910, and the equipment is to be sold. Electricity for operating the municipal electric system is now supplied by the Nashawaug Electric Power Company's plant at Plainfield, Conn. The office of the company is located at Danielson, Conn.

NEW HAVEN, CONN.—Application will be made to the State Legislature by the New York, New Haven & Hartford Railroad Company for permission to build an electric railway from New Hartford, Conn., to New Boston, Mass., through the Farmington Valley. It is said that the route will probably follow the old Lee and New Haven railroad.

PLAINVILLE, CONN.—Plans have been prepared by the Trumbull Electric Manufacturing Company, of Plainville, Conn., for extensive additions to its manufacturing plant, which will include the erection of several buildings, including a boiler house and engine house, the installation of sprinkler system and electric system. The power equipment, it is understood, has been purchased.

WATERBURY, CONN.—The Board of Aldermen has passed an ordinance in favor of the construction of an electric-light plant.

MILTON, DEL.—The Ingram Mill property is reported to have been purchased by a syndicate which is headed by N. W. White, of Georgetown, Del. It is said that the new owners propose to erect an electric plant to furnish electricity for lamps and motors in the town of Milton.

DADE CITY, FLA.—The Dade City Ice, Light & Power Company has recently installed a series tungsten street lighting system and is contemplating establishing a day service. The company is also considering changing its system from single-phase, 133-cycle to three-phase, [illegible]-cycle during the year. Emil W. Muller is president and manager.

MARIANNA, FLA.—The consolidation of the municipal electric-light and water plants, at a cost of nearly $10,000, is nearly completed. It is proposed to replace the present engine with a larger one if a suitable second-hand 120-hp, high-speed engine can be obtained. George C. Spencer is superintendent.

ST. AUGUSTINE, FLA.—The City Council has awarded the contract for lighting the streets of the city for the next year to the St. John's Light & Power Company.

ST. PETERSBURG, FLA.—It is reported that the City Council will submit the proposition to install an electric-light system in St. Petersburg to a vote. W. F. Devine is city clerk.

ATLANTA, GA.—Sealed proposals will be received at the office of the Superintendent of Prisons, Department of Justice, Washington, D. C., until Feb. 14, for furnishing and installing an electric-light and power plant in the hospital building at the United States penitentiary at Atlanta, Ga. Plans and specifications, together with information, may be obtained on application at the above office. R. V. Ladow is Superintendent of Prisons.

AUGUSTA, GA.—Contracts have been placed by the Augusta-Aiken Railway & Electric Company with the General Electric Company, of Schenectady, N. Y., for electric generating machinery, with a rating of 3600 hp, which will increase the output of the company to 6600 hp.

COLLEGE PARK, GA.—The City of College Park is reported to have sold $65,000 in bonds, of which the proceeds of $15,000 will be used for the installation of an electric light plant.

CORNELIA, GA.—The Wefford Shoals Light & Power Company, which owns two water-power sites in Banks County, about three miles from Cornelia, capable of developing 4000 hp, is contemplating further developments during the coming year. All the main transmission lines of the company are constructed for 11,000 volts. J. A. Wells is secretary and manager.

LA FAYETTE, GA. The municipal electric-light plant and water-works system have been completed and placed in operation. The plant was built by the J. B. McCrary Company, of Atlanta, Ga., and cost $40,000.

SWAINSBORO, GA.—The City Council is contemplating calling an election to vote on the proposition to issue bonds, the proceeds to be used to establish a municipal electric-light system. The purchase of the local plant is said to be under consideration. Jesse Thompson is Mayor.

MALAD CITY, IDAHO.—The Idaho Light & Power Company is contemplating extending its transmission lines to Downey and St. John, a distance of about fifteen miles, serving a population of about 3000. The company also proposes to increase the output of its plant by about 500 hp. C. F. Little is secretary and manager.

GLEN ELLYN, ILL.—The Spalding Electric Company will install a 150-hp boiler and two generators in the near future. Carl S. Spalding is manager.

LA SALLE, ILL.—Plans are being prepared by Edward Byrne, city engineer, for the installation of an electric light system for the city, to cost about $10,000.

LINCOLN, ILL.—The Lincoln Water & Light Company is contemplating changing its system to 60-cycle, three-phase, and increasing the output of its plant within the next six months. E. MacDonald is superintendent.

MT. OLIVE, ILL.—Extensive additions and improvements are contemplated for the municipal electric plant, which will include the installation of an additional water-tube boiler with a rating of from 200 to 300 hp, generator and engine, details of which have not yet been decided upon. O. A. Voepel is manager.

MURPHYSBORO, ILL.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Feb. 23, for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office building at Murphysboro, Ill., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Murphysboro Ill., or from the above office. James Knox Taylor is Supervising Architect.

PALESTINE, ILL.—The municipal light committee has contracted with the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for the installation of a series tungsten lamp street-lighting system. When the new system is completed the present arc-lamp system will be discarded. Plans are being considered for the installation of a new generator in the spring. About six miles of new wire will be needed. H. T. Loughery is chairman of light committee.

PEORIA, ILL.—Sealed proposals will be received by the East Peoria Drainage and Levee District, Tazewell County, Ill., Peoria, Ill., until Feb. 3, for the following work: Section 9—Levee and muck ditch, 165,500 cu. yd. Section 10—Drainage ditches, 64,300 cu. yd. Sections 11 and 12—Furnishing and erecting a complete drainage pumping plant, including excavations, foundations, building and machinery. The pumping plant to have a capacity of 33 cu. ft. per second, against a maximum static head of 22 ft. The equipment to consist of two centrifugal pumps, two induction motors, of sufficient rating to operate the pumps at specified capacity, two speed-reducing transmission gears, and all auxiliary appurtenances, including priming apparatus, switchboard, station wiring, etc. For further information address the Harman Engineering Company, 120 Fredonia Avenue, Peoria, Ill. Horace Clark, Eugene Brown and James Millard are commissioners.

ROBINSON, ILL.—It is expected that the plant and holdings of the Robinson Water, Light & Heat Company will be sold at public sale in the near future. Improvements to the plant, including the installation of additional equipment and the erection of seven miles of 6600-volt transmission line to Palestine, Ill., will probably follow the sale. Edward B. Pollister is manager.

SEARS, ILL.—Contracts have been placed by Samuel S. Davis and Thomas B. Davis with the Westinghouse Electric & Manufacturing Company for part of the equipment for the Sears power development, consisting of six vertical generators, one motor-generator set, one exciter and a 17-panel switchboard and accessories.

VIRGINIA, ILL.—The Virginia Light, Heat & Power Company will make improvements to its plant this year, including the installation of a 150-hp Frost boiler and a 200-hp engine. Roy Ray is manager.

GASTON, IND.—Preparations are being made by R. A. Brown for the installation of an electric-light and power plant to supply electricity for lamps and motors in Gaston. It is reported that Mr. Brown is in the market for equipment for the plant.

INDIANAPOLIS, IND.—The Big Four Railroad is erecting a third telephone wire between Indianapolis and Cincinnati. One is used for train dispatching, the other for operators in the different blocks and the third will be used as the message wire.

KNIGHTSTOWN, IND.—Plans are being prepared for rebuilding the entire distributing system of the municipal eletcric light plant during 1911. A. M. Chance is superintendent.

MISHAWAKA, IND.—The City Council has decided to erect a new pumping station in East Mishawaka to pump water from the wells, for which plans are now being prepared. The pumps will be operated by electricity.

PORTLAND, IND.—The controversy over the installation of the power plant, purchased more than a year ago from the Ames Iron Works, of Oswego, N. Y., has ended by the entering of the judgment against the city for $5,500, covering the final payment due on the purchase. The injunction suit filed by L. S. Burkett against the consummation of the deal for the machinery was dismissed.

TIPTON, IND.—Plans are being considered for the installation of a 500-hp boiler and possibly a new dynamo and other minor improvements in the municipal electric light plant in the spring. N. Hiatt is superintendent.

WABASH, IND.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Feb. 18 for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and electric wiring, of the United States post office building at Wabash, Ind., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Wabash, Ind., or at the above office. James Knox Taylor is Supervising Architect.

WARREN, IND.—Plans are being considered for establishing a day service in connection with the municipal electric plant and the installation of a 50-kw to 60-kw, direct-current generator. Additional lamps will be installed. The company would like to purchase a second-hand dynamo W. H. Hickerson is superintendent.

ATLANTIC, IA.—T. E. Nichols, manager of the municipal electric light plant, writes that the plant will be entirely rebuilt in the near future. It is proposed to increase the output by 500 kw and change the system to two-phase, 60-cycle, 2200-volt, plans for which are being prepared by the W. K. Palmer Company, of Kansas City, Mo.

BOONE, IA.—The Boone Electric Company is contemplating the installation of new equipment in its power house, consisting of four 300-hp boilers, one 500-kw, three-phase, 60-cycle, 2300-volt generating unit, one 200-kw, direct-current, 500-volt motor generator set for street railway service, switchboard, etc., for above. A new smokestack 210 ft. high is being erected and the company will purchase three new cars. John Reynolds is president and manager.

GRISWOLD, IA.—The Griswold Milling & Light Company is planning to extend its transmission line to Elliott, a distance of seven miles, in the spring. J. W. Daily is owner and manager.

GRUNDY CENTER, IA.—The Grundy Center Electric Company is contemplating substituting series tungsten lamps for the 9.6-amp arc lamps which are now in use and also establishing a day service. The company has recently purchased a 75-kw General Electric three-phase alternator and is planning to extend its transmission lines to the village of Holland this summer to supply electricity for lamps. A storage battery is also being installed to supply electric lighting service to country residences. J. B. Calderwood is owner and manager of the plant.

INDEPENDENCE, IA.—Plans are being considered for enlarging the municipal electric light plant, which will include an addition to the power house and the installation of a 250-kw generator and engine. E. R. Stanard is superintendent.

MARSHALLTOWN, IA.—Preparations are being made by the Merchants, Mechanics & Farmers' Telephone Company to begin work on the construction of its new exchange building about March 1. An automatic telephone system will be installed.

MASON CITY, IA.—The City Council is reported to be contemplating building a municipal railway from the city limits to the pumping station.

McCALLSBURG, IA.—The local telephone exchange building is reported to have been destroyed by fire recently.

WEBSTER CITY, IA.—The city is reported to have purchased a site for the proposed new power plant, work on which will begin as soon as the weather will permit.

LEAVENWORTH, KAN.—Bids will be received at the office of the Superintendent of Prisons, Department of Justice, Washington, D. C., until Feb. 16, for furnishing and installing an electric light and power plant in the hospital building at the United States penitentiary building at Leavenworth, Kan. Copies of specifications, together with further information, can be obtained upon application to the above office. R. V Ladow is Superintendent of Prisons.

STAFFORD, KAN.—The contract for reconstructing the electric light plant and water-works system has been awarded to Joseph A. Bartenlanger, of Omaha, Neb. The cost of the work is estimated at about $36,000.

WILSON, KAN.—The Wilson Electric Light Company is building a new power plant and will change the system from direct to alternating current. Upon completion of the new system the old plant will be discarded. John Weber is manager.

LOUISVILLE, KY.—The contract for installing an electric elevator in the new City Hall has been awarded to the American Machine Company, of Louisville, Ky., to cost about $5,000.

NICHOLASVILLE, KY.—Plans are being considered for the installation of a 150-hp boiler and a 75-hp steam engine in the municipal electric-light plant during the next six months. E. J. Glass is manager.

WATERVILLE, MAINE.—The Central Maine Power Company has recently acquired the plant and holdings of the Vassalboro Electric Light & Power Company, of Vassalboro, Maine, which is located at Winchester and supplies electricity in Vassalboro, North Vassalboro, Winslow and vicinity. The Central Maine Power Company is planning to erect a transmission line from its Fort Fairfax power house on the Sebasticook River through Winslow to North Attleboro. When the line is completed electricity for operating the system of the Vassalboro company will be supplied from the Fort Fairfax power house. The stockholders of the Central Maine Power Company have voted to increase the capital stock of the company by $150,000, making the total capitalization $3,150,000.

ELLICOTT CITY, MD.—The Patapsco Electric & Manufacturing Company is contemplating the installation of a gas producer and gas engines. Otto Wunder is superintendent.

HAVERHILL, MASS.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Feb. 15 for a conduit and wiring system and extension of present gas piping system at the United States post office building at Haverhill, Mass., plans and specifications for which may be obtained at the above office or of the custodian at Haverhill, Mass. James Knox Taylor is Supervising Architect.

HUNTINGTON, MASS.—Eugene E. Davis, of Northampton, Mass., is reported to have purchased the property known as Stowell's Flats, with water rights. It is understood that he proposes to erect a power plant.

WEYMOUTH, MASS.—The Weymouth Light & Power Company is reported to have purchased the old Pine Point hotel property on the Weymouth side of the Quincy Point bridge, on which it proposes to erect a large power plant.

DURAND, MICH.—Bonds to the amount of $12,000 have been authorized by the city, the proceeds to be used for extensions to the municipal electric light plant and water-works system. New equipment to be installed will include one 200-kva generator and one 75-kva generator and a 275-hp engine and alternating-current motors of from 20 hp to 50 hp to operate pumps. As yet no machinery has been purchased. A day service for lamps and motors will be established after April 1. H. F. Rosenkrans is manager.

MT. CLEMENS, MICH.—The Eastern Michigan Edison Electric Company is reported to be contemplating the erection of a new steam-driven power plant near Amy, Mich.

MUSKEGON, MICH.—The United Home Telephone Company, of Ludington, Mich., and the Independent Telephone Company, of Muskegon, Mich., have practically decided to consolidate. The new company proposes to take over all the independent telephone lines in western Michigan as far north as Manistee, with the exception of Grand Rapids. The new company will be capitalized at $500,000.

STURGIS, MICH.—J. S. Flanders, manager of the municipal electric light plant, writes that it is expected to have the hydroelectric plant ready for operation in April, 1911. The equipment will consist of two direct-connected units of 550 kw each. Sixteen and one-half miles of transmission lines carrying 23,000 volts will be erected.

YALE, MICH.—Plans are being considered for making improvements and extensions to the municipal electric light plant, which will include the installation of another unit and changing the system from direct current to alternating current. R. G. Green is superintendent.

DULUTH, MINN.—It is reported that the Great Northern Power Company is contemplating extensions to its system which will involve an expenditure of about $1,000,000 and include the erection of a substation in Superior and duplicate transmission lines so as to avoid interruptions in its service.

HIBBING, MINN.—The erection of an electric transmission line from the local municipal electric plant to the Village of Alice is under way. It is expected to have the line completed in the near future, when the municipal plant will supply electricity in Alice for lamps and motors.

KENYON, MINN.—Preparations are being made by M. T. Gunderson, owner of the local electric light plant, to establish a twenty-four service for lamps and motors.

ST. PAUL, MINN.—Col. J. H. Davidson, of the State Waterways Commission, recommends the construction of a 6000-hp steam plant as an auxiliary to the hydroelectric power plant to be erected at the high dam.

TUPELO, MISS.—The City of Tupelo will soon issue $50,000 in bonds, of which the proceeds of $15,000 will be used for improvements to the municipal electric-light plant. It is proposed to change the system from direct to alternating current and to install larger engines. W. H. St. John is superintendent.

CENTRALIA, MO.—The Centralia Light & Power Company is erecting a transmission line from Centralia to Mexico, Mo. When completed electricity for operating the local system will be obtained from the power house at Mexico. Current will be received at 11,000 volts stepped up to 16,500 volts for transmission and stepped down to 1100 volts, 60 cycle, three phase, for distribution in Centralia. The company will also supply electricity in Thompson, a small village along the line. R. H. Baldridge is president and manager.

FORSYTH, MO.—It is reported that John A. Laird, of St. Louis, Mo., is interested in a project to build a hydroelectric power plant on White River, three miles from Forsyth, where it is estimated that 2500 hp can be developed, at a cost of from $300,000 to $400,000. Electricity generated at the plant will be transmitted to Forsyth and Springfield, Mo. Mr. Laird has applied to the War Department for approval of the plan to build a dam across the White River.

NORBORNE, MO.—The Norborne Fuel, Ice & Light Company is considering the question of operating a steam-heating business in connection with its plant, using exhaust steam. F. S. Cunningham is secretary and manager.

SPRINGFIELD, MO.—It is reported that a project is under way to construct a hydroelectric power plant on the James River. W. H. Standish and associates are interested.

FREMONT, NEB.—The Fremont Gas & Electric Light Company is reported to be contemplating extensions to its system during the year.

FREMONT, NEB.—The City Council is reported to have decided to install an electrolier lighting system in the business section of the city.

FULLERTON, NEB.—The Nebraska Telephone Company has taken over the property of the Fullerton Telephone Company, the consideration being $17,000.

GRAND ISLAND, NEB.—Preparations are being made by the Grand Island Electric Company to install a 350-kw generator and engine. T. H. Fritts is secretary and manager.

McCOOK, NEB.—The McCook Electric Company is extending its transmission lines into the surrounding country to supply electricity for lamps and motors to the farmers, and also to operate pumps for irrigating purposes. A. R. Scott is manager.

SPENCER, NEB.—Arrangements are being made by W. J. Woods for the installation of an electric light plant, at a cost of about $8,000. The equipment will consist of two 35-hp gas engines and two generators with sufficient rating to supply 3000 16-cp lamps.

RENO, NEV.—It is reported that work will soon begin on the construction of a new power plant on the Truckee River by Stone & Webster, of Boston, Mass., who control the Reno Power, Light & Water Company, the Truckee River General Electric Company and other plants in Nevada and California. The new plant will be the largest on the Truckee River.

DOVER, N. J.—The Public Utility Commission has granted the petition of the Rockaway Electric Light & Improvement Company, of Rockaway, N. J., and the Dover Electric Light Company, of Dover, to consolidate under the name of the Dover Electric Light Company.

SOUTH AMBOY, N. J.—Mayor Michael A. Welsh has recommended the appointment of a committee to make investigations in regard to establishment of a municipal electric light plant in South Amboy, N. J.

FRANKLIN, N. Y.—The Delaware & Otsego Light & Power Company is contemplating extending its transmission lines to Sidney Center, N. Y., within the next two months. E. A. Mackey is president and manager.

FULTON, N. Y.—The Fulton Light, Heat & Power Company has awarded the contract for the construction of a new steam power plant at the corner of East First Street and Van Buren Street. The initial installation will provide for an output of 1000 hp.

MOUNT VERNON, N. Y.—The Public Service Commission, Second District, has granted the Westchester Lighting Company authority to issue $2,824,000 in bonds, the proceeds to be used to discharge the indebtedness of the New York Suburban Gas Company, amounting to $343,000, which was taken over by the Westchester Lighting Company, Dec. 1, 1900, and the remainder to pay off the indebtedness to the Consolidated Gas Company on certain notes.

NEW YORK, N. Y.—Announcement has been made that a syndicate of Boston capitalists has purchased the property and holdings of the Long Acre Electric Light & Power Company. It is understood that the new owners are planning to begin work on the construction of an electric plant, which will involve an expenditure of at least $10,000,000. James F. Shaw, of Boston, Mass., has been elected president of the company.

OLEAN, N. Y.—The installation of a municipal electric light plant is under consideration by the City Council. At present it costs the city about $12,000 for lighting the streets and public buildings. The purchase of the local plant has been suggested, if it can be secured at a reasonable price. The installation of an electric plant at the pumping station has also been considered.

SODUS, N. Y.—The Sodus Gas & Electric Company is contemplating extending its transmission lines eastward to Wolcott, N. Y., and beyond, to supply electricity for lamps and motors in Alton, Wallington, North Rose, Rose, Butler, Red Creek, Wolcott and surrounding country. The company will supply electricity for the plant of O. M. Curtiss, of Wolcott, which is now operated by steam power. The proposed extensions will be financed by Wolcott people, who may form a stock company. The Sodus company purchases energy for operating its system from the Rochester Railway & Light Company, of Rochester, N. Y. G. R. Mills is secretary and manager.

WINSTON-SALEM, N. C.—The Carolina Traction Company is reported to have decided to award contracts immediately for the construction of its proposed electric railway from Winston-Salem, via Rural Hall, Lawsonville and Danbury, N. C., to Floyd, Va., a distance of 102 miles. This will include a branch to Danbury, N. C. S. P. McKnight, of Southern Pines, N. C., is promoter.

CHARDON, OHIO.—The purchase of a hot-water exhaust steam boiler-feed heater for the municipal electric-light plant is under consideration. G. L. Chapman is secretary of Board of Public Works.

CLEVELAND, OHIO.—Plans are being considered to utilize electricity from the municipal electric light plant in old South Brooklyn to operate the garbage plant at Willow Station. It is proposed to extend the transmission lines from the power plant over the river on the Denison-Harvard bridge. This plant would give the city an auxiliary lighting plant in the far southeast section of the city.

MADISONVILLE, OHIO.—The question of installing a 100-kw, 2200-volt, direct-connected unit in the municipal electric-light plant in the near future is under consideration. D. H. Fisher is general manager.

NEW PHILADELPHIA, OHIO.—The telephone exchange building of the Tuscarawas County Telephone Company in New Philadelphia, Ohio, was destroyed by fire on Jan. 9, causing a loss of about $20,000.

FORAKER, OKLA.—The question of issuing bonds to the amount of $30,000 is under consideration, the proceeds of $5,000 to be used for the installation of an electric light plant and $25,000 for water-works system.

GROVE, OKLA.—Application has been made to the City Council for a franchise to construct and operate an electric-light system in Grove. W. T. and O. W. Killam are interested in the project.

WAUKOMIS, OKLA.—A. Williams, of Ames, Okla., is planning to install an electric light plant in Waukomis, Okla., to supply electricity for lamps. Application has already been made for a franchise.

BANDON, ORE.—The question of erecting electric lamps along the north and south jetties at the mouth of the Coquille River to light the harbor at night is under consideration by the City Council.

EUGENE, ORE.—The Dodge department store is reported to be contemplating the installation of a lighting plant in the near future.

KLAMATH FALLS, ORE.—Preparations are being made by the Pacific Telephone Company for extensive improvements to its local system which will involve an expenditure of about $30,000.

PANAMA.—Sealed proposals will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until March 24, for furnishing rack railway material for the Panama Canal locks, including rack steel cross ties, bolts and nuts, tie clips, washers, steel channels, rail bonds, copper conductor rails, steel conductor rails, insulators, bumpers, frogs, switches, etc. Blanks and general information relating to this circular (No. 619) may be obtained at the above office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 55 National Realty Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal.

CANTON, PA.—Plans are being prepared by the Canton Illuminating Company for extensive improvements to its plant and system during the coming summer. The company will purchase one 150-kw, alternating-current, three-phase, 60-cycle, 2300-volt generator, switchboard, transformers and controller for series tungsten lamps; also about six miles of waterproof transmission wire. The storage battery will be taken out and a twenty-four hour service established. H. L. Clark is secretary and manager.

COATESVILLE, PA.—It is reported that New York and Philadelphia capitalists, who are supposed to represent the McCall Ferry Power Company, have secured an option of the property of the Consumers' Electric Light, Heat & Power Company, of Coatesville. The same parties have obtained control of the Parkesburg Electric Company, of Parkesburg, and the Chester Valley Electric Company, of Downington, Pa., by long leases, and it is said that efforts are now being made to obtain control of the Edison Illuminating Company, of West Chester, which would give them practically entire control of the electric light and power business in Chester County.

EBENSBURG, PA.—The capital stock of the Ebensburg Light, Heat & Power Company has been increased from $50,000 to $100,000.

HASTINGS, PA.—The question of establishing a municipal electric light plant in Hastings is reported to be under consideration.

MOUNT CARMEL, PA.—The Borough Council has granted a franchise to a new company to construct and operate an electric light plant in Mount Carmel. Charles L. Cleaver, Charles A. Goldschmidt and Charles H. Robins, all of Mount Carmel, are parties named in the application for the franchise.

PHILADELPHIA, PA.—Plans have been approved by Mayor Reyburn for the installation of ornamental street lamps on Fifty-second Street, West Philadelphia.

READING, PA.—It is reported that the Klapperthal electric plant, owned by the Metropolitan Electric Light Company, of Reading, Pa., will be rebuilt at a cost of about $200,000.

SOUTH FORK, PA.—The South Fork Electric Light, Heat & Power Company is building a new power house and will install new boilers, new engines and extend its transmission lines to Summerhill and Rockville and establish a day service after June 1, 1911. The borough street-lighting service will be extended, including both arc and incandescent lamps. J. C. Bauerle is manager.

WILKES-BARRE, PA.—The Wilkes-Barre Light Company, incorporated under the laws of the State of Pennsylvania in 1910, will commence building operations Feb. 1. A modern plant will be installed. J. A. Murray is consulting engineer. The offices of the company are located at 54 Public Square, Wilkes-Barre, Pa.

WYOMISSING, PA.—The Borough Council is reported to be considering the question of issuing $60,000 in bonds, the proceeds to be used for the installation of an electric light plant and water-works system.

BRISTOL, TENN.—L. S. Randolph, of Blacksburg, Va., is reported to have been engaged to make investigations and report on the proposed hydroelectric power development in East Tennessee, near Bristol.

MEMPHIS, TENN.—Plans are being considered by the Shelby County Commissioners for the installation of an electric plant to furnish electricity for the court house building. The cost of the plant is estimated at about $10,000. George B. Coleman is chairman of the committee.

MURFREESBORO, TENN.—The installation of an electric light plant in Murfreesboro is reported to be under consideration. John Davis and Thomas Elam are interested in the project.

NASHVILLE, TENN.—The Nashville Interurban Railway Company, of Nashville, Tenn., which operates an electric railway from Franklin to Nashville, a distance of twenty miles, is planning to extend the railway from Nashville to Gallatin. The company has engaged the W. K. Palmer Company, Dwight Building, Kansas City, Mo., engineers, to make surveys, prepare plans and take charge of the construction of the road.

BEAUMONT, TEX.—Announcement has been made by James F. Weed, receiver of the Beaumont Traction Company, that if the Federal Court grants his application for authority to accept the new franchise granted the company by the City Council and to issue $125,000 in receiver's certificates he will make important extensions to the railway and other improvements to the property.

CANYON, TEX.—The City Council has granted L. T. Lester, L. E. Cowling and associates a franchise to construct and operate an electric-light plant in Canyon for a term of twenty-five years.

FORT BLISS, TEX.—Preliminary steps have been taken by the War Department toward the installation of an electric-light plant at the Fort Bliss military post to cost from $17,000 to $24,000.

FORT WORTH, TEX.—The Northern Texas Traction Company has filed an amendment to its charter increasing its capital stock from $3,500,000 to $4,500,000. This company operates an interurban electric railway between Dallas and Fort Worth.

FORT WORTH, TEX.—At an election held Jan. 12 the citizens voted to issue $2,000,000 in bonds, the proceeds to be used for water works and other municipal improvements. Extensions will be made to the street-lighting system, which will involve an expenditure of $40,000. About $90,000 will be expended for improvements to the fire-alarm system.

HOUSTON, TEX.—The Houston Electric Company is reported to be contemplating extensive improvements to its system, including the extension of new track, etc., which will involve an expenditure of $400,000.

MARBLE FALLS, TEX.—A suit brought by Herman Richter, of Burnet, Tex., against the Colorado River Power Company, which is building a large dam across the Colorado River and installing a hydroelectric power plant at Marble Falls, for $50,000 alleged damages for diversion of water rights claimed by plaintiff has been decided in favor of the defendant company by Judge Clarence Martin of the district court. He holds in this decision that the rights of the company were superior to Mr. Richter's by virtue of its files and construction of the dam.

NEW BRAUNFELS, TEX.—A special measure has been prepared by Senator Weinert, of Seguin, Tex., to be presented to the State Legislature providing for the construction of a hydroelectric plant at any point on the Guadalupe River within twelve miles in either direction from the town of New Braunfels. The bill includes the right to the City of New Braunfels of eminent domain and condemnation proceedings to acquire riparian rights, water rights, dams, etc., necessary in carrying out the hydroelectric project.

SAN ANGELO, TEX.—An effort is being made to bond the property of the San Angelo Street Railway Company for $50,000 to secure funds for extensions and improvements to the property. If the bonding proposition is not put through the property will be sold at foreclosure sale early in March to satisfy a judgment of $30,000, held by Samuel Crowther, formerly president of the company. John W. Harris was recently elected president to succeed Mr. Crowther, and Charles B. Metcalf, secretary and treasurer.

WAXAHACHIE, TEX.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Jan. 7, for construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office at Waxahachie, Tex., in accordance with drawing and specifications, copies of which may be obtained at the above office or from the custodian of site at Waxahachie. James Knox Taylor is Supervising Architect.

WATERFORD, VT.—The development of the water-power of the Connecticut River at Fifteen Mile Falls, in Waterford, Vt., is reported to be under consideration. It is estimated that 50,000 hp could be developed. The cost of the power plant and transmission is estimated at between $6,000,000 and $7,000,000. Electricity generated at the plant would be transmitted to Montpelier and Barre, Vt.; St. Johnsbury, N. H.; Littleton, N. H., and other towns and cities in Vermont and New Hampshire. Messrs. Chase & Harriman, who are connected with the plant of the Connecticut River Power Company, at Vernon, Vt., are interested in the project.

RICHMOND, VA.—E. W. Trafford, engineer of the municipal electric light plant, has presented his first budget, asking for $124,1·3 for annual maintenance and for construction and equipment as follows: On the distributing system Mr. Trafford estimates that it will require $49,321 to complete existing contracts; $1,000 for steel towers over the Chesapeake & Ohio Railway tracks; for installation of the Washington Ward distributing system, $11,459; additional lamps, $5,000; ornamental lamps for Jefferson Avenue, $4,000. The engineer reported that the plant would be completed within the original amount appropriated by the Council, but that contingent expenses, extension of dams and improvements have increased the total cost by $10,000 more than was estimated. In view of the proposed lighting system in Washington Ward, Mr. Trafford recommended the installation of an additional generator at the plant, wiring equipment and 125 lamps, making the total cost for the installation $19,910.

WARRENTON, VA.—It is reported that the local electric-light plant has been purchased by M. M. O'Connell & Son, of Washington, D. C. The price paid for the plant is said to be $20,000.

CONCONULLY, WASH.—The Pacific Coast Telephone Company is contemplating the erection of new telephone lines, one to run over the Silver Hill country and another through the Pine Creek region. T. R. Pinkerton is local manager.

MONTESANO, WASH.—The contract for installing the electric clock and system in the new Court House has been awarded to Joseph Mayer & Brothers, of Seattle, Wash., for $2,600

NORTH YAKIMA, WASH.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Feb. 18, for the construction complete, except elevator, but including plumbing, gas piping, heating apparatus, electric conduit and wiring, of the United States post office building at North Yakima, Wash., in accordance with drawings and specifications, copies of which may be obtained at the above office or from the custodian of site at North Yakima, Wash. James Knox Taylor is Supervising Architect.

PORT TOWNSEND, WASH.—The Board of County Commissioners has granted a fifty-year franchise to the Olympia Power Company to erect an electric transmission line on the highways of the county. The company proposes to erect a hydroelectric power plant on the Elwha River, where 6000 hp will be developed.

TACOMA, WASH.—Bids will be received by Nicholas Lawson, Commissioner of Light and Water, City Hall, Tacoma, Wash., until Feb. 6 for material and equipment for completing the municipal hydroelectric plant at La Grande, on Nisqually River as follows: Section 1—Bridge, estimated cost, $44,890; section 2, conduit and reservoir, $292,675; section 3, pressure pipes and anchor piers, $116,696; section 4, power house, cranes and cableway, $149,875; section 5, water-wheels and generators, $168,733; section 6, electrical equipment, power house, $88,573, section 7, electrical equipment, substation, $109,690; section 8, transmission line, $100,000. H. F. Groner is chief engineer.

CLARKSBURG, W. VA.—The Jacobs Realty Company, recently organized, to deal in real estate, etc., proposes to operate a water, light and power plant. The incorporators are: D. W. Jacobs, John W. Jacobs, C. E. Prunty, and others, all of Clarksburg, W. Va.

WHEELING, W. VA. Plans are being considered by the Wheeling Electrical Company for the erection of a new plant, at a cost of about $700,000, which will be erected on the site of the old plant on the South Side.

NEW LISBON, WIS.—At a special election held Jan. 5 the proposition to establish a municipal electric light plant and water-works system was carried.

EDMONDS, B. C., CAN.—Plans have been prepared by the British Columbia Electric Railway Company for the erection of a substation and depot in Edmonds.

KAMLOOPS, B. C., CAN.—The City Council is considering the question of installing a municipal telephone system.

VANCOUVER, B. C., CAN.—The British Columbia Telephone Company has decided to build a steamer for laying telephone cable, the cost of which is estimated at $30,000.

VANCOUVER, B. C., CAN.—Plans have been prepared by the British Columbia Telephone Company for the erection of new telephone exchanges at Kamloops, Nelson, Alberni and Duncans, all in British Columbia.

PORTAGE LA PRAIRIE, MAN., CAN. The Manitoba Power Company is reported to have notified the City Council that it proposes to submit a proposition to supply the city with power from its concession on the Winnipeg River.

EDMUNDSTON, N. B., CAN.—The town of Edmundston has applied to the Legislature for authority to issue bonds to the amount of $40,000, the proceeds to be used to establish an electric light and power plant in Edmundston, and to build and maintain a dam at the second falls on Green River to supply power for same

DUNDAS, ONT., CAN.—The by-law authorizing a contract with the Hydroelectric Power Commission and appropriating $12,000 to erect a portion of the distributing system in Dundas has been approved by the Town Council.

KINGSTON, ONT., CAN.—It is reported that Iroquois (Ont.) capitalists have acquired the water-powers adjacent to Calabogie and High Falls, which they propose to develop. Electricity generated at the plant will be transmitted to Kingston. M. Beach, of Iroquois, Ont., is interested in the project.

LONDON, ONT., CAN.—At a meeting of the board of directors of the London & Port Stanley Railway Company it was decided to authorize the city engineering department to prepare estimates of the probable cost of the work. This railway is controlled by the City of London, and Mayor Beattie has been elected president of the board for the ensuing year, and Alderman Saunders vice-president.

LONDON, ONT., CAN.—At the annual meeting of the stockholders of the London Electric Company the directors were authorized to make improvements to the plant and equipment of the company in order to compete with the new municipal distributing plant of the city, electricity for which will be supplied by the Hydro-Electric Power Commission. It is understood that work will begin on the proposed improvements about Feb. 1 and that a new type of gas or oil engine, now being manufactured in England, will replace the steam engines now in use. The company has notified the city of its withdrawal of all previous offers for the sale of its plant and business to the city. The City Council, on the other hand, will make application to the Provincial Legislature for authority to purchase the plant and holdings of the company.

ORILLIA, ONT., CAN.—The municipal electric plant at Orillia was damaged on Jan. 19 owing to the bursting of the flume supplying water at the Ragged Rapids power house. It is expected that the plant will be ready to be placed in operation within two weeks.

OTTAWA, ONT., CAN.—It is reported that an electric smelting plant will be erected at Chat Falls, on the Ottawa River, twenty miles north of Ottawa. American and English capitalists are interested in the project. Work on construction of the plant will begin in the spring.

PORT HOPE, ONT., CAN.—The ratepayers on Jan. 17 passed a by-law granting the Seymour Electric Company a thirty-year franchise to supply electricity in Seymour, Ind.

TORONTO, ONT., CAN.—Bids will be received until Jan. 28 by the chairman of the building committee for material and equipment for the erection of a power house in connection with the Toronto General Hospital. Darling & Pearson, 2 Leader Lane, Toronto, Ont., are architects.

WELLAND, ONT., CAN.—The Falls Power Company, of Welland Ont., has sold its plant and holdings to the Welland Electrical Company including the contract for lighting the streets of the town.

SHERBROOKE, QUE., CAN.—The contract for the development of the Drop Off power in Sherbrooke has been awarded to Morrow & Beattie, of Peterborough, Ont., Can., for $51,220 (not including the hydraulic or electrical equipment), providing it meets the approval of the Board of Control, city attorney and city engineer. Ross & Holgate, engineers, of Montreal, Que., will supervise the construction of the plant. The cost of the development complete is estimated at $100,000.

REGINA, SASK., CAN.—Plans have been prepared for extensive additions and improvements to the municipal electric plant this year which will involve an expenditure of about $115,000. The plans include the installation of electrical machinery, bids for which have been asked. A. J. McPherson is City Commissioner.

EL TIGRE, SONORA, MEX.—All concessions and right-of-way for the proposed electric transmission line that is to be erected to this mining district from the power plant of the Copper Queen Company in Douglas, Ariz., have been obtained. The proposed line will be sixty-six miles in length and will have a potential of 44,000 volts. The cost of the transmission line, including substations, is estimated at about $150,000.

LEON, GUANAJUATO, MEX.—The Guanajuato Light & Power Company is installing an electric-light system in Leon

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New Industrial Companies.

THE PHIFER ENGINE MANUFACTURING COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $50,000. The incorporators are: J. M. Frere, V. Atkinson and R. Seidlinger, of Wilmington, Del.

THE RADIO GAS PRODUCER COMPANY, of St. Louis, Mo., has filed articles of incorporation with a capital stock of $50,000 for the purpose of manufacturing electrical apparatus, etc. The incorporators are: J. W. Kolar, A. J. Cunningham, M. C. Burgman and others.

THE ROBERT W. HUNT & COMPANY, LTD., of Montreal, Que., Can., has been incorporated by J. W. Moffat, T. C. Irving, Jr., both of Toronto, Ont., Can. The company is capitalized at $5[illegible]0 and proposes to carry on a business of civil, mechanical, mining and electrical engineering.

THE SECONDARY CONTROLLER COMPANY, of New York, N. Y., has been chartered by Alphonzo E. Pelham and Richard Van Rennselaer Sill, both of 4[illegible]4 West Twenty-sixth Street, Grafton L. McGill, of 15 William Street, all of New York, N. Y. The company proposes to manufacture and deal in electric controllers, devices, etc.

THE SCHMIDT AUTOMOBILE ELECTRIC AIR PUMP COMPANY, of Hazleton, Pa., has been incorporated with a capital stock of

$5,000 and the following directors: Isaac Smulyan, of Hazleton, Pa., treasurer; John J. Mulhall, Louis Auerbach and Jacob Benjamin, all of Hazleton, Pa.

THE UNITED STATES ENGINEERING & MANUFACTURING COMPANY has filed articles of incorporation with the Secretary of State, Dover, Del., with a capital stock of $1,000,000. The incorporators are: J. J. Jones, of Pittsburgh, Pa.; M. K. Griffith and J. M. Griffith, of Tarentum, Pa.

THE VILLE ENGINEERING COMPANY, of Moline, Ill., has been chartered with a capital stock of $200,000 to manufacture motors, engines, automobiles, etc. The incorporators are: Willard L. Ville, Lawson M. Fuller and Otis E. Mansur.

THE WEST COAST ELECTRIC BATTERY COMPANY, of San Francisco. Cal., has been incorporated with a capital stock of $100,000 by C. A. Westenberg, F. P. Davis and F. E. Wright.

New Incorporations.

CAMDEN, ARK.—Articles of incorporation have been filed for the Rice Belt Telephone Company with a capital stock of $60,000 by W. B. Ritchie, B. C. Powell and B. C. Blain.

EUREKA, CAL.—The Eel River & Southern Telephone Company has been incorporated with a capital stock of $20,000 by H. D. Smith, E. M. Loveland, R. White and others.

SACRAMENTO, CAL.—The Sacramento Valley Power Company has been granted a charter with a capital stock of $2,000,000. The incorporators are: A. Armstrong, H. E. Willis, D. Righetti, Grant Cordrey. F. V. Vollmer, L. Sutter and E. Maytorena.

DENVER, COL.—The Ellis National Electric Light Company has been incorporated with a capital stock of $1,000,000 by A. L. Hiller, J. H. Stahl and M. McCullough.

WILMINGTON, DEL.—Articles of incorporation have been filed for the Mitchell Water & Light Company with a capital stock of $100,000 by F. M. Shive, S. E. Roberson and H. W. Davis, of Wilmington, Del.

CENTER, IND.—The Center Telephone Company has filed articles of incorporation with a capital stock of $10,000 to construct and operate a telephone exchange in Center and throughout Howard County.

CRYSTAL, IND.—The Columbia Telephone Company has been incorporated to install a telephone system in Crystall and throughout Dubois County. E. E. Ellis is president of the company.

INDIANAPOLIS, IND.—Articles of incorporation have been filed with the Secretary of State for the Wabash River Power Company with a capital stock of $200,000. The company proposes to generate and distribute electricity in towns and cities for lamps, heat and motors. The incorporators are: Horace C. Stillwell, Henry A. Mansfield, Thomas N. Stillwell, J. Walter Esterline and John L. Baker. The principal offices of the company will be located in Indianapolis, Ind.

INDIANAPOLIS, IND.—The Interstate Telephone Company has been incorporated with a capital stock of $75,000 for the purpose of acquiring and operating the existing telephone lines in Davies and Greene counties, now operated under the name of the Interstate Telephone System. Five exchanges are included, located at Odon, Elnora, Montgomery, Epsom and Scotland. The company has in operation about 350 miles of wires and 500 subscribers. It is proposed to extend the system. The incorporators are: Oscar E. Pottorff, R. P. Knight, J. G. Paul and Elizabeth A. Coulter, all of Indianapolis. The main office of the company will be located at 503 K. of P. Building, Indianapolis.

WINCHESTER, IND.—The Farmers' Telephone Company has been incorporated with a capital stock of $10,000 to erect a telephone system in Randolph County. Leander Moorman, Clarence Miller and David Lesley are incorporators.

DES MOINES, IOWA.—The Stony Hill Telephone Company, of Fayette County, has been incorporated with a capital stock of $10,000 by Daniel Brause, E. C. McMargroff, David Saltsgiver and others.

DURANGO, IOWA.—The Rose Valley Telephone Company has been organized for the purpose of erecting a farmers' telephone system. James M. Dunn is president of the company, and J. H. Denhoff is secretary.

ELKADER, IOWA.—The Boardman & Wagner Telephone Company has been granted a charter with a capital stock of $1,000.

NEW CONCORD, KY.—The Fullerton Home Telephone Company has been incorporated by John Arthur, J. R. Shepherd, Lyman Warnock and others.

SHREVEPORT, LA.—The Shreveport & Memphis Railway Company has been chartered by O. C. Ferguson and A. R. Johnson, of Homer, La., to construct an electric or steam railway to connect Eldorado, Homer and Minden, a distance of forty-five miles. It is expected later to extend the railway to Memphis.

MIDDLEBURG, MD.—The Middleburg Telephone Company has been organized to construct a telephone line from Middleburg to Greencastle. J. Frank Hale is manager of the company.

OGDEN CENTER, MICH.—The Ogden Mutual Telephone Company has been incorporated with a capital stock of $5,000 by C. E. Arnold, Ira Ashley, B. W. Baker and others.

VIRGINIA, MINN.—The Northern Minnesota Railway Company has been incorporated by Edward Himes, of Chicago, Ill.; S. J. Gusson, of Virginia, Minn.; G. F. Lindsay, of Davenport, Ia.; William O'Brien, of St. Paul, Minn., and H. C. Hornby, of Cloquet, Minn. The company is capitalized at $25,000 and proposes to build an electric railway in Minnesota.

ORCHARD FARM, MO.—The Orchard Farm Telephone Company has been incorporated with a capital stock of $1,950 by Gustave Kipp, William Schindler and Ernest Nolte.

MISSOULA, MONT.—Articles of incorporation have been filed for the Missoula & Hamilton Railway Company with a capital stock of $500,000 by H. M. Sloan, F. G. Bennett, R. A. O'Hara and Ira M. Cobe. The company proposes to build a railway to connect Hamilton and Missoula, to be operated by either steam or electricity.

CHAPPELL, NEB.—The Farmers' Telephone Company has been incorporated with a capital stock of $2,000 by J. D. Hamel, G. B. Brown and others.

FINESVILLE, N. J.—The Delaware Union Telephone Company has been incorporated with a capital stock of $100,000 by E. Hagar, of Riegelsville, N. J.; E. Frey, of Stewartsville, N. J., and S. Lippincott, of Milford, N. J.

BIRDSALL, N. Y.—The Canaseraga, Jersey Hill & Birdsall Telephone Company has been incorporated with a capital stock of $450 to operate telephone system in the town of Birdsall and also in the townships of Birdsall, Grove and Benns, connecting Birdsall and Canaseraga. The directors are: William Manning, Henry McMahon and John Clancy, all of Birdsall, N. Y.

COLLINS, N. Y.—The Zoar Telephone Company has been chartered with a capital stock of $1,250. The incorporators are: Lynn W. Shipman, Albert A. Gainsler, A. L. Anderson, Frances C. Gransler, Jacob H. Schaach, M. G. Shipman, of Gownada, and C. Mugridge, of Collins Center, N. Y.

AKRON, OHIO.—Articles of incorporation have been filed for the Northern Ohio Power Company with a nominal capital stock of $10,000 by William Christy, Charles H. Lohr, Charles Currie, C. F. More and N. O. Mather. Most of the parties are connected with the Northern Ohio Traction & Light Company. The new company proposes to erect a new power plant at Cuyahoga Falls which will supply electricity for operating the railway system of the Northern Ohio Traction & Light Company and other purposes.

CLEVELAND, OHIO.—The Beighlee Electric Company has been incorporated with a capital stock of $10,000 by H. Earl Beighlee and others.

GREENFIELD, OHIO.—The Greenfield Telephone Company has filed articles of incorporation with a capital stock of $100,000. The incorporators are: Stanley Pike and others.

CONNELSVILLE, OKLA.—Articles of incorporation have been filed for the People's Ice & Light Company by J. M. Middleton, G. H. C. Beirndollar, C. L. Goodale and C. S. McCarty. The company is capitalized at $50,000.

LEXINGTON, OKLA.—Articles of incorporation have been filed for the Good Service Telephone Company with a capital stock of $15,000 by E. M. Abernathy and R. P. Wynne, of Lexington, Okla.; J. L. Abernathy, of Purcell, Okla., and W. F. Wiley, of Oklahoma City, Okla.

NARDIN, OKLA.—The People's Mutual Telephone Company has been incorporated by N. Goin, I. S. Arnold, J. W. Coffelt, J. H. Denhart and A. B. Havins.

OKLAHOMA CITY, OKLA.—The Western Power & Irrigation Company has been incorporated with a capital stock of $500,000 by George W. Trye, C. F. Berryman, of Oklahoma City, Okla., and W. Holton Key, of Maysville, Ky.

SHAWNEE, OKLA.—The Oklahoma Short Line Electric Railway Company has filed articles of incorporation in Oklahoma for the purpose of connecting the electric railways and interurban systems of Kansas, Missouri, Texas and Oklahoma. The main line will be 175 miles in length and will connect Oklahoma City, Okla., and Joplin, Mo. A branch will be constructed from Shawnee, Okla., to Denison, Tex., a distance of 125 miles. Work on construction will begin in the near future. It is proposed to build from Shawnee to Muskogee and Oklahoma City first. The power plant and car shops will be located east of Shawnee. The company is capitalized at $100,000. The incorporators are: C. C. Wright, of Ada; M. J. Bentley, of Tecumseh; Peroy Paddock, of Oklahoma City, and T. E. Armentrout, of Kirkwood, Mo.

WAGNER, OKLA.—Articles of incorporation have been filed for the Interstate Power Company with a capital stock of $1,000,000.

BUTTE FALLS, ORE.—The Butte Falls & Eagle Point Telephone Company has been chartered with a capital stock of $5,000 by Porter J. Neff, W. P. Mealey and L. A. Newton, all of Medford, Ore.

KIMBLES, PA.—The Lackawaxen & Milford Telephone Company has been chartered with a capital stock of $5,000. The directors are: M. C. Rowland, of Kimbles, Pa., treasurer; John D. Weston and John Kuhbach, both of Honesdale, Pa.

JACKSON, TENN.—Articles of incorporation have been filed for the Citizens' Electric Light & Power Company with a capital stock of $1,50 by T. E. Mercer, Eugene Davis, M. B. Mulheron, J. M. Justice and W. Ragland.

NASHVILLE, TENN.—Articles of incorporation have been filed for the Henry M. Moses Electric Company, of Knox County, with a capital stock of $5,000, by Henry M. Moses, H. C. Keeton, B. A. Massey and R. A. Johnston.

LONGVIEW, TEX.—The Port Bolivar Iron Ore Railway Company has been incorporated by L. P. Featherstone, Fox Winnie, L. C. Luckel, W. D. Myers, W. C. Brothers, Eugene A. Wilson, Lewis A. Featherstone, Murrell L. Buckner and T. B. Stinchcomb. The company is capitalized at $50,000 and proposes to build a steam or electric railway from Longview through Gregg, Upshur, Harrison, Marion and Cass Counties to a point in Cass County about ten miles north of Hughes Springs.

OENAVILLE, TEX.—The Oenaville Rural Telephone Company has been incorporated with a capital stock of $1,000 by T. P. Aycock, W. S. Ellicott and W. T. Wright.

LEAMINGTON, UTAH.—The People's Telephone Company, of Leamington Precinct, bas been incorporated with a capital stock of $10,000. The officers of the company are: A. M. Roper, president; Leo Lyman, vice-president; J. Greathouse, secretary; T. H. Strange, treasurer, and George Finlinson, manager.

Personal.

MR. W. W. TAYLOR has resigned as manager of the Rawlins (Col.) Electric Light & Power Company and is succeeded by Mr. J. H. Jacobucci

MR. D. M. BLISS, who joined the Edison engineering staff a year ago as electrical engineer, has been appointed chief engineer of the Edison Laboratory, West Orange, N. J.

MR. WILLIAM P. SIDLEY, of Chicago, vice-president and general counsel in that city for the Western Electric Company, has been elected president of the Young Men's Christian Association of Chicago.

MR. HENRY FLOY has recently completed for a banking interest a complete appraisal of tbe properties of the Elmira Water, Light & Railway Company, including the interurban electric road between Elmira and Watkins Glen.

MR. W. H. WHITESIDE, who recently resigned from tbe presidency of the Allis-Chalmers Company, is to sail from New York on Jan. 21 with his family on the *Caronia*, bound for Spain and the Orient, for a holiday of several months.

MR. A. B. WILSON, who has been connected with the Tungstolier Company, of Conneaut, Ohio, for the past two years in charge of its St. Louis district, has been made vice-president and general manager of the Tungstolier Company of Canada, with general offices at Tornoto, Ont.

MR. EUGENE CREED, sales manager of the Toronto Electric Light Company, has been appointed chairman of the commercial committee of the Canadian Electrical Association. Mr. Creed is also a member of the appliance committee of the commercial section of the National Electric Light Association.

MR. HERBERT A. WAGNER, vice-president of the Consolidated Gas, Electric Light & Power Company, of Baltimore, addressed the Baltimore N. E. L. A. section at its last meeting on the subject of "Rates." The meeting was held at the physical laboratory of the Johns Hopkins University, and the room was taxed to accommodate the large audience.

MR. JOHN I. BEGGS, president and general manager of the Milwaukee Electric Railway & Light Company, slipped on the ice while in St. Louis on a visit during the week of Jan. 16, sustaining a bad fall which fractured his right wrist. This injury, however, has not prevented Mr. Beggs from getting about to attend to business, witb his arm carried in a sling.

MR. W. B. FOSHAY has resigned as manager of the Pacific Power & Light Company, of Walla Walla, Wash., in order to join tbe staff of the Washington-Oregon Corporation at Vancouver, Wash. This concern is taking over a number of properties, among them being the gas, electric light and water companies of Vancouver and the Vancouver Interurban Railway, all of which will be under the management of Mr. Foshay.

MR. BION J. ARNOLD has had conferred upon him by the University of Nebraska the honorary degree of doctor of engineering. Mr. Arnold began his higher education in the university which has thus tendered to him the highest degree within its command, completing his technical training in the East. In 1884 he achieved his B. S. from Hillsdale College, Mich.; in 1887 M. S., and two years later M. Ph., from the same institution. The University of Nebraska conferred on him the degree of E. E. in 1898, and in 1907 the Armour Institute gave him the honorary degree of D. Sc. Besides this collection of titles Mr. Arnold received a "diploma extraordinary" in 1907 from his old college at Hillsdale for distinguished learning and achievements in invention and in mechanical and electrical engineering.

MR. WILLIAM S. TURNER has resigned as managing engineer of the Northwestern office of W. S. Barstow & Company at Portland, having practically completed the work upon which he has been engaged in that city during the past three years. This has consisted in a considerable amount of interurban railway construction for the Oregon Electric Railway Company and supervising the contract which W. S. Barstow & Company had for underground electric conduit construction for the Portland Railway, Light & Power Company. Mr. Turner has had long experience in electric railway construction, baving been a member of the firm of Woodbridge & Turner, which did a great deal of pioneer work in electric railroading. Later Mr. Turner built some electric railroads in New Zealand for J. G. White & Co., with whom he was connected for some eight years. After a short vacation in the East he expects to make Portland his home and possibly to engage in business there on his own account.

Obituary.

MR. H. C. SCOTT, president of the National Light & Improvement Company, of St. Louis; general manager of the Waco (Tex.) Gas & Electric Company, and president of the Fort Worth (Tex.) Light & Power Company and other Texas electric-service companies, committed suicide by shooting himself Jan. 14 at his residence on Vandeventer Avenue, St. Louis, Mo. Mr. Scott's public-utility holdings are reported to be valued at more than $500,000.

MR. VAN W. WELSH.—A press dispatch from Marietta, Ohio, says that Mr. Van W. Welsh, a prominent business man of that region, was found dead in the electric light plant in Beverly, Washington County, Ohio, on Jan. 19. Mr. Welsh was president and owner of the Beverly Electric Light Company and he met his death by being caught in the machinery during the temporary absence of the superintendent of the plant. No one witnessed the accident and it is not known exactly how it occurred.

Trade Publications.

AIR-BRAKE EQUIPMENTS.—Bulletin No. 4798, issued by the General Electric Company, describes the straight air-brake equipments manufactured by it for railway service.

BELT LACING.—Bulletin No. 152, issued by the Bristol Company, Waterbury, Conn., describes and illustrates the various types of patent steel belt lacing manufactured by the company.

MINE TELEPHONES.—The Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., has issued a placard pointing out tbe possibilities and convenience of its "Mine A Phone" system.

MOTOR-DRIVEN AIR COMPRESSORS.—The line of air compressors built by tbe General Electric Company for factory, power station, car barn and many other industrial purposes is described in Bulletin No. 4810.

RESISTANCE MATERIALS.—With this title the Driver-Harris Wire Company, of Harrison, N. J., has issued a booklet which, besides containing numerous quick reference tables, lists two new alloys, "Yankee Silver" and "Therlo," recently perfected by this company.

ELECTRIC CRANES.—Catalog No. 82, issued by the Whiting Foundry Equipment Company, Harvey, Ill., gives in condensed form a description of special features of Whiting cranes, together with views of installations and names of some of the company's principal customers.

GLASSWARE.—The Phœnix Glassware Company, New York, manufacturer of illuminating glassware of all kinds, has issued as Catalog No. 19, a bound price list of over 150 pages devoted to decorated, etched and cut glassware for incandescent electric lamps. The prices and illustrations and sizes are given on facing pages.

INDUCTION MOTORS.—Bulletin No. 3141 of the Emerson Electric Manufacturing Company, St. Louis, Mo., describes its single-phase induction motors in sizes ranging from 0.1 hp to 0.2 hp. In these machines an automatic internal clutch allows the armature to attain speed and develop practically full power before engaging the pulley or load.

FEED-WATER HEATERS.—The Alberger Condenser Company, New York, describes in Catalog No. 14, just issued, its condensing apparatus, but chiefly the Wainwright feed-water heaters, expansion joints, heat extractors and air coolers. The construction and application of these well-known power plant specialties are treated at length.

IRON CABINETS AND BOXES.—The F. Bissell Company, Toledo, Ohio, has issued a bulletin describing its "Security" iron cabinets and boxes. These are made up in one piece with knockouts for cabinet work, pull or junction boxes, weatherproof cut-out work, to inclose motor starters, allowing the handle only to project, entrance switches, etc.

STARTING AND CONTROLLING APPARATUS.—A price list and bulletin of the various automatic starters and controllers for electric motors made by the Monitor Controller Company, Baltimore, Md., has been issued by the Monitor Sales Department, of that city. The list and bulletin is of the pocket-size loose-leaf type and covers the products of the company.

DIRECT-CONNECTED GENERATING SETS.—The General Electric Company has issued Bulletin No. 4804, superseding Bulletin No. 4617, and devoted to a description of its direct connected generating sets. These are built in sizes ranging from 2½ kw to 75 kw, and although originally designed for marine work are also well adapted for isolated plants or small central-station requirements.

ECONOMICAL FIRE-ROOM METHODS.—Bulletin No. 187, issued by the B. F. Sturtevant Company, of Hyde Park, Mass., is a reprint of an article by Mr. F. R. Low, editor of *Power and the Engineer*, on economical fire-room methods based on a visit to a New England woolen mill, where by the use of intelligent help recording apparatus, economizers and forced draft fans some remarkable results are obtained.

POLISHING AND GRINDING MOTORS.—The Emerson Electric Manufacturing Company, St. Louis, Mo., offers two distinct styles of motors designed especially for the requirements of dentists, each of which is furnished with chucks and polishing and grinding wheels. The motors are made in both alternating-current and direct-current types for all ordinary voltages and frequencies. Bulletin No. 3708, just issued, describes the line.

MILLING MACHINES.—Circulars Nos. 142 and 143 have been issued by the Garvin Machine Company, of New York. The first is devoted to a vertical spindle milling machine for machining gear and engine casings of automobiles, railway car motor casings, box castings and frames of special machines requiring the finishing of surface joints, spots and edges to varying gage levels and widths, and the second describes and illustrates a duplex milling machine.

ACCIDENT PREVENTER.—The Nelson Valve Company, Philadelphia, Pa., has issued for free distribution circular red cards with white skull, under which is the legend "Danger! Hands Off." The card is intended for tying to valves, switches, etc., whose manipulation would endanger property or the lives of men working on sections of wiring or piping, or as a warning to persons unacquainted with the hazard of certain apparatus, locations, etc.

INSULATION.—The Walpole Rubber Company, Walpole, Mass., which controls the Massachusetts Chemical Company, the well-known manufacturer of insulating compounds and tapes, has issued a neat pamphlet entitled, "A Visit to Walpole," describing the organization of the holding company and the output of its various subsidiaries. The company has recently erected additional buildings in Walpole with every facility for economical manufacture.

BALL BEARINGS.—The Hess-Bright Manufacturing Company, Philadelphia, Pa., has issued Catalog Form 580-A, which is exceptionally well prepared and treats of the development of the annular type of ball bearing; characteristics of plain and ball bearings; the manufacture of ball bearings and their application to automobiles, line shafting, electrical apparatus, etc. Tables giving sizes, dimensions and sustaining capacities of the bearings form part of the catalog.

TESTING APPARATUS.—The Leeds & Northrup Company, Philadelphia, Pa., has issued Catalog No. 40, devoted to apparatus for measuring low resistance and conductivity. The following apparatus is illustrated and described: Standard low resistors, current carrying resistors, apparatus for measuring low resistances and conductivity apparatus. There is also an appendix containing the theory and practice of conductivity measurements. Hoopes' conductivity bridge is described at length.

STEAM TRAPS.—Catalog No. 266 issued by the American Blower Company, Detroit, Mich., is devoted to descriptions and applications of the "Detroit" tilting tank type of steam traps and the "Detroit" return trap system for coil drainage, water lift and automatic boiler feed. A distinctive feature of the Detroit traps is that there are no valves, floats or buckets inside the tank to leak, corrode, rust or stick, and the tilting motion indicates that the trap is doing the work required of it.

ELECTRICAL SHEET STEEL.—The Follansbee Brothers Company, Pittsburgh, Pa., is distributing to motor and transformer manufacturers and others who are interested in electrical sheet steel blueprints showing the magnetic properties of its steel. The steel has exceedingly high permeability, while the loss per pound is very low. Thus, with 60 cycles at a density of 10,000 lines per square centimeter, the loss in watts per pound is 1.38, 1.42, 1.52 or 1.70, according to whether the thickness is 30, 29, 28 or 26 gage.

RAILWAY STORAGE BATTERY INSTALLATION.—Operating between Bangor, Pa., and Nazareth, a distance of approximately fifteen miles, is a small electric railway owned by the Slate Belt lEectric Street Railway Company, Pen Argyl, Pa. Owing to the heavy grades, it was necessary to install a storage battery to maintain the voltage on the line, if the time schedule was to be adhered to. The battery installation is described in Bulletin No. 130, issued by the Electric Storage Battery Company, Philadelphia, Pa.

SWITCHBOARD PANELS.—The General Electric Company has designed for use in small or isolated plants, containing but one generator, alternating-current switchboard panels which are not equipped with buses, generator switch or any synchronizing devices. Two classes of panels, one for controlling a single generator, one exciter and one or two feeders, and the other for controlling one generator, one exciter, one or two feeders and one constant-current transformer, are described in Bulletin No. 4807, just issued.

BELT-DRIVEN ALTERNATORS.—In many small stations the use of the belt drive is unavoidable, because in not a few cases the prime mover is already installed or the speed necessary cannot be obtained by any other means. The General Electric Company has built for a number of years a standard line of alternators for this service, and illustrations and brief descriptions of two-bearing alternators ranging from 30 kw to 200 kw and three-bearing alternators ranging from 250 kw to 550 kw are given in Bulletin No. 4685.

ELEVATING AND CONVEYING MACHINERY.—The Fairbanks Company, New York, has issued illustrated circular and price list No. 482 of power-transmission appliances, belting, shafting, couplings, collars, hangers, pillow blocks, pulleys, friction clutches, rope sheaves, machine-molded gears, scales, etc. The object of the company in the compilation has been to present complete information on its transmission and conveying materials, and by special attention to the illustrations and grouping of the contents it has also made of it a handy book of reference.

TURBO-GENERATORS.—The Rateau-Smoot turbines, which are of the impulse type, are built for mixed flow, low-pressure and high-pressure work. The first two are applicable to existing reciprocating-engine stations, increasing the output from 50 per cent to 100 per cent without increasing the fuel consumption. The Ball & Wood Company, Elizabethport, N. J., manufacturer of these machines, has prepared a well-illustrated catalog on the sets, showing the details of construction of the turbines and generators and pointing out the advantages of the respective types for various classes of work.

UTILIZATION OF SMALL WATER-POWERS.—Under the title "Water-Powers of the Third Magnitude" the American Spiral Pipe Works, of Chicago, issue an attractive pamphlet telling the interesting story of the hydroelectric development of the North Creek Electric Company, North Creek, N. Y. The narrative is handsomely illlustrated and shows how a 200-kw development was made on a small stream in the Adirondacks, where a head of about 600 ft. could be utilized. Special attention is paid to the building of the pipe line. The story, which is worth reading for its own sake, is sent free on request.

VOLTAGE REGULATORS.—Central-station service has been very much improved of late years by the installation of regulating devices by means of which a constant voltage is maintained at the lamp terminals. More recently manually operated apparatus has given place to automatically operated apparatus, with a consequent reduction in the operating forces and greater improvement in the service. Various types of potential regulators built by the General Electric Company are briefly described in Bulletin No. 4793, the description being preceded by general information pertinent to the subject.

SIGNS AND FLASHERS.—The Sun Electrical Company, Limited, of London, England, has issued Catalog No. 204 dealing with its signs and flashers. The company's "Kaleidoscope," "Mirrorgraph" and "Collapsible" signs are featured, together with a magnetic, mercury-contact type of flasher. In the latter the contacts between switch points are made by mercury working in a vacuum, the magnetic switch to which it is attached being in shunt to the main circuit. As the armature rocks against the tension of a spring it works a train of wheels attached to an air vane, thus regulating the time elapsing between each movement of the mercury tube, and hence between flashes.

MOORE TUBES.—The Western Electric Company has issued Bulletin No. 9465, describing the Moore tube lamp for color matchnig. This is stated to be the only artificial illuminant which gives exact daylight color values, and is being introduced into shops, mills and other establishments where color values are of great importance. As is well known, this consists of a means for a vacuum producing light by passing alternating current through highly rarefied carbon dioxide gas confined within a continuous clear glass tube. The bulletin contains a description of the arrangement and of its uses and operation. A page is devoted to the list of concerns now using the lamp and another to tabulated dimensions, data, etc.

STORAGE BATTERY.—The Edison Storage Battery Company, Orange, N. J., has issued an enlarged catalog containing complete and useful information on the various Edison cells and the diversified application of the Edison battery for pleasure and commercial electric vehicles, ignition and lighting work, industrial truck, locomotive and omnibus work and in connection with electric traction systems. Comparisons, said to be based on actual experience with and observations of lead cells of the best construction, are given of the Edison and lead battery. The company is now manufacturing five sizes of cells, identical in electrical characteristics and differing only in the number and size of plates and capacity.

NON-MULTIPLE TOLL SWITCHBOARDS.—The Western Electric Company has just issued Bulletin No. 1006, describing non-multiple toll switchboards. The apparatus presented in this bulletin is recommended for use as toll boards in either magneto or central battery exchanges, and also as magneto exchange switchboards where a desk type board is desired or a switchboard with a lower key-shelf than is ordinarily provided on local boards. The boards described are divided into two general types, those having self-restored line signals and those with manually restored line signals. Considerable space is devoted to the combined jacks and signals used with the first type of boards. The bulletin, which contains thirty-six pages, is illustrated with many photographs and diagrams and contains a table showing the capacity of standard types of non-multiple toll switchboards.

BUSINESS NOTES.

F. N. MANROSS & SONS.—The firm of F. N. Manross, of Forestville, Conn., has changed its name to F. N. Manross & Sons.

THE PELTON WATER-WHEEL COMPANY has moved from 1396 Monadnock Building to No. 2231 Harrison Street, San Francisco, Cal.

ANDERSON CARRIAGE COMPANY, Detroit, Mich., manufacturer of the Detroit electric vehicles, has changed its corporate name to the Anderson Electric Car Company.

THE COLUMBIA METAL BOX COMPANY has moved to 226-228 East 144th Street, New York City, to occupy its new five-story and basement factory building. The removal and enlarged quarters were necessitated by a rapidly growing demand for the company's switchboards, panel boards, cut-out boxes and other specialties, and in the new quarters the former equipment is more than doubled.

ELECTRICAL PLANT FOR CEMENT WORKS.—The Knickerbocker Portland Cement Company, of Hudson, N. Y., has ordered from the General Electric Company the following apparatus: Two 2000-kw, 1800 r.p.m. turbo-generators; one 75-kw, 125-volt, non-condensing turbo-generator; twenty-four 75-hp, 400 r.p.m., vertical motors; one 50-kw motor-generator set; forty-seven three-phase, 60-cycle, 440-volt induction motors, aggregating 887 hp.

MICHIGAN ELECTRIC WELDING COMPANY.—As previously announced in these columns, the Agnew Electric Welding Company, of Detroit, has changed its name to the Michigan Electric Welding Company. The present location of the company is at the corner of Third and Congress Streets, Detroit, the new quarters consisting of a one-story brick building on this corner which is 35 ft. x 60 ft. and in the rear a two-story building approximately 25 ft. x 65 ft. In addition to this there is a large storeroom. The company has installed additional machinery and is now in excellent shape to handle job welding and manufacturing for the trade in its territory. A specialty is being made of automobile work, and rod and yoke end assemblies are furnished complete, together with other parts, like the welding of tubular reach, torsion and radius, torque tubes, drag links, fore-and-aft connections, propeller shafts; also welding of any sort of forgings and parts that can be welded to rods, shafts or tubes and other job welding that can be done to advantage.

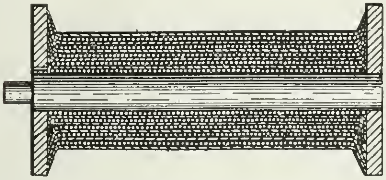
Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JAN. 17, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

981,601. MEANS FOR CONTROLLING ELECTRICALLY DRIVEN CENTRIFUGAL MACHINES; C. A. Adams, Cambridge, Mass. App. filed Apr. 3, 1907. For use in sugar houses. The centrifugal is combined with an electric motor with shunt field whose armature is in a loop circuit connected with the two mains, the direct connection between armature and one main being broken, and the loop circuit closed to cause a reversal of current through the armature, at which time a brake actuating coil is thrown in to assist the reverse current in stopping the machine.

981,612. STARTING DEVICE; C. E. Carpenter, New York, N. Y. App. filed May 17, 1907. For electric motors, the controller having a movable arm, a slidably mounted circuit breaker arranged to be set by the arm when in a predetermined position, the circuit breaker having a main and an auxiliary contact, a retaining device for the circuit breaker and means responding to abnormal increase in current in the motor circuit for releasing the same.



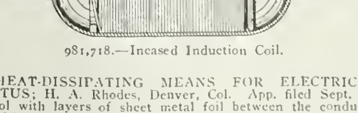
981,690.—Heat-Dissipating Means for Electrical Apparatus.

981,622. ELECTRIC VEHICLE CHARGING WALL SOCKET AND PLUG; J. N. Davis, Denver, Colo. App. filed June 1, 1909. Wall socket and plug for charging the storage batteries of electrically-operated vehicles, the plug having separated electrodes and a body and handle with a central web projecting from the body, the web forming a barrier between the contacts.

981,623. DYNAMO-ELECTRIC MACHINE; W. F. Dawson, Schenectady, N. Y. App. filed May 5, 1905. Ventilator for magnetic cores and conductors, ventilating spaces being arranged between groups of the laminated plates and deflectors in the spaces with inclined radial ends.

981,637. HOOD SUPPORT FOR CABLE TERMINALS; E. L. Grauel, Troy, N. Y. App. filed April 9, 1910. A movable sheet-metal hood with a rod supported parallel with the line of movement of the hood and a dog or catch upon the hood with a restricted passageway for the rod with a shoulder engaging the hood to hold the same under tension.

981,662. TRANSFORMER FOR ELECTRIC METAL WORKING APPARATUS; L. S. Lachman, New York, N. Y. App. filed Feb. 9, 1909. A transformer secondary having two rigid turns in parallel planes and adapted to move longitudinally with relation to each other.



981,718.—Incased Induction Coil.

981,690. HEAT-DISSIPATING MEANS FOR ELECTRICAL APPARATUS; H. A. Rhodes, Denver, Col. App. filed Sept. 13, 1909. A spool with layers of sheet metal foil between the conductors, the extremities of the sheets being slit and bent into engagement with the spool to dissipate heat.

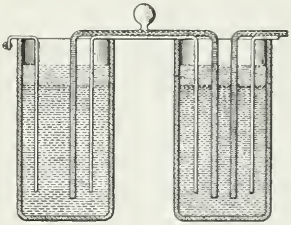
981,692. ELECTRIC SWITCH; H. R., Sargent, Schenectady, N. Y. App. filed March 19, 1900. An electric switch with an actuating spindle, a retainer, a spring tensioned by the spindle, a support with cam slot and a projection on the spindle engaging the slot to move the carrier out of engagement with the retainer so that the spring forces the carrier back.

981,713. ELECTRIC LOCOMOTIVE; N. W. Storer, Pittsburg, Pa. App. filed March 2, 1908. The cab has a central platform for the auxiliary apparatus leaving a passageway for doors and openings. The motors and running gear extend into the recess in the floor of the cab.

981,718. INCASED INDUCTION COIL; H. C. Thomson, Boston, Mass. App. filed March 6, 1909. An induction coil with metal-incased conductors connected to the terminals of the coil and a metallic casing inclosing and sealing the coil, leakage proof joints between the conductors and the casing.

981,727. MEANS FOR ELECTRIC-ARC REACTIONS OF GASES; O. Weber & G. Schreiber. App. filed March 7, 1910. For generating and maintaining arcs of great lengths and subjecting gases to the action of the arc by directing the gases at an acute angle to the length of the arc, gases being supplied in excess for the purpose of cooling.

981,734. SNAP SWITCH; J. A. York, Hartford, Conn. App. filed Aug. 12, 1907. Rotating snap switch with catch and trip and switch-bar connected to the trip, a spindle and coupler connecting the spindle and trip.



981,760.—Protective Device.

981,742. LIGHTNING ARRESTER; E. J. Berg, Schenectady, N. Y. App. filed June 1, 1907. A reactance connected in series with the conductor to be protected, condenser plates connected on each side of the reactance and a condenser plate connected to ground and in inductive relation to the first mentioned plates.

981,759. SWITCHING DEVICE; F. W. Harris, Wilkinsburg, Pa. App filed May 9, 1908. A horizontal rotatable shaft with hand-lever rotatably mounted thereon, a latch at one end of the lever, with automatic means for tripping the latch, and for preventing withdrawal of the latch when the shaft is in a certain position.

981,760. PROTECTIVE DEVICE; J. L. R. Hayden, Schenectady, N. Y. App. filed April 6, 1909. A plurality of cells each including a vessel containing an electrolyte and two electrodes terminating therein, the electrodes of the cells being connected in series and a siphon between adjacent cells being filled with an electrolyte to form an electrical connection between the cells, the siphon having a gas retainer at its highest point.

981,764. LIGHTNING ARRESTER; R. P. Jackson, Wilkinsburg, Pa App. filed Dec. 3, 1906. A supporting frame carries a plurality of two-point electric discharge members mounted on insulators with two groups of single-point discharge members mounted on insulators adjacent thereto, and two groups of fuses and a cut-out switch

981,798. FILLER FOR COILS AND THE LIKE; G. H. Rupley, Schenectady, N. Y. App. filed Aug. 7, 1907. For use with "transil" oil consisting of copal gum and carnauba wax.

981,799. ELECTRIC LOCOMOTIVE; W. Schaake, Pittsburg, Pa. App. filed Feb. 24, 1908. The wheel-base, although long, does not interfere with movement upon curves, and consists of a frame with a foot upon the bearings for the axle above the axle and vertical posts secured to the respective feet with spring upon the posts having their ends secured to the frame.

981,803. OIL GUARD FOR COMMUTATORS; R. Siegfried, Pittsburg, Pa. App. filed Oct. 3, 1905 A commutator spider with rim and annular projection for diverting lubricating fluid from the commutator and a V-shaped clamping ring with external angular projection for diverting lubricating fluid.

981,806. TRACTION ELEVATOR CONTROL; R. C. Smith, Yonkers, N. Y. App. filed Sept 23, 1907. Motor control including a shunt motor, resistances in series with the shunt field, a switch for controlling the resistance operated by an electromagnet with means for closing the circuit through the magnet on starting, accelerating mechanism for the motor and short-circuiting switch for the electromagnet.

981,816. CIRCUIT INTERRUPTER; H. R. Stuart, Wilkinsburg, Pa App. filed Feb 6, 1908. Circuit interrupter with movable and sta tionary contacts, and operating an electromagnet and means for applying a closing force to the movable member, constant until the end of the movement and increased to bring the members into engagement.

981,821. CONTACT MEMBER FOR ELECTRIC SWITCHING DEVICES; C. A. Tucker, Edgewood Park, Pa. App. filed July 6, 1908. A switching device with a stationary terminal and a contact block secured thereto by a lost-motion connection, with a coöperating contact terminal and a flexible tubular shunt surrounding the lost-motion connection and having its ends fastened to the terminal and block.

981,823. ELECTRIC SWITCH; C. S. Van Nuis, New Brunswick, N. J. App. filed Jan. 23, 1907. Knife switch with base and slot, opposed ribs and a pair of clips adjustably secured together and separated to form the space for the blades and adjustable means for resisting distortion of the clips.

981,845. TELEGRAPHY; P. B. Delany, South Orange, N. J. App. filed March 23, 1907. For private, secret service. Sending part of a letter over one circuit and another part over another circuit and uniting both parts in their proper relation by a common receiver.

981,846. KEY SPACE; A. F. Dixon, Newark, N. J. App. filed June 11, 1910. For telephone exchange switchboards, the key space comprising a body portion having a notched portion at each end and laterally projecting locking members located near each end of the body.

981,847. ELECTRIC CONTROLLER; A. C. Eastwood, Cleveland, O. App. filed Sept. 22, 1910. Separately-actuated magnetic switches are used to make the connection for starting the motor, operating it in different direction and varying the speed controlled by a master controller with a locking-nut coil on the main switch which is energized when any of the resistance switches is closed, and prevents operation of the main switch.

981,848. ELECTRIC CONTROLLER; A. C. Eastwood, Cleveland, O. App. filed Sept. 24, 1910. See 981,847. A magnetically-operated switch has its applied voltage automatically reduced to prevent its operation so that the initial switch fails to close, the initial switch closing the circuit through the resistance.

981,850. SMELTING PROCESS AND APPARATUS THEREFOR; R Fleming, New Rochelle, N. Y. App. filed July 13, 1909. For making copper matte by maintaining a long and narrow layer of electrically-heated matte in an inclosed chamber and continuously feeding heated ores and removing matte and slag therefrom.

981,864. ELECTRIC HORN; J. Lanz, Danbury, Conn. App. filed Aug. 18, 1910. An electric horn with space diaphragms carrying contacts normally touching an electromagnet for vibrating the inner diaphragm and causing the outer diaphragm to be mechanically vibrated.

981,865. TROLLEY RETRIEVER; R. F. Levens & A. H. Whatley, Providence, R. I. App. filed Dec. 7, 1907. A reel which takes up slack in the rope and an electromagnet for holding the pulley which pulls down the rope out of operation, the magnet being de-energized when the trolley wheel leaves the wire.

981,881. ELECTRICAL MOTOR; H. A. Rhodes, Denver, Colo. App. filed Sept. 13, 1909. Rotating shaft carrying a large number of radial electromagnets wound to form the field, revolving inside of a stationary set of curved steel plates arranged eccentrically with relation to the magnets so as to vary the air-gap.

981,900. PROCESS FOR PRODUCTION OF COMPOUNDS OF PERSULPHURIC ACID; G. Teichner, Nuremberg, Germany. App. filed Feb. 8, 1901. Electrolizes the acid, cools the anode and maintains the solutions at a higher temperature than the anode.

981,919. SAFETY DEVICE FOR ALTERNATING-CURRENT HOISTING APPARATUS; W. N. Dickinson, Jr., New York, N. Y. App. filed June 14, 1906. A motor, with a brake and a multiphase electromagnet having an armature closing the magnetic circuit thereof, the magnet and armature being connected between the brake and the actuating mechanism.

981,922. ELECTROLYTIC SHIP CLEANER; G. W. Frazier, Pittsburg, Pa. App. filed Nov. 28, 1908. Has a floating central station with electrodes to be applied to the side of the ship, the electrodes being supported in the water and the metal exterior of the ship being likewise connected to a current supply.

981,930. ALTERNATING-CURRENT POTENTIAL SWITCH; D. Larson, Yonkers, N. Y. App. filed May 7, 1908. A switch with a small electromagnet including a magnet coil and magnet frame with a pole extending into the coil, and switch arm of magnetic material, a pole piece movable into the coil, the magnetic circuit being completed outside of the coil through the switch arm.

981,931. ALTERNATING-CURRENT ELECTROMAGNETIC SWITCH; D. L. Lindquist, Yonkers, N. Y. App. filed May 7, 1908. An electric switch with means for opening the switch, a strong spring acting as a resilient abutment when the switch is closed, a spring for closing the switch and a support for both springs.

981,933. SNAP CONTACT; R. W. Magna, Holyoke, Mass. App. filed Dec. 16, 1908. For connecting with binding posts of electric batteries by means of a clip with pivoted spring-pressed jaws and longitudinal jaws screw-threaded to insure an interlocking engagement with the screw-threaded binding posts.

981,948. HOLDER FOR IRRADIATING APPARATUS; J. Rosenthal, Munich, Germany. App. filed March 9, 1908. A holder for a radiating apparatus with a supporting pillar, holding frame and a connecting arm between the pillar and the frame with a clamp in which the pillar and arm are slidably-mounted and a lock for locking the clamp on the pillar.

981,987. ELECTRIC CIGAR LIGHTER; V. E. Extrom & T. G. Boardman, Tomahawk, Wis. App. filed March 25, 1910. The wires to be heated are supplied with current by a step-down transformer so as to use larger current, controlled by a push button.

981,996. TEMPERATURE ALARM; A. Goldstein, New York, N. Y. App. filed March 28, 1910. A pipe in loop form with open ends and diaphragm opposite thereto controlling terminals which actuate a circuit and alarm.

981,997. SIGNAL TELEGRAPH; A. Goldstein, New York, N. Y. App filed March 28, 1910. For sending signals from the different floors of the building by a single code wheel controlled by throwing out a switch at each floor.

981,998. ELECTRICAL THERMOSTATIC ALARM SYSTEM; A. Goldstein, New York, N. Y. App. filed May 2, 1910. An electrical thermostat including a case with a diaphragm operated by air expansion, the diaphragm making and breaking the circuit, the break alone operating an alarm.

982,006. PIPE AND CONDUCTOR COUPLING; C. H. Kayser, New York, N. Y. App. filed April 13, 1910. For connecting thin metal pipes containing conductors for high temperature lines by means of elastic packing rings, the conducting wires extending through openings in the walls of hollow cylindrical terminals in the rings and being wound around the terminals.

982,032. CONTROL OF ELECTRICALLY-OPERATED SWITCHES. E. R. Carichoff, Schenectady, N. Y. App. filed Sept. 19, 1910. The switches are operated in succession by electromagnet for controlling electric motors on trains. A two-wire notching controlled system is so arranged that the contactors are prevented from operation until one of the switch members of the relay mechanism has operated and closed certain contacts causing a reduction of resistance in the actuating circuit. One contactor cannot close until the actuating circuit of the succeeding contactor has been interrupted at the relay.

982,033. EMERGENCY OPERATING MEANS FOR REVERSING SWITCHES; F. E. Case, Schenectady, N. Y. App. filed Sept. 30, 1909. An electrically-operated reverser with operative abutments actuated by fluid pressure, a controller, a valve mechanism connected with the reversing handle of the controller for admitting fluid pressure to the abutment.

982,037. ELECTROLYTIC CELL; J. R. Crocker, New York, N. Y. App filed Sept. 30, 1909. For electrolizing salt and the recovery of caustic soda. The cell includes an anode and a cathode diaphragm comprising a supporting wire screen which is inclined together with asbestos paper and cloth in engagement with the screen, the diaphragm being impregnated with zinc oxide.

982,041. MOTOR CONTROL; W. N. Dickinson, Jr., New York, N. Y. App. filed July 3, 1906. For starting single-phase motors by means of a reversing switch, a brake, a brake-releasing magnet and a switch operated by the magnet for controlling the reversing switch.

982,052. ELECTRICAL SYSTEM FOR THE SUPERVISION OF WATCHMEN; A. Goldstein, New York, N. Y. App. filed May 10, 1910. A line circuit with an automatic transmitter operating at predetermined intervals, a telephone circuit with manual control for preventing signal transmission and an automatically-operating device for intermittently connecting the telephone to line.

982,067. ALTERNATING CURRENT MOTOR CONTROL; J. D. Ihlder, New Ynrk, N. Y. App. filed Jan. 15, 1907. An electric motor with a starting resistance, accelerating-magnet switches normally short-circuiting it, auxiliary resistances normally connected to a part of the motor, the accelerating switches controlling means for cutting out the auxiliary resistances.

982,074. SAFETY SLOW-DOWN AND STOP MOTION FOR ELECTRIC ELEVATOR; D. Larson, Yonkers, N. Y. App. filed May 18, 1909. Two switches connected in parallel and a circuit-breaker operating to slow down the elevator when both switches are opened at the same time.

982,097. ELECTRODE FRAME AND HANGER; C. B. Schoenmehl, Waterbury, Conn. App. filed Feb. 9, 1910. A negative plate with a frame for engaging edges of the plate with a horizontal top portion, with a single suspending rod and having elongated head with additional means upon the rod for securing the rod and horizontal portion together.

982,100. SOLENOID-OPERATED SWITCH; H. L. Smith, Schenectady, N. Y. App. filed June 8, 1906. Provides a connection between the core and switch arm operated thereby which permits the core to respond to variations in current, but maintains a constant pressure between the contacts when the switch is closed regardless of the variations of pull exerted by the core on variation of current supply.

982,110. OUTLET-BOX SUPPORTING BRACKET FOR ELECTRIC WIRING FIXTURES; S. Adelman, Chicago, Ill. App. filed March 15, 1910. An outlet-box with a thin metal bracket perpendicular to the box secured thereto for attaching it to a stretcher in the ceiling.

982,116. CIRCUIT BREAKER; H. P. Hall, New York, N. Y. App filed June 17, 1908. Calibrating device for electromagnets, comprising a trip coil, a rotating operating handle of the adjustable stop clamped by the rotation of the handle.

982,119. VAPOR ELECTRIC APPARATUS AND METHOD OF OPERATING THE SAME; C. O. Bastian, London, England. App. filed April 28, 1910. A positive electrode of solid material, an exhaustive envelope surrounding it, a column of mercury below the envelope connected thereto, a second column of mercury carried by the envelope and a solid metallic connection between the first and second columns.

982,135. METHOD OF PRODUCING FERROBORON; C. A. Hansen, Schenectady, N. Y. App. filed Dec. 22, 1908. Heats an alkaline earth consisting of boron in the presence of silicon and a metal forming an alloy with boron.

982,146. ELECTROMAGNETICALLY-OPERATED SWITCH; C. B Larzelere, Seneca Falls, N. Y. App. filed Aug. 2, 1910. A contactor with a relay and a mechanical connection between the contactor and relay whereby the contactor when opening opens the relay contacts and a latch holding the relay open which is tripped by the contactor in closing.

982,175. ELECTRICAL AGRICULTURAL SYSTEM; C. S. Doney, Columbia Falls, Mont. App. filed April 5, 1910. The field is provided with a power house and positive and negative feed wires on opposite sides which supply current to a traveling trolley system of trolley wires, the trolley wires supplying current to the plow or agricultural implement.

982,193. OUTLET BOX; F. I. Thayer, Farmington, N. H. App. filed Sept. 15, 1910. An outlet box to be incorporated in a wall for engagement with the lathes and plaster of the partition. Details.

982,209. BRIDGING TELEPHONE SYSTEM; H. F. Joeckel, Camp Point, Ill. App. filed Feb. 21, 1910. Balanced metallic talking-line current and ground return signaling line circuit, insulated from each other, in a party line bridging telephone system.

982,213. TELEPHONE SWITCH APPARATUS; S. A. Koltonski, Boston, Mass. App. filed Jan. 21, 1910. A two-part frame, the inner part carrying the circuit springs including those operated by the receiver hook and forming a unit, and the outer part carrying the switch operating devices, including the receiver-hook lever.

982,224. LIGHTNING ARRESTER; E. E. F. Creighton, Schenectady, N. Y. App. filed July 6, 1909. An electrolytic lightning arrester wtih a horn spark gap in series therewith and a lever carrying a wiper for passing through the gap, together with many improvements in the system.

982,227. APPARATUS FOR PRODUCING OZONE; L. Glaser, Pankow, Germany. App. filed July 20, 1907. A conductor of a certain class is mounted on the shaft of the motor and rapidly moved through the air in a casing, and a resistance with high positive temperature coefficient is connected in series with conductor to prevent it from losing conductivity by cooling.

982,228. MERCURY VAPOR APPARATUS; J. T. H. Dempster, Schenectady, N. Y. App. filed March 6, 1905. A vapor-electric apparatus with a movable diaphragm actuating an electrode and electromagnetic means for moving the diaphragm.

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ENGINEERS AS PRINCIPALS IN LARGE UNDERTAKINGS.

Favorable action on the recent proposal, noted elsewhere, of Messrs. Sprague and Crosby to equip and operate vast extensions to the New York city subway system, as routed by them, will be highly gratifying to all branches of the engineering profession, as a recognition of the capabilities of engineers to take a leading part in an enterprise the design, construction and operation of which are largely matters of engineering. In the present case it is solely a question of supplying transportation to meet a pressing need; the return on the property will be entirely dependent upon the engineering skill, technical and executive, exercised in its construction and equipment, and in operation the highest commercial skill would not avail to add a single fare to the income. Apparently the newspapers consider it somewhat novel for engineers to come forward as principals in a great undertaking like the present one, thereby reflecting a prejudice that no longer has any real grounds. An organization built up and directed by engineers is now constructing the Philippine railroad system at a cost greatly exceeding that required for the proposed New York subways; and in the past ten years a number of organizations essentially engineering in their personnel have grown up that financially control and direct the operation of electric light and traction syndicates, each representing investments of the order of millions. We are not informed of the engineering interests behind the proposal of Messrs. Sprague and Crosby, but almost any of these organizations would be amply able to secure the capital necessary to carry out the proposed undertaking, and their engineering departments could, with obvious expansions, take charge at once of all details of the work. Of one thing the public would be assured, if engineering interests instead of Wall Street financiers were to predominate in the design and operation of the new subways—the final capital charges would actually correspond to the outlay, and matters affecting the convenience of the public would, as they arose, be considered with relation to all operating factors and not be dependent upon the personal mood or the cupidity of a magnate trained in a school which regards the public merely as grist for the financial mill.

It is fitting that the name of Frank J. Sprague should be associated with a proposition of the character of the present one, involving as it does the highest interests of engineering. For more than a quarter of a century he has been one of the active factors in the great industrial development of that period. Taking hold of the electric motor when it was of little more than academic interest, he freed it of the incubus of the so-called "Jacobi's law" and in a few years forced its introduction throughout the world. Similarly, he later took the electric railway, then represented by a few crude trial roads, and in a few years placed electric traction, both at home and abroad, on a definitive commercial basis, well earning for himself the name of "Father of the Electric Railway." Foreseeing that electric traction had a future beyond the single-car unit, he next devised the multiple-unit system of control, which approximates the control of a train of electric cars to the control of a single unit. And when the first great step in the electrification of steam railroads was to be taken Sprague was naturally selected as a member of the commission to lay down the lines the work should follow. In all of this brilliant career three points of character have stood out strongly which, in an enterprise like that here considered, would stand the public in good stead—scrupulous honesty, persistency of purpose and an independence of "interests" that at times verges on the aggressive.

CANADIAN ELECTRICAL RECIPROCITY.

It is certainly a very interesting coincidence that just at the time when Canada and this country are trying to enter into closer and more friendly trade relationship an evidence of hearty good will toward America should have been given by the Canadian Electrical Association in its acceptance of a proposal to affiliate with the National Electric Light Association. The idea or plan originated wholly within the Dominion and is an exhibition of largeness of view and breadth of sentiment upon which our Canadian brethren are to be congratulated. The incident is probably unique in international engineering affairs, but the absolute identity of principles and practice in the industry as pursued on both sides of the border makes it easy to carry out an affiliation for which a large common membership is already the base. Nor is it less a happy coincidence that Canada should thus join hands electrically with us at a time when our own body has a Canadian for president and an Englishman for secretary—both to-day "good Americans" in every sense of the phrase.

For some time past the National Electric Light Association has been developing successfully its plan of geographic or State sections, and only within the last week or so Mississippi has voted to fall in line. This movement gathers strength as it goes, but obviously the Canadian union is of somewhat different character, as the constitution of our society makes no provision for such an international getting together. The N. E. L. A. has, however, shown a wise spirit in doing all that is possible to build up its geographic sections, and it will now be just as anxious to help make the Canadian Electrical Association bigger and stronger and more useful than ever, enjoying as it grows the fullest measure of autonomy. It seems not unlikely that the Canadian action will do much to stimulate the desire in our other State associations to become affiliated, for such an example of willingness to co-operate and such a belief in the doctrine that the greatest good will come from united effort must carry conviction with it.

The National Electric Light Association has, indeed, done much of late years to deserve the esteem and confidence of the electrical public, and its marvelous growth in membership has been accompanied by an equal growth in influence. The federation of the two bodies is a further guarantee that the National Electric Light Association will not be controlled by narrow views nor fall into the hands of cliques or selfish groups. Such dangers always beset large societies and cannot be watched against too vigilantly. If they had not been inspired by high ideals before, the leaders of the association would now assuredly feel called upon to justify by its work and usefulness the splendid confidence thus shown in them by their central-station colleagues in Canada. We cannot but felicitate both societies. The recent expansion of the activities of the National Electric Light Association has given it a place in the international electrical field which is now only comparable with the corresponding one occupied by the German Electrical "Verband," an account in detail of which appears elsewhere in this issue. While, however, the expansion of our body has thus far been confined almost entirely to the limits of the central-station industry, the German society has gradually absorbed every electrical activity which usually finds a manifestation in a society organization.

CENTRAL-STATION DATA.

Many interesting data have been contributed to the general fund of central-station information by the Commonwealth Edison Company of Chicago the past few years. In some particulars this company has been in a position to get exact information on important subjects which is difficult for most other central-station companies to obtain through their own experience. In a recent talk by Mr. E. W. Lloyd before the Chicago Electric Club some interesting facts were given in connection with the growth of central-station business in Chicago. One of the striking statements made was that the maximum yearly load had been more than multiplied by ten in a period of ten years. This is partly due to taking on a large electric railroad load, which is not common to other central stations, but is nevertheless instructive as showing what a company with sufficient foresight in its management can accomplish in the way of supplying the power needs of a great community. The statement that ice manufacture from central-station steam-generated power is to be begun the next season in Chicago is of considerable interest, as ice manufacture has heretofore been mostly confined to steam-driven ice plants using the exhaust steam as distilled water. However, if cheap enough, electric power from a great steam-turbine plant, or from a water-power, can be profitably employed in making ice from "raw" undistilled water by means of any of the systems whereby water during freezing is kept in agitation to prevent the freezing in of bubbles and impurities.

Another interesting figure given by Mr. Lloyd is that only 70,000 out of a total of 125,000 customers are household customers. In smaller cities and towns, as is well known, the proportion of household or residence customers is much greater under a management relatively as progressive as that displayed in Chicago. This simply illustrates the typical fact that our largest cities represent the most undeveloped fields for residence business. The Chicago company is now earning $4.50 gross annually per capita of population on lamp and motor business alone, exclusive of its railway load. This represents a most notable increase the past few years, and it is the more notable because, as has just been intimated, it has apparently been harder to bring the gross earnings per capita up to a high figure in larger cities than in the small cities and towns. Earnings of $6 to $8 per capita are found much more frequently than formerly, but usually among cities of less than 150,000 population.

Mr. Lloyd's statement that a form of contract giving a lower rate to off-peak business is to go into effect in Chicago is of considerable interest, because, although many smaller companies have tried the plan, it has been considered a specially difficult matter to enforce such contracts in large cities. The method of determining the customer's compliance with the off-peak clause in this case is to be by the use of a printing attachment on the watt-hour meter, which will record at regular intervals the watt-hours consumed, so that a record of the month is readily obtainable hour by hour. Mr. Lloyd gave as the ratio of the maximum load to the connected load of the system the factor of 2.5 to date, exclusive of railway business. This represents a total system demand factor of 40 per cent, which is lower than in days of old and will doubtless become still lower as the percentage of residence business increases

IMPROVEMENTS IN FLAMING ARCS.

A recent report of Professor Marchant, Liverpool University, on developments in electric lighting indicates that the flame arc, which is considerably used for street lighting in England, has been undergoing steady improvement, so that at the present time the efficiencies reached are even higher than was the case in the practice of a year or two ago. As our readers will remember, London has been a sort of out-of-door laboratory for trying new illuminants for several years, and the competition between gas and electricity has been sufficiently keen there to insure the latest types of illuminants being kept in use Street lighting is to a considerable extent a battle between "press gas" and flame arcs, in which the latter are fully holding up their side of the conflict. Professor Marchant has been testing a number of recent arcs in the sphere photometer and the results prove to be of no little interest. One familiar type of vertical-electrode lamp showed a specific consumption of a scant 0.27 watt per mean lower hemispherical candle-power on a consumption of as little as 280 watts. In other words, here was a 280-watt street lamp giving over 1000 actual lower hemispherical candle-power. A little more powerful type of the same arc consuming not quite 400 watts showed a specific consumption of but 0.17 watt per mean lower hemispherical candle-power. Considering that this type of arc gives its maximum candle-power about 25 deg. below the horizontal, and that this is more than double the hemispherical candle-power, its useful application to street lighting in face of any kind of competition is sufficiently obvious.

These figures show plainly enough that there has been steady improvement in the electrodes for this type of arc and that the results now attainable are materially better than those which have been reported in previous seasons. Of course, the difficulty of frequent trimming still remains and the cost of the electrodes is relatively high. Our present tariff bill, with its punishment of all the varieties of electrodes which anyone ever desires to import, of course, acts to check the introduction of flame lamps, although some excellent work has been done toward providing the material in this country. Whether the American central-station manager will eventually take kindly to more frequent trimming remains to be seen, but the indications are that he would do so if the cost of the electrodes themselves was less serious. The mere matter of trimming every day is not of itself forbidding, albeit it is undoubtedly rather a nuisance. It is worth noting that the two forms first mentioned here were both trimmed with so-called white-flame electrodes, which can accordingly be pushed to an efficiency altogether better than was at first believed to be possible save with the yellow electrodes. From an esthetic standpoint the advantage of the white electrode is perhaps a material one, and it certainly is of importance if the white flame can be obtained as is here shown with a really high efficiency. Flame arcs such as those tested by Professor Marchant seem a very effective answer to any question raised by the advocates of press gas, and we shall hope to see some of them thoroughly tried out in this country, both as an example of what is being done by our friends across the water and as a stimulus to the art in general.

THE HEUSLER ALLOYS.

About eight years ago it was discovered by Heusler that certain alloys of copper, manganese and aluminum—substances which are non-magnetic in the pure state—are powerfully ferromagnetic. It is believed that the magnetic properties of the alloys circle around the manganese component as center, because the aluminum may be substituted with a certain degree of success, and the copper appears to play the part of a diluent, which at the same time helps to make the alloy malleable. The highest magnetic flux density yet produced in such alloys in low magnetizing fields appears to be about 11 kilogausses, or about equal to that obtainable in cast iron. An interesting research on Heusler alloys has recently been published by Mr. A. A. Knowlton in *The Physical Review*. It appears that when microphotographs are made of samples of these alloys they reveal white crystals embedded in the mass According to the conclusions obtained from the research, the magnetic capabilities of the sample depend upon the proportion of these crystals to the total mass; so that not only could the magnetic behavior of a sample be predicted from an examination of its microphotograph, but also the magnetic intensities developed were found to be practically in proportion to the ratio of the surface occupied by white crystals to the total surface of the microphotograph.

On the other hand, the actual magnetic condition of the sample did not always correspond with the crystalline areas. apparently for the reason that the proper temperature treatment adapted to each sample had to be used in order to elicit its latent magnetic properties. That is, the extent of the crystalline areas betokened the capacity for magnetization. under the proper temperature conditions, and not the actually existing magnetic state. Where no crystals could be found no thermal treatment was effective in developing magnetic properties. The sudden changes in magnetic condition following changes in temperature appear to be associated with corresponding discontinuities in electric resistivity, but neither with any perceptible change in microphotographic structure nor with any perceptible change in internal heat energy. Consequently, the changes occurring within the white crystals from the magnetic to the non-magnetic condition must be delicate or recondite changes, as distinguished from profound and easily detected changes. It is interesting to remember that the substance of ordinary soft magnetic iron contains, under the microscope, numerous crystals and shows an essentially crystalline structure. This suggests that the crystalline state of molecular aggregation is associated in some way with the magnetic properties of a substance. In other words, the observations on the Heusler alloys suggest that the magnetic properties of a substance may not be molecular, but may pertain to certain symmetrical structures of the molecules of the substance A single molecule might not be magnetic, although the group might be

Proposal for Independent New York Subway.

Messrs. Frank J. Sprague and Oscar T. Crosby, as representatives of certain independent financial and engineering interests, have submitted to the Public Service Commission of New York City a proposal for the equipment and operation of an independent subway system, the cost of which as estimated would not exceed $75,000,000. The proposal outlines the routes of the subway, which in its details differs from the present subway in the rearrangement of stations, including the abolition of reservoir platforms and transition tracks; reduced dimensions, but ample to accommodate the standard size of urban car, with suitable track ballasting; abolition of walls between tracks on the same level, and independent forced ventilation so that the limits of practicable schedule may not be impaired by the imposition of excess duty on train equipment.

Upon construction the lease of the road is to be on an indeterminate franchise basis to an independent operating company having an authorized stock and bond capital of $40,000,000. The proposition of Messrs. Sprague and Crosby is for the equipment and operation of the subway, which is to be built by the city according to the plans drawn by the engineers of the Public Service Commission in consultation with the engineers of the operating company, the plans to have joint approval.

Proposed German Patent Legislation.

Complaint has been made by some German manufacturers against the United States patent agreement of 1909, which is stated to have established a condition of affairs very unjust and highly detrimental to the interests of German patentees. By this agreement American owners of German patents are entirely relieved from the obligation to work their German patents either in Germany or the United States, whereas Germans are still obliged to work their patents in Germany.

With a view to removing this unjust discrimination and placing Germans at least on an equal footing with Americans in regard to the maintenance of their patent rights in their own country, it is now proposed to amend or alter the German Patents act. To that end the Imperial Chancellor has recently submitted to the governments of the various German federal states a draft of an act relating to working obligations in regard to patents.

The act provides that if the patentee, even on being offered an adequate remuneration of security, refuses to grant another person the permission to use the invention, the patent can be revoked or the right to use the invention adjudged to the other person, if the granting of such permission is found advisable in the public interest (compulsory license). Such right can be granted with restrictions and made dependent on conditions. Moreover, so far as international conventions do not interfere, the patent can be revoked if the invention is being exclusively or chiefly worked outside the German Empire or the colonies, but no decision can be rendered against the patentee before the lapse of three years from the publication of the granting of the patent.

When a motion asking for revocation of a patent on account of refusal to grant a license has been filed, the decision entertaining such motion must be preceded by a warning to the effect that revocation will ensue, at the same time stating the reasons and fixing an adequate time limit.

Under the proposed act, as it now reads, a patent cannot be revoked as heretofore for failure to work the invention in Germany, but it can be revoked—or the patentee's right thereto restricted by a compulsory license—if the patentee refuses to grant others the right to use the invention for an adequate remuneration or security offered by them, provided, however, that the granting of such permission be found advisable in the public interest.

Central-Station Investigation in St. Louis.

The investigation into the affairs of the Union Electric Light & Power Company, of St. Louis, made by the Public Service Commission of that city, reached an interesting stage on Jan. 24, when the company filed a formal statement with the commission. In this statement it is said that the cash cost of the property and business last spring was $23,411,867. For a long period of years the company failed to earn any return upon its investment, and assuming that 8 per cent was a fair return the deficit amounts to $5,739,369. Therefore, the company argues, the total investment in the company's property and business, represented by the cash put into the property and the amount which the investor has failed to receive back in the earlier years, is more than $29,000,000.

As to rates, it is said that the average rate charged by the Union company for electric service is lower than the rates prevailing in Boston, Brooklyn, New York or Chicago, and about the same as the average rate in Baltimore.

For the purpose of estimating the amount of money it would take to reproduce the existing property in business the company has retained the firm of Ford, Bacon & Davis, and they report that such cost would be about $26,000,000, without taking into account the deficit from early operation. The company asks the right simply to earn a return on its actual investment. To support its contentions it has called as witnesses Mr. C. F. Uebelacker and Mr. William Von Phul, of Ford, Bacon & Davis, and Prof. M. E. Cooley, dean of the engineering department of the University of Michigan.

President Alten S. Miller, of the Union Electric Light & Power Company, has made a report to the stockholders in which he says that the increase in gross revenue during the year 1910 was 9.3 per cent. The increase is due entirely to the increased sale of energy, since the average rate per unit sold has decreased 2 per cent below the corresponding rate for the preceding year. During the year there was an increase in operating expenses, including $29,000 for the St. Louis Public Service Commission investigation and $6,000 for the government income tax. However, the net profits were somewhat in excess of the net profits of 1909. Gross income in 1910 was $3,371,520 and net earnings $780,968. Six per cent is paid on $9,885,000 capital stock.

In conclusion Mr. Miller addressed his stockholders in relation to the public service investigation as follows: "We believe that it is immeasurably to the interest of this company and its stockholders and bondholders that the commission and the company's consumers, and the public of this city as well, be afforded the fullest and clearest information as to its service, properties and every other element affecting its business. Publicity with regard to all these matters will be of benefit to the company and to the public. This policy in its widest possible application has been adhered to throughout the inquiry."

On Jan. 25 Mr. Carroll Miller, of Providence, R. I., brother of the president of the Union Company, was a witness before the commission to show the value of development work in public-utility operations. The commission will make its report to the Municipal Assembly at the conclusion of the hearing.

Terminal Electrification at Boston.

The Joint Commission on Metropolitan Improvements, consisting of the Massachusetts Railroad, Harbor & Land, Metropolitan Park and Boston Transit Commissions, has submitted a report to the Legislature upon the electrification of steam railroads in the Boston district. The report declares by a vote of nine to seven that it is inexpedient to require the railroads to electrify their Boston lines at the present time on account of the great cost of the work and the absence of a so-called standard system of electrification. The board feels that the wisest course is to enact no legislation whatever, but to let the problem work itself out without interference by the

State. It contends that only twelve or fifteen miles radius could be electrified for the estimated cost of $40,000,000 on account of the large number of radial lines feeding the suburban districts. The board states that there seems no reason to suppose that economies would be found that would make electrification profitable to the companies for a considerable time to come. Judging from the experience in New York, the commission states, it would entail a loss in excess of the interest on the new capital required and it would be necessary to raise the suburban fares in order to furnish the required revenue. The board feels that electrification is a luxury and that if the State Legislatures begin to enact laws compelling the expenditure of large sums for a luxury there is serious danger that the roads will find it difficult to raise the money they need even for necessary improvements. In New York the only requirement has been the discontinuance of the use of the steam locomotive south of the Harlem River on account of the danger of tunnel operation. In Boston the projects for a tunnel connecting the North and South stations and a tunnel under Boston Harbor, if carried out, will necessitate electrical operation which will have to be extended to convenient points beyond the tunnel at each end. This will lead to gradual and not forced extension of the system. Even in this case some increase in revenue may have to be obtained by the roads, but there will be other economies due to the tunnel which will partially offset the cost of electrification.

The minority of the joint board includes the majority of the Massachusetts Railroad Commission and two members of the Boston Transit Commission, who dissent from the conclusion that the cost of electrification is too great to justify legislation requiring the railroads to prosecute it at present. In the opinion of the portion of the joint board which possesses the preponderance of expert transportation knowledge experience elsewhere has demonstrated both the feasibility and the financial ability of railroad corporations to equip a portion of their lines with electricity, and these members find no conditions in Boston or its vicinity which lead them to a different conclusion. They point out that the officers of the New York, New Haven & Hartford Railroad have stated publicly on several occasions their purpose, if allowed to control the Boston & Maine system, which control is now effected, to equip both systems with electricity for a considerable distance near Boston, and they also emphasize that the further proposals of the New Haven management to electrify the Revere Beach road if acquired are evidence that electrification to some extent is both feasible and within the financial ability of both companies. The studies submitted to the joint board by the Boston & Albany Railroad also indicate feasibility within a cost far from prohibitive. The minority states that it is convinced that the public welfare demands some legislation with respect to electrification, and that while it is not in favor of compelling the electrification of all steam railroads of standard gage within the Boston district before a date now to be fixed, the minority does not believe that leaving the matter in the hands of the several railroad companies exclusively will result in as speedy action as will follow some legislative requirement indicating the policy of the State. The whole question is now thrown upon the Legislature, and in view of the growth of public sentiment in the last two years in favor of electrification it is certain that there will be an active discussion of the subject before the close of the present session.

New York Companies' Section of the N. E. L. A.

The New York Companies' Section of the National Electric Light Association was fully organized at a meeting held on Tuesday, Jan. 24, in the Twenty-seventh Street auditorium of the New York Edison Company. This section, which includes all the lighting companies of Greater New York, with the exception of the Brooklyn Edison Company, which has its own separate section, bids fair to be one of the most successful in the association, having already a membership of 500. The officers of the section were unanimously elected as follows: Mr. Arthur Williams, the New York Edison Company, chairman; Mr. J. F. Becker, the United Electric Light & Power Company, vice-chairman; Mr. E. S. Bellow, Westchester Lighting Company, treasurer; Mr. Jesse Richards, New York & Queens Electric Light & Power Company, executive secretary; Mr F. C. Henderschott, the New York Edison Company, recording secretary.

The executive committee consists of the following: Messrs. F. W. Smith, United Electric Light & Power Company; H. M. Edwards, the New York Edison Company; C. G. M. Thomas, New York & Queens Electric Light & Power Company; J. T. Cowling, Westchester Lighting Company; H. E. McGowan, Flatbush Gas Company; J. E. Phillips, Richmond Light & Railroad Company; J. M. Butler, the Bronx Gas & Electric Company; Carleton Macy, Queens Borough Gas & Electric Company; Stuart Wilder, Northern Westchester Lighting Company; I. M. Beatty, Peekskill Lighting & Railroad Company; J. P. Radcliff, Jr., Yonkers Electric Light & Power Company.

Rumored Telephone Combination.

Prominent Ohio Independent telephone men say they have no knowledge of any plan to consolidate all the telephone properties between New York and Denver into one giant corporation, as was reported from St. Louis, New York and other places last week. It was said that J. P. Morgan & Company had sent out a tentative proposition for the consideration of the big Independent companies at St. Louis, Kansas City, Joplin and other places, and that the officers and directors would probably look with favor upon the offer which would put their properties into about the same position as those of the United States, Cuyahoga, Columbus Citizens', Toledo Home and Dayton Home telephone companies.

The Ohio men state that plans have been completed to do away with the dual system in that State through the absorption of the Bell exchanges in the towns and small cities by the Independent companies, and that in all probability only two or three of the largest local exchanges will be retained by the Morgan interests. In that way they believe that eventually there will be but one local company in each county, except where a county has several large towns, each of which may have a company.

In most cases the stock of the local companies will be held by local people and managed by them. The claim is made that companies owned by local men have proved a success, while the Bell exchanges, under the ownership and management of a company owning a large number of properties, have made small returns on the investment and have proved unsatisfactory in other ways. It is for this reason that the Bell interests are willing to dispose of the properties at figures favorable to the Independents.

The idea, the Independents say, is to take the lead in doing away with the dual system of telephones, under the new conditions that have arisen, and other states are expected to follow the lead. If possible, a law will be secured that will allow the merging of local companies, under proper conditions, with the business under the supervision of a public-utilities or special commission. Some of the other states have no laws preventing such mergers, and action will not have to be taken in them. But where this is necessary it is the plan of some of the Ohio men to set an example that may be safely followed by both the companies and the people, as they propose to play a fair game, with everything made public, in the future.

J. P. Morgan & Company, it is said, are in accord with all that is being done along this line and are willing to abide by the terms of the proposed law, which will require the conduct of the business to be in strict accord with fairness to the people who patronize the companies. The modern view of the operation of public utilities is to be observed and everything will be open and aboveboard, if the Legislature adopts the ideas that will be presented to it.

Telephone Rate Investigation in Chicago.

The hearings before the City Council committee on gas, oil and electric light in relation to the question of revising telephone rates in Chicago resulted in a disagreement. Alderman Pringle, chairman of the committee, says that the committee has found as the result of its investigations that the Chicago Telephone Company has a surplus of $216,000, and the committee believes that existing telephone rates should be decreased to an equivalent of that amount. Mr. W. J. Hagenah, the expert retained by the city, has been instructed to prepare a reduced-rate schedule, which will be taken up at a meeting of the committee to be held about Feb. 7.

On behalf of the company President B. E. Sunny is emphatic in saying that the company will not accept reduced rates unless it is compelled to do so by the courts. Mr. Sunny is quoted as saying: "There is not a chance of our company adopting reduced rates. We are operating on an absolute minimum margin and any reduction would nearly ruin the company."

A long statement has been issued by the company, reciting the contentions already given in the accounts of the investigation printed in this journal, with some other arguments. It is pointed out that Mr. Hagenah's figures as to the value of the company's property in Chicago are $4,600,000 less than the company's estimate. After an allowance of 8 per cent for dividends on the value so reduced and 5½ per cent for depreciation, the Council committee puts the surplus for the year 1909 at the $216,000 referred to. If this amount is wiped out by reducing rates during the next five-year period, the company says it will close each year without a dollar in its treasury in excess of the cost of operation, interest on capital stock and depreciation.

Further, the company contends that no allowance is made for the expense to which it will be put to remove its underground cables to make way for the proposed passenger subway in Chicago, for the installation of meters at customers' stations, or for any increase in the payroll of the company. Again, the company contends strenuously that the city has refused to allow it to purchase the telephone property of the Illinois Tunnel Company and that, therefore, it is about to be subject to competition. The company points out that if its rates are to be regulated by competition it is an unusual and unheard-of thing that they should likewise be regulated by the municipality. Municipal regulation necessarily means the exclusive right to conduct that class of service. The company does not ask for a general increase in rates, but it argues that some classes of service which it is now furnishing at a loss, and which are discriminatory, should, together with other needless items of expense, be abolished.

Competing Automatic Telephone Service in Chicago.

The speaker at the meeting of the Electric Club of Chicago on Jan. 18 was Mr. H. D. Critchfield, of the Automatic Electric Company, who gave an interesting account of the automatic telephone exchange system now in process of construction in Chicago for competition with the manual service of the Chicago Telephone Company. He said that the Chicago Telephone Company operates 240,000 telephones in Chicago as the result of thirty-three years of business life. This represents 100,000 lines of central-office equipment connected to about thirty exchanges. The present rehabilitation of the automatic telephone service by the Subway Telephone Construction Company for the receivers of the Illinois Tunnel Company began on May 6, 1910, and there are now more than 37,000 prospective subscribers who have signed contracts for the automatic service, each taking an individual line. Comparing these individual subscribers' lines with those of the older company, it will be seen that the competing company has more than one-third as many. The automatic company has established eight exchanges—four in the central Loop district, two on the South Side, one on the West Side and one on the North Side. The exchanges in the Loop district have a capacity for 24,500 lines and the four outside exchanges have an initial capacity of 5000 lines each and an ultimate capacity of 10,000 lines each.

In the rehabilitation of the automatic service twenty-seven miles of trench have been built, exclusive of the sixty-two miles of tunnels underlying the central business district and used for the cables of the automatic service. In the trenches 118 miles of conduit has been installed. The automatic company must have 20,000 bona fide subscribers by June 1 of this year, but according to present indications that number of subscribers will be connected up by April 1. The number of automatic telephones actually connected on Jan. 18 was 3900 and installations were being made at the rate of 260 a day—a rate which will be greatly increased.

The automatic service will not be limited to the 20,000 subscribers required by the contract with the city, but a general competing telephone service will be given at a rate of $50 a year for residence telephones and $85 a year for business houses, unlimited individual-line service being given in each case.

Mr. Critchfield said that the existing manual service is as efficient as it is possible to give under the conditions encountered in that service. He contended, however, that it is impossible to give as efficient service, or service rendered at as low a cost, by the manual system as by the automatic system. He pointed out the difference in payrolls for one thing The annual payroll of the Chicago Telephone Company, he said, is $1,528,000. To give the same service under similar conditions the automatic exchange would need a payroll of but $375,000 a year. This includes actual operating expenses, but no overhead charges. The difference between these two sums is equivalent to almost 6 per cent on the total appraised valuation of the Chicago Telephone Company.

Considering efficiency of service, the speaker said that an automatic telephone connection is made in about six seconds and the length of time required does not increase as the number of subscribers increases. On an average the manual system requires twice as much time. This means 4000 hours of subscribers' time wasted daily in Chicago, and this time is computed to be worth $720,000 a year.

By the automatic system there is no interruption during conversation, and there is an instantaneous release on the conclusion of the call. There seems to be a feeling in the telephone field, said Mr. Critchfield, that no one has a right to do business but the original people, nevertheless, the 37,000 contracts secured for the Illinois Tunnel Company show that the public wants more telephone service than it now has. There is room for the newer telephone business. Complaint is often made of the telephone operator, but the fault is not hers once in ten times. The operator is usually doing the best she can with what she has to do with; the fault is with the manual apparatus, wonderful as it is. The telephone service is very important to business interests, and with two telephones, connected to two distinct systems, the chance of total interruption of telephone service is almost negligible.

It was denied by the speaker that the automatic apparatus runs down quickly owing to wear and tear. He cited the example of the Grand Rapids (Mich.) automatic exchange to prove this. Under a seven-year guarantee in Grand Rapids the manufacturing company was called upon to replace parts in the automatic exchange valued at only $962.34 in a system that grew from 4500 to more than 11,000 telephones in the seven-year period. The depreciation on the automatic system is much less than than on any manual system. The first cost of equipment for automatic service is about one-third less than for corresponding manual service. In the items of conduit, cables and trenching the original cost is conspicuously less Mr. Critchfield also mentioned the examples of the Fall River (Mass.) and San Francisco exchanges to prove the success of the automatic telephone system. There was no discussion.

Chicago Automobile Show.

At the Chicago Automobile Show, opened on Jan. 28 at the Coliseum and First Regiment Armory, and to last a week, nearly all the makers of electric pleasure vehicles are represented. The interiors of both the Coliseum and the Armory are handsomely decorated, the former in Louis XV style and the latter as a formal English garden. Both arc and incandescent lamps are used for lighting, and with tall illuminated columns, artistic lamp standards and bowls of foliage plants, with light showing through apertures in the vases, the effect is very pleasing.

The list of exhibitors of electric carriages is as follows: Anderson Electric Car Company, Detroit; Babcock Electric Carriage Company, Buffalo; Baker Motor Vehicle Company, Cleveland; Broc Electric Vehicle Company, Cleveland; Hupp-Yeats Electric Car Company, Detroit; Ohio Electric Car Company, Toledo; Rauch & Lang Carriage Company, Cleveland; Studebaker Brothers Manufacturing Company, South Bend, Ind.; Waverley Company, Indianapolis; Woods Motor Vehicle Company, Chicago. The vehicles shown are rich and attractive, but as they are smaller than the gasoline machines and usually, but not always, finished in somber black, they are less conspicuous than their more showy neighbors.

A large variety of automobile accessories are shown in the galleries of the two buildings. Those of electrical interest are displayed by the following named exhibitors: Adams & Westlake Company, Chicago, ignition lighting system; Connecticut Telephone & Electric Company, Meriden, Conn., magnetos, steering-wheel switches, etc.; Electric Storage Battery Company, Philadelphia, Exide batteries; James L. Gibney & Brother, Philadelphia, electric vulcanizer for tire repairs; Heinze Electric Company, Lowell, Mass., magnetos, spark plugs, etc.; Kokomo Electric Company, Kokomo, Ind., ignition specialties; K-W Ignition Company, Cleveland, "high-tension" magneto; Lutz-Lockwood Manufacturing Company, Aldene, N. J., ignition dry cell; National Carbon Company, Cleveland, ignition dry battery; Pittsfield Spark Coil Company, Dalton, Mass., spark coils; Simms Magneto Company, New York, magnetos, spark plugs; C. F. Splitdorf, New York, magnetos, spark plugs; Standard Welding Company, Cleveland, electrically welded parts; United States Light & Heating Company, New York, vehicle and ignition batteries; Vesta Accumulator Company, Chicago, batteries, magnetos, lighting specialties; Warner Instrument Company, Beloit, Wis., auto-meter (speed indicator based on magnetic pull of annular permanent magnet).

Following the exhibition of pleasure cars there will be a week's showing of commercial motor vehicles at the Coliseum, Chicago, from Feb. 6 to 11, inclusive. In this show, also, there will be a number of electrical exhibits.

The Design of Electric Heating Appliances.

Mr. Charles P. Madsen, engineer for the Pelouze Electric Heater Company, Chicago, gave an instructive talk before the Lewis Institute Branch (Chicago) of the American Institute of Electrical Engineers, Jan. 25, on the subject of "Electric Heating Development."

After referring to the erroneous conceptions regarding "carrying capacity" and the significance of mere resistor material which the electric heating engineer is likely to carry with him from other fields of apparatus design, Mr. Madsen declared that the real problems in heating-appliance construction are the choice of current-carrying material of proper stable physical characteristics and the use of insulation able to withstand high temperatures unaffected. Practical resistor materials used commercially are of three classes: (1) *Loose compositions,* in which the resistance is due to loose contacts between integral particles. Cryptol, a special crystallized carbon, carborundum and pure silicon are examples of this class. Such heating elements secure high temperatures, but are cumbersome and have a large factor of variation, presenting an initially high resistance when cold, which lowers, admitting more current, as the element warms. Such elements, therefore, heat comparatively slowly. The particles are also consumed with use, changing the resistance characteristics of the element in time. (2) *Chemical precipitates,* such as the gold-chloride coating given an insulating surface, in the case of certain foreign apparatus. Here the thin deposit forms the resistance element. (3) *Metal wires,* including the newer special alloys. The low resistance of pure copper makes it bulky to use as resistor metal, while it has the further disadvantages of melting at 2200 deg., oxidizing at 1800 deg., and tending to sublime or evaporate above 500 deg. German silver, despite its high resistivity, has certain physical objections. Nickel-copper and nickel-chromium alloys, appearing under many trade names, have proven extremely successful. Nickel-steel, on the other hand, has been a sore disappointment, said Mr. Madsen. A nickel-chromium compound offered on the market contains additions of manganese and iron. An important advantage of nickel-chromium is that it is not chemically affected at high temperatures, a slight film of oxide being produced which protects it effectively. Being black in color, the oxide assists in radiating the heat. Copper-nickel compounds are useful for developing large quantities of low-temperature heat. For temperature below 300 deg. Mr. Madsen recommended copper-nickel; above this, nickel-chromium alloy. Iron is affected at high temperatures, but is useful in certain applications.

Mr. Madsen looked forward to important developments and improvements in satisfactory insulating material for heating-appliance work. At present lava, porcelain and mica are successfully used, although all of these are slightly affected in high-temperature service. Mica, besides its occurrence in small pieces in nature, has given trouble from hidden metallic salts between its laminæ, which when heated are reduced to metallic form, causing short-circuits of live parts. Built-up mica blocks may have the binding lacquer evaporated out after use, allowing the mica chips to fall apart. Although generally understood to be useful as high-temperature insulators, asbestos, glass and water glass are worthless, since they become conducting after being heated.

Heat energy is transmitted away from the element in which it is produced by three methods: conduction, radiation and convection. Embedded-wire construction employs conduction; open-wire, conduction and radiation; and the suspension-type, radiation and convection. In a toaster of the last-named type, exhibited by Mr. Madsen, the heating elements, reaching a temperature of 1000 deg., have the ¼ in. expansion in their 4-in. lengths compensated by mica springs. A reflector below the heating element redirects all downward radiation upward onto the utensil bottom, securing an efficiency of 82 per cent for this device, contrasted with the usual efficiencies of 20 per cent to 50 per cent of average iron-top disk-stoves. The speaker also exhibited a copper-top disk stove in which advantage is taken of the thermal conductivity of copper to convey heat as rapidly as it is transferred across the points of contact (even if few in number) with the irregular utensil, following the principle of the soldering tip. This stove displayed an efficiency of 68 per cent. Heretofore the softness and tendency of copper to warp prevented its use for disk-stove tops, but the top shown, although comparatively thin, was braced rigidly by a bridge construction beneath the heating element. In closing, Mr. Madsen discussed the manner of carrying on the design of heating appliances and spoke of the "factor of lag" in embedded-wire construction, which may allow the actual temperature of the wire, accompanied by its resistance, to rise, diminishing the current taken below the value corresponding to the desired temperature as given in the wire manufacturer's tables.

Street-Railway Service in Chicago.

Choosing as his subject "Transportation in Chicago," Mr. L. H. Davidson, assistant secretary of the Board of Supervising Engineers, Chicago Traction, addressed the Electric Club of

Chicago briefly at the weekly luncheon Dec. 14. Mr. Davidson gave an account of the very marked improvement in street-railway conditions in Chicago within the last three years as the result of the adoption of the "traction settlement" ordinances and their enforcement under the direction of the Board of Supervising Engineers. He told of the interest excited in other cities, and, indeed, in other countries, by the working out of the unique plan adopted in Chicago.

About 1,020,000 passengers are handled daily in and out of the downtown district in Chicago by the transportation companies of the city. Something over one-half of this number are transported by the surface railways, the elevated and steam suburban railroads taking the remainder. The street-railway equipment has been improved in every way since the rehabilitation was begun under the ordinances, and whereas the general purchasing power of a dollar has steadily decreased in the last few years, the purchasing power of the carfare nickel has as surely increased. To-day a street-railway passenger in Chicago gets a longer and more comfortable ride than ever before. The service is more frequent, and the cars are modern, well lighted, well heated and well ventilated.

To bring about these improvements large amounts of money have been expended. On Dec. 1, 1910, the grand total of the capital account of the surface railway companies, excluding the Consolidated Traction Company, was about $111,000,000, nearly equally divided between the original valuation allowed when the 1907 ordinances were adopted and the amount that has gone into actual tangible improvements since that time. The investment includes about 765 miles of track and 3000 cars, of which 2200 are of the large, double-truck type. There are thirteen substations for the distribution of electric energy, with a combined rating of about 100,000 kw, as well as twenty-six car houses.

Under the supervision of the Board of Supervising Engineers the rehabilitation has included the reconstruction of 415 miles of trolley wire, 1150 miles of cable, 200 miles of conduit in streets, 1200 duct-miles in conduits and nearly 3000 manholes.

The reconstruction work is rapidly nearing completion. The Van Buren Street tunnel under the Chicago River is now in operation, and tracks are being laid in the Washington Street tunnel, while work is progressing rapidly on the La Salle Street tunnel. The last named will consist of a double-steel tube sunk in the bed of the river. The work of relocating elevated railway columns to permit new curves for through routes in the downtown district is proceeding rapidly.

Besides accomplishing these results, the traction ordinances provide for the payment of 55 per cent of the net receipts from operation to the city, and from this source the city has received nearly $5,000,000 up to date.

In the discussion Mr. Ralph H. Rice, assistant division engineer of the Board of Supervising Engineers, pointed out that something over 7,500,000 lb. of copper has been placed in overhead trolley wires and underground feeders and auxiliaries as a result of the rehabilitation process. All purchases have been made under standard specifications.

Mr. T. Milton, of the Electric Storage Battery Company, described briefly the storage battery at the Plymouth Place substation. This battery was installed to carry the morning and evening peak. The railway company pays a fixed amount for its maintenance, and the battery shows a net saving on the investment. It carries a load of about 5000 amp during the morning and evening rush hours.

Mr. George P. Nichols commented on the improved service in Chicago, and also remarked that the companies evince an honest desire to remedy defects when complaints are made to them.

Mr. William Artingstall, one of the engineers of the Board of Supervising Engineers, described briefly the manner of constructing the steel-tube tunnel at La Salle Street. This tunnel consists of a steel shell 278 ft. long and about 24 ft. in diameter from top to bottom. It is a double bore, and each section is lined with reinforced concrete. The structure will be floated into place and sunk when the approaches are ready. In its work in the river at this place the Board of Supervising Engineers has erected the deepest cofferdam ever constructed, with the highest reinforced-concrete retaining walls for the approaches. In the Van Buren Street tunnel the grades in the approaches are as high as 11.5 per cent, but in the La Salle Street tunnel there will be no grade higher than 10 per cent.

President F. P. Vose and Mr. Davidson praised the work of the Chicago mounted police in regulating street-railway and other traffic in the central downtown district. Messrs. D. W. Roper and F. J. Postel also spoke briefly.

Regulation of Telegraph and Telephone Companies in New York.

A section of the annual report for 1910 of the New York Public Service Commission, Second Distict, relates to the division of telegraphs and telephones. By an amendment of the law which became effective on Sept. 1, 1910, the powers of the commission were enlarged so as to include corporations furnishing these services.

In the case of telephone corporations operating within the State and engaged in interstate business the statute places a part of them under the jurisdiction and supervision of the commission and exempts a part. The report says it is a matter of embarrassment and much to be regretted that the statute provides no means of determining whether a telephone corporation is under the supervision of the commission, and especially in the case of those corporations which are exempted by reason of the fact that they do not have property actually used in the public service within the State of a value exceeding $10,000. The commission points out that it has no power to examine and appraise the property of a corporation not within its jurisdiction for the purpose of determining whether it has jurisdiction over the corporation and its property, but declares that if it had such power it is questionable whether it would be practically effective, owing to the very large number of such corporations operating within the State which at least claim that they have not property exceeding $10,000 in value. This would make the task of appraisal an exceedingly long, expensive and laborious process.

To handle the additional work imposed by this additional jurisdiction a separate division of telegraphs and telephones was established, with a chief of the division in charge and a corps of assistants and inspectors.

In compliance with an order schedules have been filed by a large number of the telephone corporations. The report adds: "It appears from these schedules that in the past the corporations have put themselves in the position of charging one person more than they charge another for substantially the same rates. In the case of the New York Telephone Company alone, out of a total of over 337,000 subscribers, some 31,000 are being served under old contracts at obsolete rates, involving a difference of more than $284,000. Other companies show similar percentages of discriminatory rates, and only a few have reported no obsolete rates in effect at all.

"The public service commissions law clearly recognizes in various provisions that discrimination is not always unjust and should not always be made unlawful. It is only unjust and unfair discrimination which is condemned by that statute. When full examination and consideration have been given to the subject, if any of the existing discriminations are found to be just they can be allowed to stand. As to such as are unjust it will be the duty of the commission to issue an appropriate order requiring all such rates hereafter to conform to the standard schedules filed by the corporations. This will undoubtedly have the effect of raising the rate paid by a considerable number of persons throughout the State. It is to be anticipated that the persons affected thereby will consider that they have a vested right to the lower and discriminatory rate which they have been heretofore enjoying, and will feel that the effect of the public service commissions law and of the action of the commission thereunder has been to raise all rates. It is to be anticipated that the corporations affected may through their employees give assurance that the raise in rates which is occasioned by such order is chargeable solely to the commission and to the working of the public service commissions law.

"The commission, however, deems that it has a clear duty to perform in this respect and should not be deterred therefrom by fear of any criticism arising from persons who have heretofore enjoyed the benefit of favor or discrimination."

Now that all public service corporations using poles and wires within the streets and highways are under the supervision of the commission the report says that an important line of action may be undertaken by the commission relative to the many fatal accidents which occur, including among the victims both the employees of the corporations and the traveling public. At the same time due consideration may be given the question of the numerous and unsightly poles and fixtures which occupy the streets of many of the municipalities. After a proper study of these matters, rules and regulations may be framed which will be calculated to improve existing conditions.

The commission has directed the division of statistics and accounts to prepare a form of annual reports and a uniform system of accounts for telephone corporations.

Attention is called to the fact that the use of telephones in train dispatching is supplanting the Morse telegraph system on a number of lines. On some roads a portable telephone equipment is carried on passenger trains.

Mid-Year Meeting of the American Electric Railway Association.

The American Electric Railway Association held its annual mid-year meeting in the Engineering Societies Building, New York, on Jan. 25, 26, 27 and 28. The activity of the association during the meeting was confined to the holding of conferences by the numerous committees to which the work of the association is delegated.

On Wednesday, Jan. 25, meetings were held of the committee on standard classification of accounts, the executive committee of the Claim Agents' Association, the committee on schedules and time-tables, the committee on transfers and transfer information, the committee on block signaling for electric railways and the interurban rules committee. Each committee selected subjects for discussion at the next convention.

At a meeting of the joint shop accounting committee of the Accountants' and Engineering Associations, held on Thursday, a sub-committee was appointed to report on what constitutes maintenance, in order to distinguish between ordinary replacements and those that constitute a proper addition to capital account. The committee as a whole decided to make a study of efficiency and incentive systems in the shops, such as premiums, piece work and bonuses. Definite recommendations will be offered for consideration at the next meeting of the entire committee, which will probably be held next May.

The executive committee of the Manufacturers' Association at a stated meeting held on Thursday appointed a special committee consisting of President Charles C. Castle, Secretary George Keegan and four others to select the time and place of the next convention.

The executive committee of the Accountants' Association held a meeting on Thursday. It was announced that the association will have five committee reports at the next meeting instead of three as heretofore and that there will be two joint sessions with other affiliated associations instead of one, as was the case last year. The two new committees are the one on car-miles and car-hours and the joint committee with the Transportation & Traffic Association.

On Thursday and Friday the executive committee of the Transportation & Traffic Association held meetings at which were discussed the budget for the ensuing year, interurban rules, block signals, transfers, express and freight traffic, schedules, city rules, new members, training of employees and passenger traffic. It was decided that at the next convention no individual outside papers will be presented, but the time will be devoted to the presentation and discussion of committee reports. The chairman of each committee will arrange to have at least two persons not connected with the committee present oral or written discussion on the committee's report, each discussion being limited to ten minutes.

On Saturday the committee on equipment of the American Electric Railway Engineering Association held a meeting to select the subjects for discussion at the next convention. The subjects will include the method of heating cars; design of car body, trucks, motors and equipment parts, having in mind reduction in weight without the sacrifice of strength; unit-basis comparison of weights; coupler report of the Central Electric Railway Association, including signal, air and control connections as proposed for general standardization.

On the evening of Jan. 27 the American Electric Railway Manufacturers' Association gave a banquet at the Hotel Astor to the American Electric Railway Association, which was attended by about 500 people. The toastmaster was Mr. C. C. Castle, president of the American Electric Railway Manufacturers' Association. The speakers were: Mr. Arthur W. Brady, presiden of the American Electric Railway Association, who spoke on "The Association"; Hon. William B. McKinley, United States Congressman and president of the Illinois Traction System, on "The Public and Public Utilities"; Col. H. G. Prout, vice-president and general manager of the Union Switch & Signal Company, on "The Manufacturer," and Mr. Patrick Calhoun, president of the United Railroads of San Francisco, on "Intelligent Popular Government and Public Utilities." In his speech Congressman McKinley expressed the conviction that the relations between the railways and the public would be greatly improved by the company impressing the trainmen with the value of politeness. He said that the book of rules of the Illinois Traction System has on its cover the sentence, "Be civil and you will comply with the greatest rule of all." The speaker said that there need be no antagonism between the public and the operators of traction properties. Mr. Calhoun remarked that the prime requisite for good government is good administrators, so that the public-service corporations can be left to conduct their business in a manner most useful to the people and without being subjected to blackmail or other political jobbery. The greatest political crime is to attempt to bribe an entire community by imbuing the people with the idea that they should take away the property of the public-utilities corporations which are trying faithfully to serve them.

Proposed Modification of System of Accounts in New York.

A hearing on an order modifying the uniform system of accounts for electric corporations was held on Jan. 9 by the New York Public Service Commission of the First District. Commissioner Milo R. Maltbie presided.

Mr. H. M. Edwards, auditor of the New York Edison Company, who was the first witness, testified that he had considered the order made by the commission to take effect on Jan. 1, 1911, in regard to the distribution of subway rental. The order required that the expenditures for subway rental be excluded from operating expenses and be treated as an income deduction. Operating expenses included the cost of production, distribution and supply of electrical energy, including the cost of billing calculations, general expenses, taxes, bad debts and depreciation; the total was to be the entire cost of conducting the business. The division of this total by the quantity of energy generated or sold gave the unit cost per kw-hour. Income deductions were intended to cover the cost of the capital invested in the business and such other costs as were not directly incident to production and sale of energy.

If the order of the commission was not abrogated or changed, Mr. Edwards said the result would be to eliminate from the operating expenses for the year 1910 about $1,079,375 of subway rental expense, almost 11 per cent of the total, thereby reducing the apparent unit cost per kw-hour sold from 3.76 cents to 3.35 cents. This would destroy the value of the comparison with previous years and would withhold this very important factor when the management was considering the effect of extensions and of costs generally, because statements of costs as promulgated included the cost of operation only and did not include a statement of income deductions. The company rented subway ducts from two companies, the Empire City Subway Company, Ltd., and the Consolidated Telegraph & Electrical Subway Company. If the company owned its own subways it was probable that the cost of construction would be represented by its bonds, loans, capital stock or the investment of its surplus earnings, and the amount now represented by subway rentals would be divided into the various operating expense accounts and the interest on the cost would be treated as an income deduction. But as the company did not own its subways the conditions of the business in the boroughs of Manhattan and the Bronx were not uniform with the conditions existing elsewhere in the State. The subway companies' cost for investment included all the ducts built, of which the New York Edison Company rented only a portion. It was also a fact that only 46 per cent of the ducts built, as shown by the reports of the subway companies, were under rental. It would be impossible for the New York Edison Company to conjecture what the corresponding investment was for the ducts which it occupied. The amount of ducts which the company had under rental fluctuated constantly. It was free to abandon any duct if it could save subway rental by concentrating its cables in one duct. The subway companies' investment was as a whole and it did not follow that they would be able to show figures of cost for different sizes of ducts.

Mr. Edwards added that the subway rental situation was brought about by act of the Legislature. The amount which the company should pay for the occupancy of the ducts was approved by municipal authority. The rental was charged at a unit cost per mile of duct per annum as rented and occupied and, therefore, the expenditure could be looked upon properly only as an operating expense. The action of the commission did not produce uniformity of accounts with other companies, which charged expenditures in connection with subway ducts to operating expense

Mr. John W. Lieb, Jr., third vice-president of the New York Edison Company, testified that the uniform system of accounts was intended to provide, among other things, a comparison between the respective costs of different lighting companies so as to permit judgment of the relative efficiency with which they are conducted. By far the largest item of cost in the operating expense accounts under the heading "transmission" was "subway rentals." To leave out this item, which was nearly 50 per cent of the total cost of "transmission," would take from this cost one of the important links of the steps in the series of operating costs proceeding from production at the generating station to the delivery of the product to the consumer and would so modify the cost of transmission that it would no longer appear in its proper relation to the other elements of operating expense. Companies that did not use a high-tension generating station with a transmission system to substations usually had higher cost of production owing to their unfavorable location. The cost of production was lowered considerably by the selection of a waterside site for production favorably located for coal, water, etc., but distant from the area of energy consumption. This difference was offset in part, however, by a new element of operating expense thereby introduced, the transmission to a substation, of which subway rental was a main item. To remove this cost from the operating accounts eliminated the comparison of operating costs between different companies as heretofore in effect, so far as it was at all practicable, and destroyed one of the values of the uniform system.

Moreover, Mr. Lieb said, where a company did not have a drawing-in subway system, but operated underground, it provided an equivalent in the shape of a covering or armoring and protection to the cable, and the cost of maintaining this, which was the equivalent of a duct, would appear in that case as an operating expense. The duct for which subway rental was paid was a similar protection.

Unless there was some very weighty reason for change, it would be unfortunate to modify the basis upon which all of the accounts had been kept for many years past and all of the different elements of cost entering into the total cost of production had been computed. It would be very unfortunate to have two sets of figures of operating costs, one for use by the company and another on a different basis for use in reports made to the commission.

Mr. Frank W. Smith, secretary of the United Electric Light & Power Company, testified briefly.

Mr. R. A. Carter, vice-president of the Consolidated Gas Company, said that the principal objection to the enforcement of the order was one that was apparently made in relation to the payment of other rentals. The order directed that the rental of offices in buildings, for example, should be included in the operating expenses. It seemed to Mr. Carter that the same reasoning applied to subway rental. Furthermore, the elimination on any theory from operating expenses of an item that was an absolute and legitimate operating expense seemed objectionable, whether for the company's purpose or for the public statements. It was misleading because it created what were known commercially as fictitious net earnings. While there might be included at present in the item of subway rental as shown in the operating expenses some items of return on property which would throw a company using that system out of comparison with any other company, the elimination of the entire item would have identically the same result.

Mr. A. F. Weber, chief statistician of the commission, called attention to the fact that expenses were divided into operating, expenses, taxes, etc., and that "rent deductions" were classified among the income deductions.

Mr. Carter held that taxes, rentals for subways, etc., were expenses of the business.

Mr. L. E. Stander, accountant of the Public Service Commission, testified that the gross revenues of the Consolidated Telegraph & Electrical Subway Company for 1909 were $1,112,329. Operating expenses were $143,827, taxes $95,425, and uncollectible bills $1,531, leaving $871,546 applicable as income. The report of the subway company stated that the New York Edison Company had the right to vote a majority of its stock. The New York Edison Company owned $63,600 of common stock of the subway company and the Morton Trust Company, as trustee, for the New York Edison Company, held $1,516,000.

Mr. Weber said that the principle upon which the commission's accounting orders had been promulgated was that expenses were divided between what might be called the prime cost of production and the return upon the investment. Wherever possible a division was sought between those two elements of rent. If the companies desired to include in their operating expenses a part of the rents, they should place their contracts on a basis whereby the total operating expenses would be distributed among the different companies participating. The rent would then comprise a portion representing cost, which was properly included in operating expense, and the remainder would go to income deductions, which included the return upon the investment.

Mr. John A. Garver, of counsel for the United Electric Light & Power Company, said that every item of rent included a return upon capital.

Commissioner Maltbie said that the system of accounts represented the attempts of the commission to secure a separation of operating expenses from what the State imposed in the form of taxes and from a return upon capital.

The hearing in the matter was closed.

Proposed Telephone Commission in Ohio.

A bill to place the telephone companies of Ohio under the supervision of a public-utilities commission has been framed by Independent telephone men and within a short time will be presented to the Legislature for consideration. First, however, the fullest publicity will he given to it, so that the people may understand all its provisions. For this purpose copies will be sent to the managers of all companies in the State, with instructions to make the contents public in the most effective way possible.

The bill will vest in the commission full power for fixing and regulating rates, which must be uniform in the locality for which they are determined. Giving away service or selling it at a ruinous price for the purpose of injuring a competitor will be prohibited. Violation of an order establishing a rate for the use of a company is punishable by a fine of $500 per day.

Absolute authority is given the commission to make investigations of the business of the companies. Its experts may be sent into the offices with authority to ascertain every detail of the business. Officers and employees may be summoned before the commission with books and records to testify in any hearings that may be held. Refusal to appear is punishable by a heavy fine. Upon the complaint of a subscriber of a company the commission is required to have a hearing and inquire carefully into the charges made. If sustained, the commission must then issue an order making the changes necessary to correct any wrongs and establish justice.

No provision is made for regulating the issue of stock and bonds, and the present law relating to franchises is to stand as it now appears on the statute books. The commission may, however, give advice on franchise matters and add its approval when granted.

The bill provides that companies whose lines intersect or whose systems have been established in the same locality may be consolidated, but the rates previously charged cannot be advanced without the consent of the commission. This allows the consolidation of Bell and Independent plants, and it is claimed that this feature is not open to the objections made to the Elson bill, defeated in the last Legislature, which was alleged to be a Bell measure.

Messrs. D. J. Cable, of Lima, chairman of the board of directors of the Ohio Independent Telephone Association; Frank L. Beam, president of the association, and S. E. Ward, of Mansfield, compose the legislative committee of this organization and the bill has been formulated through their work. It is said that Mr. C. A. Otis, president of the Cuyahoga Telephone Company, has been an important figure in the work and that through him President Theodore Vail, of the American Telephone & Telegraph Company, has been brought around to favor the measure. It is stated that there will be no opposition from the Bell interests to any feature of the bill.

It is claimed by some that 200,000 subscribers to Independent local exchanges have been connected with the Bell long-distance service within the past two years. This has come about through consolidations and contracts made since the decision of the United States Circuit Court to the effect that exclusive contracts for such service, thus cutting out competition, are not legal.

The Central Union Telephone Company controls all the Bell exchanges in Ohio, with the exception of those at Cleveland and Cincinnati. In the latter city there has never been any competition, as the Independents never succeeded in getting a foothold there. It is altogether possible that many consolidations in the smaller cities and towns would follow the enactment of this bill into a law, but just what the policy of the Bell people is for the large cities is not known. It seems to be their desire to get rid of all exchanges in the smaller places on condition that their lines secure the long-distance business. The question of what policy will be followed regarding the two long-distance systems will also be interesting. The United States Telephone Company might be absorbed by the American Telephone & Telegraph Company, but whether this is part of the plan remains to be seen. Nothing has been said as yet to indicate the course that will be followed in this respect

New Jersey Commission News.

The Board of Public Utility Commissioners for the State of New Jersey has adopted as a uniform system of accounting for electric street-railway companies the classification of operating expenses, operating revenues and expenditures for road and equipment prepared as standard by the American Street and Interurban Railway Accountants' Association Oct. 15, 1908, with certain modifications.

The modifications apply particularly to the keeping of accounts for depreciation of way and structures and depreciation of equipment.

The board requires that in the account for depreciation of way and structures there shall be charged from month to month the amount estimated to be necessary to cover such wear and tear, obsolescence and inadequacy as have accrued during the month on all way and structures of the accounting corporation, less an amount equal to the sum of the amounts charged for that month to the various repair accounts in maintenance of "way and structures." For depreciation of equipment the board requires a charge to be made from month to month of the amount estimated to be necessary to cover wear and tear, obsolescence and inadequacy accruing during the month on equipment. From this there is to be deducted an amount equal to the sum of all the amounts charged during that month to various repair accounts in maintenance of "equipment." The amount estimated to be necessary to cover wear and tear, obsolescence and inadequacy for both maintenance of way and structures and depreciation of equipment is to be based on a rule to be determined by the accounting corporation, which rule is to be derived from consideration of the corporation's history and experience. A general statement of the rule in use by each company, together with the general information upon which it is based, is to be filed with the board.

The Public Utility Commissioners have granted certificates of approval to the Public Service Electric Company for the issuance, sale and delivery of $1,000,000 par value capital stock, and to the Hudson & Middlesex Telephone & Telegraph Company for the issuance, sale and delivery of $101,002 capital stock, par.

The board has approved the ordinance of the township of Deptford granting a franchise to the Gloucester County Electric Company and the agreement of merger and consolidation of the Rockaway Electric Light & Improvement Company and the Dover Electric Light Company.

Wisconsin Commission News.

The commission has authorized the Northern Hydroelectric Power Company to issue $300,000 par value of bonds, of the denomination of $1,000 each, to bear interest at the rate of 6 per cent per annum. This issue is to be made in accordance with the terms of a certain mortgage deed of trust issued to the American Trust & Savings Bank and Frank H. Jones, as trustee and co-trustee. The funds to be derived from the sale are to be used for the purpose of completing the company's plant at High Falls, Marinette County, Wis., and for the purchase of machinery.

The Legislature has confirmed the reappointment of Halford Erickson as a member of the Railroad Commission to succeed himself.

The commission has approved the flat rate of $6 per month filed by the Minehan Building Company, of Green Bay, for private street lighting This rate includes the cost of erection, connection and maintenance of iron poles, each to support five 100-watt tungsten lamps, inclosed in globes The service is to be furnished from dusk to midnight

Pursuant to a formal agreement between the village board of Genoa Junction and the Genoa Junction Electric Light Plant, the determination of a fair and reasonable rate for street lighting was left to the commission. The company desired to increase the present rate of $10 per 32-cp lamp per year to $18. The commission, upon an investigation of conditions in Genoa Junction, found that the rates were low and the returns probably not reasonable, but on the other hand the service was found to be extremely poor and the plant operation and management very inefficient. The standards of service were not being maintained and no effort has been made to increase the commercial business in any way. Under existing conditions the commission suggested that a rate of $12 was all that the plant was entitled to under normal conditions and at this rate the plant must furnish adequate service.

The present board of water and light commissioners of Jefferson appear to be considerably opposed to the schedule of rates suggested by the commission last summer upon request of the municipal plant. The former board applied for and received permission to postpone the date upon which the new rules were to go into effect until Jan. 1, 1911. The rate schedule as proposed has not as yet been put in force. The present board complains that the proposed rates will increase the bills of a number of so-called large consumers and that as a result the plant will lose a number of these consumers. The rates as proposed by the commission, and which are based upon cost of service, would effect a material decrease in the bills of the small consumers and a material increase in the case of large consumers. The commission called attention to the fact that the present rates are very inequitable and unjust, for the small consumer is being charged an excessive rate, whereas the large consumer generally gets service at less than cost. It was pointed out also that the plant investment was excessive. With water rights the cost per kilowatt of station capacity is about $250. The average investment of fifty-four plants of 150-kw capacity in Wisconsin and Massachusetts is about $125 per kilowatt, as against $190 in Jefferson, exclusive of water rights. The average plant investment as reported by the Wisconsin commission is about $152 for a plant of 100 hp to 200 hp, $115 for plants of 200 hp to 300 hp, and $110 for plants of 300 hp to 500 hp.

In order to relieve the situation slightly the commission authorized a slight change in its former rulings with respect to the per cent of active load under the various classifications. The commission, however, emphasized the fact that the situation in Jefferson must be remedied at once if further proceedings are to be avoided.

Massachusetts Commission News.

The Boston Transit Commission has submitted its annual report for the year ended June 30, 1910. The work of the commission during the year in the field was mainly in connection with the construction of the Boston terminus of the Cambridge subway, which will probably be completed early in 1912. Considerable attention has been given in conference with officials of the Boston Elevated Railway Company to the details of the station to be built under Boston Common at Park Street, in connection with the incoming Cambridge and Riverbank subways, and the probable extension of the former to the South Station. It is probable that a substation below the present Park Street station of the Tremont Street subway will be built, with motor-driven escalators to facilitate egress. During the fiscal year the Boston Elevated Railway Company paid $211,750 for the use of the Tremont Street subway. The net toll receipts for the year in the East Boston tunnel were $117,751, and the cost of collecting tunnel tolls of 1 cent for each passenger was $19,034.

The Boston Elevated Railway Company in addition paid $404,924 for the use of the Washington Street tunnel during the year. The commission has made studies of a number of subway and tunnel projects during the year, sitting as a joint board with the Massachusetts Railroad Commission by order of the Legislatures of the two preceding years. The principal constructive recommendation resulting from these deliberations is that a subway be constructed by the Transit Commission between Park Street and the South Station, and that the latter be extended from the South Station to Andrew Square, Dorchester, to provide rapid transit between Dorchester, South Boston and the city proper.

The Public-Service Corporation and the Public.

Mr. Samuel Insull was the speaker at the luncheon of the Chicago Engineers' Club on Jan. 24. His subject was "Relations of the Public-Service Corporation and the Public," and he said that the first essential in bidding for success on the part of a public-utility company is to furnish the best possible service at the lowest possible price. The business must be a monopoly in order to obtain the best results, and, therefore, the public has much to do with the question, for it has to pay for the unfortunate results of competition where competition exists. Considering specifically the production of electrical energy, Mr. Insull pointed out that to get the best results the entire production for a given area, not only for lighting but for transportation, manufacturing processes and all purposes, should come under one head. The speaker said that he was willing to advocate boldly a doctrine of monopoly as an economic proposition. He cited the example of Chicago in the central-station field to show the beneficent results of this policy.

In Chicago the central-station company has more than 125,000 customers and its maximum output is about 250,000 hp. For this year its output will be 25 per cent greater than the total output of the electricity supply companies of London, which has a population of 7,000,000 against Chicago's 2,200,000. The cash invested in the business in Chicago is about $70,000,000 and the output of the company doubles about every two and a half years. Mr. Insull gave some other statistics relating to the Commonwealth Edison Company and among other things mentioned the fact that the amount of coal consumed per unit of energy sold is now only about one-third of what it was eight years ago.

Returning to the broader aspect of his subject, Mr. Insull said that the point was not so much the relation of the public-service corporation to the public as of the public to the public-service corporation. The actual money invested in the public-service corporations of Chicago, excluding steam and interurban railroads and the suburban service of steam railroads, is between $450,000,000 and $500,000,000. The gross earnings of these properties are between $75,000,00 and $80,000,000 a year and for the last three or four years there has been expended for improvements from $35,000,000 to $40,000,000 annually. This amount has been increased by the recent rehabilitation work of the surface street-railway companies, but at the lowest estimate the future development of these properties will represent an expenditure of not less than $25,000,000 a year. The total number of employees is about 50,000, and taking an average of five to a family it will be seen that about 10 per cent of the population of the city depends for its daily bread upon the prosperity of the public-service corporations. If the steam and interurban railway companies are added it is probable that the proportion of the city's population dependent on these varied public utilities would reach not less than 20 per cent.

Thus it is a serious and a vital question that is presented to a city like Chicago by its relation to the public-service corporations. The failure of these enterprises would be a very serious matter, affecting general business conditions, and it is, therefore, evident that a policy of "live and let live" should prevail. Mr. Insull quoted with approval from an editorial in the Chicago *Record-Herald* of Dec. 30, in which it was declared that the question of rate-making, for instance, was an economic one and should not be made the football of politicians. In conclusion the speaker begged his hearers not to go away with the impression that he advocated the unlimited freedom of public-service corporations. On the contrary, he expressed himself as a strong believer in proper governmental regulation of all such enterprises. However, this regulation should not be a matter of political expediency, but should be based on what is economically right, fair and just, both to the consumer and to the investor. When this is done it will be found that the consumer will receive more satisfactory service at a lower price, for the reason that money will be cheaper if these questions are handled with broad public spirit and absolutely removed from political entanglement.

New York Commission News.

The Public Service Commission, Second District, has received five petitions from the New York Telephone Company in relation to the sales and mergers of the plants controlled by that company. A corporation has been formed, known as the Allegany Telephone Company, located at Wellsville, to which it is proposed to sell the plant and property of the New York Telephone Company situated in Allegany County, including the rights and privileges granted to the New York & Pennsylvania Telephone & Telegraph Company, the predecessor of the New York Telephone Company, by the villages of Wellsville and Andover. The price to be paid is $35,000. It is proposed to sell the Amsterdam Automatic Telephone Company to the New York Telephone Company for $150,000, and the merger is proposed of the Trumansburg Telephone Company, the stock of which is owned by the New York Telephone Company at present, and of the Jefferson County Telephone Company with the New York Telephone Company, the whole of the stock of the Jefferson County company being owned by the New York company at present. The commission is asked to transfer the property, rights and franchises formerly belonging to the Central New York Telephone & Telegraph Company in the City of Oneonta, Village of Unadilla, Village of Richfield Springs, Village of Laurens, Village of Cooperstown and Village of Walton, now owned by the New York Telephone Company, to the Otsego & Delaware Telephone Company for the sum of $98,000. The petition states that at Amsterdam and Watertown the majority of the subscribers of both of these companies have expressed their desire for the consolidation and unification of the systems. The company also alleges in its petitions that the transfer of the property in Allegany County, at Trumansburg and in Otsego and Delaware Counties permits it to be more advantageously and efficiently used and will prove of greater benefit to the subscribers under the plan now proposed by the company.

The Elmira Water, Light & Railroad Company has been authorized to issue 5 per cent first consolidated mortgage bonds to the amount of $243,995, to be sold at not less than 87. The proceeds are to be used for the discharge of indebtedness incurred for capital purposes and various extensions and improvements to its property in Elmira and vicinity. The Cliff Electrical Distributing Company, of Niagara Falls, has been authorized to issue its general mortgage bonds to the amount of $250,000. The bonds are to be sold at not less than 95 and the proceeds used to reimburse the corporation for payments made in additions and betterments of its plant.

The commission this week will give hearings on the application of the Orange & Rockland Electric Company for authority to make a mortgage for $200,000 and to issue bonds to the amount of $142,000 at present, and on the complaint of the president and trustees of the village of Ossining against the Northern Westchester Lighting Company as to the price of street lighting.

The Newburgh Light, Heat & Power Company has been authorized to construct a transmission line within a portion of the incorporated village of Walden in the town of Montgomery. This order is supplementary to an order made on July 25, 1910, permitting the company to construct its transmission lines only outside the corporation lines of the village of Walden.

Report of New York Public Service Commission, Second District.

The fourth annual report of the New York Public Service Commission for the Second District has been submitted to the Legislature. It covers the year ended Dec. 31, 1910.

Of a total of 944 corporations, municipalities and individuals engaged in furnishing public service that placed them under the jurisdiction of the commission, or incorporated to render such service, 301 were electrical corporations. There were in addition corporations which were engaged in combined electrical and other business and also a total of 145 telegraph corporations and persons subject to the supervision of the commission.

The expenses of the commission from its organization to the close of the last State fiscal year have been as follows: From July 1, 1907, to Sept. 30, 1908, $307,734; Oct. 1, 1908, to Sept. 30, 1909, $276,575; Oct. 1, 1909, to Sept. 30, 1910, $295,443. The total appropriation for the fiscal year ended Sept. 30, 1911, is $372,830, and for the ensuing year the estimate is $393,537. The foregoing figures do not include expenditures for grade-crossing eliminations.

Examinations with respect to safety of construction or operation were made of the high-tension lines or property of a number of electrical corporations. Seven investigations were made as the result of fatal accidents from electric shock. Plans are in progress for a systematic inspection of all electrical plants. As a preliminary step, electrical corporations have been required to report as to the joint use of overhead distributing systems with telephone, telegraph, railroad and other companies. In matters concerning several companies and involving adequacy and safety of service the commission required such reasonable improvements as were deemed necessary to promote the public interest, preserve the public safety, or to protect those using gas and electricity and those employed in the manufacture and distribution thereof.

Satisfactory results have followed the two years' trial of the system of company inspection under commission supervision of electric meters. Most of the companies have participated in good faith. The indifference of a few companies, however, has caused the commission to consider the necessity and desirability of putting the practice under orders. During the year eight corporations installed testing apparatus upon recommendation of the commission and twenty-five other corporations equipped themselves with additional instruments, making in all 235 corporations now provided with apparatus approved by the commission. The commission has tested 1739 station standards and certificates were issued for 1697, while forty-two were ordered recalibrated and thirty-six were calibrated by inspectors.

The monthly reports filed by corporations of consumers' electric meters show an increase of 6460 in the total number of meters tested during the year. The percentage of fast meters to the total in 1909 was 9.5 per cent; in 1910, 7.4 per cent; the percentage of correct meters for these years was 60.0 per cent and 75.2 per cent respectively. Upon its authority to establish rules and regulations to carry into effect the meter-testing provisions of the law, the commission adopted the rule that all electric meters shall be deemed to be correct whose registration is 4 per cent or less fast or slow. As against seventy-three electric meters tested in the preceding year upon complaints of consumers there were tested last year 130 meters, of which fifteen were found to be more than 4 per cent fast, thirty-five more than 4 per cent slow, two wrongly connected and seventy-eight correct within the allowable limits of error stated.

Tests on the watt-hour meters measuring the total output of electric energy from the central-station busbars have been made at two plants

The commission states that the need of an electrical laboratory exists in connection with the system of inspecting electric meters, in special meter complaint work and in the investigations into adequacy of service. The equipment for this work comprises instruments of portable character for field work and certain primary standards for laboratory use against which the portable instruments are periodically checked for accuracy and kept in calibration. Four assistant electrical inspectors and a chief inspector are employed. The total expenditure to date for all of the electrical laboratory equipment used by the commission does not exceed $6,700.

Regarding the work of the division of statistics and accounts the report says: "After two years' experience it may be said that the efforts of the division are met by most of the corporations with which it has to deal in a spirit of courtesy and co-operation. The reports filed by a few indicate, however, that there is either an intent to evade the accounting rules or that there is a lack of knowledge as to their requirements. In some cases it has been impossible to secure corrections of apparent misstatements through correspondence; nothing short of an audit of the accounts in many of these cases would produce a correct statement. In other instances, particularly where the corporations have not sufficient business to justify the employment of experienced bookkeepers, the accounting order is taken as something impossible of comprehension. This is believed to be due, however, to a lack of application rather than to any fault in the system of accounts. With the limited force at its command the division has not been able to extend to the small corporations the assistance in arriving at a correct understanding that it would like to extend, but improvement in this direction is hoped for as a future possibility.

"During the earlier days of the commission, and until the corporations had been given sufficient time in which to familiarize themselves with the more extended form of reports prescribed by the commission, it has been deemed unwise to attempt to enforce compliance with the law by bringing suits for penalties for failure to file reports in the time prescribed by law. It is now believed that the time for such leniency has passed. The forms of annual reports have become substantially settled, corporations have had sufficient time in which to install the uniform system of accounts prescribed, have learned how to make the reports properly, and there is no longer any reason why they should not obey literally, except in isolated cases, the requirements of the law with reference to the time of filing the report. The policy of the commission hereafter will be to exact the penalty prescribed by law in cases of disobedience."

Of the issues of securities which the commission authorized from July 1, 1907, to Dec. 31, 1910, the following details are of interest: Electrical corporations, stock, $5,855,500, and bonds, etc., $30,241,869, a total of $36,097,369; gas and electrical corporations, stock, $798,700, and bonds, $11,219,205, a total of $12,017,905.

On the subject of gas and electrical rates the report says in part:

"The original systems of charging for electricity, the flat-rate and uniform meter-rate systems, have the defect that owing to the different hours and length of time of consumption some consumers are supplied unprofitably. The trend in later years away from these systems indicates an endeavor on the part of electrical corporations to make every consumer theoretically, if not actually, profitable. To separate the actual costs of reaching a consumer is practically impossible, so we find entering into the more recent system of rates arbitrary and sometimes inconsistent factors, as follows:

"1. It is estimated that on the average it costs more per kilowatt of demand to reach and supply a small consumer than a large consumer; upon this basis there is a discrimination consisting of discounts because of quantity used.

"2. It is estimated that a difference exists between consumers who are able to guarantee a maximum consumption and those who cannot guarantee a definite use. From this arises discrimination between contract and non-contract users; one consumer may become entitled to discounts because of a short use of a large demand, another because of a long use of a small demand; but the consumer who can guarantee neither of these conditions obtains either no discount or relatively a less discount.

"3. It is estimated that certain large consumers are entitled to unusual consideration; this leads to discrimination in favor of the large consumer, to whom special rates or concessions are given.

"4. It is estimated that competitive conditions must be recognized. To those who may readily supply themselves with light or power obtained from some other source an electrical corporation is apt to fit the price which the company must make to get their business to their actual conditions. In this way arise discriminations in favor of each consumer whose use of electricity will warrant the installation of his own source of supply, while a higher rate is maintained for those consumers whose supply the company controls.

"These examples suffice to show the extent to which differentials between classes of consumers have grown up, and indicate the wide field for differential rates between consumers in the same class. Such differentials mean discrimination. Whether they mean unjust or illegal discrimination, and if so the extent to which such practice may be engaged in, as well as the question of relative equity or fairness of the various methods of charge in use, may only be determined by careful inquiry and detailed expert analysis of the operating conditions and resultant rates."

Reference is then made to the work of the committee, composed of representatives of the commission and the corporations, which is considering the subject. Continuing, the report states as follows:

"It is of course obvious that to whatever extent, wilfully or without intention, unjust discrimination may be practised, rates or drawbacks given, or undue preference exercised in special rates or contracts, slow and unsatisfactory progress will be made in the correction of such conditions if dependence for their adjustment rests upon the individual instances that may be brought to the attention of the commission by complaining consumers or instances upon which the commission may stumble. It is equally obvious that a proper exercise of the broad powers of requiring rates to be filed and of prescribing rules and regulations to govern same will provide means of ascertaining in many, if not all, respects, instances of illegality, injustice and unwarranted inequalities. The commission has deemed it wise, therefore, that ample time should be taken to construct well and permanently the foundation upon which this important work will rest, that necessity may not arise for retracing subsequent steps by reason of inadequate and improper preparation."

FINANCIAL ANALYSIS OF ELECTRIC CORPORATIONS.

	Total Number Corporations.	Number Paying No Dividends on Common Stock.	Amount of Common Stock Paying No Dividends.	Number Paying No Dividends on Preferred Stock.	Amount of Preferred Stock Paying No Dividends.
Elec. corp. gross rev. $25,000 and over......	39	29	$24,208,400	1	$2,000,000
Elec. corp. gross rev. $25,000 to $10,000.....	47	29	2,073,530	....	....
Elec. corp. gross revenues under $10,000.........	77	65	1,607,950	....	....
Combined elec. and gas corp. gross rev. $25,000 and over............	30	18	21,083,400	4	2,880,400
Combined elec. and gas corp. gross rev. under $25,000..............	12	8	600,800	....	....
Combined elec. roads and elec. or gas corp.......	7	5	3,150,000	1	2,029,000

From a table showing the proportion of stocks paying no dividends has been obtained the above information regarding electrical corporations.

AMERICAN ELECTRICAL ENGINEERS.

Paul L. Battey.

Paul Leon Battey was born March 11, 1876, at Marion, Kan. When about three years old his parents moved to Topeka, Kan., where he spent his early life, receiving his primary education in the graded and high schools. While in the high school he became deeply interested in the studies of physics, electricity and chemistry and finally decided to enter the electrical field for a career.

At the age of seventeen he entered the employ of the Edison Electric Illuminating Company of Topeka, Kan., as an office boy, successively occupying during the period of seven years he was employed by this company the positions of meter reader, wireman, troubleman and arc lamp repairer, head of meter department and supply stock, armature winder and motor repairer, draftsman, electrician and assistant superintendent. During this time he followed technical studies by night work in correspondence school and under Prof. A. St. C. Dunstan, of Kansas University, in Y. M. C. A. educational classes, with much experimental work in mechanics, electricity and chemistry. Later he taught the Y. M. C. A. classes in electricity and mechanical drawing.

P. L. Battey.

In 1898 and 1899 Mr. Battey attended the School of Engineering, University of Kansas, at Lawrence, thirty miles from Topeka. During this period he remained in the employ of the Topeka Edison Company as supervisor of the meter department and on special improvement assignments, working Saturday and Saturday night and spending the rest of the week at the university. At the university, besides regular work, he carried on a series of photometric tests on a large number of commercial incandescent lamps of different makes, using a spectrum photometer and an original device designed and constructed in the university shops for ascertaining the average spherical candle-power at one reading.

In March, 1896, at the age of twenty, and a short time after the announcement of the discovery of X-rays, he took the first X-ray pictures in Topeka, using an incandescent lamp as a Crookes tube and an alternating-current, high-potential, high-frequency outfit built by himself. He built a Sprengel pump and made his own Crookes tubes, learning glass blowing from Prof. E. C. Franklin, of Kansas University, at night on visits to Lawrence, and made his own calcium tungstate crystals for the fluoroscope. For two years he maintained an X-ray laboratory, doing work for many surgeons throughout Kansas and Oklahoma. Later, upon leaving Topeka, the entire high-frequency outfit, which gave a 15-in. spark, together with wireless-telegraph and many experimental attachments, was presented to the engineering school of Kansas State Agricultural College at Manhattan.

While with the Edison company Mr. Battey designed and constructed several extensive electrical displays in connection with the annual flower festival, which attracted attention, and also a special display for the State upon the occasion of the reception of the famous Twentieth Kansas Regiment upon its return from the Spanish War. Among other special work was the complete rearrangement of several publishing and printing plants for electrical operation by individual motors. Later he had charge of the electrification of the Atchison, Topeka & Santa Fé Railroad shops at Newton, Kan., and in 1897 was sent to Las Vegas, N. M., to superintend the wiring of a large hotel there. The last year with this company was devoted almost entirely to the rehabilitation of the power plant and distribution system, which firmly fixed his purpose of continuing electrical engineering as a profession.

In September, 1900, Mr. Battey left Topeka to enter the power and light switchboard department of the Western Electric Company at Chicago as a draftsman, with the view of becoming more familiar with this class of work. Three months later, owing to the resignation of the chief of the department, he was put in charge of the design of power and light switchboards. During this time he attended night classes in electrical engineering at Lewis Institute. On April 1, 1901, he accepted a position with the Arnold Electric Power Station Company, of Chicago (later called The Arnold Company), as a draftsman, with which organization he has remained, successively as chief draftsman, assistant engineer, superintendent of construction and engineer in charge. In 1907 he became a member of the firm and chief engineer of the railroad and industrial department, having complete charge of this work.

During his connection with The Arnold Company Mr. Battey has had charge of the engineering and construction of over twenty electrically operated railroad shops and industrial plants of varied character, each with its respective power plant, as well as of power plants for other service. In many of these the general arrangement and many of the details were personally designed, and numerous original schemes and devices were worked out to suit the requirements of what was considered modern design suitable for high-efficiency results. A system of combined underground and overhead electrical distribution for use in shops has been successfully used in a number of plants. In 1904, when in charge of electrical work in connection with the hydroelectric plant of the Spring River Power Company at Joplin, Mo., he designed and constructed in the field a unique high-tension, portable steel substation for use in the mining district, placing several of these in service. In 1905, in connection with the Ivorydale shops of the Cincinnati, Hamilton & Dayton Railway, he developed a system of graphical construction reports and a complete and comprehensive plan of organization for the handling of the engineering and construction of a property, to the end that the entire force should be kept in close touch with the work, with an accompanying saving of time and expense. This system was described at the time in the technical press and received favorable comment here and abroad. Much attention has been given to the perfection of the system owing to the favorable reception and rapid development of the engineer-constructor method whereby one concern handles entire properties from inception to operation. His work has also included the preparation of many engineering reports upon all classes of electrical properties. He has contributed some articles to the technical press from time to time, but the actual carrying out of work has allowed little opportunity for writing for publication.

Mr. Battey is a member of the American Institute of Electrical Engineers, Western Society of Enginetrs, Illuminating Engineering Society, National Geographical Society, Chicago Electric Club and Chicago Engineers' Club.

THE GERMAN ELECTROTECHNICAL SOCIETIES.

HISTORICAL.

In Germany the situation with respect to electrotechnical societies is somewhat complicated owing to the existence of a large number of such societies, which, moreover, are mostly bound together by mutual agreement, yet each retaining an independent organization. In order to understand this situation clearly, it is necessary to follow the historical development of the various bodies.

The oldest German electrical organization is the "Elektrotechnische Verein," which was founded in 1879. The name is due to Dr. Werner von Siemens, who coined the word "Electrotechnik" to designate the art of utilizing electricity, which at that time had ceased to be limited to telegraphy and electrolysis. Credit is also due to Dr. Werner von Siemens, one of the pioneers of electrical invention and founder of the well-known firm of Siemens & Halske, and to Dr. Stephan, the Imperial Postmaster-General, for the stimulation of interest in the project to bring together men interested in electrical engineering. These two gentlemen sent out a circular to representative men of science, to members of the government telegraph staff and others interested in applied electricity, asking them to attend a meeting with a view to founding an electrical society. This meeting was held Dec. 20, 1879, among those in attendance being Aron, Frölich Halske, von Hefner-Alteneck, Kirchhoff, Naglo, Paalzow, Slaby, Wedding, Wüllner and Zetzsche. Membership in the Elektrotechnische Verein thus founded was confined mainly to physicists, members of the government telegraph staff and manufacturers, though the army and navy were also well represented. Dr. Werner Siemens was chosen as president, and Dr. Stephan as honorary president. The purpose of the society was to further the development of the technical applications of electricity, to extend knowledge of electrical science, and by means of meetings to bring together German electrical engineers for the exchange of ideas through papers and discussions relating to their scientific, technical and commercial interests. The great interest which the young society aroused in technical circles, both at home and abroad, is indicated by the fact that at the end of the first year the membership had risen to 1550.

Dr. Werner von Siemens.

Most of the members lived outside of Berlin, and therefore could not regularly attend the meetings of the society. This led in the early eighties to the formation of similar societies in other large cities, among the first of which were the Elektrotechnische Gesellschaft in Frankfort-on-the-Main, the Elektrotechnische Gesellschaft in Cologne, and the Elektrotechnische Verein in Leipzig and Magdeburg.

The various independent societies early became aware that owing to the many economic and legislative situations arising from the extremely rapid development of the electrical industry a single organization was desirable which should represent the German electrical engineering profession as a whole in matters of national import. The Berlin society on account of its international membership could not well take the lead in achieving this end, and on account of the large number of scientific men and government officials in the membership a very lively interest in the economic questions involved could not be expected in this quarter.

The question finally became acute about the time of the Frankfort International Exposition (1891), when far-reaching electrical legislation was under consideration and it became absolutely necessary for the German electrical industry to take some action to protect its interests. In July, 1892, under the lead of Dr. A. Slaby, of the Charlottenburg Technical High School, and Mr. E. Rathenau, managing director of the Allgemeine Elektricitäts-Gesellschaft, a meeting of eminent scientific, technical and commercial men was called, at which a plan was drafted to unite the societies of Germany into a single organization. In accordance with this plan, at a meeting held in January, 1893, at which representatives from eleven electrotechnical societies were present, the Verband Deutscher Elektrotechniker was founded, with Dr. A. Slaby as first president. It may be added that, in addition to the two gentlemen above mentioned, those taking part in the founding of the new body included Budde, Corsepius, Hartmann, Heim, Kummer, Lahmeyer, von Miller, Naglo, Oechelhauser, Schuckert, von Siemens and Uppenborn.

The object of this organization was the union of the electrical engineers of Germany for the purpose of effectively representing and furthering German electrical engineering, and to provide for the formation of local societies wherever the need warranted. To-day the Verband Deutscher Elektrotechniker includes twenty-one societies in all parts of Germany, the relations of each to the main society being embodied in written agreements.

Before going further into the history of the different societies it should be mentioned that at the time of the organization of the Elektrotechnische Verein in Berlin a society periodical was founded and published under the name of *Elektrotechnische Zeitschrift*, the first issue of which appeared in 1880 with Drs. A. Slaby and Zetsche as editors. In 1890 this journal was consolidated with the *Centralblatt für Elektrotechnik*, and passed into the hands of Julius Springer, Berlin, the well-known publisher of technical books, this step having been rendered necessary on account of the increasing scope of the paper.

At the time of the founding of the Verband Deutscher Elektrotechniker the *Elektrotechnische Zeitschrift* was made the official organ of that society. Both the Verband and the Verein have an agreement with the publisher by which their members get the journal at a reduced rate, and the societies also share in the proceeds derived from advertisements. The *Elektrotechnische Zeitschrift* has now a subscription list of about 12,000, which includes a large number of subscribers in foreign countries, where the journal has a high standing. In its columns have appeared many scientific contributions of fundamental importance upon which our present-day knowledge is built. Among the early contributions may be mentioned articles on the work of von Hefner-Alteneck, on the early dynamos and arc lamps and a new light unit (Hefner-kerze); by Frölich on the measurement of large currents and on the first theory of the dynamo; by Neesen on lightning arresters, and by Aron on storage batteries and on his ampere-hour meter. Mention should not be omitted of the contributions of von Dolivo-Dobrowolski on revolving-field motors and the numerous articles on the distribution and transmission of electrical energy, based on experiments with the first high-tension electrical transmission system, installed at the exposition in Frankfort in 1891.

THE VERBAND DEUTSCHER ELEKTROTECHNIKER.

Anyone, whether living in Germany or in a foreign country, who has a scientific interest in electrical engineering or in any of its branches is eligible to membership in the Verband Deutscher Elektrotechniker. Authorities, corporations, societies and business houses, as well as individuals, are also eligible to membership. The greater part of the membership is enrolled in local societies of the Verband, which, as previously mentioned, includes, in addition to the Elektrotechnische Verein, twenty organizations. Following is a list of these bodies, with their respective membership:

Elektrotechnischer Verein, Berlin	1,738
Elektrotechnischer Verein, Aachen	89
Elektrotechnischer Verein zu Breslau	56
Dresdener Elektrotechnischer Verein	268
Elektrotechnische Gesellschaft zu Frankfurt	268
Elektrotechnischer Verein in Hamburg	168
Elektrotechnische Gesellschaft, Hannover	170
Hessische Elektrotechnische Gesellschaft, Darmstadt	66
Elektrotechnischer Verein, Karlsruhe	148
Schleswig-Holsteinischer Elektrotechnischer Verein, Kiel	40
Elektrotechnische Gesellschaft zu Köln (Cologne)	127
Elektrotechnische Gesellschaft zu Leipzig [1]	124
Elektrotechnischer Verein, Leipzig [1]	141
Elektrotechnischer Verein zu Magdeburg	98
Elektrotechnischer Verein Mannheim-Ludwigshafen	103
Elektrotechnischer Verein, München	122
Elektrotechnischer Verein am Niederrhein, Crefeld	80
Oberschlesischer Elektrotechnischer Verein	96
Elektrotechnischer Verein des Rheinisch-Westfälischen Industriebezirks, Essen	380
Elektrotechnischer Verein an der Saar, Saarbrücken	51
Württembergischer Elektrotechnischer Verein, Stuttgart	185

[1] The two societies in Leipzig have recently been amalgamated.

The members of these societies may apply for membership in the Verband, and for this privilege the society pays 2.50 marks (62 cents) per member to the Verband; and a member joining the latter body is entitled to the privilege of subscription at the reduced price to the *Elektrotechnische Zeitschrift.* The total membership of the Verband is at present 4653, of whom 4519 are members of local societies, the remainder, 134, being members of the Verband alone.

The most important event of the Verband year is the annual convention, which is usually held in the month of May, June or July in one of Germany's cities. The principal purpose of the convention, which continues three to four days, is the presentation of reports by various committees that have pursued certain work throughout the year, and the progress of which has been, from time to time, reported through the society's periodical. In addition to these reports, papers on live topics are presented, interesting installations are visited, and an opportunity is afforded members for the exchange of ideas and experiences. The program also includes pleasure trips and other social features, which serve to bring the members into closer personal touch with each other.

The conduct of the convention and the other business of the society is in the hands of an executive committee (called "Vorstand") consisting of a chairman, two substitute chairmen and four members, who are elected for two years at a convention. The chairman or one of the substitute chairmen is the legal representative of the Verband. In addition to the executive committee, there is a board of managers (called "Ausschuss") made up of members of the executive committee, ten members elected by the convention and a number of other members elected by the societies which belong to the Verband. The members of this board also hold office for two years. The local societies are allowed to have one member in this board for every 150 members of the society. At present the board is made up of fifty-one members. This board decides on all fundamental matters relating to the Verband, on proposals of the executive committee as well as of single members, and on proposals which are laid before it at the convention.

The method of election of the executive committee is as follows: The members in attendance at an annual convention receive from the retiring board of managers a complete nomination list giving definite recommendations for the make-up of the new executive committee. The formal election is then made simply by acclamation. As to the board of managers, only ten members are elected at the annual meeting, since the others are either members of the executive committee or are appointed by the branch societies. The names of the ten members to be elected are also proposed by the board of managers and these members are then elected by acclamation. The part which the members attending the annual meeting take in the elections is therefore a purely formal one.

When the executive committee has to transact business its members are summoned to a meeting. Aside from the annual meeting of the executive committee, which immediately precedes the annual convention of the Verband, the managers meet together only occasionally, when some important matter comes up which demands immediate action. This was, for instance, the case two years ago when action had to be taken concerning details of reorganization of the body. In such cases a meeting of the board of managers may be called on the motion of at least eight members of the board. The different members of the board are notified in advance by letter concerning the business to be transacted. In matters of urgency a vote by letter may be taken, in which case the chairman specifies a date by which the votes must be received.

Resolutions adopted by the executive committee are communicated by letter to the members of the executive committee and to all members of the board of managers. Every member of the executive committee has the right to send out circular letters through the chairman. A resolution of the executive committee is valid if four members are in favor of it, subject, however, to the provision that the other members must have had an opportunity to vote on the resolution. The board of managers can adopt resolutions if all its members have been notified ten days previously concerning the business to be transacted, and if at least one-half of the members are present. The resolutions of the board of managers are adopted by a majority of the board.

For the investigation and study of current topics the convention appoints special committees for a term of one year, which choose a chairman from the committee membership and hold meetings as the progress of their work demands.

All of the officials thus far mentioned are honorary and receive no pay. The general secretary, however, who is the executive officer of the society, receives a salary and he has a voice in the executive committee and in the board of managers.

The work of the Verband Deutscher Elektrotechniker has, aside from the holding of meetings for the reading and discussion of papers, covered a wide range of activity. Its "Specifications for the Installation of Electric Plants," the preliminary work on which is due to the Elektrotechnische Verein of Berlin, appeared first in 1896. They have steadily been kept up with the progress of the industry, and are accepted as standard by manufacturers, contractors, central-station managers and the local authorities. A similar work consisted in the formulation of "Specifications for Electric Railways"; "Specifications for the Operation of Electric Plants"; "Specifications for Overhead-Line Construction"; "Specifications for the Crossing of Power Lines and Telegraph and Telephone Lines": "Specifications for the Crossing of Power Lines and Railways"; "Specifications for the Protection of Electrical Plants Against Abnormal Potentials"; "Specifications for the Protection of Metallic Underground Structures from Electric Railway Stray Currents," and "Standards for the Utilization of Electricity on Board Ship." Mention should also be made of the "Suggestions for Procedure in Case of Fire," "First Aid to Those Injured in Electrical Operation" and "Rules for Protection of Buildings Against Lightning," which were taken over from the Elektrotechnische Verein: also of the "Copper Standards," "Standards for Conductors," "Standards for the Manufacture of Incandescent Lamp Bases, Plug Fuses, Plug Contacts, Insulating Tubes and Arc Lamps." A number of valuable test specifications, including specifications for transformer iron, construction material, and photometry of incandescent and arc lamps, have been drafted and have aided German manufacturers considerably in attaining their present high standard of quality. In fact, the Verband has conferred a great benefit on the German manufacturing industry by this work, which has tended to the national standardization of electrical apparatus. The specifications for rating and testing of electrical machinery and transformers have become standard in Germany and have been used as a model for similar specifications in other countries.

Important work has been accomplished by the Verband, acting in conjunction with other technical societies, as representative of the electrical industry in connection with government legislation for the regulation of electrical plants and central stations, and the taxation of plants on the basis of electrical energy output and lighting equipment. It has also promoted the education of workmen employed in electrical construction and operation and furthered the practical training of students. The activity of the Verband in broad educational matters is evidenced by its active co-operation with many other organizations; for instance, it is represented in the German Commission for Mathematical and Natural Science Studies, the Commission on Technical Intermediate Schools, the Commission on Units and Symbols, the Commission on Tests of Hauling Machinery, the Commission of German Insurance Protection Societies, the Commission of the German Museum and the Permanent Commission on German Industry. In the International Electrotechnical Commission, with headquarters in London, the Verband is represented in the council by Prof. E. Budde and Mr. G. Dettmar. A fund of 500,000 marks was left by Mr. Günther, the late editor and proprietor of the *Elektrotechnischer Anzeiger*, the proceeds of which are to be applied in aiding needy members of the electrical industry, especially mechanics and wiremen, and in assisting deserving men of this class to obtain a professional training. This fund is managed by the Verband under the supervision of the state. Another important work of the Verband is the collection and publication of central-station statistics, formerly published yearly in the *Elektrotechnische Zeitschrift*.

H. Görges.

The income of the Verband is made up as follows: Dues from the local societies of 2.50 marks (62 cents) for each recorded member; dues of 30 marks ($7.50) from each member of the Verband; proceeds from the sale of specifications, rules, etc., and the Verband's share in the advertising business of the *Elektrotechnische Zeitscrift*.

According to the last report, the surplus amounted to $37,500. The income for the last year was $20,000 and the expenditures $12,750, leaving a balance of $12,500 for the surplus.

The president of the Verband Deutscher Elektrotechniker is Geheimer Hofrat Prof. J. Görges, of Dresden. He was born in Lüneburg in 1859, and after leaving the Gymnasium at that place studied mathematics and natural science in Tübingen, Göttingen and Berlin. After passing the state examination *pro facultate docendi* at the University of Göttingen, Mr. Görges, in 1884, entered the service of Siemens & Halske in their Berlin shops, where he spent two and a half years under Hefner von Altenek in design and investigation work. After the reorganization in the Charlottenburg shops of the firm, in 1889, Mr. Görges took over the direction of the designing and testing departments of electrical apparatus. He has paid particular attention to alternating-current problems, among which may be mentioned the construction of alternating-current motors. Later he also took up the development of patents for his firm, especially those having to do with polyphase currents. After seventeen years with the firm of Siemens & Halske Mr. Görges, in 1901, accepted a professorship of electrical engineering in the Technical High School in Dresden, and was made director of the new Electrotechnical Institute, which was built under his supervision. He still holds this position. Mr. Görges has contributed much to technical literature, among which articles on the following subjects may be mentioned: Measuring instruments, polyphase distribution systems, single-phase motors, theory of parallel operation, investigations of the starting characteristics of motors.

Dettmar.

The general secretary is Mr. G. Dettmar, who is the author of "Explanations of the Specifications for Rating and Testing of Electric Machinery and Transformers." Mr. Dettmar succeeded Prof. Dr. Gisbert Kapp, now professor of electrical engineering at the Birmingham University and president-elect of the British Institution of Electrical Engineers, who was the first general secretary and served in that capacity for eleven years. At the annual convention at Braunschweig in June last Prof. E. Budde was elected president, his term of office beginning with the first of the year 1911.

THE ELEKTROTECHNISCHE VEREIN.

The Elektrotechnische Verein, which was founded in 1879, as mentioned before, has at present 2800 members, 1100 being in foreign countries. According to its by-laws, individuals, firms, corporations or government authorities are eligible to membership, in so far as they have any interest in the purposes and publications of the society. Eligibility to membership is not limited by nationality. Application for membership requires the support of two members of the society. Different classes of members, such as are common in other societies, do not exist, with the exception of honorary membership, which is conferred in recognition of important work done. At present the only honorary member is Mr. Thomas A. Edison. Prof. Dr. Wilhelm Weber, Dr. F. von Hefner-Alteneck and Lord Kelvin, deceased, were the only other honorary members. In addition to honorary membership, however, there is also the office of honorary president. One of the founders of the Verein, Dr. Stephan, was the first to hold this office, and since his time the honor has been conferred on two other members, namely, the former Prussian Minister, von Podbielski, and Mr. R. Sydow, Minister of Commerce and Industry.

In honor of its twenty-fifth anniversary the Verein founded the Siemens-Stephan tablet, illustrated herewith, which is given to men who have made notable contributions to the electrical engineering profession as a whole, or have rendered great service to the society. This tablet, which is struck off in silver and bears medallions of the two founders, is awarded every five years. Up to the present time the medal has been received by Dr. Wilhelm von Siemens, second son of Dr. Werner von Siemens, and by Dr. E. Warburg, president of the Physikalisch Technische Reichsanstalt.

The business of the society is conducted by an executive committee (called "Vorstand") and a board of managers. The executive committee is made up of a chairman, two secretaries, a legal adviser, a treasurer and a manager. The executive committee is elected annually at the first regular meeting of the year by a majority vote of those present at the meeting. The chairman cannot serve more than two years in succession, and the board of managers (called "Ausschuss"), which works with the executive committee, is elected for three years and consists of forty-eight members. The chairman is chosen by the board from its membership, and the board appoints special committees to pursue certain investigations for the board.

Siemens-Stephan Tablet.

The election of the executive committee takes place as follows: To the members who attend the election a nomination list prepared by the retiring executive committee is presented which contains the names of those proposed for the different offices. The formal election is then by acclamation. The board of managers is similarly elected. In this case one-third of the old members retire every year and a corresponding number of new members are elected by acclamation according to a nomination list proposed by the board of managers. The part which the members attending the election meeting take in the election itself is therefore a pure formality in the Verein as well as in the Verband.

President-Elect Dr. E. Budde.

The work of this board, which meets once a month from October to May, inclusive, consists in the conduct of the meetings, determination of the order of business and subjects to be discussed, and passing on papers submitted to the society. The body also takes action on the proposals and reports submitted by the executive committee, and edits the publications of the society.

The society holds regular monthly meetings from October to May, inclusive, at which papers are presented and discussed. At these meetings progress reports of the various committees of the board of managers are submitted and discussed. At the annual meeting the outgoing executive committee submits its report covering the year and renders a financial statement. For the transaction of pressing business or the presentation of papers special meetings of the society may be called. The announcements and reports of meetings are published in the *Elektrotechnische Zeitschrift*, as are also the papers and discussions presented at the meetings. Of late years it has become a custom to hold an annual conversazione or social function, which is closed by a banquet. Sometimes new electrical devices are exhibited at these meetings.

Unlike similar institutes in other countries, the Elektrotechnische Verein has no home of its own. For years the meetings were held in the auditorium of the Royal Post and Telegraph Building, later in the Technical High School at Charlottenburg, and at present in the auditorium of the German Surgical Society in the Langenbeck House.

The dues for members are 20 marks ($4) and include a free subscription to the *Elektrotechnische Zeitschrift*. According to the last report of the society there is a surplus of $55,000. The income for the year was $27,000, of which about $22,500 was from membership dues, and the remainder from the society's share in the advertising profits of the *Elektrotechnische Zeitschrift*. The expenses for the year were about $12,500, leaving a balance of $14,500.

The society, through its papers, has done much to develop and disseminate knowledge on electrical subjects. Glancing through the columns of the *Elektrotechnische Zeitschrift,* the society's proceedings will be found to reflect truly the historical development of electrical engineering. Noteworthy among the earlier contributions are the previously mentioned papers of Fröhlich, von Hefner-Alteneck, Neesen, Aron and von Dolivo-Dobrowolski. Later were important contributions on the subjects of alternating current and direct current for central-station distribution, the effect of grounding the neutral in three-wire systems on telegraph and telephone circuits, the transmission of energy by high-tension alternating current, progress in electric machine design and especially in the single-phase motor for electric traction, and the epoch-making developments in the fields of electric lighting and wireless telegraphy.

Among the scientific work accomplished by the Elektrotechnische Verein may be mentioned investigations on earth currents and their relation to terrestrial magnetic phenomena, investigations on lightning and lightning protection. As a result of these investigations, the society published in 1886 and 1891 two pamphlets on lightning and methods to be pursued in protecting buildings from lightning, which later were taken over by the Verband Deutscher Elektrotechniker. Based on the same work were special instructions for lightning protection in factories of explosive materials. In connection with the lightning investigations, the effect of atmospheric electricity and abnormal rises of potential on electric transmission lines were studied in great detail. The society played a most important part in the fixing and legalizing of electric units in Germany. When, in 1886, Werner von Siemens conceived the foundation of a Physikalisch Technische Reichsanstalt for the preservation, testing and certification of electrical standards, and the government appropriated a large sum of money for this purpose, the Elektrotechnische Verein supported the movement in an active manner. Along this line also work is done in connection with the fixing of photometric standards, credit for which is largely due to von Hefner-Alteneck. The Hefner-kerze is to-day the working photometric unit of Germany.

The Verein took an active part in the preparation of rules for the installation of electric plants, which are issued by the Verband Deutscher Elektrotechniker. It also took part in the revision of the rules of the fire insurance companies regarding electrical installations in 1892. The work of the committee appointed to investigate stray currents from electric railways served as a basis upon which the Verband Deutscher Elektrotechniker formulated rules for the protection of metallic underground structures against electric railway stray currents. Of great scientific value is the work which was published last year under the title of "Definitions of the Properties of Electric Conductors."

Finally, attention may be called to the society's attempt to establish a uniform system of symbols for the quantities used in engineering. This work is in charge of the committee on units and symbols, and represents most of the large technical societies in Germany, as well as those of Austria-Hungary and German-speaking Switzerland, with a total membership of about 60,000. The direction of this committee is at present in the hands of the Elektrotechnische Verein.

The Verein has taken part in expositions and congresses in Paris, Vienna, London, Frankfort-on-the-Main, Chicago, Genoa and St. Louis. In the International Electrotechnical Commission the Verein, jointly with the Verband, is represented by two members.

An important function of the Verein is the publication of the *Fortschritte der Elektrotechnik,* founded in 1887 by Dr. K. Strecker, which was taken over by the Verein in 1900. This publication, which is well known throughout the world, is issued quarterly and presents a digest of the world's electrical literature.

The president of the Elektrotechnische Verein is Geheimer Regierungsrat Dr.-Ing. Wilhelm von Siemens, the second son of the founder of the firm of Siemens & Halske. He was born in 1855, and after finishing his studies, which were confined principally to natural science, he became in 1884 a member and director of the firm of Siemens & Halske. He is at present a member of the board of directors of the Siemens & Halske Company, and also chairman of the board of directors of the Siemens-Schuckert Werke. One of his earliest contributions to electrical engineering was an investigation of incandescent lighting, with special reference to incandescent lamps connected in series, the result of which was embodied in papers presented before the Elektrotechnische Verein during the period from 1883 to 1888. Later Herr von Siemens did important work in connection with the utilization of polyphase currents for electric traction service. It is due to his influence that the celebrated high-tension, high-speed electric traction experiments on the Marienfelde-Zossen line were carried out. He also rendered valuable service in the development of the Siemens high-speed printing telegraph. Outside of the electrical engineering field Herr von Siemens has taken an active part in relation to national economic questions, and among his writings in this connection may be mentioned those on the right of employees to their inventions, suggestions for national financial reforms and criticism of the tax on electric energy.

As will be seen from the above, the Elektrotechnische Verein in Berlin is the oldest and by far the most important member of the Verband. With reference to number of members, the Rheinisch-Westfälische Verein comes second, its territory being the West German coal and iron fields, where electrical energy is widely used for industrial purposes. The next largest societies are those in Dresden and Frankfort-on-the-Main. The Elektrotechnische Gesellschaft zu Frankfurt was originally intended as a branch of the Berlin Verein, and is the oldest provincial society, having been founded in 1881. It took an important part in the development of the electrical industry, and it was through its influence that the works of the great firm of Lahmeyer were located in Frankfort. The memorable Frankfort Exposition and the International Congress of 1891, with its epoch-making experiments in electric power transmission, are also to be credited to the initiative of the Frankfort society.

W. Siemens.

President of the Elektrotechnische Verein.

OTHER GERMAN ELECTRICAL SOCIETIES.

This article would not be complete without mention of certain other electrical societies which are not in alliance with the Verband. One of the most important of these is the Verband der Elektrotechnischen Installationsfirmen in Deutschland, which was founded in 1902. It is made up of representatives of contracting firms, and has at present about 350 members. Its quarters are in Frankfort-on-the-Main, and its president is Mr. G. Montanus. In the same year there was founded the Verein zur Wahrung Gemeinsamer Wirtschaftsinteressen der Deutschen Elektrotechnik, the membership of which is made up of those interested in the manufacture and sale of electrical apparatus. There are at present 120 members, with headquarters at Berlin. The president is Dr. E. Sieg, president of the Hagener Storage Battery Works, in Cologne. A society representing similar interests is the Vereinigung Deutscher Elektricitätsfirmen, with headquarters in Berlin, the president of which is Prof. Dr. E. Budde.

Representatives of central stations organized themselves into a society in 1891 under the name of the Vereinigung der Elektricitätswerke, with headquarters at Dresden. The president of the society, which numbers about 400 members in Germany and abroad, is Mr. W. Meng, president of the Municipal Electricity Works in Dresden. It should be mentioned that this organization publishes an annual statistical report on the working results of central stations, which is of great value to those engaged in the design and operation of such plants.

The three societies above mentioned are primarily commercial in character. In contradistinction to these should be mentioned the Verein Beratender Ingenieure für Elektrotechnik, whose headquarters are in Berlin. The purpose of this society is to represent the interests of consulting electrical engineers and further the perfection of electrical and mechanical details of plant design. The consulting engineer in Germany is a much less important factor than in England, which fact, together with the very strict requirements for membership, which include scientific education, practical experience and absolute commercial independence of members, accounts for the small number of members in this society, which is at present only thirty-two. The society was organized in 1902, and Dr. E. Müllendorff, of Berlin, is president.

CURRENT NEWS AND NOTES.

Meeting of New York Section, I. E. S.—The regular monthly meeting of the New York Section of the Illuminating Engineering Society will be held on Feb. 9 in the Dungeon of at Castle Cave, 271 Seventh Avenue, at 8:15 p. m. The subject of the evening will be "Light and Architecture." Mr. Henry Hornbostel, of the architectural firm of Palmer & Hornbostel, will lead the discussion.

Southwestern Electrical and Gas Association.—The seventh annual convention of the Southwestern Electrical & Gas Association will be held in Houston, Tex., on April 27-29, 1911. This association, composed largely of Texas men, lays claim to being the strongest and most active State association in the United States, and its meetings are well attended and enthusiastic. Mr. D. G. Fisher, 1316 Commerce Street, Dallas, Tex., is third vice-president and secretary of the association.

Electric Signs and Poetry.—The *Commercial Appeal*, of Memphis, Tenn., prints in its issue of Jan. 15 a poem of seven stanzas by Miss Lucile Dillard Barron, entitled "Lights of Main," which gives expression to the emotion inspired by the sight of the electric signs on the main street of Memphis, whose "dazzling, witching glow set the world a-tingle and the peeping stars bade go." Among the sights sketched are "a bubbling fountain, foaming, sparkling, all ablaze, spilling out its cooling waters in a swirling, dreamy maze," and "a wondrous star arising, as a jewel magic made, and poured upon the clearings its luminous cascade."

Philadelphia Electrical Show.—Practically all of the floor space has been taken for the coming Philadelphia Electrical Show. The three local public-service corporations in the city—the Philadelphia Electric Company, Philadelphia Rapid Transit Company and Keystone Telephone Company—will take an active part in the exhibition, and the City of Philadelphia will also have an exhibit. The University of Pennsylvania will have an exhibit, as will also the Franklin Institute, the Spring Garden Institute and the International Correspondence Schools. The Philadelphia Electrical Contractors' Association will, as last year, exhibit as an association. Philadelphia is practically an untouched field for the electric vehicle for both commercial and pleasure purposes and it is expected that many types of up-to-date cars will be shown in the coming exhibition. The fact that the exhibition was planned, projected and the exhibitors procured in the space of less than two months is a tribute to the co-operative spirit of the electrical fraternity of Philadelphia.

Electric Advertising by an Airship.—The great airship of the Parseval Air Transportation Company appeared on New Year's eve over Berlin, Germany, and passed over the main streets unusually close to the ground. On each side of the huge bag were stretched large canvases of glittering stuff, on which appeared in great letters of light the words "Prosit Neujahr," meaning "Happy New Year." The ship had just returned from its gas-charging station at Bitterfeld, about 150 miles from Berlin, and the display caused a great sensation. The ship took its course to the royal castle, circumnavigated that and other important buildings, and finally returned to its station at Johannisthal. The lighting was accomplished by an electric generator in the car, taking sufficient power from the airship motor to produce electricity for two searchlights, one on each side. The outlines of the car were marked by incandescent lamps of various colors. This method of advertising is patented by the Air Transportation Company, Charlottenburg, Germany.

Corporation Industrial Education.—The *Proceedings* of the Boston convention of the National Society for the Promotion of Industrial Education, just issued, contains several papers, with discussions, on industrial training. Mr. M. W. Alexander, of the General Electric Company, West Lynn, outlines the general principles and requirements of apprentice instructions; Mr. Tracy Lyon, of the Westinghouse Electric & Manufacturing Company, describes the training which the Westinghouse company offers its apprentices, and Mr. George C. Cotton, of the Solvay Process Company, Syracuse, describes the apprentice training carried on by his company. Other papers are on apprentice instruction carried on by the Atchison, Topeka & Santa Fé Railway system and by the North End Union, a corporation apprentice school conducted by a number of employers of Boston to give training for the printing trades. Among those discussing the various papers were Prof. Sydney Ashe and Messrs. Walter B. Russell, Henry Abrahams and G. M. Basford.

Depreciation of Buildings and Machinery.—Mr. H. F Donaldson, chief superintendent of the Royal Ordinance Factories, read a paper on Jan. 12, 1911, before the (British) Junior Institution of Engineers, entitled "Depreciation of Buildings and Machinery." The author contended that depreciation funds are not, and ought not to be, matters which interest only the accountant. He proposed a method of calculating the depreciation based essentially on assigning a certain definite percentage of depreciation in value each year rather than a certain constant amount of depreciation to cover the whole cost of equipment at the end of a specified period. For example, rather than assign a depreciation of 33 1-3 per cent of the initial value each year, it is better to estimate 40 per cent of the value year by year. In the former case the values year by year would be 100 per cent, 67 per cent, 33 per cent and 0.0 per cent; in the latter case the values would be 100 per cent, 60 per cent, 36 per cent, 21.6 per cent, 13.0 per cent, etc. An outline was given of methods for determining the value to be assigned to the depreciation of various machines and buildings used for industrial purposes.

New Street Railway Tunnel in Chicago.—The new Washington Street tunnel under the South Branch of the Chicago River was used for the first time on Jan. 29. It is used by the Chicago Railways Company for street-railway service and is built in such a manner that it may form a part of the proposed Chicago passenger-railway subway when the latter is built.

Joint Meetings in Chicago.—The joint meetings of the Chicago Section of the American Institute of Electrical Engineers and of the Electrical Section of the Western Society of Engineers will continue to be held at the rooms of the latter during the remainder of the season. The February meeting will be addressed by Prof. C. F. Burgess, of the University of Wisconsin, and his subject will be *Electrolysis of Iron and Concrete*. Mr. C. D. Haskins, of Schenectady, will be the speaker at the March meeting, his subject being *Electricity and War*. At the April meeting Mr. August C. Smith, of the Cataract Power & Conduit Company, of Buffalo, will speak on *Electricity in Ice Plants*.

Illinois Society of Engineers.—The twenty-sixth annnual meeting of the Illinois Society of Engineers and Surveyors was held in East St. Louis on Jan. 25-27. Nearly all of the papers presented related to civil engineering, although in his historical review Prof. I. O. Baker, of the University of Illinois, referred to the remarkable development of the electric railway motor in the life of the society. Prof. William H. Burger read a paper on the College of Engineering at Northwestern University, Evanston, Ill. This is a new engineering college with two courses—one a five-year course in mechanical and electrical engineering. The work of the first four years fulfils the requirements for the degree of bachelor of science, while on the satisfactory completion of the fifth year of work the College of Engineering will confer the degree of civil or electrical engineer. The new president of the Illinois Society of Engineers is Mr. J. G. Gabelman and the secretary is Mr. E. E. R. Tratman, both of Chicago.

Minneapolis Electric Show.—The second annual Minneappolis Electric Show, given by the Northwestern Electric Show Association, was opened in the National Guard Armory in Minneapolis on Jan. 26 and will be closed on Feb. 4. There are about sixty exhibits, embracing a number of prominent electrical manufacturers and dealers. Prof. H. T. Plumb gives popular lectures on electric phenomena in the afternoons and evenings. A large variety of applications of electricity are exhibited and also a number of electric automobiles. The interior lighting effects are very successful, the central feature being a beautiful combination of white and colored lamps in the dome of the building displayed against a black cloth canopy as a background. In each of the four corners of the building is a somewhat similar cluster of lamps, and these are connected with the centerpieces by lines of light, which alternately appear and disappear. The combination makes a beautiful and spectacular illumination.

Electrical Show at the Georgia School of Technology.—An electrical show of unusual interest was given by the senior students of electrical engineering at the Georgia School of Technology in Atlanta Jan. 13, at which there were twenty-three working exhibits and demonstrations, with a student in direct charge of each. These exhibits ranged from electric welding appliances to a stereopticon lecture, the performance being continuous. A feature of the evening's entertainment was a luncheon partly prepared by electric cooking utensils, at which over 300 guests were seated. Several of the Atlanta firms manufacturing electrical apparatus had working exhibits with their representatives in charge. The first and second floors of the Electrical Building at the "Tech." were crowded during the show, the audience being remarkable for the number of elderly persons who took advantage of this opportunity to acquaint themselves with the manifold applications of electricity.

Minnesota Electrical Association.—The annual convention of the Minnesota Electrical Association will be held in the St. Paul Hotel, St. Paul, Minn., on March 14-16. Mr. T. C. Gordon, of Little Falls, Minn., is secretary of the association.

Results of Meter Tests in St. Louis.—During the year 1910 the Union Electric Light & Power Company, of St. Louis, tested 40,046 customers' watt-hour meters. Taking 96 per cent as the standard of accuracy of this total, 8.1 per cent were fast, the inaccuracy being in favor of the company, while over twice as many were slow, the error in this case favoring the customer.

Popular Lectures for Central-Station Men.—The electrical engineering department of the University of Illinois is considering the advisability of giving a series of six or eight popular lectures to central-station men of the State. These lectures would occupy two days' time, and would deal with such practical problems as central-station economics, illumination and the resuscitation of injured men. Under central-station economics will be discussed the relative advantages of reciprocating engines, high-pressure, low-pressure and mixed-pressure turbines, the effect on coal and steam consumption of high-vacuum, superheat and boiler pressure. The lectures in illumination will deal with the comparative costs of different illuminants for exterior and interior lighting. A practical demonstration of the use of the luminometer will be given. The resuscitation of men will be discussed and practical demonstration will be given with and without apparatus designed for the purpose.

Plan Transferring Detroit to Eastern Time to Save Daylight.—A proposal to set the hands of Detroit clocks ahead one hour, transferring the city from Central to Eastern standard time, has obtained the approval and encouragement of the Detroit Chamber of Commerce and other public organizations and now seems likely to be established. Its advocates reason that if the city should adopt the earlier time business would commence earlier in the day, leaving more daylight to be enjoyed after offices, shops and factories close in the afternoon and also saving much of the cost of artificial illumination. The translated hourly schedule will apparently benefit the central-station load curve. The earlier closing of factories will relieve its lines of certain factory lighting demand that comes during the peak load but is not considered especially profitable. The peak of the service supplied to the street railways will also be advanced earlier in the day, partially removing it from the peak load of the lighting system. The trailing profile of the evening peak will be lowered, but this will have the effect of also lowering the extreme peak on the station, for which a large investment in generating machinery must be held in reserve. On the other hand, the morning lighting curve will be substantially raised, as houses and stores will be lighted up with the earlier beginning of business. This demand will come at a time, of course, when there is ample generating capacity available and should aggregate in kw-hours approximately that removed from the evening peak. The change of one hour to Eastern time will bring Detroit clocks into agreement with those at Windsor, but viewed from the American shore of Lake Erie Detroit will present the anomaly of being the only city west of Buffalo, from which it is about 300 miles distant, using Eastern time. It is only within a few years that Detroit has become changed wholly from local sun time to standard time, this being preceded by a period during which conservatives who clung to the old setting caused such confusion that one horological wit erected a clock downtown with five hands, showing Eastern, Central and sun times.

Chicago Engineers' Club.—The Chicago Engineers' Club has under consideration the project of erecting a building for its own use to be located near the Union League Club in Chicago.

Control of Energy Transmission in Maine.—A resolution providing that no corporation engaged in the transmission of energy shall be granted unrestricted rights of eminent domain nor transmit energy beyond the limits of the State has been passed by both the House and the Senate in Maine.

Grounding in Denver.—The Denver Gas & Electric Company has finished grounding its secondaries throughout the city. The Denver city ordinance requires the grounding of wiring conduit to water service outside of the water meter, and the grounding of interior circuits is also progressing rapidly.

New Engineering Shops for Cornell.—For the purpose of providing a building to house the shops of the Sibley College of Engineering at Cornell University Mrs. Florence O. R. Lang has donated $50,000. The building will be erected in memory of Mrs. Lang's brother, Jasper Raymond Rand, Jr., of the class of 1897, Sibley College. Her father, Jasper Raymond Rand, and her uncle, Addison Crittenden Rand, founded the Rand Drill Company, now merged in the Ingersoll-Rand Company.

Valuation of Public-Utility Properties.—Mr. Horatio A. Foster recently delivered an address before the students of the Throop Polytechnic Institute, Pasadena, Cal., on the subject of the valuation of public-utility properties. Included was a digest of some of the notable court decisions on details of valuation, etc. The address, together with one by Dr. Henry S. Carhart on "The Twentieth-Century Engineers," has been printed as Bulletin No. 49, and will be sent to any one interested upon application to the secretary of the institute.

Hotel Bibles Increase Electric Bills.—An immediate result of the work of the Gideons, a religious society of traveling men, in placing Bibles in the guest-rooms of hotels in large cities, according to the *Evangelical Messenger*, has been the increase at once noted in the electric lighting bills of the hotels supplied. One landlord in St. Louis is quoted as saying: "The change I first noticed after the Bibles were placed in the bedrooms of my hotel was that my electric bill doubled. The men go on reading and my electric light bill goes on getting bigger."

Los Angeles Aqueduct Power Question.—It is proposed to submit to the citizens of Los Angeles at an election to be held March 6 the question whether the electrical energy obtained by the water-power development of the Los Angeles Aqueduct, now building, should be sold to existing electrical companies or distributed by the municipality. The manner of handling this energy is still unsettled, and it is said that the companies would like to delay the date of submitting the proposition to the people to study and explain their position more fully. The city authorities, however, are believed to be in favor of presenting the question to the voters on the date mentioned.

Returns from Public-Utility Investments.—This is the season when candidates for the mayoralty in Chicago announce their principles in ringing tones. Four of these gentlemen have delivered their pronunciamentos. One is Mr. Carter H. Harrison, former Mayor, who is still, as he has been for a number of years, for public ownership "at the earliest possible moment." That sounds reminiscent, but one sentence from Mr. Harrison's platform is of present-day interest: "In the early days when public utilities, such as the traction, the telephone, the electric light and the gas companies, were still in an experimental stage, because of the risk run, a higher rate of interest on the investment was to be expected than would be fair to the consumer to-day, when with good management returns are as certain as is the interest on the national debt."

Water-Power Studies in New York.—In his annual report to the New York State Water Supply Commission Mr. Walter McCulloh, consulting engineer of the commission, gave the results of water-storage and power surveys made during the year on the Black River, the Oswego-Seneca Rivers and their tributaries, including the Finger Lakes, a survey of the Hudson River from Hadley to Troy, and a survey on the Genesee River at Mount Morris and Rochester. Reservoirs at Hawkinsville and Higley Mountain on the Black River would add 7915 hp and 7200 hp to the minimum flow of the river at costs of $2,800,000 and $1,340,000 respectively. On the Hudson River between Hadley and Troy 27,165 hp could be added to the present 131,697 hp by means of proper storage facilities. According to the report the mean annual dependable precipitation throughout New York State is 38 in.

Circuit Court to Pass on Fellow-Servant Case.—In May, 1907, Hugh Massey, a lineman's helper, working on a "dead" 2300-volt feeder of the Milwaukee Electric Railway & Light Company, near West Allis, Wis., was killed when a switchboard operator several miles distant closed a switch, energizing the line. When the case was first brought against the company by the dead man's mother a judgment of nonsuit was entered for the company, but an appeal was taken to the Supreme Court of Wisconsin. Here the judgment was reversed and the case has now been brought back to the Circuit Court, Judge Eschweiler, of Milwaukee, presiding, for a jury trial. The outcome of this case hinges upon the ruling whether the switchboard operator responsible for the lineman's death can be construed to be a vice-principal with the company, or whether, as a fellow-servant, the company is freed of responsibility for the accident.

Chicago Commercial Vehicle Show.—At the exhibition of commercial motor vehicles to be given in the Coliseum, Chicago, during the week of Feb. 6-11 under the auspices of the National Association of Automobile Manufacturers there will be shown a number of electric vehicles, including an electric hearse. There will also be several different police-patrol wagons and motor-driven ambulances, both gasoline and electric. Unusual interest throughout the country is reported in the subject of motor wagons for municipal purposes, and undoubtedly one result of the Chicago show will be a great increase in the number of such machines in use in different cities. An electric truck designed especially for use in factories and warehouses, railroad stations and steamship docks will be shown. The platforms of these trucks are only 2 ft. above the floor and their maximum speed is four miles an hour. They are made narrow so they can run up and down the aisles of the factory, and are steered by the front and rear wheels so they can turn very short corners, being operated from either end.

Transmitting Telegrams by Telephone.—It is reported that the Western Union Telegraph Company may discontinue telephoning messages received by telegraph, where practicable, instead of delivering them by messenger. It is said that in some cases the practice has resulted in the contents of telegrams being divulged to servants and other unauthorized persons. The telegraph company says that the plan arose not from a desire to effect economy, but to expedite the service and to meet the convenience of the public. Mr. G. E. Paine, general superintendent of the Postal Telegraph-Cable company in Chicago, writes to the daily newspapers in that city to say that the discontinuance of this service refers to the supposed possibility of making the telephone and telegraph practically one machine, supplanting the messenger service. He adds that the Postal company has always used the telephone to a certain extent in receiving and delivering messages, when desired by patrons, and that this practice will be continued. The plan of extensive complementary service of the telegraph and telephone was not adopted by the Postal company last summer, he says, but was devised by the Bell telephone and Western Union telegraph interests after their combination.

New Flaming Arc-Lamp Electrode.—A patent was granted Jan. 24 to Mr. Miner W. Allen and Mr. Wallace T. Conn on an improvement in electrodes for flaming-arc lamps which consists in providing the electrode with a metallic wire extending from end to end, the object being to decrease the resistance of the electrode.

Utilities Board in Maine.—The Democrats of the Maine Legislature have declared in favor of a Public Utilities Commission of five to supplant the present Railroad Commission and also to have supervision over all other public-service corporations, including regulation of rates. The bill is drawn on the lines of the Wisconsin law with modifications in accordance with the Ohio bill.

Electrical Energy for Steel Making in Norway.—Electrical energy for use in making steel at Stavanger, Norway, will be purchased at the rate of $6.70 per hp-year for the first 1500 hp and $5.35 for 1000 hp more; 10,000 hp will be available when needed. The steel plant, which is to be constructed by the Stavanger Electro-Staaverk Company, will be completed by August, 1911. The yearly output will be 1400 tons high-grade steel billets, 600 tons steel castings, 300 tons hammered steel and 700 tons refuse for resmelting.

Substitute for Radium for Medical Purposes.—Prof. E. Rutherford, director of the physical laboratories of the University of Manchester, has announced the development of a practicable method for producing mesothorium, a substitute for radium. The new substance is said to be quite as good as radium for medical purposes and much cheaper, and can be extracted from thorium, a heavy metallic powder of an iron-gray tint, which burns brilliantly in air or oxygen and which is extracted from thorite, which is found in Norway.

Telephone Girl Signs a Bond to Remain Single.—If the newspapers may be believed, a young woman recently employed by a Spokane (Wash.) hotel as a telephone operator was required to give a $500 bond not to marry within six months from the date of her engagement, the word "engagement" being used here in a strictly business sense, of course. The reason given for this unusual requirement is that half a dozen telephone girls employed in this hotel have resigned to get married within as many months. Telephone companies often complain that it is difficult to keep their young women operators, owing to the predilection which the girls seem to have for a matrimonial career, but the idea of restraining them from this course by contract is a new one.

Educational Meetings for Detroit Electrical Workers.—The Detroit local union, No. 18, of the International Brotherhood of Electrical Workers holds weekly meetings with programs of an instructive nature, at which practical talks are given by men of local electrical prominence. The nature of these addresses and the subjects involved are, of course, arranged to interest and instruct the audiences at the meetings, which are largely made up of electricians' helpers. On Wednesday, Feb. 1, Mr. W. T. White, electrical engineer of the Murphy Power Company, Detroit, gave a talk on "First Principles of Electrical Apparatus." Other speakers before the meetings have been Messrs. Alex. Dow and R. S. Stuart, of the Detroit Edison Company; Mr. Frank Mistersky, superintendent of the public-lighting system, and Mr. M. A. Allison, master mechanic of the Ford Automobile Company.

Electricity and Fence-Wire Rust.—Investigations to discover the causes of rusting in galvanized fence wires have been undertaken by the agricultural engineering department of the University of Iowa, at Ames, Ia. It has been well known that the lower wires of the fence, down among the moist grasses and weeds where rusting action would be expected to be most active, invariably last longer than the upper wires in the dry air. Mr. M. L. King, experimentalist for the department, says that he has found that these lower wires in fences of any length ordinarily carry small currents of electricity, reaching in some cases a value as high as 0.001 of an ampere, and sometimes showing a difference of potential of as much as 1 volt above ground. Such currents are absent in the upper wires, and it has been suggested, but not proved, that the greater preservative action of the lower strands is due to the suppression of local electric couples by the through currents flowing in the lower wires.

Mississippi Electric Association.—At a meeting of the executive committee of the Mississippi Electric Association held at Meridian, Miss., Jan. 19, 1911, Gulfport, Miss., was selected as the next place of meeting of the annual convention and June 20-21 selected as the dates. The following subjects were selected for papers to be presented at the convention: Engines of 750 kw and under; steam turbines, 750 kw and under, non-condensing and condensing; low-pressure turbines in connection with engines of 500 hp and less; electrically heated appliances; engineering department of National Electric Lamp Association; relation of employees to the company and to the public; the necessity for a commercial department. A committee was appointed on National Electrical Code requirements, and an appropriation was made for conducting a question box. The unanimous consent of all the member companies of the association having been obtained, it was voted to affiliate with the National Electric Light Association as a State section. Resolutions on the death of Mr. J. A. Jones, vice-president of the Gulfport & Mississippi Coast Traction Company, were adopted.

Dr. Steinmetz Before Toledo A. I. E. E. Branch.—Dr. Charles P. Steinmetz, of Schenectady, N. Y., addressed the Toledo Branch of the American Institute of Electrical Engineers Friday evening, Jan. 27, on the subject of "Some Phenomena of High-Power Circuits." More than 150 engineers and others of Toledo and vicinity were present at the meeting and attended the informal reception and smoker held afterward at the Toledo Club. Dr. Steinmetz discussed the various losses occurring in low-potential and high-tension circuits, including leakage, corona, etc., and gave some striking comparisons of the power quantities which may be involved in the effects of line surges. The speaker also referred to the continuing advances of transmission potentials, and outlined some of the problems which will require solution if the present rate of voltage increase is to be kept up. After his formal lecture Dr. Steinmetz was the target of a wide range of inquiries on electrical and engineering subjects, and escaped from his inquisitors only in time to catch his midnight train East. The meeting of the Toledo Branch Friday evening, Feb. 3, will be addressed by Mr. Harry Caird, of Toledo, on the subject of "Flaming-Arc Lamps."

New Type of Metallic Filament.—A patent was granted Jan. 24 to Mr. Orlando M. Thowless, of Newark, N. J., on an incandescent filament produced from powders which are not readily made into filament form by ordinary methods, either through lack of ductility or because of the necessity of long and expensive processes. A hollow cylinder of a ductile metal, such as aluminum, is packed with metallic tungsten in powder or with powdered tungsten and powdered oxide of thorium intimately mixed. After the air or gases are exhausted the packed cylinder is drawn down as though made of solid metal to the requisite filamentary diameter. The result is a tubular shell of aluminum containing all through its interior a dense, uniform, continuous conductive core of highly refractory material. The filament is then cut and formed into the proper shape for electric incandescent lamps, after which the aluminum part is removed by the passage through it of an electric current or by means of suitable solvents. This may be done after the filament is mounted in the lamp bulb during the process of exhaustion, following which the filament may be raised to a very high temperature for the purpose of making a still closer union of its particles.

ELECTRIC LIGHT AND WATER-WORKS PLANT AT HOLLAND, MICH.

Operating Features and Statistical Data of a Municipal Combination System.

Lack of good business management and insufficient records are often painfully evident in private electric lighting companies and have been frequently commented upon. Municipal enterprises have a reputation among the electrical fraternity for even worse lack of system and competent management; and, in spite of all their shortcomings, the private companies usually average up better than the municipal plants. A few notable exceptions have been found among municipal plants and described at length in these columns. It is pleasant to be able to describe another notably successful and well-managed plant of this kind, that at Holland, Mich. The success of this plant, although largely due to management, can also be partially attributed to the fact that the water works and electric light plant are operated together, with certain economical advantages which would not obtain with independent operation. While the results quoted in this article may not be within the reach of other plants of similar size giving only one kind of service, they will be of much interest to the numerous central-station companies which at present operate a water-works system, or which have under consideration the electrical operation of municipally owned water works in their respective cities.

EQUIPMENT.

Before discussing the results obtained, a brief description of the equipment used will be necessary. The plant serves a city of about 10,000 inhabitants located at the head of a bay along the eastern shore of Lake Michigan. The operation is entirely by steam, and plenty of water is available for condensing. The station is located about 400 ft. from the Black River, with a lift of water from the river of about 17 ft. Condensing water is obtained through a 30-in. reinforced-concrete pipe line, 330 ft. long, and an open concrete canal at the river end, 70 ft. long. This pipe line discharges into a cold well at the power plant, which is 25 ft. deep and 12 ft. in diameter. The depth of water in the well varies from 4 ft. to 7 ft. This well and pipe line were put in by the superintendent of public works, using day labor. The excavation was entirely in sand, with quicksand below 11 ft., and the cost of the entire job was $4,474.74. Tools and appliances left over from the job were valued at $782.85 and were available for other work of the city.

Coal is obtained from a railroad siding, and in 1910 a rather unusual arrangement was put in for coal handling. This is shown in Fig. 2. A concrete coal bin holding 1100 tons was built mainly underground a short distance from the boiler-room. The railroad tracks run over the center of the bin and the tracks are supported on plate girders so that the cars dump the fuel directly into the bin, from which it is hoisted in small cars up an incline with an electric motor into the boiler-room, where it is weighed. It cost formerly 25 cents a ton to haul coal from the railroad yard to the power plant.

There are three generating units. The largest of these is a 500-kw Allis-Chalmers turbo-generator; the next in size is a Russell condensing engine direct-connected to a 300-kw Westinghouse generator, and the smallest is a Corliss condensing engine, connected with rope drive to a 125-kw Westinghouse generator. All generators are 2300-volt, 60-cycle, two-phase machines. There are three exciters, arranged to operate in parallel: A 15-kw direct-connected set; an 11-kw unit belt-driven from a motor with emergency belt drive from one of the generators and a 3.75-kw unit belted to the smallest generator.

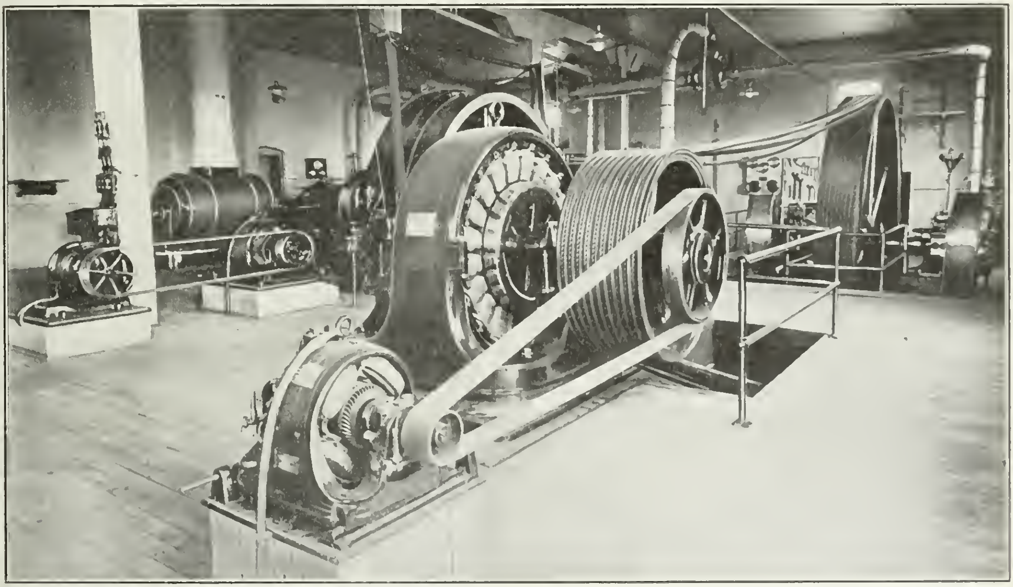


Fig. 1—General View of Engine-Room.

The switchboard consists of three generator panels, three exciter panels, one totalizing panel, four single-phase panels controlling lamp circuits, three two-phase panels controlling motor circuits and two two-circuit panels for the arc-lamp circuits. There is a watt-hour meter on each generator panel and also one on the totalizing panels, so that the totalizing meter affords a continuous check of the generator meters. Graphic recording wattmeters and voltmeter are also part of the totalizing panel equipment. A Tirrill regulator maintains the generator voltage constant and the voltage of the different feeders is further regulated by Westinghouse hand-operated, single-phase, step-type, potential regulators. The insulation of all the wire on the switchboard is slow-burning and the supports for the overhead wires back of the board are made of ¾-in. iron pipes.

On the outside overhead system the ordinary practice is to run a three-wire secondary with grounded neutral through an alley with all the houses on the north side of the alley on the north pair of wires and those on the south side on the south pair. The general plan is to run the secondary line east and west in the alleys and the primary lines north and south on the street with the transformer at intersections. The street-lighting system comprises 155 6.6-amp series inclosed-arc lamps. All electric circuits are metered. The city owns a total of 1750 meters, of which 500 are of the old commutator type and the remainder of modern induction type.

Fig. 2—Concrete Coal Bins.

One of the features about the system is the comparatively large motor load carried. At the close of the last fiscal year the connected horse-power in motors was 909. Part of the water-works pumping is done by a steam pump at the power station, but most of the pumping is done by a large electrically driven triplex pump of 3,000,000-gal. daily capacity located in another part of town where a better water supply is available.

NOTES ON OPERATION.

The 500-kw steam turbine is run most of the time, even for light loads, because its economy on the light loads is found to be better than that of the condensing Corliss engine. The full-load steam-economy test made on this turbine unit soon after it was started in February, 1909, showed a steam consumption of 20.9 lb. of dry steam per kw-hour with a vacuum of 26.75 in. The vacuum has since been increased to 27.5 in.

In cleaning boilers an unusually long time is allowed between the time a boiler is cut out of service and the time it is cut in again. When a boiler is shut down it is allowed to cool for two weeks with 8 qt. of solid soda ash in the water. This softens the scale so that it is easily removed and obviates all trouble from this source.

The power-plant operating force consists of nine men working on three shifts. This includes, however, one man at the Nineteenth Street pumping station, where the electric motor operates the triplex pump. The line work is done by three linemen, with occasional assistance from a fourth man. The city does not do interior wiring. An account of all material on hand is kept by means of a perpetual inventory, on which the number of articles or pounds of wire is kept constantly posted up to date by the meter inspector. Material taken out for a job is entered on this sheet, but the amount used is not entered until the unused part is returned.

It has been the policy for a number of years past to give free lamp renewals. Gem lamps are furnished on the free-renewal contract in sizes down to 8 cp, below which carbon lamps are supplied. Tungsten lamps are sold at about cost and nearly all the stores in town are using tungsten lamps. Blackened and burned-out tungsten lamps are exchanged by the lamp trimmer and prismatic glass reflectors, cleaned by the man who trims the street arc lamps, are loaned free to consumers in stores. The cost of carbon-lamp renewals is 0.0063 cent per kw-hour.

Testing and correcting of meters is carefully looked after, as is shown by the remarkably low percentage of lost and unaccounted-for energy for the last fiscal year. This was only 15.1 per cent for the entire system. This percentage is so low as almost to excite suspicion as to the accuracy of the switchboard output meters upon which it is based. However, since the output is metered both by the totalizing meter on the switchboard and by the meters on each panel, as before described, and as these meters act as a check on each other, the probability that the low line loss is caused by slow meters at the station is extremely remote. The low percentage of lost and unaccounted-for energy is probably due in part to the large amount of energy sold through meters for motor purposes. Since these meters have to register a smaller proportion of their output at very light loads than do lighting service meters the effect is to reduce the total amount of lost and unaccounted-for energy. Of course, the figure given of 15.1 per cent could not be attained without a thorough system of checking the accuracy of consumers' meters and looking after line and transformer losses carefully.

The lost and unaccounted-for energy for different classes of service for the last fiscal year was 21.5 per cent on lamp circuits, 11.2 per cent on motor circuits, 15.8 per cent on street arc circuits, or 15.1 per cent for the system. The total amount of energy registered on consumers' meters for the year was divided as follows: Lamps, 30.3 per cent of total; motors, 60.2 per cent of total, and street arcs, 9.5 per cent of total. It should be explained that the lost and unaccounted-for energy for the street arc circuit was based on the assumption that each arc lamp took 450 watts.

Testing and changing meters requires all of the time of one man and part of the time of another. From March 16 to July 31, 1910, 700 meters were tested at a total cost for labor of $284.74, or 40.6 cents per meter. Of this amount $75.15 was for the work of changing meters. The labor cost of repairing meters, which is kept separate, was $10.39 during this period.

During the fiscal year ended March 15, 1910, 1220 meters were tested at a cost of 45.5 cents per meter. A 4-in. x 6-in. card record is kept of each meter, giving the city's number, the maker, maker's number, when received, amperes, volts, type, number of wires, number of phases, constant and calibration constant. Under the heading are given the date on which the meter was set, the meter-book index, the name and address of the customer and the date the meter was removed or cut out. On the back are given a blank to record the date tested, the test load in watts, the error found and the repairs made and their cost. The commutator-type meters are brought in to the city shop for testing, while the induction-type meters are tested on the consumers' premises. For testing on consumers' premises there are two portable rotating standard meters in use, one of General Electric and one of Westinghouse manufacture. It is the general policy to test the commutator-type watt-hour meters once a year and the induction meters every one and one-half or two years. During the twelve months ended Feb. 28, 1910, 1220 meters were tested. Of these 829 were found within 3 per cent of accurate, 154 were within 91 per cent to 96 per cent accurate, ninety-three were between 104 per cent and 109 per cent accurate, sixty-three were between 81 per cent and 90 per cent, twenty-seven were between 110 per cent and 119 per cent,

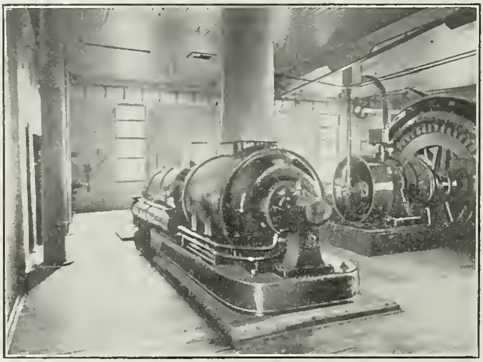


Fig. 3—Turbine.

fifty-one were 80 per cent or lower and three were 120 per cent and higher.

The work of meter reading is divided into nine routes, to cover each requiring approximately a day's work. Four men read two routes each and one reads one route. The accounts on the consumers' ledgers are kept in the same order as the meter routes, so that billing can be done directly from the meter readers' books without turning ledger pages more than one at a time. As new customers are added they are given decimal numbers in between those of the older consumers. An alphabetical index of consumers enables the accounts to be located by number.

The thirty-two transformers on motor circuits aggregate 546 kw. These take care of about 750 hp in motors. The 150-hp motor on the 3,000,000-gal. triplex pump is operated without transformers at 2300 volts. There are forty-two transformers on lamp circuits with a total rating of 401 kw, which supply a connected lighting load of 1474 kw. The connected load in kilowatts as given in the last annual report is summarized as follows:

	Kilowatts
2-cp lamps	3.8
4-cp lamps	6
8-cp lamps	70
16-cp lamps	1236
32-cp lamps	42
No. 3 Gem lamps	19
No. 4 Gem lamps	16
No. 5 Gem lamps	23
Miscellaneous Nernst lamps, meridian and tantalum	11
25-watt tungsten	2
40-watt tungsten	9.6
60-watt tungsten	5
100-watt tungsten	10
150-watt tungsten	5.3
250-watt tungsten	5.2
11.4-volt tungsten series multiple lamps	9.6
Total connected lighting load	1474.2
Commercial arc lamps	22.4
Two-phase motors	678.1
Street arcs	82
Single-phase motors	13.4
Heating devices, etc.	14
Electric flatirons	227
Total connected load	2522.1
Rating of plant	925
Maximum load for the year	730

The output of the plant for four years is shown in Fig. 5.

The watt-hours per 1000 gal. of water pumped at the city's Nineteenth Street station averaged 580 for the last fiscal year. In this no allowance was made for pump slippage, the amount pumped being calculated according to the pump displacement. The average head against which the pump operated was 150 ft.

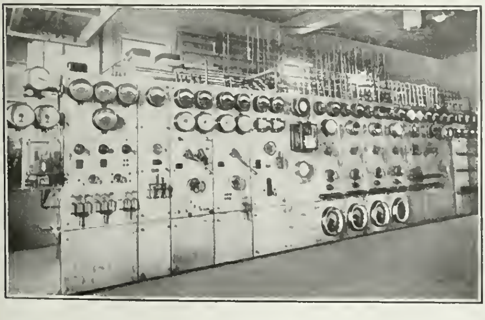


Fig. 4—Switchboard.

The city supplies electricity for lighting arches of tungsten lamps over two of the principal business streets. On Eighth Street there are twelve arches, twenty lamps to the arch, using a span-wire construction, as shown in Fig. 6. The lamps are 32-cp, 3.2-amp, 40-watt tungstens requiring about 11.4 volts each and operated twenty in series across the 220-volt secondary mains. The span wire is stretched from building to building and below this on links is suspended the electrical conductor from which the lamps are dropped. The lamps can be pulled to one side of the street for renewal, a scheme offering economical advantages over a tower wagon, especially in a small town. The merchants pay for the construction of these arches and also pay the city $62.50 per arch of twenty lamps per year. The city supplies the lamp renewals free. The drop wire supporting these lamps is No. 12 stranded. No. 14 solid was formerly used, but gave trouble. These arches are operated until 11 o'clock each night except Saturday, when they are operated until midnight. The Cutter street series socket is used.

The total cost of labor and material for installing the twelve arches on Eighth Street was $427.21, of which $138 was for labor and $339.21 for materials.

FINANCES.

Figuring the results of this plant according to the standard central-station facts and factors adopted in tables heretofore published in the *Electrical World*, the following results are obtained:

TABLE OF FACTS AND FACTORS.

Rated capacity of stations	925 kw
Total population of district served	10,000
Total liabilities per kilowatt of station capacity	$74.50
Gross yearly income per kilowatt of station capacity	$66.60
Gross yearly income per $100 liabilities	$89.40
Per cent of yearly income spent for operation, including everything but interest and depreciation	50.7
Yearly operating expense per $100 liabilities	$46.70
Total connected load in kilowatts per kilowatt of station capacity	2.7
Connected kilowatt load in lamps per kilowatt of station capacity.	1.5
Connected kilowatt load in motors per kilowatt of station capacity	0.7475
Connected kilowatt load in heating apparatus per kilowatt of station capacity	0.271
Kw-hours sold or accounted for, per 100 kw-hours generated	84.9
Kilowatt transformer capacity per kilowatt of station capacity	1.02
Kilowatt transformer capacity per kilowatt of connected load	3.75
Kilowatt station capacity per employee, all departments	40
Yearly load-factor in per cent	26.3
Gross yearly income per capita of population	$6.16
Liabilities per capita	$6.90
Watts station capacity per capita	92.5
Number of consumers per 100 of population	16.4
Number of residence consumers per 100 of population	15.4

These figures show an unusually high development of the territory served, which is especially remarkable for a municipally owned plant.

The revenues and expenditures of the electric plant for the fiscal year ended March 21, 1910, were as follows:

ELECTRIC LIGHT REVENUES AND EXPENDITURES.

Revenue:	
Receipts for current	$52,606.66
Arc lighting at $50 per year per lamp	6,800.00
Sale of material, etc	1,930.33
Public incandescent lighting	150.72
Difference in inventory	126.94
Total	$61,614.65
Expenditures:	
Operating expenses	$32,218.67
Interest on bonded indebtedness of $69,000	3,242.50
Estimated taxes the plant would pay if owned by a private corporation	1,000.00
Depreciation of plant	9,329.56
Total	$45,790.73
Profit	15,823.92

Disbursements for permanent improvements during the year amounted to $16,403.30.

Although the electric and water plants are operated together, the expenditures in each are separated on the books as far as possible. However, in order to form an intelligent opinion of the plant as a whole a brief statement of the condition of the water system financially will be given. The revenues and expenses of the water works for the fiscal year before mentioned were as follows:

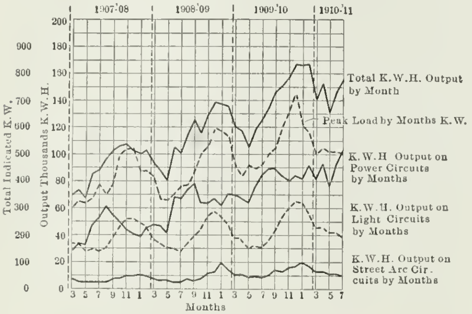


Fig. 5—Output Curves by Months.

WATER-WORKS REVENUES AND EXPENDITURES.

Revenue:	
Receipts from consumers	$14,707.00
Hydrant service, charging the city with $35 per year per hydrant	8,610.00
Difference in inventory	47.61
Total	$23,364.61
Expenditures:	
Operating expenses	$12,952.95
Interest on bonded indebtedness of $64,000	3,010.00
Estimated taxes the plant would pay if owned by a private corporation	1,000.00
Depreciation of plant	4,593.83
Total	$21,556.78

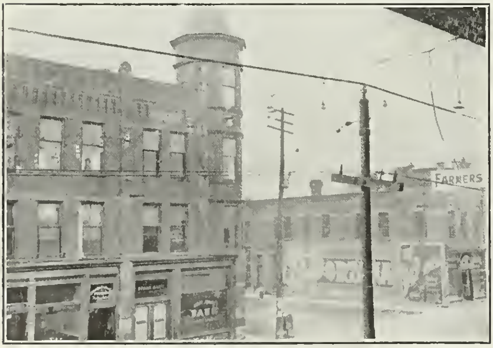


Fig. 6—Arch-Span Construction.

The value of the water-works plant at the end of the fiscal year, after taking off depreciation amounting to $4,593.83, was $136,618.22.

Depreciation is estimated on different portions of the plant as follows: Land, 0: buildings, 8 per cent; meters, 7 per cent; station equipment, 6 per cent; distribution system, 10 per cent. The total value of the electric plant, March 21, 1910, after taking out the foregoing percentages for depreciation on the value of the plant the year previous, was $116,076.41.

For a number of years previous to Sept. 1, 1910, this plant has been in the charge of Mr. James De Young, superintendent of public works. Upon his resignation, Sept. 1, to enter the employ of a syndicate controlling a number of large plants in Michigan, Mr. R. B. Champion, formerly clerk, became acting superintendent.

OIL-FUEL GENERATING STATION AND 1200-VOLT DIRECT-CURRENT SUBSTATION AT FRUITVALE, CAL.

In connection with the installation of a 1200-volt, direct-current railway system on the Oakland, Alameda & Berkeley suburban lines the Southern Pacific Company has erected at Fruitvale, Cal., a combined generating and distributing station that possesses a number of features of interest.

The fuel employed is California crude oil, which is much cheaper than coal. However, the boilers have been so designed that in case it should be found desirable to burn coal stokers or grates can be installed at both ends of the boilers. In the basement provision has been made for coal-handling machinery that may be required. The building and steel work are so arranged that automatic coal-handling and ash-handling apparatus can be installed.

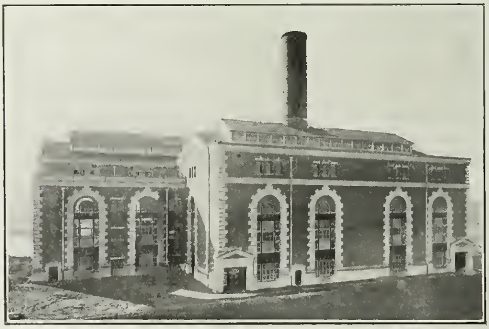


Fig. 1—Power House from the North.

The boiler-room has been designed for sixteen 645-hp boilers, twelve of which have been installed. These are of the self-cleaning type, because they deposit the scale in a pocket in the drum instead of in the tubes. Three oil burners are placed in front of each boiler. The stack, which has been arranged for oil firing with natural draft, is of unlined steel 125 ft. high and 14.5 ft. in diameter.

The main station has been arranged for four generating units, two of which have been installed. These are Westinghouse double-flow turbo-generators rated at 5000 kw continuous load, 7500 kw for two hours or 10,000 kw for one minute. They are three-phase, 25-cycle machines wound for 13,200 volts at a speed of 1500 r.p.m. The guaranteed steam consumption is not over 15.9 lb. per kw-hour, with 175 lb. gage pressure, 150 deg. Fahr. super-temperature and 28-in. vacuum. The generators are cooled by forced ventilation, the air being taken from outside the station through screened galvanized-iron ducts in good weather and from the turbine-room basement in foggy or damp weather.

Mounted on the end of each turbo-generator shaft is a 125-kw direct-current generator which supplies energy for the field circuit of the generator and the lamp circuits around the station. For insuring a continuous supply of energy for excitation and station lighting use is made of a 136-cell battery furnished by the Electric Storage Battery Company and a 125-kw General Electric steam-turbo-generator exciter set.

Four substations receive energy from the main 13,200-volt, three-phase system. One substation is at Berkeley, one at West Oakland, one at West Alameda and one at Fruitvale. The last-mentioned substation is housed in the same building with the main generating equipment. The present installation consists of three General Electric 1500-kw transformers and synchronous converter units, with space for three additional units. Each converter unit delivers direct-current energy at 1200 volts. The unit consists of two 600-volt converters with commutators joined permanently in series; the two converters are mounted on a common base and with shafts carried in a common center bearing, but free to revolve independently of each other. The converters are started from the collector-ring end at one-third and two-thirds voltage, obtained from taps on the transformers through triple-pole, double-throw oil switches. The operating handles of these switches and the full-voltage oil switches,

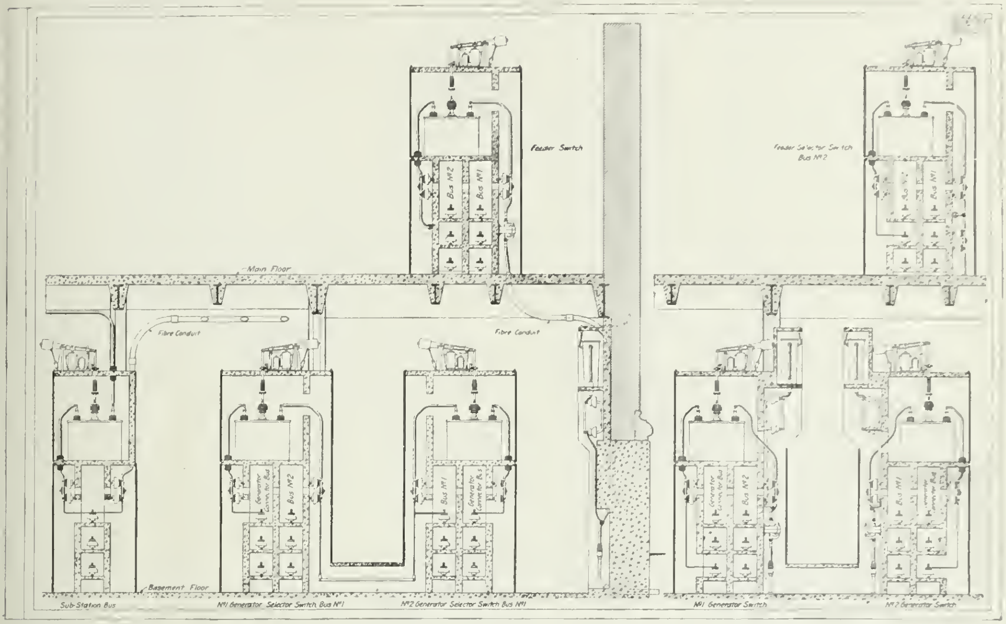


Fig. 2—Cross-Section of Switch Galleries.

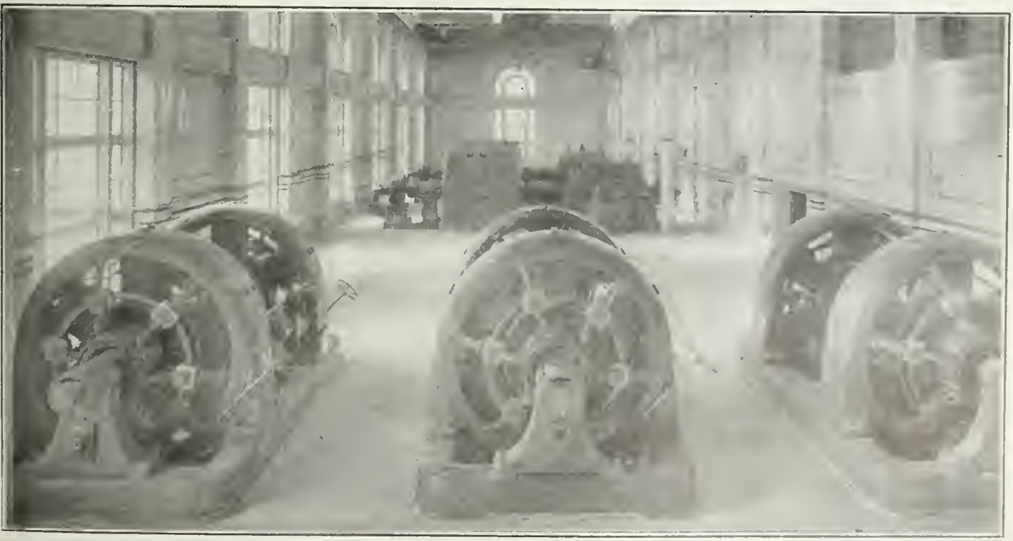


Fig. 3—View of Generating Room.

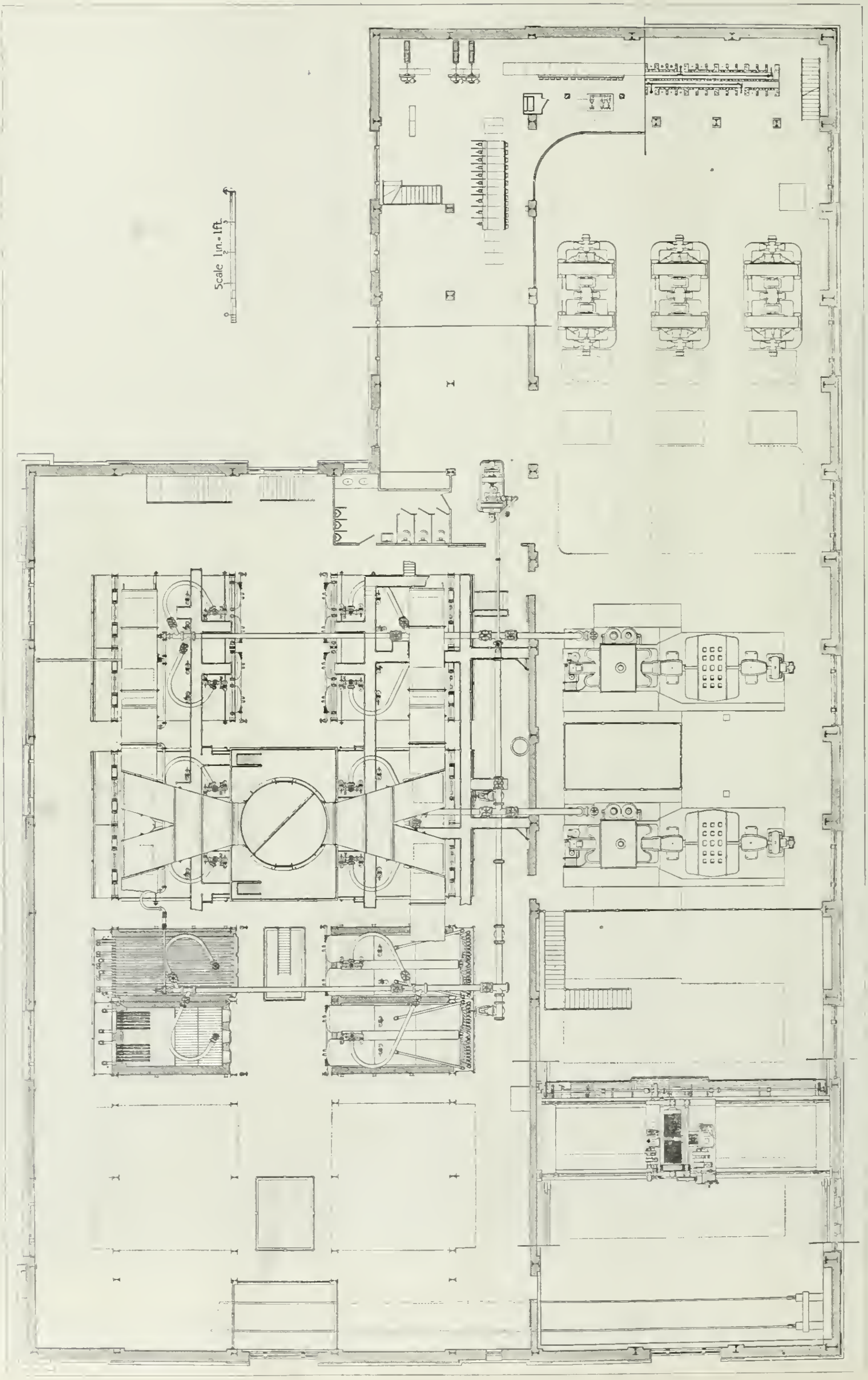


Fig. 4—Plan of Station.

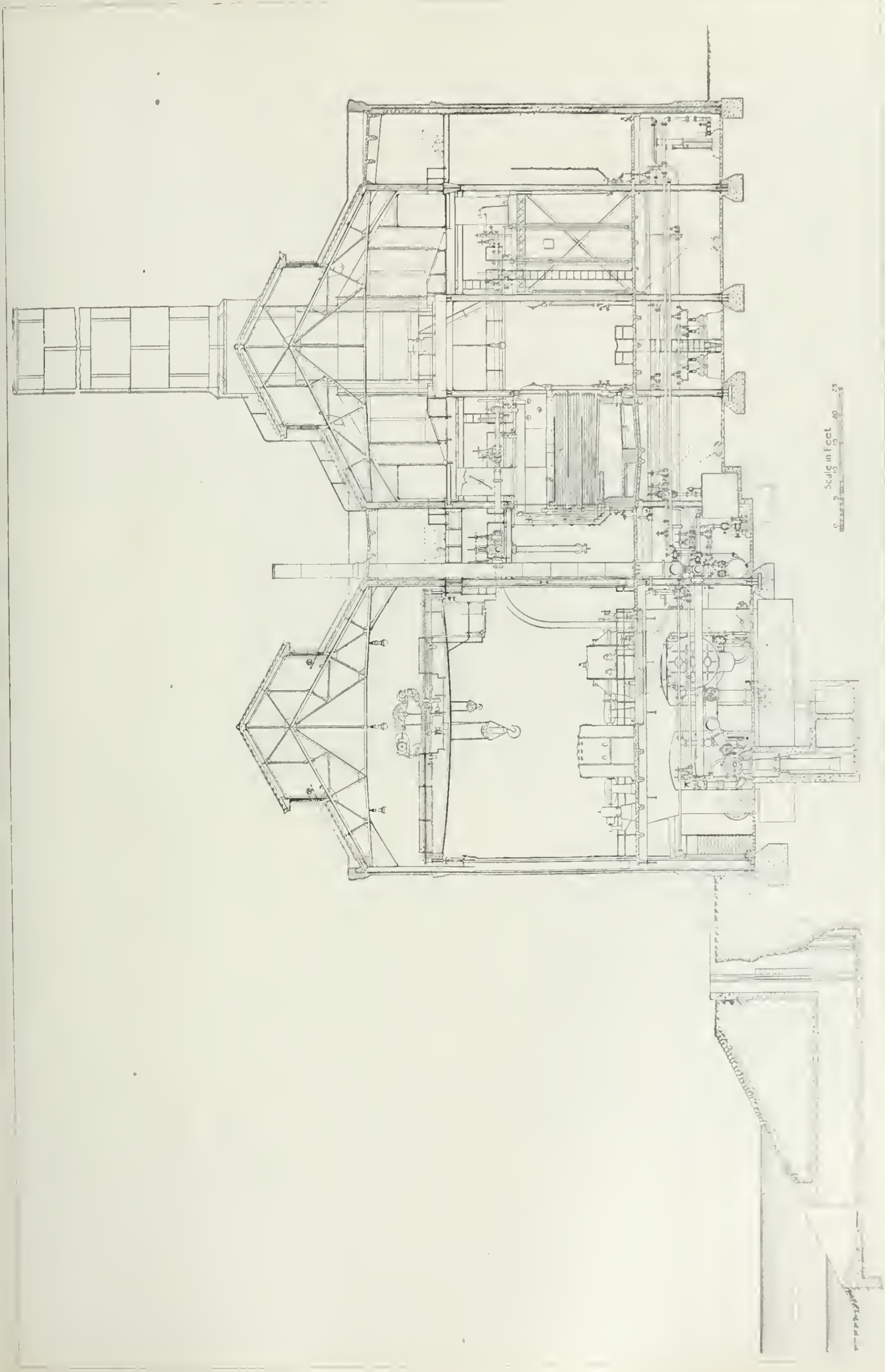


Fig. 5—Cross-Section of Station.

together with the field circuit break-up switches, negative and equalizer switches and polarity indicators, are mounted on slate panels attached to the converter bases. These bases are of cast iron mounted on oak insulating frames and, to limit insulation strains and to protect operators, the bases are connected through a resistance of 10 ohms to the 600-volt interconnection between the two halves of the unit. Additional protection is afforded the operator by the installation of tile insulated floor in the substation.

The switchboard is in two sections, one for the 13,200-volt generating equipment and the other for the 1200-volt distributing system. The two are located at the east end of the turbine-room on a gallery, the sections being placed at right angles to each other at the corner of the gallery. The generating section consists of a benchboard, instrument board and exciter and auxiliary boards. The 1200-volt board consists of front and rear panels 4 ft. apart. All switches and circuit-breakers are mounted on the rear panels and are of the remote-control, hand-operated type. The front panels contain the instruments and switch-operating levers. Spare rotary and spare feeder breakers are provided, with their switches connected to the spare breaker buses mechanically interlocked so that only one rotary or feeder at a time can be connected to its respective spare breaker bus. While the angle-iron frames of the front and rear panels are insulated from ground and from each other, the station will be operated with the front frame grounded and the rear frame insulated. Soapstone slabs are placed across the top bracing between the front and the rear panels. The 1200-volt bus is carried in a fireproof compartment above the soapstone slabs. The rotary rheostats are mounted on the soapstone slabs above the panels. A Thomson watt-hour meter and a Westinghouse recording wattmeter are installed to measure the total output of the substation. The entire switchboard was furnished by the Westinghouse Electric & Manufacturing Company.

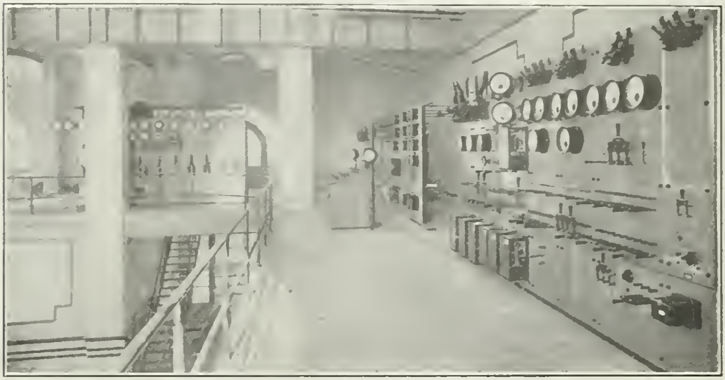


Fig. 6—Switchboard Room, South End of Gallery.

Arrangements have been made for obtaining a small supply of energy from the 60-cycle system of the Great Western Power Company. There has, therefore, been installed temporarily on one of the unused generator foundations a 2500-kw frequency changer, consisting of an 11-000-volt, 60-cycle synchronous motor driving a 13,200-volt, 25-cycle generator. A zero-center scale-recording wattmeter shows the instantaneous output from or input to the 25-cycle machine.

The above-described installation was designed, planned and specified under the direction of Mr. A. H. Babcock, electrical engineer of the Harriman lines, by Messrs. W. C. Miller, J. C. Lathroy and H. Y. Hall. The construction details were under the direction of Mr. J. Q. Barlow, assistant chief engineer, who had for his representative in the field Mr. R. T. Guppy, engineer of suburban lines, and for his architect Mr. D. J. Patterson, who was responsible for the artistic superstructure, which was built of ordinary and inexpensive materials.

A PORTABLE ELECTRIC GENERATING PLANT.

By F. W. Thompson.

The portable outfit shown herewith was designed to furnish electric energy for light power work in building operations, especially in locations where there is no electric service, or where the cost of installing such a service would be out of proportion to the value of the work to be done. The unit, which is entirely self-contained, is mounted on a specially constructed truck drawn by two horses, making the plant strictly portable.

Cables are run from a terminal board over the driver's seat into a building, for instance, and connected up to such electric tools as are ordinarily used in building construction. Ample room is provided on the truck for carrying these tools to the job.

The generating plant consists of a 15 hp twin-cylinder, gasoline engine directly coupled up to a 7½-kw, 125-volt, 500-r.p.m. direct-current generator and mounted on a common sub-base. This sub-base is mounted on specially provided stringers built into the truck and so placed that the engine thrust comes directly over the rear axle. The whole revolving member is carefully balanced. The water-cooling tank is suspended underneath the truck between the front and rear axles and when full weighs approximately 1500 lb. This acts as a counter-balance for what little vibration there is when the generator is in operation. Practice has shown that there is so little vibration that it is unnecessary to block up the truck or the wheels even when the load is constantly varying from zero to full load, as in hoisting.

The engine is provided with a specially designed governor to take care of quick changes in load, and the generator shaft has a heavy balance wheel in addition to the engine flywheel.

The switchboard is mounted on springs to take up vibration and protect all delicate parts from jar when traveling, as the truck itself has no springs. Cables are run from the generator through conduit to the main switch on the switchboard. Four circuit switches are provided and connect through cables to a terminal board over the driver's seat. The field regulator and combination voltmeter and ammeter are also mounted on the switchboard as well as the ignition-control system for the engine. A double-throw switch is provided, so that either dry cells or a storage battery may be used for ignition purposes, the latter being charged from the plant.

Provision is made for an exploring lamp and an outside red lamp as a signal when the plant is not running and is standing in the street at night. Both of these lamps are fed from the storage battery.

Underneath the truck is a 180-gal. water-cooling tank piped to two circulating pumps mounted on the engine, which force the water through the engine jackets and return it to the tank for cooling. To the rear of this tank is a double-muffler arrangement, which assures quiet operation under heavy loads. Back of the rear axle is suspended a 40-gal. fuel tank and alongside of this is a smaller tank for compressed air. Both tanks are piped to a hand air pump and air-pressure gage mounted inside the truck next the engine. The fuel-supply pipe is taken out of the top of the fuel tank and leads directly to the carburetor on the engine. On account of using an auxiliary air tank it is only necessary to give the air pump a few strokes in a day's run to make up for the increased volume in the fuel tank due to the consumption of fuel.

When the plant is shut down the air valve is closed and a relief valve opened, which relieves the pressure in the fuel tank, and what gasoline remains in the fuel pipe drains back into the tank. This also assures no loss of gasoline should a connection become loose when the portable outfit is being moved. The fuel tank is provided with a gage above the floor of the truck, showing at all times the amount of fuel in the tank. There is a gasketed and capped hole in the top of the fuel tank for filling, which is reached through an opening in the floor provided with a deck plate. The air tank, pressure gage, piping and valves are made to withstand 30-lb. pressure to the square inch. Provision is made for attaching an air hose so that this compressed air can be used for blowing out accumulations of dust around the engine, generator and switchboard.

Portable Generating Station.

Under the driver's seat space is provided for tools, lubricating oil, waste, etc. The floor space around the engine and generator and part way up the side boards is covered with zinc to keep oil from soaking into the woodwork, thus reducing the chances of a serious fire should any of the gasoline escape and by chance ignite. The truck is also provided with chemical fire extinguishers of a type specially designed to put out a gasoline fire. Side curtains of heavy sail canvas and made to roll up are provided for the two sides and rear. These are thoroughly painted, and when down are tightly strapped in place. This allows the operation of the plant in all kinds of weather. After several months' exposure to outdoor weather there has not been the slightest trouble with the operation of the plant.

There are two 16-cp lamps hung from the ceiling, one over the engine and the other over the generator, besides a pilot lamp on the switchboard. These give ample light when the curtains are down or when operating at night. While the plant was designed for motor work, it gives remarkably steady voltage when motors and lamps are operating, and there is no flickering whatsoever on a straight lighting load.

At the outset it was intended to develop a thoroughly self-contained electric generating plant on wheels, and service has shown that the idea has been fully realized. Electricity can be provided on any building operation just as soon after the arrival of the outfit as the water tank can be filled up. This, with a hose, requires less than ten minutes' time. The total weight of the plant, without water in the cooling tank, is less than three tons. One horse can easily handle it on level city pavements, but it is arranged for two horses when traveling any considerable distance. It has been drawn over twenty miles of rough country roads without the slightest damage to any of its parts. The outfit was designed and built under the personal supervision of the writer, who is an electrical constructing engineer of New Haven, Conn., for Mr. Charles E. Augur, a building contractor of the same city.

FELLING TREES BY ELECTRICITY.

By Albert Scheible.

One of the most notable tendencies of the past year toward the wider utilization of electric energy has been found in the so-called "overland central stations" of Germany, stations with circuits running to other towns over fertile farm lands which can furnish a desirable day load. But while the use of electricity has thus been extended even to driving plows over fields of wide expanse, the forests have so far been untouched. This is surprising, inasmuch as felling trees and trimming them to marketable logs means the need of power in a very congested area as compared with plowing and allied field operations That the forests have been immune from inroads of electric progress is due to the common modes of felling trees, methods on which the march of the centuries has had hardly any effect and in which it has not seemed feasible to replace manual labor by electric motors. The woodman's axe still resounds through the forests, though every wasted chip now means the loss of much more valuable timber. The effective stroke of the axe from continually changing directions would require a complicated mechanism to reproduce it and one liable to serious damage if a tree should fall upon it. The same breakage risk would be met in any attempt to drive a saw by electricity, just as in the case of the steam-actuated tree-felling saws made for colonial use by English manufacturers. Besides, the sweep of a power-driven saw, like that of the ordinary double-handled saw of common practice, requires considerable space, thus prohibiting the use of any saw until one or more trees have been chopped down where they are closely bunched. The steam-driven tree saws also require a crew of men to operate each, besides a team for moving the plant about the forest, which moving demands a general trimming of the underbrush and a fairly dry soil. The fact that these steam saws are proving economical in spite of such difficulties shows that power cutting is needed and that there ought to be a field for a tree-feller with fewer handicaps.

Aside from chopping and sawing a third method of tree felling consists in burning through the base of the trunk. To do this with a bonfire is at once slow, wasteful of timber and likely to cause a forest conflagration. Burning experiments were made a few years ago with a high-resistance wire heated by electricity and looped around a tree so as to burn its way through it. This proved too frail and costly for practice, though the trials showed that with such a method the trees could be cut much closer to the ground than with any of the older methods. Another disadvantage was that it required the

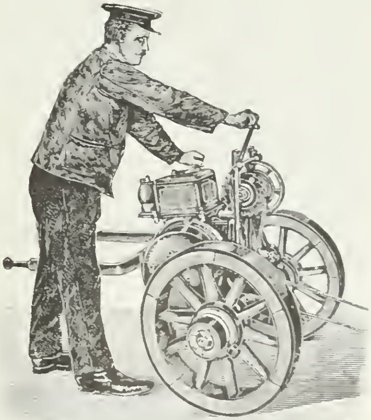


Fig. 1—The Gantke Machine for Felling Trees.

operator and the rheostat for controlling the supply to be close to the timber, thereby exposing both to danger from the falling trees.

More recently a German inventor, Mr. Hugo Gantke, has perfected another method of cutting timber by the use of a hot wire. The heat in this case is supplied not by the passage of a current of electricity, but by the friction of the wire on the tree itself. For this purpose a steel wire is looped tightly around the tree and pulled back and forth about 1500 times a minute by an electric motor. The cutting wire itself need only be a little longer than half the circumference of the tree, being coupled to steel strands which lead to the motor, thereby allowing the latter to be placed 100 ft. or even 150 ft. off. The cut can easily be started close to the earth (or, if desired, a trifle below the surface) so that, instead of the usual stumps which interfere with the transportation of the timber, no obstructions are left above the ground. This lowering of the cutting plane not only increases the length of the log obtained from any given tree, but also includes an added foot or two of the wide-spreading base, thereby enlarging the average diameter from which the lumber feet in the log are figured. The increase in the resulting quantity of lumber shows up favorably as compared with the primitive method, which wastes considerable of the length even above the remaining stump and which leaves the end of the trunk in a rough condition requiring further trimming. While such trimming of the ends is not needed where trees are sawed, the use of a saw requires a helper to follow the saw with wedges so as to avoid jamming it. With the hot-wire method no wedging is needed and the end of the log is charred so that it can be marked with crayons. The carbon coating also protects the cut ends against the action of the weather if the log is left lying on the ground for some weeks. Consequently the new method is said to increase the amount of lumber obtained, to avoid the expense of stump pulling, to decrease the cost of transporting the logs and to reduce the amount of rotting if the timber is not promptly moved.

The labor cost varies with the size and the hardness of the timber. Mr. Gantke's experiments have implied that the time required for cutting trees of a given size increases with the hardness of the wood in about the same ratio for his hot-wire method as for a double-ended saw in the hands of skilled workmen, the ratio being about 3.3 minutes for linden or ironwood and 1.8 minutes for beech or oak, in proportion to every minute needed for cutting pine of the same diameter. However, the required time does not increase nearly as fast for the friction-wire method as for hand-sawing with an increase in diameter of the same wood, even when no allowance is made for rests taken by the men in the midst of heavy cuts. Thus Mr. Gantke reports the cutting time for Scotch fir (which cuts about 6 per cent faster than pine) as follows:

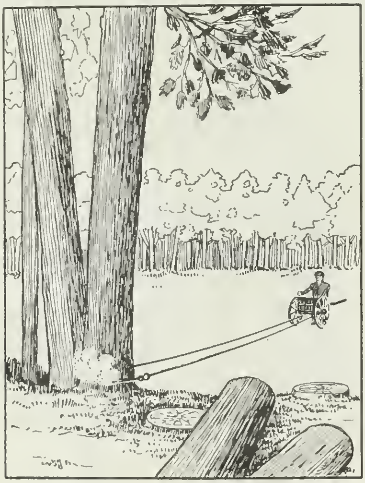


Fig. 2—The Gantke Machine in Operation.

Diameter of fir, inches.........	7.6	12	19.2
Minutes for hand sawing.......	1.5	4	12
Minutes for hot-wire cutting....	0.7	1.8	4.5

For beech similar tests showed this comparison:

Diameter of beech, inches.	7.6	12	19.2	30
Minutes for hand sawing.....	2.7	6.9	18.9	120
Minutes for hot-wire cutting.	1.3	3.4	8.5	20.8

In these comparisons it must be remembered that the hand-sawing required two men at the saw and for fair-sized trees a third at the wedges, while the hot-wire method needs but one man to operate it even on the largest trees. This, minus rests which even experienced men take between cuts, means that the real difference in output per man would be tremendously in favor of the hot-wire method. For large trees it would appear from figures lately published in the *Timber Trades Journal*, of London, that the steam-driven tree saws will do even faster work per tree, but they require four men and a span of horses, besides leaving the objectionable stumps.

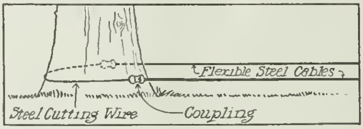


Fig. 3—Showing Cutting Wire and Cables.

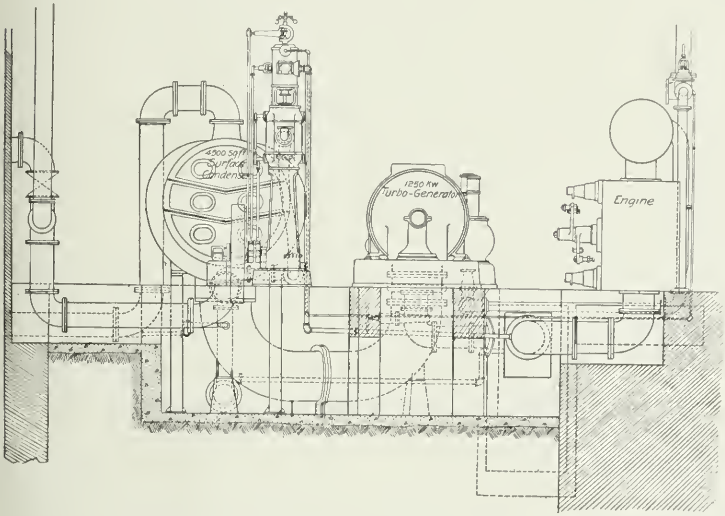
The Gantke machine, although mounted on a truck with wheels having wide tires, weighs only 550 lb. all told, the weight being so distributed as to anchor the truck against the pull of the cables when in operation. It can easily be moved from place to place by one man, and is said to be so simple that inexperienced help can readily operate it. After the cutting wire is looped around the tree and coupled to the steel cables the operator merely turns a crank with one hand to tighten the cables, while his other hand turns on the circuit. A new cutting wire is used for each tree of any fair size, the diameter and length of the steel wire used for this purpose being chosen to match the hardness and size of the tree to be cut. Of course, a large number of trees can usually be reached from a single location of the motor. The same device will also cut the felled trees to the desired marketable lengths, although the saving in time over hand-sawing is not so great with horizontal as with standing timber. In practice the motor truck is usually placed 100 ft. or 150 ft. from the trees to be cut, thus taking both the machine and the operator well out of the danger zone of the falling trees. Then, when the trees have been felled, the machine is brought close up for more conveniently replacing the friction wires when trimming the trees to the desired lengths.

The wires used sell in Germany for from 20 cents to $1.20 per 100, but Mr. Gantke claims that this expense for new wires is fully offset by the cost of sharpening axes or saws and of resetting the saws with the older methods. With European timber the power required for various woods ranges from 1½ hp to 7 hp. Where no source of electricity is accessible a portable outfit consisting of a 10-hp gasoline engine and dynamo mounted on a separate truck is used. Where virgin forests are to be cut a number of such wire-pulling electric motor outfits can be supplied from a single generator mounted on a steam-traction engine or (as suggested for some of the German colonies in Africa) on a steamer, in which case electricity could also be used in transporting the timber to the wharf.

CHANGE OF ENGINE-CYLINDER RATIO FOR EXHAUST-STEAM TURBINE OPERATION AT APPLETON, WIS.

To increase the output of a pair of nominally 1300-hp tandem-compound Corliss engines which formerly operated condensing and to permit their exhausting into two 1250-kw low-pressure steam turbines, the cylinder ratios of these engines in the Appleton (Wis.) plant of the Wisconsin Traction, Light, Heat & Power Company have been modified by increasing the area of the high-pressure cylinders 35 per cent. As operated condensing the cylinder dimensions were 19 in. x 40 in. x 36 in. The new high-pressure cylinders are 22 in. in diameter.

The Appleton power plant was built about nine years ago. At that time there were installed two generating sets, each consisting of a 500-kw railway direct-current generator and a 500-kw, 60-cycle, 300-volt alternator. These sets were driven on one end by Victor water turbines, utilizing the water-power of about 2400 hp at this point of the Fox River. On the opposite end of each generating unit there was connected through a clutch a tandem-compound Corliss engine without releasing gear. The hydraulic head is 17 ft., and it was concluded that the most economical turbines available should run at a speed of 150 r.p.m. On this account, in order to have the engines drive directly without belting, they were arranged without releasing gears. These engines were operated condensing, their cylinders being 19 in. x 40 in. x 36 in. To meet the changed conditions of operation with the exhaust-steam turbines the engines have recently been modified by changing their high-pressure cylinders. The new low-pressure turbines are 1250-kw Allis-Chalmers machines, operating at 3600 r.p.m., and driving 60-cycle, 2300-volt generators. It was desired to increase the capacity of the engines and also to reduce their cylinder ratio, both of which were necessarily affected by the change. The condensing equipment for this plant consists of two surface condensers of 4500 sq. ft. each, manufactured by the Fred M. Prescott Company, which has also furnished all pumping apparatus. No circulating pumps for the condensers are required, the difference in level between the head and tail waters being sufficient to produce the necessary circulation. The plant is equipped with four Stirling boilers each of 350 hp and equipped with Foster superheaters, raising the temperature 100 deg. above saturation at a pressure of 150 lb. per square inch. The reconstruction just described has been practically completed and tests will be made within a short time to show what results can be obtained with a composite plant of this kind.



Tandem Compound-Engine, Exhaust-Steam Turbine and Condenser.

KEROSENE AS A FUEL FOR INTERNAL-COMBUSTION ENGINES.

The advantages and the use of kerosene as a fuel for internal-combustion engines were discussed by Mr. G. H. Holley, of Detroit, Mich., in a paper before the National Gas and Gasoline Engine Trades Association convention at Racine, Wis., recently.

Pennsylvania petroleum, said Mr. Holley, contains 41 per cent to 45 per cent kerosene and only 15 per cent gasoline. The Western petroleums contain about 30 per cent kerosene and 15 per cent gasoline. This proportion in the natural crude oil explains why, in carload lots, kerosene may be purchased for 5 cents a gallon, while gasoline costs 10 cents and is rapidly rising in price.

The drawback to the use of kerosene is the difficulty encountered by the carburetor in volatilizing this heavier oil. For successful operation the carbureting action must take place with the oil heated to about 200 deg., usually by jacketing with the exhaust gases from the engine, and the kerosene vapor must be conveyed directly to the engine cylinders at high velocity.

The available energy in a gallon of kerosene is about 92 per cent of that in a gallon of gasoline. This relation has been shown both by laboratory calorimeter tests and by the actual performance of automobiles using the two fuels in internal-combustion engines. In the latter case a car ran thirty-four miles on a gallon of kerosene and thirty-eight miles on a gallon of gasoline.

For starting kerosene engines where the exhaust gases are used to heat the special carburetor it is found most practical to furnish an auxiliary gasoline tank and simple gasoline carburetor, starting up the engine as a gasoline engine. After a minute's operation the exhaust becomes sufficiently warmed to enable the engine to be thrown over onto the kerosene tank by means of a three-way valve.

Mr. Holley also referred to the practice of adding water to the kerosene to improve the carburetor action. Introducing 6 per cent to 8 per cent of water to the oil facilitates volatilization and does not interfere with the fuel value of the kerosene.

INFLUENCE OF LOAD-FACTOR ON COSTS.

In a paper on "Central-Station Economies" read at the recent convention of Byllesby companies in Chicago Mr. Eugene Holcomb, manager of the Northern Heating & Electric Company, of St. Paul, Minn., made some interesting remarks on load-factors in relation to the cost of producing electrical energy. He said that with a load-factor around 30 per cent fixed costs of water-power development can easily be more than the fuel and labor costs of an efficient steam plant. The fixed charges should not run to more than 7 mills or 8 mills per kw-hour to compare favorably. Economy in the use of water-power comes only from the greatest load-factor. The influence of load-factor on costs, and consequently on rates, must in all cases be taken into account. The curves in Fig. 1 show the influence of load-factor on investment and operating costs. These curves show that in a plant costing $250 per kilowatt capacity the fixed costs alone, at 30 per cent load-factor, are a trifle higher than the total fixed and operating costs for a plant costing $125 per kilowatt capacity with coal at $2 per ton. These costs would be 1.15 cents and 1.1 cents respectively. It will be seen by increasing the load-factor of the $250 plant from 30 per cent to 60 per cent the total operating costs would about equal the costs for the $125 plant at 30 per cent load-factor.

Attention is called to the operating costs represented by the lines below the axis. In small plants, either hydraulic or fuel-burning, of, say, 3000 kw capacity or less, with, say, three units, the labor and general office expense is independent of load-factor. These items are practically constant the year round and have the same effect on total unit costs as the capital costs. To illustrate this point, refer to the curves in Fig. 2. This represents the conditions of one of the company's plants. The curve represents interest on capital and all other charges against operation except fuel, which is shown by the straight line below the axis. This is practically the only item which varies with the output. Total costs are obtained by adding the curve and the straight line together. Load-factor herein referred to is intended to mean percentage of output to full-load output.

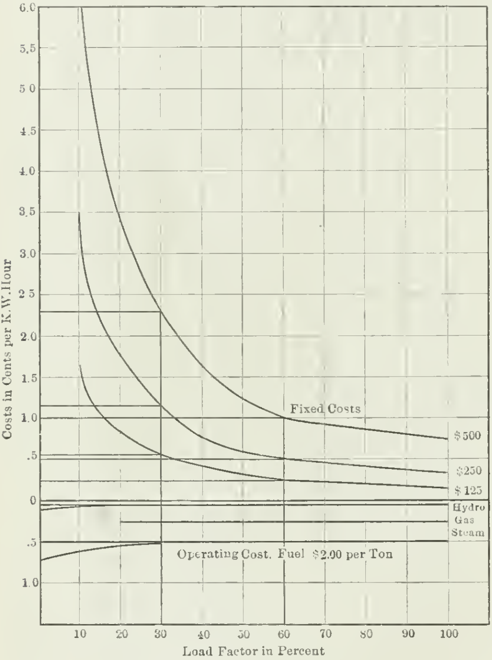


Fig. 1—Investment and Load Factor Curves.

In conclusion Mr. Holcomb said: "The things we most need for the manufacture and distribution of reliable service at low cost in any kind of a plant are: First, high load-factor, about 60 per cent. By increasing the load-factor from 30 per cent to 60 per cent the total average costs per kw-hour may be cut down 40 per cent, which is a greater reduction than can be made by any other practical means. Second, high-efficiency plants, with scientific management from finance to furnace, and skilled labor to operate them. Third, lowest ultimate-capacity costs of equipment consistent with high efficiency and long life. Centralization of supply will bring the high load-factor and great diversity of demand and enable us to supply energy for any purpose demanded in any community."

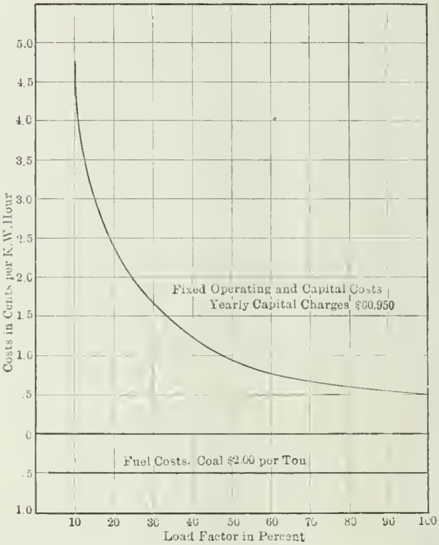
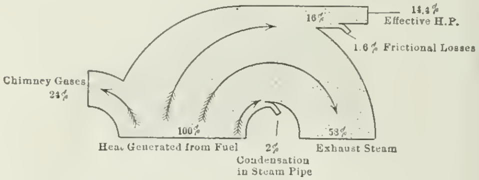


Fig. 2—Load Factor Curve for 3000-Kw Steam Station Costing $200 per Kw.

PRACTICAL NOTES ON THE WORKING AND CONTROL OF STEAM BOILERS.

By John B. C. Kershaw.

The aim of the writer is to draw attention to the lines along which progress is taking place in the working and control of steam boilers. The data are drawn partly from the writer's own experience and partly from his study of the recently published technical literature relating to boiler control and management. The heat-efficiency diagram presented herewith shows that steam engineers have considerable margin for improvement as regards the working efficiency of the ordinary steam boiler and engine. This diagram shows that of the heat energy liberated in the boiler furnace on combustion of the coal (represented in the diagram by 100) 24 per cent passes away with the waste gases, 58 per cent escapes with the condensed water and exhaust steam, and only 14.4



Heat-Efficiency Diagram for Steam Boiler and Engine.

per cent is obtained as energy in the engine. These are average figures for the ordinary steam boiler and engine, working under normal conditions, without economizers, feed-water heater or superheater. Stating the problem in another way, 1 lb. of perfectly dry fuel of good quality will yield when burned 14,500 lb.-Fahr. units, equivalent to 11,281,000 ft.-lb. or to 5.6 hp-hours. Theoretically, therefore, a hp-hour can be obtained from the heat stored in 0.18 lb. of coal. The best results obtained in practice have been 2 lb. coal per hp-hour with marine engines and 1.6 lb. with steam turbines, or from nine to twelve times the amount required theoretically. The losses that occur in this method of converting the heat energy of the fuel into the kinetic energy of the engine piston are partly inherent in the use of steam and can be avoided only by the substitution of gas as the working fluid of the engine. The displacement of the steam engine by the internal combustion engine is, therefore, only a question of time. But the practical experience of the last few years has proved that considerably higher efficiencies can be obtained from steam plants than were considered possible five or ten years ago, and it is to the remediable losses that the author purposes to direct attention. The 58 per cent heat loss shown on the right side of the diagram and the 24 per cent loss on the left side cannot of course be entirely wiped out, but a considerable proportion of the heat units escaping with the exhaust steam and with the waste gases can be recovered and returned to the boiler. Although these economies do not improve the working efficiency of the steam engine as a prime mover, they considerably improve the efficiency of the whole plant, and reduce proportionately the working costs. The economies will be discussed under four headings, as follows: Fuel, water, combustion of the fuel and steam production.

FUEL.

Engineers anxious to economize in their power costs would do well to begin with the query, "Am I obtaining the best possible fuel at the lowest practicable cost?" A close study of this subject would in many cases lead to the answer, "No."

The economies possible to engineers in relation to fuel depend upon three factors, namely, the price delivered at the works, the quality as determined by calorific tests, and the number of dealers willing to quote for the supply of the type of fuel required. The wider the field of choice the more scope there is for economizing in the cost of fuel. It is unfortunate, therefore, that most engineers are convinced that one class or type of fuel only will give good results under their own boilers, since this limits their sources of supply and prevents competition. The possibility of adapting the furnace grate of the boiler and the methods of burning to the cheapest fuel available is rarely admitted and is still more rarely acted upon. Yet hundreds and in some cases thousands of dollars might be saved per annum if those in charge of large boiler plants showed a little more open-mindedness as regards choice of fuel. In nine cases out of ten the fuel which has least to bear in the shape of railway and cartage charges will be found the cheapest, and the wise engineer will therefore adapt his furnaces and, if necessary, his boilers also to the fuel which is mined closest at hand. If all boiler plants had been designed by practical business men this need for adaptation would not occur. Unfortunately the question of fuel costs is rarely considered until the plant is ready for operation.

One other point also deserves mention. Every colliery produces good and bad grades of fuel, and if furnaces can be adapted to the fuel, the fine slack or "dant," for which it is difficult at times to find a customer, will be found out-and-out the cheapest type of fuel, in spite of its 20 per cent to 30 per cent of ash. Coke-breeze is another cheap fuel which can be made to yield valuable results when burned under suitable conditions. Fuels containing high percentages of ash are, however, not economical when they have to be carried long distances by land or sea, and should not be used when ash disposal is costly or difficult. A higher rate of wages may have to be paid the firemen when burning these cheap fuels, and this must be taken into account when estimating the relative advantages and disadvantages of low-grade fuels. As regards the choice and control of fuel supplies for steam-raising purposes, the writer is a great believer in the value of laboratory tests. Such tests are not only an aid to the engineer in the selection of the most suitable and cheapest fuel, but they will serve as the basis for the fuel contract. The percentage of volatile matter in the fuel is also of considerable importance, and this can be easily determined by a laboratory test.

The application of scientific and exact methods in the choice and control of fuel supplies for steam-raising purposes has, in fact, made striking progress during the past few years on both sides of the Atlantic. It is now customary for engineers, before signing contracts for large amounts of fuel, to have before them the test figures for the percentages of moisture and ash, and for the calorific value, of representative or average samples of the fuels chosen as being specially suitable for the steam-raising plant under consideration. In many cases, fuel contracts are now framed upon what is known as the heat-unit basis. Under this system the purchaser buys heat units instead of tons of coal and the price rises or falls according as the fuel actually delivered yields, on testing, a larger or smaller number of lb.-Fahr. units than that chosen as the standard. This system of purchase has made most progress in America, where the United States government has taken the lead in the matter. It is also making headway in the United Kingdom and on the Continent of Europe. As proof that regular sampling and testing of the fuel are of practical value to the consumer the writer may cite the experience of two large manufacturing concerns which adopted this system of checking the supplies nearly two years ago. In the first case the heads of the firm have stated that although there has been but slight variation in the heat value tests they are persuaded that the regular sampling and testing of the fuel has promoted economy, since it has led to greater uniformity in the quality of the supplies. In the other case wide variations have occurred in the heat units, followed by "pro-rata" deductions from the price paid for the fuel. These deductions have caused the colliery owners to improve their plant for washing and screening the fuel, and the supplies are now once again up to the standard level as regards ash and heat units. The consumer here again is satisfied of the value of the system, and in both cases it is still being employed.

The need for some independent check upon the quality of fuel supplies was never more needed than to-day. Owing to various causes there is now more haste and less care used in the actual mining operations, and more shale and dirt are brought to the surface with the fuel than was the case some years ago. The larger portion of this dirt finds its way into the small coal or slack, and in many mining districts tests of the small coal from certain mines have shown that there has been a marked increase in the ash during the last few years.

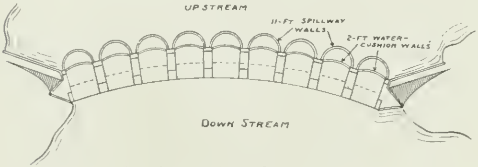
As regards the control of the fuel supplies, therefore, the writer is convinced that all fuel users consuming twenty tons or more of fuel per week would find it beneficial and economical to have regular samples taken of their deliveries even when no heat-unit basis has been adopted for the contract. The fact that samples are being regularly taken and tested can be made known to the seller, and this knowledge will have a marked effect upon the quality of the fuel supplied. In case of dispute the sample is also available for testing purposes, and if the firemen report any difficulty in keeping up steam ash and calorific tests can be made at once and the deterioration in quality can be confirmed or the reverse by the results of exact scientific tests.

This work does not necessarily involve the equipment of a fuel-testing laboratory or the engagement for his whole time of an expert chemist. The expenditure upon the sampling and testing can be varied to suit the requirements and size of the plant, and $100, $200 or $400 per annum expended in this way will usually save a still larger sum which would have been paid for several hundred tons of incombustible matter or "dirt."

LETTERS ON PRACTICAL SUBJECTS

A UNIQUE SPILLWAY CONSTRUCTION.

Hydroelectric readers of these columns will be interested in a unique spillway construction I saw in a recent trip through California. The finished spillway, as shown in the accompanying sketch, represents the solution of a problem of safely discharging a possible large overflow over a naturally restricted rectilinear distance, in this case providing for spilling 10,000 cu. ft. per second (theoretically requiring 414 ft. for the desired head) between abutments only 300 ft. apart. The spillway is part of the irrigation plan of the Orland project of the United States Reclamation Service, discharging from the reservoir level into the tail race 11 ft. below. The spillway proper consists of nine semicircular concrete walls 11 ft. high and 18 in. thick, reinforced by heavy concrete abutments, the entire dam being itself built on the 36-deg. arc of a circle of 474-ft. radius. The diameter of each spillway arc is 27 ft. and the total curvilinear distance of the nine semicircular walls is 460 ft. Allowing for incomplete approach of the water, the available length of the spillway is thus 414 ft. Just below the 11-ft. weir walls are a second series of 2-ft. water-cushion walls similarly arched. These walls create lenticular pools 2 ft. deep at the base of the weirs, in which the force of the falling water is received and dissipated, cushioning the impact on the concrete structure. At the maximum flood of water which the spillway will have to discharge the weir gages will read only 3.7 ft. higher than the crest of the spillway. The spillway section is built into a sag in a conglomerate ridge which impounds the reservoir water, and tedious and expensive excavation would have had to be resorted to to widen the 300-ft. natural opening.



Peculiar Spillway Construction.

San Francisco, Cal. James K. Montserratt.

* * *

HARD BEARINGS VERSUS SOFT BEARINGS.

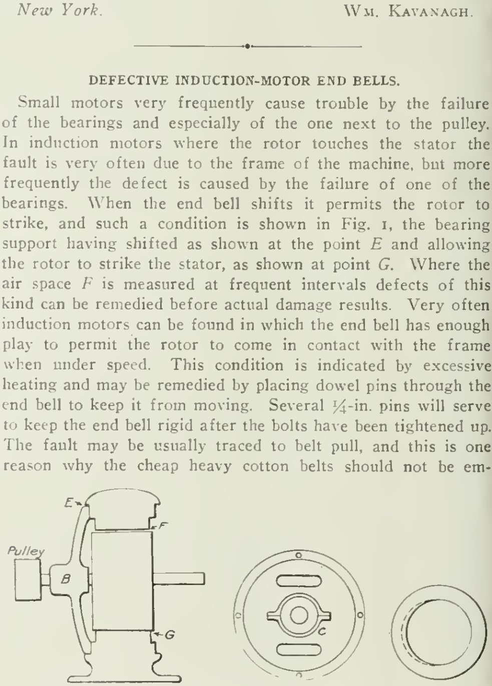
There seems to be quite an aversion to the use of hard boxes or bearings in which the journal rotates. This aversion is not only apparent with builders of motors, but also with builders of general machinery. It is only natural that the manufacturers of machinery should favor soft bearings because of the ease of manufacture and fitting to any particular machine, but such favoritism should not prejudice the practical engineer or electrician against the use or employment of hard boxes. Of course, those who are not accustomed to the use and practical utility of such bearings will in all probability talk against them. This may be due solely to the fact that their experience may be limited to the use of soft boxes. The writer admits that he favored soft boxes for years because he had not the opportunity to learn the usefulness and good points inherent in the hard box. For the past few years his experience has changed all this and this experience was a great educator. The disadvantages of the soft box are many. Practical men are aware that the soft box is incapable of withstanding a rise in temperature much above that which is normal to the feel of the hand or finger. Where the stress load or pull on the soft box is constant and a rise in temperature occurs two things may occur simultaneously. First the rise in temperature may increase, and second, the bearing will flatten, in the direction of stress. As the temperature rises, the solidity of the box becomes destroyed and the metal flows or runs and the usefulness of the box is lost. Another disadvantage of the soft box is that it is incapable of giving any indication of lack of attention or rise in temperature by sound, as does a hard box. Again, a rise in temperature can only be detected by feeling the bearing and since the motor may be located in an out-of-the-way place (as in the case of a motor boxed in and fixed to a high ceiling) it is evident the bearing will easily be destroyed owing to lack of attention, and in the case mentioned above the armature may be injured. The reliability of a hard bearing is immediately apparent, and the advantages are as follows: The bearing is capable of resisting a considerable rise in temperature and at the same time retain its shape and solidity. It indicates lack of attention by sound. It will last from three to four times as long as the soft bearing. The hard box can be used over again after it has been subjected to a temperature that no soft box is capable of withstanding, and this one advantage alone should commend its use to the practical engineer or electrician.

New York. Wm. Kavanagh.

* * *

DEFECTIVE INDUCTION-MOTOR END BELLS.

Small motors very frequently cause trouble by the failure of the bearings and especially of the one next to the pulley. In induction motors where the rotor touches the stator the fault is very often due to the frame of the machine, but more frequently the defect is caused by the failure of one of the bearings. When the end bell shifts it permits the rotor to strike, and such a condition is shown in Fig. 1, the bearing support having shifted as shown at the point *E* and allowing the rotor to strike the stator, as shown at point *G*. Where the air space *F* is measured at frequent intervals defects of this kind can be remedied before actual damage results. Very often induction motors can be found in which the end bell has enough play to permit the rotor to come in contact with the frame when under speed. This condition is indicated by excessive heating and may be remedied by placing dowel pins through the end bell to keep it from moving. Several ¼-in. pins will serve to keep the end bell rigid after the bolts have been tightened up. The fault may be usually traced to belt pull, and this is one reason why the cheap heavy cotton belts should not be employed on motors carrying heavy loads. The tension in such a belt must be very much greater than the tension in a good leather belt for the same service, so that more strain is imposed on the bearing, which soon wears and allows the rotor to come into very close proximity to the frame. Many motors have a loose bearing clamped into the side frame support, as shown in Fig. 2, and these work loose or become worn on one side, as indicated in Fig. 3. The writer has corrected faults of this kind by placing a paper liner between the frame support and the bearing, thus dividing up the air space around the rotor. The type of motor having the removable shell bearing is preferable to one in which the bearing is fixed, as in the former case shells may be carried in stock and placed in the bearing quickly when one becomes worn. This is a feature of considerable importance where a number of motors are in continuous service.

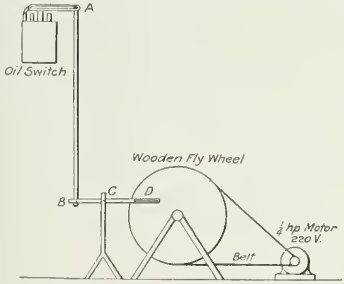


Figs. 1, 2 and 3—End Bell and Bearing Defects.

Atlanta, Ga. Arthur Jones.

REMOTE CONTROL OF CIRCUITS.

The diagram herewith shows a simple device, reliable in operation, as well as inexpensive, for the remote control of either primary or secondary circuits. The writer prefers this scheme to solenoids or carbon break switches. We feed the three-phase motor from a No. 14 wire at a potential of 220 volts, the distance from the office to the switch being a quarter of a mile. The oil switch connects the 2300-volt primaries with two series transformers, used for street lighting, and to reverse the direction of rotation of the motor, to throw the circuit on or off, a two-pole, double-throw switch is used. The center leg of the motor is always in circuit and when the switch is thrown in one position two of the phases are reversed. In the other position the connections are normal.



Remote-Control Apparatus.

Park City, Utah. D. E. King.

* * *

CURING CONCRETE FOUNDATIONS.

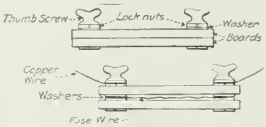
Concrete foundations, both those made of blocks and those monolithic, reinforced or plain, may be hardened in two or three days to a degree equal to the natural hardness obtained by twenty-eight days of frequent sprinkling. The quick curing may be done by the use of exhaust steam or steam at atmospheric pressure. The operation, as well as the apparatus necessary, is very simple. It is only necessary to inclose the foundation with some fairly tight covering—a box of matched boards, a mercerized tent or rough boards covered with plaster. Anything will answer which will prevent wind from blowing the steam from the concrete. If the foundation has been constructed in a fairly small room the room itself may be utilized as the inclosure for the foundation and steam turned into the room without any further covering of the concrete to be cured. The more moist the steam the better it will cure the concrete. If the work must be cured with live steam it is a good plan to discharge the steam into a trough of water which is maintained on an approximate level by means of an ordinary ball-float valve. This will at once remove any possible superheat which might exist in the steam supplied. The water will be boiled and vaporized by the higher-pressure steam, so that a very large quantity of moisture exists at all times in the curing chamber during the operation. Cement products cannot cure or harden unless they are supplied with the proper quantity of water to enable adequate crystallization to take place. Cement differs from lime in this respect, the products of which harden by carbonization, the lime being changed back again into original limestone by means of the carbon elements which chance to be present in the atmosphere. This being the fact, lime mortar will harden quickly when mixed and kept wetted with ordinary carbonated water, such as is used for a beverage. The hardening of the cement foundation may be still further accelerated by increasing the temperature of the steam with which it is surrounded. But as this can be done only by inclosing the foundation in a vessel capable of withstanding internal pressure there is little opportunity of still further hastening the curing of concrete by this method. The matter is, however, perfectly feasible, and concrete blocks, columns, shingles and all kinds of small concrete art stone are now cured in eight hours In fact, any concrete articles which can be placed inside of a 74-in x 74-ft. steel cylinder, on cars or otherwise, are now being cured in eight hours or less to a degree of hardness far beyond what is secured by twenty-eight days of ordinary air curing and constant sprinkling. As foundations cannot well be put into a curing chamber and subjected to steam of 150-lb. boiler pressure, even for so short a time as eight hours, it is necessary to resort to the comparatively slow process of curing with steam at atmospheric pressure, which requires from thirty-six hours to forty-eight hours—after the concrete has been once heated through. The specified time, then, does not begin with the minute the steam is turned on, but should be calculated from the time when the mass of concrete has become heated to the temperature of the surrounding steam-saturated atmosphere. A very good way in which to hasten the curing of large foundation work which is wanted in a hurry is to pipe around the bottom of the foundation with a line of pipes which has been perforated with very fine holes 1/16 in. or so in diameter, at intervals of 1 ft. or 1½ ft. The holes should be so located that steam issuing therefrom will flow directly toward the foundation as close to the bottom as possible Then place a few boards around the foundations in a vertical position. Tack other boards outside, clapboard fashion, and as the boarding progresses toward the top of the foundation cover the boards with dirt, sawdust, tanbark, hay, straw, canvas, rags, or any material at hand, to keep the steam against the concrete work. When the foundation is well covered turn on the steam and allow it to flow to the extent that a little vapor always issues from holes left for that purpose close to the bottom of the foundation. Forty-eight hours of steaming will cure the foundation sufficiently to allow the machinery to be placed upon it and started at once. After the concrete has once been heated through, thirty-six hours' exposure to steam at atmospheric pressure will suffice to harden it. Repairs and additions to old concrete may also be treated by steam with most excellent results. But to make new concrete adhere to old requires that certain conditions be met. The surface of the old concrete must be clean. It must be rough and some holes, in dovetail form if possible, should be dug in the surface with a chisel and hammer. Dilute hydrochloric (muriatic) acid should be applied and rubbed into the old concrete with a stiff fiber brush—the acid will destroy a bristle brush almost instantly—after which the concrete surface should be washed free of acid with a very large amount of water. The old surface can be covered with a thin mixture of cement and water—as thick as ordinary whitewash. The concrete should be wet when this wash is applied and it also should be wet before the new concrete is applied. The above precautions having been taken, build on the new concrete section, or replace the broken portion, then cover and steam as above directed and the resulting concrete repairs can be depended upon to show plenty of strength in thirty-six to forty-eight hours, provided the work has been properly carried out as directed and the new concrete properly proportioned, mixed and applied. This method of curing concrete can be made to play a most important part in emergency repairs as well as in new work.

South Bend, Ind James F Hobart

* * *

TESTING TRANSFORMERS FOR INSULATION

Central-station managers in small towns are often worried about the possible breakdown of the insulation of transformers, which might cause fires in buildings by coming in contact through the house wires, with gas pipe at the outlet of the chandelier or other possible grounds or shock customers in the act of turning on the circuit at a brass lamp socket. Every central-station manager knows what an accidental death due to electricity would mean to his company through the fear of consumers to use electricity any longer The knowledge that one of their townsmen had met death through a medium which was connected to their own homes would deter many from using electricity at all. There would be, also, the usual expensive lawsuit to consider. For a public service corporation in a small town to succeed the confidence of the townspeople is necessary. All transformers should, therefore, be tested occasionally to make sure the insulation is perfect. This should be done when the transformer is inspected to see if the proper amount of oil surrounds the windings. It is then a simple and easy matter and should not be neglected. The following is a description of how transformers can be tested on the ordinary 2300-volt line, disconnecting the consumer from service only a few minutes if the transformer insulation proves to be sound. If it proves otherwise it is well to disconnect the transformer from service for such time as is required to install a new one. Fig. 1 shows a handy fuse block suitable for this purpose. It is constructed of two pieces of wood 1 in. thick, 3 in. wide and 12 in. long. The two pieces of wood are clamped together, as shown, by means of thumbscrews and bolts. Between these blocks and fastened as shown in Fig. 2 a piece of ¼-amp or ⅛-amp fuse wire 10 in. long should be fastened. Under the locknuts and washers shown in Fig. 2 a piece of copper wire should be attached. This forms a cheap, ready-made fuse block which can be thrown about without danger of breakage. The lineman can readily fasten it to his belt by means of the copper wire when climbing the pole. The fuse block should be attached to one of the primary wires and to one of the secondary wires, as shown in Fig. 3. Should the secondary be connected to ground the ground connection should be disconnected. In small towns the secondary is rarely connected to ground. Were the ground connection allowed to remain in place while making a test the result might be misleading should a ground exist on the opposite primary line. After connecting the fuse block as shown the fuse plug No. 1 protecting the transformer should be withdrawn from its receptacle. Should the insulation of the transformer be defective the current would flow through the defect into the secondary coils and through the fuse wire into the other primary line. This would cause the fuse to blow, showing that the transformer insulation is defective. No fear need be felt about throwing a short-circuit on the line through the fuse block, as the load ⅛ amp or ¼ amp would do no harm should the insulation allow the current to flow. The connection to the primary line should now be transposed, placing it upon the other primary line, withdrawing fuse plug No. 2 and reinstating fuse plug No. 1. This is done because it is possible that a slight defect may exist in a part of the windings which might have sufficient self-induction to choke the circuit when connections to the first primary line are made. When the transposition is made it lessens the self-induction and should the defect exist the fuse will blow. Should one fear using the fuse block the same connections can be made by using the fuse block in series with a voltmeter and shunt transformer as shown in Fig. 4. This would be absolutely safe, but a low reading on the voltmeter should not be neglected, as it indicates that a defect exists and should be attended to. Station managers should not neglect the testing of transformers, as it is an easy matter for a careless workman to be careless in the use of the oil used for insulating and cooling the transformer windings, thus rendering it injurious. The writer knows of a case where cylinder oil was used by a lineman because it was oil and looked like the oil he had put into other transformers. Within six months' time complaints were received from customers that they received shocks when they touched their chandeliers. The writer personally investigated and found it possible to get a slight spark through the glass of the electric lamp similar to that produced by small static apparatus. The transformer was removed and the oil found to be in a blackened state. New oil was substituted and the shocks were no longer experienced. Upon testing the transformer a very noticeable leak was found between primary and secondary. The insulation was in a very bad state, being badly decomposed or disintegrated by the action of the oil upon the insulation. This was a rare case, as the lineman was also superintendent of the plant and knew absolutely nothing of the uses or abuses of transformers, having had no experience in alternating-current work. The plant had recently been changed from a direct-current system and he had been retained in charge. The importance of careful handling of transformer oil should be realized from the fact that the entrance of moisture into the oil lessens its insulating properties considerably and it is an easy matter for a careless workman to leave the cap off the cans in which the oil is usually transported, allowing moisture and other injurious foreign matter to find their way into the oil.



Figs. 1 and 2—Fuse Blocks.

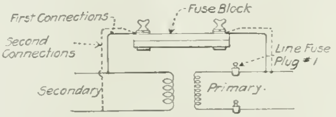


Fig. 3—Test Connections.

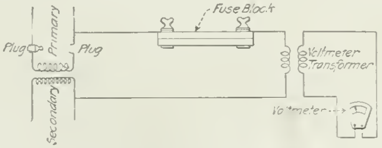


Fig. 4—Test Connections.

Brooklyn, N. Y. T. W. Poppe.

REBABBITTING MOTOR BEARINGS.

The continuous operation of motors and generators depends very largely upon the care bestowed upon them, and this is especially so of small motors. Many of the latter are thrown out of commission because of lack of attendance or for the want of proper setting. This is not only true of direct-current motors, but also of alternating-current motors, the general impression being that the latter require no care whatsoever. Where induction motors of the squirrel-cage type are set on some pieces of timber or on a vibrating foundation the vibration will cause the insulation to work out much more quickly and proper service thereafter is impossible. A good foundation is very essential for the reliable operation of motors. The care of bearings is also another important consideration, and the mere fact that a motor bearing is working well to-day does not mean that it will be in the same working condition an hour hence. It is advisable where motors are used very much to carry a separate set of bearings in stock for each size of motor in operation, so that when the babbitt is melted or becomes loose it may be replaced without the necessity of shutting down the motor for any considerable length of time. Some motor bearings have an iron shell lined with babbitt metal which is

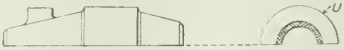


Fig. 1—Solid Bearing.

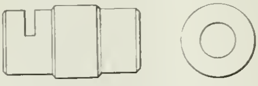
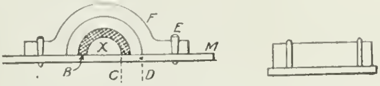


Fig. 2—Renewable Bearing.

poured in place, while others have a finished babbitt liner. Fig. 1 shows a bearing of the former type, and such are very difficult to repair, especially if ring oilers are used. Fig. 2 shows a bearing in which the babbitt is merely slipped into place. A jig for rebabbitting bearings is shown in Fig. 3. This consists of a plate *M* on top of which is a yoke piece *F* bored out to fit the bearing surface *U* (Fig. 1). An arbor *X* represents the diameter of the motor shaft. The distances *C* and *D* must be accurate, so that the bearing will fit when placed in the motor. The pins *E* serve to hold the housing in place while the babbitt metal is poured. In the engraving, Fig. 3, the babbitt metal is represented at *B* and a side view of the arbor is shown in Fig. 4. The latter shows the projecting rings to form the oil grooves. A jig of this kind will be found very useful for repairing separate motor bearings and a bearing such as that shown in Fig. 1 can also be repaired in this way, as the fitting forms the guide for the centering of the shell for the babbitt metal. Great care must be taken in the construction of the jig so that the babbitt lining will be true, otherwise it will not fit the shaft and will run hot.



Figs. 3 and 4—Bearing Jig and Arbor.

Lynchburg, Va. C. R. McGahey.

CUSHIONS FOR GENERATING SET FOUNDATIONS.

Vibrations are sometimes transmitted from operating generating sets and engines through the foundations to the structures in which they are installed. This difficulty most frequently occurs where the foundation is in intimate contact with the foundations of the building, but it may be encountered where the engine and building foundations are entirely distinct. In such cases the vibrations are transmitted through the soil in which the building and engine foundations are embedded. It has been found that if engine foundations are cushioned with a layer of sand no vibrations are transmitted. For installations where vibrations would be objectionable sand cushioning is often resorted to.

One method of sand cushioning is shown in Figs. 1 and 2. A box-like depression is arranged in the floor and a layer of sand is interposed between the inner walls of the depression and the foundation, which fits down in it. To prevent any settlement of the foundation that might be caused by sand being forced out, copper plates are arranged in the floor slab to seal the opening around the foundation's top. The floor slab should not touch the engine foundation at any point. A plan view of the construction suggested in Fig. 1 is given in Fig. 2. As indicated, the top floor is cut away from the foundation for a short distance all around, leaving an open space.

In constructing the foundation of Fig. 1, the depression having been molded in the floor, a layer of clean, dry sand is placed in its bottom. It should be noted that the section of concrete, between the dotted lines *A* and *A*, containing the copper plate is not placed until the foundation itself has been completed. Then a layer of oiled paper is placed on the bed of sand and the form for the foundation is erected on the paper. The form is lined with oiled paper and the foundation is poured. After the concrete has set the form is removed and the oiled paper is allowed to remain. The space between the foundation and the depression walls is filled with sand as high as the line *BB* (Fig. 1). The concrete section included between *A* and *A* is then poured, the copper plate being embedded in it. All of the space below the copper plate is carefully filled with sand before the plate is cast into position. Oiled paper is used as a lining, when the section *AA* is poured, to prevent concrete from flowing into the sand.

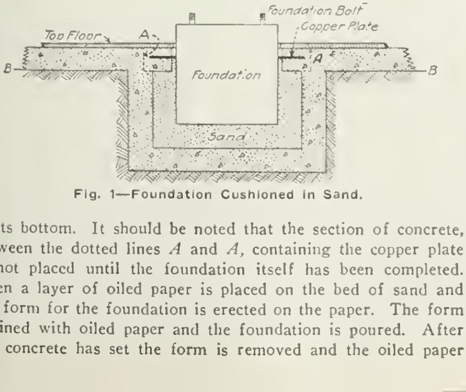


Fig. 1—Foundation Cushioned in Sand.

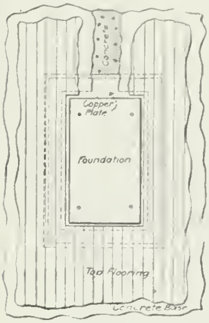


Fig. 2—Plan View of Fig. 1.

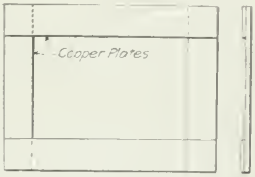


Fig. 3—Method of Arranging Copper Plates.

Four sections of copper, as shown in Fig. 3, compose the copper plate. It is not necessary to rivet the sections together because a shovelful or two of concrete will hold them in position until the whole volume of it is poured.

Where the floor and building foundations of a structure are waterproofed a construction more elaborate than that of Fig. 1 must be adopted. Fig. 4 shows a transverse section of a cushioned foundation designed for the East Side Commercial and Manual Training High School of Newark, N. J., under the direction of Mr. George W. Knight, supervising engineer for the Board of Education of that city. This foundation is waterproofed. The 4-in. brick wall constitutes part of the form for the concrete sides of the foundation and provides a surface on which the waterproofing can be laid. The rectangular projection from the concrete side wall is a key for the waterproofing. The 1-in. layer of cement in the bottom of the depression forms a protective coating for the depression-floor waterproofing. A foundation of this type is constructed in much the same manner as the one previously described. After the depression has been built the layer of sand is placed in its bottom and oiled paper is laid on top to prevent the concrete from mixing with the sand. The foundation form is built on the paper and sand stratum and is lined with oiled paper. After the concrete has been poured and has set the form is removed and the oiled paper allowed to remain. Sand to fill the side spaces is introduced and the floor course of concrete is laid. Instead of a copper plate a ring of asphalt is used in this design to prevent the sand from being forced out. The layer of grout is introduced between the bedplate of the generating set and the top of the foundation after the foundation has been completed and the generating set aligned and leveled. The ring of asphaltum is 1 in. wide.

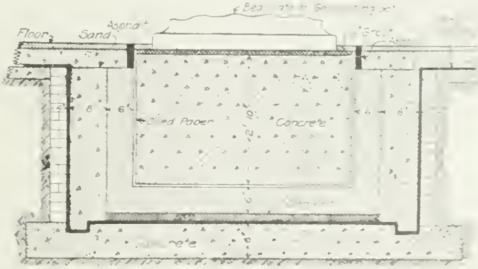


Fig. 4—Cushioned Foundation.

Philadelphia, Pa. Paul J. Carty.

QUESTIONS AND ANSWERS

In three-phase motors having three coils per group per pole the throw of the winding in one is one and ten and in the other one and nine. How will this affect the motor, and what effect has the throw or pitch of the winding on the operation of the motor? C. L. H.

In a three-phase induction motor provided with three coils per group per pole, any one of a number of different coil pitches may be employed. A coil pitch exactly equal to the pole pitch of the motor will necessitate a minimum current for any chosen amount of magnetism, and will require the minimum magnetism for producing any given value of counter electromotive force. When the coil throw is less than the pole pitch an increased amount of magnetism is required for producing the counter voltage, and an increased current is required for producing this magnetism. The wattless volt-amperes required for excitation vary approximately with the square of magnetism required. These facts are discussed at length in the appendix and Chapter IX of McAllister's "Alternating Current Motors."

It is desirable to reduce the all-day core loss of a transformer where the latter is connected to a lighting circuit imposing no load on the secondary. How can this be performed? W. J. H.

The low-load losses of a transformer, which consist largely of the core losses, can be reduced by connecting in series in both the primary and secondary circuits a transformer designed for the normal e.m.f. and transformation ratio, but having a rating about equal to the low-load value. Under normal full-load conditions both the primary and secondary circuits of the small transformer should be short-circuited, in which case the full e.m.f. is impressed across the large transformer, which therefore carries all of the load. Under low-load conditions the short-circuit should be removed from both the primary and secondary of the small transformer. In this case the total voltage is divided between the two transformers in such a way that the small transformer operates at almost the full voltage, while the large transformer consumes merely the remainder. The excitation of the large transformer being greatly decreased, its core losses practically disappear, while even the core losses in the small transformer are slightly less than its normal.

If a three-phase watt-hour meter when tested with the two series coils in series and shunt coils in parallel is correct, but when each element is tested separately one is found to be 1 per cent fast and the other 1 per cent slow, will the meter be correct on power factors below 50 per cent? It would seem that if the element which is 1 per cent slow were negative the meter would run fast. S. R. N.

Without definite information as to the cause of the inaccuracy in the registration of each element of the polyphase watt-hour meter it is impossible to state definitely what effect would be produced at power-factors below 50 per cent. An error of 1 per cent might mean 1 per cent of the watts, or it might mean 1 per cent of the volt-amperes, or again it might mean a constant error of 1 per cent of the full-load registration of the instrument. In the last-mentioned case a change in the power-factor would have no effect; in the first-mentioned case a change in the power-factor would have the maximum effect, and in the second-mentioned case there might or might not be an effect, according to whether or not the load was balanced. In any event it is preferable for the separate elements of the meter to be as nearly accurate as possible in order that all sources of error may be eliminated.

Two hydroelectric plants situated two miles apart are operated in parallel and the regulation is all taken care of in one plant which has a 300-kw, three-phase unit governed by a water-wheel governor and a Tirrill voltage regulator. The machines at the other plant are run without governor or regulator. How should the excitation to be carried at the second plant be determined? G. E. M.

When two separate hydroelectric generating plants are operated in parallel, and the load regulation is accomplished solely at one of the stations, the excitation at the remaining station should be so adjusted that the current supplied by this station is the minimum. The power which this station will supply to the system is independent in every respect of the excitation, depending solely upon the opening of the inlet valves on the turbines. If the excitation is too low, the machine will operate at an excess of current, the excess current being such as to assist in magnetizing the generator. When the excitation is too high, the machine likewise operates at a low power-factor, the excess current in this case being such as to demagnetize the generator. The minimum current is obtained when the excitation is such that the machine requires no wattless current from the system and delivers no wattless current to the system.

If the field and armature coils of a 500-volt direct-current shunt motor are connected in multiple so as to make the machine operative on a 250-volt circuit, what will be the effect on the horse-power rating of the machine? Suppose a 500-volt direct-current shunt motor has its field coils connected in multiple so as to be operative on a 250-volt circuit, but its armature coils are left connected as originally for 500 volts, what will be the effect on the horse-power of the machine when operated on 250 volts? I understand, in designing a transformer, for every turn on the secondary winding there will be 1 volt induced from the primary winding. Now, how are the amperes predetermined? For example, it is desired to build a transformer capable of reducing a pressure of 100 volts to 50 and delivering a current of 10 amp from the secondary. The primary coil would consist of, say, 100 turns and the secondary would contain 50 turns. How is just 10 amp obtained? A. E. K.

When both the field coils and armature coils of a 500-volt motor are changed from the series connection to the parallel connection in the ratio of two to one, the machine becomes a 250-volt motor, and will operate at the same horse-power output as formerly with no change in its characteristics other than a slight increase in heating at the commutator. The current at 250 volts will be twice as much as at 500 volts, and to obtain satisfactory performance at the brushes it is desirable to double their cross-sectional area. When the field coils of a 500-volt motor are connected in parallel so as to be operative on a 250-volt circuit, but the armature coils are left connected as though for 500-volt operation when the motor as a whole is run at 250 volts, the speed will be reduced to 50 per cent of its normal value and the permissible output will be decreased by 50 per cent. As a matter of fact, the machine will operate exactly as though the field coils had been connected in series and subjected to 500 volts and the armature had been subjected to 250 volts, as is frequently done with three-wire operation of motor installations. It is incorrect to assume that in every type of transformer the e.m.f. will average 1 volt per turn. As a matter of fact, only in small transformers is this the case. The average e.m.f. per turn varies slightly less than 1 volt per turn in the very small transformers to 2 volts per turn in a 4-kw transformer, 3 volts per turn in an 8-kw transformer, reaching 5 volts per turn in a 32-kw outfit, etc. The values given above apply to 60-cycle transformers in which use is made of fairly good sheet iron. The proportions would be altered if use were made of silicon steel or the frequency were either greater or less than 60 cycles. However, in the case mentioned by you 1 volt per turn is a fair value to assume. Assuming that you have in mind a 60-cycle transformer, the cross-sectional area in order to produce 1 volt per turn should be about 10 sq. in. If the transformer is wound with 100 primary turns and 50 secondary turns, it will be suitable for operation at 100 primary volts and will deliver 50 volts at its secondary terminals. Quite independent of the size of wire with which the transformer may be wound, it would deliver almost any value of current demanded, operating in this respect exactly like a direct-current generator. However, for each size of wire there would be a limiting current beyond which the coils would become overheated. If it is desired to wind the transformer so that the secondary circuit will carry 10 amp without overheating the secondary wire should be about No. 10. With 10 amp in the secondary the primary would carry 5 amp, and for a moderate amount of heating the primary conductor should be about No. 7.

Central Station

Management, Policies and Commercial Methods

ELECTRIC VERSUS HORSE-DRAWN WAGONS.

Mr. F. H. Tidnam, manager of the Oklahoma Gas & Electric Company, Oklahoma City, gave some interesting figures comparing the operation of electric and horse-drawn wagons in Oklahoma City in a paper read at the recent Byllesby convention in Chicago. In June, 1910, the gas-meter department of the company purchased a 2000-lb. electric truck which displaced two one-horse wagons. For the month preceding the cost of operating these two wagons, with two metermen and two helpers, was $345, which figured out an expense of 35 cents per order for 987 orders executed. Compared with this the cost of operating the truck for a month was $209.90, including the wages of one meterman and one helper. Electrical energy was charged at 4 cents a kw-hour. More orders were executed than in the case of the two horse-drawn wagons, the number being 1092, and the cost per order executed was only 19 cents. The total saving effected was $137.20 in favor of the electric truck.

At the present time there are in Oklahoma City about 140 electric motor vehicles and six electric commercial trucks. Mr. Tidnam exhibited a table showing that the revenue derived from the sale of electricity for charging automobiles in Oklahoma City had increased from $62.50 for the month of January, 1910, to $458.96 for the month of December, 1910. The total revenue for the year from this source was $3,370.75.

ENERGY CONSUMPTION FOR ELECTRIC ICE-MAKING.

An average expenditure of from 50 kw-hours to 60 kw-hours is required to produce one ton of ice by means of a motor-driven ammonia-compression system. The maximum demand of such an outfit reaches about 2.3 kw per ton of ice-making capacity. Of this demand about 1.5 kw per ton is due to the compressor itself, the remainder representing the work of the auxiliary apparatus. These figures represent the conclusions reached by a large central-station company after a study of a number of ice-making plants where electrical energy is used in motor-driven compressors.

SPECIAL STREET LIGHTING AT GENEVA, NEB.

Geneva is the county seat of Fillmore County, which is considered one of the best farming sections in the State of Nebraska. The population is 1741, and as a town it cannot lay claim to any greater advantages than any other town of the same size, unless it be that the management of the electric light company is very progressive. The illustration herewith shows the system of lighting in use along the two business blocks of the town. There is a park opposite these two blocks, which accounts for all the lamps being on one side. The fixtures were made up by the Geneva Electric Company, as it was very difficult to secure one that would be flexible enough to suit all requirements. The scroll work was made by a local blacksmith out of 1/4-in. x 3/4-in. iron and is secured to the fixture by a 5/16-in. bolt passing through both sides of the pipe. The other end of the scroll is fastened to the building by two 5/16-in. bolts or screws. The local manufacture of these scrolls was a very great convenience, as some of them had to be made of varying lengths to fasten to cornices and other projecting parts of the building fronts.

The fixtures were placed about 16 ft. above the sidewalk and spaced 24 ft. apart. Each contained a 60-watt tungsten lamp in a 10-in. straw opalescent ball with a 4 in. holder. The wall plates, sockets, holders and other fittings were furnished by the Benjamin Electric Company, and a 5-ft. length of 3/4-in. conduit forms the stem. The total cost of the fixture was about $3.50 exclusive of the lamp. They were installed complete at a cost of $5 each to the merchants, plus a charge for service of $1 per month.

Special Lighting at Geneva, Neb.

The lamps burn from dusk to 10:30 p. m. during the week and until midnight Saturdays. The electric light company agrees to take care of all renewals at its own expense, thereby assuring an unbroken string of lights. The installation is taken care of through a commercial club which guarantees all charges and does all collecting as well as taking care of any vacancies that may occur. This is quite a convenience to the electric light company, which bills the club for a lump sum. There are thirty-nine of these fixtures, thirty-two being on the main street and seven on a side street. They have been in operation over five months and have been exceedingly satisfactory both to the public and to the local lighting company, of which Mr. G. S. Sprague is superintendent.

"STAPLES" AND "NOVELTIES" IN ENERGY-CONSUMING DEVICES.

In the course of a paper entitled "Advisability of Utility Companies Handling Gas and Electric Appliances," read at the recent convention of Byllesby companies in Chicago, Mr Samuel Kahn, manager of the Union Light, Heat & Power Company at Fargo, N. D., said, among other things, that a public-utility company should discriminate between what he called "staples" and what are considered "novelties." By a "staple" appliance he means one that will sell for a few dollars and be of such usefulness that it becomes indispensable to the customer and therefore goes into regular service. The electric flatiron is mentioned as an example. Such an appliance is sold for $3.85, and if used on an average fifteen minutes a day the annual consumption will be 50 kw-hours, which, at 10 cents, will amount to $5 a year On the other hand, as a "novelty," the washing machine may be mentioned A good machine of this character cannot be purchased for less than $50, and the annual consumption of energy may be estimated at 27 kw-hours, producing a revenue of $2.70.

Mr. Kahn took pains to disavow the conclusion that washing machines and other appliances, like vacuum cleaners, heating pads, vibrators, etc., should not be displayed and sold by the central-station company. In certain industries these so-called "novelties" become "staples," for a laundry will use a washing machine continually, a house cleaner will need the vacuum cleaner many hours daily, a hospital will require heating pads in regular service, and a "beauty parlor" or barber shop will find the vibrators almost invaluable. Each appliance, when used in some place to which it is particularly adapted, is productive of appreciable returns.

DISTRICT SYSTEM OF METER READING.

"District System of Meter Reading" was the title of a paper read at the recent convention of Byllesby companies in Chicago by Mr. T. K. Jackson, president of the Mobile Electric Company of Mobile, Ala. By this term is meant the division of a city into a number of districts, reading and billing meters in each of these districts as a unit. In Mobile, where there are 5500 customers' electric meters, the city is divided into three such districts. The first step necessary to put into effect the district system of meter reading was the amendment of the city ordinance, which provided that a discount be allowed on all bills paid between the first and tenth of each month. This change was made without opposition. The city was then divided into districts, each having substantially the same number of meters and each having well-defined geographical boundaries.

The entire aim of the district system of meter reading was to eliminate peak-load conditions in the work of the employees of the company, and the result desired has been attained. The number of meter readers has been cut down from five to two, with an extra man to assist in making check readings and second readings. The cashier, complaint clerk and ledger clerks of the company find their work much easier, being spread throughout the month in a uniform manner. All bills are now rendered within ten days of the meter-reading day and become delinquent ten days later.

The most valuable result to the company is that by reason of having meter readers who are continuously employed fewer mistakes are made in reading meters; furthermore, as the ledger clerks are not greatly hurried fewer mistakes are made in billing, with less dissatisfaction among customers. Mr. Jackson believes that the district system of meter reading will be an unqualified success for companies which have more than 2000 consumers. He thinks an additional meter-reading district should be made for every multiple of 2000 consumers. He believes that the adoption of the district system of meter reading results in a great decrease in the losses due to failure to collect. He points out that on Dec. 28, 1907, the delinquent report of his company showed $6,906; on Dec. 26, 1908, it was $1,125; Dec. 27, 1909, $1,731, and Dec. 31, 1910, $801, showing a material decrease.

THE PRESENT TUNGSTEN-LAMP SITUATION.

An interesting paper entitled "Effect of Low-Wattage Lamps on the Central-Station Industry" was read by Mr. Alex. F. Douglas, of Portland, Ore., assistant manager of the new-business department of H. M. Byllesby & Company, at the recent convention of Byllesby companies in Chicago. Mr. Douglas gave a sketch of the development and introduction of high-efficiency lamps and showed the important question presented to the central-station company by the appearance of these lamps, with their low rate of consumption of electrical energy for the same amount of light, compared with carbon lamps. Many of the central stations finally realized that the proper handling of the new lamp meant more business for them, rather than the cutting down of their revenue. The new lamp has proved extremely useful in competing with gasoline and acetylene lighting. The speaker cited the example of Milwaukee Avenue in Chicago. More than two years ago the lighting on the street was 75 per cent gas; to-day, he said, it is just the reverse, being 75 per cent electricity, and this change must be credited to the tungsten lamp.

To-day, Mr. Douglas said, the lamp-manufacturing companies have in mind the introduction of 10-watt, 15-watt and 20-watt multiple tungsten lamps, and the question again arises, What shall the central station do to meet the situation? In view of the experience with 40-watt and 60-watt tungstens the speaker's conclusion is that the central station need not fear the new low-wattage lamps. These lamps will be relatively expensive and undoubtedly will be fragile. In addition they will necessarily be of relatively poor efficiency as compared with tungsten lamps of greater energy consumption. The cost of renewals per kw-hour may become so great that the use of the low-wattage tungsten lamps may not be economical unless the cost of electricity is very high. The raising of the standard of illumination will be further aided by the low-wattage lamps, for more lamps will be burned than heretofore. The new lamps will widen out the field for outline and display lighting and may replace small carbon lamps for hall lighting and be used with much greater freedom. Everybody likes a cheery and well-lighted house, and the new units should encourage the use of a greater number of lamps.

In concluding Mr. Douglas urged his hearers not to hold off until the situation was forced upon them. Now is the time to grasp the situation and get control of it. Every man in the new-business department should be posted on the most up-to-date methods of lighting. The central-station man should advertise the fact that he is willing at all times to assist his customers to obtain better light and stands ready to supervise any installation made to that end.

A WAY TO SOLVE THE TUNGSTEN PROBLEM.

By J. E. Bullard.

Any central station using rates not based on the three components, fixed charges, customer charges and production charges, will of necessity suffer from the tungsten invasion. The extent of the suffering will depend on the way the situation is handled by the management. The course too often pursued is to make a vigorous campaign for the class of business yielding the least profit—in other words, lighting small stores with tungstens. Residence lighting is likely to prove more profitable, for, though the revenue per customer is smaller, the introduction of various domestic heating and labor-saving devices may increase the consumption sufficiently to offset the bad effects of the tungstens. Flat-rate, off-peak sign lighting, etc., is a good way to increase the lamp load. In my opinion, however, it is far better to pay less attention to lighting and bend all the energies to increasing the motor load.

The motor load is profitable. If we define load-factor as the ratio between the actual yearly consumption and the maximum demand multiplied by 8760 we discover the following: The load-factor for lighting varies from 5 per cent to 26 per cent, with an average of 11 per cent. The motor load-factor in the case of motors rarely used may be as low as 5 per cent, while on such loads as twenty-four-hour pumping it will pass 90 per cent. Though the motor load-factor may fall below that of lighting, there is the advantage that the motor can be, and usually is, used off the peak, while lamps must be used on the peak. Again, the motor has probably reached as high an efficiency as it ever will. This means there is no danger of a decrease in revenue due to higher motor efficiency, but there is a likelihood that the incandescent lamp will reach a much higher efficiency in the not very distant future.

It would seem that in the presence of these facts all central-station managers would see the advisability of adding all the motor load possible. It would seem that their motor departments would be highly organized, and would collect and file accurate data on all the prospects in the territory served by the company. This, however, is rarely the case. The investigating done by the writer leads him to believe that the average central-station manager handicapped by unscientific rates pays far too little attention to his one great opportunity.

A certain manager speaking about the need of giving prospective motor users accurate data expressed the opinion that the selling of energy for motors in his city was mainly a "matter of bluff." He did not think it advisable to give the users of a large motor load full and accurate information, since a competing electric supply company might get hold of this information and make use of it. Another manager said it was not necessary for him to employ a regular motor-load salesman because the large manufacturers were willing to send a man to sell motors to all prospective motors users. A number of central-station men outside the large operating companies have expressed their opinion that there is danger of giving their prospective motor users too much time and information. These companies are losing great opportunities, while those who do go out and give these prospects all the information and attention necessary to get their business are daily increasing their profits.

In one case two central stations of about the same capacity served populations of nearly the same size and each had manufacturing establishments as prospective buyers. One company sold energy at a very low rate, had no highly developed sales force and would not give definite and accurate information. It is getting few orders and is facing strong competition. The other company has high rates, gets most of its business by closing down existing steam plants and has a highly developed motor department which goes into the minutest details and sticks to the prospective buyer until he "signs up" or dies. This company has comparatively few complaints, and probably will never have to fight competition. This alone is a strong argument in favor of giving a motor-load buyer all the necessary information. You would have very little confidence in a tailor who could not tell you the price of a suit before he made it, and who insisted he could guess near enough to make it unnecessary to measure you. This, nevertheless, is the way a great many central stations are going after their motor-load business.

The secret of success in the motor department is industrial engineering. Local conditions will determine how much engineering is necessary. In some cases it may require no more than indicating engines and general testing. In most cases, however, and especially in manufacturing towns, it requires extensive and accurate engineering work. There the industrial engineer should not only ascertain the cost of operating the plant of the prospective buyer with its present equipment and with electricity, but he should as nearly as possible figure the cost to the central station of supplying the energy. In this way the central station will be enabled to secure the most profitable business.

Large business concerns have a very accurate knowledge of the size of the market they can supply, and can tell quickly when they are losing to competitors. Too many central stations have acted on the supposition that they have no competition. They apparently have overlooked the activity of the steam-engine, producer-gas and gas-engine salesmen. There is scarcely a central station possessing an accurate record of all the power users in the territory it serves. It is self-evident how valuable such a record would be. It should give the size of the different plants, their present cost of energy, the cost of operating these plants by electricity and the cost to the central station of supplying the energy. If an industrial plant has a breakdown the central station should immediately offer them a complete and attractive proposition. If the central-station company is about to build a new generating plant it can more closely estimate the size and the most economical site on which to erect it.

The best efficiency from the coal pile to the engine flywheel may be placed at about 10 per cent. In the average industrial plant it is only about 2 per cent. This leaves a wide margin to the central station for transmission and other expenses not a part of the energy costs of the private plant. In spite of this fact there are in every town many plants in operation simply because their owners do not know the cost of the energy from their own plants, and the central station has never taken sufficient interest thoroughly to investigate and test those plants.

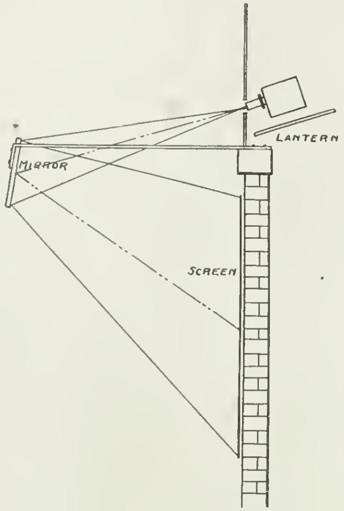
A very promising feature about the motor load is that practically no improvement which increases efficiency can be applied with advantage to the small plant. This means that while engine and boiler efficiencies gradually increase in the large units used by the central station they remain almost constant in small ones used in the private plant. Also the majority of small units used to furnish energy to factories are not operated at their greatest economy. The engines are likely to be out of adjustment, the boilers poorly fired or some other loss is in evidence.

Gas engines have a full-load efficiency of 20 per cent. They, however, will carry no overload, which means that the units must be much larger than steam units capable of doing the same work. This means the engines are rarely run at full load and the actual working efficiency is low and the cost of fuel high. In most cases gas engines operated by producer, natural or artificial gas can be displaced if the actual operating expense is carefully ascertained. Usually the fuel bill in the case of the gas engine does not represent more than 50 per cent of the actual energy cost. In the case of the steam engine the fuel cost rarely represents more than 65 per cent of the total energy cost. This is a fact overlooked by the user. It is not so much his fault as that of the central station. He does not keep his energy costs carefully separated from his other factory expenses, and though the central station has told him this fact it has not proven to him what his energy costs actually are. He, therefore, thinks he should get electricity for the price of fuel or less, and too many solicitors of motor service apparently hold to his opinion.

No central station should make the mistake of expecting the industrial engineer also to be a solicitor for motor service. The central station can get a list of the power users in the territory. The industrial engineer then analyzes their present costs of energy, figures up their total cost, and what the cost of electric energy would be if served from the central station. He then figures the cost to the central station of supplying them with the required amount of energy and selects the most profitable prospects. These he gives to the solicitor, together with the information necessary to get the business, and the solicitor gets the contracts signed. He may or may not need the further aid of the industrial engineer to do this, but if he does need it he should have it. The engineer should not be expected to solicit. He is an engineer and not a salesman. Let the salesman find the prospective buyer and let him do the soliciting and get the contract, when the engineers have prepared the technical end for him. Always take pains to impress the prospect with the attention, time and professional services you are giving him, and especially show him how you are able to save him money and how you have arrived at his actual energy costs. If you do this you will have thoroughly satisfied customers who believe in you. Not only this, but the company will increase its profits as fast or faster than its revenue and any amount of energy released by replacing carbon lamps with tungstens can be readily sold at a greater profit than was realized from the carbon lamps. The tungstens will neither reduce the revenue nor the profit, but will result in a higher load-factor to the central station. You have already allowed the illuminating engineer to show what he can do. Why not give the industrial engineer an equal chance? He will without doubt show himself even more worthy of his service than has his elder brother.

TWO ELECTRICAL ADVERTISING NOVELTIES.

Near one of the Fifth Avenue stations of Chicago's elevated Loop an ingenious projecting-lantern advertising sheet has been arranged to attract the attention of those waiting on the platform opposite. Through a protected opening in a window the lens of the lantern projects its rays against a mirror mounted several feet from the building and at such an angle as to reflect the image onto a screen on the wall below the window, where the rays come to a focus. This arrangement is made clear in the accompanying diagram. Use of the reflecting mirror extending beyond the building avoids the necessity for a window opening equal to the size of the screen, requires less room in the building and does away with the bright spot shown by the lantern lens when the stereopticon is placed on the opposite side of the screen from the spectator, as would otherwise be necessary. Tendency to distortion caused by the angle at which the screen intercepts the pencil of rays can be prevented by arranging the stereopticon slide with a swing back paralleling it to the line of the building.



Arrangement of Lantern.

Another advertising novelty shown during the Electrical Show at the Coliseum represented a famous pair of washing-powder twins actually performing in all their pictured motions. The two figures, one wielding a scrubbing brush and the other bent over a wash tub, were silhouetted against a frosted glass framed by a box cabinet. Each twin was busily plying his task at the brush or tub, but with a striking synchronism that gave the clew to the ingenious scheme used to gain the effect. The stationary portions of the cut-out figures, legs and feet, tub, washboard, etc., were all pasted closely to the frosted glass, while the parts it was desired to have appear move were bent away from the shadow plane a small distance proportional to the amplitude of the motion. Behind the glass was an electric lamp rotated about its base by a small motor. With each revolution of the lamp the shadows of the raised portions of the little figures underwent a similar movement in the opposite direction as seen on the ground-glass plane, giving an extremely ludicrous effect viewed from the front of the screen.

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MARKETING ELECTRICITY IN CHICAGO.

An instructive address on "The Market for Electrical Energy" was delivered at a well-attended meeting of the Electric Club of Chicago on Jan. 25 by Mr. E. W. Lloyd, general contract agent of the Commonwealth Edison Company. Mr. Lloyd gave a number of interesting facts in relation to the sale of electricity by his company in Chicago. He said that the contract department of the company embraces 140 men, of whom 100 are out "on the street" seeking business. The system of handling the business of the department was briefly described and the fact was mentioned that an effort is made to give prompt service after an order has been taken, often on the same day, where the company's wires are in the building occupied by the customer, as in the case of an apartment building. The work of the advertising department was referred to. An advertising committee of three, including Mr. Dana H. Howard, the advertising manager, holds weekly meetings and executes the policy of the company. Advertisements covering considerable space are inserted in the Chicago daily newspapers nearly the whole year round, at the rate of about two a week in each daily. There is also a great deal of magazine, program and direct-by-mail advertising.

In canvassing Chicago for new business the city is divided into thirty-five or forty districts for lighting business. Each of these is in charge of a solicitor, who often has an assistant. For motor business the city is divided into eight or nine districts, each having its own solicitor, as in the case of the lighting field. A distinct bureau is made of the sign business, and the city is divided into seven or eight districts for this purpose, with a man for each district, as in the other cases. Incidentally, the work entails a great deal of correspondence and sending out of literature and about 70,000 pieces of mail matter are handled each month by the department.

An interesting portion of Mr. Lloyd's address had to do with the new or comparatively new avenues for the use of electrical energy. He remarked that the investment in the central-station business of the country, exclusive of electric-railway work, has been at the rate of $125,000 a day during the life of the industry. The Chicago company owes much of its success to the great variety of its business, insuring a high diversity factor, which is extremely important. The growth of the business is shown by the fact that ten years ago the maximum load was 17,000 kw, whereas in December of last year the figure was 182,600 kw. Everybody knows that electrical energy is adapted for lighting and industrial purposes, but new ways and new processes are constantly being found to which it is especially adapted.

One of these is the sale of electricity for the operation of electric automobiles. This is a promising field, the importance of which is not fully realized. The speaker expressed himself as confident that in a few years the horse-drawn vehicle will be a comparative rarity in large cities. At the present time, according to the best figures obtainable, there are about 1300 electric vehicles in Chicago.

Another comparatively new outlet for electrical energy is supplied by the electric furnace, particularly as used for refining iron and steel. This class of apparatus is now thoroughly dependable, and it furnishes desirable business for the central station. Many successful electric furnaces are now in operation, the sizes varying from a few kilowatts to 1000 kw each.

Electric welding was mentioned as a development destined to assume increasing commercial importance. It is believed that there will be a great increase in the use of this process, with a corresponding demand for electricity. The operations now performed in a wide variety of manufacturing establishments by electric welding are most ingenious and interesting They not only make for convenience, but also reduce in a marked degree the cost of manufacture of the various articles where the process is used.

Taking up the use of electricity in artificial ice making, Mr. Lloyd announced that a contract of this description had been signed in Chicago on the morning of his speech. It is only recently that electrical energy has been employed on a considerable scale in ice making and artificial refrigeration. The speaker said that it is the policy of one large ice company with which he is acquainted to abandon its ice houses as soon as they become dilapidated and manufacture its ice by the use of electrical energy. This class of business is exceptionally desirable to the central station, because it can be obtained off the peak. Usually arrangements can be made so that the artificial ice plant will be shut down between the hours of 4 and 8 p. m. in November, December, January and February of each year. The Commonwealth Edison Company has made an exhaustive inquiry into this important subject and has found, for one thing, that between 50 and 60 kw-hours of electrical energy is required to produce a ton of ice.

In relation to electric drive in manufacturing establishments, Mr. Lloyd noted the careful manner in which estimates for this class of business are now made by the agents of the central-station company, many of whom are really experts in relation to the power requirements of a large number of industries. All classes of factories are supplied with electricity, and it is found that the advance estimates of probable requirements come remarkably close to the actual fact as determined later by meter measurements. The Commonwealth Edison Company has 11,000 motor customers and the total rating of industrial motors connected to its circuits is 188,000 hp. In view of the economies of central-station production, Mr. Lloyd believes that ultimately the private plant will disappear in Chicago. To many establishments electricity is supplied not only to drive motors, but also for heating in connection with soldering irons, furnaces, glue pots, etc.

As is well known, a large part of the output of the Commonwealth company is sold to transportation companies for the operation of surface and elevated railways. This business is still increasing, though not so rapidly, of course, as in former years.

Considering the smaller applications of electrical energy, both for industrial purposes and in the household, Mr. Lloyd took occasion to express obligation to the manufacturers of and dealers in appliances who further the sale of these devices. This work is appreciated by the central-station interests, he said. He spoke of various special campaigns to increase the volume of this small business—that is, small in the sense that each customer's requirements are small, but large in the aggregate, and particularly valuable in increasing the income per capita of the electric-service company.

The house-wiring campaign was cited, and it was said that up to date 2500 houses not before wired have been connected to the company's lines. The flatiron campaign, with which the readers of the *Electrical World* are familiar, was also mentioned. This resulted in the placing of over 10,000 electric irons. The pushing of tungsten clusters, particularly in stores and public halls, was briefly referred to. During the last three years about 16,000 of these clusters have been put out, each containing four 60-watt tungsten lamps. The campaign for special street illumination is actively pushed, and the result has been the placing of 1703 posts for ornamental street lighting, each supporting four 60-watt tungsten lamps. The sign business is important and brings in $500,000 in revenue yearly. There are now about 3000 electric signs on the company's circuits.

The company now makes no minimum charge, and of its 125,000 consumers about 70,000 are household customers. The number of watt-hour meters installed on customers' premises is 141,515, and in addition to these there are 47,418 Wright demand meters.

Mr. Lloyd referred briefly to the matter of rates. He said that the central-station output of electricity in Chicago is considerably larger than in any other city in the world. This may be taken as an indication of the average low rates which are made, and, indeed, this is the case. The rates for all classes of service are on file in the City Hall; they are designed to be as low as possible after allowing a reasonable return on the investment. The company does such a large business and has such a good diversity factor that it is enabled to sell electricity more cheaply, perhaps, than any other city not supplied with electrical energy produced by water power. The rate schedule is based on the Hopkinson method.

In July, 1909, the company put into effect its wholesale schedule of rates for both lamp and motor business, and this schedule, with its low prices, has resulted in the securing of a large amount of business. A new modification of this wholesale schedule is about to be put into effect. This modification will be known as the "off-peak" contract, and under its terms an extremely low price for electric energy is made. The peak hours are from 4 to 8 p. m. during the months of November, December, January and February. On condition that the customer uses no energy during these hours the primary charge for the entire year is reduced to a point where it is slightly over one-half the primary charge as stated in the regular wholesale contract. No change is made in the secondary rate. There are many classes of business which can be taken on this "off-peak" contract, such as electric furnaces, grain elevators, some factories, etc.

In concluding, Mr. Lloyd spoke of the cordial spirit of co-operation in all of the departments of the Commonwealth company. From the president down, he said, every man was virtually a contract agent. All are keenly interested in the work of the contract department and help it in every way. The speaker showed some curves demonstrating graphically the growth of the business. Thus, in eighteen years the receipts of the company from the sale of electrical energy have increased from 50 cents per capita to $4.50 per capita. Including the railway load the receipts of the company are about $8.50 per capita. The total connected load is equal to about 9,000,000 50-watt equivalents. Of this about 6,500,000 50-watt equivalents are due to the energy sold for lighting and industrial power and heating. The remainder is the railway load.

Messrs. F. J. Postel, Albert Scheible, Harold Almert and W. S. Taussig asked several questions, and in answer to them Mr. Lloyd gave the following additional facts:

The number of customers who pay less than $12 a year out of the 70,000 residence customers is about 1700. In relation to the manner of preventing the consumer from using energy during the peak hours under the new "off-peak" contract, it was explained that on March 1 the customer gets a refund if he has complied with the terms of the contract. Printing attachments to the watt-hour meters will be relied upon to show that electricity is not used during the prohibited hours.

In relation to the general adoption of electric cooking, Mr Lloyd said that in his judgment what is wanted in the average American family is some one device that will permit the preparation of a meal with a maximum demand for electricity not exceeding 1 kw. The aim should be to do all the cooking with a low maximum demand. The trouble is now that in the preparation of a number of dishes several different electrical appliances have to be used, and therefore the consumption of electricity reaches a maximum which renders electric cooking on a widespread scale impracticable for people of moderate means.

The last speaker was Mr. S. Phelps, of the Electric Fireless Cook Stove Company, of Buchanan, Mich., who remarked that he had devoted a great deal of study to the subject and had produced an electric "fireless" cook stove on which a meal for from five to nine persons could be prepared with the expenditure of less than 2 kw hours.

RIGHT OF ELECTRIC POWER COMPANY TO CONDEMN RIGHT-OF-WAY.

The statutes of the State of California provide that companies operating transmission lines, "electric heat lines, and electric light, heat and power lines," for public use, may exercise the power of condemning private property for a right-of-way. The Tuolumne Water Power Company was organized to operate an electric system for the transmission of electrical energy which was for sale to the public generally. The company brought an action to condemn a right of way over certain property, and it was held that the use for which the company wished the property was a public use within the meaning of the statute authorizing it to exercise the power of eminent domain.

One contention of the defendant was that the company was not entitled to acquire a right-of-way over his property by the exercise of eminent domain because it did not appear that the company was under any contractual obligation to furnish electricity to any person for any purpose or that it had a franchise to furnish electricity to any counties, cities or villages through which the proposed line was to run. On this point the California Court of Appeals said: "It is not necessary that the plaintiff should have made a contract to furnish electric power before it had installed its plant and procured the right-of-way for its line. To prevent the plaintiff from exercising the right of eminent domain until it shall have obtained a franchise from some city or village would be to deprive it of the means by which it would be enabled to construct its works and put itself in a position to make a contract. The Legislature, representing the people, has provided that the right of eminent domain may be exercised for electric power lines for public use.

"At the present day the use of electric power, not only for lighting public streets and private houses, but also for the purpose of moving railroad cars, street cars and machinery for manufacturing purposes and for use in mines and smelters, has become so general that it is almost a necessity of our civilization. The courts would not be aiding the great enterprises of the West by adopting a narrow and restricted view of the meaning of the words 'public use,' as used by the Legislature and in our constitution."

Wiring and Illumination

EFFICIENCIES OF DISTRIBUTION.

Considering "Central-Station Economies" in a paper read at the recent Chicago convention of the Byllesby companies, Mr. Eugene Holcomb, manager of the Northern Heating & Electric Company, of St. Paul, Minn., had this to say of distribution:

"Stations located near enough to load centers to permit of generating current at distribution voltages show the least loss in the distribution system. The efficiency of such distribution should be 85 per cent to 90 per cent at maximum load. Stations not so centrally located with reference to the load and using alternating current generating at line voltage with one transformation to service lines should show a distribution efficiency of approximately 83 per cent. In stations where it is necessary to step-up from generator to line voltage, with two transformations to service line, the distribution efficiency would be approximately 68 per cent. The arrangement of the distribution system has as much to do with regulation and good service as machines and transformers themselves."

INSULATED WIRE RULES FOR NEW YORK CITY.

During last summer a conference was held in New York City on the subject of insulated wire, with respect both to the material of insulation and details of inspection tests. New York City was represented by Prof. George F. Sever, the New York Board of Fire Underwriters by Mr. J. C. Forsyth and the Wire Inspection Bureau by Mr. Hugh T. Wreaks. Messrs. W. A. Conner, W. S. Clark and Everett Morse appeared for the Rubber-Covered Wire Engineers' Association, and several of the wire-manufacturing companies had representatives present. As a result of the facts brought out at the conference the Department of Water Supply, Gas and Electricity of New York City has made a number of changes in and additions to the municipal rules and regulations relating to rubber-covered wire. The new rules will, in final form, go into effect on April 1, and in the meantime criticism is invited.

An addition to the rules requires that all tests required of rubber-covered wire shall apply to all wire at the time of manufacture as well as up to and including the time of installation. For a former requirement as to character of insulation is substituted another according to which the covering must consist of rubber or other approved compounds, homogeneous in character, adhering to the conductor and of a thickness not less than that given in an accompanying table.

Every length of completed wire or cable is required to be tested after ten hours' immersion in water at a temperature approximately 60 deg. Fahr. (15.5 deg. C.), and the results of insulation tests at different temperatures are to be reduced to a basis of 60 deg. Fahr. by using factors in the accompanying table; the tests to be made after an electrification of one minute and with a voltage of not less than 100 volts. The voltage tests and minimum insulation resistance are to be in accordance with the following table, which applies to completed lengths of rubber-covered wires and cables, 0-600-volt class:

Size.	Voltage Test for One Minute.	Megohms per Mile After 10 Hrs. Immersion and After Voltage Test.
14	1500	300
12	1500	250
10	1500	225
8	1500	200
6	2000	200
4	2000	150
2	2000	125
1	2500	150
1–0, 2–0	2500	125
3–0, 4–0	2500	100
250,000 to 500,000 cir. m.	3000	100
600,000 to 1,250,000 c. m.	3500	100
1,500,000 circ. mils	3500	75
1,750,000 circ. mils	3500	60
2,000,000 circ. mils	3500	50

Any length may be tested after thirty days' immersion in clear water and must show not less than 50 per cent of insulation resistance required after ten hours' immersion.

In testing for hardness of insulation the rubber or other approved compounds used as an insulation must, after the braid has been carefully removed, be sufficiently elastic to permit all wires smaller than No. 7 to be wrapped at least five times around a cylinder of diameter as specified and left so wrapped for twenty-four hours without injury to the insulation. The diameter of cylinder shall for No. 8-10 wire be equal to twice the diameter of wire measured over the insulation, after removing the braid, and for No. 11 and smaller wire equal to the diameter of wire measured over the insulation after removing the braid. In testing for softness of insulation the rubber or other approved compounds used as an insulation must present sufficient resistance to crushing or tension to withstand the following two tests. Samples while being prepared for these tests shall have a temperature between 50 deg. and 90 deg. Fahr. and shall be kept within these limits during the tests.

Test A.—A sample of wire of sufficient length for test, about 20 in., shall have the braid and insulation removed for about 2 in. at each end, leaving the braid and insulation otherwise on the sample. One end of the bare copper shall be fastened to a clamp on a shaft of the diameter given below, and a 10-lb. weight attached to the other bare copper end of the wire. The shaft shall then be revolved ten times in ten seconds, wrapping the sample in a close, even wind round the shaft. With the tension left on the sample, it shall then be immersed in water at a temperature of 60 deg. Fahr. for twenty-four hours, immediately after which time it shall, while still immersed, be subjected to 1500 volts alternating current for one minute and shall show an insulation resistance equal to at least half that required by the table given above. The shaft diameters are to be 170 mils, 190 mils, 275 mils and 375 mils respectively for Nos. 14, 12, 10 and 8 wire respectively.

Test B.—The sample to be tested shall have the braid carefully removed for at least 1 in. from one end. The wire itself shall be connected to one terminal of an electric circuit, of which a testing tool, described below, shall be the other terminal. This circuit shall have a potential of at least 100 volts alternating current or 140 volts direct current and a resistance of at least 1000 ohms. The portion of the wire with the braid removed shall be placed on a flat surface and subjected to a pressure vertically applied by means of an edged tool of 5 lb. for fifteen minutes. The tool edge shall be sharp and the sides of the edge shall form an angle of 90 deg. with each other. During this period the tool edge when placed transversely to the insulation shall not sink through sufficiently to touch the copper wire and complete the electric circuit.

STREET STANDARDS AT MISHAWAKA, IND.

The little city of Mishawaka, Ind., some time ago adopted incandescent lamps on standards as the proper method of lighting the downtown section. The scheme employed is well shown in the accompanying illustrations, the standards holding clusters of three or five incandescent lamps inclosed in opalescent glass globes. These standards supplement the regular arc lamps which are suspended over the center of the roadway, as shown in Fig. 2, which shows the neat appearance of the standards by day. Fig. 3 is a view of the same street by night.

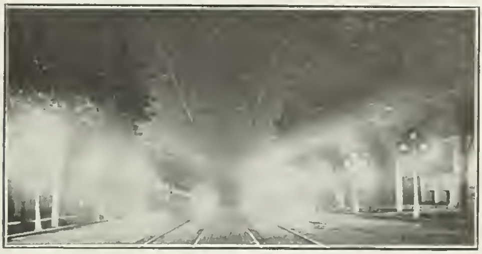


Fig. 1—Main Street, Mishawaka, by Night.

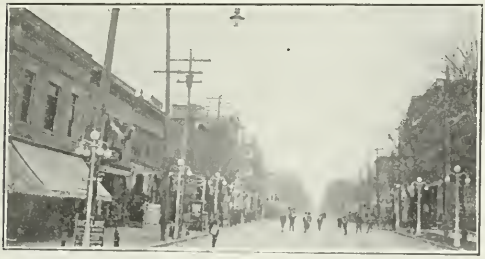


Fig. 2—Second Street, Mishawaka, by Day.

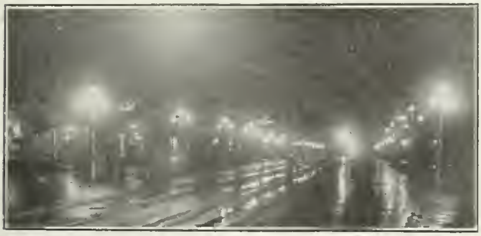


Fig. 3—Second Street, Mishawaka, by Night.

The closely spaced incandescent lamps show very plainly the value of dividing up the lighting units and also the value of placing the lamps near the ground. Compared with the once extolled tower lighting the frequent-cluster system is infinitely preferable. As will be noted from the engravings the five-lamp clusters are located at street intersections and the three-lamp clusters between. The standards are quite closely arranged, the posts being spaced in most places less than 50 ft. apart. This results in quite a high illumination for business streets, especially in a city the size of Mishawaka. The municipal light and water plant of the city purchases its energy from the Indiana & Michigan Electric Company, of South Bend, which has a hydro-electric station at Mishawaka on the St. Joseph River at Hen Island.

SPECTACULAR CENTRAL-STATION LIGHTING IN PORTLAND, MAINE.

Fig. 1 herewith shows a large electric sign used by the Portland (Maine) Electric Company in the most prominent plaza of the city, Monument Square. The sign is made up of 2-cp carbon-filament lamps and is located on the top of a mercantile building in a position which forces it upon the attention of every person passing through the square at night. The square is also the principal street-railway transfer point of the city. There are about 350 lamps in the sign. In addition the company has illuminated the front of its new office building by 284 front and cornice lamps of 4 cp. wired on a 116-volt multiple circuit. The display windows are also well lighted, the lamps in the latter case being concealed from the vision of passers-by. This installation is one of the most striking in New England and is illustrated in Fig. 2. The show-window lighting is effected by six 100-watt lamps in each case.

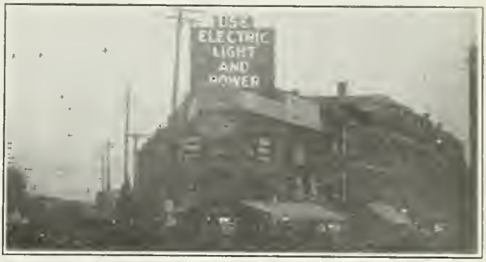


Fig. 1—Central-Station Sign in Portland, Me.

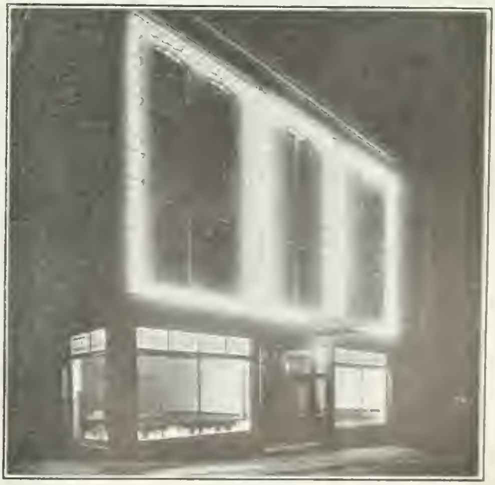


Fig. 2—Exterior Lighting of Office of Portland Electric Company.

SPECTACULAR AND SPECIAL ILLUMINATION.

"Effective Illumination" was the title of a paper read by Mr. A. Larney, manager of the new-business department of the Oklahoma Gas & Electric Company, of Oklahoma City, at the recent convention of Byllesby companies in Chicago. The writer remarked that ten years ago an investment of $3,000 or $4,000 in an electrical display would have caused comment, but at the present time spectacular electrical displays are in operation which have cost more than $50,000 to install and which contain as many as 20,000 incandescent lamps.

Mr. Larney cited the instance of the first "chariot-race" sign erected in this country, which contained 6400 lamps and cost $20,000 to install, the flasher mechanism alone costing $4,600. The local central-station company granted a rate of 3 cents a kw-hour with a minimum of $125 a month. It was thought that the amount of energy consumed would amount to $300 or $400 a month, but, as a matter of fact, after thirty days' operation the amount of electricity used at the agreed rates was less than $88; and it is a fact that on this sign with over 6000 lamps the flasher had to be speeded up in order that the minimum guarantee of the contract might be reached. This fact is a striking demonstration of the comparative inexpensiveness of this method of publicity, which is also very modern and spectacular. Moreover, there is bound to be a great increase in the matter of ornamental lighting due to the recent movement for beautifying municipalities.

Referring to special illumination designed to increase the attractiveness of business thoroughfares, the author thinks that the best method of procedure is to select the most prominent business men who are members of the local business associations and call upon them to explain the excellent results that have been achieved in other cities by brilliant illumination of business sections. The question is one which may also be discussed in the local newspapers, and in time a deep interest, followed by a real demand, may be created. The new-business department of the central-station company should not allow the matter to rest, but should assume the initiative and present the matter to merchants in such a manner that it will receive their approval.

LETTERS TO THE EDITOR.

Converter Substations.

To the Editor of Electrical World:

Sir:—The letter by Mr. S. Q. Hayes in the first issue of January on the subject of converter substations leads me to offer this statement in order to express more clearly than heretofore the situation to which the controversy on the subject relates.

Mr. Hayes, in his article on "Modern Switchboard Practice," which was published in August, describes and illustrates a cross-section of a substation and presumably assumes credit for the layout as one originating with the manufacturing company with which he is connected. Again, in his subsequent reply of October, he says, quoting his own words: "The section shown was prepared from a preliminary drawing made under the writer's direction as a suggested arrangement of the station, and this design was accepted and adopted by the engineers of the Boston Elevated Railway Company, as it embodied their ideas as well as those of the writer." From the above he undoubtedly presumed to take credit to himself for the design of the station referred to.

As was clearly stated in my letter of November, the Boston substation was laid out by the company's engineers from their own observations of the Thirty-eighth Street substation and from plans of this substation which were furnished them at their request by the Brooklyn Rapid Transit Company. The Thirty-eighth Street substation was admitted by the Boston engineers to embody features superior, in their estimation, to those found in any substation which they had visited, some of these substations being referred to by Mr. Hayes in his last article. The evidence confirming these statements we are prepared to submit, if need be, to convince Mr. Hayes of his error.

Mr. Hayes illustrates and describes a substation, referring to a specific installation, and instead of giving credit where it is due assumes the originality of the schematic arrangement, although knowing from his own personal observation that it was an exact copy instead of, as he persistently states, resembling or being similar to a station already built and in operation.

I quite agree, however, with Mr. Hayes that each feature enumerated by the writer is in no way new or novel; but in no case, to my knowledge, has it been embodied in every detail as shown in the cross-section which was illustrated and which, as already stated, is a specific case. If this layout is ancient history, it seems to me useless to describe it, as Mr. Hayes evidently considered it of interest to do.

The success of any substation from an engineering or operating standpoint does not depend entirely on any one feature, but collectively on all which go to make up the complete installation. The designing of a substation is affected in many respects by the class of service furnished, the general operating practice as well as by local conditions.

I also agree with Mr. Hayes that any engineer who fails to make use of the ideas of others or of accepted standards, and refuses to take advantage of these ideas or improve on them, will soon be relegated to the class of "has-beens," but I do not agree with him in claiming originality or credit for ideas which are not his own.

The Thirty-eighth Street substation of the Brooklyn Rapid Transit Company was laid out entirely, even to the design and general arrangement of the apparatus on the switchboard, without any assistance from outside or from any manufacturing company.

Brooklyn, N. Y. A. K. Miller.

Sir Charles Bright and the Atlantic Cable.

To the Editor of Electrical World:

Sir:—I regret that pressure of more immediate and important work has prevented my writing sooner in regard to certain remarks in the review which appeared in your issue of Oct. 20, 1910, on the abridged biography of my father, "The Life Story of Sir Charles Bright."

Let me first remark that those portions of the review to which I take exception are not at all in keeping with the review of the original two-volume edition, of which the present book is only an abridgement. Let me further state at the outset that I do not in the least mind an unfavorable review *per se* (and that in your columns is about the only one that has appeared regarding this book) except that class which suggests that I have been unfair to others, the fact being that I make a special study to be fair to everyone alike—even though I may be writing a biography of a particular man rather than a biography of several men. With these preliminary remarks I will now pass on to the unfavorable criticisms in more or less detail.

(1) The reviewer appeared anxious to lay it down that "throughout the enterprise (the Atlantic cable) Mr. Field was the guiding spirit of the company," and a resolution is quoted in proof.

I reply that the term "guiding spirit" is too general. Mr. Field was manager, and afterward managing director, but he failed to raise much capital in America, and my father and uncle secured most of it in this country, where the scheme had been under consideration some time previously, with Mr. Brett as the initiator. (I have the official list of shareholders.) Were I writing a full biography of Mr. Cyrus Field I might have quoted the resolution your reviewer does, but not if I were only writing one of the dimensions of this regarding my father, for I would point out that I omitted to quote precisely similar board of directors' resolutions acknowledging the services of my father both as one of the projectors and as engineer-in-chief. These two resolutions are, however, hanging in my hall and (as purely personal matters) are prized very highly.

(2) Your reviewer considers that I have done Mr. Mullaly an injustice, and he is called "the Hon. John Mullaly, historian of the enterprise." In reply I would say that I was not aware that he was "the Honorable" (he does not style himself so in his book) and I challenge the suggestion that he was "the official historian of the enterprise." The latter would certainly be inferred from the titlepage of his book ("The Atlantic Telegraph," not "The Ocean Telegraph" as the reviewer has it), but I am not prepared to admit the fact, *nor much that the book contains.* The few small quotations that were made by me from Mr. Mullaly were not, as a matter of fact, from his book at all, but from reports by him in the *New York Herald,* where much that was in his book originated. To make footnote reference to the *New York Herald* has little purpose in a book that is published in London, where the same does not apply to the *Times,* back volumes of which are kept in numerous places; but this would have been done had the quotations been on a larger scale. The fact that Mr. Mullaly was on board the *Niagara* on behalf of the *New York Herald* was cut out in the abridged edition along with similar particulars regarding various other press representatives, all duly recorded in the original edition.

Reference is certainly made to Mr. Nicholas Woods as representing the *Times,* for the reason that his realistic account (in that paper) of the *Agamemnon* storm is largely drawn from. The scope of the book did not lend itself to naming the various private secretaries on board, or perhaps I might have been equally permitted to mention my father's private secretary, seeing that this was a biography of my father and not of Mr. Mullaly.

I think everyone knows pretty well that Mr. Cyrus Field introduced people on these early Atlantic cable expeditions—one was Mr. Mullaly and the other Mr. Everett. I have no doubt the former did what he was directed to do uncommonly well both in the *New York Herald* and in his subsequent book, but, having official documents at hand, I do not happen to be able to indorse much that Mr. Mullaly has written.

(3) The other grievance is that I have belittled Mr. Everett's share in the enterprise. Certainly anyone putting faith in Mr. Mullaly's book would be likely to arrive at that conclusion —at first sight, at any rate—but he might also arrive at the conclusion that perhaps the book in question was not very carefully prepared and was lacking in suitable perspective.

Thus, whereas the chapter consisting of biographical sketches —pages 26 to 50— leads off with eight *pages* about Mr. Cyrus Field, followed by five and one-half *pages* regarding Professor Morse (who had comparatively little to do with the actual enterprise), followed by three and one-half *pages* about Mr Everett, only six *lines* are given to my father, and those six lines toward the end of the chapter, subsequent to similar "sketches" regarding his assistant engineers. It may be added that the only portraits given are very large ones of Mr. Field and Mr. Everett, the latter being practically a full-page portrait.

The fact remains, however, that my father was engineer-in-chief of the entire enterprise and was the only person officially recognized in that capacity. He had accordingly full control of all preliminary arrangements regarding the laying of the cable on both ships. (It was as engineer-in-chief of the undertaking that my father alone received the honor of knighthood, not as joint engineer of half the cable with someone else.)

The fact also remains that he was represented jointly on the *Niagara* by Messrs. Everett and Woodhouse, as stated on page 89 of this "Life" of my father. Mr. Everett (formerly of the United States Navy) was, in the first place, the ship's engineer—as stated by me—but owing to his intimate acquaintance with machinery took a leading part in that department as well as in the trials and the general arrangement of the paying-out apparatus for both ships. He had, however, never seen a cable laid before in his life, whereas Mr. Woodhouse had himself laid several cables in the Mediterranean Sea and elsewhere. For this reason he was in full charge of all that concerned the cable, while Mr. Everett was supreme in the matter of machinery, both carrying out the several instructions of the engineer-in-chief in much the same way as is necessarily done on a cable expedition of to-day where operations are conducted from more than one ship. Shared responsibility for the work as a whole would be impracticable.

I have much more I could say in regard to some of the details referred to, but I do not wish to do so unless necessary if only for the sake of international amenities.

I will here only repeat that Mr. Field was managing director of the Atlantic Telegraph Company, and the biography says so Further, Mr. George Saward was secretary immediately under him rather than anybody else. Mr. Everett was one of the chief assistant engineers, and the biography says so, but let me again remark that in the first instance the book was a biography of my father, the only official engineer-in-chief to the enterprise—not of the distinguished Americans named. On the other hand, Mr. Mullaly's book was entitled "The Atlantic Telegraph" and professed to be a general history of the enterprise as a whole and not in relation to any one man, or certain two or three men, in particular.

If it pleases those in America to claim everything for their countrymen, they are, of course, at liberty to do so, though not borne out by official records.

Caxton House, Charles Bright.
Westminster, London, England.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Braking of Single-Phase Commutator Motors.—F. Rusch.—The first part of a paper in which the author discusses whether the different types of single-phase commutator motors can be braked by driving them from the outside in such a way that they work as generators and return energy to the network. He first discusses the series motor and gives a mathematical theory showing that the current in the motor is the sum of a forced current of the same frequency as the e.m.f. and of a free oscillation which becomes practically zero after a very short time. The latter oscillation need not be taken into consideration as long as the machine operates as motor, but it is different when it operates as generator, since the free oscillation then tends to become infinitely large in time. This yields a braking torque which tends to become infinitely large and cannot be regulated. Formulas are given for the induction coefficients for sinusoidal fluxes and fluxes of other shapes. The paper is to be concluded, when the repulsion motor and the Winter-Eichberg motor are to be taken up.—*Elek. u. Masch.* (Vienna), Jan. 1.

Static Balancer.—C. C. Hawkins.—A theoretical paper presented to the (British) Institution of Electrical Engineers on the theory of the static balancer used in connection with a single generator feeding energy to a three-wire network. The author first considers the simple two-phase case, and calculates the divergence of the potential of the third wire when the latter is disconnected from the balancer. He then determines the distribution of the current and the amount of divergence of the potential of the third wire when the latter is connected to the balancer.—Lond. *Electrician,* Jan. 13.

Voltage Between Segments.—F. Punga.—In the design of high-speed direct-current generators and motors and synchronous converters the designer must be careful to maintain the voltage between adjoining segments below a permissible limit. E. Thomson, Pohl and M. Walker have devised windings by which the voltage between segments is reduced. Another winding devised by the present author is a double-parallel winding, the normal equipotential connections of which are arranged one-half on one side (*m*) and the other half on the other side (*n*) of the armature. (Fig. 1.) Some or all of the different equipotential rings of one side are connected (by *O*) with the corresponding equipotential rings on the other side, so that in this way the maximum voltage between segments is reduced to one-half. A special arrangement is devised by which the no-load losses which otherwise become unduly large can be reduced.—*Elek. u. Masch.* (Vienna), Jan. 1.

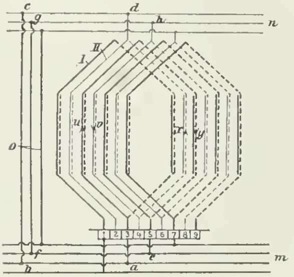


Fig. 1—Winding Diagram.

Lamps and Lighting.

Photometric Units.—E. B. Rosa.—A long paper giving a systematic discussion of the mathematical and physical relationships of the various photometric quantities. The author gives a general discussion and a derivation of formulas for a point source, distinction between luminous flux and energy, definition of intensity for unsymmetrical sources, unit disk, extended source (circular disk), infinite plane, infinite cylinder, unit length of cylinder, case of large sphere, reciprocal relations, hollow sphere, luminous flux within an inclosure. He then gives a summary of the photometric relations discussed before in detail, a few problems for illustrations and a collection of the different fundamental formulas.—*Bull. Bur. of Standards*, Vol. 6, No. 4 (November, 1910).

Storage Batteries for Portable Photometers.—A. P. Trotter.—The criticism has recently been made that in connection with photometer tests a storage cell cannot be relied upon to within 1 per cent for more than a few minutes at a time. The author has tested a storage battery of British make by an arrangement which provided for making contact for ten seconds once a minute. This is about the time occupied in making one photometric measurement. The battery which was tested had been idle for some weeks, probably partially discharged, was connected through 8 ohms and a potentiometer to the mercury troughs and discharged with the above arrangement for about 45 hours. Ordinary terminals and connectors were used without soldering or special cleaning. The volts during discharge were measured ten times during this period and were found to fall regularly from 3.945 to 3.924, or one part in 1000 per hour. The battery was charged and discharged five times, and after having been charged again it was in good condition and the former test was repeated, when the average fall was 0.05 per cent per hour.—Lond. *Electrician*, Jan. 13.

Manufacture of Metallic Filaments.—A note on a recent British patent (7331, Jan. 5, 1911) of H. Madden and W. G. Houskeeper. A heating process specially adapted to filaments prepared by squirting of tungsten paste through a die consists in subjecting every portion of the continuous filament to different degrees of heat successively by passing it through a series of contacts which cause currents of different values to flow through the portions between different contacts.—Lond. *Elec. Eng'ing*, Jan. 5.

Moore Tube Lamp.—M. Leblanc, Jr.—An illustrated summary of the properties and the present status of the Moore tube lamp.—*La Lumière Elec.*, Jan. 7.

Generation, Transmission and Distribution.

British Power-Plant Statistics.—The annual statistical table of the different electric generating companies in existence and in the course of construction in Great Britain, with data on their equipment and maps of their areas. The total connections recorded in the table are now approximately 225,200 kw, compared with 196,960 kw a year ago, an increase of nearly 15 per cent.—Lond. *Electrician*, Jan. 13.

British Energy Supply.—A long and profusely illustrated article on the electric energy transmission and distribution systems to collieries on the northeast coast of England. The largest station is at Carville, which has a total maximum equipment of 52,000 hp, divided up into eight turbo-generating units. These deliver three-phase currents at 5750 volts, 40 cycles, to the station busbars, and for purposes of transmission step-up transformers raise this pressure to 22,000 volts. There are quite a number of other plants in this district and the total rating of the plants now in service exceeds 100,000 hp, this total including the new Dunston station, which has a rating of 32,000 hp in three turbo units. The transmission system includes long stretches of underground cables and overhead bare wires. The employment of the Merz-Price system of relays has made possible the interconnection of a number of generating stations situated at varying distances from each other and the interlinking of underground cable and overhead transmission lines operating at extra-high voltage. The feature of the Merz-Price protective gear is the certainty with which it will isolate a faulty section of line from both ends, leaving the other portions of the system entirely free from fault. A table gives details of the different overhead lines, of which five lines are operated at 20,000 volts, four lines at 11,000 volts and five lines at 6000 volts. Full descriptions are also given of substations and colliery installations. A reliable supply of energy is now guaranteed to the industrial plants in this district, and as a consequence not only have old private plants been "scrapped" in large numbers, but a number of quite modern plants have already been removed in spite of the loss of capital thereby involved.—Lond. *Electrician*, Jan. 13.

Ward Leonard Control for Rolling Mills.—A note on a recent British patent (22,110, Jan. 5, 1911) of Siemens Brothers Dynamo Works, Ltd. (Siemens-Schuckert Werke). In a rolling mill or other plant controlled on the Ward Leonard system the main motor is given a series characteristic (that is, large turning moment with moderate armature current), and yet can be reversed without reversing heavy currents. This is effected by connecting the motor-field coils in series with the generator-field coils to a direct-current supply at constant voltage. The field strengths of both are also influenced by an auxiliary generator, the voltage of which depends upon the armature current of the main motor and can also be regulated by hand. When the load increases the main motor field is strengthened automatically and the generator field weakened by the influence of the auxiliary machine.—Lond. *Elec Eng'ing*, Jan. 12.

Traction.

Electromagnetic Rail Brakes.—R. Naumann.—The first part of an article in which the author describes experiments made with electromagnetic rail brakes under different conditions of the rails. The paper is to be concluded.—*Elek. Zeit.*, Jan. 12.

Corrugation of Rails.—J. H. Briggs.—The author lays stress upon the fact that any theory of corrugation must admit of the cars taking up the vibration synchronously for the corrugations to persist, and he describes experiments showing that the climbing action of the wheel on the rail permits such periodic movement.—Lond. *Electrician*, Jan. 13.

Installations, Systems and Appliances.

Automatic Battery-Charging Switch.—An illustrated description of a new automatic switch of English make for battery circuits. The connections and details of arrangement are shown in Figs. 2 and 3. Use is made of two coils, one wound with fine wire on an iron core and the other consisting of a large-section copper rod arranged as a solenoid. The former of these is carried on an arm inside the solenoid. This arm is pivoted and at the other end from the coil carries a forked switch dipping into two mercury cups. The horseshoe permanent magnet surrounds both coils. From Fig. 2 it will be noticed that the solenoid is cut into or out of circuit by the mercury switch, while the fine-wire coil is permanently connected across the mercury cups, being short-circuited when the fork switch is down. The switch, as a whole, is connected in series with the generator and battery, and if the number of cells exceeds sixty-four an adjustable resistance is placed in the fine-wire circuit. With the switch in the normal "off" position the fine-wire coil rests in close proximity to the lower pole of the permanent magnet, the south in this case. When the battery and generator are switched on to the cut-out, if the e.m.f. of the battery exceeds that of the generator, a current flows through the fine-wire winding in such a direction as to produce a north pole at the outer end of the core, which is, therefore, attracted downward and the bridge piece is held clear of the cups. When the e.m.f. of the generator rises above that of the battery this polarity changes and when the excess voltage is about 10 per cent the repulsion of the south pole and attraction of the north pole are sufficient to cause the lever to swing up and the switch then enters the mercury cups. As the attraction of the upper pole increases as the movement proceeds, the action is quite decided. The fine-wire coil is now short-circuited, but the main current flows through the solenoid in such a direction that the resulting flux maintains the polarity of the iron core in the potential coil. If for any reason the generator voltage drops below that of the battery the cut-out at first operates by gravity and breaks circuit with the current at zero. At the same time the fine-wire coil is cut in again and by its attractive action prevents any tendency to hunt or for the arm to float either in making or in breaking the circuit. Should the current reverse, the same operation occurs, the circuit being broken when the current is zero, so that there is no harmful sparking.—Lond. *Electrician*, Jan. 13.

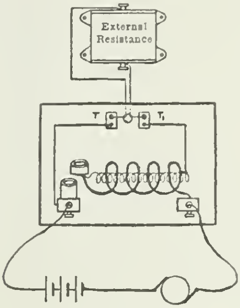


Fig. 2—Diagram of Connections of Automatic Battery-Charging Switch.

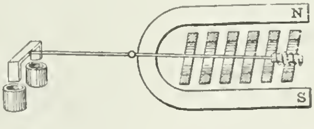


Fig. 3—Arrangement of Coils and Mercury Cups in Automatic Battery-Charging Switch.

Limit Meter.—A note on a recent British patent (28,947, Jan. 5, 1911) of E. T. Ruthven Murray for various forms of an instrument termed an "assessmeter." The object of the device is to indicate the maximum demand which a consumer may make. Should the demand exceed the limit indicated, a dimming switch comes into operation, and the consumer may either decrease his demand or increase his limit by moving the indicator on the assessmeter. He cannot, however, decrease the limit indicated. A scale of fixed charges per quarter is fixed on the meter, and on increasing the limit of current the indicator points to a higher charge or assessment. The instruments described work on the hot-wire or other principles in which the heating effect of the current is employed.—Lond. *Elec. Eng'ing*, Jan. 12.

Double Tariff.—A. Mohl.—An article in which the author describes a new double tariff in which the change from one tariff to another tariff is not made by a clock at a certain time, but by a relay whenever the current rises above a certain predetermined limit. The object is to make the double tariff available for small consumers, since a current relay is cheaper than a clock and does not need regular attendance.—*Elek. Zeit.*, Jan 12

Electricity in Agriculture.—H. Osten.—The first part of an article in which the author gives statistical data on agriculture in Germany, including the suitability of ground for different agricultural purposes in different provinces, questions of ownership, etc. He emphasizes that such commercial questions are of fundamental importance to decide what the future of electricity in agriculture will be.—*Elek. Zeit.*, Jan. 12

Wires, Wiring and Conduits.

Graphical Determination of Overhead Wires.—A. Blondel.—Without changing the principle of his old diagram for the direct calculation of overhead wires, the author presents it now in a somewhat different form. For the sake of convenience it is given in three different diagrams.—*La Lumière Elec.*, Jan. 7

Network Plans.—C. W. Rycroft.—The author points out that it is essential for the efficient working of a distribution department that it should possess a set of network plans of cables laid and contingent records on which absolute reliance can be placed, and which should combine neatness and legibility with correct and full information. This is often neglected in the first year or two of a new central station, and such neglect causes great trouble later on. The author shows how such plans and diagrams can best be arranged. The article is fully illustrated.—Lond. *Elec. Review*, Jan. 13.

High-Tension Cables.—L. Lichtenstein.—A translation of his German paper, recently abstracted in the Digest, on the latest developments in the manufacture of high-tension cables.—Lond. *Electrician*, Jan. 13.

Electrophysics and Magnetism.

Power Fluctuations in Alternating-Current Circuits.—B. Glatzel.—An illustrated description of an arrangement for demonstrating experimentally the energy fluctuations during one period in an alternating-current circuit. For demonstration purposes use is made of a wattmeter giving deflections of the needle to both sides. While its current coil is permanently inserted in the alternating-current circuit the voltage coil is connected to it momentarily only at certain instants by means of a Joubert disk, so that the reading of the wattmeter gives the instantaneous power for the conditions existing at any instant.—*Phys. Zeit.*, Jan. 1.

Volume Ionization Produced by Light—F. Palmer Jr.—Lenard has formerly shown that in addition to the well-known Hallwachs effect, or ionization produced at a charged metallic surface when struck by ultra-violet light, there exists also a volume effect which takes place in the gas itself. The present author has studied this volume ionization produced in different gases by light of extremely short wave-lengths. It is shown that comparatively large currents may be obtained in air at atmospheric pressure when extremely short wave-lengths are used as a source of illumination. Using a discharge tube filled with hydrogen as a source of light and a screen cell filled with oxygen, at various pressures ionization curves have been obtained in air, oxygen, hydrogen and nitrogen. The ionization in air, oxygen and nitrogen is considerable. That in hydrogen is exceedingly small. The currents obtained for all gases are large compared with the values of most other observers. The power of ionization increases greatly with decrease in wavelength of light, at all events in the region below λ = 1850.—*Phys. Review,* January.

Magnetic Alloys from Non-Magnetic Elements.—A. A. Knowlton.—An illustrated paper on the preparation and properties of Heusler alloys. The precautions to be observed in the preparation of the alloys are long heating, the use of silica-free crucibles and molds, casting in hot molds, annealing to the upper limit of transformation with subsequent quenching. The magnetic examination shows the favorable effect of annealing at the upper limit of transformation and the unfavorable effect of annealing at the lower limit. The transformation temperature depends upon the composition. Photographic examination shows the close dependence of the magnetic properties upon the crystalline structure.—*Phys. Review,* January.

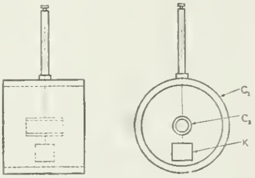


Fig. 4—Electrodynamometer.

Units, Measurements and Instruments.

Absolute Measurement of Electric Quantity.—B. McCollum.—An illustrated description of a new method for the absolute measurement of electric quantity. The author uses a type of electrodynamometer which, when used to measure the electrochemical equivalent of silver, appears to be free from the objections to the ordinary types of electrodynamometers. The instrument consists essentially of a relatively large fixed coil C_1, Fig. 4, with its axis in a horizontal position, at the center of which is suspended the movable coil C_2 with its axis parallel to the fixed coil when at rest. Attached to the movable coil is a cylinder K, of some homogeneous material, placed with its axis vertical and coincident with the axis of suspension. This cylinder is of very regular dimensions and has a moment of inertia as large as, or larger than, that of the movable coil. If these two coils be connected in series in proper relation and a current sent through them there will exist a couple tending to hold the movable coil with its axis parallel to that of the fixed coil, and if the movable coil receive an angular displacement and be released it will oscillate as a torsion pendulum. If now the form of the field due to the fixed coils be such that the restoring couple is directly proportional to the angular displacement the period of the oscillation will be independent of the amplitude and there will be obtained in effect a torsion pendulum subject to the laws of a damped oscillation. The current can be measured easily and exactly, but the quantity of electricity may be obtained directly without any knowledge of the value of the current. This fact may often be of advantage where the electrochemical equivalent of silver or other metals is being determined or, in other cases, where the time integral of current is required. A typical arrangement of the apparatus is shown in Fig. 5. B is a battery supplying current through the regulating resistance r_1 to the coils C_1 and C_2 of the electrodynamometer connected in series. S_1 is a single-pole, double-throw switch which at starting is thrown over to the terminal d so that the current is made to flow through the control C_2, which holds the movable coil C_2 at any suitable initial deflection (which need not be measured). The resistance of the circuit df should be previously adjusted nearly equal to that of the circuit ef, which contains the voltammeter VA, and the terminals d and e should be so adjusted that the switch S_1, when thrown over, makes contact with e an instant before breaking the current at d. When ready to start the experiment the switch S_1 is quickly thrown from d to c, which starts the current in the voltammeter circuit ef and at the same time breaks the circuit of the control coil C_3, thus releasing the movable coil C_2, and the vibration begins. The instrument should then be permitted to swing freely for a sufficient length of time to permit the deposition of enough silver for accurate weighing, during which time the number of complete vibrations of the movable coil is counted. When it is desired to stop the experiment a reading is taken of the last maximum deflection at the end of n_0 complete vibrations, and about a quarter period later the current is switched off and at the same instant the position of the movable coil in its cycle and also its direction of motion are noted.—*Bull. Bur. of Standards,* Vol. 6, No. 4 (November, 1910).

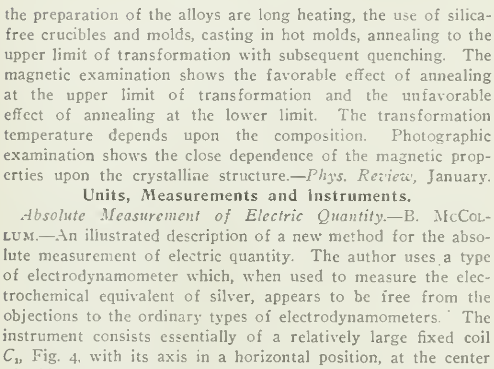


Fig. 5—Arrangement of Apparatus for Measurement of Electrical Quantity.

Mica Condensers as Standards of Capacity.—H. L. Curtis—A long paper in which the author discusses the methods of measuring capacity, the external conditions which affect the capacity, the stability of mica condensers and the relationship between the different apparent capacities. The various methods for measuring capacity with alternating current and direct current are discussed and the best methods to use when mica condensers are to be measured are indicated. A method is given by which the temperature coefficient of a mica condenser may be made very small, at most a few parts in 100,000 per degree. The effect of changes of the atmospheric pressure upon the capacity is shown to be small, though in some cases it is not negligible. An explanation of the change of capacity with voltage which is observed in the case of silvered-mica condensers is offered. Condensers which are kept in a vacuum and maintained at constant temperature can be relied upon to a few parts in 100,000. Such condensers are somewhat more stable than condensers which are maintained at constant temperature but subjected to ordinary fluctuations of atmospheric pressure. Condensers exposed to the ordinary changes of room temperature show unaccountable variations of the capacity of two or three parts in 10,000. It is shown that, taking the measured values of the specific resistance of mica and paraffin, Maxwell's theory of a stratified dielectric does not account for the absorption actually observed in the case of a mica condenser. This theory is then applied to alternating-current measurements and it is shown that, according to this theory, the loss of energy per second in the dielectric is nearly independent of the frequency, whereas measurements show that the loss of energy per cycle is almost independent of the frequency. The conclusion is drawn that this theory alone will not explain the phenomena of absorption. The capacity of a condenser with alternating current of infinite frequency is shown to be the same as the capacity with direct current when the time of discharge is infinitely short. This capacity is called the geometric capacity, since it is a function of the dimensions and dielectric constants of the dielectrics.—*Bull. Bureau of Standards,* Vol. 6, No. 4 (November, 1910).

Mutual Inductance.—F. W. Grover.—A mathematical paper in which the author gives a formula for the mutual inductance of the two parallel coaxial circles in terms of hypergeometrical series. The author's formula is a modification of that of Mathy and gives results agreeing closely with the formulas of Maxwell and Nagaoka.—*Bull. Bur. of Standards,* Vol. 6, No. 4 (November, 1910).

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—H. Poincaré.—The first part of a highly theoretical paper on various questions relating to wireless telegraphy. In the present instalment the author deals with the predeterminations of the wave-length and the damping coefficient on an exciter of given form by Fredholm's method and indicates several generalizations of this method. An application is made to the determination of the distribution of electricity in a conductor placed in a given field.—*La Lumière Elec.,* Jan. 7.

Impact Excitation Patent.—A note stating that after litigation extending over a period of nearly three years a patent has been granted in Germany to Baron E. von Lepel for his wireless-telegraph oscillation generator comprising a series of metallic disks separated by rings of paper. The grant was opposed by the Gesellschaft für Drahtlose Telegraphie (the owner of the Telefunken system), but the final result after appeal is that the Lepel patent has been granted, while a subsequent application by the Gesellschaft für Drahtlose Telegraphie describing a similar device has been refused. This is said to be the fundamental patent of the Telefunken system, which is almost universally employed in Germany.—Lond *Elec. Eng'ing,* Jan. 12.

Impact Excitation.—G. W. Nasmyth.—A first paper on experiments in impact excitation (Strosserregung) for producing high-frequency oscillations for wireless telegraphy. In the present paper the author discusses the characteristics of short arcs between metallic electrodes. For electrodes of the short arc oscillation generator copper is found to be the most satisfactory material, and with plates not more than 0.25 in. thick water cooling is unnecessary. The kind of paper used for separating the plates is immaterial, but much difficulty attends the use of mica. Charring the paper and breaking a short-circuit across the arc in oil is the most effective method of starting the arc when only a low voltage is available. Connecting arcs in parallel, each with its own choke coil and inductance, gives double power for the same applied voltage and has other advantages over series connection. The Lepel arc has a falling characteristic much steeper than those of the Duddell or Poulsen arcs and operates on smaller currents. The separation of the two characteristics obtained with and without oscillations is much greater for the Lepel arc than for the others. The characteristics for increasing arc-lengths lie one above the other at large currents, but at small currents the order is reversed. This is found to be due to marked maxima in the voltage across the arc which occur at smaller arc-lengths as the current is increased. The maxima in the voltage are due indirectly to the variation in the arc capacity, which is quite large on account of the small distance between the plates which form the electrodes. The maxima in the voltage are caused by corresponding minima in the oscillations produced by the arc. The capacity of the arc and that of the condensers are in parallel, but the inductance in series with the condensers partly neutralizes the effect of their capacity and makes the capacity of the arc more important. Decreasing the inductance of the main circuit has the same effect on the voltage as increasing the capacity of the arc. The minima in the oscillations and corresponding maxima in the voltage across the arc occur because for certain values of sparking, potential, arc current, capacity and inductance the time of discharge is a minimum compared with the time of charge. The minima in the oscillations furnish conditions especially favorable for strong quenching of the oscillation and for impact-excitation effects. Experiments with a Braun cathode-ray tube show that the maximum instantaneous or sparking potential for the arc increases as the arc current is decreased. The sparking potential is especially high in the region of the minimum. This is chiefly a capacity effect also, but is similar to certain phenomena in spark-gap excitation in which the variation in the resistance of the arc plays a more important part.—*Phys. Review,* January.

Impact Excitation.—G. W. Nasmyth.—A second paper on experiments in impact excitation. The author discusses the intensity of the Lepel arc oscillations as a function of the arc current, capacity and inductance. The intensity of the oscillations in the condenser circuit of the Lepel arc is in general two or three times as great as the direct current supplied to the arc by the generator. The intensity of the oscillations increases with the capacity very rapidly at small arc currents and more slowly at larger currents. Inductance and resistance decrease the intensity of the oscillations. As the arc current is increased at constant capacity the oscillations fall rapidly to a minimum and then increase slowly, passing through a maximum to a secondary minimum. As the capacity is increased or the inductance decreased the minima and maxima in the oscillations shift into the region of larger arc currents. A linear relation exists between the arc current for minimum oscillations and the capacity. The range through which oscillations can be obtained shifts with the minima. The explanation for the minima in the oscillations is found in the effects of the energy stored at the instant the gap breaks down. The energy stored in the inductance is large for large arc currents, while the energy stored in the capacity is large on account of the increased sparking potential at small arc currents, giving a minimum at intermediate arc currents. The condition of minimum oscillations is most favorable for strong quenching and impact excitation. The direct-current voltage across the arc increases with the capacity of the condenser circuit. The increase is most rapid at small arc currents, so that the form of the voltage-current characteristics is changed by the capacity in parallel. The capacity of the arc is added as if it formed a parallel circuit to the capacity of the condenser circuit for the intensity of the oscillations, but not for the frequency.—*Phys Review,* January.

Impact Excitation.—Mosler.—An English translation of his recent German paper on the discharge frequency of the Wien short-spark generator and its dependency upon current, capacity and inductance.—Lond. *Electrician,* Jan. 13.

Wireless Detectors.—S. M. Powell.—The conclusion of his illustrated article on the theory and practice of wireless detectors as at present used. The author concludes that the order of sensibility of detectors recently quoted by Fleming, namely, oscillation valve, magnetic detector, electrolytic and carborundum, is by no means exhaustive or even universally true, so far as it goes. The writer's experience agrees rather with the order, thermal, electrolytic, magnetic and rectifying types, the "audion" sensibility being variable, but probably between that of the electrolytic and magnetic types under the most favorable conditions. It is thought impracticable to enunciate dogmatically an order of merit for the many forms of detectors now available. The following points should rather be taken into consideration: automatic decoherence, adjustability, tuning, quick acting, sensitivity to weak signals and to strong signals, resistance, external effects (vibration and field), ease of construction and erection and ease of procuring material. The different detectors have their own special fields for special purposes.—Lond *Elec. Review,* Jan 13

Detectors of Electrical Oscillations.—L. W. Austin.—An article giving the results of measurement of the comparative sensitiveness of some common detectors of electrical oscillations. The electrolytic detector, the Perikon detector, the magnetic detector, the Fleming vacuum-valve detector and the audion of De Forest were tested.—*Bull Bureau of Standards,* Vol. 6, No. 4 (November, 1910).

Wireless Telegraphy.—O. Jentsch.—The author discusses the part Germany has taken in the development of wireless telegraphy and emphasizes especially the present general use of Braun's oscillation circuit.—*Elek Zeit.,* Jan. 12

Miscellaneous.

Magnetic Properties of Iron-Silicon Alloys.—S. GUGGENHEIM.—A translation of his German lecture giving the results of tests of iron-silicon alloys with varying percentages of silicon. The initial values of the permeability decrease at first with an increase of silicon, but they afterward increase together. The maximum values of the permeability behave similarly. For high inductions, say, from 14,000 upward, for a given strength of field the permeability decreases more quickly with an increase in the percentage of silicon. In general terms it may be said that up to about 1.8 per cent of silicon the *B-H* curves rise more slowly with an increase in the amount of silicon, but they rise quite steadily till the highest inductions are reached. From 1.8 per cent to 5 per cent of silicon the *B-H* curves rise more steeply with an increase in the amount of silicon, but the bend in the curve is much more pronounced, so that at the higher inductions a decrease in the permeability accompanies an increase in the percentage of silicon.

The accompanying table gives an outline of the figures relating to samples containing 0.194 per cent and 4.789 per cent of silicon, the last column showing the increase in the latter as compared with the former case, expressed as a percentage of the former. This table shows clearly that for the sample with the larger percentage of silicon the increase in the values of the permeability for the lower values of *B* (that is, over the range employed for the greater proportion of every-day work) is very great, whereas for higher values of the induction the permeability is slightly reduced by the presence of a greater proportion of silicon. The point where the permeability of the iron with a high silicon content begins to be less than that of one with little silicon may be taken as being in the neighborhood of $B = 13{,}000$ to 14,000. Similar results are obtained from an examination of the hysteresis losses. The results are shown in Fig. 6, where the hysteresis losses are seen to be a maximum with Si = 1.8 per cent and finally fall to very low values at Si = 5 per cent. For well-known reasons a satisfactory alloy containing more than 5 per cent of silicon cannot be obtained. But with 4.8 per cent of silicon the hysteresis and eddy-current losses amount to 1.23 watts per kilogram (at 60 cycles), which is much less than for the best sheet iron. Iron-silicon alloys containing 4.8 per cent silicon are of extraordinary hardness, but if they can be rolled (which is considered possible by special heat treatment) they will be very valuable for electrical purposes.—Lond. *Electrician*, Jan. 13.

EFFECT OF SILICON ON PERMEABILITY.

H	B Si = 0.194%	B Si = 4 789%	Percentage Increase or Decrease.
2	2,850	7,620	+168
5	8,350	11,660	+ 40
10	11,490	13,060	+ 14
20	13,670	13,860	+ 1.4
50	15,580	15 040	− 3.5
100	16,950	16,140	− 4.8

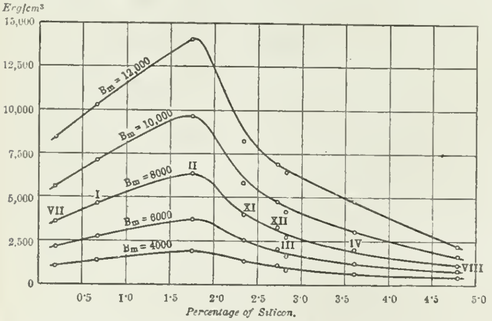


Fig. 6—Curves Showing the Relation Between the Hysteresis Losses per Cycle and per Cubic Centimeter in Ergs, and the Percentage of Silicon in the Alloy.

BOOK REVIEWS.

ELECTRIC RAILWAY TRANSPORTATION. Philadelphia: American Academy of Political Science. 4to, 202 pages, illus. Price, paper covers, $1; cloth, $1.50.

The present volume, which is the first issue for 1911 of the bi-monthly *Annals* of the American Academy of Political and Social Science, forms an important contribution to electric traction with respect to traffic and financial problems now of live interest and to the subject of the public regulation of electric railways. The Academy has in the past considered similarly great questions of the day relating to political economy and sociology, and the standing of the body gives to its publications great weight, abroad as well as at home. For the present work the collaboration has been secured of the leading authorities in this country on the various subjects treated, as will be seen in the following list of contents:

"The Urban Transportation Problem," by Mr. Bion J. Arnold; "The Decreasing Financial Returns Upon Urban Street-Railway Properties," by Dr. Thomas Conway, Jr., University of Pennsylvania; "The Depreciation Problem," by Mr. William B. Jackson, Chicago; "Methods of Increasing the Efficiency of Surface Lines in Large Cities," by Williston Fish, Chicago; "The Investigation of Traffic Possibilities of Proposed Subway Lines," by Mr. William S. Twining, New York; "Possibilities of Freight Traffic on Interurban Lines," by Mr. Frank S. Cummins, Des Moines, Ia.; "Express Business on Interurban Lines," by Mr. A. Eastman, Kingsville, Ontario; "Economic Factors in the Selection of Cars for Urban Service," by Mr. Samuel M. Curwen, Philadelphia; "Relation of the Electric Railway Company with Its Employees," by Mr. C. D. Emmons, Fort Wayne, Ind.; "The Strike Problem Upon Electric Railways," by Mr. Daniel T. Pierce, New York; "Educating the Public to a Proper Appreciation of Urban Street-Railway Problems," by Mr. A. W. Warnock, Minneapolis, Minn.; "The Presentation of Interurban Problems to the Public," by Mr. A. D. B. Van Zandt, Detroit, Mich.; "Valuation of Intangible Street-Railway Property," by Mr. Frank R. Ford, New York; "The Indeterminate Permit as a Satisfactory Franchise," by Mr. William Osgood Morgan, New York; "State Supervision of Electric Railways in Wisconsin," by the Hon. B. H. Meyer, chairman Interstate Commerce Commission; "The Fruits of Public Regulation in New York," by the Hon. Milo R. Maltbie, Public Service Commission of New York; "Supervising Engineers and Street-Railway Service," by Mr. George Weston, Chicago.

THE HISTORY OF THE TELEPHONE. By Herbert N. Casson. Chicago: A. C. McClurg. 315 pages, illus. Price, $1.50.

Written in a journalistic style, this book will be found interesting reading. It is largely biographical in character and, apparently following Carlyle, gives a dramatic setting to striking episodes in the history of the development of the telephone. The style of the author may be illustrated by the following quotation: "The peculiar electric current that these young pathfinders had to deal with is perhaps the quickest, feeblest and most elusive force in the world. It is as gentle as a touch of a baby sunbeam, and as swift as the lightning flash. Catch the falling tear-drop of a child and there will be sufficient water-power to carry a spoken message from one city to another." The book is frankly written from the standpoint of the Bell interests; Gray and the Independent movement are handled without gloves, and while scores connected with the Bell development are the subject of highly laudatory notice, Kellogg is not mentioned and the work of Edison in telephony is disposed of in less than two lines. Making allowance for its ex parte character, the book will be found highly interesting. From the literary standpoint it is far above the usual book treating in a popular and easily understood manner of a technical development.

Welding. By Richard N. Hart. New York: McGraw-Hill Book Company. 181 pages, 93 illus. Price, $2.50.

Although dealing with a subject not strictly electrical, yet this volume contains much of interest to the electrical engineer in that it covers the electric processses of welding and the various processes employed by electric railway companies in welding their rails. The major portion of the book relates to the welding of iron and steel, but outlines are given of processes suitable for welding also platinum, gold, silver, aluminum, copper and nickel.

About one-fourth of the book is devoted to electric welding, which is treated in a comprehensive manner, much attention being given to the transformer processes invented by Prof. Elihu Thomson. Among the processes suitable for heavy work considerable space is devoted to the one invented by Dr. Goldschmidt, the so-called "thermit" process, which is frequently used for making continuous welded railroad track. Practically the only disadvantage of this process is its cost, which is too high to permit its use in certain cases.

The numerous references throughout the book show that the information contained therein has been gathered from a large number of reliable sources. The selection has evidently been made with much care and the material has been arranged in very readable order. The book represents the first attempt to present such data on welding in book form, and the book should prove of value to those interested in welding processes.

A Handbook of General Instruction for Mechanics. By Franklin E. Smith. New York: D. Van Nostrand Company. 324 pages, 127 illus. Price, $1.50.

This is a very elementary treatise intended for home study by readers who have had practically no educational advantages. The ground is covered in the following order: Arithmetic; mensuration; simple machines (lever, block and tackle, wheel and axle, etc.), and strength of materials. The subjects are clearly presented and free use of numerical examples is made. The book should prove useful to workmen who desire to get an insight into the principles of mechanics.

New Apparatus and Appliances

STREET SERIES FIXTURES FOR INCANDESCENT LAMPS.

The Benjamin Electric Manufacturing Company, Chicago, Ill., is marketing a line of street series fixtures and sockets, representative illustrations of which are shown herewith. The socket is made of porcelain with integrally formed knobs, has a simple short-circuiting device and film-cut-out mechanism which may be removed at will with the lower portion, and a supporting casting tapped for ¾-in. pipe. The live portions are thoroughly insulated from the support by a petticoat porcelain insulator. The fixtures themselves are furnished with either 18-in. radial wave or flat cone reflectors and suspension straps or 40-in. goosenecks of ¾-in. iron pipe.

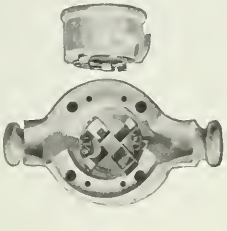


Fig. 1—Street Series Socket.

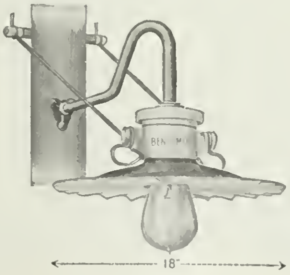


Fig. 2—Street Series Fixture.

MIXED-PRESSURE TURBO-ALTERNATOR SETS.

In the accompanying illustrations are shown two views of a 500-kw mixed-pressure steam turbo-alternator supplied by Dick, Kerr & Company, London, England, to a colliery in Scotland.

The turbine, which is of the impulse type, is designed to give 500 kw with exhaust steam having a pressure of 16 lb. per square inch absolute, or with dry saturated live steam of 90 lb. per square inch, or with a combination of both pressures, and to give the full output when working condensing with a vacuum of 27.5 in., the barometric pressure being 30 in.

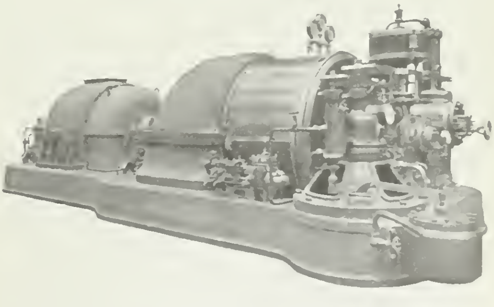


Fig. 1—500-Kw Mixed-Pressure Turbo-Alternator Set.

The turbine is mounted on a combination base, and is complete with two bearings and directly connected to its alternator through a flexible coupling.

The turbine is provided with high-pressure and low-pressure main stop valves, high-pressure steam separator, governor, steam and oil-gage pipes, emergency device for stopping when normal speed is exceeded by 10 per cent, oil receptacles with filter, directly connected oil pump, separate steam oil pumps for flooding the bearings before starting up, speed-adjusting device, etc.

The governor, which is said to be extremely sensitive, is based on a principle which allows steam to enter into the turbine in a continuous and steady flow, whether running on mixed pressure or on live steam, or when changing from one to the other.

The following are the principal features of the turbo-alternator in this combination:

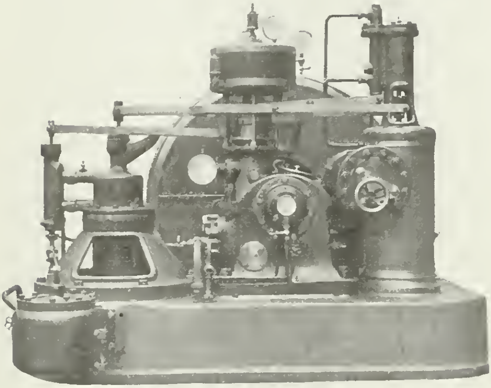
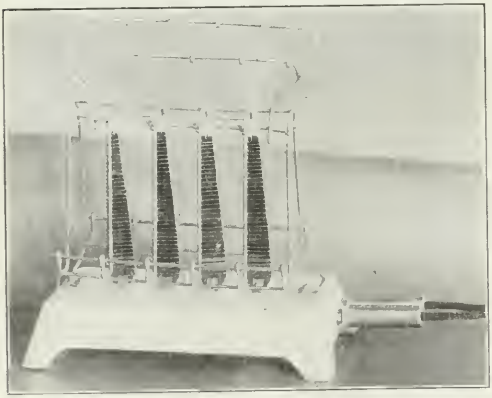


Fig. 2—500-Kw Mixed-Pressure Turbine.

It is designed to give 625 kva (500 kw at 80 per cent power-factor) at 3000 volts and 50 cycles when running at 3000 r.p.m. The temperature rise is said not to exceed 70 deg. Fahr. above an air temperature of 77 deg. Fahr. after an eight hours' run at full load.

VERTICAL RADIANT TOASTER.

The electric toaster is the most popular of the various electrical cooking devices now available. It is one of those remarkable articles which so completely satisfy all the requirements of real convenience and utility that they rapidly attain the character of modern household necessities wherever electricity is available for domestic use. When the General Electric Company brought out its first vertical type of toaster its advantages were so apparent that it received quick recognition because the new design enabled the making of two slices of toast simultaneously, greatly reducing the time and cost and increasing the convenience of preparing the favorite breakfast dainty. The vertical type of toaster served to establish the value of Calorite as a resistance material for producing intense radiant heat under the influence of an electric current. The 1911 model of the General Electric vertical radiant toaster embodies new features. The inclined rack has been substituted for the perpendicular holder of the earlier design for increasing the convenience of the toaster. The slices of toast are thus rendered more accessible and can be turned around more readily during the process of toasting. The individual contact plugs adopted for the ornamental electric heating and cooking devices are applied to the new toaster. The plugs are incased in polished nickel cylinders, which add to the attractiveness of the toaster and place it in harmony with its companions on the buffet.



Electric Toaster.

ELECTRICITY IN AN ALFALFA MILL.

The extensive use of alfalfa meal for stock feeding in the Western States has caused a very rapid growth of a new industry, namely, the grinding of alfalfa stalks for the production of this highly nutritious product. The mills are usually electrically driven and they form an attractive example of the way in which electricity contributes to the development of a new industry. A typical installation is that of the Kingfalfa Mills, at Nebraska City, Neb. The plant consists of a 300-kva, 440-volt, three-phase, 60-cycle generator of the two-bearing, belt-driven type, driven by a 300-hp non-condensing Corliss engine. The energy developed is used to drive a disintegrator or alfalfa-meal mill and other auxiliary machines, such as blower, dust collector, packer, etc. The alfalfa mill is driven by a 150-hp slip-ring type motor, which is belted direct to the mill. On account of the great weight of the mill and the inertia of the moving parts a high starting torque is required to bring it up to speed, which is a severe test on the motor and generating ant. The main motor drive and the generating unit are shown

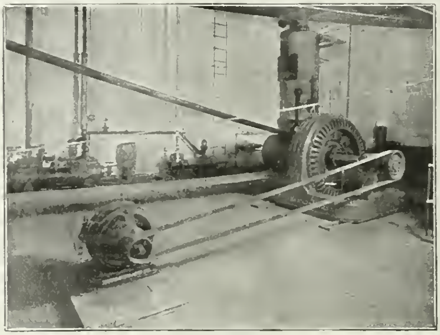


Fig. 1—300-Kw Generator.

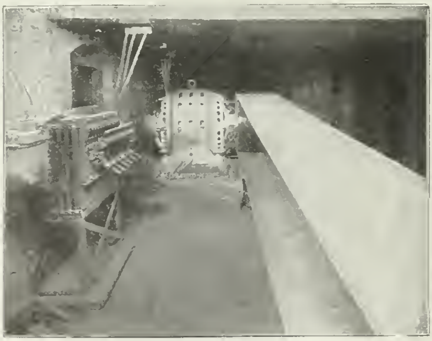
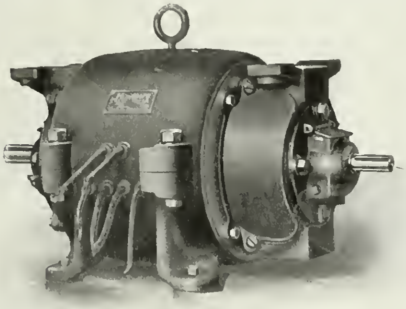


Fig. 2—150-Hp. Motor.

in the accompanying illustrations. The plant has a capacity of four tons per hour of the finished product, and in a test of several hours' continuous operation has been worked to the capacity of six tons or seven tons per hour. The entire electrical equipment was manufactured and installed by Fairbanks, Morse & Company through their branch office at Omaha, Neb.

CRANE MOTOR.

A direct-current, reversible and totally inclosed crane motor has been placed on the market by the Western Electric Company. The motor, it is claimed, combines high electrical efficiency with a compact and rigid construction, which insures absolute reliability under the severe conditions common to crane and hoisting service. The motors are of the split-frame type and are built in sizes ranging from 1¾ hp at 1375 r.p.m. to 50 hp at 525 r.p.m. The frame is cylindrical in form and of small diameter, requiring minimum headroom and reducing the moment of inertia to the revolving parts. The frame is cast of soft steel and designed with low center of gravity and ample feet surface for rigidly bolting it in place. The upper half of the frame may be lifted after removing six or eight bolts, depending upon the size of the motor. This leaves the armature and bearings intact. The heads are not split, but can be lifted out after removing the upper half of the frame and the bolts which secure the heads to the lower frame. This leaves the motor practically disassembled. The motor heads, which are held in place by four bolts, are provided with brackets for mounting the back gear shafts and brake pads for the addition of magnetic brakes. The motor heads are adjustable, so that the motor may be mounted in various horizontal positions. The laminated pole-faces, which are cast with the frame, are securely bolted to the poles, so as to reduce iron losses and insure cool operation. The bearings are of the self-oiling, revolving-ring type and their surface is provided with bronze linings. This arrangement insures the efficient lubrication and good wearing qualities necessary for heavy duty. The armature core and commutator are mounted on a quill to facilitate easy removal from the shaft without disturbing the windings. The commutator, coils and brush holders are of the latest improved design and are made for heavy duty.



Crane Motor.

STORAGE-BATTERY WHARF AND DEPOT TRUCKS.

The Hamburg-American Line has been experimenting for the last year or two with several different styles of Lansden industrial trucks, and recently has adopted as its standard a three-wheeled machine, with a speed of four miles an hour, and capable of carrying 5000 lb.

The driving wheels are provided with the usual type of solid-rubber tire; the steering wheel is spring-mounted, and for dock work is used without the rubber tire. By using the Edison battery these little machines are practically foolproof and can do the work of a steamship company or large warehouse with a saving of labor which is striking. Inspector Koetter, of the Hamburg-American Line, states that the four trucks now in use have averaged a displacement of five men each, or that one man with a truck will actually handle more freight than could have been handled by six men with the ordinary type of hand truck; and, as there is no appreciable wear on the machine and the cost of operation is very low, they represent a very profitable investment.

Storage-Battery Truck.

The Lansden company has standardized this type of truck in three different styles of varying load capacities, while the carrying platform is designed to suit each customer's needs.

POLE-LINE TRANSFORMERS.

Herewith are shown some views of a line of transformers recently placed upon the market by the Triumph Electric Company, of Cincinnati, Ohio. These are built for single-phase circuits and are of the pole-type construction. The normal frequency is 60 cycles, but the frequency limits range from 50 cycles to 140 cycles. The standard voltages are 1100-2200 for the primary and 110-220 for the secondary. The transformers are of the improved shell-type construction and possess many important characteristics of especial interest to engineers. Aside from mechanical construction and durability, trans-

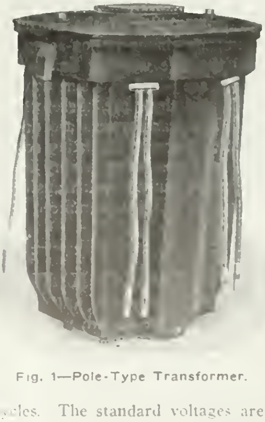


Fig. 1—Pole-Type Transformer.

former losses are the most important consideration in the selection of any particular design. Too often low core-loss values are obtained at the expense of other important characteristics. It is a well-known fact that a disproportionately low core loss will produce excessive copper loss and poor regulation. Similarly, unnecessary insulation is directly responsible for high reactance, poor regulation and a tendency to overheating, the efficiencies being correspondingly low. While core losses are continuous and should be eliminated as far as possible it is manifestly an error to sacrifice regulation and increase the copper loss in order to obtain unduly low core loss. This is particularly true in regard to regulation. A poorly regulating transformer will cause variation of potential at the lamps, giving rise to flickering and a marked tendency to decrease the life of the lamps. The transformers shown herewith are said to have excellent regulation, low copper losses and decidedly low core-loss values on account of the superior quality and high permeability of the silicon-alloy steel used. This steel the company claims is non-aging even at temperatures well beyond the safe working limit of the transformer. The core-loss claims are based on a sine wave as recommended by the A. I. E. E., and these are, therefore, fixed by a well-defined standard. The transformers are dried under vacuum and impregnated with a special insulating compound absolutely non-soluble in oil and possessing a very high melting point. Severe tests are carried out on each transformer before shipment, and all apparatus is fully guaranteed by the company.

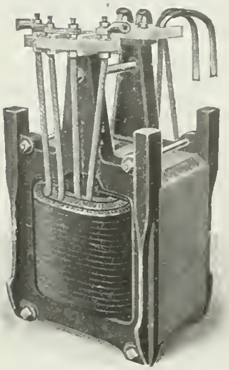


Fig. 2—Transformer with Casing Removed.

SYSTEM OF INDIRECT ILLUMINATION.

When it was announced about two years ago that reflectors and appliances had been developed which made indirect illumination commercially available the announcement was greeted with more or less skepticism, but judging by the large number of installations since made this skepticism has evidently been more or less dissipated. It was supposed by those marketing the equipment that its chief field would be in residences, and while it has met with much favor there it has been adopted in many new fields. Among those to realize its advantages were the office managers of companies employing large numbers of clerks in their counting-rooms, and this led to the adoption of indirect illumination in numerous smaller counting-rooms and offices. The installation in the new Blackstone Hotel, Chicago, resulted in numerous other hotels and restaurants making installations of the same character. The installation illustrated in these pages some time ago of the auditorium of the South Shore Country Club of Chicago attracted instantaneous and wide attention. The result of this has been similar lighting of the Steel Pier Auditorium at Atlantic City: Osborn Hall, Winnipeg, Canada; New Century Club Auditorium, Philadelphia, and many other places. This system of illumination has proved successful in many fields, and in that of church illumination it seems to have solved the problem that for years has been a serious one. About fifteen churches have installed or have specified this system. Five new theaters, as well as seven hospitals, have adopted indirect illumination, and it is finding favor in many classes of salesrooms and stores as well. A Chicago company which is installing a chain of 100 stores has adopted it as a feature of its stores. It might be mentioned that there is one class of stores where this system of illumination is not desirable, and that is jewelry stores, where direct rays to bring out the brilliancy are necessary to show off jewels, cut-glass and other articles to the best advantage. Of course, the question of proper fixtures to contain these inverted lighting units has proven a new question to the fixture manufacturers. The National X-Ray Reflector Company, Chicago, Ill., has produced a line of standard fixtures which are sold to the trade either complete or in parts. These fixtures are mostly metal composition, but the company also makes large fixtures of composition. Many artistic and classic designs have been produced to meet the demands of the trade for various kinds of interiors, two of the latest designs being shown herewith.

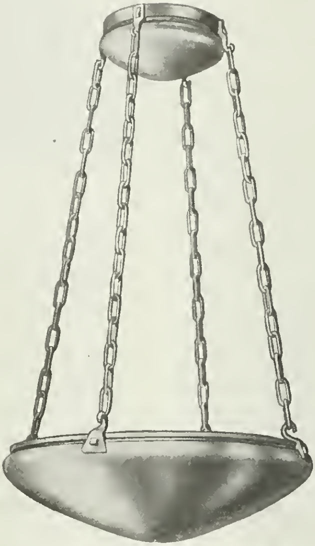


Fig. 1—Shallow-Bowl Lamp Fixture.

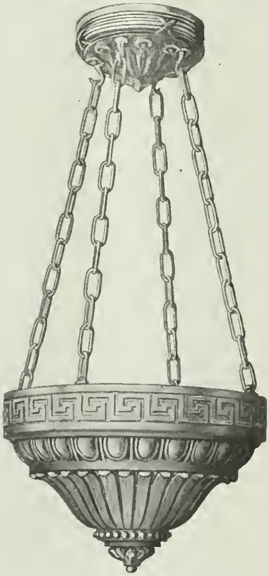


Fig. 2—Deep-Bowl Lamp Fixture.

MACHINE FOR MANUFACTURING TROLLEY WHEELS.

The Garvin Machine Company, New York City, is putting out a labor-saving machine for finishing trolley wheels. The machine, which is shown in Fig. 1, consists of a standard monitor lathe with many special features that adapt it to the rapid production of this work. The head is equipped with an automatic two-jaw chuck, with the false jaws shaped out to grip the wheel by its hub and drive from the ribs. This chuck is operated by compressed air, the cylinder being mounted on the rear end of spindle, and the air is controlled by a valve on the side of the head-stock. A turn of the valve lever causes the jaws to grip the wheel securely, while a turn in the opposite direction causes the jaws to release their grip and makes the device ready to receive the next wheel. Through this feature a big saving of time is realized and the annoyance with the ordinary type of chucks where the casting gets loose and requires the operator to stop the machine and retighten it is overcome. With this automatic chuck the grip increases, it is said, if there is any tendency to slippage, and it also takes up for variations in castings. The finishing of the wheel is done with high-speed tool steel. After gripping the wheel a runner is brought in on the wheel from the turret. This trues the wheel up in a true running position. The second turret operation is drilling the hole; the third turret operation is boring and facing the hole, and the fourth turret operation is reaming the hole. The runner is again brought in on the wheel and the turret slide locked in position by the lever shown on the side of turret base. The runner now holds the wheel running true while the heavy cut in the groove is being taken. This cut is made with a double-acting cross slide, as shown in Fig. 2, both front and rear tools coming in at the same time, the rear tool finishing from a little beyond the center and one side of the groove, the front tool taking a corresponding cut on the opposite side. The cross slide has a side adjustment to it and is operated by a hand lever. With this adjustment the tools are brought into the groove in such a manner that they are not continually cutting scale and losing their edge. The cross-slide tools are made in long strips and can be resharpened without changing their shape. The turret is of the hexagon type and the tools may be bolted to the face, or shank tools may be used. The turret slide is equipped with individual stops, one for each turret hole, and a very fine adjustment can be made. In finishing wheels in this manner they are completed, with the exception of facing the rear of hole. This may be done with a counterbore under a drill press. The wheels come from the machine interchangeable. Wheels 4 in. in diameter are finished in two minutes each and wheels 6 in. in diameter are finished in three minutes. The machine is of a rigid type of construction, weighing 1700 lb. It is simple to operate and can also be arranged for the bushings and hangers. It may also be used on any other class of turret lathe work to the same labor-saving advantage.

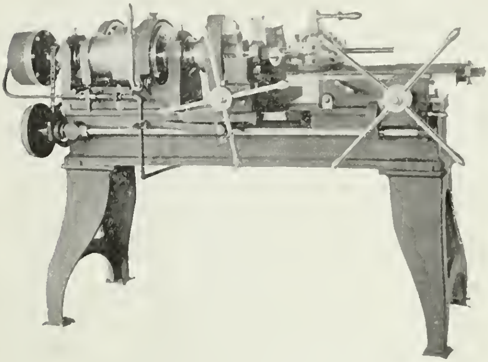


Fig. 1—Monitor Lathe for Finishing Trolley Wheels.

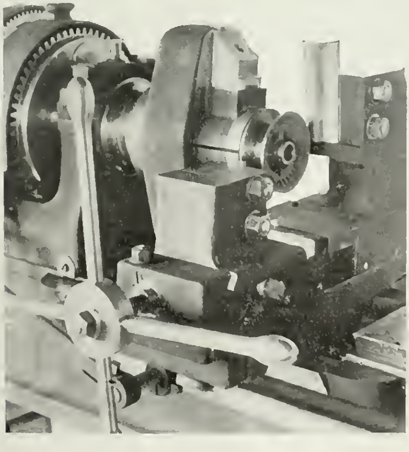
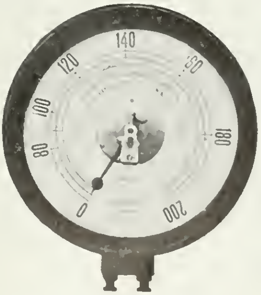


Fig. 2—Double-Acting Cross Slides.

LONG-SCALE SWITCHBOARD METERS.

A meter with readings easily legible for use in large installations where this characteristic is essential requires a long and well-illuminated scale. The long scale has been obtained by meter manufacturers in two ways. The simplest and most obvious way is to extend the pointer and the radius of the scale of a short-scale meter until the desired length of scale is obtained. The other method of obtaining a long scale is to increase the arc subtended by the scale, a method involving a completely new design of meter. It was this second method which was adopted by the Westinghouse Electric & Manufacturing Company in placing on the market a line of alternating-current switchboard meters. These are round-pattern meters of the usual size, about 9½ in. in diameter, with scales subtending an arc of 300 deg. and about 14½-in. long. The length of scale usually found only in the large illuminated dial meters is thus obtained in a meter of normal size. There is no metal front on the meter, but instead a round glass cover is used. This makes it possible to iluminate the dial from the front and thus avoid the use of special lamps. The meters operate on the induction principle. The torque depends on the action of a rotating magnetic field on a light, pivoted drum. This principle makes connections to the moving element unnecessary and, by avoiding the use of a copper coil or iron core for the moving part, reduces the weight on the pivot bearings and consequently the friction. This leads to accuracy and long life. The moving element also has inherent damping qualities and the torque developed is said to be very high. The controlling springs, which balance the torque, are made of a special alloy,

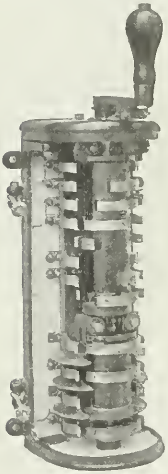


Long-Scale Switchboard Meter.

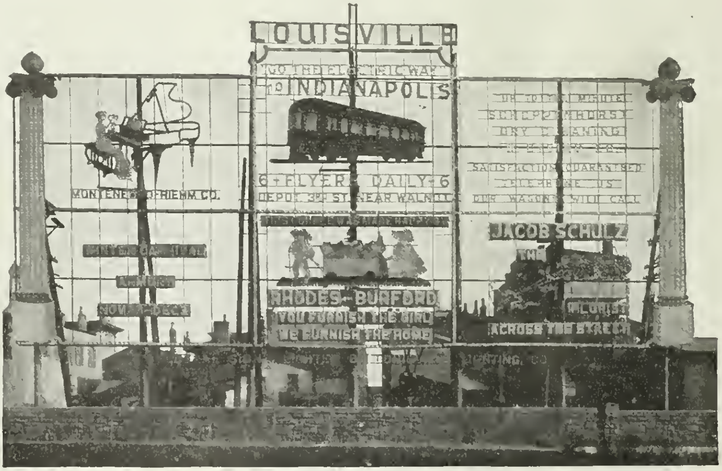
tempered and aged to insure permanence under all conditions. The type of meter shown is made for ammeters, voltmeters, single-phase and polyphase wattmeters, power-factor meters, and direct-reading frequency meters. All of these meters utilize different forms of the induction principle. Single-phase and polyphase static ground detectors are also furnished, harmonizing in size and general appearance with the rest of the line. Synchroscope and the direct-current meters are also made by the Westinghouse company of the same size and appearance, so that a complete harmonious switchboard can be arranged.

CONTROLLERS FOR ALTERNATING-CURRENT MOTORS.

Where speed control is desirable with alternating-current motors the slip-ring type of motor when provided with the proper controlling apparatus is capable of giving excellent service. For printing presses, machine tools and similar machines it is desirable to have very accurate speed adjustment and a convenient means of reversing the direction of rotation of the motor is often desired. The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has for a long time built alternating-current devices, but not until the recently extended general use of alternating currents has it been necessary to standardize a complete line of controllers for this purpose. The reversible-drum controller illustrated is made in standard ratings from 1 hp to 7½ hp and is intended for use with slip-ring types of motors. These controllers can be mounted on the press or machine within convenient reach of the operator, and speed reduction is secured through resistance in the three phases of the secondary circuit, thus maintaining an electric balance at all times, in which condition the motor operates at its best efficiency. In the standard apparatus a speed reduction of 60 per cent is obtained, and for greater reductions slight changes are necessary.



Alternating-Current Motor Controller.



Electric Sign Erected in Federal Park, Louisville, Ky.

ELECTRICAL DISPLAY SIGN.

A striking electrical display sign combining many original effects is that erected in Federal Park at Louisville, Ky. The steel framework of this sign is 100 ft. long and towers 60 ft. into the air above the surrounding buildings. At each end is a Corinthian pillar 40 ft. in height surmounted by a ball of wrought iron and art glass 4 ft. in diameter. The sign is divided into six rectangular display spaces, each measuring 20 ft. x 30 ft., upon which are built the various advertising displays. Over the sign the word "Louisville" is shown in large letters. The illumination is accomplished by means of 5503 lamps and the color designs are effective. Except for a few red lamps at the base and in the scroll in the capital, the two pillars are a blaze of white light, supporting the art-glass balls, which are lighted from the interior. The word "Louisville" and the strip lighting separating the panels are outlined in white light. One display shows a pianist playing a grand piano, operated by a flasher which causes the player's hand apparently to move up and down the keyboard of the piano and her body to assume different positions. The piano and stool are shown in red and the keyboard in white, while the lady's gown is white, her face and arms illuminated by amber lamps and her hair a very dark red. The lettering is all white. The street car is the most realistic moving effect on the sign. The wheels of the car, outlined in blue lamps, revolve forward and the track, outlined in white, apparently moves backward. Apparently the car is rushing forward at full speed, with its headlight (lighted by a 100-watt tungsten lamp) and the sparking trolley wheel adding to the realness of the effect. Suddenly a gong rings twice and the trolley stops sparking, the wheels cease revolving and the car stops. The appeal to both eye and ear makes this a most realistic electrical effect. The body of the car is green, the top red, the truck and fender blue, and the wheels and track white. The upper right-hand panel is an attractive sign in red and white lamps. Below it the florist's sign displays in natural colors a gorgeous bunch of American Beauty roses operated by a flasher so that the stems and buds appear to grow into full-blown roses, while the ribbon is made to flutter as in a breeze. The sign directly under the street car shows two barefooted children drawing a cart loaded with toy furniture. A flasher makes the little figures seem to walk, while the revolving wheels of the little wagon and the backward motion of the roadway complete the delusion of progress. The cart and furniture are painted in natural colors and lighted with white lamps. The children's hats are red, the dress and trousers blue, and the feet are lighted with amber lamps. The display in the lower left-hand panel is a sign in colored lamps. The conception and erection of the sign is due to Mr. R. H. Frazier, of the Federal Sign System, Chicago and New York, by whom the sign was constructed.

Industrial and Commercial News

THE WEEK IN TRADE.

CONDITIONS in commercial trade since the first of the year have shown such little improvement over those that prevailed during the latter part of 1910 that there is a general feeling of disappointment. During the past week trade was distinctly dull in general lines. This is the tenor of reports from both wholesalers and retailers. The only branches in which there is any semblance of activity are those furnishing supplies for farmers. Agricultural implements, fertilizers, fence wire, seeds, etc., are showing a seasonable awakening. The unusually mild weather which has prevailed all over the country has tended to start this class of business earlier than usual, but it has also done much to check activity among the retailers. Wholesalers report that purchases for spring delivery are being made very conservatively. Business men in all parts of the country are determined to run no risk of overstocking until general conditions have improved. In the iron and steel industry there is no apparent change. During the past week the rail order of the New York Central, amounting to 176,750 tons, was allotted and smaller orders amounting to 42,000 tons were placed. This, of course, increased the activities of a number of mills, but it could not be termed new business. There was also some increase in tin plates and the wire mills are busy. One feature of the past week that offers some encouragement is the continued decline in the cost of most food stuffs. This, it is hoped, will stimulate exports and will act as a deterrent on threatened demands for wage increases. Collections are only fair and they continue to be more satisfactory in the West than they are elsewhere. Business failures for the week ended Jan. 26, as reported by *Bradstreet's*, were 345, as compared with 302 the previous week, 295 in the same week of 1910, 311 in 1909, 359 in 1908 and 211 in 1907.

THE COPPER MARKET.

DURING the past week there were some quite heavy sales of copper to domestic consumers. It is hard to estimate exactly the amount of these sales, as selling agencies are prone to exaggerate. There is no doubt, however, that quite a number of large consumers of copper took advantage of the softening of prices to lay up considerable stocks for thirty-day and two-month deliveries. These sales have had the effect of steadying the copper market and holding prices, which had given evidence of a disposition to sag.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.75	12.00	.....
January	11.75	12.00	11.87½
February	11.75	12.00	11.87½
March	11.75	12.00	11.87½
April	11.75	12.00	11.87½

The London market, January 30, was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	53	17	6	54	2	6
Standard copper, futures	54	10	0	54	17	6

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.30c			11.87½c		
London, spot	£56	15	0	£53	15	0
London, futures	57	12	6	54	10	0
Best selected	60	5	0	58	10	0

It can hardly be figured out, however, that those sales have in any material way improved the copper situation. The actual consumption of copper, as every man who is familiar with the market knows, is far below the actual production. Under such circumstances the purchases of material by consumers amount only to the storing of copper for future needs and the purchases of material by speculators are only a transfer of the surplus stock from one hand to another. One of the important features of the week was the increase in copper imports. It seems to be apparent that the imports of copper into the United States during the month of January will break all recent records. During the week prices for electrolytic copper were more irregular than usual. While they were quoted as 12.25c @ 12.50c, as compared with 12.50c @ 12.75c the previous week, it is pretty well known that actual selling prices were shaded below these figures. This willingness to make concessions is the explanation of the additional sales. Exports during the latter half of January have been averaging about 1000 tons a day and the total for the month including Jan. 30, was 27,513 tons. The daily call on the Metal Exchange Jan. 30 quoted standard copper as per the accompanying table.

INDUSTRIAL AND COMMERCIAL NOTES.

Co-operative Buying for Lighting and Traction Properties.—A meeting of general managers representing various electric railway and central-station companies was held in York on Jan. 24, in the office of C. H. Bear, president of the Merchants' Electric Light, Heat & Power Company, in accordance with an arrangement for co-operative buying, which entails meetings about every three months. The meetings are held in rotation in the various cities represented in the organization Agents of the leading manufacturers of electrical supplies were present, samples of various electrical appliances were displayed and the purchases were usually heavy. In addition, operating conditions were discussed and a variety of business was transacted. The members of the organization present at the meeting were Chairman J. Blair McAfee, Philadelphia; E. C. Matchway, Norfolk & Portsmouth Railway Company, Portsmouth. Va.; W. W. S. Butler, general manager Newport News & Old Point Comfort Railway & Electric Light Company, Hampton, Va.; C. D. Emmons, general manager Fort Wayne & Wabash Traction Company, Fort Wayne, Ind.; J. W. Wolf, superintendent Ohio River Electric Railway & Power Company, Pomeroy, Ohio; C. H. Bear, president Merchants' Electric Light, Heat & Power Company, York, Pa., and I. L. Oppenheimer, general manager Lexington Railway Company, Lexington, Ky

Tri-City Railway & Light Company.—The Tri-City Railway & Light Company, which controls the railway, gas and electric light business of the cities of Davenport, Ia.: Rock Island, Moline and East Moline, Ill., has announced for the coming year construction work which will include a twenty-mile extension to the street railway system. This extension, according to an official of the company, will be built by J. G White & Company, and with its rights-of-way will cost about $750,000. Contracts which have recently been made with the cities of Muscatine and Davenport for improvements, in consideration of the granting of new franchises, will amount to about $1,250,000, which will bring the total cost of new work for the company for 1911 up to $2,000,000. The funds to carry out this improvement work will be raised through the sale of refunding and improvement bonds which were authorized last year and of which $9,500,000 out of a total of $20,000,000 have been issued.

Chicago Railroad Electrification.—Several steam railroads in Chicago have expressed their willingness to contribute funds for experimental work in the direction of the electrification of Chicago terminals. These companies have been negotiating with the city authorities for some time. Vice-President Parks, of the Illinois Central, said that the railroad officials had been experimenting for some time with other fuels than soft coal, with a view to abolishing the smoke nuisance. All of these experiments, he said, had been unsatisfactory, and now it was intended to look into the matter of electrification. The question of expense has been heretofore considered prohibitive

Hoosac Tunnel Electrification.—Two of the new electric locomotives which will be used by the Boston & Maine-New Haven Railroad companies in the Hoosac tunnel service have been delivered to the New Haven Railroad. Work on this electrification is being pushed rapidly, and it is estimated that it will cost about $1,000,000. The electric zone will cover a distance of nine miles. Work was begun last October, and it is expected that it will be completed early in the spring

Arc Light Cost in Columbus.—City officials of Columbus, Ohio, claim that the arc lights furnished by the municipal lighting plant have during the past year cost $43 each, including interest on the bonds, cost of the plant, depreciation and all the other items that enter into cost The actual price of maintenance, they claim, has been $16.28 for each lamp.

The Diesel Engine.—As recently announced in these columns, the American Diesel Engine Company has been purchased by Mr. Adolphus Busch, of St. Louis, and the engines will hereafter be manufactured by the Busch-Sulzer Bros.-Diesel Engine Company, of St. Louis. The company was incorporated Jan. 26 with a capital stock of $2,100,000, with the following officers and directors: President, Adolphus Busch; first vice-president, August A. Busch; second vice-president and general manager, James R. Harris. Directors: E. D. Meier, president American Society of Mechanical Engineers; Robert Sulzer, of Gebruder Sulzer, Winterthur, Switzerland; Rudolph Diesel, Munich, and Eugene Angert and Daniel L. Kirby, attorneys, St. Louis. The main business of the new corporation will be to build and sell the Diesel oil engine, and it will erect in the near future a complete modern manufacturing plant at an estimated cost of $1,000,000, which will start with 500 employees. The plant will probably be located in St. Louis. Mr. Adolphus Busch, who had introduced the Diesel engine in this country, purchased the assets of the American Diesel Engine Company in May, 1909, and transferred its business from New York to St. Louis under the management of Mr. James R. Harris and under the close direction of Mr. August A. Busch. Since that time Diesel engines of an aggregate of over 11,000 hp have been sold in this country. The new organization has been made in order to enter into the manufacture and sale of the engines on a large scale, and for this purpose it has been supplied with sufficient capital, the best engineering and consulting force obtainable, all the patents necessary to protect the manufacture and will have a plant with the best equipment for the particular kind of work that money can buy. Mr. Max Rotter, the present chief engineer of the Allis-Chalmers Company, has been appointed chief engineer of the new company, and agreements have been made with Robert Sulzer, of Winterthur, and Rudolph Diesel, of Munich, whereby they become partners in the new enterprise. The firm of Messrs. Sulzer Bros., as is well known, has a world-wide reputation as one of the largest builders of high-glass engines in the world.

New York State Electrical Combine.—Application is pending before the Public Service Commission of the Second District of New York for the combination of the Wayne County Gas & Electric Company, Geneva-Seneca Electric Company and the property at Phelps, N. Y., which belongs to J. Q. Howe's Sons. The concerns first named are properties that have been controlled by William T. Morris. The present application asks for the issue of $800,000 of 5 per cent bonds, $250.000 preferred stock, and $200,000 common stock. The Wayne County Gas & Electric Company is a concern that was authorized last August by the Public Service Commission, and represents the merging of the Palmyra Gas & Electric Company; Newark (N. Y.) Gas Light & Fuel Company; New Light, Heat & Power Company, Newark; Lyons Gas Light Company, and the Wayne County Electric Company. Details of this combine were published in the *Electrical World*, Sept. 1, 1910. The Geneva-Seneca company is also a merged concern, and represents the consolidation which was made last year of the Geneva-Edison Company, the Seneca Electric Company and the Economic Power & Construction Company at Geneva. These properties have been operated by the United States Gas & Electric Company. It is now proposed to combine all of the properties into one company, and to add to them the property at Phelps, N. Y. A transmission line will be built from Newark to Geneva, passing through Phelps, thus making a physical connection between the properties. It is probable that the operation of all of these properties will be taken over, when the combine is completed, by W. S. Barstow & Company.

Telephone System on Chesapeake & Ohio.—From Fortress Monroe all the way to Cincinnati, a distance of nearly 1000 miles, the Chesapeake & Ohio Railroad will soon be using the telephone method of controlling train movements. Since last March the telegraph has been supplanted for train dispatching over four of the most important divisions of this road. Two new divisions were recently equipped with telephones and have rendered service since Dec. 24. The telephone system is now complete from Richmond to Cincinnati by the James River route. The telephone system now in use comprises 545 miles with 154 way stations. When present plans are completed nine divisions will be equipped, with 992 miles and 248 telephone way stations. The railway is rushing the construction gang to get the line wires up, so that the telephones may be put into operation at the earliest possible date. The new equipment will be installed on the main line between Clifton Forge and Charlottesville, between Charlottesville and Richmond and between Richmond and Fortress Monroe. The telephone and installing material is being furnished by the Western Electric Company.

New York State Telephone Mergers.—The New York Telephone Company has applied to the New York Public Service Commission of the Second District for permission to make several transfers in telephone ownerships. It is proposed to sell for $35,000 the property of the New York Telephone Company in Allegany County to the new Allegany Telephone Company, and in connection with this certain franchises held in Wellville and Andover. It is also proposed to sell the Automatic Telephone Company for $150,000. The merging of the Trumansburg Telephone Company and the Jefferson County Telephone Company into the New York Telephone Company also is planned, the New York company owning the stock of those companies already. The plan also contemplates transferring the property and franchises formerly belonging to the Central New York Telephone & Telegraph Company in Oneonta, Unadilla, Richfield Springs, Laurens, Cooperstown and Walton, now owned by the New York Telephone Company, to the Otsego & Delaware Telephone Company for $98,000.

New Generating Plant at El Centro, Cal.—The Holton Power Company, of Redlands, Cal., is about to begin the construction of a steam plant for the generation of electricity at El Centro, Cal., where one of its generating stations is now located. The company operates a hydroelectric development and the old steam auxiliary plant has been found inadequate. To provide for future possibilities W. F. Holt, president of the company, has decided to install a much larger and more modern steam-generating plant. The new equipment will be rated at 1200 hp and is expected to be ready for operation before the close of this year. Mr. Holt announces that he will expend $250,000 this year in improving the electrical system of the Holton Power Company and that the larger part of this sum will be expended on the new steam generating plant. Contracts for the building and much of the machinery have been awarded.

Los Angeles Consolidation Completed.—Paul Shoup, vice-president of the Southern Pacific Railroad, in charge of electric lines, announces the consolidation of the management of the Pacific Electric Railway and the Los Angeles Pacific systems with these officers: J. McMillan, general manager in charge of operation; George E. Pillsbury, chief engineer, in charge of construction; E. C. Johnson, assistant chief engineer; D. W. Pontus, traffic manager; Fred S. Small, mechanical engineer, and S. H. Anderson, electrical engineer. Robert P. Sherman, general manager of the Los Angeles Pacific, retires. The Los Angeles & Redondo Railway, which also belongs to the Southern Pacific, will probably soon be placed in charge of the same officials. The deal for the physical consolidation of the Southern Pacific's electric properties was detailed in our issue of Nov. 24, 1910.

New York Telephone Building.—Plans are being drawn for the New York Telephone Company for the erection of a twenty-five story building on the corner of Walker and Church Streets. The plot on which the building will stand is 22,000 sq. ft. The telephone and Western Union Telegraph companies will occupy the entire structure except the ground floor. The switchboard which the company plans will, it is said, be the largest in the world and will seat 200 operators and take care of the service of 20,000 subscribers. R. M. Ferris, engineer of the company, will supervise the installation of the switchboard. The cost of the property and building will be about $2,500,000.

American Conduit Company.—The American Conduit Company reports that it has had the best year—1910—in its history. The company has recently shipped to London for various services sold in England 136,000 ft. of conduit. During the past three months the company has also sold to the Norfolk & Western Railroad Company very nearly a million feet of conduits, which are to be used for signaling purposes. W. W. Grant, the New York manager of the American Conduit Company, sailed for England, Jan. 18, on a business trip, and will be absent until the early part of March.

Union Gas & Electric Company.—The gross earnings of the Union Gas & Electric Company, of Cincinnati, for the last quarter of 1910, according to the report filed with the city auditor, were $530,246. This compares with $500,727 in the same period of 1909.

Financial.

THE WEEK IN WALL STREET.

THE feature of the Wall Street market last week was the sale by the City of New York of $60,000,000 of 4¼ per cent, 50-year city bonds. The average return which the city will get from this sale is about 100.90. While this may not be considered as an extremely high price, the fact that the bonds were subscribed more than five times is significant of the fact that there is plenty of money yet to be invested in good securities. The bid of the J. P. Morgan & Company syndicate, which was the largest single bid received, came within a very small fraction of being successful for the entire amount. In fact, the Morgan bid was about 100.85 for the entire issue. The failure of this bid to succeed saved Wall Street speculators from a considerable loss. There had been much short selling of these bonds before their issue, and the average price of short selling was a trifle less than 101. The result of the bidding shows that the speculators were very close to the true condition of the market. The stock market during the week continued to be strong but rather inactive. Prices have been pushed up several points, but trading has been limited and the majority of deals have been made by speculators. In truth, the condition of the market last week indicated that the entire stock market was well liquidated. There seem to be very few long holdings and there seems to be absolutely no courage in the bear clique. Neither the condition of commercial trade nor the promise of outside buying is such that there should be any definite upward movement, nor is there any such depression in business nor any such general pessimism that there should be a distinct downward movement. Money conditions are all in favor of a buying movement. The bond market is good and there is an evident desire on the part of outsiders to buy gild-edge bonds that will yield a revenue in the neighborhood of 5 per cent. Quotations for money Jan. 30 were: Call, 1½ @ 2 per cent; 90 days, 3¼ @ 3½ per cent. The quotations in the table are those of the close Jan. 30.

NEW YORK.

	Jan. 23.	Jan. 30.	Shares Sold.		Jan. 23.	Jan. 30.	Shares Sold.
All. Ch......	8*	8½	600	Int. Met., pf.	51¼	54	21,300
All. Ch., pfd.	29	33⅛	1,100	Mackay Cos.	92½*	92½*	———
Amal. Cop...	63⅝	63⅛	62,125	Mackay C.,pf.	75¼	75¾*	500
Am. D. T...	20½*	20½*	———	Man. Elev...	138	138	900
Am. Loco...	40⅛*	40¾	3,000	Met. St. Ry.	15*	15*	———
Am. Loco.,pf.	110⅜	110¼	200	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	83½*	83½*	———	Steel, com..	77⅞	79⅜	589.300
Am. T. & T..	143½	144¼	11,600	Steel, pfd....	119	120	5.280
B. R. T.....	76⅝	77⅝	13.235	W. U. T....	74½	75	3,200
Gen. Elec....	151½	153½	3,300	West'h, com.	67	66⅞*	200
Int. Met....	18¾	19⅝	8,527	West'h, pfd..	119*	117*	100

PHILADELPHIA.

	Jan. 23.	Jan. 30.		Jan. 23.	Jan. 30.
Am Rys...........	45	45¼	Phila. Elec.........	16⅛	16
Elec. Co. of A.....	12⅛	12¼	Phila. R. T.........	20¼	20⅛
Elec. St. B'ty......	53	53⅞	Phila. Trac.........	86½	86½
E. S. B'ty., pfd....	30*	30*	Union Trac.........	47¾	47½

CHICAGO.

	Jan. 23.	Jan. 30.		Jan. 23.	Jan. 30.
Chi. City Ry.......	185*	185*	Chi. Tel. Co........	118	119*
Chi. Rs., Ser. 1.....	93	93	Met. El. Co........	21	21*
Chi. Rs., Ser. 2.....	25	25	Met. El., pfd......	67½*	67*
Com. Edison.......	113	114½	Nat'l Car...........	117*	117*
Chi. Subways.......	4⅛	4	Nat'l Car., pfd......	118*	118*

BOSTON.

	Jan. 23.	Jan. 30.		Jan. 23.	Jan. 30.
Am. T. & T........	143⅝	144¼	Mex. Tel..........	6*	4¾
Cum. Tel..........	146½*	146¼*	Mex. Tel., pfd.....	6*	6
Edison E., Ill......	288	290½	N. E. Tel.........	138⅛	138½
Gen. Elec..........	151	152⅞	W. T. & T........	18½	18
Mass. E. Ry........	18	18*	W. T. & T., pfd....	89	92
Mass. E. Ry., pfd...	85½	85			

*Last price quoted.
Shares sold for five days, Jan. 23 to Jan. 28.

FINANCIAL NOTES.

Railway Consolidation Rumors in Chicago.—It is reported that negotiations are under way between the Chicago & Milwaukee Electric Railroad Company and the Northwestern Elevated Railroad Company, of Chicago, by which the former will obtain terminal facilities in Chicago, connecting with the Northwestern Elevated's tracks at Evanston, Ill. It is also reported that there is to be an actual consolidation between the two companies, although this is denied in some quarters, where it is stated that the arrangement is simply a traffic agreement. The Chicago & Milwaukee road is in the hands of receivers, but A. C. Frost, who is the former president of the company, is reported to have said that the road will pass under new management. It is also declared that Mason B. Starring, president of the Northwestern Elevated, will be the president of the new company in process of formation for the purpose of combining the franchises of the two existing companies. The report that all the surface and elevated railways of Chicago are to be combined has been revived. The companies owning these railways have outstanding stock and bonds amounting to $271,736,720. It is said that J. P. Morgan & Co. are interested in the project, which has been discussed at intervals for several years. It would seem that this possible consolidation would have an effect on the reported amalgamation of the Chicago & Milwaukee Electric and the Northwestern Elevated, as mentioned above.

American Electric Telephone Company a Bankrupt.—On Jan. 23 the American Electric Telephone Company of Chicago, by P. C. Burns as president, filed a petition in voluntary bankruptcy before Judge Carpenter, of the United States District Court for the Northern District of Illinois. The schedule of assets and liabilities accompanying the petition shows total claims against the company amounting to $597,014. The total assets are given at $396,823. The value of stock in trade, machinery, tools, etc., is placed at $220,000, and the debts due the company on open account amount to $48,470. The petition was referred to Referee S. C. Eastman, who will examine the officers of the corporation. The company has a large factory at South State and Sixty-fourth Streets, and a few years ago was a conspicuous factor in the Independent telephone field. It is said that the action of the company in asking to be adjudged a bankrupt is due to a judgment obtained against it on its debenture bonds. The bankruptcy proceedings may perhaps result in the reorganization of the company. One of the largest creditors is P. C. Burns, the president of the company.

Chicago Railways Bond Sale.—The National City Bank and Harris, Forbes & Company, of New York, are offering to the public $15,000,000 of first-mortgage 5 per cent bonds of the Chicago Railways Company. These are the bonds which were recently issued for the purpose of paying for the 128 miles of trackage taken over from the Consolidated Traction Company and for paying for the rehabilitation of all of the Chicago Railways lines. With this issue the total bonded indebtedness of the Chicago Railways Company will be $40,955,000. The company will have 445 miles of single track, and the advertisement of the bankers selling the bonds is that the net earnings, after all expenses and reasonable depreciation charges have been paid, will be more than double the interest on the bonds. These bankers are offering this issue at 98 and interest, which brings to the investor a trifle more than 5 per cent.

Kings County Electric Light & Power Company.—The financial report of the Kings County Electric Light & Power Company for the year 1910 showed that it earned a balance available for dividends equal to 9.91 per cent on the $10,000,000 outstanding capital stock, as compared with 8.41 per cent in the previous year. The company continued throughout the year its liberal policy of charging off large amounts from current revenue for depreciation. The net surplus for 1910, after payment of fixed charges, was $991,013. The full pamphlet report of the company has not yet been issued, but it will undoubtedly show that during the year the company enjoyed the largest degree of improvement and development shown in any year of its history.

Consolidated Gas, Electric Light & Power Company.—J. E. Aldred, president of the Consolidated Gas, Electric Light & Power Company, of Baltimore, makes the announcement that arrangements have been completed for listing that company's securities on the London Stock Exchange. A large amount of English and Canadian capital is invested in the Baltimore enterprise. The earnings of the company in 1910 showed a very satisfactory increase over the previous year and the campaign for new business has been actively pushed since Mr. Aldred became president.

Kentucky Securities Corporation.—A charter has been granted under the laws of Virginia to the Kentucky Securities Corporation, with an authorized capital of $5,000,000 equally divided between preferred and common stock. While no official announcement has been made, it is understood that the company is to be a holding corporation for the traction and lighting systems of Lexington and the interurban lines in Central Kentucky. These, it is said, will be consolidated under the title of the Kentucky Traction Company.

American Telephone & Telegraph Company.—The report of the American Telephone and Telegraph Company for 1910 shows that the expenditures on property, including extensions, new equipment, etc., of all the Bell companies in the United States, were approximately $60,000,000. This is more than double the $28,700,000 spent in 1909, and is the largest plant addition in any year of the company's history, with the single exception of 1908, when $80,000,000 was credited to improvements. The remarkable feature of this enormous expenditure for improvements and extensions is that it was achieved with very little new financing. On the part of the American Telephone & Telegraph Company there was absolutely none. Some of the subsidiary companies, however, sold large issues of bonds. The telephone officials estimate that it will be at least fifteen years before the annual expansion of the telephone industry catches up with the growth of population and with the growth of the use of telephones. With the standardization of equipment and the widespread concentration of telephone service the development of the business has been enormous. The growth of the Independent telephone companies has not been threatening, owing to the fact that the associated Bell companies have been able to offer customers many advantages. The only considerable Independent concern is the organization formed in Ohio about a year ago by J. P. Morgan & Company, but as Mr. Morgan is generally known to be a large owner of American Telephone & Telegraph Company securities, it is not thought that this organization will cause any serious trouble.

American Electric Telephone Company.—P. C. Burns has announced that on account of past due interest on debentures which were placed by the American Electric Telephone Company about eleven years ago, when the telephone manufacturing business was very prosperous, receivership proceedings were threatened by Eastern parties, and in order to conserve the interests of all a petition has been filed by the company for a receiver. The receiver will operate the property as before with a view of a reorganization. Mr. Burns states that the sale of many large operating plants to the Bell company so reduced the demand for central-energy apparatus as practically to destroy the once great value in the American company's patents, tools and organization used in central-energy work. Moreover, the competition in the telephone manufacturing business is very severe, caused largely by public service corporations not only selling, directly or indirectly, all kinds of supplies and apparatus to their own systems, but also selling to other systems as well. The American Electric Telephone Company, he states, has paid in full all its merchandise creditors, does not owe a dollar to any bank, and aside from a few small creditors all moneys due are owing to the bondholders and himself. The receiver will continue supplying a full line of telephones, switchboards and general telephone supplies.

Nebraska Coal & Power Company.—It has been announced in the West that an arrangement has been made by the promoters of the recently organized Nebraska Coal & Power Company with an English syndicate for the sale of a $10,000,000 issue of bonds. It is proposed to build an electric line from Caspar, Wyo., to Rawlins, Baggs and Dixon, in the same State, and possibly to reach some towns in Northern Colorado. The road will connect a rich mineral and agricultural territory with railroad trunk lines. It is proposed to build a large hydroelectric plant on the North Platte River, and probably later on another plant on the Little Snake River. The company will also sell power to mines and farmers. Captain H. A. R. Gray has been made general manager of the new enterprise.

Associated Gas & Electric Company.—The annual meeting of the Associated Gas & Electric Company was held Jan. 26. The old directors were re-elected and subsequently the old officers were again chosen. These include W. S. Barstow, president; O. Clement Swenson, treasurer, and Joseph B. Taylor, secretary. The financial report of the company showed that the net earnings for 1910 were considerably more than sufficient to pay the 6 per cent dividend on the preferred stock. In fact, the surplus after payment of this dividend would have been sufficient to pay a similar dividend on the common stock. No such dividend, however, was declared, and probably none will be declared during 1911. At the present time it is the policy of the company to leave the balances in the possession of the underlying companies.

Seattle Electric Company.—The surplus earnings of the Seattle Electric Company for the year 1910 were sufficient to meet the usual 6 per cent dividend on the preferred stock and leave a balance available for the common stock equal to 11.95 per cent. This compares with about 14.25 per cent earned on the common in 1909. The gross earnings of the company for the year were $5,588,188, and the surplus after paying all charges was $1,068,070. The company at present operates substantially all of the street railways and does the greater part of the electric light and power business in the City of Seattle. Stone & Webster, of Boston, operate the property.

Public Service Corporation of New Jersey.—A report has been made to the New York Stock Exchange by the Public Service Corporation of New Jersey showing its income account for the year 1910. The total gross income from all sources amounted to $29,205,194, as compared with $26,560,451 the previous year. After expenses and taxes were paid there was a net income of $14,593,896, and after paying interest on bonds, notes, etc., a net surplus was left for dividends of $2,200,297. The balance sheet of the company, which was filed at the same time, shows total assets of $72,870,332. The capital stock is $25,000,000 and the bonded indebtedness is almost $45,000,000.

Richmond (Ky.) Electric & Power Company.—The directors of the Richmond Electric & Power Company have authorized and will immediately issue $50,000 of 6 per cent first mortgage convertible sinking-fund bonds. The United States Trust Company, of Louisville, Ky., will act as trustee of this issue. Of these bonds $30,000 will be used to retire the present mortgage, and the remaining $20,000 will be used for extensions to the plant. These bonds are convertible at any time into 7 per cent preferred stock of the company.

Salem (N. J.) Electric Company.—W. S. Barstow & Company, of New York, have purchased the Salem Electric Company, at Salem, N. J. This company had an authorized capital of $50,000, upon which a 6 per cent dividend has been earned. Barstow & Company will continue to operate the plant, and during the coming year a considerable sum will be spent for extensions and improvements.

Chicago & Milwaukee Electric Bonds.—A new issue of $3,500,000 in bonds by the Chicago & Milwaukee Electric Company will shortly be made, the proceeds of which will be used to pay off $1,080,000 of bonds due in 1919 and the Wisconsin receivership certificates.

DIVIDENDS.

Consolidated Gas Company, New York, quarterly, 1½ per cent, payable March 15.

Duluth-Superior Traction Company, quarterly, preferred 1 per cent, common 1¼ per cent, both payable April 1.

Philadelphia Company of Pittsburg, semi-annual, 2½ per cent, payable March 1.

Susquehanna Railway, Light & Power Company, semi-annual, preferred 2½ per cent, payable March 1.

Twin City Rapid Transit Company, quarterly, preferred 1¾ per cent, common 1½ per cent, both payable April 1.

REPORTS OF EARNINGS.

Period.			Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
AMERICAN LIGHT & TRACTION COMPANY.							
1m.,	Dec.	'10	$427,098	$9,958	$417,131	......	......
1 "	"	'09	391,822	9,562	382,260	......	......
Yr.,	Dec.	'10	3,832,552	119,688	3,712,864	......	......
Yr.,	"	'09	3,345,441	106,261	3,239,180	......	......
COLUMBUS (OHIO) RAILWAY & LIGHT COMPANY.							
Year,		1910	$2,378,720	$1,618,223	$760,497	$1,011,975	*$234,170
Year,		1909	2,577,202	1,290,133	1,287,069	971,707	333,227
MASSACHUSETTS ELECTRIC COMPANIES.							
Yr.,	Dec.	'10	$2,015,771	$1,461,603	$554,167	$456,829	$97,337
Yr.,	"	'09	1,921,073	1,328,901	592,172	444,654	147,518
MEXICAN LIGHT & POWER COMPANY (Mexican Currency).							
1m.,	Dec.	'10	$736,260	$200,772	$535,488	......	......
1 "	"	'09	563,040	119,079	443,961	......	......
Year,		1910	7,234,308	2,070,866	5,163,442	......	......
Year,		1909	6,039,710	2,991,827	3,047,883	......	......
NASHVILLE RAILWAY & LIGHT COMPANY.							
Yr.,	Dec.	'10	$1,832,465	$1,030,016	$802,438	$402,426	$400,012
Yr.,	"	'09	1,724,380	1,013,883	710,497	394,353	316,144
NIAGARA FALLS POWER COMPANY.							
Yr.,	Dec.	'10	$2,203,134	$438,733	$1,764,400	$1,251,845	$665,061
Yr.,	"	'09	1,952,348	431,297	1,521,051	1,200,635	454,494
NORFOLK & PORTSMOUTH TRACTION COMPANY.							
1m.,	Dec.	'10	$179,111	$94,878	$84,233	......	......
1 "	"	'09	163,444	95,394	68,050	......	......
6 "	"	'10	1,079,823	598,059	481,764	......	......
6 "	"	'09	988,411	554,735	433,676	......	......
VIRGINIA RAILWAY & POWER COMPANY.							
1m.,	Dec.	'10	$197,794	$95,122	$102,672	......	......
1 "	"	'09	175,246	88,906	86,340	......	......
9 "	"	'10	1,131,892	560,588	571,304	......	......
9 "	"	'09	1,020,520	535,697	484,823	......	......

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*Deficit.

General News

Construction News.

MOBILE, ALA.—Preparations are being made by the Mobile Light & Railroad Company for building an extension to its Spring Hill Avenue line, several miles in length, to connect with the government street-car line in Mobile.

SPEIGNER, ALA.—Bids will be received by J. Craig Smith, president State Convict Bureau, Montgomery, Ala., for furnishing the electric supplies and accessories for the construction of main underground feeders from the hydroelectric power house at Speigner, Ala., to the State Cotton Mill, including wire, conduits, accessories, etc., to connect feeder panels at cotton mill with ten three-phase motors, materials for manholes and covers. Bids will be received for materials and construction work or for materials alone. Specifications can be obtained on application to Edgar B. Key, chief engineer, State Convict Bureau, Tuscaloosa, Ala.

BENSON, ARIZ.—The Board of County Supervisors has granted a franchise to R. G. Arthur to install an electric light plant in Benson. A company will be organized in the near future by M. J. Cunningham, S. F. Meguire, W. M. Adamson and Perter Jensen to take over the franchise.

BENTON, ARK.—The Benton Electric Light, Power & Ice Company has recently purchased a six-ton ice-making plant from the York Manufacturing Company, of York, Pa.

LITTLE ROCK, ARK.—Plans are being prepared by the Arkansas Interurban Railway Company for the construction of an electric railway from Little Rock to Hot Springs and a belt line in Little Rock, seventy miles in length. H. H. Edwards, 764 Oakwood Boulevard, Chicago, Ill., is interested in the proposed railway.

RUSSELLVILLE, ARK.—The Russellville Water & Light Company is planning to build an auxiliary steam power plant in Russellville to be completed by Aug. 1, 1911. The plant will be able to carry the entire load. The company expects to erect a transmission line to Atkins during the next six months. F. E. Leonard is manager.

WYNNE, ARK.—Preparations are being made to rebuild the municipal electric light plant at once, changing the system from direct to alternating current. Bonds to the amount of $50,000 will be issued soon to provide funds for same. W. H. Allnut is superintendent.

CALEXICO, CAL.—The Calexico Farmers & Merchants' Club has appointed a committee, consisting of J. B. Hoffman, J. F. Steintorf and H. J. Rick, to secure estimates of the cost of installing and operating an electric light plant in connection with the municipal water-works system.

COLTON, CAL.—The City Clerk has been authorized to advertise for an air compressor capable of furnishing 600 cu. ft. per minute, three 6-in. air lifts, two electric motors and two transformers.

DEL MAR, CAL.—The South Coast Land Company is contemplating the installation of another generating unit in its plant and extending its transmission lines. The installation of an ice plant in connection with the light plant is also under consideration. W. G. Abdill is manager and J. S. David is engineer of power station.

EL CENTRO, CAL.—Preparations are being made by the Holton Power Company, of Redlands, Cal., for the construction of a steam generating plant at El Centro, Cal., which will have an output of 1200 hp. The company will make improvements to its system this year, which will involve an expenditure of about $250,000, a large portion of which will be spent on the generating plant in El Centro. Contracts have been awarded for the building and a large portion of the machinery. W. F. Holt, of Redlands, Cal., is president of the company.

EUREKA, CAL.—The Vance Reedwood Lumber Company is reported to have awarded a contract to the Allis-Chalmers Company, of Milwaukee, Wis., for the installation of a large steam turbine and complete electrical equipment for an electric power plant at the Samoa Mills.

FRESNO, CAL.—The San Joaquin Light & Power Company has offered to furnish a site in Fresno, containing more than eleven acres, to the State of California for the State Normal School free of charge.

GILROY, CAL.—The Coast Counties Power Company has submitted a proposition to the City Council to lease the municipal electric-light plant for a term of five years, to make whatever extensions may be necessary, including Morgan Hill and adjacent districts, for which the city is to pay the cost after each proposed item has been approved by the Council. In return for the lease the company proposes to pay the city 10 per cent of the gross receipts during the period of the lease; it will guarantee that there will be no increase of rates during the term of the lease and also agrees to reduce the rates if sufficient patronage to justify such reduction is given the company. The municipal plant has not been operated at a profit since its installation.

LONG BEACH, CAL.—The contract for the installation of electric fixtures for lamps and motors in the new Polytechnic High School has been awarded to the Towne Electrical Company. A. B. Sturges is architect.

LOS ANGELES, CAL.—The Southwestern Sugar Company, of Los Angeles, Cal., recently incorporated, is reported to have purchased property near Perris, on the Santa Fé Railroad, where it proposes to erect a 500-ton sugar factory, at a cost of $500,000, plans for which are now being prepared. The plant will be equipped for electric motor drive throughout. D. Howarth, M. B. Jones and others are interested in the company.

MOORE'S FLAT, CAL.—Arrangements are being made by the Andy Fitz Mining & Milling Company for the erection of a mill at the Fruitvale mine. A generator will be installed to provide electricity for lighting. O. B. McKay is engineer.

OAKLAND, CAL.—The property and holdings of the East Shore & Suburban Railway Company, which operates an electric railway connecting Richmond and Oakland, have been acquired by the United Properties Company. It is said that the change in ownership of the East Shore & Suburban Railway means the extension of the Key Route into Richmond at an early date. William S. Tevis is vice-president of the railway company.

ORANGE, CAL.—The Merchants and Manufacturers' Association has appointed a committee to take charge of placing the ornamental lamp standards for the new lighting system. The standards are of cast iron and will cost $80 each. J. W. Morrison is a member of the committee.

PLACERVILLE, CAL.—It is reported that preparations are being made for the complete survey and placing of the power site, ditch rights and other interests at Chili Bar, owned by John Pearson, of Placerville and now under bond to the Sacramento & Sierra Railway Company. It is understood that the company proposes to erect a hydroelectric plant to furnish power to operate its railway. J. A. Graham, of Berkeley, Cal., has charge of the engineering work.

REDDING, CAL.—George L. Bancroft, of Denver, Col., has located a water-right three miles north of Redding, claiming 25,000 in. of water in the Sacramento River.

REDLANDS, CAL.—Plans have been prepared by the City Engineer for the installation of an ornamental street-lighting system for the business district of the city, bids for which will soon be asked. The cost of the system is estimated at about $14,000.

REDWOOD CITY, CAL.—The Sierra & San Francisco Power Company has filed amendments to its articles of incorporation. The principal place of business has been changed to Millbrae, Cal. The company is capitalized at $20,000,000. J. S. Thornton, Winfield Dorn, H. F. Jackson, George H. Whipple and W. Gregory are among the directors.

SACRAMENTO, CAL.—The contract for lighting the city for the year 1911 has been awarded to the Sacramento Electric, Gas & Railway Company. The new contract provides for the installation of new lamps by July 1 if the new style lamp suggested by the company is acceptable to the City Council.

SAN FRANCISCO, CAL.—The Tevis local system, which began furnishing electricity from a plant in the basement of the Whitney Building a year ago, under the name of the Consumers' Light & Power Company, has completed three additional plants under the United Light & Power Company as the holding company. One of these, the Equitable Light & Power Company, which has a plant in the Phelan Building, having an output of 2000 kw, began operations Jan. 16. The company also supplies steam heat through underground mains to the surrounding district. The plant of the Southside Light & Power Company, the third system, was started on the same date. The power station of the Southside company is located on Minna Street, near New Montgomery Street, which is equipped with a 2000-kw turbo-generator set, and will soon be ready to start operation. Westinghouse turbo-generators and Sterling water-tube boilers are used throughout the entire system. The Oakland branch, located at First and Alice Streets, under the name of the Central Oakland Light & Power Company, started commercial operation Jan. 14. The plant has an output of from 2000 to 3000 kw in two units. Electricity is distributed through several miles of underground conduits and contracts have been secured for considerable business.

DENVER, COL.—Acting on the suggestion of the Rocky Mountain Fire Underwriters' Association, following its recent inspection of the fire-fighting facilities in Denver, the Denver Union Water Company has arranged to make a complete electrolytic survey of its mains and to take up any necessary bonding with the Denver City Tramway Company. No damages are known to have resulted from electrolysis for four years.

FORT MORGAN, COL.—The city will purchase a 250-hp boiler for the municipal electric light and water plant in the spring. A 75-hp, 2300-volt General Electric motor for the pumping plant was recently purchased to be delivered March 1. George L. Cox is superintendent.

GRAND JUNCTION, COL.—Orders have recently been placed by the Grand Junction Electric & Ice Company, of Grand Junction, Col., for one forty-five-ton and one ten-ton high pressure side; a twenty-five-ton freezing and a sixty-ton distilling system.

TRINIDAD, COL.—The City Council is considering conduit, electrical and gasoline lighting ordinances, both of which are stipulated as part of the fire prevention improvements necessary before a lower classification and a rate reduction will be made by the Rocky Mountain Fire Underwriters' Association.

BRIDGEPORT, CONN.—Announcement has been made by the United Illuminating Company of a reduction in the price of electricity from 11 cents to 10 cents per kw-hour, the new rate to take effect from Feb. 1.

DANIELSON, CONN.—The Cochrane Power Company has given notice of its intention to apply to the superior court for authority to change its name to the Pomfret Power Company. The company is building a dam across the Quinebaug River near Cotton's Bridge, and has commenced work on the development of a power plant there.

STRATFORD, CONN.—At a recent town meeting the citizens voted to instruct the Selectmen to contract for 100 more lamps, in addition to the fifty authorized. An appropriation of $2,500 was made to pay for same.

MILTON, DEL.—The Milton Light, Power & Water Company is planning to erect an electric light and power plant in Milton to cost about $20,000. O. S. Betts, B. F. Walls and W. W. White, all of Milford, Del., are interested in the project.

WASHINGTON, D. C.—Plans have been presented to Congress by Major Judson for improving the street-lighting system on several miles of the prominent streets of the city which will involve an expenditure of about $12,000. It is proposed to erect the same style of lamp standards as are in use on Sixteenth Street.

JACKSONVILLE, FLA.—Preparations are being made by the Jacksonville Electric Company for the construction of power plant and pier on the Russell and Robinson estates, recently acquired. The cost of the power house is estimated at about $450,000. It is expected that work on construction of the plant will begin in March. The company is controlled by the Stone & Webster Engineering Corporation, of Boston, Mass. It is understood that Arthur L. Negus, superintendent of construction of the Stone & Webster Corporation, will have charge of the work.

PERRY, FLA.—The Perry Electric Company is contemplating installing a new 15-ton refrigerating plant this spring and disposing of its present 6-ton machine. J. H. Scales is secretary and treasurer.

CANTON, GA.—Plans are being considered to enlarge the municipal electric light plant during the present year. J. W. Alford is superintendent.

CARROLLTON, GA.—The Railroad Commission has granted the Gainsboro Telephone Company permission to increase its capital stock to $250,000. The company has recently been reorganized and the proceeds of the additional stock will be used for improvements to its plant.

DALTON, GA.—The City Council has authorized Mayor Trammel to secure options for a site for the removal of the water works pumping station. The electric light plant and water works station will be located on the same plot. A day service will be established in connection with the municipal electric light plant.

DALTON, GA.—Sealed proposals will be received by the Mayor and Board of Aldermen, Dalton, Ga., until Feb. 24 for furnishing material and construction work for the proposed extensions to the municipal electric light plant and water-works system and for construction of water-works pumping station and electric plant at Dalton, as follows: For furnishing approximately 225 tons 10, 8 and 6 in. cast-iron pipe and approximately 7 tons of special castings; 8 hydrants, 26 valves and 15 valve boxes; 1 150-hp boiler; 1 300-hp feed-water heater; 2 turbine pumps with direct-connected induction motors; 2 compound condensing engines with condensers; 2 150-kw alternating-current generators with a 5-panel switchboard; 1 35-arc regulator; building reinforced-concrete reservoirs and filter, power house and pumping station; erecting machinery and doing electrical construction work. Bids will be received for the whole or any part of the above work. Plans and specifications may be seen at the offices of the H. S. Jaudon Engineering Company, engineers, Savannah, Ga.; Atlanta, Ga., and at the office of W. M. Carroll, city clerk, Dalton, Ga. Copies of specifications may be obtained from the engineers by addressing them at Box 227, Dalton, Ga. Plans may be obtained by making a deposit of $25. Paul B. Trammel is Mayor.

BOISE, IDAHO.—The Boise Power, Light & Traction Company, which is making preparations for the construction of a large power plant on the Payette River. above Horseshoe Bend, and erection of transmission lines through the southern part of Idaho, states that its plans call for an ultimate development of 12,000 hp. The initial installation will provide for 5000 hp. A. L. Woodhouse is not general superintendent of the company, as reported in the issue of Jan. 12. M. M. Myers is secretary of the Boise Power, Light & Traction Company.

GRANGEVILLE, IDAHO.—The Grangeville Electric Light & Power Company is installing a hydroelectric unit consisting of a 500-hp Pelton-Francis turbine direct connected to a Westinghouse generator operating under a head of 59 ft. The wheel is of the double-runner cylindrical-case type. This plant supplies electricity for lamps and motors in Grangeville and the surrounding mining districts.

CARLINVILLE, ILL.—Bids will be received by the Board of Management of the Macoupin County Almshouse at the office of W. C. Seehausen, county clerk, until Feb. 7, for installing a lighting plant in the Macoupin Almshouse, specification for which may be obtained at the office of the county clerk.

COAL CITY, ILL.—Arrangements are being made by the Economy Light & Power Company, of Joliet, Ill., for the construction of a new power plant in Coal City, work on which will begin in the near future.

GIBSON, ILL.—The control of the Gibson Electric Light & Power Company, of Gibson, Ill., has changed hands. The new owners took possession of the property, which will be enlarged and improved under the direction of F. J. Postel, of Chicago, Ill., consulting engineer, who will serve as manager. The company supplies commercial and street lighting. A day service has already been established and special attention will be given to building up this end of the business.

BEDFORD, IND.—The City Council has decided to install a complete electric system at the water-works pumping station, plans for which are being prepared by W. L. Hurd, chief engineer of the Indianapolis Water Board.

LOGANSPORT, IND.—The city officials have refused the offer of the Logansport Heating Company to take over the municipal electric plant and to supply the city with electricity generated at its own plant, asserting that it can furnish power to the city at less than one-half it now costs the city to operate the municipal plant. The city officials claim the plant has been on a paying basis since 1905, the revenue from the plant being sufficient to purchase the machinery and rebuild the power house.

NOBLESVILLE, IND.—The Indiana Supreme Court has handed down a decision that the White River Light & Power Company, of Noblesville, Ind., is not prevented from the condemnation of land for a dam and backwater reservoir under the Act of 1909, granting the right to companies generating electricity.

PERU, IND.—The City Council is reported to have decided to install considerable new machinery and equipment in the municipal electric-light plant.

RICHMOND, IND.—The annual report of the municipal electric-light plant shows the total receipts for the year 1910 to have been $77,341 and the operating expenses $48,649, making the net earnings $28,692.

BURLINGTON, IA.—The construction of a power plant to develop from 50,000 to 100,000 hp in Burlington is reported to be under consideration. J. W. Albright is interested in the project.

CEDAR RAPIDS, IA.—At the annual meeting of the Cedar Rapids & Marion Telephone Company the executive committee was authorized to make extensions and improvements to its system, involving an expenditure of $50,000. Extensions will be made to the west side cables and conduits. J. M. Rider, of Cedar Rapids, Ia., is secretary and treasurer.

CENTRAL CITY, IA.—The City Council is considering the proposition to grant a franchise to Fred J. Cross to install an electric light plant in Central City, which will be submitted to a vote of the people. It is reported that Mr. Cross proposes to install a plant to cost $30,000 if granted a franchise.

IOWA CITY, IA.—Plans have been prepared for the construction of a large dam across the river at Steamboat Rock.

IOWA CITY, IA.—The City Council is reported to be contemplating the installation of an additional boiler and generator at the municipal water-works station for the purpose of generating electricity for lighting the streets of the city. Estimates are now being secured by the Council for cost of the same.

IOWA FALLS, IA.—O. F. Peterson, of Des Moines, Ia., has applied to the City Council for a franchise to supply heat and light in Iowa Falls for a term of twenty-five years.

MANY, IA.—The construction of an electric-light plant, water-works system and ice factory is reported to be under consideration by the municipality.

NEW LONDON, IA.—The City Council is reported to have awarded a contract to Leonard Waller for the construction of a temporary building for the municipal electric light plant, which was recently destroyed by fire. Arrangements have been made for a generator. Preparations are being made by the Council for rebuilding the plant.

RED OAK, IA.—The installation of new boiler equipment during the coming summer is under consideration by the Red Oak Electric Company. S. F. Schadel is secretary and manager.

OTTAWA, KAN.—Negotiations are under way between the Board of Water and Light Commissioners and the City of Williamsburg, Kan., with a view of supplying electricity to the City of Williamsburg from the municipal electric-light plant in Ottawa. W. O. Myers is manager of the municipal electric plant.

SCOTT, KAN.—The City Council is contemplating granting a franchise for an electric light and power plant. For further information address W. I. Silvey, city clerk.

SPRINGHILL, KAN.—At a special election held recently the proposition to issue $6,000 in bonds, the proceeds to be used to install an electric-light plant, was carried.

WAMEGO, KAN.—Plans are being considered for the installation of a 200-kw single-phase generator, direct-connected to Corliss engine, in the municipal electric plant next spring. D. A. Course is superintendent.

CADIZ, KY.—Plans are being considered by A. P. White & Company for the construction of a flour mill with an output of 150 barrels and an elevator having a capacity of 50,000 bu. The company proposes to build a hydroelectric power plant to supply electricity for operating the mill and also for other manufacturing plants and for lighting.

CALHOUN, KY.—Owing to the City Council and the Green River Light & Water Company being unable to come to an agreement in regard to rates the company has discontinued the street-lighting service and the use of water for fire protection. The Council refused to pay the rates demanded by the company.

DAYTON, KY.—The City Council has accepted the bid of the Union Light, Heat & Power Company, of Covington, Ky., for a twenty-year franchise in the City of Dayton. Under the terms of the franchise the company is to supply electricity to the residents of Dayton at the same rate given to the citizens of Newport. The city is also to receive a cash bonus of $200. The contract is to go into effect June 1, 1911.

GRAYSON, KY.—The Home Light Company is contemplating installing a larger plant provided it can dispose of the present equipment, which is in good condition. It is proposed to install generating equipment of sufficient output to provide for 1000 lamps of 16 cp and an 80-hp boiler. J. A. Bagby is secretary and manager.

HICKMAN, KY.—The Hickman Ice & Coal Company is preparing to establish a day service this season and is also contemplating the installation of a direct-connected unit, either a 100 or 150-kw alternating-current, 3-phase, 60-cycle generator. J. T. Dillon is manager.

SOMERSET, KY.—The plant and holdings of the Somerset Water, Light & Traction Company have been purchased by Joseph H. Gibson and associates for $78,000. The property includes the water-works system and pumping station, street railway, electric-light plant and ice factory. Improvements will be made to the property, involving an expenditure of about $50,000, and will include a new filter plant and engine.

AUGUSTA, MAINE.—The Moosehead Power Company will apply to the Maine Legislature for a charter to authorize the company to develop the water power on the Kennebec River between Moosehead Lake and the forks at the junction of the Dead River with the Kennebec, about forty miles above Waterville. Henry L. Harriman, of Chase & Harriman, 50 State Street, Boston, Mass., is reported to be interested in the project.

BRIDGEWATER, MASS.—The Bridgewater Electric Company is planning to extend its transmission lines to Prattown to supply electricity in that district.

BROOKHAVEN, MASS.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until March 8 for construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office building at Brookhaven, Mass., in accordance with drawings and specifications, copies of which may be obtained at the above office or from the custodian of site at Brookhaven, Mass. James Knox Taylor is Supervising Architect.

LYNN, MASS.—The State Board of Gas and Electric Light Commissioners has approved the issue of 1800 additional shares of capital stock, at $235 per share, as determined by the directors. The proceeds of 120 shares are to be used to take up bonds to the amount of $10,000 issued by the Marblehead Gas & Electric Light Company and other indebtedness of that company, amounting to $18,200, the payment of which was assumed by the Lynn Gas & Electric Company when the plant was purchased; the proceeds of 540 shares to be applied to obligations of the Lynn company on account of plant improvements; the proceeds of 180 shares for indebtedness incurred in improvements to the Marblehead plant, and the proceeds of 010 shares to be applied to further improvements and additions to plants.

MIDDLEBORO, MASS.—The residents of the Fall Brook and Rock districts have petitioned the Municipal Lighting Commissioners to extend the electric lighting service to those districts. The commissioners have agreed to extend the transmission lines, provided twenty subscribers can be secured between the present terminus of the line and the proposed extension.

MILFORD, MASS.—Plans are being prepared by the Milford Electric Light & Power Company for remodeling its systems in Milford and Hopedale at a cost of about $150,000. Improvements will be made to both the gas and electric systems.

NORTH ADAMS, MASS.—The Windsor Print Works has decided to install electric motors to operate various parts of its plant and machinery. Electricity will be furnished by the North Adams Gas Light Company. The present steam plant will be retained and a portion of the mill will be operated by steam. About thirty motors, aggregating 500 hp, will be installed.

DELANO, MICH.—Plans are being considered by the Board of Trustees to build and equip an entire new plant to replace the present municipal electric plant next summer. N. G. Sandberg is superintendent.

DETROIT, MICH.—The Public Lighting Commission has purchased the Fairview arc lamp circuit from the Edison Illuminating Company. At the time the village was annexed to Detroit the Edison company held the contract for street lighting, which was taken over by the City of Detroit.

ISHPEMING, MICH.—The Marquette County Telephone Company is planning extensive improvements to its system which will involve an expenditure of about $25,000. A. B. Miner is secretary.

ANOKA, MINN.—It is reported that the Great Northern Development Company, of Duluth, Minn., has been authorized to construct a dam at Coon Rapids, which, with the one to be erected in Anoka, will develop 35,000 hp.

IRON MOUNTAIN, MINN.—The Oliver Mining Company is reported to be building a power dam on the Menominee River, four miles above Iron Mountain, at a cost of $750,000.

MINNEAPOLIS, MINN.—The Minnesota & Ontario Power Company is reported to be contemplating the construction of a dam to develop power at Kettle Falls.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company is reported to have purchased extensive water rights on the St. Croix and Mississippi Rivers which will be developed as needed. The holdings include riparian rights and the dam sites, located several miles above St. Croix Falls, near Otsego, and in the villages of Clearwater and Monticello, together with the power development at Taylor's Falls and Minneapolis. It is proposed to erect a plant at St. Croix Falls, which will be a duplicate of the Taylor's Falls plant, which has an output of 25,000 hp.

ST. PETER, MINN.—Plans are being considered by the Water and Light Department for improvements and extensions to the municipal electric light system, which will include the reconstruction of most of the pole line, changing from streets to alleys; the installation of two additional motors, of 15 and 25 hp respectively, at Kasota, in March, which will necessitate the erection of additional pole line in that place, and the installation of transformers with a rating of 30 kw. Changes will also be made in the power house and the street lighting system in St. Peter, changing from series open arc to series Mazda lamps. William Eldred is manager.

VIRGINIA, MINN.—Plans are being considered by the Board of Education for the installation of private lighting system for the Roosevelt and the Technical High School Building, to cost about $14,000.

WADENA, MINN.—The Village Council is reported to have decided to erect a brick smokestack, 60 ft. x 80 ft., at the municipal electric-light plant.

HATTIESBURG, MISS.—Plans are being considered by W. S. F. and W. O. Tatum, of Hattiesburg, Miss., who were granted a franchise some time ago by the City Council to construct and operate a street railway and electric-light plant in this city, to begin work on construction of the same some time during this year.

AURORA, MO.—The citizens on Jan. 19 voted to grant a franchise to the Lawrence County Water, Light & Cold Storage Company to construct and operate electric and water plants in Marion. The company proposes to install a plant in Aurora at a cost of about $40,000.

McPHERSON, MO.—The Water and Light Commission is making investigations with the view of establishing a municipal electric light plant in McPherson.

ST. LOUIS, MO.—Arrangements are being made by property owners on Jefferson Avenue to install electroliers similar to those in use on Grand and Vandeventer Avenues. The cost of installing the standards and maintaining the lamps for one year will be paid by the property owners, and then it is proposed to ask the city to include the maintenance of the lamps in the general lighting fund.

KEARNEY, NEB.—The Federal Light & Traction Company is erecting a hydroelectric plant at Kearney, Wyo. About 1200 kw will be developed.

NORFOLK, NEB.—The City Council is considering the question of installing a municipal electric light plant in Norfolk. A special election will probably be called to vote on the proposition to issue $55,000 in bonds to pay for same.

PITMAN GROVE, N. J.—The Public Utility Commission has approved an ordinance passed by the Township Committee of Deptford, granting the Gloucester County Electric Company permission to erect a distributing system to supply electricity for lamps and motors in that town.

ALBUQUERQUE, N. M.—The Nash Electric Company, of Albuquerque, N. M., has been awarded the contract for the installation of electric power equipment in the new vanadium oxide plant, including generator, wiring, etc. W. A. Bonitz is vice-president and manager of the Vanadium Mines Company.

PORTALES, N. M.—Plans are being considered by the American Beet Sugar Company for the erection of a large beet sugar factory in Portales, N. M., and the installation of a large electric power plant and to construct an electric railway from Portales to Taiban, N. M., traversing the center of the proposed sugar beet district. The railway will provide both passenger and freight service. The company also proposes to [illegible] the wells for the farmers, install electric irrigating pumping plants, the cost of the latter to be paid by the farmer in twenty annual installments without interest.

ALBANY, N. Y.—Proposals will be received by the Board of Contract and Supply, Albany, N. Y., until Feb. 6 for lighting the streets of the city for a term of five years from June 21, 1911. Isidore Wa[illegible]an is secretary of the board.

BUFFALO, N. Y.—The Committee on Water of the City Council and the Commissioners of Public Works have approved the purchase of three steam turbo-generators with a rating of 5000 hp each for the new water-works pumping station from the Westinghouse Machine Company, of Pittsburgh, Pa., for $248,180. The generators will supply electricity for lighting the municipal buildings and streets in addition to operating water-works pumps.

EAST QUOGUE, N. Y.—It is reported that the village of East Quogue has decided to establish a lighting district and will enter into a contract with the Suffolk Light, Heat & Power Company for a period of five years for street lighting, with an option of extending the contract five years at the same price. Under the terms of the contract the company is to furnish forty incandescent street lamps at $18 each per year.

ITHACA, N. Y.—The Public Service Commission has authorized the Ithaca-Auburn Power Company to execute and issue a first-lien mortgage upon all its property to secure an issue in bonds to the amount of $750,000 and to issue $50,000 in capital stock. The company is authorized to issue presently bonds to the amount of $433,000, to be sold at not less than 85, the proceeds to be used for the acquisition of certain property from H. C. Mandeville, of Ithaca, for $100,000, for material and construction of an additional steam power plant, to cost $95,000, and for the construction of its distributing line and third-rail system for the New York, Auburn & Lansing Railroad Company, at a cost of $201,000.

NEWARK, N. Y.—The directors of the Wayne Telephone Company have approved plans for extensions and improvements to its system throughout the county which will involve an expenditure of about $55,000. The plans include improvements to the local system.

NEW YORK, N. Y.—Plans are being prepared by the New York Telephone Company for the erection of a fifteen-story telephone exchange building, with adequate foundation for twenty-five stories. The cost of the building with equipment is estimated at about $2,000,000.

CHARLOTTE, N. C.—The entire properties of the Charlotte Consolidated Construction Company, including the Charlotte Street Railway and the Charlotte Gas & Electric Company, have been transferred to the Southern Power Company interests, which were purchased some time ago. E. D. Latta, president of the Charlotte Electric Railway, Light & Power Company, will have charge of the local plants. The Southern Power Company now controls the electric railways, city and suburban, in Anderson, S. C.; Greenville, S. C., and Charlotte, N. C., and is building an interurban railway from Anderson, N. C., via Greenville, S. C., and Spartanburg, Gastonia, Charlotte, Greensboro and Durham, a total distance of 300 miles.

ARLINGTON, OHIO.—The Board of Public Affairs is planning to install a return tubular boiler, 72 ft. x 16 ft., and a water softener in the municipal electric plant during the coming year. R. E. Dillon is superintendent.

CLEVELAND, OHIO.—The stockholders of the Cleveland Railway Company on Jan. 26 authorized an issue of $35,000,000 in bonds. J. J. Stanley was re-elected president, and C. F. Emery and R. A. Harman, vice-presidents.

CLEVELAND, OHIO.—Bids will be received at the office of the Director of Public Service, City Hall, Cleveland, Ohio, until Feb. 7 for furnishing heat, light and power for the City Hall building. A. B. Lea is Director of Public Works.

DAYTON, OHIO.—The contract for the erection of a large addition to the Beaver power building in Dayton, Ohio, has been awarded to A. Bentley & Sons, of Toledo, Ohio.

PAWHUSKA, OKLA.—The Pawhuska Water and Light Department is contemplating the installation of 12,000 ft. of No. 2 copper primary circuit, and is in the market for a second-hand, 125-150-volt, single-phase, 60-cycle alternator, revolving armature, compound wound, Westinghouse or General Electric make preferred. L. P. Caldwell is superintendent.

RYAN, OKLA.—J. M. Thomas and associates are preparing plans for the construction of a 15-ton ice plant to be operated in conjunction with the municipal electric light plant. They propose to purchase steam power from the municipal plant. A day service will be established beginning about the middle of March. The Water and Light Department is contemplating submitting a proposition to the towns of Sugden and Terrell in the near future to extend its transmission lines to those places to supply electricity for lamps. J. M. Thomas is superintendent of the municipal plant.

ARLINGTON, ORE.—The City Council is reported to be considering the question of establishing a municipal electric-light plant in Arlington.

ASTORIA, ORE.—Plans are being made by the Nehalem Valley residents to organize a telephone company which will be known as the Nehalem Valley Telephone Company to build a telephone line from Astoria to Elsie, via Jewell, a distance of about forty miles. The company will be capitalized at $3,000. David Tweedle and James Jamieson are interested in the project.

COTTAGE GROVE, ORE.—The Cottage Grove Electric Company has been granted a twenty-five-year franchise. The company recently submitted a proposition to the City Council agreeing to make extensions and improvements to its system, involving an expenditure of $12,000, provided an extension to its present franchise was granted.

EUGENE, ORE.—Steps have been taken by the City Council for the installation of a municipal electric light system. The proposition to install a municipal plant will be submitted to the voters at the April election. The cost of the plant is estimated at from $15,000 to $30,000.

COATESVILLE, PA.—It is reported that application has been made at Harrisburg for a charter for the Chester Valley Electric Company by Philadelphia and New York capitalists, who have acquired several electric light and power plants in Chester County. It is said that the capital stock will be placed at $1,000,000 and $750,000 in bonds will be issued. The proceeds of the bonds will be used to erect a large power plant on Brandywine Creek, near Coatesville. The officers of the company are: A. B. Beadle, of New York, N. Y., president; W. W. Levering, of Philadelphia, Pa., secretary and treasurer, and J. Owen Roberts, of Philadelphia, Pa., counsel.

EBENSBURG, PA.—The Ebensburg Light, Heat & Power Company is reported to be contemplating improvements to its plant, including the installation of two generators.

INTERCOURSE, PA.—Preparations are being made by the Intercourse Electric Light, Heat & Power Company for extending its system to cover a large teritory in the vicinity of Mechanicsburg and New Holland. The company is contemplating shutting down its present power plant and securing energy for operating its system from a large power company in that vicinity. Enos L. Zimmerman is secretary and treasurer.

PHILADELPHIA, PA.—The Philadelphia Electric Company has purchased a site at the corner of Jefferson and Thirtieth streets, on which, it is reported, it will erect an auxiliary power plant.

PHILADELPHIA, PA.—An ordinance has been submitted to the Council asking for 125 additional lamps to be placed on Fifty-second Street north of Market Street, and twenty-one on Market Street between Fiftieth and Fifty-fourth Streets. A special communication was also submitted to the Council by Mayor Reyburn making a request for the twenty-one lamps on Market Street and for 100 additional lamps on Fifty-second Street south of Market Street.

PITTSBURGH, PA.—The Aluminum Company of America, Park Building, Pittsburgh, Pa., is reported to be contemplating the construction of a hydroelectric power plant on Little Tennessee River, for which preliminary surveys are being made and land and water rights purchased. As yet nothing definite has been determined on.

POTTSTOWN, PA.—Preparations are being made by the Philadelphia Suburban Gas & Electric Company for the erection of a new power house in Pottstown. The company will also build a substation in Sanatoga, Pa.

WARREN, PA.—The Warren & Jamestown Street Railway Company is planning to change its system from single-phase, alternating-current to direct-curent system, which will necessitate the construction of two new rotary converter substations, which will probably be located at Frewsburg and North Warren.

YORK, PA.—Preparations are being made by the Edison Electric Light Company for the construction of a new steam power plant, to be erected on North Water Street, York. The contract for the engineering work has been awarded to Westinghouse, Church, Kerr & Company, of New York, N. Y. A 2000-kw generating unit will be installed. When the new power station is completed the present plant will be used as an auxiliary plant. Gordon Campbell is president and manager.

CHARLESTON, S. C.—The City Council has engaged Rudolph Hering, of New York, N. Y., consulting engineer, to make investigations and prepare estimates on the cost of a new water and light plant for the city.

NEWBERRY, S. C.—The Southern Power Company has applied to the City Council for a sixty-year franchise in Newberry. The company has contracts to furnish electricity to operate the Mollohon Cotton Mill, the Oakland Mill, now in course of construction, and for the recent addition to the Newberry Mill. The company is extending its transmission line to Newberry, via Union and Whitmire. Preparations have been made for the erection of a substation in Newberry and the company is awaiting the action of the Council to begin work on same. It is expected to have the line completed by April 1.

SPARTANBURG, S. C.—The Spartanburg Railway, Gas & Electric Company, which is owned and operated by the Electric Power & Manufacturing Company, is contemplating further hydroelectric developments and extensions to its electric railways. The company has acquired the Palmer Shoals on the Broad River and the Nesbit Shoals on the Tiger River and another undeveloped water-power in the mountains which it proposes to utilize. It is proposed to extend the Clifton railway to Cowpens, two miles distanct, and the East Main Street line across Lawson's Fork and to Whitney; from there it is proposed to return by the water-works and join the North Church Street line. R. C. Crawford, of Pittsburgh, Pa., is president, and F. H. Knox, of Spartanburg, S. C., is vice-president and general manager.

SUMTER, S. C.—The plant and holdings of the Sumter Ice, Light & Power Company are reported to have been sold to Philadelphia interests It is understood that the consideration was $150,000.

HENRY, S. D.—The City Council is reported to have granted a franchise to the Henry Light & Power Company to install an electric light system in Henry.

MENNO, S. D.—Peter A. Orth has been granted a franchise to install an electric-light franchise in Menno.

COAL CREEK, TENN.—The Coal Creek Electric Light Company is making arrangements to install an ice plant and laundry in connection with its electric plant in the near future. J. P. Stanton is secretary and manager.

MURFREESBORO, TENN.—Preparations are being made by the Davis Elam Gas & Electric Company for the installation of a new plant in the near future.

NASHVILLE, TENN.—Arrangements are being made by the promoters of the Nashville-Gallatin Interurban Railway for selecting the route and making surveys for the proposed railway. It is expected that work on the road will begin in May. H. H. Mayberry is interested in the project.

BRYAN, TEX.—It is reported that J. T. Lawler, of New Orleans, La., who is planning to establish a flour mill in Bryan, proposes to install an electric plant and supply electricity in this city.

CELINA, TEX.—The Celina Electric Light & Power Company, recently incorporated, has been granted a franchise to construct and operate an electric-light plant in Celina.

CENTER, TEX.—The Center Ice, Light & Power Company has recently purchased a twenty-ton ice plant from the York Manufacturing Company, of York, Pa.

CLARKSVILLE, TEX.—The Clarksville Light Company has recently placed a contract with the York Manufacturing Company, of York, Pa., for a forty-five-ton compression side, ten-ton freezing system and twenty-five-ton distilling system.

COMMERCE, TEX.—The Commerce Ice & Power Company is contemplating the installation of another generator soon and making extensive improvements and extensions to its system. T. W. Smith is manager.

EAGLE LAKE, TEX.—The Eagle Lake Manufacturing Company is contemplating changing its system to 60 cycles and establishing a twenty-four-hour service. A. H. Koennecke is proprietor and manager.

GLEN ROSE, TEX.—Woodford M. Davis, of Dallas, Tex., is reported to be contemplating the construction of a dam across the Paluxy River nad building a hydroelectric power plant.

MADISONVILLE, TEX.—C. C. Murray & Sons, who have recently been granted a franchise to install an electric-light plant in Madisonville, will begin work at once on construction of eame. The plant will have sufficient output to provide for 1500 lamps of 16 cp. A company will be formed under the name of the Madisonville Light & Power Company to operate the plant. It is understood that an ice plant may be installed in the near future.

PECOS, TEX.—The Barstow telephone system, which operates in the Barstow section of the Pecos Valley, has been purchased by J. G. Gaither, president and principal stockholder of the Reeves County Telephone Company, which operates in the lower section of the Pecos Valley, with exchanges in Pecos, Yuvah and Balmorehea.

PROVIDENCE, TEX.—The Provident Land Company, which proposes to erect a fig-preserving plant in Providence, is reported to be interested in the installation of an electric-light plant.

TEMPLE, TEX.—The Gulf, Colorado & Santa Fé Railroad Company, which is planning to make improvements to its local shops, including the installation of additional machinery, is reported to be contemplating the installation of an electric light and power plant and also a steam-heating plant.

SPRINGVILLE, UTAH.—Owing to the present plant being unable to meet the demands made upon it, plans are being considered for the installation of a new municipal electric plant with an output of from 250 to 500 kw. The present plant has an output of 100 kw. The present plans call for a new pipe line, pressure pipe, water wheel, generators, switchboard, etc. Myron Manwaring is superintendent.

BURLINGTON, VT.—The Board of Aldermen has adopted a resolution authorizing the purchase of additional equipment for the municipal electric light plant, the cost not to exceed $27,000. The Electric Light Commissioners will soon call for bids for the installation of a new steam turbine.

FREDERICKSBURG, VA.—Application has been made to the City Council by C. P. Burgwyn, president of the Rappahannock Electric Light & Power Company, for an electric-light franchise in Fredericksburg.

MONTEREY, VA.—The W. F. Kyle Light & Plumbing Company is contemplating duplicating the present equipment of the plant. The plant is driven by a gasoline engine. W. F. Kyle is owner and manager.

METALINE, WASH.—It is reported that a franchise has been granted to W. W. Warner, representing the Sterling Silver Lead Company, to install electric light and power and telephone systems and to construct a water-works plant in Metaline.

NORTH YAKIMA, WASH.—The Pacific Power & Light Company has applied to the Board of County Supervisors for a franchise to erect thirty miles of pole line to supply electricity for lamps and motors for its telephone properties.

PASCO, WASH.—Plans are being prepared by the Hanford Irrigation & Power Company for extensions and improvements to its property in the valley and the construction of a hydroelectric power plant at Priest Rapids, enlarging and remodeling the pumping station at Coyote Rapids, increasing the capacity of the irrigating canal and the erection of a transmission line from Hanford down the river. New machinery will be installed in the power house at Priest Rapids.

SEATTLE, WASH.—At an election to be held March 7 the proposition to issue $800,000 in bonds, the proceeds to be used to purchase the equipment of the Seattle, Renton & Southern Railway Company, will be submitted to a vote. The City Council recently revoked the franchise of the company.

SEATTLE, WASH.—It is reported that the Board of Public Works has passed favorably on the proposition to construct a hydroelectric power plant on Lake Union, utilizing the waste water. It is expected that a large reservoir will be built in Volunteer Park and a steel pipe installed to convey the water to the plant. It is estimated that 2000 hp could be developed.

TACOMA, WASH.—The Metropolitan Park Commissioners have authorized Frederick Heath, acting president, to call for bids for ornamental lamp standards, lamps, wiring, etc., necessary for lighting Wright Park.

WARDEN, WASH.—Local business men are contemplating the installation of a telephone system in Warden.

FOLLANSBEE, W. VA.—The Council has granted the Steubenville & East Liverpool Railway & Light Company, of Steubenville, Ohio., a franchise to construct and operate an electric-light and power system in Follansbee for a period of thirty years. Under the terms of the franchise the company is to supply electricity for lighting the city buildings at the rate of 4 cents per kw-hour and 2000-cp arc lamps for street lighting for $66 each per year, and 80-cp incandescent lamps at the rate of $34 per lamp per year. Street lamps will not be installed at present, as the town cannot supply all the lamps needed owing to financial conditions. The chief object in granting the franchise was to allow manufacturing plants to secure electricity for lamps and motors.

WHEELING, W. VA.—The City Council has granted the Wheeling Electrical Company a franchise to erect and operate a pumping station at its new power station at Forty-second Street. The franchise runs for a period of fifty years, and in addition the company has permission to erect and maintain necessary wires and conduits. In consideration for the franchise the company is to pay the city $100 annually and to supply electricity for lamps for the Second and Fifth ward market houses free of charge.

COLUMBUS, WIS.—Bids will be received by R. J. Lueders, clerk until Feb. 7 for the reconstruction of power house of the municipal electric-light system.

MILWAUKEE, WIS.—The finance committee of the Common Council is reported to have made provision for an issue of bonds to the amount of $300,000 for the proposed municipal electric light and power plant, this sum forming the initial appropriation for same. Harry E. Briggs is Commissioner of Public Works.

MILWAUKEE, WIS.—The Board of County Commissioners of Milwaukee County has rejected all bids submitted for lighting the new $1,500,000 Grand Avenue viaduct by electricity. Vaughn & Meyer, consulting engineers, 909 Majestic Building, Milwaukee, Wis., have been authorized to submit plans for lighting the bridge.

MOSINEE, WIS.—The establishment of an electric-light plant in Mosinee is reported to be under consideration.

WESTFIELD, WIS.—Plans are being prepared by the Westfield Milling & Electric Light Company for the construction of a new power plant this year at an estimated cost of $5,000. A new 100-hp water wheel will be installed A new building will be erected adjoining the present power house. Clark Older is secretary and purchasing agent.

CASPER, WYO.—It is reported that the promoters of the Nebraska Coal & Power Company, recently organized, have made arrangements with an English syndicate to finance its project. The company proposes to construct an electric railway from Casper, Wyo., to Rawlins, Baggs and Dixon, all in Wyoming, and possibly to reach some towns in northern Colorado. The present plans include the erection of a large hydroelectric plant on the North Platte River and probably later on another plant on the Little Snake River. The company also proposes to supply electricity to mines and farmers along its lines. H. A. R. Gray is general manager.

CALGARY, ALTA., CAN.—The contract for equipment for the municipal electric plant is reported to have been awarded to Chapman & Walker, of Toronto, Ont., and includes one 1500-hp, 2300-volt, 3-phase, 60-cycle, 400 r.p.m. synchronous motor direct-connected to a 100-kw direct-current, 550-660-volt generator; one 200-kw motor generator exciter set, manufactured by Dick, Kerr & Company, Ltd., and complete switchboard apparatus, made by Cowans, Ltd., of Manchester, England.

STRATHCONA, ALTA., CAN.—It is reported that new machinery for the municipal electric-light plant has been recommended, to cost approximately $65,000.

STRATHCONA, ALTA, CAN.—Tenders will be received by David Ewing, chief engineer power house, municipal electric light plant, until March 1 for engine, boilers and generators, specifications for which may be obtained upon application to A. J. McLean, city engineer.

PORTAGE LA PRAIRIE, MAN., CAN.—The City Council has appointed a special committee to make investigations with the view of establishing an electric-light and gas plant to be owned and operated by the municipality.

ARNPRIOR, ONT., CAN.—The by-law authorizing the use of electricity for pumping water was carried. It is proposed to erect a hydroelectric plant on the Mississippi River at Galetta, which will be done by a private corporation.

HAMILTON, ONT., CAN.—Plans are being considered for the installation of equipment at the sewerage disposal pumping plant at the Beach. Electricity for operating the plant will be supplied by the Hydro-Electric Power Commission.

KINGSTON, ONT., CAN.—Alderman R. F. Elliott, chairman of the Civil Light, Heat and Power Committee, of Kingston, has been consulting with Adam Beck, chairman of the Hydro-Electric Power Commission, with a view of obtaining electricity for Kingston and other points in eastern Ontario. The commission, it is stated, hopes to secure power from Waddington, N. Y., for which investigations are being made to prepare plans and estimates of cost for same.

OTTAWA, ONT., CAN.—Engineers are now investigating the feasibility of developing a water-power on the Rideau River at Hog's Back, on the outskirts of the city. It is claimed that there would be a 30-ft. head available for power development.

STRATHROY, ONT., CAN.—The commissioners of the municipal electric-light and water plant are in the market for a 250-hp engine. A. MacLachian is superintendent.

TORONTO, ONT., CAN.—The City of Toronto will soon issue bonds to the amount of $1,000,000 to pay for installing the hydroelectric system in this city. Up to the present time $700,000 has been spent on the system within the city limits, which has been obtained by means of local loans; the proceeds of the bond issue will be used to carry the work forward.

TORONTO, ONT., CAN.—An important amendment to the Provincial Hydroelectric Act is under consideration by the Hydro-Electric Power Commission, under which provision will be made to supply farmers directly with electricity at their homes, which it is expected will be introduced to the present session of the Legislature. It is expected that a test of power for farm work will be made at the Ontario Agriculture College at Guelph, and after that it will be tried at private farms near Tilsonburg.

MEXICO CITY, MEX.—It is stated that the Canadian syndicate headed by Sir William Mackenzie, of Toronto, Ont., Can., which already owns extensive electric-light and railway systems in Monterey, Mex., has acquired the concession that was granted by the government some time ago for the construction of a large dam across the Balsas River and the installation of a hydroelectric power plant in the State of Guerrero. It is reported that the contract for construction of the dam has been awarded and will cost about $3,000,000 in gold. The proposed dam will be located in the canon of the river near the end of the Cueravaca, Mexico & Pacific division of the National Railways of Mexico.

New Industrial Companies.

THE AMMER SIGN COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $5,000 to deal in electrical signs, advertising, etc. The incorporators are: Albert Ammer, Herbert A. Combes, both of 817 Main Street; George E. Koch, 512 Brisbane Building, all of Buffalo, N. Y.

THE BRUCE-HIBBARD ELECTRIC COMPANY, of Fitchburg, Mass., has filed articles of incorporation with a capital stock of $50,000. The company controls the Leominster Electric Company and also has branches in Athol and Marlboro. The officers of the company are: Edward Bruce, of Fitchburg, Mass., president and treasurer; Albert E. Huestis, vice-president, and Paul Fielden, clerk.

THE CHILDS ELECTRIC WIND TURBINE COMPANY, of Dover, Del., has been incorporated with a capital stock of $2,000,000 by R. W. France, of Brooklyn, N. Y; L. A. Watson and C. H. Kulberg, both of New York, N. Y.

THE CLARK-NORWALK COMPANY, of Brooklyn, N. Y., has been incorporated by Harry Meinken, 1373 Dean Street, Brooklyn, N. Y.; E. M. Sceacht, Joseph G. Quinn, Jr., of 257 Broadway, New York, N. Y. The company is capitalized at $3,000 and proposes to manufacture motors, engines, vehicles, etc.

THE C. R. G. MANUFACTURING COMPANY, of Saugus, Mass., has been incorporated with a capital stock of $100,000 for the purpose of manufacturing engines, motors, etc. The officers are: C. R. Gunter, of Saugus, president, and R. A. Faye, of Boston, Mass., treasurer.

THE ELECTRIC MAGNET TOOL COMPANY, of San Francisco, Cal., has been incorporated with a capital stock of $200,000 by C. E. Frederickson, E. D. McCallam and G. S. Chamberlain.

THE ELECTRIC PROCESSING COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $5,000,000. The incorporators are: L. Jones, B. E. Hughes, A. J. Carroll, of Louisville, Ky.

THE FORD METER MANUFACTURING COMPANY, of Wabash, Ind., has been incorporated with a capital stock of $25,000 to manufacture water, gas and electric meters by E. H. Ford, T. W. McNamee and W. A. McNamee.

THE HANCOCK-HOWELL ELECTRICAL ENGINEERING COMPANY, of Buffalo, N. Y., has been chartered by Wheeler W. Hancock, Herbert H. Howell and George C. Hillman, all of Buffalo, N. Y. The company is capitalized at $5,000 and proposes to do a general contracting, electrical and mechanical engineering business.

THE HOYT ELECTRIC SALES COMPANY, of Indianapolis, Ind., has been incorporated with a capital stock of $20,000 by Francis R. Hoyt, David A. Myers and Harry A. Fenton. The company proposes to handle the entire output of the Hoyt Electric Company and also a certain device made by the company for lighting all kinds of self-propelled vehicles and other motor vehicles.

THE INTERSTATE ELECTRIC COMPANY, of Chicago, Ill., has been chartered with a capital stock of $2,500 by C. J. Huff, George Hornecker and Mrs. M. B. Huff. The company proposes to do a general electrical contracting business.

THE KIRTLAND ELECTRIC CONSTRUCTION COMPANY, of Albany, N. Y., has been granted a charter with a capital stock of $2,500 The company proposes to do a general contracting business and electrical work of all kinds. The incorporators are: Frank C. Kirtland, of Albany, N. Y.; Herbert E. Kirtland, of Rensselaer, N. Y., and Paul C. Heath, of Albany, N. Y.

THE RAILWAY BUILDING COMPANY, of New York, N. Y., has been granted a charter with a capital stock of $50,000 to do a general railway engineering and construction business and to deal in railway equipment and supplies. The incorporators are: Berkley C. Austin, Eugene W. Austin, both 76 William Street, and Walter L. Brunnell, 317 West 136th Street, all of New York, N. Y.

THE UNITED FUEL ECONOMIZER COMPANY has filed articles of incorporation with the Secretary of State with a capital stock of $150,000. The company proposes to act as selling agent for manufacturers of fuel-saving devices. The incorporators are: T. Bromley, Jr., H. C. Wagner and F. Balcom.

THE WHITE STAR MOTOR & ENGINEERING COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $3,000 by John T. Whalen, 1158 Dean Street, Robert J. Reutal, 120 Crystal Street, both of Brooklyn, N. Y., and George H. Beutel, 108 George Street, Evergreen, Queens. The company proposes to manufacture engines, machinery, etc.

W. A. BIRDSALL & COMPANY, of Newark, N. J., have filed articles of incorporation with a capital stock of $75,000 for the purpose of manufacturing vacuum cleaning supplies, heating and plumbing apparatus. The incorporators are: W. A. Birdsall, P. D. Elliott and H. Russomann, of Newark, N. J.

New Incorporations.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Sierra Blue Lakes Water & Power Company with a capital stock of $75,000 by Eugene J. Sullivan, Walter E. Sullivan and George H. Richardson. The company proposes to operate water and irrigation plants and supply electricity and water power. It also claims to own rights to the waters in Blue Lakes and the Mokelumne River, which it proposes to offer to the City of San Francisco, Cal., for $6,000,000.

MANASSA, COL.—The Manassa Milling & Electric Company has been incorporated with a capital stock of $50,000 by Samuel Jackson, Jr., Stephen A. Smith and James H. Elledge.

VINCENNES, IND.—The Vincennes Electric Company has filed articles of incorporation with the Secretary of State with a capital stock of $20,000. The company is operating an electric plant in Vincennes. The incorporators are: Albert J. Heintz, of Vincennes, Ind.; William T. Barnes and Charles W. Sherman, both of Boston, Mass.

RED CLOUD, NEB.—The East Garfield Telephone Company has been chartered with a capital stock of $10,000 by A. W. Shipman, I. H. Hawkins and Henry Emerton.

RED CLOUD, NEB.—The Nebraska & Kansas Telephone Company has been incorporated with a capital stock of $10,000 by W. G. Shannon, C. B. Steward and C. H. Arbuckle.

Personal.

MR. G. WILBUR HUBLEY, superintendent and engineer of the Louisville Lighting Company, was elected on Jan. 16 president of the Louisville Engineers and Architects' Club.

MR. THOMAS ROYCROFT, for many years superintendent of the Red River Power Company, has been elected superintendent of the Grand Forks (N. D.) Transit Company, to succeed Mr. A. W. Morrison, resigned.

MR. ARTHUR ORGUN, who was with the Jandus Electric Company until its recent consolidation with another concern, has entered in the general electrical supply business on his own account, with offices at 114 Liberty Street, New York.

MR. P. H. PALMER, electrical engineer of the Kokomo, Marion & Western Traction Company, gave an address Jan. 17 on "Power System Economics" before the Purdue Branch of the American Institute of Electrical Engineers, Lafayette, Ind.

MR. HAROLD KIRSCHBERG has resigned as illuminating engineer with the Pennsylvania Railroad Company to join the engineering staff of the Heany Company and its associated interests, the Novelty Incandescent Lamp Company and the Tipless Lamp Company.

MR. F. E. VOORHIES has resigned his position as superintendent of the Municipal Water Works and Electric Light Plant, Lafayette, La., to become consulting engineer for the cotton oil machinery trade. Mr. Voorhies is president of the Association of Cotton Oil Mill Superintendents.

MR. FRANK E. BROWN, formerly chief of the Department of Gas and Electricity, New York City, has joined with Mr. Halbert P. Hill to represent in the East the Triumph Electric Company and the General Concrete Construction Company. Mr. Brown will devote his time to large power-plant equipment.

MISS SARAH SHERIDAN, chief of the sales department of the Edison Electric Illuminating Company, of Detroit, has been appointed also to a similar position in the organization of the Eastern Michigan Electric Company, which serves the suburban territory within a radius of thirty miles of Detroit and is controlled by the Detroit company.

MR. R. C. LANPHIER, of the Sangamo Electric Company, Springfield, Ill., read a paper entitled "The Ampere-hour Meter for Electric Vehicles" at the annual meeting of the Society of Automobile Engineers, held at New York, Jan. 11 to 12. The paper gave a good many data as to the operation of electrically driven delivery wagons under commercial conditions.

MR. T. J. LYNCH, who for the past seven years has been manager of the Toronto office of Allis-Chalmers-Bullock, Limited, has been appointed manager of the Boston office of the Allis-Chalmers Company. Mr. Lynch was born and spent his early life in Boston and before going to Toronto was connected with the construction department of the Allis-Chalmers Company.

DR. EDWARD P. HYDE, of the National Electric Lamp Association, will deliver an experimental lecture on the physics of light sources before the Department of Electricity of the Brooklyn Institute of Arts and Sciences, on Wednesday evening, Feb. 8, at 8:15 o'clock, at the Academy of Music, Brooklyn, N. Y. All interested are invited. Subway cars may be taken to the Atlantic Avenue terminal, which is a short block from the Academy of Music.

MR. GEORGE WILLIAMS, connected with the firm of Henry L. Doherty & Company, lectured upon "Sign Lighting" before a large audience at the Twenty-third Street Branch of the Y. M. C. A. of New York City on Jan. 26. Mr. Williams claimed that many towns in the United States show proportionately much greater development in electrical sign display than does New York. The lecture was illustrated by stereopticon slides showing the "Great White Ways" of many of the best illuminated cities in the country.

MR. J. W. CUSHMAN, who for some time past has been special representative of the Fostoria Incandescent Lamp Company in North and South Carolina, has taken up a new position with the same company in Pennsylvania. Mr. E. V. Plane, the Fostoria representative in Georgia and Alabama, has taken Mr. Cushman's place in the Carolinas, while Mr. W. M. Tibbs, who for a number of years has been affiliated with various electrical interests in Knoxville, Tenn., will continue Mr. Plane's work in the middle South.

MR. EDWIN W. WINTER, for the past eight years president of the Brooklyn Rapid Transit Company, resigned his position on Jan. 27, to take effect immediately. Before coming to Brooklyn Mr. Winter had been connected with railroads for twenty-five years, having served as general superintendent and manager of the Chicago & Northwestern Railroad and president of the Northern Pacific Railroad. Under his presidency the Brooklyn Rapid Transit Company has been placed on a paying basis and obtained the general good will of the public, while he found it eight years ago staggering under a torrent of public condemnation and unable to pay any dividends.

MR. JOHN D. NIES, professor of electrical engineering in Lewis Institute, won the $2,500 electric automobile offered as first prize in the estimating contest at the Chicago Electrical Show. The task was to estimate the total number of feet of bare and covered wire on the four sections of an ornamental column that formed the central feature of the show. There were two layers of wire in each of the four sections, the insulated wire being underneath and invisible. The sections were tapering and the lowest one flared outwardly at the base in a slight curve. By an arithmetical calculation Professor Nies estimated the total length of wire at 19,415 ft. The measurement showed that the exact length was 19,416.1 ft. There were nearly 40,000 estimates of the length of the wire made in the competition.

MR. E. T. PARDEE, formerly manager of the Boston office of the Allis-Chalmers Company, has been appointed manager of the power and electrical department of the company at Milwaukee. Mr. Pardee was connected with the Western Union Telegraph Company at Syracuse, N. Y., from 1885 to 1891. Following this he represented the Fort Wayne Electric Corporation at Omaha and San Francisco from 1891 to 1898, being advanced in the latter year to manager of the Boston office, which position he held until 1901. In that year he entered the Boston office of the Bullock Electric Manufacturing Company as salesman and remained with the Allis-Chalmers Company in a similar capacity. Mr. Pardee was made manager of the Boston office of Allis-Chalmers Company in 1905.

PROF. MORGAN BROOKS, of the University of Illinois, addressed a joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers at a meeting held at the rooms of the latter in Chicago on Jan. 25. His title was "Inductions from a Closed Circuit of the Globe," and the lecture was based on observations and pictures gathered during a recent trip around the world. Professor Brooks said that the Japanese will soon do their own engineering work. In relation to the copying of machinery in that country the speaker pointed out that foreign inventors are to blame for not taking out patents in Japan. There are engineering colleges at Tokio and Kioto, and in their electrical laboratories are dynamos from Italy, France, Germany and England. In electrical matters the Japanese are well advanced.

MR. R. M. VAN VLEET, Chicago manager for the Cutler-Hammer Manufacturing Company since 1904, has left Chicago to take up work of greater responsibility in the executive offices of the same company at Milwaukee. After graduating from the Westinghouse students' course at Pittsburgh Mr. Van Vleet took up construction work and later acted as electrical engineer for a shipbuilding company. In 1903 he entered the employment of the Cutler-Hammer company at Pittsburgh and in the following year was made manager of the company's office at Chicago. Mr. Van Vleet has been active in the Electric Club of Chicago and has been one of the national officers of the Sons of Jove, acting as Mercury, or secretary, for the last two years. As an expression of the regard in which he is held by his Chicago associates a complete chafing-dish outfit of copper, handsomely mounted on a tray of Circassian walnut, was presented to Mr. Van Vleet.

MR. H. M. HOBART was the guest of honor on Jan. 21 at a dinner in London which was tendered by professional friends in view of Mr. Hobart's coming departure from Great Britain to join the engineering staff of the General Electric Company at Schenectady. Mr. H. F. Parshall presided and about a hundred of Mr. Hobart's friends were present. Mr. Hobart is a native-born American and upon graduation from the Massachusetts Institute of Technology joined the engineering staff of the Thomson-Houston Company, later remaining with the General Electric Company. In 1895 he went to Europe to join the British Thomson-Houston Company and was responsible for the electrical design of many important power-house and traction schemes. From 1900 to 1903 he was with the Union Elektricitats Gesellschaft, Berlin, as chief designing engineer for direct-current machinery. Since 1903 he has practised as a consulting engineer in London and lectured on electrical engineering before some of the leading technical colleges. Mr. Hobart is the author of a number of works on electric machine designs, several of which have been translated into French and German.

Obituary.

MR. ALBERT WESTEEN, for ten years manager and superintendent of the Horton Water & Light Company, of Horton, Kan., died suddenly in Galesburg, Ill., his native city, on Jan. 21. Mr. Westeen was forty-nine years of age and leaves a widow. He was in Galesburg settling up his mother's estate when he was taken suddenly ill with an attack of heart disease, which resulted in his death. Mr. Westeen was highly regarded by the people of Horton and by his business associates. He was buried in Horton on Jan. 25.

Trade Publications.

PROJECTOR LAMPS.—The Universal Electric Stage Lighting Company, of New York, has issued a folder illustrating the various Kliegl lamps, pockets, plugs, etc., for stage work.

SWITCHBOARD METERS.—Machado & Roller, of New York, have issued an illustrated bulletin describing the shunted astatic switchboard type of Columbia meter made by the Columbia Meter Company, for which the concern acts as selling agent.

TESTING AND PRECISION APPARATUS.—The Leeds & Northrup Company, of Philadelphia, has issued a number of bulletins on its electric testing instruments. These include potentiometers, resistance pyrometers, thermocouple potentiometers and resistance standards.

GROUNDING DEVICE.—In a bulletin just issued by the Paragon Sellers Company, Chicago, Ill., are given some facts about grounding. The company manufactures the Paragon ground cone applicable for electric light, telegraph, telephone, trolley and railroad signal circuits, and the bulletin gives illustrations and methods of installing the cones for these various services.

ASH-HANDLING SYSTEM—Catalog No. 8 of the Green Engineering Company, Chicago, Ill., emphasizes the salient features of the company's pneumatic ash-handling systems. These are adaptable to almost any arrangement of building structures, and may be installed irrespective of the angles of direction or the difference of elevation between points of accumulation and final disposal of ashes.

TWELVE-HUNDRED VOLT RAILWAY.—The Washington, Baltimore & Annapolis Railway some time ago was converted from a 6600-volt, single-phase road to a 1200-volt, direct-current road, and an article descriptive of the system was published by Mr. J. R. Hewett in the *General Electric Review*. Bulletin No. 4808 of the General Electric Company is a reprint of the article in question.

TUNGSTEN FIXTURES.—Bulletin No. 8 of the Benjamin Electric Manufacturing Company, Chicago, Ill., contains a line of fixtures and accessories especially designed for the use of the tungsten lamp. Reflector sockets with both flat-cone and bowl-shaped reflectors, street lighting fixtures for low-voltage and high-voltage circuits, and multiple and series sockets for large base lamps are featured.

ELECTRIC AUTOMOBILES.—The 1911 models of the Babcock electric carriages are shown in a catalog issued by the builder, Babcock Electric Carriage Company, Buffalo, N. Y., which has been manufacturing electrics for over twelve years. Eight models are illustrated and described, all of which are fitted with Philadelphia or Edison batteries. An exclusive feature of the vehicles is the foot control for stopping and for graduating the speed of the car.

BUSINESS NOTES.

THE POWER & MINING MACHINERY COMPANY moved its Chicago office to 825 Old Colony Building on Feb. 1.

THE MATSINGER DEVICE COMPANY, manufacturers of magnetos and other electrical appliances, has removed its factory and offices from Pendleton, Ind., to Lafayette, Ind.

THE CHICAGO ELECTRIC METER COMPANY, 400 South Hoyne Avenue, Chicago, manufacturer of printing attachments for meters, has equipped its factory for the repairing and calibrating of meters of all kinds. The company has added to its force several meter experts and is well equipped for this class of work.

ENGINE LUBRICATION.—Three interesting bulletins, Nos. 01, 02 and 03, all of which treat of lubrication and especially of the White Star continuous oiling system, have been issued by the Pittsburgh Gage & Supply Company, Pittsburgh, Pa. The system is applicable to small as well as large engines, pumps, compressors, etc.

ELECTRIC FANS.—The Peerless Electric Company, Warren, Ohio, has issued its 1911 fan catalog, in which are described and illustrated ceiling, desk, bracket and oscillating fans for both direct-current and alternating-current circuits. The fans are of practically the same design as those of last year and embody only very slight changes in detail.

ELECTRIC FANS.—In Bulletin No. 5352 issued by the Western Electric Company are listed this year's models of "Hawthorn" fans. The line comprises the following types: Desk and bracket, oscillating, residence, telephone booth, battery, ceiling and column and ventilating outfits. The bulletin is contained within a stiff cover of bluish-gray, with an attractive cover design.

THE WELCHELL ELECTRIC COMPANY.—The plant of the Welchell Electric Company, of Anderson, Ind., has been purchased by F. R. Hoyt, of the Hoyt Electric Company, of Indianapolis, Ind., which manufactures a high-tension magnet for automobiles and also low-tension magnet for stationary engines. It is understood that the plant will be moved to Indianapolis, Ind.

ICE MACHINES FOR CENTRAL STATIONS.—The York Manufacturing Company, York, Pa., has recently sold ice-making auxiliaries to central-stations, as follows: Center Ice, Light & Power Company, Center, Texas (20-ton); Clarksville Light Co., Clarksville, Texas (10-ton); Grand Junction Electric & Ice Co., Grand Junction, Col. (25-ton); Electric Light & Power Co., Benton, Ark. (6-ton).

MEAD-MORRISON COAL-HANDLING INSTALLATIONS.—The Mead-Morrison Manufacturing Company has closed contracts with the Boston Elevated Railway for installing a complete new coal-unloading and storage plant for its new power house at South Boston, including unloading cars of the latest design, cable road and rehandling and pick-up bridge, and with the Edison Electric Illuminating Company of Boston for equipping its plant at South Boston with coal-handling machinery.

TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has recently opened a sales office at 728 Poydras Street, New Orleans. This is the sixteenth sales office now being maintained by this company and is the third to be opened during the past year. The Triumph Company in its new factory is turning out a large amount of work and anticipates even greater returns during the coming year. A large stock of standard machines will be carried at the New Orleans office for immediate shipment.

ELECTRIC HOME LAUNDRY MACHINES.—The Hurley Machine Company, of Chicago, has issued a booklet (No. 50) devoted to the Thor electric washing and wringing machine. A series of pictures is given to show how this machine robs washday of its terrors. It is said that by its use a whole week's washing for a family of six may be accomplished in ninety minutes. Three sizes of the machine are illustrated. The motors are large enough to operate the washing machine and wringer at the same time.

ELEVATOR CONTROLLERS.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has issued a booklet describing the line of electric elevator controllers developed by the J. L. Schureman Company, of Chicago, Ill., and which are now built by the Cutler-Hammer Manufacturing Company. The controllers are applicable for direct-current and alternating-current circuits, and the particular types best suited for certain specified classes of service are pointed out. Outfits for passenger, freight and dumbwaiter service are described, as well as the accessories and various methods of control.

THE MORRIS IRON COMPANY.—The Morris Iron Company, of Frederick, Md., will take over the business of the Elmer P. Morris Company, Frederick Iron Works, Frederick, Md., and the Montrose Iron Works. These companies have been large manufacturers of iron goods, making a specialty of outdoor lighting fixtures and material. Mr. Elmer P. Morris becomes the manager and vice-president of the company. The present facilities will be greatly enlarged and the general policy continued. Stocks will be carried at the factory and at the warehouse in New York. The sales office is located at 88 West Street, New York City.

CEMENT PLANT ELECTRICAL EQUIPMENT.—The Michigan Cement Company has ordered a complete electrical equipment from the General Electric Company for its cement plant now in course of construction at Chelsea, Mich. At first only part of the electric power will be generated for the operation with two three-phase generators with exciters, one of 200 and the other of 150-kw capacity, the deficiency of power to be purchased. Thirty-five induction motors, aggregating 1133 hp capacity, have been ordered for driving the various machines. The switchboard for controlling the output of the two generators and the power company's service transformers will consist of seven panels, two three-phase, 60-cycle generator and exciter panels, four power feeder panels and one lighting and power feeder panel. A 30-kw transformer, which will carry a lighting load, is included in the order.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Geo. S. Emery, 11 N. Royal St., Mobile, Ala.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next semi-annual meeting, New York City, April or May, 1911.

American Electro-Therapeutic Association. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York. Next meeting at Philadelphia, Pa., Sept. 5, 6 and 7, 1911.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Electric Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Electric Railway Engineering Association. Secretary, Norman Litchfield, Interborough Rapid Transit Company, New York.

American Electric Railway Association. Secretary, H. C. Donecker, Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark.

Association of Iron and Steel Electrical Engineers. Secretary, James Farrington, Steubenville, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Boston, Mass., June, 1911.

Association of Railway Electrical Engineers. Secretary, J. Andreucetti, Chicago & Northwestern Railway, Chicago. Next annual meeting, Chicago, November, 1911. Semi-annual meeting, Washington, 1911.

Association of Edison Illuminating Companies. Secretary, N. T. Wilcox, Lowell, Mass.

Canadian Electrical Association. Secretary, T. S. Young, 220 King St. West, Toronto, Can.

Canadian Street Railway Association. Secretary, Allen H. Royce, 48 King St. West, Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Colorado Electric Light Power & Railway Association. Acting Secretary, F. D. Morris, 323 Hagerman Building, Colorado Springs, Col.

Eastern States Independent Telephone Association of Pennsylvania, New Jersey, Maryland and Delaware. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

Electric Vehicle Association of America. Secretary, Harvey Robinson, 124 West 42d St., New York.

Electric Club, Chicago. Secretary, F. S. Hickok, 824 Marquette Building, Chicago. Meets every Wednesday noon, 303 Wabash Ave.

Electrical Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursday of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R Staveley, Royal Insurance Building, Montreal, Can.

Electrical Credit Association of Chicago. Secretary, Frederic P Vose, Marquette Building, Chicago.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York Board of directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B Chapin, Engineering Societies Building, 29 West 39th St., New York.

Engine Builders' Association of the United States. Secretary, C. H. Lembower, Reading, Pa.

Florida Electric Light & Power Association. Secretary, H. C. Adams, West Palm Beach, Fla. Next meeting, Jacksonville, Fla., April 4 and 5, 1911.

Illinois State Electrical Association. Secretary, H. E. Chubbuck Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago. Annual convention, Chicago, 1911.

Independent Electrical Contractors' Association of Greater New York. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

Indiana Electric Light Association. Secretary, J. V. Zartman, Indianapolis, Ind.

Internal Combustion Engine Association. Secretary, Chas. Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

International Association of Municipal Electricians. Secretary, C. R. George, Houston, Tex. Next meeting, St. Paul, Minn., 1911.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

Iowa Electrical Association. Secretary, W. N. Keiser, Dubuque, Ia. Next meeting, Davenport, Ia., April 19, 20 and 21, 1911.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Davenport, Ia., April, 1911.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Independence, Kan., Sept. 21 and 22, 1911.

Maine Electrical Association. Secretary, Walter S. Hyman, Waterville, Maine.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electric Association. Secretary, Herbert Silvester, Detroit, Mich.

Minnnesota Electrical Association. Secretary, T. C. Gordon, Little Falls, Minn.

Mississippi Electric Association. Secretary, A. H. Jones, McComb City Light and Power Co., McComb City, Miss.

Missouri Electric, Gas, Street Railway & Water Association. Secretary, N. J. Cunningham. Next meeting, St. Louis, April, 1911.

National Arm, Pit & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National District Heating Association. Secretary, D. L. Gaskill, Greenville, Ohio.

National Electric Light Association, New England Section. Secretary-Treasurer, L. D. Gibbs, 39 Boylston Street, Boston, Mass.

National Electric Light Association, Pennsylvania Section. Secretary-Treasurer, Van Dusen Rickert, Pottsville, Pa.

National Electric Light Association, Nebraska Section. Secretary-Treasurer, S. J. Bell, David City, Neb.

National Electric Light Association, Georgia Section. Secretary-Treasurer, H. M. Corse, Columbus Railroad Company, Columbus, Ga.

National Electric Contractors' Association of the United States. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Niagara Falls, July 19, 1911.

National Electric Light Association. Executive Secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York.

National Electrical Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn. Next meeting, New York, March, 1911.

National Electrical Credit Association. Secretary, Frederic P. Vose, 343 Marquette Bldg., Chicago.

National Independent Telephone Association. Secretary, A. C. Davis.

Nebraska Electrical Association. Secretary, Frank McMaster, Beatrice, Neb.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New England Electrical Trades Association. Secretary, [illegible] F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New Orleans Electrical Contractors' Association. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

New York Electrical Society. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York.

Northwest Electric Light & Power Association. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting at Youngstown, May 18 and 19, 1911.

Oklahoma Public Utilities Association. Secretary, Galen Crow Guthrie, Okla.

Order of Rejuvenated Sons of Jove. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Building, Chicago, Ill.

Pacific Coast Electric Vehicle Association. Secretary, A. H. Halloran, 604 Mission St., San Francisco, Cal.

Pennsylvania Electric Association. Secretary-Treasurer, Van Dusen Rickert, Pottsville, Pa.

Pennsylvania Street Railway Association. Secretary, Charles H. Smith, Lebanon, Pa.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings, second Saturday of each month.

Pittsburg Electric Booster Club. Recording Wattmeter, O. R. Rombach, 919 Liberty Ave., Pittsburg, Pa. Meetings, fourth Monday of each month.

Railway Electric Supply Manufacturers' Association. President, A. C. Moore, Safety Car Heating & Lighting Co., Chicago.

Society for the Promotion of Engineering Education. Secretary H. H. Norris, Cornell University, Ithaca, N. Y.

Society of Wireless Telegraph Engineers. Secretary, E. D. Forbes Box 63, Brant Rock, Mass. Monthly meeting, first Monday of each month.

Southwest Electric & Gas Association. Secretary, E. T. Moore, Dallas, Tex.

Street Railway Association of the State of New York. Secretary, C. G. Reel, Kingston, N. Y.

Underwriters' National Electrical Association. Secretary Electrical committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1911.

Vermont Electrical Association. Secretary, A. B. Marsden, Manchester Center, Vt.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 145 Monroe St., Chicago, Ill.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Wireless Institute. Secretary, Alfred N. Goldsmith, College of the City of New York, New York.

Wisconsin Electrical Association. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JAN. 24, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

982,248. FLEXIBLE CONDUIT; A. E. Chernack, Boston, Mass. App. filed Dec. 20, 1909. Avoids buckling the tube by having inner and outer tubular layers of woven fabric and two intermediate layers of paper, coiled spirally with waterproof composition.

982,253. OIL-SWITCH; S. B. Condit, Jr., Boston, Mass. App. filed March 16, 1909. An oil pan with hinged cover carrying a switch below the cover with operating mechanism for the switch on the upper side of the cover.

982,266. IMPEDANCE DEVICE; W. R. Garton, Chicago, Ill. App. filed Nov. 11, 1907. A coil of insulated wire of high impedance with a sheet surrounding it of metal such as iron and an electrically-grounded terminal, grounded through a lightning arrester, alongside of the coil.

982,274. PRINTING TELEGRAPH; C. K. Jones, Kansas City, Mo. App. filed Sept. 2, 1909. Selecting relays so that the operation of a single relay in the main line circuit controls the selective action of the selective relays and any one of a plurality of type bars. Three groups of operating magnets for printing lower case, upper case, and the third group for operating the keyboard of a typesetter.

982,275. PRINTING TELEGRAPH; C. K. Jones, Kansas City, Mo. App. filed Sept. 14, 1909. Provides three sets of printing and operating magnets controlled by circuit-making relays which may be increased or diminished in number with a transmitter, a receiver, selecting relays which select the particular magnet corresponding to the letter or signal and means controlled by a single line circuit for controlling the circuit-forming relays.

982,276. PRINTING TELEGRAPH; C. K. Jones, Kansas City, Mo. App. filed Jan. 17, 1910. Electrically controlled selecting relays, primary selecting relays, secondary selecting circuits with relays in clusters, the relays in each cluster succeeding the first connected relay for simultaneous operation, each secondary relay but the last controlling the circuits through the contacts of a plurality of relays of the next cluster, printing magnets connected to the secondary relays, a retarding set of relays, the final relay of which set is operated by long pulses, a restoring circuit operated by the final relay passing through the selecting relay and primary relays.

982,281. HIGH-TENSION CURRENT PROTECTION; C. J. Lincoln and E. E. Weil, New Orleans, La. App. filed July 8, 1908. A spark gap having knife edges and needle points near the edges separated by an air gap.

982,284. SAFETY DYNAMIC BRAKING SYSTEM FOR HOISTS; J. S. McKee, Pittsburg, Pa., and J. F. Schnabel, New York, N. Y. App. filed Jan. 8, 1909. A motor with two dynamic breaking circuits, including the armature and field, a switch for each circuit and means whereby one switch controls the other so that when one is closed the other is open.

982,288. PREPARATION OF NITROGEN COMPOUNDS. E. H. Meyer, Niagara Falls, and J. M. A. St[illegible]lesen, Centre, Canada. App. filed Sept. 15, 1908. Prepares lime nitrogen by treating calcium carbid with nitrogen and eliminating carbon from the resulting product by oxidation with carbon dioxide.

982,331. THERMOSTATIC DAMPER CONTROLLING APPARATUS; B. C. Wickes, Auburn, N. Y. App. filed March 27, 1908. A damper regulator with damper actuating mechanism, a spring motor operating it and a thermostat and electric connections for actuating the dampers with a safety cut-out switch for causing the dampers to be moved into open draft position.

982,345. CANOPY SWITCH; R. B. Benjamin, Chicago, Ill. App. filed Dec. 28, 1907. Rotary make and break switch operated by a pull cord, for connecting one or more lights in circuit arranged in a canopy to be attached to the ceiling.

982,346. ELECTRICALLY-OPERATED AUTOMATIC CUT-OFF; P. A. Brown, Denver, Colo. App. filed Dec. 20, 1909. An automatic cut-out with slide bar, circuit closer and wires with a pair of magnets, an armature actuated by the magnets and a non-conducting link connecting the armature with the slide bar, contacts in circuit with the magnets actuated by the slide bar and contacts actuated by the circuit-closer, with means for preventing the recoil of the armature.

982,352. ELECTRIC SIGN; A. V. Diehl, Englewood, N. J. App. filed Dec. 31, 1909. An electric sign with a base, two parallel strips, a letter block between the strips with resilient contacts and a combined contact and catch for resiliently engaging one of the contact members on one of said strips.

982,362. MOTOR CONTROLLER; C. T. Henderson, Milwaukee, Wis. App. filed May 14, 1910. For motor-operated skip hoists, with means for starting and stopping the motor and automatically-operated means controlling the former to cause the motor to start after the load reaches a certain weight and to stop when the load has reached a certain position.

982,365. MOTOR CONTROLLING DEVICE; A. J. Horton, White Plains, N. Y. App. filed June 1, 1909. A motor controlling device with a pivoted resistance element, a longitudinally movable operating member and a switch member resiliently mounted upon the operating member, the latter moving the pivoted resistance element after the switch has engaged its contacts.

982,377. DYNAMO ELECTRIC MACHINE FOR MAINTAINING A CONSTANT ELECTROMOTIVE FORCE UNDER VARIATIONS OF SPEED; M. M. W. Mackie, Ealing, England. App. filed Aug. 24, 1906. An electric supply system with work circuit and multipolar dynamo with magnetizing winding on all of its poles, a demagnetizing winding on some poles in parallel, a storage battery supplying the work circuit in opposition to the dynamo through the demagnetizing winding, the arrangement allowing only a small current to flow when the normal voltage of the dynamo obtains and a regulating current to flow when the speed exceeds normal.

982,407. ELECTRODE FOR FLAMING ARC LAMPS; M. W. Allen, and W. T. Conn, Lakewood, Ohio. App. filed April 23, 1909. Has a wire extending through the electrode from end to end and projecting from the top, the projecting end being mechanically and electrically connected to the electrode, embedded in metal.

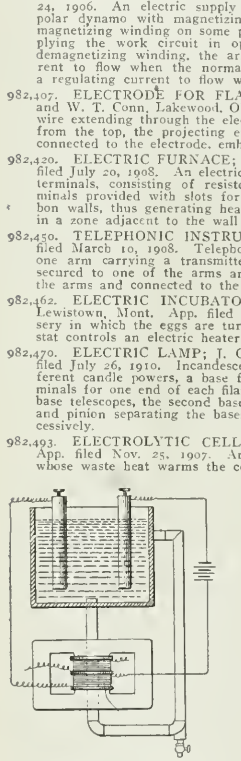
982,420. ELECTRIC FURNACE; C. F. J. Forssell, Cleveland, O. App. filed July 20, 1908. An electric furnace with a resistance between the terminals, consisting of resistor tubes fitting into water-cooled terminals provided with slots for charging them, the tubes having carbon walls, thus generating heat necessary to maintain a temperature in a zone adjacent to the wall as high as that of the wall itself.

982,450. TELEPHONIC INSTRUMENT; S. L. Van Akin, Jr. App. filed March 10, 1908. Telephone with hollow arms hinged together, one arm carrying a transmitter near the junction, a receiver also secured to one of the arms and circuit connections passing through the arms and connected to the receiver and transmitter.

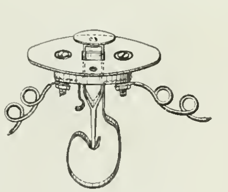
982,462. ELECTRIC INCUBATOR AND NURSERY; A. Beckstrom, Lewistown, Mont. App. filed March 11, 1909. Incubator and nursery in which the eggs are turned by a traveling belt and a thermostat controls an electric heater which heats the incubator.

982,470. ELECTRIC LAMP; J. O. Camp, Jr., Jacksonville, Ala. App. filed July 26, 1910. Incandescent electric lamp with filaments of different candle powers, a base for the lamp with separate circuit terminals for one end of each filament, another base into which the first base telescopes, the second base adapted to a lamp socket and a rack and pinion separating the bases so as to throw in the filaments successively.

982,493. ELECTROLYTIC CELL; A. S. Hickley, Manasquan, N. J. App. filed Nov. 25, 1907. An electrolytic cell with a transformer whose waste heat warms the cell.



982,493.—Electrolytic Cell.



982,544.—Electrical Floor or Wall Connector.

982,494. ELECTROLYTIC ALTERNATING CURRENT RECTIFIER; A. S. Hickley, Manasquan, N. J. App. filed June 26, 1908. Electrolytic elements in opposition with a circuit provided with translating devices bridging elements of like polarity for electrolytic-alternating current rectifiers whereby the hydroxid of aluminium is always ready formed and the cell ready to work.

982,503. INCUBATOR ALARM; W. M. Kelly, Herkimer, N. Y. App. filed July 1, 1909. Gives an audible alarm through a thermostat and electric circuit when the temperature rises or falls above a predetermined point.

982,519. AUTOMATIC SAFETY DEVICE FOR ELEVATORS; H. P. May, Kansas City, Mo. App. filed Dec. 26, 1908. Electrically-controlled means whereby the opening of the doors at each landing of the elevator throws in a brake for the operating motor to lock it and prevents movement of the car until the door has been closed.

982,535. OUTLET BOX; C. Rudkiewicz, Detroit, Mich. App. filed Aug. 8, 1910. Has a wall with a circular opening and laterally-extending notches, a tubular socket with a pipe at its outer end and a reduced inner end to fit the opening and a shoulder to engage the outer face of the wall with outward spaced lugs and a member on the inner side of the wall of the box to engage one of the lugs and preventing the turning of the socket member.

982,544. ELECTRICAL FLOOR OR WALL CONNECTOR; S. E. Steele, Pittsburg, Pa. App. filed March 2, 1910. For the floors of dining-rooms and the like, with a special socket to receive the plug having spring contacts, one end having a V-shaped seat to support the plug.

982,546. LOCK-OUT PARTY LINE TELEPHONE SYSTEM; A. Swenson, Willmar, Minn. App. filed March 22, 1907. Party line with individual calls and lock-out so as to lock out the third telephone and prevent listening in, by means of a switch-lever and electromagnet for locking it and a centrifugally-actuated circuit-closer actuated by the magneto.

982,549. ROTARY SNAP SWITCH; G. B. Thomas, Bridgeport, Conn. App. filed Aug. 14, 1908. Has a base and stops with an operating spindle carrying a crank arm, a latch-bar pivoted to the arm engaging the stops, a switch-plate with which the latch-bar is in sliding engagement and a tension and spring between the spindle and the plate.

982,551. EXCESSIVE ELECTRICAL CURRENT-ARRESTER; M. E. Vaughn, Plainfield, Ind. App. filed Aug. 9, 1909. A main conducting wire with a carbon block on each side, insulation between the blocks and wire so as to space the blocks from the wire, means for clamping the blocks and insulation to the wire and a ground wire running from one of the carbon blocks to the ground.

982,552. X-RAY TUBE; H. F. Waite, New York, N. Y. App. filed Jan. 25, 1906. An X-ray apparatus with a bulb provided with a target, a pair of electrodes and a screen between one of the electrodes and the target.

982,557. REINFORCED GRID RESISTANCE; H. J. Wiegand, Milwaukee, Wis. App. filed May 4, 1908. A grid having U-shaped reinforcing strips placed over the edges of the grid and transversely-extending ribs formed thereon.

982,563. TERMINAL OR LUG FOR ELECTRICAL CONDUCTORS; C. R. Baird, New York, N. Y. App. filed March 19, 1910. A lug to be detachably secured to a stranded conductor, including a tubular clamping member, threaded on the outside to engage a threaded sleeve which compresses the strands between the ends of the member and the socket carrying a conical boss on the inside of the sleeve.

982,576. BATTERY; H. W. Darby, Winnipeg, Manitoba, Canada. App. filed March 31, 1910. Primary battery with a U-shaped zinc electrode dipping into mercury, a carbon electrode which is porous and contains one of the electrolytes and an open ended porous insulator between the electrodes.

982,587. APPARATUS FOR PRODUCING AND UTILIZING ELECTRICAL EFFLUVIA. L. Gerard, Brussels, Belgium. App. filed Aug. 1, 1907. For making ozone by means of smooth surface metallic electrodes in contact with the outer surfaces of dielectric walls, a gas passage conveying the gas in contact with one of the electrodes on its way to the gap and a liquid insulator and cooling medium in contact with the other electrode.

982,638. TELEGRAPHIC DOT TRANSMITTER; H. H. Smith, Brooklyn, N. Y. App. filed June 22, 1910. A transmitter key with a supplemental lever pivoted on the main lever of the key and a vertical vibratory lever extending from the supplemental lever to open and close the electric circuit of the apparatus at definite intervals.

982,641. TELEPHONE MOUTHPIECE; L. Steinberger, New York, N. Y. App. filed June 20, 1910. Has an outer flange surrounding the rim for carrying a plate for bearing names and telephone numbers.

982,659. SYSTEM OF TELEGRAPHY; R. L. Dean, Kansas City, Mo. App. filed Feb. 1, 1908. A carriage with two electromagnets, two armature levers actuated thereby, a character on one of the levers for printing certain letters of the alphabet, a portion of the remaining letters of the alphabet and a character on the other lever for printing the remainder of the incompleted letters.

982,693. INCANDESCENT LAMP SOCKET; F. E. Seeley, Bridgeport, Conn. App. filed May 25, 1908. A pull socket with switch spindle and ratchet spring, with an adjustable abutment for the spring having a flanged socket forming an end bearing for the spindle, the flange being perforated to receive one end of the spring and notched to receive the detaining member.

982,695. INDUCTIVE MOTOR CONTROL; A. Sundh, Yonkers, N. Y, App. filed June 27, 1907. An inductance coil with a fixed contact in the circuit of the coil, a lever carrying a contact movable into engagement with the fixed contact to complete the circuit through the coil, a movable core for the coil and an extension carried by the core in the path of movement of the lever.

982,704. METHOD OF PURIFYING WATER; W. B. Bull, Chicago, Ill. App. filed May 31, 1910. Treats the water with a coagulating material by producing through electrolysis a solution which is a solvent of iron, forming an iron compound in a separate chamber, precipitating so as to form a coagulant and then coagulating the impurities thereby.

982,705. APPARATUS FOR PURIFYING WATER; W. B. Bull, Chicago, Ill. App. filed June 6, 1910. Apparatus for process of 982,704, with an electrolytic apparatus for producing a solution containing a solvent of iron and an alkali, a receptacle separate from the anode chamber containing a suitable metal through which the iron solvent is passed, a receptacle for the water to be purified, the metal receptacle discharging into the water receptacle.

982,729. POROUS CUP ELECTRODE; P. J. Kamperdyk, New York, N. Y. App. filed Nov. 9, 1907. For two fluid cells, the separating wall consisting wholly of graphite in the form of a hollow cup whose walls are of sinuous form or provided with ribs.

982,735. ELECTRICAL RESISTANCE; J. F. McElroy, Albany, N. Y. App. filed May 18, 1910. Includes a fine wire combined with a moisture-proof cord of refractory insulation, on which the wire is wound and an insulated support on which the cord is mounted.

982,738. INCLOSED FUSE; C. R. Moellendorf, Seattle, Wash. App. filed July 18, 1910. Complimentary shells with caps, the former insulating and the latter conducting, with a fusible element and tongues extending from the caps and means for detachably connecting the fusible element to the tongues, a strip detachably connecting the tongues.

982,751. GLOWER FOR ELECTRICAL INCANDESCENT LAMPS; O. M. Thowless, Newark, N. J. App. filed May 1, 1908. Composed of tungsten and a refractory oxide covered with refractory metal.

982,764. ELECTRIC CONDUCTOR MOLDING; S. M. Burk, Philadelphia, Pa. App. filed Dec. 9, 1907. Has a channel to receive the conductor and grooved at intervals adjacent to the channel, making the walls springy so that the conductor can be forced into the channel.

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A YEAR OF ELECTRICAL EXPORTS.

Just a month ago, commenting on the electrical export figures for November, we hazarded the guess that at the rate then being maintained the total for the year should reach the figure of $17,000,000. The returns for December, finishing the year, are now before us, and a little self-congratulation may be forgiven us in noting that the actual amount is $17,001,126. We have, however, much more satisfaction in noting that such a respectable figure should have been attained, for it is just about $4,000,000 in excess of 1909, when the total was $13,027,550, but was less than $500,000 above 1908. Hence it may be inferred that the tide of electrical export is running strongly again and that even better results may be looked for in 1911, in keeping with the general trend of advancing exports of manufactures. It is a pity to see agricultural exports slow in movement, but, with a population around 100,000,000, our farmers are profitably occupied, and to be making money seems to be the main point, whether one is exporting or not. It is to be hoped that electrical exporting is good business, and there is apparently no reason to assume that it is mere "dumping."

The figures of electrical instrument exports for December were $826,183, as compared with $681,868, while the shipments of heavy electrical machinery were $646,639, as compared with $461,149. Taking the year as a whole, Canada was our best customer in both classes, with a total of $4,290,183, roughly not less than 25 per cent Mexico took $2,641,378 and Brazil $2,234,411; while Japan was a customer to the tune of $1,602,714. The United Kingdom called for goods to the value of $928,901, or considerably less than in 1909. The Continent of Europe required only $1,052,147, so that all Europe took $1,981,048, or much less than Mexico and even less than Brazil. Such conditions do not seem likely to change and indicate where our best customers are to be found. The fact that Cuba can average about $750,000 a year is not without its significance. All told, the data of the past year are encouraging and will certainly stimulate to fresh effort in supplying old markets and finding new ones

CHANGE IN THE VALUE OF THE INTERNATIONAL VOLT.

In the discussions at the International Electrical Congress at St. Louis in 1904 it transpired that by general acknowledgment a difference of nearly 1 10 of 1 per cent existed in the voltage standards of different civilized countries From the standpoint of certain industries, electric welding, for example, a difference of 1 part in 1000 is quite insignificant Its worst effect would be a discrepancy of 1 part in 500 with respect to power measurements But apart from laboratory voltmeter measurements, wherein this discrepancy becomes quite appreciable, there is one industry in which the effect of such a discrepancy is perceptible, and that is in incandescent lighting. It is well known that carbon-filament incandescent lamps are so sensitive to voltage that 1 per cent diminution in lighting voltage at normal incandescence will increase the average lifetime 20 per cent, and 1/10 of 1 per cent in voltage by 2 per cent. Consequently, when large contracts for lamp purchases are made, subject to large-scale lamp-life tests at carefully regulated voltage, the testing voltage cannot be held to a precision of 1/10 of 1 per cent, but the mean voltage can be held to such a precision and the effect of a change in mean voltage that can change the mean life of the lamps by 2 per cent is easily detected in the course of many weeks.

After many efforts an international agreement has recently been reached between our Bureau of Standards at Washington and the National Laboratories of England, France and Germany whereby, after Jan. 1, 1911, the value of the Weston normal cell at 20 deg. C. was changed from 1.0191 volts in the United States to 1.0183 volts in all the above countries. This means that our international volt is enlarged by about 8 parts in 10,000. Consequently, since we have adopted a bigger international volt the numerical value of all voltaic cells, in terms thereof, will be reduced to this extent. The change will only be detected, practically speaking, in potentiometers and precision instruments. The Bureau of Standards has announced the above change in its Circular No. 29, issued Dec. 31, 1910. The Bureau has now brought us into accordance with the rest of the civilized world to 1 part in 10,000 in regard to e.m.f., 1 part in 100,000 in regard to resistance and 1 part in perhaps 500 in regard to candle-power. From these units as data all of the remaining electrical units fall into international alignment with all desired accuracy.

INTERNAL ELECTROMAGNETIC FORCES IN LAMP FILAMENTS.

It is known that magnetic flux density traversing any medium is accompanied by certain mechanical forces in the medium. These forces are of two kinds, namely, first, a tension along the flux paths, and second, a side thrust, or pressure, across the flux paths. In a general way we may liken a group of magnetic lines of flux to a group of stimulated fibers in the muscle of an animal. When the muscle contracts it exerts a tension along its fibers which tends to shorten the muscle and it also exerts a pressure across its fibers which tends to swell the muscle. When an athlete proudly exhibits the highly developed condition of his biceps he usually draws attention to the repulsive forces, or to the lateral swelling of the fibers on voluntary stimulation; but, of course, the tension forces, acting in leverage on his forearm, might also be brought in evidence. To express the facts in another way, magnetic flux paths, like stimulated muscle fibers, tend to shorten themselves along their axes and to spread apart or repel each other at right angles thereto. Uniform magnetic flux travels in parallel straight lines. Its tension is exerted along those lines. Its side thrust is not so evident, but the fact that the flux paths remain parallel and do not bulge apart shows that a lateral pressure from outside squeezes them together and holds the repulsive tendency in check.

It has also been shown that in the space outside of a conductor these forces are always in static equilibrium on matter unless the space is occupied by substances of different magnetic susceptibility. Thus, if the space outside a coil of active wire contains both air and iron, forces will, in general, be set up tending to alter the disposition of the two materials. There are, in fact, ammeters based upon this principle. But if the space external to the active conductor, or conductors, contains a medium of uniform magnetic susceptibility then there will be no resultant forces tending to alter the distribution of the medium. There is no resultant tendency of the air to move within a hollow active coil. Within the substance of an active conductor, however, this mechanical equilibrium disappears and magnetic forces act upon the substance of the conductor. The tension of the circular flux around an active straight wire, acting like the tension of stretched rubber bands, tends to squeeze the wire or press inward upon its surface; while the side thrust of the same flux tends to pull the wire apart along its axis—that is, to elongate it.

Mr. Carl Hering has investigated these electromagnetic forces in the past, particularly in connection with electric furnaces. Since both the magnetic tension and magnetic pressure per unit area are proportional to the square of the flux density, these forces tend to exhibit themselves most powerfully in the neighborhood of powerful currents, such as furnaces employ. Mr. Hering has shown, in fact, both experimentally and theoretically, that the "pinch" phenomenon, as the tension effect is called, creates an upper limit to the current strength that can be used in electric furnaces. In his article appearing on page 371 of this number he discusses the magnitude of the electromagnetic forces set up in metallic-filament lamps The current densities in such filaments are, as he points out, very high—from 230 amp to 450 amp per square millimeter of cross-section; but the pinch pressure is only about a decigram per square centimeter. This is not a serious pressure considering that the filaments are supported in a vacuous space and have very little other pressure to resist. Of course, as the article points out, the filament is raised to the softening temperature and the tension is applied rhythmically in alternating-current service. While bearing the existence of these electromagnetic forces in mind, we should do well to await the results of further research on the behavior of these rare metals under very high temperatures. It may be that there is some other effect besides the pinch effect present, such as a crystallizing effect. The appearance under the microscope of some tantalum filaments after a long period of service suggests crystalline deformation, or cleavage. We want to know more concerning the effect of different temperatures, shapes of filament cross-section, degree of purity of the metal, current wave shape, etc., before passing judgment upon these remarkable phenomena of surface disintegration. Articles like Mr. Hering's assist by stirring up curiosity and ventilating information.

COMMERCIALISM IN EDUCATION.

That the methods of higher education are in a state of transition in this country appears evident from the pedagogic innovations made and the many more proposed during the past several years. On the one hand, colleges of higher standing are elevating their curricula to a real professional plane, apparently having at length found it too difficult, to say the least, to instruct in the same course men for such different callings as dynamo tender and consulting engineer. On the other hand, some schools are frankly revealing that their aim is to serve, not the interests of the student, but solely those of the employer of technical graduates, even though education directed primarily to this narrow purpose may unfit the subject for obtaining the most out of life spiritually, through lowering his ideals and curbing his ambitions, and financially, through making him a mere serf to an industry. A concrete illustration of the haphazard condition of thought concerning technical education is afforded by a recent report of the Carnegie Foundation for the Advancement of Teaching on "Academic and Industrial Efficiency," prepared by a well-known and doubtless capable "efficiency engineer," whose business is concerned with the economical administration of manufacturing establishments.

While we have no quarrel with the efficiency engineer as such, nor with his efforts in the course of business to report upon any problem which his clients may desire investigated, we cannot refrain from expressing astonishment at the frame of mind of one who would direct the application to instruction in science of the canons appropriate for running a purely money-making business. The possibility of such a distortion of view is the most serious criticism that could possibly be launched against American educational methods. As well put a skilful and successful sausage maker at the task of criticising the manufacture of astronomical telescopes. An institution for training young men in science, whether pure or applied, is not a money-getting concern. Its product is not sausages, but the advancement of human intelligence, which may or may not be applied to gainful objects. Even in the narrowest technical sense it does not turn out a standardized product of salable packages of information, but an infinitely variable and intangible thing the importance of which to the world cannot be measured by the demand for it reckoned in dollars and cents. The world ultimately owes far more to the institution which produces men who guide the world's destinies in any department of activity than it does to the graduate factory that adds yet more to the rank and file of the mediocre. This at least is the situation regarding the very class of institutions the investigation of which was undertaken in the report before us. Its whole tenor was to lay emphasis upon the destruction of the academic freedom and initiative that is necessary to the advancement of human intelligence and to promote that kind of organization which, under the disguise of uniformity and system, effectively suppresses progress. It is an application to educational institutions of the methods too common in American manufacture, which insure a large output of the tolerable rather than a small output of the desirable.

A typical feature of the report is found, for instance, in the computation and distribution of costs per student-hour of instruction in the various institutions considered. It is admitted in the publication itself that this is an imperfect and somewhat uncertain basis of judgment, but the fact that it is also a positively unthinkable basis of judgment from the technical standpoint does not seem to have been realized. In physics, the subject chosen for investigation, or in any other branch of pure or applied science, the chances are that a low cost per student-hour means either overcrowding or inefficiency, or both. A high cost per student-hour may mean either few students or remarkable equipment and efficiency, or various other things familiar to those who have a practical acquaintance with technical education. One of the things that seems to have most perturbed the spirit of the author of the report is liberal space and liberal equipment for the work to be done; and various highly ingenious suggestions are made with respect to the ways in which the floor space per student instructed could be reduced, by intensive advertising of the particular department affected, by leasing part of the space to other departments, or by abolishing part of the storage space and discarding or leasing apparatus not immediately needed. One of the most naïve suggestions in this line is that obsolete (in the commercial sense) or badly worn apparatus should at once be scrapped and replaced by new. One can fancy the consternation which would overwhelm the financial authorities of the university that tried to carry out this policy. The ordinary scientific department finds it hard enough to get the apparatus immediately necessary after utilizing to the fullest extent every possible resource in the way of existing apparatus, old and new; and until a university becomes a shop, turning over and over its working capital with the greatest possible rapidity, it will not be able to replace equipment whenever something which is more up-to-date commercially comes into sight.

Other methods of economy reported are similarly unpractical, not from the standpoint of the manufacturer, but from that of the hard-working instructor. It might be possible, as was suggested, to utilize a large lecture-room for many hours per week by putting into it a large variety of classes of various sizes, but this could usually be done only by so great an increase of the teaching force as would make it feasible to adapt the hours of instruction to the requirement of keeping the room continuously filled so as to make a better economic showing for the real estate. Even such apparently businesslike propositions for economy cannot be made to work without unjustifiable increase of expense in other directions, and the same sort of argument applies to many other conditions cited.

We could mention many a large industrial establishment in which no small part of the ingenuity of the men responsible for the results has to be exercised in emergencies in dodging just the system of red tape suggested for academic use, and we could go further and specify instances in which large and thoroughly organized establishments have so overweighted themselves with the details of centralization that certain parts of the product have from economic necessity been segregated and put under the efficient rule of departmental authority. Organization is a good thing so long as it is only a means to an end. We are fully aware of the weak points in the ordinary academic administration and of how they must grate on the nerves of a skilful professional organizer; but the facts brought out in the report before us show that two institutions engaged in teaching science may differ most radically in these inconsequential matters of routine and yet both be highly successful in the one function for which they are organized, of giving good, thorough and inspiring instruction and leading men forward to efficient scientific attainment. The one thing important inside an institution is *esprit de corps*, both in the teaching force and among the students. Where it exists there will be efficient, even if unofficial, co-operation in the use of resources. Without it no skill in organization can make for efficiency, and *esprit de corps* is the one thing which would be most effectively suppressed by carrying out the educational projects of this unique proposal for the commercialization of intellectual progress. No amount of money or of systematic organization can make a great university, as more than one sorry example demonstrates; for the things of the spirit can neither be measured nor bought.

American Institute of Consulting Engineers.

The American Institute of Consulting Engineers, recently organized, held its first annual meeting at the Engineers' Club, New York, Jan. 17. The Institute is the outgrowth of a local association of consulting engineers organized in New York City in 1905. At a meeting held last December this body was extended into one of national scope and the name changed from the "Association of Consulting Engineers" to the present title. The object of the Institute is to promote generally the interests of the consulting engineer. Among the measures to be undertaken are a code of professional ethics and a schedule of charges. It will also take cognizance of legislative matters affecting the interests of engineers and will use its influence to separate the contractor from the designing engineer. The membership is limited to those actively engaged as consulting engineers in the independent practice of the profession of engineering in any of its branches and who are not also engaged in contracting. It is understood that membership is to be confined to those engineers who are full members of one or more of the national bodies representing the several branches of engineering.

At the meeting on Jan. 17 the following officers were elected for the ensuing year: President, Mr. Alfred P. Boller: vice-president, Mr. Gustav Lindenthal; secretary and treasurer, Mr. Eugene W. Stern, 103 Park Avenue, New York City. Members of the council: General T. A. Bingham and Messrs. Gustav Lindenthal, John F. Wallace, Rudolph Hering, C. O. Mailloux and A. P. Boller, New York; Ralph Modjeski, Chicago; J. E. Greiner, Baltimore; C. C. Schneider, Philadelphia. The following standing committees have been appointed: On admissions: Messrs. C. O. Mailloux, Rudolph Hering, Gustav Lindenthal, Reginald P. Bolton and J. E. Greiner; on professional practice and ethics: Messrs. John F. Wallace, L. B. Stillwell, H. W. Hodge, F. A. Moliter and Prof. G. F. Swain, of Harvard; on legislation: General T. A. Bingham, S. O. Miller and S Whinery.

A. I. E. E. Meetings.

At a meeting of the American Institute of Electrical Engineers to be held on Feb. 10 in the Engineering Societies Building, New York, Mr. William B. Jackson, Chicago, will present a paper entitled "Advantages of Unified Electric Systems Covering Large Territories."

Arrangements are now being completed for the Pittsfield-Schenectady mid-year convention to be held on Feb. 14, 15 and 16. The opening session will be held on Tuesday afternoon at the Mohawk Golf Club, Schenectady. The second session will be held at the same place on Tuesday evening. On Wednesday morning a special Pullman train will leave Schenectady for Pittsfield at 8:30 o'clock. The plant of the General Electric Company will be inspected and a technical meeting will be held at the plant. Lunch will be served at the plant and dinner at Hotel Wendell. In the evening the special train will return to Schenectady. On Thursday morning the final session will be held at the Golf Club. Lunch will be served at the General Electric Company's works, after which there will be a tour of inspection of the company's plant.

In addition to the papers mentioned on page 88 of our issue for Jan. 12 the following papers will be read: *High-Tension Testing of Insulating Material,* by Mr. A. B. Hendricks; *The Regulation of Distributing Transformers,* by Mr. C. E. Allen; *Dissipation of Heat from Self-Cooled Oil-Filled Transformer Tanks,* by Messrs. J. J. Frank and H. O. Stephens; *Oil-Break Circuit-Breakers,* by Mr. E. B. Merriam; *Proposed Applications of Electric Ship Propulsion,* by Mr. W. L. R. Emmet; *Voltage Regulation of Generators,* by Mr. H. A. Laycock; *Briefs on Vector Rotation,* by Profs. E. J. Berg and W. S Franklin.

At the meeting to be held in the auditorium of the Edison Electric Illumination Company, Boston, on Feb. 17 under the auspices of the Boston Section of the A. I. E. E. with the co-operation of the Boston Society of Civil Engineers and the American Society of Mechanical Engineers a paper entitled *Unlimited Interconnection of Electrical Networks* will be read by Mr. R. A. Philip, of the Stone & Webster Engineering Corporation.

During the Pacific Coast meeting of the A. I. E. E. to be held at Los Angeles, Cal., on April 25, 26, 27 and 28 trips will be made to the plants of the Southern California Edison Company, to Santa Ana Canyon, Mount Lowe and probably to Catalina Island.

A regular monthly meeting of the A. I. E. E. will be held in the Engineering Societies Building, New York, on March 10, under the auspices of the industrial power committee. The American Society of Mechanical Engineers will co-operate in the presentation and discussion of papers.

A meeting of the Institute will be held in Toronto, Ontario, early in April. At this meeting a paper will be presented by Mr. W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad Company, dealing with an analysis of electrification and its practical application to trunk lines for freight and passenger operation.

A. I. E. E. Reception and Ball.

For some years past it has been the custom for the American Institute of Electrical Engineers to hold an annual dinner, which has usually been made the occasion of some special feature. At the meeting of the board of directors held on Jan. 13, 1911, it was decided that the annual function this year shall be a reception and ball, which will be held in the grand ballroom of the Hotel Astor, New York City, on Tuesday evening, Feb. 28, 1911, at nine o'clock.

A feature of the occasion will be the presentation of the past-presidents' badges, and it is expected that most of the past-presidents will be present to receive the badges. The idea of conferring upon outgoing presidents of the Institute a badge or insignia of office in commemoration of the services rendered by them to the Institute has been under consideration for over a year, and the proposed presentation is the result of the recommendation of a special committee appointed to consider and report upon the matter.

The committee upon the management of the reception and ball is now actively engaged in making the necessary arrangements, and a large attendance of members and their guests is anticipated. The price of tickets is $2.50 per person, which will include supper. Applications for tickets should be sent to Institute headquarters, 33 West Thirty-ninth Street, New York City, accompanied by cash or check payable to R. W. Pope.

Joint Dinner of Engineers at Boston.

The second annual joint dinner of engineers residing or practising in Boston and its vicinity was held at the Hotel Somerset, Commonwealth Avenue, Boston, on the evening of Jan. 31. The dinner was in immediate charge of the Boston Section of the American Institute of Electrical Engineers, with the co-operation of the Boston Society of Civil Engineers and the Boston Section of the American Society of Mechanical Engineers. About 400 representatives of the engineering profession attended the dinner, which was preceded by a reception in the parlors of the hotel. In the receiving line were President Richard Cockburn Maclaurin, of the Massachusetts Institute of Technology; Col. E. D. Meier, president-elect of the American Society of Mechanical Engineers; Mr. J. J. Carty, vice-president, American Institute of Electrical Engineers; Mr Ralph W. Pope, secretary of the American Institute of Electrical Engineers; Prof. Elihu Thomson, and President Henry F. Bryant, of the Boston Society of Civil Engineers.

At the close of the dinner, which was held in the large ballroom of the Somerset, Chairman Vaughan called the assemblage to order and after a short address of welcome called upon Prof. Ira N. Hollis, chairman of the committee on an engineers' club building at Boston, to report progress. Dr. Hollis stated that twenty-one meetings of the committee and a subcommittee had been held, with the result that plans for a building in three different locations had been considered. The plans as outlined last year have not been materially changed, and these contemplate the erection of a building, including libraries for the constituent societies, auditoriums, clubhouse appointments and quarters for business establishments on the lower floors.

Chairman Vaughan then introduced as toastmaster Dr. A. E. Kennelly, professor of electrical engineering at Harvard University, who officiated in the happiest vein. The first speaker was Mr. J. J. Carty, vice-president of the American Institute of Electrical Engineers. Mr. Carty paid a high tribute to the influence of civil engineering upon electrical development, sketching the progress of engineering education from the initial courses at West Point and Troy to the present facilities. He pointed out that the breadth of vision of electrical engineers is largely derived from civil-engineering traditions, which inculcate the habit of weighing all sides of technical questions and sifting data and evidence in a scientific manner.

Col. E. D. Meier, president-elect of the American Society of Mechanical Engineers, reviewed the triumphs of American, and particularly New England, engineers and mechanics in the industrial progress of the past century, touching upon the work of Benjamin Thompson, Corliss, Whitney and others He showed the indebtedness of the world to men like Edison, Elihu Thomson, Vail and Field, who applied in practical service the investigations of Faraday, Volta and Siemens.

President Henry F. Bryant, of the Boston Society of Civil Engineers, agreed with Colonel Meier that there is now too much differentiation in engineering societies. Signs of greater centralization are at hand. The clubhouse movement in Boston is a healthy one and will unquestionably receive the support of engineers in that district. He would personally welcome the broadening of the Boston Society of Civil Engineers by the omission of the "civil" designation

President Maclaurin, of the Massachusetts Institute of Technology, spoke in the highest terms of the achievements of the Thomson family in science and engineering. He also stated that it would take a very strong magnet to drag the Institute from the vicinity of Boston, contrary to the prevailing newspaper impressions of its prospective removal, and he urged the hearty support of all engineers in the efforts of the Institute to secure more adequate grants from the State.

Professor Thomson, who was the guest of honor of the evening, received a rousing welcome on behalf of his achievements in applied science. He referred feelingly to the help of his associates and paid a tribute to the pioneer work of Mr Edison in electrical development. Professor Thomson said that, although electrical engineering is the youngest of the branches represented, it is becoming all-inclusive and is capturing the universe theoretically if not practically. He contrasted the empirical investigations of the earlier days with the improved methods of the present, but showed that there is still a most pressing need of reliable information. Only a short time ago there were but few metals at our command, whereas the development of commercial uses has now brought fairly rare elements into common service. It is impossible to exaggerate the importance of scientific investigation for its own sake, for the pure science of to-day is the applied science of to-morrow Professor Thomson urged the heartiest support of the Massachusetts Institute of Technology and said that there should be a mine of research available to engineers in a properly endowed school of technical education. This is an engineering age and the country which neglects to foster its technical schools is bound to fall behind. Research is of the greatest importance from the practical standpoint. Professor Thomson closed with the statement that he looked forward to the time when there will be a great saving of industrial waste through the utilization of technical advice and the prevention of large expenditures for ill-advised schemes which are often of a half-gambling character. He joined in the heartiest wishes for the success of the engineering-building movement in Boston.

The committee of arrangements for the dinner consisted of: Mr. J. F. Vaughan, chairman; Mr. Harry Hope, secretary, and the following members: Messrs. N. J. Neall, C. H. Hodskinson, C. B. Burleigh, H. N. Davis, E. G. Bailey, E. F. Miller, S. E. Tinkham, F. H. Fay and R. K. Hale.

Arnold Report on Passenger Subways for Chicago.

Plans for the Chicago passenger subway reported to the committee on local transportation of the Chicago City Council, Feb. 6, by its consulting engineer, Mr. Bion J. Arnold, outline two methods of relieving traffic congestion in the downtown Loop district. The plans presented may be used separately or in combination, and propose (1) a high-speed, low-level system of tunnels designed later to be extended throughout the whole city, and (2) a system of higher-level street-car subways in the business district only. Construction of the first and more comprehensive system of high-speed subways designed for operation throughout the whole city would be begun in a restricted area at first, involving only a small investment, but would be capable of expansion to cover the entire city area for high-speed operation. In the downtown district these subways would be depressed to a lower level than the surface-car tunnels proposed in the second plan, although different streets would be used by the two systems if both were constructed. If desired, the latter system of subways for the surface cars could be built by the street railway companies independently of the execution of the first plan.

The report details various suggested steps in the expansion of the subway systems from a small beginning to the ultimate completion of the plans. The construction proposed is of reinforced concrete, and the total cost of the plan covering the entire city is placed at $54,450,000. The upper-level subway for the surface cars in the downtown district is estimated to cost between $4,500,000 and $4,750,000. Allowance is made in the plans for water mains, sewers and other underground constructions.

The Pittsburgh Transportation Problem.

In a final report to Mayor William A. Magee, of Pittsburgh, just made public, Mr. Bion J. Arnold discusses in detail solutions for the present and future problems relating to passenger transportation in that city and vicinity. In outlining the improvements that should be made at once he stated that, whatever the outcome of the reorganization and regulation of the present surface system, there should be no delay in arranging for proper maintenance of the cars and tracks, for additional larger cars, for improved and maintained schedules and for proper heating, ventilating and lighting of the cars. Millions of dollars could be spent to advantage at once in the general rehabilitation of the property; the cars are rapidly becoming worn out, the generating station equipment is inefficient, overhead construction needs replacing, and feeder wire should be put in conduit in the underground district. In the Pittsburgh district an expenditure of at least $2,500,000 for betterments would be justified each year.

In regard to future developments, Mr. Arnold considers that subways will in the course of time become desirable and even necessary in order to relieve the congestion of cars on the surface of the downtown streets. The fundamental need for subways is to provide downtown terminals for electric suburban trains, rather than to provide "rapid transit." Very fair rapid-transit service is now given by the express trains of the suburban steam lines. This service has two drawbacks in its comparative infrequency and the lack of convenient downtown terminals. These two disadvantages can be corrected by electrifying the lines and using a subway route through the business center The present railroad locations under the conditions assumed will be found particularly adapted for real rapid-transit purposes

Toronto Electric Light Situation.

The annual meeting of the Toronto Electric Light Company was to have been held on Feb. 15, but the shareholders have been notified that the meeting will be adjourned until March 15, by which time it is expected that arrangements will have been completed between the representatives of the company and the City of Toronto for a harmonious working of the two competing plants, or that the private lighting company's business will have been acquired by the city corporation.

President Sir Henry M. Pellatt, of the Toronto Electric Light Company, has addressed a notice to the shareholders stating that negotiations are now pending between the company and the City of Toronto with a view to arriving at an arrangement whereby the company will continue in business under conditions which will be entirely satisfactory to both parties, or, in the alternative, for a purchase by the City of Toronto of the plant and assets of the company as a going concern at its full operating value.

The stock of the Toronto Electric Light Company has during the past few months advanced from 119 to 132 on the local stock exchange in the belief that the shareholders will benefit by the proposed sale to the City of Toronto.

Postal Telegraph vs. Western Union.

The Postal Telegraph Company has filed a complaint with the New York Public Service Commission, alleging that the Western Union Telegraph Company makes unreasonable and discriminatory charges upon messages transferred from the Postal to Western Union lines to points where the former has no branches. It is said that to every one of these messages the Western Union adds four or five words and charges for them as if they were in the body of the message. The result is that business which the Postal accepts for the convenience of its patrons not only, as a rule, returns no profit, but is a source of expense. The words which the Western Union adds to the messages received from the Postal are the date and the words "via transfer point." The Postal asserted that the added words are quite unessential to the receivers of messages.

In the hearing on the subject before the commission the counsel for the Postal company also stated that the Western Union company has sent out a circular letter relating to Postal competition which grossly misrepresents the facts and conveys to the public a false impression as to the relative importance of the two companies. He takes exception to the statement in the letter that the Western Union company has 20,000 more offices than the Postal and that the latter has to rely for the delivery of messages to these offices on its competitor. On the contrary, he stated that the Postal does not rely on these offices, and, moreover, it reaches more than 6000 of these points by telephone. It was also stated that the letter is false in other ways, including, for example, in the list of telegraph offices every signal station or flag shanty where an operator is stationed on nearly all of the railroads. As a matter of fact, it is stated that the Postal is doing about 50 per cent of the telegraph business of the country. The counsel for the Western Union company stated that the same privileges were accorded to the Postal as were accorded to individuals, and a witness on its behalf declared that the second date was necessary to the receiver of a transferred message, but admitted on cross-examination that it was easier and cheaper for the Western Union to take a message from the Postal than over the telephone.

Ohio Telephone Situation.

A telephone bill prepared by the Independents has been introduced in the Ohio Senate which permits of consolidations where there are two exchanges in a town or city. Prominent attorneys have expressed the opinion that a merger of the long-distance lines will be a violation of the Sherman anti-compact law and that the Interstate Commerce Commission will probably interfere if this plan should be carried out. With purely State companies, of course, this law would not be called into action.

Ohio telephone men are interested in the conference that took place in New York last week between the representatives of the Morgan interests and representatives of Independent companies from the West. Mr. Frank A. Davis, president of the Columbus Citizens' Telephone Company and the United States Telephone Company, and Mr. Charles A. Otis, president of the Cuyahoga Telephone Company of Cleveland, represented the Ohio interests. The object of the meeting was said to be the discussion of plans for eliminating competition throughout the country, but the details of the proposition have not been divulged. Some of the local papers announced under big headlines that a merger of all the Bell and Independent long-distance interests was under discussion and that the negotiations had reached a point where the deal might be closed at any time.

The reasonable theory, however, appears to be that the Morgan interests may acquire properties in other sections of the country along the lines on which the larger Ohio properties were taken over, and that the long-distance lines would be operated on a friendly basis, rather than that an actual consolidation will take place, especially at this time when the country is already in a turmoil over various trust matters.

The committee in charge of the matter for the Independents consists of Messrs. E. H. Moulton, Minneapolis; Theodore Gary, Macon, Mo.; H. D. Critchfield, Chicago; Arnold Kalman, St. Paul; George L. Edwards, St. Louis; B. G. Hubbel, Buffalo, and Frank H. Woods, Lincoln, Neb.

Leasing of Water-Power Sites.

President Taft has approved a plan for the leasing by the federal government of water-power sites on public lands. The principal points of this plan are that legislative authority be sought for issuing term leases for periods not to exceed fifty years and that these leases should contain stipulations to protect the public against the limitation of output of power through delayed or partial development, a yearly rental charge to be based on the amount of power available.

It is proposed that violation of the contract condition or persistence in charging consumers a rate declared excessive by a state supreme court shall be ground for the cancellation of the lease. At the expiration of the lease it is proposed to give the lessee a preference right to renewal unless the government desires to use the property for public purposes, and if the lessee fails to secure a renewal either because the government desires the land or because another applicant offers better terms, the previous lessee shall receive compensation for the actual value of improvements on the ground or be allowed to remove such equipment.

The necessity for the above plan lies in the fact that water-power sites in the Western States are largely on public lands which at present can neither be taken up by companies nor occupied except under a reversible permit.

Kennebec River Power Situation.

In a recent interview President Henry I. Harriman, of the Kennebec Dam & Reservoir Company, states that the Kennebec River power development, recently outlined in these columns, will be made in the Forks-Indian Pond district of central Maine. It is estimated that it will be possible to develop 100,000 hp on a twelve-hour per day basis or 50,000 hp continuously. Three dams are planned, one at the foot of Indian Pond, one at Chase's Stream and the third at the forks of the Kennebec River. The total fall between Moosehead Lake and the Forks is about 400 ft. In reply to inquiries about the effect of the development upon the celebrated Moosehead Lake, Mr. Harriman said that the lake will not in any way be affected by the hydroelectric developments below. The proposed dams will increase the storage capacity of the district by increasing the depth of Indian Pond.

The initial plans of the promoters provided for the transmission of power from the Kennebec district to the territory now served by the Connecticut River Transmission Company. A strong sentiment developed in Maine, however, against the supply of power beyond the borders of the State, and the policy has been adopted of confining the power sales to Maine. It is probable that a large amount of power will be utilized in the manufacture of nitrates by electrochemical methods. The cost of the development at Indian Pond is estimated at from $8,000,000 to $10,000,000. Charter rights are now being sought in the Maine Legislature. Lumber and other dealers interested in the upper waters of the Kennebec River are heartily in favor of the Indian Pond development on account of the influence which it will have in conserving the water supply and improving the conditions under which logs are driven.

New Rubber Tree.

Much interest has been excited in Mexico by an announcement that a new and heretofore unclassified tree from which a high grade of rubber may be obtained was recently discovered in a remote part of the Territory of Tepic. The tree in appearance is not at all like the ordinary rubber tree, having also the appearance of a horse-chestnut tree and bearing nuts like that tree. It is a species of nettle and neither the leaves nor the nuts can be handled without gloves. The tree was discovered by Prof. John R. Allen, of the University of Michigan, and after some experimenting with the gum obtained from the tree he secured a concession from the Mexican government for a tract of land amounting to some 800,000 acres. A company will be formed for exploiting the product. The new gum is said to be the nearest approach to Para rubber which has yet been found and is much more easily handled than any of the other rubber products. The trees are tapped for five days in succession, after which they are allowed to rest for three months before tapping again. The sap which oozes out soon coagulates, and all that is necessary is to wash it and it is ready for the market. At the present time the tract is situated some distance from any railroad, but on the completion of the Southern Pacific line the transportation facilities will be much better and the product can be laid down in New York at a far less cost than the Para rubber, it is stated.

Water-Powers of Minnesota.

A recent exhaustive report of the water-powers of Minnesota, made by the State Drainage Commission, shows that the rivers and lakes of the State represent a total of 553,700 hp, of which 113,100 hp is already utilized and 440,600 hp remains undeveloped. These figures were estimated on the horse-power on the low flow of the streams and did not take into consideration the added useful power given by storage systems, which, it is estimated, raises the number of horse-power to 750,000.

One hundred and nine power plants in the State are operated by the Mississippi River and its tributaries, producing 76,120 hp; twenty-four are in the Hudson Bay drainage system, developing 15,000 hp, and two are in the Lake Superior basin, developing 22,000 hp. Most of these plants have auxiliary steam power, especially those supplying industrial concerns. The largest plants are: Minneapolis, producing 48,000 hp from several plants; Taylor's Falls, 26,000 hp; Rainy River, 12,000 hp; Sartall, 5000 hp; Cannon Falls, 1500 hp, and Grand Rapids, 1200 hp. This indicates that one-half of the water-power of the State is available from the Mississippi River. The St. Croix River comes next, but relatively little power has been developed on this stream. According to the report the Rainy River is an important power stream and easy of development. The Red River has considerable power, but its development is difficult owing to the nature of the stream. The table given above, compiled by the drainage committee, shows the extent and situation of the developed and undeveloped power of the State.

	Estimated Power	Developed Horse-Power	Undeveloped Horse-Power
Mississippi River	234,000	60,300	173,700
Minnesota River	8,300	600	7,700
Minnesota River tributaries	9,500	2 400	7,100
St. Croix River	28,000	4,500	23,500
St. Croix tributaries	4 900	1,200	3 700
Other Mississippi River tributaries above Minnesota River.	26,300	2,000	24,300
Other Mississippi tributaries below Minnesota River	28,800	5,100	23,700
Red River (including Ottertail River)	30,400	1,100	29 300
Red River tributaries	28,300	1 900	26,400
Rainy River, including both American and Canadian rights	22,000	12,000	10,000
Rainy River tributaries	61,800		61,800
Lake Superior tributaries east of Duluth	20,700		20,700
Lake Superior tributaries west of Duluth	50,700	22,000	28,700
Totals	553,700	113,100	440,600

Storage-Battery Discussion in Chicago.

Upon invitation of the Electric Storage Battery Company a good-sized crowd of engineers and others interested in electric vehicle batteries assembled at the rooms of the Western Society of Engineers, Jan. 31, in Chicago, to listen to a description of a new type of storage battery for electric vehicles. The meeting was presided over by Mr. L. A. Ferguson, vice-president of the Commonwealth Edison Company.

Before introducing the speaker Mr. Ferguson spoke briefly on the part the storage battery has played in the last twenty years in central-station operation. It was first thought that batteries were principally useful to give a uniform load to engines. Later it was agreed in discussions on the subject that they are principally useful for carrying short peaks of central-station load. At the present time in large central stations the other uses have been superseded and a large capacity in batteries is kept simply as a reserve for use in case of temporary interruption of service from the generating stations. Mr. Ferguson referred to the fact that the Commonwealth Edison Company has twenty-two large batteries located in different parts of the city, aggregating 20,000-kw capacity. These are purely for reserve purposes. He said that he had seen the day when the great generating station at Fisk Street had its turbines completely shut down, yet the users in the downtown district of Chicago were none the wiser because of the load being carried temporarily by the batteries.

Mr. Bruce Ford, of the Electric Storage Battery Company, was then introduced as the man mainly responsible for the development of the new type of vehicle battery since the original French patents were purchased by his company

Mr. Ford then described the new battery with the aid of lantern-slide illustrations. This battery was described on page 68 of the *Electrical World* of Jan. 5, 1910. The positive plate, which is the radically new feature of the "Iron-Clad Exide," is made up of hard-rubber tubes containing the active material, with a metal core or center to conduct the current through the tube. These tubes are held together by metal conducting strips at top and bottom. The negative plate is similar to the old "Exide" negative, but made thicker because of the increased life of the new positive plate. The new battery has from two and one-half to three times as long life as its predecessor. This is largely due to the fact that flaking off of active material has been eliminated. One result of this is that cells do not have to be cleaned as frequently as formerly. The usual routine with the old type of battery was to clean three times and after the third cleaning the battery would be worn out. In answer to a question as to what part of the new battery would wear out first Mr. Ford replied that experience varied on this point, but apparently they had secured a battery in which no one element would wear out much in advance of the others. He mentioned, however, that in some cases the rubber had rotted out, and, as rubber was about the most durable thing that could be put in sulphuric acid, this would indicate that about the maximum life had been obtained that is possible with anything in a sulphuric-acid solution.

The discussion then drifted into the question of ordinary care and maintenance of batteries, and some criticism was made by one of the speakers of the policy of salesmen of electric vehicles in urging that batteries require no attention. In answer to this Mr. Charles Blizard, of the Electric Storage Battery Company, said that his company had issued 160,000 vehicle-battery instruction books, which was enough to put several copies in the hands of each user. He said if a battery would blow up when it did not receive the proper attention, and take an arm or a finger, it would get better attention. As to the saving by the absence of the necessity of cleaning the battery cells during the life of the battery he thought this would amount to 60 per cent to 65 per cent for the new type as against the old. Mr. Ferguson jocosely referred to the story of the woman's bank account and the woman who thought that there was money in the bank as long as there were checks in the book. There is somewhat of a parallel to this in the operation of electric vehicles by ladies who think that the battery is all right as long as the wheels will turn.

In answer to a question Mr. Ford said that the cost of cleaning on old-type batteries averages about $1 per cell, and the period between cleanings in usual service is from one to one and one-half years. Mr. E. W. Lloyd, of the Commonwealth Edison Company, said that his company now maintains two storage-battery experts, whose services are at the free disposal of anyone in the city charging batteries from Commonwealth Edison service. These men make it a regular business to visit garages and private users to look after the welfare of batteries and instruct users in their care.

Mr. Edward W. Goedjen, one of the vehicle-battery experts of the Commonwealth Edison Company, referred to some instructions to users to the effect that they could easily tell when batteries were nearly charged by listening to them. For himself he did not have a sufficiently "musical ear" to do this and thought it a good plan to urge the use of a hydrometer and a watt-hour meter rather than depend on the "sound" of the battery. Mr. Blizard, answering a question, said that the "Iron-Clad" battery costs from 40 per cent to 45 per cent more than the old type.

Mr. Ferguson referred to the fact that the gasoline touring car is now recognized as being rather clumsy for use around the city on account of its length and weight, and as a consequence light, short-wheel-base town cars are being brought out. He suggested that the part played by the gasoline town car should really be taken by the electric vehicle, so that during the winter months there would be no need to maintain the gasoline car at all.

The Broader Significance of Concentration in Electricity Supply.

From a point outside the arena one may obtain frequently a better view of the progress of events than is available to the participants themselves. Therefore, the well-considered article on modern central-station practice which follows, taken from *The Times* (Engineering Supplement) of London, dated Jan. 11, and based on an interview with a man who stands in the forefront of the electric service industry in the United States, should prove a useful and encouraging summary for American readers:

"The general tendency of the electricity supply industry in the United States is toward the concentration of producing plant, for the development of the steam turbine in very large sizes has made it possible to install 10,000-kw, 15,000-kw and 20,000-kw units. This development has had a marked influence on the growth of the central-supply business in the great industrial centers of the United States, and the subject is one on which the views of Mr. Samuel Insull, the president of the Commonwealth Edison Company of Chicago, who has been spending a short vacation in London, will be noted with interest. He points out that the increased size of generating plant has brought the cost of producing current down to so low a figure as to make the operation of small stations quite uneconomical, with the result that many of the old power stations in America where small units were installed have been abandoned in favor of the larger plant. A dominating factor is that the large station can be built and equipped in the United States for about one-third, and in some cases even less than one-third, of the cost of the old stations when equipped with reciprocating engines as prime movers and comparatively small units. In addition to these low capital costs the generation of current in bulk carries the advantages of low operating costs and reduced interest and depreciation charges. Thus it has been possible to quote low selling prices for the current, one result of which has been that in addition to the ordinary business of the electric supply companies a large demand has been created for current for traction requirements by tramways, elevated railways and in some cases for the operation of steam-railway termini, although in the past some of the railway companies have built and are still operating their own power stations. A very large business has also been built up in the supply of energy to industrial establishments, the proprietors of which have been attracted by the low rates.

"Some idea of the manner in which the demands for current have expanded may be gathered from the fact that the sales effected by the Commonwealth Edison Company reach a total of between 600,000,000 and 700,000,000 of Board of Trade units [kw-hours] a year, the *maximum* power generated during periods of heavy demand representing upward of 275,000 hp. Of this load only about 30 per cent is for lighting, so that 70 per cent of the energy generated is applied to traction and industrial purposes. The sphere of operation covered by the Chicago company named is about thirty miles by twenty miles—about 600 sq. miles—in which area there is a population of about 2,250,000.

"Mr. Insull appears to have been much impressed with the fact that in London the electricity and gas interests are regarded as competitive, whereas in the United States that is not the case, the gas industry tending more and more to specialize in the fields of cooking and heating, leaving lighting and power to be served by electrical enterprises. A suggested explanation is that in this country the saturation point has been reached in the gas industry, whereas in the United States, owing to the more rapid growth of the population, this is not the case. At the same time it must be remembered that the power side of the electricity supply is being developed on what may be regarded as wholesale lines and the market is consequently a much wider one than in Great Britain. With regard to the prices charged for electrical energy by the great central stations now being established in the United States, users of large quantities can make contracts at 0.375d. [0.75 cent] per unit, but the average prices for industrial power purposes are probably about 1d. per unit.

"With regard to the development of the gas engine in large sizes for use in central-station practice, its employment in the United States is at the present time confined to stations established by large corporations, such as the United States Steel Trust, in which it is possible to utilize waste gases. Mr. Insull is of opinion that the development of the gas engine in large units has been retarded by the increased efficiency and the low labor costs which result from the improvements made during recent years in the steam turbine, and he does not think it is probable that for central-station work, at all events, the gas engine will prove a serious competitor to the steam turbine unless some radical and, at present, unexpected development is made by those who are investigating gas-engine problems.

"Mr. Insull is not alone in evincing surprise that in a great center such as London the old-fashioned method of employing comparatively small units in a large number of stations is still allowed to continue, and it is obvious that the unification of the production of electrical energy would result in lower generating costs. That a cheap bulk supply for London would be a great public benefit is a matter of common knowledge, and Mr. Insull sees no reason why what has been done in the United States could not be accomplished in Great Britain. He expressed the opinion that the difference in cost between generating in one large central station and generating in existing stations is such as to make it quite a commercial proposition to buy out the whole of the existing interests and to establish one or more large modern plants to meet the needs of the greatest center of population in the world. The possibility of obtaining current for industrial requirements at a low rate should have a material effect upon the large number of small manufacturing establishments within the County of London and would act generally as a stimulus to industrial enterprises of all descriptions. By cheapening the cost of production it would possibly also have the effect of checking the exodus of large industrial undertakings from the metropolitan district."

The Public and the Public-Service Corporation.

Messrs. John M. Ewen and A. Bement presented a brief paper on the foregoing subject before the Western Society of Engineers in Chicago on Feb. 1. The authors pointed out the futility of competition as a means of regulating the supply of commodities furnished by public-service corporations. They advocated the establishment of suitable commissions as a means for handling these problems. They suggest that one commission be established for each character of service because the questions which present themselves require the attention of a board of specialists thoroughly familiar with the service.

In discussion of this subject Mr. C. V. Weston, president of the South Side Elevated Railroad Company, favored "supervision" by commission, but not "administration" by commission. He referred to the powers of the commissions in New York State as excessive. He thought the Massachusetts method better. Proper regulation should secure the integrity of the investment. He thinks in Chicago the time is rapidly approaching for a change in the method of administering the public-service business.

Mr. S. J. Larned, general superintendent of the Chicago Telephone Company, said that there is regulation and control of public-service corporations at the present time. The main question to be discussed is by whom should this regulation be exercised. Heretofore it has been mainly by legislative bodies and their actions frequently have been governed largely by political expediency. He thought it best to have regulation by bodies of specialists. With legislative bodies rate regulation is synonymous with rate reduction.

Mr. J. G. Wray, electrical engineer of the Chicago Telephone Company, favored a commission to correlate the work of the various public-service companies in the streets. At the present time there is too much confusion and economic waste.

Mr. Peter Junkersfeld said there were some dangers in commission regulation if commissions were not properly constituted, but with commissions like those existing in Wisconsin and Massachusetts, composed of competent and reasonable men and holding office continually, the existence of a commission adds stability and value to public-service securities.

Mr. D. W. Roper, referring to the difficulties of underground street work in Chicago, showed how these difficulties were increased by the nearness to the surface of the sewers. Underground distributing lines of various kinds necessarily had to stay above the sewer level.

Mr. C. D. Hill, in charge of the sewer department of the Board of Local Improvements of Chicago, said that the quality of regulation given to any public service is no worse than the government which does the regulating. If the government is rotten the regulation probably will be also. He suggested two public-service commissions for Illinois, one for the Chicago district and one for the rest of the State, as the problems to be met were so different.

Mr. John Mabbs said that the money spent on the salaries of the present Chicago City Council would, if concentrated on ten men, secure the ten best men in various branches in the country and the city would be immeasurably better governed than at present.

Mr. R. F. Schuchardt said if a class of men like those on the Wisconsin commission could be appointed and would stay in the service both companies and the public would be the gainers under commission regulation.

Mr. G. L. Clausen expressed the opinion that questions like this were not for engineers to discuss, as they are political and economic questions. The engineer should be a man of facts and figures. Mr. J. R. Cravath, in opposition to this view, said that it is being recognized more and more all the time that the engineer has a broad public duty to perform and is the man most competent to deal with many public questions. If engineers have disinterested opinions on these public questions of which they have special knowledge, they should not hesitate to use their influence toward a proper solution of them.

Public-Utility Measures Before California Legislature.

Three bills and one constitutional amendment framed by a conservation committee have been introduced in the California Legislature, now in session at Sacramento. Two of the bills provide for the appointment of boards of control—one of three members and the other of five members—which shall govern the appropriation of water for electrical and power purposes. The third bill stipulates that no water for the generation of electricity may be appropriated for longer than twenty-five years. The proposed amendment to the constitution permits cities and counties to fix annually the rates at which electric power shall be supplied, and if any company attempts to collect more than these rates its charter will be forfeited.

Messages of Governors to Legislatures.

The following abstracts of the annual messages of Governors of States to Legislatures which have just assembled supplement similar abstracts of messages published in these columns in previous issues:

GOVERNOR WEST OF OREGON

Governor West said that effective conservation, control or development of the resources of Oregon could come only through State and federal co-operation. A stream the source and flow of which were entirely within the boundaries of the State, even if within the boundaries of a federal forest reserve, should be given over to the control of the State. But in the control of interstate streams the federal government must be looked to. It was a good suggestion that the interstate waters of a basin lying within the boundaries of several adjoining States might, as far as possible, be turned over to the joint control of these States.

A movement to solve the problem of lessening the hardships from the hazards of injury and furnishing relief to the injured should be given every encouragement.

There was a demand from many quarters for the better regulation of all public-service corporations, and a movement was now on foot to place those not now subject to control under the jurisdiction of some commission. Experience had shown that just rates and treatment came only through such effective regulation and there was no excuse for further delaying action in the State.

The constant consolidation and reorganization of the public-service corporations and the lack of proper regulation in the matter of issuing stock had attracted the attention of the members of the Legislature and convinced them that there was great need of legislation which would protect the public from all unwarranted issues of watered stock. In the absence of any action on the part of the United States Congress, it was surely within the province of the State to take action in the matter.

GOVERNOR TENER OF PENNSYLVANIA.

Governor Tener said that the present Railroad Commission had done well, but, circumscribed as to its limitations, it could not fulfil the present requirements in the treatment of the relations between the people and the public-service corporations. A commission vested with all possible power should have the general supervision and control of corporations and individuals having to do with public utilities, and the present Railroad Commission should be abolished. Such a commission would create a better feeling between the people and corporations, would keep the companies within their lawful bounds and would compel them to render the reasonable and satisfactory service for which their franchises were granted. It would prevent the construction of unnecessary railroads and works and the issue of obligations not fully represented by actual value given. It would protect the companies against unfair tax, while the rights of the people would be fully conserved. The enactment of legislation creating such a commission was therefore recommended. It was desired by the people and should be welcomed by all fairly disposed corporations.

Pennsylvania, the greatest of all industrial States, should be the first to put into operation advanced legislation in respect to workmen's compensation. Governor Tener advised the appointment of a commission of workmen and employers to investigate the question and recommend a bill.

GOVERNOR HADLEY OF MISSOURI.

Governor Hadley declared that the efforts of the State and its various municipalities to accomplish effective regulation of the rates and service of public-service corporations in Missouri had not been attended with satisfactory results. The question of the regulation of public-service corporations was a continuing question of public interest and concern. The right of the people to regulate, either by legislative enactments or through orders of a commission properly authorized, the rates and service of public-service corporations was now not only generally conceded, but the necessity of such regulation was also generally recognized. The establishment of a State public-service commission would give to capital invested and seeking investment the assurance which it sought and required that investigation would precede regulation and that no radical, extreme or retaliatory orders would be adopted or enforced, and, on the other hand, it would give the people assurance that their rights would be safeguarded and their interests protected.

Governor Hadley urged upon the consideration of the Legislature the subject of a special tax upon the franchise of existing business corporations. It would be no injustice to the corporations in Missouri if the State should follow the example of other States and impose a tax of 25 cents upon each $1,000 of capitalization.

If in the opinion of the members of the Assembly there was not sufficient time to give the subject of employers' liability and workmen's compensation laws the consideration and investigation necessary for such an important change in the system of litigation and in the conduct of industrial and commercial occupations, Governor Hadley recommended that a commission be provided which would investigate the subject further and report to the next General Assembly.

GOVERNOR CARROLL OF IOWA

Governor Carroll renewed his recommendation of two years ago for the creation of a public-utilities commission or the enlargement of the powers of the Board of Railroad Commissioners. He declared that a commission clothed with such power and authority as were given by the laws of New York and Wisconsin would prove of great benefit to the State. The question of the regulation and control of the water-powers of the State should be lodged with the proposed commission.

The existing law designed to prevent the issue of watered stock did not seem to have worked any particular hardship as to the incorporation of an ordinary going business, but it had evidently proved a hindrance to the promotion of new incorporations, and especially electric railways. The particular cause of the trouble seeemed to be that the law did not take into account the expense incurred before the enterprise reached the time for the issue of stock, and that it did not take into consideration any discount in the sale of bonds. Until similar laws were passed by other States, or the federal government, Iowa seemed destined to suffer a decided disadvantage. Governor Carroll called attention to the matter in order that it might be determined whether relief could be had without defeat of the real purpose of the law, and, if none could be had, that the Assembly might decide whether the law should continue unchanged in the hope of action by other States or by Congress.

The subject of compensation of workmen merited careful consideration. It was Governor Carroll's understanding that such a law was desired both by the employer and employee, so that the conditions under which damages might be recovered and their amount might be determined in advance as far as possible.

GOVERNOR O'NEAL OF ALABAMA.

Governor O'Neal suggested that the powers of the present Railroad Commission be so enlarged as to embrace telephone and telegraph companies, with full power after hearing to adjust and regulate interstate rates.

GOVERNOR JOHNSON OF CALIFORNIA.

Governor Johnson said that the great natural wealth of water in the State had been permitted, under existing laws and lack of system, to be misappropriated and to be held to the great disadvantage of its economical development. The present laws in this respect should be amended. If it could be demonstrated that claims were held wrongfully and illegally, these claims should revert to the State, and a rational and equitable code and method of procedure for water conservation and development should be adopted.

Those in the State who had given most study to the subject of an employers' liability law would soon present to the Legislature a comprehensive bill. Governor Johnson will address the Legislature again on this subject.

It was suggested that an appropriation of at least $75,000 be made for the use of the Railroad Commission in order that it may determine the physical value of the transportation companies in the State. The commission should have the amplest power that can be conferred upon it.

GOVERNOR DONAGHEY OF ARKANSAS.

Governor Donaghey said that it was absolutely necessary that some provision be made for the regulation and control of public-service corporations furnishing water, electric light, gas and telephone service. It was generally the case that these corporations were owned by non-resident investors and that the great profit arising from the operation of the properties went outside of the State to add to the wealth of other communities. The fact that foreign capital was invested in these properties was no ground for complaint, but the fact remained that abuses in the management were permitted to grow up that would scarcely exist if those in control were on the ground and able to know what was being done. It ought to be made a misdemeanor of any water, electric light, gas or telephone company to discontinue a service to its patrons without at least forty-eight hours' written notice.

The enactment of a law providing for compulsory compensation for industrial accidents was recommended.

GOVERNOR NORRIS OF MONTANA.

Governor Norris said that the creation of the Interstate Commerce Commission and of State railway commissions had been but the beginning of a movement that should be extended to all public-service corporations. Fewer and larger corporations was a fixed policy of the business world, and combinations followed in sequence. Public service commissions with full power to regulate would bring about conditions that were fair alike to the corporations and the public. Appointive commissions with full power of removal vested in the appointing authority would prove more satisfactory than elective commissions. A public-service commission, with whose necessity Governor Norris was impressed, could also perform the duties of a tax commission.

It was clearly evident that the issue of watered stocks and bonds should not have been permitted in the first instance and that effective supervision of corporations could have prevented the difficulty. The mistakes of the past may be utilized as warnings to prevent commission of like errors in the future. The issue of capital stock and increases in stock or the creation of an indebtedness by corporations should not be allowed until some State authority had made an examination and become satisfied that a fair market value in money or property had been paid for stocks and bonds, except that a reasonable amount of promotion stock or premiums might be allowed for organization, promotion or selling purposes. He could not believe that the enactment of any laws justly and fairly regulating corporations would prevent investment and development in Montana.

Special messages will be submitted later to the Legislature upon the report of the commission recommending employers' liability and workmen's compensation acts, and upon the report of the conservation commission. The latter will recommend laws for the regulation of appropriations of water for power purposes.

GOVERNOR KITCHIN OF NORTH CAROLINA.

Governor Kitchin urged that all power and light plants in the State, and all companies selling energy for lighting and industrial purposes in the State, be placed under the jurisdiction of the Corporation Commission, and that this commission shall have the same powers and duties in regard to these properties and their rates and operation that it has in regard to railroads. A proper act, if fairly enforced, would prevent over-capitalization.

It was doubtful whether the State should have disposed of the natural powers of its streams for private benefit or profit, but this State had so disposed of its powers and the original question might therefore be academic. Governor Kitchin, however, had no doubt of the right and duty of the State to control and regulate in cases where the power or its product was sold to the public.

It was recommended that the Corporation Commission be authorized to employ an expert or experts to examine and report upon the physical condition of railroads and other public-service corporations under its jurisdiction.

GOVERNOR HAWLEY OF IDAHO.

Governor Hawley said that such action should be taken by the Legislature to amend the employers' liability law as to make it conform to the laws enacted during the last decade by the Legislatures of most of the States of the Union and to give protection to the employees engaged in all branches of labor. The law passed by the last Legislature was absolutely ineffective in the judgment of Governor Hawley.

GOVERNOR ODDIE OF NEVADA.

Governor Oddie recommended the consideration of the National Civic Federation bill providing for direct compensation for injured workmen.

GOVERNOR GLASSCOCK OF WEST VIRGINIA.

Governor Glasscock of West Virginia advocated earnestly the regulation of public-service corporations in the interest of the people of the State, as well as in the interest of the corporations themselves. The present laws were wholly insufficient to furnish parties aggrieved by the actions of public-service corporations with speedy and adequate relief.

Governor Glasscock said that he felt bound by the action of his party to recommend an employers' liability law, but he would not disapprove a proper workmen's compensation act if such a law should be enacted by the Legislature.

Vermont Public Service Commission News.

The Vermont Public Service Commission has made public its report for the year ended June 30, 1910. The report is printed as a volume of 974 pages and covers in detail every branch of the commission's work, including the supervision and returns of all the public-service corporations in the State. There are now operating in the State about seventy-five telephone companies, sixty-one electric light companies, of which twenty-one sell energy for motors, ten transmission companies, thirteen gas companies, eight telegraph companies and four express companies, making in all 171 companies subject to the supervision of the board under the new Public Service Commission law of 1908, in addition to the railroads under the supervision of the previous Railroad Commission.

The report states that blanks sent out by the commission on April 1, 1910, had been returned very slowly, and that a large amount of correspondence and personal interviews had been necessary in order to have the reports filled out properly. A good many small telephone and electric light companies have very simple methods of bookkeeping, and the commission says that it has been very difficult, and in some cases impossible, to secure anything like an intelligent report. In a number of instances companies conduct an electric light or telephone business in connection with some other business. In these cases there has been no segregation of accounts. However, the officials of all of these companies have manifested a disposition to co-operate with the commission and furnish all information possible.

The most important formal complaint handled during the year under the new law was that brought by the State's attorney of Washington County, seeking the improvement of overhead distribution conditions in the Barre-Montpelier district. As a result of the investigation an order was issued requiring radical reconstruction and rearrangement of lines, with the consent of substantially all the parties concerned. About four miles of work was required to be completed during the past season, and the remaining work is to be done in subsequent annual instalments. An exhaustive series of specifications covering the wiring improvements ordered is included in the report. Another important complaint was by the State's attorney of Rutland County against the New England Telephone & Telegraph Company charging inadequate telephone service. The company voluntarily offered to reduce all ten-party lines in Rutland and its vicinity to six-party lines. In view of the expert investigation being made by the Massachusetts Highway Commission into the question of telephone rates it was decided to hold the latter problem open pending the results of the work at Boston. The report is signed by Hon. John W. Redmond, chairman: Hon. Eli H. Porter and Hon. S. Hollister Jackson, commissioners, and Mr. Rufus W. Spear, clerk.

Massachusetts Legislative News.

About thirty bills of interest to gas and electric light companies have been introduced into the Legislature of 1911 and referred to the committee on public lighting for hearing. At the request of the Massachusetts Gas and Electric Light Commission a bill has been introduced providing that electric light companies, like gas companies, shall be expressly prohibited from leasing or contracting for the operation of their works. The board points out that during the past year its attention has been directed to an instance in which an electric light company has undertaken to make a ninety-nine-year lease of its works and distributing system to another company, and to the attempt of another company virtually to contract with a power company for the operation of its plant. The commission states that while the validity of such contracts is open to serious question they are not expressly forbidden by statute except in the case of gas companies. The board considers such contracts antagonistic to the policy of the State and a menace to the interests of consumers. A bill has been introduced on petition of Mr. G. N. Nichols that no gas or electric light company shall declare or pay dividends aggregating in any year more than 6 per cent of the par value of the capital stock of the company which is outstanding at the end of the year and that the net assets of such a company, exclusive of the value of good will and franchises, shall at no time exceed 10 per cent of the par value of the outstanding capital stock. The bill provides that any premium received from the sale of stock shall be considered as an asset and not carried by the company as a liability. A bill has been introduced into the Senate which provides that whenever the Gas and Electric Light Commission authorizes the issue of additional stock in a gas or electric light company such shares shall be sold at public auction in the City of Boston instead of being offered first to the stockholders of the company.

An effort has been made to secure easier conditions of municipal ownership by the introduction of a bill into the Senate which provides that a single ratification of a vote to acquire a plant shall be sufficient in place of the present requirement of a two-thirds vote in each branch of the city council in each of two successive municipal years. Another Senate bill provides that whenever a meter reader of a gas company makes a reading upon a consumer's premises a memorandum of the number of cu. ft. of gas consumed since the last prior reading shall be presented to the consumer. A House bill recently introduced provides that any city or town may construct and maintain a municipal lighting plant upon a single vote to that effect. Two bills have been introduced into the House providing that no meter charge shall be made in either gas or electric service. Another House bill provides that municipalities of less than 200,000 people may construct, maintain, purchase and lease conduits and connecting structures to owners or operators of wires and cables, subject to the appeal of the latter to the Gas and Electric Light Commission. A bill now before the House provides for a complete inspection of gas plants at least once a year. Another attempt has been made to undermine the rate-adjudication authority of the Gas and Electric Light Commission by the introduction of bills reducing the price of gas in East Boston and Woburn. A bill has been filed which provides that all gas, electric lighting and power companies using cash-recording meters shall be responsible for the loss by fire or theft or otherwise of all cash deposited in such meters. A resolve before the House provides that the Massachusetts Highway Commission shall investigate and report upon the advisability of having the wires of all telephone companies in the State placed underground, particularly with reference to State highways in cities of 25,000 inhabitants and upward.

Massachusetts Commission News.

The joint board consisting of the Massachusetts Railroad and the Boston Transit Commissions has submitted a report to the Legislature in favor of the acquisition of a controlling interest in outlying street railways by the Boston Elevated Railway Company. The commission approves of the stock-holding policy and unanimously agrees that the acquisition of outside companies by the Boston Elevated would be in the public interest. The board feels, however, that after 35 per cent of the stock has been acquired the Boston Elevated interests must proceed to legal consolidation by acquiring the property and rights of the subsidiary companies. Close supervision of the taking over of control is recommended, the work to be done under the jurisdiction of the Railroad Commission. According to the plans for expansion lately made public the passage of the law and the acceptance of it by the Boston Elevated Railway Company would create a single system from the operating point of view involving about 1700 miles of track and earning over $23,000,000 per year. Nearly 14,000 employees are at work on the lines concerned, and the annual traffic covers the transportation of nearly half a billion passengers. Expensive economies in energy production, distribution and car operation are anticipated.

Other important questions discussed by the joint board are the extension of the subway and tunnel leases in Boston and the proposed consolidation of the Boston Elevated Railway Company and the West End Street Railway Company. Regarding the subway and tunnel leases, the board is of the opinion that these should be extended, and that there should be a uniform date of expiration for all leases and a uniform rate of rental, which the board recommends to be 4.5 per cent on the net cost up to the year 1936. The board believes that the finances of subway and tunnel construction should be placed upon such a basis as to provide for the payment at maturity, without renewal, of all bonds issued for subway or tunnel construction No change in the existing rentals is recommended until after the present leases expire. A provision is also made for a board of arbitration to fix the rate of rental after 1936, all recommendations being conditional upon the consolidation of the West End and Boston Elevated companies, and upon the construction of the Park Street-South Station-Andrew Square subway, with its leasing by the Boston Elevated Railway Company. In the matter of Boston Elevated-West End consolidation the joint board strongly urges that it be effected by December, 1911. A single control exists to-day under the present lease, which expires eleven years hence. The majority of the board would permit the consolidation upon the desired basis of an 8 per cent dividend rate upon the common stock of the West End company, and feels that it is advisable, expedient and in the public interest to authorize the dividend rate of 8 per cent upon which the two companies have agreed. The board points out that great advantages will be obtained from this consolidation, with a saving in capital and operating expenses. A minority report is issued in favor of the consolidation, but stating that a dividend rate of 7 per cent is the return which should be fixed.

Little probability exists that the proposed bill abolishing the existing public-service commissions of the State and forming a single public-utility board will receive favorable consideration at the present legislative session. The record of the Massachusetts commissions appears satisfactory to the general public, and while the efficiency of these tribunals continues to be demonstrated in the face of constantly increasing duties there appears to be little prospect that any extended changes in policy will be inaugurated.

Hearing of Massachusetts Commission on Street-Lighting Rates.

The Massachusetts Gas & Electric Light Commission gave the first of a series of hearings at Worcester on Jan. 31 upon the petition of Mayor James Logan for a reduction in the street-lighting rates charged by the Worcester Electric Light Company. The petitioners were represented by Mayor Logan, Messrs. Anderson and Thayer, of the legal department of the city, and the consulting engineer of the municipality, Mr. William D. Marks, of New York. The company's case was conducted by Everett W. Burdett, Esq., of Boston, counsel of the Massachusetts Electric Lighting Association, President George T. Dewey and other officers of the company being also in attendance. The opening day was devoted almost entirely to the presentation of the city's case, with cross-examination by the respondent. The chief point of interest in the case is the discussion centering about the cost of lighting the streets by 4-amp magnetite lamps, Worcester being illuminated by this equipment to the practical exclusion of all other types. Nearly 900 lamps are now in service on an all-night and every-night basis, the cost to the city being $91.25 per lamp per year. The policy of the company in developing its territory was brought into question by the city, and another factor which bears upon the matter to a large extent is the unusually large amount of underground construction involved.

Mayor Logan addressed the board on behalf of a reduction in rates, contending that the situation in Worcester should be judged entirely on the basis of local conditions and that comparisons with prices elsewhere are of little value. He said that as a result of conferences with the company the officials of the latter had offered to supply the city with street lighting at a price of $86.25 per lamp per year. This was not acceptable to the municipality, since Mr. Marks had figured that a fair price for arc lamps in Worcester is $64.83 per lamp per year. The Mayor said that $83.25 per lamp was the highest price he was willing to accept. He contended that a larger exploitation of the company's commercial field would enable it to supply lighting of the city streets at lower cost. He cited numerous figures purporting to show that the company's prosperity warrants a reduction in the rate, and then called upon Mr. W. D. Marks, consulting engineer, New York, who submitted an exhaustive report of sixty-six pages in suport of the establishment of lower charges. Mr. Marks stated that in the absence of an appraisal of the property it was difficult to obtain results of the highest accuracy, his figures being based chiefly upon the book assets of the company and its tax valuation. Mr. Marks' final tabulation of estimated cost of street lighting was as follows:

Cost of energy, 1,078,650 kw-hours at 1.38 cents	$14,885.87
Depreciation, 7 per cent on $300,000............	21,000.00
Extra expense of attendance, repairs and tubes.	5,000.00
Total operating cost, average 862 lights at $47.43	$40,885.87
Profit, 5 per cent on $300,000..	15,000.00
Total...	$55,885.87
Average cost per lamp	$64.83

Mr. Marks' report contained a voluminous discussion of the principles and practice of rate-making, with particular application to conditions as seen by him in Worcester. He reached the final conclusion that "the real difficulty at Worcester appears to be a lack of proper rates for electricity resulting from a policy which produces haphazard high and low prices and restricted sales, rather than a scientific management of rationally lowered prices and large sales."

Under cross-examination Mayor Logan said that he would prefer to have the Worcester company managed by local men than by outsiders, and he recognized that the stockholders had lately withstood the tempting offer of $300 per share from parties beyond the bounds of Worcester. Mr. Burdett brought out the point that the company has reserved 352,000 ft. of ducts for the city which cannot be used for any other service and that there is a total investment of about $210,000 in duct equipment from which no revenue can be derived. About half of this investment is in unproductive city ducts. After a long discussion the Mayor admitted that the cost of carrying the investment necessary to enable the company to meet the demands of the immediate future should be borne by the consumers. Mayor Logan was willing that a 6 per cent return should be paid on all property representing the sale of stock and the fair and reasonable earnings of the company, but he objected to the payment of dividends on accumulated surplus. At the close of the hearing a continuance was taken to Feb. 24, when Mr. Marks will be cross-examined by the company and evidence submitted in rebuttal of his report, with particular reference to the cost of magnetite arc lighting as determined by the local operating conditions and administration.

New York Commission News.

The Public Service Commission, Second District, has denied the application of the receivers of the Hudson River Electric Company to exercise a franchise granted it by the village of South Glens Falls. This field, which is a small one, is now occupied by the United Gas, Electric Light & Fuel Company, of Sandy Hill and Fort Edwards. At the hearing it was shown that this company has a plant sufficient to supply proper service to the village of South Glens Falls, and that no reason appears why a new company should be allowed to enter this village for the purpose of furnishing electric lights. The Hudson River company secured a franchise from the village on an agreement to light the streets of the village at the rate of $63.87 per arc light, whereas the existing company asked $72 per arc lamp. In order that the village should have the lowest rate obtainable for lighting its streets, and at the same time the existing plant be protected from competition in such a small field, the commission advised the United Gas, Electric Light & Fuel Company to light the streets of the village at the rate offered by the Hudson River company, or the commission would feel obliged to allow the Hudson River company to exercise the franchise granted by the village. The United Gas company has filed with the commission a stipulation agreeing to furnish lights at the rate of $63,87 on a five-year contract. If the provisions of this stipulation are not carried out the Hudson River company can renew its application to light the streets of the village.

The Lockport Light, Heat & Power Company has been authorized to issue its thirty-year 5 per cent bonds upon the security of its first refunding mortgage to the aggregate principal amount of $70,000, the bonds to be sold at not less than 85 and the proceeds to be used for the improvement and extension of its plant and distributing system, and for the discharge of indebtedness incurred for proper capital purposes.

Maryland Commission News.

The commission has received a complaint designed to bring about an investigation of the financial affairs of the United Railways & Electric Company of Baltimore. The complaint was presented by attorneys acting for the Federated Associations of the Suburbs of Baltimore, representing a large number of local bodies. The complaint charges that the capitalization of the street railway lines in and about Baltimore City which the company owns is greatly exaggerated and that the sum total of the various bonds and stocks issued by the said company is greatly in excess of the true value of said property.

Arrangements are being completed for conducting hearings in the case of the City of Baltimore against the Consolidated Gas, Electric Light & Power Company on complaints as to the injustice of present rates for electric lighting. The city itself has no power to examine the books of the company, but will have assistance from the commission.

Canadian Hydroelectric Commission News.

Niagara energy was turned on at New Hamburg on Feb. 3 and the town was brilliantly illuminated that night. The local distribution plant has been entirely reconstructed under the supervision of Mr. E. B. Merrill, electrical engineer, of Toronto.

Construction Engineer Charles J. Leacock has been appointed by the commission as supervising engineer of Niagara power for the district surrounding Stratford, including the commission's transmission systems at Stratford, St. Mary's, Tavistock Mitchell and Seaforth.

At the present session of the Provincial Legislature the government has appropriated $1,000,000 to enable the Hydroelectric Commission to extend its transmission system to Tilsonburg, Weston, Port Credit, Brampton, Mitchell and Seaforth; $30,000 has also been appropriated to complete the distribution station at Port Arthur.

The Light and Heat Commission of Stratford has announced new rates for residence lighting by Niagara energy, as follows: Four cents per month, per 100 sq. ft., plus 4½ cents per kw-hour; no meter charge; less 10 per cent discount for payment by fifteenth of the month; carbon lamps renewed free. This is an estimated rate of 7 cents per kw-hour, while the old rate was 12 cents, with 25 cents per month meter rental. For stores, 12 cents per kw-hour for the first hour's daily use of installed power, and 4½ cents per kw-hour for further use, with free lamp renewals and 10 per cent discount for prompt payment.

At a special meeting of the Galt Town Council on Jan. 30 it was decided to purchase a site on North Water Street upon which to erect a transformer station. Chairman Scott announced that Niagara energy would be lighting the town the third week in February.

Hon. Adam Beck, chairman of the commission, has stated that there are 18,000 insulators on the transmission line of the commission and there had not been a single puncture or breakage yet to report. He stated that energy would be ready for delivery to Toronto within a week. Authorities of Kingston

(Ont.) desire to obtain electrical supply for Kingston and points in eastern Ontario. Mr. Beck stated that the commission hopes to secure a supply of energy from Waddington, N. Y., and experts are now at work preparing the necessary estimates and plans. It is expected these will be ready within a week, when the Eastern municipalities will be called together to consider the proposed undertaking.

An important amendment to the provincial Hydroelectric Act is under consideration by the commission, under which provision will be made to supply farmers directly with electrical service at their homes. It is considered likely that the measure under consideration will be introduced at the present session of the Legislature, which opened on Jan. 24. It is expected that a test of electricity for farm work will be made at the Ontario Agricultural College at Guelph, and after that it will be tried at private farms near Tilsonburg. The commission has been besieged with applications from farmers anxious to secure such a service, but the matter is one with which both the commission and the government yet have to deal.

CURRENT NEWS AND NOTES.

Electric Companies in Greater New York.—According to reports of the New York Public Service Commission of the First District, there are thirty-six street railways and twelve electric companies in Greater New York. The street railways are capitalized at $735,635,000 and the electric companies (including the subways) at $163,216,000.

Meeting of New York Electrical Society.—A large and enthusiastic audience greeted the speaker on the occasion of the meeting of the New York Electrical Society in the main auditorium of the Engineering Societies Building on Feb. 2, when Dr. Percival Lowell lectured on "World Evolution." The speaker explained in detail the development of the various planets and explained the relation between the periodic sunspots and their associated magnetic and electric disturbances.

Electric Railway Indicted for Overcrowding Cars.—The Grand Jury at Toronto has brought in a true bill against the Toronto Street Railway Company for maintaining a common nuisance, the nuisance consisting of overcrowded cars, inadequate fenders and lack of other safeguards. Justice Riddell, in his charge to the jury, said that the accommodation provided by the company should be "such accommodation as a decent Canadian man would demand for his decent Canadian wife and himself."

Telephone and Telegraph Taxation in Michigan.—Judge Denison, of the United States District Court at Grand Rapids, Mich., has rendered a decision upholding the constitutionality of a new law which provides for the taxation of telephone and telegraph companies on an ad valorem basis and a temporary restraining order preventing the auditor general from collecting taxes under this law has been dissolved. Hereafter these companies will pay taxes on the same basis that railroad companies do and the amounts will be much larger than they have been.

Eight Thousand Kw from One Boiler in Detroit.—During runs on the rated 2000-hp boilers in the Del Ray station of the Detroit Edison Illuminating Company, which are the largest steam-generating units ever built, more than 8000 kw has been obtained from a single boiler. Normal operation of these units is at about 7000 kw of steam production, two boilers serving a 14,000-kw turbine generator when fully loaded. The Detroit company is just completing the installation of another 14,000-kw turbine set to carry its increasing business, which has practically doubled in little more than two years. The company's organization has also undergone a rapid growth, the number of employees in the power house alone now virtually exceeding that of the entire staff five years ago.

Lighting Rates in Toledo.—The City Council of Toledo, Ohio, has taken up the subject of rates for electric lighting. Under a contract that expired Jan. 12 the rate was 9 cents per kw-hour and the service charge was $1 a month, with a reduction of 10 per cent in the bills if paid within ten days after presentation. The Council committee on lighting has recommended a rate of 6 cents per kw-hour, with a reduction of 1 cent per kw-hour if bills are paid within ten days and a service charge of 50 cents per month for the next five years. Other members of Council are in favor of making the service charge 25 cents per month. City Solicitor Schreiber holds that the city has a right to make the rate for lighting and while the company cannot be forced to accept it, if it is to continue to supply consumers the price fixed by Council must prevail.

Lakes-to-Gulf Waterway.—A meeting of the government commission of engineers appointed by the President to inquire into the practicability of a navigable waterway from Lake Michigan to the Gulf of Mexico, by way of the Chicago Drainage Canal, Desplaines River, Illinois River and the Mississippi, was held in Chicago on Jan. 13. It is reported that the commission will make a report unfavorable to the project. The voters of Illinois have already expressed themselves in favor of the issuing of $20,000,000 worth of bonds by the State to be used in constructing that portion of the Illinois River waterway between Lockport and Utica, Ill. However, it is unlikely that the State will proceed in this great undertaking without government co-operation. The Lockport-Utica section, if built, will afford opportunity for extensive water-power development.

Meeting of Empire State Gas & Electric Association.—An informal meeting of the Empire State Gas and Electric Association was held in Binghamton, N. Y., on Feb. 1. Twenty-five member companies were represented at the meeting and thirty-four delegates lunched together in the rooms of the Mercantile Press Club. Several subjects were discussed in an informal manner. The one which appeared to be of greatest interest and occupied the most time was the use of auto trucks, automobiles, motor cycles and tricycles and their merits and defects as compared with the use of horses and wagons and other means of transportation. It was decided that at the next meeting the members should be asked to prepare statistics showing the cost of operation in comparison with the older methods. The different makes of batteries and their advantages and defects were also discussed.

McCall Ferry Energy for Baltimore.—It is reported that long-pending negotiations in the making of a contract with the Pennsylvania Water & Power Company to supply energy from the McCall Ferry Dam to the United Railways & Electric Company, of Baltimore, are on the eve of being completed. The contract will provide for a minimum of 12,000 kw with the privilege of using 6000 additional kilowatts if it should be needed. The contract is to run for fifteen years, subject t certain changes and adjustments regarding price and quantity at five-year intervals. As it requires approximately 23,000 kw at the peak load to supply the traction company's needs at thi time, the amount of power to be contracted for with th Pennsylvania company will not be sufficient to meet the presen demand. It is stated that the fires under the boilers at th Pratt Street power house of the United company will be partially banked, so that the full capacity of the plant may b almost instantly available in case the supply of energy fro the Susquehanna should be interrupted for any reason. It understood that the contract will be actually signed in tim for it to become effective March 1.

Submarine Disaster Demonstrates Buoy Telephone.—The use of the buoy telephone with which submarine vessels are equipped for communicating with the surface in case of accidental sinking was well demonstrated Jan. 16, when the German submarine torpedo boat "*U 3*" went to the bottom in Kiel harbor. The buoy float was automatically released and rose to the surface, where the life-saving crew made connection with it and learned from the captain of the submarine that his stock of oxygen would support the twenty-five men of the crew for forty-eight hours. Careful preparations were then made for raising the submarine, and in three hours the submerged vessel was brought to the surface by the salvage ship *Vulkan.*

New York's Unused Water Powers.—In an address before the People's Forum at Troy, N. Y., on Feb. 5 Mr. Walter McCulloh, consulting engineer of the New York State Water Supply Commission, said that the waterfalls of the State are capable of delivering 1,500,000 hp exclusive of the amount available along the Niagara and St. Lawrence River. Only 620,000 hp has been developed to date, and with this 121,000 hp has been installed in steam engines to assist in running the plants during low-water periods. The development of the unusued water-power would increase the value to the industry by about $17,500,000 annually. The best development would involve the construction of great storage reservoirs in the upper Hudson and its principal tributaries, like the Sacandaga, the Indian and the Schroon Rivers.

A French Impression of Chicago's Central Station.—Writing in *La Nature,* Paris, Mr. Chaplet, who recently paid a visit to America, becomes enthusiastic over the industrial progress and improved factory and plant methods in use in this country, and closes with the following description of a large Western generating station, as translated by the *Literary Digest:* "In the furnace-room of the Chicago central station, furnishing an average of about 25,000 hp, there are only two skilled firemen, all in white, and a third, stationed at the end of the room in a sort of observatory fitted with electric push-buttons by means of which he signals to the chimneys that are smoking." It is a pity that the location of this boiler-room, where firemen are not only immaculate but polite even to smoking chimneys, is not given.

Cinders from Steam Locomotives.—That householders and suburbanites have reason for their urgent pleas for the electrification of steam railroads is evidenced by the recently proven fact that from 15 per cent to 25 per cent of the coal fired into the locomotives is pulled unconsumed through the stack by the intense forced draft and deposited as cinders and soot upon the surrounding landscape. This evidence has been obtained by the use of a new centrifugal cinder-separating device which several railroads are trying, and in which the flue gases are conducted through an open spiral passage, the heavy solid material being thrown to the outside, where it is collected by skimming plates and returned to the firebox to be burned. The cinders collected on trial runs in regular service have averaged from 15 per cent to 25 per cent by weight of the coal used.

Sales Department Dinner at Detroit.—The annual dinner of the sales organization of the Edison Electric Illuminating Company of Detroit is always depended upon for bringing out much mutual helpful comment and advice from members of the department. At the dinner on Jan. 24 thirty-nine were present, including several invited guests and company officials. Miss Sarah Sheridan, sales manager for the company, presided, and called upon the following speakers: Mr. S. C. Mumford, comptroller, "Relations Between Departments"; Mr. J. V. Oxtoby, attorney, "Franchises"; Mr. J. W. Brennan, purchasing agent, 'Speechmaking"; Mr. B. J. Denman, commercial engineer, "Some Narrow Escapes in Landing Contracts"; Mr. E. L. Crosby, "Signatures We Did Not Get," and Mr. Alex. Dow, president and general manager of the Detroit company, "Growth." Mr. G. W. Kato, general superintendent, and Mr. A. D. Spencer superintendent of the meter department, were also guests.

Annual Meeting of N. E. L. A. New England Section.—The annual meeting of the New England Section of the National Electric Light Association will be held in the auditorium of the Edison Building, Boston, Mass., on March 17 In view of the fact that special efforts are being made to insure the largest possible attendance at the annual convention of the association in New York City in the week of May 29-June 3, 1911, a canvass was made of the membership of the New England Section to determine whether the consensus of opinion favored dispensing with the convention features of the March meeting. By a vote of three to one it has been decided to omit the program and entertainment features of the March meeting at Boston, and a formal business meeting will be held in place of the usual reading of papers, reports of committees, etc. The meeting will be held at 2:30 p. m. and the business will include the election of officers, report of the secretary-treasurer and other purely formal matters which may arise.

Chicago Electric Club Election.—The Electric Club of Chicago held its annual meeting at noon Feb. 1 The secretary's report showed a membership of 330. The treasurer's report showed a balance of $3,260.48 after disbursements of $761.19 for the year. The report of Mr. W E. Keily, chairman of the speakers committee, read by the secretary, showed that forty-seven meetings had been held, at thirty-eight of which speakers were provided. The largest attendance during the year was 130 at the meeting at the Electrical Show, and the average was fifty. The house committee, of which Mr A. A. Gray is chairman, reported no satisfactory progress in securing better quarters for the weekly luncheon meetings Brief reports also were heard from Mr. E. R. Rockwell, chairman of the finance committee; Prof. P. B. Woodworth, chairman of the civic committee, and Mr. J. H. Delaney, chairman of the reception committee. Retiring President Frederick P Vose said a few "last words." Officers for the ensuing year were elected as follows President, Mr. Homer E. Neisz, manager Cosmopolitan Electric Company; vice-president, Mr Charles A. Howe, manager Holophane Company; secretary, Mr. Norman F. Obright, contract agent Sanitary District of Chicago; treasurer, Mr. Otis B Duncan, sales engineer J Lang Electric Company.

Ladies for State Telephone Inspection.—The Public Service Commission, Second District, of New York State has appointed Miss A. J. Conneely, of Jamestown, and Miss Lillian A. Vavasour, of Albany, as telephone traffic inspectors Both of these young women have had extended experience in telephone work, commencing as exchange operators, graduating to the position of chief operators, and because of exceptional ability and merit have been employed by the telephone companies as traveling chief operators They have acquired thorough experience in various types of apparatus used in most of the cities and towns of the State, and have made their work a study of the best methods and practices which are calculated to give the highest grade of telephone service. It will be the duty of these inspectors to enter the operating rooms of all telephone companies within the jurisdiction of the commission, determine the faults that may exist, offering suggestions or corrections on the ground and making a report of the same to the commission in order that it may follow up and if necessary issue an order enforcing an improvement in operating practices and methods. This work, it is expected, will tend toward giving more uniform practice and generally improving the telephone system throughout the State The salary of these inspectors is $1,200 per annum.

Switzerland Government Telephone and Telegraph Service.—The telephone and telegraph service which is operated by the government in Switzerland took in $3,223,000 last year at an expense of $3,222,000, leaving only $1,000 profit to the government. The population of Switzerland is 3,500,000. Per capita there were one and one-half telegrams and fifteen telephone talks last year.

Guanajuato Transmission Plant.—The third hydroelectric plant of the Guanajuato Power & Electric Company, now being installed on the Angulo River in the State of Michoacan, Mexico, is nearing completion. It will give the company a total capacity of 20,000 hp. The new transmission line of the company to San Luis Potosi, eighty-seven miles, is now in regular operation. One of the important things accomplished by the company last year was the purchase, through its subsidiary, the Central Mexico Light & Power Comany, of the power and electric light plant at San Luis Potosi for $700,000.

Austin (Tex.) Dam.—The company to which was awarded the contract several months ago to rebuild the Austin (Tex.) dam has failed to carry it out and its rights have been declared forfeited by the city. Another offer has come from George D. Moore, of Detroit, Mich., who proposes to build the dam and install a hydroelectric plant for $1,000,000, this sum to be paid in semi-annual instalments of $25,000. The proposed new dam will be located on the site of the one that was destroyed by a flood in the river some years ago. It will, however, be of an entirely different type from the former structure.

Damming of the St. Lawrence.—As a result of the passage of the Maltbie bill in the United States House of Representatives permitting the Long Sault Power Company to construct a dam on the United States side of the St. Lawrence River at Cornwall, much opposition to carrying out the plans has been aroused in Canada. Numerous Canadian protests have been forwarded to the British Ambassador at Washington. The Canadian Minister of Justice, Sir Alan Aylesworth, has stated that the company has obtained permission to build exclusively within United States territory, and Canada cannot prevent the construction of the dam so long as navigation on the Canadian side is not interfered with. The Pittsburg Aluminum Company is the interest behind the Long Sault project.

Rules for Resuscitation from Electric Shock.—The United Gas Improvement Company, Philadelphia, has published in the form of a cloth-bound pamphlet instructions for "First Aid in Cases of Electric Shock." The Schaefer method of artificial respiration is recommended and described in detail. According to this method the patient is placed face downward instead of on his back as in the Sylvester method. The latter method has been criticised by a British commission appointed to report on methods of artificial respiration as apt to be in itself the cause of death through admitting of fluids obstructing the air passage. A description is included of an emergency kit for electric shock cases, which contains some medicaments and several appliances, such as a pair of tongue pliers and a block for keeping the jaws from closing.

Electric Oscillations and Wireless Telephony.—A lecture on the subject of electric oscillations and their application to wireless telephony was delivered before the chapter of Sigma Xi at Purdue University, Lafayette, Ind., Jan. 28, by Prof. C. M. Smith, of the department of physics. Professor Smith explained the theory of wireless telegraphy and telephony in terms intelligible to those unfamiliar with electrical theory and pointed out the entirely different conditions necessary for wireless telephony as compared with wireless telegraphy. The lecture was illustrated by a large number of experiments showing the analogy between electric and sound waves, and was concluded with a demonstration of the singing-arc lamp, which reproduced very clearly a band selection through the agency of a phonograph and microphone located in a distant room.

National Water-Power Utilization.—The Secretary of Agriculture, Mr. James Wilson, has issued a pamphlet entitled "Use Book," containing regulations and instructions for the use of the national forests with special reference to water-powers. The book gives detailed information concerning the forms of applications and permits. Priority of application is the determining element in issuing permits. A person may file an application for a preliminary permit to allow the occupancy of the lands for the purpose of securing the data required for an application for final permit to construct, maintain and operate hydroelectric plants. The fee for the water-power developed varies from $0.10 per year for each net electrical horse-power for the first year to $1 for the tenth year and each succeeding year up to fifty years, when the permit expires unless renewed by application to the Secretary of Agriculture.

Canadian Hydroelectric Developments.—Mr. C. Ross, of Ottawa, who holds a lease from the Dominion government of the hydraulic powers at Carillon and Point Fortune on the Ottawa River between Ottawa and Montreal, is forming a strong company for the purpose of developing electric power The terms of the lease from the government provide for a payment of $2 per horse-power per year and $100 for rent of land. Formal application to the Dominion government has been made by the City of Edmonton (Alberta) for power rights on the Grand Rapids on the Athabasca River. Plans filed with the application show a maximum power, if all dams are built, of 60,000 hp. As the city will require half of this supply, it is hoped to interest the provincial government in undertaking a scheme of energy distribution for other municipalities in the province in a manner similar to that now being carried out by the Hydroelectric Commission for the Ontario municipalities.

Detroit-Ann Arbor Branch of the A. I. E. E. Organized.—At a meeting held in Detroit, Mich., on Jan. 28 a branch of the A. I. E. E. was organized with an initial membership of forty-eight, divided between Detroit, Ann Arbor and Jackson Meetings will be held once a month, alternating between Detroit and Ann Arbor, probably two meetings in Detroit to one in Ann Arbor. The following officers were elected: Chairman, Prof. C. L. de Muralt, professor of electrical engineering at the University of Michigan; vice-chairman, Mr. H. M. Browne, of Detroit; secretary-treasurer, Mr. B. F. Bailey, Ann Arbor; assistant secretary-treasurer, Mr. J. J. Woolfenden, Detroit. The next meeting will be held in Ann Arbor and will be of a social nature, the principal feature being a dinner given by the Ann Arbor members to those of Detroit, Jackson and elsewhere. After dinner Prof. C. L. de Muralt, the newly elected chairman, will give an address on "Some Recent Aspects of Railway Electrification."

Cargo of Magnet-Loaded Steel Rails Upsets Compass.—Leaving Gary, Ind., with a cargo of steel rails, bound up Lake Michigan, the captain of a lake vessel was recently surprised to find after steering for twelve hours steadily by his compass and chart that his ship had approached within a mile or two of the west shore when by his reckoning he should have been almost in mid-lake. After correcting his course and steering carefully by landmarks and stellar observations during the remainder of the voyage, he reported the peculiar behavior of his compass and found that this load of rails, like all the others he had carried for several years, had been loaded by electromagnets from the rail mill to the flat cars used to run onto the docks. The rails are lifted by huge horseshoe-shaped electromagnets and sufficient magnetism had remained in them from this momentary magnetization to deflect the compass more than a point when stacked end to end in the hold all in the same direction. The trouble might be averted, of course, by reversing alternate cars as the rails are loaded into the vessel, but this instance is the only one of the kind to be reported where such compass variation was caused.

CONGRESSIONAL POWER PLANT AT WASHINGTON.

Central Generating Station for Supplying Legislative Group on Capitol Hill with Electricity and Steam.

By M. C. Turpin.

Of particular interest, not only to those versed in electrical affairs, but to the general public, on account of its belonging to the national government, is the carefully designed and well-constructed power plant and distribution system recently installed at Washington for supplying heat, light and power to the public buildings on Capitol Hill. These buildings are the Capitol, the Congressional Library, the House of Representatives Office Building and the Senate Office Building. The necessity for a plant arose because of the erection of the last two buildings mentioned, which have recently been completed, and the rapidly increasing use of electricity throughout the Capitol. Formerly there were separate steam-driven electric plants in both the Capitol and Congressional Library, but they were not adaptable to an extension sufficient to provide for the wants of the new buildings. There also has been talk for several years past of a building to be devoted to the use of the Supreme Court of the United States, and it is quite possible that such a building will be erected in the near future.

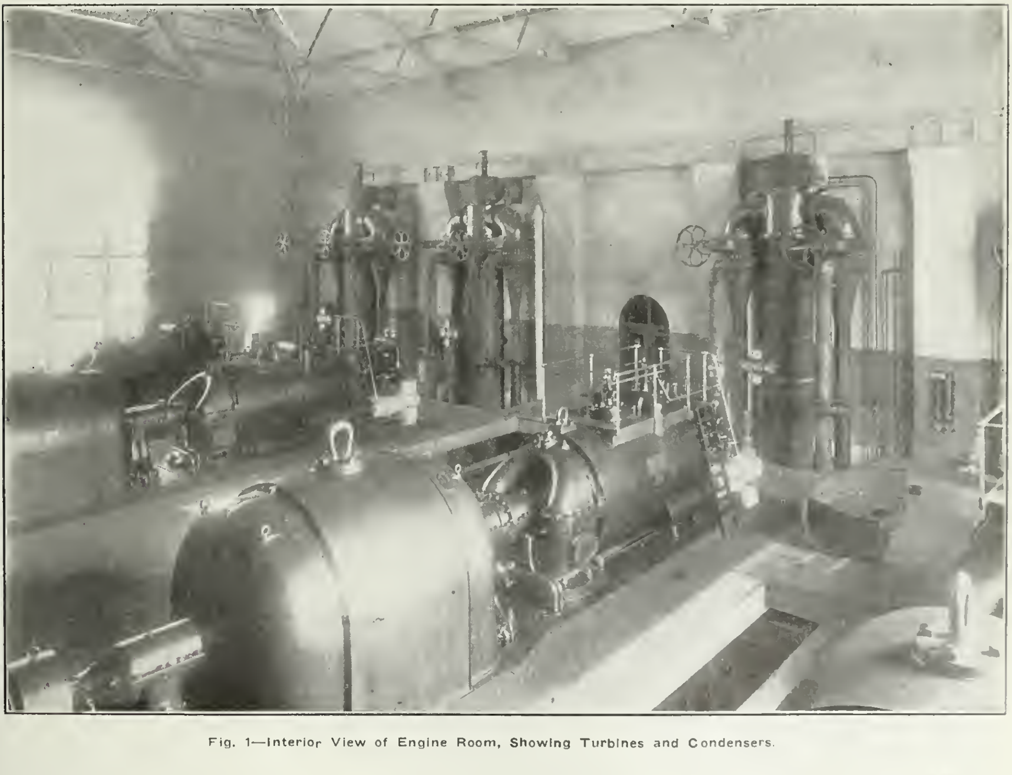

Fig. 1—Interior View of Engine Room, Showing Turbines and Condensers.

The logical result of a close study of these conditions was the decision to erect a central generating station, supply all the buildings from it and eliminate the existing steam plants. Another determining factor in arriving at this decision was the elimination of the haulage of coal and ashes to and from Capitol Hill, which, particularly during the times the Congress was in session, had always been a source of annoyance on account of the attendant noise and dirt.

It is interesting to note the growth and expansion of this plant, exemplifying, as it does, the progress of the electrical art. Beginning with individual plants using belted generators driven by high-speed engines, then changing to slow-speed, direct-connected engine sets, it finally develops into the new central plant using steam-turbine units. The first electrical installation on Capitol Hill was made in 1887 and consisted of two standard Westinghouse engines belted to two "650-light" alternators, giving a frequency of 16,000 alternations. Three sets were installed in the Senate terrace of the Capitol. A novel feature of this equipment was the use of a special steel rim driving wheel, 66 in. in diameter, belted to a 14-in. pulley on the alternator with 14-ft. centers. The exciter was belted on the opposite side of the engine from a 56-in. pulley to a 6-in pulley with 8-ft. centers.

The switchboard was particularly novel, well illustrating the advance of electrical practice when compared with the modern switchboard installed in the new plant, which is described below. This board was built of tongue and grooved flooring supported by 3-in. x 4-in. boards. The wiring was also placed on the rear, while the board was laid on the floor, after which the board was placed against the wall, leaving no intervening space. No busbars were used, each machine being connected directly to the circuit.

In the House terrace of the Capitol there were installed two Thomson-Houston "350-light" direct-current generators belted to standard Westinghouse engines. These engines were run condensing under 26 in. of vacuum and were so evenly balanced that it was possible to balance a small coin on end on the cylinder head.

At this time the use of electricity was confined exclusively to incandescent lighting and that only in some of the less important places. The popularity of this form of illuminant, however, increased rapidly and the connected load was soon very greatly increased, extending to cloakrooms, committee rooms, restaurants, barber shops and folding-rooms.

Naturally, at this early period of electric lighting the gradually increasing load and its effect had not been anticipated when installing the first wiring, so it soon became necessary to rewire the entire system. At this stage Mr. C. P. Gliem, the present chief electrical engineer, took charge of the plant and laid out a new system of wiring which took care of future increases in load.

This rapid growth also called for more generator capacity, and the Thomson-Houston generators were replaced by United States machines of "750-lights" capacity, belted to the same engines. Mr. Gliem adopted the policy of giving good service and endeavoring to install new lamps whenever requested by the legislators and those in authority. The result of this policy was that the demand continued to grow rapidly and it was soon necessary to make further additions to the plant.

In 1895 each of the existing generating equipments was replaced by two Westinghouse engine-driven units consisting of compound engines, direct-connected to 75-kw, 110-volt, direct-current generators. In 1896 a 187½-kw generator, with compound Kodak-type Westinghouse engine, was added to the Senate plant, and in 1898 a duplicate set was added to the House equipment. In 1900 a 187½-kw compound Kodak-type engine set was added to each plant.

The plants were 350 ft. apart and the switchboards were connected by a tie line consisting of three legs of nine 4/0 wires each. The capacity of the switchboards was increased from time to time by adding panels, busbars and extra wiring. Previous to 1895 a 5-kw generator driven by a Westinghouse standard engine was installed for supplying electricity to the folding-rooms in the summer when the other plants were shut down.

When the Congressional Library was built an electrical plant was installed in the basement consisting of three 100-kw Siemens & Halske outside, revolving-armature generators and Ball compound engines, and a 25-kw General Electric generator for use at times of light load. For additional information on the plants in the government buildings the reader is referred to *Electrical World,* June 8, 1907.

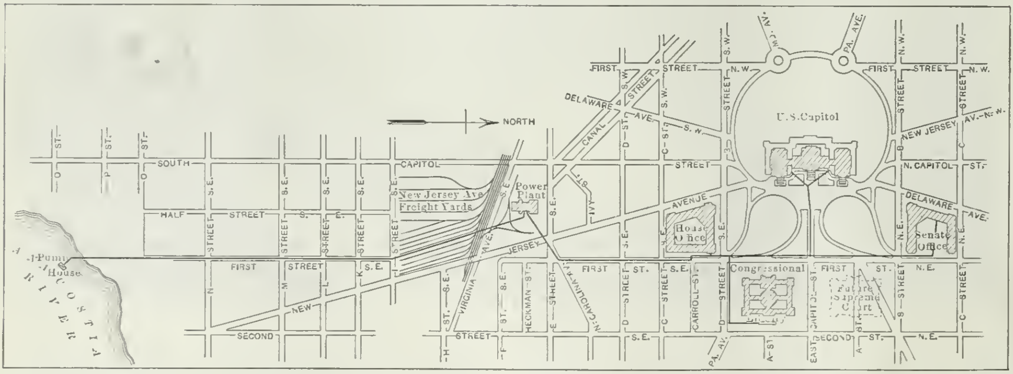

Fig. 3—Map Showing Location of Generating Station, Substations and Pump House.

An interesting point in connection with the numerous installations and changes is that they were all made without any interruption to the service. The same remarks apply to the installation and operation of the new plant; it replaced the old plants and took the load formerly carried by them without any interruption whatever to the service. An instance showing the good condition in which the equipment of the plants was kept is the following: The 187½-kw Westinghouse set purchased in 1896 ran continuously under actual operating conditions for a period of ninety-four days and nights and was shut down at the end of that period only because the Congress adjourned and there was no further need for the output. During this period the brushes were not touched nor was the oil changed. The engine was running under from 26 in. to 27 in. of vacuum and its operation was most satisfactory, a record which shows that many of the earlier machines were able to equal the records made by those of more modern design of whose spectacular operations one hears so much. Another interesting feature of the old plant was the fact that the engine-room floor was covered with Brussels carpet, quite an innovation in power-plant construction, to be sure. This carpet had been removed from rooms in the Capitol and, being yet serviceable, was utilized in this manner.

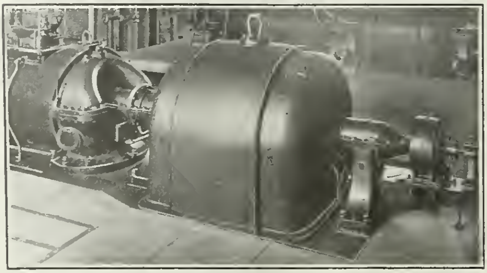

Fig. 2—Exciter on Turbine Shaft.

It was decided to install 8000 kw of generating equipment in the new plant, and although some have claimed that this capacity is greatly in excess of that necessary the government engineers had in mind the future growth of Capitol Hill and, as will be shown later, considered the principle of continuity of service of supreme importance.

The question of the location of the plant was very thoroughly considered and careful investigations were made of several proposed sites. The site finally selected was Garfield Park, a plot bounded by New Jersey, South Capitol and Virginia Avenues and E Street, Southwest. The determining factors leading to its selection were its location directly on the Pennsylvania Railroad and at a convenient distance both from the river and the buildings to be supplied. Owing to the fact that Garfield Park was a government reservation, no appropriation was required for the ground.

The predominating idea throughout the design of the plant has been continuity of service—and this has been adhered to closely even at the sacrifice, possibly, of some points of economy. The generating system selected was three-phase, 25 cycles, at 6600 volts. The reasons for the selection of this system are mainly as follows: The Capitol and Congressional Library are both wired for 110 volts and have numerous direct-current motors installed therein. Obviously, 110-volt direct current would have to be supplied to these buildings unless expensive alterations were made. It was decided, therefore, to retain this system in the existing buildings and install it in the new ones so as to have a similarity of equipment in all the buildings. The maximum transmission distance, or that from the generating station to the Senate Office Building, is approximately five-eighths of a mile. This distance and the load to be carried practically determined the use of alternating current for transmission.

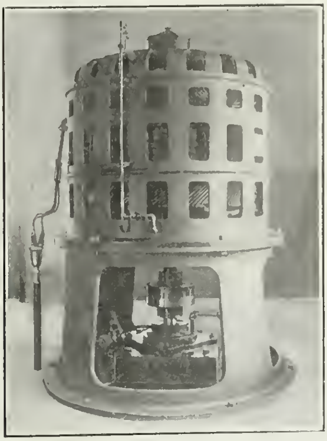

Fig. 4—Vertical Induction Motor Driving Centrifugal Pump.

The decision was reached, therefore, to generate and transmit alternating current and install motor-generator sets in each of four substations in the Capitol, the Congressional Library, the House of Representatives Office Building and the Senate Office Building. Energy had to be furnished also to the motor-driven pumps on the bank of the Potomac River, and since practically all the load consisted of motors a frequency of 25 cycles was chosen. An additional reason for the selection of the system finally chosen was that until the plant was completed it was necessary to feed the substations which were immediately established from the Bennings plant of the Potomac Electric Power Company, so that the generating equipment had to be interchangeable, wholly or in part, with the equipment in the station mentioned. This arrangement also guaranteed exceptional freedom from interruption of service, as it is not likely that a catastrophe would wipe out both stations, which are widely separated. For a description of the Bennings station and also a preliminary description of the government station as at first planned the reader is referred to the *Electrical World* for June 1, 1907.

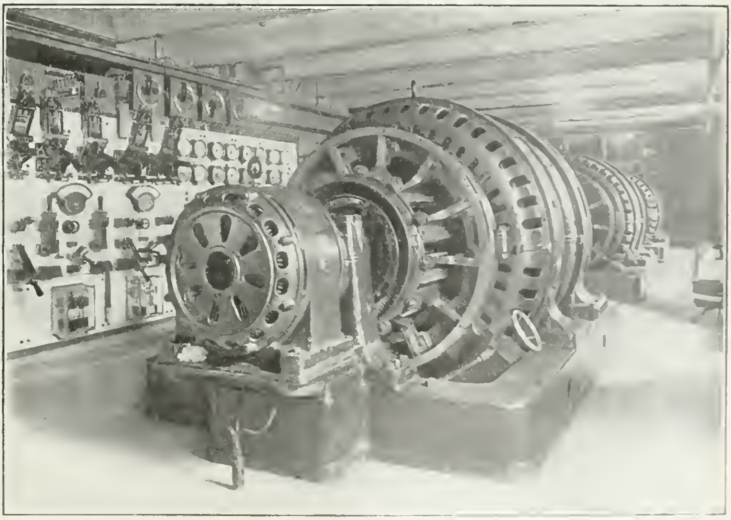

Fig. 5—Substation Interior, Showing Motor Generator Sets and Switchboard.

The accompanying sketch (Fig. 3) shows the general layout of the system and the relative location of the various points. The construction of the plant was begun in February, 1909, and the station was placed in operation July 18, 1910, although the plans were prepared and the appropriation made some years previous. In fact, the plant is a result of plans and ideas which have been maturing for ten or fifteen years.

The building is constructed of red brick procured locally and the foundation rests upon 790 Simplex reinforced concrete piles from 20 ft. to 24 ft. in length. There are two Custodis radial brick chimneys, 212 ft. in height and 11 ft. in diameter at the top, each serving a group of eight boilers. The station is well ventilated, having large windows consisting of light metal frames and wire glass which admit a flood of daylight. Artificial illumination is furnished by incandescent lamps installed on the roof trusses.

No arrangement has been made for heating the building, and it is believed none will be necessary owing to the presence of the boilers and engines. The engine-room doors are all built of copper calamine and the fireroom doors of galvanized calamine. A 50-ton electric traveling crane equipped with two 25-ton hoists operated by direct-current motors is installed in the engine-room and was of great assistance in the installation of the machinery.

A well-equipped machine shop is an important adjunct of the plant. An example of the forethought used throughout the design of the system is in the use here of direct-current motors operated from the storage battery. Thus, should any accident cripple the generating equipment, the machine shop could still be used to effect the repairs. The welfare of the employees is not overlooked and large, commodious shower baths and wire-frame lockers are provided, one set for the engine-room employees and one for the use of those in the boiler-room.

Water for condensing purposes, and also for boiler feed when desired, is taken from the Anacostia branch of the Potomac River and is pumped to the plant by 20-in. centrifugal pumps driven by Westinghouse vertical 250-hp. 6600-volt induction motors. Two pumps are installed, with provision for a third, 7 ft. below the water level. Fig. 4 shows a view of one of these vertical motors direct-connected to a pump. A small pump is installed for the purpose of removing the water from the pit where the main pumps are installed. This is driven by a Westinghouse 5-hp induction motor.

The pump house is located on the banks of the river some distance from the plant, but the operation of the motor-driven pumps is controlled from the main switchboard in the station, thus eliminating any necessity for an attendant at the pump house. Any trouble will be indicated at once by the meters on the pump-motor circuit, and the attendant can immediately start the reserve pump and send someone to investigate.

The boiler plant consists of sixteen 600-hp water-tube boilers, operated at 175 lb. steam pressure and located in two rows of eight on either side of the middle aisle. The system of steam piping is duplicated throughout, enabling any boiler, set of boilers or section of piping to be cut out without interfering with the supply of steam to the main header.

The coal is delivered over the Pennsylvania Railroad tracks to the south end of the station and dumped from the cars into a hopper from which it is automatically carried to a crusher that breaks it up and enables it to be fed to the furnaces by the automatic stokers. From the crusher it drops into a bucket elevator which carries it up over the boilers and dumps it onto a 16-in. endless belt, which in turn distributes the fuel in a storage bin extending over the length of the boiler-room. From this bin, which has a capacity of 1500 tons, the coal feeds by gravity into new model Roney mechanical automatic stokers which feed it directly to the furnace. Before going under the boiler the coal passes through and fills a hopper, the dimensions of which are known, and an automatic printing device records the number of full hoppers of coal passed, so that an accurate account of coal burned by each boiler may be kept. The entire handling of coal from the time it is dumped from the car is automatic. The crusher and elevator are operated respectively by 20-hp and 15-hp induction motors.

The boiler-feed water can be taken directly from the city mains, the river or from the hot well. Two 6-in. city water mains are laid to the plant, each being brought from a different street, thus rendering a failure of water supply extremely improbable. The city water is fed to the boilers by Metropolitan injectors. The boiler-feed water, as above stated, may be taken directly from the hot well, in which case it is fed to the boilers by Warren high-pressure, outside-packed, plunger-feed pumps. There are three of these pumps, any one of which is capable of taking care of one-half of the total boiler capacity.

The ashes from the furnaces drop into a hopper directly underneath. Hand-operated cars run on tracks directly under each set of boilers, collect the ashes and take them to the end of the building, where they are dumped into an elevator run by a 10-hp induction motor, which lifts them up and dumps them into a breaker, from which they are discharged through iron chutes into the railroad cars beneath.

The boilers deliver steam into a main header from which it may flow to each turbine direct through its own header. As previously stated, the process of duplication of apparatus is carried out very thoroughly here, the piping being so arranged that any section of piping or boiler can be cut out of service by the operation of the necessary valves.

Steam is also taken from the main header through a reducing valve for supplying heat to the various buildings. It is carried from the plant in a 14-in. main that has an 85 per cent magnesia covering 2 in. thick, over which is placed a layer of paper, and this in turn is covered by a heavy canvas which is sewed and painted.

The pipe line is carried a distance of 6600 ft. in a tunnel 4½ ft. wide and 7 ft. high, which runs from the plant under First Street to the Senate Office Building, with branches tapped off to the House Office Building, Congressional Library and Capitol. The tunnel is inspected during each shift, or every eight hours. The steam line is well anchored throughout its length; all low places are trapped and the water removed therefrom is carried back through an open return to the hot well at the power house. Expansion joints are installed every 250 ft. So well has the steam heating system been designed and installed that under normal operating conditions there is a drop in pressure of only 4 lb. from the reducing valve to the maximum point of transmission, the Senate Office Building, and the amount of water trapped is negligible.

A reserve plant of boilers, of sufficient capacity to furnish steam for the system, is maintained in the Capitol. Should the main system be prevented from delivering steam, for any reason, all that would be necessary would be to open the valves on the reserve plant and allow it to feed directly into the system.

In the engine-room there are installed four Westinghouse Parsons turbo-alternators, each of 2000 kva rating, delivering three-phase, 25-cycle current at 6600 volts. The turbines operate at 175-lb. steam pressure and the steam, after passing through the turbine, discharges into a double or twin Bulkley barometric condenser which is guaranteed to give a vacuum of 28 in. when supplied with injection water at a temperature of 70 deg Fahr. Should one side of the condenser become disabled the remaining side will continue to operate and produce a vacuum of 24 in. under the same conditions. Under actual operation these guarantees are improved and a vacuum of over 29 in. is obtained. The condensed steam discharges into a hot well, whence it may be pumped to the boilers as described above. An automatic valve permits the overflow from the hot well to discharge through a 48-in. concrete flume to the river.

Each generator has a 37½-kw direct-connected exciter mounted at the generator end of the turbo set, as shown in Fig. 2. Each exciter is of sufficient size to excite the fields of two generators and is connected to the exciter busbars. A storage battery of seventy-four cells is installed in the basement and controlled from the main switchboard. This battery has a capacity of 2400 amp-hours and floats across the exciter busbars continuously, so that should one of the exciters, for any reason, be prevented from delivering energy to the generator fields, the storage battery will automatically furnish the excitation and no interruption would ensue. The battery also acts as a voltage regulator in that it tends to hold the value of the exciting current constant, irrespective of any changes in speed of the exciter. Should the exciter speed decrease, the battery discharges, exciting the fields; should the speed increase, the battery becomes charged.

The battery is charged from the exciter busbars while on the line by means of a motor-driven booster that raises the bus voltage to the amount desired for charging. The booster set consists of a 125-volt, direct-current motor direct-connected to and mounted on a common iron base with an interpole direct-current generator with a rating of 676 amp at 65 volts. This machine is located on the engine-room floor immediately behind the high-tension concrete switchboard structure and is controlled from the main panelboard.

Energy from the exciter-storage battery busbars is used, in addition to field excitation, for the operation of the crane and machine-shop motors previously mentioned, and also for emergency lighting circuits in the main station and each of the substations. These emergency circuits are fed by separate pairs of cables from the switchboard and comprise about one-fourth of the entire lighting in each substation. They are automatically controlled by double-throw, solenoid-operated plunger switches. Under normal operating conditions the circuits are fed from the busbars and the energy for the lamps flowing through the solenoids of the above-mentioned switches holds the contacts in the upper or normal position; should the circuit fail for any reason the solenoids are de-energized and allow the contacts to drop, thereby transferring the lighting circuit to the auxiliary circuit fed from the storage battery. As stated, these auxiliary lighting circuits feed about one-fourth of the total lamp installation of each substation, so that at no time will there be any possibility of any of the stations being in darkness due to a failure of the generating or transmission system.

Perhaps no feature in the design of the entire system better illustrates the precautions taken against possible failure of supply and also the excellent construction and material employed throughout than the switchboard. This may be said to consist of two parts: the high-tension concrete structure and the low tension marble-panel control board.

All of the high-tension apparatus, including busbars, circuit-breaking devices and transformers, is mounted on the concrete structure located on the engine-room floor. The low-tension board consists of nineteen panels of white Italian marble mounted on a gallery immediately above the high-tension concrete structure overlooking the engine-room. On this board are located all the low-potential wiring, measuring instruments and control switches, and from here the operator, who has an unobstructed view of the engine-room, controls the operation of the entire system. He assumes control of the operation of the turbo-generators as soon as the engineer opens the throttle, synchronizes them and directs the engineer to start up or shut down any machine according to the load as indicated by the instruments on the board. He also controls the operation of the motor-driven pumps located at the river, a half mile distant, which were described above.

The switchboard is divided into two sections, each being a duplicate of the other, thus forming in reality two boards. The two sections are connected by oil-break and disconnecting switches that are normally in the closed position: should any trouble occur on one portion of the board, or should it be desired to work on one section, the disconnecting switches can be opened and the entire system operated from the other half of the board.

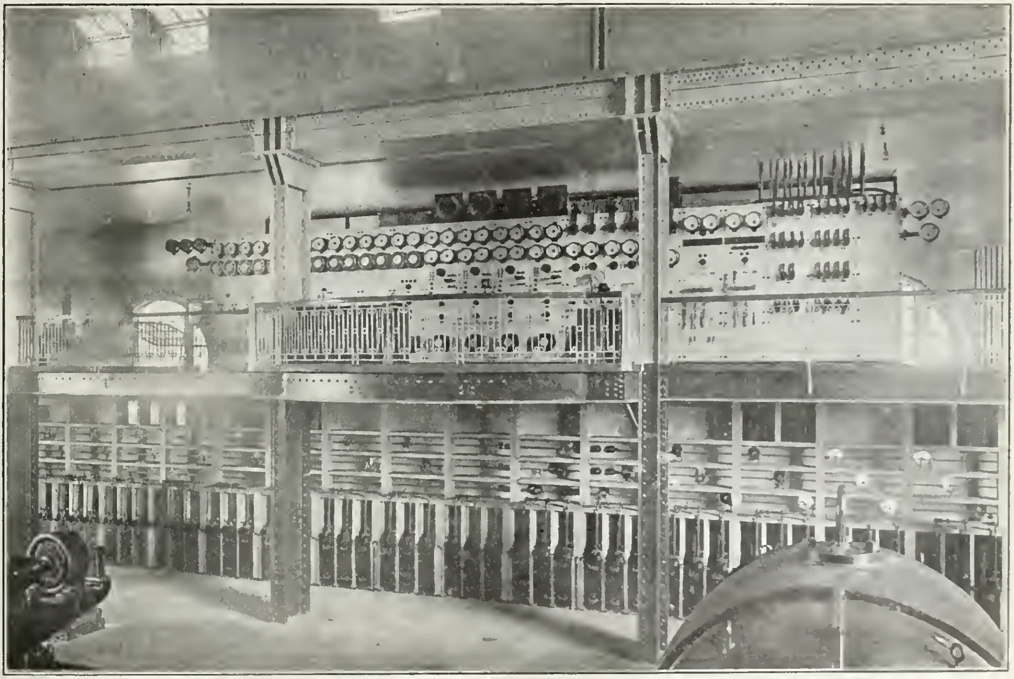

Fig. 6—View of Switchboard, Showing High and Low-Tension Structures.

Two turbo-generators are connected to each section of the board, thus carrying the division to the extent of having practically two separate plants, either one of which is capable of furnishing energy to the entire system. All station wiring is laid in loricated conduit. On the engine-room floor, opposite each turbo-generator set, is an ornamental iron post containing the following instruments for the information of the engineer: An indicating wattmeter, a synchroscope, a vacuum gage, a steam gage showing the boiler pressure and a steam gage showing the pressure inside the primary valve of the turbine or directly at the blades.

An inspection of the station at once impresses one with an idea of abundance of light, space between apparatus, particularly around the switchboard, and, as previously mentioned, the carefully laid plans to insure continuity of service.

SUBSTATIONS.

Electrical energy is sent from the generating station to four substations and the pump house, each being connected to the main station by a duplicate set of triple-conductor, paper-insulated, lead-covered cables laid in vitrified-tile conduits. The substations are located in the basements of the following buildings: Capitol, Congressional Library, House of Representatives Office Building and Senate Office Building. The equipment in these stations consists of motor-generator sets, each composed of one 6600-volt synchronous motor direct-connected to and mounted on a common iron base with one 400-kw, 125-volt, compound-wound, direct-current generator, with a small induction motor for starting purposes, and the high-tension and low-tension switchboards for the control of the alternating-current and direct-current circuits. The Capitol substation has five motor-generator sets; the House Office Building four; the Senate Office Building and Congressional Library three each. These sets may be started from the direct-current end by means of energy from the bus through starting rheostats or by means of small induction motors mounted on the end, as shown in Fig. 5, and fed through step-down transformers.

The high-tension switchboards are similar in design and construction to the high-tension switchboard in the generating plant. As stated above, each substation is connected to the main station by duplicate cables, also by the emergency lighting cables. These cables are laid in vitrified tile and follow the course of the steam tunnel connecting the various buildings. The cables are brought in directly to the high-tension switchboard, where they lead to disconnecting switches, thence to oil circuit-breakers and through disconnecting switches again to the synchronous motors.

As in the main station the operation of the station is controlled entirely from the low-tension panel switchboard. These boards are built of white Italian marble and contain measuring instruments, control switches and carbon circuit-breakers and knife-blade switches for the control of the direct-current circuits. The line panels contain control switches for circuit-breakers for two circuits from the power house and one from the station of the Potomac Electric Power Company.

The synchronous-motor panels are equipped with an alternating-current ammeter, an indicating wattmeter, a power-factor meter and a direct-current field ammeter, also control switch for the oil circuit-breaker, field rheostat, starting motor switch, field switch and the voltmeter and synchronizing receptacles. Each generator panel is equipped with two single-pole carbon circuit-breakers, an illuminated dial ammeter, field rheostat, two single-pole knife switches, a field switch and a watt-hour meter. The feeder panels are equipped with ammeters and circuit-breakers, the latter performing the combined function of fuses and switches. Voltmeters are mounted on swinging brackets at end of board.

The direct-current circuit portion of the switchboard has two sets of busbars, one for the motor circuits and one for lamp circuits. The two buses can be connected together by a tie switch so that they may be operated together. A novel feature noticeable here is the red coloring of all the handles of the circuit-breakers on motor circuits. This enables the operator to ascertain quickly and readily the motor circuits in case of trouble. A glance at Fig. 7 will show that with such a number of breakers on the switchboard it is of very great assistance to have some ready means of designation. The rheostats are mounted above the panels and operated by means of a sprocket and chain transmission. A common starting switch for use in starting the motor-generator set from the direct-current end is mounted on one of the generator panels. A marble panel containing two oil switches for the high-tension sides of the step-down transformers, used for the starting motors, is installed in a convenient location. Equalizer switches are mounted on pedestals immediately in front of the motor-generator sets.

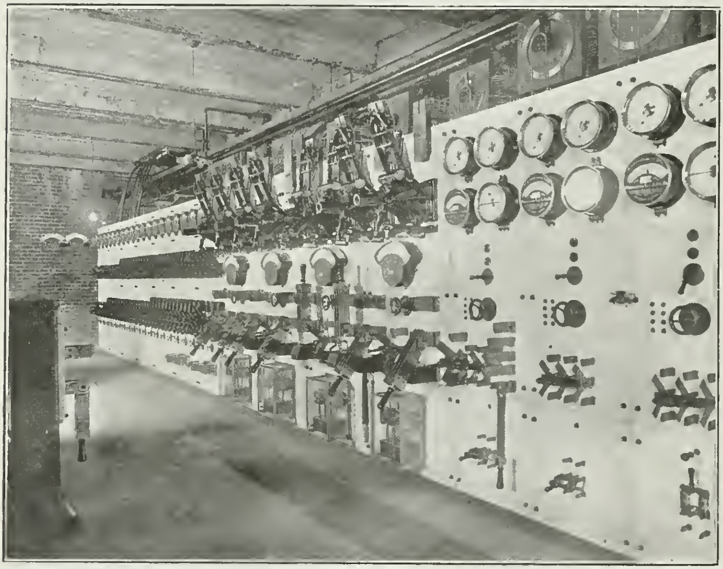

Fig. 7—Low-Tension Switchboard in Substation.

All low-tension cables in the substations are laid in racks each in its proper place, presenting a very neat and orderly appearance; a decided contrast to the conditions observed in a great many underground systems. Under each cable, where it rests on the rack, is placed a rubber washer to prevent any possibility of abrasion of the lead armor. These rubber washers were made from old garden hose that had been discarded and consigned to the junk pile. Where the cable enters the vitrified-tile conduit it has, in addition to the rubber washer, a wrapping of burlap for protection of the lead. The lead of each cable is securely bonded to the others and grounded to the water main. Reinforced concrete tunnels having an aggregate length of approximately 6000 ft. and having cross-sectional dimensions of 7 ft. high by 4½ ft. wide are used for holding the pipes for transmitting steam to the various buildings. These tunnels are lighted throughout by electricity and have convenient entrance manholes.

In the summer time, of course, Capitol Hill loses the greater part of its population and business is not very brisk, consequently the load on the plant is very light and the substations will be operated at a considerably reduced efficiency. In order to overcome this Chief Engineer Gliem has devised the following scheme: The Capitol substation will be operated and used as a distributing station, sending direct current to the other substations. As the distance is considerable and the load at times heavy a 30-kw motor-driven booster will be installed in the Capitol substation to raise the voltage an amount sufficient to compensate for the line drop. This will result in considerable saving in operating expenses, as it will eliminate the necessity for running the other substations.

The plant has been in operation since July, 1910, and already marked economies in cost of operation over the old system have been noted. From an esthetic point of view there has been a most marked improvement, and the legislators and others whose business requires their presence at the Capitol do not fail to note with much satisfaction and pleasure the absence of the noise of the engine and the smoke, dust and dirt attendant on the operation of the Capitol and Congressional Library plants.

All of the electrical apparatus has been furnished by the Westinghouse Electric & Manufacturing Company and the steam turbines by the Westinghouse Machine Company, Pittsburgh, Pa. The entire plant has been designed, purchased, erected and put into operation under the direction of Mr. Elliott Woods, superintendent of United State Capitol Building and Grounds. The work has been under the personal supervision throughout of Mr. C. P. Gliem, chief electrical engineer, assisted by Messrs. Westinghouse, Church, Kerr & Company as designing engineers in connection with the power plant.

The successful building and putting into operation of this plant have been primarily due to Mr. Gliem's familiarity with the requirements and his extended experience from many years of service in connection with the Capitol plant. It is rare, indeed, to find a large, modern electrical plant which has been designed and built by an engineer who was continually in charge during the previous twenty-four years of all the construction and operation of the former plants necessary in the development of the same activity.

The cost of the completed system as described above, including the tunnels, amounted to a sum in the neighborhood of $1,500,000.

A CONTRIBUTION TO THE THEORY OF COMMUTATION.

By H. Bewlay.

PERHAPS no single feature of direct-current machine design has caused so much discussion as the problem of commutation. The effects of self-induction and mutual induction, armature reaction and distortion have often been confused, and as a result numerous empirical methods for determining commutating characteristics have come into use, many of which neglect important factors. Previous to 1890 only scant attention seems to have been given to the problem of commutation, this being due to the use of metallic brushes which required shifting with the load, to the constant character of lighting loads and to the comparatively small size of the machines then in use.

The general introduction of the electric railway created a demand for generators and motors so designed as to operate over wide ranges of load without brush shifting, and this requirement was met by the introduction of the carbon brush and by proper design as regards the inductance of the commutated coils. The advantages of the carbon brush are both mechanical and electrical, but the feature which is of the greatest value is the high contact resistance between the brush and the commutator. It is this feature which makes possible the operation of machines with fixed brushes without the aid of interpoles or other commutating devices.

A great deal of attention has been paid to the determination of the conditions existing at the instant the segment leaves the brush. Steinmetz has investigated this subject from the standpoint of current density in "Theoretical Elements" and shown that the density at this instant is high and depends on the reactance of the coil and on the resistance of the coil and brush contact.

Unfortunately most mathematical investigations of this problem are based for simplicity on a brush covering exactly one commutator segment, while in practice, other things being equal, a brush covering from 1.5 to 3 segments will be found to give the best results on machines having simple windings. With a brush covering more than one segment there are two or more short-circuited coils in inductive relation at the instant any segment leaves the brush.

The effect on the magnetic field of any change of current in the coil passing from under the brush is thus partly neutralized by an opposite change induced in the other short-circuited coils so that the voltage at the instant of breaking contact between brush and segment is much less than would otherwise be the case. However, the induced current in the other coils tends to make their commutation more difficult, as larger changes must occur in the remaining portions of their times of commutation.

Owing to the inductive relation of adjacent armature coils the voltage in any one coil due to current changes can differ from the voltage in the adjacent coils only by an amount corresponding to the magnetic leakage between the coils, this term being used in the same sense as in transformer and induction motor design. When these inductively related coils are simultaneously short-circuited the variations between the mean and maximum values of the reactance voltage of the coils thus are small and it is possible for purposes of design to consider the average values, which can be calculated and observed with a fair degree of accuracy.

With carbon brushes the *IR* drops in the short-circuited coils are relatively so small that they may be neglected, and all voltages induced in the coils can thus be measured at the commutator.

Neglecting for the present any voltage induced in the commutated coils by the main field, it is evident that the several segments, owing to the voltages induced in the coils by current changes, will be at various potentials with regard to the brush, and as a result the current density at various points on the face of the brush will vary. This condition may be most conveniently studied by separating the variable density into a uniform density corresponding to the load current and a superposed variable density due to a cross-current caused by the potential difference between segments. The superposed variable-density curve will be a series of steps, one step for each segment, the height of each step depending on the voltage induced in the corresponding coils. As these steps are moving with regard to the brush, the average condition can be represented by a curve drawn through the center of each step.

The allowable apparent density in carbon brushes, that is, the uniform density corresponding to the load current, is well known, and it is only necessary to determine from satisfactory existing machines what are the allowable limits of the voltage across the brush and to calculate this value in new designs.

The following formula was worked out from theoretical considerations and the numerical constants were modified slightly after comparison with a large number of tests. These changes became necessary on account of the difficulty of estimating exactly the magnetic reluctance of the various flux paths. As is generally necessary, to avoid excessive complication, certain assumptions were made which, while true for many designs, do not hold in extreme cases and should therefore be kept in mind and when necessary proper allowances made

The principal assumptions are:

(*a*) The slot is open, rectangular and has approximately straight sides.

(*b*) The brush covers at least 1.6 segments in simple windings and a corresponding number in multiple windings. It is also assumed that the brush does not simultaneously short-circuit more than one more coil than the number of coils per slot.

(*c*) The coils undergoing commutation are not near a pole, but nearly midway between the two. This does not hold true if the brushes are given an excessive lead or if the coil pitch is exceedingly short. A short pitch is often desirable for the purpose of avoiding mutual induction between coils short-circuited by different brushes and is considered in the formula in the term C_e; however, the relative widths of pole and brush and the coil pitch should be carefully considered or the increased self-inductance due to the closeness of the commutated coil to the pole may exceed the gain due to reduced mutual induction.

The formula is:

$$V_c = \frac{0.067}{10^8} R t^2 Z I p \left[C_e K_e L_e + C_T K_T (5 L_e + L_f) \right]$$

Where

V_c = total voltage across brush due to reactance.

R = speed of machine in revolutions per minute.

t = turns in series per armature coil or total number of armature conductors divided by twice the number of commutator segments.

Z = number of commutator segments.

I = amperes in each armature conductor

L_e = gross length of armature core in inches

L_f = length of one end connection, that is, length of one armature conductor less L_e.

$$K_e = 4 + \frac{\text{depth of slot}}{\text{width of slot}}$$

This is a simple empirical expression which represents quite accurately the inductance due to the flux looping only coils lying in the same slot. It is obtained from both theoretical and experimental investigations.

K_T = constant proportional to the inductance due to flux looping short-circuited coils in same group. This may be taken as equal to $\frac{1}{2} \log_e \left(\frac{\text{armature slots}}{\text{poles}} \right)$ and plotted or tabulated for reference.

p = factor depending on type and connections of armature winding, and may be considered as the number of coils in series under one brush divided by the time of commutation expressed in segment travel Let $2P$ be the number of poles. In the case of lap (loop) windings let the total number of parallel armature paths between brushes be $2PN$ and let B be the brush width in segments; then

$$p = \frac{B}{N(B - N + 1)}$$

In the case of wave (series) windings having $2N$ armature paths

$$p = \frac{PB}{N(B - N + 1)}$$

C_T = average number of coils short-circuited by one brush and grouped together on the armature, or in the above terms

$$C_T = B - N + 1.$$

C_e = average number of coil sides simultaneously commutated in one slot. Let C be the number of coils per slot (not coil sides) and s the shortness of pitch of the winding in coils; that is, the full coil pitch is 180 electrical degrees; the actual pitch of the coil is x electrical degrees. Then

$$s = \left(\frac{180 - x}{180}\right)\frac{Z}{2P}$$

When

$$s > C_T + C - 1, \text{ then } C_e = \frac{CC_T}{C_T + C - 1}$$

and when

$$s < C_T + C - 1, \text{ then } C_e = \frac{2CC_T}{C_T + C + s - 1}$$

Before proceeding with the discussion of the application of the formula it may be desirable to say a few words regarding the subject of armature reaction. Inasmuch as there is no relative motion between the various armature coils, the only way in which a coil carrying a constant current can induce a voltage in the commutated coils is by means of an inductor which would vary the reluctance of that portion of the magnetic circuit common to both coils. The only mass of metal present in the ordinary machine which could act as an inductor is the pole-piece. When the commutated coil is at the edge of the pole there probably is some inductor effect and in a design with a very small number of large slots and pole tips without chamfer there would probably be such an effect for all possible brush positions. However, with modern designs in which there are sufficient teeth and properly chamfered poles to minimize noise and eddy loss and proper brush setting there is on test no indication of any voltage in the commutated coils except that due to the main field and to reactance.

In the case of machines which are to operate in either direction without change in the brush position it is necessary to keep the value of V_c within the limit which the brush will stand without excessive sparking, and in such designs the length of air-gap has no primary effect on the commutation. However, extremely small gaps are to be avoided because of mechanical reasons as well as on account of excessive eddy losses and saturation of teeth and pole tip due to the armature cross flux.

In machines which are operated in only one direction the brushes can be displaced or given a slight lead so that the main field will induce in the commutated coil a suitable voltage to balance partly the reactance. As an example, a small engine-driven generator may have a value of V_c of 3 volts and the brushes be so placed that the main field induces at no-load 1.8 volts in the coils under the brush. When the load is applied the voltage under the brush will be $1.8 - 3.0 = -1.2$ volts. The voltage, of course, changes sign at the load where the effect of the field balances the reactance.

It will be noted that the voltage across the brush in the above setting is higher at no-load than at full-load. There are several reasons why this is the best setting in a case of this sort. At no-load the cross-currents are the only ones in the brush and thus may be higher than when superposed on the load current. Most machines are run at from one-fourth to five-fourths load and it is thus advisable to favor the full-load conditions.

The voltage which a carbon brush will withstand depends on the particular grade of carbon, on the thickness of the brush and on the voltage and size of the machine.

The effect of brush thickness is probably due to the fact that the internal resistance of a thick brush reduces somewhat the cross-currents due to a given potential difference at heel and toe. The effect of machine size and voltage is probably due to the lower relative mutual induction of the coils in small low-voltage armatures, resulting in a wider variation between mean and maximum value of the reactance.

The total effect of these factors is not extremely large, and with a little experience or a few tests on satisfactory machines of the same general type the designer will be able to estimate the limiting allowable value of V_c with considerable accuracy.

One important advantage of this method is the ease with which V_c may be measured on operating machines. The observed values will be found to check very well with those calculated as above, provided the various conditions are correct. The most accurate results are obtained on large machines and when the commutator and the brushes are in good operating condition. Poor conditions of brush or commutator are almost always accompanied by high observed values of V_c.

MEASUREMENT OF INSTANTANEOUS LAMP RESISTANCE.

By Frederick Bedell.

The following method for measuring the instantaneous resistance of incandescent lamps at different parts of the alternating cycle has been used by Dr. C. A. Pierce and the writer. It is a modification of a method used by the writer for measuring mean resistance of lamps and described by him in the *Electrical World*, page 1077, June 10, 1905. We desired a method of measuring lamp resistance directly by ordinary* resistance-measuring apparatus while the lamps are in normal operation.

Four lamps, or multiples of four lamps, are arranged as in Fig. 1, being connected to the source of electric power and maintained at constant voltage. The resistance is measured by an ordinary Wheatstone bridge connected to the points a and b through a revolving contact-maker driven by the alternator. These points must be maintained at the same potential, so far as the main line-current is concerned, in order that no current may flow into the Wheatstone-bridge apparatus and disturb the resistance measurement which is being taken by battery current. This would be the condition if the four lamps had exactly the same resistance, which is not possible because a very small difference in the lamps gives sufficient difference in potential between a and b (from the main-line current) to make readings on the Wheatstone bridge either difficult or entirely out of the question. The points a and b can be brought to the same potential by means of a small adjustable resistance in series with the lamp of lowest resistance

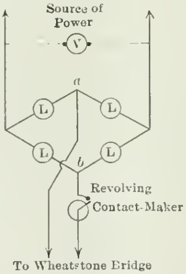

Fig. 1—Arrangement of Testing Circuits.

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*A somewhat similar method, employing a special bridge, is described in the *Electrical World*, page 803, April 20, 1907.

or by a very high adjustable resistance in shunt with the lamp of highest resistance. The latter arrangement was used by us. This resistance was adjusted at each reading so as to bring the bridge galvanometer to zero before the battery key was closed, and the usual bridge adjustments were then made. Unless the lamps are nearly alike, this adjusting resistance introduces some error.

In this way the resistance of four carbon lamps at different parts of the cycle was determined, as shown in Fig. 2. The frequency was about 20 cycles. At the start the lamps were new and cold. In addition to the periodic change in resistance there is seen to be a gradual decrease in resistance during the run, which occupied about two hours.

It was hoped that the method would prove satisfactory for an extensive investigation of various types of lamps operated with different wave-forms. The trouble is it requires an absolutely steady supply voltage, and this we did not have. With tungsten lamps we could not bring the bridge galvanometer to zero Likewise, with carbon lamps, when we attempted to superpose a third harmonic in the e.m.f.-wave we could not get conditions steady enough for satisfactory readings; it was too much, with the source of power available, to attempt to keep steady two alternators and the driving system. Under our conditions, therefore, the method has proven unsatisfactory for continuous general use and we do not recommend it to others under like conditions—unless some way is found for avoiding the difficulties. Under some circumstances it may prove useful; we ourselves, for the particular test of Fig. 2, were able to obtain consistent results.

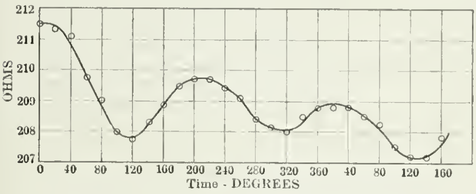

Fig. 2—Cyclic Variation in Lamp Resistance.

For measuring the mean resistance of alternating-current lamps while in operation the contact-maker is left out of the circuit. This works well with carbon lamps, but not with tungsten, the resistance of which seems unstable.

INTERNAL ELECTROMAGNETIC FORCES IN LAMP FILAMENTS.

By Carl Hering.

The appearance of some of the metallic filaments of lamps after long use suggested to the writer that perhaps the causes of some of their changes might be the internal electromagnetic forces caused by the current itself and recently pointed out by the writer.

Among these appearances of the filaments may be mentioned the globules or humps formed on the surface, the sunken cracks resembling an alligator skin, the well-known broken-rod effect of the tantalum lamps due to alternating current, etc.

The internal forces referred to are those caused by the magnetic flux which encircles the conductor. All lines of force tend to contract, hence this circular flux tends to compress the conductor radially, producing the pinch effect.[1] Lines of force of like polarity also tend to repell each other, which appears to tend to stretch the conductor.[2] Both are therefore internal forces.

The current density in tungsten filaments is extremely high, reaching several hundred thousand amperes per square inch. This and the appearance of the filament suggested finding what the magnitude of these internal forces was.

Through the kindness of Mr. G. S. Merrill the writer obtained the following data concerning the diameters of the filaments and the currents for several types of tungsten lamps, from which the other columns in the accompanying table were then calculated, the latter giving the pinch pressure:

Diameter in Mils.	Cross Section, Square Mils.	Amperes.	Amperes per Square Inch.	Grams per Square Centimeter.
2.15	3.62	0.545	151,000	0.130
1.5	1.77	0.34	192,000	0.107
1.08	0.915	0.2	219,000	0.0692
0.8	0.503	0.145	288,000	0.0662

It will be seen from the last two columns that although the current densities are extremely high the pinch pressure is small. The latter was to be expected, as otherwise the lamps would probably not have the life they do.

This contracting force can produce changes only when the material yields. This would be the case if the metal became viscous at those temperatures, and judging from the sag of the filaments they seem to reach such a state. Even if not heated throughout to such a temperature a slight decrease in section or a slight local increase in resistivity due to heterogeneity or to a crack would produce a local increase in temperature, hence a tendency to greater fluidity. This internal force may then act locally at those places.

It is well known that a small force applied continuously to certain solids will in time produce very decided effects. For instance, when a small lead shot is placed on a block of pitch it will in course of time travel completely through it, even though the pitch be always at room temperature, at which, however, it has a slight tendency to flow.

It appears likely, therefore, that even these small contracting forces as given in the table would, in the course of about 1000 hours' life of a lamp, act to change the shape of a metallic filament, as, for instance, the squeezing out of globules, because the inside of a filament must be at a higher temperature than the outside. A rod of iron, for instance, when heated rapidly by a current will melt in the inside and be squeezed out through some pore or crack, by the pinch effect, leaving the outside as a solid tube. In filaments such an effect might even heal cracks or flaws in the original filament. In the case of the iron rod the tube broke, but was immediately welded together again by the freezing of the liquid material. It, however, had changed its position slightly, thus producing the broken-rod effect seen in a tantalum filament used with alternating currents.

The alligator-skin appearance of a filament may also be caused by this contracting force, because the filaments were (presumably) made of finely divided material held together with a binder. Hence they are not absolutely homogeneous In such a case the better conducting parts will move toward the center, due to the pinch effect, leaving the lesser conducting parts protruding beyond the surface. Under proper conditions the pinch pressure must produce a segregation in a yielding conductor, forcing the better conductor to the center When this takes place, so that more current flows through a central core, the pinch pressure increases very greatly in the material immediately surrounding this core, as the writer has found by actual experiment This is no doubt due to the relatively very intense field immediately outside of a conductor.

In one of the articles above referred to the writer endeavored to show that besides this contracting force there is another internal force tending to stretch the conductor which might be called the "stretching effect" This and the pinch effect are mates, and it seems that both must exist in every conductor If such a stretching exists it also may perhaps aid in explaining some of the appearances of used metallic filaments, when considered in connection with the fact that the temperature must be higher in the inside than on the outside of a filament.

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[1] "The Working Limit in Electric Furnaces Due to the 'Pinch' Phenomenon," *Trans.* Amer. Electrochem. Soc., Vol. XV, 1909, p. 255.

[2] "The Stretching of a Conductor by its Current," *Jour.* Franklin Inst., Jan. 1911, p. 73.

With alternating currents these forces must necessarily be very much greater at the peak of the wave, as the pinch pressure and probably the stretching force also increase with the square of the current. Moreover, forces applied so suddenly become a succession of blows, and blows sometimes act differently from a continuous force, as they tend to loosen particles so that they yield more readily to a constant force. A block is more easily started to move when tapped with a light periodic force.

Both of these internal forces are independent of the direction of the current, hence are always in the same direction when the current is alternating.

NEW CENTRAL STATION IN WORCESTER, MASS., APPROACHING COMPLETION.

Brief reference was made in the issue of Aug. 11, 1910, page 331, to the plans of the Worcester (Mass.) Electric Light Company for a new turbine station in the south part of the city, which will in large degree supersede the present generating plant of the company on Faraday Street, at the northern side of the town. The new plant is rapidly approaching completion, and the recent installation of tie lines between the new and old stations, combined with the erection of a part of the boiler and turbine installation, has enabled the company to operate one of the 2500-kva units through the afternoon peak load for several weeks past. Constructive field operations began on the site of the station on May 21 and current was first commercially delivered to the system on Nov. 9, five months and eighteen days later.

The new station is located on Webster Street, between a stream called Little River and Webster Court, and immediately opposite Curtis Pond, which has been purchased by the company as a source of condensing water. A spur track of the Boston & Albany Railroad is on the property, and a complete coal-handling and storage system is being finished. In order to insure continuity of service a coal-storage yard of 6000 tons capacity is being constructed. The present annual coal consumption of the company is about 10,000 tons. Ordinarily the coal will be handled directly from the railroad cars to overhead bins in the power house. The fuel will pass through a crusher and will be elevated and delivered by a belt conveyor to the bunkers. When coal is being unloaded into the storage space it will be dumped from the cars into a pit and thence conveyed by an electrically operated grab bucket and crane and distributed in the inclosed space forming the storage yard. When coal from the yard is to be used in the plant it will be picked up by the grab bucket and delivered to a miniature steel-hopper dump car, which will be shifted to the coal hopper adjacent to the boiler-room, and then handled by the regular equipment into the bunkers. Ashes will be removed from the station by means of a skip hoist, which will be charged by ash cars running into the basement beneath the ash hoppers of the boilers. These ashes will be delivered by the skip into an overhead storage bin outside the building, where they can be delivered by gravity either to railroad cars or to wagons for city distribution.

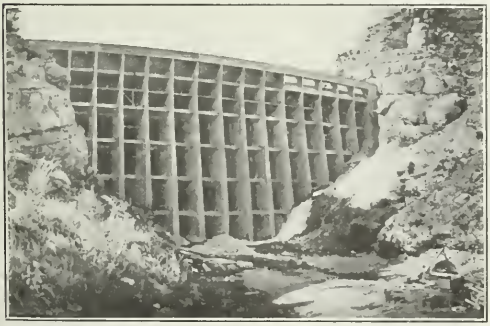
The building is laid out to house three 2500-kva Westinghouse turbo-alternators, an initial steam-generating plant composed of six 600-hp Stirling boilers and Wheeler condensers of the counter-flow mixing type. The boilers are designed for a working pressure of 200 lb. per square inch and are equipped with superheaters capable of raising the steam temperature 100 deg. It was necessary to exercise the greatest care in preparing the foundations for this plant in order to secure suitable bearing qualities for the concentrated weights imposed by the equipment. On the Webster Street site a large number of borings at various points, completely covering the property to be used, were sunk to determine the character of the subsoil. It was found that good gravel bottom underlay the surface at a practically uniform depth and at a grade that permitted economical foundation construction. In a paper recently read at Worcester on the engineering problems of power-station work Mr. Henry R. Kent, vice-president of Westinghouse, Church, Kerr & Company, consulting engineers for the Worcester Electric Light Company, stated that the foundation work in the new plant at Webster Street illustrated in a marked degree the danger of drawing general conclusions from specific information. After the first plans were drawn and the above soundings were made it was found desirable for convenience in locating the railroad spur which supplied coal to the power house to move the two stacks 14.5 ft. from the original location and beyond the area covered by the borings. The stack foundations were the first work started, and when the excavation had been carried down to the point where gravel should have been met, judging from the borings, no gravel appeared. As there were no loads in the station more concentrated than those imposed by the chimneys it was imperative that the foundations should be adequate. An investigation showed that gravel was found in a stratum about 7 ft. lower under the new position of the stacks, there being a dip caused by the old stream bed just within the lines of the extended operations of the engineers.

An interesting feature of the new work is the use of water from Curtis Pond for condensing and boiler feed through intake flumes formerly supplying water to water-wheels located in old mills on the plant site. A study of the contour showed that the grades allowed the design of a station permitting the water to flow to the plant in one flume and back to the pond in the other. This permits of a re-circulation without pumping of water for condenser work, although a circulation pump is provided in the condensing equipment to facilitate the flow. Two separate chemical analyses of the water from Curtis Pond showed that it is exceptionally good for boiler-feed purposes and that no treatment will be required, thus enabling the company to make use of the simplest type of feed-water heating equipment. The boiler plant is arranged to burn a mixture of anthracite and bituminous coal, and Taylor stokers are being installed throughout. The three turbines of the initial installation are now in position, and these are located to permit expansion of the plant, with corresponding increase in boiler batteries, and the convenient service of the coal-handling installation for a much larger station than is at present contemplated. The station has been designed with a view of reducing to the lowest terms the chances of interrupted service. Any boiler or any header section can be cut out without interfering with the operation of the rest of the station. Five 500,000-circ. mil underground cables are now in service between the new and old plants, which are about three miles apart. The electrical switching arangements and system of cables occupy space on three levels in a switchboard compartment at one side of the turbine-room. This compartment forms practically a separate structure from the power house proper, although wired glass windows are installed in the partition separating the turbine and switchboard-rooms, the operating room of the latter being somewhat above the level of the turbine-room. Two sets of three-phase buses are provided and any alternator may be thrown upon any bus, and the same may be done with any feeder. The runs of wiring are exceptionally direct, with short right-angled turns in compact areas below the level of the turbine and switchboard-room floors. Oil switches of the solenoid type and knife selector switches facilitating flexible and safe operation are installed in compartments below the switchboard-room. The General Electric Company is supplying most of the switchboard and switching apparatus.

In the commercial field the Worcester company is making rapid strides toward the popularization of electric service. Reference has been made in these columns from time to time to the rapid increase in the motor load at Worcester, which has been about 100 per cent in the past year. The service rendered by the company's uptown office and display-room has unquestionably done much to strengthen it in the popular estimation. At its display-room an interesting example of indirect lighting is in service. The room is about 65 ft. long x 22 ft. wide and 13 ft. high, with a steel ceiling coated with white paint and enamel. Thirty-five 100-watt tungsten lamps are installed about 6 ft. apart in inverted fixtures of the National X-ray Reflector Company's type, hung by chains from the ceiling. These are wired in subdivided circuits, so that the effect of operation in groups can readily be shown. The lamps are about 10 ft. above the floor, but are invisible to the person below their level. The company maintains an extensive exhibit of heating equipment and small motors and has recently demonstrated vacuum cleaning devices in a systematic manner. The show windows are illuminated by thirty-eight Mazda lamps of 25 watts rating each, and a 150-watt unit installed over the main entrance attracts considerable attention. Outside the building the company operates an electric sign in the shape of an incandescent lamp of mammoth size. The display-room is lighted daily during the week until 11 p. m. The sale of toasters, flatirons and fan motors has been excellent in Worcester, considering the rather conservative tendencies of the community. It is expected that within a few weeks the company's general offices will be moved from the Faraday Street station to the uptown quarters, which are at 375 Main Street, in the heart of the retail shopping district.

IRRIGATION BY ELECTRIC PUMPING FROM LA PRELE DAM IN WYOMING.

A 3000-kw water-power plant is being installed to utilize the hydraulic head of 136 ft. created by the famous La Prele dam, eighteen miles west of Douglas, Wyo. This structure, 136 ft. high and 475 ft. wide at the crest between natural-rock buttresses, is the highest Ambursen-type hollow reinforced-concrete dam ever built. It was completed two years ago and impounds for irrigation purposes the waters of La Prele Creek, a tributary of the North Platte River in eastern Wyoming. The reservoir thus created extends four miles back along the old creek bed, covering an area of 2800 acres, and will water in all about 36,000 acres of arid country. The dam was completed two years ago and was briefly mentioned in the *Electrical World* at that time.



Downstream View of 136-Ft. Hollow-Concrete La Prele Dam, Near Douglas, Wyo.

The dam structure consists of a great sloping deck, inclined at an angle of 45 deg., 5 ft. thick at the base, tapering to 1 ft. at the crest, carried on huge buttresses having bases 165 ft. long and 5 ft. wide, footed on the solid bed rock. The weight of the water above this sloping deck thus stabilizes the dam and counteracts the overturning thrust due to hydraulic pressure. The buttresses taper in thickness from 5 ft. at the base to 1 ft. at the top and are mutually braced by reinforced-concrete beams. Near the top of the dam, as indicated by the illustration, the contour of these buttresses was changed, after construction was well along, to permit a roadway to be carried along the crest 11 ft. above the spillway level. The five spillway openings, each 18 ft. wide, are shown at the eastern end of the dam in the picture, which is taken from the downstream side. The concrete deck and buttresses of the dam are heavily reinforced by steel-bar sections. At the base the concrete deck sustains a water pressure of nearly 60 lb. per square inch when the water is at the 136-ft. level. Sluice gates are also provided at lower levels for emptying the reservoir. Besides the roadway at the top of the La Prele dam, a passageway is provided through the buttress members, communicating by stairways with the hand-operated gear for manipulating the sluice gates.

The 136-ft. dam has been constructed by the North Platte Valley Irrigation Company wholly for irrigation purposes. This company operates a gravity system of irrigation directly from the dam, the water being first dropped 80 ft. through the 3000-kw hydroelectric power development before being conveyed to the irrigating canals. The electrical energy thus developed is then transmitted sixteen miles at 20,000 volts to a motor-driven pumping station on the bank of the North Platte River, whence water is lifted 42 ft. to irrigate additional land. Two 1500-kw water-wheel-driven generators are now being installed at the La Prele power house. Water is conveyed to these machines from the 136-ft. dam through a 6-ft. wooden stave pipe, the discharge from the 80-ft.-head hydroelectric development being turned into the local gravity system of canals from which the adjacent country is irrigated directly. Other pumping stations served by transmission lines like that under construction on the North Platte River will later be built to irrigate distant regions. The buildings for the power house and pumping stations will be of reinforced concrete and steel construction. The North Platte pumping station will contain 24-in. centrifugal pumps direct-connected to 300-hp motors. Mr. Fred W. Hart is power engineer of the North Platte Valley Irrigation Company.

MINING IRON ORE WITH ELECTROMAGNETS.

At the Moose Mountain iron-bed workings in Ontario, Canada, magnetite iron ore of a high grade is picked from the ground by electromagnets and loaded into cars for the crushers. The ferrous material occurs in the side of a hill and is loosened and broken up into 500-lb. masses by blasting. This ore and rock then rolls down to the base of the hill, where an electromagnet, mounted on a crane, is used to pick it up and load it into mine cars, at the same time effecting a rough separation since the rock and other non-magnetic material are left behind. The electromagnet used has a capacity for handling 1200 lb. of pig iron at a load, but such is the magnetic quality of the unrefined ore that 800 lb. of this magnetite can be picked up easily in spite of its unpromising character. This 800-lb. figure was obtained as the average of a number of loads, in some instances the individual lift exceeding this amount by several hundred pounds. A steam shovel was formerly used for loading the ore, but the density and hardness of the magnetite rapidly destroyed the buckets, so that other means had to be resorted to. The installation of the electromagnets also saves handling a quantity of stone which is broken up along with the ore in its native bed, and thus relieves the crushing and magnetic-separating plant, to which the material is afterward taken for concentrating before being shipped to its destination.

SOME FEATURES OF HYDROELECTRIC ENGINEERING.

Mr. J. W. Link, hydraulic engineer for H. M. Byllesby & Company, Chicago, read a paper on "Construction of Hydroelectric Plants Relative to Economy in Operation" before the recent convention of Byllesby companies in Chicago. He first discussed the history of the water-wheel and followed with an account of the hydroelectric development succeeding the original Niagara Falls installation. In relation to the use of labor-saving appliances in hydroelectric plants Mr. Link noted the argument that it is a waste of money to put in appliances which will simply mean an easier time for the operator, who might perform the work himself. There is another side to the question, however. If the labor necessary for keeping the plant in good operating condition is onerous the average attendant will get in the habit of slighting his work, especially in plants where there are only one or two men employed. This will result in a gradual loss of efficiency. Further, if the labor is overburdensome the attendant may become exhausted in the performance of his work and will thus be in no condition, either physically or mentally, to attend to his remaining duties properly. Therefore, it seems justifiable in designing a plant to install every appliance that will reduce the number of attendants or make more efficient the services of the attendants who cannot be dispensed with, provided this can be done at reasonable cost.

In relation to ice troubles Mr. Link remarked that it is frazil ice which causes the most trouble. The best arrangement for preventing the formation of frazil ice is to have the intakes located on a reservoir of considerable size and depth, where the velocities will be so low that a field of ice will form over the entire surface. But the channel or approach to such a reservoir must be of such size and form as to have comparatively low velocities and smooth flow. Otherwise frazil ice will be apt to form there and pack in under the ice field at the head of the reservoir and cut off the supply of water. The covered forebay has another advantage in that the temperature in such a structure can be kept easily above the freezing point. This will prevent the formation of ice on the racks. The speaker thought that the racks should not be submerged to any considerable depth below the surface of the water, since if they are so placed it is impracticable to clean them without drawing down the reservoir.

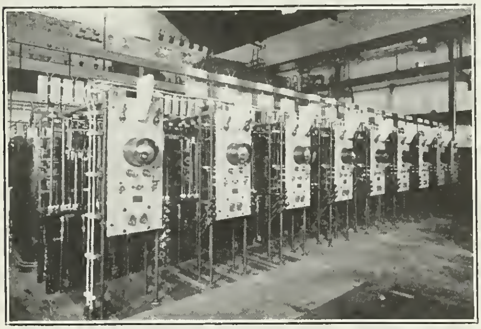
In arranging machinery in the power house due consideration should be given to providing ample floor space and headroom for easy access to the machines and for handling parts when repairs have to be made. A disregard of this provision may easily result in repairs costing from 50 per cent to 100 per cent more than would have been the case in a well-arranged plant.

Central Station

Management, Policies and Commercial Methods

LONG LIFE OF RECTIFIER TUBES AT DETROIT LIGHTING PLANT.

Unusual records of life of magnetite-arc-system rectifier tubes have been obtained at the municipal electric lighting plant at Detroit, Mich., which supplies energy for street lighting and municipal purposes. The city plant has seventeen seventy-five-lamp and one fifty-lamp 4-amp constant-current rectifying sets in service, the average life of the tubes substantially exceeding 2000 hours' use, while certain tubes have attained extreme lives of more than 5000 hours. The oil tanks in which these tubes are immersed are cooled by water circulated through them from the Detroit River. Thermometer readings of the temperatures of each tank are taken every fifteen minutes and the valves adjusted to maintain a constant temperature of 80 deg. At the Detroit plant, as in other stations, it has been found that rectifier tubes which become inoperable at a point comparatively early in their expected life if put aside and allowed to rest for a time may return to normal operating condition and can be used several thousand hours more. This phenomenon is probably due to the change of vacuum in the tube, due to occlusion or liberation of gases by the electrodes and walls. The guaranteed life of these tubes is 500 hours, but the good service which they have displayed is credited to the care taken to operate them at a uniform, comparatively low temperature.



Mercury-Arc Rectifier Sets for Detroit Street Lighting.

Some interesting conditions of cable breakdown were encountered when the former direct-current arc-machine service was converted into an alternating-current system, and this, in turn, later to the present rectified or unidirectional flow. The early cables operated satisfactorily at 6000 volts direct current, taken from arc machines, but when later utilized to transmit rectified current at the slightly higher potential of 6600 volts for the 4-amp metallic-flame arcs gave repeated trouble from breakdowns. An alternating-current potential of this value was sustained, however, without signs of difficulty. The explanation finally reached by Mr. Frank Mistersky, superintendent of the system, is to the effect that the smaller heat-storage capacity of the metallic-electrode arc, and its consequent almost instantaneous rupture of the circuit when a lamp for any reason momentarily fails, causes surges of pressure which in some cases must have reached values of 9000 volts or more judging from the spark-gaps bridged. After eliminating points of low insulation from the underground cables trouble due to this cause has ceased.

The Detroit city lighting plant contains two 2000-kw Westinghouse-Curtis turbine-generator sets excited by direct-current generators each driven by vertical triple-expansion engines. A large Stanley inductor-type alternator is held in reserve.

ESTIMATING "DEPRECIATION."

In the January issue of the *Annals* of the American Academy of Political and Social Sciences, discussing "The Depreciation Problem," Mr. William B. Jackson lays down the principle that the only way to be reasonably assured of having depreciation funds ready when they are needed is to estimate when each new part goes into service the years of service that may be expected from each part, and then to distribute the cost of entire renewal over this estimated "useful life."

By the same process the requirements for depreciation of each kind of plant in a property may be estimated and the average amount per annum that must be appropriated to care for depreciation or replacement for each kind of plant may be determined. With possession of this information it is merely a matter of taking the aggregate of these amounts to obtain the annual appropriation to the depreciation account required for the entire property. A knowledge of this amount places the management in position to have the books of their company so organized that the accounts will show, month by month and year by year, the amount of appropriation required for depreciation and the amounts of the appropriations actually made for the purpose, together with the amount of the fund that should be in the depreciation reserve and the sum actually accumulated. They are then in a position to know at all times the depreciation requirements of their company and its accomplishments in providing for deferred maintenance and depreciation reserve.

An intelligent estimate of depreciation in a property must depend upon a thorough knowledge of the nature of the service demanded by the different kinds of plant, a wide acquaintance with the general experience respecting like kinds of plants, a broad survey of the probable effect of local conditions upon the useful life of the plant, and a wide knowledge of the past and present progress of the art in order that an intelligent forecast may be made of the influences of "decrepitude" and "obsolescence" upon the rate of depreciation of the plant and the salvage values to be expected, and the estimates should be periodically revised, as time brings forth new developments to influence past conclusions.

THE NEW-BUSINESS DEPARTMENT.

Mr. E. L. Callahan, manager of the new-business department of H. M. Byllesby & Company, read a paper on "New Business" at the second annual convention of the Byllesby companies, held in Chicago on Jan. 17-20. Mr. Callahan pointed out that in addition to securing new business the men in the department usually so named constitute as well a bureau of technical and commercial information. The missionary work which does not appear as business secured on monthly reports is effective in keeping consumers satisfied and in making friends for the company. If the solicitor does his work well he will convince the customer that the various departments of the central-station company are intelligently co-operating with one another in order to give the customer the best possible service at the lowest price that is consistent with good management.

To measure up to the requirements of the modern new-business department a man must be aggressive, able to obtain results as a salesman, honest and "square" in his representations and dealings with the public, conduct himself as a gentleman under all circumstances and at all times be interested enthusiastically in the general welfare of the company. The new-business organizations of the progressive central stations of to-day are made up of specialists, each man especially trained and proficient in the securing of contracts for either motors, sign, residence or commercial lighting, heating or fuel service. Intelligent methods are necessary in order to develop the field of the company as nearly as possible to the saturation point.

The manager of the company will do well to convince his solicitors that he has confidence in them; that he is vitally interested in their personal work. Keep the solicitor informed of changes in plant or office that will tend to give the consumer better service; let him know that by imparting all such information to the public he is assisting the management, and that by keeping the manager advised of the attitude of the public toward the company and of the condition of the distributing system he is showing the proper spirit of loyalty to the manager and to the company. If the manager will seek the fullest co-operation of each employee he will get it.

Mr. Callahan mentioned the fact that at Grand Forks, N. D., a special house-wiring campaign was begun on Sept. 1, 1910. On Jan. 1, 1911, four months later, an increase of 85 per cent in electric consumers had been made. At White Bear, Minn., the number of electric consumers was increased in ten months 149 per cent. There seemed to be very little possible business at Stillwater, Minn., when the property was taken over by the Byllesby interests, but in the twelve months of the year 1910 a gain of 38.5 per cent in electric consumers was made, with an increase of 56.3 per cent in electricity sold for all purposes. It is such results as these that Mr. Callahan means when he urges intensive business-getting. The speaker added that the work of his department had been greatly facilitated by the establishment of a department of publicity at the Chicago office during the year.

MUNICIPAL LIGHTING OF SCHOOL HOUSES AT BOSTON.

The Boston School Committee has voted to experiment with the municipal lighting of a number of school buildings in the North End from a gas-engine plant to be installed at a cost of about $7,000, upon recommendation of a special lighting sub-committee. The report of the sub-committee attempts to show that the city can do this work at less expense than under the present arrangement, whereby energy is purchased from the Edison Electric Illuminating Company of Boston, but no allowance for labor cost has been included in the committee's estimates. Experience with gas-engine electric generating plants of small size in Boston indicates that the quality and reliability of the service rendered by such plants is far below that afforded by central-station supply circuits in Boston. It appears that the sub-committee does not appreciate that labor charges must be included in determining the cost of lighting, even in cases where school-house janitors operate the plants. The action of the committee is in large degree a result of a sweeping decision in favor of the Boston Edison company about a year ago against the request of the school-house authorities that lower rates should be allowed the city schools than are accorded other customers. In this decision the board took the position that the school committee is not entitled to discrimination as a large consumer of electricity; that it is an open question if scattered school houses are in reality large consumers, and that any attempt to charge for the use of the streets, either directly by some form of tax or indirectly by a concession in price made to the municipality, is virtually an attempt to shift a portion of the burden of taxation from the taxpayer to the consumer of electricity as such. The commission refused on the above ground to require the company to make a discriminatory rate in favor of the city's buildings under the committee's care.

ELECTRIC METERS AND METER TESTING.

At the Wisconsin Electrical Association convention, held at Milwaukee Jan. 18 and 19, Mr. A. J. Goedjen, superintendent of tests for the Milwaukee Electric Railway & Light Company, presented a paper discussing the construction, installation and maintenance of electric meters and the arrangement of a meter department for a small central station.

Company managers, said Mr. Goedjen, often give the customer's meter too little attention, apparently believing that it will retain its calibration as well as a yard stick or a quart measure. The Wisconsin commission requires that service meters shall be tested annually and be within 96 per cent to 104 per cent accurate. This requirement is quite reasonable, and, although often considered a regulation contrary to the best interests of the central station, it actually is fair to both station and customer, and invariably increases the income of the central station.

The author assumed an average case and showed how a central-station company which is more or less indifferent toward the accuracy of its watt-hour meters fares with the average meter on its system. The general tendency of a meter is to run slow, so that a meter which has not been adjusted and inspected for a number of years will generally run about 2 per cent slow on full load, 3 per cent slow on half load and 7 per cent slow on light load. In some cases it may not run at all on light load, due to magnetic or other material between the armature disk and the magnets. It is, therefore, fair to assume that in this case the total energy is metered at an average of 4 per cent slow, or, in other words, only 96 per cent of the energy delivered is actually recorded. It means that the total income of the plant is but 96 per cent of what it should be. This 4 per cent loss when applied to total revenue amounts to a very considerable sum, probably equal to one-fifth of the total coal bill of the plant. If the boiler efficiency of a plant should decrease 20 per cent the central-station manager would immediately investigate and remedy it; but it is questionable if he always realizes that a few per cent loss in accuracy in his wattmeters will affect his net profit fully as much. This loss in accuracy results in losing revenue on the commodity which has actually been delivered to and used by the customer.

The real importance of correct registration on low loads is not generally realized. The average meter is operating most of the time on 10 per cent or 20 per cent of full load, and since the introduction of the tungsten lamp light loads are often as low as 0.25 amp, or only 5 per cent of the rating of a 5-amp meter. At a rate of 10 cents per kw-hour at the customer's premises a 16-cp carbon 50-watt lamp consumes $0.005 worth of energy per hour. This seems small, but the meter which does not operate on one lamp will lose at least $30 annually in revenue to the station if the lamp is burning alone on the installation for seventeen hours out of every day. From this it may be seen that a meter which will not operate on one lamp may be a very costly piece of apparatus.

In Wisconsin the commission fixes the test period at one year, a very fair average. However, an alternating-current induction meter will retain its calibration as well for eighteen months as any average direct-current commutator meter will for six months. In the case of large direct-current meters the calibration might well be checked up quarterly, and large alternating-current induction meters should be checked every six months.

Besides keeping the meter in better adjustment and thus increasing the company's revenue, frequent tests should result in good in various ways.

1. The meter being kept more accurate, the complaints on bills should decrease.

2. In case of a complaint, it is very desirable to be able to inform the customer that the meter was calibrated at a recent date.

3. The very fact that the meter is checked up from time to time gains the customer's confidence in the meter and in the company.

In a general way, the chief factors affecting the accuracy of customer's meters which make necessary periodic inspection, adjustment and testing are as follows:

1. Roughening of the jewel bearing.
2. Weakening of the permanent magnets.
3. Moisture and magnetic and other matter in the meter.
4. Wearing of the commutator and brushes of a commutator meter.

1. Practically every electric meter has a jewel bearing which may crack or roughen due to usage. Most jewels are made of sapphire, which is cupped so as to receive the steel pivot at the end of the shaft, and, although sapphire is an extremely hard material, it will finally roughen with use and vibration. About 1,000,000 revolutions of the shaft of a direct-current armature is generally considered the limit of wear of a sapphire jewel, while 2,000,000 revolutions is considered a fair limit for induction meters, which have relatively lighter rotating elements.

A method of suitably cupping diamond jewels was discovered some time ago, and now diamond jewels are sometimes used in large meters subjected to severe vibration.

2. The permanent drag magnets employed in meters are used as a load which is applied to the armature shaft. These magnets are made of special steel and repeatedly magnetized and aged before being installed in a meter so as to insure permanency. However, they sometimes become weaker, gradually allowing the meter to speed up. A short-circuit in or near the meter may also affect the strength of the drag magnet with the same result. Direct-current meters now have their drag magnets set parallel to the series coils so that a short-circuit passing through the series coils will not affect the strength of the magnets.

3. Dust and moisture seriously affect meter accuracy. Most meters are well provided in this regard, but even in the best of them this feature must be watched. The felt or rubber gaskets and putty filling around the windows must be replaced or repaired from time to time. Broken windows and cracks and holes in the cover must be repaired to prevent tampering with the meter, and also to keep dust and insects out of the meter. In old meters it was the practice of some manufacturers to dip the drag magnets in a magnetic enamel which would later chip off and get into the air-gap, thus slowing up the meter. This trouble is still experienced at times in old meters.

4. Commutator and brush friction is one of the greatest meter troubles and often fails to get the attention it deserves. If the brushes bear too firmly on the commutator an undue amount of friction results. If the brushes fit too loosely on the commutator the commutator and the brushes become pitted and introduce additional friction besides making poorer contact and possibly reducing the electrical efficiency and speed of the meter somewhat. Round, silver-tipped brushes, very small commutators with few segments, and low-voltage between segments greatly decrease brush and commutator troubles.

There are numerous other conditions affecting the accuracy of meters, such as vibration, stray magnetic fields, extreme ranges of heat and cold, the wave-form, frequency, voltage, and also the power-factor if the meter is not properly lagged for inductive load.

Installing Meters.—In installing meters care should be taken in selecting a firm wall on which to mount the meter, choosing a location which is as near as possible to the point of entrance and at the same time is well protected and easily accessible for reading and testing. The current coil of the meter should never be placed in the neutral or grounded side of the meter, as it is a very simple matter to shunt out or jump a meter which is thus connected.

Great care must also be employed in connecting up polyphase watt-hour meters to make sure that both elements of the meter tend to rotate in the same direction on non-inductive load. A reversed coil or connection may increase or greatly decrease the registration of a polyphase meter. Two or three single-phase meters used in place of one polyphase meter must be connected with the same degree of care.

Central stations which change from direct current to alternating current often allow the old commutator meters to remain installed and measure the alternating-current energy. Commutator meters are usually quite inaccurate on inductive loads, such as motors and arc lamps, and even on non-inductive lamp loads they are far inferior to induction meters. In cases like this it is best to get rid of the commutator meters in one way or another and install induction meters.

In a small company where the meter man knows the details of each installation he should use good judgment in selecting meters which will best suit each particular case. For instance, if a customer does not exceed the minimum charge the meter reading does not affect the customer's bill and one of the older types of meters may well be used.

As a matter of general policy when a service is discontinued it is best to remove the meter, test it at the shop or laboratory, set it back to zero and turn it back into stock. In this way each customer starts out with a newly calibrated meter set at zero.

Probably the most serious complaint which a central-station company must meet is a meter which "creeps," that is, a meter which operates, however slowly, on no load. Meters will sometimes do this when subjected to extreme vibration or an unusually high voltage. A meter may also creep if it is metering its own load; that is, if the line and load connections are reversed. An alternating-current meter will creep if one or more turns of the series field are shorted, due either to poor insulation or to breakdown resulting from lightning. In a direct-current meter creeping may result if the meter is over-compensated for starting friction. This is a very serious complaint, and one which cannot be argued. The customer sees his meter disk revolving with no load on the meter and really has an excellent cause for complaint. Testers should be advised to watch for creeping, remembering that a meter is "creeping" only when it will rotate more than one complete revolution. If possible, laboratory tests should include a creeping test at about 125 per cent of the normal voltage to be applied to the meter in service.

A Small Station's Meter Department.—In accordance with the foregoing general principles, the author considered how a meter department of a small company should be operated.

First of all, every station, however small it may be, should have a meter department and a real meter man, who should be held absolutely responsible for the accuracy of the meters. At least one room should be set aside as a laboratory, repair-room and possibly also as a storeroom for meters. A work bench should be provided, furnished with a vise, blow torch and other necessary tools required for simple repair work. The material should include enamel for painting, shellac, and paint and stencils for numbering the meters serially.

Simple repair parts, such as glass windows, felt or rubber gaskets, glass covers, dial hands, jewels and similar material should be kept on hand. The test bench should be simple but serviceable. It should be wired with every service which will be needed in meter testing. The wiring should be arranged to allow an opening for connecting in the meter to be tested and another opening for the portable calibrator to be used as a standard meter. A lamp bank may be used as a resistance unit, but a portable resistance is far more compact and durable. A series transformer should be installed on the test-board to step up to high alternating-current values for testing large alternating-current meters. Large direct-current meters cannot well be tested at heavy load in a small laboratory and probably will need to be installed before being tested at heavy load unless it is convenient to use a low-voltage high-current storage battery for this purpose.

In testing alternating-current meters the standard should be a neat and light portable calibrator which will record accurately over a large range of voltage and current. In testing alternating-current meters a portable series transformer should be used to step the current down in a definite ratio for the 5-amp coil of the calibrator. Laboratory tests of alternating current meters should include:

1. A test at full-load current at unity power-factor
2. A test at full-load current at about 50 per cent power-factor.
3. A test at 10 per cent of full load at unity power-factor.

A half-load test at unity power-factor may also be included, but it is quite unnecessary. Unity power-factor load may be obtained by loading on any resistance or lamp bank. Inductive load may be obtained by means of an inductance in series with the resistance load, or by loading on ordinary resistance and putting the potential coil of the meters on another phase of a two-phase or three-phase system.

A meter should operate on less than 2 per cent of its rated load and should be checked up for starting current on a suitable incandescent lamp. A 5-amp meter should operate on a 2-cp carbon-filament lamp and large meters in approximately a direct ratio. Besides this, the meter should be tested for "creeping" by subjecting it to a 125 per cent voltage.

Direct-current meters should be tested by means of stop-watch and indicating wattmeter, or by means of a stop-watch, ammeter and voltmeter. Each method has certain advantages.

The per cent of error may be read from a special curve sheet or table or may be calculated. In calculating it is advisable to reduce all observations to watt-hours. The watt-hours shown by the standard meter will represent the true watt-hours during the test period. The customer's meter watt-hours during the same period are obtained from the speed of the meter and the disk constant. In calculating the exact per cent error either slow or fast the percentage is always based on true watt-hours as indicated by the standard meter and never upon the watt-hours as shown by the customer's meter.

The question of keeping the testing standards in accurate calibration is very important, and at the same time quite difficult. Alternating-current calibrators should be checked up weekly against a high-grade indicating wattmeter. This indicating wattmeter should be handled very carefully and checked up at least once each year by the manufacturer or by a laboratory. Direct-current testing instruments require considerable attention and should be checked up at least once each week. In using a milli-voltmeter and shunt for measuring current, great care must be exercised in handling the milli-voltmeter leads, as a few broken strands of copper in these leads will destroy the accuracy of the meter. A rough method of checking the accuracy of the testing instruments is to compare them with the average of several meters which have just been received from the manufacturer. If meters from two companies are available, this makes the check reliable.

"Outside" testing on the customer's premises does not differ appreciably from the inside testing as far as the instruments are concerned. Besides the calibrator, or ammeter and voltmeter, the tester must carry a portable resistance, and satchel containing leads, fuses, tape, tools and a test lamp. This test lamp may be connected on the service and used as a drop-lamp and may also be used in determining whether the meter will operate on one lamp. If the service may not be interrupted the meter must be jumped before changing any of its connections. Various kinds of protective and testing blocks have been developed and are being used quite extensively by several large companies. The purpose of these blocks is to protect the installation against tampering, and at the same time to provide necessary fuses and facilitate the work of the tester. In a number of these blocks the meter can be jumped, and the calibrator and portable resistance connected in the circuit, simply by inserting or removing a few plugs.

The operation of the meter department of a central station influences the financial success of the company very appreciably and should have careful attention from the management.

DISCUSSION

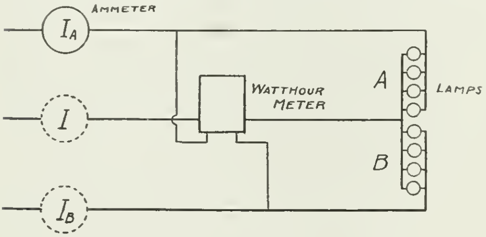
Mr. J. M. Cadby, meter expert for the Wisconsin Commission, said a good practice in a system where different types of meters are in use is to classify them according to probable accuracy, type and age, testing each class at intervals varying from sixty days to eighteen months. A tester can check from six to ten meters a day, depending upon the density, types and conditions of the installations tested. Mr. Cadby defended the installation test required by the commission as being made necessary by the jars of transportation. Asked to discuss the electrolytic meter, Mr. Cadby declared that this instrument might be used satisfactorily under specified conditions, but as its principle is that of the amp-hour meter, the normal voltage at the point installed must be first known, to compute kw-hours. When overloaded the steam vapor produced in electrolytic meters may give inaccurate results by being measured with the gases of decomposition.

Prof. C. M. Jansky, of the University of Wisconsin, pointed out that the critical index of the meter service is the torque-weight ratio, urging that the meter having the highest rotative force and lowest weight of moving element is sure to be the best adapted for service. Professor Jansky also referred to the handling of standard instruments, upon whose accuracy that of all the customers' meters depends. For checking meters at fractional power factors, where indicating voltmeter, ammeter and wattmeter are not available to find the power factor, Professor Jansky showed a method of combining voltage and current relations in a three-phase circuit to obtain any desired single-phase power factor, measuring this single-phase power factor by means of a single ammeter.

which need not necessarily be accurate. The scheme is shown diagramatically herewith. Varying the lamps in the two legs, *A* and *B*, gives the required values of currents I_a, I_b, and I, the current in the main branch. Then the power factor under which the meter is to be tested, with its potential leads as shown, is

$$\text{Power factor} = \frac{I_a - I_b}{2I}$$

Any error in the ammeter is eliminated in the calculation of the power factor. Professor Jansky showed a diagram of a connection board arranged with switches for inserting the ammeter at each point in succession. The method above outlined has been shown to give the power factor with a maximum error of 5 per cent.



Arrangement for Determining Power-Factor.

Mr. McNaughton, of Milwaukee, inquired for members' experience with marking dials for meter readers' books, and Mr. H. G. Nutting, of Fort Atkinson, Wis., described a system of billing original with him, in which a carbon copy of the dial reading is left with the consumer. This scheme was described in the *Electrical World*, Nov. 17, 1910.

Wiring and Illumination

THE LOCATION OF FIXTURE OUTLETS.

Reference was made in these columns Jan. 19 to the paper of Mr. David Crownfield before the New England Section of the Illuminating Engineering Society on "The Relation Between the Illuminating Engineer and the Fixture Designer," and a short abstract was printed of the remarks of the author on the location of outlets. In view of the importance of fixture location and the scarcity of thoroughly practical suggestions which can readily be utilized by central-station men in dealing with this subject, Mr. Crownfield's discussion of fixture location is given practically in full below.

PRACTICAL TREATMENT OF FIXTURE LOCATION.

The location of fixture outlets is a very important matter not alone from the standpoint of proper distribution of the light to obtain a certain end, but also from the standpoint of the effect of the light upon the ceilings and side walls of any space. While the kind or quality of light used in any apartment or space may affect the colors there, the location of the lamps affects only the tones of these colors. The difference is a wide one, and yet the two factors bear a direct relation to each other. By the location of the outlets depth may be added to any space treated, and by casting shadows tones are created of colors already present, and thus that subtle thing the artist calls atmosphere is brought into existence. Here the borderland between the physiological and psychological sides of the subject is approached and the opportunity is extended to develop it from a science into a unity of science and art.

PUBLIC BUILDINGS.

The location of outlets in government or municipal buildings, office buildings or banks calls for similarity of treatment, with outlets adjacent to desks or grilles for individual lighting. In addition to these there should be located on the ceiling over the general banking or public space, if the area is square, an arrangement of five or, if rectangular, seven or other uneven number of outlets, of which one is in the center and the others along the sides, spaced as architectural conditions will permit. In the case of a bank, if it is of considerable depth, two outlets may be placed in the center line and others along the sides. These center outlets should feed a considerable number of lamps to allow of some dignity being shown in their further treatment.

LIBRARIES.

Libraries should have outlets spaced to give an even distribution of light over their entire working area, but the author was of the opinion that the light on the working plane should be either reflective or diffused, since a wide experience in lighting this class of building caused him to feel that direct, unshielded light is unfitted for use in the working or reading divisions.

ART GALLERIES.

The foregoing is true of art galleries, which require a particularly diffused light. One of the best lighted galleries has an arrangement of three outlets along the center line, with a line of single ceiling outlets following the wall line around the room. In this case the aggregate wattage of the three center outlets is two-thirds that of all the outlets following the room outline. The diffused effect is secured by means of silk diffusing covering on the under side of the center outlets.

THEATERS.

Theater ceilings are usually decorated with paintings of some sort. These should be illuminated by outlets following the lines of the surrounding molding. Outlets under the balconies should be kept well to the rear, and any lamps on the balcony lines should be on the face and not on the under edge.

CHURCHES.

The location of outlets in churches is particularly dependent upon the architectural style of the building, and should be handled in a way to bring out the peculiarities of the style. The sense of gloom which seemed to hang over the Pilgrim Fathers did not pervade their churches. Mostly Colonial in their style of architecture, these were light and cheerful inside, and this style should be treated accordingly with a strong, even diffusion of light. Colonial edifices usually have a balcony running across the entrance end and down the two sides. If the church is a short rectangle in plan it may be lighted by the location of a center outlet with four other outlets, one on each corner of the ceiling. If the plan is a long rectangle, although the length will hardly ever be more than twice its width, an arrangement of one center and eight other outlets, four on each side, will be found best. As this will result in a shadow under the gallery, a line of bracket outlets should be placed along the wall between windows.

Romanesque and Gothic types of churches may be lighted by the location of outlets for brackets on the columns, or preferably on the nave walls just above the capitals of the columns, this treatment being carried around into the transepts unless a gallery interferes, in which case brackets should be used on the extreme walls only, both in the gallery and beneath it. The types of Romanesque and Gothic churches in which the roof trusses are supported by hammer beams give an opportunity for the placing of pendent outlets on the beams in the nave of the church and the placing of two ceiling outlets, one each where the line of the nave wall intersects the roof beam of the transept. In churches whose functions include an altar a line of outlets for individual lamps may be placed behind the sanctuary; where no altar is used three or more outlets may be placed over the chancel space. Where the entrance end of the church auditorium includes a gallery it will be best to place an outlet on the ridge plate over the center of the gallery. If the church has side aisles these may be lighted by wall brackets if the seating is extended into them, otherwise it will be unnecessary.

CLUBS.

Clubs are buildings of semi-private character and should be treated much the same as private houses, except that the outlets should be planned to carry a much larger number of lamps, sufficient in the larger rooms to light to a point of brilliancy at times.

PRIVATE HOUSES.

Outlets in private houses should be laid out from two standpoints; one, its usual daily or nightly service, and the other, the occasional times when entertainments are to be given. These conditions can never be met by a single high-efficiency unit, which is a barbarism—or modernism—in the room of any house. Unshielded by colored glass 40 watts is the limit of power that should be allotted to any one lamp (not outlet) where the tungsten lamp is used; and rooms requiring more light should have more outlets. Halls should have a ceiling outlet placed so that it does not come into the line of vision between two rooms, as it then breaks the depth of the vista. Living-rooms should be lighted generally by one ceiling outlet and by from two to six side outlets on the walls, allowing not less than four lamps to the center fixture. A floor plug should also be provided. Libraries should have side outlets and a center outlet for a drop lamp. Dining-rooms should have a center ceiling outlet and side outlets, beside the serving equipment. When a drawing-room or salon is included in a residence this room is usually not very large, but its presence indicates a certain formality in its use and it should be laid out to obtain a uniform, brilliant light throughout its entire area. Chambers in private houses are usually insufficiently lighted. There are times when as much light is needed in these rooms as anywhere in the house, and they should always be provided with a lamp on either side of the dresser mirror and preferably one over it also

HOUSE-WIRING WITH CONTRACTORS' CO-OPERATION AT CLEVELAND.

Three years ago the Cleveland Electric Illuminating Company offered to local contractors a house-wiring proposition by which the latter were to agree to do new construction work solicited by the company at a fixed price per outlet following the appended table, which is computed to allow a fair margin of profit to the installer. For each house wired by the contractor through his own solicitation the central station company agreed not only to allow him a bonus large enough to cover the cost of such solicitation but also to turn over to him another house-wiring job worked up by its own sales staff, agreeing to keep a sufficient staff of solicitors in the field to locate at least one house-wiring job for each one installed on the contractor's initiative. The first year of this offer only one contractor accepted the agreement, and although 300 houses were wired the proposal seemed to meet at first with the disfavor of the local craft. Noting the success of the first man to enter the agreement, however, other contractors applied for recognition on similar terms, until at the present time twenty-three contractors are taking part in Cleveland's house-wiring campaign and 3500 houses have been wired to date.

A signal advantage has been found in the use of the wiring-cost table by solicitors in calling upon prospective customers. After learning what outlets and switches the householder desires installed, the solicitor can then quickly compute the cost of the work, inform the owner and often leave the household conference with a signed contract in his pocket. The simplicity and satisfaction of this transaction are in marked contrast to the usual delay of summoning an experienced wireman or contractor to estimate on the work, followed by the later delay which ensues before the owner agrees to have the work done; if, indeed, he does not reverse his intentions after the enthusiasm accompanying the solicitor's first visit has died away. The psychological advantage of showing the owner the cost of the work and getting his consent at the first interview cannot be overestimated. The figures given in the table give a fair average of the cost of installing work of this kind and have been figured to leave the contractor a reasonable profit of 12.5 per cent. This allowance, in view of the occurrence of such wiring jobs in "pairs" in Cleveland, has been found acceptable to the contractors

To the owners of houses thus wired the electric company offers to finance the installation on its special "ten-months-to-pay" plan. Under this arrangement the customer pays 25 per cent of the cost of the work as the first instalment and the remainder in ten monthly payments of 10 per cent each.

The form of agreement entered into between the householder and contractor contains a blank schedule table, the designations of various rooms appearing on the successive lines, while in vertical columns are to be marked the types of fixtures and outlets to be used. By entering check marks in these spaces the solicitor is able to compute the required outlets quickly and has a simple record of the location of each. In general, all openings for switches, receptacles, drop cords and fixtures are considered as outlets and based on a unit price for houses of different classes of construction. The cost of switches, receptacles and drop cords is added to the price of outlets, and this sum is then the contract price for all labor and material necessary to complete the work as outlined in the schedule. All extra outlets, switches, receptacles and drop cords will be charged for at the rates according to the class of house for which the contract is written

OUTLETS FOR SINGLE FLOORING.

Number of Outlets.	Cost	Number of Outlets	Cost
5	$15.85	33	$63.80
6	17.85	34	65.45
7	19.85	35	67.10
8	21.85	36	68.75
9	23.85	37	70.40
10	25.85	38	72.05
11	27.50	39	73.97
12	29.15	40	75.90
13	30.80	41	77.82
14	32.45	42	79.75
15	34.10	43	81.76
16	35.75	44	83.60
17	37.40	45	85.50
18	39.05	46	87.45
19	40.70	47	89.37
20	42.35	48	91.30
21	44.00	49	93.22
22	45.65	50	95.15
23	47.30	51	97.07
24	48.95	52	99.00
25	50.60	53	100.82
26	52.25	54	102.85
27	53.90	55	104.77
28	55.55	56	106.70
29	57.20	57	108.62
30	58.85	58	110.55
31	60.50	59	112.47
32	62.15	60	114.40

FOR MIXED FLOORING.

	Extra
Located under double flooring, second or third story	
Ceiling outlet	$1.00
Switch outlet (controlling and center outlet)	1.00
Located under hard-wood flooring, second or third story	
Ceiling outlet	3.00
One switch outlet (controlling any center outlet)	3.00
Additional switch outlets on same gang (controlling same center outlet), each	1.50

A schedule of prices for switch hardware is also appended to the Cleveland table.

ORNAMENTAL TUNGSTEN LIGHTING FOR ALTOONA, PA.

The downtown business section of Altoona, Pa., a city of 60,000 population located on the main line of the Pennsylvania Railroad, where also are situated the railroad's principal shops, is to be lighted by 150 ornamental post standards, spaced at 75-ft. intervals and each carrying five 100-watt tungsten lamps. The lamps will burn from dusk to midnight, the Penn Central Light & Power Company, which supplies the energy, receiving for this service $1.44 per front foot per year from the tenants of adjoining property. The special lighting on the main street, Eleventh Avenue, which parallels the railroad, will be conspicuous to anyone on a passing train. Altoona is believed to be the first city in Pennsylvania to install this ornamental lighting.

ILLUMINATION EFFECTS AT MINNEAPOLIS SHOW.

At the Minneapolis Electrical Show, held in the Minneapolis Armory, Jan. 26 to Feb. 4, the booth decorative effects comprised tungsten lamps in art-glass globes and reflectors, mounted on the columns at the aisle intersections, while overhead was a rather elaborate spectacular skyrocket and flash effect, as shown in the accompanying illustration. From one corner of the armory floor, which is 150 ft. square, a skyrocket run was simulated by a string of lamps operated by a flasher. Reaching the center of the room the rocket burst into a shower of twinkling vari-colored lights, formed by incandescent lamps with thermal-break flasher sockets. During the ascent of the rocket a noise machine furnished the appropriate roar and crash. At the center and four corners of the room were large fixtures with 500-watt tungstens, the corner fixtures being extinguished when the skyrocket effect was in operation.

Illumination Effect at Minneapolis Show.

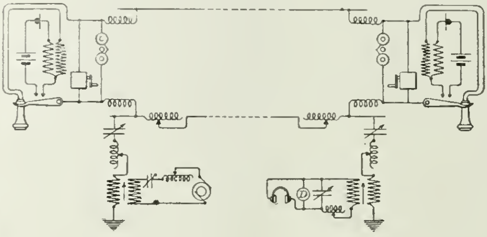
RECENT TELEPHONE PATENTS.

MAJOR SQUIER'S MULTIPLEX TELEPHONY SYSTEM.

The common conception of the value of a patent is undoubtedly based upon the protection it affords the patentee. Therefore, a patent obtained by an inventor to protect the public against possible claims of other inventors is noteworthy. Furthermore, when the disclosure of the patent, or in this case patents, is remarkable they are bound to receive liberal attention.

Such has been the case with the four patents recently issued to Major George Owen Squier, of the United States Army, previously mentioned in these pages, which are dedicated to the public and which describe his inventions in multiplex telephony According to Major Squier's system there may be superimposed upon the ordinary telephone line carrying an ordinary telephone conversation one or more telephone or telegraph currents, all maintained individual and non-interfering. This is made possible by the use of an exaggerated skin effect, brought about by the use of oscillating currents with frequencies lying between 20,000 cycles and 100,000 cycles per second. Currents of such high frequencies are beyond the range of the human ear and yet they will follow exactly the course of an electrical conductor of the caliber of the usual telephone line. They will not traverse the coils usually included in telephone circuits, but they will, on the other hand, readily affect condensers so small as to be of no effect on ordinary telephone currents.

Therefore, it will be understood at once that these currents may be led to or from the telephone wire through small condensers without a path being formed sufficient to introduce audible disturbance. As a primary factor in the isolation or selection of any particular oscillating current, the receiving circuit must be tuned to resonance for that frequency. Such a circuit will practically reject other frequencies. It is thus easy to introduce upon the line and take off and isolate a number of simultaneously transmitted currents. The next step is that of introducing a current variation in the oscillating current corresponding to voice-waves and the reconversion of this variation into sound-waves in the receiving circuit.



Multiplex Telephony and Telegraphy.

An ordinary telephone transmitter associated with the high-frequency generating apparatus serves to introduce the voice variation, while an integrating detector in the receiving circuit, properly associated with the necessary battery and a telephone receiver, serves for the reconversion to sound-waves.

Major Squier's claim covers many variations of details of his general invention, including series and parallel application and metallic and grounded circuits, etc. It will suffice, however, to show a diagram of one arrangement. The accompanying illustration shows such a diagram, *D* representing the detector and necessary associated devices.

TELEPHONE REPEATER.

A telephone repeater has been patented by Mr. H. Morgan, of Quinter, Kan. This repeater is merely two electromagnets so placed as to be intimately related inductively. It is used for intercommunication between two lines which cannot be conductively connected together for conversation.

NEW APPARATUS.

There have been many different suggestions for and designs of the electromagnetic receiver. However, Mr. W. W. Dean, of Elyria, Ohio, has now patented such a receiver in combination with the induction coil. To this end the receiver core is of E-shape and laminated. The middle leg carries the winding, which is in two parts, primary and secondary. The diaphragm confronts the three legs of the core. This patent is assigned to the Dean Electric Company.

The patent granted to Mr. F. S. Weyss, of Philadelphia, describes a rather elaborate receiver holder. The device includes a base plate for attachment to a desk set and numerous adjustment features and an arrangement for depressing the hook lever.

SIGNAL SYSTEMS.

Mr. G. W. Herrick, of St. Mary's, Pa., has patented a village police call as an adjunct of the telephone system. A special telephone line is assigned for the purpose and this is so equipped that when the central operator plugs in a battery is applied to the line to pull up distant relays. These in turn close the circuit of signal lights distributed as required. The response at the telephone station breaks the relay circuit and signals the operator.

AUTOMATIC EXCHANGE SELECTOR.

In an automatic exchange selector patented jointly by Messrs. H. B. Holmes and E. B. Craft, and assigned to the Western Electric Company, the contacts are arranged in banks of 100 on a flat surface and yet are selected by one translation and one rotation. The rotating element consists of a horizontal drum carrying ten sets of contact wipers. These are spaced longitudinally of the drum to correspond to the horizontal spacing of the contact bank. The various wipers are, however, angularly displaced, so that one after the other comes into effective position as the drum is turned. The number of angular displacements, therefore, determines the horizontal co-ordinate and the elevation of the drum determines the vertical.

PARTY LINE SYSTEM.

Three party-line lock-out selective systems have recently been patented, all patents being assigned to the Anderson Electric & Manufacturing Company. Two are the invention of Mr. N. E. Norstrom, of Chicago, and the remaining one the invention of Mr. C. A. Anderson, of Salina, Kan. One patent describes a sending apparatus which on its forward stroke sends out line-restoring impulses of one sign and upon the return sets up the desired station by longer impulses of the opposite sign, following this automatically with ringing current. The application of a power device to the sender by means of a magnetic clutch is involved in another patent. According to another method selection depends upon impulses being stopped for brief periods at predetermined intervals.

A fourth party-line patent is that issued to Mr. W. R. Ewing, of Mars, and Mr. C. P. Ewing, of Renfrew, Pa. This is a receiver-hook lock for magneto party-line stations. The lock is concealed within the bell box and is released momentarily with each revolution of the magneto drive shaft. If the line is in use the parties are made aware of any station unlocking by the alternating impulses put upon the line with the moving of the drive shaft

LETTERS TO THE EDITOR.

Voltage-Wave Distortion and Life of Incandescent Lamps.

To the Editor of Electrical World:

Sir:—With apologies for occupying so much of your space and for taxing your readers' patience, I must refer once more to the question of voltage-wave distortion and the life of incandescent lamps as expounded by Professor Kinsloe. In his letter in your issue of Jan. 19 Professor Kinsloe says that I have made some statements in my previous letter which are not supported by the best information obtainable bearing on the question under discussion, and also that the purpose of his letter is simply to point out certain conflicting proofs which I have offered.

I have read Professor Kinsloe's letter with great care and have been unable to discover what are the unsupported statements and the conflicting proofs to which he refers. Without attempting to analyze the data which he presents, I am obliged to say that I do not see in what way they are at all relevant to the question under discussion, which, as I take it, is the credibility of the results presented by Professor Kinsloe in his paper. The implication which Professor Kinsloe seems to wish to convey is that I maintain that the wave-form has absolutely no effect on the candle-power or life of incandescent lamps. This is manifestly absurd and contrary to common sense. The elementary physics of the subject indicates that the wave-form must affect both the candle-power and life to a certain degree. For instance, using a sufficiently peaked wave and a sufficiently low frequency, a lamp might be made to burn out during the first half cycle.

My contention is that under the practical conditions of 60-cycle current and carbon lamps all of our previous evidence has gone to indicate that the life of lamps is substantially independent of the wave-form of the alternating current within the limits of variation which are met in commercial practice. Professor Kinsloe will please note that I say substantially, not absolutely. The only data available to show any large decrease in life due to peaked wave are those presented by Professor Kinsloe and, as shown in my previous letter, these data are of very doubtful validity, as indicated clearly by erroneous initial values for candle-power and watts per candle

There are other inconsistencies in the data offered by Professor Kinsloe which I did not take the trouble to go into in my previous letter. For instance, the life curves of the carbon lamps do not show the early life peak in candle-power which is characteristic of good lamps. If the tests are based on the performance of any but good lamps, which behave normally on life test, very little reliance can be placed on them. As a second instance I would cite the performance of the 25-watt tungsten lamps on peaked wave. The data show that these lamps decreased in candle-power from 18 to 16 during 480 hours' life. During this time the watts actually increased from 24.3 to 27.4, or 13 per cent. Now, these results indicate either erroneous measurements or the use of lamps which differ so much from the normal tungsten lamp that they should not be used as the basis for any conclusions whatever. That this extraordinary increase in watts is not attributable to the action of peaked wave on tungsten lamps in general is shown by the fact that the tests of other sizes of tungsten lamps did not show this effect. As a further instance I might call attention to the test of 100-watt tungsten lamps where the performance on both sine and peaked wave is so unusually bad that the conclusions drawn therefrom are untrustworthy. Evidently Professor Kinsloe used for his 100-watt test lamps which blackened very badly. It is clear, therefore, that in certain cases Professor Kinsloe has drawn his conclusions either from erroneous data or from the performance of abnormal lamps such as practical experience in the testing of lamps would lead the experimenter to reject without hesitation. From tests of abnormal examples it is impossible to form an idea of the performance of the normal product.

Professor Kinsloe asks for citations of the records of tests similar to his own. I know of no such. I believe that his tests are unique.

In conclusion, may I once more call attention to the fact that the question is *quantitative* rather than *qualitative?* It is not whether the wave-form has any influence on the life of lamps, but rather what weight sould be given to the results on this subject presented by Professor Kinsloe. His results show, roughly, that the life of carbon lamps suffers by 9 per cent by burning on peaked wave as compared with sine wave and that the life of tungsten lamps suffers 40 per cent under similar conditions.

Such quantities as these are of great commercial importance, and hence it is necessary to see whether they can be corroborated. I have tried to draw from Professor Kinsloe further facts in substantiation of his results, but have failed in the attempt. I have shown that the deterioration values which he presents are not substantiated by conclusions which may legitimately be drawn from known facts. I have shown inconsistencies in his tests which have not been cleared up by him. It would seem reasonable, therefore, not to take these startling results too seriously and to conclude that until he or someone else has some definite and more reliable numerical data to present further discussion will be fruitless.

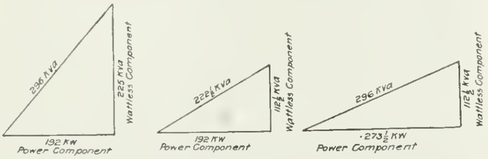
New York. Clayton H. Sharp

Power-Factor and Synchronous Condenser.

To the Editor of Electrical World:

Sir:—Although the article by Mr. L. S. Thurston in your isssue for Nov. 10, 1910, discusses the results of adding synchronous condensers to an alternating-current system without introducing any errors in methods or conclusions, yet the assumptions made by the author do not correspond to conditions encountered in actual installations, and hence incorrect deductions may be made by the uninformed from improperly applying the conclusions derived.

The author has assumed as the basis for his calculations a constant value of total kilovolt-amperes: in any practical case the actual kilowatts would be constant, while the kilovolt-amperes would vary. Consider, for example, a load of 192 kw at a power-factor of 65; the wattless component would be 225 kva and the total apparent power 296 kva. If a synchronous condenser having a rating of 112.5 kva were added, the resultant power-factor would actually be 86.5 per cent, although the table given by Mr. Thurston would indicate that the power-factor should be 92.5 per cent. The latter value would be obtained if the total apparent power remained at 296 kva. which, however, would involve an increase in the real power from 192 kw to 273.5 kw.



Figs. 1, 2 and 3—Variation of Phase Relations with Change in Power and Wattless Components.

The foregoing is not offered as a criticism of Mr. Thurston's contribution, but is intended merely to call attention to the true meaning of the table and thus prevent the possibility of error through its misuse.

San Francisco, Cal. R. H. Fenkhausen.

Regenerative Electric Traction.

To the Editor of Electrical World:

Sir:—Referring to the various articles concerning regenerative control on direct-current railways appearing in your issues dated Dec. 15 and Dec. 29, 1910, and Jan. 19, 1911, I beg leave to submit some data and conclusions which I have evolved from a long study of this interesting problem.

Like a great many problems worth solving, the regenerative problem has presented innumerable difficulties. These difficulties appeared serious enough ten years ago to chill the enthusiasm of even the most sanguine of practical railway managers

The most stubborn obstacles to the solution of the problem may be enumerated briefly as follows:

(1) The lack of space available in a standard truck for a regenerative motor of the requisite capacity. (2) The minimized torque characterizing an adjustable-speed motor. (3) The difficulty of securing perfect commutation in an adjustable-speed motor working under the conditions of weak field strength and strong armature current. (4) The difficulty of designing an adjustable-speed motor which would be sufficiently rugged electrically to withstand the abuse to which railway apparatus is necessarily subjected; in this connection it should be pointed out that the fine wire windings required for either shunt-wound or compound-wound field coils presented perhaps the most serious of all the difficulties. (5) The difficulty of obtaining smooth acceleration and retardation, particularly during the series-parallel changes with motors having decided shunt-motor characteristics. (6) The extra cost of motors with adjustable field strength and the great expenditure of power required to obtain the maximum field strength.

Several minor difficulties might be enumerated, but as these were mostly incidental to the earliest pioneering work in the regenerative field I will not tire your readers with them. It is my intention simply to demonstrate to the electrical fraternity that all of the above-mentioned difficulties have finally and completely disappeared. Regenerative traction motors may now be built to surpass in both electrical and mechanical ruggedness, in horse-power output per pound weight, in commutation and in efficiency any plain series motor at present in public use. In fact, I unhesitatingly claim that the regenerative motor herein described is as far the superior of the present traction motors as they in turn are of the motors which Mr. Frank J. Sprague was obliged to employ in his pioneering work at Richmond, Va.

In order to describe clearly the new regenerative traction motor the following diagrams are presented: Circuit diagram of Fig. 1, the space vector diagrams of Figs. 2, 3 and 4, as well as certain technical data pertaining to a 50-hp, 550-volt regenerative traction motor.

Referring to Fig. 1, the two heavy circles represent, respectively, a distributed field winding and a distributed armature winding of a traction motor *M*, both windings being of the same type—that is, drum windings embedded in the iron. The diagram illustrates a two-pole arrangement, but the actual motor, for reasons hereinafter given, should preferably be of six-pole construction. The windings are so proportioned that the amp-turns per pole in the field winding somewhat exceed the corresponding armature amp-turns, so that, when these two windings are connected in opposition, the difference between the respective amp-turns will produce a commutation field of the required strength.

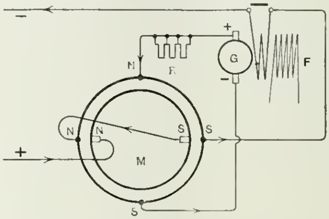


Fig. 1—Two-Pole Circuit Diagram of Regenerative Motor.

It will be noticed that the field winding is furnished with four leads; two of these are used as a line current inlet for the purpose of producing a compensating field in opposition to the armature field. The other two leads, located at 90 electrical space degrees from the first-mentioned leads, are connected to an independent source of current supply—preferably a small low-voltage motor-generator, the sole duty of which is to furnish the excitation current for the main motor.

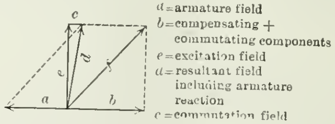
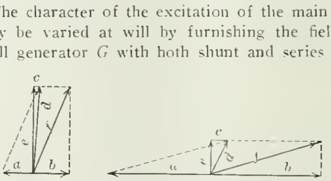

c
e
d
f
a
b
a = armature field
b = compensating + commutating components
e = excitation field
d = resultant field including armature reaction
c = commutation field

Fig. 2—Space Vector Diagram of M.m.fs. at Full-Load.

The single distributed field winding is caused to act simultaneously as a winding for excitation capable of regulation, a winding for compensation and a winding for commutation. Obviously this arrangement is exceedingly flexible, simple and reliable. The character of the excitation of the main motor *M* may readily be varied at will by furnishing the field magnet of the small generator *G* with both shunt and series windings, as shown in the diagram. That is to say, the main motor *M* may be caused to operate with the characteristic of either a shunt-wound motor, a compound-wound motor or a series motor. Moreover, the strength of the excitation field may be varied without changing its character by means of regulating resistances in the excitation circuit, as shown in the diagram.



Figs. 3 and 4—Space Vector Diagrams of M.m.fs. at Half-Load and at Over-Load.

The space vector diagrams of Figs. 2, 3 and 4 illustrate clearly the relative values of the different m.m.f. and the manner in which they vary according to the load and the changes in the excitation. Fig. 2 shows the conditions resulting from full-field excitation and normal full-load armature current. Fig. 3 illustrates full excitation and half-load. Fig. 4 shows reduced field excitation in conection with a 50 per cent overload.

Some skeptical readers may well say: "This scheme looks good and sounds plausible, but how does it work out in a real machine?" For the benefit of such "doubting Thomases" I take pleasure in submitting all of the essential data for a sample machine, thus enabling any competent expert to refigure and to criticise. Fortunately, the problem relates to direct-current apparatus, which, not being subject to the "guesswork" and the numerous "surprises" which still cling to the single-phase motors, may be calculated with absolute accuracy.

In the following are given the electrical data for a six-pole, 50-hp, 550-volt regenerative traction motor having a distributed field winding arranged according to Fig. 1: Speed = 600 r.p.m. with full field excitation: *Armature.* Core: Outside diameter = 16.5 in x 8 in. long. No vents. Inside diameter of core = 10.25 in.; 46 slots, semi-closed, 0.52 in. x 1.25 in. (0.25-in. opening).

Four coils per slot, two turns per coil, 184 coils series connected: 1-62-123-184, etc. Conductor = 3 strands of 0.072-in. square wire, all double-cotton-covered together. Area = 19,800 circ. mils. Space factor = 0.384. Resistance of armature winding = 0.166 ohm at 60 deg. C. Weight of armature copper = 66.0 lb.

Commutator: 13 in. diameter x 3 in. useful face, 184 bars, two brush-holders placed 180 mechanical degrees apart. Two brushes per holder = 0.75 in. x 1.5 in. (x 2.25 in.). Resistance of + and — brushes = 0.028 ohm.

Field Core and Coils: Outside diameter = 23 in. x 8 in. long. Inside diameter = 16.66 in., 62 slots, semi-closed, 0.52 in. x 1.5 in. (0.1875-in. opening). Seven coils per slot, one turn per coil (strip winding). Four hundred and thirty-four coils series connected: 1-146-291-2, etc. Conductor = 0.05 in. x 9/16 in. = 35,600 cir. mils. Space factor = 0.505. Resistance of field winding = 0.124 ohm at 60 deg. C. Weight of field copper = 160.0 lb.

Assuming that about two coils are effectively short-circuited by the brushes the armature amp-turns per pole at a 76-amp load equal 2300 and the corresponding field amp-turns, 2750.

The amp-turns available for the commutation field are, therefore = 450. The full (maximum) field flux (2.5 mega-lines per pole) is obtained with an excitation of 3070 amp-turns per pole from a distributed winding, which in turn calls for a maximum output of the small motor-generator of 85 amp at about 11 volts, or 935 watts.

The efficiency at half load and 600 r.p.m. is 85.5 per cent; the efficiency at full load and 600 r.p.m. is 89.7 per cent; the efficiency at 50 per cent overload and 600 r.p.m. is 89.5 per cent. Net weight of armature-core punchings = 219 lb.; net weight of field-core punchings = 323 lb.; total weight of motor about 1400 lb.

GENERAL REMARKS

The six-pole construction is preferable to the four-pole because the end connections (the heads) of the distributed windings are very much shorter and the windings more substantial. It is really difficult to conceive of a more perfect form of field winding than the "one-turn strip winding" described above. As the difference of potential between the turns is only a fraction of a volt the insulation problem becomes exceedingly simple and the space-factor excellent. The entire laminated field structure is contained in a cast-steel frame, which not only secures absolute rigidity, but adds somewhat to the useful cross-section of the yoke, while not increasing the height or the width of the motor. On account of the large internal diameter of the armature core the main bearing may be made extra long without in any way increasing the over-all dimensions of the motor.

There exists, therefore, no longer any obstacle to the introduction of a motor which will be ample for regenerative service within the limited space available.

In your issue of Jan. 19 Mr. J. G. V. Lang has referred to the tests of a regenerative equipment at Newcastle-on-Tyne in the year 1902, and it may be of interest to point out a few striking comparisons between the adjustable-speed motor then used and the one now described. The Newcastle motor had a 35-hp rating as against 50 hp of the new motor, the speed being the same. The weight of the field copper in the old motor was 273 lb. as against 160 lb. in the new. The maximum field excitation in the old motor called for an expenditure of 3060 watts as against 935 watts in the new. The total weight of the old motor was about 2000 lb. as against 1400 lb. for the new.

I am not offering any excuse for the pioneering motor, as I believe it was the best adjustable-speed traction motor of its day. However, the art has made great advances, and I think the time has now definitely arrived when railway engineers should wake up to the fact that the regenerative problem has been solved in practical form and the regenerative motor has come to stay.

New York, N. Y. Robert Lundell

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Rotary Converter.—A note on a recent British patent (24,137, Jan. 12, 1911) of Bruce Peebles & Company, Ltd., and P. D. de la Cour. This machine has an armature wound for *n* poles, a 2*n*-pole field and 2*n* brushes arranged in two sets connected to two external circuits. The magnet frame is split into two ring parts, each carrying half the number of poles excited by shunt windings across the two circuits respectively. The brushes are so arranged that the armature m.m.fs. are in the same axes as the corresponding field circuit m.m.fs. and two series compensating windings are provided, one in each circuit. The uses of the machines are as follows: Rotary direct-current converter; double-voltage direct-current generator; double direct-current voltage converter from alternating current; constant-current motor-generator for welding, arc lighting, etc.; generator and transformer for battery or flywheel load equalizing plant.—Lond. *Elec. Eng'ing*, Jan. 19.

Constant-Current Generator.—An English translation in abstract of the recent German paper describing the constant-current generator of Osnos and the Felten and Guilleaume-Lahmeyerwerke for train lighting, searchlight work, etc.—Lond. *Elec. Review*, Jan. 20.

Synchronous and Non-synchronous Reactance.—J. Rezelmann.—Another article of his long serial. In the present instalment the results of tests of an alternator with projecting poles are given.—*La Lumière Elec.*, Jan. 14.

Lamps and Lighting.

Street Lighting.—J. Edgcumbe.—An account of the results of the experimental lighting in Gower Street, in London, one-half of the street being lighted by gas and the other half by electricity. It was specified that the average candle-power of each lamp, as measured at angles of 20 deg. and 50 deg. with the horizontal, should not be less than 300. It was further stipulated that only horizontal reflectors would be permitted. The results are indicated in Fig. 1, which gives the illumination curve with gas lighting, and in Fig. 2, which gives the illumination curve with electric lighting. The full vertical lines show the position of the lamp-posts (18 ft. 3 in. high in the case of the electric lamp and 13 ft. 3 in. in the case of the gas) and the vertical dotted lines indicate the points at which the 50-deg. and 20-deg. rays respectively strike a horizontal surface 3 ft. 3 in. from the ground. The curves represent the illumination on a horizontal surface at this height from the roadway as measured at various points along the center of the street. Both the gas and electric lamps are well above the specified 300 cp, the gas lamps tested averaging something like 475 and the electric lamps 430. In spite, however, of the fact that the electric lamps give, if anything, a lower candle-power than those of the gas the curves show a considerably better distribution in their case. The minima are practically the same (about 0.07 ft.-candle), but the maxima are widely different, that of the electric lamps being about 0.35 ft.-candle and of the gas 0.7 ft.-candle, or just double. This is of special interest in view of the fact that gas lighting is usually credited with producing a more even distribution of illumination than its rival. The cause is that in the first place the electric lamp-posts are 5 ft. higher than those for the gas and are spaced slightly further apart, and, above all, the candle-power at 20 deg. with the horizontal is some 30 per cent greater than that at 50 deg., as against 15 per cent in the case of the gas lamps. The comparative uselessness of the 50-deg. rays is evident from the curves. This indicates a mistake in the specification. Another one is the specification of horizontal reflectors, since with other reflectors the electric curve could doubtless have been still further improved, although the application of such reflectors to gas lamps is a matter of considerable difficulty.—Lond. *Electrician*, Jan. 20.

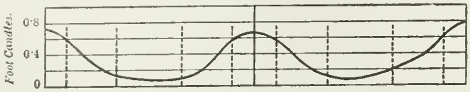


Fig. 1—Illumination Curve with Gas Lighting.

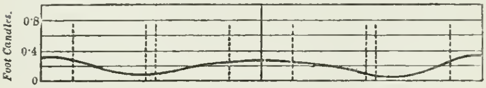


Fig. 2—Illumination Curve with Electric Lighting.

Theater Lighting.—A profusely illustrated description of the electric equipment of the new Palladium Theater in London. Electrical energy is obtained from two public supply companies, in accordance with the rules of the London County Council. A pressure of 110 volts is employed for all the lighting, while motors, electric fans, etc., are connected across the outer conductors of the three-wire system and are supplied at 220 volts. The total number of lamps in the whole building is about 4000 and altogether the lighting and motor service requirements total over 400 hp. The stage equipment comprises a main switchboard, a stage regulator, a dimmer and special effect switchboard, an electric stage lift, and the stage fittings. No "limelights" are used, all effects being provided by powerful electric projectors. All the incandescent lamps are tantalum lamps and tungsten lamps.—Lond. *Electrician*, Jan. 20.

Electric Lighting for Loading Railway Cars.—Lasser.—An illustrated description of portable electric lamps and wiring equipment for the loading of railway cars.—*Elek. Zeit.*, Jan. 19.

Generation, Transmission and Distribution.

Cement Mills.—The first part of an illustrated article on electricity in Portland cement mills giving figures on the horsepower required for the different machinery employed in cement manufacture and the best arrangement of the generating plant. —Lond. *Elec. Review*, Jan. 20.

Traction.

Electric Equipment of Tunnel.—A detailed and profusely illustrated description of the electric equipment of the tunnel which has been constructed under the Detroit River to connect the tracks of the Michigan Central Railroad in the United States with those in Canada.—*Elec. Ry. Jour.*, Jan. 14 and 21.

Track Brakes.—R. Naumann.—The conclusion of his article in which tests with electromagnetic track brakes made on the Dresden Street Railways from 1908 to 1910 are described. The action of the track brake depends only slightly on the condition of the rails, in contradistinction to the methods of wheel brakes. The track brake may be considered as the most energetic of all known brakes for street railways. It is especially useful and reliable in emergency cases and is primarily suitable for roads with a considerable grade and for high speed. Some data are given on the phenomena with electric short-circuit brakes, especially when there is a skidding of the wheels.—*Elek. Zeit.*, Jan. 19.

Installations, Systems and Appliances.

Motor Starter.—A note on a recent British patent of F. Broadbent (29,339, Jan. 12, 1911). An automatic starter suitable for push-button control is described. On pressing a starting button a solenoid pulls up the starter arm quickly to the position in which all resistance is in the armature circuit and on reaching this position a tappet switch is closed and the main switch solenoid is energized so that the armature circuit is closed. On releasing the starting button the resistance arm falls slowly against the resistance of a dashpot and the motor speeds up. Although the tappet switch is released the main switch remains closed, as the solenoid is energized by means of a by-pass connection through the main switch contacts. To stop the motor a second button is pushed to break the circuit of the main switch solenoid.—Lond. *Elec. Eng'ing*, Jan. 19.

Storage Batteries in Central Stations.—R. Werkner.—A paper read before the Electrical Society of Vienna on the influence which a storage battery has on the economy of operation of a direct-current or alternating-current central station. The author finds that in purely direct-current stations a battery always increases the economy, while in purely alternating-current networks savings can be accomplished only under special conditions. The author finally discusses combined alternating-current and direct-current substations.—*Elek. Zeit.*, Jan. 12.

Electricity and Agriculture.—H. Osten.—In the conclusion of his article the author gives data on electric plows. Steam plows have found considerable use in Germany, especially during the last ten years. There were in 1909 533 steam plows against 478 in 1908, while there are only twelve electric plows now in use in Germany. Some data are also given on electric driving of other machines used in agriculture.—*Elec. Zeit.* Jan. 19.

General Uses of Electricity.—W. W. Lackie.—A paper read before the Glasgow Section of the (British) Institution of Electrical Engineers giving notes on the use of electricity for ventilation, heating and general motor service in commercial shops. Various tables are given from commercial practice.—Lond. *Electrician*, Jan. 20.

Wires, Wiring and Conduits.

High-Tension Insulators.—A note on a recent British patent (7212, Jan. 12) of the British Thomson-Houston Company, Ltd. (General Electric Company of this country). An insulator for high pressures and to withstand severe mechanical stress consists of a cast-iron bell supporting the high-tension wire and inclosing the head of a porcelain insulator. The insulator has a cavity into which enters the strain bolt. This is provided with a ball-retaining flange and balls of copper or brass, or of steel, with an outer coating of a soft metal, are inserted between this flange and the insulator to distribute the mechanical pressure.—Lond. *Elec. Eng'ing*, Jan. 19.

Calculation of High-Tension Transmission Lines.—W. Deutsch.—The first part of a mathematical paper in which the author, starting from Roessler's graphical method of calculating transmission lines, shows that it is possible to derive the very simple method of calculation of A. Blondel and C. LeRoy. The paper is to be concluded.—*Elek. Zeit.*, Jan. 19.

Electrophysics and Magnetism.

Pinch Phenomenon.—C. Hering.—The author gives the formula for the force which acts to contract the cross-section of a conductor, due to the current, in different kinds of units. It is simplest in the c.g.s. system, where the pressure in dynes per square centimeter equals directly the square of the current in c.g.s. units divided by the section in square centimeters. With other units there are coefficients of proportionality, the numerical values of which are given.—*Met. and Chem. Eng'ing,* February.

Electrochemistry and Batteries.

Adhesion of Electroplated Silver.—A. McWilliam and W. R. Barclay.—An illustrated paper read before the Institute of Metals on the adhesion of electro-deposited silver in relation to the nature of the German silver basis metal. The investigation was caused by the fact that silver-plated spoons and other tableware begin to peel after a certain time. The investigations clearly indicate considerable differences in the adhesion of deposited silver to various grades of German silver alloys, even when all are treated under the same conditions of practice, and the authors are of opinion that this fact should have full consideration in choosing a basis metal for articles which are to receive the thickest silver deposits given and also to be required to bear rough usage. They consider that ordinary commercial alloys of copper, zinc and nickel containing more than 14 per cent of nickel are of doubtful utility in this respect. On the other hand, alloys containing 12 per cent, 10 per cent and 8 per cent of nickel, 57 per cent of copper and the rest zinc were found to endure exceptionally rough usage without giving any cause of complaint on the ground of the silver stripping.—*Met. and Chem. Eng'ing,* February.

Fixation of Atmospheric Nitrogen.—E. Lamy and M. R. Lamb.—A very full discussion of the different processes of industrial fixation of atmospheric nitrogen in the form of cyanamide or nitric acid and nitrates. The new French plant using the Pauling process is described in some detail.—*Met. and Chem. Eng'ing,* February.

Nitric Acid and Nitrates from Air.—J. Zenneck.—A translation in abstract of his recent German paper giving a review of the different processes for the fixation of atmospheric nitrogen by electrical discharges through air, with special reference to the electrical engineering features of the plant of the Badische Company.—*Met. and Chem. Eng'ing,* February.

Aluminum.—A detailed account of the presentation of the Perkin Medal to C. M. Hall; a great many details on the invention of aluminum are given in speeches of C. F. McKenna, C. F. Chandler, C. M. Hall and P. Héroult.—*Met. and Chem. Eng'ing,* February.

Units, Measurements and Instruments.

Definition of Kilogram.—E. Budde.—A discussion of the question whether the kilogram should be a unit of force (weight) or of mass. The author advocates the general use of the system of Gauss, and in order to overcome any difficulties he recommends the term kilobar for the product of 1 kg mass with the mean acceleration of gravity.—*Elek. Zeit.,* Jan. 19.

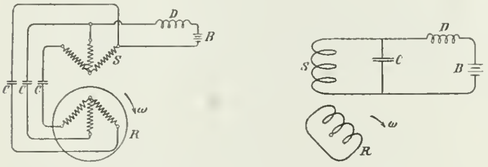
Measuring the Current in a Line During Operation.—G. Dietze.—An illustrated description of various applications of a device (called the "anleger") by means of which it is possible to measure alternating current in a conductor. The device is similar in form to tongs, so as to embrace the conductor in which the current is to be measured. The transformer principle is made use of. Some arrangements to prevent danger are described and some details are given of the following applications: With three-phase generators ammeters are often not inserted in all three conductors. It may then happen that the conductors without ammeters are overloaded. In such cases the device is very useful. It may further be employed to advantage in regulating alternating-current arc lamps, in the location of a burnt-out cable, for a quick control of the fuses after a heavy short-circuit, etc.—*Elek. Zeit.,* Jan. 12.

Exhibition of Apparatus.—A continuation of the illustrated description of the recent exposition of apparatus of the London Physical Society. It includes a Drysdale-Tinsley vibration galvanometer with a fixed coil and moving magnet, the Drysdale alternating-current potentiometer with vector diagrams constructed from readings with this potentiometer, the Drysdale non-inductive low-resistance shunt, the Wilson spark-coil apparatus for high-frequency work, recent improvements by Paul on precision resistances and the Drysdale standard-resistance coils. In the latter the wire is of a special alloy plated with nickel and is mounted on porcelain pillars, while the temperature coefficient is only one or two millionths of an ohm per degree Centigrade. Further descriptions are given of the unipivot dynamometer for measuring small alternating currents and a high-frequency milliammeter consisting of a sensitive unipivot millivoltmeter and finally of the Foster fixed-focus radiation pyrometer.—Lond. *Electrician,* Jan. 20.

Telegraphy, Telephony and Signals.

Submarine Telephone Cable.—An account of a continuation of the extended discussion of O'Meara's recent paper on submarine cables for long-distance telephone circuits. F. Gill gave details of the experience of the National Telephone Company with the Pupin system. On account of the post office owning the long lines in England the National Telephone Company's loading practice was confined to short lines. The work was begun in 1906 and it has now loaded or is loading over 2500 miles of circuit. In one example of a very short length the line was three and one-half miles long, made up of 20-lb. cable, and by the insertion of two coils the equated length was reduced from 3.5 to 1.9, an improvement of 1.84. This change was made to effect a desired result, but was not necessarily the best that could be done. By putting in one coil on a short length an improvement of, say, 1.2 to 2 can be obtained, according to circumstances. D. Sinclair, of the British Insulated & Helsby Cables Company, stated that his company had made a continuously loaded cable, according to Sir John Gavey's specification, by which a 102 per cent improvement was attained and tests on short lengths had showed that even better could be done. The company is now making another length of cable where the improvement will be considerably over 100 per cent. No doubt there is a wide field for the use of continuously loaded cables, since they can be handled in the same way as ordinary cables, the only difference being that in order to keep the electrostatic capacity down to the standard the cable is necessarily larger in diameter. As regards the cost, 100 per cent speaking improvement was obtained with, roughly, an addition of 50 per cent to the cost of the cable itself. This improvement was obtained with proportions of 100 per cent copper and 50 per cent iron by weight. He was not prepared to say at the moment whether these proportions were the best, but this point is being experimented upon and probably a less proportion of iron will be found to be better. The annealing of the iron was an extremely important factor. F. Tremain, of the post office, gave data on loaded and plain cables without leakage. He emphasized that it is rather alarming to find that nearly half the total recorded as the limit of commercial speech is absorbed in exchanges and subscribers' lines, and it led one to doubt the wisdom of placing the long-distance service at the disposal of all local subscribers. W. W. Cook stated that the successful loading of submarine cables is bound to have an important bearing on communication between England and Ireland. A. Campbell gave some results of tests on a variety of experimental samples of telephone cables which had been carried out at the National Physical Laboratory The condition of iron is of great importance for its magnetic properties. Samples of thin iron strip were wound into rings, which were tested magnetically by the ballistic method, going down to very small values of H, so as to obtain values of the permeability corresponding to those occurring in actual telephone cables. In one case the annealing raised the working permeability from 125 to 235. It was found that if the strip is only annealed before being wound on the benefit of the annealing is almost annulled by the mechanical treatment (bending, etc.) during winding, but this is by no means an insuperable difficulty in manufacture. In this connection he has sometimes recommended the trial of silicon-iron or other alloys which have large initial permeability and high resistivity, since every reduction of energy loss seemed likely to improve the conditions. The discussion is to be still further continued. —Lond. *Electrician*, Jan. 20.

Generators of Electric Oscillations for Wireless Telegraphy. —R. Goldschmidt.—In order to produce oscillations of high frequency and considerable power the author recommends the use of generators instead of sparks and arcs. The principle is shown in Fig. 3 in which *S* is the stator and *R* the rotor of a machine which is built like a three-phase induction motor. The slip-rings of the rotor are electrically connected with the terminals of the stator. The battery *B* supplies direct current and is protected against alternating currents by means of the choking coil *D*. Stator and rotor are separated by means of condensers *C*, which permit the passage of alternating currents only. The direct current passes, therefore, through the stator only. If now the rotor is revolved with a certain angular speed ω, currents of the frequency *f*, corresponding to the speed of rotation, are produced in *R*. These currents pass over *C* into the stator winding and generate in it a rotating field which rotates with the speed ω in space. The connection between *R* and *S* is such that this field rotates backward, so that its angular speed relatively to the rotor is 2ω. In *R* currents are thereby produced of the frequency of $2f$, which pass again into the stator and produce currents of the frequency $3f$ and so on. This is, however, not the form of machine used in practice. The latter is represented by Fig. 4 The rotor and stator are provided with single-phase windings. The rotor *R* is short-circuited in itself. In the stator *S* a short-circuit for alternating currents is provided by the large condenser *C*. If *S* is excited by direct current from the battery *B*, currents of the frequency *f* are produced in *R*. Consider *R* as the primary and imagine the alternating field produced by the rotor current to be resolved into two flux components rotating in opposite directions with the speed ω relatively to the motor. One of these component fluxes is stationary in space and forms the rotor reaction acting upon the stator field produced by direct current. The second component rotates in space with the speed ω and produces in the stator currents of the frequency $2f$. These currents are again resolved into a reaction component and an action component. The latter produces in *R* currents of the frequency $3f$, and so on. The difference between the two arrangements is that in Fig. 4 the currents are transmitted between rotor and stator by induction and in Fig. 3 by conduction. In the arrangement of Fig. 4 the rotor and stator alternately become the primary. It would seem at first glance that this process would produce only higher harmonics (that is, relatively smaller overtones) such as are produced in any alternating-current machine. In practice, however, this is not the case if care is taken that the lower frequencies which are not useful pass through real short-circuits and that only the frequency to be used is supplied to the antenna. If this is done the machine is a very efficient transformer from low frequencies to higher ones.—*Elek. Zeit.*, Jan. 19.



Figs. 3 and 4—Oscillators for Wireless Telegraphy.

Syntony of a Quenched Spark.—R. C. Galletti.—The author describes experiments on the syntony obtained with sparks from high-pressure continuous currents and considers the theory of the subject. The experiments were carried out at Lyons on the Moutiers-Lyons line, transmitting energy on the Thury system at a pressure up to 127,000 volts. The pressure used in the experiments was 34,000 volts.—Lond. *Electrician*, Jan. 20.

Wireless Telegraphy.—H. Poincaré.—A continuation of his highly theoretical paper. The author discusses in two different cases the problem of predetermining the wave length and the damping coefficient of an exciter of given form.—*La Lumière Elec.*, Jan. 14.

Wireless Telegraphy.—Grunicke.—The author discusses the difficulties in receiving messages transmitted by wireless telegraphy. These difficulties depend firstly on the condition of the ear of the receiving attendant; secondly, on disturbing external influences, and thirdly, on the disposition of the receiving attendant.—*Elek. Zeit.*, Jan. 19.

Miscellaneous.

Magnetic Separation.—H. C. Parmelee.—In a continuation of his serial on zinc-ore dressing in Colorado the author deals with the plant of the Wilson Mining Company and describes the Fairchild magnetic separator applied on that plant to complex sulphide ores.—*Met. and Chem Eng'ing*, February

Book Reviews.

The Steam Engine. By Charles H. Benjamin, M.E., Dr. Eng. Brattleboro, Vt.: The Technical Press. 332 pages, 194 illus. Price, $3.

This little volume is intended primarily as a textbook in institutions that do not go very deeply into the practice or theory of steam-engine design. The treatment is elementary throughout and stops abruptly with the present state of American steam-engine practice, which, in some respects, is about five years behind that of Europe. It is a pity that, in a textbook intended for the young American engineer and bearing the date of 1909, at least an outline of present-day European practice should not be given; but the author has not seen fit to take his readers any further than the American high-speed engine using at best very mild degrees of superheated steam. We learn that "the efficiency of superheated steam is slightly greater than that of the saturated steam from which it is derived"—and this at a time when the Germans and French are realizing 9 lb. of steam per hour per horse-power, while the best that we can do with the same engine using saturated steam is 35 lb. Not a word is said about the modern lift-valve or ventil type of large stationary steam engine, universal throughout Europe, nor anything of the locomobiles which have during the past six years revolutionized the isolated-plant situation. The best results the author gives us consist of tests dating in 1903 and 1904 by Professors Ewing and Jacobus, which are in no way remarkable in the light of present everyday European practice. It would be a pity if the younger generation were to run along in the same old rut that served the purpose five years ago. This will now give way before more advanced steam practice—provided that our young men are going to be taught in school the things which are already standard practice abroad and have been so since 1906. As to the rest of the book, there is the usual discussion of the Meyers and other valve gears, a chapter on condensers, which is rather short to be of much practical value; fairly complete chapters on governors and flywheels, and a fair chapter on the compound engine, though one is apt to take exception to such statements as: "When the load varies considerably it is difficult to regulate the compound engine so as to maintain good efficiency." The book as a whole is useful for students of technical institutions and high schools, but hardly adapted for senior classes in universities. It covers the field of the steam engine about as deeply as the average student can be induced to follow, and its contents are readably and logically set forth, so that it should find a ready use as an elementary treatise on the steam engine.

The Design and Construction of Internal Combustion Engines. By Hugo Guldner. New York: D. Van Nostrand Company. 692 pages, 728 illus. Price, $10.

The prominence that the large gas engine has acquired during the past decade, both as a motive power for air blowing and as a prime mover in the generation of electricity, has led one to expect, sooner or later, a real gas-engine designer's handbook—something different from the scientific treatise on the gas engine or the technical-school manual on the same subject. As the Germans have always taken the lead in the manufacture of large gas engines it is natural that this book should be from the pen of a German. Dr Hugo Guldner, well known for his practical work in the gas-engine field, and for many years director and chief engineer of the Gas-Motoren Fabrik at Aschaffenburg, is the author of the new volume on the practical design of internal combustion engines.

While the author styles it a "handbook," considerable latitude must be given to this designation, as the volume weighs over 5 lb. But full as it is, with 672 large pages of practical data on gas-engine design, the book contains far more information than even its size would indicate, as there are forty or fifty inserted working drawings of various standard makes of German, Belgian and American engines which give hosts of details impossible to put into print. All the illustrations in the book are got up in the thorough German method, giving dimensions to all sectional drawings, so that each drawing is not only a practical illustration but is also an example of something already in service and from which minor details can be designed with some assurance that they have already been tried out and found good. Another characteristically German feature of the book is in giving an example in practical figures worked out after each subject or formula treated in the text. Anyone who has ever used book formulas, especially foreign formulas where many of the common constants are as apt to be in liters or in centimeters per second as in English units, will appreciate having at least one example using the formula worked out before him to serve as a guide

The English translation of Dr. Guldner's work was undertaken by Professor Diederichs, of Cornell It differs from the original only in omitting some of the historical part and introducing considerable American practice not included in the original German edition. The book begins with a short theoretical discussion of the various cycles of operation, handling the theme with an eye principally to the needs of the practical designer. It then devotes some 250 pages to formulas for the design of the various parts of the gas engine, with copious illustrations, all working drawings from actual practice The various materials used and stresses encountered in all moving parts, engine bed, frame shafts, journals, etc., are gone into and a thorough treatment given of the casting problems for large cylinders and jackets. Another 100 pages of the book treats of gas-engine auxiliaries, such as the various producers, the air and water systems, oiling, etc., and then there follow 400 pages devoted to all modern types of stationary gas engines of all standard makes. These have not only the text illustrations, but all important engines are represented by complete dimensioned working drawings of one example of each in the form of a folded insertion. The last two chapters of the book are devoted to fuels and a discussion of the phenomena of combustion in a gas engine, the two subjects taking about sixty pages. The appendix is quite a book in itself, occupying 160 pages of small type It is divided into two sections, the first treating more exhaustively of the theory of the gas engine than was possible in the main text, and the second giving a quantity of details from practice covering exhaust and water-piping sizes, oil systems, governor and spark adjustments, etc. Taking it in all, the book will be of much value to those going into gas-engine design as professional work and of great use as a reference work to all interested in the gas engine.

Der Lichtbogen als Wechselstromerzeuger. By Willy Wagner. Leipzig: S Hirzel. 119 pages, 44 illus. Price, 4.50 marks.

A systematic treatise on the voltaic arc as a means of producing alternating currents. Advanced mathematics are freely used. The method of arc characteristic curves is largely employed. The ionic theory of the arc lamp is developed to some extent by way of explaining the phenomena. The various types of arc lamps used for this purpose are defined and the Simon mathematical theory of the principal effects is developed. A number of researches recently made in this field of physical investigation are briefly discussed. The book will be valued by advanced physics students desirous of utilizing the arc as a source of alternating currents, as in high-frequency electric measurements or in wireless telephony

New Apparatus and Appliances

NATIONAL CARBON SALESMEN'S CONVENTION AT CLEVELAND.

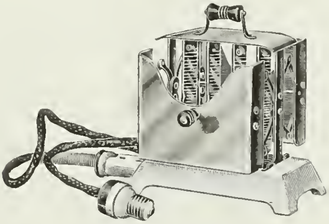
The recent fifth annual salesmen's convention at Cleveland of the National Carbon Company was the most interesting and instructive annual meeting thus far held. Each day practical demonstrations and tests were made with various types of lamps to show the kind of service that various carbons would give in these different lamps. The carbon that received particular attention during these demonstrations was the yellow flaming carbon, known as "Silvertip," which was burned in practically every known type of lamp under a wide variety of service conditions. During the discussions that followed the demonstrations the salesmen from various parts of the United States told of the satisfaction this carbon is giving in the field. They find that the silver tip does away with the loose end of the core wire and makes a firm electrical contact in the holder. There are no broken wires, therefore no lost carbons. Trimmers' time is saved and operating expenses are reduced. The salesmen were enthusiastic in their prediction about the ultimate universal use of this carbon in flaming lamps.

LARGE SERIES TUNGSTEN STREET-LIGHTING LAMPS.

Member companies of the National Electric Lamp Association have just placed upon the market a new 410-watt series tungsten street-lighting lamp designed especially to replace the older form of alternating-current inclosed-arc lamp, which, with slightly less watts consumption, it exceeds in candle-power by about 50 per cent The new lamp has a bulb [illegible] in. in diameter, and, being built in 4-amp, 5.5-amp and [illegible]-amp types, now makes available a complete line of series lamps ranging from 25 watts to 410 watts from which to select units for use on street-lighting circuits in which the illumination requirements at different points vary widely In the lower hemisphere the new large series lamp gives 420 cp. while its distribution in a horizontal direction is equal to 350 cp Like all series lamps for this class of service this lamp is operated at a specific consumption of 1.125 watts per candle-power The new 410-watt tungsten unit thus provides a more efficient and more powerful incandescent-lamp substitute for the old inclosed-arc lamp

ELECTRIC TOASTER.

The electric toaster made by the Manhattan Electrical Supply Company, of New York and Chicago, and illustrated herewith has adjustable doors for holding the bread to be toasted so that when the latter is placed close to the heating units a crisp toast is quickly obtained, whereas if the doors holding the bread be withdrawn to the proper distance a hard brown toast results. When the doors are withdrawn to their full distance the toast remains hot, but will not burn. It is thus apparent that the heat is regulated mechanically—that is, the toast is placed close to or far away from the heating element according to the degree of heat required. The base of the toaster is of porcelain and the metal parts of polished nickeled brass. The device is built for standard lighting circuits.


Electric Toaster

* * *

ENGINE-TYPE ALTERNATORS.

A line of low-speed, 60-cycle engine-type alternators embodying a number of new features of design has been recently placed on the market by the Westinghouse Electric & Manufacturing Company. The line covers machines ranging in size from 50 kva to 1100 kva, two-phase or three-phase, and standard voltages of 240 volts, 480 volts, 600 volts, 1200 volts and 2400 volts. A striking characteristic of the entire line is the ability of the generators to carry successfully commercial loads of low power-factor. The stator frames are of such design as to give great rigidity and plenty of freedom for the end connections of the armature winding. At the same time the construction is economical of material and affords excellent ventilation. The frame consists of a one-piece casting, except in sizes of such diameter that a split frame is a necessity for shipping reasons. In such cases the halves are bolted firmly together, making practically a solid frame. The frames of the smaller sizes are provided with slide rails on which the frame can be shifted to expose the rotor. The armature core is built up of laminations of japanned steel of good magnetic characteristics. The laminations are dovetailed in recesses in the frame. They are assembled under pressure and securely held by finger plates and end plates. Generous ventilating ducts are provided in the core to maintain uniform low temperature. The teeth are firmly supported at each end of the core by finger plates Repairs to the armature winding are very easily made because of the design of the winding. The armature slots are open and the coils are held in place by wedges. The coils are entirely interchangeable and are completely formed and insulated before being assembled in the core.

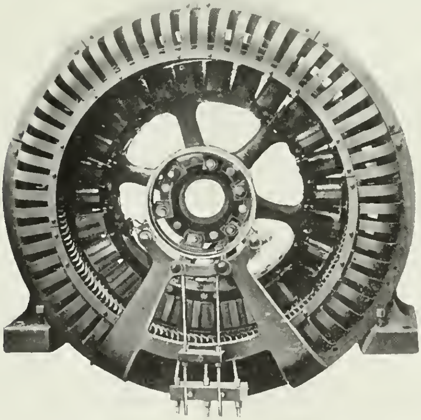


Fig. 1—Collector End of Generator.

The end bells provided for the protection of the armature winding and attached to the end of the frame are of segments built up into circular form and so bolted together that they are light and open, yet rigid and indestructible. The brush-holder brackets, except in the larger sizes, are bolted to the armature frame, which makes each generator complete in itself. On the larger sizes, however, the brush holders are mounted on a pedestal which is to be bolted to the engine bedplate. At least two brushes are provided for each collector ring, which makes it possible to adjust any brush without opening the field circuit.

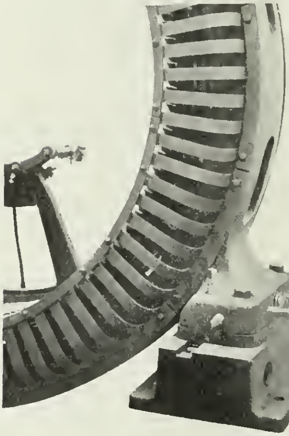


Fig. 2—Adjustable Shoe and Slide Rail.

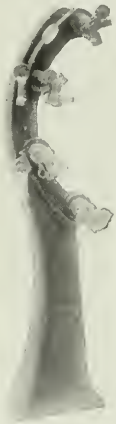


Fig. 3—Brush-Holder Bracket Stand.

The rotor is composed of a casting with laminated polepieces bolted on. The proportions of the casting are worked out with special reference to cooling strains, and the material used provides a homogeneous magnetic circuit. Edgewise-wound strap is used for the field coils of the generators. The field poles are so designed that a cage damper winding may be used when desired. Such a winding consists of a series of copper bars embedded in the pole-faces, with the ends short-circuited like the squirrel-cage winding of an induction motor The winding serves as an effective damper to any fluctuation and thus tends to prevent hunting. The cage-damper winding is not essential to satisfactory operation, however, when modern steam engines are used as the prime mover. Where internal-combustion engines are used the cage-damper winding is advisable. The collectors are of the spider type, consisting of two machined cast-iron rings mounted on a cast-iron bushing or hub, from which they are carefully insulated. The hub is bolted to the rotor spider casting, so that the alignment is entirely independent of shaft adjustments. Ample factor of safety is allowed throughout the mechanical design and the electrical design is such that overloads and low power-factors do not interfere with a service that is satisfactory in every respect.

AUTOMATIC STARTING PANELS FOR MINE DUTY.

Several interesting automatic control features are involved in certain special direct-current motor starters intended for governing motor-driven mine pumps and mine-ventilating fans which are subjected to severe voltage conditions, besides the characteristic dirt and moisture of underground operation.

The line pressure in the average mine system may vary between wide limits or may be "off" altogether for short periods, due to the severe character of the hoisting and haulage loads on the generating equipment. In spite of these interruptions it is necessary that continuous operation be secured for the pumping and ventilating machinery, or at least that this apparatus be automatically restarted and protected during each interruption and resumption of service. In many instances the working of the mine and the lives of the miners themselves depend upon the continuous operation of the mine pumps and fans.

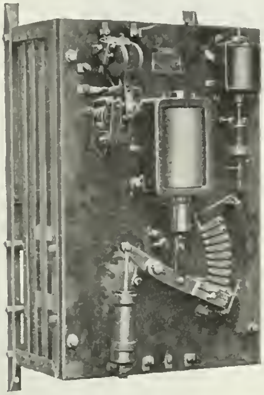


Fig. 1—Solenoid-Operated Sliding-Contact Starter for Motors up to 15-hp.

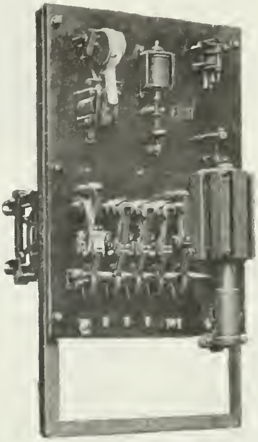


Fig. 2—Solenoid-Operated Cam-Shaft Starter, with Voltage Relay and Overload.

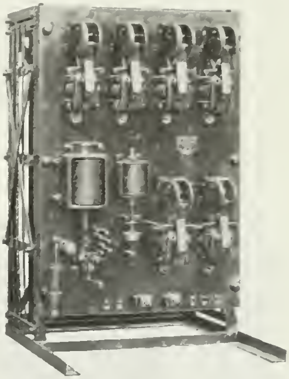


Fig. 3—Pilot-Type Starter with Magnetic-Switch Resistance Contacts for Motors Above 50-hp Rating.

The starters for mine-motor service manufactured by the Cutler-Hammer Company, Milwaukee, are of three types, depending on the size of the motor. For motors up to 15-hp rating a sliding contact-arm is used (see Fig. 1); from 15 to 50-hp, cam-operated contacts, closed successively by a single solenoid, as shown in Fig. 2, are supplied; above 50 hp a separate magnet switch is employed to close each contact step, as in Fig. 3.

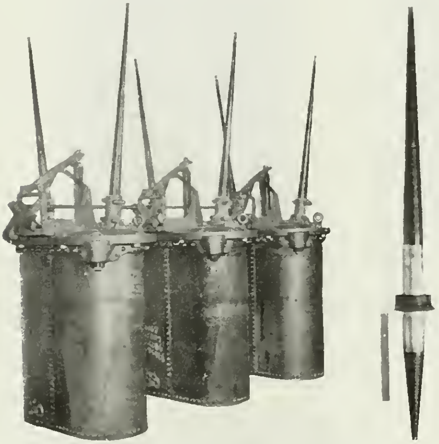
A feature special to all these mine-motor starters however, is the voltage relay which guards against voltage variations that might result injuriously to the motor, causing it to start suddenly without proper acceleration, or to flash over. If the line pressure reduces to less than 80 per cent of normal, this relay opens, breaking the circuit of the accelerating solenoid, and allowing all of the starting resistance to be reinserted into the circuit. When the line voltage again rises to its normal value the relay picks up and brings the motor to full speed by energizing the starting solenoid, which cuts out the resistance in the usual way. Where a shunt-type motor is used with this type of starter the panel is equiped with a single-coil overload arranged to trip the main switch and cut the motor from the line. When normal conditions are again resumed the overload drops, allowing the main switch to close, and the motor is again accelerated in the usual way. This single-coil overload prevents the tendency of a shunt motor to "flash over" under severe voltage fluctuations. It will be evident that if the line pressure falls to a low value while the motor is running at a good speed the machine may act as a generator and "flash over." In a compound-wound motor the series m.m.f. opposes the shunt m.m.f., resulting in practically neutralizing both fluxes and avoiding "flash-overs."

In the small sliding-contact starter, Fig. 1, the voltage relay is shown at the right, while opposite it is the main switch on the left, and in the center is the solenoid operating the face-plate arm. In the cam-shaft starter, Fig. 2, the voltage relay is in the center, the overload at the right, and the main switch at the left. The large solenoid, opposed by the dashpot, operates the cam shaft closing the contact. In Fig. 3, showing the magnet switch Cutler-Hammer starter, the voltage relay, which is recognizable near the center of the panel, breaks the circuit of the pilot solenoid to its left. It is this solenoid which during starting completes in succession the contacts energizing the successive resistance-step magnet switches.

For mine service these starting panels are covered with moisture-proof compound to guard against short circuits, and after the connections are completed the back of the entire board is sprayed with an insulating paint. Fuses are avoided, and the circuit-breakers do not need to be manually reset. The starting resistance of this apparatus is designed for continuous operation under low-voltage conditions, and is made moisture-proof so as to be unaffected by atmospheric conditions. This apparatus is especially arranged for mine service, but is recommended for any duty where severe fluctuations are encountered, such as on street railway lines, etc.

HIGH-TENSION CONDENSER-TYPE TERMINALS.

A terminal for high-tension apparatus has recently been developed by the Westinghouse Electric & Manufacturing Company, utilizing a principle not used for this purpose before. The terminal is constructed of alternate concentric insulating and conducting layers, forming a series of condensers which serve to make the distribution of potential stresses in the insulating material uniform and thus increase dielectric strength of the terminal. As a result a much smaller terminal can be used for a given voltage with a corresponding saving in cost of the entire piece of apparatus and a gain in dependability under conditions of abnormal stresses due to surges, lightning and similar causes. Any terminal passing through a metal tank forms in effect a curved condenser, the plates of which are the surface of the terminal and the surface of the hole or bushing in the tank. The insulation between the two is the dielectric of a condenser and is subject to all the conditions affecting such a dielectric. It can be shown that the static stresses in the dielectric of a curved condenser are not uniform throughout the thickness, but are greatest near the inner surface. Therefore, the thickness of the insulation must be made such that the inner layers will not be subjected to dangerous stresses, which result in the outer layers being thicker than necessary. Looking at the matter in another way, if the insulation is designed for a certain voltage per inch of thickness there will be danger of breakdown due to the higher stresses near the inner surface. For low voltages the unnecessary thickness of insulation is not important, but for voltages of 70,000 and over the ordinary insulator becomes so large as to necessitate an increase in size of the entire apparatus. By interposing the metal layers the difference in diameters of the plates of each condenser is reduced and the distribution of the potential made more uniform, which results in a saving of unnecessary thickness of insulation. An idea of the saving effected can be had by a comparison of two terminals designed and tested for 200,000 volts. An ordinary bulk-type terminal for this voltage is about 9 ft. in length and 16 in. in diameter, including insulation. A condenser-type terminal for the same voltage is 7 ft. in length and 4 in. in diameter, the volume of the former being eight times the latter. The general appearance of a condenser-type terminal is shown in Fig. 1. It is constructed by winding the successive layers on a central outlet tube.



Figs. 1 and 2—Condenser-Type Terminals.

The insulating layers consist of a special grade of paper wound under pressure and cemented and pressed together into a solid mass without weak spots. On each thickness of insulation is wound a layer of metal foil. The layers are so finished that each is shorter than the one beneath it, thus tapering the terminal and providing a creeping surface between successive conducting layers. The creeping surfaces on the end projecting into the air are naturally larger than those at the end submerged in oil. A heavy metallic flange is fastened to the outside of the terminal to serve as a support for mounting it in the tank. Fig. 2 shows a 60,000-volt oil circuit-breaker equipped with condenser-type terminals. The Westinghouse Electric & Manufacturing Company supplies these terminals with all high-voltage transformers, circuit-breakers, electrostatic voltmeters and similar apparatus.

SECTIONAL CUT-OUT BOXES.

The Columbia Metal Box Company, New York, has brought out a new sectional cut-out box which will enable a jobber or contractor by means of a small assortment of sectional units to assemble a box of almost any size in a short time. One of the many features of the box is the fact that universal cut-out holders which eliminate all drilling for cut-outs and switches are supplied with every body section. The new box also contains knockouts for ½-in. conduit evenly spaced on all sides. It frequently happens that boxes already installed must be enlarged, and while formerly it was necessary to tear out and throw away the old box and substitute a new one of the required size, now where a box such as that shown is used it will be necessary only to remove a few screws and add one or more sections as the work may require. The sectional principle has another advantage. It is often found necessary to use large conduits and the drilling of the holes has been very difficult to accomplish in boxes already made up, as few shops have drills suitable for the work. This required having the boxes made to order, which, of course, added to the cost and delayed the work. With the box shown it is only necessary to take a section to the nearest drill press, as the parts will easily slip under the smallest drill made. When assembled by means of a few stove bolts the boxes present a very substantial and neat appearance. The construction is well illustrated by the engravings. The cover extends over the edges of the body of the box ¼ in., allowing the box to be used on the cheaper grade of work requiring flush boxes, as well as for surface work The fact that the covers can be applied at any time permits the installation of the bodies when the rough work is being done, and where wooden doors and trims are required the covers need not be used at all. The sections are stamped and drawn on heavy dies from sheet steel and absolute accuracy and uniformity are thereby assured. The boxes are made in three widths, 9 in., 12 in. and 16 in., which experience has shown to be the most practical sizes. There are a body section, cover section, end section and connecting-strip section and cover-connecting strip. All parts are interchangeable and are packed in

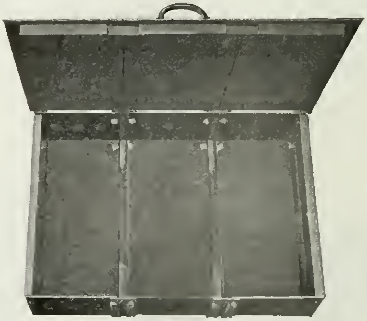


Fig. 1—Sectional Box Assembled.

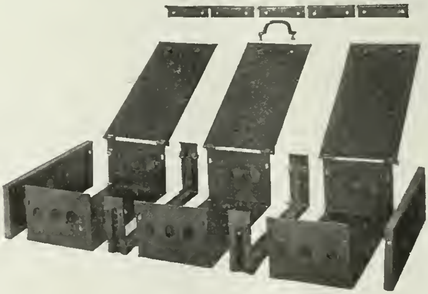


Fig. 2—Parts of Sectional Box.

heavy cardboard cartons, and as a great many sections can be packed in a very small space it enables a jobber or contractor to carry a large assortment of sizes in a minimum space The boxes have been approved by the Underwriters

AUTOMATIC SPEED CONTROLLERS FOR MOTORS.

The illustrations herewith show developments in automatic controlling devices for the regulation of the speed of motors operating vacuum cleaner systems. These devices both perform the same function. One, however, is of the motor-driven type and the other of the solenoid type.

The motor-driven type, shown in Fig. 2, which illustrates one of two 30-hp equipments supplied to the Vacuum Cleaner Company for the Pennsylvania State Capitol at Harrisburg, Pa., has a resistance arm moving over several steps of both field and armature resistance. The arm is pulled one way or the other by the two revolving magnets shown in the center of the panel. These magnets are driven through a worm-gear reduction by a small belt from the motor shaft. There is a retaining magnet which will hold the arm in any position as long as the main line switch is closed and the vacuum is at the desired point. The main line switch, shown in the lower right-hand corner of the panel, is actuated by the pilot switch and relay shown above. The diaphragm-actuated pilot switch is not shown on the panel, but mounted at a distant point, and is used to actuate the relay. In use the resistance arm will seek a point which will provide sufficient speed to maintain a desired vacuum. If there is no use for the vacuum the resistance arm will move to the lowest point and the main line switch will automatically open, stopping the motor. It will remain stopped until the vacuum falls below a predetermined point, when the motor will start again and restore the vacuum and then shut off. In this way the use of the motor will be limited to the least amount necessary and the amount of energy consumed by the motor will be the least amount possible to maintain the vacuum. In Fig. 1 the solenoid type of control is shown. In the center of the panel is the diaphragm-pilot vacuum-regulating switch which is used in connection with the relay shown at the extreme right center of the panel. This relay performs the same functions as the motor-driven type of controller above described. If the vacuum falls below the desired point the pilot switch in connection with the relay and solenoid will pull the resistance arm up against the resistance of a dash-pot until the vacuum is restored to its normal amount, when the relay will de-energize the solenoid and the arm will hold at that point unless the vacuum increases beyond the desired amount, in which case the action of the relay and magnet will cause the arm to fall at a speed regulated by the dash-pot. If the vacuum still continues above the normal amount and the resistance arm reaches its lower position, it will automatically open the main line switch shown at the extreme right of the panel, thus stopping the motor and cutting off completely the waste of current This device was especially constructed for the Connersville Blower Company, Connersville, Ind., for use in the Cuyahoga County Court House, Cuyahoga, Ohio, and included not only the controller, but an amp-meter main line switch, fuses and circuit-breaker. Motors having a speed control by variation in field resistance through a range of about three-fourths of their maximum speed are best suited for use in such equipments. This type of motor is recommended when the highest efficiency is desired. In Fig. 3 is shown a controller similar in many respects to the motor-driven vacuum regulator first above described, but which is used for an entirely different purpose. This device is a motor-driven speed-regulating printing-press controller for use in connection with large motors operating printing presses. There are several stations from which it is possible to start and stop the motor to increase or decrease the speed of the motor and to lock it. Through an ingenious mechanism the locking lever when turned to the right absolutely prevents the starting of the motor from any point. and when thrown to the left places the resistance in series with the armature and a bridge on the armature, so as to provide the very slow speeds necessary in making up the forms. The illustration shows an equipment recently installed in the Passaic *Daily Herald* plant in connection with a large Goss press. In the upper left-hand corner is shown a main line magnet switch with dynamic brake contacts arranged to close when the switch opens, thus causing the motor to act as a generator and quickly

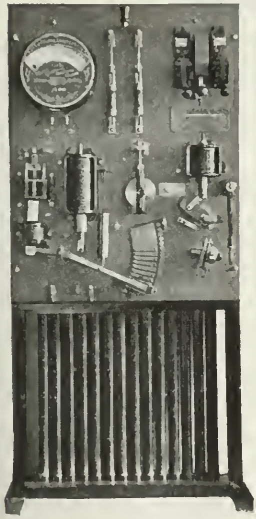


Fig. 1—Motor-Driven Automatic Speed Controller.

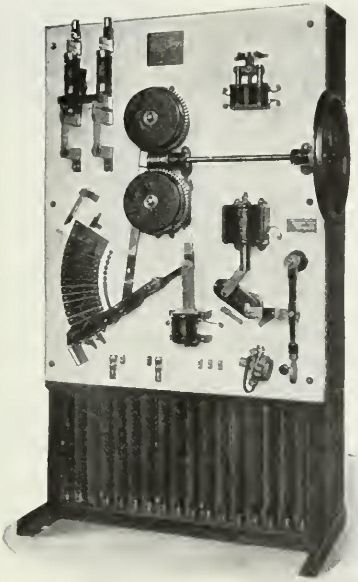


Fig. 2—Solenoid-Type Automatic Speed Controller.

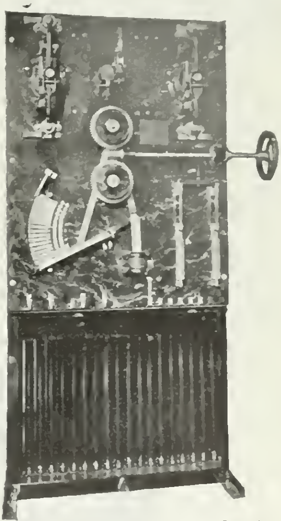


Fig. 3—Motor-Driven Speed-Regulating Printing-Press Controller.

come to a standstill. In the upper right-hand corner of the panel is shown a similar switch, which in its normal position fixes the resistance in series with the armature, but when closed by a magnetically operated means opens this circuit and at the same time operates the bridge on the armature of the motor. The motor-driven resistance arm moves over several steps of armature resistance and a similar number of steps of field resistance, thus providing the necessary range in speed regulation, the resistance being so proportioned that when the press is run at normal speed there is no resistance in any of the circuits. Ability to increase the speed about 18 per cent is provided by the insertion of field resistance. This produces the maximum speed of the press The controlling stations are all wired in multiple and any number may be used. The manufacturer of this controller claims that by reason of the method of movement of the resistance arm there is no injurious arcing to the contacts and that the tubular, sand-packed resistance which is furnished is especially useful in the pressroom of a printing office where the liability of ignition of cleaning fluids is great, inasmuch as this form of resistance completely incloses the conductors, which are subjected at times to high temperatures. The controllers are manufactured by the Automatic Switch Company, New York.

GRAPHIC RECORDING METERS.

A new type of graphic recording meter has been developed by Mr. R. C. Lamphier, of the Sangamo Electric Company, of Springfield, Ill., and Mr. H. W. Young, of Chicago, several different forms of which are manufactured, as follows: Shunt type, two-wire and three-wire direct-current ammeters and wattmeters; series or transformer type, two-wire or three-wire, single-phase wattmeters; series or transformer type, two-phase or three-phase wattmeters for use on three-wire or four-wire, two-phase or three-phase circuits. In each type the record is made on a paper chart ruled with rectangular co-ordinates and driven by clockwork mechanism. The movement of the recording pen across the chart is proportional to the quantity measured and the speed of the record chart as controlled by a driving clock. The switchboard or permanent mounting form is shown in Fig. 1. The measuring element consists of two mercury-floated motor elements so located as to actuate a common indicator to which is attached a recording pen which traces a line or curve on the moving chart. The principle employed is the same in all forms, the only difference being in the type of winding or magnets employed. The retaining case is of metal with open-glass front and sides, thus harmonizing with the other switchboard fittings. In addition to the recording feature each meter is provided with an indicating scale, thus rendering unnecessary the use of indicating ammeters or wattmeters. The various parts are finished in dull black or marine, bringing into strong contrast the indicating scale and record chart. The portable type, illustrated in Fig. 2, is intended for use in the same sense as any of the well-known forms of portable testing meters. Each meter is provided with two measuring elements which may be separately energized or may be connected in series or parallel for use on two-wire direct-current or single-phase alternating. The moving element consists of a simple metal disk rigidly attached to a shaft carrying the recording-pen mounting and control springs. The moving disk is floated in a mercury chamber which not only serves as a conducting medium for the electricity to be measured, but also by the damping action of the disk passing through the mercury renders the meter indications highly aperiodic or dead beat. Surrounding the moving disk is a magnetic field generated by electromagnets in the alternating-current meters and direct-current wattmeters, the latter being operated from shunts. Permanent magnets are employed in the direct-current ammeters. The magnetic field of the fixed elements is in such relative position to the moving system or armature that it cuts or passes through the armature field and tends to rotate the moving system. This rotative movement causes the recording pen to move across the chart against the restraining force of the control springs, which tend to return the pen to zero position. The turning force of the mercury-floated moving elements is thus balanced against the restraining or coercive force of the control springs and their point of balance or equilibrium is a measure of the current flowing in the measuring coils. The recording pen is so constructed and formed as to provide an ink reservoir of sufficient capacity for several days' use. The pen point is composed of a special metal alloy insuring a clear-cut line without blurs or blots. The clock is a standard, accurate timepiece, the function of which is to drive the record paper under the recording pen at a uniform predetermined rate, synchronous with the time markings on the record paper. The eight-day, hand-wound type has been adopted as standard and the driving springs are of such size and strength that the clock mechanism is under a strong uniform force giving a powerful torque and insuring a positive feed to the record paper. The record paper is graduated longitudinally in a set of parallel lines representing the meter calibration, the spacing being uniform with the various capacities, but of different values. At right angles to the calibration lines are parallel lines representing hours, varying in distance from each other with the particular rate of speed for which the record paper is marked. The rectangular co-ordinates allow a record to be easily interpolated, and in wattmeters the record can readily be totalized by means of a planimeter. The driving force of the clock is transmitted to the paper roll through a suitable gear and pinion, and 3 in. per hour has been adopted as the standard

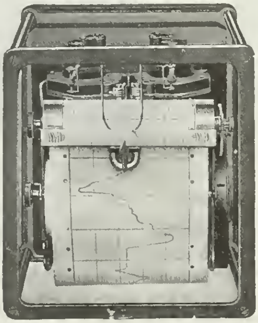


Fig. 1—Graphic Recording Switchboard Meter.

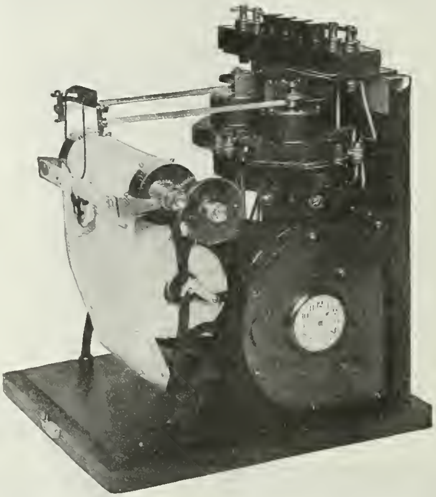


Fig. 2—Portable Type of Graphic Recording Meter.

rate of feed. The use of mercury suspension in a non-spillable chamber has the advantage of enabling meters to be shipped and installed without the necessity of making adjustments, as it is simply necessary to fill the pen and start the driving clock. The absence of bearing or jewel trouble, combined with the simplicity of installation, is another feature of importance. As the meters are of the direct-deflection type the use of relays, control magnets, contacts, etc., with their attendant troubles, is entirely avoided. The area of the moving system is so proportioned to the mercury-chamber area that the recording pen will not overshoot or under-register, insuring an accurate record on rapid load fluctuations.

ELECTRIC ROCK DRILL.

One conspicuous exception to the very general use of electricity has been in the excavation of rock. The combination of the ruggedness of the air or steam drill with the high efficiency, flexibility and economy of electricity has long been sought after, and, despite many failures, a firm conviction that it would some day be realized has been generally held. This much-desired combination is claimed by the manufacturers of the drill shown in the accompanying illustrations.

This drill does not differ materially in its operating characteristics from a reciprocating drill of the compressed-air type. The medium which transmits the energy from the motor to the plunger is air under pressure, so that the mechanism is always protected from shocks received by the plunger. This air is not exhausted into the atmosphere, but is retained to act continuously as a cushion between the piston of the plunger and the motor-driven reciprocating cylinder in which it operates. This cylinder is connected to the motor through gearing and makes about 500 strokes per minute. Flexibly connected to this cylinder through a compressible air cushion at each end is the head of the piston, which, therefore, makes an equal number of strokes per minute. It will be seen, therefore, that, mechanically considered, the equipment differs from the air drill in that the cylinder in which the air acts upon the piston is movable rather than stationary and the compressed air is retained rather than allowed to escape after having performed its work at the end of each stroke.

The mechanical details of the plunger are similar to those of the compressed-air drill The electrical details of the drill correspond accurately to standard practice, no special electrical equipment of any kind being required. A completely inclosed motor of either the series-wound direct-current or induction alternating-current type, rated at 4 hp, drives the reciprocating cylinder mechanism through gearing and crankshaft. The gearing is fully protected, while the crankshaft and connecting-rod are so inclosed that the splash system of lubrication is employed. The speed ratio is 5 to 1, a considerable range in speed is obtained by means of a series-connected rheostat.

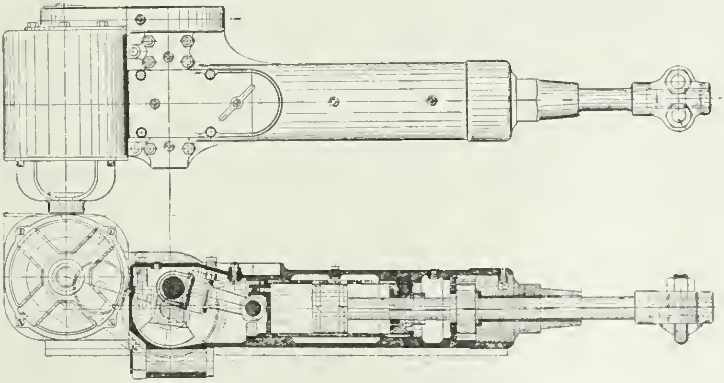


Fig. 1—Side View and Cross-Section of Electrically Operated Rock Drill.

The drill equipment exhibits two important characteristics which differentiate it from compressed-air drills and other electric drills. When the drill steel sticks in the rock the reciprocating mechanism does not come to rest as would be the case with a compressed-air drill, and yet the electric circuits are not overloaded as would be the case with a positively driven plunger. The reciprocating cylinder continues in motion, compressing and rarefying air, thereby delivering cushioned blows to the piston head. By proper adjustment of the reciprocating mechanism relative to the piston the blows can be directed to the under side of the head, thereby releasing the steel without resort to the ordinary hand tools for striking it. The energy expended during compression is largely returned during the expansion, so that the load on the motor is actually less when the drill is stuck than when it moves in the hole

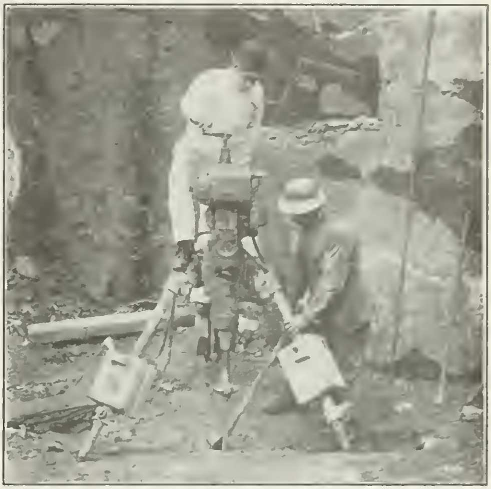


Fig. 2—Electrically Operated Rock Drill.

It is claimed that the 4-hp electric equipment can readily accomplish as much drilling as a compressed-air equipment requiring from 15 hp to 20 hp The type of drill here described has been in service for one year and is now being placed on the market by the Dulles-Baldwni Electric Drill Company, 115 Broadway, New York.

Industrial and Commercial News

THE WEEK IN TRADE.

Actual distributive trade is still very quiet, and business expansion comes slowly. It is undeniable, however, that throughout commercial circles the feeling of optimism as to the future outlook is more pronounced than in any previous week this year. This may be the result of the improvement in the stock market and the confidence that there is a large amount of surplus money in the country ready to be invested in gilt-edge bonds. For many months last year big business enterprises were held up on account of inability to place bonds satisfactorily. This seems to be no longer the case. It is probable, therefore, that considerable developments for which plans have been long matured may now be commenced. Wholesale trade during the past week can hardly be classed as better than fair. In numerous sections of the country, outside of the South, reports continue to be received that buyers are extremely conservative. The Western agricultural section is sending in a considerable volume of orders for those wares which farmers particularly need. There has been a little revival in the iron and steel industry in the way of orders for rails and structural material. Pig iron, however, shows no particular improvement. The New York Central order the placing of which was referred to last week was the last large rail order recently received, but numerous railroads are buying small quantities, mainly for repair work, and the traction companies in many parts of the country are ordering light rails. A leading official of the United States Steel Corporation is authority for the statement that new orders during January averaged 30,000 tons a day, which was considerably better than the orders received during the previous quarter Collections were generally reported as slow, although in a few centers, especially in the South and Southwest, they are regarded as fair. Business failures for the week which ended Feb. 2, as reported by *Bradstreet's*, were 290 as against 345 the previous week, 232 in the same week of 1910, 286 in 1909, 272 in 1908 and 198 in 1907.

THE COPPER MARKET.

Sales of copper during the past week in the New York market—according to reports given out by selling agencies—amounted to approximately 30,000,000 lb. The majority of this copper was deliverable within the next ninety days. It is believed that the bulk of this metal was taken by domestic consumers, and that foreign speculators bought very little. If it is really true that there have been any such sales, and that the metal has gone really to consumers, it has been the direct result of the shading in prices. It is claimed that practically all of the electrolytic copper that was on the market below 12½ cents during the week was taken up. While prices have not been nominally advanced, sales are not now being made below 12⅝ and 12¾ cents. The developments in the copper market during January did not improve the statistical position in any very material way. The production continued at as high a rate as prevailed in the fall, and while sales figures, as reported by the Copper Producers' Association, show larger takings, the condition of business did not indicate that the actual consumption of copper was up to the same month last year. The result of this condition is, of course, simply a shifting of stocks. The visible supply of copper in Europe is reported as a little in excess of 235,000,000 lb., but in this report no account is taken of the copper in stock that is represented by standard warrants. The market at the present moment is awaiting the next report of the Copper Producers' Association. Imports during January were record-breaking, and the prospect is that they will continue to be very heavy during February. Neither is there any reason to believe that the daily production of the domestic mines will be reduced. In fact, it is beginning to be considered that the agreement among producers to curtail has been ineffectual, and as it expires by limitation June 1 there is little to be hoped for it Exports of copper for the present month, up to and including Feb. 6, were 5874 tons. The daily call on the Metal Exchange Feb. 6 quoted standard copper as per the accompanying table

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.00	12.20	....
February	12.00	12.20	12.10
March	12.00	12.20	12.10
April	12.00	12.20	12.10
May	12.00	12.30	12.10

The London market Feb. 6 was as follows:

	Noon			Closing.		
	£	s	d	£	s	d
Standard copper, spot	55	6	3	55	11	3
Standard copper, futures	56	2	6	56	7	6

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.30c			11.87½c		
London, spot	£56	15	0	£53	15	0
London, futures	57	12	6	54	10	0
Best selected	60	5	0	58	10	0

INDUSTRIAL AND COMMERCIAL NOTES.

Pennsylvania Railroad Buys More Electric Locomotives.—The Westinghouse Electric & Manufacturing Company has received an order from the Pennsylvania Railroad Company for nine more electric locomotives, aggregating 36,000 hp. These locomotives are exact duplicates of the twenty-four that were originally built by the Westinghouse company for the New York tunnel service. They are run in pairs, each locomotive representing 4000 hp. Work on this new order has already been started at the East Pittsburgh shops of the Westinghouse company and will be carried forward with dispatch It is expected that delivery will be made before summer, as all of the drawings and patterns are ready for use. The frames and running gear are to be built at the Juniata shops of the Pennsylvania Company, and the brake equipment is to be supplied by the Westinghouse Air Brake Company. They will all be used in the New York terminal.

Beach Storage-Battery Car.—The large storage-battery car made by the Beach Car Company, which was described in our issue of Oct. 27, 1910, has since that time been in regular service on the Watchung branch of the Erie Railroad. It is reported that the operation has been extremely successful. The regular steam train was taken off this line in favor of the Beach car, and it is claimed that the latter takes care of all of the traffic at an expenditure of 15 cents per car-mile, as against $1.14 per car-mile for the steam train. The Beach car is also being operated in Washington. Many new cars are under construction for the Stockton (Cal.) Street Railway Company, the Ontario West Shore Railroad Company of Canada, the Philadelphia Rapid Transit Company and the Sanford (Fla.) Railway Company.

Hall Signal Company.—The officials of the Hall Signal Company say that business is excellent and that the plants of the concern are now operating almost at full capacity. Early in the fall the outlook was not so bright, and the company had begun to cut down in operations. Beginning with December business suddenly picked up and since that time has been larger than was expected. At the present time there are a good many inquiries for large installations of railroad equipment, and several orders of fair size have recently been placed. The majority of the business within the past few months, however, has been in small orders. The question of the resumption of dividends has not been considered as yet, as the management has adopted the policy of putting a large portion of its earnings into improvements and betterments.

Cable Merger Held Up.—At the annual meeting of the Anglo-American Telegraph Company in London last week it was admitted that there were difficulties in the way of concluding the provisional agreement with the Western Union Telegraph Company. F. A. Beaven, who presided at the meeting, said that negotiations were still being carried on, but he was not at all certain that the original plan could be carried He also said that no agreement would be consummated without the consent of the shareholders of the Anglo-American Company.

New York Central's Electric Extension.—Beginning Feb 2 the local trains on the Hudson River division of the New York Central were electrically operated as far as Hastings instead of Yonkers. This adds about two and one-half miles to the electric zone on this division. The use of electricity shortens the running time between the Grand Central Station and Hastings by over two minutes.

Minneapolis General Electric Company.—The Minneapolis General Electric Company has announced that by securing all the available water-power sites on the Mississippi and St. Croix Rivers within a practical distance of the twin cities it is in a position to furnish Minneapolis and St. Paul with sufficient energy to meet their industrial needs for many years to come. Among the properties recently secured by the company are sites near St. Croix Falls, Wis., and near Clearwater and Monticello, Minn. It is stated that a dam and power plant to generate 25,000 hp is to be erected at St. Croix Falls in the near future. This plant will be a duplicate of the Taylor's Falls (Minn.) plant. A. W. Leonard, manager of the General Electric Company, also announces that a new steam station replacing the one recently burned is to be erected in Minneapolis costing a large sum; a new substation, costing $500,000, is to be built within the same city and the company's offices are to be enlarged and improved at a cost of $35,000. Stone & Webster, of Boston, are the operators of the Minneapolis General Electric.

United Metals Selling Company.—It has been reported in financial circles that the United Metals Selling Company, which has since 1900 handled the copper output of the Amalgamated Copper Company, will be absorbed by the Anaconda Copper Mining Company. This company is the operating concern of the Amalgamated. None of the officers of the big copper combine would either deny or confirm the reported change in control. The United Metals Selling Company has a capital of only $5,000,000, and is controlled at present by Amalgamated and Lewisohn interests. It has paid dividends of from 10 per cent to 30 per cent a year, and until a year ago, when the American Smelting & Refining Company, controlled by the Guggenheims, withdrew its metal-selling business from the United, that company marketed all but a small portion of the copper output of the United States. At the present time it handles more than 50 per cent of it.

Citizens' Light & Power Company.—The decision of the Court of Appeals of Alabama in the case of Henry L. Doherty vs. the Citizens' Light & Power Company of Montgomery, Alex. Rice, its president, and others, has been handed down, affirming the decision of the lower court. This leaves in effect the court order prohibiting the Citizens' company from making any extensions or improvements to its plant or from issuing any new securities. In this connection Richard Tillis, who is now president and chief owner of the Citizens' company, has announced that if the court eventually ordered that the property must be turned over to Doherty, he would have an entirely new electric light plant in operation within six months. Mr. Tillis said that all the details for such a plant had been arranged and the plans drawn. The new plant is expected to cost about $400,000 and the franchise has been already obtained.

Telephones for Chicago & Western Indiana.—The Chicago & Western Indiana Railroad Company has just ordered a complete equipment of railway telephone material. The new dispatching system will cover the entire line of this road and of the Belt Railway of Chicago, a subsidiary road. There will be three circuits. One is the train-dispatching wire of the Chicago & Western Indiana lines, another the train-dispatching wire of the Belt Railway and the third a message circuit paralleling the train-wire circuit at both roads. A total of fifty-five way station telephone outfits and 104 stations selector outfits will be provided. At Eighty-third Street, Chicago, the circuit will be terminated in a special switchboard. Special facilities will be arranged for handling the message wire, so that the circuit can be controlled from both the Dearborn Street station and the Eighty-third Street station.

Fort Dodge, Des Moines & Southern Electric Locomotives.—The General Electric Company is building four electric locomotives for the Fort Dodge, Des Moines & Southern Railroad. These locomotives, it is claimed, will pull 800-ton trains and will also be used for switching service. This railroad was designed for single passenger car operation, but of late years the freight work has grown to such an extent that the original 600-volt system is unable to handle the traffic. With the advent of the new locomotives this system will be changed to 1200 volts. Two complete locomotive equipments have also been ordered from the General Electric Company, and will be used to re-equip the two old locomotives, which will be adapted to the new 1200-volt system.

Paulson Wireless Company.—In our issue of Jan. 5 we published the statement that the Paulson Wireless Company had been incorporated under the laws of Arizona with an authorized capital stock of $25,000,000. The Secretary of State of California has declined to permit this incorporation to do business in California, giving as a reason the fact that the name of the concern was similar to that of the Paulson Wireless Telephone & Telegraph Company, which was already incorporated. Beach Thompson, of San Francisco, the promotor of the company, who made the application, asserted that his company had obtained the patent rights for California which were formerly held by the Paulson Wireless Telephone & Telegraph Company.

Westinghouse Apparatus for Panama Canal.—The Westinghouse Electric & Manufacturing Company has sold the Isthmian Canal Commission two 75-kw motor-generator sets with a switchboard for the control of each. One of the motor-generator sets will be located in the substation near the site of the Gatun Locks and the other on the Pacific side near the Pedro Miguel Locks. The apparatus will be used in connection with the construction of the lock gates. The outfits will operate on 25-cycle, 2300-volt energy transmitted from the power stations at Gatun and Miraflores. The motor-generators will convert this alternating current to direct current at 230 volts for use on the various small tools used in the gate construction

Cement-Mill 11,500-hp Motor Equipment.—The Westinghouse Electric & Manufacturing Company has recently closed a contract with the Universal Portland Cement Company for motors to operate its No. 6 plant at Buffington, Ind. The motors will be of the mill type, having characteristics specially suitable for cement mill work, and they will operate from 5 hp to 200 hp, the aggregate capacity being 11,500 hp. This plant will be the largest in the United States, having a daily capacity of approximately 12,000 barrels, and will be electrically operated throughout, the various drives being of the latest development for cement-mill work.

Maine Power Company.—Arthur B. Leach, of New York, and Linwood C. Tyler, of Bangor, have applied to the Maine Legislature for a charter for the Maine Power Company, with a capital of $1,500,000 and with authority to purchase the property, rights and franchises of the Bodwell Water Power Company. The new company also asks authority to issue bonds to pay for the purchase. The property is located in Old Town and Milford on the Penobscot River near Bangor. Engineers who have examined the property estimate that the generating plant can be developed to full capacity for $500,000.

Rapidan (Minn.) Dam Completed.—The large power dam at Rapidan, Minn., which will furnish power for much of the southern part of the State, has been practically completed, and the lake behind the structure is almost filled. The dam, which was erected by H. M. Byllesby & Company, of Chicago, is 60 feet high and is surmounted by a bridge, which is now open. The whole structure, including the power house, is reinforced concrete. The lake formed by the dam will be five miles long.

Allis-Chalmers Company.—In the Jan 26 issue of the *Electrical World* it was stated that the Allis-Chalmers Company had made a considerable number of very profitable foreign sales. It is now given out by officials of the company that inquiries at the present time are highly satisfactory, but that immediate sales to domestic consumers are being somewhat held up. The greatest improvement, both in inquiries and sales, has been shown in gas engines, mining machinery and flour-mill machinery.

Estimated Cost of Hoosac Tunnel Electrification.—Discussing improvements planned for the Boston & Maine Railroad system, referred to last week, Vice-president and General Manager Frank Barr rectently stated that the estimated cost of electrifying the Hoosac Tunnel, in Massachusetts, is $612,000, and that the company will place in service five electric locomotives at a cost of $250,000.

Conduits for Winnipeg.—Bids will be received by Magnus Peterson, secretary civic board of control, until Feb. 22 for all the conduit work to be done by the city this year. It is the purpose of the authorities to place gradually all electric wiring underground at an estimated cost of $650,000. Specifications may be seen at the office of F. E. Cambridge, city electrician

National Jobbers' Convention in California.—The annual convention of the National Electric Manufacturers and Jobbers' Association is to be held at Monterey, Cal., the latter part of April, the arrangements being in the hands of a San Francisco committee of the Pacific Coast Jobbers' Association

Financial.

The Week in Wall Street.

While there was no particular news to stimulate a buying movement in the Wall Street market last week, such a movement developed and prices were pushed up several points. The volume of transactions for the week was 3,513,000 shares, which is one of the largest weeks in the past six months. There was a widespread feeling of optimism, and it began to look as if a genuine bull movement had been started. It is undoubtedly the case that much of the support of the market came from high banking sources. There were many reports, which were probably authentic, that what are known as "good people" were buying. It is doubtful, however, if the upward movement has carried much weight with some of the shrewdest professional manipulators. In fact, at the close of last week quite a number of the best commission houses warned their customers that the market was already higher than seemed to be warranted, and that it was likely to pause. It is not often that commission houses issue pessimistic circulars, because 95 per cent of the outside customers buy rather than sell. The most stimulating feature in the financial market last week was the almost enthusiastic condition of the bond market. Not only are large and important issues of bonds rapidly taken by the public from the banking houses, but the announcement made by Judge Lovett, of the Harriman lines, that a bond issue of $75,000,000 was contemplated for improvements and extensions was taken as a direct implication that one of the shrewdest groups of financiers in the world was of the opinion that there was no reason to fear for the future. The money market during the week continued to be very easy. Both in this country and in Europe rates were low, and the banks seemed to be well supplied with funds. Quotations Feb. 6 were: Call, 1½@2½ per cent; 90 days, 3@3¼ per cent. The quotations in the table are those of the close Feb. 6.

NEW YORK.

	Jan. 30.	Feb. 6.	Shares Sold.		Jan. 30.	Feb. 6.	Shares Sold.
All. Ch......	8½	8½	1,500	Int. Met., pfd	54	54¼	21,800
All. Cb., pfd.	33⅛	33⅛	4,775	Mackay Cos.	92½*	94⅜	2,500
Amal. Cop...	63⅛	66½	95,600	Mackay C.,pf.	75¾*	76⅛	490
Am. D. T...	20½*	20½*	———	Man. Elev...	138	139¾	234
Am. Loco....	40¾	42¼	5,370	Met. St. Ry.	15*	15*	———
Am. Loco.,pf.	110¼	110	700	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	83½*	83½*	———	Steel, com..	79⅜	81¼	592,900
Am. T. & T..	144¼	145⅝.	27,750	Steel, pfd....	120	121⅞	11,154
B. R. T.....	77⅝	78¾	34,980	W. U. T....	75	74¾	7,450
Gen. Elec....	153½	154¾	1,800	West'h, com.	66⅞*	70	1,520
Int. Met...	19⅝	19¾	8,920	West'h, pfd..	117*	119*	200

PHILADELPHIA.

	Jan. 30.	Feb. 6.		Jan. 30.	Feb. 6.
Am. Rys.... ...	45¼	45	Phila. Elec........	16	16¾
Elec. Co. of A.....	12¼	12¼	Phila. R. T........	20⅛	20⅝
Elec. St. B'ty.......	53⅞	55½	Phila. Trac.........	86½	86½*
E. S. B'ty., pfd.....	30*	30*	Union Trac.........	47½	47¾

CHICAGO.

	Jan. 30	Feb. 6.		Jan. 30.	Feb. 6.
Chi. City Ry.	185*	185*	Chi. Tel. Co........	119*	118½
Chi. Rs., Ser. 1..	93	93*	Met. El. Co........	21*	20*
Cbi. Rs., Ser. 2.. ..	25	24¾	Met. El., pfd.......	67*	65*
Com. Edison.... ...	114½	115	Nat'l Car...........	117*	117*
Chi. Subways.	4	4*	Nat'l Car., pfd......	118*	118*

BOSTON.

	Jan. 30.	Feb. 6.		Jan. 30.	Feb. 6.
Am. T. & T.. ..	144¼	145¾	Mex. Tel.........	4¾	4¾*
Cum. Tel...........	146¼*	147⅜	Mex. Tel., pfd....	6	7
Edison E., Ill.......	290½	292	N. E. Tel..........	138½	140
Gen. Elec....... ..	152⅞	155	W. T. & T........	18	22½
Mass. E. Ry...... .	18*	18½*	W. T. & T., pfd....	92	97*
Mass E. Ry., pfd...	85	87½			

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*Last price quoted.

Shares sold for five days, Jan. 30 to Feb. 4.

Financial Notes.

United Properties Company.—Negotiations are said to be pending for the purchase of the reorganized Ocean Shore Railroad Company, of San Francisco, by the United Properties Company, the recently incorporated $200,000,000 concern of which Frank Smith, of the Pacific Coast Borax Company, is president. The Ocean Shore line is intended to link San Francisco with Santa Cruz. Notice of the organization of this big holding company was published in our issue of Jan. 5, but up to this time no information has been given out as to any properties that have been taken over. It is understood that the United Properties Company will shortly control all of the electric railway properties on the east shore of San Francisco Bay. The financial interests which organized the company are large owners of these properties.

Stone & Webster Properties.—Stone & Webster, of Boston, have issued a full combined statement of the thirty-one electric railway, electric lighting, gas and water-power companies under their management for the year 1910. The combined capitalization of the companies is: Bonds and coupon notes $68,328,500, preferred and common stocks $79,394,700, total $147,723,200. The total earnings, expenses, etc., were: Gross earnings $22,023,126, operating expenses $12,251,915, net earnings $9,771,211, interest charges and taxes $4,818,637, surplus $4,952,574, dividends $2,885,763. The companies operated the equivalent of 1092 miles of single track and carried 286,943,000 passengers. The total connected lighting load, 16 cp equivalent, was 2,094,920 lamps; total commercial power load 112,100 hp; total combined power station capacity approximately 185,800 hp, of which 84,400 hp is water-power.

Ohio Traction Merger.—A syndicate of New York bankers, in connection with Cincinnati capitalists, are planning to merge a number of Ohio traction companies which operate over 300 miles of track. The plan contemplates taking over all of the companies which converge in Cincinnati from the north and east of that city, and grouping them under one holding concern. Engineers are now examining the situation, and if their report is satisfactory the bankers have outlined a plan of consolidation the principal feature of which is to be a blanket bond issue covering the entire system and providing for the retirement of the outstanding bonds of the subsidiary companies.

Nashville Railway & Light Company.—The year 1910 was the most successful in the history of the Nashville Railway & Light Company. Both gross and net earnings showed liberal improvements over the previous year, while the surplus over and above expenses was considerably larger. The actual increase in net earnings for the full year was 12.9 per cent. The increase in operating expenses was only 1.6 per cent. The most striking feature in the company's yearly report is the saving that the management has been able to achieve in the lowering of operating expense bills. The company handled 6.25 per cent more business at an increased cost of only 1.6 per cent.

Madison Gas & Electric Company.—The Wisconsin Railroad Commission has authorized the Madison Gas & Electric Company to issue $627,000 of thirty-year 6 per cent bonds. This is a part of the proposed total issue of $3,000,000. These bonds are dated Oct. 1, 1910, and are callable on any interest date at 110. Of the present issue $400,000 will be reserved to retire at maturity $400,000 of first-mortgage bonds, due April 1, 1926, or earlier at the option of the holders, and $227,000 will be used to retire outstanding notes issued on account of constructions, additions, etc. The American Light & Traction Company controls the Madison company.

Oklahoma Railway Company.—A meeting of the stockholders of the Oklahoma Railway Company, Oklahoma City, has been called for Feb. 24, to authorize an increase in the capital stock from $3,000,000 to $15,000,000. The stock when increased will consist of $5,000,000 of preferred and $10,000,000 common. The shareholders will also be asked at the same meeting to approve a $12,000,000 bond issue. The increase in capital, it is said, is for the purpose of furnishing funds for building interurban lines to connect Guthrie, Oklahoma City, El Reno, Shawnee and Norman.

New Yorkers Buy Ohio Plant.—A party of New York capitalists, represented by Smith & Potter, 10 Wall Street, have acquired the Citizens' Electric Light & Power Company of Upper Sandusky, Ohio. Extensive improvements will be made to the plant, and an up-to-date, twenty-four-hour service is promised. The company has a capital of $24,600. The officers of the company are: Frank A. Porter, 10 Wall Street, president; S. N. Blake, vice-president and general manager; Edward Tschanen, secretary.

People's Light & Power Company.—The Nashawaug Electric Power Company, which operates a plant in Plainfield, Conn., has been taken over by the People's Light & Power Company of Danielson, Conn. The Nashawaug company supplies energy for operating the municipal plant at Jewett City, and also to the Lawton Mills Corporation. The People's Company has a capitalization of $60,000 stock and $30,000 bonds.

Public-Service Bond Offerings.—Plympton, Gardiner & Company, of New York and Chicago, are offering to the public the following public-service corporation bonds: St. Joseph Light, Heat & Power Company first-mortgage 5 per cent, due in 1937; Equitable Gas Light Company of New York 5 per cent, due in 1932, and Third Avenue Railroad Company, New York, 5 per cent, due 1937.

North Boston Lighting Company.—It is reported that the New Haven capitalists who control the North Boston Lighting Company have worked out a plan for merging five small properties in order to secure economy in management. These properties are the Malden & Melrose Gas Light Company, capital $1,584,000; Malden Electric Company, capital $525,000; Suburban Gas & Electric Company, of Revere and Winthrop, capital $684,000; Salem Electric Light Company, capital $275,000, and the People's Gas & Electric Company, of Stoneham and Reading, capital $150,000. The holding company will issue 47,548 shares of 6 per cent cumulative preferred stock and 31,447 shares of common stock. The corporate titles of the subsidiary companies will remain as at present, but the management is to be centralized. Charles H. Tenney, of Boston, is president of the holding company, and the New Haven trustees are: Herbert C. Warren, Edward M. Bradley and Samuel A. York.

Laclede Gas Company.—The directors of the Laclede Gas Company, of St. Louis, have authorized an issue of $1,000,000 additional common stock at $110 to pay $1,000,000 of notes due Feb. 1. The stockholders of record March 2 will have the right to subscribe for this new issue. In addition to this, $1,200,000 of common stock will be distributed to stockholders of record March 27 as a 10 per cent bonus. When these new shares are issued there will be $2,500,000 5 per cent cumulative preferred and $10,700,000 common outstanding. The authorized issues of the company are $2,500,000 preferred and $17,500,000 common. The Laclede Gas Company does an electric lighting business in St. Louis, but purchases its energy from the Union Electric Light & Power Company.

Tampa Electric Company.—Stone & Webster, which firm controls the Tampa Electric Company, have recently offered $300,000 of first mortgage 5 per cent bonds. These new bonds bring the total outstanding bonded indebtedness up to $932,500, on which there is an annual interest charge of $46,625. In 1910 the company earned enough net to meet this charge and at the same time have a balance available for dividends equal to 11¼ per cent on the $1,700,000 outstanding capital stock. The company does practically all of the electric railway and the entire electric lighting and power business of Tampa and operates an electric railway between Tampa and Port Tampa. It operates over forty miles of track and has two power stations with a total capacity of 4425 kw.

Mexican Light & Power Company.—The report of the Mexican Light & Power Company for the first eleven months of 1910 shows that its gross earnings during that period were $6,498,048, Mexican currency. The operating expenses were $1,870,094, leaving net earnings of $4,627,954, which was an increase in net earnings amounting to $2,024,032, as compared with the same period of the previous year. In the absence of an official report it is estimated that the returns for the month of December will bring the net earnings for the year up to more than $5,000,000, Mexican currency, which is equivalent to $2,500,000 gold.

United Railways of St. Louis.—The report of the United Railways of St. Louis for 1910, while somewhat in excess in gross earnings of 1909, did not exhibit a sufficient gain to offset the increased expenses. The figures are only available for the eleven months which ended with the calendar year. These show that the total surplus over all charges in 1910 was $958,038, and in 1909 was $1,200,410. The net earnings for this period also showed a decrease of 2.60 per cent. This deficiency is attributed to higher wages, to extra labor that had to be employed and to the greater cost of construction and repair materials.

Mexican Hydroelectric Development.—It has been authoritatively announced in Mexico City that a Canadian syndicate, headed by Sir William Mackenzie, president of the Canadian Northern Railway, has acquired the concession granted by the Mexican government some time ago for the construction of a dam across the Balsas River and the installation of a large hydroelectric plant in the State of Guerrero. The contract for the construction of the dam has already been let. The cost will be approximately $3,000,000 in gold. The same group of capitalists already owns extensive railway and lighting systems in Monterey.

Savannah Lighting Company.—Application has been made to the Superior Court at Savannah, Ga., by the Savannah Lighting Company for permission to increase its capital stock limit from $500,000 to $2,000,000. It is stated in the application that this increase in capitalization is made necessary to meet the constantly increasing needs of the company. Considerable enlargement of plant will be made as these needs develop. It is not proposed to issue all of this stock at the present time, but to do so as the necessity arises.

Detroit Edison Company.—The preliminary figures for 1910 of the Detroit Edison Company show very liberal increases over the previous year. They indicate that the company earned a surplus available for dividends equal to about 10½ per cent on the $6,000,000 of capital stock which is now outstanding. The report shows that there has been such a substantial improvement in the company's business that the recent increase in the dividend rate to 7 per cent was fully warranted

Shawinigan Water & Power Company.—The report for 1910 of the Shawinigan Water & Power Company, of Montreal, shows a surplus, after deducting all fixed charges, of $407,255, which is equal to 4.8 per cent on the $8,500,000 capital stock This compares with 4.6 per cent in 1909. It is believed that the company will be greatly benefited by the contract recently made with the Montreal Light, Heat & Power Company to furnish 40,000 hp.

DIVIDENDS.

American Smelters Securities Company, quarterly, preferred "A," 1½ per cent, preferred "B," 1¼ per cent, payable March 1.

El Paso Electric Company, 2½ per cent, payable March 15.

Federal Light & Traction Company, preferred, quarterly, 1½ per cent, payable March 1.

Lynn Gas & Electric Company, quarterly, 3 per cent, payable Feb. 1.

Mobile Electric Company, preferred, quarterly, 1¾ per cent payable Feb. 15.

North Texas Electric Company, preferred, semi-annual, 3 per cent; common, quarterly, 1½ per cent, both payable March 1

Portland (Ore.) Railway, Light & Power Company, quarterly, 1 per cent, payable March 1.

REPORTS OF EARNINGS.

Period		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
AMERICAN DISTRICT TELEGRAPH COMPANY						
Year,	1910	$580,008	$491,503	$88,504	$76,8[illegible]8	$11,61[illegible]
"	1909	549,225	464,661	84,563	70,888	7,67[illegible]
CATARACT POWER & CONDUIT COMPANY.						
Year,	1910	$1,467,171	$907,083	$4[illegible]6,881	$122,122	$294,7[illegible]
"	1909	1,211,930	948,891	265,287	[illegible]	134,937
DALLAS ELECTRIC CORPORATION						
Dec.,	1910	$139,292	$76,211	$63,081	$23,743	$39,338
"	1909	119,766	75,105	44,661	27,675	16,98[illegible]
Year,	1910	1,469,318	951,145	518,173	3[illegible]9,034	2[illegible]9,139
"	1909	1,320,122	821,491	498,63[illegible]	337,811	[illegible]
DETROIT EDISON COMPANY.						
Year,	1910	$2,833,248	$1,667,603	$1,165,645	$[illegible]37,7[illegible]3	$627,8[illegible]
"	1909	2,059,011	1,184,617	874,394	[illegible]	4[illegible]2,87[illegible]
GALVESTON HOUSTON ELECTRIC COMPANY						
Dec.,	1910	$115,123	$68,986	$46,137	[illegible]	[illegible]
"	1909	100,867	58,482	42,385	23,[illegible]	19,32[illegible]
Year,	1910	1,312,986	796,742	516,243	29[illegible]	[illegible]
"	1909	1,206,544	709,034	497,510	[illegible]63,899	233,61[illegible]
LAKE SHORE ELECTRIC RAILWAY SYSTEM						
Dec.	1910	$95,570	$52,640	$42,930	$34,70[illegible]	$8,227
"	1909	89,062	47,754	41,307	35,011	6,296
Year,	1910	1,206,1[illegible]	632,53[illegible]	573,578	417,[illegible]	[illegible]
"	1909	1,109,083	586,184	522,899	4[illegible]4,95[illegible]	[illegible]
LOWELL ELECTRIC LIGHT CORPORATION.						
Dec.,	1910	$43,291	$23,483	$19,808	$4,4[illegible]	[illegible]
"	1909	36,768	18,491	18,49[illegible]	[illegible]	[illegible]
Year,	1910	430,619	243,877	186,742	55,[illegible]33	[illegible]
"	1909	361,209	201,7[illegible]1	159,50[illegible]	[illegible]	[illegible]
MINNEAPOLIS GENERAL ELECTRIC COMPANY.						
Dec.	1910	$127,741	$51,669	$76,072	[illegible]	[illegible]
"	1909	1[illegible]7,556	[illegible]	[illegible]0,438	[illegible]	[illegible]
Year,	1910	1,276,041	49[illegible],647	783,394	[illegible]	[illegible]
"	1909	1,1[illegible]8,756	464,0[illegible]	644,[illegible]	[illegible]	[illegible]
NORTHERN OHIO TRACTION COMPANY.						
Year	1910	$2,[illegible]77,041	[illegible]	[illegible]	[illegible]	[illegible]
"	1909	2,437,426	1,348,0[illegible]3	[illegible]	[illegible]	[illegible]
PHILADELPHIA COMPANY OF PITTSBURGH						
Year,	1910	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
"	1909	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SEATTLE ELECTRIC COMPANY						
Dec.,	1910	$10[illegible],343	[illegible]	[illegible]	[illegible]	[illegible]
"	1909	[illegible]	[illegible]80,858	[illegible]	[illegible]	[illegible]
Year,	1910	[illegible]88,183	[illegible]	[illegible]	[illegible]	[illegible]
"	1909	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TORONTO RAILWAY COMPANY.						
Year,	1910	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
"	1909	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TWIN CITY RAPID TRANSIT COMPANY.						
Year,	1910	[illegible]	$3,667,702	$3,863,946	$1,466,394	[illegible]
"	1909	[illegible]	3,204,627	3,675,140	[illegible]	[illegible]

General News

Construction News.

DOTHAN, ALA.—The City Council is reported to be considering the installation of an electric light plant and water-works system to provide for a city of 50,000 population. The work will include the construction of a 1,000,000-gallon reservoir, driving one or more artesian wells, new pumping units and boilers complete. The electrical equipment will include a 500-kw Corliss engine driven unit, switchboard, etc. R. W. Lisenby is clerk.

FORT SMITH, ARK.—The Fort Smith Light & Traction Company is reported to be considering plans for building an extension from Van Buren to Fort Smith, four miles in length.

HAZEN, ARK.—The Hazen Power & Light Company is reported to have awarded contract for the erection of a power-house to D. S. Proctor, of Hazen, Ark., for $5,000. The cost of equipment for plant is estimated at $10,000, contracts for which have been placed.

BAKERSFIELD, CAL.—It is reported that the entire street railway system in Bakersfield will be rebuilt, at a cost of about $400,000. It is also stated that the Bakersfield & Kern River Electric Railway Company is contemplating extending its Chester Avenue line to the Kern River oil fields and to Watts, about eight miles distant. A. G. Wishon is general manager of the Bakersfield & Kern Electric Railway.

GLENDALE, CAL.—Application has been made to the Board of Supervisors by Charles E. Salisbury for a franchise to construct and operate an electric railway between Glendale and Burbank.

MERCED, CAL.—Arrangements are being made by the San Joaquin Light & Power Company for improvements to its gas system in Merced, which will include the erection of a new gas holder, to cost about $25,000.

SACRAMENTO, CAL.—Announcement has been made that the Pacific Gas & Electric Company will make extensive improvements to its property in Sacramento, which will involve an expenditure of about $1,000,000 and include the erection of a new steam-power generating plant, improvements to the railway system, additions to the gas plants, etc. The cost of the steam-power plant is estimated at $500,000 and will provide for an output of 15,000 hp. John A. Britton is vice-president and general manager.

SAN FRANCISCO, CAL.—The San Francisco City amendments voted at the November election and embracing several utility measures have been ratified by the State Legislature.

SAN FRANCISCO, CAL.—It is reported that the only improvement to be undertaken by the Great Western Power Company this year will be the installation of an additional unit in its plant at Las Plumas, the cost of which is estimated at $200,000.

SAN FRANCISCO, CAL.—The Indian Valley Electric Light & Power Company has decided to remove its principal office from Quincy, Cal., to 1108 Crocker Building, San Francisco, Cal. Plans are being considered to extend its system in Plumas County. O. C. Pratt is president of the company.

DENVER, COL.—Plans are being made by the Craggs & Canon Railway Company for the construction of eleven miles of tracks between Craggs, Eldorado Springs and Boulder during the coming year.

DENVER, COL.—The Board of Public Works has awarded the contract for the erection of fifty-four ornamental lamp standards for the Fourteenth Street viaduct to the Capitol Foundry Company, of Denver, Col., for $1,525. A resolution has been introduced in the City Council for abrogating the old contract for street lighting with the Denver Gas & Electric Light Company, calling for a flat rate of $28 per year for 50-cp lamps used on the streets and boulevards, and substituting a new contract providing for 75-watt tungsten lamps at $20 each per year. The old contract has five years to run and the new one is for a period of ten years. Under the new contract the company agrees to install new lamps as required, to replace the lamps now in use with tungsten lamps, and also to place the wires underground on the streets where the lamps are now in use, for $20 per lamp per year.

GREELEY, COL.—The Denver, Greeley & Northwestern Railway Company has secured rights of way and important terminals for its proposed electric railway between Denver and Greeley. The company has also made arrangements for financing its project. J. D. Houseman is general manager.

GUNNISON, COL.—It is reported that the proposition to install a municipal electric light plant will be submitted to a vote at the spring election.

MILLIKEN, COL.—The Town Trustees have granted the Northern Colorado Power Company a franchise to supply electricity for lighting in Milliken. The Colorado Telephone Company was also granted a franchise for the same length of time.

PLAINFIELD, CONN.—The People's Light & Power Company, of Danielson, Conn., has purchased the controlling interest in the Nashawaug Electric Power Company, which operates an electric plant in Plainfield, Conn. The Nashawaug company supplies electricity for operating the municipal electric plant at Jewett City, and also for lighting mills and tenements of the Lawton Mills Corporation. A transmission line is to be erected from the power station at Plainfield to Central Village, where connection may be made with the lines of the People's Light & Power Company.

WASHINGTON, D. C.—The Graushaar Brass Manufacturing Company, of St. Louis, Mo., has been awarded the contract for furnishing lighting fixtures for the government buildings at Goldsborough, N. C., for $290; Henderson, N. C., at $556; Council Bluffs, Ia., for $2,830; Danville, Ill., at $3,269; Jackson, Tenn., $1,462 and Sioux City, Ia., for $715.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Feb. 14 for furnishing at the Brooklyn Navy Yard the following supplies: Schedule 3298—50,000 ft. portable lighting cable, 38,000 ft. rubber insulated duplex conductor wire, 30,000 ft. silk-covered lamp cord, 10,000 ft duplex telephone wire. Applications for proposals should designate the schedules desired by number.

WASHINGTON, D. C.—Sealed bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Feb. 21, 1911, for furnishing at the navy yard, Brooklyn, N. Y., the following supplies: Schedule 3331—80 feeder junction boxes, 22,000 ft. interior communication cable, 20,000 ft. telephone cord, 100,000 ft. bell wire, 35,000 ft. single-conductor wire, 155,000 ft. twin-conductor wire. Application for proposals should designate the schedule desired by number.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Feb. 14 for furnishing at the navy yards and naval stations the following supplies: Portsmouth, N. H., Schedule 3296—Water tube boiler. Brooklyn, N. Y., Schedule 3298—Electrical wire and cable. Norfolk, Va., Schedule 3302—Fire-alarm annunciators, sheet brass and copper and malleable iron unions. Applications for proposals should designate the schedules desired by number.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until Feb. 23 for furnishing and installing lighting fixtures for the Philadelphia immigrant station, at Gloucester, N. J., and the United States buildings at Belleville, Ill.; Connersville, Ind.; Emporia, Kan.; Estherville, Ia.; Independence, Mo.; Woonsocket, R. I.; Athens, Ga.; Quincy, Ill., and Newbern, N. C., drawings and specifications for which can be obtained at the above office. James Knox Taylor is Supervising Architect.

SANFORD, FLA.—The Sanford Traction Company is reported to be contemplating building an extension to its railway, fifteen miles in length A. P. Connelly is general manager.

ATLANTA GA.—The City Council has awarded the contract for electrical work for the Grady Hospital annex to Peet & Power Company, of New York, N. Y., for $3,760

BLANTON, GA.—The Blanton Rural Telephone Company is reported to be contemplating the erection of a rural telephone line from Blanton to Valdosta, a distance of ten miles.

BOISE, IDAHO.—The Idaho-Oregon Light & Power Company is reported to be preparing plans for making large extensions to its Ox Bow tunnel power plant, which will involve an expenditure of more than $4,000,000, including extension of present transmission lines and erection of new lines into other territory and construction of additional substations. The J. G. White Company, of New York, N. Y., has the contract for the present development. William Mainland is president, and Sinclair Mainland is secretary and treasurer, both of Oshkosh, Wis.

CALDWELL, IDAHO.—The Gem Irrigation District is reported to have awarded the contract for a pumping plant for pumping water for irrigating 29,500 acres in Owyhee County, south of the Snake River, to F. W. Sheffield, of Spokane, Wash., for $864,000. Electricity for operating the system will be generated at the Thousand Springs and transmitted to the pumping station, which will be erected on the Snake River, a distance of 120 miles.

ORFINO, IDAHO.—Arrangements are being made by the Orfino Electric Company to install a new plant about four miles from the present plant, which will be equipped with a 150-kva generator and a 265-hp Leffel water turbine. Five miles of transmission line, having a potential of 6600 volts or 10,000 volts, three-phase, 60-cycle, will be erected. A substation will be built in Orfino equipped with one step-up and one step-down transformer. H. E. Shepherd is manager.

SAND POINT, IDAHO.—The Northern Idaho & Montana Power Company, Sand Point division, is planning to extend its transmission lines to Dover, Idaho, in the near future, and also to Priest River. H. E. Morton is manager.

ALGONQUIN, ILL.—Peters Brothers are reported to be building a new building, 55 ft. x 120 ft., two stories high, to be used as a machine shop. A new lathe and drill press will be purchased. The plant will be equipped for electric motor drive.

CHICAGO, ILL.—Sealed proposals will be received by the City of Chicago at the office of the Commissioner of Public Works, City Hall, Chicago, Ill., until Feb. 11, 1911, for furnishing and installing two 20,000,000-gal. centrifugal pumps and two 1000-hp synchronous electric motors, together with piping, wiring, switchboard and other apparatus, at the Twenty-second Street pumping station according to plans and specifications on file at the office of the Department of Public Works, 705 City Hall. Proposals must be made out on blanks which will be furnished at said office. B. J. Mullaney is Commissioner of Public Works.

MT. CARMEL, ILL.—Plans are being considered for the erection of a large power plant at the Grand Rapids dam in Mt. Carmel, where it is estimated that a minimum of 3500 horsepower can be developed. The present plans include the installation of a steam auxiliary plant to provide power in case of floods or other emergencies. G. E. K. Hixson, of Harrisburg, Ill., is interested in the project.

MT. PULASKI, ILL.—Messrs. West & Vail, owners of the Mt. Pulaski electric-light and power system, are contemplating the installation of new boilers or a suction producer gas outfit in the spring.

NASHVILLE, ILL.—The Nashville Electric Light Company is planning to rebuild its entire system, install a steam turbine and establish a day service. Twenty additional street lamps will be installed. K. A. Steinhauser is secretary and general manager.

PANA, ILL.—It is reported that the Christian County Telephone Company is contemplating rebuilding its local lines next summer.

ROCKFORD, ILL.—The Chamber of Commerce has appointed a committee to push the project to install ornamental lamps in the business district of the city. Fred S. Sterling is chairman of the committee.

TAMPICO, ILL.—The Dixon, Rock Falls & Southwestern Railway Company will award contracts for the construction of a ten-mile extension of its railway and equipment for one power house during the next two months. J. J. Burns, Isabella Building, Chicago, Ill., is purchasing agent.

TAYLORVILLE, ILL.—The Taylorville Railway, Light, Heat & Power Company is planning to construct about three miles of new track this spring.

RICHMOND, IND.—Plans are being prepared by the Dille & McGuire Manufacturing Company for extensive alterations and additions to its plant during the spring. New buildings will be erected on the site adjoining its present plant. The plant will be equipped for electrical operation.

ROCKVILLE, IND.—Arrangements are being made by the Parke County Telephone Company to rebuild its system, changing to a metallic system. The cost of the work is estimated at about $10,000.

BELLEVUE, IA.—Plans are being considered by the City Council for the installation of a 100-hp producer gas outfit, to be direct-connected, in the municipal electric light plant. Otto E. Hintze is superintendent.

BOONE, IA.—It is reported that the substation of the Fort Dodge, Des Moines & Southern Railway Company was recently burned and all the machinery destroyed.

CENTRAL CITY, IA.—At an election held Jan. 30 the citizens voted to grant a franchise to Fred A. Cross, of Monticello, Ia., to construct and operate an electric-light plant in Central City. The proposed plant will also supply electricity for lamps and motors in Coggon and Centerpoint.

GRAND RIVER, IA.—The installation of an electric light plant is reported to be under consideration. It is understood that a company will be organized to operate the same.

JESUP, IA.—The Farmers' Mutual Telephone Company is reported to be contemplating the installation of a new switchboard and other improvements.

SHENANDOAH, IA.—The City Council is reported to have entered into a contract with the Shenandoah Ice, Heat & Power Company, whereby the company guarantees to take over the municipal waterworks system and install high-pressure pumping machinery with a capacity of 250,000 gallons per day.

TRAER, IA.—Arrangements are being made to organize a new company to take over the property of the Mutual Telephone Company, operating exchanges in Traer, Reinbeck and Gladbrook. The new company will be capitalized at $60,000. R. M. McElhinny, R. C. Wood, John Sherret, F. C. Van Vliet and Adolph Moeller are directors.

COLDWATER, KAN.—J. S. Worley & Company, Reliance Building, Kansas City, Mo., engineers, have been engaged to prepare plans for the installation of an electric light plant and water-works system in Coldwater, for which bonds to the amount of $30,000 have been issued. W. F Baker is city clerk.

DODGE CITY, KAN.—At an election to be held Feb. 9 the proposition to issue $25,000 in bonds, the proceeds to be used for the installation of a municipal electric-light plant, will be submitted to a vote.

LA CYGNE, KAN.—It is reported that preliminary plans are being prepared by J. S. Worley & Company, Reliance Building, Kansas City, Mo., for the installation of an electric light plant and waterworks system in La Cygne, to cost about $30,000. C. L. Potter is Mayor.

McPHERSON, KAN.—The City Council is negotiating with the City of Inman with a view of supplying electricity from the municipal electric plant for lighting that city. Negotiations are also under way with the towns of Canton and Galva to supply electrical service from the municipal plant.

COLUMBIA, KY.—The Columbia Lighting Company is contemplating changing its system from alternating-current to direct-current this summer. It proposes to dispose of the present dynamo and install a 60-kv direct-current generator. A. H. Ballard is secretary and manager.

RICHMOND, KY.—The directors of the Richmond Electric & Power Company have authorized bonds to the amount of $50,000, which will be issued immediately, of which the proceeds of $30,000 will be used to retire the present mortgage and the remaining $20,000 will be used for extensions and improvements to the plant.

LAFAYETTE, LA.—Preparations are being made by the Industrial Institute for the installation of an electric light plant. It is understood that contracts have been placed for equipment for same.

MANY, LA.—Plans are being made by the Many Ice, Water & Light Company, recently organized, for the construction of a power plant in Many. Prof. W. C. Roaten is president of the company, and W. Robinson is general manager.

AUGUSTA, MAINE.—A bill has been brought up in the Maine Legislature to allow the Aroostook Valley Railroad Company to acquire the railway and franchises of the Canadian Pacific Railway Company between Presque Isle, Maine, and Aroostook Junction, N. B., thirty-three miles in length. The Aroostook Valley Railroad Company operates an electric railway in connection with the Canadian Pacific Railway Company from Presque Isle to Washburn, a distance of fourteen miles, and secures electricity for operating its cars from the large power plant at Aroostook Falls.

BANGOR, MAINE.—Application has been made to the State Legislature by Arthur B. Leach, of New York, N. Y., and Linwood C. Tyler, of Bangor, Maine, for a charter for the Maine Power Company, with a capital stock of $1,500,000, with authority to purchase the property, rights and franchises of the Bodwell Power Company and to issue bonds for that purpose. The property is located in Old Town and Milford, fifteen miles from Bangor. It is stated that the plant can be developed and made a financial success by an expenditure of about $500,000.

WATERVILLE, MAINE.—The Waterville & Fairfield Railway & Light Company will purchase a 400-kw or 500-kw, two-phase, 60-cycle, 2300-volt turbo-generator set within the next ten weeks. Ralph J. Paterson, of Waterville, Maine, is purchasing agent.

BALTIMORE, MD.—It is reported that preliminary plans are being prepared by the American Tobacco Company for the erection of a large power house, to be located at Boston and Patuxent Streets, Baltimore Painter & Posey are engineers, and T. W. Pietsch is the architect

FREDERICK, MD.—Preparations are being made by the Morris Iron Company for enlarging its plant in Frederick, Md. The plant will be equipped for electric motor drive, and it is expected that the company will install an electric power plant to provide electricity for same. Additional equipment will be required for foundry and machine shop, including overhead traveling cranes.

DANVERS, MASS.—The Electric Light Commissioners have recommended an appropriation of $1,000 for construction during 1911, and $2,000 for extensions and additions to the municipal electric light plant Owing to the large number of arc lamps in use for street lighting the small arc machine is greatly overloaded. The commissioners are considering the installation of tub transformers and discarding the old arc equipment.

EAST BRIMFIELD, MASS.—The Snell Manufacturing Company has recently installed a generator at its plant in East Brimfield to furnish electricity for lamps and motors for its factory.

LYNN, MASS.—Announcement has been made by the Lynn Gas & Electric Company that the price of gas will be reduced from 80 cents to 75 cents per 1000 cu. ft., to take effect from April 1.

MILFORD, MASS.—The County Commissioners are reported to be considering the question of installing an electric light plant at the jail on Summer Street to furnish electricity for lighting the building, which is now lighted by gas.

NEW BEDFORD, MASS.—The directors of the Union Street Railway Company have authorized extensions and improvements to its system, involving an expenditure of about $400,000. Henry H. Crapo is president.

WESTFIELD, MASS.—Sealed proposals will be received by the Committee on Repaving Elm Street and Park Square, Westfield, Mass., until Feb. 17 for furnishing and installing wires for the underground system for the transmission of electricity for lamps and motors. Following is an approximate of the lead-covered copper cable required. 22,250 ft. No. 6, B. & S. gage, solid 800 volt; 20,678 ft. No. 0, B. & S. equivalent 19-strand, 3000-volt; 750 ft. No. 2, B. & S. equivalent, 19-strand, 3000-volt; 8884 ft. No. 4, B. & S. equivalent, 7-strand, 3000-volt. 22,[illegible]97 ft No. 6, B. & S. equivalent, 7-strand, 3000-volt. Plans may be seen and blank forms of proposals, contract and specifications obtained at the office of Oren E. Parks, town engineer. James H. Bryan is chairman of the committee.

DETROIT, MICH.—The Public Lighting Commission has submitted estimates to the Controller asking for $510,836 for the municipal electric light plant this year. The improvements include a new building, to cost $70,000, to serve as a storehouse, shops and office building; extensions to boiler room, $17,000; for improving street-lighting system on Woodward Avenue from Adams Avenue to the Boulevard. $47,301.

improving lighting system, underground construction, etc., on Michigan Avenue, from Third Avenue to the site of the new Michigan Central Station, $51,683; for better lighting of North Grand Boulevard, beginning a system which the commission hopes to extend to all parts of the boulevard, removing overhead wires and installing lamp standards, $7,555; for removing overhead wires and extending conduits on several streets, $14,627; for poles and lines, $50,700 and for required apparatus, $27,830; for equipping election booths, $5,000. The estimates this year show the cost of maintaining arc lamps to be $30 each per year, a reduction of $1.75 from last year and $15 per lamp from ten years ago.

SAULT STE. MARIE, MICH.—The construction of a transmission line from Sault Ste. Marie to Pickford, which may later be extended to De Tour or St. Ignace, is reported to be under consideration.

VANDALIA, MICH.—At an election held recently the citizens voted to grant the Milling & Power Company, of Cassopolis, Mich., a franchise for a period of thirty years to supply electricity in Vandalia for lamps and motors. A contract for street lighting for a term of ten years will be executed. About forty street series tungsten lamps will be installed. The Milling & Power Company obtains energy for operating its system from the hydroelectric plant of the Constantine Hydraulic Company at Constantine, Mich. The transmission line from Constantine to Cassopolis passes through Vandalia.

DULUTH, MINN.—The City Council is contemplating petitioning the State Legislature to pass an act enabling the City of Duluth to submit the proposition to issue bonds to the amount of $700,000 for the installation of a municipal electric-light plant.

FARMINGTON, MINN.—L. Larson has applied to the City Council for a franchise to install an electric light plant in Farmington, Minn.

GRAND RAPIDS, MINN.—Plans are being considered by the Electric Light Commissioners for extending the transmission lines of the municipal electric light plant to the village of La Prairie.

HUTCHINSON, MINN.—The Hutchinson Lighting & Manufacturing Company is reported to be purchasing equipment for its light and power plant. Thomas Pitts is manager.

LAPRAIRIE, MINN.—Plans are being considered for the installation of an electric-light service in Laprairie. It is proposed to secure the service from the municipal electric-light plant in Grand Rapids.

MINNEAPOLIS, MINN.—The Minneapolis, St. Paul, Rochester & Dubuque Electric Traction Company is planning to construct an electric railway to connect Faribault, Owatonna, Dodge, Center, Cassen and Rochester, about seventy miles in length. M. W. Savage, of Minneapolis, Minn., is president of the company.

RED CLOUD, MINN.—Local capitalists are contemplating the installation of an ice plant. It is proposed to purchase exhaust steam and power from the municipal electric plant.

ROCHESTER, MINN.—Plans are being considered for moving the municipal electric-light plant nearer the river and installing a system of cluster lamps, plans for which have been prepared by Earl Jackson, of St. Paul, Minn., engineer.

NEW AUGUSTA, MISS.—The New Augusta Telephone Company is planning to extend its telephone system in the rural districts.

KANSAS CITY, MO.—The Missouri & Kansas Interurban Railway Company, which operates an electric railway connecting Kansas City and Olathe, Kan., a distance of twenty-two miles, has sold its property to the McKinley traction interests. The new owners will extend the railway to Lawrence and Topeka.

KIRKSVILLE, MO.—The City Council has decided to call an election to submit the proposition to issue bonds to the amount of $65,000, the proceeds to be used to install a municipal electric light plant to furnish electricity to light the streets of the city and to pump water from the Chariton River, six miles distant, to the voters.

MILES CITY, MONT.—The capital stock of the Miles City & Eladaka Telephone Company has been increased from $6,000 to $25,000.

CHAPPELL, NEB.—It is reported that the proposition to issue bonds, the proceeds to be used for the construction of an electric light plant in Chappell, will be submitted to a vote.

CORTLAND, NEB.—The Cortland Telephone Company is contemplating the construction of a new telephone exchange building.

LINCOLN, NEB.—The Lincoln Traction Company has submitted a proposition to the City Council offering to furnish and maintain all wires, transformers, not including lamps and globes, for the ornamental lighting system in the business district for a period of five years, with the provision that the city may have the option to cancel the contract at any time by giving 60 days' notice and purchasing the equipment at cost of installation. The offer is based on a 5 per cent return of the investment of $12,000, which the City Light Commissioner estimates as the cost of completing the installation, as follows: Five per cent on $12,000, the cost of installation, $600; 5 per cent for maintenance and depreciation on installation, $600; lamps and globes to be furnished at cost; electricity for lamps to be supplied at the rate of 3 cents per kw-hour, which is 25 per cent less than the city is now furnishing it. If given the contract the company claims it can complete the installation of the system within one week.

STRATTON, NEB.—At an election held recently the proposition to install an electric light plant in Stratton was carried.

WYMORE, NEB.—The installation of an electric-light plant in Wymore is reported to be under consideration.

FALLON, NEV.—The City Council is reported to be negotiating with the United States government in connection with utilizing the water power in the canal, located six miles from Fallon, to generate electricity to be transmitted to the City of Fallon. The canal has a drop of 26 feet, carrying 50 second-feet of water. C. L. Noble is city clerk.

BRETTON WOODS, N. H.—Announcement has been made that the Boston & Maine Railroad Company is planning to equip the railway which climbs Mount Washington for electrical operation. It is proposed to build a power plant at the base of the mountain to supply electricity for operating the railway and for a searchlight, which it is proposed to install at the summit; also for lighting the hotel at the top of the mountain.

MILLVILLE, N. J.—The Millville Manufacturing Company, of Millville, N. J., has engaged Charles T. Main, of Boston, Mass., mill architect and engineer, to take charge of the reconstruction of the power system of its cotton bleachery. The original equipment, consisting of simple condensing engines, driving line shafting and return tubular boilers, is to be replaced by non-condensing steam turbine and a battery of high-pressure water-tube boilers. Induction motors will be used to operate the entire bleachery. The contract for turbine and electrical equipment has been awarded to the Allis-Chalmers Company, of Milwaukee, Wis.

MORRISTOWN, N. J.—The Morris Township Committee has entered into a contract with the Morris & Somerset Electric Company for street lighting for a period of five years, under the terms of which the company is to furnish seventy or more tungsten lamps of 25 cp at the rate of $18 each per year. The company also agrees to extend its lines without charge to the township.

NEW BRUNSWICK, N. J.—The Hudson & Middlesex Telegraph & Telephone Company has filed an amendment to its charter increasing its capital stock to $1,000,000.

SALEM, N. J.—The plant and holdings of the Salem Electric Company, of Salem, N. J., have been purchased by W. S. Barstow & Company, of New York, N. Y. It is understood that the new owners will make extensions and improvements to the plant during the coming year.

ALBANY, N. Y.—The New York Telephone Company has applied to the Public Service Commission, Second District, for permission to purchase the property of the Amsterdam Automatic Telephone Company for a consideration of $150,000, to merge the Trumansburg Telephone Company, the Jefferson County Telephone Company, and to transfer the rights, property and franchises formerly belonging to the Central New York Telephone & Telegraph Company in Oneonta, Unadilla, Richford Springs, Laurens, Cooperstown and Walton, now owned by the New York Telephone Company, to the Otsego & Delaware Telephone Company for the sum of $98,000. The New York Telephone Company also asks for authority to sell its property in Allegany County, including rights and privileges granted to the New York & Pennsylvania Telephone & Telegraph Company by the villages of Wellsville and Andover, to the Allegany Telephone Company, of Wellsville, the consideration to be $35,000.

BINGHAMTON, N. Y.—The City Council is considering the question of issuing $158,000 in bonds, the proceeds to be used to establish a municipal electric-light plant in Binghamton. The proposition will probably soon be submitted to a vote.

ELMIRA, N. Y.—The Public Service Commission has authorized the Elmira Water, Light & Railroad Company to issue bonds to the amount of $243,995, to be sold at not less than 87, the proceeds to be used for the discharge of indebtedness incurred for capital purposes and various extensions and improvements to its property in Elmira and vicinity.

ERIEVILLE, N. Y.—Messrs. Parker and Newton have purchased the plant and holdings of the Earlville Telephone Company and are organizing a new company under the name of the Erieville Telephone Company to operate the same. Plans are being made for extensive improvements, including the installation of a new switchboard at Erieville, the reconstruction of the village lines, and dividing the heavy-loaded farmer lines. The system in New Woodstock will be greatly improved, as well as the toll service, which will be obtained by the way of New Woodstock.

HOLLEY, N. Y.—The Village Trustees have engaged Charles D. Cole, of Albion, N. Y., to make investigations at the municipal electric light plant and report to the board as to the advisability of making improvements and extensions to the system or disposing of same.

MOUNT VERNON, N. Y.—The Common Council has passed a resolution providing that a bill be sent to the Legislature compelling the electric light, telephone and telegraph companies to place all their wires underground throughout the city. The bill if passed will go into effect immediately and the city is to be given the right to remove all poles left above ground after Jan. 1, 1912.

NEW YORK, N. Y.—The Board of Estimate has granted the Electric Protection Company a franchise to install and operate an automatic fire and burglar-alarm service in this city.

OGDENSBURG, N. Y.—Sealed proposals will be received by the Board of Water Commissioners, Ogdensburg, N. Y., until March 7 for the construction of covered sand filters, pipe lines, steam and electrical pumping machinery, water turbine, electrical equipment, boilers and other appurtenances. Plans may be seen and copies of specifications, proposal bond and contract obtained at the above office, or at the office of

Hazen & Whipple, consulting engineers, 103 Park Avenue, New York, N. Y. James M. Wells is chairman of the board.

ELIZABETHTOWN, N. C.—The Bladen Telephone Company is planning to erect and operate telephone lines in the Counties of Bladen, Columbus, Cumberland, Brunswick and New Hanover. The company is capitalized at $10,000 and the incorporators are: John McDowell, R. S. White and J. D. Mercer.

MURPHY, N. C.—It is reported that a company has been organized to construct a hydroelectric power plant. George A. Browning is interested in the project.

WILMINGTON, N. C.—The Tidewater Power Company will soon be in the market for a boiler, one 500-kw rotary converter and two 200-kw transformers. A. B. Skelding, of Wilmington, N. C., is purchasing agent.

BUXTON, N. D.—The stockholders of the Red River Valley Telephone Company has increased its capital stock from $100,000 to $200,000.

CLEVELAND, OHIO.—The Cleveland Electric Illuminating Company has awarded contracts for the superstructure of its new power house on East Seventieth Street, amounting to $150,000, to the National Concrete Fireproofing Company for general work and to T. H. Brooks & Company for structural steel work.

CLEVELAND, OHIO.—Sealed bids will be received by the Cuyahoga County Building Commission, 425-427 Garfield Building, Cleveland, Ohio, for electric light fixtures for the new court house. Plans and specifications may be seen at 149 Court House, and duplicate copies may be obtained from C. F. Schwenfurth, architect, New England Building, Cleveland, Ohio. A deposit of $200 will be required for the plans, of which $100 will be refunded upon return of same.

HAMILTON, OHIO.—The plant of the Carr Milling Company at Hamilton, Ohio, is reported to have been destroyed by fire recently, entailing a loss of about $120,000. It is understood that the mill will be rebuilt. Considerable flour milling machinery and power equipment will be required.

LUCKEY, OHIO.—The Webster Telephone Company is contemplating extensive improvements to its system.

MONTPELIER, OHIO.—Plans are being considered for improvements to the municipal electric light plant, which will include the installation of a two-phase, revolving-field generator and establishing a twenty-four-hour service for both lamps and motors. It is proposed to discard the Warren alternator now in use. A. E. Waymire is superintendent.

MT. VICTORY, OHIO.—The plant and holdings of the Mt. Victory Telephone Company have been purchased by the United Telephone Company, of Bellefontaine, Ohio, for a consideration of $19,250. The Mt. Victory company operates exchanges at Mt. Victory and Ridgeway.

SPRINGFIELD, OHIO.—The executive board of the Osterlin Orphans' Home is reported to be considering the installation of an electric-light plant at that institution.

UPPER SANDUSKY, OHIO.—The plant and holdings of the Citizens' Electric Light & Power Company are reported to have been purchased by the American Gas & Electric Company, of Providence, R. I. It is understood that the plant will be enlarged and improvements made.

WOODSDALE, R. F. D., TRENTON, OHIO.—It is reported that plans are being considered for the construction of a large electric power plant in Woodsdale to furnish power for the paper mills in this vicinity. Surveys have been made of the property belonging to the Chatfield-Woods Paper Company, of Cincinnati, Ohio. It is said that Eastern capitalists will construct the plant, the cost of which is estimated at $500,000. The plant, if erected, will supply electricity to the surrounding villages.

ARDMORE, OKLA.—Ed. S. Perry of Coalgate, Okla., is reported to be preparing plans for the construction of a hydroelectric power plant.

BOYNTON, OKLA.—The City Council is reported to be considering the question of installing an electric light plant, water-works system and laying of gas mains.

FORAKER, OKLA.—The proposition to issue $5,000 in bonds, the proceeds to be used for the installation of an electric light system, is reported to have been defeated at an election held recently.

OKLAHOMA CITY, OKLA.—A meeting of the stockholders of the Oklahoma Railway Company will be held Feb. 24 to vote on the proposition to increase the capital stock of the company from $3,000,000 to $15,000,000, and also to approve an issue in bonds to the amount of $12,000,000, the proceeds to be used for the construction of interurban railways connecting Guthrie, Oklahoma City, El Reno, Norman and other central Oklahoma cities.

HOOD RIVER, ORE.—The plant and holdings of the Hood River Light, Power & Water Company are reported to have changed hands again, and are now owned by the Pacific Coast Light & Power Company. It is understood that if the city votes to take over the water-works system work on the electric line through the Hood River Valley will begin in the spring. It is also reported that the new company proposes to transmit electricity generated at the plant on the Hood River to Portland.

MEDFORD, ORE.—The City Council has granted a franchise for an electric railway through Medford.

REDMOND, ORE.—Preliminary plans are being prepared by the Crook County Water, Light & Power Company for installing a 250-kw alternating-current, 60-cycle, 3-phase, 2300-volt hydroelectric plant at Cline Falls, four miles distant. A transmission line will be erected from the plant at Cline Falls to the substation in Redmond. It is expected to have the plant completed and ready for operation by next October. J. G. McGuffie is superintendent.

DOYLESTOWN, PA.—Plans are being made by the Philadelphia & Easton Electric Railway Company for extending its railway from Doylestown to Lansdale, Pa., a distance of ten miles, where connections will be made with the Montgomery Traction Company, which operates a railway to Norristown and thence to Philadelphia, via Chestnut Hill.

LANCASTER, PA.—A syndicate of Philadelphia capitalists has purchased the property and holdings of the Lancaster & York Furnace Street Railway Company, of Lancaster, Pa., and of the Colemanville Water & Power Company, of Colemanville. The new owners will improve and extend the electric railway.

MERCER, PA.—The County Commissioners have awarded the contract for the installation of an electric plant in the new court house to the American Warming & Heating Company, of Pittsburgh, Pa., for about $8,600. The small plant now in the court house will be utilized to supply electricity for the outside lamps and the clock.

NEW CASTLE, PA.—The Council Committee is making investigations of available sites for the proposed municipal electric light plant in New Castle.

PITTSBURG, PA.—Plans are being considered by the Joplin & Pittsburg Railway Company for the construction of a small power house. The company also expects to purchase a generator with a rating of about 400 kw, an engine rated at about 600 hp and a 150-hp boiler. W. A. Satterlee is general manager.

WILKES-BARRE, PA.—The Wilkes-Barre Railway Company is planning to increase the output of its power plant and expects to purchase one 1500-kw low-pressure turbine, one 750-kw motor-generator set, four 500-kw rotary converters, two 300-kw rotary converters and condensing outfit; also twenty new cars. Thomas A. Wright is general manager.

CHESTERFIELD, S. C.—The capital stock of the Chesterfield Telephone & Telegraph Company is to be increased to $6,000. The proceeds will be used for improvements to the system.

MOBRIDGE, S. D.—Application has been made to the Council for a franchise to install an electric-light plant in Mobridge by Tanner Brothers, of Webster, and Hill & Smith, of Mobridge.

RAPID CITY, S. D.—It is reported that the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., has entered into a contract with the Dakota Power Company, of Rapid City, S. D., to supply electricity from its hydroelectric power plant at Pactola to operate the machinery at the four mica mines, near Custer, S. D., owned by the former. The Dakota Power Company recently took over the plant and holdings of the Rapid City Electric & Gas Company, which will be rebuilt and improved.

WAUBAY, S. D.—Application has been made to the City Council by Boyle & Weller, of Webster, S. D., for a franchise to install an electric light plant in Waubay, S. D.

KNOXVILLE, TENN.—It is reported that the Aluminum Company of America, of Pittsburgh, Pa., has commenced work on the construction of a large hydroelectric plant on the Little Tennessee River. It is said that the project includes the development of a new town. The Aluminum Company recently purchased the franchises, property rights and other holdings of the Knoxville Power Company. It is understood that the plant, when completed, will furnish electricity in Knoxville and other towns and cities for industrial purposes.

TRACY CITY, TENN.—Preparations are being made by the Citizens Telephone Company to extend its telephone lines to Monteagle and Pelham. A switchboard will be installed in Tracy City.

BRENHAM, TEX.—Preparations are being made by the Brenham Compress Oil & Manufacturing Company for the installation of an electric power plant to provide electricity for operating its oil mill, which will be equipped for electric motor drive. The equipment will include a 300-hp compound condensing engine direct connected to a 25 kw generator, switchboard and motors. The plant will be changed to three-phase, 60-cycle, 2300-volt system. It is understood that contracts for machinery have been placed.

DALLAS, TEX.—The City Commission has accepted the bid of the Dallas Electric Company for the installation of ornamental street lamps on Elm Street. Under the terms of the contract the company agrees to supply and maintain the lamps at the rate of $45 each per year for a period of five years. It is understood that the cost of the lamp standards and the maintenance for the first year is to be paid by the property owners in that district. The contract for furnishing the lamp standards was awarded to the Elmer P. Morris Company at $55 each.

GLEN ROSE, TEX.—A franchise has been granted to Woodford M. Davis, of Dallas, Tex., to erect a dam across Paluxy Creek to furnish power to operate an electric light and power plant.

GREENVILLE, TEX.—The Greenville Development Company is reported to be contemplating the construction of an electric railway from Greenville to Mineral Heights, a distance of about three miles.

HOUSTON, TEX.—Plans are being prepared by the Southwestern Telegraph & Telephone Company for the construction of a telephone exchange building at San Jacinto and Capitol Streets, Houston, Tex., to cost about $400,000. The company also contemplates the erection of an exchange building in the Harrisburg district.

KIRBYVILLE, TEX.—The installation of an electric light plant in Kirbyville is reported to be under consideration. J. W. Fleming and J. Morton are said to be interested in the project.

LOMETA, TEX.—The local electric light and water plant is reported to have been purchased by J. E. Baker, of Killeen, Tex. It is understood that the new owner proposes to make improvements to the systems.

NIXON, TEX.—The business men and farmers of Nixon and Leesville have purchased the Nixon telephone system from O. W. Askey, for a consideration of $4,000.

WACO, TEX.—At an election to be held Feb. 14 the proposition to issue $250,000 in bonds, the proceeds to be used for the construction of an electric light plant, will be submitted to a vote.

OGDEN, UTAH.—The City Council has granted a franchise to A. L. Brewer, J. S. Lewes, Joseph Scowcroft, J. N. Spargo and A. T. Wright to construct and operate an electric power plant and supply electricity for lamps, heat and motors in Ogden.

BURLINGTON, VT.—The Burlington Light & Power Company has served an injunction restraining the City Council from expending $27,000 for additional equipment for the municipal electric light plant. The company claims that the purpose of installing additional machinery is for the purpose of supplying electricity for commercial lighting, which it claims the city has no right to do under its charter. A bill enabling the city to issue $50,000 in bonds for additional equipment was killed in the Senate, and the City Council voted to authorize the Electric Light Commissioner to spend $27,000 for improvements.

RUTLAND, VT.—Arrangements are being made by the Rutland Railway, Light & Power Company for the construction of a new substation near the Eureka quarry at North Poultney. The building will be 20 ft. x 20 ft. and will be equipped with 75-kw transformers transforming current from 13,200 volts to 2300 volts. G. Tracy Rogers is president.

LYNCHBURG, VA.—The Lynchburg Traction & Light Company has recently purchased a 1000-kw Curtis turbo-generator, which will be installed at its plant at Lynchburg in March. The company expects to place contract during the next two months for building one mile of track in Lynchburg. D. C. Frost is superintendent.

BELLEVUE, WASH.—Preparations are being made by the Bellevue Electric Company, of Bellevue, Wash., recently incorporated, for the construction of an electric plant, work on construction of which will begin in the spring. The company proposes to supply electricity for a large dairying district lying between Lake Washington and Lake Sammamish, and the coal mining and timber district adjacent. It is understood that the company also contemplates building a railway, twenty miles in length.

HILLYARD, WASH.—The Panhandle Railroad Company, which is erecting a large power plant on the Priest River, has applied to the City Council for a franchise to supply electricity for lamps and motors in Hillyard. The company offers to furnish arc lamps for street lighting at $48 each per year and electricity for domestic purposes for 8 cents per kw-hour. The city now pays the Washington Water Power Company $60 per lamp per year for street lighting, and 10 cents per kw-hour for electricity for domestic lighting. A proposition has also been submitted by the company whereby the city may own its own distributing plant and purchase energy at wholesale of the company. The company expects to have its plant ready for operation within eighteen months.

SPOKANE, WASH.—The Allis-Chalmers Company, of Milwaukee, Wis., has been awarded the contract for the installation of a new unit for the up-river pumping station, to cost $12,000. This unit will complete the four units at the new pumping station, each unit having a capacity of 12,500,000 gallons per day.

NEWVILLE, W. VA.—The Newville Telephone Company, recently incorporated, proposes to purchase the telephone line in the Holly district in Braxton County, and will also build additional lines. The company is capitalized at $5,000. Benjamin H. Adkison, of Corley, W. Va., and Jesse Skidmore, of Newville, W. Va., are among the incorporators.

BAYFIELD, WIS.—Plans are being considered for changing the station equipment of the municipal electric plant. It is proposed to install direct-connected units, new switchboard and motor-driven pumps, and to change the current to three-phase, 60-cycle, 2300 volts, which will probably be done in 1912. F. M. Herrick, Jr., is superintendent.

BONDUEL, WIS.—Messrs. Dietrich & Brandt, owners of the Bonduel Roller Mills, are reported to be contemplating the installation of an electric-light plant.

CECIL, WIS.—The Green Valley Toll Line Company has filed amendments to its charter increasing its capital stock from $2,500 to $15,000.

MOSINEE, WIS.—Preparations are being made to erect an electric-light plant in Mosinee to cost about $4,000. W. A. Von Berg is engineer in charge.

MT. HOREB, WIS.—The Mt. Horeb Electric Light Company is contemplating the installation of an ice plant, exhaust-steam-heating system and also establishing a day circuit. H. M. Harper is president and general manager.

CALGARY, ALTA., CAN.—Announcement has been made by the Calgary Power Company that its plant at Kananaskis will be ready to supply power by April 1.

CALGARY, ALTA., CAN.—Bids will be received by the City Commissioners until Feb. 13 for 200, more or less, five-lamp ornamental lampposts, to be delivered in carloads as required. Globes are to be of light alabaster. Each post must be equipped with Edison sockets, all complete and ready for wiring up. Bidders will also submit prices on extra globes which might be required. Tungsten lamps will be supplied by the city. All parties tendering bids must submit designs, together with full dimensions, weights, etc. A. G. Graves is city commissioner.

EDMONTON, ALTA., CAN.—Superintendent Griffith of the municipal telephone system has submitted estimates for improvements and extensions to the municipal telephone system this year, providing for an expenditure of $130,000.

EDMONTON, ALTA., CAN.—Preliminary plans have been prepared by the City of Edmonton for a hydroelectric development of 60,000 hp on the Athabasca River, 105 miles north of this city. Application for permission for the development has been made to the Dominion government.

EDMONTON, ALTA., CAN.—Announcement has been made by the provincial government that it will erect a telephone line from Athabasca Landing to Fort McMurray, a distance of 250 miles, this year. A line will also be built into the Peace River County, where about 250 miles will be erected during 1911.

OKOTOKS, ALTA., CAN.—The Alberta Electric Company has applied for a charter for the purpose of building a number of electric railways in this province. The main office of the company will be located in Okotoks.

KELOWNA, B. C., CAN.—Preparations are being made for the installation of additional equipment in the municipal electric light plant, including a 75-hp tandem compound engine, direct-connected to a 50-kw alternating-current generator and exciter, to take care of the night load after midnight. Bids are now being received for the machinery. For further information address D. Leckie.

KITSILANO, B. C., CAN.—The British Columbia Telephone Company has awarded a contract to Smith & Sherbourne, Vancouver, B. C., for the construction of a new telephone exchange in Kitsilano, to cost $44,000.

SOUTH VANCOUVER, B. C., CAN.—The British Columbia Telephone Company has been granted permission to erect telephone lines in various parts of the city. The company will make extensive additions to its system at once.

VANCOUVER, B. C., CAN.—The city electrician has recommended various improvements needed by the city, which will require an expenditure of $200,000.

VERNON, B. C., CAN.—Arrangements have been made by the Coteau Power Company for the construction of an electric railway to Lumby, work on which will begin as soon as the weather will permit.

VERNON, B. C., CAN.—The Kamloops-Okanagan telephone "circle" has been completed by the government. The circle is 372 miles around and required over 500 miles of wire. Several branch lines will be erected by the government this year.

BRANDON, MAN., CAN.—H. P. Blackwood, attorney, of Winnipeg, Man., has applied to the Manitoba Parliament for a charter for a company which proposes to build electric street railways in and about Brandon.

BRANDON, MAN., CAN.—Plans are being considered for improvements to the water-works system, including the erection of an elevated tank and the installation of two electrically driven pumps. A. W. Shaw is superintendent and engineer.

WINNIPEG, MAN., CAN.—McDonald, Sullivan, Haggart & Tarr, attorneys, are seeking a charter for a company which proposes to construct several electric railways in Manitoba

WINNIPEG, MAN., CAN.—The Winnipeg River Railway Company has applied for a charter for the purpose of building an electric railway from the City of Winnipeg to the Winnipeg River, a distance of seventy miles. H. P. Blackwood is attorney.

WINNIPEG, MAN., CAN.—Tenders will be received by F. C. Patterson, chairman Manitoba Telephone Commission, until Feb. 14 for all supplies and materials required by the department during the present year, the cost of which is estimated at $600,000.

WINNIPEG, MAN., CAN.—Smith, Kerry & Chace, of Toronto, Ont., and Winnipeg, Man., consulting engineers for the civic power plant, now being constructed at Point du Bois, estimate that additional machinery required for the completion of the development will cost $980,000.

WINNIPEG, MAN., CAN.—Plans have been prepared by the Manitoba Telephone Commission for extensive developments and repairs to the system this year, which will involve an expenditure of over $2,000,000. A large number of new lines will be built and rural systems organized this summer. F. L. Patterson is chairman of the commission.

WINNIPEG, MAN., CAN.—Bids will be received until Feb. 22 by Magnus Peterson, secretary Civil Board of Control, for all the conduit work to be done this year. It is proposed eventually to place all wires in the city underground, the cost of which is estimated at $650,000. Specifications may be seen at the office of F. E. Cambridge, city electrician.

DUNDAS, ONT., CAN.—The Hydroelectric Power Commission has announced the rates to be charged for electricity for lamps in Dundas.

The price has been placed at 3½ cents per kw-hour with a discount of 10 per cent for prompt payment. In addition to this charge, and apparently in lieu of meter rent, a monthly charge will be made of 4 cents per 100 sq. ft. of floor space for premises lighted. The rate charged at present by the Hamilton Electric Light & Power Company to small consumers is 10 cents net per kw-hour and 25 cents monthly for meter rent.

HAMILTON, ONT., CAN.—The City Council has adopted a resolution authorizing the Board of Control to engage an engineer to prepare plans and estimates of cost of establishing a distribution plant for electricity to be supplied by the Hydro-Electric Power Commission.

HAMILTON, ONT., CAN.—The Dominion Power & Traction Company is planning extensions to its system during the coming year, which will include the installation of a 6400-kw alternating-current generator and a 7100-hp Voith turbine at its power house in Hamilton, also increasing the output of the substation in Hamilton by 8000 kw, Westinghouse equipment to be installed, and increasing the capacity of the Brantford (Ont.) substation by 3000 kw, using both Westinghouse and General Electric equipment. W. C. Hawkins is secretary and general manager.

CARMANGAY, SASK., CAN.—The provincial government will open an exchange in Carmangay during the next two months and will erect telephone lines to the adjoining settlements.

PRINCE ALBERT, SASK., CAN.—The Dominion Parliament has granted the City of Prince Albert permission to develop a water power north of this city, to cost about $2,000,000, for which preliminaries are now being prepared.

PRINCE ALBERT, SASK., CAN.—The Electric Light Committee is contemplating the installation of a 600-kw direct-connected unit, engine or turbine, in the municipal electric light plant, for which tenders will be called for. Bids will be called for preliminary work in connection with a 10,000-hp hydroelectric plant. R. Wright is superintendent.

REGINA, SASK., CAN.—Plans have been prepared by the City of Regina, for completing the municipal street railway system during 1911, which will involve an expenditure of $212,500 and include the construction of 5½ miles of track, to cost $135,000; six cars, $38,000; snow sweeper, $4,500; car barns, $15,000 and the installation of a generating unit, $20,000. The city plans to expend as much more in 1912.

SASKATOON, SASK., CAN.—Recommendations have been submitted by E. L. White, superintendent of the municipal electric light plant, for improvements and extensions to the municipal plant, requiring an expenditure of $140,650. Additional machinery will be purchased.

New Industrial Companies.

THE ALBERGER GAS ENGINE COMPANY, of Buffalo, N. Y., has been chartered with a capital stock of $221,000 by C. H. Taylor, L. E. R. French and I. G. Holender, all of Buffalo, N. Y. The company proposes to manufacture and deal in engines, machinery, gas engines, boilers, etc.

THE BENTLEY-SNYDER COMPANY, of North Aurora, Ill., has been incorporated with a capital stock of $75,000 by Wilton Bentley, Frederick T. Snyder and James V. Cunningham. The company proposes to manufacture and deal in metals, electricity and electric furnace products.

THE CARR-HAMILTON ENGINE COMPANY, of Wheeling, W. Va., has been incorporated with a capital stock of $25,000 by W. M. Carr, Benjamin E. Hamilton, Jacob Loomis and others. The company proposes to manufacture engines.

THE CARR-HAMILTON ENGINEERING COMPANY, of Wheeling, W. Va., has filed articles of incorporation with a capital stock of $25,000 to do a general engineering business. The incorporators are: W. M. Carr, B. E. Hamilton, Jacob Loomis and others.

THE ELECTRIC FIRE ENGINE COMPANY, of Newark, N. Y., has been chartered with a capital stock of $12,000 to do a general contracting business, etc. The incorporators are: J. A. Hynes, W. L. Browe, Sr., and H. Spangenthal,, of Newark, N. Y.

W. H. GAHAGAN, of Brooklyn, N. Y., has filed articles of incorporation with a capital stock of $25,000 for the purpose of doing a general engineering and construction business. The incorporators are: W. H. Gahagan, H. J. Cusick and H. Frohwitter, of Brooklyn, N. Y.

THE GREYHOUND MOTOR COMPANY, of Buffalo, N. Y., has been chartered by W. A. Chadeayne, G. A. Getter and F. G. Baker. The company is capitalized at $50,000 and proposes to manufacture motor vehicles, engines, meters, etc., and has established its works and offices at 1443 Niagara Street, Buffalo, N. Y.

THE INTERNATIONAL ELECTRIC FIXTURE & CONTRACTING COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $100,000 by Oliver T Hiras, Paul Brown, Jr., and Robert Holmes.

THE T. FRED LEE COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $50,000 for the purpose of manufacturing electrical supplies and appliances. The incorporators are: T. F. Lee, of Brookline, Mass.; W. B. Johnson, of New York, N. Y., and F. F. Green, of New Rochelle, N. Y.

THE MONITOR CONTROLLER COMPANY, of Baltimore, Md., has been incorporated with a capital stock of $5,000 by William B. Turner, William T. Holmes and Charles R. Darling, 106 Gay Street, Baltimore, Md. The company proposes to manufacture mechanical and electrical devices.

THE MORRIN CLIMAX BOILER COMPANY, of Jersey City, N. J., has been chartered with a capital stock of $100,000 by T. F. Morrin, E. T. Morrin and T. J. O'Day. The company proposes to manufacture boilers, steam generators, pipe fittings, etc.

THE NEWCOMB CARBURETOR COMPANY, of Harrison, N. Y., has been incorporated by E. C. Newcomb, of North Scituate, Mass.; E. C. Chamberlain, of New York, N. Y., and G. F. Chamberlain, of Harrison, N. Y. The company is capitalized at $100,000 and proposes to manufacture carburetors, gas-engine supplies, etc.

THE NEW YORK INCANDESCENT LAMP COMPANY, of Owego, N. Y., has been incorporated with a capital stock of $150,000 to manufacture electric lighting fixtures and do a general electrical business. The incorporators are: Frank C. McKinney, of Montclair, N. J.; Raymond E. Taylor, 27 Pine Street, and Joseph Gerrardt, 193 West 134th Street, both of New York, N. Y.

THE NYE COMPANY, of Buffalo, N. Y., has been chartered with a capital stock of $10,000 by George B. Nye, Walter Devereux and William Palmer, all of Buffalo, N. Y.

THE PAUL STEWART COMPANY, of Cincinnati, Ohio, has been chartered with a capital stock of $50,000 for the purpose of dealing with electric lighting, traction and manufacturing corporations throughout America, in buying and selling power equipment and machinery, such as engines, generators, motors, etc. The company has purchased a site in Redbank, on the Pennsylvania Railroad, and has already erected one steel and concrete building, 100 ft. x 54 ft., to be used as a shop and warehouse, equipped with traveling cranes and other appliances. The office of the company will be located in the First National Bank Building, Cincinnati, Ohio. Paul Stewart, formerly with the John A. Stewart Electrical Company, is president.

THE RADIO GAS PRODUCER COMPANY, of St. Louis, Mo., has been chartered by J. W. Kolar, A. J. Cunningham, M. C. Burgman and others. The company is capitalized at $50,000 and proposes to manufacture electrical apparatus.

THE STANDARD ELECTRO-UTILITIES COMPANY (an Arizona corporation) has filed articles of incorporation under the laws of the State of Illinois with a capital stock of $150,000. The company proposes to manufacture electrical and mechanical devices.

THE STIRLING ELECTRIC COMPANY, of Lafayette, Ind., has been chartered for the purpose of manufacturing electric appliances and devices of all kinds and machine tools and instruments, apparatus, etc The incorporators are: Samuel T. Murdock, Thomas Duncan, R. B Wallace and Julius Bealowitz.

THE VICTORIA COMPANY, of Rochester, N. Y., has filed articles of incorporation with a capital stock of $40,000 for the purpose of manufacturing and selling suction cleaners, hardware, specialties, etc. The incorporators are: B. P. Mills, M. F. Van Buskirk and W. S. Johnson all of Rochester, N. Y.

THE WI-KO ELECTRIC COMPANY, of Chicago, Ill., has been incorporated by R. Witz, S. Korf and C. W. Escher, all of Chicago, Ill. The company is capitalized at $25,000 and proposes to manufacture electrical and gas fixtures and appliances.

New Incorporations.

BIRMINGHAM, ALA.—The City Railroad Company has applied for a charter to build an electric railway in Birmingham, Ala. The company is capitalized at $3,000 and the officers are: Paul Mitchell, president: DeWitt B. Lightber, vice-president and treasurer, and A. F. Kummer, secretary.

BENSON, ARIZ.—Articles of incorporation have been filed for the Benson Electric Light, Power & Ice Company by Peter Jensen, R. C Arthur, W. M. Adamson, S. F. Meguire and M. J. Cunningham. The company is capitalized at $150,000 and proposes to generate and furnish electricity for lamps and motors and conduct an ice and real estate business.

FRESNO, CAL.—The Fresno, Coalinga & Tidewater Company has been incorporated with a capital stock of $300,000 by Charles J. Shaw, of Hollister, Cal.; A. G. Metz, of Monterey, Cal.; W. J. Kilby and Frank Cheney, of Coalinga, Cal.; J. W. Briscoe, of Bakersfield, Cal., and others. The company proposes to construct an electric railway to connect Fresno, Coalinga, Tidewater and Monterey.

LOS ANGELES, CAL.—The Aerial Trolley Car Company has been incorporated with a capital stock of $100,000 by J. A. K. McMillan, A. E Dufur, C. C. Melrose, J. W. and E C. Fawkes.

SAN FRANCISCO, CAL.—The Shasta Valley Power, Land & Irrigation Company has been incorporated with a capital stock of $300,000 by C. Chinn, L. J. Hehring and J. W Cochrane

WILMINGTON, DEL.—The National Public Service Corporation has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $300,000. The incorporators are W. N. Akers, M. C. Taylor and W. I Malony, of Wilmington, Del.

EARLVILLE, ILL.—The Earlville Electric Light & Ice Company has been chartered with a capital stock of $25,000 by John A. Dupee, C. A. Frank, A. C. Sadler and others. The company proposes to generate electricity and gas and supply steam heat and ice.

EUREKA, ILL.—The Eureka Electric Service System, of Eureka, has been incorporated with a capital stock of $40,000 by T. O. Tanton, Mary H. Whetzel and H. W. Bullock. The company will take over the Eureka Electric Service System, owned and operated by the late W. J. Whetzel, who was killed recently, an account of the fatal accident having been given in the issue of Dec. 29, 1910. The company will supply electricity in Eureka and deal in electrical supplies.

WHAT CHEER, IA.—Articles of incorporation have been filed for the What Cheer Electric Light Company with a capital stock of $4,000 by Burris Wilson, L. C. Wilson and Robert Bowie.

ASHVILLE, KY.—The Citizens' Telephone Company has been granted a charter with a capital stock of $3,000. The incorporators are: E. W. Elliott, J. C. Bruce, J. G. Coffman and others.

HAZARD, KY.—The Jackson-Hazard Company has been incorporated for the purpose of constructing a long-distance telephone system from Jackson to Potters Fork, Ky., a distance of fifteen miles. The company will rebuild the three exchanges.

BINGHAM LAKE, MINN.—Articles of incorporation have been filed for the Bingham Lake Rural Telephone Company with a capital stock of $2,000 by John H. Henderson, V. E. Rogers and William H. Dummett, Jr.

MAYSVILLE, MO.—Articles of incorporation have been filed for the DeKalb County Electric Light Company with a capital stock of $15,000 by E. A. Bunton, W. F. Wingate and O. W. Idon.

BROADVIEW, MONT.—Articles of incorporation have been filed for the Treasurer State Telephone Company with a capital stock of $25,000 by H. W. Bangert, A. Bouchard and E. S. Kingman.

SANTA FE, N. M.—The Valley Telephone Company has been incorporated with a capital stock of $50,000 by J. R. Livesay, William E. Beecher and C. B. Bosworth.

JOHN STATION, N. C.—Articles of incorporation have been filed for the John T. John Company with a capital stock of $125,000 by S. T. John, W. A. McKoy, F. A. Kendall and R. F. Stewart. The company proposes to build an electric-light plant and engage in a general mercantile business.

KERNERSVILLE, N. C.—Articles of incorporation have been filed for the Sedge-Jordan Telephone Company by D. W. Sink, of Winston-Salem, N. C., and others. The company is capitalized at $10,000.

LAKEVIEW, N. C.—The Electric Light & Power Company, of Lakeview, has been chartered with a capital stock of $25,000 to develop water-powers, install electric plants and to supply electricity for lamps and motors. The incorporators are: F. R. Danley, J. R. McQueen and J. B. Eastman.

WALLACE, N. C.—A charter has been granted to the Duplin Light & Power Company with a capital stock of $10,000 for the purpose of operating a light and power plant in Wallace. J. C. Carey and others are incorporators.

CHEHALIS, ORE.—The Chehalis & Cowlitz Railroad Company has been chartered to build a railway from Chehalis to a point on the Cowlitz River on Cowlitz Prairie, twenty miles southeast of Chehalis, to be operated either by steam or electricity. The company is capitalized at $300,000 and the incorporators are: H. C. Coffman and George A. Robinson.

BEAVER MEADOW, PA.—The Beaver Meadow Electric Company has been granted a charter with a capital stock of $5,000. The directors are: Calvin Pardee, Jr., of Hazleton, Pa., treasurer; Alfred D. Pardee and Calvin Pardee, both of Philadelphia, Pa.; A. W. Drake and John S. Wise, both of Hazleton, Pa.

COLMAR, PA.—The Caln Township Electric Company has filed articles of incorporation with a capital stock of $195,000. The directors are: L. Albert Gray, of Colmar, Pa.; Charles C. Aeugle and John H. Nash, both of Philadelphia, Pa.

COLMAR, PA.—The Chester Valley Electric Company has been incorporated with a capital stock of $5,000 and the following directors: L. Albert Gray, of Colmar, Pa., treasurer; Charles C. Aeugle and John H. Nash, both of Philadelphia, Pa.

EAST GREENVILLE, PA.—The East Greenville Electric Light, Heat & Power Company has been incorporated with a capital stock of $5,000 by James A. Krauss, William I. Zyner, Jacob N. Knetz and Adam J. Dimming, all of East Greenville, Pa. Levi Y. Meschter, of East Greenville, Pa., is treasurer.

MEADVILLE, PA.—Articles of incorporation have been filed for the Meadville Electric Light Company with a capital stock of $6,000. The directors are: Charles Blystone, John E. Reynolds and Rufus C. Adams, all of Meadville, Pa.

ORANGEBURG, S. C.—Articles of incorporation have been filed for the Orangeburg Railway Company with a capital stock of $50,000 to construct a railroad from Orangeburg to Springfield, thirty miles in length, to be operated by steam or electricity. W. C. Wolfe is president and J. A. Berry, secretary, both of Orangeburg, S. C.

ABERDEEN, WASH.—The Citizens' Lighting & Power Company has been organized by local capitalists. The company has secured a lease on the Anderson & Middleton mill power plant and has applied to the City Council for a franchise to supply electricity for lamps and motors in Aberdeen. It is said that the company also proposes to operate an electric railway.

BRANTFORD, ONT., CAN.—The Lake Erie & Northern Railway Company has applied to the Dominion Parliament for a charter to build a radial electric railway from Brantford to Port Dover. The capital stock of the company is placed at $1,000,000, and the incorporators are: H. Donley, of Simcoe; W. S. Brewster, R. E. Ryerson, John Muir and W. D. Schultze, of Brantford.

OTTAWA, ONT., CAN.—Articles of incorporation have been filed for the North Fork Power Company, with a capital stock of $500,000. The directors are: F. H. Chrysler, C. J. R. Bethune and N. G. Larmouth, all of Ottawa.

PORT ROWAN, ONT., CAN.—The Port Rowan & Rural Telephone Company has been incorporated, with a capital stock of $5,000, by J. W. Robison, J. S. Smith and J. L. Beck.

SUTTON, ONT., CAN.—The Sutton & North Gwillimbury Telephone Company has been chartered with a capital stock of $5,000 by W. Merritt, S. B. Purdy and W. Winch.

Personal.

MR. CHARLES B. HUNT has resigned as manager of the London (Ont.) Electric Company.

MR. JOHN S. MALTMAN, formerly superintendent of the Kankakee (Ill.) Electric Light Company, is now electrical engineer with the Robertson Engineering Company, Baltimore, Md.

MR. WINFIELD A. HUPPUCH has been appointed member of the New York Public Service Commission, Second District, to succeed Mr. John N. Carlisle, whose term of office has expired. The position pays $15,000 per year.

MR. ARTHUR ALLARD, formerly assistant engineer of the Mexican Light & Power Company, Mexico City, has been appointed manager of the Compañia de Luz y Fuérza del Istmo de Tehuantepec, Oaxaca, Mexico.

MR. DELMER C. FINDLAY, who was formerly associated with Smith, Kerry & Chase, Calgary, Alberta, Canada, has been made electrical engineer for the Vancouver Portland Cement Company, Victoria, B. C., which is equipping its mill for electrical operation.

MR. C. E. DOWNTON, assistant superintendent of the Westinghouse Electric & Manufacturing Company, will lecture on Feb. 9 before the senior class of Rose Polytechnic Institute, Terre Haute, Ind., on "The Advantages of an Apprentice Course."

MR. E. ST. CLAIR CLAYTON delivered an address on "Practical Motor Work" at the semi-monthly meeting of the Baltimore Consolidated Company's section of the National Electric Light Association, held Jan. 31 at the physical laboratory of the Johns Hopkins University. The lecture was a comprehensive presentation of the subject and was illustrated by lantern slides showing a wide range of installations in Baltimore and cities throughout the country.

MR. L. S. TWOMEY has been appointed Pacific Coast representative of the engineering department of the National Electric Lamp Association and has opened an office at 1648 Sixteenth Street, Oakland, Cal., where he will have charge of the illuminating and commercial engineering and publicity work of the association's technical department for the Western States.

Obituary.

MR. FREDERICK G. HESSE, emeritus professor of mechanical engineering at the University of California, died at his home in Oakland, Cal., on Jan. 27, at the age of eighty-six. Prof. Hesse was well known in engineering circles on the Pacific Coast, where he gained prominence from the invention of many of the principal features of the Pelton, or tangential, type of water-wheel.

MR. LOUIS R. ALBERGER, president of the Alberger Condenser Company and of the Alberger Pump Company, of New York City, died at his home in New York on Jan. 31. Mr. Alberger was born at Buffalo, N. Y., April 10, 1864, and after the usual preliminary education entered Yale College. After leaving Yale he went into business with his father, Mr. J. L. Alberger, of Buffalo, who was experienced in the vacuum processes used in the salt industry. In 1887 Mr. Alberger came to New York and entered the employ of Henry R. Worthington, and when in 1901 he left the latter firm and formed the Alberger Condenser Company he was recognized as one of the best informed men in the condenser and pump industry. The Alberger Pump Company was formed in 1907. The interment took place in Mr. Alberger's native city on Feb. 3.

MR. HAWTHORNE HILL, who for the past twelve years had been associate editor of the *India Rubber World*, died from an attack of pneumonia at his home in Brooklyn, Feb. 2. Mr. Hill was born in Marion, Ky., April 13, 1857, and his entire business life was devoted to editorial work. Before coming to New York in 1887 he was upon the editorial staff of the Louisville *Courier-Journal*. In New York Mr. Hill was connected with the *World* and *Sun* for a time, but in 1889 determined to give up daily newspaper work and cast his lot with technical journalism. His first connection was with *Hardware*, which had just been established by Mr. John R. Dunlap. He was also associated with Mr. Dunlap when the *India Rubber World* and the *Engineering Magazine* were founded. In 1899 the *India Rubber World* was bought by Mr.

Henry C. Pearson, and Mr. Hill continued with the paper as associate editor. Mr. Hill in 1886 married Miss Lillian Sawyier, of Frankfort, Ky., who survives him. He also leaves two grown sons and a daughter. The interment was in Greenwood Cemetery, Feb. 4.

DR. F. A. KJELLIN, well known for his connection with the development of the electric induction furnace, died Dec. 30, 1910, in Stockholm, Sweden, after a very short illness. Dr. Kjellin was born in Vardinge, near Stockholm, on April 27, 1872. He was educated at the Royal Technical Institute in Stockholm, from which he graduated in 1893. During the years 1893-1895 he carried out a great deal of experimental work in chemistry and metallurgy and worked out a new method for the electrolytic precipitation of zinc. During 1895-1897 he assisted Professor Wiborgh in developing the well-known Wiborgh thermophon for the determination of high temperatures. From 1897 to 1899 he was engaged in the developing of the so-called "Lux light," which is now used very extensively in Europe. Dr. Kjellin has the honor of having improved the electric furnace almost to perfection technically and made it commercially successful, and all the induction furnaces known to-day are founded on the same principles, which only shows that Dr. Kjellin had to share the fate of many other inventors in not being able to cover his inventions fully by patents. The induction furnace was invented and patented long before, but it was not until 1899, when Dr. Kjellin installed his first furnace at Gysinge, that it became a commercial success. During the years 1899 to 1904 he superintended the steel works at Gysinge. In 1904 he became co-owner of the Swedish Metallurgical Company and stayed with this company in the capacity of chief engineer until recently, when he founded the Allians engineering bureau in Stockholm. In 1907 the University of Upsala bestowed upon him the honorary degree of Doctor of Science.

F. A. KJELLIN

Trade Publications.

ELECTRICAL INSTALLATIONS.—Bulletin No. 111 of the Sprague Electric Company, of New York, contains a number of generator-room illustrations and a large though partial list of installations of the company's engine-type generators.

TELEPHONE ARM.—The E-B Sales Company, Newark, N. J., has issued an illustrated folder devoted to telephone arms which can be attached to any kind of a desk, table, wall, post or window casing, and remains self-balancing in any position.

RECORDING GAGES.—Bulletin No. 140 of the Bristol Company, Waterbury, Conn., covers a complete line of recording gages for pressure and vacuum. It is stated that more than 20,000 Bristol recording gages have been sold for all varieties of industrial service.

DRUM CONTROLLERS FOR INDUSTRIAL SERVICE.—The General Electric Company issued Bulletin No. 4811, describing its drum controllers. This bulletin contains descriptive matter and data in considerable detail and supersedes the company's previous bulletin on this subject.

WIRES AND CABLES.—A publication which should be of service to purchasing agents, central-station managers and all having occasion to buy or use wire and cable for any service is the General Electrical Company's Bulletin No. 4787, devoted to wires and cables. The book contains much data.

OIL-BREAK SWITCHES FOR POLE-LINE SERVICE.—Bulletin No. 4813, issued by the General Electric Company, describes an oil-break switch adapted to use on alternating-current series arc systems for sectionalizing feeder systems, cutting in and out transformers, and similar classes of service requiring a switch to be operated under load.

TRANSFORMERS.—Bulletin No. 451 issued by the Triumph Electric Company, of Cincinnati, Ohio, describes the company's line of transformers designed for overhead work. These are built for single-phase circuits of all standard voltages and frequencies, the standard lighting transformers being wound for 1100-2200 primary and 110-220 secondary voltage.

ELECTRICAL VEHICLE AMPERE-HORN METER.—The Sangamo Electric Company, of Springfield, Ill., is distributing an attractive booklet entitled "The Ampere-Hour Meter for Electric Vehicles." Considerable information is given as to the proper method of charging both commercial and pleasure vehicles. This publication should be of interest to central-station managers who are soliciting charging loads.

FEEDER VOLTAGE REGULATORS.—The General Electric Company has issued a revised bulletin, No. 4791, which supersedes its previous bulletins on this subject, "Feeder Voltage Regulators." The bulletin describes regulators of the induction type and switch type, single and polyphase, hand-operated and automatically operated. It contains connection and dimension diagrams, together with weights of the various regulators described.

INTERIOR CONDUITS AND FITTINGS.—Sprague Electric Company, New York, issued in January Catalog No. 436, giving descriptions, illustrations and prices of iron-armored insulating conduit, Greenfield flexible steel-armored conductors; Greenfield flexible steel conduit, double and single strip types; Greenfield steel-armored flexbile cord; boxes, fittings, tools, etc. The catalog is divided into six sections and covers the entire conduit products of the Sprague company.

ARCHITECTURAL ILLUMINATION.—An attractively executed souvenir booklet issued by the Banner Electric Company, Youngstown, Ohio, illustrates and describes the illumination of the magnificent Allegheny County Soldiers' Memorial in Schenley Park, Pittsburgh, Pa., the artificial illumination of which edifice has been pronounced by critics to be one of the greatest achievements of illuminating engineering. Seven four-color views and a number of small sketches show details of the memorial and blending of the illumination with the architecture.

SWITCHES AND SOCKETS.—Catalogue No. 13, issued by the Arrow Electric Company, Hartford, Conn., covers the latest steps in the evolutionary development of Arrow switches and sockets. The company's surface switches are characterized by lightness of moving mechanism, quick break, mechanical strength and smooth action. The push button switches are constructed with the binding posts thoroughly locked in porcelain. The sockets have a center contact of rounded phosphor bronze and the porcelain is designed to permit a straight run for the wire and ample room for wiring. The snap socket is already familiar to our readers. Other Arrow specialties are included in the catalogue.

SMALL DIRECT-CURRENT BELTED GENERATORS.—In Bulletin No. 4812, issued by the General Electric Company, are described small direct-current generators ranging in rating from 1¼ to 20 kw, and suitable for small plants, hotels, residences, factories or mills, where the average length of the feeder circuits is 400 yards or less and the maximum length is not greater than three-quarters of a mile. The generators are provided with sliding bases which facilitate adjustment of the belt and can be installed on the floor, wall or ceiling. With the exception of the 1¼-kw generators, all are provided with commutating poles, so rendering a change in position of the brushes with change of load unnecessary. The bulletin contains table of ratings, weights and dimensions.

ARC-LAMP LOWERING GEAR.—The arc-lamp lowering gear made by the London Electric Firm, Croydon, England, consists of an improved contact and suspension device, having one working part and a self-sustaining winch. The device does not depend on the action of springs, levers, catches or clutch gear. There is a plunger with two piston-ring contacts and a pin engaging a ratchet to take the weight off the rope. The gear can be fitted to any existing arc lamp, span wire, etc., and by means of fittings can be used for converting any form of fixed arc lamp into one that can be lowered for trimming and repair. List No. 125, issued by the company, illustrates and describes all the various lowering gears and fittings and their applications. A large number of photographs of converted carriers are given to show the applicability of the system to nearly all types of existing arc-lamp posts.

STEAM TURBINES.—The De Laval Steam Turbine Company, of Trenton, N. J., has just published a 120-page book, which is probably the most complete commercial exposition of the steam turbine that has so far appeared. The work is devoted to single-stage turbines, with and without gears, but in order to explain the relative advantages of the several types of turbines, as multi-pressure and multi-velocity stage types and re-entrant types, it takes up the various questions connected with available energy in the steam between different pressures and temperatures, spouting velocities, effects of pressure and vacuums, steam friction, forms of nozzles and buckets, strength of wheels, disks and drums, vibration of rigid and flexible shafts, proper speeds for driven machines, such as direct and alternating-current generators, centrifugal blowers and pumps, advantages of rope and belt drives for many situations, etc.

BUSINESS NOTES.

NEW FT. WAYNE ARC LAMP.—A new type of magnetite lamp embodying underfeed up draft is being developed by the Ft. Wayne Electric Works. The lamp was designed by J. J. Wood, general manager of the works, and tests indicate it to be highly satisfactory.

GARWOOD AGENCIES.—The Garwood Electric Company has appointed Mr. Henry Widmer, 73[illegible] Union Street, New Orleans, La., as agent for the sale of its product in the State of Louisiana, southern part of Mississippi, City of Mobile, Ala., and all territory within a radius of fifty miles of this city. Mr. Milton S. Nettleton, 29 College Street, New Haven, Conn., has also been appointed as its agent for City of New Haven and surrounding territory.

TELEPHONE CONDENSER COILS.—A new departure in the manufacture of telephone condenser coils has recently been decided upon by the Electric Specialty Company, of Cresco, Ia., which is now impregnating coils as a whole instead of using the former method of insulation. The company has recently added a modern vacuum drying and impregnating apparatus to its equipment, having purchased one of the latest and improved types of machines, with cast-iron steam-jacketed tanks, as manufactured by the Buffalo Foundry & Machine Company, of Buffalo, N. Y.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JAN. 31, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

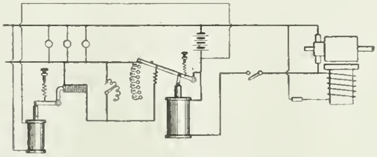
982,784. DYNAMO ELECTRIC MACHINE; B. A. Behrend and A. B. Field, Pittsburgh, Pa. App. filed Oct. 28, 1909. The rotor is a concave cylinder which turns inside of a cylindrical stator so that the air gap is greater through the middle portion of the rotor core than at the ends, thus producing uniform density of the flux.

982,789. ELECTROMAGNETIC POWER-TRANSMITTING MECHANISM; A. J. Bowie, Jr., San Francisco, Cal. App. filed April 18, 1907. A positively driven power shaft with a plurality of electromagnetic induction mechanisms between the power shaft and the driven shaft, the mechanisms being preferably magnetic clutches.

982,800. ELECTRIC REGULATION; J. L. Creveling, New York, N. Y. App. filed Feb. 2, 1909. A generator with storage battery, a lamp circuit, resistance being centered in the lamp circuit depending upon the output of the generator and determined and regulated independently by the voltage across the battery.

982,804. CLOCK; H. C. Ehrick, Bucyrus, Ohio. App. filed May 27, 1910. Clocks controlled from a master clock, the latter having a contact caused by the second hand at minute intervals to energize the electromagnetic actuating means and the local clocks.

982,806. DYNAMO ELECTRIC MACHINE; C. J. Fechheimer, Milwaukee, Wis. App. filed May 13, 1909. A rotary member with core, the end portions having rings of greater diameter than the middle and thicker near the center than near the periphery, so as to secure uniform flux density.



982,800.—Electric Regulation.

982,809. AUTOMATIC HOIST; G. C. Grable, Minneapolis, Minn. App filed April 18, 1907. Hoists with reversibly movable cars with an electric control for the cars of scales, including a reversing switch, a rheostat and magnetic controllers with a switch lever for each car connected to the controllers and controlled by the cars.

982,811. DYNAMO ELECTRIC MACHINE; A. M. Gray, Milwaukee, Wis. App. filed April 3, 1909. Secures uniform flux density by means of rotary and stationary cores separated by an air gap of uniform width throughout the middle of the machine and of less width at the ends.

982,813. DYNAMO ELECTRIC MACHINE; D. Hall, Norwood, Ohio. App. filed Jan. 15, 1906. Auxiliary winding on a double commutator machine for utilizing armature reaction, including balancing coils, one portion of the coils in series with the brushes at one commutator and another portion in series with the brushes in the other commutator.

982,822. AUTOMATIC FIRE DETECTOR; R. Y. Hughes and L. J. Hoffmann, Aberdeen, S. D. App. filed July 30, 1909. Thermostat containing within an elongated member a mass of mercury in a fusible plug occupying less than the internal capacity of the member.

982,830. DYNAMO ELECTRIC MACHINE; A. Kingsbury, Pittsburgh, Pa. App. filed March 4, 1907. For air circulation and cooling, the dynamo having a middle chamber with one or more side exhaust ports and containing armature and field magnets, an end chamber communicating with the middle chamber, inlet ports at one side of the end chamber and inlet ports for the middle chamber adjacent to those of the end chamber.

982,831. THERMOELECTRIC COOKER; R. S. Kirkpatrick, Des Moines, Ia. App. filed March 11, 1908. A container with a padding lining in which the article to be cooked is placed, a metallic lining within the insulating lining, an electric heater within the metallic lining and a cover for the container.

982,841. SWITCH BOX OR RECEPTACLE; C. C. Maison, Cleveland, Ohio. App. filed Feb. 15, 1910. The box has ears for fastening it to the thin partitions in which it is mounted and is provided with apertures through which the wires pass.

982,869. ELECTRIC SWITCH; W. T. Pringle, Philadelphia, Pa. App. filed April 7, 1909. A knife switch covered by a casing to hold the lever in its different positions, two spring-pressed arms surrounding the switch handle to hold the switch.

982,872. ELECTRIC LIGHTING SYSTEM; F. W. Reeves, Pittsburgh, Pa. App. filed Aug. 23, 1909. To prevent current loss in incandescent lamps, the current being supplied by a current interrupter instead of by the constantly connected generator. The interrupter consists of a rotary brush between the generator and the lamp circuit controlling contact.

982,873. CURRENT CONDUCTOR; J. Regenstreif, Berlin, Germany. App. filed June 2, 1910. For incandescent lamps in which the stem carries a framework which carries a filament, which framework is supported by a collar surrounding the stem.

982,897. MOTOR CONTROL SYSTEM; E. W. Stull, Norwood, Ohio. App. filed April 10, 1908. Fluid means operate the switch of a railway system, the switches being individually removable from the casing actuated means.

982,913. APPARATUS FOR CONTROLLING ELECTRIC MOTORS; G. H. Whittingham, Pikesville, Md. App. filed May 31, 1910. For controlling motors for printing presses with a main switch, resistance regulator, electromagnet for controlling the resistance and an electromagnetic break with switch and connections for de-energiznig the break without de-energizing the electromagnet which controls the resistance

982,930. ELECTRIC SIGNALING DEVICE; D. M. Bliss, New York, N. Y. App. filed March 18, 1907. Current converter for signaling, the signals being of the harmonic type and acting selectively, the converter being a rotary switch operating on segments connected through resistance coils and divided into sets so that in the rotation of the commutator the current delivery is reversed in direction and varied in strength.

983,029. MAGNETO-ELECTRIC MACHINE; W. W. Dean, Elyria, Ohio App. filed Jan. 28, 1910. Magneto-electric machine for automobiles with a horseshoe magnet mounted upon the base, carrying a soft iron pole piece inside one of the limbs, a heavy metallic winding beneath the pole piece and an armature between the poles.

983,039. INSULATOR PROTECTOR; J. E. Field, Gains, Mich. App. filed Feb. 17, 1910. A blank including a neck overlying the upper end of the insulator and enveloping it below the upper end, the neck having a loop for the passage of a wire.

983,043. METHOD OF SUPPLYING ELECTRIC FURNACES WITH POLYPHASE CURRENTS; P. Girod, Ugine, France. App. filed Aug. 24, 1910. Distributes the current equally among the several electrodes by inverting the terminals of one of the transformers supplying the furnace, so as to increase the potential difference between those electrodes which are separated by the greater resistance.

983,062. STORAGE BATTERY ELECTRODE; P. J. Kamperdyk, New York, N. Y. App. filed Dec. 6, 1909. Conducting plate with edge ribs and intermediate intersecting ribs with porous cups in the cells between the ribs, the cups having edge ribs on all their sides, a corrugated face and longitudinal ribs filled with active material at the side adjacent to the conducting plate.

983,063. MOTOR CONTROLLING SWITCH; S. H. Keefer, Plainfield, N. J. App. filed Nov. 8, 1909. For starting and reversing motors by means of a solenoid, two contacts carried by the movable member thereof, two fixed contacts for engaging the solenoid contacts when the latter is de-energized and two fixed contacts engaged by the solenoid contacts after it is energized, thus making it impossible to reverse the motor, even though the pilot switch be manipulated, until the counter e.m.f. has fallen to a predetermined point.

983,098. TELEPHONE SYSTEM; F. C. Unger, St. Louis, Mo. App. filed Nov. 1, 1909. Local battery or magneto system with grounded generator connected to the cord circuit at central, repeating coil bridged across the cord, clearing out drop connected to the middle contacts of two of the coils of the repeating coil and also connected to the generator and subscribers' telephones provided with local batteries.

983,113. APPARATUS FOR LIGHTING LAMPS; E. Barber, Philadelphia, Pa. App. filed Feb. 23, 1910. Automobile with acetylene lamps to be ignited from the sparking current, the connections being thrown by switch whose contacts are normally connected with the circuit of the gas engine igniter and which can be connected with circuit wires having sparking contacts adjacent to lamp burners.

983,161. ELECTRIC CONDUCTOR; E. Morss, Boston, Mass. App filed Jan. 17, 1910. Insulated conductor with braided covering having a warp thread of a thickness to form a raised line so as to identify the conductor.

983,162. ELECTRIC WALL BOX; M. Murray and J. D. MacDougal, Chicago, Ill. App. filed Jan. 25, 1909. Outlet box with flange on the end wall having a notch on its inner end so as to form guide wheels, attaching ears on the ends of certain flanges, a panel sliding in the guide ways and an ear on one end of the panel lying against one of the attaching ears when the panel is closed.

983,175. ELECTRIC PRIMARY BATTERY; F. W. Spanutius, Jersey City, N. J. App. filed March 21, 1905. Primary battery having one set of stationary electrodes and a set of rotating electrodes secured to a shaft and driven through gearing.

983,178. ELECTRIC CUT-OFF; W. N. Sturgeon and H. R. Shanley, Galesburg, Ill. App. filed April 29, 1910. Snap switch with bearing yoke, key shaft and coiled spring, one terminal secured to the base of the yoke and the opposite terminal to the shaft.

983,190. INDICATING DEVICE; C. N. Wisner, Memphis, Tenn. App filed Jan. 31, 1910. Signboard for stock quotations having indicating wheels carrying numbers and a series of magnets with armatures and stops for stopping the wheel in a predetermined position.

983,191. ELECTRIC SIGNAL SYSTEM; F. B. Wood, New York, N Y. App. filed July 6, 1908. Fire alarm system with make and break wheels, locking devices therefor and unlocking magnet for each transmitter, an unlocking circuit and means for operatively including but one of the magnets in the unlocking circuit at a time.

983,230. DYNAMO BRUSH HOLDER; O. Hohme, Radebeaul, near Dresden, Germany. App. filed Nov. 17, 1909. Two clips with a carrier adjustably connected therewith, pins on the carrier, a brush box with slots suspended from the pins and a spring-pressed brush in the box.

983,235. RAIL BOND; J. A. Jamison, Wilkinsburg, Pa. App. filed Aug. 10, 1910. A sleeve of ductile metal surrounds the bolt and is expanded into electrical contact with the walls of the bolt hole in the rails.

983,240. TELEGRAPH SYSTEM; I. Kitsee, Philadelphia, Pa. App. filed Feb. 1, 1909. Positive and negative impulses are transmitted over the line and control a signaling device, either the ascending or descending portion of the wave being relatively steep and converter being employed at the receiving end in whose secondary a sharp wave is induced, doing away with relays for controlling the receiver.

983,245. ELECTRIC APPARATUS; C. A. Lohr, Chicago, Ill. App. filed Feb. 11, 1908. For making and breaking contacts in mercury lamps by setting the liquid in rotation through centrifugal force and starting an arc in the evacuated space by the deformation of the liquid.

983,258. CONNECTOR FOR ELECTRIC CONDUCTORS; W. L. Bliss, Brooklyn, N. Y. App. filed Aug. 27, 1907. Two complementary members are provided, a plurality of electric conductors projecting from one, and sockets being carried by the other with means for locking the complementary members in coupled position.

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DISCRIMINATION IN POSTAL RATES.

A measure affecting the interests of subscribers to technical journals has come before Congress in the form of an amendment to the post office appropriation bill. In a rider to the appropriation bill it is proposed to increase from 1 cent to 4 cents per pound the rate of postage on the advertising sections of certain classes of publications. All the daily newspapers and certain small publications whose mailings per issue amount to 4000 lb. or less are to retain the rate of 1 cent per pound. The imposition of a rate of 4 cents per pound on the advertising pages of the popular magazines and on technical and trade journals (which have little or no political influence), while the great dailies with their enormous Sunday editions and their so-called Sunday magazines retain the rate of 1 cent, would, if enacted into law, constitute a rank discrimination. It would practically wipe out the profits of some publications and would put many reputable journals out of business. It would affect journals like the *Electrical World* to such an extent that they would be forced to pass at least a part of the burden on to their subscribers and advertisers in higher charges for services rendered. While this journal is perfectly willing to pay what it should to meet the needs of the government, it protests and asks its friends to protest against a proposal that threatens unnecessarily to cripple it. The postal deficit arises from inefficient management, not from low rates on second-class matter. The loss on the rural free delivery system should not be made up by exorbitant charges levied on the publishers of reputable periodicals.

THE CHICAGO TELEPHONE CONVENTION.

Having been once postponed, doubtless owing to important considerations of policy, the annual convention of the National Independent Telephone Association, held in Chicago on Feb. 8, 9 and 10, was awaited with interest in view of the great unrest in the telephone field. In the last year or two there have been many mergers or alliances of Bell and Independent companies and there have been rumors of still more important combinations in the last few weeks, the name of the financial house of J. P. Morgan & Company being freely mentioned in connection with the alleged negotiations. It was felt that the National Independent Telephone Association might make some declaration on the subject that would be interesting, at least, and perhaps of much importance. What the association did was to adopt resolutions saying that any statement to the effect that the officers of the association had been holding frequent conferences with the Bell company or J. P. Morgan & Company looking to the merging of all Independent and Bell interests was without foundation in fact; further, that the association was organized for the benefit of the strictly Independent operating companies; that the organization had never authorized negotiations looking toward a merger with competing interests, and that it "avows its purpose to be the further development and the perpetuation of the integrity of the Independent telephone system as a whole." The first clause of these resolutions may be variously interpreted, but the concluding statement quoted seems to be a defiant declaration of adherence to competition rather than combination in telephone service.

The president of the association, Mr. Woods, who was active at the 1910 convention in introducing the contract plan of association organization, admitted that the parent Bell company has bought many Independent plants in the last few years in important centers. He recommended, first, the regulation of telephone companies by public-service commissions, and, second, compulsory physical connection, by law, of telephone properties. The association adopted resolutions strongly indorsing the first proposition. As to the second, the opinion at the convention seemed to be all in its favor and probably the most impressive address of the meeting was made by Mr. Theodore Gary in favor of it; nevertheless, there seems to have been no formal official action to recommend to the public and the lawmakers the compulsory physical connection of telephone properties. Many able men attended the convention, but there seemed to be some feeling of uncertainty in the air and the only important action was that summarized above. One result of the convention should be to give an added impetus to the public-service commission idea, for the Independents are numerous, geographically widespread and not without much political influence in many of the States.

LIGHTING IN ARCHITECTURE.

It would seem that each step taken in the development of decorative lighting has been initially a hazardously wasteful step from the standpoint of economics as existing at the time. Primitively, lights were used either to signal with at a distance or to find the path by. The notion of light as a decorative agent can hardly be said to have manifested itself in ancient times. The first possibilities in this direction came about with the production of candles in colored translucent chambers, such as glass bowls, or Chinese paper lanterns. Later developments arose with the advent of gas, when the architectural elements of a building could be clearly limned out at night by lines of gas jets. Still later developments arose with the various types of electric lamp as they appeared. But each new application for purely decorative purposes was essentially an extravagance at the time of its appearance. We are gradually coming to realize that if a decorative application of any kind can be made sufficiently pleasing to the mind its cost of production may be considerable and yet be not worth taking into account from the treasury of a large community. From a purely utilitarian standpoint there is perhaps no more extravagant and unjustifiable expense than that of suporting a picture gallery or a symphony orchestra, and yet a world in which neither of these forms of expenditure could find advocates would be a more sad and dismal world than ours. In the same way extravaance in expense of public lighting may be well worth while if the esthetic and decorative effects produced are commensurate, in the public estimation, with the cost.

For instance, in all recent national and international exhibitions, such as those of Paris, Chicago, Buffalo and St. Louis, a very prominent feature of the decoration has been the illumination of the buildings and grounds at night, both by electricity and by gas. Here the esthetic effects produced have been considered as outweighing the very considerable expense of the lighting equipment. It seems likely that the large cities will develop lighting effects more and more as time goes on. The change which has come about in this respect during the last decade is very striking. It is probably due not alone to greater facilities for supplying lighting, but also to a greater public appreciation of, and demand for, esthetic artificial outdoor illumination. It is particularly in this direction that the progress of illuminating engineering toward more efficient illuminants will be of great public service. Doubling the illuminating value of a given amount of electrical power means a vast esthetic possibility of gain.

MEASUREMENTS OF INTRINSIC BRIGHTNESS BY A NEW METHOD.

It is a remarkable fact that the most elementary and fundamental visual concept is that of brightness. Yet in our industrial and scientific measurements, or in our photometric literature and discussions, the term and the measure of brightness are conspicuously absent. When we direct our eyes toward any group of illuminated objects we are ordinarily conscious at once of differences in their brightness, and it is largely owing to such differences in brightness that we are able to interpret the image formed on the retina in relation to the qualities and disposition of the objects viewed. Similarly, when we look at a group of luminous sources the differences between their brightness is the first conception ordinarily formed in the mind. Yet when we come to examine text-books on photometry, or on the photometric aspects of vision, it is remarkable how much is left unsaid concerning brightness by comparison with what is said concerning luminous intensity, luminous flux, illumination and other topics. Yet these subjects so voluminously discussed are secondary to brightness in the order of psychological development.

One reason for the modesty of brightness in our literature and speech, as compared with its assertiveness in sensation, is that we have had very few methods of, or means for, measuring it. The brightness of a luminous source may be defined as the surface density of its candle-power, as measured perpendicularly to the surface. If we know the candle-power of a luminous source, as well as its surface area in square centimeters and the geometrical relations of that surface, we can derive the candle-power per square centimeter or brightness of the source. In general, the brightness will not be the same at all parts of the surface. Moreover, except when a lamp is inclosed in a translucent and heavily frosted globe it is not easy to find the surface area of the source. In the case of a candle-flame, for instance, we find it hard to determine the surface area of the flame, and the brightness of the flame expressed in candles per square centimeter differs in different parts of the flame. Messrs. Herbert E. Ives and M. Luckiesh describe, on page 438 of this issue, an interesting method of measuring the brightness at, or in the immediate vicinity of, a point on a luminous surface. It consists essentially in superposing on the retina of the eye the image of the said point on the image of a luminous surface of known and adjustable brightness in such a manner that the two images blend together without perceptible discontinuity when the two brightnesses are equal. Strictly speaking, of course, this assumes that the two brightnesses compared are homochrome, or of the same color. If the two brightnesses are heterochrome, or do not match in color, then no perfect blend can be made and an estimate only can be formed of their relative brightness as in ordinary heterochrome photometry.

The plan ingeniously adopted is to form an enlarged image of a glowing Nernst filament beyond a condensing lens and to examine with a telescope against this image as a background that of the luminous source at the point to be tested. In the case of incandescent-lamp filaments the image of the Nernst glower is formed at the filament and the contrast of the glowing filament against the glower image is made to disappear. This measures the brightness of that particular small element of the filament, as within the glass lamp bulb, in terms of the known brightness of the Nernst glower. It is mentioned that the brightness of the ordinary filament varies materially from point to point, an observation which is not ordinarily apparent to the unaided eye. In the case of a flame, or of a bulky luminous source, a filamentary image has to be made of the particular part of the surface considered, by means of a little filamentary mirror, and the measurement made as before, after allowing for the losses of brightness in reflection. The apparatus is a very pretty one and should be developed into a standard instrument. It should prove very useful to the illuminating engineer in many ways. The standard source of brightness, whether a Nernst glower or a large tungsten filament, will need to be carefully standardized and calibrated, as also the condensing lens, the Nichols prism and the filamentary mirror. If these elements could be worked up by a manufacturer of photometric apparatus for the purposes of the photometric or factory laboratory a real benefit would be derived by photometrists and the demand for the apparatus might be substantial.

QUANTITATIVE ANALYSIS OF MUSICAL TONE.

As we all know, the telephone reproduces at a distance the sounds of the speaker's voice through the aid of alternating currents over the wires connecting the speaker and listener. Moreover, the reproduction of speech is sufficiently good to be practically satisfactory over the normal telephone circuit. On the other hand, we know that the sound reproduction is far from being perfect—partly by experience, since we frequently fail to recognize through the telephone the voice of an interlocutor, and partly by theory, since a diaphragm is unable to vibrate equally to all frequencies of impressed vibrations. It responds to certain favorite frequencies much more powerfully than to those outside the friendly circle, while to some unfriendly frequencies it refuses appreciably to respond.

There are certain sounds that a telephone ordinarily reproduces powerfully, such as the *oo* sound in *cool;* other sounds it reproduces very weakly, such as the sibilant sounds, final *s*, and the like. The word *specie* is much disliked by the telephone, and what it delivers in this case is usually *pea-ee*. Much depends, of course, on the strength and clearness of the vocal tones delivered to the transmitter diaphragm, and on the distance of the speaker's lips from that diaphragm. We all become more or less expert in deciphering and guessing the sounds uttered by the receiving telephone, and, ordinarily, we succeed very well; but there can be no doubt that languages of large and clear vowel sounds, like the Italian, have a distinct advantage for telephonic purposes over languages that, like our own, use the half-closed more than the widely opened lips.

As soon as we attempt to investigate, quantitatively, the extent to which the telephone reproduces the sounds it receives we find ourselves struggling in a vortex of difficulties. The movements of the receiving telephone diagram are so small in their amplitude that, for a long time, it was contended that there was no actual vibration of the diaphragm, but only a molecular vibration within its substance. This feeble amplitude makes the analysis of the sounds uttered by the receiving telephone extremely difficult. Then the alternating currents conveying the sounds are of very feeble amplitude and are difficut to analyze. Again, the sounds of ordinary speech are so complex as to make the inquiry too difficult, even confined to the transmitter alone. Simple uniform standard sounds must be used that can be reproduced indefinitely without fatigue. If we blow steadily into a simple instrument, like the cornet, we shall produce not a single simple musical tone, but a combinations of various tones superposed, and it is difficult to analyze the resultant tone into its components.

In order to arrive at a final solution of the problem, it becomes necessary as a first step to analyze the sound emitted by the standard source into its fundamental and harmonics, assigning to each component its proper intensity. An experimental research in this direction has recently been published by Mr. P. H. Edwards in *The Physical Review.* The plan consisted in mounting a series of Helmholtz resonators, tuned to respond to a series of ascending musical tones, and suspending in the mouth of each resonator a Rayleigh disk, consisting of a mica disk, smaller in diameter than the resonator mouth and carrying a minute mirror. The disk is suspended in a vertical plane by a fiber and is damped in its motion by a little vane dipping into oil. The plane of the disk is set to make an angle of 45 deg. with the plane of the resonator mouth. When the resonator is excited the vibration of the air into and out of the resonator mouth tends to turn the disk to close the mouth, like a small throttle-valve. By measuring the movement of a spot of light reflected from the mirror on a scale the intensity of each component harmonic in the composite sound may be measured. When a violin was bowed near the above series of resonators it was found that the fundamental tone was very weak in the lowest notes, much weaker than the octave triple-frequency harmonic, or double octave. In the higher notes this was not the case. Curves accompany the paper, showing that not only do different violins differ very much in their tone-composition on one and the same note, but that one and the same violin differs very much in its tone-composition on different notes. It would seem possible, by such experimental procedure, to ascertain what are the essential features of a sweet musical tone in an instrument and to submit the instrument to a quantitative test throughout the whole range of its register. At a later stage the method should be applicable to telephonic investigation.

Public Policy Work of the N. E. L. A.

For some months past the public policy committee of the National Electric Light Association has been studying the various problems connected with "welfare" work; and last year the association sent Dr. W. H. Tolman abroad to secure for it the latest data as to European practice, the chief countries investigated being Germany and England. Conditions in this country have also been looked into closely. With the object of forecasting its suggestions to the membership at the next convention in New York City, the committee held a meeting in Washington last week, and remained in continuous session throughout Friday and Saturday, Feb. 10 and 11, at the New Willard Hotel. There were present Messrs. C. L. Edgar, chairman; W. W. Freeman, president; N. F. Brady, E. W. Burdett, H. M. Byllesby, H. L. Doherty, G. H. Harries, S. Insull, J. B. McCall, S. Scovil, W. H. Blood, Jr., Arthur Williams, T. E. Murray, president of the Association of Edison Illuminating Companies; R. S. Hale, and T. C. Martin. The committee discussed most exhaustively and reached conclusions to be embodied in suggestions for action by member companies, where such plans have not been put in force already, as to provision for accident insurance, sickness insurance, profit-sharing by employees, and the payment of annuities as a recognition or reward for continuous and meritorious service.

Philadelphia Electric Show.

Philadelphia's electric show was thrown open to the public Monday night when Mayor Reyburn pressed the button which set in motion all of the machinery and appliances in the exhibition. As heretofore the show is being held in the First Regiment Armory, at Broad and Callowhill Streets. The decorations of the building are very handsome. The entire floor has been laid out as a Venetian garden and presents a beautiful and pleasing aspect. The various booths which contain the exhibits of the many firms are gayly decorated and covered with electric lights of many colors. Myriads of electric lamps of every type, from the powerful flame arc to the tiny miniature, are used in the decoration. Broad Street has been spanned with numbers of electric arches from the City Hall to the Armory.

Pending Legislation Regarding Niagara Falls.

After June 1 the diversion of water from Niagara Falls is subject to the discretion of the Secretary of War, limited only by the international treaty between the United States and Great Britain. The Burton act expires by limitation at that time, and although the existing treaty permits 20,000 cu. ft. of water per second to be diverted by each country, the Burton act limits the diversion upon the American side to 15,600 cu. ft. per second, but permits a temporary increase of diversion under revocable permits, so that in case the increased diversion affects the falls it may quickly be stopped. It further restricts the quantity of power that may be brought into the United States from Canada to 160,000 hp, with revocable permits in addition, but the aggregate must not exceed 300,000 hp. For a fuller text of the provision of the Burton act and its effect on electrical developments at Niagara Falls the reader is referred to the *Electrical World*, June 29, 1907. Many of the predictions made at that time have come to pass, and in view of the reciprocity treaty now pending before Congress the following concluding paragraph of the article in question is of interest: "The net result, therefore, and the probable effect of the Burton bill, if continued, is a restriction within the State of New York of the use of Niagara power to substantially the amount of the present demand and the forcing of the three great plants now partly constructed on the Canadian side to seek a market in Canada for about two-thirds of the output of their completed plants instead of transmitting the larger part of that power to the State of New York and possibly beyond as originally intended. There is every indication pointing to the belief that even without change in tariff schedules the Canadian market eventually will be sufficient to absorb all the power originally intended for American consumption. A substantial reduction by the United States in tariff rates on manufactured articles would stimulate the power market in Canada to a point where the demand would precede the rate of installation of all the additional generating units."

There is now pending in the rivers and harbors committee of the House of Representatives a measure known as the Alexander bill which seeks to remove entirely the restrictions upon the transmission of energy from Canada into the United States and further provides for the permanent diversion of water on the United States side to the maximum of 20,000 cu. ft. per second. The bill does not increase the amount of water that may be taken from the Niagara River at the falls as already provided for by treaty, but merely seeks to render the amount agreed upon available and not subject to revocable permits and seeks also to provide an outlet for surplus energy developed on the Canadian side. At the present time the limit of the amount of power that may be imported from Canada into the United States has almost been reached.

St. Lawrence Power Project Likely to Be Defeated.

By a vote of sixty-six to eighty-four the House of Representatives on Feb. 7 defeated the plan proposed for damming the St. Lawrence River at Long Sault Rapids, although the bill for this purpose was unanimously reported from the rivers and harbors committee. Opposition to the measure was put upon the ground that it did not conform to the new policy of the United States for the conservation of water-power and that it granted a ninety-nine-year lease when the general dam act fixes the limit in such cases to fifty years. A hearing was held by a sub-committee of the committee on commerce in the Senate on Feb. 8, but no action has as yet been reported.

The Long Sault Development Company, which is closely allied with the Aluminum Company of America and in whose interest the present bill was drafted, obtained a perpetual charter from the State of New York and owns the riparian rights on both sides of the St. Lawrence River at the rapids. It is estimated that 500,000 hp can be developed from the water and the estimated cost of the development was placed at $40,000,000.

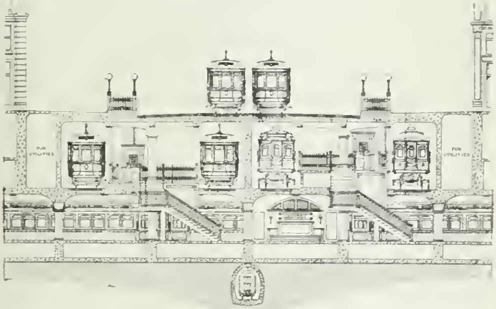
In Canada public sentiment, educated by the success of the Hydroelectric Power Commission of Ontario, is opposed to the grant. The Canadian government does not object to the damming of the South Sault if it is properly canalized, but objects to anything that will interfere with navigation on the North Sault, which is partly in American and partly in Canadian territory. The feeling prevails in Canada that the generation of electricity should be so controlled that the energy will be equally distributed to the citizens of the two countries at fair and reasonable rates. Similar views have been expressed by the chairman of the American Section of the International Waterways Commission.

Arnold Report on Chicago Passenger Subway System.

As noted briefly in the *Electrical World* of last week, Mr. Bion J. Arnold, chief subway engineer for the City of Chicago, presented his report, entitled "General Statement of Problem and Description of Plans for a Passenger Subway System for the City of Chicago," to the City Council of Chicago on Feb. 6. The report consists of a printed pamphlet of seventy-five pages with twenty-three maps and plates.

Mr. Arnold remarks that he has studied the transportation problem of Chicago for nearly a decade. He recommends what he calls Plan No. 1, shown in its developed state as a system of high-speed subways extending over the entire city. It is not proposed, however, that this comprehensive plan of subways shall be built at once, but rather in five steps or stages, which are carefully described in detail. From a comparatively small nucleus it is thus proposed ultimately to build a comprehensive subway system for the whole city, constantly tending to enlarge the present business district and capable of unlimited expansion. Plans are ready for the construction of the first step outlined and specifications and detailed drawings can be prepared so that contracts could be let for this portion of the subway within sixty days from the date that authority is given to proceed with the work. The report of Mr. Arnold was referred to the local transportation committee of the City Council. In the annual Chicago municipal budget for this year is an item of $2,035,000 to provide for the beginning of subway construction.

Mr. Arnold points out that the problem of preparing working plans for a subway system in Chicago is especially difficult, not only by reason of the existence of about sixty miles of freight tunnels under the streets in the central business district, these tunnels being in general but 33 ft. below the surface of the streets, but also from the further fact that the policy of the city is not yet settled as to the method of financing subways.



Proposed Chicago Subways—Section Showing Surface Routes, High-Level Subway, Low-Level Subway and Freight Tunnel.

Plan No. 1, which Mr. Arnold favors if practicable, is designed so that by its means high-speed and local trains could be operated independently of any of the present traction companies, if desired. Upon the tracks of this subway could be run at first the present surface-line cars, later the present elevated railway trains, and finally, when extended, the trains of a high-speed comprehensive subway system covering the entire city.

Plan No. 2 is intended to apply to a system designed to be used exclusively by the surface-line cars for the relief of present congestion in the central business district, utilizing the existing tunnels under the river and so located that it would not interfere with the ultimate construction of the high-speed subway of Plan No. 1. Mr. Arnold remarks that no extensive subway system can be justified from an investment viewpoint unless it is so designed that ultimately high-speed trains, each having a carrying capacity of not less than ten of the present elevated cars, could be operated through it at times of maximum traffic.

Plan No. 1 as recommended provides through-routing from the northern part of the city to the southern part and vice versa, as well as from some of the east and west streets and from the diagonal subways, but it makes no attempt to secure universal through-routing. After considerable planning, by adopting reinforced-concrete steel construction and in some instances combination I-beam and concrete construction, designs have been developed which if followed will permit the construction of both high-level and low-level subways of sufficient size without interfering seriously with the freight tubes of the Illinois Tunnel Company. Shallow construction for the high-level subways will permit sufficient room for the low-level subways to pass beneath them and over the freight tunnels. As the first step of Plan No. 1 it is proposed to construct the downtown nucleus with six stations, that at State Street and Jackson Boulevard being shown in the illustration. This step provides for 7.8 miles of single track in a two-track subway and is estimated to cost $8,000,000. The subway would be constructed so that two additional tracks, making a four-track subway, could be added when needed.

The electrical energy necessary for the operation of the initial subways will be delivered at the busbars of the substation, or substations, which will be located along the line of the subway. These substations will be supplied with three-phase energy coming through underground mains at high potential and stepped down by air-cooled transformers of 2000 kw to 4000 kw before being passed through rotary converters. The direct-current output of these rotaries will be distributed by means of a low-tension switchboard to the various sections into which the overhead trolley for surface cars and the third-rail for elevated railway trains will be divided under the control of a load dispatcher. "The great importance of continuity of service and the known weakness of feeders," says Mr. Arnold, "will make advisable the installation of a distant-control equipment whereby the load dispatcher may change the distant connections between feeders and the contacting trolley or third-rail as easily as he may disconnect and rearrange the feeders on the substation switchboard."

The report contains a number of appendixes giving details of routes in various streets and connections with existing surface and elevated railways. The report shows evidence of care and thoroughness in its preparation and is distinguished by clarity and conciseness.

SUBWAY DISCUSSIONS.

Apropos of the presentation of the Arnold report a paper presented at the regular meeting of the Western Society of Engineers in Chicago, Feb. 8, by Mr. A. S. Robinson, on "The Shuttle System of Chicago Subways," is of some interest. The author divides Chicago, for transportation purposes, into a northern and a southern section, with an imaginary boundary line at Monroe or Adams Street. Cars would be routed entirely through the business district from one section to the other, either to convenient points in the vicinity of the portals or to the ends of the lines, where their direction would be reversed for a return trip. These lines would be in high-level subways and might be connected by a low-level subway on Monroe and Adam Streets, acting as a transfer only. At the crossings of the high-level subways one line is carried beneath the other to avoid grade crossings, coming again to the upper level as rapidly as possible.

In the discussion letters were read from Mr. Bion J. Arnold, chief subway engineer of Chicago, and Mr. John Ericson, city engineer. Mr. Arnold said that he had been unable to give the time to the paper to discuss it properly. Mr. Ericson pointed out the desirability of placing public-utility conduits under sidewalks and in alleys. Mr. George Weston, of the Board of Supervising Engineers, Chicago Traction, took issue with the author on several points and said he concurred with the recommendations of the Arnold report in many respects. Mr. Weston also remarked that none of the plans so far proposed contemplates any change in the Illinois Tunnel Company's grades. Mr. Boucher elucidated Mr. Arnold's report and said that the estimated cost in Mr. Robinson's paper ($2,513,000 per mile of double-track subway equipped ready to operate) as taken from bids obtained in New York was too high for Chicago conditions. Mr. P. E. Green remarked that there did not seem to be a full realization of the amount of space under the streets taken up by public utilities. In some streets these structures as at present installed take up practically the whole width of the street from curb to curb. The paper was also discussed briefly by Messrs. A. J. Saxe, Emil Gerber and H. H. Evans.

Addressing the Chicago Real Estate Board, on Feb. 9, Mr. Charles V. Weston, president of the South Side Elevated Railroad Company, said that before the city enters extensively into the building of subways it must have a great density in population in order to meet the financial side of the problem. He said that the present street and elevated railways of Chicago were not operated to their full capacity owing to congestion in the central business district.

Independent Telephone Convention Denies Merger and Indorses Public-Service Commissions.

Unusual interest attached to the annual convention of the National Independent Telephone Association in Chicago on Feb. 8 to 10, owing to the widespread reports of the merger of many important Independent telephone companies with the Bell interests and also to the reported activities of the financial house of J. P. Morgan & Company in the telephone field. Another subject of interest was the relation of the telephone industry to State and governmental regulation, particularly as exemplified of late by the regulation of interstate telephone traffic by the Interstate Commerce Commission at Washington.

The attendance at the convention was perhaps 550, of whom about half were telephone operating men and the remainder supply men. An exhibit of telephonic appliances was made in connection with the convention. An air of suppressed excitement pervaded the convention, but the principal business was transacted in committee meetings and private conferences, as usual. The association took important action in confirming its complete independence of Bell interests, and also stating its adherence to the principle of the regulation and control of all public-service corporations by duly empowered commissions. Compulsory non-discriminatory physical connection of telephone properties, whether Bell or Independent, was also strongly urged in the convention, and appeared to be favored by nearly all the delegates present, but no official action in relation to it was taken. In resolutions adopted in relation to public policy, which were carried without opposition, reports that the merging of Independent and Bell interests had been sought by officers of the Independent association in conferences with Bell officials and representatives of J. P. Morgan & Company were expressly denied by the association, which reaffirmed its adherence to the principles and development of Independent telephony.

A resolution was also passed demanding the regulation and control of all public-service corporations by State commissions having the power to fix rates, both maximum and minimum, so that protection might be secured against competitive rate-cutting. Congress was also asked to vest the Interstate Commerce Commission with similar powers for interstate telephone business, clearing up ambiguities which exist in the present Interstate Commerce Law as written.

OPENING PROCEEDINGS—PRESIDENT'S ADDRESS.

The convention was late in assembling on Wednesday morning, Feb. 8. Mr. Howard W. Hayes, assistant corporation counsel, welcomed the association to Chicago on behalf of Mayor Busse. He reviewed the telephone situation in Chicago, and spoke a good word for telephone competition. An eloquent response on behalf of the association was made by Mr. Nelson G. Hunter, of Wabash, Ind.

President Frank H. Woods, of Lincoln, Neb., who presided, delivered his annual address, which was couched in conversational language. In a part of the field the point of saturation in telephone service has been reached, he said, but in other parts ample opportunity for competition exists. The American public invited telephone competition, but has provided no means to prevent competition from being attacked or destroyed, and various illegal mergers have been permitted. Mr. Woods believes that the American Telephone & Telegraph Company is finally convinced that it cannot own and control all the telephone properties of the country. This company has bought many Independent plants in the last few years in important centers, but is apparently content that thousands of small companies shall remain Independent.

Mr. Woods made two important recommendations. The first is the regulation of telephone service by public-service commissions, and the second is compulsory physical connection between telephone systems. The anti-trust laws have failed to check monopoly through lack of enforcement. Many Independent companies have reached a point where readjustment of their rates is demanded. This, in the face of cutthroat competition, he said, should be intrusted to a public-service commission. Furthermore, commission control will be an effective check on fraudulent promoting, and the commission can also decide whether competition shall be allowed in any community. The public-service commission should not only regulate rates, but fix them. Mr. Woods said that the tendency even among the Independents is toward consolidation. Two large systems have grown up, but such a condition cannot be permanent. If one group of properties reaches one section and another group another section, interconnection must be made. The public has desired competition, and the Independents have given it; if the public desires universal service, the Independents must give that also. But the principle of telephone competition must be preserved, the exact method of interchange being decided by the commissions. Real universal service should be given—not, he said, the kind advertised by the Bell company. Private branch exchanges may have trunk lines connecting to the exchanges of two competing companies, thus giving the subscriber connection with the two systems. Competition should be retained, declared Mr. Woods, but not under conditions that make the service too expensive or annoying. One company should control both the long-distance telephone and telegraph service. Just how to make the adjustment where two local companies exist is a question to be left to the future and be decided under the jurisdiction of the public-service commissions. Heretofore the Independents have been opposed to interchange with Bell companies because they felt they were not treated fairly.

The president spoke of the difficulty the Independents experience in raising money to make extensions. However, there is no more reason for discouragement in this respect now than at any time in the past. The trouble is due to the close connection of the Bell interests with the men powerful in the money market. But competition has proved its worth. The present development of Independent telephone interests represents an investment of $350,000,000.

Mr. J. B. Ware, of Chicago, secretary and treasurer, presented his report, in which he spoke of the raising of a special fund of $125,000 during the year to meet the grave crisis in the Independent telephone field. The association has a card index of 18,662 Independent telephone companies which are now in operation. Of these perhaps 5000 are commercial companies, the remainder probably being principally rural or neighborhood systems. Mr. Ware showed how the low Independent telephone rates have led to a very large increase in the use of residence telephones, and said that in the Central West the number of city telephones is about 10 per cent of the population.

GENERAL BUSINESS.

On Thursday morning Mr. Manford Savage, of Champaign, Ill., read a paper on various aspects of the rate question. Mr. Savage favors regulation by general public utility commissions rather than by purely telephone commissions. The commission form of government for cities, he said, is a promising departure from the viewpoint of the telephone companies.

The subject of reciprocal or mutual insurance of telephone properties was discussed by Mr. J. B. Hoge, of Cleveland, general manager of the Telephone Fire Insurance Exchange. The plan adopted involves the use of emergency switchboards adapted to all classes of service, to be shipped quickly from Chicago wherever needed in case of fire. Mr. B. G. Hubbell, of Buffalo, indorsed the scheme of telephone companies placing a portion of their insurance on the mutual plan, particularly income insurance or use-and-occupancy insurance. Mr. Theodore Gary, of Macon, Mo., also indorsed the plan. Mr. Woods, of Lincoln, Neb., remarked that the work Mr. Hoge is doing is resulting in the equalizing of insurance rates on telephone properties.

President Woods appointed Mr. N. G. Hunter, of Wabash, Ind., chairman of the committee on resolutions, the other members being Messrs. E. H. Moulton, of Minneapolis; J. H.

Wright, of Jamestown, N. Y.; Walter J. Uhl, of Logansport, Ind., and H. D. Critchfield, of Chicago.

Matters connected with pending negotiations were discussed in an executive session of the association Thursday afternoon. No official statement of what transpired at the secret meeting was vouchsafed, but it was stated that the report of the committee on credentials was adopted without opposition and that during a recess the burning questions of the convention, such as the absorption of important Independent companies by the Bell interests, the Ohio situation and the relation of J. P. Morgan & Company to the telephone industry, were discussed informally and freely.

On Thursday evening there was a banquet at the Hotel LaSalle. Mr. Manford Savage was toastmaster, and speeches were made by Messrs. B. G. Hubbell, of Buffalo; Nelson G. Hunter, of Wabash, Ind.; Col. Will Visscher, of Chicago, and Mr. H. D. Critchfield, of Chicago.

COMPULSORY PHYSICAL CONNECTION.

Vice-President E. B. Fisher, of Grand Rapids, Mich., presided part of Friday morning, when was delivered probably the most important address of the convention, that of Mr. Theodore Gary, of Macon, Mo., on "The Effect of Compulsory Connection on the Future of Independent Telephone Companies." Mr. Gary first reviewed the history of such connection between competing companies, as established by the sublicensee agreement of 1904. Later the Independent companies, to meet the onslaughts of the Bell interests, undertook to provide exclusive contracts between the Independent companies themselves. The courts in Missouri have decided one clause of these contracts to be contrary to the State anti-trust laws, although the case is still pending. In Ohio, in a similar case, judicial opinion is divided. In Oklahoma there is a constitution provision that telephone companies must interchange traffic. In Montana and South Dakota connections between all telephone companies may be enforced. In all these states, however, the principle of the validity of exclusive contracts is still in the courts and has been passed upon by no court of last resort. The speaker asserted that at the present time there is physical connection to competing exchanges between about 8000 telephone companies, supplying 2,000,000 subscribers' stations. This connection has not been compulsory, but is the result of the immutable law of supply and demand.

Independents look with suspicion on those who connect with Bell companies as not "true blue," but Mr. Gary now thinks the matter might have been worked out differently several years ago when the subject of physical connection was first broached. Such connections are now a condition and not a theory. The question is whether in the future they shall be made by contract, or by statute and not be confined to a favored few. Mr. Gary believes that the connection should be made compulsory under the supervision of public-service commissions. The National Independent Telephone Association made a bad mistake some years ago, he thought, in handling the connection question sentimentally instead of as business men should. The fact that Mr. Gary himself advocated such compulsory physical connection four years ago showed that the idea was not a recent Bell or Morgan project. In the speaker's opinion such connection is bound to come, and the Independent companies should prepare their statements and have something to do with the manner in which the subject shall be handled by commissions. Mr. Gary opposed physical connections on a contract basis providing for exclusive service. Independents, he said, should insist on real universal service. In Missouri the Independent companies will not make contracts with the Bell organization unless every other telephone company has the same privilege.

But before compulsory physical connections can be enforced general powers must be given to the interstate and State commissions. These commissions should define apparatus standards, apportion costs of making connections, consider the replacement of obsolete apparatus and have authority to fix rates. The law might even require the sender of a message to designate the route over which he wishes to talk just as a traveler at a union railroad passenger station buys a ticket on the road he wishes to patronize. Penalties should be provided for discrimination, and the law should give equitable compensation to each company handling the message. The right to appeal to the commission should be preserved, and it might be necessary to invoke the right of eminent domain to make physical connection with the switchboards of competing companies.

CONCLUDING PROCEEDINGS.

Mr. Woods took the chair at the conclusion of Mr. Gary's speech, and in relation to the status of telephone companies before the Interstate Commerce Commission at Washington said that such companies are not obliged to appoint residential agents or attorneys to represent them before the commission.

Mr. A. A. Godard, of Topeka, Kan., reported that the legislative committee, of which he was a member, had drafted a bill to be presented to various Legislatures in relation to the regulation and control of telephone companies by public-service commissions. This bill will be printed and distributed by the secretary.

A communication from Mr. W. F. Goodrich, of La Crosse, Wis., in relation to the working of the public-service commission in that State, was received and extracts from it were read. A gentleman from Mississippi told of the work of the railroad and telephone commission in that State. In one case where the Bell company gave free service as a competitive measure the commission made the company take out its free telephones. However, the Bell company is allowed to meet competitive rates, although the law says that telephone rates should be the same in towns of the same size throughout the State of Mississippi. There is no minimum rate; the telephone companies can charge as little as they like, and in one case a system with twenty miles of line gives service for $5 a year.

One Ohio delegate opposed the plan of compulsory nondiscriminatory physical connections under the supervision of the State commissioners. This gentleman remarked that in a given territory the Bell company might give very good service with the help of outside experts and then discontent Independent subscribers, getting them to change companies, explaining that the few Independents left could be reached over the trunk lines between the competing exchanges.

On the recommendation of Mr. Melchers, chairman of the committee on nominations, the association elected the following directors: Frank H. Woods, Lincoln, Neb.; E. B. Fisher, Grand Rapids, Mich.; B. G. Hubbell, Buffalo, N. Y.; H. D. Critchfield, Chicago, Ill.; S. E. Ward, Mansfield, Ohio; L. D. Kellogg, Chicago, Ill.; F. N. Kondolf, Rochester, N. Y.; Richard Valentine, Janesville, Wis.; E. H. Moulton, Minneapolis, Minn.; Theodore Gary, Macon, Mo.; Walter J. Uhl, Logansport, Ind.; Manford Savage, Champaign, Ill.; A. E. Boqua, Fort Smith, Ark.; J. C. Casler, Dallas, Tex.; E. D. Schade, Johnstown, Pa.; W. J. Melchers, Alma, Mich.; N. G. Hunter, Wabash, Ind. These directors will appoint the officers of the association.

After making some amendments to the by-laws so as to allow small companies in states having no state organizations to vote in the national association, the convention was adjourned.

TECHNICAL AND OPERATING CONFERENCE.

While the great interest of the convention centered on matters of public policy, several sessions of a "technical and operating conference" were also held under the chairmanship of Mr. L. E. Hurtz, of Lincoln, Neb. The first paper presented, on Wednesday afternoon, was a long and scholarly production by Mr. W. D. Kerr, of Chicago, who is a counselor on public-service problems. His subject was "Public Relations of Telephone Companies," considered under several headings. While state commissions, he said, do not offer a conclusive solution of the public relations of public-service companies, they present the best way of meeting the situation now available. In the discussion, Mr. Folsom, of Circleville, Ohio, spoke of the diversity of telephone rates and the advantage of compiling compendiums of rates, say, by states. Mr. Johnson, of Columbus, referred to the proposed State telephone commission of Ohio, previously mentioned in the *Electrical World.*

Mr. Hugh T. Wreaks, of the Wire Inspection Bureau of New York, read a paper on "Inspection of Telephone Wire," in which he made a plea for the proper specification and inspection of conductor wire. An abstract of this paper is presented elsewhere in this issue.

On Thursday morning, at another short technical session, Mr. B. F. Wasson, of Clinton, Ill., described his system of signals to be used by construction men in building pole lines and stringing wires. He has written a booklet on the subject, which on motion was approved by the association.

The question box was then taken up. Discussing "phantom" circuits, Mr. George K. Gann, of Lincoln, Neb., said that these circuits form one-third of the total circuits of the Independent telephone system of Lincoln. More satisfactory results are obtained by using "phantom" circuits than with physical circuits. Grounds on the physical circuits, however, usually put the phantoms out of service. Proper transposition does away with cross-talk. Ringing troubles caused by inserting the "phantom" coils in the physical circuits can be obviated by adjusting the relays and by other means. The efficiency of the physical circuit is slightly lessened after the coils are inserted, but not sufficiently to be a detriment. Ordinary lighting protection is used. The longest "phantom" circuit in the Lincoln territory is eighty-five miles, but it is practicable to have circuits of this character 500 miles or longer.

Another question related to maintenance expense per telephone. Mr. Glass, of Pekin, Ill., placed this figure at from $6.50 to $7.00 in small exchanges and at $9.00 for larger exchanges. These amounts include practically total operating expense, without interest on investment. Mr. Brown, of Abilene, Kan., put maintenance expense pure and simple at $2.02 per telephone, while the total operating expense was $8.30. Another figure given was $8.50 (not including interest and taxes) and this seemed to be about the average figure in exchanges of 1000 subscribers. Methods of advertising toll business were discussed briefly.

On Friday morning Mr. A. J. Shands, of St. Louis, read a paper on "Private Branch Exchange Traffic," advocating that private branch exchange operators be employed by the company instead of by the subscriber. A discussion followed.

Mr. George K. Gann, of Lincoln, Neb., read a paper on "Special and Emergency Long-Distance Traffic." Discussion on Mr. Gann's paper was cut short by the resumption of the general sessions. This was the last feature of the technical and operating conference.

Lease of Reclamation Dam Power Rights.

A bill is now before Congress amending the National Reclamation Act in order to permit of leasing rights to utilize power made available by irrigation dams. The proposed amendment reads as follows:

"That whenever a development of power is necessary for the irrigation of lands, under any project undertaken under the said reclamation act, or an opportunity is afforded for the development of power under any such project, the Secretary of the Interior is authorized to lease for a period not exceeding ten years, giving preference to municipal purposes, any surplus power or power privilege, and the money derived from such leases shall be covered into the reclamation fund and be placed to the credit of the project from which such power is derived: Provided, that no lease shall be made of such surplus power or power privileges as will impair the efficiency of the irrigation project: Provided, further, that the Secretary of the Interior is authorized to make such lease for a longer period, not exceeding forty years, with the approval of the Water Users' Association, or associations under any such project, organized in conformity with the rules and regulations prescribed by the Secretary of the Interior in pursuance of section 6 of the reclamation act, approved June 17, 1902."

The people of Texas, particularly of the upper Rio Grande valley, which is to be directly benefited by the Elephant Butte dam and reclamation project, are much interested in the proposed amendment. As soon as the amendment is passed by Congress a company with a capital stock of $3,000,000 will be formed to install a hydroelectric plant in connection with the Elephant Butte project and construct electric power transmission lines down the valley of the Rio Grande to El Paso and other towns.

Telephoning to a Moving Train.

Renewed experiments with telephoning to a moving train are to be tried by the Stratford-on-Avon & Midland Junction Railway in England, using the invention of Mr. H. V. Kramer, of Birmingham. The electromagnetic-induction principle will be used, coils of wire wound about the cars and in series with the train apparatus forming the primary winding of the open-core repeating coil, the secondary of which is a wire paralleling the rails on the ground and connected to the station instruments. Besides the advantages which travelers will enjoy of communicating with friends while the train is speeding, this use of the telephone for signaling and dispatching purposes is expected to result in increased safety of train operation.

Patent Court of Appeals.

A committee of the American Bar Association in an appeal for support of the bill now before Congress authorizing a Court of Patent Appeals, to be presided over by four judges assigned from among the federal judges by the Chief Justice of the Supreme Court and a presiding judge appointed by the President and confirmed by the Senate, cites several cases to illustrate some of the evils that the establishment of such a court would mitigate.

One great question relating to the effect and operation of the patent law which is open to-day is whether the owners of or licensees under different patents, controlling patented articles of similar use which would compete in the market, if such competition were unhindered—like sewing machines, or typewriters, or automobiles—can lawfully form a combination under the protection of their patents to uphold their prices. On this subject the Circuit Court of Appeals for the Third Circuit decided that they could not; that each patentee has his own monopoly of his own invention; but that two or more patentees cannot unite to form a new monopoly; that the public is entitled to the benefit of competition between articles covered by different patents as well as between different unpatented articles. On the other hand, the Circuit Court of Appeals for the Seventh Circuit has held in later cases that the anti-trust statute does not apply to patented articles and that patentees or licensees under different patents relating to the same thing have lawful right to combine to maintain prices as a result of the monopoly conferred by the statute. There is thus one rule of law binding upon the citizens of the Third Circuit, comprising the States of New Jersey, Pennsylvania and Delaware, and another rule of law binding upon the citizens of Indiana, Illinois and Wisconsin of the Seventh Circuit. What the law is in the other States of the Union no one knows.

Reference is made to a litigation involving a patent for an electric cigar lighter. Eldred sued Kessler for infringement of a patent on this device. The defendant prevailed in the Circuit Court of Appeals for the Seventh Circuit on an issue of non-infringement covering all the claims. The court held that the patent was one of narrow scope and that, being so construed, it was not infringed by the Kessler lighter. This decision was in 1900. Eldred then brought suit on the same patent in the Second Circuit against the user of a cigar lighter similar to the Kessler lighter, but made by another manufacturer. The Circuit Court of Appeals in that circuit construed the patent broadly enough to find infringement. This involved a square conflict between the Circuit Courts of Appeals of the Second and Seventh Circuits. Eldred then began suit on the same patent against Breitwieser, who was a user of a Kessler lighter in the Western District of New York, got a preliminary injunction against him and sent out threats of suit against Kessler's customers elsewhere. Kessler then filed a bill against Eldred in the district of his residence to enjoin him from bringing or prosecuting suits against his (Kessler's) customers anywhere on account of the use of cigar lighters covered by the decree in the original suit, on the ground that as between them the question of infringement of the Eldred patent by the Kessler lighter was *res adjudicata* under the decision of the Circuit Court of Appeals for the Seventh Circuit. That case went to the Supreme Court of the United States, which held that Kessler was entitled to the injunction. Thus, if one buys a cigar lighter from Kessler in Illinois or anywhere else he may use it anywhere, even in the Second Circuit where the patent has been held valid. If one buys that cigar lighter from any other maker than Kessler, he may use it in the Seventh Circuit and not infringe; but if he brings it into the Second Circuit and uses it he at once infringes. If one makes such a lighter in the Second Circuit he infringes; but he may carry it into the Seventh Circuit and use it freely. If a user of such cigar lighters were sued in the Second Circuit by Eldred for infringement of his patent and an injunction asked, the court would have to exclude from its restriction (as was done in the case of Consolidated vs. Diamond) all lighters made by Kessler. What might happen in any one of the other seven circuits one may only surmise.

Another case cited relates to an improvement in washing machines. This patent was first held valid in the first suit brought upon it by the United States Circuit Court of Appeals for the Eighth Circuit. It was a highly useful invention and the defendant in that case, accepting the decision as establishing the validity of the patent, bought it from the patentee. But manufacturers in other parts of the country were so attracted by the utility of the device and so encouraged by the uncertainty of the finality of the decree in the Eighth Circuit that they took the chances of infringement. The purchaser of the patent happened to have the money and determination to stand up for his rights and brought suit against infringers in five different States, as follows: Two in Illinois, one in Wisconsin, two in New York, one in Missouri and one in Indiana. In five of these cases appeals were taken to Circuit Courts of Appeals. The litigation began Oct. 18, 1898, and ended with the decision of the Court of Appeals for the Seventh Circuit on March 18, 1909. In these various proceedings the time of twenty-one federal judges was occupied in sixteen contested hearings. The printed records and briefs contained in all 10,850 pages, and the total costs amounted to over $65,000. All this was to settle the rights of the patentee under a patent covering so little a thing as a part of a washing machine. And they have not been settled yet, except that infringers appear to have given up from mere discouragement. There is good reason to believe that if the appeal in the first suit had been to such a court as is proposed in this bill, having jurisdiction coextensive with the Union, its decision would have been acquiesced in everywhere without further contention.

The committee says that the worst effect of the existing situation is that it undermines confidence. It demoralizes the bar. A lawyer does not know how to advise his clients. It tempts both attorney and client to take chances. The law-abiding citizens who want to obey the law, who want to respect valid patents, but do not want to be terrorized into acquiescence in invalid patents, do not know what to do and cannot find out. There is, it concludes, but one remedy, and it is in a single court of last resort in patent cases. It is impracticable to throw this burden on the Supreme Court and the only wise alternative is to put such final jurisdiction in the hands of a single court equipped with judges of the highest qualifications attainable for the special work committed to them, and so organized that it will be adequate to the present business and capable of growth in the future by mere additions to the number of its judges.

Unified Electric Systems.

At a meeting of the American Institute of Electrical Engineers held on Feb. 10 in New York Mr. William B. Jackson, Chicago, presented a paper dealing with the advantages of unified electric systems covering large areas. The advantages resulting from serving any territory from a comprehensive transmission and distribution system as a substitute for disconnected central stations located in the cities and villages were summarized as follows: Saving in generating-station equipment made possible through taking advantage of the diversity of different communities by serving them from the same transmission system; lower generating cost per kw-hour due to larger plants and improved loading factor; less investment in plants per kilowatt rating on account of larger plants as compared with smaller; the possibility of decreased percentage of spare apparatus by appropriate arrangement of plants; saving in cost made possible by centralized management, general superintendence and other general expenses; the possibility of providing rural and suburban service that could not be profitably reached by a local central station; the possibility of large corporations providing service which would be too extensive for small companies to undertake; the development of water-powers for electric service.

Brief outlines were given of several representative [illegible] now serving large territories. The system of the Pacific Gas & Electric Company, San Francisco, covers 12,000 sq. miles and supplies energy to 150 towns separated by as great a distance as 200 miles. The Southern California Edison Company's system covers about 1000 sq. miles. The Commonwealth Power Company and the Grand Rapids-Muskegon Power Company, in Michigan, serve twenty-five towns ranging in population from 90,000 to 112,000 inhabitants. The North Shore Electric Company, Chicago, serves a district covering 1200 sq. miles and containing sixty towns varying in population from 100 to 27,000. The system of the Eastern Michigan Edison Company covers about 900 sq. miles around Detroit, serving nineteen towns ranging from 150 to 19,000 inhabitants. The Edison Electric Illuminating Company of Boston serves a territory of about 625 sq. miles containing thirty-six towns ranging from 800 to 670,000 inhabitants. Other extensive systems are those of the Janesville Electric Company in Wisconsin, the Hudson River Electric Power Company in New York, the Southern Power Company in North and South Carolina, and the systems around Niagara Falls in Ontario and New York.

The author expressed the opinion that one of the most important advantages which a strong, unified and comprehensive electric system possesses over a number of small separate supply companies serving a territory lies in its ability to serve consumers profitably which the smaller companies are unable to serve. The advantages of the company with extended transmission lines are emphasized through the improvement of load-factor which may be accomplished when the requirements of several cities affording good winter loads are associated with the motor loads of industries which operate only in the summer.

Discussion.

Mr. Peter Junkersfeld, of the Commonwealth Edison Company, Chicago, said that in investigating the possibilities of extending a transmission and distribution system over a wide area it is necessary to consider the character of the territory to be served, the local cost of fuel, the design, construction and extension of the system and the management of the organization. In view of the fact that individual towns may either increase or decrease in population and prosperity, while a large group of scattered towns do not exhibit wide changes in population or prosperity, and such changes as do take place are almost invariably increases, it will be appreciated that a system covering an extended area including a large number of towns represents a much more stable investment than when confined to a single community and can be more readily financed.

Prof. W. L. Robb, of Rensselaer Polytechnic Institute, Troy, N. Y., expressed the opinion that a unified electrical system represents a better economic undertaking in a territory containing numerous small scattered villages than in a territory where there are many large towns or cities. The local plants in cities can be run at a profit, but the villages are unable to operate separate plants without financial loss.

Mr. Frederick Darlington, of the Westinghouse Electric & Manufacturing Company, Pittsburgh, stated that the item of obsolescence is of greater moment in small stations than in a unified system in which use is made of highly efficient large generating units. One of the operating advantages of the large system resides in the ability to maintain twenty-four-hour service and thus to sell energy for various purposes during the non-peak hours. Of the many non-peak loads that can be obtained one of the best is irrigation pumping, the daily and seasonal variation in which is well suited for combination with the lighting load.

Mr. George H. Lukes, of the North Shore Electric Company, Chicago, said that experience has proved that many small industries spring into existence along a system supplying twenty-four-hour service in towns where such industries would not have located if the electric service had not been available.

Mr. N. T. Wilcox, of the Lowell Electric Light Corporation, Lowell, Mass., claimed that in comparison with good management good engineering is much more important. Unsatisfactory management can easily be rectified at any time, but defective engineering can be remedied only at costs that are often prohibitive.

Mr. Philip Torchio, of the New York Edison Company, mentioned the fact that many of the economic losses which burden the small stations can be eliminated by combining the stations under one management and supplying energy from a unified system. The reserve equipment will be much smaller than the aggregate reserve equipment of the small stations, and even the maximum load on the unified system will be smaller than the sum of the maximums of the individual stations.

Mr. L. L. Elden, of the Edison Electric Illuminating Company of Boston, stated that in a certain system calculations had shown that the saving in installation cost was $125,000, due to unification of the small systems by reason of the diversity factor between the separate systems.

Dr. C. P. Steinmetz called attention to the fact that there is no limit to the extent to which unification of systems may be carried in that the larger the generating unit the more economical is the operation. Thus a 20,000-kw turbo-generator unit is more efficient that a similar unit of 14,000-kw rating, which in turn is more efficient than a 10,000-kw unit. He said that, although the fixation of nitrogen electrically from the air can be carried on intermittently, yet it is not at present economical to do so because of the large cost of equipment that would be idle at times. A more practicable scheme would be to combine fertilization by nitrogen with irrigation pumping to obtain simultaneously the best agricultural results and the most advantageous load on the electrical system.

The Pittsburgh Transit Problem.

Mr. Bion J. Arnold delivered an address on Wednesday, Feb. 8, before the Engineers' Society of Western Pennsylvania at Carnegie Library, Pittsburgh, on "Pittsburgh's Transit Problem." Mr. Arnold, who has been investigating the question of electric traction in the Pittsburgh district, discussed the matter at some length from the standpoint of an engineer. He gave many statistics to prove his conclusions and reminded his hearers that Pittsburgh is a district, not a city, and that the traction development should be worked out with this in view.

He showed that the population of the district is relatively scattered as compared with other cities and that the success of future rapid transit growth would be dependent on the growth in population. Statistics were given showing that the growth of Pittsburgh during the past two years had been large, and it was pointed out that the realty values along the line of the New York subway had increased more than 100 per cent beyond the normal rise.

The financial and operating records of the Pittsburgh Railways Company were analyzed in detail and compared with those of other cities. Mr. Arnold stated that in his opinion the methods available for permanent betterment of Pittsburgh's transit situation were a reduction in fixed charges, a temporary waiving of dividends, a reduction of operating costs by re-routing some of the lines and an increase in earnings by encouraging people to ride more. He urged the necessity of the railway company carrying out the recommendations which the State Railroad Commission made some months ago in regard to service, and also advocated the establishment of a public utility bureau for checking purposes. Mr. Arnold also advocated the increase of the bonding power of the city to enable the construction or the purchase of transit facilities by exempting self-supporting bonds from the debt limit.

In concluding his address Mr. Arnold predicted that the Pittsburgh district, now comprising about 1,000,000 people, will probably double its population within the next thirty years and that within this time the earnings from transportation will increase from $10,000,000 to $40,000,000, which increase would justify a future expenditure of $150,000,000 for proper transit facilities.

Mayor William A. Magee, who has for some time past actively engaged in the solution of the transit situation, preceded Mr. Arnold with a short address in which he advocated the formation of a board of impartial, capable men to arbitrate the questions arising between the city and the railways company. The Mayor did not express any definite ideas as to the powers of the board or its selection.

Tests for Insulated Copper Wire.

At the convention of the National Independent Telephone Association held in Chicago, Feb. 8-10, Mr. Hugh T. Wreaks, secretary of the Wire Inspection Bureau of New York, read a paper on "Wire Inspection." Although the talk was addressed specifically to telephone engineers, much of the information contained is applicable to electric lighting companies. The author enumerated some of the tests, explaining what they meant and how they could be interpreted. For convenience these tests were grouped as follows: Braid, ordinary-grade rubber insulation, high-grade rubber insulation, soft-drawn copper wire, hard-drawn copper wire, tinning, copper-steel wire, galvanized-iron wire and lead-covered paper cables.

Mr. Wreaks pointed out that the function of the braid is to add strength to the wire and to serve as a protector to and prevent the action of air on the compound or conductors underneath. Rubber insulation, both low and high grade, has been in the past, and is even now to a greater or less extent, a bone of contention between purchasing agents and wire manufacturers. The characteristics of a good compound are high insulating qualities, long life, both physical and electrical, and sufficient strength to withstand without damage such handling as it will receive when being installed. The quality of strength is not so important, especially when the insulation is covered by a braid. There are, however, many engineers who claim that a relation exists between electrical, physical and aging qualities of a rubber insulation, but the author stated that the Wire Inspection Bureau had made a number of experiments along these lines without discovering any such relation.

For making electrical tests on rubber insulation it is necessary to install large water tanks, together with the necessary cranes and other apparatus for handling the coils and putting them in and removing them from the water, as all electrical tests on rubber compounds are made on coils immersed in water. Transformers capable of giving at least 3000 volts, and preferably 10,000 volts, are needed, together with switchboards and the necessary apparatus for the purpose of applying the voltages required to locate the weak spots, which either show up immediately or are observed when the insulating resistance is taken. The latter treatment requires a sensitive galvanometer mounted so as to be free from vibration, together with necessary scale, telescope, shunt and high-resistance batteries.

The physical tests on ordinary-grade insulation were classified under three heads: Hardness, flexibility and softness. The test for hardness requires no apparatus except a sharp knife and a little practice, and consists in carefully removing the braid and then wrapping the insulation on itself and seeing that no cracks develop in less than twenty four hours' time. The test for flexibility consists in wrapping the insulated and braided wire under tension around a small mandrel immersed in water and measuring by electric tests the damage, if any, that has been done. Tests for softness are made directly on the insulation and, by means of an electric current and a scale, tell how many pounds' pressure it takes for a given tool edge to cut through the insulation. Physical tests on high grade insulation are usually of the nature of a stretch and return test, say, from 2 in. to 6 in and return in one minute to 2¼ in., then a stretch without breaking to 9 in. The tests also call for a breaking strain of about 800 lb. per square inch. Specifications for high-grade rubber insulation generally call for chemical tests, which are more or less of the nature of identification tests. They also serve a useful purpose, but as yet no chemical test of value has been developed for ordinary-grade rubber compounds.

Tests for both soft-drawn and hard-drawn copper wire are in the main alike in kind, but different in degree, elongation tests and breaking-strength tests being called for for both, and a twisting test being called for for soft copper Hard copper, again, must be carefully observed for splinters since these are very dangerous to the linemen in handling the wire. In making tests for strength and elongation a tensile machine is required, which for hard-drawn wire has to register quite a high breaking strain. Physical tests on soft-drawn wire, except in large sizes, need only simple apparatus. Conductivity tests are also specified for both soft-drawn and hard-drawn wire, although for the former they are of less importance as practically all copper when soft has a conductivity above specifications. When hardened through annealing, baser metals may be used which may appreciably lower the conductivity. The resistance of the copper is, of course, important and is included in conductivity measurements, the two together helping to check up the lengths of the coils and the amount of a given order. The quantity of copper cannot be determined without a knowledge of its cross-section, and measurements with micrometer calipers are necessary. These measurements are also essential in checking up insulations and braids.

Tinning on wire is put on not only to preserve the copper presumably against any action from free sulphur or oxidizing agent in the rubber compound, but also to protect the copper from the air in case the braid or compound on the wire is damaged in spots. This latter occurrence is, however, not anticipated and will require a tinning much heavier than is generally used. In tinning copper wire the tin must be put on before the wire is insulated and must, therefore, form a flexible coating and one not likely to be damaged in handling and in the insulating process itself. Too thick a coating of tin would obviously be apt to chip off in this handling. A chemical test for tinning is made by alternate immersions in a solution of hydrochloric acid and a solution of sodium sulphate of stated strength and for stated periods of time. Another test specified is to band the wire around a given mandrel, depending upon the size of the wire, and then immerse the wire in the sodium solution for stated intervals. Both of these tests must be made with care, since otherwise the exposed copper ends of tested metals will affect the test and possibly the solution. These tests are empirical in their nature and are what might be termed factor or safety tests, being more severe than are generally made in practice. The experience of the author fails to show any corrosive action due to oxidizing agents in the insulation. Other points of wire and cable inspection covered by the author had to do specifically with telephone work.

Light and Architecture.

Following a highly enjoyable beefsteak dinner served in the Dungeon of the Castle Cave, New York, on the evening of Feb. 9, the New York Section of the Illuminating Engineering Society held its regular monthly meeting, which was devoted to a discussion of architecture and illumination. The discussion was opened by Mr. Henry Hornbostel, who outlined the conditions leading to the installation of the artistic luminous ceiling over the auditorium in the Allegheny County Soldiers' Memorial Building, Pittsburgh. He claimed that the lighting units now available offer almost unlimited possibilities for the use of light of different colors in the decorative illumination of interiors. He expressed the opinion that the time is not far distant when the present types of lighting fixtures will be superseded by fixtures of the completely illuminated type or be abandoned in favor of luminous ceilings.

Mr. Donn Barber remarked that it behooves those dealing with illuminating problems to recognize the rapid advances being made in the art and arrange all present installations with this fact clearly in mind.

Mr. S. F. Voris stated that the architect will be much benefited by consultation with the illuminating engineer concerning the engineering features of illuminating problems

Mr. Bassett Jones, Jr., explained the relation which should exist between the illuminating engineer and architect by stating that it is the duty of the illuminating engineer to specify the lighting equipment and arrangement which should be employed to obtain the results desired by the architect to correspond to the plan which he has conceived for the interior considered as a whole. Many of the lighting problems, such as those relating to factories, stores, etc., can safely be left to the illuminating engineer, but the architect is needed when dealing with interiors where artistic effects are desired

Mr. V. R. Lansingh claimed that, although the first requirement imposed upon the illuminating engineer is to obtain exactly the results desired by the architect, yet of almost equal importance is the obtaining of these results at the minimum cost. Although efficiency is of small moment in many lighting installations, yet efficacy and economy are of importance in all.

Mr. D. McFarlan Moore said that well-distributed large-surface sources of illumination are far preferable in many cases to distributed point sources. By employing glass-tube lamps with the proper gases for the conducting column there may be obtained a wide variety of different colored lighting units for all artistic purposes.

Widening Scope of Electrical Activities.

The new officers of the Chicago Electric Club conducted the regular meeting at noon, Feb. 8, at the Kuntz-Remmler restaurant, with Mr. Homer Niesz in the chair. The secretary, Mr. N. S. Obright, announced the appointment of chairmen of various committees as follows: Speakers committee, Mr. C. A. Howe; membership committee, Mr. George H. Jones; house committee, Mr. A. L. Millard; entertainment committee, Mr H. A. Mott; finance committee, Mr. W. R. Bonham; civic committee, Mr. J. W. Mabbs. These chairmen are to appoint the other members of their committees. Mr. Frederick J. Pearson, chairman of the Chicago Section of the Illuminating Engineering Society, spoke on the prospect of having the next convention of that society at Chicago and urged that the Electric Club send an invitation to the council of the society to ratify and strengthen other invitations which had been given to hold the convention at Chicago, probably in September. Upon motion of Mr. Vose the officers were instructed to send a telegram of invitation to the council of the Illuminating Engineering Society.

The speaker of the day was Mr. Albert Scheible, research engineer, who spoke on "The Widening Scope of Electrical Activities." Mr. Scheible reviewed in a very concise way the newer uses of electricity, which are continually widening. He introduced his remarks by saying that men were paying the penalty of super-specialization by knowing but little about what was going on in fields other than the ones in which they were particularly interested. One result of this had been a duplication of research work by manufacturers in attempting to develop new appliances and methods. The purpose of the research engineer as compared with the ordinary consulting engineer is to tell manufacturers what has been done abroad and at home along the same lines and so avoid needless expenditure. As an example of the necessity for this he referred to the case of a porcelain manufacturer a few years ago who discovered that porcelain is an electrical conductor when red hot. This manufacturer had great plans for making use of this property of porcelain until Mr. Scheible told him that he had simply rediscovered the principle of the Nernst lamp, which principle was already in extensive use. Mr. Scheible's talk was full of specific illustration of the general points which he made and described many ingenious and interesting devices. Among these was a process for rendering opaque drawing paper translucent like tracing paper, so as to do away with the necessity of making tracings. The drawings are run through a hot wax bath, then between electrically heated rollers and in a short time come out translucent and ready for the making of blueprints, thus doing away with the expense and room occupied by boys and men employed for tracing the original drawings. He referred to the method of location of underground pipes by induction coils and the steering of torpedo boats by wireless. With the increase of methods of electric communication secrecy is becoming more difficult. The overthrow of the Portuguese government was announced to the world instantly by wireless, although cablegrams were censored. He spoke at some length on opaqueness and translucency of various substances to light and to electromagnetic and electrostatic waves.

Methods used for detection of ore, coal or water in underground deposits were touched upon. In sanitation and ventilation electricity furnishes means for air moving by fans or air purifying by ozone, for air heating and for air cooling. When used in cooking it affords definite results as against the uncertainty of flame sources.

Mr. E. L. Elliott, of New York, being present, was called upon and spoke a few words on the tremendous possibilities for improvement in the efficiency of light production. At the present time about 5 per cent is the highest efficiency obtained in practice.

New York Commission News.

The Public Service Commission, Second District, has served upon the Binghamton Telephone Company the complaint of Frank P. Mitchell, of Binghamton, alleging that the rates charged by that company are in excess of the provisions of the franchise under which the company is now operating. Under the franchise it was provided that the charge for business purposes should be $30 per annum and for private dwellings $15 per annum. The new schedule of rates put into effect provides for a charge of from $18 to $30 for residential service and from $36 to $48 for business service. The company has been required to answer the complaint within twenty days.

The commission has served upon the Hudson Counties Gas & Electric Light Company a complaint of the Board of Trustees of the village of Cornwall, County of Orange, alleging that the lamp service is below standard, the power insufficient and the rate of $20 for a 25-cp street lamp unreasonable and beyond what the taxpayers should pay, such rate including a profit in excess of a fair return upon the money actually invested in its business in the village of Cornwall. The company has been required to answer the complaint within twenty days.

During the present week the New York City Commission will hold hearings on the application of the Kings County Lighting Company for approval of a sliding scale for gas rates; on a complaint against the Queens Borough Gas & Electric Company as to rates for gas and on a complaint against the same company as to rates for electricity.

The Public Service Commission, Second District, has received complaints from the Boards of Trade of the villages of Lake Placid, Saranac Lake and Tupper Lake directed against the Western Union Telegraph Company, the Great Northwestern Telegraph Company of Canada, the Postal Telegraph Company and the Champlain Telegraph Company as to alleged unreasonable telegraph rates charged from these places. It is shown that the rates complained of are greater than from other places within a short distance of these points. The rate to New York is 50 cents, while from Malone, Plattsburgh, Potsdam and other points in Franklin, St. Lawrence, Lewis, Jefferson and Essex Counties the rate to New York is 35 cents. The rate to Carthage is 60 cents and from Westport to Carthage is but 35 cents. To Alexandria Bay the rate is 50 cents, and from Westport to Alexandria Bay it is 35 cents. To Syracuse the rate is 50 cents, and from Canton to Syracuse 35 cents. To Buffalo the rate is 50 cents, and from Elizabethtown to Buffalo 35 cents. To Albany the rate is 50 cents, and from Elizabethtown to Albany 35 cents. The commission is asked to make an investigation and fix just and reasonable rates between the points of complaint and other points in the State of New York. The company is given twenty days to answer the complaints.

As a result of an investigation and proceedings before the Public Service Commission, Second District, the village of Fort Edward has secured a reduction in the price of street arc lights from $80 per lamp to $63.87 per lamp per year. The village of South Glens Falls has also secured a reduction in the price per arc lamp from $72 to $63.87 per year. The Hudson River Electric Company secured a franchise and contract in South Glens Falls for furnishing street lighting. The United Gas, Electric Light & Fuel Company, of Hudson Falls, has for a term of years furnished street lighting for the village and vigorously opposed allowing a competing company to come into that small field. After investigation the commission advised the United company that it should reduce the price of street lighting to $63.87 per lamp, and if such an agreement were made it would deny the application of the Hudson River company to enter its field. A stipulation granting the reduced rate has been made.

Citizens of Fort Edward had also complained of the price of street lighting in that village, and the commission caused an investigation of this complaint to be made and advised the United Gas, Electric Light & Fuel Company, which also operates in Fort Edward, that it believed it should reduce its price from $80 to $63.87 per lamp, and this has also been agreed to. The two villages have approximately 100 street lights of 2000 cp in use.

Massachusetts Commission News.

The Massachusetts Highway Commission has approved the addition of certain new telephone rates by the New England Telephone & Telegraph Company to the schedules placed in service by the board about four months ago for the Boston and suburban district. The schedules laid down by the board, according to the views of the company, offer at equitable rates sufficient and suitable classes of service to meet the varying legitimate requirements of all subscribers, with one possible exception, in the Boston district. The company feels, however, that although the district or zone service of the new schedule is apparently better adapted to the needs of the majority of the subscribers, there are nevertheless a very substantial number of residence subscribers who have little use for residence service, but who, on the other hand, have one or two exchanges outside their local district which for social or family reasons they have been in the habit of calling in the past with more or less frequency. The company informed the commission that a substantial number of these subscribers, unless they curtail the use of their trans-suburban calls, will have the cost of their residence service materially increased. The company points out that no four-party line unlimited service, in a rapidly growing multi-exchange territory, such as the suburbs of Boston, no matter how remunerative to the company, can be permanently retained in the schedule without distinct unfairness to the rest of the subscribers. The company, therefore, submitted to the board a tentative offer of one-party and two-party line unlimited suburban service at the rates of $45 and $36 per year, this being a reduction from the original rates of $54 and $42 per year in force in the district prior to the institution of the zone rates. The commission's approval of these additional rates places at the disposal of the suburban patron making use of them the opportunity to call forty-four different exchanges, covering an area of about 400 sq. miles, without extra charge, and affords the public probably the most liberal metropolitan telephone facilities in the world.

The Massachusetts Gas & Electric Light Commission gave a hearing at Worcester on Feb. 9 upon the appeal of the Worcester Electric Light Company against a grant by the municipal authorities to Mr. A. S. Lowell of the right to lay a conduit and transmit electricity across Foster street between two branches of his mercantile establishment. The company was represented by its counsel, Mr. Everett W. Burdett, of Boston; President George T. Dewey, and other officials. Mr. Charles M. Thayer conducted the case for the respondent and contended that the intention was simply to transmit electricity diagonally across the street from an isolated plant owned by his client to a large retail store at present lighted by the central-station company and by the local gas-light service. Evidence was introduced to the effect that there was no intention of selling electricity on the block plant basis. For the company Mr. Burdett pointed out that the whole trend of the State's policy had been to prohibit the transmission of electricity across public thoroughfares, and he cited several decisions of the commission to that effect. He argued that if one person should be granted the right to transmit electricity under, over or across the public ways there would be no proper reason why others should not be given the same privilege, and the result might easily be the improper extension of isolated plant competition throughout an entire business center, with much needless duplication of plant and equipment and a general demoralization of the central-station commercial field. The board took the matter under advisement.

In connection with the petition of Mayor Logan for reduced street-lighting prices in Worcester the next hearing date has been changed to Feb. 27, at Worcester, when Mr. William D. Marks, consulting engineer for the city, will be cross-examined by counsel for the Worcester Electric Light Company.

A hearing was given last week by the legislative public utility committee upon the plan of Governor Foss to abolish the present State commissions and create two new public service commissions, one having jurisdiction in Greater Boston and the other outside. Secretary Travis S. Whitney, of the Public Service Commission, Second District, New York, was present by request and explained the features of the New York regulative tribunal and laws. So far as New York conditions went he was convinced that the abolition of the old methods was a good procedure. He admitted that comparisons between the New York and Massachusetts systems were difficult to make in view of the fact that public-service corporations have been gradually improving under Massachusetts supervision for a long period, while little supervision existed in New York three years ago. Mayor Fitzgerald, of Boston, appeared on behalf of the bill to establish two new tribunals. There appears to be little prospect that the present commission system will be altered in Massachusetts, evidence of the necessity of such a change having been conspicuously absent in discussions of the matter.

The Boston & Worcester Street Railway Company has petitioned the Railroad Commission for authority to issue additional capital stock to the amount of $437,000 to meet the cost of improvements.

Wisconsin Commission News.

The commission has authorized the Durand Light & Power Company to put into effect a new schedule of rates for commercial lighting which will result in a material increase in revenues. The present rate of 6 cents per kw-hour, it was alleged, did not furnish sufficient revenue to keep the plant and system in an efficient condition, nor did it make distinction between the different classes of consumers.

The plant is a water-power development, and it was shown in the investigation that the yearly operating expenses were considerably below the average for plants of the same size under similar conditions. Seventeen plants in Wisconsin gave an average of $23.62 per consumer per year, $27.89 per kilowatt of generator capacity, and $23.61 per kilowatt of connected load. The expense per kilowatt of connected load for Durand was but $14.84 for the year 1910. From an analysis of the commercial lighting costs the following schedule of unit costs was arrived at: One hour's daily use of the active connected load, 12.2 cents; two hours' daily use, 7.54 cents; three hours' daily use, 5.99 cents, etc. On this basis the commission suggested that a rate of 12.2 cents per kw-hour for the first thirty hours' use per month of the active connected load, 6.8 cents for the next sixty hours, and 4.5 cents for all above ninety hours would be an equitable schedule. It was found that this schedule gave about the same total results as the one applied for and which was granted by the commission. This schedule is as follows: For business houses, a charge of 15 cents per month per active 50-watt carbon or per 40-watt tungsten lamp, when the active load constitutes 60 per cent of the connected load, plus 4 cents per kw-hour for the energy used. For occasional users a rate of 12 cents per kw-hour may be granted. For residences, churches, halls, etc., a charge of 15 cents per month per active unit, when 35 per cent of the connected load is considered active, plus 4 cents per kw-hour for the energy used.

The increased revenues under the new schedule will amount to about 1.5 per cent on the total plant valuation and must be borne chiefly by the short-hour users.

The plant carries an unusually high power load by reason of the fact that several large mills are operated by electric power supplied by the company. The commission called special attention to the fact, brought out by the detailed cost analyses, that at the present contract rate given to the larger power users these cost the plant, on the basis of three hours' use per day, about four times as much as they pay, while on the basis of seven hours' consumption they cost about three times as much as they pay

The town of Weyanwega and the Weyanwega Electric Company having failed to reach any agreement concerning rates for street lighting have appealed to the commission for an opinion and have agreed to abide by such opinion. A representative of the commission has been sent to Campbellsport to adjust differences regarding the rate to be paid for electric energy by the village of Lamira. The village, which is located about ten miles from the plant of the Campbellsport Electric Company, desires to obtain energy from that company, but at a lower rate than the company is willing to make

That the Railroad Commission has the power to abrogate a contract entered into in the form of a franchise granted by a city to a public-service corporation, and may render null and void the provisions of that franchise, is the text of a decision handed down recently by the Supreme Court in the case of the City of Manitowoc against the Manitowoc & Northern Traction Company. The decision is of far-reaching effect, for it means that no franchise now in effect has the force of a binding contract between the parties thereto, provided the commission sees fit to step in and alter any provisions in the franchise. The question came to the Supreme Court on an appeal from the Circuit Court of Manitowoc County where the trial court refused to make permanent a temporary injunction against the railway company, restraining it from raising the rate of fare between Manitowoc and Two Rivers from 10 cents to 15 cents. The franchise states that 10 cents shall be the maximum fare between the two cities. All contracts will remain in force until the rates provided therein have been changed by the commission. If the rate is changed the contract is superseded. As the Manitowoc company has failed to bring the matter before the commission for a determination as to the reasonableness of the new rates the old rate must hold until such action has formally been taken and the new rate approved.

By handing down a decision that the indeterminate-permit clause of the Wisconsin public utilities law is legal, the State Supreme Court has upheld one of the most important powers possessed by the commission. The case was brought up by the Kenosha Electric Railway Company, which contended that a certificate of public convenience and necessity from the commission need not accompany a franchise secured from the City Council. The company furnishing lighting for the City of Kenosha recently surrendered its franchise and took an indeterminate permit. Shortly after this the railway company obtained a lighting franchise from the City Council, but did not apply to the railroad commission for a certificate of convenience and necessity. The lighting company prevented the railway company from carrying out the provisions of its franchise by instituting *in quo warranto* proceedings, which resulted in the railway company's appealing to the courts on the ground that the law was void. The Supreme Court has also held that the city ordinance of Milwaukee requiring that the street-car company sprinkle the pavement between its tracks and 1 ft. on each side is valid.

A decision in the matter of the complaint of the City of Sheboygan against the Sheboygan Railway & Electric Company, involving the rate and quality of service for street lighting, has been handed down recently by the Rate Commission. The city alleged that the company had failed to carry out the provisions of the street-lighting contract and had failed to furnish lamps of as high a candle-power as was provided for in the contract. The old contract called for an arc lamp of "full 2000 cp," for which payment was to be made at the rate of $74 per year. One year before the present contract was drawn up the company changed its equipment from the direct-current open arc to the 7.5-amp inclosed series alternating arc, but no reference is made in either contract to the type of lamp to be used. The latest contract expired in September, 1910, and the company has since been furnishing light for which the city is willing to pay, but not at the rate of $74 per annum as fixed by the expired contract.

In its testimony the company claimed that the cost of lighting the streets of Sheboygan is much in excess of the revenue derived therefrom when the service is charged with its proper share of the total expenses, but that the company was able to carry the street-lighting business at an apparent loss because a considerable portion of the fixed expenses now being charged to street lighting would still continue should the company cease to furnish the service. When the affairs of the company were analyzed the commission failed to find that any such conditions existed. Whereas the company claimed a total investment of $57,536 chargeable to street lighting, and an annual expense for this branch of the service of $20,796, the values as determined by the commission were $38,900 and $13,196 respectively. This corresponds to a yearly cost per lamp of $107 according to the company's figures and $68.38 according to the figures of the commission. In arriving at these values the commission allowed 12½ per cent for engineering, legal expenses, contingencies, etc.; 4.7 per cent for depreciation, and 8 per cent for interest. These percentages are the ones usually used by the commission. As a result of this determination the commission ordered that the rate for street-lighting service should not exceed $68 per lamp per annum.

The commission noted the fact that the plant as a whole was earning less than 2 per cent on the cost of reproduction and that this was due to the fact that the expenses of the street-railway department were all out of proportion to the earnings; in other words, that the street-railway service is being furnished at less than cost. In this connection the commission states that it does not consider it good policy for the losses in one department to be made up from the surplus earnings of the other departments, but that each branch of the service should be self-sustaining. However, the point is made that there possibly are conditions under which, for social and economic reasons, it might be good policy for a city or community to depart, at least temporarily, from this rule.

With regard to the meaning of the term "2000 cp" appearing in the contract the commission cited numerous authorities throughout the country and quoted from the results of the Colorado Springs controversy.

In order to determine the quality of service rendered by the respondent company the engineers of the commission made a rather extended series of tests on from nineteen to fifty-two lamps in the City of Sheboygan. These results were compared with the results of tests made, under similar conditions, upon forty-seven lamps in other cities where the same type of lamp was being used, giving satisfactory service. These observations covered in general such matters as power consumption between lamp terminals, power consumption per lamp as measured at the power plant, lamp voltage, circuit current, candle-power of the lamp at an angle of 45 deg. below the horizontal and measurements of illumination produced. From the wattage tests it was found that the average power taken per lamp in Sheboygan was 430 watts, whereas similar measurements in the other cities investigated gave an average of 474 watts. The latter value approximates the normal value for this type of lamp of 480 watts between lamp terminals, and the lamps in Sheboygan fall short by about 10 per cent. The average candle-power, at 45 deg. below the horizontal, as determined by tests made upon fifty-two lamps in Sheboygan, was 210, while the results of forty-seven tests made in the other cities gave an average of 292. The average illumination falling upon a vertical plane 50 ft. distant from a point beneath the lamp, was 0.068 ft.-candle and 0.083 ft-candle respectively.

The comparisons clearly indicate that the service rendered by the respondent company was not satisfactory and that the equipment is not being used to render a fully normal service. The commission stated that the reasons for the poor service were to be found very largely in the company's method of lamp adjustment, in the behavior of the arc regulators, which are not being operated under the conditions recommended by the manufacturer, in instrument errors, etc. The company was ordered to improve its service and to make the same reasonably adequate.

By virtue of a decision in the case of the City of Neenah against the Wisconsin Light, Heat & Traction Company and the Wisconsin Electric Railway Company, recently handed down by the commission, the respondent companies are ordered, within twenty days, to grant a 5-cent fare with transfer privileges between the two systems within the city limits in substitution for the fare of 5 cents now charged by each road for travel within the corporate limits. Both companies operate interurban lines between Neenah and Manasha, but the Wisconsin Electric Railway Company is the only one whose line traverse the City of Neenah from one end of the city to th other. The Wisconsin Light, Heat & Traction Company's line extend but a short distance within the city limits.

It has hitherto been necessary to pay a fare of 5 cents o each road, and the city contended that the double fare wa inequitable and not conducive to the best interests of the cit The respondents contended that the bulk of their business wa between the Cities of Neenah and Menasha and that the strict city business within the corporate limits of Neenah did n justify the joint fare; also that their franchises called f fares not lower than 5 cents within the city limits. The cor mission found that the city business did warrant a joint fa and the franchise objection was overruled on the authority the recent Supreme Court decision in which it was held that t commission had the power to abrogate the contract rights a franchise in respect to rates when such rates are placed dispute before the commission.

CURRENT NEWS AND NOTES.

Electrical Expansion in Turkey.—It is reported that the Minister of Public Works of Turkey has invited bids for electric street railways in the cities of Adana and Adrianople and for the distribution of electric energy in the provinces of the same name.

National Dinner and Rejuvenation of the Sons of Jove.—The Sons of Jove will hold a national dinner and rejuvenation at Coney Island, N. Y., on June 2. The time and place have been chosen to accommodate the large number of electrical men who will attend the convention of the National Electric Light Association in New York during that week.

Hydroelectric Energy for Brazilian Mines.—Right to develop the Falls of Bracuhy, in Angora dos Reis, Brazil, has been granted by the Brazilian government to the Bracuhy Falls & Metallurgical Syndicate, which will utilize this hydroelectric energy in the operation of mines and iron-refining processes. Without storage the water-power is said to have a capacity of 24,000 hp and with dams 100,000 hp.

Gas Explosion Near Elgin, Ill.—Two men were killed and fourteen were injured seriously by a gas explosion in a house in Carpentersville, near Elgin, Ill., on Feb. 6. A gas main in the basement had been leaking for several hours, and a number of men were trying to repair the leak when the explosion took place. One of the men killed was employed by the Western United Gas & Electric Company, of Aurora, Ill.

Examination for Electrician.—The United States Civil Service Commission will hold an examination March 8 to fill a vacancy in the position of electrician in the Bureau of Standards at $900 per annum, experience in storage-battery work being a qualification. Further information, including list of places where the examination will be held, may be obtained by addressing the commission at Washington, D. C., referring to Circular No. 172.

Electric Vehicle Committee of N. E. L. A.—A meeting of the committee on electric vehicles of the National Electric Light Association was held at the University Club, Chicago, on Feb. 9. The members present were: Messrs. J. T. Hutchings, Rochester, N. Y., chairman; C. E. Michel, St. Louis; George Harvey Jones, Chicago; P. D. Wagoner, Long Island City; W. G. Bee, Orange, N. J., and F. M. Tait, Dayton, Ohio. The committee considered its report to be made at the coming New York convention. It will hold two more meetings, probably, before completing the report. After adjournment the committeemen inspected the Chicago Commercial Vehicle Show at the Coliseum.

George Washington Memorial Building.—The George Washington Memorial Association is starting a campaign to erect at Washington by popular subscription a memorial building to George Washington which will contain auditoriums for the meeting of patriotic, scientific and other societies of national scope, and provide a home for such scientific, educational and similar organizations as may make Washington their headquarters. Among members of the advisory committee are Hon. Elihu Root and Dr. Ira Remsen, of Johns Hopkins University. Further particulars may be obtained from the publicity bureau of the association, Demarest, N. J.

Train Dispatching by Telephones.—Complete telephonic train-dispatching equipment is now in use on the Dunkirk & Allegheny Valley division of the Lake Shore & Michigan Southern Railroad between Dunkirk, N. Y., and Titusville, Pa. Twenty-six telephone stations are in use on this division, with a selective call system, so that only the station wanted receives the call. These stations are established in all of the towns upon the line and all of the principal sidings where trains meet. The greater part of the train dispatching is now done by the use of the telephone system. The telegraph instruments have not been removed, however, and probably will be retained, as it is the intention to supplement rather than supersede them by the telephones.

Contest Over Truckee River Power Right.—The California Legislature, now in session, has passed a resolution requesting President Taft not to approve the proposed contract by which the government is to give the Truckee River General Electric Company a perpetual right to divert the waters of Lake Tahoe into Nevada. The resolution passed by the California Legislature declares that the lake and its watershed lie chiefly in California, and that the natural outlet of Lake Tahoe is the Truckee River in California, through which the overflow waters of the lake flow for over thirty-five miles through that State; that this river is a source of wealth to the State amounting to millions of dollars, and that the diversion would do great damage to California in depriving it of waters that can be used for irrigation and for power purposes.

Tungsten Production in 1909.—Advance figures from the Geological Survey publications indicate that the 1909 production of tungsten reached 5289 short tons of concentrates containing 60 per cent of tungsten trioxide, compared with 3898 tons in 1908 and 6062 tons in 1907. In very few of the returns, however, is the percentage indicated, which is necessary in comparing figures. It is probable that most of the exported ore is richer than 60 per cent in tungsten trioxide, and that the figures are therefore low. The principal sources of the 1909 production were: United States, 1619 tons; Argentina, 900 tons; Australia, 1200 tons; Bolivia, 168 tons; Germany, 106 tons; Portugal, 609 tons, and the United Kingdom, 421 tons. The value of the tungsten ore produced in the United States during 1909 was $614,370, compared with $229,955 in 1908 and $890,048 in 1907. With the recovery of the American steel trade during 1909 prices rose above those of 1908 and ranged from $5 to $9 per unit for tungsten ores, the average price being $6 to $6.50 per unit. Tantalum incandescent electric lamps have such strong competition in tungsten lamps that the demand for tantalum minerals seems rather to have decreased than grown. The tantalum used in this country in 1909 was imported from Germany.

Motor Advertising Penetrates Prison Walls.—An interesting example of the varied and extensive circulation attained by advertisements of the large electric manufacturing companies is well illustrated in the following incident which recently occurred in the upper portion of New York State. A letter was received by one of the manufacturing companies written on the stationery of a local hotel inquiring as to the use of a small motor for laundry work and mentioning an advertisement that had recently appeared in one of the magazines. A motor salesman was immediately dispatched to the town whence the inquiry came. He went to the manager of the lighting company and asked if he had any knowledge of the person making the inquiry. The manager had never heard of him, but suggested that the salesman go to the hotel from which the stationery originated and see if he could find any trace of the writer. The hotel manager pleaded ignorance of any such man at first, but on further questioning of the employees his identity was revealed. It was found that the man was an inmate in the State prison located in the town and worked in the prison laundry. A conversation with the warden of the prison confirmed this fact, and it was stated that the man was much interested in his work, had seen the advertisement and wanted to get the authorities interested in the purchase of a motor to run some of the washing machines.

Electric Iron Smelting.—Four additional electric iron smelters are being installed at Heroult, Cal. The original furnace has been in constant operation for some time, producing steadily about 20 tons of pig iron every day.

Colorado Electric Club.—Judge C. J. Gavin gave the talk on "Opportunities in the Electrical Field" at the weekly lunch on Jan. 26. He said that his real subject was "Electrical Men I Have Met," but he presumed the subjects were nearly synonymous, as he had met most of his electrical friends under "trying" circumstances. He traced the legal history of electricity in Colorado and especially spoke of the original "visionaries" who had done pioneer work. Mr. E. Edwards was elected chairman.

Electric Power for Canadian Farmers.—The Ontario Hydroelectric Commission will ask for an amendment to the provincial hydroelectric power act in order to bring about the supply of rural electrical service. The measure has not been yet introduced, but it is stated that under its provisions a minimum of twenty farmers can make requisition to obtain a local power service, the cost of distribution being chargeable against the users, the electric power to be supplied at reduced voltages to the distribution system erected and maintained by the farmers.

Minimum Lighting Rate in Ohio.—In a suit at Springfield, Ohio, last week, Judge Middleton handed down a decision denying the right of the Springfield Light, Heat & Power Company to make a minimum charge of $1 a month to consumers. Since the new ordinance fixing the rate at 8 cents per kw-hour went into effect the company has been enforcing this minimum charge. but the court holds that as the company accepted the ordinance fixing a maximum rate it has forfeited its right to fix a minimum charge which would make the rate of any consumer more than the maximum named in the ordinance.

Governor Wilson on the Engineer.—At the tenth annual banquet of the Alumni of Stevens Institute, held at the Hotel Astor, New York, on Feb. 8, Governor Wilson of New Jersey was one of the speakers, his topic being "The Necessary Thoroughness and Skill of the Engineer and His Right to a High Place in Public Esteem." He spoke of the impossibility of graft in the engineering profession, showing how poor materials and workmanship would soon show up in such a way as to cause the downfall of the dishonest engineer. He drew a comparison between authorship and engineering, showing that while the author can write a book in which only one chapter is worth while the engineer must make his work uniformly good.

College Electrical Show.—The third annual electrical show by the students in electrical engineering at the Michigan State College, at East Lansing, Mich., will be held the second week in March. This year, the State Legislature being in session, special invitations will be sent to the members. At the time people from all over the State will be visiting the college because of other meetings going on. The features of the electrical show are principally in relation to the application of electricity to domestic uses, including electric heating and electric cooking devices, with exhibits of electric washing machines and electric vacuum cleaners. Methods of electric wiring and electric lighting will be exhibited and a typical dining-room or bedroom properly lighted will be a feature.

Slight Damage from Electric Fires in New York City.—The annual report of the electrical department of the New York Board of Fire Underwriters shows that twenty-four fires of those investigated were attributable to electricity and caused a loss estimated at $27,530. Five fires were due to short-circuits; nine were due to grounding of conductors on gas pipes and other metal; two were due to sparks thrown from operating switches; three were attributable to overloaded circuits; one was due to defective joints; one to loose contact, and one was due to heat from an incandescent lamp igniting inflammable material. Of two causes which resulted in no damage, one was due to an explosion of an incandescent lamp in gasoline, and one was due to the ignition of a moving-picture film in a booth.

Brooklyn Edison Company to Entertain Contractors.—On Feb. 25 the Edison Electric Illuminating Company of Brooklyn will entertain the electrical contractors of the city at the Montauk Club. The Brooklyn Edison Company maintains most cordial relations with the electrical contractors and this is one of the get-together methods it frequently employs.

Meeting of the National District Heating Association.—The third annual convention of the National District Heating Association will be held in Pittsburgh on Tuesday, Wednesday and Thursday, June 6, 7 and 8. The headquarters will be in the Fort Pitt Hotel, and the sessions and exhibits will be held in the banquet-room on the ground floor of that building. The program will be of more than usual interest to those engaged in central-station heating. Eleven papers, covering a wide range of subjects, will be presented and discussed. All papers will be printed in advance of the convention. The entertainment provided will be especially interesting and the city selected is particularly advantageous both as to accessibility and interest for central-station heating men. Mr. D. L. Gaskill, Greenville, Ohio, is secretary.

Dam Blown Up to Get Light for City.—According to a dispatch from Pocatello, Idaho, by voluntarily sacrificing property valued at $100,000, former Governor Brady, on Feb. 4, furnished electric lights to Pocatello, which had been in darkness since the substation and transformer house of Brady's power company was destroyed by flood water two nights previously. "By dynamiting the power company's dam," says the dispatch, "Brady, who personally superintended the work of redeeming Pocatello from darkness, was able to reach the company's transformers, buried deep below the surface of a flood in the Portneuf River, and connect them again with the company's high-tension transmission line from the plant at Ann Falls. Three hundred pounds of dynamite were used in blowing out the company's dam to reduce the level of the flood water around the wrecked transformer house. By the lifting of the railroad blockade and the resumption of the electric light system Pocatello is once again in normal condition."

Proposed Pole-Line Legislation.—A bill has been introduced in the California Legislature proposing radical changes in the stringing of power, telephone and telegraph wires in that State. The bill requires a distance of 13 in. between the pole and a wire, making a space of 26 in. in which the lineman will be free to work. Cable lines are to be strung on crossbars, instead of along the poles on brackets, and laterals from underground conduits to the crossbars of poles must be incased in wooden casing of 1½ in. thickness. The big fight of the Electrical Workers' Union is for the 26-in. space between the wires on crossarms next to the pole. A representative of the Electrical Workers' Union of San Francisco during the hearing on the bill explained that a space of 26 in. for the lineman to work in at the crossbars of the poles was absolutely necessary for his safety, as in that space he could shift about and would not be obliged to crawl around and come in contact with the high tension of live wires on the pole. Yellow paint for the crossarms carrying high-power wires was also advocated to warn the lineman of the danger. Mr. John A. Britton, of the California Gas & Electric Corporation, asked that the law be made to apply to lines to be constructed hereafter, giving the companies four years at least to change the existing lines to conform to the new requirements. Mr. Britton explained that the Public Utilities Commission, which he stated he fully expected would be formed this year, will have entire charge of such matters.

STATION OF THE MIDDLETOWN (CONN.) ELECTRIC LIGHT COMPANY.

Complete Substitution of Alternating Current for Direct Current on All Circuits.

THE Middletown Electric Light Company was one of the earliest companies in Connecticut to undertake public electric lighting. Naturally, the apparatus first installed became antiquated and inadequate for the growing demands of the large business that developed under the management of Mr. L. C. Whitney, who has been manager of the company for the past seven years.

The original plant was located in the center of the city to permit the favorable distribution of direct current through a three-wire system. The generators were belted to a jackshaft driven by simple, non-condensing engines, which were added from time to time as the demand for energy increased. With the extension of the circuits to outlying districts and particularly for supplying energy to motors it became necessary to install an alternating-current system and two-phase belted generators, and additional engines were purchased until the number of machines in the plant required to carry the load during the winter of 1909-1910 had reached a total of thirteen, with the coal consumption averaging about 9 lb. per kw-hour.

Three years ago a hydroelectric company offered to deliver energy to the Middletown company at 1½ cents per kw-hour on a meter basis. This price compared with the cost of producing energy in the style of station then owned by the company seemed so attractive that a contract was signed, but the hydroelectric company failed to complete its plant, and last winter its successor made another proposition to the Middletown Electric Light Company to furnish alternating-current energy delivered to the high-tension side of transformers to be located on the property of the Middletown Electric Light Company at the price of 1¾ cents per kw-hour, with a load-factor of 26.7 per cent at the start, increasing to 35.7 per cent at the end of ten years, the life of the contract.

For advice as to the desirability of this proposition the Middletown company called in Mr. Henry Floy, consulting engineer, of New York City. Mr Floy advised that when considered in connection with the transformer and switchboard losses, as well as the stand-by charges, the interest and depreciation on the investment required to put the station in the necessary condition to comply with the terms of the contract as to a reserve steam plant, the contract price named was higher than the cost of producing energy by a modern steam plant. The results of this analysis and conclusion indicate the necessity for careful consideration of the apparent saving to be effected by the use of water-power as against steam and explain why the auxiliary obligations assumed in purchasing water-power energy apparently furnished at less cost often result in a real increase in the expense of energy production The Middletown company's directors thereupon decided to build a new station on the bank of the Connecticut River. Plans and specifications were immediately got out and contracts promptly let, so that construction work was begun May 5 and so expeditiously carried forward that the station commenced taking up its electric load exactly four months and one day thereafter and ever since has been successfully performing its functions.

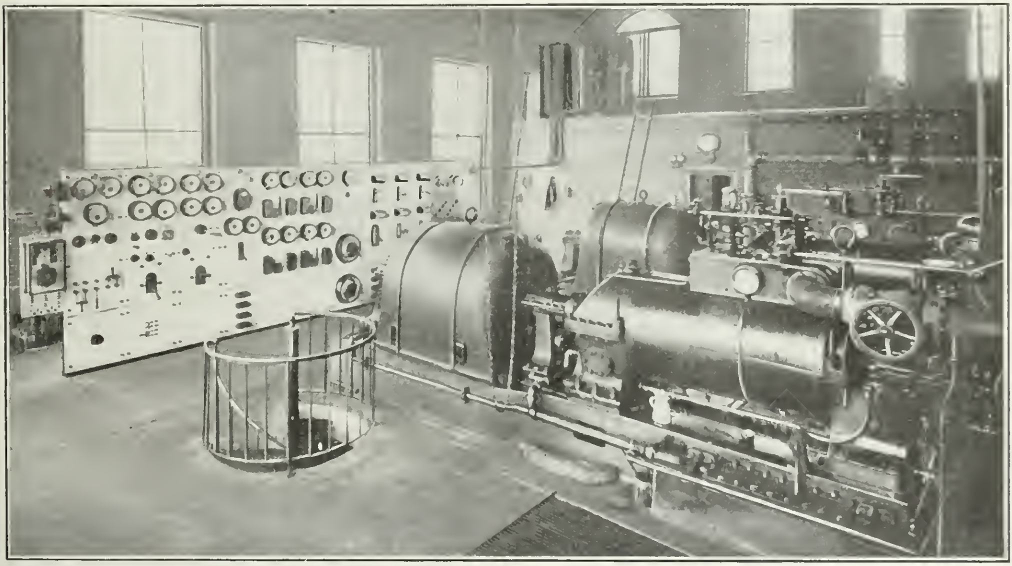


Fig. 1—General View of Generating-Room.

In March wash borings had been made to determine the suitableness of the proposed building site and sandstone rock was located at a depth of from 20 ft. to 30 ft. The engineer's plans contemplated a building supported on concrete steel piles, and the contract for this work was awarded to the Raymond Concrete Pile Company, including that for the concrete floors and walls up to an elevation of 21 ft. This elevation was chosen because it was the highest point to which the river had been known to rise at any time during the last fifty years. The concrete piles, which were made monolithic with the building, averaged a little over 20 ft. in length. The upper part of the building is of Harvard brick, with black headers; the flat roof is of ferro-concrete carried on steel trusses and covered with tar and gravel, and a light limestone coping for the windows and trim gives an ornamental effect that harmonizes well with the concrete work. The contract for the superstructure was awarded to a local firm, Mylchreest Brothers

All windows are considerably above the top of the concrete work, and four openings for doors have been provided with battens so that in case of an extreme rise in the river the doors may be closed and the operation of the station continued uninterruptedly. The building is strictly fireproof throughout, metal doors being provided to separate the boiler and engine-rooms, thus making it unnecessary for the company to carry any fire insurance whatever.

The company's old generating station, which has been abandoned, contained several 250-hp vertical "porcupine" boilers. Three of these which were in first-class order were removed and installed in the new plant and an additional new boiler was purchased, making a total installation at present of four 250-hp boilers. Each of these is equipped with an independent iron stack 30 in. in diameter and approximately 30 ft. in height above the top of the boiler. The stacks pass through openings in the concrete roof, which are protected from the weather by means of iron umbrellas which encircle and are clamped to the stacks. The installation of automatic stokers was considered, but in view of the present operating capacity of the plant it was found that the advantages to be obtained would not compensate for the fixed charges and depreciation on the investment.

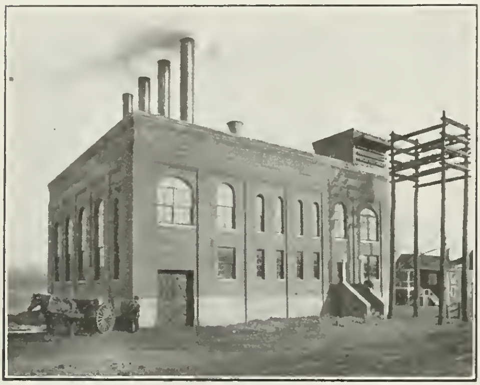


Fig. 2—Exterior View of Power Station.

Although the property of the company is so located on the Connecticut River as to permit receiving coal in barges, the advantageous prices offered by local dealers caused the company to close contracts for local delivery of coal, thus saving losses in shrinkage, storage, investment, etc., necessary for apparatus to unload the fuel from barges. The company is prepared to install coal-handling apparatus in case any economies could thereby be effected. As spring floods are apt to inundate the property on which the plant is located and have been known to rise several feet over the adjoining streets, it was considered essential that a supply of coal be at all times assured. To meet this condition a contract was awarded to the Jeffrey Manufacturing Company for a 150-ton coal bunker with screw conveyor and elevator. Run-of-mine soft coal is dumped from 1-ton carts onto a steel "grizzly" at the corner of the building, which serves as the top of a concrete hopper. Pieces too large to pass through the 4-in. x 5-in. openings of the grid are broken by a mall, and the coal dropping onto the bottom of the concrete hopper passes through the building wall into a cast-iron boot located in a concrete pit below the boiler-room floor. The chutes for delivering coal from the bunker to the steel floor in front of each boiler, the boilers themselves and the feed-water piping are shown in Fig. 3. The piping was installed by Messrs Kellogg & Company in line with the best practice, the high-pressure steam piping being of wrought iron with Vanstone joints and extra-heavy cast-iron fittings with long-sweep bends. The downtakes from the boiler nozzles are of considerable length to compensate for the expansion in the boiler itself, this arrangement bringing the steam header relatively near the floor. The connections between the boilers and generating units are short and direct. Each boiler is equipped with Foster automatic non-return and stop valves. The main header may be cut in two by the closing of a heavy by-passed gate valve, leaving practically two headers, each connected to one-half the total boiler plant. There are an auxiliary header and two lines of piping supplying both exciters and both boiler-feed pumps; there are also twin boiler-feed lines, so that a shut-down of the plant is practically an impossibility.

The turbine-room is a large, well-lighted square room with brick partitions and gallery at one end and a basement for the condensing apparatus. The room is designed to accommodate two 500-kw and one 1000-kw steam turbo-generators, although at present only two 500-kw, 3600-r.p.m. Westinghouse-Parsons turbines driving Westinghouse two-phase, 60-cycle, 2400-volt generators have been installed, together with duplicate 25-kw turbines driving direct-current 125-volt exciters. The turbines are set on I-beams supported at either end and at the center on concrete piers, thus forming with the floor of the turbine-room the ceiling of the condenser-room and permitting the location of the condensers directly under and close to the exhaust outlet of the turbines. The condenser-room is waterproofed on the bottom and four sides and has no openings aside from pipes except through the turbine-room floor. In the condenser pit are two Leblanc condensers with steam turbines—that are operated condensing—driving rotary circulating and vacuum pumps. The exciter turbines as well as the boiler-feed and sump pumps exhaust into a 750-hp Cochran feed-water heater. In addition to the condensing apparatus there are located in the condenser pit sump pumps for discharging low-pressure drips into the sewer, a trap for returning the high-pressure drips to the feed-water heater and a galvanized-iron storage tank for receiving the discharge of the air pumps, which thus provide water for all power-house purposes except drinking. Water is taken by an automatically controlled pump in the boiler-room from the storage tank, passed through a Blackburn & Smith filter and discharged into a tank located about 20 ft. above the boiler-room floor. From this tank water is automatically supplied to the feed-water heater, which in turn supplies the boiler-feed pumps or furnishes hot water for the wash basins. In addition to the source of water supply from the river the city mains have been extended by the lighting company so as to make them available as a reserve and for supplying drinking water. A Westinghouse air compressor provides air for cleaning the electrical machinery, blowing out the boilers and operating the boiler-tube cleaners.

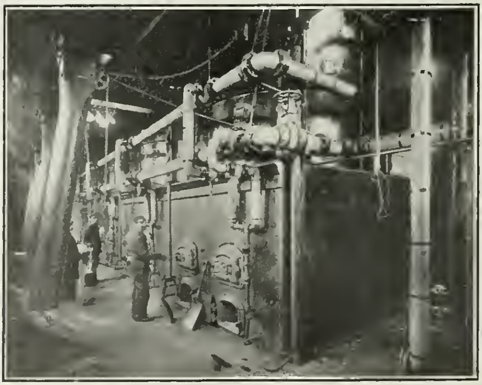


Fig. 3—Boiler-Room.

The switchboard consists of white marble panels with subbases, partly new and partly transferred from the old station. There are a single exciter panel to control the two exciter units, two generator panels with non-automatic oil switches, a totalizing panel with polyphase watt-hour meter, motor and lighting feeder-circuit panels equipped with Westinghouse fuses or

Condit time-relay switches and an alternating-current arc-lighting panel. A Tirrill regulator with a synchronizer and voltmeters adjoins the exciter panel. The panels are equipped with the usual instruments, such as indicating wattmeters, ammeters, etc. The arc transformers, which are located on the gallery over the offices, and the arc switchboard were transferred from the old station, set up and put in operation in one day, thus avoiding any inconvenience in the supply of street lighting in changing over from the old to the new station. The wiring in the building is all run in a loricated conduit embedded in the concrete floors or running up the brick walls to the wire tower in the southwest corner of the building, where the wires are fanned out on cross-arms preparatory to passing through porcelain bushings set in the wall of the tower to a wooden structure just outside of the building connecting with the pole lines. Each conductor has in circuit a choke coil located in the tower and a General Electric lightning arrester just outside the building on the wooden-pole structure. Incandescent lamps arranged in rows along the sides of the building are used for lighting, thus affording uniform illumination free from shadows.

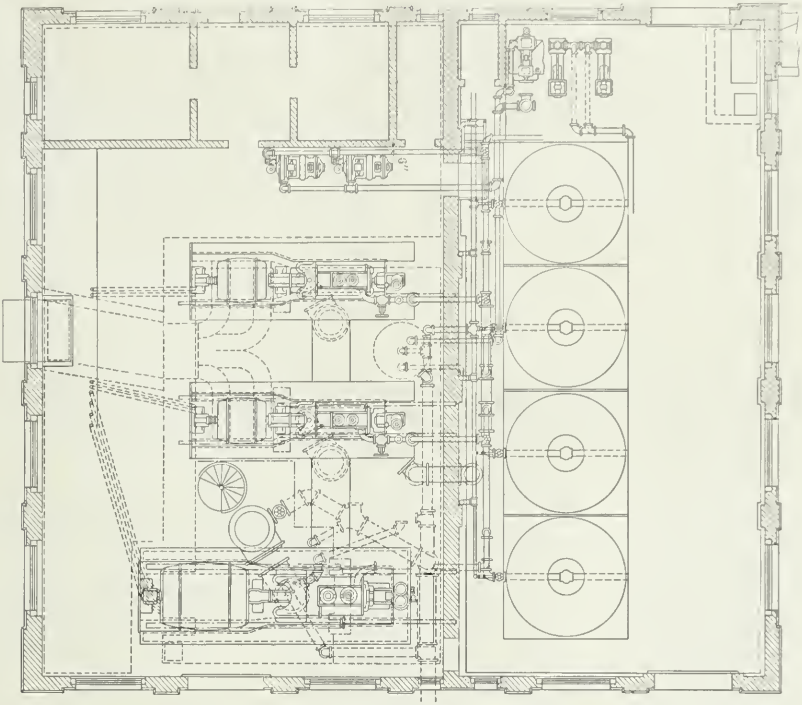


Fig. 4—Plan of Power Station.

The turbine-room is ventilated by means of 20-in. copper "Star" ventilators provided in the roof, which is also finished with copper flashings. Pure cool air is supplied to the turbines through galvanized-iron ducts leading from the south side of the building under the floor directly to the air intakes of the turbines. Heated air is discharged into the condenser room and, rising through gratings in the floor, passes off through the ventilators.

A concrete intake measuring 5 ft. square on the inside and 20 ft. in height was built on land and, the foundation having been prepared by a diver, was lowered into position flush with the dock line. On its front face are iron bars on 2½-in. centers and on the insides are twin net strainers with 1-in. openings. A 16-in. cast-iron intake pipe, protected by a ½-in.-mesh copper screen, conveys water from the intake to the condensers in the power plant. The circulating water, etc., is discharged through a 16-in. pipe running from the condenser-room to the corner of the plot upon which the plant is located.

When it was decided to build the new station it was also decided to abandon the use of direct current, which necessitated changing over more than 100 motors, in addition to fan motors, arc lamps, etc., of the direct-current type. The direct-current motors differed in size from a fraction of a horsepower up to 25 hp, and the change from direct current to alternating current required extensive changes in the distributing system. These have taken a long time to accomplish and have been relatively expensive. The changes have been made at such times and in such a way as to avoid inconvenience to customers.

The president of the Middletown Electric Light Company is Mr. D. Ward Northrop, the secretary and treasurer Mr. H. L. Mansfield, and the manager Mr. L. C. Whitney. Mr. H. A. Willard is chief engineer.

ADDITIONS TO COMMERCE STREET STATION, MILWAUKEE.

The electrical generating capacity of the Commerce Street power plant of the Milwaukee Electric Light & Railway Company, Milwaukee, Wis., is being increased by two 14,000-kw high-pressure turbine alternators and two 7500-kw low-pressure turbine alternators, the latter utilizing the exhaust steam from the eight vertical, cross-compound engines already installed. The new work involves the installation of very extensive and complete switching apparatus for the alternating-current section of the plant, including a number of interesting features embodying the most modern design and practice.

DEVELOPMENT OF THE PLANT.

The construction of the original Commerce Street plant, with its engine-driven equipment, was commenced in 1902 at the time the steam turbine was first attracting the serious attention of engineers. The plant was, therefore, originally designed with the idea of being only temporary to tide the system over such a period as might be required to determine the suitability from various points of view of the steam turbine for large power-plant work. Later, as the plans progressed, it was decided to make this plant of a substantial character so that it might be permanent and be held as a reserve in case a large turbine plant was built which would supersede it for regular operation. Under these conditions four vertical, cross-compound Allis-Chalmers engines (28 in. and 60 in. x 48 in.) were installed, direct-connected to 1500-kw, 13,200-volt, 25-cycle General Electric generators. Each engine received steam from two Edge Moor boilers, having a combined heating surface of 13,000 sq. ft.

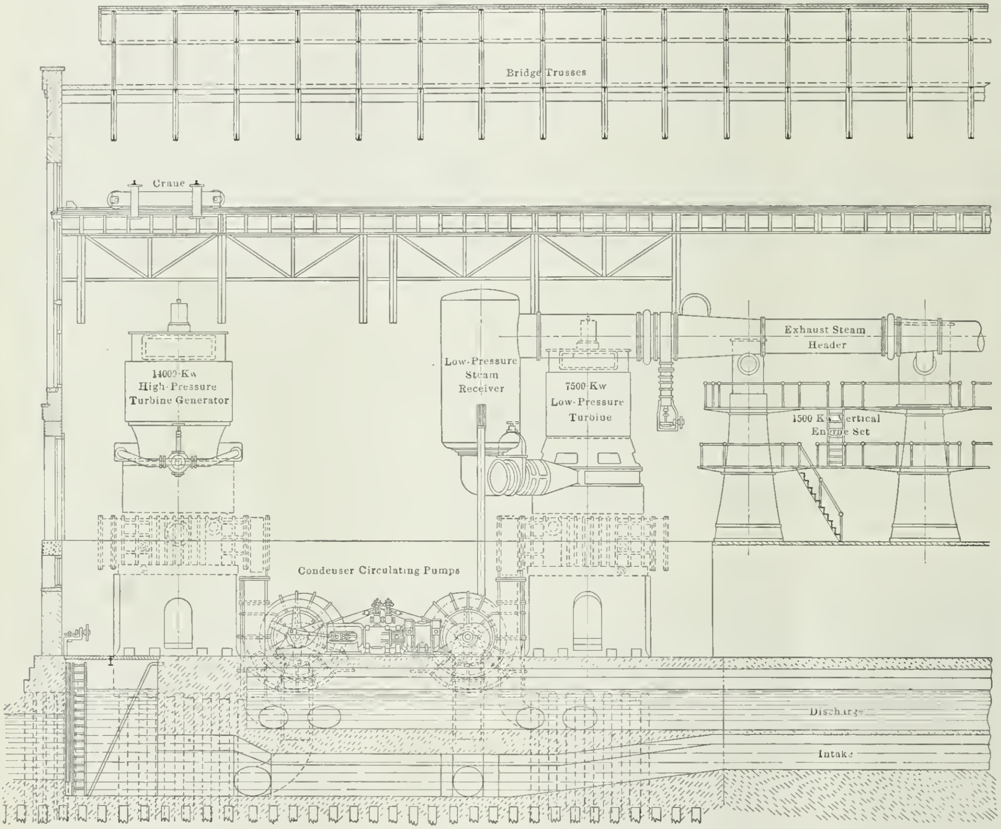


Fig. 1—Longitudinal Section Through Station.

The plant was built on the unit plan so far as possible, each pair of boilers having a separate self-supporting steel stack, and each alternator a separate turbo-driven exciter. So far as the piping is concerned (although headers are arranged for interconnection) any unit may be operated independently of the other units.

In the early part of 1904 the requirements of the system had become such that additional power was necessary, the increased demand being chiefly for 600-volt direct current for the operation of cars in the congested section of the city. Although the dependability of the steam turbine had by this time been pretty well established, this was only in connection with alternating-current generators. As the Commerce Street station was a favorable point from which to distribute direct current, it was decided on this account to add four additional engine units (32 in. and 68 in. x 60 in.) of the same type as before, driving 2000-kw, 600-volt direct-current generators. Simultaneously with this extension there was an increased requirement for 60-cycle alternating current for lighting and motor purposes.

As space was available under the switchboard gallery two 1000-kw vertical Curtis turbines driving 60-cycle, 2300-volt General Electric generators were installed. In connection with this installation there were added eight additional Edge Moor boilers of approximately 7000 sq. ft. heating surface each. The same unit plan of arrangement was carried out in this extension as in the first. Although the units, so far as piping is concerned, in each half are interchangeable, there is no steam connection between the two sections, so that the bursting of a pipe or any similar accident cannot affect more than half of the plant. The coal-handling apparatus of this plant consists of man-trolleys and special dumping wagons and Jones underfeed stokers.

PRESENT TURBINE ADDITION TO STATION.

Early in 1910 it was determined that further extensions and additions must be made, as the existing equipment was severely overloaded. Accordingly, an 80-ft. tract of ground north of the plant was acquired. Contracts have been placed for the building and machinery, and a large part of the building work has now been completed. The machinery to be installed in this extension consists of two 7500-kw low-pressure, 25-cycle, vertical Curtis turbines and two 14,000-kw high-pressure, 60-cycle, vertical Curtis turbines. The condensing apparatus for these four turbines is exactly alike, both for the 7500-kw low-pressure machines and the 14,000-kw high-pressure machines, the actual amount of steam in each case being approximately the same.

These condensers will be of the Worthington base type, located wholly under the turbines, and each will have 25,000 sq. ft. of cooling surface in 1-in. tubing. The circulating pumps, having a capacity of 30,000 gal. per minute, will be of the 36-in. centrifugal type, each driven by a 22-in. x 24-in. Laidlaw-Dunn-Gordon Corliss engines. These engines will also drive the dry-vacuum pumps, 31 in. x 24 in., direct-connected behind the steam cylinders. The wet-vacuum pumps are 5-in., two-stage centrifugal pumps, and will be arranged to be driven by both induction motors and small steam turbines. It is the intention normally to adjust the turbine speed of this unit so that the induction motor will be as nearly as possible in synchronism with the main generators, allowing the motor to float on the line. Should the turbine for any reason fail the motor would then continue to operate the pump, or if through any failure of the turbine governor the speed should materially exceed normal the motor would act as an asynchronous generator and tend to prevent disastrous overspeeding. Independent turbine-driven exciters will be provided, each directly connected to its respective generator.

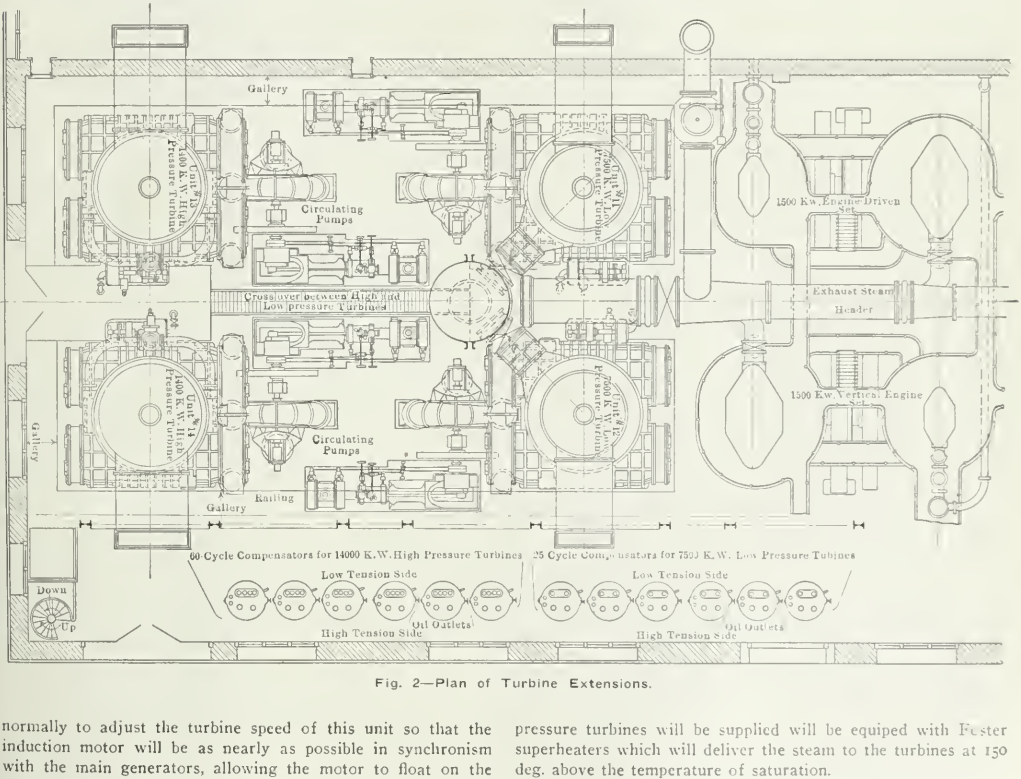

Gallery
Unit #13 1400 K.W. High Pressure Turbine
Circulating Pumps
Unit #11 7500 K.W. Low Pressure Turbine
1500 Kw. Engine Driven Set
Cross over between High and Low pressure Turbines
Exhaust Steam Header
1500 Kw. Vertical Engine Set
Unit #14 1400 K.W. High Pressure Turbine
Gallery
Circulating Pumps
Unit #12 7500 K.W. Low Pressure Turbine
Railing
Gallery
60-Cycle Compensators for 14000 K.W. High Pressure Turbines
25 Cycle Compensators for 7500 K.W. Low Pressure Tubines
Low Tension Side
Low Tension Side
Down
Up
Oil Outlets
High Tension Side
Oil Outlets
High Tension Side

Fig. 2—Plan of Turbine Extensions.

BOILERS AND PIPING.

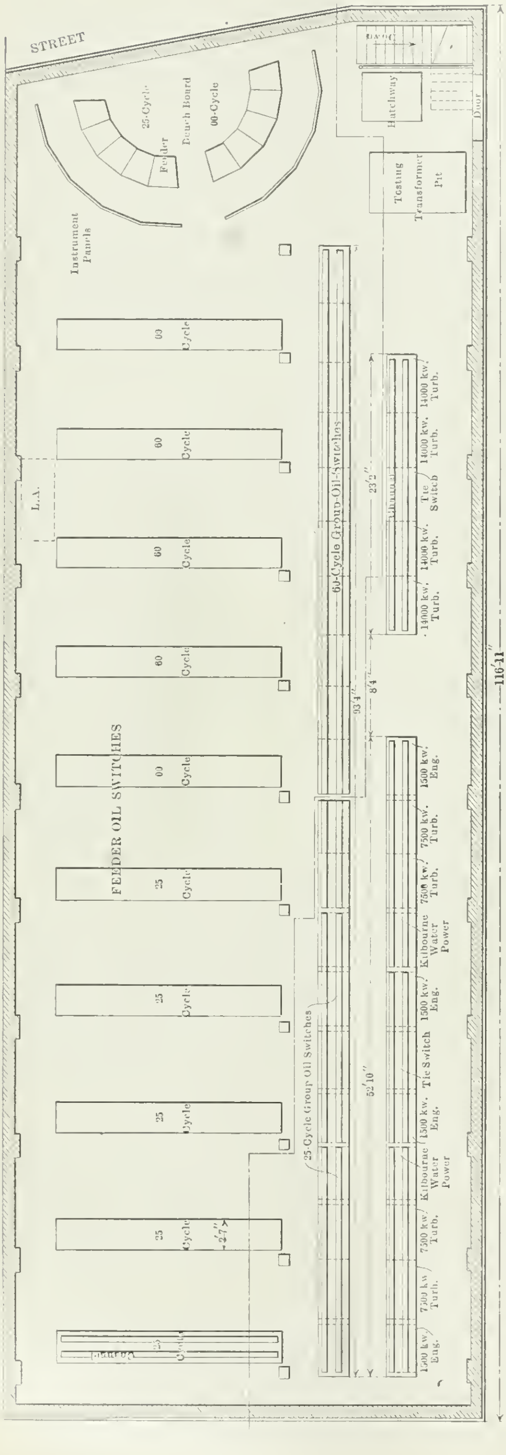
The boiler installation for this extension will consist of eight additional boilers similar to the original installation and each having 7500 sq. ft. of heating surface. For boiler feeding an arrangement of pumps with opposed cylinders is planned, using pot-form pumps with compound Corliss engines, in connection with Hoppes heaters.

It will be noted that, considered on a conventional basis, the total capacity in kilowatts in this plant is very much in excess of the boiler capacity. Having determined that under peak conditions a boiler horse-power can be produced without difficulty on about 5 sq. ft. of heating surface without materially affecting the efficiency of the boilers, the company's engineers have concluded that it is better to do this during the peak, operating all the boilers, excepting those withheld for cleaning repairs or during the lighter load periods of the day, than to have a much larger boiler installation, as is commonly done, operating at a ratio of 10 sq. ft. during the peak and having a large number of boilers banked all the rest of the day.

Each boiler is equipped with a superheater built on the top of the boiler and in reality an integral part of the boiler. This superheater has 25 per cent of the total boiler heating surface and is used as an economizer through which the gases pass after leaving the water-heating surface of the boiler. At normal rates of operation approximately 60 deg. of superheat is obtained from this source. In addition to this the eight new boilers which are to be installed and from which the high-pressure turbines will be supplied will be equiped with Foster superheaters which will deliver the steam to the turbines at 150 deg. above the temperature of saturation.

It has been found by test that the various engines, non-condensing, will have their maximum efficiency with a total capacity of about 4000 kw in excess of the rating of the generator, and as the generators will readily operate without excessive heating with this additional load the total station capacity is considered to be 63,000 kw. The real estate occupied by this installation is 143 ft. x 240 ft. So far as the power plant proper is concerned there is, therefore, 1 kw installed for each 0.545 sq. ft. of real estate.

A feature of this installation which, in its construction, has involved much study is the low-pressure piping between the engines and the turbines into which they exhaust. To make this piping as short as possible and to avoid unnecessary bends it was decided to carry it overhead, and the last end of this pipe, next to the separator, was made 66 in. in diameter in order to reduce the velocity of the steam sufficiently to permit proper



First Floor Plan

Fig. 3—Arrangement of Oil Switches.

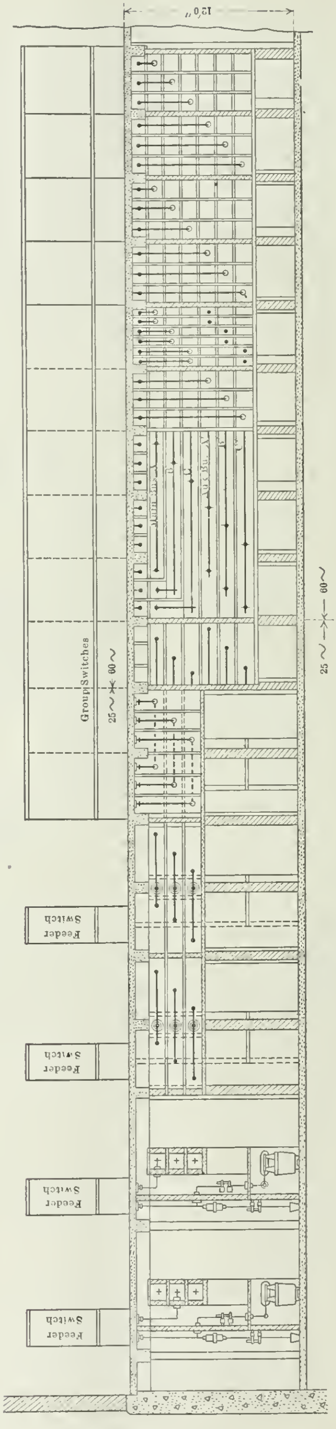


Fig. 4—Section Through Switch House, Showing Bus Structure in Basement.

action on the part of the Hoppes separator. This separator is 10 ft. in diameter and approximately 22 ft. long. As the pipe referred to has a fairly rigid connection to each engine, the expansion must be necessarily taken up at intervals between the engines. However, as it was not considered safe to trust to the rigid connections as anchorages it became necessary to design a harness which would anchor the pipe to itself.

GENERATING EQUIPMENT.

As has already been mentioned, the new generating equipment of the enlarged station will comprise two 14,000-kw, 60-cycle turbine generators and two 7500-kw, 25-cycle low-pressure-turbine machines. This apparatus will be in addition to the existing equipment of four engine-driven 1500-kw, 25-cycle, 13,200-volt alternators, four engine-driven 2000-kw, 600-volt direct-current generators, and two 1000-kw, 4000-volt, 60-cycle turbine generators, whose output is used directly for lighting purposes.

The 60-cycle, 13,200-volt feeders will thus be supplied from two 14,000-kw alternators, while the 25-cycle generating equipment of the station will comprise the four existing 1500-kw, engine-driven, 13,200-volt, 25-cycle alternators, together with the two newly installed low-pressure turbines driving 7500-kw, 25-cycle alternators and utilizing the exhaust steam from the eight engines.

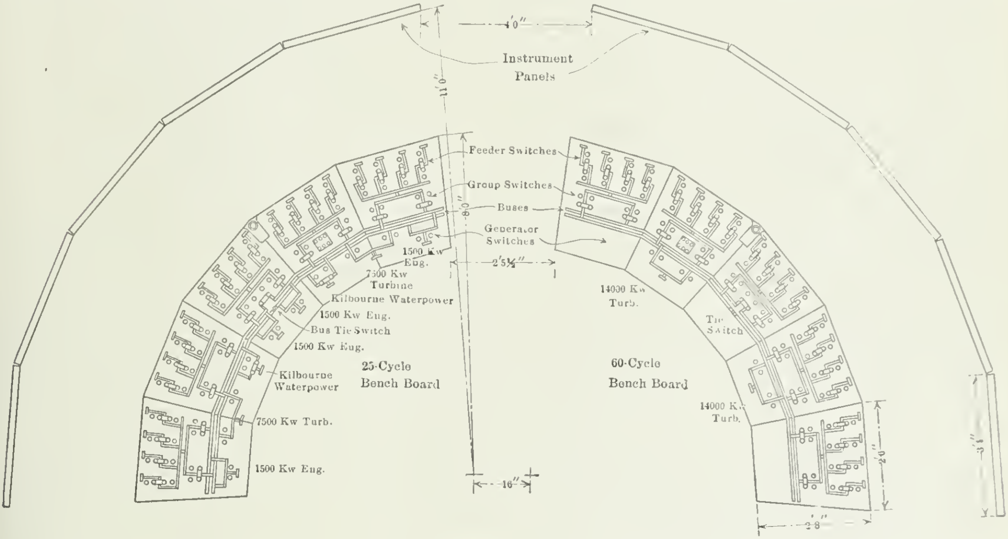


Fig. 5—Feeder-Control Benchboard.

GENERATOR COMPENSATORS.

The generator pressure of both the new 14,000-kw and 7500-kw turbine generators is 6600 volts, or one-half the bus potential of 13,200 volts. The energy from the generators will be fed through compensators of the auto-transformer type having a ratio of one to two between taps. These compensators will be installed under the operating switchboard gallery in the generator room and directly opposite the machines they serve. The 7500-kw, 25-cycle generators will be equipped with banks of three 1250-kw compensators, the total three-phase rating of these groups aggregating 3750 kw, or one-half of the generator rating, since only half of the generator output is actually transformed in the compensators. The 14,000-kw, 60-cycle generators will be similarly served by banks of three 2333-kw compensators aggregating 7000 kw in three-phase rating. The use of these compensators with half-potential generators marks the newest practice in the installation of large turbo-generator units and is designed to suppress surges and to protect the armature coils of the generators against severe shocks or short-circuits.

The incoming 25-cycle transmission lines from the 8000-hp Kilbourn water-power plant on the Wisconsin River, 120 miles distant, pass through the Commerce Street station from the West Allis substation and are handled as local station generating capacity in making up the busbar connections at the operating switchboard, being furnished with oil-switch remote control similar to the other generator units. In the case of these transmission-line switches this control is duplicated at the feeder switchboard in the switch house.

The generator switchboard will be equipped with operating signals of the ship's type, duplicate dials with pointers indicating positions labeled "Stop," "Start," "Field Off," etc., being installed on the gallery and at the side of the turbine units themselves, so that close communication can be maintained with the generator floor. The generators will also be equipped with totalizing watt-hour meters, while indicating wattmeters showing the load on each machine are to be installed near the steam gages for the engineer's reference.

SWITCH HOUSE.

The electrical switching of the enlarged and reconstructed Commerce Street station will be divided between the overhead "operating" switchboard in the generator room itself and the dispatching or feeder benchboard in a new switch house erected just across Poplar Street from the power house. All operations pertaining to the actual manipulation of the machines themselves, including the connection of incoming generators to the busbars, will be controlled from the generator switchboard, while the switching of the ten group and forty feeder circuits will be handled from the feeder benchboard at one end of the special structure in which the group and feeder oil switches are to be housed.

The switch house is a 117-ft. x 40-ft. brick structure of one story and basement, and is about 60 ft. distant from the main power house. Fig. 4 shows the arrangement of the generator, group and feeder oil switches and the control switchboard on the main switch floor level, while the basement contains the busbar compartments, lightning arresters, instrument transformers, etc.

The control benchboard in the switch house, locally designated as the "feeder benchboard," will comprise two five-panel sections, ranged on the arc of a circle. The left-hand section will control the twenty 25-cycle feeders and the right-hand section the same number of 60-cycle feeder switches. On the vertical boards behind the benches will be mounted the instruments, etc. The arrangement of the switch contacts on the panels of the benchboard follows that of the oil switches themselves in the switch house.

The duplicate 60-cycle and 25-cycle generator buses are sectionalized at points of symmetry of connected apparatus, the main buses being broken by remote-controlled tie switches, while the auxiliary buses are equipped with simple disconnecting blades only. The tie switches will be operable from both the feeder benchboard and the operating switchboard in the power house, indicating lamps at both points showing the position of the switches. Each half of the 25-cycle buses will be arranged to be connected to two 1500-kw engine-driven alternators, two 7500-kw turbine generators and one Kilbourn line, the corresponding switches being grouped symmetrically about the sectionalizing switches. These generator switches will be controlled entirely from the generator switchboard in the power house, indicator lamps showing the position of the switches at the feeder board. The Kilbourn or West Allis substation lines, however, will also have control points located on the feeder benchboard so that they can be handled from either board.

The group switches, each controlling four feeder circuits, will be ranged in a row parallel with the generator switches and, like the four feeder switches under each of them, will be all controlled from the feeder switchboard. The feeder switches will be installed in parallel rows at right angles to the generator and group switches and directly over the group buses, at the end of each of which aluminum-cell lightning arresters will be connected. Ample room has been left in the busbar compartments so that instrument transformers can be connected on any feeder to register the energy taken by it. At the control benchboard name-plates will be attached to the group-switch contacts, showing the destination of the feeders connected under each group. The oil switches in the switch house will be inclosed in clear wire-glass doors, so that an unobstructed view of the operating parts and, indeed, through successive rows of switch inclosures will be rendered easily possible.

OTHER PLANTS OF MILWAUKEE SYSTEM.

The new reconstructed Commerce Street plant of the Milwaukee Electric Railway & Light Company will serve the combined electric railway and central-station load of the city in conjunction with the other steam plants of the company at Oneida Street and in the Public Service Building. The Oneida station contains two 1050-kw, 600-volt, engine-driven direct-current generators; one 1050-kw, 250-volt generator, and four 400-kw, 125-volt generators, besides two 1500-kw, 25-cycle, 250-volt motor-generator sets, one 500-kw balancer set and a 1500-amp-hour, 250-volt storage battery. In the Public Service Building, which contains the company's offices, are three 1500-kw, 2300-4000-volt, 60-cycle, non-condensing high-pressure steam turbines, exhausting into the steam-heating system from which the central section of the city is supplied with heat, and two 1500-kw motor-generator sets similar to those at the Oneida station. The Milwaukee system also receives about 6000 kw from the Kilbourn water-power plant, at the Dells of the Wisconsin River, 120 miles west of Milwaukee. This development, which was described in the *Electrical World*, Sept. 23, 1909, contains four 1500-kw, 2300-volt, 25-cycle, three-phase alternators, driven at 100 r.p.m. by 2778-hp, six-runner, 57-in. water turbines operating under 17-ft. head. Banks of single-phase, 1000-kw water-cooled transformers raise the generator voltage to the transmission potential, 44,000 volts, later raised to 70,000 volts. The concrete dam is 400 ft. long, rises to a maximum height of 55 ft. above the bed of the stream and is carried on a base 48 ft. wide. The superstructure is built as a spillway with twelve adjustable-crest gates. The Milwaukee company has also recently completed the construction of its Clinton Street substation on the south side of Milwaukee, which will contain four 2000-kw, 25-cycle, 600-kw rotary converters, three of which are being installed at once. This station has also been designed for use as a switching point for lighting service.

Mr. John I. Beggs is president and general manager of the Milwaukee Electric Railway & Light Company; Mr. C. J. Davidson is chief engineer of power plants, and Mr. O. M. Rau is electrical engineer.

EFFECT OF FREQUENCY ON THE VARIATION OF CANDLE-POWER OF INCANDESCENT LAMPS.

In view of the discussion on the performance characteristic of incandescent electric lamps that followed the publication in our issue for Nov. 17, 1910, of the results of tests made by Prof. Charles L. Kinsloe at the Pennsylvania State College, it is believed that an account of tests made by Messrs. E. B. Kiely and H. P. Wasserboehr, Jr., at the Massachusetts Institute of Technology and submitted by them as a graduation thesis in June, 1910, will prove interesting at this time.

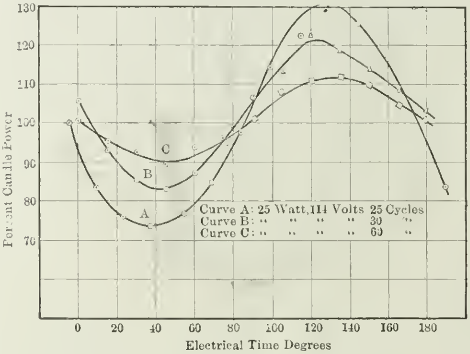


Fig. 1—Curves Showing Per Cent Cyclic Variation in Candle-Power Tungsten-Filament Lamps.

The tests have a bearing on the present discussions, in showing the initial variation of candle-power fluctuation with frequency for sinusoidal e.m.f. waves, but they are not directly comparable with the results reported by Professor Kinsloe, whose tests related to the effect upon the life and mean candle-power throughout life of the variation in the wave-form of the e.m.f. at constant fundamental frequency. However, they do indicate the extent of candle-power variation which may reasonably be expected in well-designed systems.

The method of determining the candle-power variations, briefly stated, consisted in measuring the intensity in a single horizontal direction at successive and regular electrical time intervals throughout the cycle. A small single-phase synchronous motor, which had been developed and built in the laboratories of the Institute, was arranged to rotate a sectored disk in front of the lamp. This occluding disk had six slots, one per pole of the driving motor, and each with an opening of 8 mechanical degrees. It was adjustable about the motor shaft to provide for admitting light to a Lummer-Brodhun photometer at any desired point in the cycle. The field of light was

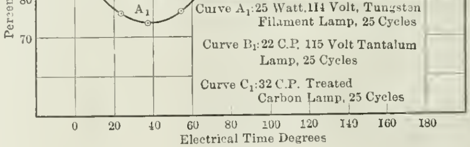


Fig. 2—Curves Showing Per Cent Cyclic Variation in Candle-Power.

reduced by a second fixed screen having a ¼-in. slot. In order to obtain the maximum and minimum points of the candle-power curve the fixed and revolving slot widths had to be very small, while to reduce the error due to passage of slot through the field required a large ratio of revolving to fixed slot width. After some experimenting the above-mentioned widths were adopted as the best compromise and no correction was made in the final results.

Owing to a difference in ratio of energy input and output at any instant, a lag is introduced into the candle-power curve. In order to investigate this matter, and also to determine the zero current point and to provide a means of detecting any angular oscillations in the synchronous motor, an ingenious application of an oscillograph was made. The vibrator was connected in the lamp circuit and a direct-current carbon arc lamp was placed before the revolving disk. The intense beam of light from the arc was reflected by means of a train of mirrors and totally reflecting prisms to the vibrator mirror and thence to the ground-glass screen. With the cylindrical mirrors at rest and observing the two images on the screen—because of two slots per pair of poles—the angular position of the occluding disk was easily adjusted for the zero current point. Any hunting of the motor was detected by surging of the images.

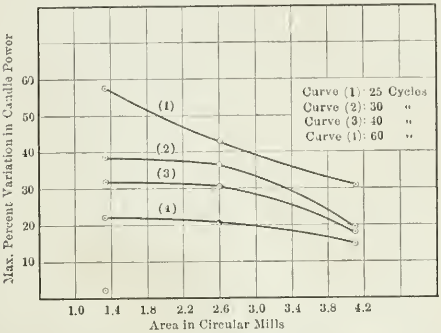


Fig. 3—Maximum Per Cent Candle-Power Variation and Cross-Sectional Area of Tungsten Filaments.

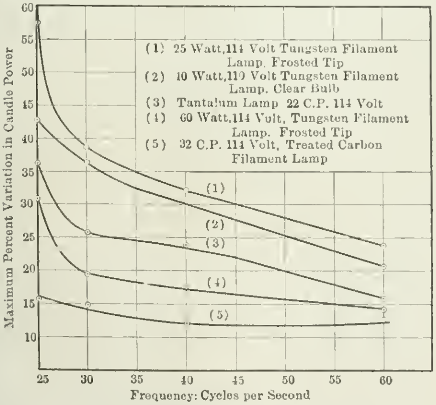


Fig. 4—Curves Showing Maximum Per Cent Variation in Candle-Power with Frequency.

By these means candle-power curves were obtained for the following types of lamps: 25-watt tungsten, 40-watt tungsten, 60-watt tungsten, 22-cp tantalum and 32-cp treated carbon. The tests were made at 25, 30, 40 and 60 cycles—the variable frequency being obtained by means of a motor-generator set The curves were obtained for rated volts, 5 volts above and 5 volts below, but the per cent variation was approximately the same, with exception of the 25-watt tungsten on 25 cycles, and will, therefore, be omitted from the summary of results.

All of the curves obtained of the candle-power show a form approximate to that of a sine displaced by the average value of intensity from the axis of abscissas.

The amplitude of variations increases very rapidly on the lower frequencies for the metallic-filament lamps. Fig. 1 shows the curves for the 25-watt tungsten-filament lamp on 25, 30 and 60 cycles. The ordinates are in per cent of the average candle-power obtained by the planimeter. All of the curves show a well-defined lag which is approximately 40 electrical time degrees, as will be seen by reference to the above-mentioned curves.

The amount of variation at a given frequency is largely dependent on the cross-sectional area, character of the surface, and heat storage capacity of the filaments. The curves of Fig 2 are given to show the differences in amplitude for the 25-watt tungsten, 22-cp tantalum and 32-cp carbon, all on 25 cycles. It may also be interesting to note the relation between variation of intensity and area of cross-section for the tungsten filament lamps, which is given in Fig. 3.

The results of the thesis which are most useful are put in the form of summary curves shown in Fig. 4, where the percentage variation is considered as 100 times the difference between the maximum and minimum divided by the mean It is to be noted that the metallic-filament lamps show a point of sharp curvature between 25 and 30 cycles. In a paper before the A. I. E. E. Dr. Clayton Sharp reported stroboscopic tests on an 8-cp carbon lamp, and at the time called attention to a possible critical frequency between these limits. This fact points to the desirability of adopting a frequency for low-frequency incandescent lighting slightly above the point of curvature.

While the methods involved in a work of this kind offer many chances for experimental error, the general consistency of the results and the extreme care with which they were taken lead the writer to offer them as reliable information on the subject in question.

* * *

RELATIVE EFFICIENCY OF LIGHT PRODUCTION BY CONSTANT TEMPERATURE AND VARIABLE TEMPERATURE INCANDESCENT LAMP FILAMENTS.

By Evan J. Edwards.

THE question of relative efficiencies of incandescent lamps operated on direct current and on alternating current has been much discussed, but never very carefully analyzed. The writer has not found that the question of the existence of a difference in efficiency is a settled one Therefore, of course, no quantitative values have been presented. It is the purpose of this discussion, mainly, to present a method by which the efficiency ratio may be quantitatively obtained for any candle-power function on the basis of equal light production and to show that the efficiency of a given average of light production is probably always higher when obtained from a varying filament temperature

It may be well to begin a discussion of this kind by a few general considerations of the problem in hand and to define some of the terms which will be used. A lamp filament is a receiver of energy, a holder of energy and a deliverer of energy when in operation. When operated at constant temperature it receives energy at a certain rate, depending on the pressure applied and the resistance of the filament; it holds a certain amount of energy, depending on the temperature, dimensions and specific heat, it delivers energy by radiation and conduction (mostly radiation) at a rate determined by the temperature and exactly equal to the rate of receiving. But when operated at variable temperature, as by alternating current, it receives energy at a certain rate at any instant of time depending on the pressure applied and the resistance of the filament at that instant of time; it holds a certain amount of energy which depends on the difference between the total input and output of energy up to that time; it delivers energy at a rate which depends upon the temperature at that instant and upon nothing else for a given lamp. Moreover, it delivers exactly as much during one cycle as it receives during that time. Therefore, there are three energy relations which need to be considered in connection with this problem; namely, the rate of energy input, which will be referred to as the input; the actual energy stored in the filament, and the rate of energy output, which will be referred to as the output.

Obviously, in the case of a filament operating at a variable temperature the input, the filament energy and the output are all variable. The filament temperature rises during the time over which the input exceeds the output. The important fact in this connection, however, is the dependence of the output upon the filament temperature and therefore upon the luminous intensity. This function (variation of output with candle-power) can be very easily obtained experimentally, since under constant condition of filament temperature the output is equal to the input. It is, therefore, necessary only to operate the lamp at various luminous intensities and measure the power input. This relation for all types of incandescent lamps is very approximately of the form

$$\text{Watts} = K\,(\text{cp})^n \qquad (1)$$

where "n" is a constant for any particular type of lamp and varies from about 0.432 for tungsten to about 0.336 for untreated carbon. The exact relation may be expressed in the same form except that "n" is a variable and a function of the candle-power.

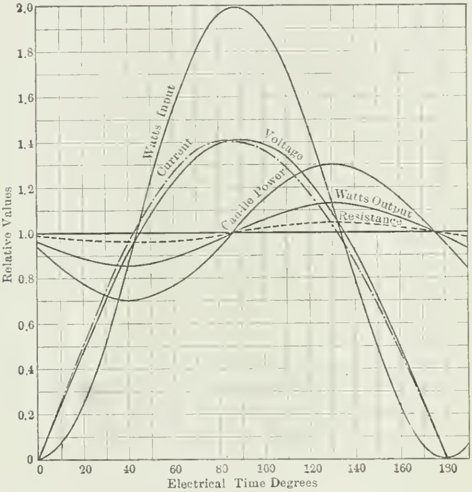


Fig. 1—Curves Showing Instantaneous Performance of Tungsten-Filament Lamps on Alternating Current.

Perhaps the above analysis will be more easily understood by referring to Fig. 1, which is a picture of all the variations going on within a lamp. It is drawn for a 30 per cent sine variation of candle-power, above and below the average, for tungsten filament. The output and resistance functions are built up directly from the candle-power. The voltage is taken as a sine, the current from the voltage and resistance and the input from the voltage and current. The scale is unity for average values in all cases except current and voltage, which are taken as unity for the effective voltage value. The lag of candle-power behind input watts is easily located since, at the instant of either maximum or minimum output and candle-power, the output and input must be equal. This is, of course, true because the temperature is constant at these points. In mathematical terms the angle between crest of voltage and crest of candle power is

$$\theta = \cos^{-1} \frac{(\text{cp max.})^{\frac{m+n}{2}}}{\sqrt{2}}$$

where "n" is defined by the relation of watts output to candle-power in the equation

$$W = (\text{cp max})^n$$

and "m" is defined similarly for resistance and candle-power in equation

$$R = (\text{cp max})^m$$

Maximum candle-power is, of course, expressed as the ratio to average. θ is given in degrees for various lamps at several values of maximum candle-power in the following table:

Maximum Candle-Power	Tungsten.	Tantalum	Graphitized Carbon.	Carbon
1.4	39.2°	39.8°	40.7°	41.7°
1.3	40.5°	41.1°	41.7°	42.2°
1.2	42.0°	42.4°	42.7°	43.0°
1.1	43.5°	43.7°	43.8°	44.0°

Although the angle of lag has no particular bearing upon the subject of this paper, it might be excusable to comment at this point upon its very narrow possible limits. As will be referred to later in this paper, the 30 per cent rise in candle-power for tungsten filament represents the maximum found in practice. The angle is probably always between the limits of 40 deg. and 45 deg. for a sine voltage.

In order to compare the efficiency of light production under conditions of variable temperature with that obtained under conditions of constant temperature let it be assumed that the same average luminous intensity (taken as unity for simplicity) is to be obtained with the same lamp in each of the two ways. Let the power required (output or input) in the case of constant temperature be unity. Then power output at any instant for variable conditions is

$$w = (\text{cp})^n \qquad (2)$$

Total energy output or input per candle-power cycle is

$$E = \int_{0}^{2\pi} (\text{cp})^n \, d\theta \qquad (3)$$

And the ratio of energies (variable to constant) is

$$\text{Ratio} = \frac{1}{2\pi} \int_{0}^{2\pi} (\text{cp})^n \, d\theta \qquad (4)$$

Therefore, the relative efficiency may be obtained for any case where the candle-power function and "n" are known.

Let a simple case be taken as an illustration. The candle-power of a 25-watt (110-volt) tungsten-filament lamp operating at 25 cycles varies about 30 per cent above and 30 per cent below the average value and is of a form more or less approximate to a sine. The exponent "n" has an average value of about 0.432. Then if it be assumed that the exponent remains constant for the range taken, the ratio of energies (alternating current to direct current) required to produce the same average candle-power is given by

$$\text{Ratio} = \frac{1}{2\pi} \int_{0}^{2\pi} (1 + 0.3 \sin \theta)^{0.432} \, d\theta = 0.9943$$

(mathematical integration).

In order to obtain the exact ratio of energies it is only necessary to take into account the difference brought about by the actual function not being a true sine and the fact that the exponent does not remain strictly constant. It is possible to obtain the candle-power function experimentally to a fairly good degree of precision. Several assumed functions covering a range of deviation from the sine greater than could actually be realized in practice were taken, and the cases which were considered extreme introduced an error of less than 0.1 per cent in the energy ratio. The writer believes that the deviation of the candle-power from the sine will in any actual case introduce an error in the efficiency ratio of less than 0.03 per cent. The law of change of the exponent "*n*" may be determined experimentally for any lamp to a good degree of precision.

It is known that "*n*" increases with candle-power. The increase of "*n*" from 0.7 to 1.3 of normal candle-power as obtained by experiment on various lamps is about 1.6 per cent for tungsten, 2.6 per cent for tantalum and graphitized carbon and 2.8 per cent for treated carbon. (Change expressed in per cent of normal "*n*".) Approximately 4 per cent change is required to change the energy ratio by 0.1 per cent and an 18 per cent change is necessary in order that the energy ratio be unity. (Obtained graphically.)

The above considerations apply to all conditions of operation of incandescent lamps operated on alternating current. The larger lamps and higher frequencies change only the amplitude of the candle-power function and the ratio of energies becomes closer to unity. It seems very safe to conclude that for any case the efficiency ratio may be obtained to a precision of better than 0.1 per cent by obtaining the amplitude of candle-power and values of "*n*" experimentally and assuming the candle-power variation to be a sine. Moreover, in view of the fact that "*n*" changes by much less than the value required to make the ratio unity for all commercial incandescent lamps, it seems also justifiable to conclude that a given average candle-power is always obtained more efficiently by alternating-current than by direct-current operation.

The energy ratio has been worked out for all types of lamps, assuming the candle-power function to be of the form of a sine and using the actual function connecting watts and candle-power as determined experimentally, and it is submitted in Fig. 2. As will be seen, the ratio is plotted with variation of the amplitude of the candle-power in order that it may be applied to various sizes of lamps and frequencies of operation. Making use of the data obtained by Messrs. Kiely and Wasserboehr* at the Massachusetts Institute of Technology, the energy ratio of the various sizes and frequencies is plotted in Fig. 3 and gives the energy ratio within the precision of their work. It is included here as an illustration of the application of the above method of analysis to some practical cases and also to put into convenient form the values of efficiency ratio which may be expected from these lamps under various conditions of frequency.

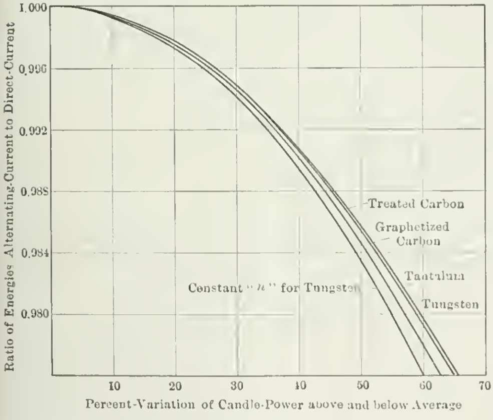


Fig. 2—Relation Between Energy Ratio and Candle-Power Variation.

It was the intention in the beginning to present a method rather than to give accurate quantitative results in this paper. The actual values as given by the curves may be slightly modified by later and more exhaustive work in connection with obtaining the law of change of watts with candle-power or by changes in the characteristics of the filaments in question due to new and improved methods of manufacture. However, these results will be affected little, as will be seen by reference to Fig. 2, by noticing the effect of the change of exponent for tungsten, one curve being plotted for constant "*n*" and the other for a variation of 1.6 per cent between the limits 0.7 and 1.3 normal candle-power.

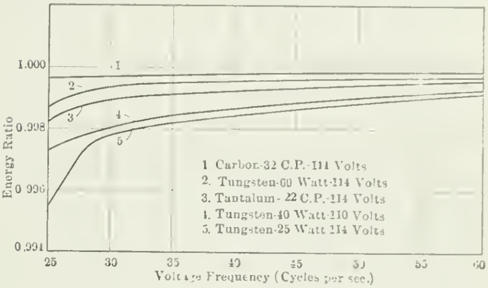


Fig. 3—Relation Between Energy Ratio and Voltage Frequency.

The ratio of energies as given above, of course, is directly the ratio of the specific consumption when expressed in watts per candle-power. It should be noted that it is the relative efficiency when operated at the same average candle-power, and not the ratio of candle-powers at the same effective voltage. The ratio of intensities at the same effective voltage is probably a little closer to unity than the energy ratios for the same candle-power, since a lamp operates with a power-factor slightly less than unity, the current slightly leading the voltage, except at the zero voltage points for filaments with positive temperature-resistant coefficient. Careful photometric tests have indicated a higher average candle-power when operated at variable voltage, but such tests can hardly be expected to afford a means of accurate determination, since the increase in candle-power is probably no greater than 0.2 to 0.4 per cent in extreme cases, while an average deviation from the mean of candle-power settings of not over 0.4 per cent is considered very good in photometric work.

The results as given in the above curves would be very difficult to obtain by actual measurement on a photometer, because in addition to the lack of photometric precision one would encounter difficulty in measuring the alternating-current power input to a sufficient degree of precision.

It should, of course, not be inferred that it is better to operate a lamp at variable temperature because the efficiency is higher on the basis of the production of a given intensity. For all practical cases the ratio is so nearly unity that it is of no commercial consequence, but the slight difference is really in favor of constant temperature conditions, for the lamp would show a shorter life on variable temperature operation. In other words, if the proper operating efficiency be defined as that to allow a given life, that for constant temperatures is unquestionably higher. The effect of the variation of temperature on life may be obtained by an integration of the so-called correction factor as figured by a well-established relation between candle-power (expressed as its ratio to normal) and efficiency, leaving out of account the effect which may be due to the reversals of current as in the case of tantalum. This shows for the case of an 11 per cent change above and below normal candle-power, as is approximately true for the 25-watt tungsten-filament lamp on 60 cycles, a reduction in life of 4 per cent, which, of course, is far in excess of the change in efficiency.

The curves as presented by Messrs. Kiely and Wasserboehr are for a wave of voltage closely approximating a sine. The effect of a peaked wave would probably be to increase very slightly the amplitude of the variation of candle-power. There is good reason to believe that the increase of amplitude would be inappreciable at ordinary frequencies. The author hopes later to investigate the effect of the wave shape on the amplitude of candle-power, at which time, by the methods of this paper, the effects on efficiency and life may be determined. An effect which will produce a higher efficiency will of necessity produce a shortening of the life. It can hardly be expected that either will be of sufficient magnitude to allow of easy determination by direct test.

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*See page 430 of this issue.

ELECTRICITY ON FARMS IN NEW YORK STATE.

Water-powers on small streams in New York State afford the means of bringing many electrical conveniences and labor-saving appliances to neighboring farm homes. An interesting account of some of these farm water-power installations is contained in an illustrated report, "Water-Power for the Farm and Country Homes," prepared by David R. Cooper, engineer-secretary for the New York State Water Supply Commission. After directing attention to the many small streams which might be harnessed to do useful work the report enumerates some of the uses for electrical energy on the farm, mentioning lighting, feed grinding, root cutting, fanning, grinding, sawing, hoisting, drilling, ensilage cutting, clipping, cream-separating, churning, vacuum cleaning, mixing, etc., besides the domestic purposes of the ordinary home.

Examples of actual work done by electric power are given as follows:

A 6-hp motor will thresh 250 bu. of oats, grind 20 bu. of corn, grind 48 bu. of feed, grind and press 250 bu. of apples or saw seven cords of hard-oak stovewood an hour, in the last instance taxing the ability of four men to stack the wood in cords as fast as it is sawed. A 12-hp motor driving a 50-in. circular saw will cut 4000 ft. of oak or 5000 ft. of poplar lumber in a day. A 10-hp motor running a 16-in. ensilage cutter and blower will deliver ensilage into a 30-ft. silo at the rate of 7 tons per hour. A 1-hp motor will supply water for ordinary farmhouse uses. From the up-State New York farm installations described in the report the following data are abstracted:

The 100-acre farm of Mr. E. B. Miner, near Oriskany Falls, Oneida County, N. Y., is devoted to hop raising, mixed farming and dairying. The sons of the family studied engineering at college and, becoming convinced of the possible uses of the stream near their homes, designed and built the 17-hp water-power plant and dam which now lights the farm buildings and saves many chores. This timber-crib dam, 36 ft. long and raising the water 4 ft., is carried on heavy concrete sills cast in a 2-ft. x 1.5-ft. ditch dug across the stream bed. Above the dam crest is a row of 1-ft. flashboards held erect by chains locked by pins which can be withdrawn by a capstan, dropping the boards in case of high water. There is also a supplementary 40-ft. spillway, with crest a few inches higher than the main dam, helping to discharge heavy floods. From the dam a 60-ft. canal and forebay leads downstream to the power house, where a vertical-shaft 17-hp turbine wheel is installed. A double pulley arrangement increases the speed of the water-wheel's rotation to the 1100 r.p.m. required by the 12.5-kw belted generator at the far end of the 12-ft. x 16-ft. power house. At this point Oriskany Creek drains 14 sq. miles, furnishing throughout nearly all the year the flow of 2900 cu. ft. per second required to drive the water-power plant at full load under the available head of 6 ft. From the power house to the farm buildings, 1700 ft. distant, an aluminum-wire line is carried on 20-ft. poles set at 100-ft. intervals. The energy thus delivered is used to operate a circular saw, machine lathe and drill press, vacuum-cleaning system (used also for operating milking machines in the twenty-five-stall cow barn), cream separator, churn, grindstone, ventilating and cooling fans, electric iron, sewing machine, egg beater and water pump. The house is also warmed by five electric heaters, maintaining an indoor temperature of 75 deg. when it is zero outside. The water-wheel and generator run continuously, night and day, and self-oiling attachments make the plant require little attention. Mr. Miner says the water-power is worth to him several times its cost, which he does not state, but which engineers estimate to have been about $1,800 complete for dam, power house, line and equipment.

Mr. Stephen Loines, of Brooklyn, has a summer home on the shore of Lake George, his property including a seven-acre pond at an elevation of 180 ft. above the lake. The outlet of this body of water is caught in a 6-in. spiral riveted pipe and conveyed 1600 ft. down a gulley to the little power house, which contains a 10-hp, 24-in. impulse wheel operating under a 165-ft. head. The 6.5-kw generator delivers energy to a sixty-cell house-lighting battery, an eighty-four-cell battery for a 35-ft. cabin launch, a forty-eight-cell battery for a 20-ft. open launch, and a forty-cell battery for an electric roadster, all of which are in nearly continuous use five months in the year. Another development on the estate comprises a 2-in. pipe with a fall of 110 ft. in its 1200-ft. length, operating a 3-hp impulse wheel used to drive a saw belted directly to the shaft. An unusual use of hydroelectric energy on the Loines estate is the operation of the roof of the private astronomical observatory just above the cottage. The dome roof is mounted on wheels and is moved by a 1.5-hp motor.

Mr. J. Van Wagenen, of Lawyersville, Schoharie County, N. Y., a practical and scientific farmer, utilizes the 15-ft. head created by an old disused sawmill dam. His 5-hp water-wheel is belted to a 3-kw, 125-volt generator, the output of which is conveyed over 3700 ft. of pole line to the houses of the owner and a neighbor. As it was undesirable to visit the plant, half a mile away, night and morning to stop and start the turbine, as well as inadvisable to waste water during the dry season by letting the plant run all the time, the turbine valve has been attached to a pull-wire extending to the bedroom window of a neighbor living 700 ft. distant. Pulling this wire at 5 a. m. starts the plant, and releasing it at night allows a counterweight to drop, turning off the water. For this service of starting and stopping the machine the neighbor gets his electric service free for his house and barn. The plant maintenance has been trifling. The owner wired his house at a cost of $40 for material, doing the work himself. The plant cost a little over $500, the dam being already built and most of the installation work being done by the owner at odd hours:

Dynamo, 3 kw (second-hand)	$50
Water-wheel, 9 kw (naked wheel)	55
Governor (new)	75
Wire (7,400 ft.)	210
Labor (installing water-wheel)	40
Fixtures (lamps and the like)	38
One small motor, 2 hp (new)	50
Total	$518

Such a water-power plant Mr. Van Wagenen declares to be equivalent to a hired man's services, doing away with many chores and laborious duties about the place.

Mr. J. T. McDonald has a farm near Delhi, N. Y., which is equipped with three water-wheels utilizing the 15-ft. head created by a dam and 900-ft. raceway. A 25-hp turbine runs a sawmill and feed mill; a 3-hp wheel runs small saws and machine tools, and a 6-hp wheel drives the electric generator. The turbine gate is opened and closed by a switch in the owner's house, while the field circuit and rheostat are brought to the same point, enabling the voltage to be regulated closely.

Mr. Frank Caspar, in Schoharie County, has a turbine water-wheel driving a generator which lights a furniture factory, church, village street and his own home. The plant is started and stopped by a pull-wire which opens a small valve admitting water pressure to a cylinder, the piston of which operates the gate.

In addition to a 36-in. impulse wheel operating under a 210-ft. head and driving a sawmill on the place of Mr. Arthur Cowee, near Berlin, N. Y., a smaller impulse wheel is direct-connected to a 3-kw generator supplying electricity to 160 lamps

The penstock for the main wheel is a 10-in. cast-iron pipe, 1680 ft. long.

One of the largest farm water-power installations is that at the 5160-acre farm, "Heart's Delight," of Mr. W. H. Miner, the output of which is live stock, poultry and dairy products for high-class city hotels. All crops raised on the farm are fed directly to the stock. The smaller water-power source is a group of three small dams built across Tracey Brook to create storage reservoirs. From the lowest of these a 44-in. penstock, 670 ft. long, carries the water to the power house under a 19-ft. head. Here two turbines of 30-kw and 12.5-kw capacity respectively are installed, driving 220-volt, direct-current generators. Another concrete dam is built across the Chazy River, the water being led through a concrete penstock, 48 in. x 60 in. in section and 630 ft long, to a second power house, where a fall of 30 ft. is obtained. Here two turbines drive alternators, the output of which is conducted to the central farm buildings, three miles distant. Hydraulic rams are also used for water pumping on this farm In all twenty-five motors are installed for the variety of purposes mentioned in the foregoing, since nearly every modern use of electricity is employed on this farm.

The report closes with a discussion of some of the considerations involved in constructing a small water-power plant.

Central Station

Management, Policies and Commercial Methods

VOLTAGE RELAY CHANGES TRANSFORMER RATIO AT DISTANT MOTOR INSTALLATION.

The Toledo Railways & Light Company supplies energy to the 1200-kw motor load and 300-kw lighting load of the Toledo factory of the Overland Automobile Company, which is nearly three miles distant from the generating station. As the voltage regulation at the distant end of the 4000-2300-volt line transmitting this heavy combined motor and lighting service was found to be inferior for lighting purposes, it was necessary to devise means of holding the secondary pressure at the factory more nearly uniform, without involving the expense of an induction regulator. A potential relay has been accordingly arranged to close when the factory-line pressure drops below 109 volts or 108 volts, energizing a magnet the armature of which releases a weight. In falling this weight operates a switchblade transferring the line connection from the 2300-volt terminals of the transformer primaries to 2080-volt taps brought out from the winding, restoring the secondary pressure again to its normal value, 115 volts. This automatic regulation is applied, of course, only to the six 50-kw lighting transformers, and as installed in the Toledo instance has to be replaced by hand when the line pressure rises.

TUNGSTEN LAMPS AND DEFECTIVE VOLTAGE REGULATION.

Since tungsten lamps have come into general use central-station companies which have large numbers of these lamps on their lines are enjoying some benefits not generally recognized. With carbon lamps it was not infrequently the case that consumers used the least amount of light they could get along with. The candle-power of lamps installed would be cut down closely to fit the absolute needs and necessities of the user because of the expense of operation. The result of this was that if a central-station company allowed its voltage to get below normal the fact was soon painfully apparent in lack of satisfactory light at the consumers' premises Much dissatisfaction with the service and loss of business has resulted from abnormally low voltages. The actual voltage maintained at the lamps varies much more than is commonly supposed in the great majority of central-station and isolated plants.

With tungsten lamps conditions have been somewhat changed by the fact that consumers have usually installed a sufficient candle-power of tungsten lamps to give more than barely enough light. Consequently when the voltage has been below normal the customer has not realized the fact and has considered his service as fairly satisfactory. Of course, too, the fact that the tungsten lamp does not decrease in candle-power as much for a given percentage of lowering in voltage as the carbon lamp has had a helpful influence. On a certain central-station distributing system recently some very surprising results were obtained by testing the voltage during peak load at various points. In general, there were many places where the voltage was considerably below the normal at which it was supposed to be maintained, yet this service, as far as the customers were concerned, was considered very satisfactory, and the existence of the low voltage had not been suspected before the voltmeter tests were made. There is an old saying among electrical men that "human voltmeters are not reliable." In other words, it is impossible to judge of the voltage on the circuit by looking at the lamp filament. Nevertheless, since lighting service is the object of maintaining voltage, voltage conditions cannot be so very bad if the service, from the standpoint of the customer, is thoroughly satisfactory. From this it is not to be concluded that we recommend that central-station companies relax their vigilance to maintain voltage at consumers' lamps as near normal as possible.

FEBRUARY MEETING COMMONWEALTH EDISON N. E. L. A. BRANCH.

The Commonwealth Edison branch of the National Electric Light Association in Chicago held its regular meeting on Feb. 7 at Auditorium Recital Hall, when a program was given which was both entertaining and instructive. Three brief papers were presented. Mr. F. J. Arnold described the methods of the engineering department of the Commonwealth Edison Company. This department consists of fifty-seven members. In it the plans are made for all new work. When new work is contemplated the first thing is an estimate of its cost for the budget. When this is passed upon and approved by the president and directors the statistical department makes an entry of the preliminary estimates, after which the engineering department goes ahead with plans and detailed estimates. This department is under Mr. R. F. Schuchardt, electrical engineer

Mr. A. G. DeClerq, after an amusing running commentary on the papers that had been presented to the branch on the various departments of the company's work, took up the work of the construction department. Men in this department are always subject to call for emergencies at any hour, day or night, and may have to work many hours continuously when on a repair job. When at work they depend very largely for their safety on the care and vigilance of others. He gave the methods of handling various work orders. Some of these orders come from the operating department, some from the contracting department and some from the engineering department. This department is under the management of Mr. J. H. Goehst.

Mr. C. J. Hejda described the work of the testing department, which was started thirteen years ago with two men. This department is divided into general testing, meter testing and chemical testing It furnishes and calibrates all of the instruments used by the construction department in new work and maintains the accuracy of instruments in use.

Following the papers a five-minute intermission for social purposes was given, after which Mr. John Manley opened the discussion with some interesting facts about the construction department and its work. He said that the methods in use in the direct-current low-tension work were practically those worked out twenty years ago by Mr. L. A. Ferguson, now second vice-president, no better methods having been evolved. He then spoke of the fine work done by the house-wiring department, in which some of the finest residences in Chicago are rewired without serious disturbance of the contents or occupants. After some more discussion a glee club of eighteen members furnished some music, illustrated from time to time with stereopticon cartoons. Miss Booth sang two solos accompanied by a string quartet, and Mr. J. W. Ferguson told some of his entertaining stories. It was announced that the membership of the Commonwealth Edison branch had reached 790. About 400 were in attendance at this meeting.

ANTI-GASOLINE CAMPAIGN IN COLORADO.

Mr. F. D. Morris, Colorado Springs, Col., secretary of the Colorado Electric Light, Power & Railway Association, has mailed to every gasoline user in the State a copy of the illustrated account of the gasoline lighting outfit explosion in a St. Louis poolroom published in the *Electrical World*, Jan. 5, and reprinted in the Colorado Springs *Gazette*, Jan. 27, accompanied by some remarks by Mr. C. L. Reasoner, city electrician of Colorado Springs, in which he pointed out that defective gasoline systems endanger property and imperil lives. Central-station men commenting on this account of a typical gasoline explosion have declared it to constitute one of the best arguments against gasoline lighting ever published, and widespread distribution has been given the item in Colorado, so that all the central stations of that State may profit.

RELATIONS WITH THE PUBLIC.

Under the title "Franchises" Mr. Arthur S. Huey, vice-president of H. M. Byllesby & Company, Chicago, read an interesting paper at the recent convention of Byllesby companies in Chicago. Mr. Huey gave candid consideration to the relations of the public-service company and its community, and, speaking for his own organization, said: "We prefer to hold our franchises by retaining the confidence of the people; to hold the privileges conferred by the public not by right of law but by right of merit." A little later he said:

"When I urge upon each one of you to look upon your franchise as a trusteeship to be administered in the interests not only of your company, but of the people, I view the matter from a business point of view and speak as a business man. The interests of the people and of utility corporations are interwoven. The city needs the utility; the utility is non-existent without the city. The prosperity of a city demands a wholesome growth; the opportunity for utility earnings likewise requires this growth. Good service and fair rates promote the welfare of the public. Use of the service offered determines the welfare of the company."

The speaker made a list of what may be regarded as the principal obligations of both parties to a franchise. The obligations of the utility company include the following:

First—Rendering of good, adequate and continuous service. Second—Fair and reasonable rate schedules. Third—No discrimination among customers of the same class, or between classes of customers for like service. Fourth—Extension of service into all populated sections of the municipality and suburbs. Fifth—Earnest endeavor to market the greatest possible volume of service. Sixth—Adoption of approved inventions and developments in machinery and apparatus. Seventh—Sound financial management. Eighth—A high standard of physical maintenance. Ninth—Public-spirited attitude in all matters concerning the general welfare and advancement of the community. Tenth—Broad and liberal business administration. Eleventh—Keeping faith with the people in all agreements, promises and announcements. Twelfth—Strict obedience to law, and no participation in politics.

Mr. Huey enlarged on his subject at considerable length. One of his striking observations is as follows: "In few lines of endeavor do petty practices cost so dearly as they do in the operation of public utilities. It is suicidal to adopt a policy bounded by the straight-laced terms of contract and franchise, cap-sheafed by the motto, 'We don't have to.' The 'we-don't-have-to' spirit, gentlemen, has caused unmeasured and well-deserved woe to public-utility corporations. It was one of the mortal sins of the old-time operator, and we of the present day are still doing penance for its commission."

Considerable attention was paid by the speaker to the development of natural resources; and in relation to this subject, and, indeed, in the conduct of all public utilities, he believes that fair-minded consideration of the question will convince any commission or other public body that a liberal compensation is deserved by the private capital invested in the enterprise.

Summing up, Mr. Huey said that if the management is progressive and conducts its business as a public trust the terms of its franchise matter little. On the other hand, if the management refuses to recognize the equity of the public and declines to be liberal and fair, that management will go down to merited defeat and financial loss, regardless of the most liberal franchise every granted.

THE STORY OF A CREEK.

There is a creek running through the village of Gowanda, N. Y., and thereon hangs a tale. When this creek started out to make a place for itself in this world it wasn't a creek, it was merely a trickle. By and by it picked up another trickle or two and resolved then and there to become a rivulet. Puffed up with ambition, one fine spring morning it suddenly turned into a creek and ever after it was called Cattaraugus. From this creek the Keyes Electric Company generates its electricity, and in a neatly printed and cleverly written booklet it tells the people of Gowanda what a great streak of liquid it is and what a high grade of electricity it produces. The uses to which this electricity can be put in the household, factory, store or office are nicely pointed out, and without jarring on the sensibilities of the reader the company says that it wants him to know that it is ready to install for him or any one a service of the modern electric devices that add to the measure of human comfort. Gowanda has a population of less than 3000, so that as far as central stations go that of the Keyes Electric Company would not be considered large. Its advertising literature, however, outclasses much of that issued by companies in cities a hundred and even a thousand times as large.

CENTRAL-STATION PROBLEMS IN GERMANY.

Comparing from an economic standpoint the manufacture of electrical apparatus with the production and distribution of electrical energy in Germany and Austria, Dr. C. Kinzbrunner, writing in the *Elektrotechnische Zeitschrift*, Sept. 29, 1910, says that the attentive observer will note an essential difference in organization in the two industries. Manufacturing, he says, is not only technically further developed, but even the sales end of the great German concerns leaves little to be desired. They proceed generally from the sound business standpoint that today, where manufacture has reached a certain degree of completeness, the center of gravity of business must lie in the sales organization. And this with right, for a good business man will always be in position to sell a little-desired article, and in this wise obtain results—even if only slightly productive—while, as a rule, the most skilled engineer is seldom able to sell even a very good article.

Strangely enough, the relations in the case of central stations are essentially different. Here there has always been and is to-day an extremely lively development in relation to technical results. The most painstaking care is applied to the cheapening of the product (electrical energy), to surety of action and, indeed, in esthetic sense, to the outer appearance of the structure. But the business and sales organizations of most stations are in bad condition. How many central stations in Germany and Austria make a study of methods for the spread and extension of the use of electricity in their district? How many have at the head of their sales organizations an unfettered chief, who employs trained sales representatives? No manufacturer would concentrate all his work and endeavors on the betterment and cheapening of his products, leaving their sale to chance, but yet there is in Germany and Austria to-day a large number of electric stations that are organized in this way, quite out of joint with the times. Where they could earn an extra mark ($0.25) they are satisfied with saving a pfennig ($0.0025).

As is well known, the introduction of metal-filament lamps has rendered the position of many electrical stations difficult, especially those supplying energy chiefly for lighting purposes. In spite of the increase in the number of consumers and connections, the number of kw-hours consumed remains constant only under most favorable conditions, and actually decreases in many cases. Furthermore, this condition will not be changed until the majority of consumers have gone over to metal-filament illumination, which at the present time is not the case.

It is significant that a decrease of kw-hour consumption is required to cause the heads of many electrical stations to ponder ways and means whereby a greater consumption could be obtained. At this juncture, then, becomes evident in many establishments the lack of a modern business organization.

From an economic standpoint the majority of stations suffer from two defects. First of these is the non-uniform and insufficient use of distribution lines, the high installation cost of which influences dividend capacity. Since this generally occurs in poorer cities and districts, the increase in the consumption depends on the cheapening of the individual house installation, cheaper production or pro-rata decrease in the initial charges. It is also in just such districts that enlightenment of the public to the hygienic esthetic and economic advantages of electric illumination is insistently required.

The second great economic defect is the small load-factor and the disproportionately large demand during the evening hours in the winter months, resulting in unequal division of consumption. Even though much has been done toward the betterment of the load-factor, still the fact must not be lost sight of that this is a pressing economic problem for the solution of which the technician, salesman and organizer are required. The engineer and operator are only too easily inclined to regard the small load-factor as an unavoidable fact; not so with the salesman, who knows of operation only as much as is absolutely necessary. He would regard it as unbelievable that, for example, of the 8760 working hours of an electric station the proportionately great installation charges should be fully utilized only during some hundred hours, for the entire remaining time lying more or less idle. The engineer of an electric station with a load-factor of about 15 per cent and a fuel consumption of, for example, 4 pfennigs per kw-hour will generally regard as well spent an investment of some thousand marks whereby the fuel consumption could be diminished to 3.5 pfennigs. The salesman, or the commercially inclined engineer, will, however, prefer in many cases to spend the same amount for the betterment of the load-factor and in this way increase the dividend capacity of the station more than was possible by diminution of fuel consumption.

One of the greatest difficulties which oppose the introduction of electric service, especially in the smaller city quarters, is the cost of installation. Petroleum oil lamps are cheap and require no installation. Gas has the great advantage of very small installation cost; in addiiton, it happens that the gas works do their utmost to make the installation costs as small as possible or even in many cases bear them themselves.

Greatest are the difficulties in the case of electric light. The interests here are unfortunately much divided. The contractor, who is quite independent of the central station, has naturally the greatest interest in selling his customer as much as possible and at a high price. In spite of this an electric installation can be put in which will correspond to all the demands of safety and at the same time not be essentially higher in price than an equally good gas installation, but the general public is usually frightened at the cost of installation, and properly so. Therefore, many a contractor prefers giving over the installation entirely to laying it out as simply and cheaply as possible and selling to his customer cheap but effective fixtures. Where it is a question of extending consumption in the poorer districts the costs of installation are either divided pro rata, or, as generally brings good results, the consumer pays a rate for his lighting which covers the cost of installation in the course of the first year. The central station has hitherto done all too little to aid the poorer consumer in the introduction of electricity by either the greatest possible reduction of installation expense or its complete removal.

A special kind of advertising for the extension of electricity in the household could also be effected by the contractors and builders. This class is generally better instructed in the application of gas than electricity, and here is opportunity for skilful action on the part of the electric interests.

Electric cooking has an especial significance in improving the station load-factor in Germany, where in the middle-class and smaller households the principal meals of the day occur in the morning and mid-day hours, when consumption for lighting is insignificant. The importance of the most rapid extension of electric cooking can scarcely be overestimated. In addition to this, it happens that where, besides electric cook stoves, coal and gas are reserved for use electricity will receive the preference without question in summer.

Wiring and Illumination

FIXED PRICES PER OUTLET FOR WIRING.

For many years no electrical contractor who made any claim to giving close estimates on wiring jobs would have thought of taking a job at a certain price per outlet, looking at the building and the possible difficulties to be encountered. Nevertheless there is a marked and commendable tendency at the present time in various cities for central-station companies and contractors to get together and agree upon a certain unit price per outlet for wiring in certain specified classes of buildings, especially residences. The plan has much to commend it and its advantages should be thoroughly considered. Considering the matter first from the contractor's standpoint, it is evident that a considerable amount must be added to the cost of any small job for the time taken in preliminary work and estimates.

Now, if a number of buildings, for example, residences of a certain height and floor construction, are wired and the average price for each kind of outlet is determined as a result of experience, it has been found feasible to establish certain prices per outlet based on this experience and take jobs accordingly without detail figuring on particular cases. In other words, the contractor may lose a little money on some particular house, but it will be made up in the average run of the business and in the meantime he will be saving the cost of preliminary figuring and estimating. It is especially desirable to eliminate these preliminary costs on small residences where the price of the complete job must be brought down to the lowest figure possible in order to get the business in large quantities. It has been the custom of central-station companies in some cities for several years to establish schedules of prices for the wiring of houses, either on the cash or instalment plan. This wiring would either be carried out by the central-station company or by local contractors who had agreed to the schedule of prices made.

From the business-getting standpoint the plan has decided advantages because it enables the contractor to tell the prospective consumer on the spot the cost of wiring his building without the necessity for delay in getting figures and a second interview. If the central-station company is not in the contracting business and the central-station solicitor has to tell the consumer that he will have to wait for prices from some contractor the consumer's enthusiasm is likely to die out and the wiring of his building be put off indefinitely. The same is true in regard to minor improvements in lighting which the central-station man can frequently suggest. The first question the customer usually asks about changes of this kind is, "How much will it cost?"

Of course, there is much work where any conservative contractor will want to figure individually, but for the wholesale wiring of ordinary small buildings the adoption of certain unit prices which can be applied to the class of building as a whole undoubtedly is a help to getting business. The same is true of prices for making common alterations for the use of tungsten instead of carbon lamps. For example, many rooms are equipped with fixtures hanging low, and when tungsten lamps are adopted a single lamp placed high and controlled either with a pendent switch or a wall switch would be desirable. Established prices for making this kind of a charge might well be made and advertised.

MEASUREMENTS OF INTRINSIC BRIGHTNESS BY A NEW METHOD.

By Herbert E. Ives and M. Luckiesh.

The fact that the candle-power per unit of area of most artificial light sources is many times that of the sky or a white sunlit surface has been known for some time. Sufficient comment has been made upon the consequent ill-effects of exposing the eye to bare lamp filaments to render unnecessary a discussion of that phase of the matter here. Various tables have been published from time to time, presumably calculated from the dimensions and the candle-power.

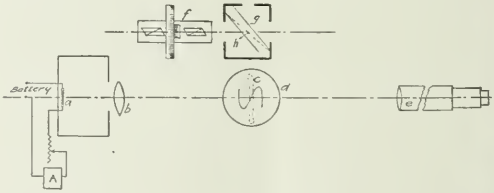
A piece of apparatus constructed for a somewhat different purpose has lent itself to the making of measurements of intrinsic brightness in a more direct manner than any hitherto known to the writers. The method is applicable to cases where the measurement of dimensions in connection with candle-power is not easy and so has made possible the collection of some hitherto undetermined data. In general the values given in previously published tables are confirmed as to order of magnitude. However, some interesting exceptions occur, and these, together with the details of the method, warrant some description.

The instrument used is a modification of the Holborn-Kurlbaum optical pyrometer. In this latter instrument the furnace or surface the temperature of which is to be measured is viewed directly, while between the eye and the object is placed an incandescent lamp filament. The current in the filament is varied until the filament becomes invisible—that is, until its intrinsic brightness is the same as the background. A previous calibration of the filament on a "black body" makes it possible to state this intrinsic brightness in terms of "black-body temperature," or the temperature the filament (or background) would have if of the same emissivity as a black body. A temperature measurement with this instrument might, however, be expressed in terms of brightness per unit of area if desired. To accomplish this use could be made of the data of Nernst* on the candle-power per square millimeter of a black body at various temperatures.

In attempting to apply this method of measuring intrinsic brightness to the measurement of illuminants the usual conditions are reversed. That is, instead of having a background of large extent, against which the auxiliary lamp filament may be matched, the surfaces to be measured are often of very small dimensions. For instance, an incandescent lamp filament is so small that the attempt to match one with the brightness of another filament crossing it is altogether impracticable. Magnification helps little here, as the magnification must be so large that only lamps in specially made bulbs with plate-glass windows, causing no distortion, could be employed. This would prevent the use of the pyrometer as made. It might be thought, however, that the filament to be measured could be substituted for the pyrometer lamp and a "black-body" furnace used for background. The obstacle to this is the high intrinsic brightness of certain of the lamp filaments, which would necessitate operating a black body at temperatures much above those ordinarily used and only practicable, if at all, with furnaces of specially refractory material.

These various difficulties are very satisfactorily overcome by a background chosen after some search, namely, the *image of a Nernst glower*. In the first place, the glower happens to have a higher intrinsic brightness than any of the incandescent filaments. In the second place, since it is operated in the air, and not in a bulb, an image may be formed by a lens without distortion. In the third place, the ordinary commercial glower is large enough so that only a few-fold magnification is necessary.

A few words are necessary in regard to the use of an image as a background. It follows from geometrical optics that the intrinsic brightness of an image in space, as viewed from the side away from the lens forming it, is equal to the brightness of the original source, provided the beam of light entirely fills the pupil of the eye or the aperture of the telescope with which the image is viewed. Consequently, an image of any convenient size may be used and it may be focused in any plane desired, such for instance as that of a lamp filament in a bulb. In the latter case the relative position of filament, lens and bulb is such that no troublesome distortion is introduced by the glass of the bulb.



Plan of Apparatus for Measuring Brightness of Light.

It must be clearly understood that this peculiarity of the brightness of an image holds only if the image is in space and is viewed from behind—that is, it would not hold if the image were formed on a diffusing surface, when the brightness would vary with the size. As a practical qualification to the general statement is the necessity of taking into account the absorption of the lens which forms the image, as will be noted.

A plan of the apparatus is shown in the accompanying illustration, where *a* is the Nernst glower inclosed in a tin box to avoid drafts. For this work a direct-current, 0.6 amp glower was used, without the heating coil. No ballast was used, but the voltage was cut down from 140 to the normal (115) by resistances. Current was read by the ammeter *A*; *b* is the lens, in this case a Hasting's triplet of 2-in. focus; *c* is the enlarged image of the glower, in the plane of *d*, the incandescent lamp to be measured, and *e* is the observing telescope.

In order to make measurements it is obviously necessary to vary the brightness of the Nernst image and to know the values of this brightness. Several means of changing the candle-power of the Nernst were tried, and finally two were employed, each for a different range. In measuring the incandescent lamps it was found most satisfactory to change the Nernst by varying the current through it. Separate photometer measurements gave the relationship between current and brightness in the glower. This means of varying the brightness could not be used for low values (below 200 cp per square inch) owing to the failure of the glower to operate. For other illuminants of lower intrinsic brightness a pair of nicol prisms, *f*, were inserted. Their angle of rotation relative to each other could be read; when a setting was made each side of the extinction point (θ_1 and θ_2) the brightness of the glower image was $a \sin^2 \frac{\theta_2 - \theta_1}{2}$, where *a* is the transmission of the nicol prisms at their point of maximum transmission. This formed a very satisfactory method for varying the brightness of the background and would have been preferable throughout were it not that the absorption of the nicol prisms reduces the background intensity below the value necessary for matching the lamp filaments at their normal operation.

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*Phys. Zeit., pp. 380-383. June 1, 1906.

For the measurement of flames and other illuminants of an extended character it was necessary to introduce an auxiliary device. Clearly, flames, being transparent, cannot be matched against a bright background, and similar or equally great difficulties arise with certain of the other illuminants. For the purpose of measuring these a thin reflecting filament was made, consisting of a ½-mm strip of silver, *h*, chemically deposited on the back of a 7-deg. prism. Against this a second prism was cemented with Canada balsam, so that the outer faces of the prisms were parallel, but at an angle with the silver strip. This compound prism was inclosed in a small box, *g*, with front, back and a narrow side opening. By this means all reflections except those from the silver strip were invisible at the telescope. Portions of flames reflected in this strip appear very much like the lamp filaments and disappear very satisfactorily against the background.

Certain constants of the instrument had to be determined. The intrinsic brightness of the Nernst was obtained by measuring the candle-power of a portion of the center of the glower, the ends being covered by a metal diaphragm. The width of the opening and the diameter of the filament (hot) were measured with a micrometer microscope; the candle-power divided by the area gave the desired value at the current used. A candle-power-current curve gave the value of this quantity at other currents.

The absorption of the lens, *b*, was determined in the following manner: A similar lens was first used to form an image of the glower of a convenient size. This was matched against a filament. The original lens was then placed next the second one and an image formed similar to the first. This was matched against the filament by changing the current through the latter. A measurement of the relative brightness of the incandescent lamp in the two cases made possible the determination of the transmission of the lens used.

By a similar method the absorption of a single thickness of lamp bulb was determined. The reflecting power of the silver strip was determined by substituting for it a first-surface platinum mirror, with a sharp edge, the reflecting power of which was known. Measurement was made of the intrinsic brightness of an opal glass in front of an incandescent lamp, using each mirror in turn. Their difference in reflecting power and the known reflecting power of the one gave the requisite data. The values of these constants as determined were: Transmission of lens, 90 per cent; of lamp bulb, 90 per cent; reflecting power of mirror, 73.5 per cent; maximum transmission of nicol prisms, 23.6 per cent.

The measurements were made in the manner indicated above, with few variations. All the electric illuminants were operated carefully at their correct commercial rating. The gas and oil illuminants were taken as they came. Several of the sources were of such character that it was necessary to measure them by projecting an image upon the silver strip. These were the Welsbach mantle (to secure a measurement of the mesh) and the carbon and magnetite arc lamps. This involved only the correction for the absorption of the additional lens. In the two latter cases neutral-tint absorption glasses were also necessary. Neutral-tint glasses were used over the eye-piece of the telescope when necessary to reduce the brightness of the image to a workable value.

In order to test the accuracy of the method a piece of flashed opal glass under a diaphragm was placed in front of a tantalum lamp and measured both directly upon a photometer and indirectly by means of the apparatus described. By direct measurement the value of the intrinsic brightness was 1.80 cp per square inch; with the apparatus it was 1.83, an agreement as close as could be expected. Similar measurements on a Welsbach mantle and values for a hairpin-filament carbon lamp of measured candle-power and projected area of filament showed nearly as good agreement, thereby indicating the method to be reliable.

Most of the measurements shown are the mean of several sets made at different times. In the case of the incandescent lamps the figures are the mean of measurements on the several filaments of the metallic-filament lamps or parts of the one filament in the carbon lamp. Differences of as much as 10 per cent have been noted in one lamp at different points in the same filament all well away from the end connections. The method furnishes, in fact, a very sensitive "spot test." The least satisfactory of the figures given are those for the carbon and magnetite arc lamps, due to extreme difficulty in maintaining their images steadily upon the reflecting strip. The use of a wider strip, in which the whole image could be watched, would probably largely overcome this difficulty. The Cooper Hewitt mercury-arc lamps had been operated for several hundred hours and the tube was somewhat blackened.

The values obtained in the present investigation are given in the accompanying table, together with some values given by Barrows* for comparison. These latter values appear to be in part selected from previously published values by others and render unnecessary quoting other tables. As given, the incandescent lamp values determined by the authors refer to the brightness *inside the bulb;* they will be about 10 per cent less as ordinarily viewed.

Source.	Barrows.	Ives & Luckiesh	
	Candle-Power per Square Inch.	Candle-Power per Square Inch	Candle-Power per Square Mm
Sun at zenith	600,000	.	.
Crater, carbon arc	200,000	84,000	130
Open carbon arc	10,000–50,000		
Flaming arc	5,000		
Magnetite arc	... ..	4,000	6.2
Nernst glower	800–1,000		.
Nernst glower (115-volt, 6-amp. d. c.)		3,010	4.7
Incandescent lamps:			
Tungsten, 1.25 w.p.c	1,000	1,060	1.64
Graphitized carbon filament, 2.5 w.p.c	625	750	1.2
Tantalum, 2.0 w.p.c.	750	580	0.9
Carbon, 3.1 w.p.c	480	485	0.75
Carbon, 3.5 w.p.c	375	400	0.63
Carbon, 4.0 w.p.c	300	325	0.50
Inclosed carbon arc (d.c.)	100–500		.
Acetylene flame	75–10[illegible]		
Acetylene flame (1-ft. burner)		53.0	0.082
Acetylene flame (½-ft. burner)		33.0	0.057
Welsbach mantle	20–25	31.0	0.048
Welsbach (mesh)		56.0	0.067
Cooper Hewitt mercury-vapor lamp	16.7	14.9	0.023
Kerosene flame	4–8	9	0.014
Candle flame	3–4		. .
Gas flame (fishtail)	3–8	2.7	0.004
Frosted incandescent lamp	4–8		
25-watt frosted tungsten lamp:			
Tip		1.67	[illegible]26
Side		6[illegible]	[illegible]
Moore carbon-dioxide tube lamp	0.6		

It will be seen that the values here given agree well with those given by Barrows, with the noticeable exception of the tantalum and graphitized carbon filament. The new values, which have been carefully checked on several lamps, indicate a higher intrinsic brightness for the graphitized carbon than for the tantalum. There is nothing strange in this, for there is no question that, at the same temperature, carbon, because of its relatively non-metallic "black" character and consequent high emissivity, would be much brighter than the metal tantalum. There is found here an illustration of the fact often not grasped that efficiency does not depend upon high emissive power (which would place carbon above the metals), but upon the relative emissive power and hence the relative amount of radiation in the infra-red and in the visible spectrum. The emissivity of the graphitized carbon filament is so much higher than the emissivity of the tantalum that even at a lower efficiency the intrinsic brightness is higher.

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*Barrows, "Electrical Illuminating Engineering," p. 3.

The variety of illuminants that were measured shows the general applicability of the method. Among other figures those of the Welsbach mantle might be especially noted, for both measurements of the mantle as a whole and of the incandescent fibers separately are given. The latter were obtained by forming an image of the mantle upon the silver reflecting strip.

Some improvements in the apparatus might profitably be made as a result of experience with these measurements. Chief among these would be the use of some other background. The direct-current Nernst glower proved a somewhat fragile tool for the usage dictated by this experimental method. A thick tungsten filament in a fairly flat and uniform or large diameter bulb would be preferable. It could be safely overrun sufficiently to match filaments of the same material, while the other filaments would match it at its normal voltage or below. In the event of using a filament of this type a purely substitution method would be advisable, referring all measurements to a filament of known brightness, itself matched against the special tungsten background.

These modifications of the procedure here used would be well to follow were intrinsic brightness measurements found of such use in any photometric method as to make convenience in obtaining them of practical importance—which is not anticipated. As a matter of fact, the present apparatus was devised to test the possibility of rating incandescent lamps at a uniform specific consumption by setting them at the same intrinsic brightness. The method has been found good, but unfortunately *too good* for commercial incandescent lamps. These, as mentioned above, vary from filament to filament and from point to point on one filament by an amount corresponding to several volts. Further difficulties might have developed due to differences in vacuum or to differences in the character of the filament surfaces, depending upon their amount of seasoning; but the non-uniformity of the filaments sufficed to condemn the method. The apparatus, however, lent itself to intrinsic brightness measurements with the results tabulated above.

The authors wish to express their thanks to Mr. E. H. Bailey for assistance in making measurements.

RECENT TELEPHONE PATENTS.

LOADED PHANTOM.

The loaded-phantom telephone circuit has been looked to as the most accessible means of extending the long-distance range both commercially and from a transmission standpoint. From the transmission standpoint the range is largely dependent upon the effective cross-section of the conductors, but from the commercial standpoint the limit is evidently determined by the maximum investment that will allow of a practicable rate for service. The loading of lines with Pupin coils very materially increases the effective size of the conductor at a reasonable cost. Similarly the phantom doubles the conductor size by using two in parallel as one, i. e., two complete physical metallic circuits inter-connected so that they may each be used for an individual message and simultaneously used for a third superimposed message.

Unfortunately, heretofore two loaded circuits would not serve as a practicable phantom, as the loading coils through their magnetic and electrostatic leakages caused too great losses and cross-talk. These defects are partly due to the relative position of the load-coil windings to the core and casings of the coil, these forming condensers. They are also due to consequent magnetic poles formed at the junction of the two windings. Mr. Thomas Shaw, of Hackensack, N. J., has invented a load coil which overcomes both these difficulties. In his coil each winding is made in two parts, and one part of both windings covers one-half the toroidal core of iron wire. The inner section on one part of the core and the outer section on the other are associated and vice versa. With this arrangement the effective inductance to the physical circuit is little changed, while for the phantom, as the counterbalancing or differential effect of the overlapping winding is distributed over the entire core, there are no consequent poles formed. Again, by properly associating and arranging the inner and outer layers and abutting ends of the windings with respect to the line wires, the condenser effect may be made negligible as a producer of cross-talk.

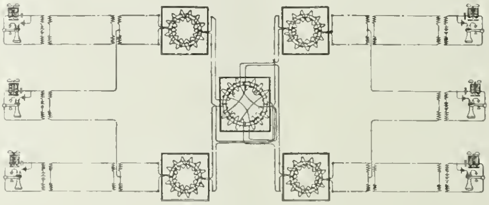


Fig. 1—Loaded Phantom Circuit.

A second patent, granted jointly to Mr. Thomas Shaw and Mr. G. A. Campbell, of Brooklyn, involves a means of loading phantom circuits. These may be composed of either loaded or non-loaded physical circuits. The phantom loading coils may be similar to those in the above-mentioned patent granted to Mr. Shaw, being, however, inductively arranged for two wires in parallel, or they may be a special four-circuit coil constructed upon similar principles. In the latter case one set of phantom-load coils suffices for both physicals, while in the former two sets are required, one set for each physical. Both these patents are assigned to the American Telephone & Telegraph Company. The accompanying illustration shows diagrammatically the preferred form of the loaded phantom of loaded physicals.

TELEPHONE AND TELEGRAPH SYSTEM.

The accompanying illustration shows a telephone and telegraph system invented and patented by Mr. H. O. Rugh, of Sandwich, Ill., his patent being assigned to the Sandwich Electric Company. The Wheatstone-bridge arrangement of resistances and inductances is the essential factor. Telegraph currents traverse the arms in parallel so that the telephone taps are practically at equipotential points. Telephone currents, on the other hand, travel the non-inductive path. It will be seen that telephone stations may converse over the upper or through wire while adjacent stations are holding intermediate conversations over the telegraph circuit. The system contemplates a selective step-by-step signal and the use of the through line for telegraph purposes.

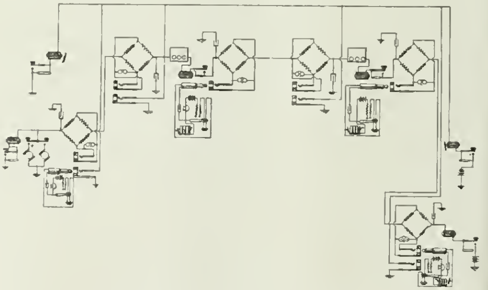


Fig. 2—Rugh's Telephone and Telegraph System.

CALL-DISTRIBUTING SYSTEM.

In a telephone-exchange system patented by Mr. A. H. Dyson, of Chicago, and assigned to the Kellogg Switchboard & Supply Company, the call-distributing scheme of operation seems to be carried to well nigh its ultimate. Not only does the invention contemplate its use for "A" positions, but the principle is adapted to the trunking to "B" positions and distant exchanges. The "A" operators have before them signal lights and locking keys. When a station originates a call the calling line is associated automatically with a non-busy line lamp at a non-busy "A" position. The "A" operator responds by means of the corresponding listening key, whereupon the calling party announces the exchange name of the desired station. Associated with the listening key are locking keys in number sufficient to correspond to the number of different offices. The "A" operator depresses the desired one. This key locks and automatically initiates the selection of the calling line and its connection to a non-busy trunk to the desired exchange. The "B" operator responds and, ascertaining the desired number, connects the trunk to the proper multiple jack. If the line is busy a busy signal is sent back to the caller, and if not busy a ringing current is sent out to the called station. The "B" operator has supervisory signals both ways, and upon completion of a conversation she disconnects the trunk, thus automatically knocking down all circuits to normal and releasing the "A" keys.

LETTERS TO THE EDITOR.

Capacity of Condensers in Parallel.

To the Editor of Electrical World:

Sir:—The accompanying diagram shows an adjustable condenser, with plugs in two different positions, which invites attention to the fact that with unused plates it makes a difference whether or not the plugs are placed parallel.

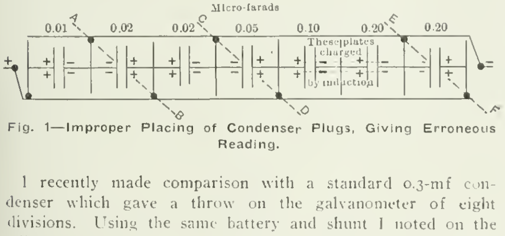


Fig. 1—Improper Placing of Condenser Plugs, Giving Erroneous Reading.

I recently made comparison with a standard 0.3-mf condenser which gave a throw on the galvanometer of eight divisions. Using the same battery and shunt I noted on the adjustable condenser that when the plugs were arranged as in Fig. 1, that is, parallel as per the dotted lines *AB*, *CD* and *EF*, the throw was ten divisions on the galvanometer, but with the lines of plugs not parallel, as in Fig. 2, the throw was eight and correct.

I varied all plugs, putting them in on the opposite sides, and in each case when the plugs were parallel the reading would be ten, but when not parallel, as in Fig. 2, the reading was correct—that is, eight.

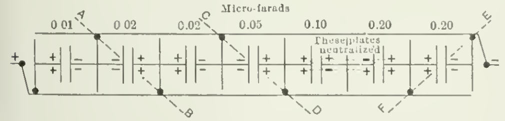


Fig. 2—Arrangement of Plugs So That Unused Condenser Plates Are Neutralized.

On the accompanying diagrams are shown the charges on the condenser plates of Figs. 1 and 2, which I believe sufficiently explains this variation.

It seems that when the plugs are parallel the unused plates are charged and used by induction. When the plugs are not parallel the induced charges on the unused plates are equal and in the opposite direction, which neutralizes those plates as it is intended should be done.

Valdez, Alaska. B. O. Lenoir.

Wattless Power.

To the Editor of Electrical World:

Sir:—I have read with much interest the communications of Messrs. C. O. Mailloux, John R. Carson and B. Spencer Greenfield appearing in your issues of Jan 12 and 19.

With regard to wattless phenomena, I seem to have been accused by some of these writers of quarreling with the accepted mathematical methods of dealing with alternating-current phenomena, which are far more ingenious, accurate and conclusive than any that I could suggest. That is not the point of discussion, which is, briefly: What clear, concise and useful name shall we adopt to designate these phenomena in the various forms in which they appear?

Mr. Mailloux's second communication, to my mind, seems to suggest many valuable things. I am much pleased with the term reacting power, for it suggests in itself a power which is merely a quantity of energy transmitted back and forth between the generator and the receiver circuit and not appearing in its outside delivery. This power may be split into reactance power and condensance power or into inductance power and capacity power. These four adjectives go together in pairs; one should not be used without the other.

Referring to Ohm's law, I would say that it is impossible to discuss the e.m.fs. of an alternating-current circuit without arguing in a circle. They form a closed figure. It has been customary heretofore to open the circle or closed figure at the terminal e.m.f. and argue around the circle until the forces balance and to begin with what seems to me to be a very injurious statement that Ohm's law does not hold. If Ohm meant the terminal e.m.f. in framing his law this is certainly true; but there is no evidence except by inference that he did mean this. If, however, we open the closed diagram at the resultant e.m.f. and split it up into its components, attacking the problem analytically rather than synthetically, we can point out that Ohm's law does hold provided that the right *E* is selected. This *E* is definable in two ways, not in one; the first as *IR* and the second as the vector sum of the other e.m.fs. contained in the circuit.

I wish to take exception to the last paragraph of Mr. Carson's communication, in which he urges that Ohm describes the resistance of a circuit as a constant and seems to carry with this description the idea that the resistance of the circuit would be a constant, no matter what happened to it. It seems to me that to argue the fallacy of the law on account of change of the resistance due to rising temperature is quite as misleading as to argue the fallacy of the law in case the circuit was surreptitiously opened and more resistance inserted. The same reasoning, to my mind, holds good when high-frequency phenomena force the current to travel in certain parts of the circuit and to leave other parts of the circuit partially or fully out of commission, as is the case in the well-known skin effect.

Referring to gases and the conduction of electricity through them in highly attenuated confines, there is much evidence to show that the transference of electricity in such a case is by the convection of highly charged particles and not by conductance in its regularly understood form. As convection and conductance are two entirely different physical phenomena, it is not surprising that one law does not cover them both.

In undertaking a theoretical discussion it is always best to try to make laws, theories and formulas fit facts, and when a condition of affairs arises which can be explained only by a faulty premise it should be finally rejected. It is much better in discussing phenomena of this kind to show how fundamental laws work, rather than why they fail. To have a fundamental physical law work in one case and not in another is, to the writer's mind, very confusing and undesirable.

New York. George T. Hanchett

Voltage-Wave Distortion and Life of Incandescent Lamps.

To the Editor of Electrical World:

Sir:—Referring to Professor Kinsloe's letter in your issue of Jan. 19, I regret exceedingly that any of the statements in my letter in the issue of Jan. 12 should have been considered by him to be "misleading or incorrect."

When Professor Kinsloe's original communication was first read there appeared to be two main points in which his report was incorrect.

First, statements concerning the regulation that would be obtained on the circuit whose wave was distorted by means of a saturated reactance.

Second, the fact that he found considerably less candle-power with the same watts on the distorted wave.

With reference to the first point, that "no effect worth considering could have resulted from this cause," my statements were based on the results of tests made on an arrangement, as near as I could produce it, like that described in the original article. When the same degree of distortion that was shown by the wave in the report was reached, the variation of voltage in the distorted circuit was, as near as could be determined, twice that of the generator. When the generator voltage was raised or lowered by 1 volt the voltage on the lamps on the circuit, which included the saturated reactance, changed by 2 volts. The regulation is also affected by frequency changes.

The object in questioning the regulation of a circuit distorted in this way was to find out what sort of an arrangement was used which did not behave in this way to a greater or less degree. We still lack this information.

With reference to the second point, the tests made and confirmed by those which Dr. Sharp communicated seem pretty good evidence that any difference of watts per candle on the two waves is of a different order from and much smaller than that recorded in Professor Kinsloe's paper. As the evidence submitted to establish this point has not been questioned, perhaps it need not be referred to again.

With reference to the oscillogram accompanying my letter and the conclusions drawn from it, these have no real bearing on the points being discussed, except that this means was taken to justify the use of a wattmeter instead of a voltmeter for the electrical measurement on both circuits. I did not intend to "lead one to believe that there is *almost no change* in resistance or temperature of tungsten filaments during a voltage cycle," for we all know that there is such a change, and that this change of temperature is sufficient to produce a "flicker visible to the naked eye." Because of the great increase in luminescence that accompanies a small increase in temperature this well-known flicker effect is due to a *small cyclic change of temperature*, too small, as shown by the waves, to make the power-factor of the lamp differ from unity by an amount that may be detected by ordinary measuring instruments. I have not attempted to discuss the question as to whether or not wave distortion *appreciably* affects the life of metal-filament lamps. My purpose in writing was only to call attention to the fact that for reasons which have now been somewhat thoroughly discussed Professor Kinsloe's publications cannot be accepted as sufficient evidence to warrant the conclusions which he has drawn from them.

Schenectady, N. Y. L. T. Robinson.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Voltage Drop of Three-Phase Generators.—J. Sumec.—The author gives the voltage vector diagram of the synchronous machine and then bases on this an analytical method for calculating the voltage drop. The increase of the magnetic stray flux with the increasing load is taken into consideration. A numerical example is added and various special points are discussed.—*Elek. Zeit.*, Jan. 26.

Lamps and Lighting.

Illumination of Public Libraries.—J. D. Brown, L. S. Jast and J. Darch.—Three papers presented before the (British) Illuminating Engineering Society on the illumination of public libraries. Jast emphasizes that point lighting should be avoided wherever possible, but it is probably a necessary evil for the reading tables or desks in most public libraries. For this purpose he prefers on the whole the ordinary cone-shaped opal shade as deep as it is possible to get it, so that the reader seated at the table is unable in any ordinary position to see any part of the lamp itself. For lighting the narrow gangway between bookcases the best average results are achieved by lamps over the center of the gangway. In the Croydon library "linolite" lamps have been fitted on the cornices of the cases, so arranged that the lamp on one case illuminates the books on the opposite case. Darch recommends that for low ceilings the lamps should be placed as high as the proper illumination of the ceiling will admit, and the direct light kept from the eyes by means of opaque or semi-opaque screens, in which case the lamps should not be inclosed in obscured glass. The form of these screens will depend upon the circumstances, but Fig. 1 is a suggestion for an average case and may cover an arc lamp, a filament lamp, incandescent gas or a regenerative burner. Indirect lighting is also specially suited to low ceilings. For reading desks he thinks it is important that each reader should have a separate lamp and readers should be left to switch on and off their own lamps. Some notes are added on lighting of news-stands. There was an extended discussion on the subject. The subject is also discussed in a long editorial.—Lond. *Electrician*, Jan. 27.

Metallic-Filament Lamp.—A note on the Graetzin metallic-filament lamp. Tests made by the Reichsanstalt on nine lamps did not show a single breakage up to 4000 hours; some of the lamps are still burning at 6000 hours. The lamps tested were of about 26 cp at 115-117 volts direct current and had an initial specific consumption averaging 1.157 watts per mean hefner candle measured at right angles to the axis of the lamp. After 1000 hours the average candle-power was 23.54 and the consumption 1.27 watts per hefner and after 2500 hours the candle-power was still over 20, the consumption being 1.44 watts per hefner. Even after 4000 hours the candle-power averaged nearly 18 hefners. The special lines are the high-candle-power lamps of from 100 cp to 1000 cp for public lighting.—Lond. *Elec. Review*, Jan. 27.

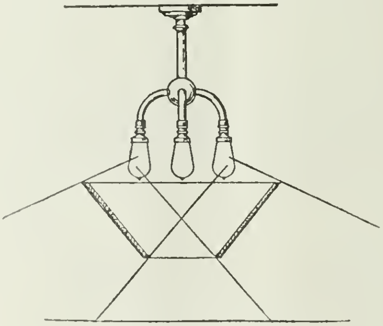


Fig. 1—Illumination of Public Libraries.

British Metallic-Filament Lamp Works.—An illustrated description of the Brimsdown lamp factory in which the Kuzel colloidal process for making tungsten lamps is employed. Some details are given of the forming of the filament and the testing of the lamps. The present output is 2,500,000 lamps a year.—Lond. *Electrician*, Jan. 27.

Arc-Lamp Electrodes.—A note on a recent British patent (9076, Jan. 19, 1911) of Gebr. Siemens & Company. Electrodes for flame-arc lamps are of carbon impregnated with or having cores of a mixture of one or more oxides of cerium, lanthanum, didymium or zirconium, with oxides of calcium, strontium and barium. A compound of calcium oxide with cerium peroxide is a suitable substance, and the addition of fluorspar tends to prevent hissing of the arc.—Lond. *Elec. Eng'ing*, Jan. 26.

Generation, Transmission and Distribution.

Transmission System in Germany.—An article on the project of a transmission system in the district of Mittelfranken. For the present the City of Ansbach is supplied with electrical energy from a plant containing two Diesel engines of 335 hp and 540 hp coupled to 5000-volt, three-phase generators. A very large transmission system is, however, projected and contracts have been made with 1529 towns for energy supply. Either a water-power will be developed or a large steam plant will be built near Nuremberg. The latter seems to be more profitable since the first cost is much less and the generating plant would be at the center of gravity of the transmission system. It is expected that nine-tenths of the total energy would be sold to the cities of Nuremberg and Furth.—*Elek. Zeit.*, Jan. 26.

Energy Transmission.—W. T. Taylor.—A paper read before the (British) Institution of Electrical Engineers on modern long-distance transmission of electrical energy. The author, after a short introduction, deals with the general design of long-distance transmission systems worked at pressures up to 100,000 volts, poles, insulators, protective devices and switchgear receiving special mention.—Lond. *Electrician*, Jan. 27.

Electric Equipment of Docks.—W. Dixon and G. H. Baxter.—An illustrated paper read before the (British) Institution of Mechanical Engineers on modern electrical dock equipment with special reference to electrically operated coal hoists. The paper deals with the electrical equipment of the Rothesay dock on the Clyde. This installation has been carried out by the authors, and the results obtained show a great saving over hydraulic operation, while as regards reliability, etc., the electrical plant leaves nothing to be desired.—Lond. *Electrician*, Jan. 27.

Traction.

Railless Traction in Germany.—A note stating that two installations of railless traction have recently been provided in Bremen to connect the outlying districts with the ordinary tramway service in the city. The cars are similar to motor omnibuses in size, but they are much lighter and also possess advantages in being quieter while running and in not emitting any odor due to exhaust gases. The cost of construction is said to have been about one-fourth of that of ordinary tramways. The electric conductors, one for the positive and one for the negative, are placed about 8 in. apart, one above the other. The trolley consists of two rollers which travel on the upper wire and two hoops which are pressed against the lower one. In order to allow the car to deviate from a straight line and to pass other vehicles the wires connecting the car with the trolley are automatically uncoiled from a drum placed inside the car. This drum also takes up the spare wire immediately it becomes slack. For small deviations, up to 6 ft., a patent cable loop is provided. When one car meets another the conductors of the cars exchange trolleys.—Lond. *Electrician*, Jan. 27.

Catenary Suspension.—Hensig.—An English translation of his recent German paper on the use of catenary suspension for street railways.—Lond. *Electrician*, Jan. 27.

Installations, Systems and Appliances.

Trouble in Two-Phase Networks.—A. T. Bullen.—An illustrated article on a peculiar "two-phase complication" in a two-phase, four-wire system with 200 volts between the outer and inner wires. There is usually an earth of greater or less resistance on each outer, which does not vary to any great extent from time to time, but it is not entirely unknown for one outer to be only relatively slightly earthed on one day and dead earthed the next. Some time ago there was connected to the circuit a 75-hp, two-phase motor, its consumption being measured by two single-phase meters with series transformers. The average monthly consumption was, roughly, 1000 kw-hours on each phase. For some cause the motor developed a serious fault and had to be partially rewound. The rewinding was intrusted to a local firm, and unfortunately resulted in the wires to the terminals becoming crossed inside the motor. The machine was reconnected to the mains, connecting the same leads as before to the same terminals so that as the net result one winding was connected across the two inners and the other across the two outers, as indicated in Fig. 2. Owing to a peculiarity in the earths the motor started, although slowly. It continued to run under these conditions for a considerable period with a current, measured by an ammeter in one winding, about 20 per cent in excess of the current when correctly connected. The results as indicated by the company's meters were perplexing. One meter commenced to run backward at about one-quarter the speed of the other, or, to be more precise, the registration on one meter was 2400 per month as against 600 in the reverse direction on the other. The motor refused to start one day; then the wrong connections were discovered. The following explanation is given: X and Y represent the two windings of the motor; IO and $I'O'$ are the inners and outers of phases A and B respectively of the company's supply; a and b are the meters on phases A and B respectively, the series transformers being omitted for the sake of clearness; a' and b' are the ammeters on the same circuits. The motor connections are as shown. E and E' are partial and dead earths respectively on the outers of phase A and B. The difference of potential under these conditions across the inners is rather less than 283, and across the outer an unknown quantity, x, which was just sufficient to produce a dull glow on the 200-volt lamp tapped across. The phase angle between these two voltages is much less than the phase difference would have been had the motor been correctly connected, hence the poor starting torque (see Fig. 3). By vectors, $O'Z$ represents, in phase and magnitude, the voltage across the inners, less than 283, since $O'I$ is a voltage less than 200. OO', the voltage across the outers, has a phase difference from $O'Z$ represented by the angle φ. $O'R$ and $O'S$ are the fluxes created by these voltages, resulting in a rotating field represented in magnitude by $O'T$. It is now clear that, under the conditions defined above, motion will take place, the motor running in the correct direction. The alterations in conditions can only be explained by the partial earth becoming a dead earth and thus destroying all difference of potential between the outers of the two phases. Since no rotating field now results the motor refuses to start. A test on the outers after stoppage showed definitely two dead earths. Some suggestions are also made as to the reason why the two meters read differently. It is recommended that the terminals of motors should not be marked simply 1, 2, 3, 4, and that it would

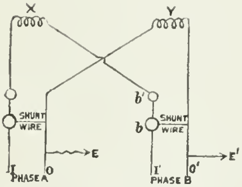


Fig. 2—Motor Connections.

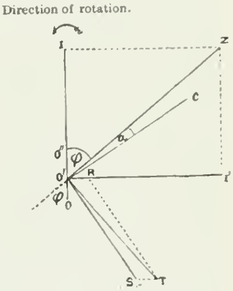


Fig. 3—Phase Connections.

simplify matters and prevent recurrences of mistakes if they could be marked A_1, A_2, B_1, B_2.—Lond. *Elec. Review*, Jan. 27.

Meters.—H. E. Goody.—The author emphasizes that the "readableness" of a meter is a very important property and that an attempt should be made at the standardization of electricity meter dials. In having to read a dozen types of dial inspectors are at a disadvantage compared with their gas-company confrères. Apart from the individual difficulties of particular meters, this extensive variety of dials greatly increases the liability of error. The author suggests the following tests: "Fix the meter in a perfectly dark cellar, 8 ft. from the ground. Stand on the ground 6 ft. away and strike a match; if the meter can be read under those conditions it may be considered to have passed the test. If the meter cannot be read or can be read only with great difficulty experiment with others until success is attained."—Lond. *Elec. Review*, Jan. 26.

Small Central Stations.—A. R. Garnier.—The first part of a long serial giving statistical data on economic conditions of establishing and running small central stations. He thinks this is a subject to which far more attention should be paid. The article is to be continued.—*L'Industrie Elec.*, Jan. 25.

Electric Cooking.—H. Gray.—A paper read before the Manchester Section of the (British) Institution of Electrical Engineers. The author gave results of tests to show that the cost of electric cooking with energy at 1.5 cents per kw-hour could work out cheaper than with gas at 62 cents per 1000 cu. ft.—Lond. *Elec. Eng'ing*, Jan. 26.

Electricity in Agriculture.—Krohne.—An article with reference to the recent French paper of P. Lecler presented before the International Congress at Marseilles giving data on the use of electricity for plowing and also for driving various other agricultural machines.—*Elek. Zeit.*, Jan. 26.

Wires, Wiring and Conduits.

Earthing of High-Tension Transmission Systems.—W. M. Dempster.—The author points out that certain of the advantages of earthing the neutral of low-tension three-wire direct-current and four-wire alternating-current systems do not appear to be realized on extra-high-tension systems. At present there exists a considerable diversity of opinion as to the relative merits of star and delta connections for extra-high-tension transmission networks. He refers to an incident in which a coal mine was connected not only by means of the regular line, but also by means of a stand-by line to the station, but on an accident to the former the latter also broke down at once when connection was made. This was a three-phase system and it was found that in both lines one phase had broken down; thus out of six wires there were four that were sound and by selective switching the faulty phases could have been ascertained. The author recommends employing a single spare wire to replace one that has broken down. For this purpose short lengths of flexible cables should be kept on hand. This might afford as great a security as a double line of six wires. The amount of insulation required by an earthed delta system would be very little more than that required by an earthed star system, the line voltages being the same, but a star system is liable to fail in six ways, whereas a delta system may fail in only three ways, and the number of ways in which a system can fail may be taken as some measure of its vulnerability.—Lond. *Elec. Review*, Jan. 27.

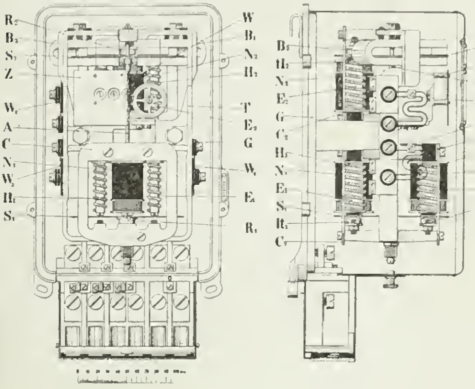
Overhead Lines.—L. Berland.—A long theoretical paper giving formulas and diagrams of the effect of temperature variations and wind pressure on overhead lines in order to enable one to calculate quickly a transmission line in such a way that even under the most unfavorable conditions of temperature and wind pressure the different coefficients of safety are within the limits permitted by the French law. If the coefficient of safety is 5 with a wind pressure of 120 kg per square meter it becomes 5.72 if the wind pressure becomes zero and the temperature remains at 10 deg. If the coefficient of safety is 5 with a wind pressure of 30 kg per square meter it becomes 5.08 if the wind pressure becomes zero and it becomes 10.88 if the temperature passes from —20 deg to +10 deg. C. The limits of the coefficients which satisfy the French regulations are, therefore, 5.172 and 10.88. It would, therefore, be necessary to allow a coefficient of safety of 10.88 when stretching the line at a temperature of +10 deg. C. and with zero wind pressure, whereby the coefficient of safety could never get below 5 under the conditions of temperature and wind pressure considered in the French law.—*L'Industrie Elec.*, Jan. 25.

Calculation of Transmission Lines.—W. Deutsch.—The conclusion of his mathematical article in which the author explains the method of Blondel and LeRoy for investigating the phenomena in long-distance high-tension lines with a practical example for the calculation of a cable.—*Elek. Zeit.*, Jan. 26.

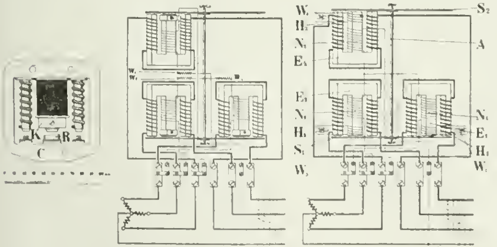
Units, Measurements and Instruments.

Electric Meters.—W. Lubach.—A review of recent progress in the manufacture of electric meters in Germany. A single factory is now making 600 meters per day and all the German meter factories are being re-enlarged and re-equipped. About one-half of the production is exported to other countries. In Germany itself the number of meters in use during the last ten years has increased 1000 per cent, and it is expected that within the next ten years it will again increase by the same percentage. According to statistical data of many years the life of an electricity meter is on the average about seven years. The main reason for the changes in meter manufacture is the greater use of metallic-filament lamps. While in installations with carbon lamps meters for from 10 amp to 50 amp were mostly used, a fairly good-sized installation, say, of eighty metallic-filament lamps, each of 25 cp, requires a meter of only 10 amp and 220 volts. Smaller installations require meters of from 1 amp to 5 amp, and there is a very large demand for such sizes. With the old types of meters the curious observation was made in smaller and medium-sized installations that the energy consumption of the meter itself was greater than the energy consumption of the consumer if the latter used only one or two of his metallic-filament lamps The consumption of an older type of 220-voltmeter being about 6 watts, there was a consumption by the meter of 144 watt-hours in a day, while a metallic-filament lamp consuming 26 watts requires only about 125 watt-hours if used for five hours during the day. As a matter of fact, there are new lamps on the market which consume only 18 watts or 15 watts. The requirement is, however, made now that the consumption of the meter in the shunt circuit shall not be more than 1.5 watts at 110 volts. Stricter requirements are also made concerning the starting of the meter. A few years ago one was satisfied when a meter gave correct readings at one-tenth full-load and when it started at one-hundredth full-load; now correct readings are required at one-twentieth or one-fiftieth full-load and starting at one-two-hundredth full-load. With direct-current meters the difficulty of protecting them against external magnetic fields is also increased. With induction meters for single-phase and polyphase currents the stricter requirements can be more easily fulfilled. Measuring transformers have been perfected to such a degree that it is no longer necessary to calibrate the meters together with the transformers. By correctly proportioning the stray fluxes with respect to the active fluxes the effects of voltage variations in single-phase and polyphase meters have been brought to zero. Modern meters are also independent of the frequency. Less progress has naturally been made recently in the Thomson direct-current watt-hour meter based on the dynamometer principle, as it had been improved before to a large degree. Magnet motor-meters for direct current have found greater favor in the last years and have been improved in various respects. With respect to accuracy at low loads the electrolytic meter is most exact. Meters with mercury anodes were greatly improved by using a solution of mercury iodide and potassium iodide, and the formation of crystals in older types of meters has been overcome. However, this type of meter has not been sufficiently long in practical use, and the lack of a recording device is a disadvantage since it encourages fraud. In a few German works maximum-demand indicators and in a large number of works double-tariff meters are being used, while other plants have returned to the flat rate.—*Elek. Zeit.*, Jan. 26.

Induction Meter.—An official announcement of the Reichsanstalt on the construction and calibration of induction meters for four-wire and three-wire three-phase systems of the Siemens-Schuckert Company. The meter shown in Figs. 4 to 8 is for use with three-phase systems with a neutral wire, but can also be used in three-wire, three-phase systems. There are two armature disks S_1 and S_2 mounted on the same axle A and three groups of electromagnets, E_1, E_2, E_3, and two braking magnets, B_1 and B_2. The design of a single electromagnet group is shown in Fig. 6, which shows the three magnet cores of the iron piece. These three cores are screwed to the iron yoke ring C. The direction of rotation of the rotary field has no effect on the registration of the meter, so that the three outer wires can be exchanged at will when the meter is connected. An additional displacement of phase of the shunt field is produced by means of a solid copper ring K for meters for less than eighty alternations and the excess of this displacement beyond 90 deg. is annihilated by means of the three resistors of low resistance, w_1, w_2, w_3. For frequencies of 80 or more alternations no solid copper ring is used, but a small additional coil, its circuit being closed through a resistor of adjustable resistance W. The former arrangement is shown in Fig. 7, the latter in Fig. 8. The iron cylinder R, which is opposite to the central shunt pole of the electromagnet, is cut off so as to have an oblique surface for adjusting the starting. Two iron screws in the yoke ring, opposite to the two outer main-current poles, are used for regulating the torque. All the effective parts are mounted on the frame T. The two braking magnets B_1 and B_2 act on the front part of the upper armature disk. The two armature disks S_1 and S_2 are made of sheet aluminum 1 mm (39 mils) thick and have a diameter of 115 mm (4½ in.).—*Elek. Zeit.*, Jan. 26.



Figs. 4 and 5—Induction Meters.



Figs. 6, 7 and 8—Induction Meters.

Instruments.—The conclusion of the illustrated description of the recent annual exhibition of apparatus of the Physical Society in London. The description includes a potentiometer, a recording accelerometer working on the Wimperis principle and some precision instruments.—Lond. *Electrician*, Jan. 27.

Instruments.—H. Pecheaux.—A brief description of various measuring instruments exhibited at the Brussels Exhibition in 1910, including the Duddell oscillograph, the Einthoven thread galvanometer, the Duddell hot-wire galvanometer for measuring high-frequency currents, etc.—*La Lumière Elec.*, Jan. 28.

Telegraphy, Telephony and Signals.

Telephone Cables.—The conclusion of the very extended discussion of the recent paper of W. A. J. O'Meara. D. Davies, of the Eastern Telegraph Company, said that experiments suggested by Sir Oliver Lodge were made in the laboratories of the Associated Telegraph Companies some time ago with the object of producing a distortionless cable An artificial line of the ordinary type used in submarine telegraphy was made and into this they introduced inductances at regular intervals right along the line. These inductances were ironless and were variable. Leakages were also introduced at similar intervals, and these intervals were represented by about 3 mfd of the line The interval corresponded with about ten nautical lengths of cable of mean thickness. The leakage could be varied in resistance from zero up to 1 megohm and the inductance could be varied from zero up to 1 henry. The conductor of the cable itself could also be varied, so that the arrangement was flexible. The cable became extremely lively when distortionless. Signals issued at the distant end very much of the same character as they were sent in. The signals needed little or no correction in the way of shaping at the receiving end, and the line acted almost as an ordinary aerial line. From the distortionless point of view the experiment was a successful one, but, unfortunately, although the signals came out very crisp and sharp they were very attenuated. Results are also given of experiments with loaded cables without leakage. B. S. Cohen, of the National Telephone Company, had prepared figures relating to tests for drumminess which, he thought, formed an additional argument in favor of using light conductors loaded pretty heavily instead of heavy unloaded conductors. He also gave results of experiments that had been carried out with parallel loading according to the system of S. P. Thompson (as distinguished from the series system of Pupin). In Fig. 9 the upper curve A shows the variation of attenuation with frequency on an unloaded line consisting of 20.5 miles of 20-lb. conductor cable. The next curve, B, shows the variation when the same line was loaded on the Thompson method with a 0.2 henry coil placed across the line every five miles, giving a loading of 1 henry per mile. The spacing was in accordance with the Pupin spacing formula. It is seen that between the limits of 600 periods and 1100 periods, indicated by the dotted lines, the attenuation variation was greater than when the line was unloaded. The third curve, C,

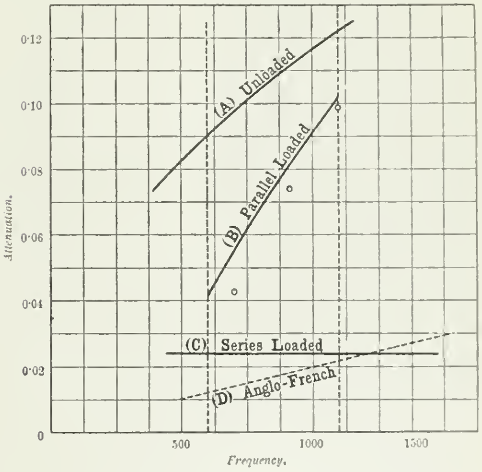


Fig. 9—Loaded Lines. Attenuation and Frequency.

shows ordinary series loading on the same line. The attenuation variation is practically negligible. The dotted curve was obtained by measurement on the Anglo-French cable. He would like to ask what was wrong with this measurement. There must have been a great deal of unloaded cable in circuit, and, therefore, the curve did not give the true attenuation variation for the loaded cable.—Lond. *Electrician*, Jan. 27.

Improvements of Telephones.—K. W. Wagner.—Progress in telephony will probably be based on further improvements in the Bell and Gray instrument. The author discusses various scientific points of the theory of the telephone. If an alternating current of the frequency n is passed into the receiver winding, the receiver winding has an impedance $r + j 2 \pi f L$, due to the combination of the effective ohmic resistance r and the effective self-inductance L. The values of r and L depend on the frequency and are also different when the diaphragm is in vibration or at rest. The author has determined experimentally the values of r and L as functions of the frequency $\omega = 2 \pi f$. The results are given in Fig. 10 and show especially a very sharp maximum of the curve r at the frequency of the fundamental wave of the diaphragm (condition of resonance). The question arises whether a receiver which behaves so differently for different wave-lengths is able to reproduce speech correctly. As a matter of fact, the receiver to which the illustration refers does so. The author concludes that the proportion of the amplitudes of the harmonic components does not solely determine the character of a sound. Breisig has found by experiment that for purposes of telephony the only important frequencies are between $2 \pi f = 4000$ and 6000. Devaux-Charbonnel and Cohen and Shepherd have shown that frequencies below 4000 and above 7000 may be left out without any effect on the transmission of speech. To improve the receiver its sensitiveness must be increased, for instance, by a better utilization of its energy. This may be accomplished by an arrangement in which the mechanical forces of the magnetic field act in the most effective way on the diaphragm. For a circular diaphragm a circular flux is the best one. This is obtained when one pole-shoe is a cylinder and the second pole-shoe is a concentric hollow cylinder, the winding of the receiver being placed between the two. While others were not successful with such constructions, probably on account of defects in the design, Baehr has made such a receiver which is superior to ordinary receivers. He wanted to decrease the parasitic sounds in the receiver. To do this the higher harmonics of the diaphragm should have as small amplitudes as possible or the diaphragm should be tuned strictly to the fundamental wave. For this purpose the momentum of inertia should be concentrated in the center of the diaphragm. Baehr used diaphragms of mica, wood and brass with a circular piece of iron in the center. This arrangement is effective only with receivers with a circular symmetric magnetic flux. The author finally discusses the energy losses in the receiver, due to the heat produced in the circuit, eddy-current losses and hysteresis losses. The paper is to be concluded.—*Elek. Zeit.*, Jan. 26.

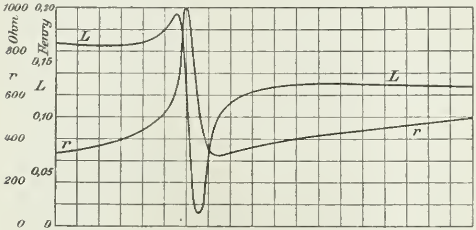


Fig. 10—Telephone-Receiver Resistance and Self-Inductance for Conditions of Resonance.

Telephone Condensers.—A note on a recent British patent (30,548, Jan. 19, 1911) of C. Cordes. Insulating substances of high dielectric capacity are produced from vegetable or animal oils, such as castor oil, by treatment with hydrogen in the presence of a finely divided metal, which acts as a catalyzer. Double the capacity for a condenser of given size is claimed as compared with paraffin condensers.—Lond. *Elec. Eng'ing*, Jan. 26.

Tenant's Right to Install Telephone.—In Germany a house owner had forbidden his tenant to get telephone connection, but the court decided that the house owner must permit his tenant to make the installation if he wants it.—*Bl. f. Post u. Tel.*, Vol. 6, 1910, page 299; *Elek. Zeit.*, Jan. 26.

Theory of Wireless Telegraphy.—H. Poincaré.—In an appendix to his highly theoretical paper on several problems relating to wireless telegraphy the author gives some mathematical proof necessary to demonstrate his former calculations. Among others, he demonstrates a theorem analagous to that of Green.—*La Lumière Elec.*, Jan. 28.

Wireless Telegraphy in Germany.—The (British) Marconi Company had made wireless installations on several German steamers of the North German Lloyd and the Hamburg-American Line, while the (German) Telefunken Company had made numerous installations on other German steamers. There has been sharp competition between the two companies, but they have now combined. The new company has taken over all existing installations.—*Elek. Zeit.*, Jan. 26.

Wireless Telephony.—A note on a recent British patent (1518, Jan. 19, 1911) of A. A. Jahnke and S. C. Tate. Their heavy-current transmitter for wireless telephony consists of two iridium-platinum electrodes inclosed in a chamber filled with carborundum granules. One electrode is attached to the main diaphragm. The annular wall of the chamber is of porous material, and alcohol or other volatilizable hydrocarbon is forced into the chamber through this wall. The evaporation of the alcohol cools the granules.—Lond. *Elec. Eng'ing*, Jan. 26.

Miscellaneous.

Electric Properties of Celluloid.—G. L. Addenbrooke.—Celluloid belongs to the class of what may be called abnormal insulators, of which water and alcohol are perhaps typical. In several ways celluloid would be an ideal insulator for many purposes if its properties could be brought into line with such materials as rubber and shellac, but at present this does not seem possible. Although as an insulator celluloid of ordinary quality ranks much below even gutta percha, nevertheless from a practical point of view its insulating properties are for many purposes quite respectable, and the writer has been much pleased lately with the properties of some of the copper wire covered with a celluloid varnish which is now coming in use. It would be consequently unwise to condemn it altogether for insulating purposes. The author gives some results of tests of his own and compares them with tests of Vallauri. The latter used "commercial black celluloid," while the author employed ordinary transparent celluloid. Hence there are some discrepancies in the results. Vallauri found a specific resistance of 8000 megohms per centimeter cubed, while the present author found 40,000 megohms per centimeter cubed. In such tests it is important to secure perfect contact with the conductors in making condensers and in testing the properties of insulators. When the dielectric is not liquid and cannot be melted into contact with the conducting plates there is only one method which will give approximately correct results for comparative purposes, and that is to test the material between two mercury faces under some pressure. To use any material with a solvent action which might contain any traces of moisture is almost certain to cause an alteration of the properties of the dielectric. Some notes are also given on capacity and power-factor.—Lond. *Electrician*, Jan. 27.

Ozone Ventilator.—An illustrated description of an ozone ventilator made by a German company in which the ozone is produced by the action of a Nernst filament. The whole apparatus is automatic and may be used either as a ventilator alone or as a ventilator and ozonizer together. The atmospheric oxygen is transformed into ozone in amount of not more than 0.1 per cent. Even with continuous operation no higher intensity is produced, since when the concentration tends to increase, the excess of ozone is at once decomposed. The power consumption of the ozone-ventilator is 85 watts. It is used on 200-volt and 230-volt direct-current circuits.—*Elek. Zeit.*, Jan. 26.

Book Review.

Induction Coils and Transformers. By H. Winfield Secor. New York: Modern Electric Publishing Company 92 pages, 70 illus. Price, 25 cents.

Amateurs interested in the construction of induction coils and transformers for high-potential, high-frequency, X-ray, wireless-telegraph and wireless-telephone purposes will find in this pamphlet a number of useful suggestions for the design, proportioning and selection of material for induction apparatus. Tables giving coil dimensions, condenser sizes, sparking distances, dielectric constants and wire data applicable to the amateur's problems are included as an appendix to the descriptive matter. The book is one essentially for young amateurs the treatment being of little or no value from the standpoint of design.

New Apparatus and Appliances

COMMERCIAL VEHICLE SHOW IN CHICAGO.

Several types of electric commercial vehicles were shown at the Commercial Vehicle Show in Chicago, given under the auspices of the National Association of Automobile Manufacturers, which came to an end on Feb. 11. The exhibition as a whole was an excellent one and was distinguished by its practical character, many of the vehicles being lettered with the signs of the business houses for which they were made. Gasoline trucks up to 10 tons and electric trucks up to 7 tons carrying capacity were shown.

The Anderson Electric Car Company, Detroit, had a delivery wagon, an express wagon and a chassis for any body. Edison batteries are used exclusively in these vehicles.

The Automobile Maintenance & Manufacturing Company, Chicago, showed two of its latest types of delivery wagons with disk wheels. This company gave a clever demonstration of the ingenious Walker balance drive which is employed on the cars of its manufacture.

The Baker Motor Vehicle Company, of Cleveland, had a 4000-lb. truck complete and a chassis for a 1000-lb. wagon.

The General Vehicle Company, of Long Island City, displayed a 3½-ton truck, a brand new 700-lb. delivery wagon and a 2000-lb. wagon. A feature of the exhibit was the silver cup won by this company in the Atlantic City reliability run of Aug. 12 and 13, 1910.

The Lansden Company, of Newark, N. J., had six vehicles on exhibition, mostly delivery wagons. One of these was an express wagon that has been in use for seven years in Washington. This car was driven from Washington to New York for the automobile show there over the country roads and is going back into regular service. It has a mileage record of 39,000 miles, averaging 295 working days a year. Another interesting feature of the exhibit was a 3-ton industrial truck designed for shifting goods at railroad stations, freight houses, steamship piers, etc. Another feature was an ambulance provided with solid tires and an elaborate arrangement of spiral springs to make riding easy.

Studebaker Brothers Manufacturing Company, of South Bend, Ind., displayed a 3-ton electric truck, a 5-ton and 7-ton chassis, a delivery wagon and a 1-ton baggage wagon.

Waverley Company, Indianapolis, displayed an ambulance which is especially interesting because it is equipped with an electric heater, electric water heater, a portable lamp and attachments for electrical instruments used for medical apparatus. This company also displayed a handsome electric hearse and a light delivery wagon.

Among the accessories of electrical interest shown were exhibits by Adams & Westlake Company, Chicago; American Ever-Ready Company, New York; Bosch Magneto Company, New York; Briggs Manufacturing Company, Elkhart, Ind.; Briggs & Stratton Company, Milwaukee; Connecticut Telephone & Electric Company, Meriden, Conn.; Edison Storage Battery Company, Orange, N. J.; Eisemann Magneto Company, New York; Electric Storage Battery Company, Philadelphia; Heinze Electric Company, Lowell, Mass.; Kokomo Electric Company, Kokomo, Ind.; Lutz-Lockwood Manufacturing Company, Aldene, N. J.; National Carbon Company, Cleveland; Pittsfield Spark Coil Company, Dalton, Mass.; Remy Electric Company, Anderson, Ind.; Simms Magneto Company, New York; C. F. Splitdorf, New York; United States Light & Heating Company, New York; Vesta Accumulator Company, Chicago; Willard Storage Battery Company, Cleveland.

AN ELECTRIC VEHICLE DINNER.

The third annual banquet given to electric vehicle manufacturers by the Electric Storage Battery Company, of Philadelphia, took place on Wednesday evening, Feb. 1, at the Mid-Day Club, Chicago, the following firms being represented: Automobile Maintenance & Manufacturing Company, Baker Motor Vehicle Company, Batten-Dayton Motor Company, Broc Electric Vehicle Company, Columbia Motor Car Company, Columbus Buggy Company, Dayton Electric Car Company, Hupp-Yeats Electric Car Company, Ideal Electric Company, C. P. Kimball & Company, Ohio Electric Car Company, Phipps-Grinnell Electric Auto Company, Rauch & Lang Carriage Company, Studebaker Automobile Company, Waverley Company and Woods Motor Vehicle Company.

Among the guests present prominent in the electric field were Messrs. Hayden Eames, Louis A. Ferguson, of the Commonwealth Edison Company; A. L. Salt, Western Electric Company, and C. E. Michel, of the Union Electric Light & Power Company. Mr. Herbert Lloyd, president of the Electric Storage Battery Company, and Mr. Godfrey H. Atkin, manager of the Chicago office, acted as hosts. At the conclusion of a vaudeville entertainment, which was given after the banquet, Mr C. D. Firestone, president of the Columbus Buggy Company and representing the Columbus Buggy Company, in the name of the guests returned thanks to the Electric Storage Battery Company; to Mr. Herbert Lloyd, its president, and to the entire staff of the company located in every prominent business point in the United States, who, he stated, are ever ready to aid and care for every want of battery users

EMERSON AND TROJAN ALTERNATING-CURRENT FANS.

The Emerson Electric Manufacturing Company, of St. Louis and New York, offers, as heretofore, a complete line of induction desk, oscillating and ceiling fans. This line includes 8-in., 12-in. and 16-in. swivel-trunnion desk fans, 8-in. hinge-type desk fans, 12-in. and 16-in. oscillating fans, special 12-in. slow-speed quiet residence-type swivel-trunnion and oscillating fans, two-blade, four-blade and six-blade ornamental-type ceiling fans and four-blade plain-type ceiling fans. The company reports improvements in several types of its fans for the season of 1911. The model shown in Fig. 1 is a three-speed 8-in. induction fan. It has the full swivel-trunnion adjustment, sliding lever switch, patented Parker blades, hardened-steel shaft and heavy double-wire guard of the larger sizes of Emerson fans and may be converted into a swivel-trunnion bracket fan. The 12-in. and 16-in. Emerson fans offered for general service are four-blade, two-speed fans of the same general appearance as the types illustrated. In addition a new residence type is offered this season. This is a three-speed induction fan equipped with six Parker blades. It operates at a maximum speed of 1150 r.p.m. and the fan furnishes a well-distributed breeze for large living-rooms and operates with very little noise. The residence-type fan is also made in the oscillating style, in addition to which 12-in. and 16-in., medium-speed, four-blade oscillators, throwing more powerful breezes, can be furnished. All Emerson oscillators have a renewable oscillating worm shaft, so that all wearing parts of the oscillating mechanism can be renewed by the user. One of the novelties in fan motors offered by the company is the bedroom type shown above. This is an 8-in. Emerson trunnion fan mounted on a support which may be readily attached to the end post of the foot of any brass or iron bed. This fan is furnished complete with attachment plug and cord and push switch on an 8-ft. reinforced cord, so that the control of the fan is within easy reach of the user. The Emerson company also manufactures the Trojan line of swivel-trunnion desk and oscillating fans in 12-in. and 16-in. sizes made in previous seasons. In addition a new 8-in. Trojan fan is offered this season, operated by a three-speed induction motor. It has triangular blades and bronze bearings; the motor is mounted in a drawn brass shell and base, and the motor body, base, fan blades and guard are attractively finished in brushed brass, satin finish. It is somewhat lighter in weight than the Emerson 8-in. induction fan. In ceiling fans the company makes a two-blade ornamental type for small offices, etc., where a gentle distribution of breeze is primarily desired, and a four-blade, two-speed plain type. A new type of Emerson induction ceiling fan is the three-speed, ornamental type, 32-in. sweep, six-blade fan shown herewith. This is designed to be hung in halls, doorways and entries. It is reported that small ceiling fans of this design have been extensively used in many sections of the country to keep out insects and that where the fan is used the screen door is often abandoned. This type of ceiling fan operates at a higher speed than the wide-sweep types and throws a stronger breeze directly under the fan, while not so well suited for general cooling purposes as the wide-sweep type.

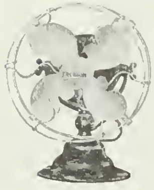


Fig. 1—Three-Speed Fan.

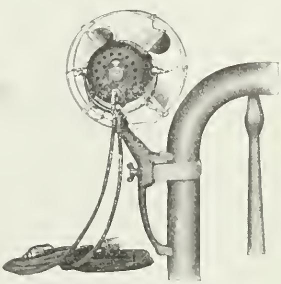


Fig. 2—Fan for Bedroom Use.

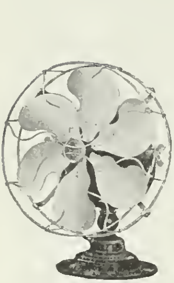


Fig. 3—Residence Type of Fan.

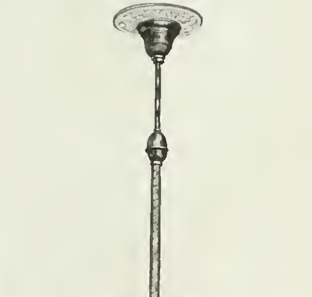


Fig. 4—Ceiling Fan.

CALIFORNIA GAS-ENGINE INSTALLATION WITH CRUDE-OIL PRODUCERS.

There is now in process of construction for the Holton Power Company, of El Centro, Cal., a gas-engine-driven generating plant which, it is believed, will greatly affect the means employed for producing power in those sections of the country where fuel oils are available and where water cannot be obtained in sufficient quantity for use in steam plants. The only satisfactory method of using this kind of oil successfully devised up to the present time has been the burning of it under boilers in which steam is generated for use in some type of prime mover. Within the past few years extensive experiments have been made on gas producers using this crude oil as a fuel, and these have now been worked out successfully, as is attested in their use by the government. The installation under construction will consist of a producer of this type and an Allis-Chalmers gas engine.

El Centro, where the plant of the Holton Power Company is to be located, is in the heart of what is claimed to be the richest agricultural section in the world, the Imperial Valley. Since the great irrigation project for this section has been completed numerous small communities have sprung up and towns have been established, to supply which the Holton Power Company has constructed a hydraulic plant at Holtville and a steam-auxiliary plant at El Centro. The present gas-engine plant is an addition which will take care of the rapidly growing business of the company. The towns served are El Centro, Calexico, Mexicala, Brawley and Imperial. Street and house-lighting circuits, motors for ice plants, cold-storage plants, brick manufacturers, cotton gins, pumping stations and other industrial purposes are supplied.

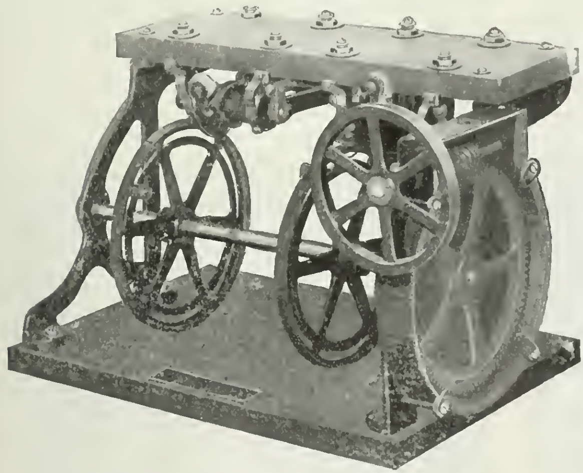
The new plant will be housed in an addition to the existing steam plant and will consist of three Ensign Amet oil-gas producers, furnished by the International Amet Producer Company, and an Allis-Chalmers 1000-hp, twin-tandem gas engine direct-connected to an alternating-current generator. All auxiliaries will be driven by Allis-Chalmers motors. With this installation electricity can be generated with a very great saving over present methods. Oil will be stored in a concrete tank from which it will be piped to the producers. In the producer a small amount of the oil is burned while the rest is vaporized and broken up into a fixed power gas suitable for use in the gas engine. The gas as it leaves the producer is exceptionally clean, having been scrubbed and freed of all impurities. It is, therefore, ready for immediate use in the engine or it can be stored in the holder ready for future use in case the plant serves as an emergency unit. From the producer the gas goes to the engine, which is provided with an air-starting device of sufficient capacity to put the engine into active service almost instantly. Cylinders, exhaust valves, pistons, piston rods and all parts coming in contact with the hot gases of explosion are water-cooled. The inlet valves are of the stratification type, which allows the separate control of both the gas and air, thus the mixture can be properly proportioned to meet the load. These valves are automatically operated and controlled by a centrifugal governor, belt-driven from the main shaft. The engine is direct-connected to a three-phase, 60-

cycle, 2400-volt, 150-r.p.m. alternator. Very close electrical regulation is provided by a 15-ft. flywheel weighing approximately 40,000 lb. This will make it possible to operate the gas-engine unit in parallel with both the hydroelectric plant and the steam plant. A complete gravity oiling system will be installed, which will make hand oiling unnecessary and will automatically keep all parts lubricated as long as there is oil in the main tank.

Operating with a much higher efficiency than can be secured when the oil is used as fuel under a boiler the installation will mean a great saving in the first cost of fuel. In addition there will be a great saving in the supply of water necessary. The only water needed for this installation is that used in the producer for the washing and that used in cooling the engine. While the amount used for cooling the engine is comparatively large it can be used over and over again, as the only loss is through evaporation in the cooling tower. The initial temperature of the cooling water is very high, being 95 deg., while it will leave the engine at approximately 145 deg. In order to save this water for further use a cooling tower will be built which will reduce the temperature to normal.

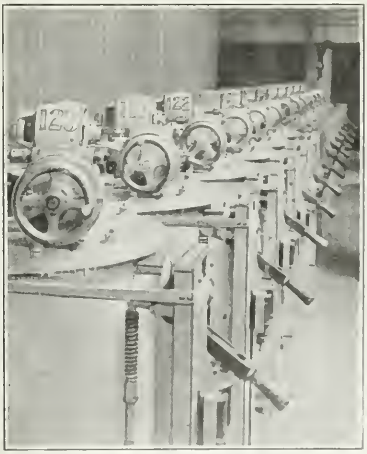
ELECTRIC SIGN FLASHER.

The Reynolds Electric Flasher Manufacturing Company, Chicago, Ill., has recently placed on the market a new line of single-pole, double-pole and triple-pole, quick-break knife-switch flashers which are claimed to be simple in construction, free from troublesome parts and to require little attention. The switches, which are made from pure copper, engage in bronze jaws made with the well-known Reco patent grease reservoir, a safeguard against burning, the grease dissipating the heat and reducing the arc to a minimum as well as continually lubricating the switch blade, insuring long life. The switches are opened and closed by a purely mechanical method. Switch blades and jaws are quickly and easily renewed by the removal of one or two screws. An improvement is the adjustable feature by which long or short, quick, or slow flashers may be regulated to suit any requirement. Switch wheels are provided with slots supporting the rollers which throw the switches in and out, and by moving the rollers back or forward adjustments are quickly and easily made, an ordinary screwdriver being the only tool necessary. The gearing is inclosed and runs in oil, giving a dustproof, self-lubricating and non-wearing drive.


Electric Sign Flasher.

ALTERNATING-CURRENT FEEDER REGULATORS.

Where an alternating-current central station is in competition with a direct-current plant in a large city conditions are very often unfavorable to the alternating-current proposition. The chief disadvantage arises from the sensitiveness of the voltage regulation to any changes in load. Where a large part of the load is made up of elevators or other machinery requiring frequent starting an alternating-current line is apt to suffer considerably more from fluctuations in voltage than is an equivalent direct-current line. The direct-current system suffers only from line drop, while the alternating-current line has the line drop of resistance and reactance and in addition an actual reduction of voltage at the generators or transformers due to the wattless current at the low power-factor of starting. A load that would produce a fluctuation in a direct-current line of 2 per cent or 3 per cent might, under some conditions, cause as much as 20 per cent fluctuation in an alternating current line. In such cases the use of feeder regulators removes entirely this disadvantage of the alternating-current system and in many cases gives even better regulation than is obtained with a direct-current system. A case in point is that of the United Electric Light & Power Company, of New York. The 146th Street substation of this company supplies a load made up largely of apartment-house equipments, consisting mostly of lamps and elevator motors. The voltage fluctuation on the feeders due to the starting of elevators puts such a heavy drawback on the service as to make competition with the direct-current systems in the city, equipped with storage batteries and other equalizing devices, almost impossible. Equipping the system with feeder regulators, however, has not only resulted in marked benefits but has, it is claimed, made the service preferable to that of the direct-current system. The regulator equipment consists of twenty two-phase automatic induction-type feeder regulators, manufactured by the Westinghouse Electric & Manufacturing Company, Pittsburgh. Each regulator is of 85-kva rating and has a range of regulation of 10 per cent above or below the busbar voltage. Each regulator is operated by a 220-volt, 4/10-hp Westinghouse direct-current motor controlled by regulating relays. The relays operate through voltmeter compensators so as to maintain constant voltage at the service end of the feeders. Each feeder has a complete equipment of compensator, relays and regulators. The results obtained are in some ways remarkable. So sensitive are the relays that the voltage at the service point at no time varies more than 1 per cent. The automatic operation is practically instantaneous, and lamps, even in the same building with the elevator that is started, barely show a flicker. The voltage at the station end


Alternating-Current Feeder Regulators.

of the feeder, however, varies as much as 15 per cent, showing the part played by the regulators in smoothing out the voltage curve. The accompanying illustration shows a photograph of fourteen of these regulators in operation. The regulation depends on the angular position of a rotatable secondary core and winding relative to a stationary primary core and winding, the two windings being connected in series. Rotation of the secondary is produced by the small motor at the top of each case, controlled by the relays. The adjustment of voltage is gradual, which corresponds to practically an infinite number of steps. Each regulator is self-contained and cooled by air blast, with which the station is amply supplied for cooling its transformers.

ELECTRIC DRIVE IN A CEREAL MILL.

The sanitary preparation of pure-food products is best accomplished by using machines driven by electric motors, as this eliminates the use of the long lines of overhead shafting with their multitude of belts, pulleys, etc., which are characteristic of the mechanical drive and which tend to keep dust in circulation in addition to rendering a well-lighted factory an impossibility. Moreover, oil drips from the overhead shafting and limits the location of the machinery to spots free from this trouble. In addition the electric drive presents the highest degree of flexibility. In view of these advantages the Postum Cereal Company adopted the electric motor drive as the only one adapted to the production of the high class of food products it produces. This article deals only with the production of "Post Toasties," although the company also manufactures "Grapenuts" and "Postum," and employs the electric drive in their preparation. "Post Toasties" are made from corn grits, and from the time the latter leave the cleaning-room until the finished product, in the form of flakes, is sealed in cartons the entire process is handled by machinery exclusively, every precaution being taken to insure that the product shall be prepared under strictly sanitary conditions and be entirely free from dust or foreign substances. After undergoing a thorough cleaning process, the corn grits are cooked in rotary steam cookers, each of which handles 1500 lb. of the grits per batch. A 10-hp, 440-volt, three-phase motor drives six of these large retorts and is in continuous operation twenty-four hours a day for six days of the week, and at times it is necessary to run it seven days a week during rush periods. The group drive is employed, as the occasion never arises when it is desirable to run only a part of the cookers. As the service is not severe and the rugged induction motor is well adapted for continuous service it is not probable that it will ever cause an interruption of service. From the cookers the grits are carried by conveyors to a drying and curing process which puts the grain in condition for the flaking rolls, where the grits are rolled into thin flakes. There are forty-two of these and each roll is driven by a 35-hp, 440-volt, three-phase induction motor by means of a Reynolds silent chain. The load is a heavy and continuous one, and has frequently been tested, showing at times as high as 40 hp on each motor. The crushing of the hard grain into flakes is the source of considerable vibration, which is, to a certain degree, transmitted to the motors without apparently causing any trouble. These motors are also operated twenty-four hours a day. The flakes pass from the rolls through the ovens, where they are toasted. They are then conveyed to the packing-room, where a 10-hp squirrel-cage induction motor drives the conveyors and automatic packing machinery. The load here is very irregular and the motor operates eighteen hours a day. The finished product is delivered to this room by conveyors, and automatic machines then fill the cartons with it and seal them up ready for shipment. Fig. 2 shows four 7½-hp induction motors driving large ventilating exhaust fans used in connection with steam-radiator and drying apparatus. These motors also are in operation twenty-four hours a day. All the motors have given excellent service and have caused little or no trouble during the five years they have been in operation. The cost of maintenance has been practically nothing and there is no dead load to carry as in a plant which has the mechanical drive with its long main shaft, its countershafts, idlers, loose pulleys, etc. Two 150-kw and one 200-kw three-phase generator are installed in the engine-room of the factory, and, in addition, electrical energy at a potential of 4600 volts is purchased from the Commonwealth Power Company, Jackson, Mich., and stepped down to 440 volts for use throughout the factory by four 500-kw transformers. The electrical equipment throughout was built by the General Electric Company.

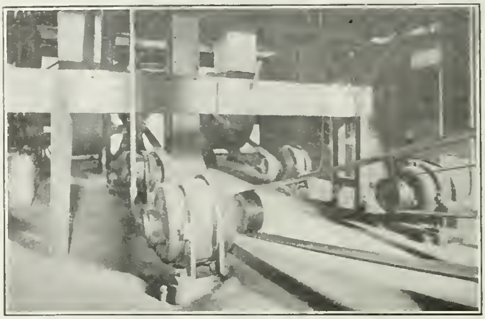


Fig. 2—Induction Motors Driving Ventilating Exhaust Fans for Drying Apparatus.

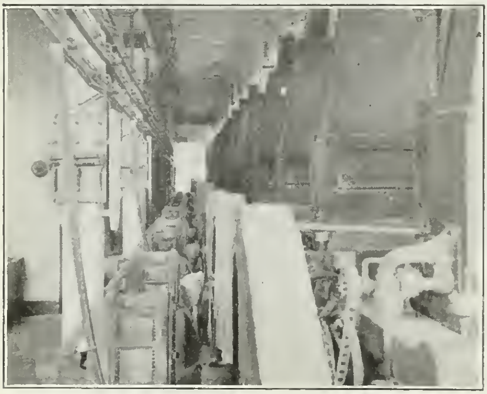


Fig. 1—Induction Motors Driving Flake Rolls.

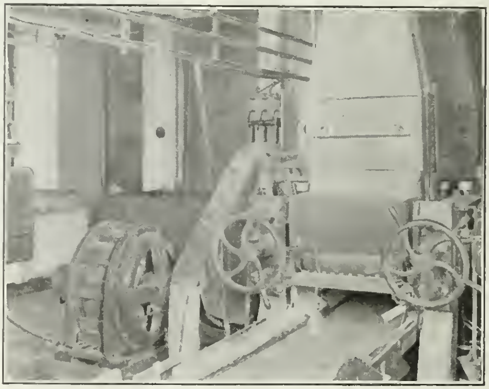


Fig. 3—Induction Motor Driving a Flake Roll.

Industrial and Commercial News

The Week in Trade.

COMMERCIAL business continues quiet with considerable irregularity according to the different sections and different lines. As a rule the West and South show greater activity than any other sections. During the past week there continued to be a very healthy demand for agricultural implements, fertilizers and other products required by farmers. There was also, owing to weather conditions, a very large trade in rubber footwear. Wholesalers and jobbers report that orders are increasing but that there is yet apparent a spirit of conservatism which leads country merchants as a rule to buy only for immediate needs. The textile industry is still considerably disturbed and there is no evidence that cotton mills expect to increase output in the near future. In the iron and steel industry there is a much better feeling. Orders came in more rapidly in the last two weeks than at any time within the past three months and steel manufacturers as a rule are of the opinion that the low point has been passed. While there were no large rail orders during the week, quite a number of small sales were made and the demand for structural material was notably improved. In the building trades lumber and other building materials are still quiet. Official reports show in 110 cities increases in building projects over the same period last year. Chicago reports that $120,000,000 of buildings are planned for 1911 in that city. It is almost too early as yet to make any definite estimate of the great basic industry of the country—agriculture. Only a few reports as to the season's crops have been received but the outlook is generally pronounced hopeful. The heavy snows of the past week throughout the Northwest and the wheat-growing sections are taken as indicative of large crops. It is predicted that the acreage of both wheat and cotton during the coming year will be considerably larger than in 1910. Collections continue to be only fair, but business troubles are not particularly numerous. Business failures for the week which ended Feb. 9, as reported by *Bradstreet's*, were 291, against 290 the previous week, 249 in the same week in 1910, 211 in 1909, 326 in 1908 and 204 in 1907.

The Copper Market.

ACCORDING to the regular statement of the Copper Producers' Association for the month of January, which was the feature of the market last week, there was an increase in surplus stocks during the month of 20,409 295 lb., the total at the end of the month being 142,439,490 lb. This is to be compared with 98,463,239 lb. a year ago. Of the increase for the month more than 12,000,000 lb. is apparently due to steps that were taken to correct the discrepancies in the export reports made in 1910. It has been the custom of the association to report copper on lighters and ready for shipment as exports, while the United States government reports only give the copper actually cleared. This always created wide differences in the two reports, and the association has now taken steps to bring its figures into closer accord with the official reports. The general figures given out by the association for January were: Production, 115,696,591 lb., a decrease of more than 8,000,000 lb.; foreign deliveries, 53,208,739 lb., a decrease of 35,000,000 lb.; domestic deliveries, 42,078,557 lb., which is about the same as during the previous month, and total stocks, 142,439,490 lb. The interesting features of the report were that production was reduced and that sales were decreased. The low prices which have prevailed for copper for the past few weeks have brought out many small orders for finished materials and there has been especial activity shown in wire and cable since the beginning of the current month. It is estimated that recent sales for this class of material have aggregated between 10,000,000 lb. and 15,000,000 lb. and that they are directly traceable to price concessions made by manufacturers. Most of these sales have been directly covered by the purchase of new electrolytic copper or by the exercise of options which had been placed some months ago. Electrolytic copper during the past week sold from 12¼ cents to 12⅜ cents for cash and 12.40 @12.45 thirty days. Exports for February, including Feb. 10, have been 8185 tons. The daily call on the Metal Exchange Feb. 11 quoted standard copper as per accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.87½	12.12½	.....
February	11.87½	12.12½	12.00
March	11.87½	12.12½	12.00
April	11.87½	12.12½	12.00
May	11.87½	12.12½	12.00

The London market Feb. 10 was as follows:

	Noon.			Closing		
	£	s	d	£	s	d
Standard copper, spot	54	15	0	55	0	0
Standard copper, futures	55	8	9	55	15	0

Extreme fluctuations for this year:

	Highest.			Lowest		
Standard	12.30c			11.87½c		
London, spot	£56	15	0	£53	15	0
London, futures	57	12	6	54	10	0
Best selected	60	5	0	58	10	0

Industrial and Commercial Notes.

Ruling on Mica Duties.—The new Customs Court of Appeals has handed down a decision affirming the decision of the Board of General Appraisers in a case involving the duty on cut or trimmed mica. This case was brought in the name of J. W. Myers & Company, customs brokers, and involved mica imported at the port of Plattsburgh, N. Y., and at Albany. Speaking of the decision, Lewis W. Kingsley, president of the Mica Insulator Company, said: "The present decision of the Customs Court entirely sustains the position of the mica importers. According to the Payne-Aldrich tariff law unmanufactured mica pays duty at the rate of 5 cents per pound and 20 per cent ad valorem, while manufactured mica pays duty at the rate of 10 cents per pound and 20 per cent ad valorem. The mica in controversy was that which had had its edges trimmed with a knife. The appraisers held that this was manufactured mica, and imposed a duty at the higher rate. We appealed from this decision to the United States Board of General Appraisers, which board reversed the appraiser and decided that knife-trimmed mica was not manufactured. The government then appealed to the Customs Court, and the present decision practically settles the question by affirming the decision of the Board of General Appraisers. This permits knife-trimmed mica to come in at the lower rate of duty. It will be to the advantage of all electrical manufacturers, as it materially cheapens the product. There continues to be an excellent demand for mica, although there is no boom of particularly heavy business in sight."

Stave Long-Burning Lamp.—Theodore Stave, of the Stave Electric Company, New York, has recently returned from Germany, where he secured the American rights for the Tito Livio Carbone long-burning flame-arc lamp, which burns 150 hours or more on a single trim. The carbons are 10 in. long by ⅝ in. in diameter, and impregnated with luminous salts. Both the lamps and carbons are manufactured in Germany by the Allgemeine Elektricitäts Gesellschaft, and have been adopted for street lighting in Potsdam, Frankfort and in some portions of Berlin. In France a number of railroad corporations have also adopted them, the Gare de Lyons, in Paris, being illuminated with these lamps. Contracts for street lighting in Paris with the same lamps are now being drawn. Mr. Stave says that already he has had quite a number of orders for these long-burning lamps, and that inquiries are numerous. He has recently sold to the Alden-Sampson Company, of Detroit, thirty of the lamps; to the Syracuse Malleable Iron Company, sixty, and to James Leffel, Springfield, Ohio, thirty-eight. He expects to establish a factory in this country within a short time for their manufacture.

Union Switch & Signal Company.—The annual report of the Union Switch & Signal Company for the year 1910 showed a net profit of $1,250,000. It is said that the net earnings for January largely exceeded those of the corresponding month last year. New orders are being received in greater quantities than was anticipated at the present time, as it is generally the rule that the winter months are very dull. The present outlook, based upon January business, indicates that the company's gross and net earnings in 1911 will be largely in excess of those in 1910, which was the best year's business the company ever had. The improvements in the processes of manufacture will permit of the production of double the output of 1910, and the factory cost is being constantly decreased.

General Electric Sales.—It is given out that the new orders booked by the General Electric Company during the month of January were about 85 per cent of the orders booked during the same month in 1910. This means a business at the rate of about $58,000,000 per year. It is well known, however, that the first month of a company's new fiscal year is invariably below the average. Big manufacturing concerns endeavor to crowd into the closing month of their fiscal year all the business possible to swell the annual total. January's total was almost $1,000,000 less than the average monthly rate of 1910. The General Electric officials declare that they will be very well satisfied if the volume of business in 1911 is as large as it was last year. It is stated that manufacturing profits during 1910 were larger than for several years past. The company is steadily gaining in economy of production. During last year the manufacturing profit was close to 15 per cent, which is to be compared with less than 9 per cent in 1909. New construction work in 1911 will be relatively small; in fact, very little will be done beyond completion of the foundries and pattern shops already under way at Erie, Pa. The company has at the present time a capacity fully 30 per cent greater than its actual requirements.

New Haven Railroad Electrification.—The New York, New Haven & Hartford Railroad Company has declined $50,000,000 of additional money on the same basis at which it recently sold $22,000,000 of 4½ per cent notes. The company claims that at the present time it needs no additional capital. It is expected that the Hoosac tunnel electrification, which was the first work undertaken by President Mellen after he took charge of the Boston & Maine Railroad, will be finished early next month. This will double the capacity of the tunnel, and enable the Fitchburg Railroad to send through 2000 cars a day instead of 1000. The Massachusetts State Railroad Commission has reported against the electrification of steam roads in and around Boston, because it involved an expenditure of $40,000,000, but it is said that the New Haven road stands ready to invest $25,000,000 in such a project. The New Haven's plans call for the electrification of the Boston and Harbor tunnels and a four-track Salem tunnel, so that trains may be run electrically from Readville on the south to Beverly on the north.

Westinghouse Power Sales.—Among the recent power equipment sales made by the Westinghouse Electric & Manufacturing Company are apparatus to equip the power plant of the Standard Oil Company's refinery at Bayonne. This equipment includes four 225-kw generators with transformers, switchboards and other apparatus. A large number of individual motors were also sold to the same company. The plant will be gas-engine-driven. The same company has also sold to the Bethany Worsted Mills, of Passaic, N. J., one 1200-kw turbo-generator set. Sales of small motors for factory purposes within the past few weeks have aggregated between 5000 hp and 6000 hp. Reports from the general offices of the company indicate that since the first of the year the business has been very gratifying and it is believed that by the end of the company's fiscal year, March 31, the net earnings will show nearly 16 per cent for the assenting stock. The shipments in January from all plants amounted to about $3,000,000 which is 25 per cent greater than for the same month in 1910.

Swiss Magneto Company.—It was announced in Chicago last week that several men prominent in business and financial circles in that city and the East had purchased outright the patent rights of the Swiss Magneto Company. Among those interested are Joseph Ratzer, New York City; H. P. Smith and F. J. Wende, Chicago; B. B. Clarke, Madison, Wis., and M. B. Harxhurst, Waukegan, Ill. The consideration involved is said to be $100,000. This company has been manufacturing in its Chicago factory for about a year the ignition device known as the Swiss, and while for some time past entirely under control of American interests, the latter have been paying rather heavy royalties to the foreigners. This new arrangement removes the last vestige of foreign financial interest in the company. The management has contracted with the inventor for his services for a period of ten years and will also retain the various foreign engineers who have been associated with him. The Swiss is a high-tension magneto.

Westinghouse Export Orders.—Rockhill & Victor, of Shanghai, China, have ordered from the Westinghouse Electric & Manufacturing Company a 150-hp induction motor and water rheostat, to be used in operating a flour mill. Through Showan, Thomas & Company, of Pekin, the Chinese government has purchased two Westinghouse 150-kw direct-current generators and nine-panel switchboard for use in the Bureau of Engraving. The Salvador Madera Cia, San Luis, Mexico, has ordered a 160-kw direct-current generator, and the San Juan Light & Transit Company, of Porto Rico, has placed an order for Westinghouse apparatus, including seven 30-kw, single-phase, 60-cycle, 1100/110-320-volt transformers; five 25-kw, single-phase, 60-cycle, 1100/110-220-volt transformers, and a total of 200 hp in back-geared motors for a machine shop.

Lighting in Detroit.—The public lighting commission of Detroit has completed estimates of the funds that will be needed the coming year for extensions and improvements of the system. The total amount to be submitted to the controller is $526,436, but credits for the sale of old material and bills due for lighting service bring this down to $510,836, which is $89,126 above the amount granted last year and $13,000 less than was asked for the year before. Estimates show that the cost of maintaining arc lamps this year is $30, a reduction of $1.75 from last year and $15 from ten years ago. The saving is accredited to the use of modern apparatus and the commission is of the opinion that it can be reduced to $25 a year.

More Brooklyn Edison Equipment.—The Edison Electric Illuminating Company of Brooklyn has ordered from the General Electric Company the following equipment: One 12,000-kw turbine; two 1000-kw frequency changers; two 1500-amp boosters and four 45-kw balancers. In addition to this, switchboards and a large quantity of smaller apparatus were ordered. These purchases practically complete the Brooklyn Edison's requirements for power house additions during 1911. About an equal amount of equipment was ordered two weeks ago from the Westinghouse Electric & Manufacturing Company, which order was detailed in our issue of Jan. 26.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Lexington, Ky.; Dixie, Idaho; Snyder, Okla.; Polsen, Mont.; Westport, Conn.; Boston, Mass.; Dothan, Ala.; Great Falls, Mont.; Hope, Idaho; London, Ont., Can.; Phoenix Mills, N. Y.; Sandusky, Ohio; Helena, Ark.; New Iberia, La.; Wilmington, N. C.; Lansing, Mich.; Hiram, Ohio; Prineville, Ore.; Edmonton, Alta., Can.; Pittsburg, Kan.; Vancouver, B. C., Can.; Gilmore, Idaho; Pierce City, Idaho, and Coraopolis, Pa.

California Power & Manufacturing Company.—Articles of incorporation have been filed in California for the California Power & Manufacturing Company, with a capital stock of $5,000,000. The project is being promoted by F. G. Baum, of San Francisco. It is announced that the company will operate in the upper part of northern California. At the present time the promoter is not prepared to give the location of the hydro-electric development of his project. It is stated, however, that the organization is in nowise connected with the San Francisco power station.

Alabama Traction Company.—Work is being rapidly pushed forward on the lines of the Alabama Traction Company in Montgomery. This is the company that obtained a franchise from the City of Montgomery last Fall and proposes to run a line in opposition to the Montgomery Traction Company. About seven miles of track will be laid at the present time and the ties and rails are already on the ground. The present plan is to operate this road with storage-battery cars, though as yet no contracts for these cars or their equipment have been let.

American Manufacturers' Export Association.—Henry T. Wills has been appointed secretary of the American Manufacturers' Export Association. Mr. Wills is an expert in export trade matters, and has been secretary of the National Tariff Commission Association. Among the large manufacturing companies having membership in the association are the General Electric and Westinghouse companies.

Alberger Condenser Company.—George Q. Palmer, formerly vice-president, has been made president of the Alberger Condenser Company and the Alberger Pump Company. Mr. Palmer is succeeded as vice-president in the Alberger Condenser Company by D. H. Chester, and in the Alberger Pump Company by W. S. Doran.

Los Angeles Electric Railway.—Paul Shoup, manager of electric properties for the Southern Pacific Railway Company, is preparing plans for the construction of a tunnel in Los Angeles for the Los Angeles Electric Railway from Hill Street westerly. The rights-of-way for this project have already been secured.

Financial.

The Week in Wall Street.

Sales of stock in Wall Street were somewhat reduced last week and business was very much less enthusiastic in tone. Prices remained fairly steady and the net changes for the week showed advances in about as many instances as recessions. In no instance was there any considerable change in an active issue. It seemed that the stock market was simply indulging in one of those pauses for breath-taking which very frequently occur after pronounced movement in either direction. These periods are regarded by traders of long experience as furnishing a better index to the actual strength or weakness of the market than does an excited buying or selling movement. If after a period of buying and an upward movement the market holds its position with fair strength it is generally thought that the advance was substantial and not purely speculative. Of course at the present time it is not to be expected that there will be any definite long swing in either direction. Professional and outsider are waiting for the decisions in the trust and rate cases. For this reason it is not at all surprising that the recent movement which began Dec. 6 and lasted until a week ago was one in which the outside public took absolutely no part. It was thought when the advance commenced that the market had been thoroughly oversold and was well liquidated. It is now the impression that there is a fairly heavy short interest in many of the active issues. It is not likely that there will be any definite movement in either direction until after the decisions above referred to have been rendered. The financial world is not willing to take an advanced position until its basis of operations has been settled. The money markets both at home and abroad have remained extremely easy and the bond market continues to be very satisfactory. Rates for money Feb. 11 were: Call, 2@2¼ per cent; 90 days, 3 per cent. The quotations in the table are those of the close Feb. 11.

NEW YORK.

	Feb. 6.	Feb. 11.	Shares Sold		Feb. 6.	Feb. 11.	Shares Sold.
All. Ch.	8½	8*	400	Int. Met., pfd	54¼	55	11,140
All. Ch., pfd.	33⅛	32½*	800	Mackay Cos.	94⅛	94*	500
Amal. Cop.	66½	66	74,050	Mackay C., pf.	76⅛	76¼*	455
Am. D. T.	20½*	20½*	———	Man. Elev.	139¾	139¾*	500
Am. Loco.	42¼	41½*	2,750	Met. St. Ry.	15*	15*	———
Am. Loco., pf.	110	110*	125	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	83½*	84½*	200	Steel, com.	81¼	81½	509,350
Am. T. & T.	145⅝	145	7,800	Steel, pfd.	121⅞	119	6,000
B. R. T.	78¾	78⅝	16,970	W. U. T.	74¾	74¾*	2,300
Gen. Elec.	154¾	155½	2,600	West'h, com.	70	70*	1,600
Int. Met.	19¾	20¼	5,200	West'h, pfd.	119*	119*	———

PHILADELPHIA.

	Feb. 6.	Feb. 11.		Feb. 6.	Feb. 11.
Am. Rys.	45	44½*	Phila. Elec.	16¾	16⅜
Elec. Co. of A.	12¼	12⅛*	Phila. R. T.	20⅝	20¼
Elec. St. B'ty.	55½	54	Phila. Trac.	86½*	85¾
E. S. B'ty., pfd.	30*	30*	Union Trac.	47¾	47¾

CHICAGO.

	Feb. 6.	Feb. 11.		Feb. 6.	Feb. 11.
Chi. City Ry.	185*	185	Chi. Tel. Co.	118½	122½
Chi. Rs., Ser. 1	93*	93*	Met. El. Co.	20*	20*
Chi. Rs., Ser. 2	24¾	25	Met. El., pfd.	65*	65½*
Com. Edison	115	115	Nat'l Car	117*	117*
Chi. Subways	4*	4*	Nat'l Car., pfd.	118*	118*

BOSTON.

	Feb. 6.	Feb. 11.		Feb. 6.	Feb. 11.
Am. T. & T.	145¾	145½	Mex. Tel.	4¾*	4¾*
Cum. Tel.	147⅜	148*	Mex. Tel., pfd.	7	7*
Edison E., Ill.	292	291*	N. E. Tel.	140	142*
Gen. Elec.	155	155¼	W. T. & T.	22½	20
Mass. E. Ry.	18½*	17½*	W. T. & T., pfd.	97*	96*
Mass. E. Ry., pfd.	87½	88			

*Last price quoted.
Shares sold for week Feb. 6 to Feb. 11.

Financial Notes.

Metropolitan West Side Elevated Railway Company, Chicago.—For the calendar year 1910 the Metropolitan West Side Elevated Railway Company, of Chicago, reports gross earnings of $3,069,945 and net earnings of $1,513,929. These compare with $2,818,430 and $1,418,076 respectively for the preceding year, the percentages gained being 8.9 per cent and 8.1 per cent. The ratio of operating expenses to gross earnings for the year 1910 was 50.69 per cent. The total charges against income for the year 1910 were $1,070,068, leaving a surplus of $442,731 available for dividends. Of this amount, $261,237 was distributed in dividends and $181,494 carried to surplus, the total surplus now standing at $1,712,118. The company has $9,000,000 preferred stock, $7,500,000 common stock and $15,000,000 in bonds. The daily average number of passengers carried during the year was 156,794, an increase of 8.23 per cent compared with 1909. President Britton I. Budd and the other officers and directors were re-elected.

Chicago Pneumatic Tool Company.—For the year 1910 the Chicago Pneumatic Tool Company reports profits of $1,054,809. After deducting bond interest, depreciation and other charges there remains $694,926, or 10.77 per cent on the $6,485,800 stock outstanding. This figure compares with 3.86 per cent in 1909 and 0.33 per cent in 1908. The present dividend rate is 4 per cent. The year was the best in the history of the company, the profits being twice as large as in 1909, and somewhat larger than in the previous record year of 1906. In his report to the stockholders President W. O. Duntley said that during the year practically all the plants were operated to their full capacity. Early in the year the development and manufacture of a light motor truck for commercial use was begun, and while this branch of the business is yet only in its infancy the indications are that it will be developed rapidly.

Consolidated Gas & Electric of Baltimore.—The board of directors of the Consolidated Gas, Electric Light & Power Company, of Baltimore, at a meeting last week declared a quarterly dividend of 1 per cent on its common stock, payable on Feb. 15, to the stockholders of record at the close of business on Feb. 8, 1911. In adopting quarterly dividends on the common stock of the company, it was announced that this was only another step toward popularizing the securities and shares of the company, and that the policy of the company is in every possible way to encourage the small investor to invest in securities in Baltimore rather than to look elsewhere. The vacancy on the board of directors caused by the death of General Ferdinand C. Latrobe was filled by the election of John L. Bailey. Mr. Bailey is the treasurer of the company, which office he has filled since Jan. 1, 1908, when he succeeded the late Joseph W. Clark.

Rumored Allis-Chalmers Merger.—There has been a persistent rumor in financial circles during the past week that a merger is being negotiated between the Allis-Chalmers Company and the American Steel Foundries Company. These companies are already closely allied in the fact that Judge Elbert H. Gary, W. V. Kelley and Max Pam are on the executive committee of each of them. The consolidation has been hinted at ever since D. W. Call, an official of the American Steel Foundries Company, was recently elected president of the Allis-Chalmers Company. Mr. Kelley denies positively that any merger is contemplated and says that he can see no reason why such a merger would be desirable. Officials of the Allis-Chalmers Company also make positive denials.

Minneapolis Street Railway.—The preliminary announcement has been made by Willard J. Hield, vice-president of the Minneapolis Street Railway Company, which is controlled by the Twin City Rapid Transit Company, concerning the proposed improvements to be undertaken in 1911. These will include the completion of an addition of 50 per cent to the power generation at the steam plant; the installation of more boiler capacity, better stoking equipment and smoke consumers. It is estimated that the total cost of the improvements will be in the neighborhood of $1,000,000. The installation of a 14,000-kw steam-turbine unit and auxiliary apparatus which was begun last year will be completed.

Providence Telephone Company—At the annual meeting of the stockholders of the Providence Telephone Company last week an increase in capital stock from $3,000,000 to $5,000,000 was authorized. The directors later voted to issue $500,000 of the new stock for subscription at par to stockholders of record Feb. 9.

Sterling Electric Company Reorganized.—The Sterling Electric Company, of Lafayette, Ind., has been reorganized and the name changed to the Sterling Electric Works. The new company is capitalized at $200,000 and officers have been elected as follows: President, Samuel T. Murdock; vice-president, R. B. Wallace; secretary-treasurer, Thomas Duncan. Of the $200,000 of stock, $50,000 will be held in reserve.

Titusville Company Sold.—It is reported that the Titusville (Pa.) Electric Light & Power Company has been purchased by a number of electrical men of Philadelphia, and other Pennsylvania cities, including Messrs. E. F. McCabe, William M. Measey, H. L. Elkins, Charles S. Boll and Frank G. Kennedy, Jr. The new owners have taken possession of the property, and Mr. McCabe will be in charge.

Kings County Electric Light & Power Company.—James N. Wallace, president of the Central Trust Company of New York, was last week elected a director in the Kings County Electric Light & Power Company in the place of the late Hugh Grant. Mr. Wallace also succeeded Mr. Grant as a director of the New York Edison Company.

Mississippi River Power Distributing Company.—Arrangements have been made by the Mississippi River Power Distributing Company for the issuance of a large block of bonds to provide funds to carry on the work of completing the big dam at Keokuk, Ia. The amount of the issue has not been definitely settled, but it is understood that the bonds will be placed by Stone & Webster, of Boston. The Mississippi River Power Distributing Company owns the entire capital stock of the Keokuk & Hamilton Water Power Company, which has under construction transmission lines from Keokuk to St. Louis. The energy will be delivered to a transformer station to be built by this company in St. Louis. The Union Electric Light & Power Company, of St. Louis, has recently purchased the contract for energy which the Laclede Gas Light Company made with the Keokuk Power Company through the North American Company. After the North American Company disposed of the Laclede company the new management of that concern desired to be rid of the contract. This contract calls for $98,000 worth of power and runs ninety-nine years. The Union Electric Light & Power Company now has a contract with the Keokuk company for 60,000 hp. The Laclede company is rebuilding its steam plant in St. Louis which was burned in 1907.

United Gas & Electric Company.—The United Gas & Electric Company, of 40 Wall Street, New York, has filed a certificate with the Secretary of State of New York, increasing the capital stock from $4,000,000 to $5,500,000 by the addition of $1,500,000 of common. The present authorized capital is $2,500,000 common and $1,500.000 preferred. The new capitalization will be $4,000,000 common and $1,500,000 preferred. The preferred is 5 per cent cumulative. All of the common stock of the United Gas & Electric Company is owned by the Susquehanna Railway Light & Power Company. The United, in turn, owns quite a number of gas and electric companies in widely scattered sections. The principal electric companies are: Colorado Springs Electric Company, Colorado Springs Light & Power Company, Elmira (N. Y.) Water, Light & Railroad Company, Leavenworth (Kan.) Light Heat & Power Company, Lockport (N. Y.) Light, Heat & Power Company, Pike's Peak Hydroelectric Company, Richmond (Ind.) Light, Heat & Power Company and the Union Gas & Electric Company, Bloomington, Ill.

Trumbull Electric Company.—At a special meeting of the stockholders of the Trumbull Electric Company, of Plainville, Conn., last week, it was voted to increase the capital stock from $100,000 to $500,000. The increase will be divided equally between preferred and common. The preferred will carry a 7 per cent dividend. The company also elected four new members of the board of directors, who were: A. J. Sloper and Judge J. E. Cooper, of New Britain, Conn.; Carl W. Jones and Stanley W. Gwillim. The directors elected John H. Trumbull, president: Frank T. Wheeler, vice-president, and Henry Trumbull, secretary and treasurer. The Trumbull Electric Company manufactures electric switches and other electric fixtures, and the common stock is all held by the officers of the company. Mr. Sloper and his friends are said to have acquired all of the $200,000 of new preferred stock. It is proposed to build a large addition to the plant at Plainville, and greatly extend the manufacturing operations.

Northern States Power Company.—H. M. Byllesby & Company, of Chicago, have issued an attractive booklet containing handsomely illustrated articles pertaining to the public-utility properties managed by them. These embrace electric light and power, gas, steam-heating and street-railway enterprises in thirteen Western and Northwestern States. Twenty-five municipalities in the Northwest are served by properties which are held by the Northern States Power Company, which is under the direction of Byllesby & Company. The booklet states that these properties are all in productive territory and that the opportunities for increasing the volume of business and augmenting earnings are unusually attractive. Several large water-power enterprises are now under construction which will reduce the operating expenses and eliminate competition.

Annual Report of Chicago Telephone Company.—At the annual meeting of the Chicago Telephone Company on Feb. 8 the gross revenue of the company for the year 1910 was shown to be $11,331,153. The general and operating expenses amounted to $5,187,547 and repairs and maintenance to $3,888,532, leaving net earnings of $2,255,072, from which $2,160,000 was paid in dividends. The net earnings were equal to 8.35 per cent on the capital stock. This figure compares with 8.22 per cent in 1909 and 7.62 per cent in 1908. The increase in gross revenue over 1909 was about 15 per cent, but expenses increased over 17 per cent. The number of telephones connected to the system increased 38,259 during the year, and the number of employees is 9370. The company has $27,000,000 in capital stock and a bonded debt of $5,000,000. Other liabilities include "replacement reserves" of $4,113,644. This is a new account. It includes "reserve for depreciation" and "surplus" as of Dec. 31, 1909; also that portion of net earnings of 1910 charged to depreciation and several items transferred from "miscellaneous reserves." These amounts are invested in the company's plant. John M. Clark, for a number of years president of the company and later chairman of the board of directors, retired as a director of the company. He was succeeded by Angus S. Hibbard, general manager of the company.

Pacific Power & Light Company.—It was announced last week that the Pacific Power & Light Company had definitely determined to construct its new hydroelectric plant at Pasco, Wash. This station will ultimately cost $500,000. The property and franchises necessary for its development have already been secured. The first unit of the plant will cost about $83,000 and work is to be begun upon it as soon as the plans are completed. As soon as it becomes necessary further units are to be added. The new plant will care for the transmission lines feeding the Yakima Valley and the lines to Walla Walla and Lind, where a connection will be made with the line of the Washington Water Power Company. It will also supply the lines to Hanford, Priest Rapids, Kennewick and various shorter lines to irrigation projects.

Philadelphia Rapid Transit.—The directors of the Philadelphia Rapid Transit Company have authorized a call for proxies from the stockholders for a special meeting to be held Feb. 28 to sanction the new financing plan. The committee of two of the Union Traction directorate made its final report on this plan to the directors of the Rapid Transit Company last week, and the report was approved by the board. This is the plan that was outlined by E. T. Stotesbury, before he became a director in the companies, to take charge of the financing of the traction properties.

American District Telegraph Company.—At the annual meeting of the American District Telegraph Company of New York last week the balance sheet showed assets of $4,466,974. The surplus on hand was $597,326. While the business of the company increased during the past year the annual report states that the earnings in the future are somewhat uncertain, owing to the additional cost of messenger labor made necessary by recent legislation. The net earnings for the year were $88,504.

Heavy Increase in Traffic.—A table prepared last week by Dr. A. F. Weber, chief statistician of the Public Service Commission, shows that during the year 1910 the total ticket sales on the New York elevated system were 299,415,317 as against 270,221,490 on the subways. This shows an increase on the elevated lines over the previous year of 13,011,524, or about 4.54 per cent, and on the subways an increase of 13,452,509, or 5.24 per cent.

Lynn Gas & Electric Company.—The net earnings of the Lynn (Mass.) Gas. & Electric Company for 1910 were $3,608,806, which is almost 37 per cent on the $1,000,000 of capital stock. Since 1901 the net earnings of the company have increased threefold. For the nine years from 1901 through 1909 the stockholders have received cash payments of $155 per share, averaging 17 and 22 per cent.

DIVIDENDS.

Detroit United Railway Company, quarterly, 1¼ per cent, payable March 1.

General Electric Company, quarterly, 2 per cent, payable April 15.

Kings County Electric Light & Power Company, quarterly, 2 per cent, payable March 1.

Pacific Gas & Electric Company, preferred, quarterly, 1½ per cent, payable Feb. 15.

Philadelphia Electric Company, quarterly, 1½ per cent, payable March 15.

Rochester Railway & Light Company, preferred, quarterly, 1½ per cent, payable March 1.

Susquehanna Railway, Light & Power Company, preferred, semi-annual, 2½ per cent, payable March 1.

Tampa Electric Company, quarterly, 2 per cent, payable Feb. 15.

General News

Construction News.

DOTHAN, ALA.—Plans are being considered for increasing the output of the municipal electric plant by 200 per cent and moving it to a new site. B. R. Pilcher is manager.

TEMPE, ARIZ.—The Tempe Light & Power Company has applied to the City Council for permission to assign its franchises to the South Side Gas & Electric Company.

ASHDOWN, ARK.—The construction of a municipal electric-light plant in Ashdown is reported to be under consideration.

CLARKSVILLE, ARK.—It is reported that the electric-light plant, lumber mill and planing mill owned by E. J. Connell was recently destroyed by fire, causing a loss of about $35,000. It is understood that the plant will be rebuilt.

HELENA, ARK.—The Helena Gas & Electric Company, recently incorporated, it is reported, will take over the plant and holdings of the Helena Gas Company. It is said that the new company contemplates improvements to the plant, including the installation of additional machinery. Claude S. Fitzpatrick and J. B. Miles, Jr., are among the incorporators.

LITTLE ROCK, ARK.—The Little Rock Railway & Electric Company has recently purchased a 2500-kw Curtis turbine from the General Electric Company, of Schenectady, N. Y., for its power plant at Little Rock.

MONTICELLO, ARK.—The municipal electric-light and power plant is reported to have been destroyed by fire recently, entailing a loss of about $15,000. The town will be without light or water service until arrangements can be made to secure power and necessary machinery installed.

SMITHVILLE, ARK.—The Farmers' Mutual Telephone Company, recently organized with headquarters at Smithville, is planning to erect telephone lines to Imboden and other points in Lawrence County. N. L. Dunahue is president.

COLUSA, CAL.—Notices of three water appropriations have been filed by Byron D. Beckwith; one on Fresh Water Creek, one on Bear Creek in Colusa County and the other on Cache Creek in Lake County. The water is to be used for both power and irrigation purposes. It is proposed to erect a dam on Bear Creek and utilize the lower end of Bear Valley as a reservoir. The present plans include tunneling through the hill easterly from Bear Valley to the head of Fresh Water Creek and to divert the water past the Mountain House, utilizing it at the outlet of the tunnel for power. It is proposed to erect three power stations. Below the Mountain House the water will be used for irrigation.

LIVE OAK, CAL.—Negotiations have been closed whereby Henry Berg, Jr., and Nathan Metz, of Marysville, have purchased the property of the Live Oak & Encinal Light & Power Company. The consideration is said to be $10,000. The owners, it is said, will extend the transmission lines over Sutter County to supply electricity to operate the electric pumping plants to be established throughout the county for irrigating purposes.

LOS ANGELES, CAL.—The Los Angeles Railway Company has applied to the City Council for permission to equip the old Santa Monica steam railroad for electrical operation. This road extends from Clemente Junction, at Thirty-eighth and Alameda Streets, west across the city to Santa Monica, a distance of about eighteen miles.

OAKLAND, CAL.—The Oakland Traction Company is planning to construct twenty miles of new track in Oakland, contracts for which will be placed during the next six weeks.

SAN FRANCISCO, CAL.—Bids will be received at the office of the Constructing Quartermaster, Fort Mason, Cal., until March 1 for constructing addition to power house and installing pumping machinery at the United States army general hospital, Presidio of San Francisco, Cal. Plans and specifications can be secured at the above office, for which a deposit of $10 will be required, which will be returned upon receipt of plans. Major George McK. Williamson is quartermaster

SAN FRANCISCO, CAL.—The Board of Public Works has decided to request the Board of Supervisors to issue $600,000 of the Geary Street railway bonds in addition to the $500,000 already disposed of. City Engineer Manson states in his report to the board that of the $500,000 already issued the proceeds of $218,000 have been set aside for the purchase of rails, ties and other track material and equipment, and $880,000 more will be needed at once to provide for the following: Special track work, $60,000; land for power house, car house, etc., $140,000; cars, $300,000; construction of buildings, $80,000, and for construction of track and overhead work, $300,000.

SIMSBURY, CONN.—E. C. Buckland, vice-president of the New York, New Haven & Hartford Railroad Company, has informed the committee appointed by the town to ask for better railway accommodations into Hartford that the company will equip the eastern end of the Central New England Railroad and its New Hartford branch for electrical operation, so as to provide electric service between Hartford and Simsbury, Collinsville, New Hartford and Winsted. The New Haven company has applied to the Legislature for a charter to operate an electric railway north from New Hartford, through Barkhamsted and Colebrook to the Massachusetts line, and is also asking the Massachusetts Legislature for the right to construct part of the railway in that State which will connect New Hartford with the Berkshire towns.

SOUTH NORWALK, CONN.—Announcement has been made by the Housatonic Light & Power Company of a reduction in the price of electricity for lamps, amounting to about 20 per cent. Under the new schedule of rates no discount will be allowed. The rates are as follows: From 1 to 49 kw-hours, 12 cents per kw-hour; from 50 to 99 kw-hours, 11½ cents; from 100 to 149 kw-hours, 11 cents; from 150 to 199 kw-hours, 10½ cents; from 200 to 299 kw-hours, 10 cents, from 300 to 399 kw-hours, 9½ cents; from 400 to 499 kw-hours, 9 cents, and from 500 kw-hours upward, 8½ cents. The minimum charge is $1 per month. The reduction was voluntary on part of the company. George H. Caffrey is superintendent of the local division.

WESTPORT, CONN.—It is reported that the Westport Water Company is planning to make improvements to its plant and proposes to duplicate the present equipment in the power station.

WASHINGTON, D. C.—Sealed proposals will be received until Feb. 27 at the office of the Chief Signal Officer, War Department, Washington, D. C., for furnishing under Proposal No. 501 300 miles of field wire, 11-strand, on spools, in lengths of 2640 ft., spools to be furnished by the signal corps. For further information address Captain A. S. Cowan purchasing officer.

WASHINGTON, D. C.—The House of Representatives on Feb. 7 defeated the bill introduced by Representative Molly, of New York, giving the Long Sault Development Company the right to construct and maintain locks, dams, canals and power houses in the St. Lawrence River, near Long Sault, Barnhart and Sheek Islands, N. Y., to utilize the water-power of that river. The bill was also opposed in Canada.

LIVE OAK, FLA.—The Live Oak Electric Company, recently organized, is reported to have purchased the local electric light plant and planing mill. It is understood that the consideration for the electric plant was $40,000. Harry J. Wood is president and treasurer, C. E. Jones vice-president and A. Lee Humphreys secretary of the new company.

DALTON, GA.—It is reported that the Ocoee Power Company, of Chattanooga, Tenn., is contemplating erecting a transmission line from its plant on the Ocoee River, near Cleveland, into Dalton.

MINERAL BLUFF, GA.—The Pure Food Milling Company is reported to be negotiating with the Municipal Electric Light and Water Commission, of Blue Ridge, Ga., to supply electricity in Blue Ridge for lamps and motors. The cost of extending the transmission line from Blue Ridge to Mineral Bluff is estimated at $2,500.

TALLULAH, GA.—It is reported that arrangements have been completed by the Georgia Power Company to begin work on the hydroelectric development at Tallulah Falls, where it is estimated that [illegible] hp can be developed. The work will include the erection of a dam [illegible] ft. high and to tunnel water 1¼ miles to secure 600-ft. fall; construction of steel towers to carry transmission lines to Atlanta, Ga., ninety miles distant, where a large distributing station will be erected. Electricity will be transmitted at 11,000 volts; a distributing station will also be erected near Tallulah and electricity transmitted over 300 miles of wire; machinery will include six electric generators having a rating of 15,[illegible] kw each. All contracts will be awarded through the Northern Contracting Company, of Detroit, Mich., and New York, N. Y. C. Elmer Smith, of York, Pa., is president of the company. C. O. Lenz, 71 Broadway, New York, N. Y., is engineer in charge

THOMSON, GA.—Preparations are being made to establish a day service in connection with the municipal electric plant at once. L. J. Porter is superintendent.

DIXIE, IDAHO.—Announcement has been made by the [illegible] & Power Company, which owns the greater portion of Dixie townsite as well as water rights for about three miles along Crooked Creek, that it will begin work on the installation of a power plant to supply electricity to operate its own placers and other mines in this vicinity and also for illuminating purposes.

GILMORE, IDAHO.—It is reported that preparations are being made for the installation of a [illegible] hp power plant to supply electricity for lamps and motors in Gilmore and for operating the machinery in the Gilmore mines.

HOPE, IDAHO.—The citizens of Hope are considering the question of installing an electric light and power plant. There is a good water power within the town limits which could be developed to provide power for operating the plant. For further information address I. H. [illegible], vice-president.

PIERCE CITY, IDAHO.—The Sprague Company is reported to be contemplating the construction of a hydroelectric power plant. The proposed plant will be located about two miles above Pierce City and will supply electricity to operate the mines of the Sprague Company.

the Idaho Placer Company, and also the Ozark quartz mine. Paul F. Hare is manager.

BELVIDERE, ILL.—The Public Service Operating Company has recently been awarded a new contract for street lighting, under which it is to install a new system within the next three months. It is proposed to install either the General Electric magnetite system or the Westinghouse metallic flame arc lamps. It is now expected to install two 50-lamp circuits and one 75-lamp circuit. T. C. McKeen is manager.

CHICAGO, ILL.—The Board of Trustees of the Sanitary District of Chicago has rejected all bids received for a transformer for the seventh unit to be installed at Lockport and has authorized Isaac Bryant, clerk, to advertise for new bids.

CHICAGO, ILL.—Plans are being made to form a new company for the purpose of combining the franchises of the Northwestern Elevated Railroad Company and the Chicago & Milwaukee Electric Railway. This will give the interurban cars from Milwaukee and the North Shore access to the heart of the city without changing at Evanston. Mason B. Starring, president of the Northwestern Elevated Railway Company, is to head the new company.

PINCKNEYVILLE, ILL.—The Farmers' Telephone Organization, formed by the farmers of Perry County, is planning to install a switchboard at Pinckneyville. W. F. Bills, of Swanwick, is president, and Charles Schmairiede, of Pinckneyville, is secretary and treasurer.

ANDERSON, IND.—The annual report of the municipal electric light plant shows total earnings for 1910 of $99,000; expenditures, including repairs and operating expenses, of $45,687, leaving a balance of $53,313. The street-lighting system includes 290 arc lamps, the cost of which is estimated at $64.14 each per year.

ELKHART, IND.—A new telephone company has been organized under the direction of H. D. Critchfield, of the Automatic Electric Company, of Chicago, Ill., and a franchise will be asked to install and operate an automatic telephone system in Elkhart.

INDIANAPOLIS, IND.—The Indiana Legislature has made appropriation for the following work: For rewiring the Northern Hospital for the Insane at Logansport, $15,000; for power plant for Indiana University at Bloomington, $10,800; for rewiring Indiana Reformatory at Jeffersonville, $2,375, and for outside electric lighting system at the School for Deaf, $2,000.

KOKOMO, IND.—The Kokomo, Marion & Western Traction is reported to be planning to build an extension from Kokomo to Frankfort, twenty-seven miles in length, during 1911.

KOKOMO, IND.—The Kokomo, Marion & Western Traction Company, which operates a lighting plant in Kokomo, has filed amendments to its charter with the Secretary of State, allowing the company to install and operate a steam-heating plant in this city. The company proposes to utilize exhaust steam to operate the heating plant. George J. Marott is president.

LOGANSPORT, IND.—It is reported that plans are being prepared by the Central Station Engineering Company, 164 Dearborn Street, Chicago, Ill., for extensions and improvements to municipal electric-light plant and lighting sytem at Logansport.

MARION, IND.—Arrangements have been made by the citizens to bring suit to test the validity of the contract made by the City Council with the Marion Light & Heating Company for lighting the streets for a period of ten years. It is contended that the action of the Council will convert the municipal electric light plant into junk and practically destroy all prospects of the city obtaining a municipal plant for commercial lighting.

PORTLAND, IND.—The City Council has granted the Como Telephone Company a franchise to install a telephone system in Portland.

SOUTH BEND, IND.—The Chicago, South Bend & Northern Indiana Railway Company has decided to double-track its railway on several streets in this city at a cost of about $75,000.

SOUTH BEND, IND.—The Indiana & Michigan Electric Company has reduced the rate in South Bend for electricity for lamps from 12 cents to 10½ cents per kw-hour. The reduction was voluntary on the part of the company.

AFTON, IA.—The proposition to install an electric-light system in Afton, it is said, will be submitted to a vote.

DAVENPORT, IA.—The Tri-City Railway Company is planning to build an extension between Davenport and Muscatine, requiring thirty-five miles of track, and also five miles of new track in Davenport and Muscatine during the coming year.

PLYMOUTH, IA.—Local business men are considering the question of erecting a dam in the Shell Rock River to furnish power to operate an electric-light plant in Plymouth.

ATCHISON, KAN.—The Atchison Railway, Light & Power Company is reported to have submitted a proposition to the citizens of Rushville to supply electricity for lamps and motors provided the town would build the transmission line connecting the two places. The power plant at Rushville was recently destroyed by an explosion.

FAIRVIEW, KAN.—It is reported that bonds to the amount of $3,500 have been voted for the installation of an electric-light plant in Fairview.

LURAY, KAN.—The installation of an electric light plant and water-works system in Luray is reported to be under consideration.

PITTSBURG, KAN.—Plans are being prepared by the Joplin & Pittsburg Railway Company for the erection of a power plant in Pittsburg. The company also expects to purchase one 400-kw generator, one 600-hp engine and one 150-hp boiler for the new plant. This item by mistake was printed under Pittsburgh, Pa., in the issue of Feb. 9. The company is also planning to extend the railway to connect with the city park in Pittsburg. William A. Satterlee, of Pittsburg, Kan., is purchasing agent.

SPEARVILLE, KAN.—The Commercial Club is advocating the establishment of an electric light plant in Spearville. It is reported that Ira Hickman is interested in a company which proposes to install a plant here.

SYLVAN GROVE, KAN.—The question of installing an electric light plant and water-works system in Sylvan Grove, to cost about $17,000, is reported to be under consideration.

CLINTON, KY.—The Clinton Water & Light Company is reported to be contemplating the installation of an ice plant.

LEXINGTON, KY.—The Kentucky Securities Company, recently incorporated for the purpose of taking over the traction properties owned and controlled by the Lexington & Interurban Railways Company, is preparing plans for rebuilding the entire street railway system of Lexington and various interurban lines extending to the surrounding towns, including the construction of a large power plant in this city. The proposed work will involve an expenditure of more than $1,000,000.

PADUCAH, KY.—A committee has been appointed by the Commercial Club, of which S. B. Caldwell is chairman, to look into the proposition of constructing an electric railway from Paducah to Fulton, Ky., by the way of La Center, Wickliffe, Mayfield and Murray. E. Q. Lockyear, of Evansville, Ind., is promoter.

PAINTSVILLE, KY.—It is reported that a company is being organized in Paintsville to install an electric light plant. H. La Vier, Clarence W. Howes, H. M. Stafford and D. J. Wheeler are interested in the project.

SHELBYVILLE, KY.—It is reported that N. B. Waugh, of Shelbyville, Ky., who is promoting the construction of an electric railway from Shelbyville to Mount Eden, has secured financial backing for the project and is now securing rights of way for the proposed road.

NEW IBERIA, LA.—The Southwestern Power & Traction Company, which proposes to build an electric railway from New Iberia to Lafayette, La., is planning to erect a power plant in New Iberia and substations along the route of the proposed railway. It is understood that the company will supply electricity for industrial plants along the route of its railway. F. W. Crosby, of New Orleans, La., is president.

BALTIMORE, MD.—Announcement has been made that Robert J. McCuen, superintendent of lamps and lighting, would make a recommendation to the Council and Board of Estimates that an independent franchise be given to the Patapsco Water & Power Company to supply electricity in Baltimore in order that it might compete with the Consolidated Gas, Electric Light & Power Company to supply electrical service to the municipal buildings. The company has submitted a proposition to the city offering to supply electricity for the municipal buildings at the rate of 2 cents per kw-hour if granted a franchise. The lowest price given by the Consolidated company is 3 cents per kw-hour under the existing contract, which expires June 1. Victor G. Bloede is president of the Patapsco Electric Company.

HAGERSTOWN, MD.—Wilbur J. Bragonier, Charles W. Wolfensberger and Daniel C. Gilbert have organized a company under the name of the Hagerstown Electric Park Company for the purpose of establishing an amusement resort. The capital stock is placed at $5,000.

BOSTON, MASS.—The School Board has passed a resolution providing for the installation of an independent electric light plant, to cost $7,000. The proposed plant will be equipped with gas engines and will supply electricity to the Eliot, Christopher, Columbus, Paul Revere, Hancock and Cushman schools in the North End.

NORTH ADAMS, MASS.—The City Council has adopted a resolution authorizing a committee of five to investigate the question of municipal ownership of gas and electric light plants, either by purchase or installation of new plants.

PALMER, MASS.—The Central Massachusetts Electric Company is contemplating extending its system across the bridge at North Wilbraham into the eastern end of Ludlow to supply electricity for lamps and motors to that section of the town.

PITTSFIELD, MASS.—Plans are being made by the Berkshire Street Railway Company for the construction of an extension, thirty miles in length, to connect Great Barrington, Hunting and Berkshire.

STERLING, MASS.—At a special town meeting held recently the citizens voted to install an electric light system in Sterling. The Selectmen were authorized to secure funds for completion of the work.

LANSING, MICH.—It is reported that surveys are being made by the Michigan United Railways Company for an extension of its system to Chesaning.

LANSING, MICH.—Plans are being considered by the Michigan United Railways Company for installing its own power plants, for which surveys are now being made under G. N. Lemon, chief electrical engineer, with headquarters in Jackson. The company now secures electricity for operating its system from the Commonwealth Power Company, of Jackson, Mich.

HIBBING, MINN.—The Council has decided to change the voltage of the municipal electric-light plant from 1100 volts to 2200 volts.

DULUTH, MINN.—It is reported that prominent Michigan capitalists who are interested in the White Iron Lake Iron & Water Power Company are contemplating the construction of a dam 12 ft. high, which would back the water for nineteen miles in the White Iron and Birch lakes. It is estimated that 25,000 hp could be developed. The company, it is said, proposes to supply electricity to the mines at Tower and Ely and vicinity and to the sawmill at Vinton. H. C. Kendall is president of the company; Frank H. Cutting, vice-president; William S. Eaton, secretary, and R. H. Eagan, treasurer.

MINNEAPOLIS, MINN.—Resolutions have been introduced in the City Council instructing the Twin City Rapid Transit Company to make several extensions to its system, to be completed and in operation within ten months.

MINNEAPOLIS, MINN.—The City Council has decided to advertise for bids for furnishing electricity for street lighting for one, three and five years. The service is now furnished by the Minneapolis General Electric Company, which charges $84 per year per lamp, although the city pays only $70 each as provided by the Walker rates.

NORTH BRANCH, MINN.—A company is being organized to install an electric light plant in North Branch to supply electricity in this and surrounding towns. The company is to be capitalized at $50,000. Mr. Spivak is interested in the project.

SAUK RAPIDS, MINN.—It is reported that the bill authorizing the construction of the Sauk Rapids dam has been passed. It is expected that work on construction of the dam will begin in the spring.

MERIDIAN, MISS.—The Mississippi Home Telephone Company is contemplating the extension of its long-distance service to towns in adjacent states. The first connection will be made with New Orleans, La.; Memphis, Tenn., and Shreveport, La. The proposed work will involve an expenditure of $2,500,000.

BURLINGTON JUNCTION, MO.—At a special election held recently it is reported that the citizens voted to purchase the plant of the Burlington Junction Electric Light & Power Company, for which bonds to the amount of $8,500 were autborized. The plant will be improved and operated by the municipality. The plant was established about three years ago.

CANTON, MO.—Steps have been taken by the Commercial Club, of Canton, Mo., to secure the construction of an electric railway from Canton to Memphis, Mo., via Monticello. It is said that two routes are under consideration, either of which can be built at a cost not to exceed $160,000.

IRONDALE, MO.—It is reported that preliminary arrangements are being made for the construction of a hydroelectric power plant and electric railway in Irondale. James P. Ward, of Irondale, is said to be interested in the project.

WEST PLAINS, MO.—The local telephone system is reported to have been sold to J. W. Boyer, of Jennings, La.

BILLINGS, MONT.—Preliminary arrangerrents are being made by the Billings Traction Company for the construction of its proposed electric railway, work on which will begin in the spring.

GREAT FALLS, MONT.—Preparations are being made to replace the equipment of the power plant of the Great Falls Electric Properties, recently destroyed by fire. E. I. Holland, of Great Falls, is manager.

POLSON, MONT.—It is reported that active construction work will begin early in the spring on a hydroelectric power plant which will supply electricity in Polsen and vicinity. The power site, which is a natural one of 800-ft. effective head, is located within eight miles of this city. Frank Faucett, of Polsen, is engineer.

UTICA, NEB.—The proposition to issue $5,000 in bonds, the proceeds to be used for the installation of an electric-light plant in Utica, is reported to be under consideration.

JAFFREY, N. H.—The State Legislature has passed a bill authorizing the town of Jaffrey to construct and maintain an electric light and power plant.

CALDWELL, N. J.—It is reported that the incorporators of the Pine Brook Electric Railway Company, which proposes to operate an electric railway between Caldwell and Denville, a distance of about thirty miles, has decided to equip the road with storage-battery cars. The cost of construction of the railway is estimated at about $18,000 per mile.

SOUTH ORANGE, N. J.—The Sillcocks-Miller Company is erecting a factory at South Orange, N. J., 50 ft. x 100 ft., three stories high, with power house adjoining. A modern ventilating system and a small power plant will be installed. The company manufactures artificial leather specialties, celluloid novelties, etc. W. S. Sillcocks is president of the company.

LAS CRUCES, N. M.—The Water Users' Association of the upper Rio Grande Valley and others who will be directly benefited by the fulfilment of the Elephant Butte Dam and land reclamation project by the government are interested in the legislation which is now pending in Congress to permit the organization of an electric power and transmission company to be operated in conjunction with the large irrigation enterprise. The bill empowers the Secretary of the Interior to lease power sites on reclamation dams for a longer period than ten years. If the measure is favorably acted upon by Congress a subsidiary company of the Water Users' Association will be immediately organized. It will be capitalized at $3,000,000, the stock to be apportioned among the members of the Water Users' Association in proportion to the number of acres of land that they may have under irrigation. The purpose of the organization is to erect a hydroelectric power plant to provide electricity for operating various industries in the Rio Grande Valley and also to construct and operate an electric railway in connection with the enterprise, to extend from the dam site at Elephant Butte down the valley through El Paso to Fort Hancock, a distance of more than 100 miles. Richard Burges, attorney, of El Paso, Tex., is representing the association at Washington. Felix Martinez, of El Paso, is one of the promoters of the power and electric railway project.

BUFFALO, N. Y.—It is reported that a company is being organized by parties interested in the International Railway Company, of Buffalo, N. Y., for the purpose of constructing and operating an electric railway through Abbott Road from Cazenovia Street to the south city line of Buffalo. It is understood that it will connect with the Buffalo Southern Railway, which now enters the city at South Park Avenue. The new company will be capitalized at $100,000. Morris Cohn, of Niagara Falls, N. Y.; Thomas E. Mitten, of Chicago, Ill.; Edmund B. Osler, of Toronto, Ont., Can., and others are interested.

FULTON, N. Y.—The Oswego River Power Transmission Company, of Syracuse, has applied to the City Council for a franchise to erect a transmission system for distributing electricity for lamps, heat and motors in Fulton. Eugene M. White is attorney for the company.

GLOVERSVILLE, N. Y.—Bids will be received by the City of Gloversville until Feb. 21 for lighting the streets of the city by electricity for terms of five and ten years. Not less than 132 arc lamps and 194 incandescent lamps will be required.

LOCKPORT, N. Y.—The Public Service Commission, Second District, has authorized the Lockport Light, Heat & Power Company to issue bonds to the amount of $70,000, to be sold at not less than $85 and the proceeds to be used for improvements and extensions to its plant and distributing system, and to take up outstanding indebtedness.

LYONS, N. Y.—It is reported that the Crowell-Sherman Stalter Company is contemplating the construction of an electric power plant in Lyons.

NEW YORK, N. Y.—Judge Lacombe in the United States Circuit Court has signed an order authorizing Adrian H. Joline and Douglas Robinson, as receivers of the Metropolitan Street Railway Company, to construct an additional coal hoist at the power station, located at First Avenue and Ninety-sixtb Street, the cost not to exceed $50,000.

NEW YORK, N. Y.—The New York, Ontario & Western Railroad Company has issued a large list of tools and equipment which will be required by the company, the cost of which is estimated at about $50,000. The list includes a complete line of machine tools and equipment for a blacksmith shop, most of which will be motor driven. C. A. Draper, 56 Beaver Street, New York, N. Y., is general purchasing agent.

NIAGARA FALLS, N. Y.—The Public Service Commission, Second District, has authorized the Cliff Electrical Distributing Company, of Niagara Falls, N. Y., to issue $250,000 bonds, to be sold at not less than 95, the proceeds to be used for improvements to its plant.

PHOENIX MILLS, N. Y.—Bids are being asked by the County of Otsego for the construction and equipment of a power house in Phoenix Mills, 30 ft. x 50 ft. F. D. B. Ingalls, Rosenbloom Building, Syracuse, N. Y., is engineer.

SYRACUSE, N. Y.—The Auburn & Syracuse Electric Railroad Company is planning to double-track several of its lines in Syracuse during 1911.

WAVERLY, N. Y.—The Elmira, Corning & Waverly Railroad Company has recently purchased from the General Electric Company, of Schenectady, N. Y., three 3000-kw rotary converters with transformers and switchboard for its power house in Corning.

RUTHERFORDTON, N. C.—The Isothermal Traction Company, which is planning to construct an electric railway from Gastonia, via Rutherfordton, to Asheville, a distance of 100 miles, is reported to have applied to the State Legislature for permission to change its name to the North Carolina Interurban Traction Company. K. S. Finch, of Charlotte, N. C., is president.

WILMINGTON, N. C.—Preparations are being made by the Tidewater Power Company for extensions and improvements to its power plant in Wilmington and system at Lumina, Wrightsville Beach. Additional machinery will be installed at the power station, including a 500-kw rotary converter, one 500-hp boiler and 200-kw lighting transformers, the boiler capacity will be increased 50 per cent. The present 150-kw converter will be transferred to the substation at Wrightsville Sound, where it will be used as an auxiliary in cases of emergency. A. B. Skelding is general manager.

FARGO, N. D.—It is reported that the plans to be prepared by the city engineer for the proposed filtration plant and pumping station will include an electric light plant.

NEW LEIPZIG, N. D.—The Home Telephone Company, recently incorporated, is planning to install a local telephone system in the spring. A rural line will be erected, taking in Birdsall, Burt, Mott and Bentley. F. B. Ewald, Jr., of New Leipzig, is interested in the company.

AKRON, OHIO.—The Northern Ohio Traction & Light Company, it is reported, has acquired the right of way for double-tracking its railway between Cuyahoga Falls and Newburg, work on which, it is understood, will begin this spring.

ATHENS, OHIO.—Arrangements are being made by the Hocking-Sunday Creek Traction Company to commence work on construction of its proposed electric railway between Athens and Nelsonville in April. It is proposed eventually to extend the railway from Nelsonville to Lancaster. E. B. Young, of Nelsonville, Ohio, is president of the company.

CAMDEN, OHIO.—The Camden Telephone Company has increased its capital stock from $20,000 to $30,000.

CINCINNATI, OHIO.—The Cincinnati Traction Company is installing two additional 525-hp Babcock & Wilcox boilers, equipped with Murphy furnaces, in its Pendleton power station.

CINCINNATI, OHIO.—The Ohio Electric Railway Company is reported to have disposed of $6,000,000 in bonds, and $4,000,000 in capital stock, the proceeds of which will be used for improvements and extensions to its properties. Among the railways controlled by the Ohio Electric Railway Company are the Cincinnati, Dayton & Toledo, the Indiana, Columbus & Eastern, the Columbus, Newark & Zanesville, the Dayton & Western and the Lima & Toledo Traction Company.

CLEVELAND, OHIO.—The stockholders of the Cleveland, Painesville & Eastern Railroad Company, of Cleveland, Ohio, it is reported, have voted to increase the capital stock of the company from $2,000,000 to $3,500,000. It is also stated that bonds to the amount of $500,000 have been authorized, the proceeds to be used for extensions and improvements to the system.

COLUMBUS, OHIO.—Preparations are being made by the Columbus, Mt. Vernon & Mansfield Railway Company for the construction of an electric railway to connect Columbus, Mansfield and Mt. Vernon. It is expected that an extension will be built to New Albany and Johnstown. L. P. Stevens is general manager.

FORT RECOVERY, OHIO.—The Fort Recovery Telephone Company has filed amendments to its charter increasing its capital stock from $10,000 to $15,000.

HIRAM, OHIO.—Lloyd M. Hill, proprietor of the local electric light plant, is planning to change the system from direct current to alternating current next July. Mr. Lloyd purchased the Hiram College electric light plant.

LORAIN, OHIO.—It is reported that the Black River Telephone Company, of Lorain, Ohio, is arranging to increase its capital stock from $100,000 to $200,000, the proceeds to be used for the erection of a new building and the installation of a new automatic exchange.

SANDUSKY, OHIO.—The City Council has instructed the Director of Public Service to procure plans and estimates for the installation of a municipal electric-light plant in Sandusky.

SPRINGFIELD, OHIO.—Judge Middleton recently handed down a decision denying the Springfield Light, Heat & Power Company, of Springfield, Ohio, the right to make a minimum charge of $1 per month to consumers. Since the new ordinance fixing the rate at 8 cents per kw-hour went into effect the company has been enforcing this minimum charge, but the court holds that as the company accepted the ordinance fixing a maximum rate it has forfeited its rights to make a minimum charge which would make the rate to any consumer more than the maximum named in the ordinance.

BLISS, OKLA.—The lighting plant owned by Miller Brothers is reported to have been destroyed by fire.

BOLEY, OKLA.—The capital stock of the Boley Light & Power Company has been increased from $5,000 to $20,000.

HEAVENER, OKLA.—The Degna-McConnell Coal Company, of Wilburton, Okla., is reported to have petitioned for a franchise to install and maintain an electric light plant in Heavener.

SAPULPA, OKLA.—The Sapulpa Interurban Railway Company is planning to build an extension of its railway from Sapulpa to Tulsa, a distance of fifteen miles, during 1911.

SNYDER, OKLA.—The proposition to issue $40,000 in bonds for the installation of an electric light plant and enlarging the water-works system will soon be submitted to a vote. The present plans call for an expenditure of $25,000 for installation of electric plant and $15,000 for extensions to the water system.

EUGENE, ORE.—The city attorney has been directed to draw up an ordinance providing for issuing bonds to the amount of $25,000, the proceeds to be used for the installation of a tungsten incandescent street lighting system.

JOSEPH, ORE.—The Joseph Electric Light & Power Company is contemplating erecting a transmission line into the farming section, which will ultimately be extended to Enterprise, six miles distant. Another transmission line six miles long will be erected in another direction to supply electricity for lamps and motors. A day circuit will also be established. J. J. Rejab is superintendent.

KLAMATH FALLS, ORE.—The City Council has granted the Klamath Falls Light & Water Company a 50-year franchise to supply electricity for lamps and motors in Klamath Falls.

PORTLAND, ORE.—Plans are being made by the Mt. Hood Railway & Power Company for the construction of an extension from Portland to Bull Run, twenty-two miles in length, during 1911.

PORTLAND, ORE.—Bids will be received at the office of Whidden & Lewis, architect, 701 Corbett Building, Portland, Ore., until Feb. 23 for furnishing and installing electric combination and gas fixtures in the rooms and corridors of the east wing of the new court house at Multnomah County, plans and specifications for which may be obtained from the architects.

PRINEVILLE, ORE.—Plans are being considered by the Prineville Light & Water Company for improvements and changes to its system during the summer, which will include the installation of hydroelectric power, using long-distance transmission. The present steam power plant will be abandoned. C. L. Shattuck is superintendent.

SHERIDAN, ORE.—It is reported that C. G. Arnold is contemplating the installation of a telephone system in Sheridan, for which application will soon be made for a franchise.

TURNER, ORE.—The Interior Warehouse Company, a subsidiary of Balfour, Guthrie & Co., has been granted a franchise by the City Council to install an electric light plant in Turner. The Council and Mayor are considering the question of lighting the principal streets of the town.

VALE, ORE.—It is expected that the Telluride Power Company will extend the transmission line from its hydroelectric plant on the Malad River, Idaho,, to Vale within the next two months. The company is to erect 150 miles of transmission lines.

PANAMA.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal, Washington, D. C., until March 3 for furnishing manganese steel castings, steel castings, wire rope, gear and milling cutters, auger bits, foundry core machine and electric fans. Blanks and general information pertaining to this circular (No. 622) may be obtained from the above office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 55 National Realty Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal.

CORAOPOLIS, PA.—Bids will be received at the office of the borough clerk until March 1 for the following apparatus: One 1,500,000-gal. triplex pump, one 150-hp gas engine for driving pump, two 225-hp gas engines to be direct-connected to 175-kva, 2300-volt, 60-cycle, three-phase alternating-current generators, one 75-hp gas engine to be direct-connected to a 50-kva, 2300-volt, 60-cycle, three-phase, alternating-current generator, two 175-kva, 2300-volt, 60-cycle, three-phase, alternating-current generators, complete with exciters; one 50-kva, 2300-volt, 60-cycle, three-phase, alternating-current generator, complete with exciter; one five-panel switchboard complete; one 50-light series, luminous or metallic flame arc lamp equipment, complete. Specifications may be obtained from Sidney B. Martin, consulting engineer, Room 616, Penn Building, Pittsburgh, Pa.

DILLSBURG, PA.—The Dillsburg Electric Light & Power Company has executed a mortgage for $20,000 in favor of the Security Title & Trust Company, of York, Pa., to secure a bond issue, the proceeds to be used to acquire real estate and water rights, to erect and equip power-plant and transmission lines to meet the present and future demands made upon it.

DOYLESTOWN, PA.—Plans are being considered by the Philadelphia & Easton Electric Railway Company for building an extension from Lansdale to Doylestown in the spring.

MEYERSDALE, PA.—The Economy Telephone Stock Company has decided to erect a telephone line into Coal Run from Salisbury, and also from Hooversville into Holsopple. C. C. Hedkel is president.

PHILADELPHIA, PA.—It is reported that the Keystone Telephone Company is planning to erect a telephone system and exchange on Five-Mile Beach, to cost about $45,000. The wires will be placed underground.

SCHUYLKILL HAVEN, PA.—The County Commissioners at Pottsville have awarded the contract for the construction of electric power plant, installation of elevators and building sewage disposal plant at the Insane Asylum at Schuylkill Haven, Pa., to the W. G. Cornell Company, of New York, N. Y., for $114,800. Charles T. Straughn, of Pottsville, Pa., is County Controller.

WASHINGTON, PA.—Bids will be received by the Borough Council until Feb. 20 for lighting the borough, except the Eighth Ward, for a period of five and ten years from May 1, 1911. John Griffiths is secretary.

WOMELSDORF, PA.—The Womelsdorf & Rehrersburg Rural Telephone Company has decided to make several extensions to its telephone lines, among which will be the erection of a line to Cross Keys Hotel and vicinity, and an additional circuit to Strausstown.

SAN JUAN, P. R.—The San Juan Light & Transit Company has recently placed a contract with the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for seven 30-kva, single-phase, 60-cycle, 1100-volt transformers; five 25-kva, single-phase, 60-cycle, 1100-volt transformers and a total of 200 hp in motors for machine shop.

CHARLESTON, S. C.—The Charleston Consolidated Railway & Light Company has recently purchased from the General Electric Company, of Schenectady, N. Y., two 2000-kw turbo-generator sets, two 125-turbo exciters and three 500-kw, 550-volt motor generator sets for its plant in Charleston.

DEADWOOD, S. D.—The Nebraska Telephone Company is reported to be considering an expenditure of $85,000 to complete the improvements started last year.

RAPID CITY, S. D.—The Nebraska Telephone Company, it is said, is contemplating the erection of a new telephone exchange in Rapid City.

MEMPHIS, TENN.—Announcement has been made by the Lake View Traction Company that it will soon begin work on the construction of its proposed railway. The company holds franchises for seven miles of track in Memphis. W. W. Hayden is engineer.

AUSTIN, TEX.—The Board of City Commissioners has under consideration another offer to rebuild the large dam across the Colorado River and install a hydroelectric plant in Austin. The Dumont-Holmes Steel Concrete Company, which was awarded the contract several months ago, has faifed to carry it out and its rights have been declared forfeited by the city. George D. Moore, of Detroit, Mich., has submittd a proposition offering to build the dam and hydroelectric plant for $1,000,000, this sum to be paid in semi-annual instalments of $25,000. The new dam will be located on the site of the one destroyed by the flood several years ago.

BROWNSVILLE, TEX.—The City Council is considering the question of submitting the proposition to issue $40,000 in bonds for additional improvements to the municipal electric light plant and water-works system to a vote of the people. Bonds to the amount of $30,000 were recently issued for this purpose.

EL PASO, TEX.—The County Commissioners are reported to be considering the installation of a lighting plant to light the county buildings.

EL PASO, TEX.—The construction of an electric railway from Engle, N. M., to Fabens, Tex., 100 miles in length, is reported to be under consideration. Richard Burgess, of El Paso, Tex., is said to be interested in the project.

EL PASO, TEX.—Preparations are being made by the El Paso Electric Company for improvements and extensions to its properties to meet the increasing demands made upon them. The company is owned and controlled by the Stone & Webster Corporation, of Boston, Mass.

HOUSTON, TEX.—Arrangements are being made by the Houston-Galveston Interurban Electric Railway Company to begin work on the construction of its extensive terminals in Houston, which with other improvements in this city will involve an expenditure of $500,000.

KIRBYVILLE, TEX.—The installation of an electric light plant iin Kirbyville is under consideration. J. W. Fleming and J. Morton are interested in the project.

LAREDO, TEX.—The Laredo Electric & Railway Company has recently purchased a 400-hp boiler from the Keeler Boiler Company, of Williamsport, Pa.

LONGVIEW, TEX.—The Lacy Telephone Company has awarded a contract for the erection of poles from Longview to the Texas Southern Crossing, a distance of fifteen miles. Contract will soon be let for the remaining fifteen miles to Ore City.

SAN ANTONIO, TEX.—The San Antonio Gas & Electric Company and the San Antonio Traction Company, both controlled by the American Light & Traction Company, are contemplating extensive improvements and extensions to their systems this year.

SULPHUR SPRINGS, TEX.—Plans are being considered for the installation of a new exchange and switchboard in Hopkins in connection with the rural telephone system.

CAMAS, WASH.—The Northwestern Electric Company has applied to the City Council for a fifty-year franchise to supply electricity for lamps and motors in Camas. The company has filed a claim for a dam and power site on the North Fork of the Lewis River.

KOOSKIA, WASH.—Preparations are being made for the construction of a dam across the Middle Fork and the installation of a power plant this year. It is expected that work will begin as soon as spring freshets are over. W. J. Bell, of Newaygo, Mich., and T. H. Croswell, of Spokane, Wash., are interested in the project.

PASCO, WASH.—Arrangements are being made by the Pacific Power & Light Company for the construction of the first unit of its distributing plant, to cost about $83,000. The cost of the plant complete is estimated at $500,000. The company has petitioned the City Council for vacation of a portion of Riverside addition, which it intends to secure for a site for its proposed electric distributing plant and gas plant, work on which will begin in the near future. The generating plant is located on the Nachez River, about ninety miles above Pasco.

SPOKANE, WASH.—Sealed bids will be received by the City of Spokane, Wash., until Feb. 24 for one switchboard, complete; 60 call boxes, complete; 40 signal lamps, 400 storage-battery cells and battery rack, plans and specifications for which are on file at the office of chief of police. John Gifford is purchasing officer.

CAMPBELLSPORT, WIS.—The capital stock of the Campbellsport Electric Light & Power Company has been increased from $10,000 to $40,000.

STOUGHTON, WIS.—Bonds to the amount of $18,700 has been issued for the purchase of the water-power of the Yahara River. Improvements and alterations will be made this spring which will involve an expenditure of about $6,500.

WAUSAU, WIS.—Plans are being made by the Marathon County Telephone Company for the erection of two telephone lines out of Rib Falls, material for which has already been ordered. One line will extend northeast seven miles, and the other south, two miles. F. P. Stone is president.

WAUTOMA, WIS.—The capital stock of the White River Farmers' Telephone Company has been increased from $1,500 to $4,500.

EDMONTON, ALTA, CAN.—The commissioners are contemplating the purchase of a 500-kw motor generator for the substation of the Edmonton Radial Railway, which connects Edmonton and Strathcona The railway is operated by the municipality. H. A. MacCormack is superintendent.

VANCOUVER, B. C., CAN.—The city electrician will soon ask the City Council for an appropriation of from $150,000 to $200,000 to purchase new equipment and extensions to the present light system during the coming year. The apparatus to be asked for will include 300 arc lamps, 40 fire-alarm boxes, 15 semaphore street signals, 28 miles of wiring, 30 police call boxes and a large number of lamps.

WINNIPEG, MAN., CAN.—The Winnipeg Electric Railway Company has awarded the contract for the generating equipment for its new power station, to be erected this summer, to the Canadian General Electric Company. Curtis turbo-generator sets will be installed in four units having a rating of 3000 kw each.

FREDERICTON, N. B., CAN.—It is reported that application will be made at the next session of the Legislature for incorporation of the St. John River Electric Power Company, which proposes to erect a dam across the St. John River, at or near the Hawkshaw bridge, forty miles above Fredericton, to generate and transmit electricity for lamps, heat and motors. John E. Stewart, of Andover, is reported to be interested in the project.

COBALT, ONT., CAN.—The Cobalt Reduction & Refining Company is plannnig to install an electric smelting, reduction and refining plant at its works. It is expected to have the plant in operation by July 1.

IROQUOIS, ONT., CAN.—M. F. Beach, of Iroquois, is reported to be interested in a project to develop a water-power on the Madawaska River, at High Falls, near Calabogie.

LONDON, ONT., CAN.—At the annual meeting of the London Street Railway Company held Feb. 1 the directors decided to abandon the proposals from the Hydro-Electric Power Commission for power from Niagara Falls and go ahead with the construction of a steam power plant.

NIAGARA FALLS, ONT., CAN.—The Niagara Frontier Railway Company will make application to the Ontario Parliament for a charter, giving it power to construct and operate an electric railway from Fort Erie, Ont., through Niagara Falls to the town of Niagara; also to operate telephone and telegraph lines.

OTTAWA, ONT., CAN.—The People's Railway Company, of Berlin, Ont., is applying for a Dominion charter on the ground that several of its proposed terminals are located at ports on international waters, including Owen Sound, Collingwood, on Georgian Bay; Port Dover and Port Stanley, on Lake Erie; Hamilton, on Lake Ontario, and Goderich, on Lake Huron. The company also asks authority to increase its capital stock to $5,000,000 and to develop water-powers as well as to operate steamship lines and elevators.

STRATFORD, ONT., CAN.—The Hydro-Electric Power Commission has appointed Charles J. Leacock supervising engineer of Niagara power system for this district, having jurisdiction over the systems at Stratford, St. Mary's, Tavistock, Mitchell and Seaforth.

MONTREAL, QUE., CAN.—A syndicate, it is reported, has been formed in Montreal for the purpose of constructing an elevated railway, fourteen miles in length, to extend along Craig and St. James Streets from the western to the extreme eastern limits of the city. Another section extending north and south will be built up St. Lawrence, Main or St. Dennis Street.

QUEBEC, QUE., CAN.—The Quebec Railway, Light & Power Company is planning to extend its system from Beauport to Montmorency Falls this year, which will call for the construction of about six miles of track.

PRINCE ALBERT, SASK., CAN.—The City of Prince Albert is reported to have been granted the La Colle Falls power franchise and lands that will be flooded by damming of the river.

SAN LUIS, MEX.—The Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., has recently received an order from the Salvador Madera Cia, of San Luis, Mex., for one 160-kw. direct-current generator.

New Industrial Companies.

THE AVERY-LOEB ELECTRIC COMPANY, of Columbus, Ohio, has been chartered with a capital stock of $25,000 by Oscar Avery, A. E. Loeb, C. W. Mammond, A. U. Loeb and A. L. Frey.

THE GAS POWER MACHINERY COMPANY, of Los Angeles, Cal., has filed articles of incorporation with a capital stock of $200,000. The incorporators are: Lyman Stewart, E. C. Sterling, G. R. Harrison, F. C. Nellis and C. W. Foote.

THE HENRY M. MOSES COMPANY, of Nashville, Tenn., has been incorporated with a capital stock of $5,000 for the purpose of dealing in electrical supplies. The incorporators are: Henry M. Moses, H. C. Keeton, B. A. Massey and others.

JAMES HARTLEY'S SONS, INC., of Brooklyn, N. Y., have filed articles of incorporation with a capital stock of $5,000 to manufacture and deal in engines and machinery. The incorporators are Thomas Hartley, 4417 Sixth Avenue; John Hartley, 2 Lorraine Street, and James Hartley, 4417 Sixth Avenue, all of Brooklyn, N. Y.

THE McDOWELL, LATIMER COMPANY, of Metuchen, N. J., has been incorporated with a capital stock of $25,000 by H. G. Latimer, G. McDowell, of Brooklyn, N. Y., and R. Borgfeldt, of Metuchen, N. J. The company proposes to manufacture internal combustion engines, etc.

THE MAGNETIC TRANSMISSION COMPANY, of Brooklyn, N. Y., has been chartered with a capital stock of $100,000 by C. E. Cood, of Brooklyn, N. Y.; C. F. Elliott, of New Brighton, and B. E. Henry, of New York, N. Y. The company is capitalized at $100,000 and proposes to do general contracting and general electrical work of all kinds; also electrical and mechanical engineering business.

THE PARROT HEATER COMPANY, of Jackson, Mich., has been incorporated with a capital stock of $20,000. The company proposes to manufacture gas and electric heaters.

VAILE-KIRNES, of Dayton, Ohio, have filed articles of incorporation with a capital stock of $100,000. The company manufactures hydraulic, electrical and pneumatic machinery. The incorporators are: J. Henry Vaile, Hugh W. Kirnes and others.

THE WARD, DOUCET & FOSTER COMPANY, of Boston, Mass. (electricians), has been incorporated with a capital stock of $50,000 by John B. Ward, William C. Doucet, Almon Foster and John G. Brackett.

New Incorporations.

EUREKA, CAL.—The Humboldt & Eastern Railroad Company has applied for a charter for the purpose of building a railway from Eureka to the Sacramento Valley, via Trinity County. The company is capitalized at $250,000 and the incorporators are: W. S. Clark, C. H. Palmtag, H. J. Jackman and others.

OAKLAND, CAL.—The San José Short Line Railway Company has been incorporated with a capital stock of $80,000 by Gavin McNab, B. M. Aikens, R. P. Henshall, L. Elkins, G. W. Mordecai and F. L. Stewart. The company is a subsidiary of the United Properties Company.

OAKLAND, CAL.—The Sacramento Short Line Railway Company has been incorporated as a subsidiary company of the United Properties Company by B. M. Aikens, Gavin McNab, R. P. Henshall, L. Elkins, G. W. Mordecai and F. L. Stewart. The company is capitalized at $10,000,000.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the California Power & Manufacturing Company, with a capital stock of $5,000,000, by F. G. Baum, C. W. Slack, C. S. Goodard, George R. Roy and J. T. Piggett. The company will operate in northern California.

BRIDGEPORT, CONN.—The Bridgeport Electric Power Company has applied to the Legislature for a charter giving it the right to generate and sell electricity for lamps and motors in Bridgeport and adjacent towns; also to build subways and conduits in Bridgeport and vicinity. The company is to be capitalized at $1,500,000. The incorporators are: W. G. Clark, W. C. Ryckman, C. N. Gilpin and T. F. Fitzsimmons.

BRIDGEPORT, CONN.—Application has been made to the State Legislature by the Pequonnock Company, of Bridgeport, Conn., for a charter in which is included the right to build and operate an electric railway between Bridgeport and Trumbull. It is understood that the primary object of the company is to develop the property in the so-called Thompson tract. The incorporators are: C. Lewis Bill, Theodore B. Ford, F. B. Curtis and Leo C. Morehouse.

FORT LAUDERDALE, FLA.—Articles of incorporation have been filed for the Fort Lauderdale Ice & Light Company with a capital stock of $50,000. The officers of the company are: Henry R. Brown, of Fort Lauderdale, Fla., president; J. L. Billingsley, of Miami, Fla., vice-president; Thomas M. Bryan, secretary, and F. A. Barrett, treasurer, all of Lauderdale, Fla.

ANTIOCH, ILL.—Articles of incorporation have been filed for the Antioch Telephone Company with a capital stock of $2,500 by Wallace E. Drum, Charles T. Richards and Jay E. Cribb.

BRIDGEPORT, ILL.—The Bridgeport Light & Power Company has been chartered with a capital stock of $25,000 by R. D. Donnelly, W. E. Beyban and B. H. Lytle.

STERLING, ILL.—Articles of incorporation have been filed for the Sterling-Moline Traction Company with a capital stock of $100,000. The company proposes to construct and operate an electric railway from Sterling to Moline, from Sterling to Lyndon, and from Princeton to Prophetstown, Ill. Work will begin on construction of the proposed railway in the near future. Charles E. Windom, of Sterling, Ill., is one of the directors.

BACKUS, MINN.—Articles of incorporation have been filed for the Backus Rural Telephone Company by Laurence Dougherty, J. W. Bailey, O. A. Miller and others.

JOHNS, MISS.—The Johns Telephone Company has been organized to construct and operate a telephone line between Brandon and Johns. The company is capitalized at $25,000 and the incorporators are: H. C. Patrick, J. C. Crain, W. S. Crook, I. P. Russell and others.

MT. VERNON, MO.—The Mt. Vernon Telephone Company has been chartered with a capital stock of $6,000 by John M. Allen, Henry McCanz, Norman Smith and others.

JAMESBURG, N. J.—Articles of incorporation have been filed for the Jamesburg Electric Company by Louis Rafello, Philadelphia, Pa.; Merritt W. Pharo, of Tuckerton, and Milton I. Voorhees, of Jamesburg. The company is capitalized at $10,000 and proposes to supply electricity in Jamesburg for lamps and motors.

WOODMERE, N. Y.—The Woodmere & Rockaway Electric Light & Power Company has been chartered with a capital stock of $100,000 by L. F. Corea, R. Krause, of New York, N. Y., and E. Johnson, of Brooklyn, N. Y.

GRAHAM, N. C.—The Alamance Power Company, of Alamance County, has been incorporated to develop water power and generate electricity on Haw River. The company also has the right to operate cotton mills and do a mercantile business. The company is capitalized at $300,000. The incorporators are: F. L. Williamson, of Burlington; J. Harvey White and E. S. Parker, of Graham.

TULSA, OKLA.—The Sand Springs Interurban Railway Company has been incorporated with a capital stock of $50,000 to build an electric railway from Tulsa to Sands Springs, a distance of six miles. Electricity for operating the proposed railway will be secured of the Tulsa Corporation. The officers of the company are: Charles Page, of Tulsa, Okla., president; W. E. Rohde, Tulsa, superintendent, and W. H. Henderson, chief engineer.

BUTLER, PA.—Application will be made to the Governor by the Pittsburgh, Butler, Slippery Rock, Grove City & Northern Street Railway Company for a charter to construct and operate an electric railway in the Borough of Butler, Borough of Slippery Rock and Borough of Grove City, about twenty-six miles in length. The incorporators are: William C. McCandless, John Troutman, F. L. Forrester, John C. Kerr and William M. Galbraith.

NEW CASTLE, PA.—The Wilmington & Southern Traction Company has been incorporated to take the portion of Wilmington, New Castle & Southern Railway between New Castle and Delaware City, which was recently purchased by R. H. Richards at foreclosure sale.

ANDERSON, S. C.—The Piedmont & Northern Railway Company has been granted a charter with a capital stock of $5,000,000 for the purpose of taking over the property and holdings of the Greenville, Spartanburg & Anderson Railway Company and interurban railways projected. The incorporators are: J. B. Duke, of Somerville, N. J.; B. N. Duke, of New York, N. Y.; W. S. Lee, of Charlotte, N. C.; Ellison A. Smyth and Lewis W. Parker, both of Greenville.

SPRINGFIELD, S. C.—Articles of incorporation have been filed for the Springfield Electric Light & Power Company with a capital stock of $20,000 by J. McB. Dean, Michael Cleaton, E. J. Boland, J. B. Smith and others.

PIERCE, S. D.—The Omaha & Western Iowa Traction Company has filed articles of incorporation with a capital stock of $250,000. The incorporators are: C. E. Brown, M. E. Gallion, C. Desmond McDonough and others.

CELINA, TEX.—The Celina Electric Light & Power Company has been incorporated with a capital stock of $5,000 by W. I. Bryan, Edward Langford and V. L. Patrick.

ALUM RIDGE, VA.—The Floyd-Montgomery Telephone Company has been incorporated with a capital stock of $10,000. The officers of the company are: W. W. Thompson, of Sowers, Va., president; M. R. Gordon, of Copper Valley, Va., vice-president, and R. T. Akers, of Alum Ridge, Va., secretary and treasurer.

NICKELSVILLE, VA.—Articles of incorporation have been filed for the Dungannon & Nickelsville Telephone Company with a capital stock of $5,000 by J. W. Broadwater, president; J. J. Quillan, vice-president; R. L. McConnell, J. W. Bostix and others.

VANCOUVER, WASH.—Articles of incorporation have been filed for the Northwestern Electric Company with a capital stock of $5,000,000 by B. A. De Yarmon, of Vancouver, Wash.; B. C. Conduit, of Oakland; C. E. S. Wood, H. H. Parker and Erskine Wood, of Portland, Ore. The company has filed on water rights in the Lewis River which provide for 10,000 cu. in. per second.

CLARKSBURG, W. VA.—The Domestic Fuel & Light Company has been granted a charter with a capital stock of $50,000. The incorporators are: Angus W. McDonald, John Wehrle, George S. Crouch, Jr.; E. W. Knight and C. C. Stone, all of Charleston, W. Va.

CLIFFTOP, W. VA.—The North Fayette Telephone Company has been chartered with a capital stock of $5,000. The incorporators are: R. L. Walker, John E. Hugart and others.

CAZENOVIA, WIS.—Articles of incorporation have been filed for the Westford Telephone Company with a capital stock of $1,000 by John Keller, Peter Milford, Joseph Duren, F. Rockweller and J. M. Bauer.

HINTZ, R.F.D., UNDERHILL, WIS.—The Lonzy Brook Telephone Company has been formed with a capital stock of $6,000 by H. H. Behn and others.

OTTAWA, ONT., CAN.—The High River, Saskatchewan & Hudson Bay Railway Company will apply to the Dominion Parliament for a charter to construct and operate an electric railway in the Provinces of Alberta and Saskatchewan, thence to Pas, in the Northwest Territories.

JOLIETTE, QUE., CAN.—The Joliette & Lake Manuan Colonization Railway Company has made application to the Dominion Parliament for a charter to construct a railway from Joliette, Que., to Montreal, to be operated either by steam or electricity.

Personal.

DR. J. E. WHITEHEAD, professor of applied electricity at the Johns Hopkins University, lectured last week on "Recent Progress in the Art of Illumination" before the Baltimore University Club.

MR. L. H. LATHROP has been appointed superintendent of the Menominee & Marinette Light & Traction Company, of Menominee, Mich., succeeding Mr. W. R. Putnam, whose resignation was announced in these columns Jan. 19.

MR. EDWARD J. O'HAYER, JR., general Eastern passenger agent of the New York Central Lines, was married Feb. 8 in Indianapolis to Miss Ada Moore Alexander. The happy couple will reside at the Hotel Marie Antoinette, New York City.

MR. W. H. GLENN has been elected vice-president of the Georgia Railway & Electric Company, Atlanta, Ga., in recognition of his valuable services to the company. Mr. Glenn is a graduate of the Georgia School of Technology and has been connected with the company since 1891.

MR. THOMAS A. EDISON celebrated the sixty-fourth anniversary of his birth on Feb. 11 by a particularly busy day at his laboratory in Llewellyn Park, Orange, N. J. He received telegrams of congratulation from a number of the leaders in the electric lighting industry and other scientific fields.

PROF. D. C. JACKSON returned Feb. 7 from a flying trip to England, where he made preliminary arrangements for a report to the British government in connection with the valuation of the telephone system of the National Telephone Company, which is to be taken over by the government on Jan. 1, 1912.

MR. HARRY CURTIS RICE, vice-president and manager of the General Incandescent Lamp Company, of Cleveland, Ohio, was married Feb. 7 to Miss Edna Tyler Kindelon, of Oakland, Cal. The ceremony was performed in Lynn, Mass., Mr. Rice's former home. Mr. and Mrs. Rice are spending their honeymoon on an excursion through the Southern States.

COLONEL E. E. NASH, secretary-treasurer of the Warren Electric and Specialty Company, addressed the Business Men's Association of Warren, Ohio, at its annual meeting, directly following a noon lunch on Friday, Feb. 3. He referred to the relation of the National Electric Lamp Association with Warren, which city is the headquarters of no less than five of the association's member companies.

MR. JOHN I. BEGGS, president of the Milwaukee Electric Railway & Light Company, has been elected president of the St. Louis Car Company, of St. Louis, Mo. The election took place at the recent annual meeting, which was the first held by the corporation since its reorganization by Mr. Beggs. Mr. Edwin Missner, chief clerk of the Milwaukee Electric Railway & Light Company, has been appointed assistant to the president.

MR. H. M. BEECHINOR, formerly with the Allegheny Light Company, of Pittsburgh, has been appointed Cleveland representative of the American Electric Fuse Company, with offices at 423 High Avenue. Mr. W. W. Walsh, formerly of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, will act as the Pittsburgh representative of the American Electric Fuse Company. His office will be at 409 House Building.

MR. F. H. ENSIGN, manager of the Pacific Gas & Electric Company at Phoenix, Ariz., for the past five and one-half years, bas resigned that position in order to devote his time to personal interests. He has become financially interested in the New State Electric Supply & Fixture Company and the New State Auto Aerial Company and assumes the management of both concerns in addition to other personal interests in Phœnix and throughout the valley. Mr. Ensign retains a connection with the Pacific Gas & Electric Company as consulting engineer. Mr. R. G. Whitmarsh nas been elected by the officials of the company to succeed Mr. Ensign as manager.

MR. B. S. BARNARD, who has been associated for the past fifteen years with the Standard Vitrified Conduit Company, of which for the past several years he has been president, on Jan. 1 became interested in the Clermont Sewer Pipe Company, of Clermont, Pa. This company will place on the market a high grade of vitrified clay conduit, both multiple and single duct. Its property includes deposits of clay, shale and coal and natural gas, located so centrally as to secure the advantage of low freight rates in all directions. Mr. Barnard's New York office is 50 Church Street, and his plant starts up March 1.

B. S. BARNARD.

MR. G. W. BRINE has resigned as treasurer of the Georgia Railway & Electric Company, being succeeded by Mr. I. S. Mitchell, Jr., formerly cashier of the company. Mr. Brine still retains his connection with the company, however, being vice-president and secretary and one of the directors. Mr. Brine, although born in New England, has been associated with Southern electrical developments for a number of years. His entry in the electric light field was made in 1884, when he was connected with the southern district of the Edison General Electric Company. In 1894 he accepted a position with the Georgia Electric Light Company, where his steady application to the interests of the company resulted in his promotion to be secretary-treasurer and manager. When in 19[illegible] the company was consolidated with the railway and other lighting companies in Atlanta into the Georgia Railway & Electric Company he was made vice-president and treasurer and manager of the electric department.

MR. DAVID HARLOWE, traffic manager of the Allis-Chalmers Company, of Milwaukee, has been appointed by the Wisconsin Railroad Commission to fill the place of Prof. B. H. Meyer, resigned. Mr. Harlowe has been connected with the Allis-Chalmers Company for over twenty-five years, becoming traffic manager of the old E. P. Allis Company in 1893. Before this he was associated with Mr. Dwight W. Keyes, general freight agent of the Chicago, Milwaukee & St. Paul Railroad. Mr. Harlowe was born in England in 1865. Several years ago a place on the commission was offered to him, but at that time he declined to serve. His four-year term begins this month.

Obituary.

MR. SAMUEL A. BUFFINGTON, president of the Consolidated Gas & Electric Company, of Chicago, died on Feb. 8 of inflammatory rheumatism following grip. He was thirty-eight years of age. While the company of which Mr. Buffington was president at the time of his death is engaged in gasoline lighting, the decedent was well known in electrical circles, as he established the Chicago Telephone Supply Company in 1898 and was also interested in electrical manufacturing enterprises. He was also president of the Land Company of North America and president of the Giant Construction Company, which founded the town of New Chicago, Tex.

MR. PARMALEE J. McFADDEN died at his home in Greenwich, Conn., on Feb. 9. Some years ago Mr. McFadden was engaged in electrical pursuits in Chicago, where he is pleasantly remembered. He had charge of a department in the Chicago office of the old Edison General Electric Company and was afterward connected with the General Electric Company in Chicago for a short time. He was a man of literary and scholarly tastes, and while in Chicago was an occasional contributor to the technical press. Afterward he engaged in literary work for A. C. McClurg & Company in Chicago and Dodd, Mead & Company in New York. At tbe time of his death he was associate editor of the *St. Nicholas* magazine.

Trade Publications.

RECORDING THERMOMETERS.—Bulletin No. 127 issued by the Bristol Company, Waterbury, Conn., is a forty-page illustrated catalog of the company's Class III recording thermometers, including description and lists of the compensated, gas-filled recording thermometers. A number of important applications are mentioned.

HOW TO READ ELECTRIC METERS.—"Electric Meters: How to Read Them" is the title of a booklet just issued by the Westinghouse Electric & Manufacturing Company. As the title suggests, the booklet is intended as an instruction in the reading of watt-hour meters for the layman, and to this end it is written in a popular style, easily understood by anyone.

GRAPHIC RECORDERS.—The Sangamo Electric Company, Springfield, Ill., is distributing Bulletin No. 22, describing its portable and switchboard type of graphic recorders. Several pages are devoted to a discussion of the application of the graphic recorders to soliciting power, checking input of electrically driven machines, etc. The bulletin should prove of assistance to central-station managers confronted with the day-load problem.

GENERAL ADVERTISING LITERATURE.—For the purpose of placing before the electric-lighting industry information concerning the advertising campaign which it has pursued, with the idea of convincing the public that electric light is now cheaper, the General Electric Company has isued a pamphlet entitled "How the General Electric Company Is Enlightening Eighteen Million People." The company hopes to induce lighting companies to co-operate in further advertising locally along similar lines with material placed at their disposal by it.

BUSINESS NOTES.

MR. WILLIAM T. DONNELLY, consulting engineer, has removed his offices from 135 Broadway to the Whitehall Building, 17 Battery Place, New York City.

PAWLING & HARNISCHFEGER COMPANY, Milwaukee, Wis., builders of cranes, hoists, etc., announce the opening of a branch office at 533 Baronne Street, New Orleans, La., under the management of Mr. T. W. Waddell.

THE BOSTON INCANDESCENT LAMP COMPANY has just completed a two-story addition, 80 x 30 ft., to its factory at 128 Maple Street, Danvers, Mass. This company manufactures the well-known "Boston" renewed lamp, and by the addition of this new space its facilities for the production of these lamps are now largely increased.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 7, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

983,275. ELECTRIC SWITCH; F. H. Hallefas, Chicago, Ill. App. filed May 28, 1910. For reversing the current supplied to the motor, the switch having upstanding spaced ends, a pair of stationary contacts to coöperate with the ends and a movable contact for connecting the switch and ends.

983,291. ELECTRIC HEATER; M. M. Kohn, New York, N. Y. App. filed Oct. 1, 1909. Heater has a body with upwardly extending wall, a plurality of forms adjacent to the wall, an electric conductor in each form, the forms being removable and shaped to conform to the wall.

983,292. ELECTRIC HEATER; M. M. Kohn, New York, N. Y. App. filed Oct. 30, 1909 A base, a plurality of coil holders of rectangular form removably screwed thereto and a heating coil in each holder with a switch for throwing the coils in series or multiple.

983,303. ELECTRIC FURNACE; H. Nathusius, Friedenshutte, Germany. App. filed May 6, 1908. A furnace with a hearth, carbon electrodes above the hearth and steel electrodes in the base of the hearth, adjacent electrodes differing in polarity throughout the hearth.

983.306. AUTOMATIC FIRE ALARM; E. F. Oliver, Monroe, Ind. App. filed Dec. 4, 1909. Automatically liberates a fire extinguishing gas and sounds a local alarm when the temperature reaches a certain degree and sounds a fire-station alarm when the temperature reaches a certain degree above the local alarm sounding degree.

983,308. ARMATURE FOR MAGNETO ELECTRIC MACHINES; C. A. Pfanstiehl, Highland Park, Ill. App. filed April 18, 1910. For spool type magnetos, a removable core forming a bundle of wires whose ends are connected to the pole pieces.

983,345. THERMOSTAT; J. Boekel, Philadelphia, Pa. App. filed April 30, 1910. Adjustable thermostat with mercury chamber and controllable air outlet to provide an adjustment for varying the sensitiveness of the thermostat.

983.360. X-RAY FRAME; A. Granger, New Orleans, La. App. filed June 20, 1910. X-ray camera mounted upon sliding standards with fluorescent screen.

983.361. BACK-GEARED MOTOR; A. M. Gray, Milwaukee, Wis. App. filed Feb. 28, 1910. Low-geared motor in which the frame comprises a field yoke and end heads with supporting portions and a counter shaft on the yoke, the ends being stationary and the yoke adjustable.

983,364. FIXTURE LAMP; M. Harris, Pittsburg, Pa. App. filed Nov. 11, 1908. A lamp with separately located glowers, a heater near each glower and a ballast and cut-out in circuit with each heater and glower.

983.373. DEVICE FOR LAYING UNDERGROUND WIRES; J. M. Jones, Buffalo, N. Y. App. filed Sept. 21, 1910. Does away with rods by using a linked structure or chain with means for keeping the leading links rigid.

983.380. CONTROLLER; C. E. Lord, Norwood, Ohio. App. filed June 30, 1906. A controller with casing, a switch outside of the casing open to the atmosphere operated by the controller upon abnormal circuit conditions.

983,399. RECIPROCATING MECHANISM; H. H. Ralston, Norwood, O. App. filed April 20, 1907. For giving an axial reciprocating movement to the brushes of the dynamo to change the wear point on the commutator.

983,403. ELECTRICAL SIGNALING DEVICE; J. G. Schafer, Brighton, Iowa. App. filed May 24, 1909. For country mail boxes which by means of circuit wires closes an alarm in the house when a letter is deposited in the box.

983,414. APPARATUS FOR REGULATING OR CONTROLLING THE PRESSURE OF THE CURRENT IN AN ELECTRIC CIRCUIT; J. Watkinson & A. E. Payne, London, England. App. filed June 13, 1910. For regulating or controlling the pressure of the current by means of a switch arm moving over resistances, each consisting of cells of graphite, the arm carrying a roller which bears upon the contacts and having flat springs for further contact.

983,430. PROCESS OF MANUFACTURING IRON ELECTRODES FOR USE IN ALKALINE ACCUMULATORS; Axel Theodor Konstantin Estelle, Fliseryd, Sweden. App. filed March 19, 1910. Subjects an iron salt to electrolysis in the [illegible] of a solution in another metal insoluble in alkaline solution.

983,443. ELECTRICAL ALARM THERMOM [illegible] Heddle, Nelson, British Columbia, Canada. App. filed J [illegible] 909. An alarm thermometer with graduated scale and slidir [illegible] t, a thermostat bar, a pin extending therefrom, an indicator [illegible] by the pin and an alarm controlled thereby.

983,453. METHOD OF TREATING ORES BY THE BLAST FURNACE PROCESS; F. A. Kjellin, Stockholm, Sweden. App. filed Oct. 23, 1909. Feeds iron ore and fuel into a blast furnace, heats the entire charge and then passes an electric current through the charge in that section of the furnace where the reduction of the lower oxides of iron to metallic iron begins.

983,489. IGNITER; H. N. Fullerweider, Waveland, Ind. App. filed April 18, 1910. Clamp for gas burners with improved guards for preventing the electrode conductor wires from accidental engagement with the burner stem.

983,491. SANITARY APPLIANCE FOR TELEPHONES; G. T. Hadley, San Francisco, Cal. App. filed Jan. 10, 1910. Hollow globe of thin metal which is perforated and fits over the receiver mouthpiece.

983,500. ELECTRIC REGULATOR; H. K. Kouyoumkian, St. Louis, Mo. App. filed April 26, 1910. Cuts resistance coils in and out by means of a movable arm operating over two sets of contacts, the resistances being in two series with the arm pivoted between the contacts.

983,519. MOTOR CONTROL SYSTEM; E. W. Stull, Milwaukee, Wis. App. filed Sept. 10, 1909. Motor-controlled system for a plurality of motors with a power-operated controller for varying the resistance and a manually-operated master controller for putting the motors in series and partly in parallel.

983,536. METHOD OF REMOVING STATIC ELECTRICITY; W. H. Chapman, Portland, Maine. App. filed Jan. 23, 1908. Charges an insulated conductor with an alternating charge of high voltage and passes the paper or yarn within the electrostatic field and places near it a small conductor which is grounded.

983,548. METHOD AND APPARATUS FOR EQUALIZING TEMPERATURE; H. B. Gale, Cambridge, Mass. App. filed Sept. 19, 1910. Electric heater for heating a liquid as part of a heating system, the extent of the heat-conducting surface between the heater and the liquid being adjusted and the supply of current controlled upon changes in temperature of the heater.

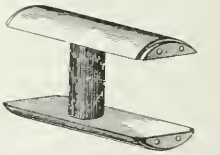
983,558. ELECTRIC SIGN; E. A. Leopoldt, Cincinnati, Ohio. App. filed Oct. 9, 1909. An elongated electric socket with side and bottom contacts to form connection with an incandescent lamp with the terminals of the lamp at selective points lengthwise of the socket.

983,570. HOLDER FOR TELEPHONE RECEIVERS AND THE LIKE; S. K. Rothschild, Detroit, Mich. App. filed Nov. 4, 1910. Telephone receiver with an outer casing and ball bearings between the receiver and the casing, the latter serving as a handle, so as to prevent twisting of the cords.

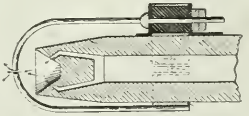
983,573. SUSPENDED INSULATOR; C. W. Schultz, Scranton, Pa. App. filed Jan. 3, 1910. Suspended insulator for trolley wires, including a shell for holding the insulating material tapped to receive a screw bolt and an annular recess to receive the supporting pipe.

983,660. ELECTRIC SWITCH; C. S. Van Nuis, Philadelphia, Pa. App. filed July 26, 1907. A switch in which a stationary contact is retained within the base by means of a molded mounting with a wedge for securing the mounting to the base.

983,670. ALTERNATING CURRENT SYSTEM OF DISTRIBUTION, REGULATION AND CONTROL. J. Bijur, New York, N. Y. App. filed March 29, 1906. Alternating current supply, alternating work circuit, storage battery compensating for variations in load and a regulator operating when the load on the work circuit varies from the average.



983,308.—Armature for Magneto Electric Machines.



983.489.—Igniter.

983,701. INSULATOR FOR ELECTRIC INSTALLATION CANOPIES; G. W. Gardiner, Chicago, Ill. App. filed Sept. 12, 1910. A canopy with central opening, a conduit passing through it and a hard rubber sleeve on the conduit passing through the opening, the canopy being held in position by a nut on the sleeve.

983,703. ELECTRICAL WRITING APPARATUS; D. P. F. Ghadiali, Surat, Ind. App. filed May 21, 1909. High-tension currents supply a tool for writing, the pen including a tube with an enlargement to receive mercury in which tube wires are arranged, connected by the mercury and a needle is resiliently mounted to make a contact.

983,713. FIRE ALARM; S. J. Heinrich, Bellevue, Pa. App. filed March 14, 1906. A fire alarm with clock train operating an indicator arm which passes over a dial with a sector connected with the arm, a lever having an armature, a magnet attracting the armature, a circuit for the magnet with controlling means for the lever operated by the train and a thermostat in the circuit.

983,717. ELECTRIC TOY; A. Huck, Nuremberg, Germany. App. filed March 29, 1910. Toy motor for toy locomotives which can be detachably secured to the locomotives and also taken apart. Details.

983,727. ELECTROCHEMICAL PROCESS FOR CLEANING AND POLISHING SILVER PLATE AND THE LIKE; A. M. Kohler, Brixton, London, Eng. App. filed July 6, 1909. Immerses the article and aluminum in a receptacle containing an aluminum salt solution, liberates hydrogen thereby which combines with the oxide and then dries the article.

983,742. ELECTRIC HAND LAMP; J. W. Mead, Buffalo, N. Y. App. filed April 20, 1910. A magneto with its magnet constructed to form the handle and an incandescent lamp on the magnet in circuit with the armature of the magneto.

983,760. BATTERY AND HOLDER; G. L. Patterson, New York, N. Y. App. filed May 26, 1908. A frame carrying cell connectors, one including an annular conductor plate with a series of cell-engaging spring fingers projecting therefrom and a resilient connector in electrical connection therewith, its outer end being within the open center of an adjacent conductor plate.

983,815. FLEXIBLE CONDUIT FOR ELECTRIC CONDUCTORS; C. A. Flack, Parnassus, Pa. App. filed Dec. 31, 1908. Non-metallic flexible conduit with an inner textile tube covered by a spiral strip with spaced edges and a textile covering and binding over the tube.

983,817. ELECTRIC CIRCUIT CONTROLLING MEANS; C. J. Fox and W. C. Grein, Rochester, N. Y. App. filed July 9, 1910. Push button switch with a key for closing the opening into which the plug is inserted, which can be made inoperative, can establish a connection with other contacts, or open them for safety.

983,835. POWER FACTOR CONTROLLER; J. Pearson, Somerset, Wis. App. filed July 20, 1907. For varying the power factor on an alternating circuit by means of synchronous machines running in parallel, and an exciter in the field of one, a rheostat in the field of the exciter, reverse acting solenoids for adjusting the rheostat, reverse acting relays for controlling the solenoids, electrical connections with fixed contacts for rendering the relays reverse-acting, and an automatic power factor regulator with fixed and movable windings, one responsive to current changes and the other to voltage changes.

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SUBURBAN ELECTRIC SERVICE.

Chicago has acquired a well-deserved reputation for electrical progress, and in no wise is it better shown than in the provisions made for supplying the widely scattered suburbs with energy for lamps and motors. The North Shore Electric Company, of which a general account is given elsewhere in these columns, has for its function the supply of a wide stretch of suburban territory, in the main beyond the districts so well covered by the Commonwealth Edison Company, with which it co-operates. It furnishes another instance of the advantages of unification of electric supply. In a territory of more than 1200 sq. miles the North Shore company serves a population of 250,000 people from four modern generating stations. These replace nearly a score of small and uneconomical plants operated by non-condensing engines and run too often in the short-sighted way common in such cases. We wish that we were able here to present a full account not only of the new system, but of what it has done for the communities interested. For one thing, it has extended twenty-four-hour service over its entire territory and has thus made possible the advantageous use of motors everywhere. It would be interesting in addition to know by how much the price of electrical energy has been reduced to the average consumer. That it has been reduced goes without saying, but we fancy the amount would upon the whole be rather surprisingly large, even though it is safe to assume larger receipts from the community arising from larger use. There is no place in which consolidation produces a more striking economic result than in just this class of service.

Consumers have the cheerful habit of kicking at monopolies on general principles. It would be a good thing if they would cease from this diversion long enough once in a while to see what the net result of, say, five years of electrical monopoly has been upon the price of the commodity. Electric service is, in fact, about the only item in the cost of living that has been steadily reduced during a period of phenomenally rapid rise in prices. And electric supply companies are notable in that they have not squealed and whined over increased expenses, begging public sympathy and permission to raise prices, but in a manly way have met the situation by improving their methods of generation and distribution. It is just the policy typified by the work of the North Shore Electric Company that has won out. As to methods, the company in question has simply followed good current practice without attempting anything in the least radical. It has kept its voltages within moderate limits and its distribution system to simple and safe lines. If one were to offer any criticism it would be that the work here and there errs on the side of conservatism. With a territory eighty miles in length and more than thirty in extreme width it is probable that the present voltages might be materially raised to great advantage. One does not usually, however, get the chance to lay out a territory like this, as a whole, with a free hand, and so in this instance the scheme bears marks of progressive development and of occasional temporizing with difficulties on the whole best met by radical remedies. For instance, it is here and everywhere rather unfortunate to be operating at two frequencies for the sake of more conveniently supplying energy for railway service. This service is a logical part of the work of a great network of supply, but is it necessary to use 25-cycle generators for the purpose? Would it not be much better in most instances to secure uniformity in the generating plants by making a deal for the employment either of 60-cycle synchronous converters or of the beautiful synchronous converters used abroad which run at about half synchronous speed and thus give 30-cycle conditions of commutation on a 60-cycle supply?

As at present constituted the whole system is served from nine substations, distributing energy at 2300-4000 volts to the working lines. At three points the high-tension system is connected to the transmission circuits of the Commonwealth Edison Company so that there can be effective interchange of energy when desirable. Two of these touch the 2000-volt underground "ring" mains, a feature of distribution that might with great advantage be copied in every large urban territory. The ring system, indeed, is considerably used in the North Shore work, and wherever it has been possible each ring has been supplied from two independent sources, while the lines to the substations are generally in duplicate. The whole system is divided into three operative divisions, each worked from a convenient headquarters in telephonic touch with the others and with all important points in the system. In a network thus constituted not only is the energy supply obtained on much more favorable terms than with the separate stations replaced, but the service is as a whole much more reliable and better regulated. With the great generating equipment available and the diversity of demand usually found the conditions for uniform voltage at any one point are materially improved if reasonable care be exercised. The three load curves shown in the article point a moral. One substation shows a peak from 4 p. m. to 5 p. m., another a very sharp peak at 6 p. m. due to residence lighting and a third a blunt peak lasting from 5:30 to 7:30. The amount of diversity in demand is very striking and the result of experience frequently shows that even in so apparently homogeneous a load as is found in suburban territory the time-variation of demand is so considerable as to be a very important factor in the service conditions. The bigger the system the better are the service conditions and the greater the advantages of unified supply.

THE DIRECTION OF ROTATION IN ALTERNATING-CURRENT VECTOR DIAGRAMS.

Two very interesting papers were presented by title at the recent mid-year meeting of the American Institute of Electrical Engineers at Pittsfield and Schenectady, by Prof. W. S. Franklin and Prof. E. J. Berg respectively, on the subjects of vector-diagram production and rotation. One of these papers is a brief for one direction of rotation and the other paper for the other, the idea being that these two short papers, with the discussion on them, might serve as evidence before the International Electrotechnical Commission and aid in arriving at a decision as to the best direction for international adoption and standardization. It is a sad but evident fact that the literature of alternating-current technology is divided into two classes; namely, that in which as time advances the vectors in the vector diagrams rotate clockwise and that in which they rotate in the opposite direction, or counter-clockwise. A vector diagram is a conventional diagram for representing to the eye conveniently and comprehensively a number of quantitative cyclic relations in an alternating-current circuit. Some of these relations are complicated and involved, so that the vector diagram is a bridge upon which to pass over deep-water mathematics. The bridge thus comes to assume fundamental significance in the mind, and it is very awkward to have to reverse this bridge, end for end, in passing from one textbook or pamphlet to another. Some readers have trained themselves to be ambidextrous in this respect and profess to be able to read the dial diagrams just as well from the back as from the front of the clock; but the average student becomes so wedded to one direction of rotation that he derives very little pleasure or profit from reading diagrams of the contrary rotation. German writers frequently place an arrow on their vector diagrams to point out clearly in which sense the time is to cause rotation.

The two Institute papers show that the two opposed methods are derived from pure mathematics by different routes—the one via trigonometry and trigonometrical projections, the other via polar co-ordinate representation, with time as the argument. Each method uses fundamentally the same direction of positive rotation. Each of the two methods may, therefore, claim to be based on fundamental mathematics and neither can maintain that the fundamental principles of the other are wrong. The whole question is one of use, convenience and convention. The polar co-ordinate method claims that it lends itself readily to finding the equivalent sinusoidal values of a complex wave-form. The clock-diagram method claims that it lends itself readily to harmonic analysis for Fourier components. It is earnestly to be hoped that the International Electrical Congress will carefully consider the question and issue a unanimous decision at Turin in September. We believe that its decision would be respected in all countries and that the present chaos would give way to uniformity. Probably nothing the commission could do would be so universally useful.

ELECTRIFICATION THE ONLY PRACTICAL PREVENTIVE OF LOCOMOTIVE SMOKE.

With the example of New York City before it Chicago has been struggling for years to obtain the electrification of railroad terminals within its borders. But as there are some twenty-six trunk-line railroads entering Chicago, using six passenger terminal stations, five being union stations, with an elaborate system of interchanging freight, the problem is a very serious one, from which the railroads shrink, although probably nearly all progressive steam-railroad operators are willing to admit privately that electrification of the Chicago terminals is bound to come at some future date—to be staved off as long as possible. Electrical men appreciate the gravity of the problem, but most of them who are familiar with the situation believe that the railroads will display greater wisdom, in this day of keen surveillance of public utilities, to take the bull by the horns and make an honest effort to meet the demands of the people—that is, to make a start in the right direction now rather than to wait until forced to make the change by the irresistible force of thoroughly aroused public opinion, with more drastic requirements than would now, perhaps, be enforced.

The charge against the steam locomotive discharging smoke and cinders into the air, and with the noise of its exhaust, is that it constitutes an intolerable nuisance in a densely populated city. In Chicago the railroad men have answered that the lomomotives make but a small proportion of the total smoke and that, from the viewpoint of smoke prevention, the electrification of railroad terminals is unwarranted. To investigate this claim the Department of Smoke Inspection of the City of Chicago has made a study of the subject, and as the result Mr. Paul P. Bird, smoke inspector of the city, read an interesting paper before the Western Society of Engineers a few days ago on "Locomotive Smoke in Chicago." Mr. Bird finds that the steam locomotives of the city use 18.5 per cent of the total amount of soft coal consumed, but they produce 43 per cent of the total smoke and over one-half of the dirt traceable to smoke. This is due to unavoidable defects in the locomotive, compared with stationary steam plants, by which the smoke from the former is much more dense and carries a large amount of cinders. Indeed, Mr. Bird makes the startling estimate that 560 tons of cinders are thrown into the air from the stacks of locomotives in the City of Chicago every day.

Considering possible remedies for this state of affairs, the author examines the suggested use of semi-bituminous coal, anthracite coal, coke or oil as fuel for locomotives. But all of these are objectionable, for reasons which are given, and Mr. Bird is forced to the conclusion that electrification of railroad terminals affords the only solution of the problem. "The study that has been made along these lines," he says, "indicates clearly that electrification offers the only final and satisfactory solution of the locomotive smoke problem. The use of special fuel for preventing smoke on steam locomotives is only a makeshift and will not satisfy the public." This is positive language, but the conclusion seems to be justified fully by the facts in the case. The municipal authorities, the various associations of business men, the newspapers, the women's clubs, the "Chicago plan" advocates and the other agencies that are fighting the inertia of the powerful railroad corporations in Chicago to bring about electrification will find in Mr. Bird's paper a strong weapon of attack.

A METHOD FOR STUDYING THE INTERNAL INDUCTANCE OF LINEAR CONDUCTORS.

In dealing with a natural phenomenon in a practical way, for the purposes of engineering and business, there is a certain order of progress and development, which is partly real and objective, partly psychological and subjective. Let us suppose that the phenomenon is the ordinary flow of water through a tube, as utilized in hydraulic supply mains. The first step is made when the process is applied to any practical extent, no matter how crudely, as when water from a spring is conducted to a little hamlet through a ditch or duct. The next step is when pipes are made to carry the water underground so that the supply does not freeze up in winter. Another step is when long aqueducts are made over hill and valley for carrying a large supply of water to a city. In each succeeding step new problems arise, new laws have to be discovered, new principles established, and knowledge increases with never-ending ramification. Details which would seem too trivial to consider at one stage become of critical importance at a later stage. The solution of one problem becomes in turn but the formulation of the terms of a new and deeper problem. But with each solution new knowledge and new powers are gained.

The linear inductance of a conducting loop, such as may be formed by a pair of parallel wires, affords another instance of the same sort as the above. A pair of aerial parallel copper wires have a linear inductance of, say, 4 millihenrys per mile of loop. This inductance is mainly due to the magnetic flux linked with the conductors and in the air between them. A relatively small part is due to the magnetic flux inside the copper wires. If, however, iron be substituted for copper the linear inductance may be increased to, say, 30 millihenrys per mile of loop; for, owing to the vastly greater permeability of the iron in the substance of the wires, the magnetic flux inside the wires is greatly intensified, although the permeability of the air in the loop external to the wires has not changed, so that the internal linear inductance is now about 26 millihenrys per mile and the external inductance about 4. The exact values of the internal linear inductance are not easy to predetermine. The permeability of the iron is not uniform, but, as we know, varies with the magnetizing force This magnetizing force differs at different radial distances from the axis of the wire, so that a sort of average magnetic permeability has to be found by experiment. Experiments thus far published show conclusively that the permeability varies with the strength of the current in the wire.

Again, it is well known that an electric current is a phenomenon involving both the conductor and the dielectric outside the same. The current always starts at the bounding surface of the two, as we understand the process, namely, at the surface of the wire, and extends thence both ways. It penetrates as an electronic transfer inside and downward in the conductor. It penetrates as a distribution of electromagnetic flux into and through the dielectric. If the rate of alternation of the current is sufficiently rapid it does not penetrate beyond a certain skin-depth into the conductors. This alters both the effective linear resistance and the effective linear inductance of the conductors. Moreover, the magnetic field set up in the wire is not concentric with the axis of the wire if the two wires forming the loop lie close together. Hence arises an additional complexity in the results. Consequently, we have as yet no formula upon which we can rely for expressing precisely the linear inductance of an iron-wire loop. Measurements have been made and published of the inductance of such loops, but owing to the shortcomings of our mathematical processes in the above respects these measurements have not yet been reduced to definite analysis. When very feeble currents are used, in not large iron wires and at low frequencies, the average permeability ordinarily appears from the measurements to be in the neighborhood of 150. When more powerful currents are used the permeability rises very greatly, but just how high it is hard to say, owing to the combined effects of non-uniformity, skin effect and flux eccentricity. Mr. Frank F. Fowle suggests in his article, on page 485, a particular plan of testing iron-wire loops from which the permeability may be deduced on the assumption that it is uniform throughout the substance of the conductor and also that the skin effect is negligible. The going and returning conductors are made concentric so as to eliminate the eccentricity of magnetic flux. Experimental observations in this direction are much needed, provided that they are followed up mathematically to a reliable conclusion.

Program for Minnesota Convention.

The program for the fourth annual convention of the Minnesota Electrical Association, to be held in St. Paul on March 14-16, has been carefully prepared and includes papers as follows: *Curb Lighting*, Ludwig Kemper, Albert Lea: *Window and Sign Lighting*, George Steinwedell, St. Paul; *Residence Lighting*, C. E. Van Bergen, Duluth; *Sales Departments for Small Cities*, Herbert Markle, Stillwater; *Gas-Producer Engines for Central Stations*, A. W. Wagner, Huron; *Gasoline Competition*, by a representative of the National Electric Lamp Association; *Testing Wattmeters*, F. R. Cutcheon, St. Paul; *Engine and Boiler-Room Records*, E. Holcombe, St. Paul: *Insurance*, Mr. Ritt, St. Paul: *Day Load for Central Stations*, E. L. Callahan, Chicago; *Incandescent Lamp Improvements*, Henry Schroeder, Chicago; *Safety in Line Construction*, H. G. Winsor, Minneapolis.

The convention will be held in the sun parlor of the handsome new St. Paul Hotel. There will be a banquet in the palm room of the hotel and visits are planned to the plants of the Northern Heating & Electric Company and St. Paul Gas Light Company, including the celebrated sand-rock tunnels of the latter. Mr. Robert W. Clark, of Minneapolis, is president of the association.

Electric Railway Investigation in Providence and Buffalo.

At the request of the Mayor and Common Council of Providence, R. I., Mr. B. J. Arnold, chief engineer board of supervising engineers, Chicago Traction, will conduct an examination of the surface-railway conditions of Providence and will present a report on this subject with recommendations as to the improvements. On Feb. 11 Mr. Arnold outlined in a speech before the Conservative Club at Providence some of the problems which were confronting street railway companies at the present day and the methods which had been adopted in other cities, particularly in Chicago, to improve the local street-railway system. According to Mr. Arnold the best results are secured only when the subject is approached in a broad and co-operative spirit by the public, the company, the city government, the property owners and the financiers interested in the property. Other speakers were Mr. Edward G. Buckland, vice-president of the Rhode Island Company, which controls the electric railways in Providence, and Mr. Henry Fletcher, Mayor of the city.

Mr. Arnold has also been engaged by the International Traction Company of Buffalo to make an appraisal of its properties. This appointment was made because of proposed refinancing plans of the company for which the Public Service Commission, Second District, New York, required an appraisal of the physical property of the company. The company submitted the name of Mr. Arnold as appraiser to meet this requirement and the commission approved his selection.

Illinois Electric Railways Association.

At the meeting of the new Illinois Electric Railways Association in Chicago on Feb. 17 permanent organization was perfected, with Mr. H. E. Chubbuck, Illinois Traction System, president, and Mr. C. E. Flenner, Aurora, Elgin & Chicago Railroad, secretary. A constitution and set of by-laws were adopted. Active members consist of electric-railway companies, paying $10 initiation fees and 50 cents per mile of trackage as annual dues, and supply companies, paying $25 a year per company member. Associate members are individuals, who may be non-residents of the State, and pay $5 a year. Meetings are to be held in January, March, May, September and November of each year. In relation to suggested affiliation with the Central Electric Railway Association of Indiana and Ohio the committee previously appointed reported favorably on the proposal, but the report was laid on the table. A committee on automatic signaling was appointed. It consists of Messrs. G. T. Seeley, South Side Elevated Railroad, Chicago; John Leisenring, Illinois Traction System, Peoria; E. F. Gould, Aurora, Elgin & Chicago Railroad, Wheaton; T. M. Childs, Chicago, Lake Shore & South Bend Railway, Michigan City, Ind., and L. E. Gould, *Electric Railway Journal*, Chicago. The next meeting of the association will be held in Bloomington on March 17.

German Commercial Methods in Japan.

United States Consul-General Thomas Sammons, at Yokohama, Japan, reports that German manufacturers recently secured an order in Tokyo for electrical apparatus and water-wheels amounting to approximately $950,000. This order was placed by the Tokyo Electric Light Company and included six 7700-kw generators and water-power turbines, twelve 4000-kw transformers, twelve 3600-kw transformers and corresponding switchboard apparatus. Of the above-named apparatus the Allgemeine Elektricitäts-Gesellschaft, of Berlin, obtained an order for about 75 per cent, namely, approximately $400,000 for electrical apparatus and $300,000 for the water-wheels. The Siemens Company, of Berlin, obtained an order for approximately $175,000 of the electrical apparatus and the Shibaura Engineering Works, of Tokyo, in which the General Electric Company is interested, obtained an order for only about $50,000 of the electrical apparatus. Consul Sammons reports that he has made a careful investigation of the prices made by the German firms and the conditions under which the order was taken, and finds that the Germans, on the electrical apparatus, were only about 9 per cent lower than the chief American competitor, the General Electric Company. These German quotations were at first understood to be quite radical; that is to say, 25 per cent to 30 per cent below American prices. It is evident, however, that some of the German manufacturers are quite willing to sell below cost in certain instances with a view to meeting competition and securing control of desirable markets.

Irrigation Pumping Plants in the Southwest.

Men interested in the reclamation of land in the semiarid regions of the Southwest and Mexico are giving attention to the study and comparison of the different means that may be employed for placing water upon their farms. During the last few years the demand for pumping machinery has increased enormously in this vast territory of wonderful irrigation possibilities, but even the great development already accomplished is slight compared with what may be done in the future. Manufacturers and dealers in irrigation equipment are finding the new field a fruitful one for their efforts.

Without entering into a technical discussion of the different types of irrigation plants that are already in use, a review of the situation may be of interest. It has been amply shown that what may be economical to the farmer in one locality may be expensive in another. For this reason there has been no uniform adoption of irrigating pumping plants in Texas or other parts of the Southwest and Mexico. Improvements along this phase of the industry are being constantly made, however, the manufacturers standing ready to meet the demands of the farmers.

The beginning of the era of irrigating pumping machinery as a part of the farm equipment in Texas does not date back many years. Ten years ago there were a few scattered pumping plants in the territory immediately adjacent to San Antonio, used chiefly by truck growers. To-day there are hundreds of these plants in operation in that section and the land reclamation movement has extended all the way to the Rio Grande, embracing a territory that is 100 miles to 300 miles north and south by 500 miles east and west. Counting the rice-growing region of the upper Gulf coast, the width of the irrigation belt in that State is more than 1000 miles.

In Mexico remarkable progress is being made in the use of modern pumping plants for irrigating large areas of land. Irrigation is not a new thing in that country. It was practised by the Aztecs when the Spaniards invaded the land four centuries ago. In some parts of the republic the old, roughly hewn overshot wheels, operated by man-power, are still in use to lift the water from wells and streams, allowing it to run over the land. But the touch of progress and development is being felt there to almost as great a degree as in Texas, and the wants of the farmers in this particular are being supplied chiefly by American manufacturers.

Fuel is a problem in most parts of the semi-arid region of the Southwest and Mexico. An exception is in the south Texas region, where the low-growing mesquite and other thorny varieties of timber growth cover the ranch lands and furnish cheap fuel for the comparatively few steam-pumping plants found there. In the Rio Grande Valley section around Laredo coal mines provide fuel. But, notwithstanding the abundant wood and coal resources, it has been found cheaper to use gasoline engines or electrical equipment for the pumping plants. Another fuel resource just made available for the great number of irrigation pumping plants in the Laredo region is natural gas, piped through the Bermuda-onion and other vegetable farms from the Reiser gas field, about twenty miles distant. The adoption of natural gas for fuel for the engines promises to become general in that part of Texas, although before this fuel supply was available electric transmission lines were constructed from a central power plant in Laredo up and down the valley, and many of the farmers were using this energy to operate their pumps. Notwithstanding the fact that the water lift on the Rio Grande in the vicinity of Laredo ranges from 55 ft. to 105 ft. the cost of placing water upon the land is said to average less than in most irrigated localities. Of course, this cost depends largely upon the kind of crop that is being grown, but even for Bermuda onions, which require an unusual amount of water, the expense from this source for the farmer has ranged from $10 to $12 per acre per year.

There are about thirty-eight irrigation pumping plants in the lower Rio Grande Valley, in what is known as the Brownsville country, more than 300 miles below Laredo. All of the irrigation plants in the lower Rio Grande Valley are of very large capacity, ranging from 50,000 gal. to 150,000 gal. of water per minute each. Each one of these plants is operated by electric power and the others by either gasoline or steam.

In the more western part of Texas, in the plateau region of Mexico and in most parts of the arid region of New Mexico and Arizona producer-gas and gasoline engines are used to operate the pumping plants. Electrical energy has come into use for this purpose in some localities, particularly in the Mimbres Valley around Deming, N. M., and in the vicinity of Portales. Hydroelectric plants, which have for their chief purpose the furnishing of power for irrigation pumps, are proposed for a number of localities in Arizona and Mexico. As an auxiliary to the great land reclamation of the government in the Salt River Valley of Arizona a hydroelectric plant near Phœnix will supply a large amount of power for the farmers. At a point on the Conchos River eighteen miles from Santa Rosalia, Mex., a Canadian syndicate is building a great water-storage reservoir and will install a hydroelectric plant and pumping machinery to irrigate about 250,000 acres of valley land. There are many other similar enterprises of lesser size on foot in that country.

In Mexico the producer-gas engine is coming into even more general use for operating irrigation pumps and other machinery than in the semi-arid region of this country. Many engines of this type have been installed during the last year in the States of Durango, Coahuila, Chihuahua, Sonora, Nuevo Leon and Tamaulipas, where the land is particularly well situated for irrigation. It is claimed by Americans and Mexicans who have placed producer-gas engines in use that they are not only cheaply operated but they are easily handled by the natives. Charcoal is comparatively inexpensive in most parts of Mexico. In the plateau region of Durango, where there are many of these engines, the charcoal is brought down from the timber-covered mountains by native burners.

Producer-gas engines for operating pumping plants in the upper Rio Grande Valley of New Mexico and Texas, as well as on the Mexico side of the international boundary stream, in the territory that is to be embraced in the great Elephant Butte reclamation project, are strongly advocated by P. E. Fuller, the United States engineer and expert who is in charge of the pumping and irrigation investigations in the Salt River Valley of Arizona. The owners of the land to be irrigated by the Elephant Butte project have formed a water users' association which contemplates installing a hydroelectric plant at the dam to cost about $326,000, providing energy for operating auxiliary pumping plants on the farms. In a recent address before this association Mr. Fuller advocated the establishment of a pumping plant on every 160 acres in the valley. Pending the installation of the proposed hydroelectric plant he urged the use of producer-gas engines to operate the individual pumping plants that are to be established. He said that pumping against a 70-ft. or 80-ft. head was not impracticable when producer-gas engines are used. To install a large pumping plant, sufficient to irrigate about 15,000 acres at 30-ft. lift, the initial cost per acre would be about $28, using producer-gas generated from coal costing $4.40 per ton. The cost per acre-foot at the well is placed at $1.90 and the cost of placing three acre-feet of water upon the land per year is estimated at $5.70.

In the vicinity of Douglas, Ariz., a project is being promoted for establishing pumping plants to irrigate about 10,000 acres. All through the ranch territory of South Texas pumping plants to irrigate tracts of land ranging in size from 1000 acres to 25,000 acres are being installed or are under consideration. Besides these larger propositions there are scores of smaller irrigation projects of individual farmers who have from ten to 200 acres that are to be watered in this manner. In some localities of western Texas where running streams of water are not available it is found practicable to harness a number of surface wells to one pumping plant and so obtain a supply of water to irrigate a large acreage of land.

Scope of the Illuminating Engineering Society.

At the weekly luncheon of the Electric Club of Chicago on Feb. 15 Mr. F. J. Pearson, chairman of the Chicago Section of the Illuminating Engineering Society, read a short paper on "The Illuminating Engineering Society—Its Origin, Scope and Future." Mr. Pearson gave an outline history of the society from the first meetings in 1905, which resulted in its formation the next year. He told of the benefits of the organization to merchants, central-station operators, manufacturers and others, and in a general way gave the members of the Electric Club an idea of the scope and influence of the society. One interesting fact he mentioned was that about 60 per cent of the members of the society are electrical men, about 20 per cent connected with gas lighting, while the remaining 20 per cent may be classed as "miscellaneous."

In the discussion Mr. George C. Keech, first chairman of the Chicago Section, spoke about the remarkable series of lectures last year at Johns Hopkins University and also referred to the coming annual convention of the Illuminating Engineering Society to be held in Chicago. Mr. J R Cravath, also a former chairman of the Chicago Section, referred in an interesting manner to the origin of the term "illuminating engineer" some eight or nine years ago. Mr. F. H. Bernhard, the secretary of the Chicago Section, told of the work of the local section, and Mr. George H. Stickney, of Schenectady, alluded to the importance of the subject of illuminating engineering and also to the value of the work of the society in collecting engineering data to aid illuminating engineers.

Mr. F. P. Vose reviewed briefly the relations of architects and electrical contractors. It is often the case, he said, that contracts for electrical work drawn by architects are decidedly unfair to the electrical contractors The architect's decision is final, and sometimes very unreasonable and inequitable exactions are made The speaker would like to see some movement on the part of the electrical contractors to combat the tendency of architects to exact unreasonable terms in relation to electrical construction. Mr. H. E. Niesz, president of the club, said that the Electric Club would be glad to co-operate with the electrical contractors in furthering such a movement. The thanks of the club were extended to Mr. Pearson for his instructive address.

Economic Limitations to Aggregation of Electrical Systems.

At a meeting of the American Institute of Electrical Engineers held in Boston on Feb. 17, Mr. Robert A. Philip, of the Stone & Webster Engineering Corporation, Boston, presented a paper dealing with the economic limitations to aggregation of electrical generating and distributing systems. The paper was particularly timely in view of the paper of the week previous at the New York meeting by Mr. William B. Jackson, of Chicago, on unified electric systems covering large areas. Mr. Philip's paper consisted of two principal sections, the first discussing the economic value of electric service on the basis of many broad generalizations of unique interest, and the second treating mathematically the phenomena and conditions surrounding the transmission of energy through networks of great magnitude. The author's conclusions were summarized as follows:

Electricity is essentially a secondary source of energy standing in the relation of a common medium of exchange to other energies. Prime energy is like property, electric energy like money. Every circumstance unfavorable for economical generation can be found in varying degrees among isolated plants, while central stations may take advantage of every practicable economy. The public-service corporations which distribute energy constitute clearing houses for balancing the individual increases and decreases of energy requirements of a community as a whole and provide a centralized reserve for meeting promptly any total net increase. In the aggregate the disproportion of isolated prime movers in their fields must be enormous. Diversity factor contains almost inconceivable possibilities. It is to be expected that in time the country will be covered with high-tension lines. The large plant gives centralized reserve, the large system gives a diversity factor among accidents and an interchange of reserve. Electric energy, though poured in unlimited amounts into a system of indefinitely great extent, must be as mobile as trains on a railroad network, must be universally uniform in quality, must never be totally interrupted, and though in amount unlimitedly great must not be uncontrollable. To meet these requirements electric transmission must take the alternating-current form and the energy should be transmitted at constant potential. Finally, this system is one using high reactance made transparent by leading wattless currents and transmitting energy by displacing the phase of the voltage instead of varying its amount.

Discussion.

Mr. J. F. Vaughan, Boston, commended the extension of large systems as beneficial in solving the smoke problem by wiping out the small coal-burning plants. Already the aggregation of systems has been carried to a great extent and there appears to be scarcely any limit except the rupturing capacity of the individual oil switch.

Mr. N. T. Wilcox, Lowell, Mass., emphasized the effect of low-cost cement in reducing the expense of water-power development and urged the need of good engineering in network planning. A poor engineering job becomes a permanent tax on a property. The saving in investment through diversity factor is of vast importance. As Mr. Torchio pointed out the week before in New York, there was only 24 per cent reserve in equipment in the New York Edison system in 1909 compared with 66 per cent on twenty-seven supply systems in London.

Prof. C. A. Adams, of Harvard University, submitted interesting graphic illustrations of the points concerning the use of synchronous apparatus discussed in Mr. Philip's paper.

Mr. J. Echen, Boston, touched upon the difficulties of voltage regulation with large inductive loads. Conductors of large size tend toward high reactance and increasing voltages bring trouble from corona loss.

Dr. A. E. Kennelly, Harvard University, commented on the tendencies toward mutually interlaced systems and brought out the new conceptions of regulating methods which must be maintained on such systems—voltage that is constant rather than unity power-factor. That means many synchronous motors with fields adjusted to give the right amount of leading current at the various points of the network, with adjustment as the load varies. This principle is likely to be approached as systems grow. If an inductive load goes off the line very suddenly a large change in field strength becomes necessary. It is not altogether advantageous to have high inductances in the line. Surges are more likely under such conditions.

Mr. E. N. Lake, Boston, emphasized the importance of uniformity and standardization in large networks.

President Dugald C. Jackson reviewed the benefits of unified electric systems and pointed to the struggle between plant sizes and controlling devices corresponding to that between guns and armor plate. He felt it to be a matter of congratulation that Mr. Philip has shown that a short-circuit on a nation-wide network could affect only a limited area. Phase control is more important than voltage control in large systems.

In closing Mr. Philip sketched the possibilities of using independent disconnecting devices and automatic regulators of synchronous apparatus on great systems. When the limit of circuit-breaking devices is reached it will be necessary to resort to reactance, but controlling mechanism has not yet been carried to its ultimate development. He felt that systems would be developed to meet the conditions, although many details are still unsettled.

Alternating-Current Motors for Elevator Service.

At the regular monthly meeting of the Pittsburgh Section of the American Institute, held Tuesday evening, Feb. 14, in the rooms of the Engineers' Society of Western Pennsylvania, the subject of "Alternating-Current Motors for Elevator Service" was discussed. The discussion was confined generally to polyphase motors, although single-phase motor applications were mentioned by some of the speakers.

Mr. W. H. Patterson, of the Westinghouse Electric & Manufacturing Company, opened the discussion with a paper illustrated by views of apparatus and curves dealing with the subject from the manufacturers' point of view. He stated that there were two kinds of polyphase motors used for elevator work, namely, squirrel-cage motors with high-resistance secondaries and slip-ring motors with external resistance in the secondaries. The former is much simpler, the control consisting of a reversing switch mounted in any convenient location. It has characteristics particularly adapting it to elevator work, such as maximum torque at starting, decreasing as the speed increases, which is just what is needed for such work. This type of motor gives twice full-load torque with two and one-half times full-load current at starting and so may be connected directly on the line without any starting device. Another characteristic possessed by this type of motor which makes it particularly adaptable to elevator service is that the starting torque is equal to the "pulling-out" torque. Thus the acceleration is smooth, a fact that adds greatly to the comfort of the passengers. The motor has a relatively high power-factor at starting and, it was stated, would not affect the lines so much as a constant speed squirrel-cage motor. At the present time the motors are limited in capacity to from 18 hp to 20 hp.

The slip-ring motor is used with some form of controlling device and for elevator speeds of from 250 ft. to 300 ft. per minute. The great difficulty with alternating-current motors in this service is the braking, which with direct-current motors is a comparatively simple manner, as the motor acts as a generator, being short-circuited through a resistance. The slip-ring motor develops twice full-load torque with twice full-load current at starting, but the power-factor is not so high as that of the squirrel-cage type during this period. Alternating-current motors for elevator service have been in use for several years now and have fully demonstrated their adaptability for this class of work.

Mr. F. E. Town, of the Otis Elevator Company, described the magnet control of slip-ring motors and explained the difficulties encountered in their application as compared with direct-current motors, particularly with regard to braking. Mr. H. D. James gave an interesting review of the history of alternating-current motor application from its inception, dealing with the commercial as well as the engineering features. He called particular attention to the fact that elevators carried human freight and no chances could be taken which would in any way lessen the factor of safety. An accident would not only be the cause of a damage suit, but would endanger the reputation of the system used. The general discussion was participated in by several engineers who viewed the subject from the standpoints of manufacturer and central-station operators.

Illuminating Problems in Small Towns.

The subject for discussion at the meeting of the Chicago Section of the Illuminating Engineering Society on Feb. 16 was "Illumination Problems in the Smaller Cities." No set paper was presented, but several members took part in a general discussion. Mr. J. R. Cravath said that the illuminating problem in the small city is essentially one for the central station to meet. The lighting company should see that its customers get the best results for their money. The speaker considered illumination as applied to stores, residences and streets. The merchants in the small towns are prone to use drop-cord lamps on the level of the eye, and it is hard to get them to spend money for diffusing or reflecting glassware. They are accustomed to the glare of gasoline lighting units, and are apt to think that if there is no glare the light is insufficient. However, conditions are gradually improving, and in many small cities and towns there are numerous stores with high-level light sources supplied with reflectors. In residence lighting there are still many small houses that have nothing but lamps attached to drop cord. Where fixtures are used they are often poorly designed, and it should be the business of the central station to see that the supply dealer of the town carries fixtures that will permit of modern efficient lighting.

Where drop cord is used the lighting may be improved by attaching tungsten lamps at the ceiling and controlling them with pendent or wall switches. In street lighting a frequent country-town condition is that of an arc lamp at every other street corner, lamps thus being spaced from 600 ft. to 1200 ft. apart. This lighting is not only insufficient, but it produces a conspicuous glare effect. The solution seems to be to use tungsten lamps spaced more closely together—perhaps a 100-watt lamp at each street intersection. But not all small cities have inefficient street lighting, and Mr. Cravath spoke of the example of Albert Lea, Minn., a city of 6000 inhabitants, where ornamental posts, each supporting a 60-watt lamp, are spaced at intervals of 55 ft. on one residence street, while on business streets the same type of post, but supporting three lamps of the same size, is used, spaced at the same intervals. This accomplishment shows the possibility of educating the people in smaller cities to the use of modern street lighting.

Mr. C. A. Luther, of the People's Gas Light & Coke Company, Chicago, remarked that there is a great field for educational work in the smaller cities and, indeed, in the large cities also. There is such a thing, he said, as overburdening the customer with light, and this is not good practice. The Illuminating Engineering Society should be of particular benefit to the employees of small companies, and these companies will do well to insist on having such of their employees as are engaged in lighting work join the society.

Mr. A. L. Eustice commented on the lack of reflecting devices in small towns.

Mr. C. A. Howe corroborated Mr. Cravath in the assertion that the problem is "up to" the central-station man in the small town. There is an almost limitless field to teach the manner of obtaining proper results from light sources. The lamp-manufacturing companies and the manufacturers of reflectors are conducting educational campaigns along this line. A general manager for a syndicate of small companies can do much good in carrying on this educational work, both on his own account and by calling to his aid the illuminating engineer. The smaller cities are waking up to the importance of this subject, and the society should lend them its aid.

Mr. J. G. Learned, of the North Shore Electric Company, told of the value of lectures on the elements of illuminating engineering as conducted by the commercial lighting interests. His company, which does a suburban central-station business, realizes the practical importance of illuminating engineering, which places in the possession of the solicitor a means of convincing lighting customers that the company is really trying to serve their interests. Ignorance on the part of customers and prospective customers is the greatest obstacle encountered in selling electricity in small towns. Here is a great field of work for the Illuminating Engineering Society. Perhaps it might co-operate with the fixture manufacturers and the electrical contractors, or perhaps it might go farther and reach the public at large through articles in the popular magazines, for illuminating engineering is a subject that is of importance to all persons who use their eyes by artificial light.

Dr. Herbert E. Ives, of Cleveland, vice-president of the general society, representing the Chicago Section, was introduced and spoke on society matters, referring to the coming Chicago convention, the plan of forming local or section membership committees and the formation of a new committee on research. Dr. Ives advocated joint meetings with medical societies, boards of education, college faculties, etc., to spread knowledge of proper methods of illumination. There is endless opportunity, he said, for general missionary work along this line.

Mr. Preston S. Millar, of New York, general secretary, spoke briefly on society matters, referring to the thriving condition of the organization.

Electrification Only Remedy for Railroad Smoke Nuisance.

At the meeting of the Western Society of Engineers in Chicago, Feb. 15, Mr. Paul P. Bird, city smoke inspector of Chicago, presented a paper on "Locomotive Smoke in Chicago."

Chicago, said Mr. Bird, is the greatest railroad center in the country and one of the greatest manufacturing centers. Soft coal from Illinois and Indiana is the universal fuel used, and the result has been the fouling of the atmosphere with large quantities of smoke and dirt. Railroad men have contended that the railroads make but a small part of the total smoke of Chicago, and that from the viewpoint of smoke prevention the electrification of railroad terminals is unwarranted.

An investigation made by the city department of smoke inspection, however, has brought out the following conclusions: Although the locomotives of the city use only 18½ per cent of the total coal, they make 43 per cent of the total smoke and over one-half of the total dirt, sparks and cinders. The locomotives consume within the city limits, 5000 tons of soft coal daily, or about 1,850,000 tons annually. According to the Ringlemann system of smoke density the average locomotive smoke in Chicago is 23 per cent. The lowest average density of smoke produced by any one road is about 10 per cent, probably as low an average as can be maintained with soft coal. If all locomotives in Chicago maintained an average smoke density as low as 10 per cent, the locomotive smoke would still form 29 per cent of the total smoke and probably produce over one-third of the dirt. Locomotives in the neighboring towns outside of Chicago make an average smoke density of about 41 per cent, showing that the anti-smoke campaign in the city has already reduced the smoke nearly one-half. Approximately 10 per cent of all coal fired in a locomotive fire-box is discharged from the stack in the form of cinders. Within the city limits of Chicago about 560 tons (fourteen carloads) of cinders from locomotive smokestacks are dropped every day. There are 2200 miles of railway track in the city limits, and at all times about 1400 different locomotives working in the city.

There are nearly 7000 high-pressure stationary steam boilers in Chicago, their total rating aggregating 1.000,000 hp. An average of 5 lb. of coal is used per boiler hp-hour.

Mr. Bird grouped smoke-producers into seven classes: (1) Central district, or downtown, stationary boiler plants, chiefly in office buildings, hotels, warehouses, factories, etc. (2) Miscellaneous power plants not in central district, including all stationary high-pressure boiler plants in factories, mills, electric power houses, packing houses, breweries, etc. (3) Flat and apartment buildings. (4) Domestic heating. In classes 3 and 4 are included low-pressure steam heating or other domestic heating plants using soft coal. (5) Special furnaces. This class includes all special furnaces used in various manufacturing processes, as iron and steel plants, kilns, annealing ovens and the like. (6) Railroad locomotives. (7) Steam vessels. The accompanying tables shows the coal consumption and smoke produced by these classes:

Class	Consumer	Annual Coal Consumption, Tons	Per Cent.	Per Cent. of Smoke Density.	Per Cent of Total Smoke.
1	Central district	1,500 000	15.0	3.75	6
2	Misc. power plants . .	4,500,000	45.0	6.5	30
3	Flats	750,000	7.5	3.0	2½
4	Domestic. . . .	650,000	6.5	3.0	2
5	Special furnaces	600,000	6.0	20.0	12½
6	Railroads . . .	1,850,000	18.5	22.3	43
7	Boats.	150,000	1.5	25.0	4
	Total.	10,000,000	100.0		100.0

From 8 per cent to 18 per cent of all bituminous coal put into locomotive fire-boxes is discharged from the stack as sparks and cinders, while in stationary plants, where the coal is burned with low draft and tall chimneys, few cinders are carried out with the smoke. Smoke from locomotives is hence far more objectionable than that from stationary plants, besides being discharged near the ground and trailed over long courses.

Mr. Bird points out that general use of anthracite coal or of coke for locomotives would eliminate smoke, but the other nuisances due to steam locomotives would not be diminished. Fuel oil makes very objectionable smoke unless carefully handled. The general use of any specially selected fuel will greatly increase the cost of that fuel to the railroads and the practical difficulties involved would make it a very difficult reform to bring about. The locomotive fire-boxes would have to be changed if coke or hard coal were used. Concluding this phase of his investigation, Mr. Bird makes the emphatic declaration: "The study that has been made along these lines indicates clearly that electrification offers the only final and satisfactory solution of the locomotive-smoke problem. The use of special fuel for preventing smoke on steam locomotives is only a makeshift and will not satisfy the public."

In the discussion following Mr. Bird's paper a number of steam-railroad men took part, and they all opposed electrification, or at any rate any immediate attempt at electrification. Some of them spoke in vigorous language. Others discussing the paper were: Messrs. William B. Jackson, A. Bement, R. H. Kuss, Albert Scheible, P. M. Chamberlain, Dr. W. A. Evans, H. H. Evans and M. L. Harris.

Pittsfield-Schenectady Convention of the A. I. E. E.

The opening session of the mid-year convention of the American Institute of Electrical Engineers was held at the Mohawk Golf Club, Schenectady, N. Y., on Tuesday afternoon, Feb. 14. The introductory remarks were made by Mr. E. A. Baldwin, chairman of the Schenectady Section, who explained in detail the reasons for holding mid-year conventions and welcomed the visiting members both to Schenectady and Pittsfield. On account of the inability of President Jackson to attend the opening session, the reply to the words of welcome was made by Past-president Charles F. Scott. Mr. Scott outlined the growth in the membership of the Institute. About eight years ago the total membership in the largest center, namely, New York, was no greater than the present membership centered around Schenectady. Although the growth in the Institute membership has been quite remarkable, it merely reflects the growth of the electrical industry. During the past few years the engineer has considerably broadened his work so that at the present time he may be considered the most active agent in modern civilization. Most of the elements which distinguish modern from ancient civilization, such as means of transportation, communication of intelligence and expansion of the working hours throughout darkness, are attributable to the engineer.

Mr. D. B. Rushmore, senior manager of the Institute, was placed in charge of the meeting on account of the absence of the president and vice-presidents. The technical portion of the session was devoted to the presentation and discussion of three papers dealing with the general subject of materials. These papers were presented by Messrs. A. B. Hendricks, W. J. Wooldridge and H. R. Wilson.

MATERIALS.

The paper by Mr. Hendricks contained much data relating to laboratory tests made upon small samples of commercial insulating materials. Use was made of generators delivering sinusoidal e.m.fs., the machines being of both the old smooth-core type and the modern distributed-field type. For increasing the e.m.f. from the generator value to the value for testing use was made of transformers with massive cores and few turns in the winding; that is, transformers of low leakage reactance and impedance. The author stated that modern testing transformers operate at from 5 volts to 20 volts per turn as compared with from 1 volt to 3 volts formerly.

In commenting on the A. I. E. E. specifications that testing transformers should be required to withstand double normal high-tension voltage between high-tension winding and low-tension winding and core, the author stated that a better and more rational method of test is to apply an "induced" voltage 50 per cent above normal, the middle or end of the high-tension winding being grounded.

The most nearly perfect method for determining the high-tension voltage with convenience and accuracy is one involving the use of a voltmeter coil on the main core. All that is required is a coil of a few turns inserted symmetrically at the middle of the high-tension winding and connected thereto at the neutral point. This method is far preferable to the spark-gap method, which is liable to be the source of error and trouble. For example, when the known e.m.f. (found by the conversion ratio) was 69,300 volts, the e.m.f. indicated by spark-gap varied from 86,000 to 73,800, according to whether the gap was used alone or with resistance in parallel.

The paper contained reports of tests on oil, pressboard, wood and hard fiber, presented in the form of curves showing the dielectric strength, specific capacity, arcing voltage, time test and energy loss under various conditions. It also contained numerous suggestions relating to the methods for testing solid and liquid materials.

The paper by Mr. Wooldridge dealt with the hysteresis and eddy-current exponents for silicon steel. Experience has shown that the core loss in silicon steel operated at high densities cannot be predicted from the values obtained at low densities by use of the well-known eddy-current and hysteresis exponents of 2.0 and 1.6 respectively, on the basis of constant coefficients, as is generally done. The author separated the eddy-current loss value from the hysteresis loss value and attributed the change from the predicted values to variation in the exponents. He assumed that the eddy-current exponent varied from 2.0 at 6000 lines per square centimeter to 1.6 at 16,000 lines per square centimeter, while the hysteresis exponent was assumed to vary from about 1.57 at 6000 lines to 3.2 at 16,000 lines per square centimeter. The tests were made on 0.014-in. sheet steel.

The paper by Mr. Wilson dealt with those features of transformer design which are affected by commercial requirements, with special reference to the limits of standardization. He stated that a reduction in the insulation factor of safety will give a reduction in core loss and that a low core loss obtained in this manner may easily deceive a prospective customer who cannot be expected to be acquainted in detail with the strength of the various insulating materials and methods of using the same. In regard to the relation between efficiency and cost, it is to be noted that where the cost of energy is low a low-efficiency transformer is preferable to a higher-priced high-efficiency unit.

The merits of low-reactance transformers are frequently overstated. The higher the reactance the greater the ability of a transformer to withstand short-circuits. It is desirable, therefore, to have high reactance in transformers used in a large interconnected system.

Discussion.

Dr. C. P. Steinmetz stated that the paper by Mr. Hendricks contained a synopsis of the present knowledge relating to insulating materials and the methods of testing such materials. He called attention to the fact that, of all of the materials used in the construction of electrical apparatus, the insulation is by far the most important. In view of the advances that have been made recently in the production and utilization of insulating materials, it seemed desirable for the standardization committee of the Institute to specify more fully the characteristics of insulation and the methods by which these characteristics may be determined. In regard to the discrepancies found in the measured value of e.m.f. when a spark-gap in air is used for determining the voltage, Dr. Steinmetz expressed the opinion that these discrepancies can be attributed largely to transient phenomena which require considerable investigation. The voltmeter method of determining high-tension e.m.f. is very convenient, but since the voltmeter measures the effective rather than the maximum e.m.f. it is essential to utilize a sine wave e.m.f. with the voltmeter.

Mr. A. H. Pikler said that the paper by Mr. Hendricks was of much value in describing methods of testing insulating material in which a high degree of accuracy can be obtained. He stated that in insulating dynamo-electric machinery it is preferable not to depend upon fibrous materials except as a binder. The general requirements for insulation are the absence of moisture and the elimination of sharp corners on the conductors. For strictly insulating purposes a filler compound is better than an insulation of the layer type. When use is made of the voltmeter method of determining the testing e.m.f. it is essential to employ a transformer of low reactance if dependance is to be placed on an auxiliary voltmeter coil. This condition is rendered necessary on account of the fact that the voltmeter on the auxiliary coil measures the main magnetic flux, which may not indicate correctly the voltage on either the primary or the secondary coil when there is considerable magnetic leakage. Mr. Pikler expressed the opinion that Mr Wooldridge should have specified all details of the tests of which he reported only the results, and should have mentioned the method used by him in separating the losses.

Mr. R. D. Mershon called attention to the fact that the voltmeter method of determining the testing e.m f. had been found thoroughly reliable during the tests made at both Telluride, Col., and Niagara Falls, N. Y. He also stated that the auxiliary-coil method is a correct one to use provided the tests are conducted with the proper amount of care.

Prof. W. L. Puffer claimed that in determining the high-tension e.m.f. excellent results may be obtained by means of a static voltmeter connected across the high-tension coils.

Mr. E. W. Rice, Jr., mentioned the fact that in the construction of transformers an almost unlimited number of combinations of different dimensions, parts, coils, cases, cores, etc., can be employed. However, the multiplication of the number of different transformers is uneconomical, since by employing a lesser number of different units the aggregate cost may be considerably reduced. However, it is safe to say that at least 5000 different varieties of transformers have been produced in the factories of the General Electric Company.

Dr. A. S. McAllister called attention to the large variation in the exponent of eddy-current losses reported by Mr. Wooldridge, and expressed the opinion that the actual variation in loss was considerably less than that reported. The only known factor to which a change in the eddy-current loss could be attributed would be a small change in resistance, which would represent a correspondingly small variation in the coefficient rather than in the exponent.

Mr. L. T. Robinson stated that static hysteresis loops made upon the same silicon steel confirmed the value of the hysteresis losses reported by Mr. Wooldridge. For some reason it has been found impossible to predict the eddy-current loss from the known value of the resistivity of the silicon-steel sheets.

Mr. J. L. R. Hayden expressed the opinion that the variation in the eddy-current exponent reported by Mr. Wooldridge was due to inaccuracy in separating the eddy loss from the hysteresis loss. A slight change in the value assigned to the hysteresis loss would represent a large change in the eddy-current loss, on account of the relatively smaller value of the latter.

Prof. George F. Sever called attention to the convenience of a method of measuring the high-tension testing e.m.f. by means of condensers employed with a static voltmeter arranged somewhat according to the potentiometer method.

Mr. H. L. Schermerhorn expressed the opinion that in testing insulating materials use should be made of pieces larger than those employed by Mr. Hendricks. He suggested that standard sizes should be selected for pieces subjected to the testing e.m.f.

Mr. E. M. Hewlett stated that the A. I. E. E. standardization curve for the break-down voltage across a spark-gap in air should be extended up to at least 500,000 volts in order to cover the range of testing e.m.f. now employed.

Mr. William J. Foster described the various forms of generators which may be employed for producing sinusoidal e.m.f., including the old smooth-core alternator and the modern generator with distributed-field winding.

Upon motion of Dr. Steinmetz it was decided to refer the matter of standardizing the methods of high-tension testing to the board of directors of the Institute in order that it may receive proper attention on the part of the standardization committee.

TUESDAY EVENING SESSION

The evening session on Tuesday, which was also held at the Mohawk Golf Club, was devoted to the presentation and discussion of four papers dealing with the general subject of high-tension transmission problems. These papers were written by Messrs. J. H. Cunningham, F. F. F. Creighton, G. Faccioli, and Messrs. E. J. Burkholder and R. H. Marvin. Abstracts of these papers and the discussions thereon will appear in a later issue.

TRANSFORMER DAY AND FINAL SESSION.

On Wednesday the convention was transferred to Pittsfield to afford the members an opportunity to visit the transformer factory of the General Electric Company and listen to the presentation and discussion of papers relating to transformer problems. Of the five papers presented, four dealt specifically with transformers and the fifth contained much information of value to transformer manufacturers and users. The transformer papers were presented by Messrs. F. C. Green, C. E. Allen, J. M. Weed, and Messrs. J. J. Frank and H. O. Stephens. The fifth paper was one by Dr. C. P. Steinmetz, entitled "Mechanical Forces in Magnetic Fields." Abstracts of these papers and the discussions will appear in a later issue.

The final technical session was held on Thursday morning at the Mohawk Golf Club. At this session papers were presented by Messrs. E. B. Merriam, entitled "Oil-Break Circuit-Breakers": W. L. R. Emmet, entitled "Proposed Applications of Electric Ship Propulsion," and H. A. Laycock on "Voltage Regulation of Transformers." The subject of vector rotation was also briefly discussed.

OIL-BREAK CIRCUIT-BREAKERS.

In his paper on oil-break circuit-breakers Mr. Merriam stated that while the duties of an oil circuit-breaker are to connect, disconnect and isolate different parts of an electrical system, its most important function is to relieve the system of dangerous overloads or short-circuits which would otherwise prove disastrous to the service.

A distinctive feature of the oil circuit-breaker lies in the fact that when the alternating current which is maintaining an arc in oil passes through zero, at which point the electromagnetic energy is a minimum, the current is interrupted and remains so until the voltage rises to a sufficient value to puncture the insulating film of oil which has had time to flow in between the contacts.

A description was given of the auxiliary devices which render the oil switch selective in action and the conditions were stated under which it is advisable to use a non-automatic switch and when an automatic or a time relay one should be used.

Since the efficacy of an oil circuit-breaker depends, to a great extent, upon the quality and the condition of the oil, it is necessary to inspect it regularly to see that it does not become carbonized or for any other reason unfit for service. The subject of oil is very carefully considered and much valuable information is given regarding suitable dielectric strength and other requirements.

The rupturing capacity of an oil circuit-breaker depends upon several conditions, such as the velocity with which the contact part, the electrical characteristics of the circuit, the quality of oil used, the number and direction of breaks, etc. If the contacts move apart slowly the arc formed has time to become very violent and destructive. If the power-factor is less than unity the voltage is not in phase with the current and this makes it more difficult to squelch the arc.

The rupturing capacity of an oil switch is affected by the magnitude of the current, and hence anything which will reduce the current will diminish the work of the circuit-breaker. For this reason, and in order to limit the amount of energy which may be concentrated at any fault, the present tendency is to design generators with large internal impedance, thus limiting the maximum instantaneous value of the short-circuit current and permitting the use of oil circuit-breakers on systems of greater concentrated power than heretofore.

Discussion.

Mr. E. M. Hewlett claimed that it is highly advantageous to employ a time-limiting device with a circuit-breaker in order that the circuit may not be opened until the current has passed through its maximum flow and become sufficiently reduced by the lowering of the voltage of the generator.

Mr. L. C. Nicholson stated that almost any type of oil switch now upon the market will open its circuit without damage when called upon to do so for the first time. If thrown into the circuit at once and opened under load the chances are that the switch will be damaged, and if thrown in for the second time and opened for the third time it is very probable that the switch will be unable to operate successfully. He attributed these results to the carbonization of the oil. If sufficient time is allowed after each opening of the switch for the carbonized particles to settle in the bottom of the tank the oil returns to its former insulating condition and the switch operates without distress. He stated that from his own experience he has been led to conclude that a time lag in the opening of a switch of two seconds is better than any time lag of a less value.

Mr. W. L. R. Emmet said that oil switches as now built are as large as they should be constructed for the service for which they are intended. In order that they may perform their functions properly it is best to employ series reactance in order to limit the current under short-circuit conditions. He cited the case of a short-circuit in Chicago where twelve 12,000-kw generators had delivered current simultaneously through cables to a single short-circuit. These cables were ripped completely from the walls in which they were embedded and thrown out into the room.

Mr. R. D. Mershon expressed the opinion that the effect noted by Mr. Nicholson might equally well be attributed to a rise in temperature of the oil as to the carbonization of the oil. If the effect were produced by temperature rise the switch would return to its normal condition after a sufficient time interval, just as was found by Mr. Nicholson.

Mr. J. Barrow called attention to the fact that reactance inserted in series with a switch in order to limit the current changes the angle of lag of the current with respect to the voltage, and hence is not as advantageous as might seem at first sight, since for best opening conditions it is preferable for the e.m.f. and the current to reach their minimum values simultaneously.

Dr. A. S. McAllister stated that the disadvantage of having a reactance in circuit at all times, in order that it might be available for limiting the current when the switch opened, could be avoided by placing a short-circuit around the reactance to be opened by the relay device just prior to the opening of the switch itself.

Prof. W. S. Franklin expressed the opinion that distilled water, which has a high resistivity, might prove advantageous as a substitute for oil in circuit-breakers. When a water circuit breaker opens considerable steam would be produced, but this result need not be disadvantageous. He stated that the arcing formed at a switch might be sufficiently minimized by placing in parallel with the switch contacts a circuit consisting of a resistance in series with a condenser formed of aluminum cells, such as are used with lightning arresters.

Mr. C. F. Scott stated that one should not expect a switch designed for a small transmission system to take care of short-circuits produced in a very much larger system with which it is used several years later after the system has grown. Oftentimes switch failures can be attributed to the use of switches under conditions for which they were not originally intended.

Dr. C. P. Steinmetz remarked that the object of a switch is to protect the system, and it is not desirable to arrange for the system to protect the switch. He said that the spark around the switch can be minimized to any desirable extent by the use of a condenser, but that such a scheme may shift the burden from the switch to the system, and thereby produce the very damage which the switch is intended to eliminate.

Mr. H. L. Smith called attention to the desirability of consistency in the rating of switches. Considerable confusion exists at the present time by reason of the fact that no standard method is employed in the rating of switches intended for various purposes.

Mr. E. W. Rice stated that it would be undesirable for a switch to open instantaneously, even if such a result could be obtained. In a large electrical system continuity of service is the prime requisite. In order to obtain continuity it is essential that when a single feeder is in trouble the switches on the other feeders and those on the generator should remain in circuit, while only the switch on the feeder in trouble opens. Thus, time limits must be employed with switches in large interconnected systems.

ELECTRIC SHIP PROPULSION.

In his paper on "Proposed Application of Electric Ship Propulsion" Mr. Emmet showed that a steam turbine designed for direct connection to the propeller shaft is very large, expensive and relatively inefficient, while a high-speed turbine is very simple in construction, small and highly efficient. It is desirable to employ some speed-reducing arrangement for allowing the turbine to operate at high speed while driving the propeller at low speed. One of the important advantages of electric propulsion as compared with other possible methods of speed reduction lies in the fact that arrangements can be made by which the ratio of the reduction is changeable so that the turbine may be run at its most effective speed under more than one condition of the vessel's operation. The possibility of such a change in speed ratio is particularly valuable in connection with warships since such vessels need very high speed for emergency conditions and also need to operate economically at low speed so that their radius of action may be made as wide as possible with a minimum dependence upon coaling stations. It will be seen that these qualities cannot well be combined in a ship whose propellers are driven directly by turbines, even if she is equipped with special turbines for cruising conditions.

For use with a certain battleship he suggested a 12,000-kw steam turbo-alternator and two motors, each rated at 7000 hp. The two motors would be coupled together into a single unit and connected to the propeller shaft. One of these motors would be of the induction type with squirrel-cage armature, the stator windings being so arranged that they could be connected either for thirty poles or for fifty poles, a suitable group of heavy toggle switches to effect this pole-changing being carried by the frame of the motor itself. The other motor would be of the type with a definitely wound rotor connected through slip-rings to external resistors of the water-immersed and water-cooled type. The resistors would be delivered directly to the sea water, which would freely circulate around the resistors.

Normally the ship would be operated at higher speeds with two generators and four motors, all of the motors having the thirty-pole connection. The turbine speed would then be reduced in the ratio of 7.5 to 1, the generators having four poles. When the speed became sufficiently reduced improvement of economy could be effected by disconnecting one of the generators and two of the motors, and when the speed had fallen sufficiently low a still further gain could be accomplished by connecting the remaining motors for fifty poles instead of thirty poles. With this change the ratio of reduction would be increased from 7.5 to 1 to 12.5 to 1, and a new cycle of favorable speed operation in the turbine would be begun.

Discussion.

Dr. C. P. Steinmetz described in detail the conditions imposed upon the propelling equipment used in the naval vessels. In order for the cruising area to be as large as possible it is essential that the cruising speed be maintained at the highest efficiency. Moreover, it is necessary to minimize the weight of the equipment in order that the maximum of fuel may be carried in the vessel. Thus, the primary requisites for cruising service are space, weight and operating economy. When a battleship is in action it is absolutely essential for it to operate at a speed which is much higher than the cruising speed. Under these conditions, however, efficiency in operation is of small importance compared with rapidity. Of all known prime movers the steam turbine is most advantageous for propelling battleships. However, it possesses two disadvantages, namely, its constant-speed characteristic and the high rotative speed which must be employed for proper economy. Therefore, when the steam turbine is employed it is necessary to make use of some speed-reducing and speed-varying mechanism. It is in connection with this service that the electrical equipment shows to such great advantage.

By means of a turbine-driven generator and directly connected motor the propeller shaft may be run at its highest efficiency during the cruising speed and may be controlled most conveniently for action during battle. Moreover, it possesses to the highest extent the characteristic of reliability under emergency conditions which must be maintained in naval equipments.

Mr. Gano S. Dunn compared the electrical propulsion of ships to the electrical operation of factories, and stated that it is not correct to confine the comparison to an efficiency basis. Experience has shown that the incidental advantages of electrical operation in factories more than compensate for any possible decrease in efficiency when the electrical equipment is inserted as an indirect link between the prime mover and the machines to be operated.

Mr. W. B. Potter remarked that the problems involved in electrical propulsion of ships are in many respects similar to those found in gasoline-electric cars. Seemingly, if the gasoline engine is to be used for propelling a car, it would be best to drive the wheels directly by means of the engine. However, it has been found highly desirable to allow the engine to drive a generator and the generator to supply energy to motors for propelling the car. When this arrangement is employed the engine operates at all times under its most efficient conditions, while the variation in torque at the different speeds is obtained most advantageously by means of the electric motors. The reliability of the gasoline-electric car is practically absolute so far as the electrical equipment is concerned, the only doubtful element in the equipment being the gas engine.

VOLTAGE REGULATION OF GENERATORS.

Much information relating to the methods by which automatic voltage regulators can be applied to direct-current and alternating-current generators was given in the paper by Mr. Laycock. Mention was also made of a special automatic device to be placed on an alternating-current system where heavy short-circuits are encountered. If the voltage regulator is employed and a short-circuit is experienced, the action of the regulator will tend to hold the voltage up and therefore give the exciter full field. Often in hydroelectric installations when this happens the water-wheel gates are wide open, full excitation is supplied to the exciters and generators, and if the short-circuit is suddenly relieved the voltage is likely to rise above normal value before the excitation can be reduced on the generators and exciters. The time required to reduce this excitation is the time taken by the generators and exciters to demagnetize their fields between maximum full field voltage and the voltage corresponding to the normal-load excitation, which may be from two to six seconds. This is augmented by the time required for the water-wheels to reduce the speed to normal. This can be overcome by placing overload and high-voltage relays in the transmission lines set so that should the current increase to a given value the relays will trip, open the connections to the regulator and reduce the voltage to a certain value (to be determined by the operating engineer) and after the short-circuit is burned off and the current becomes normal again the relays will close and the regulator will automatically be returned to service.

Discussion.

Mr. H. G. Reist explained that when an automatic voltage regulator is employed it is essential to make use of generators having a high degree of regulation, while by means of voltage regulators use can be made of any convenient type of generator quite independent of its regulating characteristics

Mr. C. J. Fechheimer stated that in many types of alternators the cost depends largely upon the degree of regulation demanded. When a high degree of regulation is not required, the generator is much cheaper than otherwise would be the case, hence the installation of a voltage regulator results in a considerable decrease in the cost of generating equipment.

Mr. E. F. W. Alexanderson described several methods by which the voltage regulating characteristics of the generating equipment can be varied at will by slight mechanical changes in the operating mechanism of the voltage regulator.

VECTOR ROTATION.

In a short paper Prof. W. S. Franklin compared the clockwise and counter clockwise rotating vectors and stated that the counter clockwise representation does violence to the established convention as to the positive direction of rotation.

Prof. E. J. Berg, in a second short paper, stated that the crank diagram lends itself only to very expert mathematicians in case of polyphase circuits with distorted-wave shapes. For use with distorted waves the polar diagram is preferable to the crank diagram. The author claimed that the question of rotation does not enter since the rotation is counter clockwise in any case. In the polar co-ordinate system time rotates counter clockwise; in the crank diagram the e.m.fs. or currents are made to rotate counter clockwise.

On account of the lack of time the notes on vector rotation by Professors Berg and Franklin were not presented. A communication from Dr. Kennelly, who was responsible for initiating the discussion, was presented by Prof. C. A. Adams. Dr. Kennelly expressed the opinion that the polar-coördinate method of representation is excellent for determining the mean effective value of a distorted wave by means of a planimeter, but that it is disadvantageous when analyzing the harmonics of a distorted wave.

Professor Adams in his own behalf stated that the selection of the direction of rotation of vectors depends largely upon the habits of the person making the selection. The merits in the case are about equally divided between the two methods proposed. The selection of one standard method would, therefore, depend more largely upon the relative number of those who had formed the habit of using the separate methods than upon the relative merits of the methods proposed.

ENTERTAINMENT FEATURES.

The Pittsfield-Schenectady convention will long be remembered for the forethought expended in providing for the convenience of the visiting members and the thoroughness and promptness with which the arrangements were carried through. Between the morning and afternoon sessions held on Tuesday at the Mohawk Golf Club, Schenectady, an excellent lunch was served in the clubhouse, so that the visitors were afforded abundant opportunity for becoming acquainted and were relieved of the necessity of finding some convenient restaurant.

. Wednesday being Pittsfield day, a Pullman train with diner attached for breakfast was provided for conveying the members from Schenectady and Albany to Pittsfield, where lunch was served at the works of the General Electric Company and dinner at the Hotel Wendell. The members were conducted through the works, where transformers and arc lamps were shown in all stages of manufacture.

On Thursday at the close of the final technical session electric cars were provided to convey the members from the Golf Club to the works of the General Electric Company, where lunch was served and the party was escorted on a tour of inspection through the factories. Both on Tuesday evening and Thursday evening corona effects were shown on the General Electric Company's experimental transmission line near Schenectady, while on Wednesday a 750,000-volt testing transformer was shown in operation in Pittsfield. The registered attendance was 325, about 25 per cent of whom were out-of-town members.

Proposed Ohio Public-Service Commission.

A public utilities bill has been introduced in both houses of the Ohio Legislature which covers all public service corporations with the exception of street railways and municipal plants. The bill fulfils a pledge in the Democratic platform, upon which the present Governor and the Democratic members of the Legislature were elected.

The present State Railroad Commission is to be transformed into "the Public Service Commission of Ohio," and, in addition to its present duties, it will have supervisory powers over all electric light, telephone, gas, heating, water and other similar corporations. The present commission has control over only steam and interurban electric roads. The bill gives the commission control over the issue of stocks and bonds. It can fix rates for service according to the tax value of the properties, and they can be increased only in proportion to the additional values listed in the tax returns. A fair rate is to be established in the beginning and the commission may increase it in case it is found that it is not sufficient to cover the necessities in the way of dividends, cost of operation, depreciation and improvements. All companies must have a depreciation fund. All companies must furnish a just and reasonable service and rates and charges that are not in compliance with the terms of the bill are to be taken as unlawful. No free service is to be given and no rebates, drawbacks or other considerations of the kind are to be allowed.

The plan of giving free service in competition with another company is prohibited. This practice was followed to some extent by telephone companies some years ago in Ohio, but not of late. Any change in rates requires a notice to the commission of thirty days, and, if allowed, a notice of thirty days must then be given the patrons. Complaints made by patrons must be investigated, but if a company makes complaint, a notice must be published in a newspaper in the city in which the business is located and ten days are allowed for such publication. The commission must then investigate the matter and make a ruling upon it. Companies must make such extensions and repairs as are ordered, an order of the commission being considered lawful in such cases.

In emergencies the commission may, with the consent of the company, temporarily suspend or alter rates. Full and complete information regarding new construction must be in the possession of the commission at all times and may require a separate accounting of the construction and operation. To be able to maintain a systematic record of all matters the commission shall fix standards of service and products of all the utility companies under its charge.

Officers of companies may be required to produce books and records, and may be compelled to testify at hearings. In case two companies are unable to agree upon a joint rate within a reasonable time, the commission may fix the rate and apportion it between them. Municipalities may, within a year of the expiration of franchises, fix a rate at which a utility company may operate, pending the granting of a new franchise; but, upon complaint of the company, the commission shall have a hearing, and, if it is found that the rate fixed is insufficient, unreasonable and will not yield a proper return, it may fix a fair and reasonable rate for the period fixed by the council. This rate shall be based upon the value of the part of the property used for the convenience of the people residing in the municipality, and be such as will give a fair return on the market value of the stocks and bonds. The ability to furnish service during that period must also receive consideration.

Utility companies cannot issue notes, stocks or bonds to run longer than twelve months without the authority of the commission, and the commission is not allowed to authorize such issues to reimburse expenditures from the income for betterments unless the accounts be kept in such a manner as to show clearly the purpose of the expenditure. A company cannot use the proceeds of an authorized stock or bond issue to refund short-term notes.

Authority cannot be given any company to capitalize its franchise for more than it actually paid to the municipality or other political subdivision for the grant, nor shall the capital stock of a consolidation exceed the combined capital stock of the companies interested and such additional sum as was paid in cash.

No contract for consolidation or issue shall be capitalized in the stock of any corporation, nor shall any corporation hereafter issue bonds as a lien upon any merger contract. Telephone companies, in order to consolidate, must have the consent of the commission, and the same is true in the case of a lease or the purchase of the stock of one company by another Before authority to do any of these things is given a hearing must be had and it must be shown that there are good reasons for the step.

In order that two companies with properties lying wholly or partly within the State may consolidate, it must be shown that the consolidation will be for public convenience and that adequate service will be furnished. In no case shall the aggregate amount of stock and debt of the consolidated companies be increased by this step. Orders of the commission may be enforced by mandamus proceedings brought by the Attorney-General, but no company will have power to bring injunction proceedings against the commission. An appeal may be taken to the Common Pleas Court and the orders of the commission may be stayed by that tribunal and finally may be modified or vacated entirely.

Salaries of the members of the commission shall be $6,500 per year each, but the annual expense of the department is limited to $90,000.

Proposed Public-Service Commission in Illinois.

A bill has been introduced in the lower house of the Illinois Legislature by Mr. Rawleigh to give the existing Railroad & Warehouse Commission jurisdiction over public utilities. The term "public utility" is intended to mean all corporations or individuals engaged in supplying telephone service or heat, light, water or power for public use. The bill is elaborate and provides for interchange of service between public utilities, uniform accounts, adequate depreciation, proper rates, standards and measuring instruments, testing of meters, public hearings, first-class service, protection from competition unless public necessity demands the second utility, "perpetual franchises" under the control of the commission, purchase of private plants by municipalities and other features of public-service regulation. It is similar to the law under which the Wisconsin Commission operates, but does not apply to any city having a population of 200,000 or more, thus exempting Chicago.

Perhaps this bill will not be passed, as it is reported that another bill, to represent the ideas of the State administration on public-service regulation, will be introduced. However, it is believed that a public-service commission of some sort is inevitable in Illinois and that the law creating it, if not passed at the present session of the Legislature, will be enacted at some succeeding session.

Massachusetts Legislative News.

The committee on public lighting recently gave a hearing on a bill providing that all issues of stock of gas or electric lighting companies shall be sold at public auction in Boston instead of being offered to stockholders at a price fixed by the board of directors, subject to the approval of the Massachusetts Gas & Electric Light Commission. Mr. G. N. Nichols, of Lynn, Mass., appeared on behalf of the bill, stating that it was based upon a recent statement of General Morris Schaff, of the Gas & Electric Light Commission, to the effect that new stock should be sold at auction to the general public. General Schaff stated at the hearing that he did not wish to interfere with the actions of boards of directors, and that he did not criticise dividends as high as 15 per cent under proper conditions, but he objected to the present plan of issuing stock at a substantial amount per share below the market price. Former Attorney-General A. E. Pillsbury appeared in opposition to the bill on behalf of the Massachusetts Gas Companies, and Mr. Everett W. Burdett appeared against the bill for the Massachusetts Electric Lighting Association. The opponents of the bill declared that if it were enacted it would take the State back to a system which had been discarded fourteen years ago and that the present system of jurisdiction by the Gas & Electric Light Commission amply protects the public. The point was made that the price of gas or electricity is the chief matter of interest to the public, and the price of stock as determined by the board of directors of a gas or electric light company can be set aside by the commission if in its judgment it is too low to be consistent with the public interest. The point was also brought out that the present method provides for an exhaustive investigation of the financial resources of the company by the commission; that this is practically always conducted at the hearings upon petitions for stock increases, and that there has resulted ample protection to the public interests.

New York Commission News.

The Public Service Commission, Second District, has received a joint petition from the New York Telephone Company and the Clifton Park Telephone Company for approval of the transfer of the plant of the Clifton Park company to the New York Telephone Company. The Clifton Park company operates in Jonesville, Saratoga County, and the territory immediately adjacent thereto. The company as a reason for its desire to transfer its plant states that as the New York company operates generally in Saratoga County, the plant can be more advantageously and efficiently used in connection with the system of that company. It is proposed to pay $4,365 for the property. A joint petition has also been received from the Ticonderoga Home Telephone Company and the Ticonderoga Telephone Company, asking for the approval of the transfer of a portion of the plant of the Ticonderoga company to the Home company. Both companies operate in the village of Ticonderoga, Essex County, and it is considered by both companies that a single system can be more advantageously and efficiently operated in that place. The Ticonderoga Home company proposes to pay $9,200 for the apparatus of the Ticonderoga company.

The commission will give a hearing this week on the application of the Delaware County Electric Light & Power Company, of Delhi, N. Y., for permission to issue capital stock, a mortgage and mortgage bonds, and for the transfer to it of the Delhi Electric Company. A further hearing will be held on the complaint of the Board of Aldermen of New York and various civic organizations of the greater city as to the interborough rates charged by the New York Telephone Company.

The Middleport Gas & Electric Light Company has asked for permission to exercise franchises granted for the furnishing of electricity for light, heat and power purposes in the town of Hartland, Niagara County, and the Wayne County Gas & Electric Company has petitioned for permission to exercise franchises for furnishing light in the village of Manchester, Ontario County, and the village of Newark, Wayne County.

The commission has received a complaint from residents of the incorporated village of Coxsackie, Greene County, directed against the Upper Hudson Electric Company, alleging excessive prices for electricity sold and delivered in that village. It is stated that the rate charged for commercial lighting in Coxsackie is 15 cents maximum and a minimum monthly charge of $1, and for street lighting $10 per incandescent lamp of 25 cp per year on the moonlight schedule. The complainants point out that the Upper Hudson Company, operating at Coeymans and Ravena, which are approximately ten miles from the generating station at Coxsackie, has charged for the past three years 6 cents maximum with no minimum monthly charge and has offered to furnish street lighting to the unincorporated village of Ravena for $13 per lamp of 32 cp per annum, to burn all night long every night from dusk to dawn The petition further points out that the Atlantic Light & Power Company charges but 12 cents maximum in Coeymans, Ravena and New Baltimore with a maximum monthly charge of 50 cents. For street lighting the charge is $20 per lamp of 32 cp for all-night service. The complaint has been served upon the Upper Hudson Company and an answer required within twenty days.

The commission has had under consideration an application by the Geneva-Seneca Electric Company to purchase the electric plant of J. Q. Howe's Sons at Phelps, N. Y., and a further application for approval of agreement of consolidation proposed to be entered into by and between the Geneva-Seneca Electric Company and the Wayne County Gas & Electric Company. Hearings have been had, and after investigation the commission has given preliminary consent to the consolidation of these several properties. Final approval is contingent upon the execution of the agreement of consolidation amended in conformity with suggestions made by the commission, upon the submission for approval of the first mortgage proposed to be executed by the consolidated company, and upon the filing of an amended petition correcting and supplementing the original petition in certain essential respects.

The Geneva-Seneca company supplies electricity in the City of Geneva and villages of Seneca Falls and Waterloo. The Wayne County Gas & Electric Company operates in the villages of Palmyra, Clyde, Newark and Lyons and supplies gas and electricity in each of these places, except in Clyde, where electric service only is furnished. The electric plant of J. Q. Howe's Sons is located in the village of Phelps, half way between the northern tier of the communities supplied by the Wayne County company and the southern tier in which the Geneva-Seneca company operates. With the completion of the consolidation project, it is planned to tie all these towns together for purposes of electrical distribution by the construction of a transmission line from Newark through Phelps to Geneva.

The commission has made an order requiring the Black River Telephone Company to appear before the commission to show cause why its manager published in a circular issued to the residents of Adams, N. Y., announcing a schedule of rates, the statement: "We wish to announce to you that the following rates for telephone service will become effective on Feb. 1, 1911, pursuant to an order of the Public Service Commission, Second District, Albany, N. Y." The increased rates are higher than the rates provided for in the franchise granted by the village of Adams, Jefferson County, to the Black River Telephone Company, and the apparent intent of the circular was to cause patrons to believe that the increase put into effect was due to the direct order of the commission. The company is also ordered to show cause why an order should not be made requiring the company to lower its rates in the village of Adams to the rates provided in the franchise under which it is operating in that village.

In various parts of the State there have been increases in telephone rates of companies under the jurisdiction of the commission, and in many places the commission finds that minor officers of these companies have attempted to place the responsibility for increased rates upon the commission. The commission is determined that the public shall not be misled by any such statements, and for this reason has caused a public investigation in the Adams matter, where a printed circular had been issued and distributed to telephone patrons. In no case has the commission ordered any company to increase its rates, and its sole efforts on the question of rates thus far have been directed to wipe out many discriminations existing in various parts of the State in which favored parties receive service at lower rates than their less fortunate neighbors do for like service.

Maryland Commission News.

Allegations charging the Diamond State Telephone Company with setting up excessive and discriminatory rates for telephone service within the town of Cambridge were filed with the commission by the Cambridge Board of Trade last week. The complaint alleges that the company is charging different rates for identically the same service to different residents of Cambridge.

The much delayed report of Prof. C. E. Munroe, of Washington, on the matter of a reduction in the price of gas and electricity was received last week. The report is a lengthy one and among the conclusions reached by Professor Munroe is that the Consolidated Gas, Electric Light & Power Company should be required to manufacture gas by the Kopper's gas oven method or by another method which would be equally efficient, as it would then be possible to sell gas at a lower rate. He also recommended that the London sliding scale be adopted, with proper modifications to meet local conditions, to the sale of gas in Baltimore. He further advocated that a concession should be made in the candle-power requirements, provided that the price of gas be reduced to 80 cents.

Canadian Hydroelectric Commission News.

At a meeting of the Ottawa (Ont.) Municipal Electric Commission, on Feb. 11, a large reduction in lighting and power rates was announced following a conference of the officials with Hon. Adam Beck and representatives of the Hydroelectric Commission.

Lighting rates are to be reduced (including the abolition of the meter charge) 19 per cent. Power rates for unlimited service are to be reduced from $25 to $23.40 per horse-power per year. For limited service the charge will be as low as $10.30 per horse-power per year.

For electric lighting hitherto the charge has been made entirely by meter at a rate of 8 cents per kw-hour. In future there will be a basic and fixed charge of 4 cents per month per 100 sq. ft. of area lighted, this being arrived at by taking the outside measurement of the house or building, including porches, verandas, sheds, outbuildings, cellars and unfinished attics, less 10 per cent allowance for walls, and multiplying that area by the number of stories in height. According to Mr. J. A. Ellis, secretary of the Municipal Commission, the charge of 4 cents per 100 sq. ft. is equivalent to about 3 cents per kw-hour. In addition to this charge there will be a meter rate of 3½ cents per kw-hour, less 10 per cent discount for prompt payment, no meter rental being charged. These prices are figured out to aggregate a rate of 6½ cents per kw-hour, instead of 8 cents as formerly. As a result of the announcement of these reductions it is anticipated that the Ottawa Electric Company will similarly reduce its charges to consumers.

CURRENT NEWS AND NOTES.

A. I. E. E. Annual Convention.—The exact date and place for the next annual convention of the American Institute of Electrical Engineers have as yet not been selected, but it has been decided to hold the convention in the Middle West late in June. The place will probably be Chicago or some summer resort in the neighborhood of that city.

Eiffel Tower Ready for Transatlantic Wireless.—After elaborate preparations, it is announced that the long-distance wireless telegraph equipment of the Eiffel Tower at Paris will soon be ready to communicate directly with New York City. Communication by wireless between Paris and Tunis and other points in Africa has now been an accomplished fact for several months.

Secretaryship of A. I. E. E.—The board of directors of the American Institute of Electrical Engineers has decided to submit to the membership the proposal to create an honorary secretaryship for life, with salary, for Mr. Ralph W. Pope, who has been elected secretary of the institute annually for the past quarter century. It will also ask the membership that the selection of the executive secretary be placed in the hands of the board.

Colorado Electric Club.—At the Thursday luncheon of the Colorado Electric Club on Feb. 16 the speaker was Mr. A. Dobbs, advertising manager for coco-cola, and the Adscript Club, of Denver, were guests, the total attendance being over 300. Mr. Dobbs' history of advertising and explanation of the present high plane of his vocation were very well received and formed a pleasant diversion in the usual technical talks.

Illuminating Engineering Convention to Be Held in Chicago.—On invitation of the Chicago Section of the Illuminating Engineering Society, the Chicago Association of Commerce and the Electric Club of Chicago the next convention of the Illuminating Engineering Society will be held in Chicago. The exact date has not been fixed, but the convention will be held probably late in August or early in September.

Institute of Operating Engineers.—On the evening of March 9 the Institute of Operating Engineers will hold the second of its monthly meetings in its rooms at the Engineering Societies Building, 29 West Thirty-ninth Street, New York. Prof. William D. Ennis, professor of mechanical engineering in the Polytechnic Institute of Brooklyn, will present a paper on the "Commercial Aspects of the Work of the Operating Engineer." Two other prominent engineers will be called upon to enter into the discussion of the paper. All interested are invited to attend the meeting.

Committees of Chicago Electric Club.—The chairmen of standing committees of the new administration of the Electric Club of Chicago are as follows; Membership, Mr. George H. Jones; house, Mr. A. L. Millard; speakers, Mr. C. A. Howe; entertainment, Mr. H. A. Mott; finance, Mr. W. R. Bonham; civics, Mr. John W. Mabbs. The full membership of the speakers committee is as follows: Mr. Howe, chairman, and Messrs. A. A. Gray, N. B. Parsons, J. R. Cravath, Frank F. Fowle, George C. Keech, James H. Delany, H. F. Holland, Ralph H. Rice, F. P. Vose, Frank L. Perry, George H. Lukes, R. S. Mitten, E. H. Noyes and Edward Wray.

Executive Committee of Independent Telephone Association.—At a meeting of the new board of directors of the National Independent Telephone Association, held at the office of the association in Chicago on Feb. 18, the executive committee was elected. It consists of Messrs. Frank H. Woods, Lincoln, Neb.; E. B. Fisher, Grand Rapids, Mich.; H. D. Critchfield, Chicago; Theodore Gary, Macon, Mo.; Walter J. Uhl, Logansport, Ind.; L. D. Kellogg, Chicago, and Richard Valentine, Janesville, Wis. The election of officers was postponed until the next meeting, to be held on March 10. Until then President Woods and the other officers hold over.

Revised Standard of Rubber Insulation to Be Enforced in Chicago.—Mr. William Carroll, city electrician of Chicago, has issued a notice saying that on and after April 1 the Department of Electricity of Chicago will not approve any rubber-covered wire that does not comply with the revised specifications of the Electrical Department of New York City. (See *Electrical World* of Feb. 2, 1911, page 318.) The specifications prescribe tests to be made on rubber-covered wire and are designed to raise the standard of rubber insulation. Mr. Carroll says that these specifications will exclude some of the rubber-covered wires on the market at the present time, and he asks for the co-operation of insulated-wire makers and dealers in the effort to raise the standard. Frequent tests will be made on the wire used in Chicago installations to determine whether they comply with the new specifications.

Chicago Section of Illuminating Engineering Society.—The program of future meetings of the Chicago Section of the Illuminating Engineering Society is as follows: March meeting, "Tests on the Lighting of a Small Room," by Mr. J. R. Cravath; April meeting, "Recent Improvements in Train Lighting," by the electrical engineer of the Chicago, Milwaukee & St. Paul Railway; May meeting, "Lighting of the People's Gas Light & Coke Company's Building in Chicago," by Mr. C. A. Luther, at a meeting to be held in the building described; June meeting, "Daylight Illumination." A local committee of three to co-operate with the general committee in making arrangements for the 1911 convention of the whole society, to be held in Chicago, has been appointed by Chairman Pearson, of the Chicago Section. It consists of Messrs. George C Keech, J. C. D. Clark and John F. Gilchrist.

Contract Agents of Commonwealth Edison Company.—A meeting of the contract agents of the Commonwealth Edison Company, Chicago, was held on the evening of Feb. 14 at a Wabash Avenue restaurant, where the gentlemen in the party took dinner in a body. Mr. E. W. Lloyd, general contract agent of the company, presided, and addresses were made by Mr. George C. Keech, general sales agent of the Cooper Hewitt Electric Company, on "The Mercury-Vapor Lamp"; Mr. W. A. Durgin, assistant chief testing engineer of the Commonwealth Company, on "The Value and Methods of Light Measurement," and Mr. W. P. Lyon, of the contract department of the Commonwealth company, on "Practical Data on Illumination." Mr. John F. Gilchrist, assistant to the president of the Commonwealth company, also gave a talk, and there was an excellent musical program by employees of the company. Mr. Durgin's paper was illustrated by lantern slides and by demonstrations of light measurements by means of photometers and illuminometers.

Electricity at a Cement Show.—The fourth annual Chicago Cement Show was held at the Coliseum from Feb. 16 to 23. The most impressive feature of the show was the number of concrete mixers of various types, most of them shown in operation by being belted to small electric motors. To the electrical visitor it was of interest to note that the most conspicuous location in the center of the main floor was occupied by two of the handsome concrete lamp-posts such as are used in Lincoln Park and on the North Side bouvelards in Chicago to support arc lamps. These posts were described in the *Electrical World* some time ago. An interesting gallery exhibit consisted of the drawings accompanying the recent passenger subway report of Mr. Bion J. Arnold. Of purely electrical exhibits there were hardly any, unless exception is made in the cases of the Locke electric tile drill and the Schlueter electric floor surfacer. The former machine had never before been shown in the West. It is made by the Locke Tile Drill Company, of New York, and consists essentially of a small electric motor connected by means of a circular cam, ball bearing, floating ring and a spring to a percussion drill.

N. E. L. A. Commercial Section Membership Campaign.—A sterling-silver loving cup, 10 in. in height, has been donated by Mr. J. Robert Crouse for presentation to the person who shall succeed in securing the greatest number of new members for the Commercial Section of the National Electric Light Association before May 15, 1911. Mr. Crouse is chairman of the membership committee, its other members being Messrs. Edward E. Bailey, Napoleon H. Boynton, Charles D. Burleigh, Duncan Campbell, W. R. Collier, I. W. Dixon, I. D. Gibbs, L. D. Mathes and J. C. McQuiston. Large posters, embellished with a full-sized reproduction of the cup and giving the conditions of the contest, will be sent to the principal central stations and electrical manufacturers of the country and the committees hope that these posters will stimulate immediate interest in membership among the employees who will read them. About 200 men have already been enrolled in the contest, and one may enter for the prize by registering with Mr. Crouse and asking for campaign material The large number of contestants from the larger central stations—as many as eight in one case—has introduced another element of chance by which the smaller central station or manufacturer may carry off the cup. Mr. Crouse's address is 1823 East Forty-fifth Street, Cleveland, Ohio.

Coming Iowa Convention.—In calling attention to the convention of the Iowa Electrical Association to be held in Davenport on April 19-21 the secretary notes that the Coliseum, where the convention will be held, presents a clear floor space of 100 ft. x 175 ft. There will thus be ample space for exhibits.

Ice Machines in Minnesota.—Four artificial ice machines to be operated electrically from the lines of the Albert Lea Light & Power Company have recently been sold in Albert Lea, Minn., to large ice users. This is in spite of the fact that the ice crop never fails in Minnesota and the town is situated alongside a large lake from which ice can be harvested.

Lignite Coal in Alberta.—The Dominion Geological Survey, in a special bulletin, announces the presence of a valuable lignite coal area at Edmonton, Alberta, fourteen miles in extent and estimated to contain 80,000,000 tons. The report states that this coal used in the gas-producer of the down-draft type is more economical for power production than the best grade under the steam boiler.

Canadian International Waterways Commission.—The Canadian Section of the International Waterways Commission will be appointed as soon as legislation giving effect to the new treaty is passed and salaries provided. It is learned that Sir George C. Gibbons, of London, Ont., has been tendered and has again accepted the chairmanship of the body, but the other members have not yet been determined upon.

West Virginia Independent Telephone Association.—The West Virginia Independent Telephone Association will hold its fifth annual convention on March 23 and 24, 1911, in the City of Clarksburg, W. Va., with headquarters at the Waldo Hotel. The main social feature will be a smoker on the evening of the 23d. Mr. R. M. Dalzell, secretary, Wheeling, requests that manufacturers secure hotel accommodations early, as a fire recently destroyed one of Clarksburg's big hotels.

Wireless Experiments on Union Pacific Trains.—Before the New York Railroad Club, Feb. 17, Dr. Frederick H. Millener, of Omaha, Neb., described experiments conducted by the Union Pacific Railroad for equipping its trains with wireless telegraph outfits. Portable-type sets installed in the baggage cars were used, and for emergency aerials ordinary steel-ribbed umbrellas have been employed as antennas. Operators on moving trains have been able to communicate with signal towers and other trains at distances of from 500 ft. to thirty-five miles. A number of prominent railway men attended the meeting.

Special Train to Houston Convention.—If seventy-five reservations can be secured a special train will be run from Dallas to Houston, Tex., for the convention of the Southwestern Electrical and Gas Association to be held in Houston April 27-29. It is proposed to leave Dallas on the Houston & Texas Central at 11 p. m. on April 26, arriving in Houston at 7 a. m. the next day. Delegates from New York, Chicago and St. Louis are asked to leave St. Louis at 9 a. m. on April 25, arriving in Dallas the next morning and spending the day in that city. Mr. D. G. Fisher, 300 Commerce Street, Dallas, Tex., is secretary of the association.

Iron-Rail Telephone Poles on the Isthmus.—Construction work on the permanent telephone line along the relocated Panama Railroad, Isthmus of Panama, is now proceeding between Caimito and New Frijoles, and as soon as that section is completed the building of the line between Gatun and Monte Lirio will be begun. It is interesting to note that old steel rails 28 ft. long are used for poles. These rails are set in concrete bases, the amount of concrete in the bases varying according to the character of the ground, the swampy sections requiring heavier foundations than elsewhere on the line. The concrete base has been a valuable adjunct in iron-pole construction on the Isthmus. It has served not only to prevent rusting, but it makes a strong construction for which bracing is unnecessary.

Tragic Result of Latter-Day Journalism.—While endeavoring to procure evidence that Cook County was being defrauded in coal deliveries a reporter for one of Hearst's Chicago daily newspapers managed to get in a position in one of the substations of the Chicago Sanitary District where he could look unobserved on an alleged payment for coal not actually received. The substation in question is located on the grounds of the Cook County Hospital and the reporter wanted to observe while remaining unseen what was going on in the adjoining weighmaster's room. He succeeded in getting into a position in the substation where it was supposed that no human being would venture, but in doing so came in contact with 12,000-volt primary connections of a transformer and was instantly killed. An assistant engineer tried to recover the body of the unfortunate newspaper man and was also killed.

Theft of Electricity in St. Louis.—According to the St. Louis *Star*, J. H. Long, proprietor of a poolroom at 506 North Fourteenth Street, St. Louis, was fined $50 and costs, amounting in all to $66.45, in Judge Miller's court on Feb. 3 for stealing electricity from the Union Electric Light & Power Company. Long pleaded guilty, and the sentence in his case is said to mark the beginning of a determined effort on the part of the company to break up the practice of stealing electrical energy, which is known or suspected to exist in numerous instances. In Long's case a "jumper" was arranged around the meter so that energy could be taken from the service wires without being measured. Long denied that he placed the jumper in position, but admitted that it was found in use and that he would have to take the consequences. It is thought that the amount of the fine and costs was many times the value of the electricity obtained without payment.

Manhood Engineer.—In recent years the word "engineer" has come to be used in many senses foreign to the original significance, as exemplified by such titles as sales engineer, advertising engineer, commercial engineer, industrial engineer, efficiency engineer, publicity engineer, production engineer, etc. The latest addition to the list is suggested by an article in a college publication the writer of which says he desires "to call the attention of university men to the fact that there is a profession of "manhood engineering," that this profession is well beyond its experimental period, and that it offers scope for a life work." From the article it would appear that the Y. M. C. A. has started a movement toward establishing fellowships in colleges for the training of secretaries for conducting its work, and that the term "manhood engineering" is applied to the course of study and also to the new profession that will be created. To the fellowship is attached a salary of $500 per annum during the two years of incumbency.

Lakes-to-the-Gulf Waterway.—The board of government engineers appointed by President Taft and headed by Gen. W. H. Bixby has made its report to Congress on the project of constructing a waterway along the Desplaines and Illinois Rivers to connect the present terminus of the Chicago Drainage Canal with the Mississippi River, thus forming an important link in the Lakes-to-the-Gulf waterway project. The commission reports that a waterway not exceeding 9 ft. deep from Chicago to the mouth of the Illinois River is entirely feasible. The section of the channel between Lockport, Ill., the western terminus of the Chicago Drainage Canal on the Desplaines River, and Utica, Ill., the head of navigation on the Illinois River, can be constructed for less than the $20,000,000 the expenditure of which has already been approved by the voters of Illinois. If the waterway is built the State should transfer to the federal government the locks and control of the channel so far as it relates to navigation, the State of Illinois retaining the ownership and control of the water-power rights.

ELECTRIC SERVICE AROUND CHICAGO.

Generation, Transmission, Distribution and Sale of Electricity by the North Shore Electric Company.

SURROUNDING Chicago completely on the north, west and south, the territory served by the North Shore Electric Company is large and varied, and the operations of the company in this suburban area present many peculiar and interesting problems that are well worthy of study. The territory served includes practically all of Cook County outside of Chicago, all of Lake County and parts of McHenry, Kane, DuPage and Will Counties. The total area served is approximately 1284 sq. miles, with an estimated population of 250,000, and is about eighty miles long from north to south with an extreme width from east to west of about thirty-two miles. This extensive region covers wide areas of farm lands, but also includes seventy-one incorporated cities and villages to which electricity is furnished. The largest city on the company's lines is Evanston, bordering Chicago on the north, with a population of about 25,000, while the smallest village is Rondout, with a population of 100. Of the entire population of 250,000 in the territory it is estimated that about 160,000 people live in the cities and villages. The company supplies alternating current for all purposes within this area. Fig. 2 is a map showing the territory served and also the generating stations, substations, cities and villages and transmission and distribution lines. The main office is in Chicago.

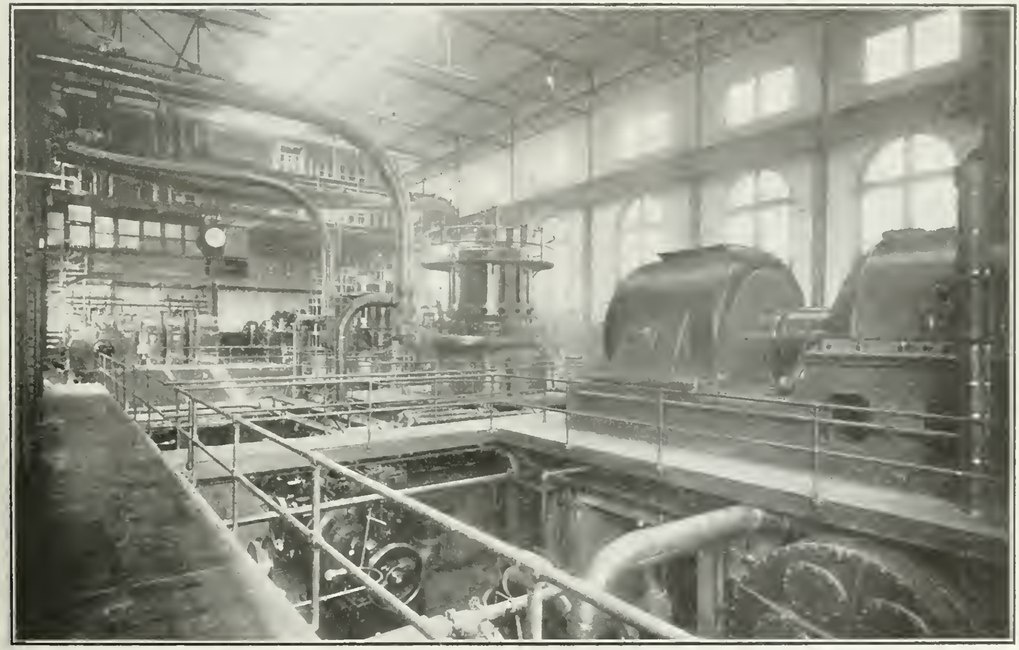


Fig. 1—Interior of Blue Island Generating Station of North Shore Electric Company, Near Chicago.

The character of the population in this territory is varied. The residential suburbs of Chicago contain well-to-do people and others of moderate means doing business or employed in the large city. There are also a number of manufacturing cities and villages in which are located the plants of companies having offices in Chicago. The farming districts include areas devoted to truck farming and dairy farming, as well as general farming country, and, in the northern part of the territory particularly, there are a number of large country places used as summer residences by "gentlemen farmers."

Of the seventy-one cities and villages now served by the company twenty-two were served formerly by eighteen local companies operating non-condensing steam plants rated at from 50 kw to 500 kw. In only one or two towns was there any attempt to furnish twenty-four-hour service or to supply electricity for motors. Of these plants the only one remaining in operation is the Evanston station, which is a combined hot-water-heating and electric light plant, and which has been remodeled since it was taken over by the North Shore Electric Company. At the present time twenty-four-hour service is furnished in all territory supplied by the company. Electricity is sold to three railway companies as well as to commercial customers, and the company supplies water for domestic purposes from pumping stations in LaGrange and Harvey and hot-water central-station heating in Evanston and Waukegan. All told, the number of electric light and power customers is 16,000, while there are 2500 customers for water and 200 for heating. The company has street-lighting contracts in forty-six communities, and 1800 series-tungsten and 1500 series-arc lamps are installed for this purpose. The connected load amounts to 15,000 kw for lighting, 9000 kw for general power and 4500 kw used for railway service.

GENERATING STATIONS.

Four generating stations supply electricity to this extensive territory. The station at Waukegan is rated at 4000 kw, that at Evanston at 700 kw, while Maywood and Blue Island have a rating respectively of 2250 kw and 7000 kw. The location of these stations is shown on the map, Fig. 2. The largest is at Blue Island, and Fig. 1 represents the interior of this station, while Fig. 3 is an exterior view. An extension to this station which will double its size is under construction.

Owing to the fact that the company supplies not only 60-cycle energy for general lighting and power, but also sells 25-cycle energy in large amount to interurban railway companies it was necessary to install in two of the generating stations, those at Waukegan and Blue Island, generating units of each frequency. In the Waukegan plant the 60-cycle equipment consists of one 500-kw, 2300/4000-volt vertical turbo-generator, one 1000-kw, 2300/4000-volt vertical turbo-generator and one 2500-kw, 25-cycle, 9000-volt horizontal turbo-generator. In order to tie together the 25-cycle and 60-cycle systems a 1000-kw frequency changer was installed at this station.

At the Blue Island station the 60-cycle energy is supplied by a 4000-kw, 60-cycle, 12,000-volt horizontal turbo-generator. The 25-cycle units consist of one 1000-kw, 9000-volt, 25-cycle vertical machine and one 2000-kw vertical unit. A 2000-kw vertical frequency-changer set is here installed. The 25-cycle end of this machine is wound for 9000 volts and the 60-cycle end for 2300/4000 volts, step-up transformers being used to raise the voltage to 12,000 volts. Up to the present time all 25-cycle units installed by the company have been wound for 9000 volts, thus conforming to the existing 9000-volt system of the Commonwealth Edison Company of Chicago, with which the North Shore Electric Company maintains harmonious relations. Most of the 60-cycle generating units installed by the company are wound for 2300/4000 volts, the exception being the 4000-kw horizontal turbo-generator at the Blue Island plant, which is wound for 12,000 volts on account of the fact that the greater portion of the 60-cycle output of this station is transmitted to a distance on 12,000-volt lines.

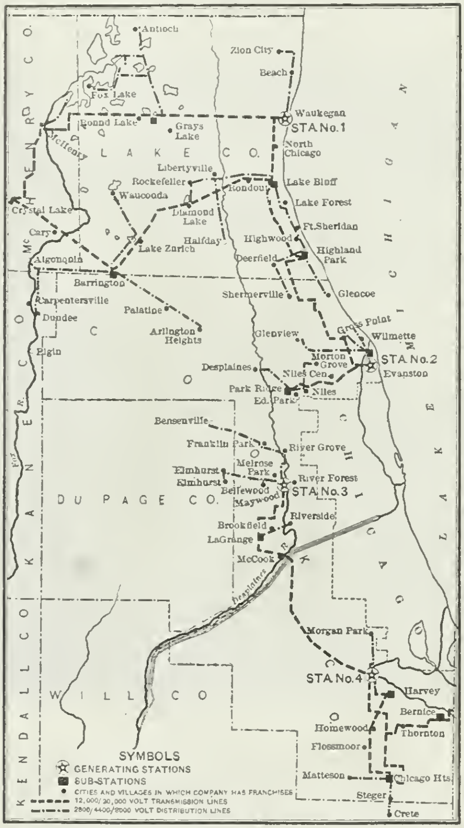


Fig. 2—Map Showing Transmission Lines and Territory Served.

At the Blue Island generating station the busbars are all located in an air chamber in the basement and are inclosed in brick compartments. Disconnecting switches with brick barriers between them are mounted in this busbar compartment and the wires are brought from them directly to the terminals of motor-operated oil switches, which are placed on the floor above. All of the switching apparatus is electrically operated and is controlled from a benchboard located in a gallery at one end of the station.

The exciter system consists of one 70-kw generator direct-connected to a 440-volt induction motor, one 50-kw machine direct-connected to a steam engine, one 100-kw unit direct-connected to a steam turbine, two 42-kw exciters direct-connected to two 500-kw frequency changers and one 100-kw exciter direct-connected to the 2000-kw frequency changer. The switching arrangement for all of the exciters is such that any number of them may be cut in on either of two buses, one of which is used for 25-cycle and the other for 60-cycle excitation.

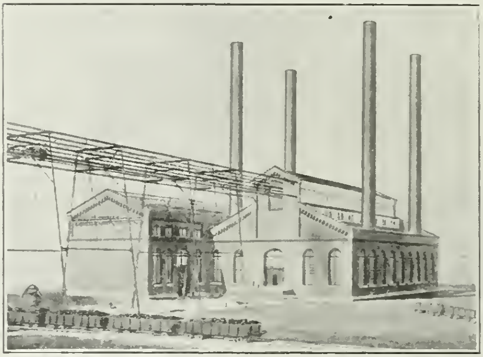


Fig. 3—Blue Island Generating Station.

The auxiliary motors at the Blue Island station used for cranes, coal crushers, stokers, etc., are all of 440 volts and represent a connected load of about 300 hp. They are supplied from a three-phase, 25-cycle transformer stepping down from 9000 volts to 440 volts.

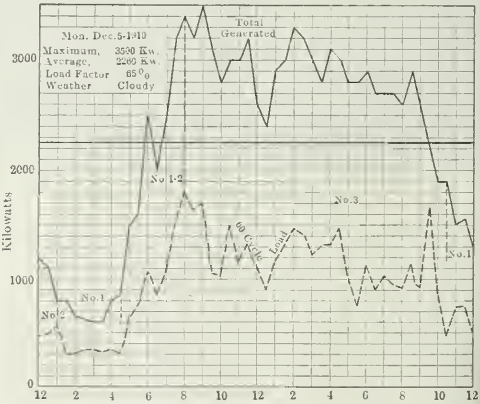


Fig. 4—Typical Load-Curve of Blue Island Generating Station.

The output of the Blue Island station is used for lighting, industrial motors and railway service. Fig. 4 is a typical load curve for this station, showing the total load generated in the upper curve and the 60-cycle load on the lower dotted line. This diagram represents the load on Dec. 5, 1910.

The Maywood station supplies 60-cycle energy only, the generating units in this station being wound for 2300/4000 volts.

TRANSMISSION LINES.

About 150 miles of 12,000-volt and 20,000-volt, three-phase, 60-cycle transmission lines are operated by the company. To these lines are connected about 2000 miles of 2300/4000-volt distribution lines and about forty miles of 4600/8000-volt distribution lines.

A standard type of construction for 12,000-volt and 20,000-volt transmission lines has been adopted. As practically all of the territory covered by the transmission lines is also supplied with local service requiring 4000 volts, it has been found advisable up to the present time to use wooden poles exclusively. Each transmission-pole line is intended to carry two three-phase transmission circuits arranged in a triangle, one circuit on each side of the pole.

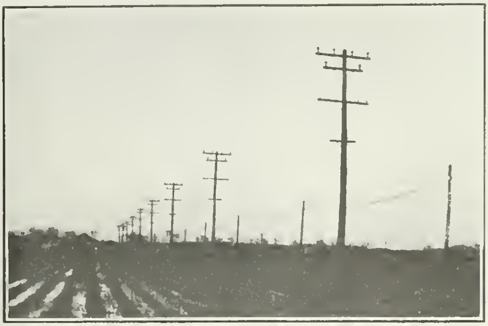


Fig. 5—Typical Two-Circuit, 20,000-Volt Transmission Construction, with Secondary and Telephone Lines.

Fig. 5 is a reproduction of a photograph showing typical construction for two 20,000-volt transmission lines. A four-pin arm is placed in the upper gain in order to allow the temporary use of this cross-arm for a single circuit, the three wires being arranged in a horizontal plane. Fig. 6 shows the typical construction for one transmission line. The spacing between the wires is 30 in. The insulators are of the 33,000-volt porcelain type and are mounted on steel pins. The gain for the 4000-volt cross-arm is spaced 5 ft. below the lower transmission line. A cross-arm for the company's telephone wires is attached 5 ft. below the 4000-volt cross-arm. Up to the present time the need of a ground wire for lightning protection has not been felt, although such a ground wire may be added if necessary. Transmission lines are protected at the stations and substations by lightning arresters either of the multi-gap or aluminum-cell types, all 12,000-volt and 20,000-volt arresters purchased within the last two years being of the latter type.

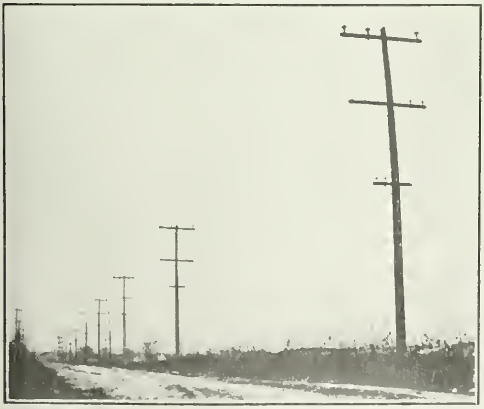


Fig. 6—Three-Phase Transmission Line, with Secondary and Telephone Circuits.

In Fig. 5 the two 20,000-volt transmission lines are shown on the two cross-arms at the top of the pole. Lower down is the cross-arm for local service, while beneath that again is the telephone cross-arm. Fig. 6 is similar, except that only one transmission circuit is provided at the top of the pole, and therefore only one cross-arm is needed for this purpose. Fig. 7 shows a typical transformer installation on a pole, the transformers being used to supply energy for industrial motors.

Two standard voltages have been adopted for 60-cycle transmission—that is, 12,000 volts and 20,000 volts. All transformers are wound so that they can be operated on either 12,000 volts or 20,000 volts. As previously mentioned, the company sells electricity to three interurban electric railways. Two of them buy 25-cycle energy at 9000 volts, 13,200 volts and 33,000 volts. They own and operate their own transmission lines and the energy is delivered to them and measured at the power-house switchboard. The third railway buys 60-cycle energy at 12,000 volts, the electricity being measured and delivered to this railway company at the Indiana State line.

Connection is made with the system of the Commonwealth Edison Company at three points—Blue Island, Evanston and Maywood. The 25-cycle, 20,000-volt underground-transmission "ring" of the Commonwealth Edison Company loops through the Evanston substation of the North Shore company and here transformers are installed stepping the voltage down to 9000 volts for the frequency changers and 13,200 volts for supplying the transmission line leading to the Winnetka substation of the Chicago & Milwaukee Electric Railway. At Blue Island connection is made by means of two combination overhead and underground transmission lines extending from the Blue Island station to the Roseland substation of the Commonwealth company. One of these lines is operated at 20,000 volts and is tapped into the Commonwealth high-tension "ring" at this substation. The other line, an auxiliary line, is operated at 9000 volts. At Maywood a 4000-volt, 60-cycle connection of limited capacity is maintained by the Commonwealth system for break-down service.

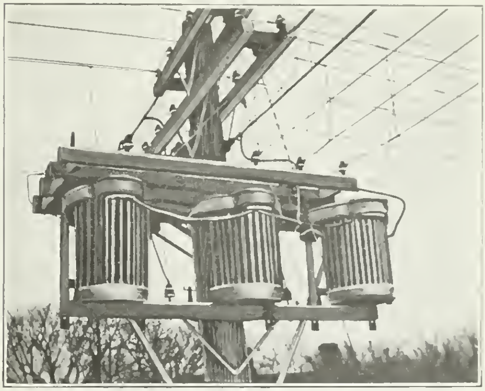


Fig. 7—Typical Transformer Installation on Pole for Industrial Motors.

Two supply lines are provided for each important substation, so that one may be used in the event of interruption of service on the other. A reference to the map (Fig. 2) will show how this plan has been carried out. The "ring" system of transmission has been freely used, and wherever possible two sources of energy are connected to each ring. This plan involves a considerably larger investment than would be otherwise needed, but it is believed that it is warranted under the conditions, as it not only results in shorter interruptions of service, but facilitates and renders less dangerous the maintenance of transmission lines.

DIVISION OPERATION.

On account of the radial distribution of population around Chicago along steam-railroad lines, the system of the North Shore Electric Company naturally divides itself into three main divisions. The first division comprises the portion north and northwest of Chicago. This receives its supply of energy from the Waukegan and Evanston generating stations and also some from Chicago. A 20,000-volt overhead transmission line extends from Evanston to Waukegan and loops through the Highland Park and Lake Bluff substations. A 20,000-volt transmission line in the form of a loop extends from the Waukegan station west through Gray's Lake to Barrington, thence back to the Lake Bluff substation, where it taps the main transmission line. A separate transmission line, about ten miles long, extends west from Evanston to the Park Ridge substation. The electrical operating headquarters for this division are located at the Evanston substation. The division chief operator acts as load dispatcher and is in constant touch with all switchboard operators and the load dispatcher of the Commonwealth Edison Company over the private-telephone system maintained by the company.

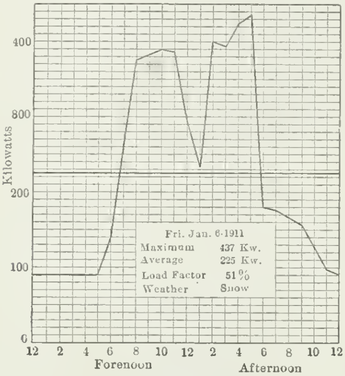


Fig. 8—Typical Load-Curve of Harvey Substation (Motors and Small Lighting Load).

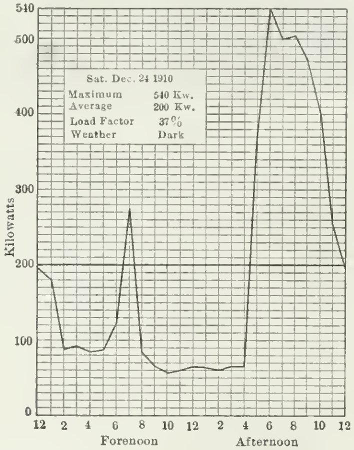


Fig. 9—Typical Load-Curve of Highland Park Substation (Almost Exclusively Residence-Lighting Load).

The second division lies west of Chicago and is supplied from the Maywood generating station. A 12,000-volt transmission line extends from the Maywood power house to the LaGrange substation, which is a combined lighting and pumping substation. A transmission line from the Blue Island power house to the LaGrange substation, forming a link between Maywood and Blue Island, will shortly be put into service. The Maywood plant is the operating headquarters for this division, and the chief engineer of the station acts as load dispatcher.

South of Chicago is the third division, which is supplied from the Blue Island station. From this generating plant duplicate transmission lines extend to the Chicago Heights substation and duplicate 4000-volt tie lines extend to the Harvey substation, which is a combined lighting and pumping substation. The operating headquarters for this division are located at the Blue Island station. The chief engineer of this station acts as load dispatcher and is in touch with both the Commonwealth Edison load dispatcher and the North Shore substation operators through private telephone lines maintained by the North Shore company.

SUBSTATIONS AND DISTRIBUTION.

The list of substations, with their ratings and in some cases special characteristics, is as follows: Lake Bluff, 450 kw; Highland Park, 1200 kw; Park Ridge, 500 kw; Barrington, 525 kw; LaGrange (lighting and pumping), 825 kw; Harvey (lighting and pumping), 300 kw; Chicago Heights, 1800 kw; Gray's Lake, 250 kw; Evanston, 2400 kw (frequency-changer, 1500 kw, and transformer, 900 kw).

As intimated previously, the usual local distribution is a 2300/4000-volt, four-wire, three-phase system. Single-phase lighting is supplied from one phase of the four-wire system and energy for motors in excess of 7½ hp is supplied from the three-phase system.

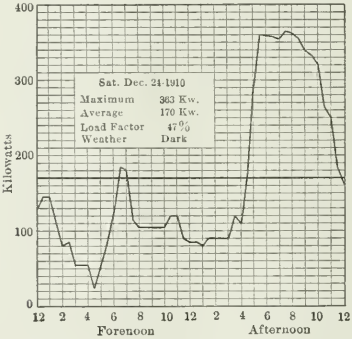


Fig. 10—Typical Load-Curve of LaGrange Substation (Pumping, Lighting and Some Motor Load).

The company has adopted the plan of stepping up the voltage on certain long feeders from 2300/4000 volts to 4600/8000 volts. This is done by means of compensators or boosters in the substation. Special transformers are used on the line, and they are wound with primaries for either 2300 volts or 4600 volts and secondaries of 115-230 volts. Wherever these 8000-volt lines enter thickly settled communities the voltage is stepped down by means of transformers on poles from 4600/8000 volts to 2300/4000 volts.

For the convenience of customers and the maintenance of proper relations with the various municipalities served, the territory is divided into seven districts, with a district office located at some convenient point in each district in charge of a district superintendent. The company work in each district is carried on through various departments, such as those relating to inspection, distribution, meters, inside wiring, contracts, accounting, stores, etc., the head of each department reporting to the district superintendent. The district superintendent in turn reports to the vice-president of the company in Chicago on matters of general policy and to the other general department heads in the main Chicago office on matters pertaining to their respective departments.

The substations supply electricity for varied purposes. This is well indicated by the three typical load curves which are given herewith. Fig. 8 shows the load on the Harvey substation on Jan. 6, 1911. A very large proportion of the output of this substation is used by industrial concerns, and this fact is clearly shown in the double peak.

Fig. 9 shows load curve on the Highland Park substation. This supplies almost altogether a residence district, although there is a small amount of electricity used for motors. The great dominance of the evening lighting peak is clearly indicated by this curve.

Fig. 10 is a curve showing the load on the LaGrange substation on Dec. 24, 1910. This substation is of particular interest because it is also a pumping station, and the curve indicates the characteristics of an output of a station supplying electricity for pumping, lighting and some motor load.

Fig. 11 is an illustration showing the exterior of a typical substation building, that at Evanston being selected. Fig. 12 shows the interior of the LaGrange pumping substation and Fig. 13 is a view of the switchboard in the LaGrange substation.

The LaGrange substation is particularly interesting in its combination of water-works pumping and central-station service. It was described in an article published in the *Electrical World* of Feb. 2, 1907, page 240. Horizontal centrifugal pumps and deep-well centrifugal pumps are used. Since that article was published another artesian well, 2100 ft. deep, has been added to the water-works equipment. The diameter of this well for a distance of 250-ft. below the surface is 15-in., reduced successively at greater depths to 10 in., 8 in. and 6 in. For the operation of this well there has been installed a third deep-well pump similar to those described in the article previously published. In addition one of the two 350-gal. horizontal pumps previously described has been replaced by a new pump having a rating of 750 gal. per minute.

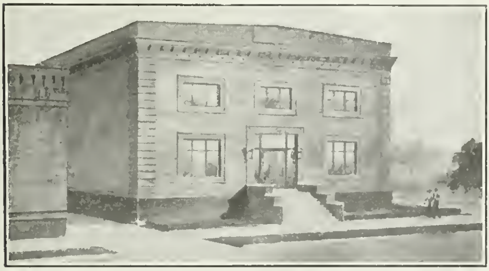


Fig. 11—Evanston Substation of North Shore Electric Company.

Fig. 14 is a wiring diagram of a typical transformer substation of the North Shore Electric Company. Solid lines represent three wires or three pieces of apparatus of the same kind. Dot-and-dash lines represent a single wire or bus, while dotted lines represent future work.

Starting with the 20,000-volt, three-phase transmission lines, which are either feeding the substation as a link of a high-tension transmission loop or high-tension feeders for large customers, these lines enter the building either through the roof using a combination of porcelain and fiber bushings or through the wall through special line entrances made up of bituminous fiber conduits. In some cases when the horn-gaps for electrolytic lightning arresters are mounted on the roof of the building, while the tanks for the arresters are mounted inside of the building, the line as well as the taps of the lightning arresters comes through separate entrances. However, it has been found preferable to mount horn-gaps inside the building whenever space permits, as the horn-gaps have to be operated each time the lightning-arrester films are reformed.

From the line-disconnecting switch the energy passes through choke coils and current transformers to the oil switch. The oil switch mostly in use is a K-6 General Electric type. This is a high-voltage switch, but of a lighter capacity than the H-3. The K-6 oil switch is top-connected, while the H-3 oil switch, which will have to replace the K-6 when the capacity of the system increases, is a bottom-connected switch. The substation is designed, however, so that one type can be substituted for another type without much work and without spoiling the appearance of the layout. The oil switch is connected to the bus through a disconnecting switch mounted on the same concrete compartment which incloses the bus. The 20,000-volt bus is amply provided with bus-disconnecting switches, so that any desirable combination can be made for splitting the bus.

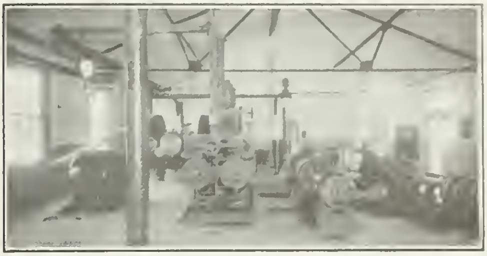


Fig. 12—Combined Pumping and Substation at LaGrange.

After passing through the K-6 oil switch the energy passes to the transformers, which step down from 20,000 volts to 2300/4000 volts with the neutral grounded. Only single-phase transformers have been used so far because few substations demand more than two banks of transformers, in which case it is cheaper and safer to use single-phase than three-phase transformers. The transformers are connected to the 2300/4000-volt distribution bus through K-2 oil switches. The 2300-volt bus is in most cases a single bus with an auxiliary bus, so that transformers or feeders can be connected to one bus while extension work is being done on the other bus, disconnecting switches being used for this purpose. This construction has been found to be good enough in substations where it is necessary to have only one bus pressure. In cases where a high and a low bus are required, or where the substation load could be divided on two different systems, a double bus system with oil switch to each bus is necessary

The K-6 oil switch consists of three single elements operated by one single solenoid, while the K-2 switch used on transformers and feeders is a single-pole switch with a solenoid for each element, so that any one phase can be operated independently of the others. Both types of switches are operated by direct current supplied by a storage battery charged by means of a mercury-arc rectifier set. A small knife switch is used for a control switch. The K-2 control switch is a special combination three-pole, single-throw knife switch so that all three phases of the feeders or transformers can be closed or opened at once or any single pole operated independently of the others.

Fig. 13—Switchboard in LaGrange Substation

From the K-2 oil switch the next step is through automatic regulators to a transfer switch. This transfer switch is a single-pole, double-blade, double-throw knife switch. One throw connects to the regulator, another throw to the transfer bus and the middle connects to the outgoing feeders. By means of this switch any one feeder can be fed from any other feeder in case it is necessary to clean the oil switch or work on any apparatus connected between the bus and transfer switch. In case of trouble with the regulator that particular phase can be thrown on to the transfer bus while the regulator is cut out of the service, the regulator being provided with transformer couplings so that this can be done in a very short time.

In cases where the transfer switch can be mounted near the line entrance it is also used as a line-disconnecting switch. The three-phase feeders leave the building through bituminous-fiber entrances. Lightning arresters, provided with disconnecting switches, are connected to each phase. The neutral is provided with a spark-gap, which is connected to the ground bus through a disconnecting switch.

ORGANIZATION, RECORDS, BUSINESS-GETTING, ETC.

The North Shore Electric Company reported for the fiscal year ended Sept. 30, 1910, capital stock outstanding of $4,964,000 and bonds amounting to $4,705,000. The gross earnings for the year were $1,386,062 and the net earnings $478,506, leaving $266,182 after paying bond interest. On Sept. 30, 1910, the connected business of the company, exclusive of railway business, was given as 453,238 16-cp equivalents. The growth of the business has been rapid. The officers of the company are as follows: President, Mr. Samuel Insull; vice-president, Mr. Frank J. Baker; secretary and treasurer, Mr. John H. Gulick; assistant secretary and treasurer, Mr. E. D. Alexander. The remaining heads of departments of the company are as follows: General superintendent, Mr. George H. Lukes; general contract agent, Mr. John G. Learned; purchasing agent, Mr. George R. Jones; mechanical engineer, Mr. J. L. Hecht. It should be added that Messrs. Sargent & Lundy, consulting engineers, designed the generating stations of the company.

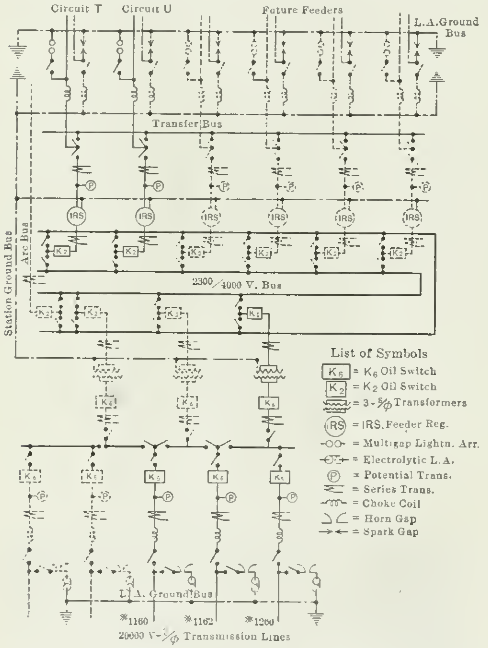


Fig. 14—Wiring Diagram of Typical Transformer Substation of the North Shore Electric Company.

Owing to the extensive and varied character of the territory served the matter of records assumes especial importance.

All territory inside of corporate limits, cities and villages is shown on maps drawn to a scale of 200 ft. to the inch. These maps are on sheets 16 in. x 19 in., each sheet showing a quarter section. Fig. 15 is a reproduction of one of these quarter-section maps, showing the location of poles and wires in a portion of Evanston. The sheets are mounted on cloth and bound in books. The poles occupied by the company are shown on these maps with appropriate symbols to indicate whether the pole is owned entirely by the company or jointly with others. The transformers, primaries, feeders, mains and secondaries are also indicated.

Circuit maps are also used, and they are intended to give a bird's-eye view of each circuit, being drawn to various scales, depending on the territory covered. They are, however, of uniform size, 16 in. x 19 in., and are also bound in book form. In these maps no attempt is made to indicate the poles, but the general route of the feeders and mains is shown together with the location of lightning arresters, junction fuses, etc.

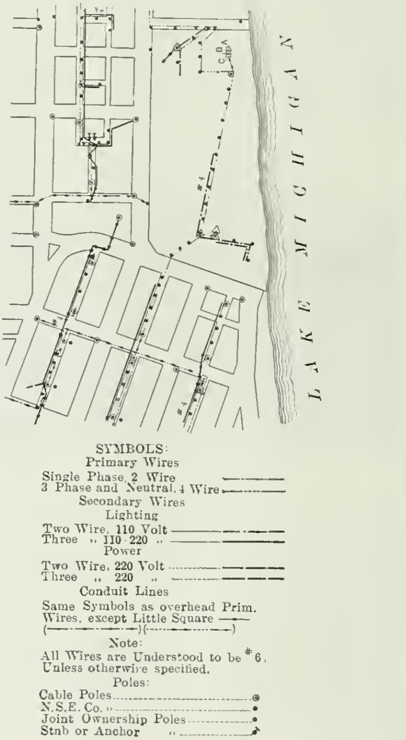


Fig. 15—Quarter-Section Map (Evanston, Ill.), Typical of Those Used in Records of North Shore Electric Company.

Street-lighting maps are also included in the records. These are similar to the circuit maps and show the routes of all street-lighting circuits, with the location of all street lamps.

Owing to the large territory served it has been found impracticable to maintain maps of the country region showing the location of each pole. However, maps on a scale of 4 in. to the mile have been made up to show the routes covered by the distribution lines in the country, and on these maps are indicated the number and sizes of poles between given points.

There are also transmission-line maps on various scales showing the routes of transmission lines. These maps may or may not indicate the location of each pole, depending on the importance of the line.

The rate charged by the North Shore Electric Company for electricity used for lighting is a maximum-demand rate of 14½ cents per kw-hour for the first thirty hours and 8 cents per kw-hour for the remainder of the bill. A discount of 1 cent per kw-hour is allowed for prompt payment. The power rate is a maximum-demand rate of 10 cents per kw-hour for the first thirty hours, 5 cents for the second thirty hours and 3 cents for the remainder of the bill, with a discount depending on the quantity used.

In securing new business methods must necessarily be adapted to the character and peculiarities of the territory served. The company's contract department consists of the general contract agent, an engineer, two power agents and twenty-three district solicitors. The general contract agent, the engineer and the two power agents make their headquarters at the general office in Chicago, while the solicitors make their headquarters at the district offices in the field. The district solicitors report through the district superintendents to the general contract agent. Each solicitor has a specific territory and he is held accountable for securing new business in his district. All of the employees of the company are very enthusiastic in relation to securing new business and co-operate freely with the employees of the contract department.

Liberal offers are made to secure new business. One of these relates to the wiring of old houses on the company's lines. The wiring of such houses and the furnishing of fixtures are done at cost and customers are given two years to pay the bill. The company also furnishes signs, tungsten clusters and ornamental street-lighting posts on a rental basis. Store windows are wired at a reduced price, and the company will furnish the original installation of carbon lamps for window lighting, furnishing renewals free of cost. Household appliances that may be attached to lamp sockets are placed among customers for a trial period of from seven to thirty days, depending upon the article placed. Some of these appliances are also sold under a twelve-month-payment plan.

Every effort is made to secure available power business by placing motors out on a rental basis and also selling them on time payments. The company advertises in about thirty-six newspapers in its territory and takes advertising space to an amount equal to the bill of the newspaper for electricity. The result of this practice has been very favorable. Direct-by-mail advertising campaigns are carried on continuously. Solicitors are paid a salary and commission on all business secured.

A recent addition to the company's activities is the establishment of storage-battery charging outfits for automobiles at all stations, all substations and some of the sub-offices. This is a great advantage to the increasing number of users of electric vehicles in the suburban area around Chicago. Rectifier sets are used to obtain the direct current for battery charging.

A METHOD FOR STUDYING THE INTERNAL INDUCTANCE OF LINEAR CONDUCTORS.

By Frank F. Fowle.

The internal inductance of linear conductors of certain types becomes of much relative importance when iron or steel forms the conductor material, wholly or partly. Iron conductors are employed to a large extent in telephony and telegraphy, and steel also. The latter is frequently used in long spans where copper or aluminum conductors form the remainder of the circuit, either for telephone, telegraph or energy transmission service. Compound conductors of copper and steel, or aluminum and steel, are also finding various uses. The properties of such conductors are becoming, on the whole, of increasing importance.

The inductance of any circuit composed of two or more open wires is susceptible of separation into the sum of two components, one of which is the inductance due to the magnetic field wholly outside of the conductors themselves and the other of which is the inductance due to the magnetic fields wholly within the conductors. The latter is termed the internal inductance or the internal component of inductance. The external component depends entirely upon the grouping of the conductors and their respective interaxial distances. The internal component depends upon the permeability of the conductor materials and, if copper-clad or aluminum-clad types are employed, upon the relative proportions, distribution and conductivity of these metals; if the conductors are placed close together there is still a further influence due to induced magnetization when iron or steel forms the material.

The internal inductance of a solid cylindrical homogeneous conductor is given by the well-known expression

$$L_1 = \tfrac{1}{2}\mu. \qquad (1)$$

While the expression is simple, the conditions within the conductor may be rather complex. This holds true especially in iron or steel conductors or in compound conductors of which those materials form a part. Considering first the simplest case, that of a homogeneous conductor, the flux distribution is in the form of concentric whirls about the conductor axis, in plane a perpendicular to the axis. The density is non-uniform and varies from zero at the axis to a maximum at the surface or circumference. The density is further affected by the permeability; if the latter is unity the density is everywhere equal to the magnetizing force and susceptible of exact calculation in a simple manner, but when the permeability corresponds in value to the properties of iron or steel the density is more difficult to determine. The magnetizing force is relatively small and the portion of the *B-H* curve which applies is quite below the ordinary range, so that special measurements would ordinarily be necessary. These are difficult to carry out because of residual magnetization, which exists to some extent even in the best grades of iron, and, of course, is more prominent in steel.

The value of inductance given in expression (1) is based on a constant value of permeability, which is not obtained, of course, in iron and steel. A value of μ which gives the actual or correct inductance in the latter case is necessarily an average or apparent value. No exact formula can be derived for L_1 under such circumstances without an analytical expression for the relation between B and H within the necessary limits. A direct physical determination of permeability from a sample of wire can be made by the usual methods, but it will not be possible to reproduce the peculiar flux distribution which ordinarily exists in the wire. An average value of the permeability determined from a *B-H* curve is not the proper value to use in expression (1) because annular elements of the wire section, of equal radial thickness, do not represent equal fractions of the whole internal inductance. In other words, the apparent or equivalent permeability of (1) is not easily found from a *B-H* curve; instead of being a simple mean it is a weighted mean, and the determination of the proper weights is not a simple operation.

The difficulties are increased, if anything, when compound wires are considered. The expression for the internal inductance of such a bimetallic conductor, taken from a serial article by the writer on "Electrical Properties of Compound Wires," which appeared in the *Electrical World* of Dec. 22 and Dec. 29, 1910, and Jan. 12, 1911, is given as follows:

$$L_{12} = \tfrac{1}{2}\mu I_1^2 + 2\mu_2 I_1 I_2 + \tfrac{1}{2}\mu_2 I_2^2 \left(1 - \frac{2r_1^2}{r_2^2 - r_1^2}\right) + 2\mu_2 \left(I_1 - \frac{r_1^2 I_2}{r_2^2 - r_1^2}\right)^2 \log \frac{r_2}{r_1} \qquad (2)$$

where the subscripts $_1$ and $_2$ refer to the core and the concentric shell respectively, I denotes the proportion of the total current, r denotes the radius and μ the permeability. When the shell is composed of any non-magnetic material the value of μ_2 becomes unity and vanishes from all the terms of (2). The term which contains μ_1 corresponds to the core inductance and is identical with (1) except for a factor equal to the square of the proportion or percentage of core current with respect to the whole.

Since the inductance and the permeability of a homogeneous wire bear a numerical relation to each other, as shown by (1), it is obvious that one method of studying permeability is by the measurement of inductance. This relates, of course, to the apparent permeability. The same applies to the case of a compound wire, such as copper-clad steel. Such a method, either independent of or coupled with physical determinations of permeability by one of the usual methods, should give satisfactory results if the internal inductance can be isolated from external inductance or if the latter can be made practically negligible.

The separation of internal and external inductance is not physically possible with ordinary loops of open wire, as circuits are usually constructed, nor would it be satisfactory to bring the parallel sides of the loop close together because of complications in the resultant flux distribution. It is possible, however, to restrict the external field by utilizing a concentric return of non-magnetic metal after the plan of a concentric cable, as shown in Fig. 1. In this illustration r_1 represents the radius of the conductor, r_2 the inner radius and r_3 the outer radius of the concentric return. Such a method or arrangement has several obvious advantages. In the first place there could be no mutual inductance with any nearby circuits; in the second place, the external inductance can be made very small comparatively by making r_2 as nearly equal to r_1 as conditions will permit, and in the third place the flux distortion at the ends and the corresponding correction for end-effect can be made negligible without setting up an excessively long circuit for experimental purposes.

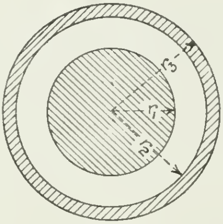


Fig. 1—Cross-Section of Linear Cylindrical Conductor with External Concentric Return.

The internal inductance of the central conductor in Fig. 1 has already been given by expression (1). The external inductance is

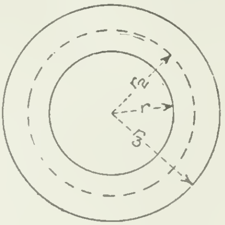


Fig. 2—Section of Concentric Return.

$$L_2 = \int_{r_1}^{r_2} \frac{2\mu_2}{r} d\,r = 2\mu_2 \log \frac{r_2}{r_1} \tag{3}$$

and the value of μ_2 will ordinarily be unity since it represents the permeability of the matter or substance between the two conductors. There remains only the internal inductance of the concentric return to complete the whole inductance. Referring to Fig. 2, which shows the concentric return, the total current strata inclosed within the radius r are given by

$$I_r = I_1\left(1 - \frac{r^2 - r_2^2}{r_3^2 - r_2^2}\right) \tag{4}$$

or

$$\frac{I_r}{I_1} = 1 - \frac{r^2 - r_2^2}{r_3^2 - r_2^2} \tag{5}$$

where I_1 is the whole current in the central conductor; the direction of the latter is taken as positive and the direction of current in the return as negative. Taking the whole current as unity, the field intensity at the end of a radius r is

$$B_r = \frac{2\mu_3}{r}\left(1 - \frac{r^2 - r_2^2}{r_3^2 - r_2^2}\right) \tag{6}$$

The internal inductance is the product of expression (5) and (6) integrated between the limits of r_2 and r_3, or

$$L_3 = 2\mu_3 \int_{r_2}^{r_3} \left[1 - \frac{r^2 - r_2^2}{r_3^2 - r_2^2}\right]^2 \frac{d\,r}{r} \tag{7}$$

$$= \frac{2\mu_3}{(r_3^2 - r_2^2)^2} \int_{r_2}^{r_3} (r_3^4 - 2\,r_3^2 r^2 + r^4)\ \frac{d\,r}{r}$$

$$= \frac{2\mu_3}{(r_3^2 - r_2^2)^2}\left[r_3^4 \log \frac{r_3}{r_2} - r_3^2 (r_3^2 - r_2^2) + \frac{r_3^4 - r_2^4}{4}\right]$$

$$= \frac{2\mu_3 r_3^4}{(r_3^2 - r_2^2)^2} \log \frac{r_3}{r_2} - \frac{\mu_3}{2}\left(\frac{3\,r_3^2 - r_2^2}{r_3^2 - r_2^2}\right) \tag{8}$$

The total inductance is the sum of three components, one for the core or inner conductor, one for the space between the conductors and one for the outer conductor, or

$$L_0 = L_1 + L_2 + L_3 \tag{9}$$

$$= \tfrac{1}{2}\mu_1 + 2\mu_2 \log \frac{r_2}{r_1} +$$

$$\frac{2\mu_3 r_3^4}{(r_3^2 - r_2^2)^2} \log \frac{r_3}{r_2} - \frac{\mu_3}{2}\left(\frac{3\,r_3^2 - r_2^2}{r_3^2 - r_2^2}\right) \tag{10}$$

This formula gives the inductance in c.g.s. units, using Napierian logarithms. The latter are obtained from common logarithms by means of a multiplying factor of 2.3026. The factor for converting (10) from c.g.s. units to mil-henries per 100 ft. is 0.003048.

For experimental purposes it would be possible to set up perhaps 100 ft. of iron, steel or copper-clad steel conductor as the core in an arrangement like Fig. 1; this could best be in one continuous straight line. After serving the conductor with a single wrapipng or paper for insulation, a split concentric return of sheet metal (perhaps copper) could be applied and held in place by turns of twine or insulated wire. The outer or return conductor could be made in suitable sections with butt joints and a bonding of solder. At one extreme end the conductors would be joined and the opposite ends connected to the measuring apparatus through short twisted leads. The whole arrangement amounts to an experimental concentric cable with minimum insulation thickness between conductors.

Assuming that the core conductor was No. 8 B. W. G. iron with a diameter of 0.165 in., wrapped with paper having a thickness of 0.004 in. and a concentric return of No. 24 B. & S. gage (0.0201 in. thick), the several elements of the whole inductance in c.g.s. units would be as follows, assuming $\mu_1 = 1000.0$, $\mu_2 = 1.000$ and $\mu_3 = 1.000$.

$$L_1 = 50.000$$
$$L_2 = 0.095$$
$$L_3 = 0.152$$
$$L_0 = 50.247$$

If a precision of only 0.5 per cent in the final result was necessary, the values of L_1 and L_3 could be almost neglected, or, in other words, no correction need be applied to the measured result of value of L_0 in arriving at the inductance or the apparent permeability of the iron core. The corrections ought to be calculated for each case, however, to settle the question of their negligibility.

It would be possible to incase the iron conductor in a metal tube if preferable for any reason, instead of the arrangement just described. The tube could be cut into suitable sections with the joints bonded; of course, the tube diameter should be made small so as to leave but little space between the two conductors. Collars of fiber or dry wood could be used to keep the core central with respect to the tube.

This proposed method is also suitable when the core conductor is stranded, either of iron, steel or copper-clad steel. The theoretical investigation of internal inductance for a conductor of this type is necessarily complicated owing to the altered character of the magnetic circuit and the accompanying distribution of flux. The flux densities would lie between very wide limits and the corresponding variations in permeability would render the theoretical treatment very difficult, except possibly by some approximate method.

The theoretical deductions given above are based entirely on the assumption that the current densities are uniform over each conductor cross-section, or, in other words, it is assumed that the current penetrates the conductor fully. This is true for continuous or low-frequency alternating currents, but is modified by the skin effect at high frequencies. Under the last conditions it would be necessary to introduce still another correction for the shunt capacity effect due to the condenser action between the core and its concentric return. The method is designed, however, to investigate the properties with continuous or low-frequency alternating currents as determined by the usual conditions of energy transmission.

USE OF FLYWHEEL SET TO EQUALIZE ORE-DOCK LOADS ON CENTRAL-STATION SYSTEM.

A FLYWHEEL equalizing set, comprising a 300-kw direct-current machine connected to a 25-ton flywheel and acting alternately as a motor and as a generator, storing up energy from the line or returning it on demand to the local hoisting load (the momentary peaks of which may reach 3500 amp at 250 volts), is installed at the new Toledo ore docks of the Cincinnati, Hamilton & Dayton Railroad, the energy to operate which is purchased from the 4000-volt alternating-current transmission system of the local central-station company. This equalizing set, employing the flywheel-inertia principle invented by Mr. H. Ward Leonard, is the first of its kind operating in conjunction with a rotary converter supplied from an alternating-current source. Not only does the flywheel set prevent the heavy surges of demand from reaching the central-station company's line in their bare, aggravated form, but it will also enable the dock installation to earn a lower rate for its energy supply, resulting from the decreased peak demands. The new ore-dock installation was completed on schedule time, Jan. 1, and was to have been tested immediately, but ice in the Maumee River at Toledo has made it dangerous to tie an ore vessel to the dock for practical unloading, so that the first actual use of the new installation may be delayed until spring.

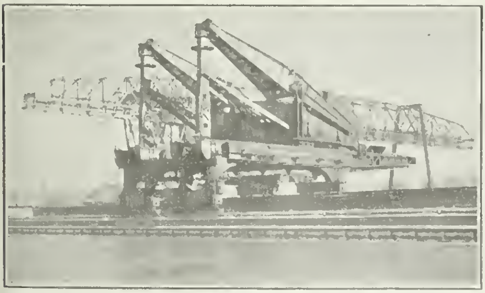


Fig. 1—Vessel Unloaders and Movable Bridge Structure of New C., H. & D. Ore Docks, Toledo.

This new Cincinnati, Hamilton & Dayton dock has a storage space 700 ft. long by 420 ft. wide, with a capacity for 1,000,000 tons of iron ore. Along the water's edge run two vertical rotating-leg vessel unloaders, each carrying a 15-ton bucket. These discharge into cars or into an intermediate pile from which the bridge bucket takes. The bridge spanning the main storage area, and on which the trolley carriage with its 10-ton bucket runs, is a 420-ft. steel structure moving the 700-ft length of the dock on two elevated rails 280 ft. apart. An unusual feature of this bridge has been the extension of the 125-ft. waterside cantilever, which overhangs two railroad tracks and enables the bridge bucket to load cars directly from the main storage pile. The trolley carriage has a velocity of 800 ft. per minute along the bridge, while the latter has its own lateral motion of 150 ft. to 200 ft. per minute on its rails. Each of the two unloaders is designed to unship 400 tons of ore per hour, with two men in the hold "cleaning" up the ore and shoveling it to the buckets as the bottom is reached. The ore dock itself represents an interesting piece of filled construction in the shoals of the Maumee River at this point. Nearly 800 wooden piles were first driven, and around these sand excavated from the future channel way and turning basin by a suction dredge was deposited until the surface was raised above normal river level. The foundations and anchorings for the dock structures are said to be the heaviest in the Great Lakes region.

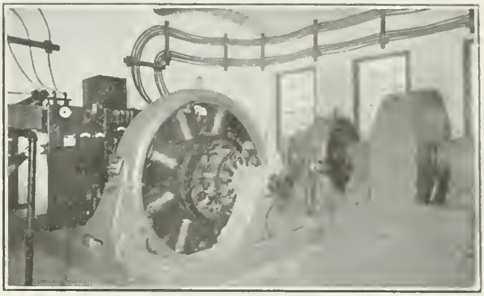


Fig. 2—Rotary Converter and Flywheel Equalizing Set.

Energy to operate the hoists and traveling motions of the dock structures is received in the form of 4000-volt, 25-cycle, three-phase alternating current from the power house of the Toledo Railways & Light Company, nearly three miles distant. In the substation on the dock property this 4000-volt energy is reduced to 170 volts by three 185-kw transformers, from which it passes to the alternating-current side of the rotary and is converted into 250-volt direct current for supplying the crane-trolley rails, both polarities being of the protected type and insulated from ground.

Across these 250-volt buses is floated the flywheel-generator set. This comprises an essentially standard-type compound-wound direct-current machine, the armature of which is rigidly connected to a 25-ton flywheel and runs at 600 r.p.m. Although normally taking energy from the line and running as a motor, in case of excessive peaks of demand by the cranes or unloading apparatus this unit is converted into a generator, supplying energy to assist the rotary converter and line in meeting the heavy load. When the current taken by the load exceeds 1500 amp a reverse-current relay closes contacts to a magnet switch which short-circuits the series winding of the flywheel machine, enabling it to pick up as a shunt-wound generator, sharing the peak demand with the rotary converter. Since the flywheel must meanwhile develop this energy at the expense of its velocity of rotation, as the speed falls, magnet switches close in succession cutting out field resistance of the generator, holding up the latter's voltage. At its maximum drop in velocity the speed of the flywheel set does not fall below 80 per cent of its normal rate, 600 r.p.m. The flywheel outfit is designed to carry an 850-kw demand for fifteen seconds before reaching the limit of its velocity drop. The combined rating of the machines is sufficient to meet any load that may be imposed by the concurrence of the heaviest demands of both unloaders and the bridge. In case the alternating-current supply should be interrupted sufficient energy would be residual in the flywheel rotating at 600 r.p.m. to lift both 15-ton unloader buckets out of the vessel's hatches, releasing her from the dock in case service could not be at once restored. Some idea of the small amount of power absorbed by the 25-ton flywheel when running will be afforded by the statement that with brushes in place but field off this set will continue to turn for three hours before coming to rest from an initial speed of 600 r.p.m. The rotary converter has a rated output of 2200 amp at 250 volts, while that of the flywheel generator is 1200 amp, making it possible to absorb peaks up to 3400 amp or more without disturbance to the alternating-current lines outside of the substation. A curve-drawing wattmeter is installed on the switchboard for recording current demands. The starting contactors for the flywheel set are also mounted on the switchboard, together with the main direct-current circuit-breaker, which is fitted with an overload relay having a coil of one turn, the magnetic circuit of which simply incloses the main bus. Similar elementary windings are also employed to operate many of the other relays on the board, the single winding being sufficient in view of the large current conveyed by the huge buses.

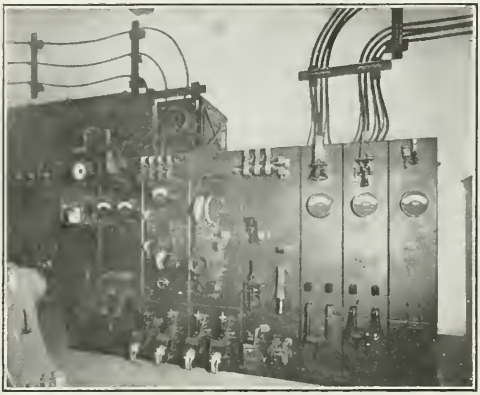


Fig. 3—Switchboard and Automatic Control Apparatus of Flywheel Equalizing Set.

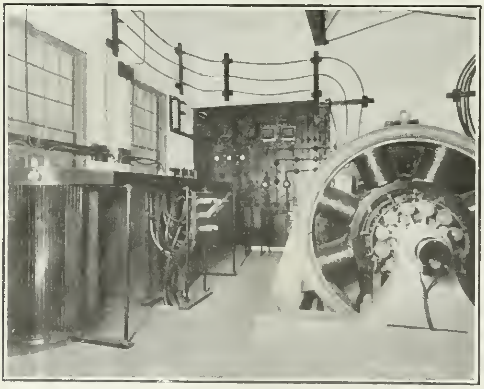


Fig. 4—High-Tension Entries, Transformers and Rotary Converter in Dock Substation.

Experience with the new flywheel set when using the conveyor machinery to hoist small quantities of ore from the storage piles indicates that both peak demand and energy consumption are saved for the customer. A flywheel set operating on 550-volt direct current from the trolley-feeder lines of the electric company has already been in use at another Toledo dock for a year and is very effective in smoothing out demand peaks, although, of course, this is less important in the case of a trolley system than on a commercial power line and lighting system.

The unloading and bridge-transferring equipment of the new Cincinnati, Hamilton & Dayton dock was built and erected by the Wellman-Seaver-Morgan Company. The flywheel-equalizing set and rotary-converter apparatus were furnished by the Allis-Chalmers Company, and the automatic control switchboard was designed and built by the Cutler-Hammer Manufacturing Company.

SPECIFICATIONS AND TESTS FOR INSULATING TAPE.

By William P. Munger.

So far as the writer is aware, there have not appeared adequate specifications and tests for that most important material—friction tape. Some writers and most users advocate the inspection of tape for closeness of weave, thickness, ratio of friction compound to braid, and other unimportant qualities. The six qualities to which all the other qualities are contributory and for which standards and tests should be set are:

1. Insulation, the property for which tape is used.
2. Character of compound, a quality often neglected.
3. Adhesiveness, which mainly determines the life of the joint.
4. Mechanical strength, important mainly from the workmen's viewpoint.
5. Feet per pound.
6. Durability.

The last two items determine the real cost.

A good specification and test for insulation is that given at the September, 1910, meeting of the Pennsylvania Electric Association by Mr. Thomas Sproule, chairman of the committee on overhead-line construction. (See *Electrical World*, Sept. 22, 1910.) This specification should be amended by stating that the standard taped joint shall be made with ¾-in. tape.

The test for injurious substances in the compound is best made by boiling a portion of the sample for two hours in distilled water and testing separate portions of the aqueous extract with litmus paper for reaction; with silver nitrate and nitric acid for chlorine; with barium chloride and hydrochloric acid for sulphur compounds, and by the cyanide method for iron. If black specks are found in the aqueous extract which it is impossible to dissolve in dilute or strong hot acid, the compound probably contains free carbon and the tape should not be used if other is obtainable. It is obvious that the compound should not contain drying or semi-drying oils, and, although it is not practicable to insist on their entire absence, other conditions being the same, that tape should be favored which contains the least amount of these undesirable oils. The percentage of compound to braid in the finished tape is not always easily determined, and is really unimportant except that there should be enough to impregnate the braid sufficiently and give the maximum adhesiveness.

In order to find the numerical values of other qualities several standard brands of tape were recently tested in the laboratory of the Stromberg-Carlson Telephone Manufacturing Company.

The adhesiveness was obtained by the following method: Take two pieces of the sample, lap the adhesive side of the end of one onto the back of the other, and press the lap between hard-rubber sheets held in the jaws of a bench vise, so as to give a pressure in making the joint which can be exactly reproduced in the next test. Then clamp each free end of the strip thus made in a set of jaws so arranged that they can be moved apart and a constantly increasing tension applied to the strip. The length taken between the jaw-sets should be about 80 cm. It is obvious that in operating this device enough tension will finally be applied to either break the tape outside the joint or cause the joint to fail. By repeated trials a length of lap will be found when the tape will break and the joint fail at the same instant. No account is taken in this test of the mechanical breaking strength because that is a separate specification. The results on the several samples are shown in columns 1 and 2 of Table I.

TABLE I.—RESULTS OF TESTS OF INSULATING TAPES.

Sample No.	Length of Splice.		Breaking Strength.		Feet per Pound. (5)	Meters per Kilogram (6)	Effect of Drying.	
	Inches (1)	Centimeters (2)	Pounds (3)	Kilograms. (4)			Wgt. Loss per Cent.	Appearance. (8)
1	4.25	10.7	38.0	17.23	93.0	62.36	1.94	Fairly adhesive.
2	1.50	3.8	34.1	15.46	153.0	102.59	1.84	Not very adhesive.
3	6.00	15.2	38.9	17.63	108.6	72.86	3.14	Unaltered.
4	1.75	4.4	35.9	16.28	144.0	96.56	1.96	Fairly adhesive.
5	2.50	6.3	36.7	16.64	165.0	110.64	0.51	Fairly adhesive.
6	3.00	7.6	....	.....	120.0	80.46	1.62	Dead.
7	5.00	12.7	40.6	18.41	117.0	78.45	3.30	Nearly dead.
8	3.50	8.9	35.9	16.28	193.8	129.41	2.30	Dead.
9	4.50	11.4	42.7	19.32	150.3	100.78	2.40	Dead.
10	7.50	19.0	23.3	12.56	165.9	111.24	2.20	Dead.
11	12.00	30.4	36.4	16.51	156.2	104.74	0.20	Dead.

The tape should be of sufficient strength to permit being tightly wound or applied without tearing or other injury. Samples of tape 0.75 in. wide were broken in a Schopper machine to determine what breaking strength should be the minimum requirement. During the tests, reported in columns 3 and 4, the jaws of the machine were protected from the adhesive material of the tape by strips of thin paper stuck on to the part clamped.

The number of feet per pound was obtained by weighing a strip of ¾-in. tape 3 ft. long and dividing this weight by three. For converting from grams into pounds avoirdupois use is made of the factor 453.6, the approximate number of grams in a pound. These figures are given in columns 5 and 6 of the table of results.

An adequate test for durability is hard to find, but in the absence of a better method the samples were suspended in dry air at 220 deg. Fahr. for four hours and the results obtained were as given in columns 7 and 8 of Table I.

Tabulating the samples in order of merit Table II is obtained.

TABLE II.—ORDER OF MERIT OF SAMPLE TAPES TESTED.

Length of Splice.	B. S.	Feet per Pound	Wt. Loss.	Appearance.
2	9	8	11	3
4	7	10	5	5
5	3	5	6	4
6	1	11	2	1
8	5	2	1	2
1	11	9	4	7
9	4	4	10	6
7	8	6	8	8
3	2	7	9	9
10	6	3	3	10
11	10	1	7	11

The samples listed above the dash are above the minimum requirements as set in the specifications which follow. It will be seen that samples 2 and 5 in each case were above the minimum requirement, while sample 4 was below only in feet per pound.

The rank of the tape which passed the character-of-compound and insulation tests and is above the minimum requirements should be determined, first, by the stability of the adhesiveness as taken by the heat test given above; second, by length of splice; third, by feet per pound, and, fourth, by breaking strength.

The following complete specifications are given, not as final, but as a contribution to the progress of testing and standardizing materials:

SUGGESTED SPECIFICATIONS.

General.—The article desired under these specifications consists of a thin, flat woven braid or tape of uniform width, thickness and strength throughout, impregnated with an adhesive and insulating compound, adhering firmly to the braid, and containing no sulphur, chlorine, iron or other compounds which will act injuriously on metals or the braid.

Compound.—The right is reserved to reject, without further test, any and all tape which shows the presence of injurious impurities in the aqueous extract obtained by boiling a sample in distilled water for two hours.

Insulation.—When submerged in water, and after having been submerged in water continuously for forty-eight hours, a standard taped joint shall have an insulation resistance of not less than 1000 megohms. The joint to be tested shall be a standard Western Union joint in No. 14 B. & S. gage, outside distributing wire. The distance between the ends of the insulation or length of the bare wire exposed in the completed joint shall not exceed 1.5 in. (38 mm). The joint shall be wound with two wrappings of tape, 0.75 in. wide (19 mm), put on in reverse layers with 0.5 in. (12 mm) overlap, the length of the taped joint to be 2.5 in. (64 mm). In testing the tape the joint and 2 ft. (161 cm) of the wire shall be immersed in the water.

Adhesiveness.—When the friction side of an end is pressed firmly onto the reverse side of another end and the free ends subjected to uniformly and slowly increasing tension, the length of the lap, when the joint fails, and at the same time the tape tears outside of the joint, shall not be more than 102 mm, or about 4 in.

Strength.—The breaking strength of a length of tape (0.75 in. wide) broken in any accurate tensile-strength machine (the distance between the jaws of which when the tape is in position to be tested is 105 mm, or approximately 4.125 in.) shall not be less than 33 lb., or approximately 15 kilos. The average of four lengths thus broken shall be considered the breaking strength of the sample.

Weight.—The total length of 0.75-in. (19 mm) tape as delivered shall not be less than 150 ft. per pound (100.6 m. per kilogram), other widths in proportion.

Durability.—The compound on the tape shall be insoluble in water at ordinary temperatures and when exposed to a moist atmosphere of approximately 90 per cent humidity at 80 deg. Fahr. for forty-eight hours shall absorb not more than 2 per cent by weight of moisture.

When exposed suspended in single strips (not rolled) to still dry air at 220 deg. Fahr. for four hours the tape shall not lose more than 2 per cent by weight, nor shall it be hard and stiff or have lost its adhesiveness to such a degree that a good joint cannot be made with the sample after cooling to ordinary temperatures.

If kept in the original package the tape shall be guaranteed to show no marked deterioration in adhesiveness, strength or insulation at the end of one year.

Delivery.—Unless otherwise expressly specified the tape shall be delivered in rolls ¾ in. wide (19 mm), weighing ½ lb. avoirdupois (0.227 kilo), each roll packed in a separate carton or box.

ELECTROPLATED PORCELAIN.

One of the popular lines for which American jewelers have been finding a rapidly growing market during the past few years is that of glassware decorated with a network of thin silver in a variety of ornamental designs. This silver coating is applied by an electro-deposition process which has greatly cheapened the cost of such glassware over that of the original hammered silver plate. The same process could undoubtedly be used for coating the whole exterior of a tumbler, vase or other article with a shell of metal, but for most pieces of glassware this would detract from the appearance. However, if such a continuous coating were applied to porcelain the resulting product would combine the heat-insulating and easy-cleaning qualities of the porcelain with the rich appearance of the solid metal. The combination should also be superior in wearing qualities to both the fragile porcelain and the easily dented metal, and this at a decided saving in cost over that of solid silver or even plated silverware.

Such a line has lately been offered on the European market by the Electro-Porzellan-Werke, of Berlin, under the attractive name of "Electro-Porcelain." This ware as at present offered consists chiefly of platters, bowls, tureens, tea-kettles, coffee-pots, tea sets and egg dishes. Where covers are required, these are plated in the same way, but are left loose, as usual with chinaware, instead of being hinged. The metal coating is generally of silver, though the same designs are also offered with nickel casings at a reduction of about 10 per cent in the price. Some articles are also made of porcelain with the usual white inner surface and the outside glazed a rich brown, but having only the handles, knobs and edges of the covers and openings nickel-plated. The process of manufacture is understood to be based on a patent issued to Mr. Alexander Gerbing for producing a conducting coating on a non-conductor. Mr. Gerbing does this by dissolving the silicate of some alkali, suspending finely powdered graphite in the solution and applying this to the surface of the porcelain.

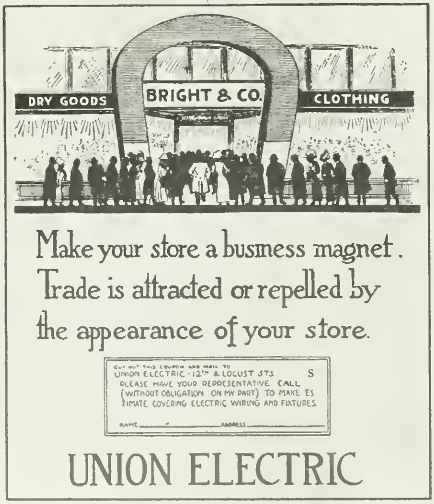
How much cheaper this rich-looking product can be than the solid metal is apparent from the German list prices as shown by the following: Platter, 14 in., with silver bottom and rim, $3.80; teapot with silvered exterior, 1-liter size, $3.35; milk pitcher. quart size, brown glazed. with silver plating only on handle and around mouth, $1.50.

Every housewife knows how much easier it is to clean the interior of a porcelain vessel than one of silver, hence such a metal-coated line should find a ready market and its introduction may add another to the already long list of electrical manufactures.

Central Station
Management, Policies and Commercial Methods

CENTRAL-STATION ADVERTISING IN ST. LOUIS.

The accompanying facsimile of a recent advertisement in a St. Louis daily by the Union Electric Light & Power Company, a liberal buyer of newspaper advertising space, will show the broad, simple lines on which this advertising is conducted, with one striking idea made prominent. As originally printed this announcement occupied a space 6.5 in. wide and 7.625 in. high.


DRY GOODS
BRIGHT & CO.
CLOTHING

Make your store a business magnet.
Trade is attracted or repelled by
the appearance of your store.

CUT OUT THIS COUPON AND MAIL TO
UNION ELECTRIC · 12TH & LOCUST STS S
PLEASE HAVE YOUR REPRESENTATIVE CALL (WITHOUT OBLIGATION ON MY PART) TO MAKE ESTIMATE COVERING ELECTRIC WIRING AND FIXTURES.
NAME ________ ADDRESS ________

UNION ELECTRIC

Newspaper Advertisement of Union Electric Light & Power Company, St. Louis.

Simultaneously the company does much street-car advertising with panel cards to which are attached blocks of detachable mailing cards containing on one side arguments for electric lighting and on the other the address of the company and blanks for the name and address of the "prospect." The street-car passenger who is interested tears off a post card, inscribes his name and address on it, attaches a 1-cent stamp and drops it in a mail box. The company does the rest

TUNGSTEN STREET-LIGHTING DEVELOPMENT AT ALBERT LEA, MINN.

The small amount of money appropriated for street-lighting purposes in American cities, and especially in the smaller towns throughout the Central States, has been a matter of frequent comment in these columns. As far as the downtown districts in the larger towns are concerned this condition has been improved in recent years by the introduction of special lighting of various kinds, either on ornamental posts or by arches and festoons of lamps. In the "Northwest," which is the term frequently applied to the territory tributary to St. Paul and Minneapolis, the development, especially in street lighting of downtown districts, has been particularly notable because it has been taken up by small towns of 5000 to 10,000 inhabitants, where it might be expected that such expensive installations would not be thought feasible. This movement is a striking testimonial to the progressiveness of the people of these Northwestern towns.

In the *Electrical World* of Dec. 9, 1909, page 1421, was described the first installation of ornamental tungsten-lamp posts made at Albert Lea, Minn. This was one of the pioneer towns in the Northwest to take up such lighting and the installation was remarkable at that time because of the size of the community, it having a population of only about 6000.

Fig. 1—Single-Lamp Tungsten Posts on Residence Street, Albert Lea, Minn.

Recently another installation of posts has been made in Albert Lea that is even more remarkable and significant than the first, because it marks the introduction of street lighting with tungsten lamps on ornamental posts at frequent intervals on a long stretch of residence street. This new installation, which is on Main Street, consists of seventy-seven posts, each having one 60-watt tungsten lamp, tip upward, inclosed in a 14-in. opalescent globe. The posts are set about 85 ft. apart, or eight to a block. The installation, like that on Broadway before described in these columns, was made and paid for by the Albert Lea Light & Power Company, of which Mr. Ludwig Kemper is treasurer and manager. The municipality contracted with the company for the lighting and maintenance of these posts for a period of ten years.

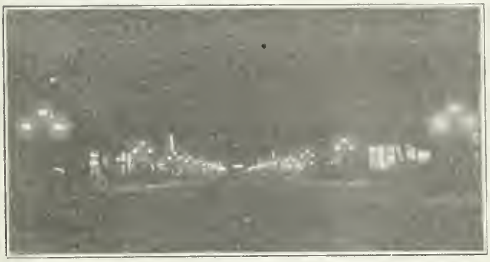


Fig. 2—Three-Lamp Tungsten Posts on Business Street, Albert Lea, Minn.

The single-lamp posts on Main Street are shown in Fig. 1 The contract price per year for these is $24.50 on an all-night, every-night schedule. Mr. Kemper states that the cost of installation, including all underground work, was $43 per post. The post itself, complete with globe and lamp, costs $32 delivered at Albert Lea. The heavy ornamental cast-iron post was made by Mott & Company, of New York. Charging 15 per cent for interest and depreciation and $3 per post per year for maintenance, the electric light company figures that it nets 6 cents per kw-hour. The lamps are operated on 110-volt multiple circuits. The wiring is placed underground in ¾-in plain iron-pipe conduits buried about 2 ft. under the surface in the parkway inside the curb line.

The original installation on Broadway, which is the main business street, consists of fifty-two three-lamp posts. The appearance of this street at night is shown in Fig. 2. The company receives $45.10 per post for this three-lamp lighting. Each post carries two 60-watt and one 40-watt multiple tungsten lamp. One 60-watt lamp burns all night every night, and the other two lamps until midnight. This lighting is also done under a ten-year contract.

CENTRAL-STATION LECTURES ON ILLUMINATION.

An interesting and successful experiment in central-station publicity work was recently conducted by the Stearns Lighting & Power Company, of Ludington, Mich. Assisted by representatives of the Fostoria Incandescent Lamp Company and of the Holophane Company two public lectures on illumination were given at the Opera House at that city on Thursday evening, Jan. 26, to a large audience. Although the affair had been widely advertised, some misgivings as to its success were felt Thursday afternoon, both because the weather was inclement and because there were two other attractions scheduled for 8 o'clock, the hour set for the illumination lectures. The fact that the lectures drew a full house—over 900 persons out of a total population of about 10,000 being present—was therefore doubly gratifying to those in charge.

The first speaker of the evening was Mr. Ralph Beman, of the National Electric Lamp Association, who gave a thirty-minute address on residence and store lighting, with particular reference to the efficiency and wide applicability of metal-filament lamps. Mr. Beman's talk was illustrated by about thirty lantern slides showing good and bad examples of store and residence illumination.

A very simple demonstration, made for the purpose of showing the enormous range of sizes in which metal-filament lamps may be had, astonished not a few in the audience. The demonstration consisted in switching off all the lamps in the theater and then turning on, first, a 1-cp pocket flashlamp, and, second, a 400-watt (350 cp) incandescent, which lighted up the whole room.

The second speaker was Mr. Harry F. Swindell, of the Holophane Company, whose address on the use of reflectors as affecting illumination occupied an hour. Various types of reflectors, including those especially designed for residence lighting, were demonstrated and explained by Mr. Swindell.

Musical numbers preceded and followed each of the lectures and added much to the pleasure of the audience. Numbered coupons were given in exchange for the admission tickets at the door, and upon the conclusion of the program at 10 o'clock an art-glass electric table lamp was presented to the holder of the "lucky" coupon.

The purpose of the lighting company in giving an entertainment of this unwonted variety was twofold: First, to show its consumers the importance of proper selection of illuminating equipment and intelligent laying-out of installations if satisfactory service is to be secured; second, to present the advantages of electric lighting before prospective customers. The meeting was advertised in the daily papers for a week, display cards were placed in the store windows and admission tickets and invitations were sent out by mail.

Results in the shape of inquiries at the lighting company's office began to be manifest as early as 9 o'clock on the morning after the lecture. One of these early inquirers who sought advice on how to make the show-window lighting of his store more effective decided to replace the one 187-watt graphitized-filament lamp and obsolete reflector which then adorned his window with five 60-watt metal-filament lamps and corresponding reflectors of modern design. Within a week over a score of direct inquiries resulting from the meeting had been received. The success which this means of central-station publicity met at Ludington could be repeated in the great majority of central-station towns.

No effort is spared by the Stearns Lighting & Power Company to give its customers good service. Such an occurrence as an interruption of the lighting service is practically unknown, and the voltage regulation, owing to the use of generator and feeder regulators, is very close. One of the reasons for the public meeting above described was that it was felt that the company's efforts to give continuous, well-regulated service would be of little avail so long as obsolete illuminating devices remained in general use on the consumers' premises.

The power plant is operated with exceptional economy, presenting an interesting example of the utilization of by-products. As a sawmill and a salt plant are controlled by the same interests that operate the lighting and power company, sawdust from the sawmill is used for fuel under the boilers of the power house, while the exhaust steam from the engines, at 10-lb. pressure, is used in the evaporation of salt. The daily peak load on the three generators is normally about 1100 kw. Mr. F W Hawley is manager of the central station.

Energy for residential use is sold on a sliding-scale meter rate which varies from 10.8 cents to 5 cents per kw-hour according to the number of kw-hours used per month. The price of illuminating gas in Ludington is $1.30 per 1000 cu. ft

ANNUAL REPORT OF A CENTRAL-STATION SALES DEPARTMENT.

By H. W. Hillman.

In the organizations of the vast electrical manufacturing corporations which transact a business of more than $1,000,000 every six days, there are sales offices all over the world, and the sales department is considered to be one of the most important departments of the corporation. In connection with central stations the situation has been a little different. Comparatively speaking, it has been but a short time that much importance has been attached to the sales department. How easy it is to remember the time when there were no exhibition rooms for the display of electrical devices, when very little advertising was done by the local companies and a well-educated electrical solicitor was unknown!

Now the situation has changed. The small stations, as well as the large, pride themselves upon the character of their salesrooms; advertising is quite as common among electric light plants as among the merchants of the community, and electrical solicitors are as numerous as any other class of salesmen in the country.

TABLE I.—"SERVICE IN," IMMEDIATE PROSPECTS.

Customer.	Connected Horsepower.	Maximum Demand.	Average Horsepower.	Estimated Annual Hp-Hours.	Cost of Service and Meter.	Annual Income.
1	25	20	10	60,000	$57.10	$1,147.50
2	5	5	3	5,000	40.00	140.00
3	5	5	4	3,000	30.00	81.00
4	30	25	20	15,000	500.00	300.00
5	150	100	75	200,000	168.00	3,000.00
6	15	10	6	3,000		81.00
7	1	1	¾	1,800	30.00	44.00
8	3	3	2	2,700	50.00	54.00
9	100	75	35	105,000	150.00	1,575.00
10	1	1	1	900	20.00	27.00
11	15	15	10	10,000	30.00	300.00
	350	260	166¾	406,400	$1,075.10	$6,749.50

Aggressiveness in the sales department is commendable. Activity and bustle exhibited in the sales office of the electrical corporation are good for the public to notice; but, after all, the question is, What do all the activity and the aggressiveness amount to if the general manager is continually bothered with contracts which have been signed covering business "off the lines"? What do they amount to if the general manager finds that the business is not well assorted; that it is too much of one kind; that it is pointing too much toward low-price transactions?

It is appropriate to stop and think for a moment of what are the real duties of the sales department just at this season. The writer names but one, and it is timely: Prospective business report for 1911. By all means get it out before the general manager requests it. He has enough things to do.

TABLE II.—IMMEDIATE MOTOR PROSPECTS, "ON THE LINE."

Customer.	Connected Horsepower.	Maximum Demand.	Average Horsepower.	Estimated Annual Hp-Hours.	Cost of Service and Meter.	Annual Income.
1	15	12	7½	3,000	$97.10	$80.00
2	5	5	4	5,000	95.00	125.00
3	125	100	100	150,000	358.10	1,900.00
4	20	20	15	25,000	132.10	620.00
5	15	20	10	50,000	277.10	1,150.00
6	35	30	15	30,000	91.10	600.00
7	2	2	2	750	42.00	22.00
8	2	2	1	750	50.00	22.00
	219	191	154½	264,500	$1,142.50	$4,519.00

Surely it will be appreciated if you will bring your report to his desk, thoughtfully arranged, intelligently classified, and also recapitulated for his general observation, but filled with valuable, interesting details if he should desire them.

But how to make out such a report! There's the rub! It has not been called for before. What is the object of such a report? Will the general manager have any practical use for it, or is it like some other reports with which all are more or less familiar, which have required nights and days to compile, with enormous amount of detail, only to be filed and sidetracked for data of more practical character?

The writer will first give some idea of how to make out the report; then describe how valuable it is to the head of the sales department; then its value to the engineering department and to the general manager, and finally how such a report becomes a necessity for the proper guidance of the executive committee and the board of directors whenever large appropriations for extensions and new generating apparatus are brought up for approval. Table I shows the way to begin such a report. It is wise to begin in this manner because the business indicated is the most desirable which can be found. The service is already in; it costs little to secure the contracts; it is the most immediate of all business in prospect. Table II shows the way to include the second page of details. This is the class of business next most desirable. It is "on the lines"; only secondary service is necessary to run it, and it is considered immediate. Tables III and IV show business for industrial purposes that should be watched carefully. Table V shows extensions on motor circuits. Sometimes members of the sales department are discouraged over this class of business because the general manager has given strict orders not to go after it. But it is important business nevertheless. The active, enthusiastic agent continually watching such business will some day be rewarded by finding that the policy has changed. The company wants the business. A disgruntled solicitor who has the habit of finding fault about occasional arbitrary decisions of the general manager regarding extensions will wake up some morning and find that an isolated plant has been installed and the business lost to the company.

TABLE III.—"SERVICE IN," SLOW MOTOR PROSPECTS.

Customer.	Connected Horsepower.	Maximum Demand.	Average Horsepower.	Estimated Annual Hp-Hours.	Cost of Service and Meter.	Annual Income.
1	250	200	125	375,000	$233.00	$3,600.00
2	150	60	40	50,000	525.50	1,000.00
3	300	220	200	600,000	150.00	6,000.00
4	150	110	100	540,000	4,000.00	5,652.00
5	450	400	300	480,000	100.00	6,000.00
6	1,000	1,000	1,000	336,000	375.00	5,040.00
7	200	175	150	100,000		1,000.00
8	50	40	25	60,000	50.00	900.00
	2,550	2,205	1,940	2,541,000	$5,433.50	$29,192.00

TABLE IV.—SLOW MOTOR PROSPECTS, "ON THE LINE."

Customer.	Connected Horsepower.	Maximum Demand.	Average Horsepower.	Estimated Annual Hp-Hours.	Cost of Service and Meter.	Annual Income.
1	15	15	10	25,000	$84.00	$575.00
2	150	70	50	60,000	143.00	1,200.00
3	20	18	10	18,000	124.60	459.00
4	15	14	12	25,000	55.10	531.25
5	15	15	15	25,000	57.10	531.25
6	100	50	30	75,000	88.10	1,311.00
7	35	30	20	40,000	61.10	700.00
8*	56	50	36	305,530	550.00	4,500.00
9	40	40	30	259,000	270.00	3,237.00
10	15	15	7	5,000	87.10	105.00
11	30	25	15	17,500	121.10	350.00
12	50	40	35	50,000	201.10	875.00
13	14	14	8	4,800	50.00	144.00
14	60	60	30	100,000	50.00	1,500.00
15	90	75	50	80,000	100.00	1,200.00
16	20	20	15	30,000	50.00	600.00
17	80	80	50	140,000	75.00	2,100.00
18	10	10	5	15,000	30.00	450.00
	815	641	428	1,274,830	$2,197.30	$20,368.50

*Twenty-four-hour business.

In Table VI, item 6, is shown the residence business in prospect. It should be classified in such a manner that solicitors can go after it in sections, thus striving for lower cost of running service. This method offers a high degree of economy and has worked especially well in actual experience. Item 7, the downtown business, is sufficiently interesting and important to require a detailed sheet.

There are other sheets that could be included, the number depending upon the size of the company, the character of the city, etc. Where the company is branching out extensively into the suburbs, and transmitting long distances, there is usually considerable prospective business along the transmission lines which is always in mind.

When all the detailed sheets are ready they should be compiled in the form of one sheet like Table VI. Such a report furnishes to the head of the sales department the most detailed information. If he peruses it carefully, the very first thought which comes to him involves a principle important to the company. He can encourage his solicitors to work more than ever "on the lines." Next, whenever the subject of extensions comes up for his decision he will have the information in detail without question. How often he has been to the general manager for his advice about extensions when he did not have his story well learned, when he was asked questions that he could not answer! He had not yet become sufficiently clever to know that he ought to have had the information before he ever went to the general manager's office.

TABLE V.—EXTENSIONS, SLOW MOTOR PROSPECTS.

Customer.	Connected Horse-power.	Maximum Demand.	Average Horse power.	Estimated Annual Hp-Hours	Cost of Service and Meter	Annua, Income
1	50	45	25	90,000	$266.10	$1,575.00
2	100	60	40	120,000	900.00	1,800.00
3	150	60	50	100,000	828.00	1,750.00
4	300	125	75	250,000	1,353.00	3,100 00
5	200	150	125	300,000	75.00	3,130.00
6	100	90	25	25,200	1,000 00	504.00
7	100	90	25	25,200	500.00	504.00
8	300	280	200	1,200,000	2,800.00	1,2000.00
9*	50	50	50	300,000	500 00	3,000 00
	1,350	950	615	2,410,400	$8 222.10	$27,363.00

*Twenty-four hour business.

With this report system every bit of business is classified. If a solicitor hears of any new business it is placed on the report. He cannot so place it unless he has the facts. Hence the head of the sales department always has details before him for intelligent discussion of such extensions. Thus it is that the report is of much value to the sales department, to its head and to the solicitors. When the general manager sees it he is keenly interested. He has often patiently asked for just such information whenever deals were brought up before him for some opinion as to precedence of one over the other, or when the company could get to such a place with its lines, or exactly what expense would be involved. Now he can see at a glance the cost of service and the annual income. He is not only able to render a more intelligent opinion in connection with specific matters, but he can advise more intelligently than ever regarding classes of business which the sales department should favor.

If the chief engineer is fearful that he cannot get through the fall season with the present load on account of low water conditions and inadequate steam facilities, then by all means push the residence business, the small commercial lighting deals, and keep away from the large motor users. If a season of hard times is just about showing itself and the directors say, "We should like to spend as little money as possible," the report at once becomes valuable. If a season of hard times has passed and money has become more plentiful, if the directors desire to push business more aggressively, the prospective report is not only valuable as a general guide, but it is helpful because of its detailed information.

How has the chief engineer heretofore determined the number and sizes of generators for which plans should be allowed? Oftentimes it has been more or less of a guess, and frequently based upon horse-power capacity. This report deals in hp-hours and the head of the sales department should learn to talk to his general manager in hp-hours. The chief engineer wants hp-hours, not horse-power.

In Table VI it will be noted, under commercial lighting, that there is $30,000 of business from the sale of the equivalent of 600,000 hp-hours; yet, in Table III, note, under "Service in, Slow Motor Business," that for $29,000 of business the company would have to furnish 2,541,000 hp-hours. It is plain to be seen that the character of business which the sales department must push depends upon the policy of the company and the condition of the generating system.

How true it is that the sales department may be big or little, depending upon how it is handled! The head of the department should assert himself and diligently strive to show the general manager the possibilities of the department. The sales department prospective report will become standardized and the general manager will depend upon it considerably for his recommendation as to purchases of increased generator capacity.

On the one hand, there is the sales department waiting on the engineering department. Sales of energy for motors are stopped and soliciting is done only on small lighting and motor deals. New apparatus is expected almost any time. The co-operation of the sales department with the engineering department at such a time preserves the dignity and the reputation of the company. It protects the company against making contracts to serve customers which cannot be fulfilled. On the contrary the prospective report, which shows nearly 10,000,000 hp-hours in prospect and almost $200,000 business, makes the general manager think; it makes the chief engineer study, it creates a discussion among the directors, and sooner or later the sales department becomes the cornerstone of the central-station business.

The sales department manager has not only made his reputation by being thorough in this particular report, but he has established a system which will keep the department thorough in its plans and in its work. The solicitors are educated to be thorough. They have become more thoughtful than they were

TABLE VI.—STATEMENT SHOWING PROSPECTIVE BUSINESS, ANNUAL INCOME AND COST FOR EXTENSIONS AND SERVING.

Classes.	Connected Horse-power.	Maximum Demand.	Average Demand.	Annual Hp-Hours.	Cost Service Extensions	Annual Income
Service in, immediate prospects	350	950	615	406,400	$1,075 10	$6,749.50
On line, immediate prospects	219	191	154	264,500	1 142 50	4,519 [illegible]
Service in, slow prospects	2,550	2,205	1,940	2,541,000	5 433 50	29,192.00
On line, slow prospects	815	641	428	1,274,830	2 197.30	20,368.50
Extension, slow prospects	1,350	950	615	2,410,400	8,222.10	27,363 00
Residence business	450	275	208	166,666	5,000 00	10,000 00
Lighting, business district	1,500	900	600	600,000	7,000 00	30,000.00
Miscellaneous city extension	26	15	10	13,800	1,8[illegible]	1,1[illegible]4 [illegible]
Miscellaneous motor addition	1,200	700	500	750,000	5 000 [illegible]	15,[illegible]
Suburban extension "A"	595	430	315	867 000	2,064 20	11 84[illegible]
Suburban extension "B"	342	275	241	318,600	6,0[illegible]	7[illegible]
Suburban extensior "C"	26	15	9	1[illegible],333	1 00[illegible]	[illegible]
Suburban extension "D"	250	130	90	80,[illegible]	4,[illegible]	4[illegible]
Suburban extension "E"	90	75	50	37,000	[illegible]	1[illegible]
	[illegible]763	7,062	5,326	[illegible]	$52[illegible]	[illegible]

before. They are better guided and directed than ever before.

Repeating a statement in the beginning of this article, it is commendable to exhibit aggressiveness in the sales department: activity and bustle are good for the public to witness; yet how much more pleasant and safe it is for the general manager to have in addition the feeling that the work each day is thoroughly well planned, that a system has been well laid out and approved by all. There is nothing haphazard about such activities. Aggressiveness following the inauguration of such a system will bring rich rewards.

Everyone realizes now how important is the sales department of the central station. Volumes have been written upon the needs of the department. Papers have been read setting forth how the solicitors should follow this and that class of business. A great many, if not all, of these suggestions, have been helpful to the central-station business. The object of this article, however, is to emphasize particularly the character of the report outlined; how easy it is to compile; how intelligible it is to the sales department head, to the general manager; and how valuable to the directors. Emphasis is placed upon the appropriateness of such a report at this season of the year It represents the forerunner of all the work of the sales department. It is as essential to the proper operation of the department as gasoline is to the automobile.

The attention of the sales department head reading this article is called to the "Advantages of the Holding Companies" as set forth in a recent circular of a prominent securities company in New York. Advantage number two reads as follows: "Savings in operation due to comparisons of each minute division of expenses of the other companies." The traveling business manager of the large holding company would study this report carefully. He would arrange immediately to have such a report made uniformly by all the companies under his charge. Then each month, as the amount of new business is reported by each company, it would be shown not alone in dollars and cents, but also in hp-hours, and the cost of securing it would likewise be shown. It would not take long to detect which company was most earnestly striving for business "on the lines," or which company was most active in following the policies laid down by the big holding company.

First, it is of prime importance to know if a company has, besides other prospects, two different classes of business which it might go after, one which would produce an income annually of $30,000 from the sale of 600,000 hp-hours, and another class which would bring but $29,000 from the sale of 2,541,000 hp-hours. Second, it is exceedingly important to know the relative cost of handling both classes of business. The former deal would appear insignificant in the small amount of horsepower served, and the cost of installation and service might be more than for the business which appeared very important because of its large horse-power capacity.

These are only two cases mentioned. There are others continually arising in sales department practice among central stations. If the sales manager has such a report in front of him at all times, kept up to date continually by the different solicitors, he will know his business well and will do his business well for his company. Another advantage given in the circular issued by the securities company is as follows: "The beneficial spirit of co-operation and rivalry can be established between local managers." When sales departments of all the holding companies are equipped thoroughly with prospective sales reports, and the members of such departments are being governed by them in their soliciting, then will a higher degree of co-operation have been exercised in connection with the sale of electricity for lamps, heating appliances and motors.

With reference to the word "rivalry," which was used in stating the last advantage mentioned by the circular the sales department, which gives particular attention to this kind of report, will approach the coming year with a feeling of pride. If there is only one station in the entire holding company which is using such a report, then it rivals the other companies. On the contrary, if other stations have likewise adopted the same kind of report, then opportunity is offered for rivaling them in the character of the report, and in the selection and securing of the business shown best to accord with the policy of the company as set forth by the general manager.

No sales manager who has once worked with this system will ever return to the methods which he formerly used. With the new prospective report before him at all times he will be able so to conduct his force that salesmen for all the other companies in the syndicate will be drafted from his department. Then will he have shown his ability to conduct a training school for operatives. Then will he be able to let men go from his department to take higher positions in some of the other companies without noticeable detriment to his own department and his own company. This is a feature which the large New York securities company is advertising as pertaining to it. Therefore it must be an important feature, because it is advertised to many thousands of prospective public investors. Such a report offers hope and encouragement for the future. Its careful perusal is accompanied by cheerful thoughts, and if there is anything which will make one sales department better than another it is to possess a higher degree of cheerfulness.

Wiring and Illumination

WIRING RULES FOR SAN FRANCISCO.

The Department of Electricity of the City and County of San Francisco has promulgated certain rules and regulations supplementary to the National Electric Code, which become effective March 1, 1911. According to these rules the installation of electrical conductors in wooden molding will not be approved. Service switches must be inclosed in an approved iron cabinet, provided with a glass door on which will appear the words "main service switch" in lettering not less than 1 in. in height. The service switch must be installed immediately within the main entrance of a building not provided with a basement having an entrance from the sidewalk, or not more than 6 ft. from the basement entrance of a building, and where appearance is a feature, the main service switch may be installed at the main switchboard or meter board and controlled remotely by a flush push button switch located in the main entrance. Wires from the controlling switch to the service switch must be installed in rigid conduit.

Feeder and service wires must always be of sufficient size to carry the lamp and motor circuits when these are loaded to their full capacity. In the case of lamp circuits this will mean 6 amp to each circuit installed. A two-wire service is called for where two circuits or less are run and a three-wire or convertible service is stipulated where more than two circuits and not more than six circuits are installed. The neutral wire of the convertible service must have a carrying capacity equal to the full load. A three-wire service of either the convertible or non-convertible type is specified where more than six circuits obtain. No service wires smaller than No. 12 are permitted.

In addition to the city ordinance, which provides that in the fire limits all wires used for conducting electricity, except those for telephone, telegraph and call-bell signaling systems, etc., shall be inclosed in conduit or other approved armor, the use of rigid conduit is made mandatory for feed wires to centers of distribution, motors, signs, reflectors, heating devices, resistance coils, low-voltage transformers or choke coils; wires for exits, entrances, fire escapes, halls, public toilets and baths, and lobby lamps in public halls or in hotels, apartment or office buildings of over two stories in height; service wires; wires on the exterior of buildings; wires to lamps outside of buildings when fed from concealed circuits; wires in theaters, nickelodeons, etc.; wires in elevator shafts; wires for basements, except where concealed in finished walls or ceilings; wires exposed to mechanical injury or flying combustible material; wires within 4 ft. of belts or pulleys; wires in or on marquises, and wires in damp places, such as stables, breweries, hotel or restaurant kitchens, bath houses, etc. In all of the cases named the conduit must extend from the lamps, motors, etc., to the center of distribution.

Wires in flexible steel-armored conduit or steel-armored cable will not be approved on the exterior of buildings or in other damp places, or when placed in concrete or in channels in concrete or brick walls unless protected with a lead covering between the wire and the armor. The use of armored cables for concealed work will not be approved, unless installed in such a manner as to be readily withdrawn and replaced at any time without damage to walls, ceilings, floors or other portions of the building.

The installation of more than three No. 14 or more than two No. 12 or No. 10 wires will not be approved in a 2-in. conduit; nor will more than four No. 14 or No. 12 or more than two No. 14 or No. 12 duplex wires be approved in one 3¼-in. conduit. Conduit of a size sufficiently large to permit of the easy insertion and withdrawal of other numbers or sizes of wires must be provided. The use of any compound or lubricant other than soapstone is prohibited. In three-wire (not three-phase) systems the neutral fuse must be omitted and the neutral wire must have a carrying capacity equal to the larger of the outside wires. On standard 110-220-volt systems no installation of interior wiring will be approved with more than twelve sockets to the circuit, except in the case of border or foot-lights in theaters. The department will approve 10-amp fuses on 110-volt lighting circuits and 6-amp fuses on 220-volt lighting circuits.

In the interior of buildings the load on any 27-volt circuit must not exceed 12 amp, and No. 12 wire must be used. On the exterior of buildings No. 12 wire must be installed for each circuit and the load must not exceed 15 amp. No. 16 wire must be installed for four lamps or less in fixture work, and in fixtures having more than four lamps No. 14 or larger wire, as may be determined by the load, is called for. The rules provide for the installation of low-voltage transformers on the exterior and interior of buildings. When installed on the exterior of buildings the low-voltage transformer must be mounted on a marble slab or soapstone base not less than 1 in. in thickness and of sufficient size to extend 2 in. on all sides of the transformer, the transformer and base then being inclosed in a weatherproof iron cabinet painted to prevent rust and having at least three 1-in. holes in the bottom for ventilating purposes and provided with a self-closing door hinged at the top and fastened by a catch at the bottom. All wires must enter the cabinet through conduit, and a clearance of 3 in. on all sides, top and bottom, must be maintained. The transformer, slab and cabinet must be securely fastened to walls by screws, no part—device, slab or cabinet—being dependent on another for support. Transformers of heavily covered types will be approved without a cabinet, if installed on the frame of a sign or, on a slate base, if fastened to the building and the wires are brought within 3 in. of the point of entrance to the device in conduit provided with approved terminal fittings. On the interior of buildings low-voltage transformers must be installed in the same manner as upon the exterior, except that they must be located in the basement at some point where there is no probability of combustible material being piled against the device and with the additional precaution that an iron vent pipe not less than 2 in. in diameter shall extend from within the top of the iron box to some point on the exterior of building at least 2 in. from the surface thereof, the end of the vent pipe to be turned so as to prevent the entrance of rain.

Heating devices must be protected by cut-outs and controlled by indicating switches. The cut-outs must be placed at the center of distribution and at each outlet. This arrangement will necessitate running separate pairs of wires from the center of distribution to each outlet, fused at the normal capacity of the heating device, as shown on the name plate. The size, therefore, of these feeds can be determined only if it is known what type of heater is to be used and the maximum current consumed by the same. A red pilot lamp must be installed at each outlet and connected to the heater circuit, being operated from the same switch as the heater.

In closets used for the storage of wearing apparel or other combustible matter lamps, whether suspended from the ceiling or located on the side walls, must be equipped with an approved metal guard. In damp places the lamps, fixtures or brackets located within the reach of basins, bathtubs, sinks, washtubs or faucets must be protected with keyless waterproof sockets and be operated by a wall switch.

The schedule of inspection fees ranges from 5 cents for each outlet at which current is to be controlled or issued for four lamps or under to $2.50 for a generator of more than 15-kw output. Fifty cents is the minimum amount of any bill of fees to be charged. For service surveys of old electrical installations a maximum fee of $1 is charged, and where the time exceeds one and a half hours a fee at the rate of 75 cents an hour applies. It is necessary in order to obtain a permit to carry on electrical work for an authorized representative of the firm or individual proposing to do the work to file the requisite specifications in person, when a written permit will be issued. Applications by mail or telephone will not be recognized, and under the ruling of the joint board of Fire and Police Commissioners no electrical work can be performed without the permission of the Department of Electricity.

ILLUMINATION OF A MODERN FACTORY.

By Harry C. Spillman.

The rapid growth in the output of automobile factories in Detroit during the last few years has created considerable competition among the industrial engineers of these factories, each in his turn trying to outdo the others in factory equipment and installation. This competition has brought forth ideas of the highest grade, resulting in some excellent planning and installations in this kind of factory construction. The Hudson Motor Car Company's factory, which was recently completed, is without question one of the best of its kind, everything embodied in its design and equipment representing the very best and latest practice. The owners desired to bring the efficiency of this plant to the highest point and to make it the standard of comparison, and with this end in view a free hand was given to the writer in executing his designs.

The many details were so carefully planned and laid out that within eighteen weeks after starting the excavation the buildings were entirely inclosed and occupied and ten weeks later the entire factory was fully equipped, including the complete electrical and mechanical installations. This record relates to the entire plant, which consists of three large buildings of two floors, ranging from 400 ft. to 600 ft. in length and containing nearly 200,000 sq. ft. of floor space, besides a large office building, numerous small buildings and the boiler house from which the entire factory is heated. All the buildings are of reinforced-concrete construction, with steel sash, which makes them practically fireproof.

Special attention was given to the architectural appearance of these buildings and their surroundings, as the plant is located in one of the principal thoroughfares of the city.

Illumination proved to be the important problem, the result desired being equal distribution of light, avoiding glare, sharp shadows and the use of individual lamps at the benches, as there is very little vise work to be done in the factory. It was also desired to avoid the placing of lamps in the center aisle, which is used only for the trucking of material. To accomplish this a thorough study was made of the various lamps, fixtures, etc., on the market, the outcome of which was the use of 60-watt tungsten lamps in Holophane-D'Olier steel reflectors. The distribution curve for this lamp and shade gives practically a uniform circle of light 10 ft in diameter when hung 8 ft. above the working plane, which is 30 in. from the floor for this class of work. The structural columns are placed 20 ft. apart, so that each bay measures 20 ft. square and contains four lamps placed on 10-ft. centers. From these figures and the accompanying diagram it will be understood that there are four lamps for every 400 sq. ft. of floor space, which allows 0.6 watt per square foot of floor space in the side bays. As this illumination also takes care of the center aisle the actual luminous expenditure is decreased to 0.4 watt per square foot of floor area. This scheme of illumination has worked out so successfully that the intensity of light is far beyond expectations and photometer readings show that there is an average intensity of 3.1 ft.-candles at the working plane, with a variation of less than 0.3 of a ft.-candle. Calculations gave an average of 2.2 ft.-candles, but the walls, being white, doubtless are responsible for this increase. The middle aisle, which is 20 ft. wide and lighted entirely by the lamps in the side bays, shows an average intensity of over 2 ft.-candles, which is ample for trucking material. The layout as planned, therefore, gives excellent illumination without the addition of a single lamp.

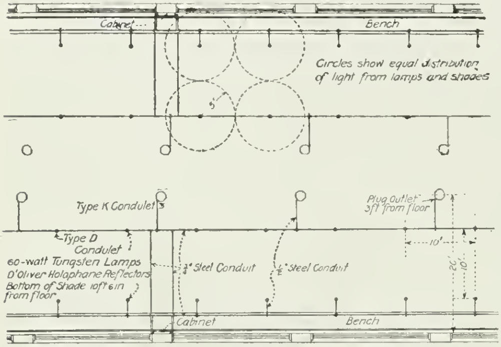

Cabinet
Bench
Circles show equal distribution of light from lamps and shades
5'
Type K Condulet
Plug Outlet 3ft from floor
Type D Condulet
60-watt Tungsten Lamps
D'Oliver Holophane Reflectors
Bottom of Shade 10ft 6in from floor
¾" Steel Conduit
½" Steel Conduit
10'
20'
10'
Cabinet
Bench

Fig. 1—Plan of Assembling Room, Showing Arrangement of Tungsten Units in Bays, Wiring, Etc.

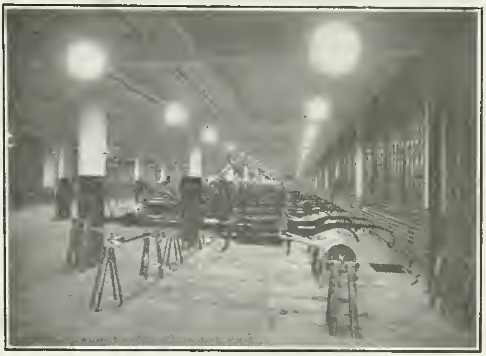


Fig. 2—Lighting in Erecting Room, Showing Truck-Aisle Illumination from Lamps in Bays.

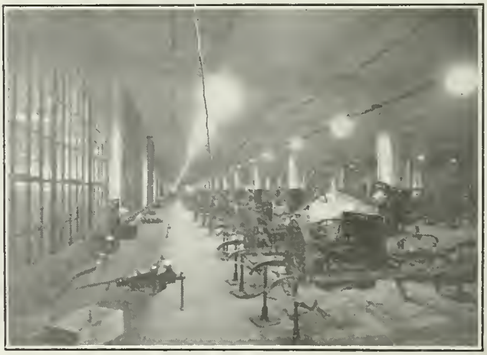


Fig. 3—Illumination of Engine-Fitting Room in Hudson Motor-Car Factory.

As only eighteen months have elapsed since this company placed its first automobile on the market, showing its rapid growth, and as it is expected that the plant will increase with similar strides in the future, it was decided to purchase energy from the Detroit Edison Illuminating Company instead of building a power plant which, in all probability, would prove to be too small and inadequate in a few years. Electrical energy is purchased directly from the primary lines and passed through two sets of transformers having neutral taps on the secondary side and 5 per cent and 10 per cent taps on the primary side. One bank of transformers is used for power and the other for lighting service, so that any variation on the power circuits will not disturb the lighting voltage. The secondary leads from the transformers run to the distributing switchboard, from which the different circuits are controlled for the entire factory. All the circuits are in steel conduit, not a single wire being exposed, except drop cords to the lamps. In order to carry out this scheme successfully 5-in. steel conduit had to be used for a number of the circuits. Three-phase energy at 220 volts is used for motor service and 110-volt, single-phase energy is used for illumination, derived from 220-volt, single-phase, three-wire circuits led from the distributing switchboard to the lighting cabinets where all lights are controlled. The only switches outside of these cabinets are located in the hallways and toilet-rooms. The circuits to the lamps are run through ¾-in. steel conduits, each containing three circuits made up of No. 14 duplex wire. Two of these circuits each carry eight lamps, the reserve circuit being for plugs and future lamps. Condulet fittings are used throughout the installation, and in most cases a condulet is installed so that future extensions can be made if desired. The drop cord which leaves the condulet through a one-hole porcelain cover is of No. 18 reinforced black lampcord, known by the trade as "slicked." In addition to this, two outlets are installed on each column for extension cords. The wire used for this installation is double-braided, rubber-covered, containing not less than 30 per cent Para.

The drop in the feeders from the distributing switchboard to the cabinets shows 3 per cent when all lamps are lighted. The lamp circuits have an additional drop of 2 per cent, which gives a total drop of 5 per cent. This drop is nearly constant throughout the factory, varying less than 1.5 volts, so that only one type of lamp need be used, the 111-113-115-volt, 60-watt, clear-bowl tungsten lamp, which is burned on the middle voltage. There are about 1500 lamps throughout the factory, and they have been in operation about seventy-five days. Since they were installed considerable construction work has been going on, including the installation of a sprinkler system and the covering of overhead steam and water pipes, causing the lamps to receive a great deal of jarring, since the cords are connected directly to the circuits without springs or shock absorbers. Nevertheless, since the installation it has been necessary to renew an average of only 1.8 lamps per day, which shows a remarkably low maintenance on 1500 lamps.

A man inspects the entire installation every day, trying out each circuit. In case a lamp fails to burn, before removing it from the socket he gives it a slight jar or sway with a short stick, which allows the broken filament to fuse together, generally saving the lamp. As many as three filaments have been broken in a single lamp and the unit restored to successful operation.

The lighting for the office building was carried out under the same general scheme, with the exception that single-lamp metal fixtures are used, finished in statuary bronze to match the hardware, carrying focusing-type glass Holophane reflectors for the 60-watt lamps. These shades were sand-blasted inside, adding to their appearance and causing the reflector to give nearly the same distribution curve as the standard intensive-type shade. Each office has full control of its lamps by individual switches. The hallways are lighted by clusters of three 60-watt tungsten lamps in Holophane glass hemispheres and controlled by three-point switches. There are also scattered throughout the building baseboard receptacles which are used for dictaphone and desk-lamp connections. The annunciator and telephone systems are run in one steel conduit system having both baseboard and floor outlets. No. 18 rubber-covered wire is used for this purpose and as many wires as possible were pulled into each conduit so that in case future telephone or an annunciator connection is required the wires are all ready in place and the connection can be made in a very few minutes. It was found that ten of these wires could be easily pulled into a ½-in. pipe, twenty-eight into a ¾-in. pipe and forty-eight into a 1-in. pipe. More than 40,000 ft. of annunciator wire were required to fill these conduits. In order to avoid long pulls two distributing boxes were placed on each floor and a 1-in. conduit extended from these boxes to the telephone and messenger room. Three-quarter-inch lines then connected these distributing boxes to the baseboard and floor outlets, which are connected together with ½-in. conduits.

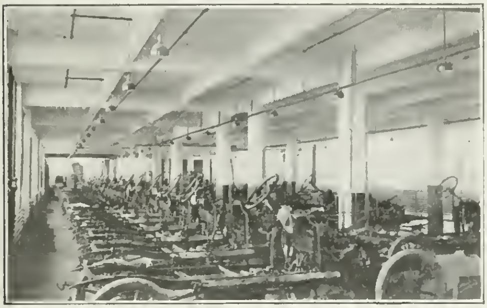


Fig. 4—Tungsten Lamps in Metal-Shade Reflectors, Used to Illuminate Assembling Room.

The grounds are illuminated by means of twelve flaming-arc lamps mounted on 35-ft. iron poles, spaced about 300 ft. apart. The arcs are fed by No. 6 lead-covered cable and each lamp is controlled by a separate switch. It is found that this gives excellent yard illumination and as the carbons burn for a long period they demand very little attention.

The entire installation has proved very satisfactory and the illumination has attracted a great deal of attention and received many commendatory remarks. The general scheme is contemplated by other factories which are now under construction.

RECENT TELEPHONE PATENTS.

LOCK-OUT PARTY-LINE SYSTEM.

Multi-party lines have been in use since the very early days of telephony, and almost from their inception inventors have been devoting attention to the problem of selective signaling of the stations and the locking out of non-wanted stations. As far back as the early eighties efforts were made to operate harmonic ringing for twenty or more station lines and the step-by-step system was conceived about the same time. Of all the various arrangements proposed the most interesting are those employing the sectional-line principle. According to this method, the line is divided into sections from station to station and these are built up to form a continuous line between the desired stations, incidentally excluding intermediate stations. Such is the system patented by Messrs. C. A. Soans and A. H. Graves, of Chicago, and assigned to the Homer Roberts Telephone Company. In this system one wire of the line is continuous, while the other is in station-to-station sections with signal-conducting means bridging the gaps between sections. At each such gap there is a pole relay and at one end of the line is a central office. From the pole relays the drops or branches from the main line to the respective stations are carried. It will thus be understood that but two wires need be used for these station loops. The system is so arranged that a calling station sets a signal before the operator. The latter responds and sets the finding key, whereupon the calling line is automatically built up to the calling station through the response of one after the other of the pole relays. When a party is desired upon another line the operator plugs to that line and sets a sending dial to the proper number. This forwards sufficient impulses to build up the line to the desired station, whereupon ringing of that station automatically begins. The system includes equally simple means for restoring the lines to normal after a connection is completed.

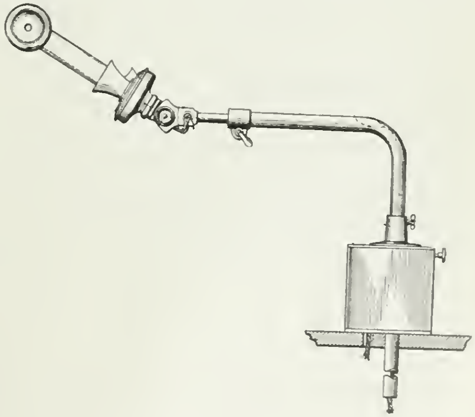
SIGNAL SYSTEM.

The system of Mr. S S. Stolp, of Chicago, relates to a lamp-signal system. In this system calling is accomplished between stations by depressing a calling key which applies grounded direct current through a vibrating bell and a locking drop in multiple. The drop closes a lamp circuit from the main line to ground. The lamp is thus left glowing after a call until the drop is unlocked by a response at the telephone.

SWINGING ARM FOR DESK USE.

With the increasing use of desk telephones there arise more and more situations where the cords not only become a source of trouble from excessive wear, but in addition they become a nuisance to the user. For such situations the swinging and folding arms have been introduced. Most of these, however, while providing a fixed position for the main cord, make no provision for protecting the receiver cord.

For railway-dispatch work the cords have at times proved particularly troublesome, especially if these are mounted upon the desk telegraph and other instruments. For such situations Mr. S. L. Van Akin, Jr., of Liverpool, N. Y., has patented the set shown in the accompanying illustration. Such an arm completely protects the main cord and no receiver cord is necessary. The arm swings, is telescoping and the instrument may be put at any desired angle to the horizontal. In addition the receiver ear-cap is carried upon a ball-and-socket joint so as to conform to the face of the user. The hook-switch mechanism is contained within the housing at the base of the arm and it is operated by swinging the arm from mid-position.



Telephone Instrument.

SWITCHING APPARATUS.

A switching apparatus for intercommunicating systems forms the subject of a patent recently obtained by Mr. S. A. Koltonski, of Boston, and assigned by him to the Electro Mechanical Works. The chief feature lies in so arranging and assembling the parts that all plungers and levers of the keys are integral with the front plate, while all switch springs corresponding are mounted upon the back plate. The plungers may all be removed without disturbing springs or wiring.

Letters to the Editor.

Economy of Electric Fireless Cooking.

To the Editor of Electrical World:

Sir:—In the report in your issue of Feb. 2 of the address of Mr. E. W. Lloyd before the Chicago Electric Club on "The Market for Electrical Energy" reference is made to some remarks by the writer in the discussion of the address in which he is quoted as saying: "A meal for from five to nine persons could be prepared with the expenditure of less than 2 kw-hours." May I point out that this quotation is in error, the statement of the writer being that the electric fireless cookstove referred to "would do *all* the cooking and baking for a family of from five to nine persons with a maximum consumption of less than 2 kw-hours," and I further said, in explanation, that "a meal of bacon, eggs, toast, coffee and oatmeal could be prepared for five persons in less than thirty minutes with a consumption of less than ½ kw-hour"? As a further indication of the economy of electric cooking it may be added that with the same cooking outfit a consumption of 1200 watt-hours is sufficient for a meal consisting of two or three kinds of vegetables, pie or cake, roast beef, brown potatoes, gravy and coffee for five persons, all of which could be prepared between 9 and 12 o'clock with a maximum demand of 660 watts.

S. Phelps,
General Manager Electric Fireless Cookstove Company.
Buchanan, Mich.

Street-Lamp Ratings.

To the Editor of Electrical World:

Sir:—There are certain elements for grim amusement in connection with the measurement of candle-power of arc lamps and their ratings—especially their ratings for street-lighting purposes. While various correct and incorrect ratings are glibly applied to arc lamps, the fact is, as those who have done most in arc-lamp photometry well know, that all varieties of arc lamps vary so greatly in the distribution of light and in the consequent candle-power obtained at any one point, that it is only by a long and tedious series of measurements that one can even approach a correct rating for any given lamp. The humor of the situation is that while an arc lamp may be rated to give a certain candle-power at a given angle below the horizontal the real average value may only be obtained once out of many readings, as the light is varying from far below to far above the average. When the open or inclosed carbon-arc lamp is used for interior lighting the variation caused by the wandering of the arc around the carbon tips is not so serious as in the case of street lighting. Most interiors have fairly light walls and ceiling, and the reflection from these helps to counterbalance the variations in light as the arc wanders around the carbon ends. In street lighting, however, there is but little reflection from buildings and surrounding objects to help out the illumination when the arc happens to be on the opposite side of the carbon tips from the observer.

Here it is very pertinent to raise the question whether the minimum illumination obtainable should not have an important bearing on the practical rating of a lamp rather than to take unqualifiedly an average obtained only after hundreds of carefully taken observations. The non-technical man naturally asks the question at once as to what good the illumination above average does him when it is really the minimum illumination he obtains which governs his ability to see his way along the street. On the other hand, it would hardly seem fair to the arc lamp to rate it according to some very low candle-power readings obtained occasionally under unusual conditions. Nevertheless, it must be admitted that if one had two lamps which gave an equal average candle-power in the direction most useful for street-lighting purposes, and one of these lamps varied greatly above and below average, while the other operated at all times very close to the average, he would unhesitatingly select the lamp with the least variation.

One practical bearing of this point at the present time is in connection with the substitution of large series-tungsten lamps for carbon-arc lamps in the smaller towns. As a specific example of this we may take the case of the 6.6-amp inclosed, alternating-current, series-arc lamp as compared to a 250-watt series-tungsten lamp equipped with proper reflector. According to the arc-lamp ratings in the reports of the 1907 and 1908 committees of the National Electric Light Association the effective candle-power of the arc lamp referred to (measured at a distance from the lamp equal to about ten times its height) is 196. Making due allowances for the depreciation caused by dirt on the tungsten lamp in practice, and also for the increase in effective candle-power caused by the reflector, one would expect the two lamps to be about on a par for street-lighting purposes. When one considers, however, that the tungsten lamp gives a steady light, while the average figure named for the arc is really one obtained by readings varying far above and below the figure named, the tungsten lamp comes out decidedly ahead in the comparison. Carrying the comparison a step further, it is doubtless true that the 250-watt tungsten lamp referred to could be satisfactorily substituted for arcs of somewhat higher rating than the 6.6-amp inclosed series arc.

In making all substitutions of this kind at the present time, however, central-station companies should bear in mind the troubles which have arisen in the past through the substitution of one kind of lamp for another without formal authorization by city officials. It is always best that these matters be fixed definitely and in due form and that specific permission be granted to substitute a certain specific lamp for the one in use. In doing this it is well for the company to state its case fully, making no secret of the fact that there will be advantages to the company in making the change if there be such advantages in the specific case under consideration. Such changes should be asked for on the ground of mutual advantage to city and company, such advantage being made possible by recent improvements in the electric-lighting field.

Chicago, Ill. Charles L. Tremaine.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Paralleling Alternators.—A note on a recent British patent (22,224, Jan. 26, 1911) of Siemens Brothers & Company for an instrument for indicating equalizing currents of alternators in parallel. The primary coils of a current transformer are inserted in series between the common busbars and the circuit of similar phase of each generator, and the secondary coils are connected in series with one winding of the phase-difference indicator of that generator. The other winding of the phase instrument is traversed by the resultant current due to the sum of the separate currents flowing in these secondary coils.—Lond. *Elec. Eng'ing,* Feb. 2.

Reversing of Polyphase Motors.—A note on a recent British patent (28,661, Jan. 26, 1911) of the Siemens-Schuckert Company. To avoid sparking at the switch contacts and heavy rushes of current when reversing three-phase induction motors of low frequency the field is maintained near its full strength during reversing by first short-circuiting the two phases to be reversed at the instant when they are at equal potential.—Lond. *Elec. Eng'ing,* Feb. 2.

Lamps and Lighting.

Arc Lamp.—A note on a new arc lamp of Ruhling which is very similar to the old Jablochkoff candle, but has a new feature which renders it self-starting. As in the Jablochkoff candle the two carbons are parallel, and are separated by a strip of non-conducting plaster, and a metallic bridge is provided for starting the arc. In the original lamp, if the current is interrupted, the arc cannot restart without restriking by hand; but in the new lamp a certain amount of powdered copper is incorporated in the plaster, and when the arc goes out a film of copper is deposited across the plaster and forms the necessary bridge for restarting the arc. The reducing effect of the carbon in the arc prevents the copper from oxidizing. The lamp can be used in any position—vertically upward like a true candle, horizontally, or with suitable carbons pointing vertically downward in an economizer, with a blow-out coil, as a flame lamp. In the first two cases absolutely no mechanism is required, and in the flame lamp the very simplest device is sufficient to permit the carbon to feed against a stop as burned away. The sizes of the two carbons in the continuous-current lamps are proportioned so as to burn away at an equal rate and a steady light can be obtained with a current as low as 2.5 amp to 3 amp. The candle-power curve of Fig. 1 shows that the candle-power is a maximum in the axial direction, which would indicate that, with the carbons nearly horizontal, a distribution of light not unsuitable for street lighting can be obtained.—Lond. *Elec. Eng'ing,* Feb. 2.

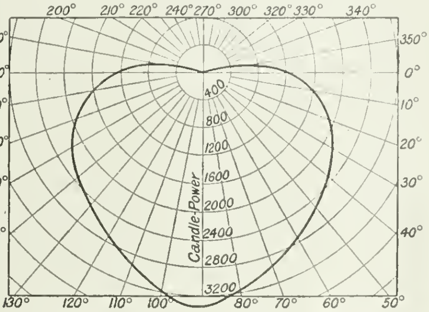


Fig. 1—Polar Curve of Candle-Power Distribution.

Flame-Arc Lamps.—A note on a recent British patent (12,483, Jan. 26, 1911) of the Siemens-Schuckert Company. In order to remove the fumes from the globe of a flame-arc lamp an annular passage with outlets in the upper part of its outer wall is provided above the globe. Screens or rotary cowls are fixed outside over these openings, so that wind striking the lamp may set up a suction effect.—Lond. *Elec. Eng'ing,* Feb. 2.

Generation, Transmission and Distribution.

Industrial Networks.—J. R. Dick.—The voltage drop in the mains is not of such importance in industrial networks as in lighting networks. It does not unduly affect the efficiency of motors, although it reduces the working speed, but this can be allowed for, in relation to the machinery operated, by adjusting the ratios of the driving gears. With synchronous or induction motors the speed is independent of the pressure drop in the distributing system as long as the frequency is kept constant. The question of speed regulation is of great importance in many instances, such as the textile, and in no application of electric driving is it negligible. Polyphase motors exhibit a decided advantage over direct current in respect to constancy of speed. In the majority of installations up till now the same mains furnish both motor service and light, but for industrial areas, where it is hoped ultimately to satisfy practically every demand for power by electrical means, it is at least worth considering whether it would pay in such cases to put down a separate network for motor service. There is every probability that the price of electric energy could be made substantially smaller than with a common network. The design of an industrial network is usually dependent on the condition that the energy lost in the mains should not exceed a certain proportion of that usefully employed up to a limit of, say, 10 per cent, and the maintenance of a constant pressure within 2 per cent or 3 per cent limits is practically ignored. The author shows by mathematical analysis that the current density, to satisfy the condition of minimum volume of copper in a system of mains characterized by a definite percentage of loss of power, must be constant throughout, or conversely, if a constant-current density is used, the amount of copper will be a minimum. Kelvin's law is a particular case of the general law of "constant-current density." The rigorous application of the principle of a constant-current density involves a change of cross-section at every point where an installation is connected to a long length of main. But it is possible to find an average current in the main, if a constant cross-section be taken (as is customary in practice), which will give the same loss of power.—Lond. *Electrician,* Feb. 3.

Electric Power in Potash Mines.—Baldamus.—The development of the German potash industry has been going on simultaneously with the development of electrical engineering. The present article gives an interesting historical review. In 1883 the potash industry had four small separated stations of together 70 hp, which also supplied lighting. At present the potash works have a most up-to-date electrical equipment for all purposes of mining, lighting and industrial purposes in general. They have stations of more than 1000 hp and buy energy up to 6000 hp from other plants. The potash industry has been a good consumer of the German electrical manufactures and has been equipped in return with the best electrical machinery. —*Elek. Zeit.*, Feb. 2.

Alternating-Current Elevator Motors.—W. H. Patterson.—An article on the use of induction motors for elevator service. The wound-secondary induction motor has high starting torque characteristics and speeds satisfactory for operating elevators of all capacities up to a maximum speed of 250 ft. per minute. Elevators operating at higher speeds are practically always two-speed machines and this feature immediately eliminates the alternating-current motor from a practical standpoint, as with any given amount of resistance inserted in the rotor circuit the speed will vary with the load. Thus, on high-speed elevators running from 250 ft. to 600 ft. per minute, direct-current motors are always used. Another feature that limits the use of alternating currents to elevators operating at speeds of not over 250 ft. per minute is that in order to accomplish dynamic breaking of an induction motor for automatically slowing down the elevator car a small motor-generator set is necessary to supply direct-current excitation to the primary. Therefore, in driving all modern high-speed electric elevators direct-current motors are used. Squirrel-cage induction motors require no controller, as they are not connected directly across the line. A drum-type reversing switch is used to control the direction of rotation. A controller for use with polyphase slip-ring elevator motors is also described.—*Elec. Journal.* February.

Electricity in Steel Mills.—B. Wiley.—An article illustrated by diagrams with special reference to the different systems for electrically driving the main rolls of steel mills.—*Elec. Journal,* February.

Electric Heating and Cooking.—H. Gray.—The author first describes a number of tests on gas-heated apparatus and electric utensils to ascertain the efficiency and comparative cost of use. He then discusses the design of electric apparatus and finally future developments. In electric cooking there is some difficulty in attaining a practical uniform heat round all parts of the food, particularly in big sizes of ovens. The arrangement adopted by the author is to generate the heat at the bottom, deliver it then into vertical "flues," the flues passing it into the oven proper at the top. The hot air is then forced from the tops by fresh hot air continually rising in the flues—through all the area containing food—to the bottom, where it again comes in contact with the heating elements and the process then repeats itself. Fig. 2 shows the direction of the air currents in a diagrammatic manner. The circulation of air from top to bottom is absolutely certain as long as heat is being generated, and there is a slight wastage of heat always going on, due to absorption of heat by the food and heat leakage, which tends to make a slight reduction in the temperature of the air as it moves from the top to the bottom. This difference in temperature in practice is found not to exceed 15 deg. Fahr. when cooking temperature is attained, and with this difference the speed of the air is quite sufficient to sweep away all "air-locks" from the top and around the food. This slight temperature variation, which is not 5 per cent of the total temperature, is not sufficient to affect practical uniformity of cooking from top to bottom of the oven. With regard to retaining the heat in the general body of the oven the general practice is now to have the oven double-jacketed with the hollow walls filled with dry air retained in a cellular state by means of finely divided asbestos or slag wool. Both of these materials give excellent results if the jacket is made 1½ in. to 2 in. thick. A charge of over 2 cents per kw-hour will generally confine the use of electrical cooking to the well-to-do people, with whom the somewhat increased cost over gas or coal is negligible compared with the advantages obtainable. At 1½ cents per kw-hour, and with apparatus turned out in quantity, nothing should in the future stop great developments. An account of the long discussion which followed is also given.—Lond. *Electrician*, Feb. 3.

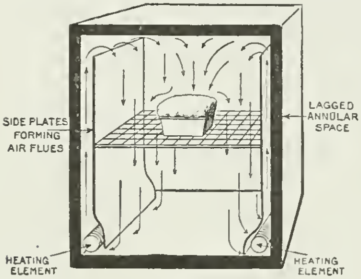


Fig. 2—Diagram of "Circulating" Electric Oven.

British Central-Station Statistics.—Tables completing the annual statistics on the connections to British central stations supplying only lighting and motor load and to stations taking a bulk supply and stations having combined lighting and traction loads respectively.—Lond: *Electrician*, Jan. 27. These statistics are now summed up in several diagrams and tables. For the City of London stations (total connections 385,391 kw) the figures are as follows:

Municipal.		Companies.	
D. c.	59,685 kw	D. c.	76,904 kw
A. c.	32,278 kw	A. c.	27,322 kw
Mixed	26,994 kw	Mixed	142,208 kw
	118,957 kw		246,434 kw

For the provinces (total connections 1,106,886 kw) the figures are as follows:

Municipal.		Companies.	
D. c.	366,138 kw	D. c.	92,797 kw
A. c.	123.706 kw	A. c.	26,600 kw
Mixed	425,819 kw	Mixed	72,826 kw
	914663 kw		193,223 kw

In 1909, for the first time, the connections to the provincial stations exceeded 1,000,000 kw and the rate of increase was well maintained during 1910.—Lond. *Electrician*, Feb. 3.

Fool-proof Devices.—A general discussion before the West of Scotland Branch of the (British) Association of Mining Electrical Engineers on the function of fool-proof devices. W. A. Wilson started the discussion and emphasized that the expression "fool-proof" should be confined solely to such apparatus as may have to be handled by fools by reason of their vocation; but that the apparatus to be handled by skilled men should only have such devices attached to it as will protect men who are thoroughly conversant with their working and will in nowise hamper the skilled attendant or render the apparatus accessible with difficulty. His reason for suggesting that there should be such limitation is that there appears to be a growing tendency to surround all electrical gear with devices and safeguards, the principal object of which appears to be the preservation of human life irrespective of whether or not it interferes with the action of the trained engineer or the industry for whose benefit he works. It is doubtless proper to have electric switch gear at the working face of a mine, which is in daily use by men skilled in the winding of coal, so protected as to preclude, if possible, the chances of a shock. It is equally proper to insist that a fuse on a switchboard shall not be in such a position as to damage the eyes of the attendant in carrying out his duties. But it is different in purely electrical installations with which only electricians come in contact. D. Martin said that there were not so many fools as ignorant men, and an ignorant man should be educated to such a standard that he would realize that if he increased the capacity of the fuses, for example, he jeopardized the life of the coal-cutter or haulage motor. Unquestionably the miner inevitably, by reason of his vocation, became a more or less reckless man.—Lond. *Electrician*, Feb. 3.

Variable-Speed Driving Gear.—A note on a recent British patent (30,556, Jan. 26, 1911) for a variable-speed polyphase driving gear for ships, etc., granted to H. A. Mavor, H. M. Hobart and Mavor & Coulson, Ltd. This patent covers a system in which two or more motors with means for varying their pole numbers are supplied with currents of different phase numbers and frequencies from two or more generators. At maximum load all the machines and the different windings are used at their full capacity without interfering with each other. An important feature is that synchronizing of the generators is avoided.—Lond. *Elec. Eng'ing*, Feb. 2.

Wires, Wiring and Conduits.

High-Pressure Transmission Lines.—R. B. Matthews and C. T. Wilkinson.—A paper read before the (British) Institution of Electrical Engineers. There is no engineering difficulty which will prevent the building of transmission lines of great length, but financial considerations may at present limit the length to 400 miles. For transmission systems steel towers and suspension insulators have practically replaced wooden poles and pin-type insulators. Flexible structures, too, are taking the place of rigid systems. Fig. 3 shows curves which can be taken as fairly representative of the cost per mile for a given voltage. The costs are independent of the conductor, but include the cost of the pole or towers and their erection and that of the wires. It is not practicable to build a wood-

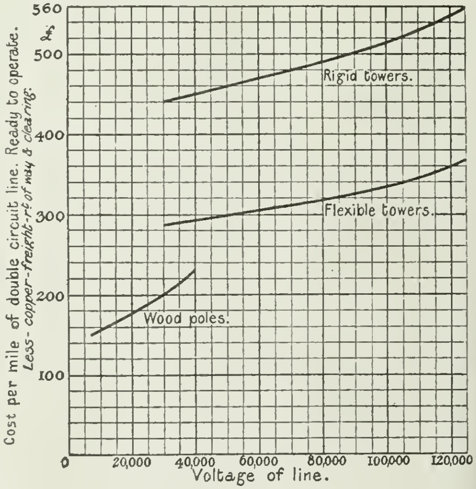


Fig. 3—Curves Showing Relation Between the Cost of Various Poles and the Line Voltage.

pole line for above 40,000 volts for two circuits, since the length of the cross-arms becomes excessive. Further, the cost curve slopes up somewhat steeply, and in the neighborhood of 50,000 volts would cross the flexible tower curve. The latter means a construction with an average life of thirty years, whereas the wood-pole line can only be assumed to have an average life of twelve years. Figs. 4 and 5 give useful data with regard to the yield of the earth foundation and the sag of the wire between supports on the pole line. Interruptions to service may be divided into three classes: Mechanical failure, mechanical failure following electrical causes, and wilful damage. The chief contributor to the first cause may be expected to be ice. Ice forms equally freely on wires whether they are alive or dead up to an operating voltage of 66,000, above which no reliable information is obtainable. Mechanical failure may occur from electrical causes, such as heavy short-circuit and lightning discharge. Care should, however, be taken to study the topography of the country before constructing the line and even to build two separate lines. Earth wires and lightning rods are of undoubted value, and the tower should be earthed. A liberal factor of safety should be allowed on the insulators and ample spacing should be given to the wires. An ingenious system for the protection of highways and railway crossings is to support the span immediately on either side of the railway or highway, and the spans on either side of this crossing span are of extra length. The two crossing poles carry the necessary insulators, etc., but the wire is not tied tightly to them, but is supported in such a manner that in case of breakage it will readily slip through and be pulled clear by the longer spans.—Lond. *Electrician*, Feb. 3.

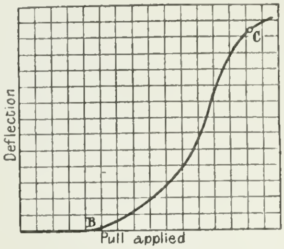


Fig. 4—Yield of Earth Foundation.

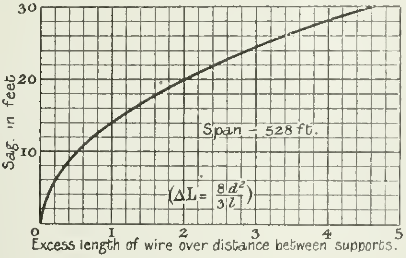


Fig. 5—Sag of Wire Between Supports.

Electrophysics and Magnetism.

Atomic Nature of Electricity.—F. Ehrenhaft.—The author discusses the recent investigation of R. A. Millikan, who concluded from his experiments that electricity has a corpuscular nature and that the electric charge of the corpuscle is 4.9×10^{-10} electrostatic units. He, himself, had concluded from his own experiments, carried out with the aid of the ultramicroscope, that some particles carry smaller charges. He points out that Millikan did not investigate particles as small as he did himself with the ultramicroscope. He finds that it is just these exceedingly small particles, with a radius below 3×10^{-6} cm, which carry charges smaller than the so-called electronic charge. He criticises Millikan's modification of Stokes' law according to Cunningham's formula. He still maintains that it is not proved that there exists a minimum electronic charge of the order generally given.—*Phys. Zeit.*, Feb. 1.

Electronic Theory.—L. T. More.—A critical discussion on the recent theories of electricity. The author wants to overcome the difficulties between the old and the new theories of the following hypothesis: He proposes that in order to make the ratio of the electric charge *e* to the mass *m* of the corpuscle agree with the experimental evidence of its value and to account for electromagnetic mass, *m* may be considered the mass of a particle of matter in the Newtonian sense of constant and small value, and the *e*, electrical charge, to be a force attribute of matter which varies with the velocity of the particle.—*Phil. Mag.*, February.

Electromagnetic Pulse Theory.—C. G. Barkla and T. Ayres.—The authors emphasize that experiments on the phenomena of scattering of X-rays furnish what appears to be the strongest evidence in support of the electromagnetic pulse theory. They describe experiments showing the remarkable agreement between the pulse theory and experiment under limited conditions.—*Phil. Mag.*, February.

Rays of Positive Electricity.—J. J. Thomson.—An account of experiments of positive rays made with very large discharge tubes. At very low pressures he found that the patterns on the phosphorescent screen produced by the positive rays after they had passed through electric and magnetic fields were separate parabolic curves. In all these experiments the rays were detected by the phosphorescence they produced on a willemite screen. The author endeavored to apply photographic methods to the study of these rays and was especially successful after putting a photographic plate inside the tube itself and letting the positive rays fall directly on the plate instead of onto the willemite screen. The arrangement of the apparatus is described in detail and the photographs taken by this method are analyzed and discussed in detail.—*Phil. Mag.*, February.

Thomson Effect.—P. Cermak.—An account of measurements of the Thomson effect in lead, mercury, tin, zinc, cadmium and aluminum; the effect has been found extremely small, but never constantly nothing. In the transition from the solid to the liquid state the curve representing the Thomson effect is a continuous one, while that representing the change in resistance is a broken one.—*Ann. der Physik.*, No. 16, 1910, pages 1195-1215; abstracted in *Amer. Jour. of Sciences*, February.

Scattered Röntgen Radiation.—J. A. Crowther.—A note on his recent British Royal Society paper in which he gave an account of experiments made to determine what fraction of the incident radiant energy was scattered per unit mass of a radiator when primary Röntgen rays fell upon it. From the numbers obtained a value was deduced for the number of electrons per atom of the radiating substance. The value obtained agreed closely with that previously deduced from experiments on the scattering of homogeneous beta rays, being very nearly three times the atomic weight of the substance. The distribution of the scattered radiation was measured. It reached a maximum forward and backward along the line of the primary beam and fell to a minimum at right angles to this direction. At any given angle with the primary beam there was always a preponderance of scattered radiation in the forward direction. The preponderance increased the more nearly the line of the primary beam was approached.—Lond. *Electrician*, Feb. 3.

Crookes' Dark Space.—F. W. Aston.—A note on his recent Royal Society paper on the distribution of electric force in Crookes' dark space. The method used in the investigation was one due to J. J. Thomson and consisted in shooting a beam of homogeneous cathode rays transversely through the discharge and observing the deflection of the beam at various points. The results so obtained were free from the very serious objections which might be urged against the "sounding-point" methods used by previous observers. The electric force in the negative glow was found to be negligibly small, while within the Crookes dark space it was satisfied within experimental error by the simple formula $\mu (D-X)$, where D is the length of the dark space, X the distance from the cathode and μ a constant. The result indicated the presence of a uniform charge of positive electrification within that region. The distribution was the same for all gases, pressures and currents used. By integrating the forces so obtained the potential fall across the dark space was calculated and was found in all cases to agree, within experimental error, with the actual potential between the electrodes. The large and abrupt fall of potential at the surface of the cathode found by other investigators was probably a result of faulty methods, an explanation of which was suggested.—Lond. *Electrician*, Feb. 3.

Electric Dust Figures.—J. Robinson.—A brief paper referring to the recent observation of Richmond on dust figures obtained by the passage of electric sparks at the end of a Kundt tube. The present author shows that it is hardly possible to maintain the electrical theory of this phenomenon. It seems more probable that the cause of the ripples lies in the sound of the spark and that they resemble the ripples between the nodes in a Kundt tube rather than the nodes themselves.—*Phil. Mag.*, February.

Units, Measurements and Instruments.

Simplicity in Measures.—C. Hering.—An article on simplicity in the measures of physical quantities. The author gives a critical analysis of the present systems of measures and units and of the interrelations between the different groups of units. He shows by examples that many of the numerous every-day calculations of the engineer, which must be made with such units, could have been greatly simplified and their clear understanding facilitated and enhanced had the systems by which some of these units were originally designated been more rational and consistent ones. While it is admitted that it might be too revolutionary to change our present irrational system to the rational one by a complete and radical transformation, yet this very desirable change, which is bound to come in time, could be greatly encouraged and accelerated by continually keeping the ideal system in the mind, teaching it to students and approaching it at every possible occasion by small but positive and decided steps in the right direction, and by all means not making existing matters worse by taking any steps in the wrong direction away from this path to the ideal. A close approximation to this ideal system is already in extended use among physicists under the name of the c.g.s. system, and there appears to be no reason why engineers, who apply physical laws to practical problems of construction, should not also enjoy the advantages of similar simplicity in their practical work.—*Jour. Franklin Inst.*, February.

Energy Losses in Condensers.—J. A. Fleming and G. B. Dyke.—An illustrated article on the measurement of energy losses in condensers traversed by high-frequency electric oscillations. The authors describe an arrangement which they have devised for measuring condenser losses in a high-frequency circuit, a modified form of Peukert discharger being employed. The results show that in all cases the equivalent resistance increases with the condenser current. Measurements of the energy losses are given for a large number of condensers and exponential formulas have been obtained.—Lond. *Electrician*, Feb. 3.

Telegraphy, Telephony and Signals.

Long-Distance Telephone Circuits.—Abstracts of a large number of written communications contributed on the recent paper of O'Meara before the (British) Institution of Electrical Engineers. B. S. Cohen stated that a large number of elaborate tests had been carried out in different countries to find out whether there was any one single frequency which would give results when used both for calculating and for direct experiment which would be in agreement with those results obtained by actual speech measurements. The methods adopted in carrying out these experiments had varied considerably and yet it was noteworthy that the results obtained were invariably in close agreement in showing that a single frequency of the order of 800 was the correct figure. This was as far as the volume factor of audition was concerned. F. Jacob proposed the term "space loadance," in contradistinction to "continuous loadance," to describe the condition of self-inductance as obtained with coils and continuous iron-wire winding respectively. Leakage must be considered as a property of a dielectric which has not a function of its insulation resistance.—Lond. *Electrician*, Feb. 3.

Wireless Telegraphy.—H. A. Hall.—An article referring to the use of carborundum, galena and other crystallic rectifiers in wireless telegraphy. The author proposes to use an intensifier constructed similarly to a magneto, but, of course, dispensing with the field magnets and in their stead having many turns of wire wound to a high resistance and a finely laminated core in the armature, the poles of which are connected to the make-and-break M and rubbing contact P respectively (Fig. 6). The idea of the make-and-break in this intensifier is to make contact when the armature is in the strongest part of the field; otherwise we should expect to receive an approximately uninterrupted sine curve. The make-and-break consists of an iron trough filled with mercury into which dips a steel needle. In an experimental apparatus it was found that at each make-and-break a distinct click was heard in the telephone receiver T, due undoubtedly to the contact of different metals. Barring this one small flaw the receiver gave great satisfaction. The intensifier is placed in an iron box so as not to be directly susceptible to outside influences, such as the earth's magnetic induction. The armature is rotated at high speed by clockwork through the pinion C; A is the antenna, G the rectifier, B the battery and R a variable resistance.—Lond. *Elec. Review*, Jan. 13.

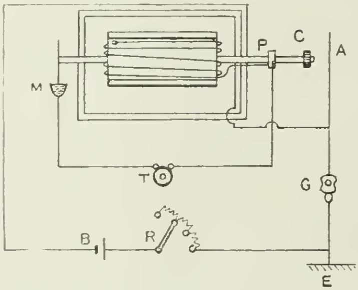


Fig. 6—Wireless Telegraphy Apparatus.

Book Reviews.

Automobile Mechanician's Catechism. By Calvin F. Swingle. Chicago: Frederick J. Drake & Company. 110 pages. Price, $1.25.

The 400 questions and answers which make up the text of this handbook cover the various details of automobile construction, operation and repairs. The questions are arranged in alphabetical order by the subjects of which they treat. Thus, the first page opens with questions on acetylene, asking about "inconveniences connected with the use of acetylene light." True in automobile lighting as in interior illumination, the drawbacks mentioned are: Acetylene "contains impurities which endanger the health when burned in a closed room. Carbon dust gets into the burners and clogs them, sometimes causing explosions. In order to get satisfactory operation from such a system, * * * strict cleanliness must be maintained, and various parts examined and replaced from time to time as becomes necessary." The arrangement of ignition and fuel-feed systems and the symptoms and repairs of automobile troubles are also explained.

Brookes' Automobile Handbook. By L. E. Brookes. Chicago: F. J. Drake & Company. 701 pages, 321 illus. Price, $2.

This manual is intended to serve as a text-book for the instruction of owners, operators and repairmen of automobiles. Most of the reading pages are devoted to the gasoline car, due attention being given to the ignition circuits, batteries, magnetos, commutators, distributors, etc. Reference is also made to the electric vehicle, giving brief instructions for the care and operation of lead-cell storage batteries, charging circuits, etc. The details of mechanical construction gone into in the case of the gasoline and steam cars also apply, to a degree, for electric automobiles. In spite of the presumed up-to-date character of the work it is surprising to note on page 270 a word of warning expressed against the use of electric lighting of automobiles. Overlooking the thousands of low-voltage tungsten lamps already in satisfactory use on gasoline cars, the author writes: "It is well to remember that electric lamps consume a great deal of power. One 16-cp lamp requires about 1/12 hp to operate it, the electrical energy per candle-power being a trifle over 4 watts." Of course, the 16-cp tungsten lamp, operating at a specific consumption of 1.25 watts per candle-power, takes only 20 watts, or about 1/37 hp, and is even more economical, as well as infinitely safer and cleaner, than acetylene, oil or other illuminant. Moreover, an automobile does not require a unit as large as 16 cp.

Journal of the Municipal School of Technology, Manchester, England. Vol. 3, 1910. 392 pages, numerous illustrations.

This volume is the third of a series of annual compilations of investigations undertaken by members of the teaching staff and students of the School of Technology, Manchester, England. Some of these investigations are in the nature of essays, while others are extensive experimental researches. An idea of the type of studies can be obtained from the following list of electrical subjects. "Flash-over Voltages"; "Electric Traction Vagabond Currents"; "The Design of Small Direct-Current Machines"; "Notes on Elimination of Sparking"; "The Utilization of Exhaust Steam for Electric Driving." These are six out of the total of thirty-four studies recorded. The subjects relate to steam engineering, mechanical engineering, electrical engineering, physics, chemistry, archæology and textile industry. Unfortunately, nearly all the work is expressed in English units instead of in metric units, so that a valuable book like this is virtually a secret document to all workers outside of England, her colonies and the United States. The notation should be the combined English and metric.

Elektrische Uhren. By A. Tobler. Second edition. Edited by Johannes Zacharias. Leipzig: A. Hartleben. 255 pages, 120 illus. Price, 4 marks.

This is a revision of an early volume of the publisher's celebrated electrotechnical series. The subject of electric clocks has so developed since the appearance of the first edition that the subject of fire telegraphs has been dropped to make room for the largely increased amount of material on electric time mechanisms. The subject is divided into three parts: The description of various time-marking devices, which occupies two-thirds of the book; time telegraphs; electric chronometers, and a chronological list of inventors of electric clocks patented in Germany between the years 1877 and 1909. The work is very complete and is well illustrated. It should be a valuable reference on the subject of electric clocks.

The Principles of Electric Wave Telegraphy and Telephony. By J. A. Fleming. Second edition, revised and extended. London: Longmans, Green & Company. 906 pages, illus. Price, $7.50.

This well-known textbook on wireless telegraphy has undergone considerable extension in its second edition The work is not only a comprehensive treatise on the principles underlying wireless telegraphy, but also a history of the development of that art and an exposition of the apparatus used in it. A brief chapter on wireless telephony has been added. The work will be invaluable to technical students of wave telegraphy and of applied electric radiation.

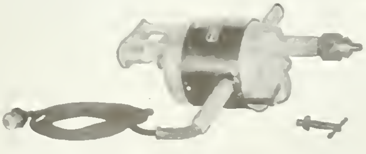
Electric Traction on Railways. By Philip Dawson. London: The Electrician Company 855 pages, 606 illus. Price, $9.

This is a textbook on electric railways especially as built and operated in Great Britain. The book commences with a brief historical description of the evolution of electric railways. It then considers fundamental dynamical relations and the types of electric motor and system. The engineering theories of various types of motor are developed in their simplest terms. Construction and methods of operation are dealt with in a very practical way. The power plant and the substation each receive a separate chapter. "Repairs" and "Financial Considerations" are the titles of the two concluding chapters. The book is well and copiously illustrated and also well indexed. It will be useful as a textbook to the technical student of electric railway engineering and as a reference book to the practising electric railway engineer interested in comparing systems and operations abroad with those in this country. American practice, however, receives a considerable share of illustration and description.

New Apparatus and Appliances

PORTABLE ELECTRIC BREAST DRILL.

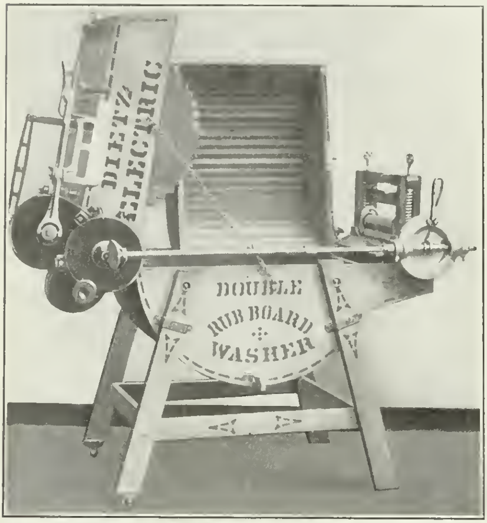
The Western Electric Company has brought out a line of "Hawthorn" portable electric drills which are made for use on 110-volt or 220-volt direct-current and 60-cycle, single-phase, alternating-current circuits, an Edison socket and cord being supplied so the drill can be operated from any standard lamp socket or screw base receptacle. The motor is incased in a dustproof case and all electrical parts are insulated and protected. The frame is of black japan, with nickel-plated trimmings, and an aluminum breast plate or spade handle can be had, as desired. Small oil chambers, so placed as to prevent leakage when the drill is being used, insure good lubrication for all moving parts. The motor, weighing about 20 lb., is supplied with two knurled side handles and the controlling switch is located within reach of the right hand grasping the handle, which allows the operator full control of drill. A Jacob's clutch, which takes drills up to and including 3/8 in. in diameter, and the necessary tightening key are furnished. The tool will be found a handy one for doing a large variety of work, its motor-driven feature saving much laborious effort.



Portable Drill.

A NEW-STYLE ELECTRIC WASHER.

A radical departure in the design of motor-driven washing machines is the feature in a new Dietz electric washer, now being placed on the market. In contrast to the design employed for some time by electric washing-machine manufacturers, it is built on the old double rub-board principle, so favorably known in the hand-operated form to the American housekeeper; and the designer of the original double rub-board hand-operated machine is also the designer of the new Dietz electric machine.



Dietz Electric Washer.

Power is supplied from a 1/5-hp Westinghouse motor through a rawhide pinion to a gear which drives a bicycle sprocket and chain geared to the crankshaft on the washer. A clutch provides ready means of starting and stopping the washer.

The wringer is mounted on the end of the machine and may be operated with the machine open, when the clothes are wrung out from the tub into the rinsing water, or with the machine closed, when the goods run back from the rinsing water on to the top of the tub. This is made possible by a reversing drive in the wringer, the clutch of which may be operated so quickly that it is possible to back material out before damage results in case it starts incorrectly.

"WESTERN ELECTRIC HAWTHORN" FAN MOTORS.

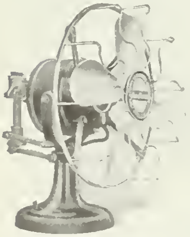


Fig. 1—12-in. Mechanically Operated Oscillating Desk Fan.

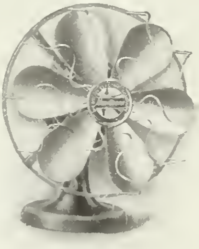


Fig. 2—12-in. Residence-Type Desk and Bracket Fan.

To the already large list of "Western Electric Hawthorn" electric fan motors five new types have been added. The most important addition to the line is a new mechanically operated oscillating fan. The oscillating device consists of a double-worm reduction controlled by an oscillating lever. The gears are inclosed in a dust-proof case which is filled with lubricant. Tool steel is used for the worms and phosphor bronze for the worm wheels, thus insuring long life for the mechanism. In this fan the much-desired trunnion feature is retained, thus making a wide adjustment in the vertical plane possible when the fan is used either as a desk or a bracket type. The oscillating motion is very smooth and even, and wholly free from jarring. The range of oscillation is 90 deg. and is adjustable. The success of the 12-in. alternating-current, six-blade residence fan introduced last year has led the company to place on the market this same style of fan for use on direct-current circuits and also an oscillating fan of the six-blade type. As the increase in the number of blades allows the speed to be cut down without any decrease in the volume of air moved, this fan operates noiselessly, and because of this fact has become very popular. It can be adapted for use either as a wall or bracket type and has two speeds. Another type of direct-current fan has been developed, known as the 32-in. ceiling fan. This fan is attractively designed and is well adapted for use in small offices, houses, hotels, clubs, etc. In exhaust fans the "Hawthorn" fans are being furnished with the well-known Blackman blade, a feature which will be appreciated by all users of small ventilating outfits. The line of "Western Electric Hawthorn" fans now consists of 8-in., 12-in. and 16-in. desk and bracket fans; 12-in. and 16-in. oscillating fans; 8-in. telephone-booth fans; air-operated and mechanically operated oscillating fans and a full line of battery fans, ceiling fans, column fans and exhaust fans for all commercial voltages. These fans are made in various sizes for use on all standard commercial circuits, both alternating current and direct current, by the Western Electric Company.

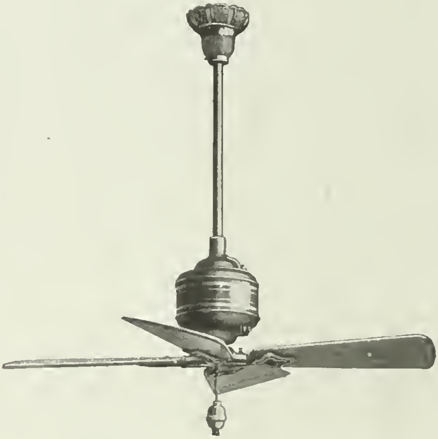


Fig. 3—32-in. Direct-Current Ceiling Fan.

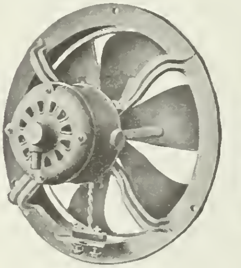


Fig. 4—16-in. Ventilating Fan with Blackman Blades.

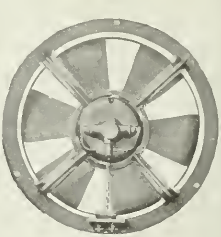


Fig. 5—16-in Direct-Current Ventilating Fan.

PHILADELPHIA ELECTRICAL SHOW.

Philadelphia's second electrical exhibition, given under the auspices of the Electrical Exhibition Company, Ltd., in the First Regiment Armory, Broad and Callowhill Streets, Philadelphia, was opened, as announced in last week's issue, on the evening of Feb. 13. In honor of the event City Hall is fitted with welcoming signs and rows of incandescent lamps skirting the cornices of the building proper; but the statue of Penn, capping the famous tower, is not bathed in the light from searchlamps as was the case in previous shows. Broad Street, from the City Hall to the Armory, is decorated with incandescent arches and signs similar to those employed last year; but the illumination is supplemented this year by arc lamps forming part of the new street-lighting system recently installed in the City of Brotherly Love. These twin arcs are placed on both sides of the street and also on isles of safety in the center of the roadway and together with the arches of incandescent lamps make a pleasing picture when viewed from the exhibition hall with City Hall in the background.

The exhibition hall itself is most tastefully arranged, the decorations surpassing anything heretofore attempted in Philadelphia shows. The whole resembles a sunken garden with vine-covered pergolas enlivened by incandescent electric flowers. The roof is hidden by an azure canopy caught up with metal stars in which incandescent lamps shine every once in a while by thermostatic action. The exhibits, with the exception of that made by the Philadelphia Electric Company, are arranged along the side walls and under the pergolas. The booths are all alike and are partitioned by bronzed pedestals and urns in front and by white columns in the rear. In a majority of cases the urns bear electric flowers. The beams of the pergolas are tipped with 50-watt frosted-bulb tungsten lamps and under the beams are 100-watt tungstens in opalescent reflectors for general booth illumination. The appropriateness of the decoration, with its harmony of color and design, is due to Messrs. Kayser & Allman.

During the two weeks of the show a series of electrically cooked luncheons will be given in order to familiarize visitors with the advantages of electric cooking. Lectures will also be given on electric therapeutics in the lecture hall off the main entrance, and the really valuable electrical medical apparatus will be demonstrated and explained by competent lecturers. No less than six manufacturers of electric vehicles have exhibits of their products arranged along one side of the exhibition hall for ready inspection and comparison. In a show of this kind exhibits are not lacking that appeal to the householder. For example, eight kinds of vacuum cleaners are shown.

The Philadelphia Electric Company's exhibit occupies a space covering the entire east end of the hall, on a raised platform reached by four flights of steps, one at either end and two in the center. A white balustrade, interspaced with bronzed urns containing natural flowers and artificial electric flowers, incloses the platform. At each end of the space is erected a white Grecian temple, the two being connected by five columns which divide the space they cover into natural spaces for exhibits. The temples are outlined by tungsten lamps and are decorated by bay trees and smilax twined around the columns. Each of the latter is surmounted by a large opalescent globe inside of which are colored lamps operated on "skeedoodle" sockets. A large electric sign of tungsten lamps has been placed over the entire exhibit and the sign is also framed in smilax with hanging foliage effect in which hundreds of miniature electric lamps have been hung. In the center of the platform is an electric fountain of fair proportions.

The idea of the exhibit is not to show the extent of the service given by the Philadelphia Electric Company so much as to demonstrate the facilities offered its customers and the methods pursued in the matter of giving good service. To this end one of the temples is used as an illuminating engineering booth and in it is placed a lumichromoscope containing eight compartments, showing eight of the best known electric illuminants in a comparative manner. There is also on exhibition a color cabinet for the purpose of demonstrating the absorptive and reflective values of various colored wall papers, etc. There are also several comparison booths in which the illuminating value of various lamps and reflectors can be shown the public. Frames of photographs, showing installations which have been reconstructed and made efficient by the illuminating engineering department of the company, are displayed.

The temple at the other end of the exhibit is fitted up in an attractive manner as an electric shop and contains practically every known piece of electrical apparatus for use in the home, office, etc. The connecting space in the rear of the columns connecting the temples is occupied by the engineering department. The thought in this exhibit appears to be to show to the public the amount of care taken in maintaining meter accuracy, as well as to give an exposition of the means taken to furnish a reliable service. A meter-testing rack for demonstrating the methods of testing alternating-current and direct-current meters, with the necessary instruments, tools, load boxes and other appliances coincident with this work, is featured. A recording instrument rack, fitted with recording ammeter, voltmeter and wattmeter connected in series with the standard type of house meter and arranged so that a comparison can be made between the energy recorded by the meter and by the instruments, is also shown in this section. Glass showcases containing laboratory standardizing instruments of precision, such as are used for standards in the laboratory and meter department, are included in the exhibit. Among the instruments shown are a potentiometer with shunts and other accessories, portable testing sets, direct-reading ammeters, indicating tachometers, standard cells, Zeiss binocular microscope used for the inspection of jewels and steel bearings, Miller voltmeters and other laboratory apparatus.

The power exhibit contains a three-section panelboard with angle-iron frame on which are mounted a service cut-out box and watt-hour meters as used for standard motor installations The service is four-wire, two-phase, 220-volt and supplies a 7.5-hp motor driving through shaft and belting a 4-kw, 125-volt direct-current generator. The generator supplies energy to a lamp bank. One panel of the board contains an indicating ammeter and voltmeter and on the other panel are mounted indicating ammeters to show the normal running and starting currents of the alternating-current motor, and a reverse-phase relay with 100-amp circuit-breaker for protecting the service. A motor-testing table in the exhibit is arranged to show the methods of testing motors under service conditions. and wattmeters equipped with high-speed charts are connected to the motor service. An oscillograph is exhibited and shows the wave forms of single-phase and two-phase alternating currents. etc.

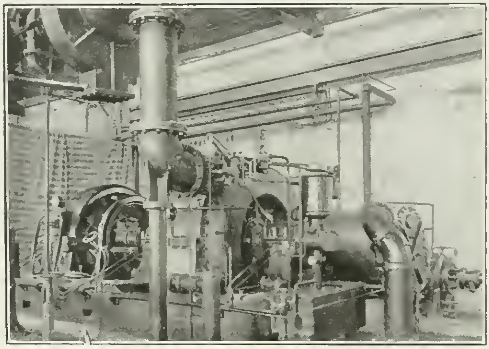
At the north end of the exhibit the sign department is located. Model letters of various type signs are shown, also a miniature illuminated billboard. At the south end of the exhibit is a small space fitted up as a lounging place. Advertising literature covering all branches of the business is given to all visitors. A feature of the general arrangement is the use of glass risers on the steps leading to the platform. These risers are illuminated from the rear by electric lamps and painted with the slogans, "If it isn't electric it isn't modern" and "Electricity, everywhere for everything. in Philadelphia."

The list of exhibitors is as follows: American Telegraph Typewriter Company, Auxiliary Fire Alarm Company, L. D Berger, Charles Bond Company, J. F. Buchanan & Company, Judson C. Burns, J. F. Burns, the H B. Camp Company, Capitol Turbine Company, City of Philadelphia, Columbus Buggy Company, Commercial Truck Company of America, Edison Storage Battery Company, the Electric Storage Battery Company *Electrical Review* Publishing Company, Electrical Contractors' Association, *Electrical World* Engineering Equipment Company, Federal Sign System (Electric), Flexlume Sign Company, Fort Wayne Electric Works, Franklin Institute, General Electric Company, General Vehicle Company, Gillinder & Sons, Inc, Gudeman & Company, International Correspondence Schools, Invincible Renovator Sales Company, Keller Manufacturing Company, Keystone Telephone Company of Philadelphia, Kinetic Engineering Company, Lewis-Roth Company, Machedo & Roller, the McCrum-Howell Company, National Carbon Company, Otis Elevator Company, H. T. Paiste Company, the Pennsylvania Storage Battery Company, *Popular Electricity* Publishing Company, the Philadelphia Electric Company, Philadelphia Printograph Sales Company, Philadelphia Rapid Transit Company, Philadelphia Storage Battery Company, Rider-Ericsson Engine Company, F. S. Rollins, Simplex Electric Heating Company, Spring Garden Institute, State Optical Company, Straight Filament Lamp Company, University of Pennsylvania, the Waverley Electric Company, Westinghouse Electric & Manufacturing Company, Williamson Company and Woods Electric Garage.

The show closes Feb. 25.

LOW-PRESSURE TURBINE INSTALLATION AT DAVENPORT, IA.

About two years ago the Bettendorf Axle Company, of Davenport, Ia., was considering an addition to its electrical equipment due to the growth of the plant, and made a thorough investigation of the various prime movers suitable for the purpose. Taking into consideration the heating of the shops in winter and the fact that the old power plant was running non-condensing all factors pointed to the low-pressure or exhaust turbine as the most suitable unit to install from the standpoint of reliability, simplicity, economy and maintenance.


Lop-Pressure Turbine Driving 250-Volt Direct-Current Generator.

The power equipment at that time consisted of two 100-kw direct-connected, high-speed, tandem-compound, engine-driven units, a number of hydraulic pumps and an air compressor exhausting into one header, making an ideal arrangement for connection to an exhaust turbine. Having made a study of various turbine plants, the company decided to install a 500-kw horizontal Curtis turbine. This turbine was put in operation in September, 1909, and has been in service for about fourteen hours a day since. It now supplies all 250-volt energy required by the plant, the load at present amounting to 250 kw on an average, this power being used mostly for the operation of cranes, for the lighting of shops and for lifting magnets. When machinery now under construction is completed and installed the load will be doubled. The main steam supply is derived from the exhaust of the hydraulic pumps, but, owing to the fact that these pumps are subjected to interrupted service due to breakdowns on the system, other means of supplying steam had to be provided and a connection was therefore made from the exhaust header to the high-pressure steam pipe through a Foster pressure-reducing valve. By means of this connection the required amount of steam to keep the turbine in operation is secured. This arrangement works very satisfactorily, as the valve operates within a range of ½ lb. drop in pressure. The average back pressure is about 3 lb., and to take care of an excessive back pressure the exhaust header is provided with a 12-in. relief valve set to operate at 5 lb. pressure. All steam to the turbine passes through an 18-in., two-stage separator, which separates all oil and moisture from the steam. A Worthington condenser is installed, the condensed steam being returned to the boiler feed-water heater.

While no figures are available to substantiate a statement as to the exact performance of the turbine, it is thought possible, when running with 28-in. vacuum, to recover 75 per cent of the energy delivered to the pumps, compressors and reciprocating engines. In cool weather it has been possible to run for weeks with a vacuum of from 29 in. to 29½ in., this, of course, making quite a difference in the steam consumption. In order to maintain a good vacuum it has been found necessary to pipe the steam seal, in which the carbon packing rings are located, with high-pressure steam to insure against any leakage of air around the shaft. The amount of steam required for this purpose can best be found by experiment and when once adjusted requires very little attention.

Before putting the turbine in service it was run for a few days under various loads, the generator being loaded from a water rheostat. It was found that sufficient exhaust steam was available to furnish 425 kw continuously and as much as 575 kw for short periods. Six boilers of about 120 hp each were in service at that time. The results of the test would indicate that from 75 per cent to 80 per cent of the energy delivered to the engines and auxiliaries was recovered.

The governing of the turbine is very good, as with a load fluctuation of about 500 amp the variation in potential does not exceed 2 volts or 3 volts. The lighting load consists of inclosed-arc, flame-arc, mercury-vapor and incandescent lamps, all of which show up very much better when operated by the turbine than when the engine-driven units carry the load. This improved performance is owing to the better regulation of the turbine.

In operating the turbine a practice is made of drawing a few buckets of oil from the tank every two weeks and adding the same amount of fresh oil. This seems to keep the oil in good condition. No trouble has been experienced in keeping the bearings cool, this being accomplished by means of circulating water. In order to maintain a uniform flow the water is taken direct from the mains and passed through a reducing valve which takes care of any fluctuation in pressure in the main supply. The emergency governor is tested regularly once a week. It has never failed to respond to increase in speed, invariably tripping the stop valve on the turbine. It is found that the attention required by a turbine generator of the size here installed is not as much as that demanded by one of the engine-driven units. Good results are obtained without the use of a receiver between the units and the turbine, as the reducing valve makes up for any deficiency in the steam supply which might be due, as stated before, to the stoppage of one of the engines or pumps. With this arrangement a sufficient supply of steam (direct from the boilers if necessary) is always assured, thus making the installation fully as reliable as the high-pressure engine or turbine and much more economical than either of these when running non-condensing. The longest continuous run so far made with this turbine has been five days and nights. No shut-downs due to trouble of any kind with the turbine have occurred since the turbine was first put in operation.

REGENERATIVE CONTROL FOR ELECTRIC VEHICLES.

For years an occasional suggestion has been made relating to a control system whereby an electric vehicle in going down a hill should turn the motor into a generator and thereby return to the battery a very considerable amount of extra energy required to climb the hill. The Lansden Company, of Newark, N. J., has actually used such a system for a period of two years, having covered a distance of over 19,000 miles with an experimental model, and recently it has been applied to a 5-ton truck for Mr. George Ehret, the brewer.

A system of this kind shows on the level, of course, no increase in mileage over the ordinary series type of motor, but where grades in excess of a few per cent are encountered a very considerable gain is effected, 35 per cent often being returned to the battery on the down grade. Another result of this simple method of control is that the truck becomes practically a constant-speed machine, climbing ordinary hills at practically the same speed as on the level and held back on the descents, not by brakes, but by the force required to generate the energy returned to the battery. This eliminates all the wear and tear due to brakage and implies a motor wagon of the greatest efficiency and cheapest repairs.

The details of design have been completely worked out, both motor and controller being designed especially for the Edison battery. The controller actually handles a very small quantity of current, only a fraction of that driving the machine, meaning much less wear and tear, less attention and adjustment and a greater assurance of safety.

The Lansden Company has gone a step further in designing this 5-ton truck and by making radical departures has still further increased the truck's efficiency by using a helical spring suspension with flat leaf springs as distance or reach-rods. This cushions the strains of starting, of road obstructions, or of stopping, with the result that a big 5-ton truck rides and is handled as easily and smoothly as an ambulance.

GENERAL ELECTRIC FANS.

The General Electric Company's fan-motor models for 1911 represent a complete line designed for satisfying the requirements of a wide field of application. Several improvements are noticeable, one being the adoption of a new induction winding for the 8-in., 12-in. and 16-in. alternating-current fans, which obviates the use of a centrifugal switch for controlling the starting winding, thus eliminating all noisy contacts and insuring quiet operation with low energy consumption and great speed range. The entire line includes both alternating-current and direct-current, 8-in., four-blade desk, bracket, oscillating and telephone-booth fans; 12-in., six-blade residence bracket and oscillating fans; 12-in. and 16-in. standard desk and bracket fans; 12-in. and 16-in. oscillating fans for either desk or bracket use; together with a great variety of ceiling counter-column and floor-column motors of attractive plain and ornamental design. The desk, bracket and oscillating fans in general are convertible for either desk or bracket use and vice versa, by means of a hinged joint, attaching the motor body to the base, which permits of a simple and quick vertical adjustment. The telephone-booth fans are suspended from brackets by means of a spring suspension, thus preventing vibration from being transmitted to the walls of the booth. The six-blade fans operate very quietly and are designed especially for use in residences, hospitals and other places where such operation is desirable. The motors are equipped with suitable switches for giving three speeds, the maximum ranging from 1250 r.p.m. to 1600 r.p.m., thus providing a regulation sufficient for all requirements. The alternating-current motors carried in stock are for circuits of 25 cycles at 110 volts; 40 cycles at 120 volts; 50 cycles at 100 volts, 110 volts, 200 volts and 220 volts; 60 cycles at 110 volts and 220 volts, and 133 cycles at 110 volts. The direct-current motors are for 110-volt and 220-volt circuits. The alternating-current ceiling and column fan motors are designed for operation on 25-cycle, 40-cycle, 50-cycle and 60-cycle circuits. The plain types have two speeds, ranging from 150 r.p.m. to 225 r.p.m. The direct-current motors are designed for 110-volt and 220-volt circuits. The plain types operate at 200 r.p.m. The ornamental single-speed types operate at 200 r.p.m. and the three-speed types at 100 r.p.m., 150 r.p.m. and 200 r.p.m. Both the alternating-current and the direct-current fans are of the four-blade type; the former have a sweep 52 in. and the latter 58 in. They are wired for electrolier attachments of two or four lamps.

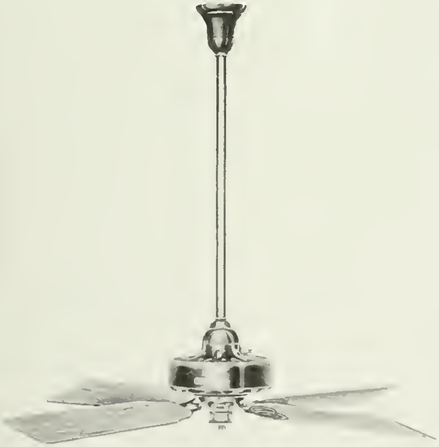


Fig. 1—Plain-Type Direct-Current Ceiling Fan.

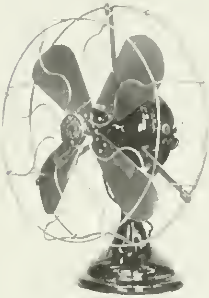


Fig. 2—12-in. and 16-in. Alternating-Current Desk Fan.

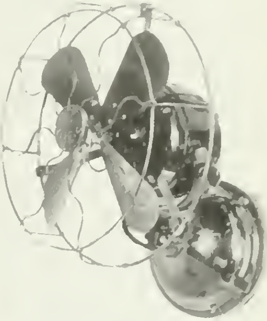


Fig. 3—12-in. and 16-in. Alternating-Current Bracket Fan.

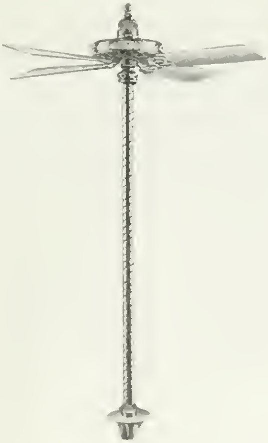


Fig. 4—Ornamental-Type Alternating-Current Column Fan.

Industrial and Commercial News

THE WEEK IN TRADE.

COMMERCIAL conditions during the past week looked a trifle brighter. There are several reasons for this. In the first place, timely and badly needed rainfalls have brought the prolonged drought to an end, and crop conditions in the West and Southwest have been materially improved thereby. Another reason for improvement is in the fact that the demand for finished steel has increased so that quite a number of mills which have been running part time are now actively in operation. This demand has added to the buying capacity of the industrial sections and has stimulated to some extent retail trade. There are still many complaints, however, concerning the retail distribution. The unusually warm weather has practically destroyed the usual winter trade in heavy wearing apparel and has caused some carrying over of stocks. The wholesale trade during the past week has improved very little. From the Southwest there was somewhat better demand, but no other section shows any addition to its buying ability. The most discouraging branch of trade at the present time is the textile industry. Neither in cotton nor in woolen materials is there any feature that promises well for the future. The prices of raw material have been irregular and have disturbed commercial conditions, and the demand for finished products has been lighter than for many years. Curtailment has been going on and will probably be continued, and prices are being shaded in order to make sales. Such lines as farm machinery, implements, seeds and fertilizers are very active, but this is nothing more than was expected at this season. The railroads are ordering but little equipment, and are merely filling in. As a rule the reports of traffic are not particularly encouraging, and net earnings are showing very much less gains than gross earnings, owing to increased expenses. Collections on the whole are rather slow, although from some of the agricultural sections payments are reported as prompt. Business failures for the week ended Feb. 16, as reported by *Bradstreet's*, were 235 as against 291 the previous week, 269 in the same week in 1910, 282 in 1909, 326 in 1908 and 177 in 1907.

THE COPPER MARKET.

DEVELOPMENTS in the copper market last week were of minor importance. The takings, both by domestic consumers and for export, were very light. Of course, the market is still in the hands of the great financial interests which have for years sustained the price of the metal in order to protect the prices of stocks. There is not much likelihood, therefore, that there will be any serious break in the price of copper. When consumers can buy electrolytic copper in the neighborhood of 12 cents they had better be content to take in all the stocks they require. It is not at all probable that the enormously wealthy holders of Amalgamated and other copper stocks will permit prices to be shaded much below this figure. It is stated that during the past week manufacturers of finished copper and brass have contracted for moderate amounts to be delivered in March and April. The buying, however, is, as a rule, from hand to mouth and to cover orders already in sight. With little pressure to sell and little anxiety to buy, the market remains very quiet. Electrolytic closed last week at about the same figure as the week previous, but standard was quoted a trifle higher. Exports continue to be rather light. For the month, including Feb. 18, they were 10,060 tons. The daily call on the Metal Exchange Feb. 17 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.10	12.20	.....
February	12.10	12.20	12.15
March	12.10	12.20	12.15
April	12.10	12.20	12.15
May	12.10	12.20	12.15

The London market, Feb. 17, was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	55	0	0	54	16	3
Stand copper, futures	55	12	6	55	8	9

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.30c			11.87½c		
London, spot	£56	15	0	£53	15	0
London, futures	57	12	6	54	10	0
Best selected	60	5	0	58	10	0

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*Last price quoted.
Shares sold for week Feb. 13 to Feb. 18.

INDUSTRIAL AND COMMERCIAL NOTES

Western Electric's January Earnings.—January was the first month of the Western Electric Company's new fiscal year, which will correspond with the calendar year hereafter. Earnings were slightly in excess of January, 1910, which is a very satisfactory showing in the face of the fact that some of the large electric manufacturing companies showed a decrease as compared with the previous January, and considering that in December, that being the last month of the old fiscal year, every effort was made to "clean up" orders on hand, so that the carry-over would be as small as possible. The larger January showing comes from within and without this country, and the increase was very evenly distributed. Western Electric's gross business for the twelve months ended with last November totaled $61,000,000, and for the thirteen months ended with December approximately $68,000,000. The company is in a strong position in regard to financial resources, and will be able to continue its policy of concentration at Hawthorne this year, without incurring further funded obligations.

Doherty Suit in Montgomery.—Henry L. Doherty & Company last week brought another suit in the United States Court in Montgomery, Ala., against the Citizens' Light, Heat & Power Company and Richard Tillis. It will be remembered that the Doherty company has been in litigation with the Citizens' Light, Heat & Power Company for a year over an alleged contract of sale made by Alex Rice, president of the company, to Doherty. Two weeks ago the United States Court of Appeals decided in Mr. Doherty's favor a motion to prevent Richard Tillis, who is now the owner of the Citizens' company, from extending his lines. The new suit which was brought last week asks for a permanent injunction preventing Mr. Tillis or the Citizens' company from extending the business of that organization.

Rio de Janeiro Tramway Equipment.—The Rio de Janeiro Tramway, Light & Power Company, Rio de Janeiro, South America, has placed an order with the Westinghouse Electric & Manufacturing Company for two 2500-kva, 3000-r.p.m., 6300-volt, three-phase, 50-cycle turbo-generators. The Westinghouse Machine Company will furnish the turbines, which will be equipped with No. 11 Leblanc condensers. This equipment will be placed in a new station, which will operate in connection with the power company's water-power station. The station will be located in the city and will be used only when the water is low and the water-power plant cannot deliver its full capacity.

Westinghouse Electric & Manufacturing Company.—The Cia Beneficiandora de Pachuca de Mexico has recently bought one 915-kva O. I. S. C. auto-tranformer from the Westinghouse Electric & Manufacturing Company. The 3-phase, 10,000-volt high-tension, 6600-volt low-tension transformer is designed to operate on either 50 cycles or 60 cycles, and will connect together two systems, one of 10,000 volts and the other of 6600 volts, in case of failure of either system. The transformer will be able to switch the 1000-hp load of a compressor motor from one circuit to the other in case of failure of the circuit that is operating.

Consolidated Gas Company.—The Consolidated Gas Company of New York has definitely determined to make no further contest against the 80-cent gas law. The actions which were brought by the company to have this law declared unconstitutional, and which were still pending in the United States Circuit Court, were formally discontinued last week upon motion of the company. This practically means that there will be no further litigation over the law or over the rate for gas. It has been shown to the satisfaction of the company that at the 80-cent rate a reasonable dividend can be paid.

Insulated Wire Wanted.—The General Purchasing Officer of the Isthmian Canal Commission, Washington, D. C., invites sealed proposals in triplicate for furnishing to the commission 6000 ft. of No. 6 stranded rubber-covered, weatherproof wire. Bids will be opened not later than 2:30 p. m., March 6, 1911.

Insulated Wire.—The demand for insulated wire is not at all satisfactory. The president of one of the largest manufacturing companies in the country says that the opening up of spring business has brought very few additional orders for insulated wire. In some localities large building operations are planned upon an extensive scale, but as a rule it does not appear that building during the year will be up to the average. As this wire manufacturer says, the wire contracts are usually the last let in connection with a new building, and for this reason the wire manufacturers never can tell exactly what they have in the way of new business until midsummer. He says: "The insulated wire business has been seriously interfered with by price cutting and by the placing upon the market of materials which we think are inferior to those made by the old-line companies. This kind of business has demoralized the regular trade. The companies are at present, however, enjoying a period of fairly cheap raw material. Rubber is not excessively high and other materials are much cheaper than they were eighteen months ago. The margin of profit is therefore more satisfactory."

Important Telephone Conferences.—Several important conferences were held in New York last week between Independent and Bell telephone interests located in the West with a view of arriving at some definite operating arrangement that would result in the mutual advantage of both sides Among those attending the conference were H. P. Davison, representing the Morgan interests; Mr. Kingsbury, representing the American Telephone & Telegraph Company, and several prominent financiers from Columbus, Ohio, Indianapolis and St. Louis representing independent properties. No official statement was given out concerning the results achieved at the meetings, but one of the Western men said: "It will be some time yet before this matter can be consummated. There are many obstacles to be overcome which will require a great deal of time and consideration. I can say, however, that nothing will be accepted which is not beneficial to the independent interests."

Electrical Jobbers' Meeting.—The Electrical Jobbers' Association met in convention at French Lick Springs, Ind., Feb. 15, 16 and 17, and about 300 electrical supply men and guests were in attendance. As in the case of most of the former gatherings of this association, no technical papers were read, but many discussions were carried on relating to the welfare and promotion of the jobbing business. Among those who addressed the meeting was W. H. Merrill, of the Underwriters' Laboratories of Chicago, who gave an informal talk on standardization of appliances and material. The next meeting will be held April 25, 26 and 27 at Del Monte, Cal., and a special train is being arranged for to leave Chicago April 18.

New York Edison Company.—The New York Edison Company on May 1 will move its Delancey Street offices in New York City to a new building across the street from its present location. This change has been made necessary by the rapid growth in the company's business in that section. In 1910 the Delancey Street department of the company made a 30 per cent net gain in the number of customers and approximately a 35 per cent net gain in 50-watt equivalent power supply. This station serves the garment shops and crowded tenements of the East Side, and these, it is said, are putting in electric service wherever it is possible.

Japan Ordering Apparatus.—The Westinghouse Electric & Manufacturing Company has just received an order for one 200-kva rotary converter, two 125-kva O. I. S. C. transformers and one three-panel switchboard, for shipment to the Nikkon Gas & Electric Company, Nikkon, Japan. The rotary will be used on street railway service. It is designed for operation at 365 volts, two-phase, 60 cycles alternating current and 550 volts direct current.

Moloney Electric Company.—The Moloney Electric Company, of St. Louis, manufacturer of transformers, is equipping a large manufacturing plant in Windsor, Ont., to take care of its Canadian business. The Chicago office of this company, in charge of Mr. R. T. Merrick, has been removed to 1406 Fisher Building, from the Railway Exchange.

Chicago to Have a Commercial Representative in South America.—The Chicago Association of Commerce has made an arrangement with Frank C. Enright to represent the 3000 or 4000 commercial houses which constitute its membership in South America, making his headquarters at Buenos Aires. Mr. Enright is to promote the trade of members of the association in South America in every way possible, and he is to give his exclusive services to the association at a fixed salary. Mr. Enright was born in Buenos Aires, of Irish parentage about thirty-five years ago He will sail from New York for that city on April 20.

Financial.

The Week in Wall Street.

The volume of trading in the Wall Street market was considerably reduced last week and prices receded several points for most of the active issues. The market is practically in the same condition as at the last report. After the January advance a pause has taken place in the upward movement, and this is due in the first place to the fact that the steam behind the movement was not particularly strong and the professional speculators who were in charge of the manipulation were inclined to be timid. It is generally believed in Wall Street that the decisions in the Standard Oil and Tobacco cases will be handed down in a very short time. These decisions involve the very life of our great industrial corporations. If it is held that the practices employed by the Standard Oil and American Tobacco Companies are in violation of the law, hundreds of our largest industrial enterprises will be compelled to amend their business methods. As far as regards actual developments last week, there was little of importance except the elimination of the Gould party from Missouri Pacific. This has been hinted at in financial circles for a good many months. Missouri Pacific has never enjoyed that measure of success which its position seemed to deserve and which came to its rivals in the Central West. It is believed that with the introduction of a new management and with stronger financial backing the property will soon be revolutionized. The money market continues to be easy and there is apparently enough cash for all the business that is being transacted. The rates Feb. 20 were: Call, 2¼ @ 2½ per cent; 90 days, 3¼ per cent. The quotations in the table are those of the close Feb. 18.

NEW YORK.

	Feb. 11.	Feb. 18.	Shares Sold.		Feb. 11.	Feb. 18.	Sbares Sold.
All. Ch......	8*	7⅞*	400	Int. Met.,pfd.	55	54	9,250
All. Ch., pfd.	32½*	32*	400	Mackay Cos..	94*	92½	100
Amal. Cop...	66	65¼	46,940	Mackay C.,pf.	76¼*	76	500
Am. D. T...	20½*	20½*	———	Man. Elev..	139¾*	139¾*	460
Am. Loco....	41½*	41¼	3,200	Met. St. Ry.	15*	15*	———
Am. Loco.,pf.	110*	110*	———	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	84½*	84½*	———	Steel, com...	81½	80⅞	434,230
Am. T. & T.	145	146¼	11,450	Steel, pfd...	119	119⅜	5,605
B. R. T....	78⅝	78½	18,575	W. U. T....	74¾*	74½	1,700
Gen. Elec....	155½	153½*	900	West'h, com.	70*	70	2,500
Int. Met.....	20¼	19⅞	6,465	West'h, pfd..	119*	119*	———

PHILADELPHIA.

	Feb. 11.	Feb. 18.		Feb. 11.	Feb. 18.
Am. Rys..........	44½*	45	Phila. Elec....	16⅜	16½
Elec. Co. of A.....	12⅛*	12⅛*	Phila. R. T........	20¼	19¾
Elec. St. B'ty.......	54	55	Phila. Trac........	85¾	85*
E. S. B'ty., pfd.....	30*	30*	Union Trac.........	47¾	47

CHICAGO.

	Feb. 11.	Feb. 18.		Feb. 11.	Feb. 18.
Chi. City Ry........	185	185*	Chi. Tel. Co........	122½	121
Chi. Rs., Ser. 1.....	93*	93*	Met. El. Co........	20*	20¼
Chi. Rs., Ser. 2.....	25	24½*	Met. El., pfd.......	65½*	65½*
Com. Edison.......	115	116*	Nat'l Car..........	117*	117*
Chi. Subways.......	4*	4*	Nat'l Car., pfd.....	118*	118*

BOSTON.

	Feb. 11.	Feb. 18.		Feb. 11.	Feb. 18.
Am. T. & T.......	145½	146¼	Mex. Tel..........	4¾*	4¾*
Cum. Tel..........	148*	149*	Mex. Tel., pfd......	7*	6*
Edison E., Ill.......	291*	290¼	N. E. Tel..........	142*	142
Gen. Elec..........	155¼	153½*	W. T. & T.........	20	20½
Mass. E. Ry.......	17½*	17¼	W. T. & T., pfd....	96*	95
Mass. E. Ry., pfd...	88	87½*			

Financial Notes

Mackay Companies.—The annual meeting of the Mackay Companies was held in Boston last week, and the present board of trustees was re-elected. The profit and loss accounts of the companies for the fiscal year which ended Feb. 1 show receipts of $4,125,907, and disbursements, including $2,000,000 for preferred dividends, of $2,069,020. Clarence H. Mackay, president of the companies, said in his report: "The past year has been one of healthy expansion in business, and our companies are in excellent physical and financial condition. During the year we completed a 830-mile trunk telegraph line between Oakland, Cal., and Salt Lake City. This new line was constructed of the most modern type copper cable, running 20 lb. between poles.

In addition, we have put in sixty lines of the same type between several Pacific Coast cities. The money received about a year ago from the sale of our holdings of American Telegraph common stock has been reinvested in high-grade securities. During the year we have completed a new cable between Waterville, Ireland, and western England, with underground connection to London." The report also states that the night-letter system, which was inaugurated during the year, has brought in a considerable amount of business, but the managers of the company are not yet ready to declare that it is entirely successful.

Kings County Electric Light & Power Company.—The annual report for 1910 of the Kings County Electric Light & Power Company, which owns all of the stock of the Edison Electric Illuminating Company of Brooklyn, was made public last week. It showed that the gross earnings of the company for the year were $4,338,987, as compared with $3,733,840 the previous year. After the payment of all expenses and charges there was left a surplus for the year's business of $1,009,233, which is equivalent to a little more than 10 per cent on the outstanding capital stock. Anthony N. Brady, president of the company, says in his annual report: "The number of customers Dec. 31, 1910, was 23,866, an increase of 4028 over the preceding year, and total connections in 50-watt equivalents were 2,036,473, an increase of 264,116. During 1910 14,192 contracts were signed, against 12,494 in 1909; power in horse-power was contracted for to the extent of 17,731, against 11,506 in the preceding year, and total lighting and power in 50-watt equivalents was contracted for up to 813,992, against 561,605 in 1909."

Studebaker Merger Plan.—There has been incorporated under the laws of New Jersey the Studebaker Corporation with an authorized capital stock of $45,000,000. The company was formed, as it was stated by its incorporators, to purchase the assets and property of the Studebaker Manufacturing Company, of South Bend, Ind. This concern, it is announced, is devoted to the manufacture of carriages, wagons and automobiles and owns and operates the E. M. F. automobile concern of Detroit. The Studebaker Corporation will manufacture electric vehicles as well as gasoline and will also continue the original Studebaker business, which was the making of horse-drawn vehicles. In addition to the above lines of industry the Studebaker company has acquired the right to manufacture several brands of popular gasoline motor cars. The purchase involves the acquisition of $7,447,253 in cash and the property taken over was paid for in the stock of the new corporation to the amount of $43,498,000, of which $13,500,000 is 7 per cent cumulative preferred.

Light & Development Company.—The Light & Development Company, of St. Louis, which was organized last year and applied for a franchise from the city to operate a light and power plant in competition with the Union Electric Light & Power Company, has made a report concerning its present activities. The company is now operating in St. Louis isolated plants in the Famous, the Leader and Buckingham buildings, furnishing light, power and heating at each installation. It is also operating outside of St. Louis the Cape Girardeau (Mo.) Water-Works & Electric Light Company, stock $150,000, bonds $150,000; the Paris (Tex.) Light & Power Company, stock $200,000, bonds $200,000; the Fort Scott (Kan.) Gas & Electric Company, stock $350,000, bonds $350,000, and the Talequah (Okla.) Light & Power Company, stock $40,000. H. Wurdach is president of the Light & Development Company; W. A. Smith, vice-president, and H. W. Beck, secretary.

Electric Security Offerings.—Among the important offerings last week of electrical securities were: By Harris, Forbes & Company, New York, $4,044,000 5 per cent, first-lien and refunding bonds of the Consumers' Power Company, of Michigan, at 96 and interest, and by P. W. Brooks & Company, New York, $700,000 first mortgage, 5 per cent bonds of the Kankakee (Ill.) Gas & Electric Company at a rate to net about 5.40 per cent. The Consumers' Power Company is the operating company of the public utility properties in Michigan which were formerly owned by Hodenpyl, Walbridge & Company, of New York, and E. W. Clark & Company, of Philadelphia. All of the stock of the Consumers' Power Company is held by the Commonwealth Power, Railway & Light Company, an $18,000,000 holding concern organized by the same interests under the laws of Maine.

Federal Sign System (Electric).—Brokers in Chicago and New York announce the sale of a limited amount of 7 per cent cumulative preferred stock of the Federal Sign System (Electric), Chicago, of which John H. Goehst is president and John F. Gilchrist is treasurer. The stock is offered at par and accrued interest with a bonus of 40 per cent of the common stock voting-trust certificates. The majority of the common stock is held in a voting trust, with Samuel Insull, Mr. Goehst and Mr. Gilchrist as voting trustees. The company is engaged in selling, renting and operating electric signs and in the sale of electricity-consuming devices and supplies in nineteen cities, including Chicago, New York, St. Louis, Cincinnati, Philadelphia, Baltimore, Pittsburgh, New Orleans, Buffalo and Kansas City. It is closely related to the Federal Electric Company, which does a manufacturing business.

National Carbon Company Stock.—At a meeting last week of the governing committee of the Chicago Stock Exchange $4,500,000 preferred stock and $5,500,000 common stock of the National Carbon Company were admitted to the regular trading list. This action was in the nature of a readmission, the stocks having been excluded last December on account of the action of the directors in declaring a dividend without any previous notification to the stockholders. This dividend, which was $15 per share, was declared without any warning at all to the governing committee of the exchange.

Cumberland Telephone & Telegraph Company.—The twenty-eighth annual report of the Cumberland Telephone & Telegraph Company, which was for the year 1910, shows that the gross earnings from all sources amounted to $6,897,080, which was an increase over the previous year of $281,712. Operating expenses were $3,894,409, a very small increase over the previous year. The net earnings of the company increased $266,742. After deducting interest and dividends the company carried over at the end of the year a surplus of $832,856.

Montreal Light, Heat & Power Company.—On Feb. 10, a number of important actions brought against the Montreal Light, Heat & Power Company by the City of Montreal for assessment against the following companies, controlled by the power company, were settled by mutual agreement between the attorneys for the various parties: Montreal Gas Company, $64,805; Royal Electric Company, $42,576; Imperial Electric Company, $3,718; Lachine Rapids T. & L. Company, $10,629; total, $121,727.

Consolidated Gas, Electric Light & Power Company.—From a communication just sent out from the Consolidated Gas, Electric Light & Power Company, of Baltimore, it is learned that the company proposes to increase its common stock to the extent of $2,199,966, instead of $1,500,000, as was given out in connection with the company's new financing plan. The present authorized common stock issue is $6,300,034, and it is the plan of the company to increase it to $8,500,000.

American District Telegraph Company.—Theodore N. Vail, president of the American Telephone & Telegraph Company, was last week elected president of the American District Telegraph Company, of New Jersey, succeeding Robert C. Clowry, formerly president of the Western Union Telegraph Company. This is simply a change in organization, which is in line with the introduction of the telephone interests in the Western Union Telegraph Company.

DIVIDENDS.

American Gas Company, quarterly, 1¾ per cent, payable March 1.

American Railways Company, quarterly, 1½ per cent, payable March 15.

Blackstone Valley Gas & Electric Company, preferred, quarterly, 1½ per cent, payable March 1.

Brooklyn Rapid Transit Company, quarterly, 1¼ per cent, payable April 1.

Detroit Edison Company, quarterly, 1¾ per cent, payable April 15.

Federal Mining & Smelting Company, preferred, quarterly, 1¾ per cent, payable March 15.

Galveston-Houston Electric Company, semi-annual, preferred, 3 per cent; common, 1½ per cent, both payable March 15.

International Smelting & Refining Company, quarterly, 2 per cent, payable March 1.

Manhattan Elevated Railway Company, quarterly, 1¾ per cent, payable April 1.

Northern Ohio Traction & Light Company, quarterly, ¾ per cent, payable March 15.

St. Joseph (Mo.) Railway, Light, Heat & Power Company, quarterly, ½ of 1 per cent, payable March 1.

West Penn Traction Company, semi-annual, 1 per cent, payable March 15.

General News

Construction News.

CALERA, ALA.—The local electric light plant, owned by Mrs. Stein, of Calera, has been purchased by Everett Crim, who will take possession at once.

EUFAULA, ALA.—The City Council is reported to have engaged an engineer to prepare plans and estimates of cost of constructing a municipal electric-light plant for Eufaula.

SEWARD, ALASKA.—The Alaska Telephone Company, recently organized, proposes to erect a telephone line from Seward into the Iditarod, 500 miles in length. Branch lines will be extended to all mining camps in this territory.

PHŒNIX, ARIZ.—Sealed proposals will be received at the office of the Salt River Valley Water Users' Association, Phœnix, Ariz., until March 14 for furnishing, complete, electrical apparatus for use in a plant to be built at the junction of the South and Consolidated Canals on the Salt River project, Arizona. Bids will also be received at the same time and place for supplying two hydraulic turbines with accessories. Further information may be obtained on application to the office of the Salt River Valley Water Users' Association, Phœnix, Ariz., or the office of the United States Reclamation Service, Phœnix, Ariz. Charels A. Van Der Veer is secretary of the association.

CHICO, CAL.—It is reported that local capitalists, who purchased the Spiegle ranch, located on Deer Creek, are contemplating the establishment of an electric generating plant. The purchase includes rights to 500 in. of water in Deer Creek. T. N. Nash is reported to be interested in the project.

LOS ANGELES, CAL.—Sealed proposals will be received at the office of the United States Reclamation Service, Federal Building, Los Angeles, Cal., until March 10, for furnishing turbine water wheels for the Salt River project, Arizona. For further information address the above office or the United States Reclamation Service, Department of the Interior, Washington, D. C. F. H. Newell is director.

MARYSVILLE, CAL.—Investigations are being made by the Great Western Power Company with a view of extending its transmission lines to Marysville if sufficient business can be secured. Other towns and cities in the valley have been visited with the same object in view.

NEVADA CITY, CAL.—Arrangements are being made by the Bay Counties Power Company to establish wireless communication between the different power plants owned by the company and among the mines and water-power stations in the county. George Scarfe is local manager.

NEWPORT, CAL.—The City Council has passed a resolution providing for the construction of a municipal electric-light plant in Newport. Bonds to the amount of $55,000 will be issued to cover cost of same. L. S. Wilkinson is city clerk.

OAKLAND, CAL.—The City Council has granted the Oakland Traction Company a franchise to construct and operate an electric street railway in Hopkins Street from Fruitvale Avenue to Redwood Road in the annexed district for a period of thirty-five years, in return for which the company is to light the street its entire length and to pay the city 2 per cent of its gross receipts.

PETALUMA, CAL.—The City Council has granted a franchise to the Petaluma & Santa Rosa Electric Railroad Company to operate an electric railway through the city. The company proposes to build a railway to Point Pedro and connect with San Francisco by fast ferries.

SAN FRANCISCO, CAL.—The Pacific Terminal Company, recently incorporated with a capital stock of $5,000,000, is a subsidiary of the United Properties Company. The articles of incorporation give the company the right to acquire real estate for water and rail terminals, to construct railroads, operate steamships and to charter power plants. Among the directors are: F. M. Smith, of Oakland, Cal.; W. S. Tevis, of Bakersfield, Cal.; R. G. Hanford and Gavin McNab, of San Francisco, Cal.

TUSTIN, CAL.—The citizens have voted to form a lighting district in Tustin.

DENVER, COL.—Plans are being prepared by the Denver Gas & Electric Company for extensions and improvements to its systems this year, involving an expenditure of about $400,000, and will include the installation of boulevard lighting systems and extensions of gas mains. It is expected to erect ornamental lamp standards on the Speer, Montclair and other boulevards during the year. This work will be under contracts with the city and in conformity with designs made by Henry Read, head of the art commission. William J. Barker is vice-president and general superintendent.

NEW LONDON, CONN.—Sealed proposals will be received at the office of the Constructing Quartermaster, New London, Conn., until March 7 for construction of brick hospital building and installing plumbing, hot water heating, electric wiring and fixtures at Fort H. G. Wright, N. Y. A deposit of $10 will be required for plans. Captain F. T. Arnold is constructing quartermaster.

NORWALK, CONN.—A bill has been presented to the State Legislature by Representative Henry Matheis asking permission for the City of Norwalk to purchase electricity from the municipal electric plant at South Norwalk for street lighting; under the present law this cannot be done. The Housatonic Light & Power Company now supplies the service. Another bill has also been presented for consolidation of the two cities.

WASHINGTON, D. C.—Proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until March 6 for furnishing an electric type freight lift, hoistway, etc., for the United States custom house and post office building at Brunswick, Ga. Plans and specifications may be obtained at the above office. James Knox Taylor is Supervising Architect.

WASHINGTON, D. C.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until March 10 for furnishing and installing lighting fixtures in the United States buildings at Ashtabula, Ohio; Brainerd, Minn.; Centralia, Ill.; Dayton, Ohio; Lexington, Ky.; Lima, Ohio; Lincoln, Ill., and Detroit, Mich. Plans and specifications may be obtained at the above office. James Knox Taylor is Supervising Architect.

ATLANTA, GA.—The installation of a new lighting system in Grant Park is under consideration. It is proposed to install incandescent lamps on ornamental lamp standards.

MONTICELLO, GA.—The Jasper Cotton Mills has changed its name to the Castle Cotton Mills and the capital stock of the company has been increased from $200,000 to $1,000,000. The company proposes to build a plant to be equipped with 50,000 spinning spindles, 5000 twister spindles and 1200 looms, to be operated by electricity, which will be furnished by the transmission line of the Central Georgia Power Company, of Macon, Ga. About 5000 hp will be required. William T. Lang, of West Point, Ga., is president of the new company. It is understood that work will soon begin on construction of the plant.

POCATELLO, IDAHO.—It is reported that the substation and transformer house of the Idaho Consolidated Power Company in Pocatello was destroyed by the flood waters of the Portneuf River.

BLUE MOUND, ILL.—Frank L. Suffern is reported to have purchased the local electric light plant formerly owned by Luther C. Nichols.

PARIS, ILL.—The City Council has granted the Central Illinois Public Service Company, of Mattoon, Ill., a fifty-year franchise in this city for the proposed extension of its interurban railway to Charleston.

PEORIA, ILL.—Plans are being prepared by the Illinois Traction System for the construction of an extension of its system from Beatrice to Adams, a distance of thirty miles. In order to secure the extension capital stock to the amount of $300,000 must be subscribed by Gage County.

RIDGEFARM, ILL.—The Georgetown Electric Company, of Georgetown, is reported to have purchased the local electric light plant.

SANDOVAL, ILL.—The installation of a municipal electric light plant in Sandoval is reported to be under consideration. Joseph Thomas is Mayor: R. R. McCall and W. J. McNally are members of the committee.

SHELBYVILLE, ILL.—The Queen City & Shelby County Mutual Telephone Company has voted to purchase the property of the Shelby County Telephone Company and independent lines heretofore operated by E. M Harwood for $14,425.

TOLONO, ILL.—The local electric light plant is reported to have been taken over by the Chase Engine & Manufacturing Company. It is understood that the new owners will erect transmission lines to Sadorus, Pesotum and Philo.

CHESTERTON, IND.—The Northern Indiana Gas & Electric Company has recently ordered two 3850-kva steam turbines from the Westinghouse Machine Company, of Pittsburgh, Pa. The turbines will be connected to a 750-kva, 13,200-volt, 3-phase, 60-cycle Westinghouse generator and will operate on a steam pressure of 75 lb. and will exhaust into a vacuum of 28 in.

CYNTHIANA, IND.—Bonds to the amount of $4,000 have been issued by the Town Board to secure funds to install an electric light plant in Cynthiana.

FORT WAYNE, IND.—The Board of Public Works, the Board of County Commissioners and the Fort Wayne Civic Improvement Association are working in conjunction to secure a uniform ornamental street lighting system for the business section of the city. Samples of lamp standards and lamps are being asked for and a committee has been appointed to make the selection

SOUTH BEND, IND.—The control of the South Bend Home Telephone Company has passed to the Automatic Electric Company, of Chicago. The company operates seven exchanges in South Bend and vicinity. Sanford F. Harris, of Chicago, Ill., is president, and Elmer E. Daley is general manager.

SWAYZEE, IND.—The Swayzee Co-operative Telephone Company has increased its capital stock by $2,500, the proceeds to be used to improve and enlarge its plant.

WARSAW, IND.—The Winona Electric Light & Water Company is reported to be contemplating improvements to its system, including the installation of new pumps.

ADAIR, IA.—The W. K. Palmer Company, of Kansas City, Mo., is reported to be preparing plans for the installation of an electric-light plant and water-works system in Adair, for which bonds to the amount of $30,000 were recently authorized.

ALBIA, IA.—The Albia Interurban Railway Company is planning to extend its railway from Albia to Baxton, a distance of nine miles.

CORYDON, IA.—Bids will be received by the City of Corydon, Ia., until Feb. 28 for the construction of three miles of sewers and a disposal plant, six miles 4 to 8-in. water mains, 70,000-gal. steel tank on 100 ft. tower. Bids will also be received at the same time for pump house and reservoir, hydrants, valves, etc., triplex pump and deep well pump, 15-hp and 30-hp motors and electrical equipment. Plans are on file at the office of the Iowa Engineering Company, Chase Block, Clinton, Ia., copies of which may be obtained for $5 each job.

EAST PLEASANT PLAIN, IA.—The local exchange of the Pleasant Plain Telephone Company was recently destroyed by fire.

WAPELLO, IA.—The Iowa Telephone Company is contemplating improvements to its telephone exchange, involving an expenditure of about $8,000.

KANSAS CITY, KAN.—The question of purchasing the local electric-light plant to be owned and operated by the municipality is under consideration. It is proposed to issue bonds to the amount of $350,000, the proceeds to be used to buy the plant and improve the same. J. L. Porter is Mayor.

SYLVAN GROVE, KAN.—Plans are being considered for the installation of an electric-light plant and water-works system in Sylvan Grove. The cost of the proposed work is estimated at about $35,000, bids for which will be called for about July 1, 1911. George P. Taylor, of Stockton, Kan., is engineer in charge. W. H. Breihan is city clerk.

HARRODSBURG, KY.—James Lloyd and others are contemplating erecting a telephone line from the local telephone exchange to the Cedar Grove district. The erection of a telephone line from Harrodsburg to Duncan is reported to be under consideration.

LOUISVILLE, KY.—Proposals will be received at the office of Samuel D. Jones, business director of the Board of Education, Administration Building, Eighth and Chestnut Streets, Louisville, Ky., until Feb. 24, for furnishing and installing chairs in the assembly room and furnishing electric-light fixtures at the Broadway School. Plans and specifications may be seen at the above office or at the office of Brinton B. Davis, architect, Atherton Building, Louisville, Ky.

WHITESBURG, KY.—It is reported that the Eastern Kentucky Home Telephone Company, which recently purchased systems of the Whitesburg Telephone Company and the Letcher County Home Telephone Company, is contemplating improvements and extensions, including the installation of an exchange in Whitesburg, rebuilding toll lines and connecting with long-distance lines from Stonega, Va., to Pikeville, Ky. The main office of the company is located in Pikeville, Ky. M. Starkey is general manager.

NEW ORLEANS, LA.—The Southwestern Traction & Power Company, recently incorporated to build an electric railway from New Iberia to Lafayette, a distance of seventy-five miles, it is reported, will begin work on survey of the proposed railway within a few weeks. It is understood that financial arrangements have been made. The company is capitalized at $1,500,000. F. W. Crosby, of New Orleans, La., is president.

BALTIMORE, MD.—The directors of the Consolidated Gas, Electric Light & Power Company have authorized, subject to ratification by the stockholders, an issue of $1,500,000 in common capital stock to be offered to the stockholders at par, of which the proceeds of $735,000 will be used to retire $700,000 preferred stock at $105. A special meeting of the stockholders will be held March 1 to vote on the proposition.

CHESTERTOWN, MD.—The Kent Traction Company, recently incorporated, proposes to build an electric railway to connect Tolchester, Fairlee, Georgetown and Chestertown, ten miles in length, for which, it is said, rights of way have been secured. It is also proposed to build a branch to Rock Hall. The company is capitalized at $200,000. Frederick G. Usilton, Wilbur W. Hubbard, J. H. Sidds and T. D. Bowers are among the incorporators.

BOSTON, MASS.—The New York, New Haven & Hartford Railroad Company has presented a bill to the State Legislature submitting a proposition for the acquisition of the Boston, Revere Beach & Lynn Railroad, under the terms of which the New York, New Haven & Hartford Company agrees to construct another tunnel beneath the harbor, an underground connection with the New Haven system and the extension of the Revere Beach line to Beverly; also to equip the Revere Beach road for electrical operation. The plan also includes a connection with the eastern division of the Boston & Maine Railroad, which is now controlled by the New Haven company.

BOSTON, MASS.—Sealed bids will be received at the office of the Constructing Quartermaster, 263 Summer Street, Boston, Mass., until March 15 for construction, plumbing, heating, electric wiring and fixtures for one quarters for commissioned officers, two quarters for non-commissioned officers, one quarters for field officer, addition to post hospital, for construction, plumbing, electric wiring and fixtures for fire station, and construction complete of storehouse and shop building at Fort Andrews, Mass. Plans can be seen, specifications, blank forms and full information obtained at the above office. Plans and specifications can also be seen at the office of the Chief Quartermaster, Department of the East, Governor's Island, New York Harbor. A deposit of $25 will be required for plans and specifications. Captain A. M. Miller is constructing quartermaster.

FALL RIVER, MASS.—The Standard Fabric Company has purchased a site on South Watuppa Lake and will begin work on construction of its plant as soon as the weather will permit. The building will be 220 ft. x 88 ft., three stories high. The company will manufacture novelties in laces, ribbons, tapes, etc. The plant will be equipped for electrical operation. Edward T. Marvell is architect and engineer.

GRANITEVILLE, MASS.—The Lowell Electric Light Corporation has petitioned the Westford Board of Selectmen for locations for its poles and wires in this village. At present many houses are being wired for electric lamps. It is expected that the proposition for street lighting will be submitted to the voters at the annual town meeting in March.

SALEM, MASS.—Plans are being prepared by City Electrician Ashby for placing the municipal fire alarm, police and telephone wires in conduit, the cost of which is estimated at about $40,000. About six miles of cable will be required. The city passed a law requiring all wires in the business section of the city to be placed underground.

MANISTEE, MICH.—The proposition to issue $90,000 in bonds for the construction of a municipal electric-light plant is reported to be under consideration.

SAULT STE. MARIE, MICH.—The City of Sault Ste. Marie has made formal application to the War Department, Washington, D. C., for the lease of the Chandler Dunbar water-power canal taken over by the United States on condemnation proceedings. Some time ago the city voted to install a municipal electric-light plant and proposes to develop the water power of the canal to provide power to operate the proposed electric plant and waterworks system.

DULUTH, MINN.—At a recent election the proposition to issue $300,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant and improvements to the waterworks, was carried. C. S. Palmer is city clerk.

DULUTH, MINN.—The Minnesota Canal Power Company, which for ten years has been securing the right of way, flowage rights and other privileges in connection with the operation of its proposed hydroelectric power plant, is about to enter the head of the lakes. Water will be secured from the St. Louis River above Cloquet. It is proposed to construct a canal from Cloquet to the hill back of Ironton, ending in a flume which carries the water to the big turbines in the plant. The water will have a drop of 600 ft. from the top of the hill to the power plant. It is estimated that 80,000 hp can be developed, which will be transmitted to Superior, Wis., and Duluth, Minn. The company has been granted a permit by the government for the construction of the canals.

MINNEAPOLIS, MINN.—Preliminary plans are being prepared by the City Council health and hospitals committee for furnishing light and heat to the new Hopewell Hospital, light for Camden Park and power for the Northeast pumping station from the crematory plant. The committee has decided to purchase a generator, to cost $3,000, to furnish service to the Hopewell Hospital. J. W. Allen, park commissioner, was requested to submit a proposition to the Park Board to supply electricity for lighting Camden Park for 5 cents per kw-hour. The Minneapolis General Electric Company asks 10 cents per kw-hour for the same service. It is estimated that 400 hp could be supplied to the Northeast pumping station to operate the new electrical pumps. Application has been made to the State Legislature for authority to issue $100,000 in bonds for improvements to the plant.

VIRGINIA, MINN.—A petition has been presented to the City Council asking it to purchase the local electric light plant and water-works system or to build new systems.

McCOMB, MISS.—The construction of a municipal electric-light plant in McComb is reported to be under consideration.

NEWTON, MISS.—It is reported that an ordinance has been passed by the Mayor and Board of Aldermen providing for an issue of $11,000 in bonds, the proceeds to be used for the construction of an electric-light plant.

CHILLICOTHE, MO.—Plans have been prepared by Fuller-Coult Company, Chemical Building, St. Louis, Mo., for the construction of a municipal electric-light plant in Chillicothe, Mo., for which bonds to the amount of $50,000 have been issued.

COLE CAMP, MO.—It is reported that the proposition to issue bonds to the amount of $10,000, the proceeds to be used for the installation of an electric light plant and water-works system, will be submitted to a vote at an election to be held in April.

FORSYTH, MO.—The Ozark Power & Water Company, recently organized, is contemplating the construction of a hydroelectric power plant on the White River, three miles from Forsyth. The present plans of the company contemplate the development of 2500 hp, at a cost of about $400,000.

KANSAS CITY, MO.—The Kansas City, Lawrence & Topeka Electric Railway Company is planning to build an extension between Zarah and Lawrence, a distance of twenty-four miles, during 1911.

KANSAS CITY, MO.—Plans are being made by the Interstate Railway Company for extensions to its system during 1911, which will call for the construction of forty-eight miles of main track and five miles of sidings.

MARIONVILLE, MO.—The Lawrence County Water, Light & Cold Storage Company, of Aurora, Mo., is reported to have secured a franchise in Marionville to construct and operate an electric-light plant and water-works system, to cost approximately $40,000.

MONETT, MO.—It is reported that bonds to the amount of $35,000 will be sold by the City of Monett to provide funds for the construction of an electric-light plant, plans and specifications for which have been prepared by Rollins & Westover, engineers, Beals Building, Kansas City, Mo. It is expected that contracts for construction of the plant will be awarded soon.

ST. LOUIS, MO.—It is reported that the Union Electric Light & Power Company, of St. Louis, Mo., has taken over the contract which the Laclede Gas Light Company made with the corporation which is to build a large hydroelectric plant at Keokuk, Ia., and transmit electricity to St. Louis. The contract calls for 4000 hp and runs for ninety-nine years. Alton S. Miller is president of the Union Electric Light & Power Company.

GORDON, NEB.—At a special election held recently, it is reported, the citizens voted in favor of the proposition to issue bonds for the installation of electric-light, sewer and water-works systems.

ORD, NEB.—The City Council is contemplating issuing bonds for the purchase of the local electric-light plant.

VALENTINE, NEB.—It is reported that the city will install its own street-lighting system as soon as the new dam, which is being built by the municipality, is completed.

MADISON, N. J.—The Council has adopted the recommendations of the light committee and voted to authorize an expenditure of $16,687 for improvements and extensions to the municipal electric plant.

ROSWELL, N. M.—Plans are being prepared by the Berrendo Irrigation Farms Company, which, it is reported, has purchased the property of the Roswell Electric Light & Power Company, for extensions and improvements to its system, involving an expenditure of about $250,000. Additional buildings will be erected and new machinery installed. It is expected that work will begin on the proposed improvements within two months.

ODGENSBURG, N. Y.—Announcement has been made by the Odgensburg Power & Light Company of a reduction in the price of gas to $1.50 per 1000 cu. ft. Arrangements are being made by the company to enlarge its gas plant at a cost of about $16,000. The company, which also controls the street railway, is planning to erect a new car barn.

HANKINSON, N. D.—Application has been made to the Council by H. G. Squires, of Galesburg, Ill., for a franchise to operate an electric-light plant in Hankinson.

AKRON, OHIO.—The City Council is considering the question of constructing a municipal electric light plant. The Northern Ohio Traction & Light Company has the present contract for lighting the city, which will soon expire.

CINCINNATI, OHIO.—Sealed proposals will be received at the office of Director of Public Works, City Hall, Cincinnati, Ohio, until Feb. 28, for lighting streets, lands, lanes, squares and public places of the City of Cincinnati, excepting all the property under the control of the Board of Park Commissioners, for a period of ten years, beginning June 1, 1912. Plans and specifications and blank proposals can be obtained at the office of the Director of Public Service. John J. Wenner is clerk.

CLEVELAND, OHIO.—Only one bid was received for furnishing light and heat for the city hall building, which was submitted by the Cleveland Electric Illuminating Company, in which it agreed to supply the service for $13,596. It is said the bid will be rejected and the plant in the basement of the city hall will be rehabilitated.

COLUMBUS, OHIO.—The contract for electrical work for the New Hartman Theatre Building, including the theater, has been awarded to the Avery-Loeb Company, North Third Street, Columbus, Ohio. The cost of the work is estimated at about $25,000. Richards, McCarty & Butford, are architects.

LORAIN, OHIO.—The River Telephone Company, of Lorain, has filed amendments to its charter increasing its capital stock from $100,000 to $300,000.

YOUNGSTOWN, OHIO.—Plans have been prepared by the Banner Electric Company for large extensions to its plant on the South Side, which will involve an expenditure of about $250,000. The company manufactures incandescent lamps.

HOLLIS, OKLA.—The Chickasha Cotton Oil Company is reported to be contemplating the installation of an electric light plant and ice plant in connection with its oil mill. R. G. Latting is general superintendent.

OKLAHOMA, OKLA.—The Western Power & Irrigation Company, of Oklahoma City, Okla., has increased its capital stock from $200,000 to $500,000, the proceeds to be used for the construction of an electric railway from Cordell to Colony, Okla., work on construction of which is expected to begin within a year. The company at present is installing a hydroelectric power plant at Mountain View, Okla., near which a dam has already been completed across the Washita River by the Ambursen Hydraulic Construction Company. The plant, when completed, will supply electricity for lamps and motors for the towns in the Washita Valley. The Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., of which W. F. Barnes is State representative, is installing the plant. C. T. Berryman is president of the Western Power & Irrigation Company, and George W. Fry secretary and treasurer.

PAWHUSKA, OKLA.—The Pawhuska Water & Electric Light Department is contemplating the installation of 12,000 ft. of No. 2 weatherproof copper wire, and [illegible] in the market for one second-hand [illegible] or [illegible] kw, single-phase, 60-cycle, 2300-volt alternator, revolving armature compound wound, Westinghouse or General Electric preferred. L. P. Caldwell is superintendent.

SENTINEL, OKLA.—The proposition to issue $12,000 in bonds, the proceeds to be used for the construction of an electric light plant, will be submitted to a vote at an election to be held in March.

EAGLE POINT, ORE.—Arrangements are being made for the construction of an electric-light plant on Little Butte Creek, near Eagle Point, to supply electricity for lamps and motors in this village. It is understood that surveys have been made and a dam site located. Easter capitalists are reported to be interested in the project.

SPRINGFIELD, ORE.—The contract for the construction of the power house of the Oregon Power Company in Springfield has been awarded Sherman & Hunter, of Eugene, Ore.

VALE, ORE.—Plans are reported to be under way whereby electricity will soon be transmitted to Vale from the power plant on the Malad River, Idaho, owned by the Telluride Company, Salt Lake City, Utah.

BRADFORD, PA.—The Bradford Electric Light & Power Company has recently placed a contract for a 375-hp horizontal gas engine with the Westinghouse Machine Company, of Pittsburgh, Pa. The engine will be direct-connected to a Westinghouse 250-kva, 2400-volt, 60-cycle, 3-phase generator. Natural gas will be used for fuel.

ETNA, PA.—It is reported that plans have been prepared for the construction of an electric light plant and pumping station in Etna, to cost about $50,000.

HARRISBURG, PA.—Two bills have been presented to the State Legislature by Representative Mills, of Bradford County, as amendments to existing acts, giving to electric light, heat and power companies the right of eminent domain and authorizing such companies to supply light, heat and power to any city, township or borough in this or an adjoining State. It is understood that the bills were introduced in behalf of the McCall's Ferry Power Company, which is operating a large hydroelectric power plant on the Susquehanna River.

HAZEL DELL, PA.—The residents of the Borough of Hazel Dell are considering the question of installing an electric light plant. The proposition may be submitted to a vote at an early date.

LOCK HAVEN, PA.—The City Council has instructed the Light and Sanitary Committee to ask for bids for lighting the streets by electricity, and also to ask for bids for the construction of an electric plant to be owned and operated by the city. The Lock Haven Electric Light & Power Company has the present contract for street lighting, which will expire in about six months.

NORRISTOWN, PA.—Announcement has been made by the Montgomery County Rapid Transit Company, which operates the Trooper-Souderton electric railway, to extend its electric railway from Skippack to Schwenksville, and thence to Green Lane and Pennsburg. Daniel M. Auders and Henry J. Farquhar are receivers.

PHILADELPHIA, PA.—Among the improvements planned by Mayor Reyburn is the construction of a four-track subway to run the entire length of Broad Street, a distance of eleven miles, to be controlled by the city and leased; the extension of the Market Street subway system of the Philadelphia Rapid Transit Company to Camden, N. J., through tunnel under the Delaware River, and the erection of a large convention hall on the edge of Fairmount Park. The proposed improvements, it is said, are to be made under a $60,000,000 city loan, of which $28,000,000 will be spent on the Broad Street Subway. It is understood that steps have already been taken to have the loan approved by the State Legislature.

PROVIDENCE, R. I.—At the annual meeting of the Providence Telephone Company the stockholders voted to increase the capital stock of the company from $3,000,000 to $5,000,000, to be issued at the discretion of the directors. Of this $500,000 will be issued at once.

ROCK HILL, S. C.—The City of Rock Hill has purchased the property of the Rock Hill Water & Electric Company, consisting of the water-works system, electric-light plant and street railway, which will be operated by the municipality. The consideration was $100,000, for which the city will soon issue bonds to pay for same and will take over the plants at once. Martin Maloney, of Philadelphia, Pa., is president of the Rock Hill company.

ST. GEORGE, S. C.—It is reported that the question of issuing $1[illegible] in bonds, the proceeds to be used for the construction of an electric light plant and water-works system, is under consideration.

BRYAN, TEX.—The City Council is reported to have accepted the proposition submitted by H. T. and J. S. Lawler, of New Orleans, La., for the erection of a flour mill and installation of an electric-light plant to supply electricity for lamps and motors in Bryan and also to furnish water and to build a sewerage system. The cost of the mill and power plant is estimated at $50,000.

MEMPHIS, TENN.—Plans are being considered for the construction of a municipal electric light plant in Memphis. It is proposed to issue $1,000,000 in bonds to provide funds for same. It will be necessary to secure permission from the State Legislature to issue the bonds.

MILES, TEX.—The local electric light plant, owned and operated by S. M. and T. J. Farmer, was destroyed by fire Feb. 5, causing a loss of about $10,000.

NAPLES, TEX.—It is reported that Charles E. Grant and M. H. Sullivan are contemplating installing an electric light plant in Naples.

SAN MARCOS, TEX.—The San Marcos Utilities Company is reported to have been granted a franchise to supply electricity for lamps in San Marcos. The company contemplates making improvements to its plant, to cost approximately $10,000.

LOGAN, UTAH.—K. C. Schaub, who has been preparing estimates of the cost of remodeling the city water-works system, has submitted his report to the City Council, in which he estimates the cost at $112,000 if cement conduits are used and $93,000 if the conduits are made of wood. The plans include the construction of a conduit 5600 ft. long, extending from DeWitt springs to the head of the present power plant site. In that distance a fall of 194 ft. could be secured, which would be available for power purposes. The proposition to bring this power to the mouth of the canyon to be used for generating electricity for the Agricultural College is also under consideration.

CHASE CITY, VA.—Contracts have been awarded for construction and equipment of the Chase City municipal electric light plant as follows: For construction work and electrical equipment, to John L. Livers, of Grottoes, Va., and to the Erie City Iron Works, of Erie, Pa., for boiler and engine. J. Kent White, of Crewe, Va., is engineer.

WAVERLY, VA.—It is reported that bonds to the amount of $7,000 have been voted, the proceeds to be used for the installation of an electric-light plant and street improvements.

SPOKANE, WASH.—Among the improvements contemplated by the Washington Water Power Company are the following: Completing water-power developments at Little Falls, construction of new power plant above Little Falls, securing more flowage rights in the Spokane River and Cœur d'Alene Lake, placing all wires underground in Spokane, extension to the local light and power systems, completing the construction of storage battery plant in Spokane, the installation of additional machinery in the local substation, the erection of a transmission line from Pond d'Oreille to Newport, Wash., the construction of new track and purchase of new cars, etc. The company is reported to have awarded the contract for four large water-wheels, having a total rating of 90,000 hp, to the I. P. Morris Company, of Philadelphia, Pa. D. L. Huntington is president and manager.

TOPPENISH, WASH.—The Valley Light & Power Company, it is reported, is extending its transmission lines to Zillah, Wash.

BOWLING GREEN, W. VA.—The Bowling Green Home Telephone Company, it is said, is contemplating making extensions to its system, which will involve an expenditure of about $10,000.

BUNGERS, W. VA.—Slater S. Tuckwiller is reported to be planning to install an electric light plant. It is understood that it is proposed to develop a water-power.

BARABOO, WIS.—Reports have been filed showing the cost of the proposed municipal electric-light and power plant to be approximately $45,000. The alternative proposition is purchasing current from the Wisconsin River Power Company at Prairie du Sac, which involves the erection of a substation and distributing system at a cost of $30,000. No action has been taken, but the prevailing sentiment is in favor of a municipal plant.

CHIPPEWA FALLS, WIS.—The plants and holdings of the Chippewa Falls Water Works & Lighting Company have been purchased by the Chippewa Valley Railway, Light & Power Company, of Eau Claire, Wis. The property will hereafter be conducted and operated under the name of the Chippewa Valley Railway, Light & Power Company. George B. Wheeler is secretary and general manager.

LADYSMITH, WIS.—Plans are being made by the Chippewa Valley Telephone Company for further improvements to its system, including the extension of its cable lines.

NEW LONDON, WIS.—It is reported that a farmers' telephone line has been organized in New London to be a tributary to the Fox River lines.

LETHBRIDGE, ALTA., CAN.—City Engineer Arnold, who has been making investigations regarding street railways, recommends the City Council to build the proposed municipal railway system at once.

PINCHER CREEK, ALTA., CAN.—The town of Pincher Creek is asking for bids for an issue of $22,000 debentures, the proceeds to be used for the purchase of the local electric-light plant, owned by the Pincher Creek Electric Light Company. G. D. Plunkett is secretary and treasurer.

NELSON, B. C., CAN.—It is reported that electricity from the municipal electric plant is being supplied to consumers at less than cost. An increase in rate has been ordered which will go into effect at once.

NELSON, B. C., CAN.—The Nelson Street Railroad Company is contemplating improvements to its system, to cost about $10,000.

PRINCE RUPERT, B. C., CAN.—Bids will be received by the City of Prince Rupert, B. C., until March 2, for $40,000 telephone debentures. Ernest A. Woods is city clerk.

ARGYLE, MAN., CAN.—Arrangements have been made by the Municipality of Argyle whereby the Manitoba government will take over the municipal telephone system and add it to the provincial system.

NEEPAWA, MAN., CAN.—Plans are being prepared by the Manitoba Telephone Commission for the erection of a new telephone exchange in Neepawa.

WINNIPEG, MAN., CAN.—The Winnipeg Electric Railway Company is planning several extensions to its system, including a line to Winnipeg Beach, this year.

LIVERPOOL, N. S., CAN.—Surveys are being made, it is said, in connection with a project to develop extensive water powers in this vicinity to be used to generate electricity. J. L. McLeod and George S. McLaren, of Liverpool, N. S., are reported to be interested in the enterprise.

FORT WILLIAM, ONT., CAN.—The Kaministiquia Power Company is planning to enlarge its plant near Fort William, for which $250,000 has been appropriated.

GUELPH, ONT., CAN.—It is reported that bids are being received by the Street Railway Commission for construction of an extension of the Guelph Radial Railway in St. Patrick's Ward.

HAMILTON, ONT., CAN.—Applications, accompanied by qualifications and testimonials, will be received by the city clerk until March 15 from electrical engineers for the purpose of preparing estimates of the cost, plans and specifications for a municipal electric power and light system for the City of Hamilton. S. H. Kent is city clerk.

HAMILTON, ONT., CAN.—The City Council is reported to be considering the purchase of the plant of the Cataract Power Company to be operated by the municipality.

OTTAWA, ONT., CAN.—The Morrisburg & Ottawa Electric Railway Company is reported to have applied for a franchise to construct an electric railway on Main Street to connect with the Ottawa Street Railway. C. M. Willard, of Morewood, Ont., Can., is president of the company.

OTTAWA, ONT., CAN.—An amendment is proposed to the provincial hydroelectric power act which will enable the furnishing of electricity for lamps and motors to farmers along the line of the Hydro-Electric Power Commission system with branches to adjacent settlements.

RENFREW, ONT., CAN.—It is reported that investigations are being made by the engineers of the Hydro-Electric Power Commission of the upper lakes of Bonnechere River, for the purpose of locating sites for dams for storage purposes. The town of Renfrew is expending $150,000 for power development.

ABERDEEN, SASK., CAN.—Several applications for power having been made to the provincial government, the town of Aberdeen has requested that at least one-third of the power at La Colle Falls be reserved for its own use.

ABERNETHY, SASK., CAN.—The D Line Rural Telephone Company is contemplating building a number of extensions to its system in the spring.

ASQUITH, SASK., CAN.—Plans are being prepared by the provincial telephone department for the erection of a long-distance telephone line between Saskatoon and Biggar, passing through this town.

GRENFELL, SASK., CAN.—The Board of Trade has organized telephone companies in the rural districts of Weldon and Brownhill and is now planning to form a company in the Tetlock district.

KERROBERT, SASK., CAN.—Arrangements are being made by the civic authorities for the installation of a municipal electric light plant in Kerrobert.

KERROBERT, SASK., CAN.—The Kerrobert Board of Trade has applied to the Saskatchewan government for a local telephone system and connection with the long-distance telephone lines in the province.

MOOSEJAW, SASK., CAN.—The Moosejaw Electric Company has applied for a charter to build a street railway system in Moosejaw and to adjoining towns. The company will be capitalized at $500,000. D. R. Street, A. H. Dion and N. J. Kerr, all of Ottawa, Ont., are interested in the project.

REGINA, SASK., CAN.—A bill is now before the Legislature which provides for a tax of 2 cents per acre on all land in the province for telephone purposes.

WOLSELEY, SASK., CAN.—Announcement has been made by the Saskatchewan government that it proposes to build a long-distnace telephone line from Wolseley to the Manitoba boundary.

YORKTON, SASK., CAN.—The civic authorities have decided to offer for sale the plant of the Yorkton Northwest Telephone Company to the Saskatchewan government.

PACHUCA, MEX.—The Cia Beneficiandora de Pachuca de Mexico has recently purchased one 195-kva, oil-insulated, self-cooling auto-transformer from the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa. The 3-phase, 10,000-volt high-tension-6600-volt low-tension transformer is designed to operate on either 50 cycles or 60 cycles and will connect together two systems, one of 10,000 volts and the other of 6600 volts in case of failure of either system. The transformer will be able to switch the 1000-hp load of a compressor motor from one circuit to the other in case of failure of the circuit that is operating.

New Industrial Companies.

THE ADSIT TELEPHONE MANUFACTURING COMPANY, of St. Paul, Minn., has been incorporated with a capital stock of $500,000. The company proposes to manufacture telephones and telephone supplies. G. N. Berrgren is president and G. E. Adsit, vice-president.

THE ATWOOD VACUUM CLEANER COMPANY, of Rockford, Ill., has been chartered with a capital stock of $50,000 by James T. Atwood, Howard C. Atwood and Myra C. Atwood. The company proposes to manufacture and deal in electrical machinery.

THE CHARLES H. DEBS COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $5,000 to manufacture and deal in electric and gas fixtures. The incorporators are: Charles L. Cohns, Charles H. Debs and Joseph Rosenberg.

THE DENNISTON COMPANY, of Buffalo, N. Y., has been chartered with a capital stock of $150,000 by E. E. Denniston, E. C. Anderson and F. U. Browne, of Buffalo, N. Y. The company proposes to manufacture motors, engines, machinery, etc., also vehicles of all kinds.

THE FOREST CITY ENGINEERING COMPANY, of Cleveland, Ohio, has been incorporated by William von Wolffradt, E. von Wolffradt, L. H. Miller, N. S. J. Zwick and R. E. Needham. The company is capitalized at $10,000 and proposes to do general engineering work.

THE GRAVITY CONDENSER COMPANY, of Milltown, N. J., has been incorporated by G. Reimers, M. Reimers, of Milltown, N. J.; F. A. Sondheimer and G. L. Sondheimer, of New York, N. Y. The company is capitalized at $100,000 and proposes to manufacture condensers and machinery.

INDEPENDENT FIXTURE COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $5,000 to manufacture and deal in gas and electric-light fixtures, etc. The incorporators are: P. L. Utley, Ralph Utley and Elmer E. Challenger.

THE LARRABEE ELECTRICAL COMPANY, of Portland, Maine, has been organized with a capital stock of $10,000 for the purpose of manufacturing electrical supplies. The incorporators are: H. Perkins, president; Henry C. Larrabee, treasurer; G. H. Sturgis, clerk; Frank M. Larrabee and Clifford S. Libby, all of Portland, Maine.

THE LEWIS ELECTRIC WELDING & MANUFACTURING COMPANY, of Toledo, Ohio, has been incorporated by G. L. Lewis, Frank W. Otis, Ewald Preus, H. W. Fraser and E. J. Marshall. The company is capitalized at $10,000 and proposes to manufacture electrical and mechanical appliances.

THE LEXINGTON MACHINE WORKS, of Lexington, Ky., has filed articles of incorporation with a capital stock of $12,000 and proposes to manufacture gas engines and special machinery.

THE MERRITT ENGINEERING COMPANY, of Elizabeth, N. J., has been incorporated with a capital stock of $250,000 by Horace R. Wemple, of Elizabeth, N. J.; Ernest Wemple, of Cranford, N. J., and Daniel W. Merritt, of Brooklyn, N. Y. The company proposes to manufacture and sell oil engines, etc.

THE METEOR AUTO TANK COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $50,000, for the purpose of manufacturing automobile tanks, lamps, etc., chandeliers, electroliers, etc. The incorporators are: G. Leveene, E. J. Bosse and S. J. Mayes, of New York, N. Y.

THE NEW JERSEY MOTOR EQUIPMENT COMPANY, of Elizabeth, N. J., has been chartered with a capital stock of $100,000 by G. Sesber, of Richmond, N. Y.; E. Nugent and L. Hoffman, of Elizabeth, N. J. The company proposes to manufacture machinery and patents for mechanical appliances, etc.

THE PENNSYLVANIA RAILWAY MOTOR COMPANY, of Warren, Pa., has been incorporated with a capital stock of $200,000. The directors are: R. N. Brown, of Warren, Pa., treasurer; J. A. Veile, Frank M Knapp, O. W. Ensworth, all of Warren, Pa.

THE WARDER, CLARK & CHAPLIN COMPANY, of Rochester, N. Y., has been incorporated by Charles Warder, 233 Tremont Street, Rochester, N. Y.; Jay R. Clark, Ironequoit, N. Y., and Edwin R. Chaplin, 36 Monroe Avenue, Rochester, N. Y. The company is capitalized at $12,000 and proposes to do general electrical construction work and deal in electrical apparatus and supplies.

THE WILSON MOTOR STARTER COMPANY, of Franklin, Pa., has been chartered with a capital stock of $30,000. The directors are: William McC. Wilson, of Franklin, Pa., treasurer; John A. Wilson and G. J. Spohrer, all of Franklin, Pa.

THE WINTER BATTERY COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $10,000 to manufacture and deal in batteries and kindred articles. The incorporators are: H. C. Bangs, Harry Rubens, Jr., and Carey W. Rhodes.

New Incorporations.

SAN FRANCISCO, CAL.—The Monterey & Pacific Grave Telephone Company has been incorporated with a capital stock of $100,000 by E. C. McGee, C. Bull, J. D. O'Connell, R. C. Smith and H. Haber.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the California Telephone Herald Company with a capital stock of $1,000,000 by G. S. Holbrook, W. A. Whelan, W. B. Heckmann, A. H. Vorrath, R. M. Graham, B. Boreham, William T. Newverth, A C. Gould and A. Jacoby.

COIN, IA.—The Buck Creek Mutual Telephone Company has been chartered with a capital stock of $5,000 by H. M. Myers, Frank Annam, H. D. Ellis, W. L. Annam, Herman Seifering, Henry Muller and J. H. Meyers.

WEST POINT, IA.—The West Point Mutual Telephone Company has been incorporated with a capital stock of $20,000. The officers are: J. W. Piper, president; J. C. Junkunz, secretary, and J. H. Richardson, treasurer.

ALBANY,, ILL.—The Albany Telephone Company has been incorporated with a capital stock of $3,000 by E. B. Dimond, Herbert J. Simpson and T. H. Adams.

BOSTON, MASS.—The North Boston Lighting Company, which is an amalgamation of several lighting companies in the vicinity of Boston, in which considerable New Haven capital is invested, has been organized. The trustees are: Herbert C. Warren, Edward M. Bradley and Samuel A. York.

POINDEXTER, R. F. D., SILOAM, N. C.—The Poindexter Telephone Company has been incorporated with a capital stock of $3,250 by O. J. Martin, H. J. Mickey and others.

EPPING, N. D.—The Epping Telephone Company has been incorporated with a capital stock of $25,000 by O. Ellingson, C F Carpenter, Charles O. Edell, R. L. Hambleton and John Hannegrafs, all of Epping.

BARBERTON, OHIO.—The Barberton Light & Power Company has been incorporated with a capital stock of $[illegible]0,000 by Charles L Johnson, F. A. Fobes, A. L. Miller, F. M. Clay and E. J. Quigley. The company will lease the electric plant of the Barberton Inn and supply electricity for residential lighting in Barberton.

BREWSTER, R. F. D. NAVARRE, OHIO.—The North Brewster Electric Light, Heat & Power Company has been chartered with a capital stock of $5,000 by J. P. Thomas and others.

GENEVA, OHIO.—The People's Telephone Company has been incorporated by C. J. Crowther, G. M. Surridge, H. Buff and George J. Bradley.

MONROE, OKLA.—The Monroe Telephone Company has been incorporated with a capital stock of $1,000 by C. E. Riggan, J. H. Banning, B. D. Woodson, W. J. Gasaway, W. F. Hunt and E. A. Flynn.

HELLERTOWN, PA.—The Lower Saucon Telephone Company has been incorporated with a capital stock of $5,000. The directors are: Theodore F. Laubach, of Hellertown, Pa., R. F. D. No. 2, treasurer; Daniel M. Weber, Edward J. Schaeffer, John B. Boyer, Stewart C. Riegel and Titus W. Weaver, all of Hellertown, Pa.

HELLERTOWN, PA.—Articles of incorporation have been filed for the Sadsbury Township Electric Company with a capital stock of $5,000. The directors are: Theodore F. Laubach, of Hellertown, R. F. D. No. 2, treasurer; Daniel M. Weber, Edward J. Schaeffer, John B. Boyer, Stewart C. Riegel and Titus W. Weaver, all of Hellertown, Pa.

WEST CHESTER, PA.—The East Bradford Light, Heat & Power Company and the West Goshen Light, Heat & Power Company have been granted charters. Both companies are capitalized at $5,000 and the directors are: Benjamin W. Haines, of West Chester, Pa., treasurer; Samuel Marshall, of West Goshen township; Marshall H. Matlack, of West Chester, Pa.

KYLE, TEX.—Articles of incorporation have been filed for the Kyle Telephone Company with a capital stock of $5,000 by C. F. Heidenrich, T. F. Harwell, P. Allen and others.

SUNSET, TEX.—Articles of incorporation have been filed for the Sunset Heights Water, Light & Power Company with a capital stock ot $20,000 by Richard Rodgers, B. R. Hardin and W. E. Courtney.

CLAUDVILLE, VA.—The Three-Fork Telephone Company has been chartered with a capital stock of $5,000 and the following officers: A T. Jessup, president; W. H. Waller, vice-president, and J. H. Barnard, secretary and treasurer.

SHAWSVILLE, VA.—The North Fork & Bradshaw Telephone Corporation has been incorporated with a capital stock of $5,000. The officers of the company are: F. T. Sesler, president; S. W. Kenzie, vice-president, and G. C. Bain, secretary and treasurer.

CHEHALIS, WASH.—The Chehalis & Cowlitz Railway Company has been chartered with a capital stock of $300,000 by H. Coffman and George Robinson, of Chehalis, Wash. The company proposes to construct a steam or electric railway from Chehalis to a point on the Cowlitz River.

WOLSELEY, SASK., CAN.—The Westfield Rural Telephone Company has been incorporated to build a rural telephone system southeast of this city. S. Fleming is secretary pro tem.

Personal.

M. W. GODFREY BOYD has resigned from the sales department of Lamont, Corliss & Co. to become manager of the sales department of the New York Incandescent Lamp Company.

MR. ELAM MILLER has been appointed commercial engineer of the Pacific Telephone & Telegraph Company, reporting to the general commercial superintendent at San Francisco.

MR. J. W. M. BURTON has resigned as secretary and manager of the Paxton Electric Company, of Paxton, Ill., to accept a position as salesman for the Mills Electric Company, of Peoria, Ill.

MR. F. F. BARBOUR, assistant to the president of the Portland (Ore.) Railway, Light & Power Company, has resigned his position to accept a similar one with the Pacific Gas & Electric Company of San Francisco.

MR. F. H. COOKE, general agent for the Illinois Traction System at St. Louis, Mo., recently delivered an address before the St. Louis Sales Managers' Association upon "The McKinley System and the St. Louis Market."

MR. C. E. THATCHER who lately arrived on the Pacific Coast from the East, has been appointed city manager of the Western Union Telegraph Company in San Francisco to fill the vacancy created by the resignation of W. A. Newcomb.

MR. D. McFARLAN MOORE will lecture before the department of electrical engineering of Columbia University, New York, on Friday, February 24, at 8 p. m., on tube lighting. The address will be illustrated by numerous interesting lantern slides.

MR. W. H. DE WITT has succeed Mr. Frank Arnold as operating superintendent of the Fort Dodge, Des Moines and Southern Railroad at Ames, Iowa. Mr. F. M. Johnson is purchasing agent; Mr. H. W. Fisk, electrical engineer, and Mr. W. R. Dyer, claim agent

MR. S. O. OCHS of the Russian Importing Company, Boston, Mass., sailed for Russia on the *Kaiserin Auguste Victoria* on Feb. 11. Mr. Ochs represents several American manufacturers of electrical and other apparatus which is being introduced to the Russian public.

MR. ARTHUR P. PIERSON, who has for the past five years been actively identified with the general electric supply business, has been appointed exclusive agent for New York and vicinity for the Brilliant Electric Company, of Cleveland, Ohio, manufacturers of all types of incandescent lamps.

MR. J. LE CONTE DAVIS presented a paper on "The Electric Locomotive of the Pennsylvania Railroad," at the February meeting on Friday Feb. 17, of the Baltimore Section of the American Institute of Electrical Engineers. The meeting was held in the physical laboratory of Johns Hopkins University, and the paper was illustrated by projections from lantern slides.

MR. FRANK KOESTER, previously with the Interborough Rapid Transit (Subway) Construction Company, the J. G. White Company, the Guggenheim Exploration Company, and the American Smelting & Refining Company, all of New York, recently opened an office at 115 Broadway, New York, as consulting engineer. Mr. Koester is author of two engineering treatises, "Steam Electric Power Plants" and "Hydroelectric Developments and Engineering."

MR. G. R. G. CONWAY has been appointed chief engineer of the British Columbia Electric Railway Company, from Feb. 1. The appointment is to a new position created on account of the rapid growth of the districts served by the company. Mr. Conway was formerly in charge of the water-works of Aberdeen, Scotland, as well as of several undertakings in Mexico. He came to Vancouver about the first of the present year to consult with the local management concerning the position and to look over the field.

MR. A. S. GRENIER, formerly general manager of the Pacific Power & Light Company, has been elected vice-president of that company, in charge of operation and construction. Mr. James E. Davidson, who has been new-business manager of the company, has been appointed general manager. Both officials have headquarters in Portland, Ore. Mr. H. R. Kingman has been made local manager of the North Yakima branch, vice Mr. H. E. Way, who has been appointed assistant to the chief engineer.

DR. EDMUND ARTHUR ENGLER has tendered his resignation as president of the Worcester Polytechnic Institute to take effect at the close of the present school year. Dr. Engler was graduated from Washington University, St. Louis, Mo., with the degree of A. B., in 1877. He received the degree of Ph.D. in 1892 and LL.D. in 1901. For twenty years, from 1881 to 1901, he was professor of mathematics at Washington University, and he served as dean of its School of Engineering from 1896 to 1901. In 1901 he was appointed president of the Worcester Polytechnic Institute.

MR. W. W. MOORE, who has been in the employ of the Wesco Supply Company, of St. Louis, for the past nine years in various capacities from that of traveling salesman to manager of the Birmingham branch, has resigned from its service to open an office for himself in the Empire Building, Birmingham, Ala. Mr. Moore, in addition to work as consulting and constructing engineer, especially along water and electric lighting plant lines, for which he is qualified both by training and by experience, will also act as manufacturer's agent for several lines of mine supplies and machinery.

Trade Publications.

CORLISS ENGINES.—The Allis-Chalmers Company has issued Bulletin No. 1510, which describes its direct-connected Reynolds Corliss engines.

TURBINE GOVERNORS AND PENSTOCK RELIEF VALVES.—The Ludlow Valve Manufacturing Company, Troy, N. Y., has issued a binder containing bulletins of its various water-wheel governors.

SIGN FLASHERS.—Bulletin No. 3 of the Reynolds Electric Flasher Manufacturing Company, Chicago, describes two popular flashing effects, script writing and chaser. The wiring connection for both are also given.

INSULATING JOINTS.—In its Bulletin No. 1101 the Wirt Electric Specialty Company, Germantown, Pa., gives illustrations, brief descriptions and complete price lists of insulating joints for electric and combination fixtures

ELECTRIC HOISTS.—The Allis-Chalmers Company, Milwaukee, Wis., has issued Bulletin No. 1445, covering its electric hoists intended for mine and other service. The bulletin supersedes Bulletin No. 1506 and is an exposition of modern hoisting practice.

WATT-HOUR METERS.—The Sangamo Electric Company, Springfield, Ill., is distributing Bulletin No. 20, giving full description of its mercury-flotation meters. Considerable information is given on the theory of operation, methods of making adjustments, etc.

TELEPHONE FITTINGS.—The K. & B. Company Philadelphia, Pa., has issued a circular pertaining to its line of telephone fittings. These include devices for holding telephones within easy reach of desks, walls, etc., and include swinging and balanced brackets and pantograph arrangements.

FANS AND BLOWERS.—Ilg Electric Ventilating Company, Chicago, has circulated a loose-leaf catalog containing mechanical data and general descriptions of its blowers, ventilating sets, propeller fans, automatic shutters, etc. The data are given in the form of curves and tables and are valuable.

KNIFE SWITCHES.—Bulletin No. 25-A of the Mutual Electric & Machine Company, Wheeling, W. Va., illustrates and price-lists the company's full line of "Bull Dog" all-copper knife switches. These switches have large contact surface and milled and sweated contacts. Switches over 30 amp in size are regularly equipped with lugs.

LAUNDRY MACHINES.—The Hurley Machine Company, Chicago, manufacturer of the Thor electric laundry machines, has issued Catalog E, describing the product in detail and its uses. The Thor washer is designed on the reversing cylinder principle, and is built in various sizes and of different materials to suit various requirements.

STORAGE BATTERY INSTALLATION.—Bulletin No. 131, issued by the Electric Storage Battery Company, Philadelphia, describes the installation of "chloride accumulators" in the Lake Hopatcong Yacht Club, Lake Hopatcong, N. J. The club house is lighted by electricity furnished by a small gas-engine-driven set in conjunction with a storage battery.

INDICATORS.—Dobbie McInnes, Ltd., Glasgow, Scotland, manufacturers of automatic continuous indicators for steam and gas engines, reducing gears and all accessories for indicating purposes, have issued a pamphlet on the commercial value of indicator diagrams and instructions for the use of the engine indicator, together with leaflets and pamphlets covering their product.

NAME PLATES.—Catalog No. 5, issued by the Crowe Name Plate & Engraving Company, Chicago, illustrates in color the line of etched engraved signs, tablets, dials, plates, labels, etc., manufactured by the company. These include generator, motor, rheostat, meter, telephone and other name plates, having the name of the manufacturer and the rating of the apparatus, etc.

INSULATOR SUPPORTS.—Bulletin C of the Steel City Electric Company, Pittsburgh, Pa., describes and illustrates the malleable iron clamps made by it for securing insulators to exposed steel framework in wiring mills, foundries, factories, bridges, etc. The supports do away with the necessity of designing and making forgings, hook bolts, straps and other special rigging, and no drilling of holes is necessary.

CATECHISM ON DIRECT-CURRENT APPARATUS.—Under the above title, Fairbanks, Morse & Company, Chicago, have published an interesting booklet, giving in simple language definitions of electrical terms and describing the construction and uses of different electrical machines. As the title indicates, this treatise is prepared in the form of a series of questions and answers. The bulletin incidentally illustrates Fairbanks-Morse apparatus.

ELECTRIC SIGNS.—The 1911 catalog of the Flexlume Sign Company, Buffalo, N. Y., and St. Catharines, Ontario, illustrates the various types of signs made by the company and contains testimonial letters from users. The letters of the Flexlume signs are of prismatic glass molded in bold relief and only one lamp is used per letter. The sign is equally attractive by day and by night. The company also manufactures all types of signs from the smallest glass transparency to the largest exposed-lamp roof signs.

ELECTRIC LAUNDRY EQUIPMENT.—The Hurley Machine Company, of Chicago, has issued an attractive pamphlet (Catalog E) devoted to its electric laundry machines, both for the home and for commercial laundries. Washing machines, wringers and ironing machines are shown in various sizes and combinations. Westinghouse motors are used to drive the machines. A list of eighty-five parts of the laundry machine shows the care and attention needed in designing this class of apparatus.

MEGGERS AND BRIDGE MEGGERS.—A comprehensive 40-page catalog on this subject has just been published by James G. Biddle, Philadelphia. The descriptive matter was prepared by Prof. A. J. Rowland, of Drexel Institute, and contains a lot of valuable information on the subjects of insulation-testing and resistance measurements. A considerable number of illustrations and diagrams help to make the text matter clear, and the pamphlet is unusually interesting and valuable for what is really a trade publication.

STEEL FLUMES.—T. C. Egleston, Denver, Col., has issued Catalog No. 6 on Maginnis galvanized steel flumes for power, irrigation and mining canals. No solder or rivets are used in the flume. A flat sheet of galvanized steel is passed through a forming machine which leaves the sheet in a semi-circular form, with a bead rolled in each edge of the sheet. A steel rod of the proper size to carry the weight of the flume is threaded at both ends for a nut and lies in the bead when the flume is in place. A steel channel rests over the bead on the inside of the flume and when the flume is assembled and the nuts tightened the rod draws tight in the hollow of the bead and the channel presses with the same force on the edges of the bead, thus forming a watertight joint.

BUSINESS NOTES.

THE ASBESTOS PROTECTED METAL COMPANY has established a Western office at 613 Fisher Building, Chicago, with Mr. Wilmot W. Burritt in charge as district manager.

ST. LOUIS FIXTURE HOUSES CONSOLIDATE.—The Gross Gas & Electric Fixture Company and the C. F. O'Reilly Electric Fixture Company, both of St. Louis, have effected a consolidation under the name of Gross-O'Reilly Chandelier Company, located at 11[illegible]7 Locust Street, St. Louis.

CONNECTICUT TELEPHONE & ELECTRIC COMPANY.—Mr Charles E. Stahl, of Chicago, previously Western representative for the Mosier spark plugs and accessories, has been appointed Western representative for the Connecticut Telephone & Electric Company, of Meriden, Conn., manufacturers of ignition specialties and shock absorbers. The company will open a branch office at Chicago with Mr. Stahl in charge. Mr. E. D. Bright, special representative, will in the future take care of Eastern territory for the company. Mr. William H. Lolley, of the Remy Electric Company, will in the future cover the Detroit territory previously taken care of by Mr. Bright.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 14, 1911.

[Conducted by W F. Bissing, Patent Law,, 2 Rector St, N. Y. City.]

13,208. APPARATUS FOR SMELTING ORES YIELDING A VOLATILE METAL; Wm. McA. Johnson, Hartford, Conn. App. filed Dec. 12, 1910. An electric smelting furnace containing a porous-body carbonaceous material with electrodes in contact therewith and a condenser for the zinc product.

983,881. MAGNETIC SEPARATOR; A. & M. Dings. Milwaukee, Wis. App. filed March 16, 1905. A conveyor with an electric magnet above it, having pole pieces, a carrier extending across the conveyor and revolving in a plane parallel thereto and carrying a set of auxiliary pole pieces, each traveling past each pole-piece of the magnet, and a number of poles being in proximate relation to the pole-piece when crossing the conveyor.

983,887. PROCESS OF GRAPHITIZING; C. F. J. Forssell, Lakewood, O. App. filed April 22, 1907. Heats carbon and magnesia in an electric furnace above the temperature at which magnesium carbid can be formed until graphitization is effected.

983,888. METHOD OF GRAPHITIZING; C. F. J. Forssell, Cleveland, O. App. filed April 29, 1907. Heats carbon and sodium carbonate in an electric furnace above the temperature at which sodium carbid can be formed.

983,898. RINGING-KEY; E. R. Hobbs, Buhl, Idaho. App. filed Jan. 23, 1908. For telephone systems, including a cord circuit and plug, a master key, a plurality of selective switches, the master key controlling the connection of the ringing wire to the cord and a supplemental key determining whether one or a plurality of stations shall be rung.

983,905. TELEGRAPH SOUNDER; H. T. Johnson, New York, N. Y. App. filed June 25, 1908. Telegraph sounder for use on circuits of high or low resistance such as local circuits and line circuits, having a switch intermediate the magnet coils and sounder terminals, with means for connecting the switch so as to throw the coils in series and with one of the sounder terminals to connect the coils in multiple.

983,907. APPARATUS FOR GENERATING OZONE; C. Knips and E. Ey, Charlottenburg, Germany. App. filed Sept. 7. 1910. An air chamber, a water chamber and an ozone tube passing through the water chamber into the air chamber with compressed supply pipe connected with the air chamber, a water tank, a pipe connecting the tank with the water chamber and a pipe connecting the upper part of the tank with the air supply.

983,908. ELECTRIC SWITCH; F. W. Kurtz, New York, N. Y. App. filed Oct. 12, 1909. For throwing lights in and out for hallways, etc., by means of a base carrying contact plugs mounted on concentric rings with a manually operated switch arm carrying a pointer co-operating with a dial for controlling the same.

983,931. DETINNING AND DEGALVANIZING SCRAP; A. S. Ramage, Newark, N. J. App. filed July 3, 1909. Electrolyzes the by-product of the process, consisting of zincate of soda, thus producing metallic zinc and a resulting liquor which is reused.

983,932. MAGNETO ELECTRIC GENERATOR; F. I. & B. P. Remy. Anderson, Ind. App. filed March 20, 1909. An integral metallic frame open at the side whose ends receive center bearings, with an armature conductor shaft insertable therethrouch, carrying windings and an inductor. The pole pieces are held in place by the magnets overlapping the frame and pole pieces.

983,933. AUTOMATIC PRESSURE GOVERNOR; W. J. Richards, Milwaukee, Wis. App. filed June 29, 1907. For controlling the operation of a motor compressor by means of a pressure-actuated switch, a quick make-and-break being produced by a magnet attracting the switch arm for accelerating its closing movement and for retarding its opening movement until the influence of the air pressure is sufficient to overcome the tendency or attraction of the magnet, thus producing a sudden opening of the switch.

983,943. ELECTRIC HAMMER; R. S. Smith, Marshall, Texas. App. filed July 28, 1909. Electric drop hammer whose head is attached to a plunger actuated by a solenoid and controlled by a hand lever.

983,966. TELEPHONE TESTING SYSTEM; C. S. Winston, Chicago, Ill. App. filed May 9. 1907. Cord circuit with a talking strand testing strand, impedance coil, condenser and induction coil in series with a battery, one terminal of the impedance and condenser being connected with the test conductor during testing, a test receiving device and means for preventing connection between the testing conductor and the cord circuit during a complete connection for talking.

983,976. MOTOR CONTROLLING DEVICE; C. E. Carpenter, New York, N. Y. App. filed May 9, 1907. For starting, stopping and controlling an electric motor by means of a swtich forming the armature of a magnet whose pole pieces form contacts and a spring which under tension opens the switch, the contacts being kept closed until the spring is placed under tension.

983,979. AUTOMATIC ELECTRIC IGNITER FOR ORCHARD HEATERS; T. Chapman, Denver, Colo. App. filed Jan. 13, 1909. For igniting oil burners arranged about an orchard by means of a circuit controlling fusible devices which hold the contacts out of circuit and which are controlled by a thermostat. This opens the covers of the oil burners and igniters ignite the fuel.

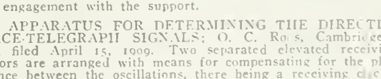
984,008. ELECTRIC SELF-WINDING CLOCK; W. H. Kallenbach and C. C. Bertsch, Boston, Mass. App. filed Oct. 26, 1909. A spring actuates a clock mechanism and is periodically rewound by the automatic operation of electrically energized winding mechanism.

984,011. PROCESS OF ETCHING BY ELECTROLYSIS ON RELIEF OR INTAGLIO; A. D. Lapointe, Sioux City, Ia. App. filed June 6, 1910. Applies a current of electricity to prints on zinc, etc., placed in a solution of a nitrate salt of the metal used.

984,016. VACUUM TUBE; D. McF. Moore, East Orange, N. J. App. filed March 17, 1910. A vacuum tube containing a chamber partially filled with liquid with porous inlet and porous outlet, the latter leading to the vacuum tube, the porous inlet and outlet both being unsubmerged by the liquid for one position of the chamber and one of them submerged for other positions, enabling ready shipment of the tube.

984,053. PULL SOCKET FOR INCANDESCENT ELECTRIC LAMPS; A. Weber, Sr. App. filed March 21, 1908. A shell with rotary switch removable from the casing and rotary shaft for operating it carrying a ratchet engaged by a pawl pulled by a cord.

984,068. BATTERY BOX; A. H. Brandon, Toledo, O. App. filed Jan. 12, 1910. The box has compartments for the cells with sheet metal fingers on the inside of the lid which press upon the terminals of the cells.



984,095.—Storage Battery Tank.

984,095. STORAGE BATTERY TANK; H. Lesley. Philadelphia. Pa App. filed June 16, 1910. The tank has a lining which projects outwardly and downwardly from the top of the tank, the edge of which is angular to the top, to direct the drip.

984,097. TERMINAL; C. E. Lundgren, La Crosse, Wis. App. filed July 5, 1907. An electric terminal, including a shank with its end pointed and having a split edge to turn back the point as it is driven into engagement with the support.

984,108. APPARATUS FOR DETERMINING THE DIRECTION OF SPACE-TELEGRAPH SIGNALS; O. C. Roos, Cambridge, Mass. App. filed April 15, 1909. Two separated elevated receiving conductors are arranged with means for compensating for the phase difference between the oscillations, there being a receiving circuit associated with each elevated conductor and an oscillation detector with each circuit.

984,119. ELECTRIC FURNACE; H. L. Wood, Schenectady, N. Y. App. filed July 2, 1906. A resistance heater with a [illegible] protecting envelope in proximity thereto, out of contact therewith, having high affinity for the materials of the heater namely, [illegible] and yielding a reduction product stable at the temperature at [illegible] carbon begins to disintegrate.

984,123. CARTRIDGE FOR MELTING FURNACES. M. R. [illegible], New York, N. Y. App. filed May 1[illegible], 19[illegible]. A cartridge for melting furnaces composed of thin sheet metal to contain the charge and of the same shape and size as the interior of the furnace

984,125. COMMUTATOR. W. A. Dick, Pittsburg, Pa. App. filed Sept. 20, 1906. Has a clamping ring with a plurality of rings between the clamping ring and the cylinder segments, some of which have an outer flange at one side and an inner flange at the other side.

984,128. ELECTRIC LIGHTING SYSTEM; E. M. Fitz, Columbus, O. App. filed Feb. [illegible]3, 1909. An electric lighting system with a main circuit, an auxiliary circuit, a switch for interrupting the circuits alternately and means for supplying a lighting circuit and a lower heating circuit for different positions of the switch.

984,129. INSULATING TUBE; C. LeG. Fortescue, Pittsburg, Pa. App. filed June 9, 1910. Of the condenser type, comprising a plurality of telescoping sections, each having alternate layers of insulating and conducting material.

984,130. WATERPROOF ELECTRICAL SOCKET; E. H. Freeman, Trenton, N. J. App. filed Nov. 30, 1910. Plug socket, consisting of two sections connected by a spring snap with an outside protector casing inclosing the receptacle and holding the sections together, the sections of the casing being screwed together to form a lock for the snap.

984,154. ELECTRICAL SIGNALING AND ALARM APPARATUS; C. H. Pool, New York, N. Y. App. filed Nov. 8, 1910. An electrically controlled signal in circuit with a test circuit with an additional source of current and alarm, the latter normally open. A thermostat controls the alarm and operates the signal and the alarm, the alarm being in the nature of a loud-speaking telephone.

984,156. INSULATING STRUCTURE; A. B. Hevnders and H. E. Mateer, Wilkinsburg, Pa. App. filed May 13, 1909. Insulating bushing for separating transformer leads, consisting of concentric cylinders of conducting material separated by insulating cylinders with overhanging skirts of conducting material mounted upon the exposed ends of the cylinders, the cylinders being of greater lengths to provide steps.

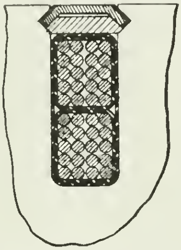
984,160. METHOD OF TESTING ELECTRIC TRANSFORMERS; M. C. Rypinski, Pittsburg, Pa. App. filed Dec. 6, 1907. For testing the polarity of ratio of transformation of transformers by means of an indicating instrument, a switch and suitable circuit connectors.

984,175. LIGHTNING ROD; C. E. Yarian, Galion, O. App. filed March 7, 1910. For the ground connection of a lightning rod to keep it moist by means of a pipe to which water may be supplied by a funnel extending above the ground, the pipe being perforated and containing the end of the rod.

984,182. MAGNETIZABLE WEDGE FOR DYNAMO-ELECTRIC MACHINES; J. M. Barr, Wilkinburg, Pa. App. filed Aug. 2, 1909. A coil-retaining wedge for open-slot dynamos, comprising a yielding magnetizable bar of channel shape and a non-magnetizable wedge forced into the bar to expand it.

984,202. SELECTIVE SIGNALING SYSTEM; J. Erickson, Chicago, Ill. App. filed Aug. 16, 1905. A line circuit with a plurality of signals and a call for selectively operating the signals, including generators in series grounded at a point between them, each signaling means comprising a polarized ringer with magnet for preventing the bell from ringing, the operating circuit of one signal including the bell in series with a winding of its associated magnet.

984,203. SELECTIVE SIGNALING SYSTEM; J. Erickson, Chicago, Ill. App. filed Aug. 16, 1905. A line circuit with a plurality of signal receivers, a calling apparatus for selectively operating a signal, the calling apparatus including synchronized alternating generators connected in series and grounded at a point between them with a normally closed shunt around the bell of the signal, which is automatically opened when the bell is to be rung.



984,182.—Magnetizable Wedge for Dynamo-Electric Machines.

984,204. LOCK-OUT FOR PARTY LINE TELEPHONE SUBSCRIBERS' STATIONS; J. Erickson, Chicago, Ill. App. filed April 16, 1906. Switch springs and subscribers' switch hook for directly operating the springs with an electro-magnet having an armature for controlling the springs, the parts being removable as a unit.

984,210. SPRINKLER ALARM SYSTEM; A. Goldstein and H. F. Blackwell, New York, N. Y. App. filed April 13, 1910. A conduit for liquid flow, a by-pass normally open, a water-wheel in the by-pass which drives an electric generator which rings an alarm.

984,211. ELECTRICAL ALARM SYSTEM; A. Goldstein, New York, N. Y. App. filed Aug. 6, 1910. A telephone circuit, including subscribers and central station receiving and transmitting apparatus with call signals and a protective circuit, with means for indicating trouble on the protective circuit at a distant point and means independent of the telephone and call for signaling over the telephone from the distant station.

984,218. SELF-WINDING ELECTRIC CLOCK; R. L. Hight, Decatur, Ill. App. filed Sept. 10, 1909. Intermittently wound, and means for automatically controlling the re-winding by an electric magnet.

984,224. ELECTRIC TAPLET; N. Klein, New York, N. Y. App. filed Dec. 16, 1909. An electric taplet block for splicing or tapping wires having grooves and recesses for the wires. Details.

984,235. TELEPHONE SYSTEM; A. Nemeth, New York, N. Y. App. filed Aug. 20, 1910. For reproducing news by means of a series of microphones manually controlled from a central station and arranged over a line.

984,238. SWITCH; G. E. Palmer, Winchester, Mass. App. filed June 25, 1910. Switch device fused on one side which can be so adjusted that line wires may be led from either side to the switch and the service wires led off from the other side without crossing the wires, the switch contacts being operated by a sliding rod and handle.

984,245. ELECTRIC LAMP SOCKET; J. S. Stewart, New York, N. Y. App. filed Oct. 13, 1909. Keyless lamp socket suspended from a cord with upper and lower housing, the lower housing telescoping over the upper and locked together by tongue and groove with U-shaped clip.

984,248. MEANS FOR STARTING VAPOR CONVERTERS IN SERIES; P. H. Thomas, Montclair, N. J. App. filed March 8, 1907. A plurality of rectifier bulbs in series, each having two main annodes, two supplemental annodes and a cathode, supply and load circuits and connections therefor, with separate means for passing current between the supplemental anodes and the cathode and starting connections external to the bulb between the source which is connected with the main anode and the supplemental anodes.

984,260. DYNAMO ELECTRIC MACHINE; H. G. Berensten, Pittsburg, Pa. App. filed July 28, 1909. Avoids machine work in trimming castings by bolting the parts together and providing spacing bushings with tapered end to fit into recesses, through which bushings the bolts pass.

984,286. TROLLEY ATTACHMENT; F. J. Moeller and F. J. Seyerle, Pittsburg, Pa. App. filed Sept. 16, 1909. Trolley harp with guard plates on opposite sides of the wheel and a cable connected to the guard plate.

984,297. ELECTRIC METER; W. H. Pratt, Lynn, Mass. App. filed April 20, 1904. Alternating current induction meter, particularly a Watt meter with magnetic core having two small air gaps, poles on each side of each air gap, a potential coil to magnetize the core, a second magnetic core with pole opposite the air gaps and series coils on the last-named poles.

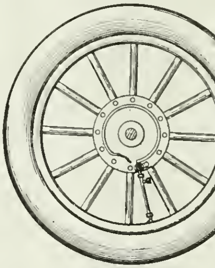
984,308. PREHEATER AND REDUCER FOR ELECTRIC SMELTING FURNACES; A. Stansfield, Montreal, Canada. App. filed Nov. 11, 1909. A furnace with the chambers one side thereof, an inclined chute connecting the chamber and the furnace, a combustion space above the chamber and pipes in the space communicating with the chamber and space.

984,315. GAS IGNITER; C. B. Stilwell, Wayne, Pa. App. filed Feb. 24, 1909. For igniting the gas from a burner by means of a revolvable valve carrying a nozzle driven by a pinion with a sparking mechanism for igniting the gas escaping from the nozzle, the latter igniting the main burner.

984,325. COMBINATION CIRCUIT CONTROLLER; J. L. Wagner, Chicago, Ill. App. filed Nov. 2, 1905. Combination lock for preventing tampering with the circuit so that the circuit cannot be closed until the lock is in a definite position.

984,327. MOTOR CONTROL APPARATUS; D. Wald, O. C. Britsch and M. Taigman, New York, N. Y. App. filed April 23, 1910. For starting, stopping and controlling electric motors, such as tbe motor of a sewing machine, the treadle of which operates the control apparatus. Details.

984,371. ELECTRIC FURNACE; H. Hoff, Dudelingen, Luxemburg. App. filed Sept. 25, 1909. An open hearth with a slanting passage, a conduit projecting thereinto for conveying air to the furnace and a pipe for conveying coal dust into the conduit.



984,453.—Tire-Inflation Testing Appliance.

984,453. TIRE-INFLATION-TESTING APPLIANCE; E. A. Terpening, Geneseo, Ill. App. filed April 28, 1906. A Bourdon spring tube which is connected with the air pressure in the tire actuates an alarm mechanism when the air pressure reduces.

984,459. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Woodbridge, Philadelphia, Pa. App. filed March 20, 1908. Three-phased circuit with means for suppressing harmonics developed by the synchronous apparatus.

984,467. SYSTEM OF ELECTRICAL DISTRIBUTION; J. Bijur, New York, N. Y. App. filed March 26, 1908. An alternating circuit with storage battery for regulating fluctuation of load, a rotary converter and an alternating booster between the work circuit supplied by alternating current and the storage battery.

984,472. PURIFIER; C. W. Clark, Los Angeles, Cal. App. filed Sept. 3, 1909. Electrolytic liquid purifier containing a series of coils of wire suitably spaced and forming electrodes and removably secured to sections.

984,496. CARBON HOLDER FOR ARC LAMPS; W. N. Selig, Chicago, Ill. App. filed Feb. 11, 1910. A bracket with a U-shaped head and clamping block with a rounded-end carbon contacting surface slidably mounted within the head and screw for actuating the block.

984,502. SIGNAL ATTACHMENT FOR LETTER BOXES; W. E. Williams, Wilkes-Barre, Pa. App. filed Aug. 2, 1910. For rural free delivery, which rings an alarm when the letter is deposited.

984,503. PRODUCING CALCIUM; W. G. Arsem, Schenectady, N. Y. App. filed Aug. 18, 1909. Decomposes calcium carbid by heating it in a vacuum and collecting and condensing the resultant vapor by means of an electric furnace.

984,507. DENTAL MOTOR; W. E. Butler, David City, Neb. App. filed Sept. 3, 1909. May be operated by a battery with a single pair of main conductors leading to the armature of the motor, two pairs of circuit terminals in the main conductors and a series of contacts in coactive relation with the circuit terminals and grouped to actuate the motor in one direction or the other and to short-circuit the armature.

984,511. ELECTRIC MOTOR CONTROLLING APPARATUS; H. W. Leonard, Bronxville, N. Y. App. filed May 11, 1909. Means for controlling the armature and field, including two low-voltage windings, connected in series, one controlling the field.

984,520. FLUOROSCOPE; C. E. Campbell, Lynn, Mass. App. filed March 12, 1910. Fluoroscope with collapsible body extended by a pair of arms.

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JOSEPH WETZLER.

It is with deep regret that we record in this issue the death of a former editor of this journal, Mr. Joseph Wetzler, a personal and intimate friend of many to whom this will be the first sad news that he has passed from among us. A man of many natural gifts, of high culture and strong convictions, Mr. Wetzler gave half his life and his best years to electrical journalism and was one of the personal forces that helped make the *Electrical World* what it is to-day, a decade after he left the editorial ranks. We desire to take this opportunity of laying thus on his untimely grave our tribute of esteem and admiration.

WIDESPREAD WELFARE WORK.

The reports of the public policy committee of the National Electric Light Association have of late years commanded a large amount of attention, chiefly from the importance of the subjects discussed and the breadth of view indicated by the treatment. Through such reports, for example, the association was early on record in favor of the physical valuation of public utilities as part of the basis of rates, and in favor of the indeterminate franchise as against the old form of a limited one, preferring to lay the emphasis on good behavior rather than a hard-driven bargain. The report of last year was a document peculiarly entitled to high praise and one which will probably long be distinctive as the starting point in the "welfare work" that is now engaging the attention of the association officers. Few society publications of such a character reach this office, and we cannot but feel that if there were more of them, breathing the best ideals and statesmanship of the time, the social problems connected with capital and labor would be most appreciably lessened.

Last year the association sent an expert abroad to investigate welfare work in general in England and Germany, and the committee report embodied some fundamental principles and data on the subject. It is now announced, as will have been noted from our columns, that the public policy committee of this year is dealing boldly with a whole program which embraces accident and sickness insurance, profit sharing by employees and the payment of annuities for long and meritorious service. When it is remembered that the association has some 1200 corporations in its membership and embraces at least 90 per cent of the investment and earnings in the central-station industry, the significance of such work cannot be overestimated.

The report, to be presented we presume at the New York convention three months hence, will be awaited with keenest interest, for it is obvious that if reasonable and logical, as may be expected, it will have an influence far outside the field it is intended to cover. There will be many and valid reasons why all the corporations should not adopt all the suggestions, often because a good start has already been made in one or another direction. But, as this journal knows full well, even when we cannot effect immediately a desired change, it is something accomplished to set men thinking and to apply the right stimulus. It is also worth while for an industry as thus organized to be in advance of public opinion rather than to follow it reluctantly and coerced. To-day we are all of us far more socialistic than we know, and it is time that we learned the difference between destructive and constructive socialism. The latter is a worthy aim of the association when it seeks to make every employee a faithful partner in the business. Such aims as this, like the other efforts to promote real conservation of national resources and to lessen the dangers from electrical shock, are a fitting and proper part of the work of the association, deserving universal commendation.

SOME POSSIBILITIES OF SUMMER LOAD.

This is the annual season at which we feel impelled to stir up our central-station friends as to the desirability of acquiring a heating and cooking load to comfort them during the dreary summer months when there is comparatively little doing in the lighting business. Considering the fact that electric cooking devices and electric heaters are now in a very satisfactory practical state, and that over a large part of the country electricity is easily available, it is most extraordinary that greater progress has not been made in this line of business. Electric heating, of course, cannot compete with other methods during the winter months when heat has to be used continuously except at very low cost for energy. Between seasons, however, and all the year round in special cases. it can be profitably worked at a figure which would be unquestionably remunerative to the majority of stations. Central stations make no outcry against taking motor load at figures very much below the customary lighting schedule and should not hesitate to take on heating and cooking load upon a similar basis of price, for heating and cooking furnish an off-the-peak load of a character intrinsically very desirable.

Motor service almost inevitably furnishes a considerable lap load at the time of the afternoon peak in spite of all efforts to the contrary. The heating and cooking load, on the other hand, comes on only as the peak is falling off, and from this standpoint is rather more than less desirable than motor load of similar amount. A good many central stations make prices as low as from 5 cents to even a little less than 3 cents per kw-hour for heating and cooking service, and business thus acquired represents a not inconsiderable amount of clear gain. At 5 cents per kw-hour a good deal of cooking business can be taken on. At 4 cents or 3 cents a considerably larger amount would be available, and near the lower figure electricity for auxiliary heating becomes feasible. The critical price for the large development of this sort of business seems to be in the neighborhood of 3 cents per kw-hour. In a few instances cooking apparatus has been taken on on a flat rate, as at Hartford, Conn., but most supply companies rather look askance at this proposition. Metered energy, however, at 3 cents to 5 cents per kw-hour could certainly be furnished in many cities to very great advantage and in large amounts, even where there is vigorous competition from gas. There is no intrinsic reason why the electric range should not become as common an article as the gas range, provided the supply companies are willing to make a suitable figure for this class of load in consideration of its being off the peak and out of season. But it is quite futile to exploit heating and cooking devices at ordinary rates in the face of competition from gas. If a flat-rate basis is not feasible, then separate metering is the logical course to follow. A group of electric heaters and electric ranges can be made quite as remunerative as a group of small motors, and there is no reason why the latter should have any monopoly of low prices and special meters.

THE NEW FLAT-RATE CAMPAIGN.

It is instructive to note how considerable interest has been aroused in the flat-rate system for residence lighting similar to that inaugurated some time since in Hartford. At the present time some thirty or forty companies have fallen into line and are taking on residence lighting under contract at a fixed price per lamp per month, with some device to protect the station against demand larger than that contracted for. The price varies somewhat from place to place, but seems commonly to be based on about 1 cent per watt per month for the contract demand. In all cases tungsten lamps are employed, and in some instances renewals are free, while in others the cost of renewals is put upon the customer as a species of guarantee against excessive burning hours, for which it is probably not ineffective. The interesting part of the proposition from the central-station standpoint is that it has given every evidence of paying. In fact, there is good reason to believe that the load so taken pays quite as well as that secured on the ordinary meter basis, everything considered. The records so far available show that the average use of the contract load is less than four hours per day, and since at the usual rate the price paid is in the neighborhood of $120 per kilowatt per year, it will readily be seen that the prospect for returns at a fair price is excellent. There is this difference, however, between the contract load and the meter load, that in the former case the customer knows exactly what he is going to pay and the payment is the same for every month; so that the usual apparently heavy bills for the winter months do not appear, although they are made up for by the extra payments during the summer.

Psychologically the flat rate seems to have the advantage even at substantially equal price, and thus far there has been comparatively little complaint of any attempt on the part of the customers to beat the game by various devious methods. Of course, there are times when the limitation of demand is inconvenient, especially in houses equipped with many lamps as a matter of convenience, in which on special occasions the load might naturally run high. Practically, of course, this difficulty can be met, as it has been in some cities using the maximum demand indicator, by allowing the indicator to be put out of circuit, say, one night a month on previous notice to the company. A concession of this kind on the flat-rate system would cost the company very little and would obviate any practical trouble from the cause mentioned. Besides this, it is, of course, a fact that comparatively large installations can be advantageously handled on the ordinary meter basis, and experience thus far has indicated that most of the load secured by the flat-rate scheme is in flats and residences, which either would not furnish any business on a meter rate or would furnish it on comparatively an unremunerative basis. A large proportion of this contract load, where it has been obtained, is new business and business taken directly out of the clutches of the local gas company. After all is said and done, the gas companies manage to keep running and pay good dividends by relying very largely upon the aggregate of many small consumers. Electric supply companies can no longer afford to discourage this comparatively petty business, because it foots up to a considerable yearly total, and by a flat-rate scheme it can be obtained and kept.

CENTRAL-STATION ICE-MAKING.

In a canvass made from this office among central stations having ice-making auxiliaries, more detailed information of which is given on a following page, it is significant to note that 130 companies declared satisfaction with the results of combination ice and electric plant operation, twenty-four even taking occasion to express themselves enthusiastically on the subject, while only four reported discouragingly. Of special interest, too, is the fact that these favorable results were obtained among the smaller stations, principally in towns of less than 5000 population. When it is recalled that 70 per cent of the 6000 central stations of the country are in such communities of 5000 or less, the real magnitude of the profit-earning field thus opened to the small-plant operator during the light-load summer season begins to become apparent. It should be remembered, too, that central-station ice-making is to some extent conducted off the wastes of the purely electrical plant, and, as the reports of certain combination plants have revealed, the earnings of the ice equipment during only a few months of the year may match or exceed the whole annual return on the electrical apparatus. Ice-making may also render twenty-four-hour operation possible during light-load periods in instances where otherwise it could be conducted only at a loss. In the way of more broadly popularizing the use of electricity in the smaller electrically uneducated communities such twenty-four-hour service, therefore, means much during the heated season, when electric fans and irons are at a premium and prospective motor users are most susceptible.

Nor are artificial ice plants nearly so restricted in geographical distribution by climatic range or the competition of natural ice as is generally believed. Of course, the practical, profitable value of a combination ice plant is limited by the market for its product, and in many regions the demand for ice will not fully tax the by-product capacity of the central-station plant serving the same community with electricity. But artificial ice is purer and more sanitary than that naturally frozen, and the demand for such superior ice is subject to cultivation and increase until ice-using habits have been formed, much in the same way that the modern standards of illumination have been raised by the introduction of more nearly perfect illuminants. The announcement in these pages last week of the installation of several motor-driven compression plants in Minnesota, alongside Lake Albert Lea, where the ice crop never fails, shows that the cleaner, purer qualities of artificial ice need not fear competition from the natural product, even in north latitude 47 deg. The present investigation among central-station plants has been particularly illuminating in showing the number of ice-making stations in Oklahoma, Kansas and other States in the central West. In several of these the ratio of installations to population is not far below that found in certain Southern States where ice-electric operating conditions are supposed to be at their best. The facts thus point out that the combination-plant industry has tended to develop most extensively in new territories rather than especially in those States which are particularly arid in climate. Such plants should, therefore, be viewed as an evidence of general progressiveness and foresight, reflecting the general tendency in small cities of newly developed regions to install only the most modern and productive equipment. Given two towns or cities of equal size, one 50 or 100 years old and the other perhaps a tepee town ten years before, the younger community is likely to be far in advance in electrical plant and business methods, as in its buildings and public improvements, of its more ancient and conservative fellow. It is, therefore, due rather to this attitude of progressiveness that ice and electric plants exist in such numbers in the newly settled South and Southwestern States, and central-station students investigating the conditions under which combination plans operate successfully should not ascribe the remarkable results obtained in these new sections entirely to climatic conditions.

Ice-making will undoubtedly solve the problems of many small and struggling central stations whose summer loads are at present carried with indifferent financial success. Such plants are thus enabled to make more complete use of their exhaust steam, permitting one set of investment and operating costs to operate two profitable businesses. Even where an ice plant is already installed in a town the advantages of economy which the central station enjoys by reason of its combination operation enable it to put up effective competition to the existing ice factory. Office and plant forces can be employed to double advantage in the combined plant, the men who must be carried on the payroll over the slack periods being occupied profitably during the summer season in the ice plant. In larger cities it may be found that the special problems of the respective electric and ice-making businesses will require that they be conducted separately. But in the great majority of the central stations of the country—these 4700 odd, indeed, which are operated in towns of 5000 or less—ise-making seems likely to prove the solution of some of the grimmest of the small-plant managers' problems of operation. The significance of the field thus being opened is already being realized by central-station men and designing engineers, and ice-machinery manufacturers who intelligently grasp the opportunity and make a study of the special conditions in this field should profit largely Heretofore small stations have been planned too frequently with the single idea of electrical generation, while the commercial advantages of by-product manufacture have been rather overlooked. Special study of the proper co-ordination of electric and ice-making equipment should provide a useful field for a number of combination-plant designing engineers, their technical recommendations being preceded, of course, by careful commercial investigation into the present and probable future ice demand. Each station in itself involves relatively small equipment, as plants go nowadays, but the aggregate import presented by nearly 5000 such stations cannot fail to receive proper recognition from the central-station industry, the designers of power plants and the manufacturers of machinery At least 250 such plants already point the way to more successful central-station operation in small communities.

Licensing Professional Engineers.

Several bills have been introduced before the New York State Legislature prohibiting the practice of engineering by anyone unless so authorized by a license issued to him by a State board of engineering examiners. Laws to a similar effect have been passed in a few States and others are pending before a number of legistlatures. The bill at Albany which is being most strongly pressed resembles the law applying to State qualification for the practice of medicine. It is understood that the movement originally leading to the introduction of the bills at Albany was encouraged by certain labor unions.

At a meeting of the American Society of Civil Engineers on Jan. 18 the subject of the licensing laws was discussed at length in connection with a report of the board of directors recommending a model for a bill for presentation before legislatures which were committed to the passage of license acts From the discussion it appeared that the sentiment of the society is almost unanimous against the principle of licensing, but in view of the strong probability of that principle being enacted into law the board reported and the society approved the model bill submitted, with the understanding that it should be presented as a substitute for the bills on the subject brought before the legislature. As approved the model bill was accompanied by a resolution as follows:

"*Whereas* there are national societies of engineers in the United States membership in which can be secured only after rigid examination of the fitness of aplicants to practise as engineers; and

"*Whereas* the public has ample protection if it will employ only those who have thus demonstrated their ability; be it

"*Resolved,* That the board of directors of the American Society of Civil Engineers does not deem it necessary or desirable that civil engineers should be licensed in any state; and be it further

"*Resolved,* That if, notwithstanding this, the legislature of any state deems the passage of a statute covering the practice of civil engineering desirable for the protection of the public, the accompanying draft of such a statute, which has been prepared by the board as embodying proper requirements for that purpose, is recommended."

A committee of the American Institute of Electrical Engineers has been appointed to consider the subject of the New York State bills, and that body will probably send representatives to Albany to oppose the bills at a hearing to be given the present week. At a meeting of the council of the American Institute of Consulting Engineers, held Feb. 24, it was decided to oppose all the bills now pending at Albany to license civil engineers, and the president, Mr. Boller, and the committee on legislation of the Institute were instructed to attend the hearings of these bills and to use all legitimate means to prevent their passage.

Public-Policy Work of the N. E. L. A.

Indications are that one of the most important and far-reaching reports ever made by the committee on public policy of the National Electric Light Association will be presented at the coming convention in New York City, May 29-June 3. Judging by the number of long sessions already held and others scheduled to be held, the recommendations of the committee, which is headed by Mr. C. L. Edgar of the Boston Edison company, will embody mature thought and study. The committee has sharply defined its work in order that it may be more effective. Neglecting the broad questions of public-service commissions, natural resources, rates, franchises, legislation, etc., thought has been concentrated on those vital points which affect the companies and the relations of their employees to them, all of which are broadly covered in what is generally termed welfare work. With a large number of the Edison companies contemplating or actually engaged in this work of human interest, and with governmental regulations and laws respecting employers' liability, it was felt that no more timely and important work could be undertaken by the committee this year. The vice-chairman of the public policy committee, Mr. Arthur Williams, of the New York Edison Company, spent some months abroad last year immediately after the St. Louis convention in a thorough investigation and study of welfare work and embodied much of his findings in a report on the subject before the Association of Edison Illuminating Companies. Doubtless some of the results of his investigations will also be reflected in the public-policy report this year. President Freeman has already launched a very broad profit-sharing-investment fund and pension system in Brooklyn, and Mr. Scovil's company in Cleveland has a profit-sharing arrangement with its employees. The Public Service Corporation of New Jersey recently announced a pension and benefit system, and investment funds are in vogue among a number of the larger lighting companies. The personel of the committee having the public-policy work of the N. E. L. A. in charge is as follows: Messrs. Charles L. Edgar, N. F. Brady, E. W. Burdett, H. M. Byllesby, Henry L. Doherty, George H. Harries, Samuel Insull, J. B. McCall, S. Scovil, Charles A. Stone, Arthur Williams. This is conceded to be the most important standing committee of the association.

British Decision in Favor of Marconi.

On Feb. 21 a decision was rendered by an English court upholding the validity of a patent granted to G. Marconi relating to the principle of wireless tuning. The English patent sustained corresponds to an American patent issued to Marconi (No. 763,772) dated June 28, 1904. The defendant was the British Radio-Telegraph & Telephone Company, and its defense against the charge of infringement was that the principle of the patent in suit was anticipated in an English patent issued to Braun in 1899. Among the experts who appeared during the proceedings and were examined in open court were Messrs W. D. Duddell, James Swinburne and C. Vernon Boys.

The defense claimed that Marconi was absolutely anticipated by Braun in "loose-coupling" tuning. The counsel for the plaintiff claimed that Mr. Marconi had conceived the desideratum of having a closed reservoir which should gently give out energy, and the idea of a reservoir circuit which should have a constant oscillation backward and forward of such character that the oscillations would only gradually be given out to the other circuit, so that it should persistently oscillate. There was not, he said, a trace of these principles in any document before the date of the Marconi patent; there was no hint about it in Lodge, and there was no "building up" in Lodge. The result of the resonance that one got by tuning everybody knew, but the one thing that people did not know was that connecting a closed reservoir with an open aerial and attuning these, apart from trying to tune the aerial in one to the aerial in the receiver, was in fact an application of a well-known method of tuning in a new way and for a new purpose.

The Marconi interests claim that the patent upheld covers the entire principle of wireless tuning. As described in the patent specifications, the invention consists in including in a wireless-telegraph system, at the transmission station, the combination, with an oscillation transformer of a kind suitable for the transmission of very rapidly alternating currents, of a persistent oscillator and a good radiator; one coil of the said transformer being connected between the aerial wire and earth and the other coil connected in circuit with a condenser, a producer of Hertzian oscillations in the form of a spark producer, and an induction coil (constituting the persistent oscillator) controlled by a signaling instrument. The complete system also includes at the receiving station an oscillation transformer, one coil whereof is included between the aerial receiving wire and earth, constituting a good absorber of electrical oscillations, while a device responsive to electric waves, such as an imperfect contact or a device for operating the same, is included in the circuit with the other coil of said transformer. The system also requires at both stations the inclusion in the lines from the aerial conductor to the earth of variable inductances and the use at both stations of means for varying or adjusting the inductances of the two circuits at each station to accord with each other. The specification states that by this arrangement a perfect tuning of the apparatus is secured at a transmitting station and one or more of a number of receiving stations.

Western Union Award in Telephone Case Confirmed.

On Feb. 20 Judge Colt, of the United States Circuit Court, at Boston, confirmed the report of the master in the suit of the Western Union Telegraph Company against the American Bell Telephone Company for an accounting on stocks received by the Bell company as rentals and royalties for telephone licenses. The present case was placed with Mr. Everett W. Burdett, as a special master of the court, on Feb. 1, 1904, and the award, just confirmed, was made in 1909. Under the award the Western Union Telegraph Company will receive $2,579,914 in cash and 20,087 shares of stock which had been received by the Bell company as rentals and royalties for licenses to use telephones.

The litigation arose under a contract made in 1879 under which the Western Union Telegraph Company retired from the telephone field. At that time there was a struggle for supremacy in the telephone field between the Western Union and the National Telephone Company, now the American Bell Telephone & Telegraph Company, and a compromise was finally arranged whereby the Western Union Company agreed to go out of the telephone business and to turn over all of its telephone patents to the Bell company, the latter agreeing not to enter the telegraph field and to pay the Western Union 20 per cent of all rentals and royalties received from licenses or leases for telephones in the United States for a period of seventeen years. After this contract was made the Bell company gave exclusive licenses to companies in various parts of the United States for a certain percentage, generally 35 per cent, of their stock. For four years after making the contract the Western Union received an annual income from telephone royalties of between $400,000 and $500,000, but in 1883, when these transactions came to its attention, the telegraph company entered a protest and the litigation just ended was begun. The case was first given to a referee, who ruled that the Western Union was not entitled to recover, which decision was confirmed by the federal court. The case was then taken to the Court of Appeals, which gave the decision entitling the Western Union to 20 per cent interest in the shares of the Bell sub-companies, with accrued dividends during the seventeen years of the life of the contract. This was in 1904, when Mr. Burdett was appointed receiver, and the recent confirmation of his award ends the long-drawn-out litigation.

Sectional Trolley Wire Patent Declared Void.

In our issue of Nov. 17, 1910, an abstract was given of an opinion rendered by Judge Bradford, of the United States Circuit Court of the Eastern District of Pennsylvania, sustaining broadly a patent granted Sept. 10, 1895, to William M. Schlesinger covering the use of a sectional trolley wire in connection with safety cut-outs. Upon appeal the case was taken before the United States Circuit Court of Appeals of the Third District, and last week an opinion was handed down reversing the decision of the lower court.

The opinion of the court, which was rendered by Judge Buffington, after discussing the various points at issue, held that it is clear that in 1885, when Schlesinger first applied for his patent, he had not made and did not disclose the device covered by the contested claim which appears in the patent as issued. The original claims were broadly for sectional working conductors with safety catches for each section irrespective of whether single or multiple feeders were used, while the subject-matter of the claim in suit comprises separate feeding conductors, thus broadening the device to cover supply of electricity—a material change of front.

The situation presented is that of a patent application made in the early stages of the electrical art covering an electric car service, which application was promptly and properly rejected. The righteousness of this rejection remained unchallenged for some seven years, and, indeed, appears now unchallengeable if the disclosures then made constitute the sole ground for the patent. During this interim there was a rapid and general advance in the railway art, and when, therefore, the patentee, seven years after his original application and enlightened by such intervening years of progress, seeks, not to prosecute his original application, but to amend the same, and on the basis of such amendment to make claims of a different character from those originally made, it becomes the duty of the court to scrutinize zealously and jealously such belated application.

In conclusion the court held that Schlesinger's amended application and later claim constituted a distinct departure from his prior application, and that the claim in question was therefore wrongfully issued and void. The decree of the court below was ordered revised and the bill dismissed.

Boston $100,000 Electric Vehicle Campaign

The Edison Electric Illuminating Company of Boston will start immediately a $100,000 campaign of education and for the exploitation of the electric vehicle in the 550 square miles of territory covered by its lines. The company has recently purchased thirty-four electric pleasure and commercial vehicles and will replace about 120 more of its horse wagons and thirty-nine gasoline cars with electrics. Orders for the vehicles will be distributed among different manufacturers who are factors in the Boston territory. The Edison company is also equipping and will operate a public garage under the auspices of the Electric Vehicle Association of America, which will give a low rate for complete service to encourage the industry.

The campaign will be inaugurated at a dinner and conference in Boston on March 3 given by the Edison Electric Illuminating Company. Seventy-five electric vehicle companies, motor manufacturers and allied industries have been invited and also all local vehicle representatives. The Boston Automobile Show opens the next day, in which every square foot of exhibition space has been sold, though the total space is 50 per cent more than at the recent New York Show, with an overflow that fills Horticultural Hall completely.

Twenty-fifth Anniversary Dinner of Boston Edison Company.

The twenty-fifth anniversary of the inauguration of service in the first generating plant of the Edison Electric Illuminating Company of Boston was observed on the evening of Feb. 20 at the Algonquin Club, Commonwealth Avenue, by the officers and some of the employees of the company. President Charles L. Edgar occupied the chair, and Vice-president Walter C. Baylies and nearly all of the members of the board of directors occupied seats at the head table. About 125 persons were present. At a special table with the committee in charge of the celebration sat Mr. C. S. Hadaway, the oldest employee of the company in point of continuous service. President Edgar acted as toastmaster, and Mr. Everett W. Burdett and Mr. W. C. Baylies were the principal speakers. The company began the supply of electricity on Feb. 20, 1886, to the Bijou Theater on the occasion of a production of "Iolanthe." To-day the company serves an area of about 625 sq. miles and a population of considerably over 1,000,000 persons. About 1200 persons are employed by the company, and its annual station output is about 100,000,000 kw-hours.

Meeting of Electric Vehicle Association of America.

The regular monthly meeting of the Electric Vehicle Association of America was held in the Engineering Societies Building, New York, Feb. 27. In the absence of President Blood, Vice-president Arthur Williams occupied the chair. The topic for the evening was an illustrated paper by Mr. Alexander Churchward, of the General Electric Company, and chairman of the standardization committee of the association, on "The Standardization of the Electric Vehicle—Part I—Voltage." After reviewing briefly the desirabilities of standardization in the number of cells to be used in electric vehicles the author pointed out that this was easily obtainable with the commercial vehicles, but not so in the case of pleasure vehicles, where a great variation exists. The crux of the paper was a plea for the adoption of some standard or standards which would help the owner, builder and central station. At present vehicles in operation possess anywhere from 10 cells to 44 cells of acid battery and from 40 cells to 62 cells of alkaline battery, so that the maximum charging voltages required range from 26 volts to 112 volts. The author proposed a standard for lead batteries of 30 cells, 40 cells and 42 cells and 40 cells, 60 cells and 62 cells for the nickel-iron battery. This would mean the adoption of two charging voltages with a small amount of regulating resistance.

By means of curves, which will not be a part of the paper, the author then showed the influence of voltage on the efficiency of the motor and controller equipment. At overloads the efficiency falls off considerably in the lower voltages, due principally to brush losses. To overcome this it was suggested that a composite graphite-copper brush be employed, but this necessitates a special motor because the commutation characteristics of the standard motor using graphite brushes are not correct for a composite brush. The author felt that if the voltage were increased the number of cells in all the various makes of vehicles of a given capacity will be the same and the charging current will be approximately the same for the same size vehicle of different makes also. When one or more standard voltages are adopted then charging plugs, cables and resistances can be made to take care of all makes of vehicles and conditions will be better for the central station than they are at present.

Discussion.

Mr. J. W. Lieb, Jr., of the New York Edison Company, in opening the discussion by invitation told of the great advantages of standardization in other industries and emphasized the benefits to be derived from standardization in the electric vehicle industry while it was still in its infancy. Afterward, he said, when the capital invested is very great, standardization would entail great sacrifices which manufacturers might not be so willing to make.

Mr. Bruce Ford, of the Electric Storage Battery Company, suggested that where the acid and alkaline batteries are close, as in the proposed standard, the acid cell figures be shifted to coincide with those of the alkaline cell.

Mr. J. D. Forrer, of the Westinghouse company, said that simplicity and cheapness are essential attributes to standardization. If the voltages be maintained within the range of the three-wire system there will be much latitude available in charging, with resulting economy.

Mr. Lloyd, of the General Vehicle Company, commented on the absence of standard central-station voltages and also standard rates. Mr. Lloyd, of the Philadelphia Electric Company, said that central-station voltages ranged between 110 and 115, and Mr. Lieb, of the New York Edison Company, said 108 to 118 would be about the limits in direct-current systems. Mr. Lieb also explained the origin of this difference. When incandescent lamp filaments were made of bamboo threads the lamp manufacturer tried as best he could to turn out 110-volt lamps. Most of them were lamps of this voltage, but there were also a number of lamps ranging from 104 to 118 or over. These were separated and one city would receive 110-volt lamps, another 108-volt lamps, another 118-volt lamps and so on, so that the voltage of the system in any city at that time depended on the voltage of the incandescent lamp obtainable. Once established the voltage has persisted.

Mr. Kennedy, of the Studebaker company, felt that the industry was not ready for standardization just yet and that until the manufacturers sold more vehicles the central stations should put up with the variations in the number of cells.

Mr. Ward, of the Ward Motor Vehicle Company, said his company started out in the business with the assumption that the standard voltage was 110 and, therefore, equipped its vehicles with 42 cells and 80-volt motors with satisfactory results.

Much of the discussion drifted to the question of rates, and this was evidently to the liking of the vehicle manufacturers, most of whom had something to say on the subject. It was pointed out by the central-station men present that rates were not germane to the subject of the evening and new rates could not be made off-hand, nor would public service commissions pass them without warrant. Mr. Williams said that in a number of the large cities the rate question, especially as it applied to electric vehicles, was being looked into and receiving careful attention and that in due time the results would be announced.

Mr. F. Smith, of the United Electric Light & Power Company, then outlined the tentative program for the next months. At the March meeting a paper on "Tires" will be presented and possibly some experiences by owners and others of the behavior of electric vehicles in snowstorms. At the April meeting Mr. Kennedy, of the Studebaker company, will present a paper on operating costs in large garages. The May meeting will be addressed by Mr. W. W. Freeman, of the Brooklyn Edison company, and the subject will be co-operative advertising for boosting the electric vehicle. There is also the possibility of a joint meeting with the N. E. L. A., in convention at that time in New York. Messrs. Myer and Lloyd, of the Philadelphia Electric Company, will present a paper in the fall on the central station and the electric vehicle industry.

Meeting of the Philadelphia Electric Company Section, N. E. L. A.

The regular monthly meeting of the Philadelphia Electric Company Section, N. E. L. A., was held Feb. 20, 1911. Reports of the committees were submitted, those of the membership and the awarding of prizes committees being of chief interest. The membership committee reported that the total membership to date is 420.

The committee on the awarding of prizes reported that nineteen suggestions were received and three awards made as follows: First prize to Mr. E. S. Wilson, second prize to Mr. W. M. Barnes, and third prize to Mr. George G. Finley.

The winning suggestion was to the effect that a competent representative visit each new consumer after the first monthly bill had been delivered in order to be assured that the service is satisfactory, and if possible to interest the consumer in electrical devices, such as electric irons, chafing dishes, coffee percolators, etc., etc.; also that a central incandescent-lamp station be located at which all renewed lamps should be graded and redistributed. The suggestion winning the second prize was that in each issue of *Current News* a part should be set aside for the latest electrical developments, attaching thereto a short description which would place before every employee of the company the most modern electrical devices as developed. The third suggestion covered data for solicitors, suggesting that a loose-leaf book be developed in which could be placed illustrations of modern devices, such as shades, signs, photographs of interior and exterior lighting, etc.

The secretary announced that Dr. Spitzka would deliver a lecture on "The Effects of Electricity on the Human Body" on March 20.

The paper of the evening, "The Work Involved in Handling Consumers' Accounts by the Tabulating System," by Mr. H. R. Kern, was ably presented, and covered that branch of company's accounting pertaining to the consumer very thoroughly.

Mr. Cremer, representing the Hollerith Company, made a brief address, in which he outlined the history of the Hollerith tabulating machine, it being brought out that this machine was developed in order to record and subdivide properly the census report. The machine made its appearance after the census of 1880 and was first used in the census of 1890. By its use the work can be done ten times as fast as and at one-third the cost of a system employing regular clerical methods. Both Mr. Kern's and Mr. Cremer's talks provoked considerable discussion and many points which heretofore have not been understood were explained. Unfortunately, the weather conditions were anything but ideal, which kept the attendance down to fifty-five members and guests.

On March 1, at the commercial department branch meeting, a lecture by Mr. Nelson B. Hazeltine, of the Holophane Company, was given, the subject being "Reflecting and Diffusing Mediums for Artificial Illumination in the Home," and on March 2 the accounting department will have its meeting, at which papers will be presented and also a short sketch entitled "His Model Wife."

Relation of Meter Efficiency to Revenue.

At the February meeting of the Brooklyn Company Section of the National Electric Light Association Mr. William Eichert read a paper on the relation of meter efficiency to revenue in which he emphasized the necessity of a systematic method of maintaining watt-hour meters and pointed out the importance of the commercial side of the subject. The author said that it is an easy matter to maintain accuracy regardless of cost, but to do so at a minimum cost is the duty of the progressive meter engineer. As an illustration of how a company's income can be affected through inaccurate meters, the author submitted two tables, one containing an estimate of the average kw-hour consumption per annum of various classes of installations and the other containing an estimate of the kw-hours lost each year on residence installations through slow meters. The multiples given below the table are for determining the losses for other classes of installations.

TABLE I.—ESTIMATED ENERGY CONSUMED BY VARIOUS INSTALLATIONS YEARLY.

Total Kilowatts Connected.	Residence Lighting.	Business Houses.	Saloons, Confectionery.	Signs and Outline.	Motors 8 Hours per Day.	Motors 24 Hours per Day.
.6	150	600	900	1200	1,500	5,000
1.2	300	1,200	1,800	2,400	3,000	10,000
1.8	450	1,800	2,700	3,600	4,500	1,5000
3.0	750	3,000	4,500	6,000	7,500	25,000
6.0	1,500	6,000	9,000	12,000	15,000	50,000
9.0	2,250	9,000	13,500	18,000	22,500	75,000
12.0	3,000	12,000	18,000	24,000	30,000	100,000
18.0	4,500	18,000	27,500	36,000	45,000	150,000
36.0	9,000	36,000	55,000	72,000	90,000	300,000
72 0	18,000	72,000	110,000	144,000	180,000	600,000

TABLE II.—KW-HOUR LOSS PER ANNUM DUE TO SLOW METERS.

Meter Efficiency	TOTAL CONNECTED RESIDENCE INSTALLATION IN KILOWATTS									
	.6	1.2	1.8	3.0	6.0	9.0	12	18	36	72
99%	1.5	3.0	4.5	7.5	15	22	30	45	90	180
98%	3.0	6.0	9.0	15.0	30	45	60	90	180	360
97%	4.5	9.0	13.5	22.5	45	67	90	135	270	540
96%	6.0	12.0	18.0	30.0	60	90	120	180	360	720
95%	7.5	15.0	22.5	37.5	75	112	150	225	450	900
94%	9.0	18.0	27.0	45.0	90	135	180	270	540	1080
93%	10.5	21.0	31.5	52.5	105	157	210	315	630	1260
92%	12.0	24.0	36.0	60.0	120	180	240	360	720	1440
91%	13.5	27.0	40.5	67.5	135	202	270	405	810	1620
90%	15.0	30.0	45.0	75.0	150	225	300	450	900	1800

For business houses multiply by 4; for saloons and confectionery multiply by 6; for signs and outline lighting multiply by 8, for motors (8 hours per day) multiply by 10; (24 hours per day) multiply by 30.

A careful study of these figures shows clearly that if meters do not have proper attention the earnings of a company may be considerably decreased.

In selecting a meter the author stated that it is unwise to accept all the manufacturer's claims as to the accuracy of the instrument. The lighting companies in the State of New York are governed by the Public Service Commission as to the rules and tests to which new meters should be subjected before they become accepted types. Nevertheless when meters are delivered and before they are set they should be subjected to tests. Each meter should be adjusted on 10 per cent and 100 per cent load and a thorough inspection made to discover mechanical defects. Alternating-current meters should be tested on a power-factor of about 60 per cent to insure accurate registration on inductive loads.

On the selection of meters for various installations the author had much of importance to say. This question is of moment from the financial standpoint, as it is obvious that the demand factors vary, and if meters are installed of the same capacity as the installation without regard to the demand factor considerable revenue is lost in cases where only a small percentage of the installation is used at any one time. For example, a sign having 100 50-watt lamps on a three-wire circuit would require a 25-amp, 230-volt, three-wire meter, as the demand factor in this case would be 100 per cent of the meter's capacity, while in the case of a residence having 100 50-watt lamps the demand factor would be only about 20 per cent and a meter of much smaller capacity would suffice. This distinction is made for the reason that meters have a tendency to register slow on light loads, and it is obvious that unless some consideration is given to the demand factor the majority of meters would be registering on light loads at a loss to the supply company. The author gives the schedule printed on the next page for determining the proper size of meters to be employed.

When metering direct-current motor circuits the question of inrushes must also be considered, as the tendency of inrushes is to weaken the retarding magnets of the meter and cause over-registration. To overcome this difficulty it is the practice to install a meter having a capacity as nearly equal to that of the inrush as possible without losing sight of the demand factor.

The author then dwelt on the question of meter locations, installation tests and inspections. The schedule of periodic tests adopted by the Brooklyn Edison Company is as follows: One test every two years, single-phase induction meters of all sizes; one test per annum, direct-current meters up to and including 25-amp capacity; two tests per annum, direct-current meters from 50-amp to 100-amp capacity, and polyphase meters; four tests per annum, direct-current meters from 100 amp and over; six to twelve tests per annum, meters for large consumers operating from eight to twenty-four hours a day. In addition the company has a number of customers which it supplies with energy from its high-tension feeders. These meters, being operated from shunt and series transformers, are tested from two to six times per annum. In testing meters on consumers' premises the company is bound by the rules and regulations promulgated by the Public Service Commission.

TABLE III.—SCHEDULE FOR DETERMINING CAPACITY OF METERS TO INSTALL LAMPS.

Class of Installation.	Per Cent of Total Load.
Residences and apartments	25
Churches, theatres, clubs, hallways, entrances, general stores, and offices	60
Saloons, restaurants, moving-picture machines, general arc lighting, and charging outlets	75
Signs, outline, and window lighting	100

TABLE IV.—MOTORS—MINIMUM CAPACITY IN AMPERES PER HORSE-POWER.

Current.	115-V.	230-V.	500-V.	2400-V.	6600-V
Direct	6	3	1.4	..	..
Alternating, single-phase	8	4	..	..	..
Alternating, two-phase	4	2	..	.2	..
Alternating, three-phase	5	2.5	..	.25	.08

Note.—No meter shall be installed of less amperes per horse-power than shown in this table.

TABLE V.—METER EFFICIENCY WITH RESPECTIVE JEWELS.

Total Tests.	Type of Bearing.	Efficiency at 10% of Load.	Efficiency at 100% of Load.
	T. R. W. Meters,	Direct-Current	
1085	Sapphire	89.4	97.5
1030	Diamond	96.5	98.5
	Type C Meters.	Direct Current.	
1344	Sapphire	96.8	99.2
499	Diamond	98.2	99.7
	Type I Meters.	Alternating Current.	
848	Sapphire	97.6	99.5
	Type D Meters	Alternating Current.	
507	Sapphire	97.2	98.8
306	Diamond	98.8	100.2

Most of the meters used by the Brooklyn Edison Company operate on jewel and pivot bearings. The manufacturer of these meters supplies sapphire jewels in meters up to 100-amp capacity and cupped diamond jewels in meters of larger capacity. It has been found in practice that a sapphire bearing will not stand very much wear and tear owing to the softness of the stone, and when a jewel becomes worn or roughened it increases friction to such an extent that the meter becomes very inaccurate. In cases where vibration is very heavy a hole is sometimes worn through the stone and the meter stops entirely. In order to overcome this difficulty the company has found it necessary to dispense with the use of sapphires almost entirely and use diamond jewels. The tabulation printed above shows the increase in efficiency when diamond jewels are used.

Massachusetts Legislative News.

The Senate has refused to order a third reading of House Bill 1466, which provides that no charge shall be made by gas companies for the use of meters. The committee on public lighting has sent in an adverse report on House Bill 744, providing for legislation to regulate the price of gas in the city of Woburn. The committee recognizes that bills of this character, which are frequently presented for the consideration of the General Court, strike a direct blow against the adjudication of gas and electric rates by the State commission having jurisdiction over these public-utility corporations. The Legislature has thus far consistently refused to undertake such regulation of rates and has rejected specific bills which tend to turn back the rate-fixing procedure to the General Court, preferring to leave such problems to the expert tribunals most competent to deal with them. A resolve granting the Massachusetts Institute of Technology $100,000 annually for the next ten years has been reported by the committee on education. The committee on public lighting has reported a bill authorizing the town of Danvers to supply electricity in the towns of North Reading and Middleton.

A hearing was given by the committees on railroads and metropolitan affairs on Feb. 24 upon the petition of the Boston & Eastern Electric Railroad Company (M. H. Woodbury) for the passage of a bill insuring the issuance of a certificate of exigency to the company by the Railroad Commission. C. S. Baxter, counsel for the company, reviewed the history of its attempts to secure authority to spend $12,000,000 in building a high-speed electric interurban railroad between Boston and the North Shore cities and towns, including Lynn and Salem. He contended that the merits of the project have practically been admitted by the commission and severely criticised the majority of the board for its refusal to issue a certificate which would enable the company to take immediate steps toward construction. During the hearing Representative Wolcott brought out the point that the New York, New Haven & Hartford Railroad Company's plan to electrify the Boston, Revere Beach & Lynn Railroad and build a tunnel under Boston Harbor for the purpose of providing rapid transit from Essex County and furnishing quicker service between the northern and southern suburban districts of Boston might seriously interfere with the Boston & Eastern development. It is generally admitted that this substantial adoption of the Boston & Eastern Company's plans by the existing systems is the chief obstacle in the way of the building of a new electric road. There appears to be little doubt that an electrified rapid transit service between the populous centers of the North Shore and the heart of Boston will be realized in the comparatively near future.

* * *

New York Commission News.

The Public Service Commission, Second District, served orders upon the Catskill Illuminating & Power Company and the Ithaca Gas Light Company to appear before the commission on Monday, Feb. 27, and show cause why suit should not be begun against them to recover penalties for failure to manufacture and distribute gas in accordance with the prescribed standards. The routine tests of the gas of these companies having shown deficiencies, an inspector was assigned to make a careful and thorough inspection of the quality. In each instance the gas was found not to meet the requirements as to candle-power. Each company supplies coal gas, for which the illuminating power is 16 cp.

The Buffalo General Electric Company has been authorized to issue its thirty-year 5 per cent gold bonds to the amount of $420,000. The bonds are to be sold at not less than 95 and the proceeds used for the acquisition of certain property at the northeast corner of Washington and Huron streets in the city of Buffalo and for the construction thereon of a building for the general uses and purposes of the company.

A complaint has been received from the Keeseville Telephone Company stating that the Ausable Home Telephone Company has entered its field in the village of Keeseville and installed telephones upon the free-trial-service plan until at present the Ausable company has seventy-five substations in that village. The Keeseville company also complains that the Ausable company is discriminating in the question of toll rates as between subscribers. The complaint has been served upon the Ausable company and an answer required within ten days.

A petition has been received from residents of the village of Newark, Wayne County, directed against the Wayne Telephone company as to the rates charged by that company under a schedule which went into effect Feb. 1, 1911, and the discontinuance of the sale of coupon books. The petition alleges that the new rates are unjust, unreasonable and unjustly discriminatory and are higher than the rates charged by the same company for like services in other villages in Wayne County. The complaint has been served on the company and an answer required within ten days.

A complaint has been received from the Newburgh News Printing & Publishing Company and other residents of Newburgh directed against the rates charged for gas and electricity by the Newburgh Light, Heat & Power Company. The complaint alleges that the rates charged are unwarranted and excessive and asks for an investigation of the works, plant, system and methods of the company, with a view to determining the price to be charged for gas and electricity in the City of Newburgh.

Wisconsin Commission News.

During the past two weeks the commission has listened to the arguments in the matter of the application of the Kenosha Electric Railway Company for a certificate of convenience and necessity. This petition was entered into jointly by the city and the electric railway company and has been vigorously opposed by the Kenosha Gas & Electric Company. The case grew out of the franchise granted by the City of Kenosha to the electric railway company under the terms of which the company was to furnish the municipal lighting and to engage in a general lighting and power business in opposition to the Kenosha Gas & Electric Company, from which the city was unable to obtain a satisfactory contract for street lighting. This action was taken upon the expiration of the street-lighting contract with the gas company. The railway company began installing adequate machinery and commenced doing business immediately upon the granting of the franchise. Thereupon the gas company surrendered its franchise and received an indeterminate permit from the State. The company then secured an injunction restraining the railway company from extending its business, upon the claim that the indeterminate permit barred the railway company from doing a competing business, and the latter was defeated in its appeal, for the Supreme Court upheld the indeterminate-permit law. The application for a certificate of convenience and necessity was then filed with the commission.

The testimony shows that the Kenosha Gas & Electric Company has failed to give satisfactory service, either as to quality or price; that the equipment is not sufficient to furnish the service necessary or that would be necessary were the gas company to do the entire electric utility business; that the attitude of the management has antagonized the citizens and that no improvement in this respect has been evident notwithstanding the many appeals of both Council and citizens; that no effort has been made or is being made either to improve or to extend the company's business.

From statistics reported to the Railroad Commission it was shown that the gas and electric company has 2.6 consumers per 100 inhabitants, whereas the average of thirteen cities, ranging in population from about 7000 below to 8000 above that of Kenosha, shows an average of approximately six consumers per 100 of population. From the tests made by the inspectors of the commission it was evident that the standards of service have not been maintained in a manner at all satisfactory. The testimony showed, furthermore, that the total cost per average kw-hour generated by the gas company was 6.69 cents. With the new equipment installed and a light and power franchise it was estimated that the railway company could generate energy at an average cost of 3.6 cents per kw-hour.

The case has aroused considerable interest in the State because of the many features involved and because of the fact that it is the first time, under commission control, where a second company has endeavored to enter a field in competition with an existing company. This case is the natural result of a public demand for better conditions, occasioned by a company's general disregard of its obligations as a public utility. The Kenosha Gas & Electric Company is controlled by the Milwaukee Light, Heat & Traction Company.

Upon application to the commission the Mount Morris Farmers' Telephone Company has been empowered to effect a material increase in its rates and tolls. On the basis of the increased valuation occasioned by a considerable improvement in the service, and a rate of depreciation of 6½ per cent, the company will be earning 7 per cent upon the investment under the new rates, which is the rate generally allowed by the commission.

The commission has canceled its certificate, dated Aug. 31, 1910, authorizing the Clifton Light & Power Company to issue $25,000 par value of bonds and has approved an issue of $200,000 par value of 6 per cent bonds. The bonds are to be issued and sold for the purpose of supplying funds for the purchase of additional pole lines, right-of-way, real estate upon which to construct another dam in the town of Clifton, Pierce County, Wis., and other structures necessary to the carrying on of a general hydroelectric business.

The commission has authorized the Horicon Light & Power Company to issue $10,000 par value of 6 per cent bonds and 100 shares of common stock of the par value of $100 each. The entire issue of stock and bonds, to an amount not to exceed $5,000, is to be issued to the Beaver Dam Light & Power Company in exchange for a transmission line constructed by it between Beaver Dam and Horicon and a substation and distributing system at Horicon. The balance of the bonds are to be sold for money only and at not less than 80 per cent of their par value.

New Jersey Commission News.

A question as to the right of the Board of Public Utility Commissioners of New Jersey to assist in maintaining a monopoly by withholding its approval of a franchise from one gas company seeking to compete with another already established was raised at a hearing upon the application of the Atlantic Highlands Gas Company for approval of an ordinance passed by Shrewsbury Township granting it a franchise to operate within that municipality. The board's approval was opposed by the Consolidated Gas Company of New Jersey, which is already in the field. For the latter company it is claimed that before May 1 the Consolidated company will have piped all the territory within which the Atlantic company proposes to operate. It is also contended there would be no benefit to the community from a duplication of the franchise.

The attorney for the Atlantic Highlands Company raised a question as to the power of the board to protect the monopoly from the competing company. He pointed out that the territory which the new company proposes to serve is now without gas, and claimed that although the Consolidated company had had ample opportunity to provide for such service it had made no effort to do so until the Atlantic Highlands Company attempted to enter the field and supply the public demand. The board reserved decision

The Board of Public Utility Commissioners has approved the application of the Atlantic City Electric Company for the issuance, sale and delivery of $10,000 first and refunding mortgage 5 per cent sinking gold bonds at the par value thereof.

Joseph Wetzler.

Cable advices from London announce the death in that city of Mr. Joseph Wetzler on Feb. 22 from heart failure. As no previous news had reached friends in this country as to his illness, the intelligence has been a most painful shock. Mr. Wetzler was born at Hoboken, N. J., Dec. 6, 1863, his father, a German, being one of the founders of the leather industry in New York City. He showed early a strong inclination for mechanical study and at the early age of nineteen graduated from the Stevens Institute of Technology in the class of 1882. Entering the Weston factory of the old United States Electric Light Company at Newark, he spent a year there and then began to indulge his taste for technical writing. As a member of the staff of the *Scientific American* he made and described a series of interesting studies on the magnetic conditions of the iron and steel buildings on Manhattan Island and on the polarity of the new Brooklyn Bridge. This work attracted the attention of the management of the *Electrical World*, which had started in 1883, and he joined its staff as an associate editor, 1884-5, part of his first work being the compilation of a proposed American electrical phrase book, based on his translations from the French and German. He is entitled to no small share of the credit of building up the *Electrical World* and later, in 1890, of establishing the weekly *Electrical Engineer*. He retired from active journalism when the two properties were merged in 1899.

JOSEPH WETZLER.

Mr. Wetzler was a man of broad outlook and sympathies and intensely interested in educational work. He helped to found the American Institute of Electrical Engineers as a charter member, in 1884, and served both as manager and as vice-president. He represented the Institute as a delegate to the Paris Electrical Congress of 1889. He was also prominent in the affairs of the New York Electrical Society and was its president 1892-3-4. He was also a member of the Institution of Electrical Engineers of England, the Elektrotechnischer Verein of Vienna, the American Electrochemical Society and the American Association for the Advancement of Science. He was a member of the Masonic Order and one of the early and active members of the Reform Club of New York. He was, in addition, active and influential in the upbuilding of the Hebrew Technical Institute of New York.

In the spring of 1898 Mr. Wetzler founded the Electrical Engineer Institute of Correspondence Instruction, which has educated creditably many thousands of students in electricity by the written method. Owing to the rapid increase in the number of students in Great Britain and the colonies he saw it to be necessary to establish offices in London. Going over for that purpose, he had remained there ever since, administering the affairs of the Institute and gratifying in England and on the Continent his passion for music and the sciences. His wife (Miss Pauline Gerson) and he had a host of friends all over Europe and were constantly in France, Germany and Austria. He had many flattering invitations to return to America and was named once or twice for educational positions of influence, but could not be induced to return to this country, although the damp English climate was harsh to a constitution never very robust.

Mr. Wetzler was a voluminous writer. He assisted Dr. E. J. Houston in the issuance of the well-known "Electrical Dictionary"; in 1887 was joint editor of the first American book on the electric motor and electric railway; was an editor of the electrical section of Appleton's "Cyclopædia of Applied Mechanics," and contributed to the electrical series in *Scribner's Magazine*, afterward put into book form. He did also a considerable amount of translating, revising, compiling and annotating for various handbooks and other kindred publications, work for which a command of foreign languages and an extraordinarily retentive memory made his services peculiarly valuable. In these ways, and through his wide friendly acquaintance with all the great inventors and engineers, he was able to make a deep impress on the electrical journalism and development of the day; and his untimely death will cause him to be deeply lamented and missed on both sides of the Atlantic.

CURRENT NEWS AND NOTES.

Meter Reading and Photography.—Courtesy and ingenuity were combined by a North Side customer of the Commonwealth Edison Company, Chicago, who sent a photograph of the watt-hour meter and maximum-demand indicator on his premises at a time when the meter reader was unable to obtain access owing to the customer's absence during the greater part of the day. This voluntary action enabled the company to send a correct bill.

Central-Station Lectures.—Professor Ernst J. Berg, of the University of Illinois, is delivering a second course of lectures on electricity and applied electricity before the employees of the Commonwealth Edison Company of Chicago. Of four lectures two remain to be delivered, the dates being March 11 and April 22 and the place Recital Hall, Auditorium Building. The respective subjects are *Direct-Current Generators* and *Shunt and Series Motors.*

Michigan Electric Association's Proceedings.—The proceedings of the seventh annual convention of the Michigan Electric Association, held in Port Huron, Mich, Aug. 16-18, 1910, have been published in a cloth-bound book of 101 pages, embellished with a portrait of Mr. A. C. Marshall, of Port Huron, the 1909-10 president of the association. Mr. Herbert Silvester, of the Peninsular Electric Light Company, of Detroit, is secretary of the association.

Novel Use of the X-Ray.—A would-be immigrant to the United States from China was recently subjected to an X-ray test at Boston to determine his age. Photographs were taken of the wrist and knee bones by the radiographic method at the suggestion of the alien's counsel, who sought thereby to prove his client to be seventeen and not twenty-five years of age, as claimed by the immigration officials. It is reported that the Chinaman successfully met the demonstration.

A Large N. E. L. A. Question Box.—Under the energetic editorship of Mr. M. S. Seelman, Jr., the Question Box of the *Bulletin* of the National Electric Light Association has developed in a surprising manner. The previous editors have done excellent work in building up the department, and now in the February issue it has been necessary to devote no fewer than ninety-four pages to the box. The range of questions and answers indicates the immense variety of the technical and commercial questions now arising incessantly in the field, while it is interesting to note that many of the questions are answered by the foremost men in the industry. This is leadership and co-operation of the highest kind.

Smoke Nuisance in Milwaukee.—Milwaukee has aligned itself with the considerable number of cities fighting the smoke nuisance. A committee of citizens has been formed, and the adoption of a more drastic ordinance and the bringing of suits against offenders are under discussion.

Central-Station Business in Rural Communities.—The North Shore Electric Company, which recently extended its service into a wide country area north and northwest of Chicago, is securing considerable business from agriculturists and "gentlemen farmers" in the vicinity of Barrington, Libertyville and Fox Lake, Ill.

Winnipeg River Water-Powers.—According to a recent estimate water-power aggregating 437,000 hp is available along the course of the Winnipeg River between Kenora and Lake Winnipeg, a distance of 140 miles. Of this total, authorization has been given for the development of 125,000 hp, the remainder being still under the control of the government.

Denver Electric Club.—An interesting talk on electricity for advertising purposes was given by Mr. G. E. Williamson, illuminating engineer for the Denver Gas & Electric Company, at the weekly lunch of the Colorado Electric Club Feb. 23. This is the first of a number of technical talks which will be varied by talks on various matters of public interest such as have heretofore been usual at these meetings.

American Society of Mechanical Engineers.—The sixty-third meeting of the American Society of Mechanical Engineers will be held in Pittsburgh, Pa., from May 30 to June 2 inclusive. The society has not met since 1884 in Pittsburgh, where it has a membership of 160 out of a total of over 4000. An executive committee consisting of Messrs. E. M. Herr, chairman; George Mesta, J. M. Tate, Jr., Chester B. Albree, D. F. Crawford, Morris Knowles and Elmer K. Hiles, secretary, will have charge of the Pittsburgh meetings. It is expected that from 300 to 400 members and ladies will be in attendance. There will be professional sessions, when papers will be read and discussed, and inspection trips through the leading local industrial establishments, besides automobile trips through the parks, a visit to Carnegie Institute, Memorial Hall, etc.

Human Engineering.—The latest addition to the rapidly growing list of departments of "engineering" is "human engineering." The new branch has already an organ, *Human Engineering*, published monthly in Cleveland, Ohio. In this publication the branch is defined as "a new profession called into being by new conditions in the industrial world," and elsewhere is referred to as relating to the human side of industry and conservation of human energy. It differs from "manhood engineering," another recently established profession, in that the latter relates more particularly to ethical "uplift" work, while it seems to encroach somewhat on the territory of the new profession of "social engineering." Unlike the social engineer, manhood engineer, efficiency engineer, etc., the members of the new profession are somewhat handicapped with regard to titular designation, as the term "human engineer" has an element of ambiguity.

Electric Heating on a Large Scale.—A recent contributor to a Chicago daily newspaper looks forward to the day when it will be possible to keep the general temperature of the atmosphere at about 60 deg. Fahr. all the year around. In order to do this every fall of water must be "harnessed" to machinery capable of producing electricity. Should more power be needed, it will only be necessary to "harness" the tides. Then, according to this prophet: "With an unlimited supply of electricity at hand the problem of heating and cooling the atmosphere is only a mechanical one. * * * One hundred years from now no one will be permitted to secure heat or light by burning wood or coal. This will throw a great many out of work, but as everyone will secure heat and light for almost nothing, it will not mean hardship for anyone." It is rather interesting to observe the nonchalant way in which this seer dismisses the detail of heating or cooling the entire atmosphere as "only a mechanical problem."

Exportation of Electricity to Mexico.—A 40,000-volt electric transmission line is being constructed from the power plant of the Copper Queen smelter at Douglas, Ariz., to El Tigre, Mexico, sixty-five miles. In addition to supplying energy for operating the machinery of the mines and ore-reduction mills of El Tigre district industrial plants will be supplied at Fronteras, Ysabel and other places. It is stated that when the Copper Queen Mining & Smelting Company applied to the Mexican government for a concession to transmit electricity across the border several novel questions bearing on the international feature of the proposed business arose and were carefully considered. One of these was whether electricity came under any of the heads of commodities upon which a duty could be assessed. It was decided that the electric energy should be admitted free of duty. The transmission line is being strung on poles of Texas pine. The power plant of the Copper Queen company is being enlarged to provide the additional power for the new service.

New York N. E. L. A. Section Meeting.—The New York Edison Company's Section of the National Electric Light Association held its third regular monthly meeting on Monday evening, Feb. 20, 1911, at the Edison Auditorium, 44 West Twenty-seventh Street, New York City, about 300 members and their friends being present. Mr. Arthur Williams presided, and after a short business session Mr. C. E. Allen, of the Westinghouse Electric & Manufacturing Company, delivered an address upon distributing transformers illustrated with a number of good lantern slides. Mr. Henry Schroeder, of the General Electric Company, followed with an illustrated lecture on incandescent lamps, giving the history of the art of their manufacture from the beginning up to date. A successful vaudeville performance followed, after which the entertainment committee provided luncheon, together with cigars. This was the first social meeting of the section and the officers and committees felt much gratified at its success. The section has now a membership of 580, which promises to increase to 1000 before many months.

Rates Compared to Special Assessments.—In a long paper on "Public Relations of Telephone Companies," presented at the Chicago convention of the National Independent Telephone Association on Feb. 8, Mr. William Dunton Kerr, a public-service counselor, made this interesting comparison between special assessments and the rates of public-service utilities: "In many particulars charges for public services are nothing but special assessments levied upon the individuals directly benefited to defray the cost of the services. The purpose of special assessments is to distribute the burdens of particular public improvements among those benefited substantially in accordance with the benefits received by each. In like manner it is the function of the rate schedule of a utility to distribute the burdens of the service according to the benefits received by individual patrons. This is a rule of equality founded on the public character of the service. It is the first duty of government to do substantial equality to all citizens; it is no less the duty of a private company performing a governmental function. This duty can be performed only by a proper adjustment of rate schedules. The rate may properly be regarded as the agency for the distribution of service burdens according to the incidence of benefits."

Braking of Trains on Grades.—At a meeting of the Central Railway Club to be held at the Statler Hotel, Buffalo, on March 10 Mr. John P. Kelly will present a paper entitled "The Influence of Gravity on Trains Descending Grades and the Brake Power Necessary for Safe Control."

No N. E. L. A. New York Convention Exhibition.—In response to a circular letter, 97 per cent of the manufacturers' section of the National Electric Light Association voted to omit the customary exhibition at the annual convention of the National Electric Light Association to be held in New York City May 29 to June 2.

New York Section, I. E. S.—At the next meeting of the New York Section of the Illuminating Engineering Society, which will be held at Gimbel Brothers' store, at Sixth Avenue and Thirty-third street, on March 9, Messrs. Clarence L. Law and Albert Jackson Marshall will present a paper entitled "The Lighting of a Large Department Store," which will be devoted to the design and test of the lighting equipments in the Gimbel store.

New York Electrical Society Meeting.—The next meeting of the New York Electrical Society will be held in the Hispanic Society Building, 156th Street and Broadway, on Thursday evening, March 16. The speaker will be Mr. F. O. Blackwell, who will deliver an illustrated lecture on hydroelectric development in Mexico. The Hispanic Museum will be open for the inspection of the members of the electrical society.

Travel in the New York Subway.—The New York Public Service Commission has prepared a statement showing the yearly ticket sales at every station of the subway from the time of its opening on Oct. 27, 1904, to Dec. 31, 1910. The total number during this period was 1,212,771,225. The traffic increased from 116,209,313 passengers in 1905 to 270,321,490 in 1910. The total gross income at 5 cents per ticket has been more than $60,000,000.

Cost of Public Service Commission.—According to reports of the State Department on the cost of maintaining the Public Service Commission of the First District, New York, the cost of the commission to New York City has been nearly $1,100,000 a year, which is about ten times the cost of the commission for the Second District, which covers the remainder of the State. The former commission employs 614 persons, including many engineers and traffic experts. Each commissioner receives a salary of $15,000. Mr. John N. Carlisle has been selected to make a study of the expenses and accomplishments of the commission.

Electrically Driven Gas-Producer, Gas-Engine Ship.—A vessel built by Messrs. McLaren Brothers, Dumbarton, Scotland, to the joint order of that firm and Messrs. Mayor & Coulson, electrical engineers, Glasgow, has recently been launched and will be ready for official trials on the Firth of Clyde at an early date. She is 50 ft. in length between perpendiculars and 12 ft. in breadth, and she will be propelled by machinery consisting of a four-cylinder Crossley gas engine of 45 hp., using producer gas, with electrical transmission to the propeller. The vessel has been built primarily for demonstration purposes in order to show the efficiency of electrical propulsion, but she has been fitted with two saloons and she will have a certificate for fifty passengers.

Day Letter-Telegram Service.—As a result of its satisfactory experience with the "night letters," the Western Union Telegraph Company inaugurated on March 1 a system of "day letters." According to the official statement, the day letter-telegram, like the night letter-telegram, is a fifty-word telegram to be written in plain English, code words and code language not being accepted. It is to be transmitted as the facilities of the company will permit during business hours of the day, full-rate telegrams having priority of transmission. The rate charged for a day letter of fifty words or less is one and one-half times the fifty-word night-letter rate, and for each additional ten words or less one-fifth the initial charge. For example, the night-letter rate from New York to Chicago is 50 cents; the day-letter rate is 75 cents, with 15 cents for each additional ten words. The New York-Washington night-letter rate is 30 cents; the day-letter rate 45 cents, with 9 cents for each additional ten words over fifty. The New York-San Francisco day-letter rate is $1.50 for fifty words, with 30 cents for each additional ten words.

Engineering Education Commended at Boston.—Engineering education received high praise from representative publicists and business men at a recent legislative hearing at Boston in connection with the plea of President Richard C. Maclaurin, of the Massachusetts Institute of Technology, for a grant of $100,000 per year from the State for the next decade. Among the speakers were Frederic P. Fish, Esq., former president of the American Telephone & Telegraph Company; Mr. W. C. Fish, manager of the Lynn works of the General Electric Company; Commissioner of Public Works Louis K. Rourke, of Boston; President A. Lawrence Lowell, of Harvard University, and Mayor John F. Fitzgerald, of Boston. All the speakers expressed forcefully the far-reaching value of technical education to the State, emphasizing the increasing importance of the engineer in modern affairs. President Maclaurin pointed out the necessity of larger development on account of the successful and over-crowded condition of the Institute, showed how the increased cost of living has had to be faced in connection with the retention of able instructors, and said that a new location for the institution, with a new and effective plant, is an absolute necessity. He closed by showing that unless the State provides for higher technical education ti must decline in prosperity and influence, and drew a parallel between the conditions and policy of Germany and those of Massachusetts in fostering this class of training. The Institute authorities desire an increase in the annual appropriation by the State of from $25,000 to $100,000.

Meeting of Cleveland A. I. E. E. Section.—The Cleveland Section of the A. I. E. E. held its regular monthly meeting on Monday, Feb. 20, in the Engineering Building of the National Electric Lamp Association as guests of the latter and listened to three papers on subjects pertaining to electric illumination. The first was by Mr. H. T. Spalding on "Mazda Street Lighting." the second by Dr. P. W. Cobb on "The Physiology of Glare," and the third by Dr. Herbert E. Ives on "The Production of Artificial Daylight." Mr. Spalding presented numerous stereopticon views of various types of street-lighting fixtures and installations. Dr. Cobb discussed the effect of scattered light in the eye in diminishing sensibility. Referring indirectly to the tests of Mr. Arthur J. Sweet, which indicate that glare in artificial lighting is caused by light coming from sources located within a fairly definite angle of approximately 25 deg. with the direct line of vision, Dr. Cobb said that while 25 deg. or thereabouts may be the practical limit of glare effect, he was aware of no physiological basis for such a limit. Dr. Ives discussed and demonstrated the "additive" and "subtractive" methods of producing light of the color known as "average daylight." He produced light of this color, using the additive method, by adding light from a tungsten-filament lamp to that from a mercury-vapor lamp in the proportions of one to two, approximately. Using the subtractive method he cut off from the light of a tungsten-filament lamps by means of a selective screen just enough light of the longer wave-lengths so that the transmitted light had the color of average daylight.

HYDROELECTRIC ENERGY FROM A STATE CANAL.

Plant of Maumee Valley Electric Company Utilizing 62-Ft. Head Furnished by Miami & Erie Waterway.

FIFTY years ago the State of Ohio finished the old Miami & Erie Canal, a waterway connecting the Maumee and Miami Rivers and providing a navigable link between Lake Erie and the Ohio River for the large water-borne traffic of the period. From the broad reaches of the Maumee River at Toledo the canal ascends around the rapids above the city by a series of locks leading to a level section twenty-three miles in length fed from the storage reservoir impounded by the new Grand Rapids dam, built two years ago.

At a point eight miles southwest of the City of Toledo the twenty-three-mile level section of the canal approaches within 800 ft. of the river, here 62 ft. below it, making available an admirable water-power site by the construction of a lateral extension canal from the State waterway to the crest of the river bank.

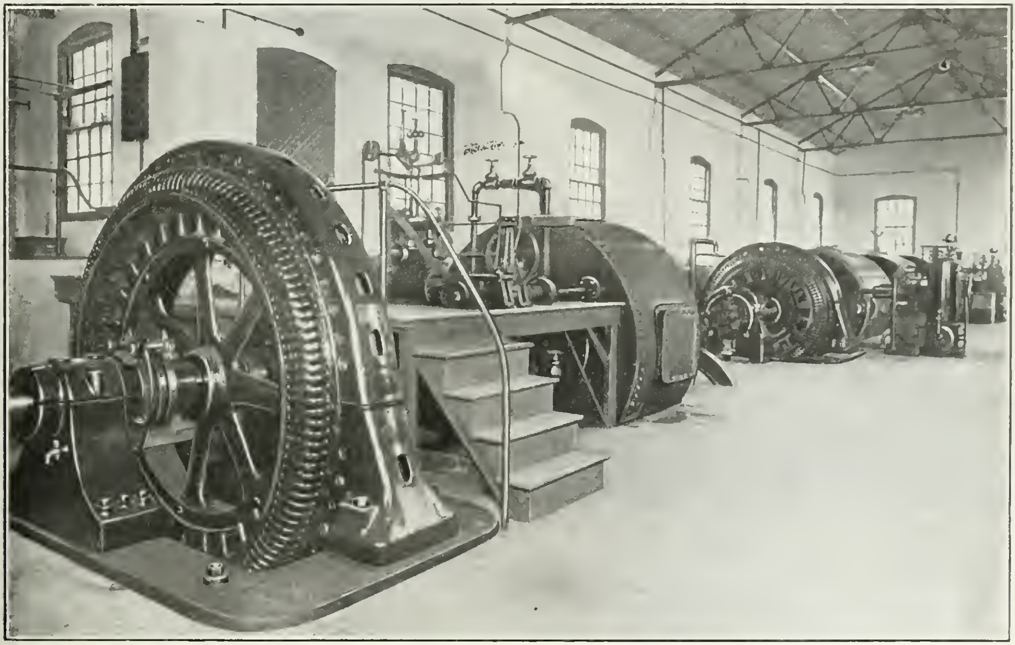

Fig. 1—Interior of Generator-Room, Showing Water-Wheels and Alternators.

Due to the competition offered by the railroads in the rapid handling of freight this old canal has fallen almost into disuse, barely one boat a year now traversing its grass-grown banks and rusty locks. The State has been unable to increase the canal traffic, even though the locks have been rebuilt and the canal put in the very best condition. In order, therefore, to place the canal property on a paying basis the State engineers consented to deliver water for power purposes, and this proposition was approved by the Ohio Legislature, the amount of water delivered being limited, however, so that the property will not be impaired or navigation destroyed.

To utilize this water-power the Maumee Valley Electric Company, originally organized some years ago, installed at that time one water-wheel unit and an auxiliary steam plant of approximately 800 hp, furnishing energy to operate an interurban belt line and other properties. Owing to various contingencies the power station was later shut down for a period of two or three years, until recently, when the company was reorganized and the power station rebuilt and enlarged.

The water-power generating capacity of this new station, operating continuously at full load, is transmitted eight miles at 13,200 volts into the City of Toledo, to augment the steam-power generating system of the Toledo Railways & Light Company, besides operating a local 300-kw railway rotary converter feeding directly into the 550-volt trolley of an interurban line which passes the power house. In addition to the water-wheel units the Maumee plant contains a 600-hp auxiliary steam engine which was installed at the time of the original station, several years ago, and can be connected to drive one of the water-wheel generators in case of emergency.

As above noted, the twenty-three-mile level section of the State canal is fed through one lock from the Maumee River above the new Grand Rapids dam, built two years ago. This dam impounds a reservoir in the old bed of the river, eighteen miles long and 1400 ft. wide, the storage capacity of which serves to maintain the canal system and developments below during low-water periods.

The completed power extension forebay, extending 800 ft. from the canal to the river bank, is approximately 94 ft. wide at the surface, its banks sloping to a width of 40 ft. to 60 ft. at the bottom, at an average depth of 14 ft. At its end, where the water enters the flumes, there is a concrete retaining wall containing three gates which are raised and lowered by hand-operated worm gear. In front of the gates is located an inclined steel-bar trash rack carried on I-beams. The penstock flumes leave this concrete wall, into which they are suitably anchored, at different angles, diverging to accommodate the center-line distances of the side-entrance water-wheel cases in the power house below. Each penstock is approximately 230 ft. long and 7 ft. 6 in. in diameter, the upper sections being built of 5/16-in. boiler plate, while in the lower portions this thickness is increased to 7/16 in. The flumes have a slope of 1⅝ in. per foot and are carried at approximately 12-ft. intervals on concrete piers. At the top of the hill, near the gates, where the tubes pass under a country boulevard and an interurban railway track, the flumes are protected by a reinforced concrete wall arched to carry the earth load.

The present power house comprises the new water-wheel structure, 110 ft. by 30 ft., and the old combination-plant building, 70 ft. by 200 ft., containing the boilers and engines originally installed. The new building has concrete foundations, carried to bed-rock, the walls being of brick, with steel trusses supporting the roof. The present water-power equipment comprises two 26-in. double-runner and one 26-in. single-runner water-wheels. The former machines are of the Allis-Chalmers horizontal type with side entry and center discharge, and each drives, at 400 r.p.m., a 2300-volt, 60-cycle, three-phase Allis-Chalmers alternator delivering 190 amp per phase. The individual exciters are mounted on extensions of the shafts. The speed of these units is controlled by Allis-Chalmers type I oil-pressure governors, with oil pumps belted to the shafts. A small motor manipulated from a double-throw switch on the switchboard enables the setting of the governors to be controlled by the operator. The 26-in. Leffel single-runner double-discharge turbine drives an Allis-Chalmers alternator similar to the other machines, but delivering 115 amp per phase. Its exciter is belt-driven. This Leffel unit is controlled by a Lombard mechanical governor. The average head under which the station operates is 62 ft.

In case of low water or other contingencies this last generator is arranged to be driven by the 600-hp Hamilton Corliss tandem-compound engine through an 8-in. line shaft connected by clutches. This shaft is belted from the 20-ft. engine flywheel. Four 250-hp Stewart boilers are provided for furnishing steam for the engine, and all auxiliary equipment is kept ready for emergency conditions.

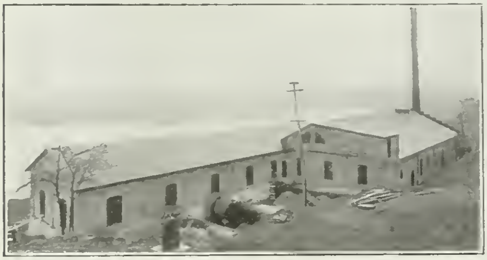
Fig. 2—Maumee Valley Combination Water-Power and Steam Plant.

In the concrete foundations carrying the water-wheels are molded the draft tubes to discharge the water leaving the turbine units. These tubes where they leave the turbine cases are round in form and gradually change in shape, so that at the point where the water discharges into the tail-race the section is rectangular. Meanwhile the water has been changed in direction from a vertical drop to a horizontal discharge, and, due to the increasing area of the tube, it is discharged at a comparatively low rate of speed Owing to the careful attention given these draft tubes the normal vacuum has approached the theoretical, there being a hydrostatic head of 21 ft. from the center of the turbine to the surface level of the water in the tail-race.

In preparing the foundations for the building and draft tubes excavations had to be carried 27 ft. below the power-house level, or approximately 10 ft. below water level, through a very hard flint rock underlying the clay, making progress extremely slow and difficult. In spite of these obstacles and the scarcity of labor, the work, after being started May 9, 1910, was finished so that the complete plant was ready to operate Dec. 26.

Lead-covered cables inclosed in conduit convey the output of the generators and exciters to the switchboard, which is mounted on a concrete platform raised 6 ft. above the generator-room floor and well above any possible high water. The switchboard comprises two exciter panels, three generator panels and three line panels, each complete with phase ammeters and kw-hour meters. Voltmeters and a synchronoscope are provided on swinging brackets. The switchboard, of blue Vermont marble, was supplied by the Allis-Chalmers Company. From the 2300-volt buses the three-phase, 60-cycle energy is raised by duplicate banks of three Allis-Chalmers self-cooling, oil-insulated transformers to the transmission voltage of 13,200 volts. The two transformer banks are arranged for paralleling, through connector switches, to the two line entries for which the station has been designed and the first of which is now installed. From the transformers the lines pass through insulator-mounted choke coils to the entries, being tapped by lightning-discharge paths through General Electric aluminum-cell arresters placed on the gallery above the switchboard floor. On the switchboard balcony is also located a 300-kw, 550-volt rotary converter supplied through a bank of 2300/375-volt step-down transformers. This rotary is employed to feed direct current into the trolley wire of the Maumee Valley belt-line interurban railway, which passes the power house.

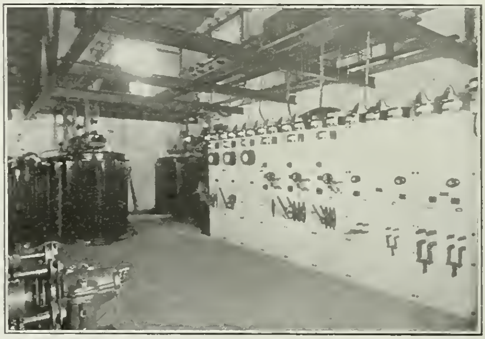
Fig. 3—Switchboard Gallery, Showing Transformers and High-Tension Exits.

The 13,200-volt transmission line into the City of Toledo is carried on 40-ft. cedar poles set at 110-ft. intervals on the bank of the old canal, which passes through the city. The single three-phase circuit is made up of No. 1 copper wires mounted on iron-pinned 23,000-volt insulators. The line extends along the canal bank for eight and one-half miles to the lightning arrester and transfer house at Erie Street, where the 13,200-volt conductors are connected to the underground transmission system of the Toledo Railway & Light Company. Within the city limits the wooden-pole height is raised to 50 ft., and at several street crossings 60-ft. steel towers have been used in order to comply with the requirements of the city engineer.

Fig. 4—Placing Penstock Tubes in Position During Construction of New Water-Power Addition to Plant.

As above noted, the Maumee Valley water-power plant is being operated at its full rating continuously to feed into the 18,000-kw steam-power system of the Toledo company, which is thus enabled to reserve more of its steam-generating capacity for meeting peak loads. The energy thus purchased, in addition to the output of a 5600-kw steam-turbine set just being installed at the main Toledo power house, is made necessary by the rapid increase which the local electricity supply business has undergone within the last few years. The Toledo steam plant, with which the Maumee water-power works, is also unique among central stations in the variety of steam-engine and steam-turbine types installed and in the number of forms, frequencies and pressures at which the generated output leaves the station.

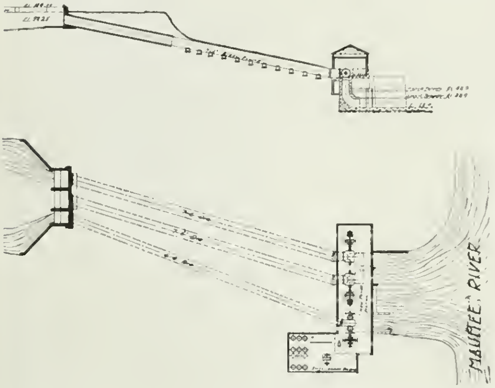

Fig. 5—Arrangement of Forebay, Penstocks, Power House and Tailrace.

Besides the present Maumee plant, the Maumee Valley Electric Company has under way plans for erecting three other hydroelectric stations, having purchased all the rights and water privileges necessary for these plants, so that the entire system, when completed, will have a total generating capacity of at least 15,000 kw.

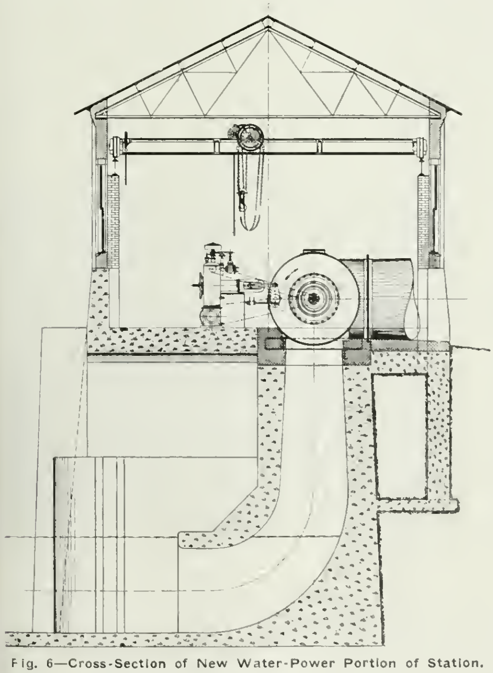

Fig. 6—Cross-Section of New Water-Power Portion of Station.

Mr. J. M. Ashley, of Toledo, is president of the Maumee Valley Electric Company, and Mr. H. L. Crawford, of New York, is treasurer. Mr. W. P. Wallace, now superintendent and general manager of the company, superintended the entire construction of the new water-power plant from the plans and specifications of Mr. Robert R. Livingston, consulting engineer, New York City.

The commercial possibility of the low-head hydraulic developments which may be carried out in almost a level country is becoming important, as, for example, the development on the St. Joseph River, in Michigan and Indiana, where there has been installed a generating capacity of about 18,000 kw. The total drainage area of the St. Joseph River is 4500 sq. miles, whereas the total drainage area of the Maumee River is 6700 sq. miles. In all these developments there is a wide difference between high-water and low-water levels and it is found necessary to install several plants in order to develop a large amount of primary power. By this means the period of low water is supplemented by the storage capacity of the dams in connection with each development.

CENTRAL-STATION ICE-MAKING AUXILIARY.

The Present Status of Combination Ice and Electric Plant Operation and Practice.

HEREWITH are presented some significant figures on the present status of ice manufacture by combination central-station plants, taken from a thorough investigation which the *Electrical World* has prosecuted during the past three months. The information here given thus represents the latest data available on the practical matter of this solution of the small central-station's income problem—profitable operation during the light loads of the summer season. The facts adduced seem to show, however, that a goodly number of plant operators have already learned how to convert this indifferently productive summer period into one of the most profitable periods of the year.

As has been pointed out many times in these columns, the combined operation of ice-making and electric generating equipment provides a profitable use for exhaust steam or the surplus power of the station apparatus during non-peak periods, applies to double duty a single investment for real estate, buildings and steam apparatus, and utilizes the same office and plant force to handle both departments of the business. The costs chargeable to each process are thus substantially diminished and margins of profit left which would be impossible in single-utility operation.

ICE-MAKING PROCESSES.

Ice is commonly made by either the ammonia-compression or the ammonia-absorption process. In the absorption system the heat of the steam is used directly to expand the ammonia gas in the "generator," producing in this way sufficient pressure to cause the gas to liquefy in the water-cooled condenser coils. Passing from these the ammonia liquor is then evaporated in the expansion coils, in contact with the brine or material to be chilled, taking up in the process heat which is delivered to the cooling water at the end of the cycle. The steam used to "boil" the ammonia gas can also be condensed and collected as distilled water. This, after being reboiled by passing over steam coils, is used to fill the freezing cans.

In the compression system a motor-driven compressor is employed to produce the pressure at which the ammonia liquefies in the cooling coils. The remainder of the cycle is similar to the preceding system. With such a compressor motor load situated either in the station itself or directly controllable from the switchboard extremely favorable conditions for improving the plant load-factor are established, for the compressor runs long hours daily, but can be slowed down or practically stopped during hours of peak electric demand. The steam and electrical apparatus of the station is thus enabled to operate twenty-four hours a day at a relatively high technical efficiency, besides carrying a very profitable by-product load. Some of the latest tank plants complete the freezing process in an eighteen-hour to twenty-hour cycle, making an almost ideal "fill" for the broad valley of the daily load curve. The continuous twenty-four-hour electrical service incidentally made possible at a season when electric fans and irons are in demand will do much to popularize the use of electricity in small towns otherwise restricted to night service. Although distilled water from the exhaust will be available for the compression system as before, several processes are now offered designed for using undistilled or "sweet" water where desired. In these compressed air bubbling from the bottom of the tanks agitates the water, clearing the freezing surface of impurities.

In general the absorption system has a higher first cost than a compression plant, is more applicable to the larger sizes, operates more economically and with the expenditure of less fuel, but requires a comparatively large quantity of cooling water to remove the greater amount of heat from the ammonia gas. The compression system, however, is not dependent upon location near the steam equipment for its operation and is in many ways more flexible in its application.

COMBINATION ICE-ELECTRIC PLANTS.

According to the last issue of the "McGraw Electrical Directory" 105 central-station companies report the manufacture of ice, while there are 122 others whose corporate names indicate that ice-making is included in their charter rights, although they have not so reported. The last report of the United States Census Bureau on the electric generating plants of the country declares that 212 combination ice-making plants were in operation in 1907. Taking these lists as a beginning, supplemented by the names of other combination plants obtained from the principal manufacturers of ice-making machinery, letters of inquiry accompanied by stamped return envelopes were sent to all central-station companies whose activities were thought to include ice manufacture. A blank on the inquiry form requested the names of other ice-making stations in the vicinity of the plants addressed, and in this way a number of hitherto unlisted stations were located.

In all 297 companies were addressed, from which 163 replies have been obtained. Of these 146 confirmed the understanding that they were operating ice plants, besides giving a quantity of other confidential information extremely valuable in deducing the practical situation in the industry to-day. Seventeen reported no ice-making auxiliaries, having been incorrectly listed, or having such equipment still in contemplation, or having disposed of their ice interests. With 146 operating ice plants out of the 163 replying to the circular inquiries, it is thus conservative to assume that of the 297 plants addressed there are at least 250 combination ice and electric plants in the country.

LOCATION OF COMBINATION PLANTS.

The distribution of these plants offers some interesting considerations. The stations reporting are located chiefly in the smaller towns and cities, and in conjunction with electric plants of some 50-kw to 500-kw rating. The number of plants in places of a given population is as follows:

Under 2500 inhabitants	48 plants
Towns of 2501 to 5000 inhabitants	48 plants
Cities of 5001 to 10,000 inhabitants	27 plants
Cities above 10,000 inhabitants	15 plants

Ness City, Kan., with a 5-ton ice plant in a community of 750, is the smallest town reporting an ice-making auxiliary.

As might be expected, a number of the plants listed are in the warm Southern States, but nevertheless the list contains some surprises in pointing out the relative number in what are generally considered the Central and North-Central States. Oklahoma is credited with 22 combination plants; Kentucky with 18; Illinois, 16; Missouri, 15; Kansas, 13; Arkansas, 10; Virginia, 8; West Virginia, 5; Colorado, 4; Indiana, 4; Nebraska, 4; Iowa, 4; California, 4; Wisconsin, 2; Connecticut, 2, and New Jersey, 2. Michigan, Nevada, New York, Ohio, Oregon, Pennsylvania, Washington and Hawaii each have one combination plant.

In the South, of course, Texas, with its tremendous and rapidly developing area, has the largest number of ice-electric plants of any state, about 83 being listed. Florida comes next with 17; Tennessee, 8; Louisiana, 7; Mississippi, 5; North Carolina, 5; Georgia, 4; South Carolina, 3, and New Mexico, 3.

The preponderance of plants in the more newly developed states, such as Oklahoma, Texas, etc., is indicative of the progressive character of the electrical industry in those regions. In such new territories modern high-class construction usually characterizes equipment which in more slowly moving and conservative communities is sometimes allowed to lapse far past the point of obsoleteness. The number of combination ice-making plants using their steam equipment to its fullest efficiency is, therefore, only an expected result of the progressive and alert tendencies of these new states.

OPERATING DATA.

A Western company operating a 25-ton plant reports that it is consuming about 65 kw-hours per ton of ice produced, this figure, however, including the refrigeration of four large storage-rooms. After crediting investment and operating costs out of the $3 received per ton the company finds it earns a net rate of about 1.5 cents per kw-hour used. According to the investigations of a leading central-station company from 50 kw-hours to 60 kw-hours are required to produce 1 ton of ice by means of the compression system. The maximum demand of such an outfit reaches 2.3 kw per ton of ice-making capacity per day, of which 1.5 kw is required to drive the compressor itself. Most of the central-station plants investigated use the compression-system equipment.

The ice-making capacity per kilowatt of station rating varies between the wide limits of 1000 lb. to 80 lb. per twenty-four hours. On the average 600 lb. of ice per day can be made per horse-power of engine capacity, but the limit to this ratio revealed by the reports sent in is rather set by the market of the community for ice. However, even such demand is a progressive quantity, for artificial ice is clean and pure, and the habit of ice using once established grows in a community until the demand becomes a profitable one to supply. The number of inhabitants per ton of ice-making capacity was found to vary from thirty or forty to 400 or 500, the majority of the towns reporting, however, averaging 110 to 180 persons per ton of ice-making equipment.

The ice prices reported range from 50 cents to 30 cents per 100 lb. for retail or residential purposes, by far the most popular figure, however, being 40 cents per 100 lb. This rate is often subject to discount to regular consumers, such as soda fountains, saloons, etc., while the wholesale prices go down to from 20 cents to 30 cents per 100 lb.

Most of the plants reporting are operated either continuously throughout 365 days of the year or at least 300 days to 250 days. In the Northern States, of course, this period of operation is reduced to the warm season, and in some instances falls to two or three months. Even within such limits the operation of the ice factory in competition with the natural product has not failed to make the ice investment in certain cases earn a larger yearly profit in ninety days than the all-year-round electric plant in 365 days.

The final question asked of combination ice-plant operators was this: "Has the combination plant proved satisfactory?" Of the replies received 130 were in the affirmative, twenty-four taking occasion to express enthusiasm at the results obtained. Two replied "fairly satisfactory," and four in all answered "unsatisfactory." In two other instances ice plants were reported abandoned from unassigned causes.

The results obtained thus show that, while in four instances ice plants were a disappointment, in more than 130 stations, or 97 per cent of those answering this query, such combination plants have proved signally successful.

USE OF ELECTRICITY ON THE CATSKILL AQUEDUCT.

Large Motor Load on Newburgh Light, Heat & Power Company's Lines Furnished by Contractors.

THE Catskill aqueduct, which will deliver 500,000,000 gal. of water per day to New York City from the 130,000,000,000 gal. Ashokan reservoir in the south Catskill Mountains, will be ninety-two miles long, from the headworks at the reservoir to the equalizing reservoir at Hill View, about two miles southeast of Yonkers and one-half mile north of the New York City line. Four general types of aqueduct construction are employed—cut-and-cover, grade tunnel, pressure tunnel and steel pipe. The pressure tunnels are built entirely in rock with vertical shafts, some of which are permanent waterway shafts connecting the tunnel with the adjacent cut-and-cover or permanent drainage shafts for future unwatering for inspection or necessary repairs. Others are temporary construction shafts which will later be sealed and plugged with concrete.

About twenty miles of this aqueduct is being constructed with electricity supplied by the Newburgh Light, Heat & Power Company, for which work the contractors have a total of 4400 hp in motors installed. The most notable of these installations is that of the Degnon Contracting Company at Forest Glen. This company has the contract for the Wallkill pressure tunnel, the excavation for which is now nearly complete. This tunnel, which is 23,391 ft. long and 14.5 ft. in diameter, is reached through six shafts 350 ft. to 480 ft. deep and electricity is employed as the chief source of power in all the work.

A central distributing plant has been erected by the contractor about 1500 ft. east of the tunnel center line near Shaft 4. Energy at a potential of 33,000 volts is received at this station and the voltage reduced to 2200 volts by two sets of three 300-kw water-cooled, oil-insulated, 60-cycle, single-phase transformers connected in delta. There are five air compressors installed in the station, four of which are each driven by a 500-hp induction motor and one by a 300-hp motor. The motors are three-phase machines operating at 2200 volts and are belted to the compressors. In addition there is a 600-kva, 2200-volt synchronous motor running light on the system to improve the power-factor. The company has a transmission line of its own running along the route of the tunnel over which two circuits are maintained. One is a three-phase, three-wire circuit for the hoists, and the other a circuit for lamps and smaller motors. The energy goes out at a tension of 2200 volts and is stepped down to different potentials as required at the tunnel shafts. Lightning arresters are connected to this four and one-half-mile line every one and one-half miles. The 33,000-volt line over which the energy is received was also erected by the company from New Paltz to the tunnel, a distance of four and one-half miles. This line is identical in construction with the high-tension lines of the Newburgh Light, Heat & Power Company running from Honk Falls to Newburgh over the Shawangunk Mountains.

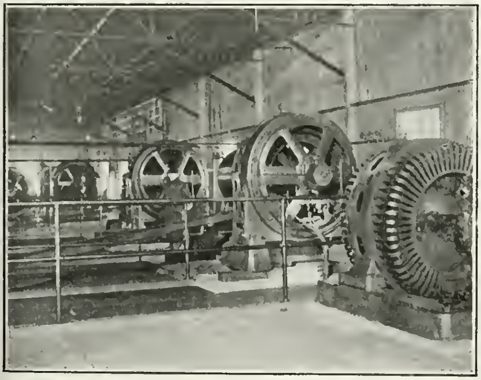
Fig. 1—Induction Motors Driving Compressors in Degnon Contracting Company's Station at Forest Glen, N. Y.

Fig. 2—High-Tension Line at Forest Glen Crossing.

The total energy consumption for all purposes as metered at the central plant last July when all the headings were working was as follows: Compressors, 25,300 kw-hours a day; hoists, 2780 kw-hours; lamps, blowers, electric locomotives and pumps, 1570 kw-hours; making a total daily consumption of 29,650 kw-hours.

The power house, a building with steel-roof trusses and corrugated steel roof and sides, covers a ground area of 80 ft. x 160 ft. and is located a short distance from the Wallkill Valley Railroad, a single-track branch line which furnishes the only transportation in the vicinity. Adjacent to the plant is a small stream across which a sheet-pile dam is built to form a pond from which to take water for cooling the compressed air and the transformers. The hot water is discharged into the pond again, but at some distance from the intake, so that cool water is always available. The synchronous motor already mentioned is equipped with a 6-kw exciter on the same shaft. In view of the large induction motor load the contracting company is under agreement to operate this machine as a means of improving the power-factor and to help the regulation on the Newburgh system. A drop of 80 volts was noted on the Forest Glen board when the synchronous motor was not in operation, showing that the motor takes care of a large inductive drop. With the motor off the line a number of readings were taken extending over several hours and an average power-factor of 83 was found on a load ranging from 700 kw to 1000 kw. At this power-factor the synchronous motor absorbing about 45 kw will easily take up the wattless component on the average load,

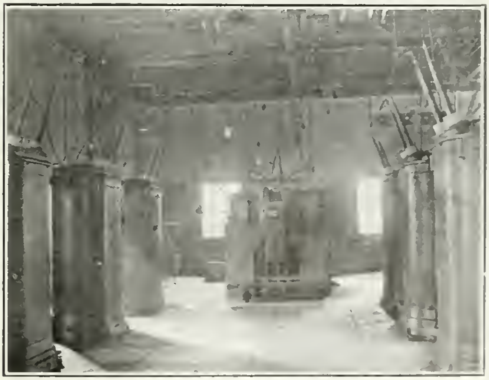
Fig. 3—High-Tension Transformers in Operation at the Forest Glen Station.

which ranges about 875 kw, and thus keep the power-factor near unity.

At each of the six shafts are two elevators or hoists operated by a 150-hp, 2200-volt, three-phase induction motor. The hoist is capable of a speed of 500 ft. per minute and is located in a shed adjacent to the shaft. Solenoid brakes set automatically if for any reason the supply of energy is interrupted. There are also automatic switches on the headframes to prevent overwinding. The shed at Shaft 4 also houses a 10-kw motor-generator set for supplying direct current to a trolley system in the tunnel. There are four of these sets in all, located at as many shafts for this purpose. At Shaft 4 are also installed three 20-kw transformers for stepping down the potential from 2200 volts to 220 volts for use in lamps and motors. To one side of the shaft is a concrete mixing plant operated by a 30-hp motor, and in connection with this plant there is a motor-operated hoist rated at 22 hp. The 30-hp motor is a trifle large for the work intended, but the company had it on hand and applied it to a 15-hp load rather than invest in a smaller machine.

The mine locomotives used are six in number and are operated by 15-hp motors. These have given excellent satisfaction in removing rock to shafts and pulling concrete for lining the tunnel. They are also economical in operation. At each shaft electrically driven centrifugal blowers are provided for ventilation. The blowers at the two heading shafts have a capacity of 7500 cu. ft. of free air per minute at a pressure of 6.5 oz. By blowing compressed air into the heading while blasting and for a short time afterward in conjunction with the blowers smoke troubles are obviated. The tunnels are lighted by 16-cp lamps spaced about 25 ft. apart with extra portable lamps in heavy lamp guards at working faces. The portable lamps are removed when blasting is about to take place and the firing of the blast is done with the 220-volt lighting circuit. The shoot wires are strung on the opposite side of the tunnel from the lighting circuits and the connections and firing switch are placed 500 ft. back from the heading. The cut as well as the other bench holes are wired in series.

For the purpose of taking care of seepage electric and air-driven pumps are installed. There are two three-stage, 100-gal. centrifugal pumps operated against a 400-ft. head by 30-hp. motors and four 200-gal. pumps each driven by a 50-hp motor. The electric pumps are operated for short periods only, being held in reserve for emergencies. At the Bonticou substation, from which energy on the cut-and-cover aqueduct running around the ridge of the mountain from the tunnel to the next contract, is supplied the company has installed 300 kw in transformers for stepping down the potential from 33,000 volts to 2300 volts. A 150-hp compressor outfit is located at this substation and the rock crushers and concrete mixers used on this section have their motors also supplied with energy from this point.

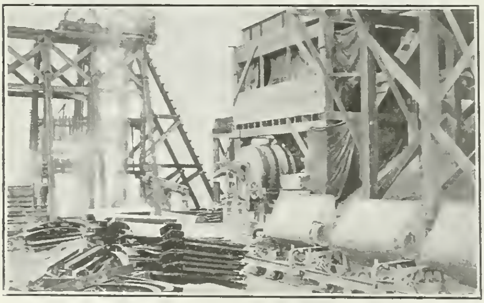
Fig. 4—Concrete Mixer Cars and Head Frame.

Two miles northwest of Stone Ridge is the Atwood station of the seven-mile aqueduct section which the H. S. Kerbaugh Company is building. A four-mile, 33,000-volt line runs from the High Falls substation of the Newburgh Light, Heat & Power Company to Atwood, where it enters a 50-ft. x 80-ft. power house. Here three 300-kw transformers reduce the voltage to 2300 volts, at which pressure two 300-hp motors drive air compressors, the output from which is used chiefly for drilling. A 2300-volt line runs north to the machine shop, where a 30-hp motor is installed, and another 2300-volt line supplies energy to a "mixer" on which are installed motors aggregating 220 hp. Several miles north of the Atwood power house are a 200-hp motor-driven stone crusher and two 30-hp mixing motors. The total load aggregates 850 kw.

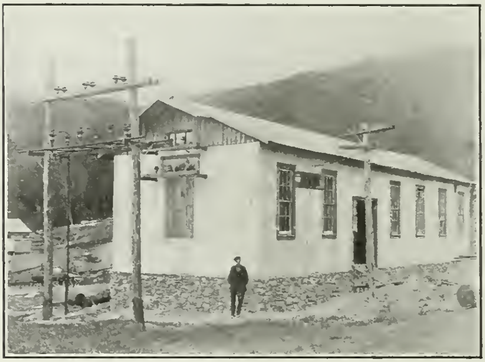
Fig. 5—Substation at Bonticou.

Part of the Kerbaugh contract consists of nearly five miles of cut-and-cover work and on a portion of this a most interesting portable plant is employed, although the plant is not now in operation, having been shut down for the winter. The concrete aggregates are mixed dry at the crusher plant at the north end of the contract and brought to the portable mixing plant. Cement is added here and the concrete is mixed on the flat car. A small derrick is located on the car for handling the stone and cement from the material train. The mixer discharges the concrete into a chute which carries it out over the trench. No extra grout is used in finishing the invert, a 2-in. steel shaft about 16 ft. long being used to roll the surface. The balance of the concrete work is performed by the main plant, consisting of two principal parts. The first is the crushing and mixing plant and the second part serves both to handle the concrete and the outside forms.

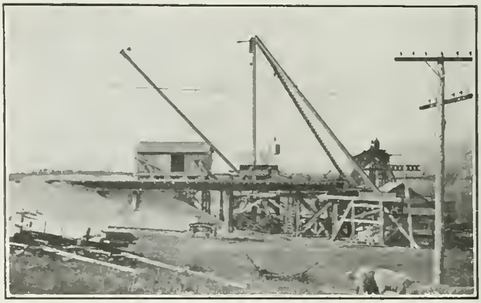
Fig. 6—Concrete Mixing Plant at Shaft.

The first part comprises a steel framework mounted on two 60-ft. steel cars placed side by side which run on two standard-gage tracks on the curve of the invert. From the crusher on the floor of the car a 16-in. bucket conveyor carries the material to a revolving screen at the top of the plant. The stone rejected here passes through a crusher and sand rolls and is again dumped into the conveyor and revolving screen. Below the sand and stone bins, which hold 40 cu. yd. and 20 cu. yd. respectively, are the measuring hoppers and a mixer. The mixer dumps into buckets which are picked up by electric hoists and carried to the forms. Each of the two buckets used for handling the concrete has four wheels fastened to the rim for operation on a short track which supports it while being filled from the mixing spout.

The part of the plant used in placing the concrete and handling the outside forms consists of a two-truss steel bridge 140 ft. long upon which travel the several hoists for performing the various operations. The traveling hoist for handling the concrete buckets is suspended beneath the bridge and is equipped with one 11-hp motor for hoisting and two 3-hp motors for propelling. Three sets of track are provided for this carriage so that when the machine is being operated around a curve that set of tracks is used which will suspend the carriage more nearly over the top of the work. On top of the bridge is another traveler provided with overhanging arms to which chain hoists are attached for handling the outside forms. The traveler is equipped with two 5-hp motors. Another chain hoist is provided at the rear support of the bridge and this is also equipped with a 5-hp motor. The hoists are suspended from an I-beam over the center line of the aqueduct. The saddles, each of which is 2 ft. wide, are picked up by the hoist, turned 90 deg. and carried forward through the supporting frame and reset ahead. When several saddles are set ahead the entire plant is pulled forward. This process is repeated about five times in moving 60 ft.

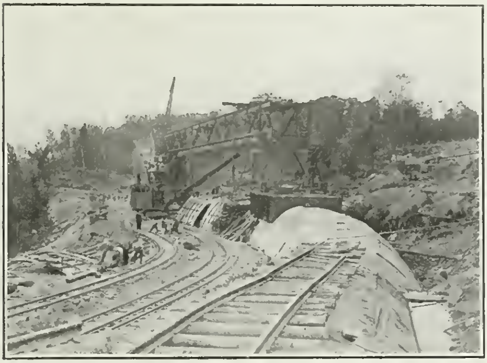

Fig. 7—Electrically Operated Rock Crusher, Concrete Mixer and Concrete Placer.

The forms used on the work are of sheet steel braced and built to fit inside the perimeter of the aqueduct. These are made in 5-ft. lengths and are hinged at a point about 2 ft. above the invert. The bottom 2 ft. of the forms can thus be turned in on the hinges and the entire form supported on an A-frame carriage. The carriage is equipped to run on a standard-gage track and is operated by a 30-hp motor. Fifteen feet of forms is handled by the carriage at one time.

Two tracks parallel the line of the aqueduct work upon which the stone and sand are brought in wooden skips, the latter being handled by electric derricks. The concrete work for 60 ft. of arch is started in the morning and carried to completion. This usually requires seven hours, when about 171 cu. yd. of concrete is poured. There are in use 180 ft. of inside forms, 60 ft. being concreted, 60 ft. being under green concrete which supports the saddles and 60 ft. of forms being moved. Of the outside forms 120 ft. only are used. The greatest dimensions of the aqueduct, which is shaped somewhat like a horseshoe, are 17 ft. x 15 ft. The thickness of concrete averages 2 ft. The "mixer" shown in Fig. 7 combines all the functions of concreting, mixing, forming and laying the material.

THE CENTRAL-STATION MOTOR LOAD.

The Extension of Electric Motor Service in New England.

ELECTRIC MOTOR SERVICE AT FITCHBURG, MASS.

The Fitchburg Gas & Electric Light Company, serving a population of about 40,000 persons, has a connected motor load of about 1720 hp. Energy is supplied to miscellaneous industries in the city, and in the past three years the company's connected motor load has been supplied mainly from a steam plant equipped with compound condensing engines and direct-connected alternators. Recently the company entered into an agreement with the Connecticut River Transmission Company whereby an interchange of energy takes place according to local conditions on each system. At times of a shortage of power due to low water the central station supplies energy to the transmission system reciprocally upon an agreement by which the latter sells electricity to the Fitchburg company when the supply is available and the load requirements suitable. The Fitchburg company now has about sixty-four customers using energy for motor service only. The rates in force encourage long-hour consumption, and the load-factors in some of the industrial plants driven by motors are excellent.

In the summer season the company operates a brickyard equipped with a 50-hp motor of the induction type. This service begins as soon as the frost leaves the ground and stops when the freezing weather sets in, and is attractive on account of its absence from the yearly peak. At certain periods some of the motor-driven machine shops in the city run night and day. An all-night service is supplied in a number of comb shops in the driving of tumblers by 5-hp motors and larger sizes. Another customer of the company is a grain mill equipped with two motors totaling 80 hp. The maximum demand of this installation is 80 hp. Two afternoon newspapers are run by electric motors, the service requiring a connected load of 11 hp in one case and 15.5 hp in the other. This load comes off the lighting peak in almost all cases. In a prominent machining establishment equipped with fifty-three motors, with a combined rating of 275 hp, the maximum demand measured by the lighting company has been about 100 kw, and in another similar competitive establishment with forty motors, having a total rating of 100 hp, the maximum measured demand has been 30 hp. In a further case of this kind a machine shop equipped with motor-driven high-speed lathes has ten motors, with a total rating of 115 hp, and the maximum demand noted has been 80 kw. A fourth instance, having in the plant twenty-two motors, mainly of ½-hp and ¼-hp rating, and a total rating of 29 hp, has a maximum demand of about 11 hp. These results, favorable to central-station service, are largely due to the use of individually driven electric motors in the industrial plants, while the owner gets the benefit of taking energy only while he is actually performing productive work in his factory or shop.

TWO SUGGESTIVE CENTRAL-STATION LOAD CURVES.

The influence of a substantial motor load upon central-station output is well illustrated in the two accompanying load curves of the East Bridgewater station of the Edison Electric Illuminating Company, of Brockton, Mass., for two days in the latter part of 1910. In the past three years, between June 30, 1907, and June 30, 1910, the connected motor load of this company, which is one of the Stone & Webster group, has increased from 627 hp to 3480 hp. There is now about 1 hp of connected load for every nine inhabitants of Brockton, which is a prominent shoe manufacturing city about twenty miles south of Boston. Electric service at Brockton and throughout the adjacent district is now supplied from a turbine station of the company at East Bridgewater, the benefits of centralization having been demonstrated by the shutting down of the former small and relatively inefficient steam stations in Brockton and adjacent towns and the inauguration of a single and comprehensive service from the turbine plant. An eight-hour day is the rule in the Brockton district, and the results are somewhat favorable to central-station investment economy, since there is very little overlapping of the peaks except in the few darkest weeks of the year and even then the overlapping is of short duration.

Fig. 1 shows a typical load curve of the East Bridgewater station, the readings having been platted for Friday, Sept. 16, 1910. The flat character of the curve throughout the day and the absence of any pronounced afternoon peak are significant.

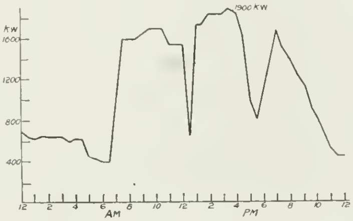

Fig. 1—Typical Load Curve of East Bridgewater Station.

The maximum reading during the day on the station output was 1900 kw, or about 300 kw above the average of the forenoon and about 150 kw above the early afternoon average. Curve 2 shows the load on this station during the extreme peak of the year, on Thursday, Dec. 15. Although the excessive lighting demand is evident, rising to a total output of 2900 kw for both lamp and motor service, the influence of the motor load during the day is clearly favorable. The duration of the extreme yearly peak was not much over two and one-half hours, and it was well within the rating of the station, which contains two 1500-kw Curtis turbo-alternators. For the year ended June 30, 1910, the load-factor of this station was 33.3 per cent and the station factor was 30.7 per cent.

ELECTRIC MOTOR APPLICATIONS AT QUINCY, MASS.

Off-peak electric motor service business has attained a substantial development at Quincy, Mass., where the Quincy Electric Light & Power Company supplies about seventy-seven customers with energy for motor service in connection with the operation of granite sheds. Quincy is a suburban city in the Boston district, with a population of about 32,000 inhabitants. The company's connected motor load on June 30, 1910, was 1030 hp. The service is very attractive from the central-station standpoint, since the consumption of energy is practically always stopped by 4:30 p. m., the hours of the granite industry being from 7 a. m. to the above time. All the motor service in Quincy is of the alternating-current type, so that the company has the opportunity to utilize its generating equipment for the motor work in the daytime and for lighting service during the evening and night. The demands of individual installations are also relatively large and well sustained, and only very small amounts of steam are required in the industry.

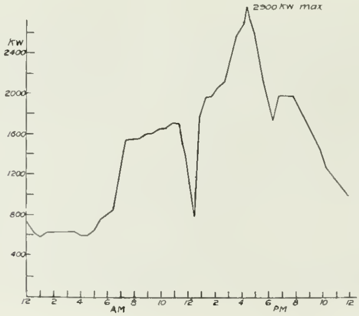

Fig. 2—Extreme Peak-Load Curve of the East Bridgewater Station

Among the representative stone sheds at Quincy equipped for electrical operation is that of Hughes & Johnson. This house manufactures granite monuments and has two motors in service, one being a 50-hp outfit and the other a 35-hp unit. The larger motor is installed in a shed on the premises and arranged to drive an Ingersoll-Sergeant double-acting compound air compressor capable of delivering 215 cu. ft. of air per minute at about 90 lb. per square inch, and also a Mead-Morrison electric derrick of 20 tons rating. The motor is equipped with a 14-in. pulley which is belted to a 54-in. countershaft pulley, and from the countershaft the compressor is belted off a 36-in. pulley and the hoist off a 40-in. pulley. The compressor operates continuously and the derrick intermittently, the motor being of sufficient size to handle both temporarily. The derrick has a 49-ft. boom, and in the stoneyard which it serves are two surfacing machines, drills, etc., which are operated by air from the motor-driven compressor. In the finishing department of the plant are a 10-ton traveling crane, a pump for washing stone by means of water from an adjacent well, and three polishing machines, all group-driven by the 35-hp motor. Energy is supplied to the establishment for motor service by a three-phase, 550-volt, 60-cycle overhead circuit carried to the plant from a distributing transformer installation on a pole about 100 yd. distant, as shown in the accompanying photograph. The lighting company has adopted the policy of carrying its 2300-volt service to local distributing centers only, instead of to all customers, the centralization of distributing transformer equipment being very attractive and the losses light for the short distances over which the 550-volt energy is locally transmitted in each case.

Among other prominent stonecutters using electric motors in Quincy are Milne & Hector, equipped with two 50-hp motors, one of which is usually sufficient to carry their fluctuating loads; E. H. Doble & Company, 50 hp; Monohan Granite Company, 50 hp, and J. L. Miller, F. Barnicoat and F. Craig Company, 50 hp each.

One of the most interesting applications of electric motors in eastern Massachusetts is at Quincy Adams station, in the city of Quincy, the principal shipping point of all the granite produced in the territory. The handling of heavy freight between trucks and railroad cars is accomplished here by the use of a 40-ton Shaw electric traveling crane spanning a combined railroad yard and teamway, as shown in the accompanying photograph. The crane was installed by the New York, New Haven & Hartford Railroad Company for the purpose of expediting the handling of heavy freight, the former work having been done at another station in the vicinity which was equipped with a slower and less convenient steam derrick of smaller rating. The present derrick, which was supplied by the Shaw Electric Crane Company, of Muskegon, Mich., operates both horizontally and vertically, and travels north and south in the

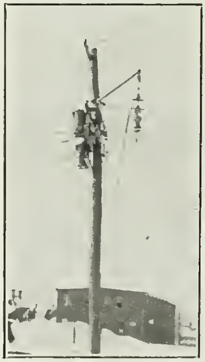

Fig. 4—Distributing Transformer.

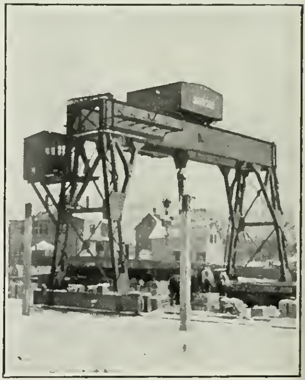

Fig. 5—Electric Crane in Freight Yard.

yard for a distance of 160 ft. The crane consists of a heavy steel girder structure carried on posts terminating at their bottoms in channels carried on wheels capable of running back and forth in a track of about 50-ft. gage, which is the span of the crane. The hoisting mechanism of the crane is installed in a covered structure on top of the main crane girder, and there are two 50-hp motors in service. The motors are operated by three-phase, 550-volt energy supplied by three horizontal trolley wires carried along the travel of the crane on wooden posts, as shown herewith. The energy consumed by the crane is metered in a pole box at one side of the runway, and the lines on the station side of the meter are the secondaries of step-down transformer equipment installed at a center of distribution in the neighborhood. A main switch and fuses are mounted in the meter box. The crane is controlled from a cab hung from the main girder at one end, and it is in service on weekdays from 7 a. m. to 12 a. m. and from 12:30 p. m. to 4 p. m. By its use eleven freight cars can be loaded without shifting. The busiest season is from March to November.

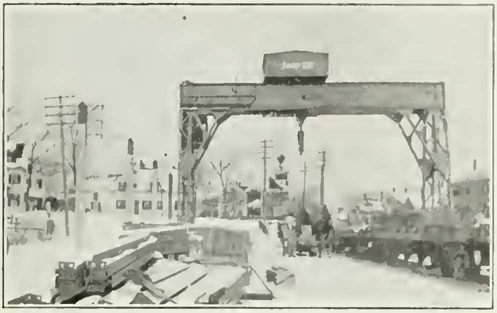

Fig. 6—Electric Crane in Freight Yard.

Fig. 7—Electrically Operated Granite-Cutting Plant.

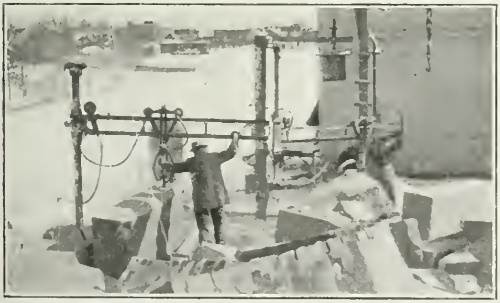

Fig. 8—Motor-Driven Granite-Cutting Machine.

CENTRAL-STATION ELECTRIC MOTOR SERVICE AT WORCESTER, MASS.

The Worcester (Mass.) Electric Light Company serves one of the most prominent manufacturing cities of the East, and illustrates in a marked degree the benefits of motor-load expansion, both to the company itself and to the community. In 1907 the connected motor load of the company was 1449 hp and the income from this service was $44,596. In 1910 the connected motor load totaled 2070 hp and the company earned from this service in the year ended June 30 last $66,000, or a gain of practically 50 per cent in revenue. The influence of this increase upon the economy of the generating station of the company is noticeable in a reduction of operating cost at the busbar, exclusive of fixed charges, by approximately ¼ cent per kw-hour.

Among the larger customers to which the company now supplies energy are the following: Worcester *Telegram*, about 150 hp connected motor load; J. B. Garland & Son, grain elevator, 115 hp; Worcester Brewing Corporation, 300 hp; Crompton & Knowles Loom Works, 300 hp in group drives; Cudahy Packing Company, 15 hp, refrigeration load; Worcester Market, refrigeration and miscellaneous service, 50 hp; W. H. Leland & Company, grinding machinery, summer night work frequent, about 100 hp. The newspaper load above cited occurs mainly during the small hours of the night and is influential in placing a better load on the station at a time which is usually rather devoid of motor load. The city sewer department operates three automatic electric pumping stations. At the Gold Street station are two 5-hp, 500-volt motors arranged in duplicate for operating a 4-in. centrifugal pump with a lift of about 9½ ft. At the Lake View station are two 15-hp motors arranged in duplicate for the operation of air compressors in connection with Shone ejectors lifting sewage by three stages 180 ft. At the Highlands pumping station are two 5-hp motors operated in connection with compressors and a Shone ejector lifting sewage 65 ft.

GROWTH IN CENTRAL-STATION MOTOR SERVICE AT LOWELL, MASS.

Rapid growth in the central-station motor-service business has been a feature of the electrical situation in Lowell, Mass., during the past three years. In the year ended June 30. 1907, the Lowell Electric Light Corporation sold 2,196,736 kw-hours for motor service and derived from this a revenue of $76,651. In the corresponding fiscal year 1910 the company had a connected motor load of 8250 hp, compared with 5071 hp in 1907; its motor-service income was $160,588 and the sales of energy for motor service were 6,336,052 kw-hours. There is now 0.9 hp of connected motor load in Lowell per inhabitant. The present day load on the company's station is from 3500 kw to 4000 kw. The company's load-factor is running between 33 per cent and 38 per cent. On account of the limited amount of water in the Merrimac River, which flows through the city, the company is taking up the supply of electricity to textile mills with a considerable measure of success.

ATTRACTIVE NEWSPAPER MOTOR LOAD AT BOSTON

One of the latest motor load acquisitions of the Edison Electric Illuminating Company of Boston is furnished by the Boston *Herald*, a daily newspaper of long-time prominence in the life of the city. The *Herald* owns one of the most completely equipped electrically driven plants in the country Electrical energy was formerly generated in the *Herald* building by a gas-engine plant operated from the local city service, but a recent change in management, combined with a thorough study of the requirements by the Edison company, has led to the shutting down of the gas-power equipment and the entire adoption of central-station service for both lighting and motor service.

The *Herald* plant is located in a special building at the rear of the newspaper commercial offices. The importance of the electric drive in permitting rapid production of fresh editions led the management of the paper to install an extensive individual driving service for the separate machines. Out of an entire page of eight columns in the paper perhaps only one-half column may be set by hand. Motor-driven machinery is installed at every step. Three 55-kw and one 25-kw gas-engine units are superseded by the Edison service. The plant contains one Hoe color press and four Hoe sextuple presses, the latter being driven in each case by a 4-hp motor for slow motion and a 50-hp motor for regular production. Jenney control appliances are provided in connection with the press motors, so that push-button operation is all that is required in the pressroom. The presses are started with the small motors and then operated by the larger ones. Motor-driven starting boxes are provided, and the equipment is arranged to cut in the resistance automatically in case the supply of energy is cut off temporarily. The motors are installed in concrete pits below the presses. The total rated output of the plant is about 375,000 eight-page papers per hour. The larger presses are capable of printing ninety-six-page issues. Electric hoists are used in the pressroom in handling the rolls.

A list of the principal equipment follows:

Stereotype Room.—Matrix roaster, ½ hp; three tail cutters, each, 5 hp; two curved shavers, each, 2 hp; one flat shaver, 3 hp; one jig saw and drill, 1 hp; one flat router, 1.5 hp; one bending machine, 2 hp; two curved routers, 2 hp each; one saw and beveler, 1 hp; one sump pump, 3 hp.

Machine Shop.—Speed lathe, back-geared to ½-hp motor; one circular saw, 5 hp; one engine lathe, 1 hp; one emery grinder, ½ hp.

Composing Room.—Twenty-seven linotype machines, each equipped with a ¼-hp motor arranged to start when the operator takes his seat; two sets of field coils on each motor and three speeds of machines, 70 r.p.m. to 74 r.p.m.; maximum setting capacity, 9000 ems per hour each. Copy carrier in composing-room, ½-hp motor; three copy carriers serving proofreaders' desks, ½ hp each; two matrix rollers, each 3 hp; matrix endless-belt conveyor to basement, 2-hp motor; one lathe for line work, ⅔ hp; one metal saw, 1 hp. Cuts are handled by push-button elevator, motor-operated.

Engraving Department.—Two powdering machines, 3 hp each; two etching machines, each 3 hp; one saw and trimmer, 2 hp; two flat routing machines, 20,000 r.p.m., one ¼ hp each.

Mailing Room.—Four conveyors, back-geared to 2-hp motors; job presses, ¼-hp and ⅓-hp motors; addressograph, ⅓ hp.

The larger part of this work is handled either during the daytime or in the night hours of the early morning off the main peak of the service. Several other newspapers in Boston are operated by motors receiving energy from Edison circuits.

ELECTRIC MOTOR SERVICE AT CAMBRIDGE, MASS.

Long-hour motor service has been cultivated to a large degree by the Cambridge Electric Light Company within the past two years. A specially advantageous load of this character has been furnished by the Cambridge subway, which is now rapidly approaching completion under the hands of the H. P. Nawn Contracting Company, of Boston. The subway is being built by the Boston Elevated Railway Company. The uses of electricity in its construction were described in the *Electrical World* of July 28, 1910, the load being particularly desirable on account of its being on the system twenty-four hours per day and seven days per week. The demands for electricity have naturally dropped off somewhat with the completion of some of the heavier work, but the company is still supplying continuous service to a limited extent. Among the large customers now using the company's service are the John P. Squires Packing Company, 1200 hp, with about 600 additional horse-power to be added shortly; the Boston Woven Hose Company, 1000 hp; the Riverside and University presses, about 130 hp each; the Wood Lumber Company, 160 hp; C. F. Hathaway & Son, bakers, 85 hp to 100 hp; John Cross & Company, owners of a new shoe factory, 175 hp, and the Manhattan Market, about 50 hp.

The above loads are either of the off-peak or long-hour type for the most part. The bakery load is largely carried during the night; the woven-hose establishment operates a night shift at certain times, and the two large printing plants are operated almost entirely on a day basis. At the Squires plant a heavy refrigerating load is carried in the summer season, with a considerable amount of energy utilized much of the time in the butchering and box departments. The Manhattan Market is the largest in the city, and is one of the best equipped in the State from the electrical point of view. In addition to the usual meat, fish and delicatessen departments the market does a large business in the sale of dairy products, fruit, canned goods and kitchenware. Most of the motors are of the three-phase induction type, operated on a 550-volt circuit. The most important mechanical service performed in the market is refrigeration, and the Manhattan plant is equipped with a 7.5-ton York ice machine belt-driven by a 15-hp motor, together with a Dean vertical triplex brine pump having a rated output of 90 gal. per minute. In one of the first years of this plant's service the cost of operation by electricity was $2,600 less than when the market used ice, energy being supplied at 2.5 cents per kw-hour and ice being sold at about $3 per ton. It has been found that cuts of meat exposed in the cooled showcases remain drier and in good condition much longer than under the old method of ice cooling. Small fan motors are used to circulate air in the cooled rooms, and the ice boxes are electrically lighted. Other equipment in the plant includes a coffee mill driven by a 1.5-hp motor, a ventilating fan driven by a 0.5-hp motor for the main cold chest, a 2-hp Enterprise meat chopper, and a complete system of parcel and stock conveyors operated by a 7.5-hp motor. The conveyors carry the parcels from the counters to a checking desk and thence to an assorting-room in the basement, where all outgoing orders are assembled for team delivery. After the orders are assembled they are carried to the first floor by a conveyor and transferred to the shipping wagons. Each conveyor is a continuous belt and all empty parcel boxes are returned automatically to the sender. All conveyors are 17 in. wide. The 7.5-hp motor above mentioned drives the conveyor between the first floor and basement by worm gearing, and by means of a countershaft the same motor also drives an elevator used for handling heavier articles between the receiving department and the street floor. The latter hoist is specially equipped with lugs to handle barrels and has a rating of 600 lb. A belt conveyor is also provided in the plant between the shipping department and the first floor. This has a rating of 100 lb. and is driven by a 1-hp motor. Electricity has been in use in this market about five years. The proprietors are thoroughly convinced that central-station service is the most economical and efficient for their work, and enlargements of the establishment are certain to be operated by electric motors.

ELECTRICITY IN AN AUTOMOBILE-SERVICE DEPOT.

Electricity is extensively used in the largest automobile-service depot in New England, which is that of the Packard Motor Car Company at Boston. About a year ago this establishment was opened to the public under the management of Mr. Alvan T. Fuller. It is located on Commonwealth Avenue in the Allston district of Boston, and consists of a four-story and basement reinforced-concrete building, 352 ft. long x 70 ft. wide, entirely devoted to the garaging, assembly, sale, display and maintenance of automobiles. The structure was erected at a cost of about $300,000; about 300 persons are employed in it and about $1,000,000 worth of high-grade cars can readily be stored in the building at any one time. The electric service of the building is supplied by the Edison Electric Illuminating Company of Boston and it is in the main of the off-peak type, the plant shutting down daily at 5:30 p. m.

The electric motor installation includes about a dozen machines of the induction type scattered throughout various departments, in general operating the equipment on the group-driving basis. The first floor of the building is equipped with facilities for handling a large number of quick-repair jobs, a large corps of expert testers always being available, and it also includes an electrical department where magnetos and batteries are given particular attention by specialists. On this floor the battery and magneto-room is equipped with a ⅛-hp motor which drives a magneto and coil tester, and a U-shaped helix is also provided for the magnetization of permanent magnets in magneto apparatus. This coil takes 5-amp at 110 volts direct current, the supply being taken from a mercury-arc rectifier, which is also used in charging sparking batteries The electrical department is connected with the other floors of the building by a Burdett-Rowntree double dumb-waiter installation, each waiter being driven by a 4-hp motor. The waiters pass through the center of the stockroom department, where are stored supplies valued at about $200,000, maintained for the benefit of the owners of these cars. The waiters are of the automatic type with push-button operation for different floor stops.

The repairing facilities on the first floor of the building include a small machine shop with the tools driven in group by a 2-hp, 220-volt induction motor. The machine tools thus operated include a twist drill, lathe and grinder. On this floor is a portable tire pump driven by a short belt from a 1/6-hp, 110-volt induction motor. All the floors of the building are connected by an electric elevator of about 8000-lb. rating driven by a 25-hp motor. With this equipment two of the largest automobiles may be lifted simultaneously to the top floor of the establishment. Space is provided in the building for the installation of a second elevator of this rating when necessary. The entire plant is equipped with an automatic telephone call-bell system which rings the gongs on each floor according to a prearranged signal when any officer of the establishment is required at the wire. An electric time-program clock is also in service.

The top floor of the building contains the overhauling department, which is one of the most extensive of its kind in the world. A large part of the company's business consists in the modernization of cars of a former year's production. The overhauling work is segregated into divisions for the handling of rear end, clutch, steering, motor, carburetor and other portions of the motor vehicle, and the floor of the building is clear of posts, giving a maximum efficiency in the working space. On this floor is a coach department in which the most complete body repairs can be handled, including both upholstery and carpenter work, whether the bodies are of wood or aluminum. On this floor is a machine shop equipped with three lathes, a grinder, two drills and a forge blower driven in group by a 7.5-hp induction motor mounted on a steel framing attached to the concrete wall of the department. To meet the insurance requirements a blacksmith shop on this floor has been installed substantially on the outside of the building, with wired glass and other fireproof construction separating it from the repair division proper, including a separate entrance. The blacksmith shop contains three forges supplied with air by a blower located inside the overhauling department.

The third floor contains an enameling department, wheel-building machinery, a paint shop and upholstery division, with woodworking shop. Two 1/6-hp motors are in service in connection with the individual driving of heavy sewing machines for upholstery work. The woodworking plant consists of a band saw, grinder and stone driven by a 3-hp motor, one or two other special machines being provided on the same countershafting. The benches in the upholstery department are arranged so that the operator sits in a recess and faces the length of the bench rather than its width. In the basement of the plant are two 2-hp motor-driven drainage pumps, the motors being of the induction type. All the energy for the building is drawn from a transformer on the outside, which is connected with the Commonwealth Avenue substation service of the Edison company. A three-panel switchboard equipped with Wright demand meters is in service on the first floor. All the wiring is carried in iron conduit, and the establishment is equipped with fifty mercury-vapor lamps of the 4-amp, 100-watt size. The paint shop is lighted by tungsten lamps, which are used in the offices also. A large electric sign installation will shortly be made on the roof. Mr. C. A. Jacobs is chief electrician, Mr. A. P. Wilburn is assistant superintendent and Mr. R. H. Bolles is superintendent of the establishment.

ELECTRICITY ON BARGE CANAL WORK

Contractors' Construction Plant for Deepening and Widening the Present Erie Canal at Lockport.

THE New York State Barge Canal consists of an enlargement and relocation of the present Erie and Oswego canals so as to accommodate barges of 2000 tons capacity. The improvements, which were authorized by the State Legislature in 1903, are estimated to cost $101,000,000. The total length of the improved canals, including the Champlain Canal, is 433 miles and the section replacing the Erie Canal from Troy to Buffalo will be 353.5 miles long. Many of the contractors engaged in the work along this branch of the barge canal employ electricity to a greater or less extent, and a notable installation at Rochester was described in these columns a year ago. From a point a few miles west of Rochester to the Niagara River the work of enlargement involves the present Erie Canal and includes in its length a sixty-mile level between Rochester and Lockport. Through this section of the canal the traffic is a maximum and the terms under which the work is being done require the maintenance of the channel throughout the season of navigation, from May 15 to Nov. 15. During the rest of the year the water is out of the canal bed, enabling work to be carried on in the dry.

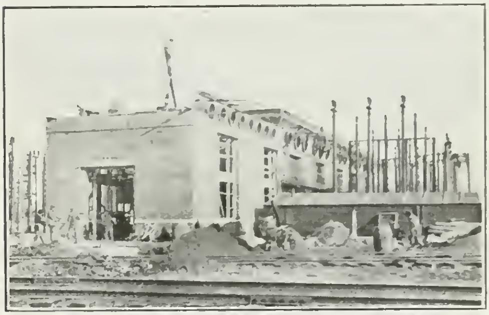

Fig. 1—Contractors' Annex to Niagara, Lockport & Ontario Power Company's Substation.

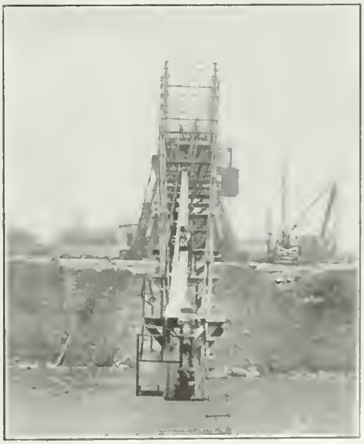

Fig. 2—End View of Cantilever Crane.

The section immediately west of the sixty-mile level and extending from Lockport to the guard lock at Sulphur Springs, a distance of about five miles, is being enlarged by the United Engineering & Contracting Company, of New York City, and will be completed in the spring of 1912. A feature of the construction work is that electricity is employed throughout except in the steam shovels, and the work involves a connected load of some 2000 hp used twenty-four hours a day. The field headquarters of the company are at about the mid-point of the contract section between the canal and the Buffalo, Lockport & Rochester Railway, the electric line over which supplies and machinery are brought. The group of buildings near the canal consists of an office building, storehouse, power house, machine and blacksmith shops, an oil house and a number of small structures; a group further removed is the camp and comprises boarding and lodging houses.

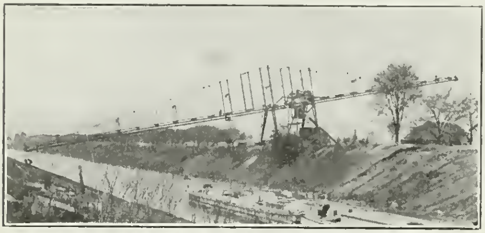

Fig. 3—Cantilever Crane on Barge Canal.

The location of the first group of structures was largely determined by the location of the high-tension lines of the Niagara, Lockport & Ontario Power Company, from which the energy is purchased. The switching station of the transmission company is located close by, and here the potential is stepped down from 60,000 volts to 2200 volts, and circuits carrying energy at this potential run to the compressor house of the contractor. The load required an addition to the Niagara, Lockport & Ontario Power Company's switching station at the expense of the contractor, who in addition owns the step-down transformers. The energy is purchased at 60,000 volts and the operation of the contractor's step-down station is intrusted to the transmission company. The transformer equipment consists of three 500-kw water-cooled, delta-connected, 60,000-2200-volt, single-phase transformers.

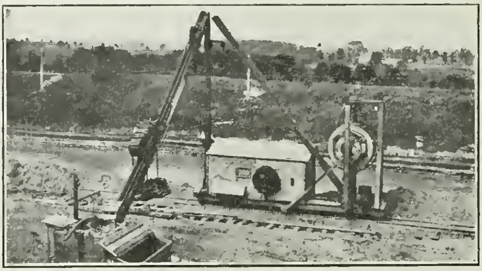

Fig. 4—Portable Transformer House.

The main equipment in the power house of the contractor consists of a large air-compressor plant producing normally 8400 cu. ft. of free air per minute at a pressure of 105 lb. per square inch. Each compressor is a two-stage duplex machine driven by an electric motor located between the compressor cylinders. The compressors are three in number and were employed by the same contractor in the underground tunnel work of the Pennsylvania Railroad across New York City a few years ago. At that time they were driven by direct-current motors supplied with energy from the mains of the New York Edison Company. At present each of the compressors is driven by a 500-hp, 25-cycle synchronous motor wound for 2200 volts and operating at a speed of 107 r.p.m. Two exciter sets comprising a 75-hp motor and a 50-kw generator are installed, either of which is large enough to supply the excitation of the three motors in question.

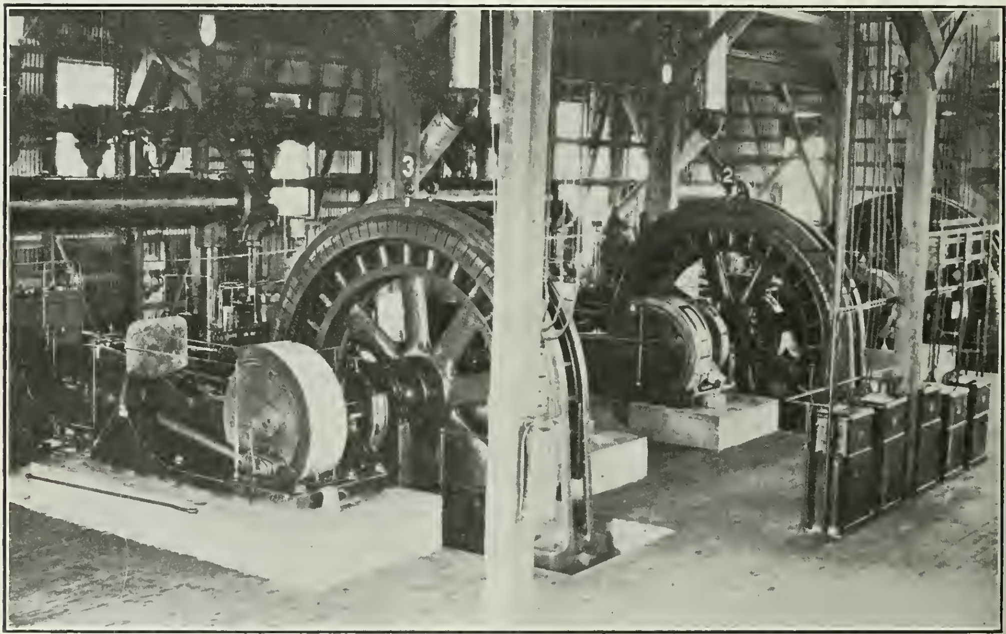

Fig. 5—Motor-Driven Compressor Plant of the United Engineering & Contracting Company at Lockport, N. Y.

From the compressor plant air lines run along the bank of the canal for supplying air to drills, hoists, an excavator and a number of small pumps. In addition to the air line, a water line and three-phase electric transmission line are carried practically the entire length of the contract. The three-phase line supplies energy for the operation of a cantilever crane, a number of pumps and a tipple near the eastern end of the work. In addition electricity is used for lamp circuits, "G. I." flaming-arc lamps operating on 25-cycle circuits being employed at night. The electrically driven pumps are of two sizes. Six of them are 6-in. volute pumps with a capacity of 1000 gal. per minute against a 48-ft. head and each is direct-connected to a 25-hp, 440-volt induction motor. Two others are 12-in centrifugal pumps having a capacity of 4000 gal. per minute against a head of 50-ft. and each is driven by a 100-hp induction motor

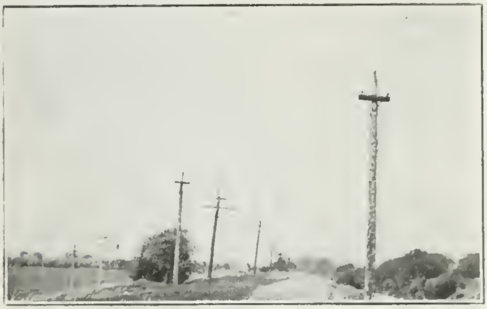

Fig. 6—Contractors' Transmission Line.

For taking out the earth section the contractor installed a large cantilever crane 382.5 ft. long and mounted on a tower with a 35-ft. x 37-ft. base The cantilever arm overhanging the canal is 192 ft. 9 in long and that over the spoil bank 152 ft. 1 in. The trolley has a run of 360 ft It is possible to use this outfit while navigation is in progress. The crane is operated by a 225-hp induction motor geared to two drums, one for hoisting and the other for the trolley traverse ropes. The energy is obtained from the three-phase line on the other bank of the canal and connections are made with this line by conductors suspended across the canal and terminating on the other side in a traveling transformer car The wires are carried high enough to clear the towpath and barges, and the suspended length allowed is sufficient to permit the transformer car to travel about 100 ft. along the canal However, since a greater travel than this was desired for the crane without changing the connection to the pole line, and since it was necessary for the crane to travel independently of the car, a flexible connection was provided for the two. This scheme was designed by Mr. W. C. Lancaster, assistant manager of the contracting company.

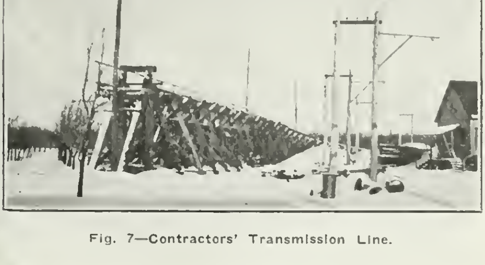

Fig. 7—Contractors' Transmission Line.

The transformer car is mounted over one pair of the rails on which the crane runs and a stiff-leg extends across to a truck on the other pair of rails. On the transformer car are four 60-kw transformers stepping down the potential from 2200 volts to 440 volts. Three of these are in service and the fourth is provided as a spare. During the summer it is found that the transformers are liable to overheat, and for that reason a 2-hp induction motor is installed to operate a fan for keeping up a good circulation in the transformer house. Each of the three low-tension lines emerging from the transformers is carried to a pair of trolley wheels which engage heavy wire forming three separate circles carried on insulators on the outside of a drum. From each of these circular wires a permanent connection is taken off on the inside of the drum and the three connections thus secured are wrapped into a large cable which is wound on a drum adjacent to the three circles of wire. About 100 ft. of this cable are provided and the other end is connected to the operator's cabin on the cantilever

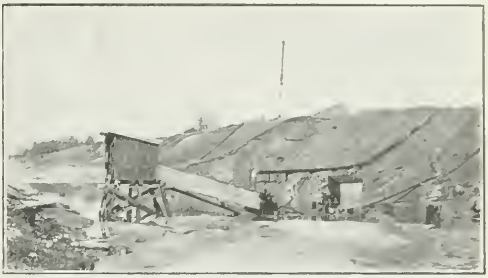

Fig. 8—Electric Pump in Canal Bed.

Provision is made for keeping the cable taut on the reel and for that purpose a wire rope is wound around a small auxiliary drum on the same shaft as the reel and is led to a seven-part tackle, the stationary block of which is at the top of the mast on the transformer-house side of the outfit. The other block is attached to a carriage traveling on a rail on the stiff-leg which reaches across the track from one set of crane rails to the other. This carriage is loaded with 3½ tons of pig iron and its weight serves to prevent undesirable sag between the crane and the transformer car, and to wind up the cable when the distance between the two is decreased Upon the truck carrying the lower end of the stiff-leg is a tool house in which there are a machinist's bench and a telephone connected with the central power house.

When the car and the crane have gone as far ahead as possible it is necessary to disconnect the lines on the towpath side of the canal and to move the connection forward to the next pole. This distance is 125 ft. Long practice has made the operators in charge of the machine very proficient in advancing the line. A test of the time lost in the change was made to determine the efficacy of the arrangement. Over the telephone line terminating in the tool house orders were given to the

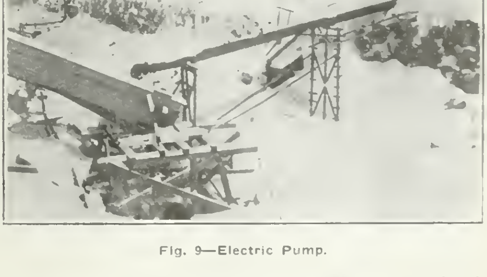

Fig. 9—Electric Pump.

power house to shut off the circuit. The three lines were then disconnected, carried forward 125 ft., the terminals hoisted to the next pole and connections restored. From the time the order was given to shut off the circuit until a counter-request was made to turn it on again was eighteen minutes.

The crane travels on four four-wheel trucks, one beneath each leg of the tower. In some cases it has been necessary to do considerable cribbing where hollows had to be crossed. This scheme insures a track with all rails properly spaced and safeguards against the rails spreading. The rails rest on tie-plates and are provided with rail braces, while the stringers are properly spaced and held by short lengths of angles spiked to the ties. About 240 ft. of such track is used, and, depending somewhat on the progress of the work, either one or two 30-ft. sections are moved in a day, requiring the use of a single-drum air-driven hoisting engine, which drags the parts of the track ahead.

Fig. 10—Electric Pump.

The load-factor of the entire system in winter, when most work is done, averages 75 per cent and during the summer it is about 50 per cent.

* * *

ELECTRICAL IRRIGATION ON THE OUTSKIRTS OF CHICAGO.

On a truck farm within three or four miles of the city limits of Chicago, bordering on a small river, there was installed last year a small electrically driven irrigation plant which is of unusual interest, because it is near a large city and in a region where there is abundant precipitation of moisture, taking the year as a whole. Although the normal rainfall is sufficient for ordinary growing crops, yet there are often prolonged dry periods, and the owner of the plant is convinced that it will pay him to irrigate his land at these times, particularly in forcing "garden truck" for the early market.

A recent central-station extension enabled the enterprising farmer to take advantage of the many conveniences afforded by the use of electrical energy. The owner has had his house, barns and out-buildings completely wired for electricity, so that the premises are now electrically lighted. There is also a 32-cp incandescent lamp in the barnyard. This lamp is controlled from the house, so that when anyone drives into the yard after dark a switch in the house may be turned on and the yard is instantly flooded with light. An electric motor is placed in the basement of the house, and to it is belted a line shaft from which a cream separator, a washing machine, a churn and other small machines are driven.

The present irrigation plant (Fig. 1) consists of a single-stage centrifugal pump belted to a 5-hp. three-phase, 60-cycle, 220-volt General Electric motor. The pump is driven at 740 r.p.m. and delivers 480 gal. of water a minute against a 25-ft. head. To install this outfit a pit or recess was dug in the bank of the river. Over this hole a platform was built upon which the pump is mounted. From the pump a 6-in. intake pipe 8 ft. long drops vertically into the water. This intake is provided with a valve which prevents the water flowing back into the river when the pump is shut down, and thereby the pump remains primed for a considerable length of time and seldom has to be primed by hand when starting. The arrangement of the pumping outfit is shown in Fig. 2.

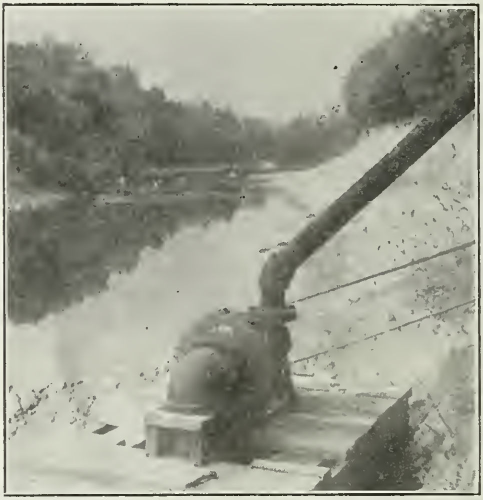

Fig. 1—Motor-Driven Centrifugal Pump.

A 4-in. discharge pipe is carried from the pump to the top of the river bank and water is discharged into a ditch which conveys it to portions of the farm which it is desired to irrigate. The discharge of the water on the land is illustrated in Fig. 3.

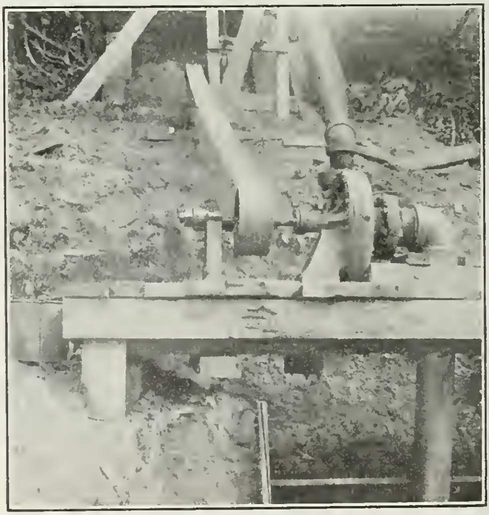

Fig. 2—5-hp Motor Belted to Pump.

The irrigating system was installed late last season and will be extended, probably. So far the water has been used only to irrigate twelve acres of sweet corn, the water being run between the rows in the furrows left by the cultivator.

A test shows that the pump motor requires an input of

4.4 kw, and the meter showing energy used on this service registered 148 kw-hours between July 15 and Aug. 19, 1910, which would indicate that the pump was operated approximately thirty-four hours, or about one hour a day. It is estimated that this expenditure of energy was sufficient to deposit on the land about 980,000 gal. of water. This would be sufficient to cover the field irrigated three times to a depth of 1 in. Apparently the pumping of the water cost about 1.5 cents per 1000 gal.

Fig. 3—Discharge of Pump.

The pumping installation cost the owner about $200 and he was required to pay $75 toward the cost of the line serving it, which was rather long considering the amount of energy taken by the motor. The motor has been used for cutting feed for cattle during the winter, having been transported to the barn for that purpose, and it will be used at other points about the farm when not needed to drive the pump.

The owner of this pumping installation expects to irrigate about 25 acres of land with it this year, and he is also considering the installation of a similar or smaller plant to irrigate his land on the other side of the river.

ELECTRIC DRIVE IN A CHICAGO LIMESTONE QUARRY.

ONE of the most interesting of the recent industrial applications of electricity in Chicago is the new electrically operated plant of the Chicago Union Lime Works Company at Nineteenth and Lincoln Streets. It is of interest, not only because it is an excellent example of the usefulness of electric drive, supplanting an old steam plant, but because of the unusual character of the stone quarry itself.

Few people realize that there are several stone quarries in operation within the city limits of Chicago. Perhaps the one of greatest interest is that of the company referred to in the present article. It is within twenty minutes' ride of the Union Loop district by elevated railway, and yet here, almost in the heart of a large city, is a great hole in the earth nearly as large as a city block and almost 300 ft. deep. This unusual condition is explained by the fact that the quarry was established in 1859 by Mr. T. W. Phinney, the president of the company, who is now advanced in years and resides in Newport, R. I. At the time it was established this quarry was well out in the country, but the city has gradually grown around it. A high board fence surrounds the pit on all sides, so that the ordinary passer-by is not aware of its existence.

The quarry has been gradually excavated straight down in solid limestone rock, the sides of the pit going down sheer to a depth of nearly 300 ft. The rock is blasted out at the bottom and hoisted to the works at the top, where a part of it is converted into crushed stone and the remainder burned in limekilns.

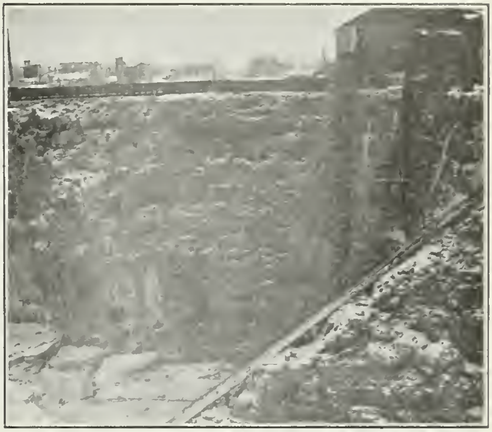

Fig. 1—General View of the Limestone Quarry.

For many years the plant was operated by steam, but as nowadays nearly all modern stone plants use electric drive, it was determined last year to erect an entirely new crushing plant and at the same time substitute electricity for steam. This change in motive power is an economical one, particularly as the use of steam involves a live-steam pipe line about 400 ft. long to operate the pump at the bottom of the quarry with the consequent losses by condensation. All the operations of the plant are now conducted by means of electrical energy, and the proprietors are well satisfied with the change. Fig. 1 gives a general view of a portion of the quarry, showing the abandoned plant at the right and the new electrically operated plant, with its vertical hoist, at the left of the old plant. The long stairway for workmen, on a rock incline, is also shown.

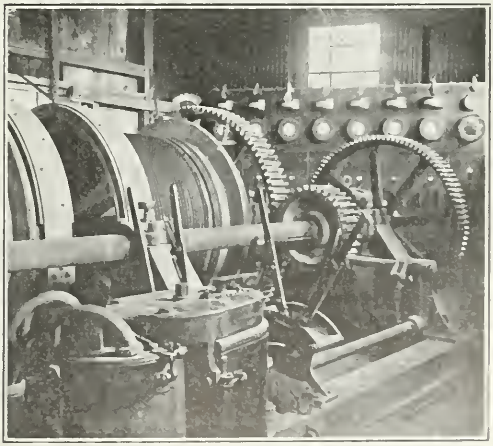

Fig. 2—Electric Hoist and Switchboard.

Electricity is purchased from the Cosmopolitan Electric Company and comes to the plant over an overhead four-wire circuit carrying 2300/4000-volt, three-phase, 60-cycle alternating current. The incoming wires are taken through lead-covered cables into a fireproof transformer-room in the steel-and-concrete crusher house. This transformer-room has floor dimensions of 8 ft. x 12 ft., and its walls consist of slabs of concrete which were poured on the spot. It contains six General Electric air-cooled transformers for the motor circuits and also one 10-kw transformer for the lighting circuits. The secondary circuits from the motor transformers are operated at 440 volts, and the lighting circuits at 110 volts. All wiring throughout the plant is in conduit.

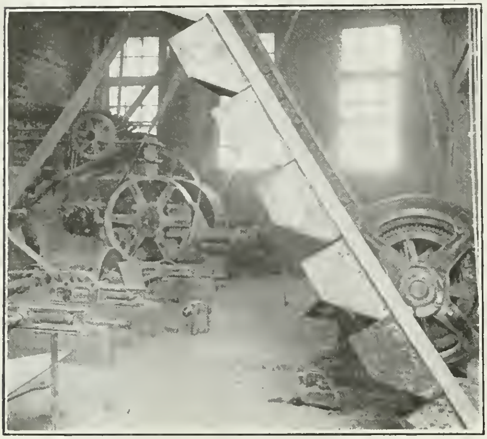

Fig. 3—7.5-hp Motor Driving Crushers and Rolls.

There are six motors in the plant, all made by the Allis-Chalmers Company. The largest one is rated at 125 hp and is directly geared to the winding drum of the balanced hoist which lifts the cars of limestone rock from the bottom of the quarry to the unloading platform of the hoist in the crusher house, this being a straight lift of 290 ft. The rotor of the hoisting motor is phase-wound, and the controller for operating the motor is of the Cutler-Hammer drum type. At the top of the hoist the cars are run onto the tracks of a tramway and either pushed by hand to the edge of a No. 7½ crusher, where their contents are discharged, or else turned by means of a turntable and run along a track leading to the tops of the kilns.

The controlling switchboard for all motors and lamps is located in the room containing the hoisting machinery, and is shown in Fig. 2. It is an eight-panel slate board consisting of one service panel, six motor panels and one lighting panel The last named controls the circuits supplying one flaming-arc lamp and 125 incandescent lamps used about the premises Each of the motor and lighting panels is equipped with the necessary switches and also with a Westinghouse watt-hour meter and a Wagner ammeter. There is also a bracket-mounted Wagner voltmeter and, on the service panel, a total watt-hour meter made by the Fort Wayne Electric Works Behind the board is placed a printing attachment made by the Chicago Electric Meter Company to show the maximum-demand registration.

A 75-hp motor is belted to shafting which drives two continuous-bucket elevators, two revolving screens and two shaking screens. The No. 7½ crusher previously referred to is directly belted to a 75-hp motor. Another motor of the same size drives shafting to which are belted two No. 3 crushers and two sets of crushing rolls. This is shown in Fig. 3. An air compressor made by the Chicago Pneumatic Tool Company is directly belted to a 75-hp motor, the motor, compressor and tank being housed together on the ground level. Two lines of piping for compressed air lead from the tank to which the air compressor is attached. One of these runs down into the quarry and serves to operate the pneumatic drills used to make the holes in the rock for blasting. The other air line is subdivided and runs to convenient points in the crusher house, where compressed air is used for various purposes, such as blowing out the motors, etc.

At the bottom of the quarry, in its own housing, is a 60-hp motor which drives a three-stage centrifugal pump of the Escher-Wyss type. This pump serves to free the bottom of the quarry both from surface water and from the water of springs which are encountered in the rock. It lifts the water a distance of 260 ft. to the surface of the ground, where it is discharged into a sewer. The capacity of this pump is 400 gal. a minute, and it is direct-connected to its motor. All motors are of the 440-volt, 60-cycle, three-phase, alternating-current type.

The products of the Chicago Union Lime Works Company are lime and crushed stone. To one unaccustomed to lime burning it is interesting to note that the fuel used in the kilns consists of shavings and manure, which is said to give the best result. Mr. Julian J. Pleas is vice-president of the company and Mr. T. P. Henderson is secretary and treasurer. The consulting engineer for the new crusher plant, including electrical equipment, was the J. C. Buckbee Company, Mr. James J. Bassett having immediate charge of the installation. The Lounsbery Brothers Company was the electrical contractor.

ELECTRICITY FOR FARMERS IN KNOX AND PEORIA COUNTIES, ILL.

ONE of the first among the small central-station companies to make a practice of carrying its electric service wires to the doors of neighboring farmers is the Elmwood Electric Light Company, which from its steam-driven generating station at Elmwood, Ill., furnishes electricity for lighting and motors to about fifty farms scattered along the lines of its transmission system in Knox and Peoria Counties within a radius of twelve miles.

The extent of the present distribution lines is shown by the accompanying map of the system, on which the locations of the farm customers have been indicated by black circles. The principal business of the Elmwood company, of course, is the supply of energy to consumers in the several small towns reached by its lines, as shown In Elmwood, where the power plant and office of the company are located, it has 300 customers; in Yates City, 120; in Douglass, 30; in Maquon, 100, and in Brimfield, 120. As indicated, the company is extending its lines to Monica and Princeville, where additional loads will be taken on. The region penetrated by this new 13,200-volt transmission line is of unusual agricultural wealth and a number of farmers' installations will be added to the Elmwood system when this extension is completed.

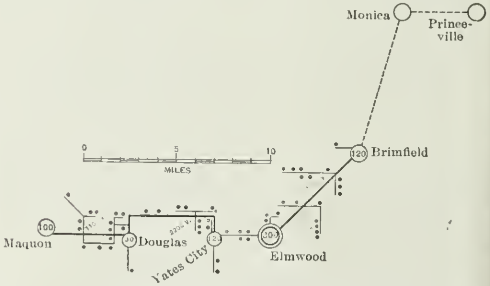

Fig. 1—Transmission System and Farm Customers of Elmwood (Ill.) Electric Light Company.

The generating equipment at Elmwood comprises a 325-hp Chalmers-Corliss engine driving by belts an "80-light" Wood arc machine and one 100-kw and one 138-kw Fort Wayne 1100-volt, 60-cycle, single-phase alternator, besides a 125-hp Cooper-Corliss engine driving an 85-kw Fort Wayne 1100-volt, 60-cycle, three-phase alternator. Elmwood and the system east are served from one phase, the western extension by a second phase, while the third phase will remain idle until the new Princeville line is completed. The three-mile line from Elmwood to Yates City operates at the generator e.m.f. of 1100 volts, while the lines beyond, to Douglass and Maquon, have their pressure stepped up to 6600 volts through a 30-kw transformer at Yates City. The eastern system, from Elmwood to Princeville, will utilize 13,200-volt transmission, raising the pressure of the present Brimfield line, which operates at 2000 volts.

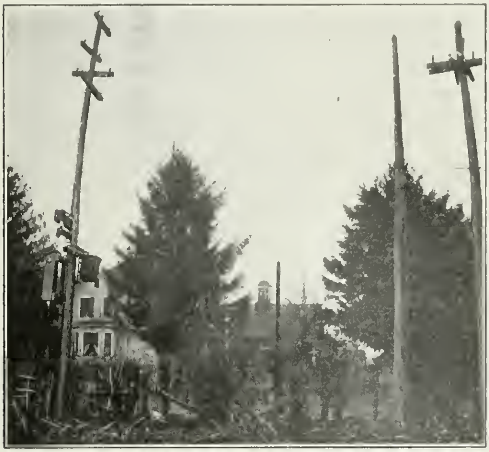

Fig. 2—Step-Down Transformer Supplying Eight Farms Through Six 1-kw Transformers and Three Miles of Land.

From the main transmission lines step-down transformers of from 5 kw to 10 kw rating reduce the line potential to the distributing pressure, 2200 volts or 1100 volts. This single-phase, 60-cycle energy at this voltage is then brought directly to the farmer's yard, where a 1-kw pole-type transformer again reduces it to the house pressure, 104 volts. In some instances two farms are served from the same 1-kw transformer where this can be conveniently done. Two farms on the line between Yates City and Douglass are served through 1-kw step-down transformers directly from the 6600-volt transmission wires. Several of the 1100-volt and 2200-volt secondary distributing lines are three miles or more in length, serving half a dozen farmers along the route.

The Elmwood company offers to extend its lines to any farmer desiring service within three-quarters of a mile of its existing lines provided the farmer pays $1 per pole (thirty-five to the mile) and hauls and sets the poles. Part of this secondary distributing system uses iron wire, No. 8 extra BB being found to combine the required mechanical strength and conductivity necessary for these scattered services. The poles are set at intervals of from 140 ft. to 170 ft. Such pole-line secondaries cost the company about $100 a mile, and a farmer's installation, including meter, transformer and labor of installation, costs about $50 complete. All farmers' services are metered, both meters and transformers being furnished by the company. No contract or agreement to use a required amount of electrical service is demanded of a prospective customer in order to get the company to extend its lines to his house, except the payment for poles and hauling, as above mentioned.

The rate for electrical energy to all consumers on the Elmwood system, whether in the towns or on farms, is 10 cents per kw-hour regardless of the quantity consumed. The urban customers pay a monthly minimum of $1 for each service, while the farm minimum is $2 a month. Besides the extra cost of reaching farm customers, including line and twenty-four-hour transformer losses, which are naturally disproportionately high for isolated services, the extra minimum bill imposed upon the farmer is justified by the greater number of lamps he usually has installed and his consequently greater demand during the lighting peak. The average farmhouse on the Elmwood system has from twenty to thirty lamps, including porch lamps and yard lamps, and generally several lamps in the stable.

The farm peak lighting load comes on earlier than the usual town load. On the country lines another distinct lighting peak comes shortly after 3 a. m., when the farmers begin to rise early to commence the day's work, eating breakfast and doing the morning chores by electric light. Unusual lighting demands were also noticed by the station attendant during last November, when the farm employees were working early and late picking corn.

Besides the lighting service every farm on the Elmwood system has one or more electric flatirons, of which the housewives make good use. A number of small motors are employed to operate churns, pumps, washing machines, fans, cream separators, feed grinders, etc. Except flatirons electric heating and cooking appliances do not seem to take well with farm users in the experience of the local company. Farm appetites usually require appeasing on a larger scale than electric cooking appliances are capable of operating economically.

All farm customers are equipped with meters, which are read at two-month intervals by a representative of the company who uses an automobile for getting around. At these visits the inspector reads the meter, estimates the consumption and then figures the bill for the preceding two-month period, collecting the amount before he leaves the house. Some member of the farmer's family is usually always at home, and as the electrical man's visit is expected, a blank signed check or money to cover the amount is waiting when he arrives. A few lamps, sockets and small repair parts are also taken along in the automobile or wagon, and burned-out lamps or broken fittings are replaced. Lamps and parts are sold at nearly cost. Emergency repair service, such as the replacement of blown link fuses, etc., is rendered without charge. A telephone call to the main office at Elmwood brings the repair man in haste. The trouble call cost the consumer nothing. He is, however, equipped with extra Edison-base fuse-plugs so that these can be replaced

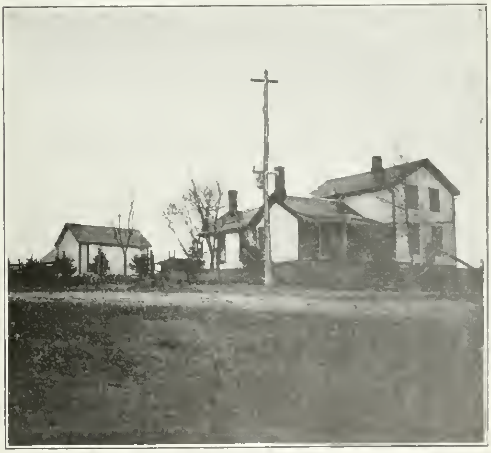

Fig. 3—Typical Farmer's Installation on Elmwood System.

without summoning the repair man. Country houses are wired at cost by the electric light company. Such installations average $1 a lamp, not including ornate fixtures which a customer may desire.

The farmer's average monthly electric bill on the Elmwood system is from $2.50 to $3. In the summer time the $2 minimum is usually registered by the housewives' ironing consumption. Winter bills rise proportionately higher. Farm customers are satisfactory and thoroughly reliable. They pay promptly on demand and seem pleased with the quality of the service rendered them. Most of the customers of the Elmwood system own from 100 acres to 600 acres of fine farming land, which is assurance of their substantial financial rating. Besides demanding more lamps about the place, the average farm owner uses more electricity each month than the town dwellers in similar circumstances. No effort has been made by the Elmwood company to obtain its present farm customers, for the demand for its service has always exceeded the extent of its lines. As each farmer heard of his neighbor's improved lighting conveniences he also applied for service, and many importunities have been received from residents at uneconomical distances from the lighting lines. Once the service is installed and the farmer has invested labor and expense in his pole line he becomes a satisfied consumer, and no other form of contract or agreement is required to hold him as an electrical customer. Mr. E. L. Brown, who is president and general manager of the Elmwood Electric Light Company, expresses himself as well pleased with the results of his farmer-line extensions and contemplates large-scale increases to this business when additional lines now under construction are completed. His son, Mr. E. O. Brown, is district manager of the company.

COST OF GENERATING ELECTRICAL ENERGY IN STEAM-DRIVEN CENTRAL STATIONS OF SMALL AND MEDIUM SIZE.

By E. F. Tweedy.

In view of the very large number of central stations of small and medium size scattered throughout this country some figures showing the actual cost of producing a kw-hour in a number of stations which come under such a classification should be of interest. The figures herein presented are believed to be authentic, inasmuch as they have been obtained from reliable sources which give not only the cost of operation in detail, but considerable information regarding the type of equipment as well. While the stations which have been selected have a yearly output, as measured at the switchboard, of less than 9,000,000 kw-hours, it is not the writer's intention to use this figure as the dividing line between central stations of medium and of large size, for if it were so used it would be difficult properly to classify the few really large central stations which have yearly outputs running into the hundreds of millions of kw-hours.

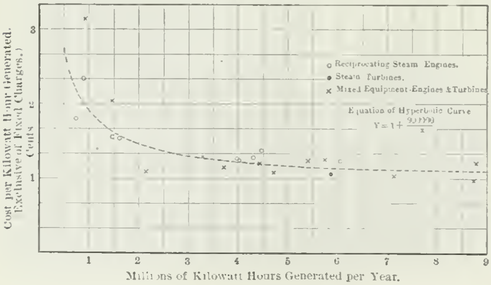

Fig. 1—Curve Showing Total Cost per Kw-Hour Generated.

Fig. 1 shows the total cost per kw-hour generated—including such items as fuel, labor, repairs, supplies, etc.—plotted against the total number of kw-hours generated per year, for some twenty-odd central stations. These stations not only vary considerably in size, but also as regards the nature of their equipment. While all of these plants are operated condensing, some of them—particularly the smaller ones—are still using belt-driven generators of comparatively small capacity.

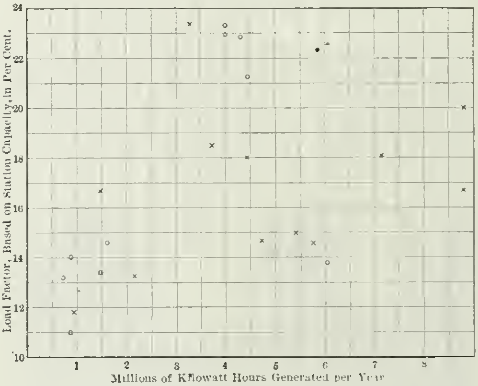

Fig. 2—Load-Factor Percentages for Plants of Various Outputs.

Bituminous coal, ranging in price from $2.75 to $5 per gross ton, is used almost exclusively, although in a few of the plants a certain amount of coke, coke-breeze or screenings is used. With the exception of one plant, the boilers are all hand-fired.

It will be observed that those plants in which turbine units have been installed show no lower cost of operation than the reciprocating-engine plants of similar output, which is not altogether surprising for plants of the capacities shown. The lessened cost per kw-hour with increased yearly outputs is of considerable interest, and it is evident that 1 cent per kw-hour at the busbars is about the lowest unit cost which may reasonably be expected—with present types of steam-driven equipment—until a yearly output in excess of some 10,000,000 kw-hours is reached. Fig. 1 shows that the variation in cost per kw-hour with the output is substantially hyperbolic in character and may be approximately expressed by the equation $Y = 1 + (900{,}000 \div X)$. This hyperbola is shown by a dotted line, and it is evidently asymptotic with respect to an X axis drawn through 1 cent per kw-hour. Of course, this relation does not hold good for greater yearly outputs than are shown in Fig. 1, for the cost per kw-hour soon falls below the 1-cent line as the yearly output is further increased, and it becomes ½ cent or less in stations of very large output.

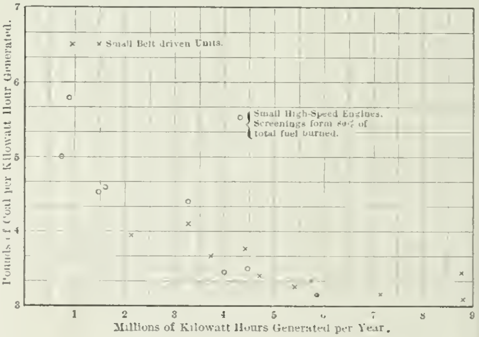

Fig. 3—Coal Consumed per Kw-Hour.

While the load factor should, and undoubtedly does, have a considerable influence upon the cost of producing a kw-hour, the variation in unit cost does not follow the variation in load factor with any degree of closeness in the stations herein cited. The load factor increases in a general way with the output in kw-hours or with the size of the central station, due, as a rule, to an increase in the connected motor load, but Fig. 2 shows that such increase is not at all uniform for the plants herein considered. The load-factor percentages shown in Fig. 2 are based upon the rated capacities of the stations, as the maximum hourly outputs were not available in all cases. When based upon the maximum outputs the yearly load factors would probably average some 10 per cent greater than the figures given. The highest load factor for any of these stations, based upon rated capacity, is about 23 per cent and the lowest 11 per cent, while the average is approximately 17 per cent.

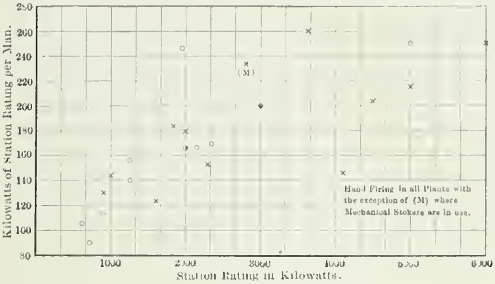

Fig. 4—Generator Rating per Man Employed, for Various-Sized Stations.

The reduction in the cost per kw-hour as the yearly output in kw-hours increases is, of course, due to the smaller coal consumption per kw-hour which, as a rule, obtains in the larger stations and to the lower labor costs per unit generated. Fig. 3 shows the consumption of fuel per kw-hour in these same plants. While the consumption of fuel per unit generated very evidently varies inversely as the output, this variation is not altogether uniform, due primarily to differences in the quality of the fuel which is burned and to the different types of equipment which are in use. It is evident that 3 lb. of coal per kw-hour may be considered to be a minimum figure for steam plants with an annual output not exceeding some 10,000,000 kw-hours. In very large stations, of course, this figure may become 2 lb., or even less.

Fig. 4 shows the number of kilowatts of rated station capacity per man employed, power-plant labor alone being considered. The abscissas represent the rated capacities in kilowatts of the same stations whose outputs are shown upon the other charts. It is interesting to observe how the number of kilowatts per man increases as the stations become larger in size. As a result of this the labor cost per unit generated becomes progressively less as the capacities—and outputs—increase. The lowest cost of labor per kw-hour for the plants herein considered is slightly below ¼ cent and the highest cost is slightly above 1½ cent; the average labor cost per kw-hour generated for all of the plants is 0.43 of a cent.

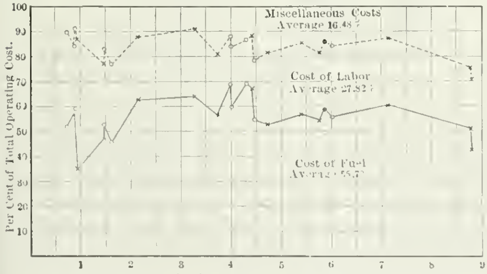

Fig. 5—Percentages of Total Operating Costs Due to Fuel and Labor Expense.

Fig. 5 shows the percentage relations of the cost of fuel and of labor to the total operating cost. It is evident that these relations are in no way affected by the annual output. The average percentage which the cost of fuel bears to the total operating cost is found to be 55.7, while the average percentage for labor is 27.8. The average of these two items combined, is, therefore, slightly over 83 per cent, which leaves an average of a little less than 17 per cent of the total operating cost to cover such items as repairs, supplies, etc. The average ratio which the cost of fuel bears to the cost of labor is approximately two to one.

In closing, the writer would venture the opinion that central-station managers, both individually and collectively, would greatly profit from a more free interchange of data bearing upon the cost of operating the properties which are in their charge. This could readily be accomplished through the channel which is afforded by the technical press, and figures of this kind—if confined to a dollars-and-cents basis and properly interpreted according to the conditions under which electrical energy is being generated—would be of great interest and value. The generation and sale of electrical energy is not like the ordinary manufacturing business, where competition generally makes it necessary carefully to conceal the cost of production. Central stations—except possibly in a few rare instances—are in no sense competitors and the interest of one is the interest of all when it comes to the matter of producing a unit of electrical energy at the lowest possible cost.

DESIGN AND OPERATION OF WATER RHEOSTATS

By Francis H. Davies.

In designing a water rheostat for dissipating any considerable amount of electrical energy a large number of difficulties are apt to arise. Outwardly it would appear a simple matter to provide a tank or series of tubs and the requisite electrodes, and by manipulation to secure the desired load, but in practice it is found that for tests upon all but the smallest plant something far more reliable and easy to operate is required. There is room in most central stations and testing departments of any importance for a well-designed and permanent water rheostat, and many are so equipped, but there is very little information available as to their construction and the designer has generally to start from the beginning each time and arrive at a satisfactory solution by a process of trial and error. Anything approaching to standardization in design is, of course, impossible owing to the widely different conditions which obtain, but there are certain natural laws which enter into every case alike, and there are features of mechanical design which, with suitable modifications, may be advantageously incorporated in any type of water rheostat.

The resistance of water decreases materially with rise in temperature, and it is not possible to give any figures of practical value in this respect, as the quality of water and to some extent the conditions make an appreciable difference. Fig. 1 gives the results of a test carried out by the writer on what may be taken as good average water from the public service. These results are to some extent useful, as they indicate what may be expected under average conditions. The current was direct at a pressure of 500 volts and the test lasted two and one-half hours, during which time no additional water was added for cooling purposes. The chief point of interest lies in the relation between the two curves. The manner in which the current rises shows that the resistance of the water decreases in a greater ratio than the rise in temperature, and there is little doubt that this may be at least partly explained by the presence in the water of iron from the electrodes, which effect would naturally become more pronounced as the solution became stronger. Proof of this lies in the fact that with alternating current the decrease in resistance is by no means so marked.

In the matter of specific resistance water is known to vary between very wide limits, and it is, therefore, necessary in designing a water rheostat to take fully into account the class of water which will be employed. Owing to its comparative purity it is almost always preferable to utilize the town supply, but it is necessary to bear in mind that all so-called pure waters are by no means alike in specific resistance. They may, indeed, vary considerably in different districts. Published figures from authoritative sources show that the specific resistance of the water of one district may be as much as seven times that of another. It is, however, when canal or river water is used that the greatest difficulties are experienced, as the specific resistance of such is by no means as constant as that of the average town supply. It will be found, as a rule, to vary considerably with the time of year, being at its lowest when the water is most impure. For instance, a canal which runs through an urban district will contain a quantity of decaying matter, and in summer the resistance of its water may be considerably lower than in winter. Some testing operations carried out by the writer in which two electrodes were suspended in a canal showed that to secure an equal load at the same voltage the electrodes during the summer had to be spaced six times as far apart as in the winter. An additional reason in favor of employing pure water is that the hot overflow from the testing tank may with advantage be used as boiler feed, and some installations are specially designed to this end, as, for instance, that illustrated in Fig. 3.

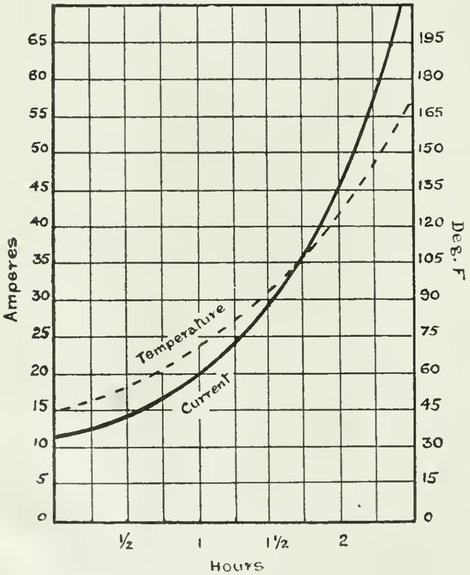

Fig. 1—The Variation of Current with the Temperature of Water.

It is a common practice where the resistance of a testing tank is found to be too high to add a percentage of sulphuric acid, soda or salt to the water. This may be necessary at times, but whenever possible it should be avoided, particularly at the commencement of a test. Unless care is taken and the effect of increased temperature fully anticipated there is always a chance that the apparatus may be rendered temporarily useless by more rapid fall in resistance than was expected. In any case salt or soda should be used in preference to acid, as the corrosion of the tank and electrodes will be less. An electrolyte which has been recommended, at any rate, for small resistances, is a 2 per cent solution of aluminum sulphate, the electrodes being of lead. It is found that little if any fumes or sediment is formed, and unlike most chemical electrolytes it is clean. The resistance varies inversely with the strength of the solution, but not proportionately.

Given the right conditions, a pond or any sheet of water may be used as an artificial load and many suitable arrangements for the electrodes will suggest themselves. It is, however, seldom that matters can be ordered in that way, and, as a general rule, a specially designed tank is necessary. Iron finds the greatest favor, but wood, brick and earthenware have all been used and their individual qualities are worth investigating before finally deciding.

Fig. 2 is a diagram of an iron testing tank installed in a large generating station, partly under the supervision of the writer. It was designed to handle both direct current at 600 volts and single-phase current at 2000 volts, and at all loads up to its full capacity of 1000 kw was very satisfactory. The outer tank is comparatively heavy, being built of cast-iron plates with rust joints. It is fitted with an inlet at the bottom and an outlet at the top for the cooling water, which is taken from the station circulating-water main and discharged into an adjacent canal. The inner tank is of stout sheet iron and bottomless, and the beams from which it is suspended are in turn hung from a steel rope which is broken in several places with insulators. The rope runs over a pulley block, through a counterweight to balance the tank and down to a small winch, by which means the immersion of the inner tank is readily adjusted with delicacy. In addition to providing for the suspension, the wooden beams prevent any risk of a short-circuit should the steel wires break. No weight is carried by the connecting cable, which is of a heavy flexible type attached to one end of the tank. This arrangement is the one used for working with direct current at 600 volts, the positive pole being connected to the inner tank and the negative to the outer, which is grounded. When it is desired to operate with 2000 volts alternating current one or both of the rod electrodes are used. These are of ¾-in. iron suspended in much the same manner as the tank, and, as will be seen from the top sectional view, Fig. 2, when in the water they are each surrounded by an earthenware drain pipe, the top of which is slightly below the level of the water. The result of this arrangement is that the circulation is greatly improved and the contents of the tank are thereby kept at a fairly uniform temperature. The fact that there are two rods and two tanks allows of great variety in the electrical connections, and widely

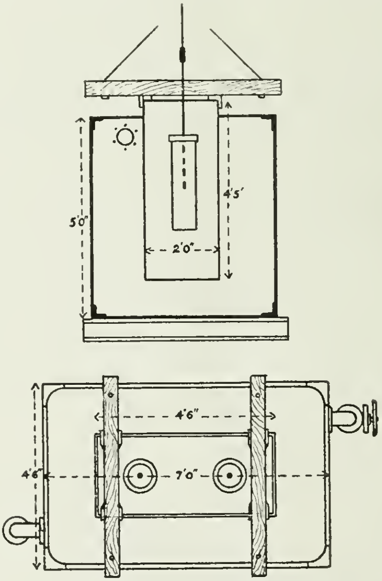

Fig. 2—Testing Tank for Direct and Single-Phase Alternating Current.

varying needs may be met by means of different combinations of the electrodes.

Fig. 3 shows in diagram form the main principles of a testing tank designed to absorb up to 2000 kw of three-phase power at 7000 volts. It is of special interest, as besides being very successful it is arranged to operate in connection with the boiler feed-water system, as mentioned above. The tank is built of 5/32-in. galvanized-iron plate and is 6 ft. in diameter and 4 ft. 3 in. deep. It is situated, as shown, over the feed-water tank and one of the supply pipes from the main is taken to it through the valve *B*. Water passes into the testing tank through the ¾-in. holes in the bottom of the 4-in. standpipe *S*, and it should be noted that the aggregate area of these holes is greater than that of the pipe. A portion of the inlet water flows up to the less number of holes at the top of the pipe and, emerging at the surface of the water, materially checks evaporation. The hot overflow from the testing tank passes down the two pipes at the sides and into the boiler-feed tank. At the top of the pipe *S* is a triangular plate which carries three neutral electrodes *N*, and above this, attached to the small vertical pipe, is a frame carrying the three main electrodes *E*, which are spaced at angles of 120 deg. and are 7 in. distant from the vertical plates. The pipe to which the frame is attached runs outside the smaller one, which acts as a guide, and there is also a vertical rod attached to the electrode frame, which, passing through a hole in the triangular plate, prevents lateral movement. The frame carrying the plates is raised and lowered by a small motor equipped with a winding drum and blocks and tackle. This motor is controlled from the switchroom, which is a great convenience to those carrying out the test.

Wooden tanks are the cheapest to build, and if properly designed have been found very satisfactory. For any given load they are smaller than metal tanks, as the conductivity of the latter renders it necessary to allow for a good space between the electrodes and the sides and bottom of the tank. Difficulty is sometimes experienced with leakage at the joints and with ignition of the wood, but both these troubles seem rather to arise from faulty construction and handling than from any inherent defect in wooden tanks.

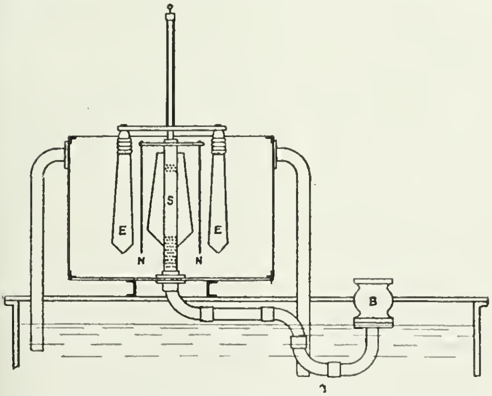

Fig. 3—Testing Tank for Three-Phase Alternating Current, Showing Arrangement for Delivering Hot Overflow to Feed Tank

Fig. 4 illustrates a good design which has been used by a prominent firm of engine builders for years and was brought to public notice in a paper read by Messrs. Morcom and Morris before the Institution of Electrical Engineers, Great Britain, in March, 1908. It is constructed of two layers of ½-in. spruce, tongued and grooved, and all the joints are tarred and calked. The boards are fixed together by screws in such a manner that there is at least a distance of ¾ in. of wood between any part of the screw and the water, and the whole tank is thoroughly tarred when completed. The cooling water is introduced by a canvas hose which enters at the outlet end of the tank and lies along the bottom as far as the other extremity. The outlet consists of a sectional weir, and the water after passing over this flows away through a hole in the bottom of the tank. Iron electrodes are fixed to and thoroughly insulated from stout wooden bars which rest across the sides of the tank and may be readily moved along its length when it is desired to adjust the load. Prominent features of this tank are its length and shallowness, both of which are desirable in the interests of cheapness and a wide range of working. The design is unquestionably good, but such extreme shallowness is only possible when the tank is constructed of insulating material. In the size illustrated the capacity should be about 300 kw to 400 kw, and to absorb greater outputs it would only be necessary to connect other tanks of the same description in parallel.

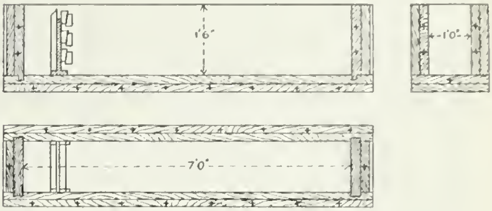

Fig. 4—Method of Constructing Wooden Testing Tank.

Examples of brick or earthenware tanks are rare, but particulars have been published of one of the former class which is employed at a school of technology to absorb some 20 kw at 500 volts. Its internal dimensions are 6 ft. 9 in. x 2 ft. 6 in. x 2 ft., and it is built of glazed blue bricks set in cement to a thickness of 9½ in. A ½-in. layer of mastic asphalt is provided in the walls in order to make them thoroughly watertight. At one end of the tank there are four fixed plates with an area of 1 sq. ft. each. They are spaced at a distance of 7½ in. and their length is parallel to that of the tank. The other electrode consists of three similar but movable plates. V-shaped at the bottom and suspended from a carriage, the wheels of which run on rails parallel with the tank. At the one extreme the movable plates fit between the fixed ones and are fully immersed, but as the other extreme is approached the plates rise partly out of the water, owing to the track being fixed at an angle. This latter is an interesting feature which might be employed with no little advantage in many instances.

Electrode area is an important consideration, and it is best to err upon the safe side. The generally accepted figure for current density is from 0.5 amp to 1 amp per square inch, and if the latter figure be exceeded not only will wasting be rapid, but trouble will be experienced with unsteadiness of the load. This latter is due to the formation of steam and bubbles on the plates, which, changing in quantity and location, vary the area of electrode exposed to the water. An ample supply of cooling water will mitigate this, and it has been determined experimentally that to keep the rise of temperature within desirable limits, that is to say, about 70 deg. Fahr., 5 gal. of cooling water are required per kw-hour.

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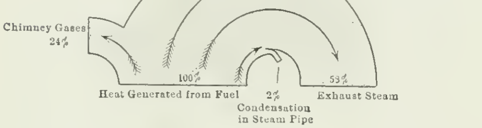
THE INFLUENCE OF FEED WATER ON ECONOMICAL STEAM GENERATION.

By John B. C. Kershaw

THE purity and temperature of the feed water are of great importance in their bearing upon economical steam generation, and in many cases considerable saving could be effected by greater attention to the boiler feed. The advantages to be gained by using water free from gaseous and other impurities, at a temperature approximating that of the water already in the boiler, are now generally recognized and the problem for most engineers in charge of steam boilers is how to obtain the maximum of purification and temperature at a minimum of cost. In some cases it will be found cheaper to make use of the town supply, when this is a fairly soft surface water, than to erect and run a softening installation. With regard to this question of softening each case can be decided only after studying all the local conditions and the probable cost for labor, repairs and chemicals if softening plant be erected. It is unwise to assume without investigation (as one finds is often done, especially in small plants) that a dirty, impure water which costs nothing is going to prove the cheapest source of supply. The operating costs of softening plants increase with the amount of calcium and magnesium salts in the water to be purified, and the writer has known a case in which the purification plant has been shut down owing to the amount of soda-ash required for purification.

With regard to the chemistry and general principles of water softening the writer has little to add to the information already published on this subject, but recommends that no water which contains over 20 parts suspended and dissolved matter per 100,000 of water should be allowed to enter the boiler and that the intermittent type of softening apparatus should be adopted where circumstances permit. The use of boiler fluids and secret compounds is strongly condemned. Gaseous impurities and oil are especially dangerous, and tests for their presence should be regularly carried out. The economy to be gained by close supervision here is that due to fewer stoppages for scaling and repairs and a prolonged life for the boilers. One of the indirect advantages of raising the water to boiling temperature before admitting to the boiler is that the gaseous impurities are expelled and that internal pitting and corrosion in the neighborhood of the feed-pipe are thereby stopped.



Heat-Efficiency Diagram for Steam Boiler and Engine.

The necessity for care in the use of softening reagents has often been referred to. In a recent case the condensed water obtained from the steam tested acid and it was found that carbonic acid gas was being evolved within the boiler from an excess of sodium carbonate, although caustic hydrate was also present. Two other cases of corrosion due to the unwise use of softening chemicals have come recently under the writer's notice. In the first case a feed water was being treated in the boiler with one of the secret remedies for magnesium scale formation, and little doubt exists that the corrosion observed was due to the excessive use of this boiler fluid with a water that contained only slight traces of magnesium salts. In the second case an impure soda-ash was being employed in the same way inside the boiler, and the corrosive action was attributed to the accumulation of chloride salts in the water contained within the boiler. In this case the feed water was sufficiently pure without any treatment at all, and the money spent on soda-ash was therefore sheer waste. It may not be out of place to remark that the soda-ash which is sold to engineers for water-softening purposes has been found in two cases recently tested by the writer to be adulterated with considerable amounts of sodium chloride. As this salt tends to accumulate within the boilers and to cause trouble in various ways engineers would be wise to purchase their supplies of this chemical direct from the makers under a guarantee as to purity.

As regards the separation of emulsified oil from hot-well or condenser water, engineers who have tried all the ordinary methods of separation and are still troubled with the presence of oil might give an electrolysis separator, known as the Davis Perrett apparatus, a trial.

The principle of this separator is the production by electrolysis of a basic ferrous precipitate, the individual particles of which are positively charged with electricity. The negatively charged oil particles absorb this precipitated ferrous carbonate and aggregate into groups which are easily removed by filtration. Further details of the apparatus and method are given in a paper entitled "The Separation of Oil from Condenser Water by Electrolysis," by R. Ellis, published in the *Journal* Society Chemical Industry, Aug. 15, 1910.

As regards the attainment of the maximum temperature in the boiler feed, the usual plan of procedure is to depend solely upon the economizers for this work. The writer suggests that it would be found more economical in all large plants to combine all types of feed-water heater into one system, water from the hot-well and condensers passing through two or more economizers worked in series on the counter-current plan, and then into the thermal storage vessels, live steam being employed for the last stage of the heating, prior to the water entering the boiler.

The use of live steam would of course be reduced to the lowest minimum possible with the attainment of the desired temperature in the feed water. The feed-water pumps would be placed at such a point in this system that water about 160 deg. Fahr. under a good head would be supplied them; otherwise difficulties in pumping would occur. The water should be filtered just before entering the pumps to prevent damage to the pump barrels by any solid matter that might be present. Where natural draft is relied on for working the boilers the exit gases from the economizers cannot be reduced below 450 deg. Fahr. without spoiling the draft. In many modern plants, however, forced or induced draft is employed and the exit gases can be reduced to a temperature of 220 deg. Fahr. Below this point troubles with condensed water and with sulphur acids will occur.

All portions of the heat recovery plant ought to be thoroughly lagged and insulated against loss of heat, otherwise the efficiency of the apparatus may be reduced 50 per cent. In the writer's opinion the losses by radiation in most boiler plants are well above the 5 per cent at which they are usually estimated. Many engineers in charge would be appalled if they knew exactly what proportion of the total heat of the fuel is being dissipated and lost in this way.

Study of the engraving proves that there exists a very wide field for the exercise of engineering ability in the arrangement and working of that portion of the plant which is designed to recover the maximum possible amount of heat from the exhaust of the engines and from the waste gases of the boilers. Even such a simple change as working the economizers in series on the counter-current system has been known to effect a remarkable increase in the temperature of the effluent water and corresponding reductions in the heat carried away to the chimney.

A reduction of the total heat losses by 10 per cent to 20 per cent can certainly be obtained by use of the usual methods in this portion of the steam raising plant alone, and the writer is by no means convinced that the limits of practicable heat recovery have yet been attained. The laboratory method of testing fuel in a calorimeter suggests many lines upon which further developments may occur.

As a final suggestion for obtaining a higher efficiency from the feed-water-heating plant, the regular cleaning of both the internal and external surfaces of condensers and cooling pipes is recommended, especially in those cases where the water is raised to a temperature of 160 deg. Fahr. or more in the apparatus. The loss due to scale and other deposits in condensers and feed-water heaters is certainly larger than is generally recognized.

LETTERS ON PRACTICAL SUBJECTS

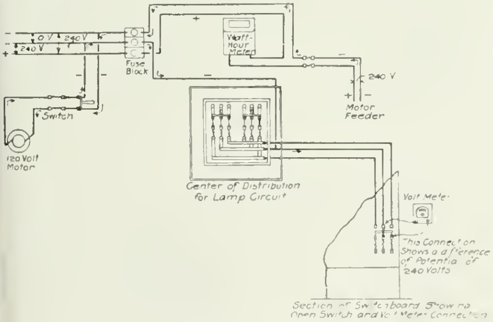
LOCATING BURIED PIPES WITH AN EXPLORING COIL.

The "howler" and exploring-coil method used in testing for electrical faults can be employed successfully in locating underground water and gas pipes when it is necessary to get at these quickly through hard, frozen ground. The principle is familiar to all who have done electrical testing and consists in traversing the pipe to be located with an interrupted current of audible frequency. By moving an exploring coil to which a head-telephone receiver is attached back and forth over the supposed site of the pipe points will be found where the induced characteristic buzz or hum of the current frequency becomes loudest, locating the position of the pipe. The interrupted current for the pipe can be obtained from any make-and-break device, but is most effectively produced by a commutator giving a succession of short breaks, followed by an intermission. This note is distinctive and will not be confused with the sounds due to earth currents from other sources. After the pipe is once located its direction and position can be followed by carrying the exploring loop along the surface of the ground and noting points where the induced hum is loudest. Pipes buried 10 ft. or more beneath the ground's surface can be accurately located by this method, although care must be taken that the test current does not cross to other conductors in the distance located.

Chicago, Ill. C. A. Hieronymus.

A LIVE NEUTRAL WIRE.

When on a test for grounds the voltmeter reads 240 volts between one outside live leg and the dead neutral leg of a lighting feeder on the Edison service one would be very cautious about throwing in the switch that controls that feeder. As the service is already grounded a full ground reading should be 120 volts. At a recent ground test of the electrical equipment in a new loft building the switches on the switchboard were individually pulled out and a voltmeter placed in circuit from one live leg to each dead leg of every feeder. All feeders tested clear except one controlled by a 150-amp switch and this read 240 volts. This was a three-wire feeder for the lamps on the west side of the building and fed from the switchboard to a center of distribution on the seventh floor, where it split and reduced in size, one section feeding the panels on the seventh to twelfth floors inclusive and the other section feeding the panels on the sixth floor to the second floor inclusive. Each section is controlled by a switch in the center of distribution. The energy is metered on each floor and not at the switchboard. A two-wire motor feeder runs up the same riser shaft as the lamp feeder from the switchboard to a center of distribution on the sixth floor, where it splits and reduces and feeds a 50-amp switch on each of the lighting panels from the second to the twelfth floors inclusive. The energy in this feeder is metered the same as for the lamps except that it is connected directly to the 50-amp switch and from there it feeds to the meter and thence to the line. This motor feeder is outlined because it is involved in the result mentioned. The tenant occupying the seventh floor drives his sewing machines with 120-volt motors. The wiring to these motors was run by an electrician employed by him. To get 120 volts he connected to one of the legs of the motor feeder described and for his ground tapped on the neutral busbar in the lighting center of distribution ahead of the switches and fuses. The motors were very small and were thrown across the line with knife switches. The ground test was made during business hours and the sewing-machine motors were operating. When the lamp-feeder switch was pulled the motors stopped, but remained across the line and therefore raised the potential of the neutral leg of the lighting feeder to that of the outside leg of the power feeder—that is, 240 volts above the opposite outside leg through the armature of the motor The leg of the motor feeder that supplied these machine motors was not the one that went through the watt-hour meter, therefore the energy was not being metered and the machine motors were run and not being charged against. This was proved by removing the fuse from the leg of the motor feeder that passed through the meter and then operating the machine motors. Under the existing conditions had the motor circuit been connected to the metered leg of the motor feeder the tenant would be charged with twice the amount of energy that he was actually using because the potential of the meter is 240 volts as shown in the diagram

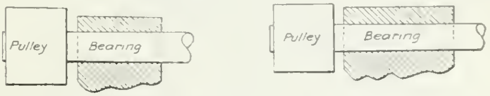

0 V
240 V
240 V
+
Fuse Block
Watt-Hour Meter
240 V
Motor Feeder
Switch
120 Volt Motor
Center of Distribution for Lamp Circuit
Volt Meter
This Connection Shows a difference of Potential of 240 Volts
Section of Switchboard Showing Open Switch and Volt Meter Connection

Wiring Diagram.

New York. J. P. Morrissey

FAULTY MOTOR BEARINGS.

The practical application of electric motors has revealed the fact that too often the designers have not been mindful of actual requirements. This is especially true of bearing surfaces, motors being usually constructed with equal bearing surfaces regardless of the fact that one side carries a pulley and must withstand belt thrust and extra strain. The desire to eliminate or cut down the number of patterns and to build a cheap motor is doubtless the cause of this condition of affairs and while the interchangeability of the bearings and housings is an undoubted advantage, unless the bearings are of ample dimensions it is a penny-wise pound-foolish policy to build motors thus. No one would think of purchasing a side-crank engine having both bearings of the same length, and the same condition will obtain in time with regard to motors. Fig 1 shows how motor bearings are now built for both sides of a machine and Fig. 2 shows the relative dimensions that the bearing on the pulley end of the motor should have There will then be provided sufficient bearing surface to resist the belt strain and much trouble and annoyance caused by present construction will be obviated



Figs. 1 and 2—Motor Bearings.

Baltimore, Md. M. R Cass[illegible]

ELECTRIC PLATE DRIER FOR PHOTOGRAPHERS

Photographers, both commercial and amateur, who frequently have need to do work in a hurry and want plates dried quickly after developing, will find an electric heater and an electric fan effective agents in accomplishing this result. For this purpose a wooden chute should be built, at one end of which the plate racks can be inserted, while at the other a coil of electrically heated resistance wire, in the blast of a small 8-in. fan, is placed. A sliding door can be arranged at the heater end of the chute to vary to the desired quantity the amount of air entering. An electric toaster of the incandescent-wire type, or the coils of an old starting box, will make a satisfactory heating element. The drying chute should be mounted over the developing and fixing tanks so that the plates can be started drying as soon as they come from the last bath. The time then required to dry them thoroughly ready for printing will be surprisingly short to those accustomed to wait on the natural process.

Cleveland, Ohio. JOHN G. WEEKS

METHODS OF MOUNTING MOTORS ON SIDE WALLS AND COLUMNS.

In wooden buildings motors of moderate output can be mounted on the side walls as shown in Fig. 1. Substantial cleats, preferably of yellow pine, are bolted to wall posts and the bed plate of the motor is bolted to these. Lag screws should not be used (unless many can be driven in) because, although they may appear to be quite firm when inserted, the vibration of the motor tends to loosen them and they may pull out. Bolts securing the cleats will extend entirely through the posts and to the outside of the building. Depressions should be arranged in the outside surface of the wall, as indicated in Fig. 1, into which the bolt heads can be set. Pieces of board should be nailed over the depressions so that water, from rain or snow, cannot drip from the bolt heads and make streaks on the wall. Small motors can, in wooden buildings, usually be bolted directly to the posts or columns. In buildings of weak construction it is sometimes necessary to build wooden frames, extending from floor to ceiling and strongly braced, to carry motors located on side walls. Although such frames often rest directly against a wall they are, structurally, entirely independent and self-supporting.

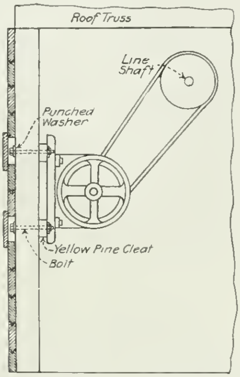


Fig. 1—Motor Mounted on Cleats at Side Wall.

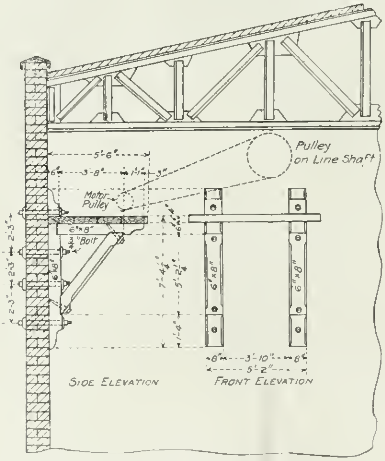


Fig. 2—Wooden Wall Bracket for Motors.

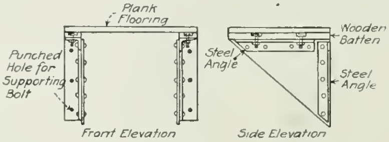


Fig. 3—Structural Steel Bracket Supports.

It appears to be the present tendency to mount motors, where they must be located at side walls, directly on the walls, as outlined in Fig. 1, rather than on brackets. When a motor is arranged with its bed plate in a vertical plane the erector should always be certain that the motor end frames are so located in relation to the main frame, that the oiling devices will feed properly. It is usually the practice with electrical machine manufacturers to ship motors with their bed plates arranged for operation in a horizontal plane and below the motor frame—that is, the motors are ordinarily shipped for floor mounting. A motor arranged for floor mounting can, as a rule, be adapted for wall mounting by removing the end frames (which carry the bearings), rotating them through an angle of 90 deg. and replacing them.

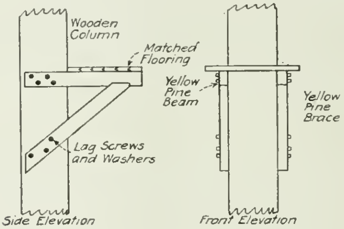


Fig. 4—Wooden Column Bracket.

Some erectors prefer to mount motors located at side walls on brackets. A wooden motor-bracket, designed for mounting on a brick side wall, is illustrated in Fig. 2. Brackets of this design were used for supporting 15-hp and 20-hp motors in the Omaha (Neb.) shops of the Union Pacific Railroad Company. The bolts supporting the brackets extended entirely through the brick walls and each had a substantial washer under its head.

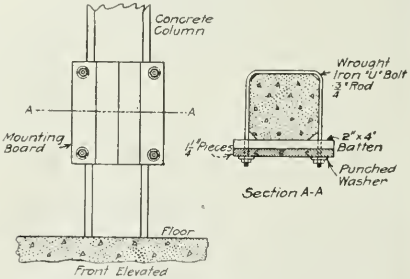


Fig. 5—Mounting Board for Reinforced Concrete Column.

Where many brackets are to be used it is usually economical to have a pattern made and use bracket supports of cast iron rather than of wood. The pattern for this is easily made in one piece. Holes to accommodate the bolts for binding the supports to a wall and for clamping the bottoms, to which the floor boards are nailed, are drilled in the casting by the erector.

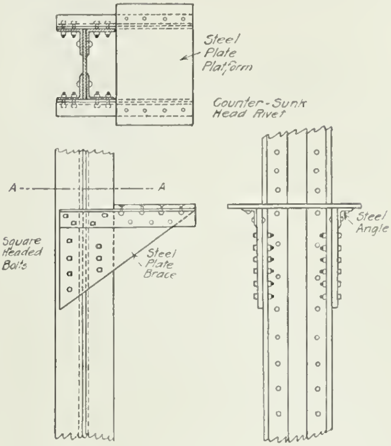


Fig. 6—Structural Steel Motor Bracket and Column.

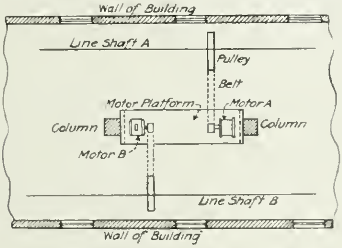


Fig. 7—Motor Platform Between Columns.

Wall-bracket supports can be made of structural steel angles and steel plates, as suggested in Fig. 3. Obviously, steel supports are preferable to cast-iron ones, as for equal strength ley are lighter and they are not so brittle. Another point in vor of steel construction is that when it is taxed beyond its pacity it will give an indication of distress before failing, whereas cast iron may crack without warning. Where facilities are available for shearing plates and structural sections and for riveting them together economically steel bracket supports have much to commend them.

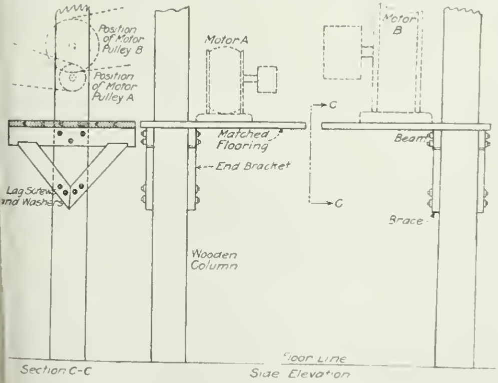


Fig. 8—Wooden Platform for Two Motors.

Motors are often advantageously mounted on columns. Fig 4 shows the construction of a simple form of column bracket. This construction can only be used where motors of relatively small output are involved. The braces and beams are clamped to the column with lag screws, each having a punched washer under its head. Enough lag screws should be used so that there can be no possibility of their working loose. The upper end of each brace is set about ½ in. into the beam and is held there with wood screws. It is well, as a rule, to use matched stock for motor brackets. If plain stock is used it ultimately dries out and shrinks, leaving open spaces between adjacent boards for dust, dirt and probably oil to come down continually through the spaces. This is largely avoided where bracket floors are made of "matched" stock. They can then be cleaned systematically by the motor inspector.

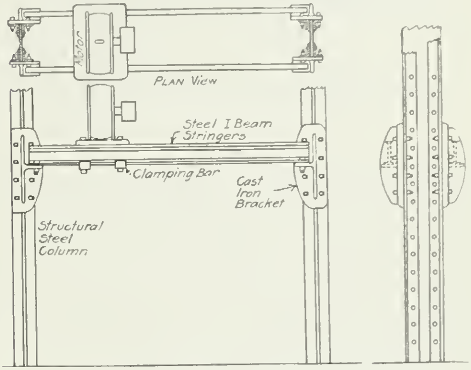


Fig. 9—Structural Steel Stringers and Supports.

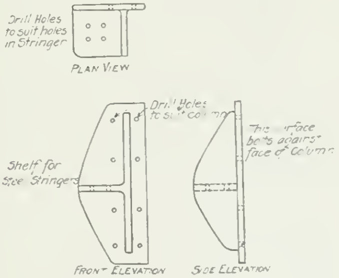

Drill Holes to suit holes in Stringer
Plan View
Drill Holes to suit Column
This surface bolts against face of Column
Shelf for Side Stringers
Front Elevation
Side Elevation

Fig. 10—Details of Cast-Iron End Bracket.

In buildings of reinforced concrete small motors can be mounted on a mounting board like that of Fig. 5. It is sometimes advisable when erecting this kind of mounting board to chip out a groove for each of the "U-bolts" in the rear face of the column. By this expedient any tendency for the mounting to slip down the column is corrected. The wood used should be well seasoned so that there will be but little shrinkage.

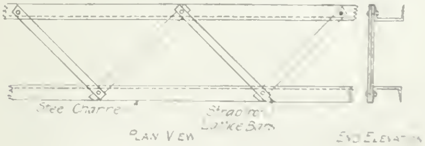


Fig. 11—Latticed Channel Stringers.

Starting devices for motors can also be mounted on boards like that of Fig. 5. Obviously lighter construction may be used for these.

A neat and economical bracket for a structural steel column is illustrated in Fig. 6. A steel plate forms the floor or platform and all of the components of the bracket are riveted together. Bolts are used to attach the bracket. A portable, electrically operated breast drill and an "old man" to maintain it in operating position will be found valuable tools where much drilling is to be done in structural steel members already erected. The outfit will pay for itself in a short time. Where a bracket must be attached to the face of a column instead of to its side it can be arranged like the one shown in Fig. 3. Countersunk-head rivets should be used to secure the platform plate. Button-head rivets interfere with the locating of a motor bedplate on a platform.

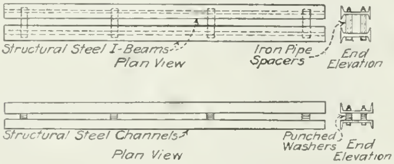


Fig. 12—Assembled Stringers.

It frequently occurs in arranging group drives that two motors can be advantageously mounted on one platform, supported by two columns, as indicated in the plan, Fig. 7. The starting device for each motor can be mounted on the adjacent column near the floor. In a wooden building a platform of this type can be constructed as suggested in Fig. 8. The motors are, if possible, located close to the columns so that the bridge between the brackets can be made of the lightest material possible and yet be stiff enough to carry the motors.

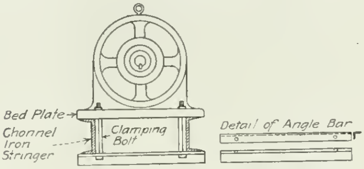


Fig. 13—Application of Angle-Clamping Bar.

Stringers made of structural steel I-beams or channels serve to support motors in steel-frame buildings where two motors can be arranged to drive from between adjacent columns. A typical installation is outlined in Fig. 9. Only one motor is shown on the stringers in the illustration, but another or more could be supported. The feature of this method of mounting is the cast-iron end bracket (see Fig. 10 for detail), which carries the stringers at the columns. End brackets can be made from structural steel, but it is not always possible to make them so they can compete in cost with cast-iron ones. It is usually possible so to design one cast-iron end bracket that it can be used for a majority of applications about a plant. Different drillings will be necessary to adapt the brackets for different columns and stringers, but the same pattern and castings can be used for all. In designing such an end bracket it should be made sufficiently strong to carry the largest motors that it will ever be called upon to bear. This procedure will render it excessively heavy for supporting small motors, but, unless there are many small motors, it will be more convenient and probably more economical to make all end-bracket castings from the same pattern. It should be noted that the pattern is of one-piece construction and is easily and cheaply made.

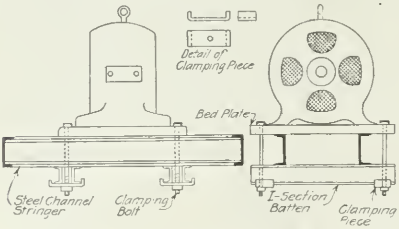


Fig. 14—Channel-Clamping Bars.

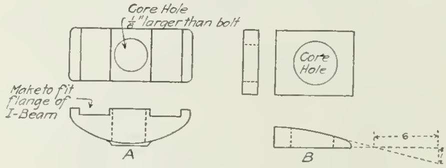

Core Hole ($\frac{1}{8}$" larger than bolt
Core Hole
Make to fit flange of I-Beam
A
B
6

Fig. 15—Beam Washers and Flange Washer.

No floor is necessary with the construction shown in Fig. 9. The motor bedplate is clamped to the stringers, possibly by one of the methods suggested in Figs. 13 and 14. These will be discussed later. The stringers may be single channels (Fig. 11) or single I-beams, or they may be assembled from two or more channels or I-beams, bolted together, as detailed in Fig. 12. If stringers are long and lateral deflection is feared the members may be reinforced with lattice-bars, as shown in Fig. 11. In the assembled stringers of Fig. 12 short lengths of pipe are used as spacers in the member *A*, which is composed of I-beams, and punched washers are used for *B*, which is made up of channels. If many assembled stringers are to be used it may be cheaper to have regular spacers made of cast iron than to use the pipes and washers.

One of the simplest methods of clamping a motor to steel stringers is outlined in Fig. 13. A length of angle iron, properly drilled, is used for a clamping bar and standard bolts passing through the motor bedplate hold the components in correct relation. The method shown in Fig. 14 is sometimes uesd where large motors are involved. In this case small channels, possibly 3 in. or 4 in. deep, are used for clamping bars. A clamping piece (see detail in Fig. 14) forged from a wrought-iron bar is used to prevent the clamping bars from spreading. If enough will be used to make it worth while to have them cast I-beam washers of iron, similar to that of Fig. 15 *A*, should be used instead of the forged-iron clamping piece shown in Fig. 14.

Sometimes it is convenient to bolt a steel plate for supporting a motor to stringers, as shown in Fig. 16. The plate is drilled for the bolts that hold down the motor bedplate. Flat-head bolts should be used for attaching the platform plate to the stringers so that there will be nothing extending from its surface to interfere with the lateral adjustment of the motor. Flange washers (Fig. 15 *B*), which are beveled to fit the insides of flanges of I-beams and channels, are used under the nuts of the flat-head bolts.

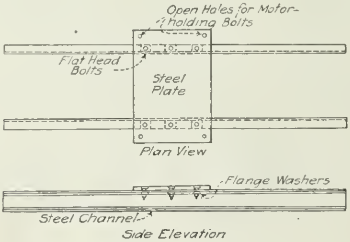


Fig. 16—Steel Plate Platform.

Pittsburgh, Pa. H. F. Bearnes.

QUESTIONS AND ANSWERS

How may the resistance used in starting boxes for motors be calculated? R. K.

The method for calculating the resistance of a motor-starting rheostat depends largely upon the type of motor with which the rheostat will be used. The resistance of a starting rheostat for a series motor would be proportioned somewhat differently from that for a shunt motor. Assuming that you have in mind a shunt motor, it may be stated that the value of the resistance inserted between adjacent notches on the rheostat depends upon the resistance of the armature and the permissible fluctuation in the current. If the current is to be allowed to fluctuate by 50 per cent, then the final section of the rheostat should have a resistance equal to 50 per cent of that of the armature, the next to the last should have a resistance equal to 75 per cent of that of the armature, the second from the last should have a resistance of 112 per cent of that of the armature, the next step 168 per cent, etc. If a variation of only 25 per cent is permitted, the last step on the rheostat should have a resistance equal to one-fourth of that of the armature, the next step should be 31 per cent of the armature, the next 39 per cent, the next 49 per cent, the next 61 per cent, etc.

We deliver 133-cycle energy a distance of one mile, using a 500,000 circ. mil cable. Tests show a 7 per cent drop with two-thirds load (60 amp at 1100 volts). The wires are 16 in. apart and 20 in. from circuits carrying similar current. We contemplate changing the cable to a solid wire and also contemplate installing three step-up transformers, each rated at 60 amp, 1100 volts, to raise the voltage to 2200, or else renew three circuits to a distance of one mile from the power house to carry 60 amp at 1100 volts. The present circuits are of No. 1 and No. 2 wire and 500,000 circ. mil cable. What would be the loss in the three transformers as compared with the line loss with the circuits carrying 2200 volts? What would be the skin effect? H. S. T.

The skin effect due to eddy currents is relatively negligible in a 500,000-circ. mil cable when operated at 133 cycles. Even in a solid conductor of this size, the diameter of which would, of course, be about 7/10 in., the eddy-current effect would tend to increase the resistance by somewhat less than 10 per cent, so that even with a solid wire the effect can be neglected. A standard transformer for raising the e.m.f. from 1100 volts to 2200 volts would suffer a loss not greater than 1320 watts. If a two-to-one ratio transformer were used as an autotransformer the loss could be reduced to perhaps 600 watts. If the latest type of silicon-steel transformer were employed the loss could probably be reduced to even below 700 watts. When transmitting 60 amp over a total length of 10.000 ft. of No. 1 wire the loss would be 4500 watts; with No. 2 wire the loss would be 5800 watts. With a 500,000-circ. mil conductor the loss would be 720 watts. If the e.m.f. were doubled and the same size of conductor were employed as before, the loss in each case would be reduced to one-quarter of the value just stated. Thus, if a transformer were employed on the No. 2 circuit the loss in the circuit would be reduced from 5800 watts to about 1500 watts, to which, of course, must be added the loss in the transformer, which might perhaps equal 1000 watts. giving a total of 2500 watts instead of 5800 watts.

Is it correct to assume that the mutual force between any two wires and the third in a three-phase system is proportional to the instantaneous current value, that is, that it varies at the same frequency as the line current? What is the maximum value of the force between two conductors in a 60,000-volt three-phase circuit with wires spaced 84 in. apart when the current is 100 amperes per wire? W. S.

The force exerted upon a unit length of any conductor carrying a current in a magnetic field is equal at each instant directly to the product of the field density and the current strength, all values being expressed in c.g.s. units. At any distance d from a straight conductor carrying a current i the flux density in air is equal to $2i \div d$, expressed in c.g.s. units. In the case of a straight conductor carrying 100 amp (10 c.g.s. units of current) the flux density at a distance of 84 in. (213 c.g.s. units of length — cm) the flux density would be $20 \div 213 = 0.094$ c.g.s. unit (line per square centimeter). The force exerted upon a conductor at this point carrying 10 c.g.s. units of current would be $10 \times 0.094 = 0.94$ dyne per centimeter of length, or about 0.000063 lb. per foot of length, tending to cause the conductor to cut across the flux. When either the field or the current varies the force varies accordingly; when they both vary simultaneously and sinusoidally at a certain frequency the force varies at double this frequency and reaches a maximum value equal to double the value calculated for the mean effective value of the current and flux. In a three-phase system the force exerted upon each wire varies both in time and in direction, as can be calculated from the above considerations. In any event even with the closest spacing of the wires the force is truly negligible in any transmission system.

In operating in parallel our two 2300-volt, three-phase alternators in separate stations, we find on trial that when the excitation on one machine is so adjusted that the machine delivers a minimum current, the power factor of this machine rises to about 100 per cent, while that of the other machine falls to about 55 per cent. For example, with 160 kw on the first machine the excitation can be reduced so that the machine will deliver 40 amp per lead. At the same time the other machine, with a load of 220 kw, has a current of 100 amp per lead. As the excitation on the first machine is decreased the current of the other machine increases, but the sum of the currents of the two machines is not constant. Should the excitations be adjusted for equal power-factors or for minimum currents? G. E. M.

In a three-phase system with an e.m.f. between leads of 2300 volts each kilovolt-ampere requires ¼ amp in each lead. A load of 160 kw requires 40 amp in time-phase with the e.m.f. and such additional current in time-quadrature therewith as is necessary to supply the wattless kilovolt-amperes demanded by the load. At 220 kw the power component of the current is 55 amp; when the indicated current is 100 amp the wattless component must be $\sqrt{100^2 - 55^2} = 83$ amp. Neither the power component of the current of each generator nor the total wattless component of current delivered to the system can be altered in any respect by varying the excitation of the two generators, provided the resultant e.m.f. remains at 2300 volts, the load on the system does not vary and the prime movers are not changed. However, the wattless component can be shifted from one generator to the other at will or can be divided between them in any desired proportion. If the machine with the smaller load carried all of the wattless current its indicated current would be $\sqrt{40^2 + 83^2} = 92$ amp and its power-factor $40 \div 92 = 0.435$; the other machine carrying only 55 amp, the apparent total of the two machines would be 147 amp. If the wattless current were so divided that the smaller machine carried 40 amp and the larger 43 amp, the indicated current of the former would be $\sqrt{40^2 + 40^2} = 56.6$ amp with a power-factor of 0.707, and that of the latter $\sqrt{55^2 + 43^2} = 70$ amp with a power-factor of 0.787; the apparent total would be 126.6. In the case cited the apparent total was $40 + 100 = 140$ amp. Thus one should expect a considerable variation in the apparent total of the currents delivered by the machines when the relative excitations are varied. The minimum apparent total is obtained when the wattless current is divided between the two alternators in proportion to the power components which these machines carry—that is, when the power-factors of the two machine loads are equal. For minimum loss of power by the currents in the generator circuits the wattless current should be divided between the generators in such a way that the sum of the square of the separate parts multiplied by the resistances of the generator circuits is a minimum; such an adjustment would depend solely upon the value of the wattless component of the load current and would not be affected otherwise by the value of the power component. However, such a method represents an unnecessary refinement. Ordinarily if the power-factors of the separate generators are adjusted to equality by means of power-factor meters the loss will be kept sufficiently low. The excitation of two widely separated generators in a system where the load power-factor is high and can be adjusted by setting one of the generators for the minimum current by means of an ammeter, thereby eliminating the necessity for a power-factor meter.

Central Station
Management, Policies and Commercial Methods

ICE CREAM AS CENTRAL-STATION BY-PRODUCT.

In conjunction with its 200-kw electric plant the Nashville (Ill.) Electric Light Company operates a refrigerating outfit with a daily capacity for freezing eight tons of artificial ice. An unusual adjunct of the central station, however, is an ice-cream plant for which the ice-making capacity of the station is largely utilized. The ice-cream machinery has a daily output capacity of 400 gal. of ice cream.

ELECTRIC TRUCK GARAGE TO BE ESTABLISHED IN BOSTON.

The Edison Electric Illuminating Company of Boston will shortly establish a garage for electric trucks in the Atlantic Avenue district of the city as a preliminary to the inauguration of an active campaign on behalf of the commercial storage-battery motor vehicle. The garage is to be the first in the city for electric trucks exclusively and will also be operated as the first sanctioned garage of the Electric Vehicle Association of America. The initial capacity of the garage will be twenty-five vehicles, with provision for double that number later. Expert attendance will be provided by the company, and if the public responds to the work in behalf of electricity it is probable that the company will open an uptown garage for pleasure-vehicle service. A campaign of education to instruct the public in the advantages of electric motor wagons will be pushed.

The Boston Edison Company has been a user of both gasoline and electric automobiles for a long period, but has only recently decided entirely to eliminate horses in its service. Orders have been placed which will practically quadruple the present electrical equipment, making the company the owner and user of thirty-nine trucks. Of these fifteen are to be employed in the downtown sections and the remainder in the suburban districts. Among the new trucks will be a derrick wagon for use in pole erection. The company has been remarkably free from troubles in its electric vehicle service which are capable of withdrawing it from operation. At present about forty electric trucks and delivery wagons are in service in Boston and the outlook for larger developments is most attractive Among the recent purchasers of electric trucks is the American Express Company, which has decided to give this type of equipment a thorough trial in exacting service.

HINTS ON MARKETING CENTRAL-STATION ICE.

Mr. H. L. Titus, manager of the Sterling Consolidated Electric Company, of Sterling, Col., which operates a 10-ton ice-making auxiliary in connection with its 225-kw electric plant, advises central-station men contemplating ice manufacture to arrange for the sale of their product directly to the consumer from their own office, without recourse to a contractor or other delivery middleman. In this way complaints come directly to the office of the electric company, which can thus keep in closer touch with its customers, better increase its business and by careful selection of drivers keep complaints at the minimum and get more satisfactory service than by selling ice at the platform under a contract.

Mr. Titus testifies that ice-making forms an excellent load for an electric plant, since during the ice season proper, when the refrigerating apparatus must be operated continuously throughout the twenty-four hours, the electrical demand is at a minimum. As the fall electric lighting load increases the ice-making duty required of the plant falls to less than six hours a day, while during the winter months three hours' operation is found sufficient to hold down the temperature in the storage-room and freeze all the ice that is necessary for the trade.

The ice-making auxiliary at Sterling operates twenty-four hours a day during three months of the year and for the remaining months several hours a day. The population of Sterling is 3300, and during the past season, the first in the experience of the local company, an average output of 18,500 lb. of ice per day was made at the plant. This was sold retail at 50 cents per 100 lb., wholesale at 35 cents and in carload lots at 20 cents.

FLATIRON RENEWALS FREE.

A few years ago it would have been hard to find central-station men who would entertain the idea of maintaining electric flatirons for consumers and renewing their various parts, following the practice in regard to free renewals of carbon-filament lamps. Nevertheless, the developments of the last five years have brought this idea into consideration, and in fact many companies have virtually adopted the plan either tacitly or openly. Until a comparatively few years ago the electric flatiron was but little used and was considered as an article with a rather uncertain life and expensive to renew as to its heating element. Later, more durable irons were produced and central-station companies succeeded in introducing them in large quantities and in adding materially to their revenue from residence consumers thereby. In order to foster this business the companies in many cases either guaranteed the irons or, without making any promises, as a matter of fact, renewed the heating elements and worn-out or defective cords or plugs It was found that consumers having irons might neglect to get them repaired promptly if out of order, and that the iron would be laid aside on the shelf for fear of the expense incurred in getting it fixed or until a convenient opportunity offered. The central-station manager realized that irons standing on the shelf were earning him no revenue, and as a result some companies have settled down to the practice of keeping consumers' irons in working condition, just as they make periodical renewals of lamps. The first cost of renewal parts on electric irons is really lower than on any other electric energy-consuming device in proportion to the energy it consumes. In other words, the company can really better afford to spend money on maintaining consumers' irons than on the maintenance of any other consumers' appliance.

ILLUMINATING PROBLEMS IN SMALL TOWNS.

The symposium on illuminating problems in small towns held at the last meeting of the Chicago Section of the Illuminating Engineering Society showed a notable agreement of opinions on one point, namely, that the illuminating engineering problems in the small towns are up to the central-station company for solution in the great majority of cases. While most of the speakers agreed that it is frequently difficult to get electric light users in small towns properly to arrange and equip their lamps to get the best results, nevertheless, continued effort along this line by the central-station company invariably leads to good results in improving the general conditions prevailing in the town and increasing the percentage of the total lighting business done by the electric light company.

An instance was cited where the central-station manager said it was hopeless to try to get rid of gasoline plants in the commercial district, as he had tried it for six years without success. A new manager with proper enterprise and knowledge of proper methods soon had most of the gasoline plants put out of business. It is, of course, true that the contractors in some towns are more alive than the central-station company, but as a general rule the initiative must be taken by the company

BALTIMORE ELECTRIC GARAGE.

The Consolidated Gas, Electric Light & Power Company, of Baltimore, will open a large garage on March 1 in which to charge commercial electric vehicles and store vehicles for such owners as desire it, taking care of the motors and making all repairs. The building, which is located at 30 South Eutaw Street, fronts 100 ft. on Eutaw Street and is 200 ft. deep. In addition to the storing, charging and repairing of electric-driven vehicles the company has entered the sales end of the motor-vehicle business and has obtained the Baltimore agency of the General Vehicle Company, of Long Island City, New York. Trucks will be kept on exhibition and ten trucks for the company's own use will soon be in use. The many advantages possessed by the electric as compared with the gasoline trucks, of which latter it has several in use, have led the company to decide upon the electric to displace almost all of its horse-drawn vehicles.

TRANSMISSION SYSTEM SERVING SMALL TOWNS NEAR RADCLIFFE, ENGLAND

To serve a number of small towns and farming communities in Mid-Lancashire, England, an electric generating station has been built at Radcliffe and a network of 10,000-volt transmission lines carried in several directions for a radius of fourteen miles over the countryside. Among the villages served is the farming town of Ainsworth, a little place too small to support an electric plant of its own, but now enjoying all the modern advantages of its big urban neighbors. Ainsworth is four miles from the generating station at Radcliffe, and the transmission potential of 10,000 volts is reduced by local transformers to the 230-volt distribution pressure. Lighting is furnished many householders virtually on a flat rate at 26 shillings ($6.50) a year for four lamps. The landlord or owner of the group of houses purchases this energy through a meter, and usually profits slightly by the difference between his meter reading and his flat-rate sales. The average cost of operating a single lamp as many hours as desired during the year is reported to be $1.25. Wiring of houses or cottages costs from $3 to $4 complete with lamps, it is declared, and even the payment of this amount may be distributed over several months. The wiring used is described as being run "along the outer walls, supported by staples," and doubtless would hardly be permitted under American wiring regulations.

The street lighting of Ainsworth is to cost $13 per 59-cp lamp per year on a ten-year contract, at the expiration of which the lamps, standards and lines will become the property of the parish and charge will be made for energy only. These lamps are also installed along the country roads at 180-ft. intervals. Barns, stables, dairies and farm buildings of all kinds are now lighted by electricity and motors are used to do much of the mechanical work about the places.

A butcher in Westboughton (at the easternmost point of the company's area) works his sausage machine by electricity with a ¾-hp motor at an average cost, as reported, of less than 2 cents a week. The installation, including motor, cost $70. His neighbor, a shopkeeper, keeps seven lamps burning until late hours at night at a cost of less than 25 cents a week. The installation and wiring of the shop cost, with lamps, about $25, repayment of which is spread over a term of years. This compares strikingly with the lighting charges of most village gas companies in England.

It is the experience of neighboring urban districts which has led rural Ainsworth to take up electricity, and its action, small though it may seem, may prove a notable factor in the revival of English village and agricultural life. This pleasing example of the obtaining of electric service by small rural communities, it must be remembered, is due to the combination of a number of small village needs into a real metropolitan demand

FUEL SAVING BY REARRANGEMENT OF ICE APPARATUS.

A saving in fuel amounting to at least half of that previously burned has been gained by the Yorktown Electric Light & Ice Company, of Yorktown, Tex., as a result of rearranging certain of the parts of the ice-making equipment originally furnished. This company has a ten-ton ice plant in conjunction with its 60-kw electric generating station. The ice machinery is operated for 100 days each year, during which period it produces about 5000 lb. of ice per day Yorktown's population is 2000.

After replacing a producer-gas engine by a Corliss steam engine for driving the electrical generator it was decided to substitute a similar Corliss gear for the slide-valve engine running the ammonia compressor. At first this change was advised against, as it was feared that the lower water rate of the more efficient engine would not pass enough steam to supply distilled water for ice making. The experiment was then tried of mixing an equal quantity of well water with the distilled water. By subsequently reboiling and filtering this mixture a good clear quality of ice was produced. This showed that the more efficient Corliss engine could be substituted as far as the production of raw material for ice making is concerned, and the change at first contemplated is now being made

Another experiment also showed that the exhaust-steam line could be used for reboiling the distilled water practically as well as the high-pressure live steam direct from the boilers. This change resulted in economy in the amount of steam used for the auxiliary purpose of preparing the raw water for the freezing tanks. It was also shown that the cooling water from the ammonia condenser could be used to advantage for cooling the steam condenser, on account of the wide difference in temperature ranges of the two pieces of apparatus. This modification was, of course, accompanied by a substantial saving in the quantity of circulating water required. Part of the cooling water coming from the ammonia condenser is also used to jacket the oil separator in the condenser exhaust line, the lower temperature at which the separator is thus maintained making it operate more efficiently in removing oil from the steam.

ICE-MAKING PROFITS OF A SMALL CENTRAL STATION IN THE MIDDLE WEST.

The combination ice-making and electric-generating plant in a small Middle-Western town of 3500 inhabitants, in about the same latitude as Topeka, Kan., is operated from a common set of steam boilers, and as the electrical machinery is in service twenty-four hours per day the refrigerating equipment is operated with very little additional labor and at a correspondingly low cost. In fact, in this instance, the ice-making business has proved to have even a larger earning capacity on an investment basis than the electric plant itself, although the use of electric service in the little city for lighting, motor drive and heating has meanwhile been developed to a record-breaking extent.

The absorption plant installed has a rated capacity for producing ten tons of ice per twenty-four hours, and averaged this output during the past season, except during the warmest portions of July and August, when eleven tons per day was pulled. Since it is during these warm months that ice brings the highest prices it will be readily understood that the overload production of the plant at this time is especially significant in raising the earning capacity of the station.

During the months of June, July, August and September, 1910, the plant produced 2,194,180 lb. of ice, which, at the current retail prices (ranging from 30 cents to 50 cents per 100 lb., according to quantity), brought in $6,883.13, or an average of $6.36 per ton. The total cost of producing this quantity of ice and delivering it to the consumers was $3,338.08, or an average of $2.95 per ton. During this time it should also be understood the coal scarcity due to the strike was at its worst, and some of the fuel used to produce the ice mentioned above cost as much as $3.50 to $4 per ton, delivered in the bin, for a very poor run-of-mine quality.

From the preceding figures it is seen that the profits on the ice for the four months amounted to $3,545.05. After deducting fixed expenses of $391.87, which includes charges to cover insurance, taxes, etc., this leaves $3,153.18. Charging 5 per cent for depreciation on the $17,500 investment shows a net profit during the four months of $2,300, representing at once a 13 per cent return on the $17,496.23 invested. Considering the additional service rendered by the refrigerating plant, it is probable that even this pleasing rate of return was exceeded.

The schedule of prices under which the above ice was sold follows: Retail to the small consumer, 50 cents per 100 lb.; where two tons per month are used, 40 cents; over four tons, 35 cents, and over eight tons, 30 cents. All of the excess ice over and above the requirements of the town was sold in car lots at $3.25 per ton.

Installed in the plant are two 2200-volt, two-phase, 60-cycle engine-driven alternators aggregating 140 kw, supplied with steam by 250-hp rating in boilers. Such an electric plant in combination with an ice plant is undoubtedly a paying proposition, since summer is the season when the electric plant is at its low point in load. At this time the ice plant helps over this valley in working the boilers up to winter efficiency and giving profitable employment to men drawing full pay but who would otherwise not be rendering full value to the company. The combination is a happy one, declares the local manager of the company, and adds that it will undoubtedly be adopted by many small plants within the next few years.

REPLACEMENT OF STEAM POWER BY CENTRAL-STATION SERVICE FOR MILL AND ELEVATOR OPERATION.

By R. B. Mateer.

Not many years ago flour mills and grain elevators were located upon navigable streams. The waterwheel was found practicable for power purposes. But the advent of the railroad necessitated locating mills and elevators along the "bands of steel" which link States together. Junction points located in the grain-growing sections always boasted of grain elevators; these were tributary to the large elevators and mills located at railroad centers.

The Longmont Farmers' Mill & Elevator Company, with a number of elevators in the Rocky Mountain district, operates, among others, a large mill and elevator in Denver, Col. Originally a steam plant was installed in this mill, complete with generator for lighting purposes. The machinery consisted of one 250-hp Allis-Chalmers compound engine operating the roller mills used in grinding flour. The rope-drive connection used has proved very efficient. A 100-hp Allis-Chalmers engine was belted to the line shaft driving the elevator and the lighting generator. The three 125-hp boilers were fired with fuel from the northern Colorado fields.

Prior to June, 1909, it was necessary to fire the entire battery of boilers as long as the mill and elevator were to continue in operation. Desire for increased efficiency in plant operation, however, led to the making of a careful inspection of the existing equipment by the power department of the Denver Gas & Electric Company, which recommended that the mill continue to be operated for the present by the 250-hp engine, but that the small engine and generator be shut down and a 100-hp, 2200-volt motor be installed in the basement of the elevator for the operation of that portion of the equipment. It was further suggested that milling and elevator expenses, so far as mechanical drive were concerned, be segregated.

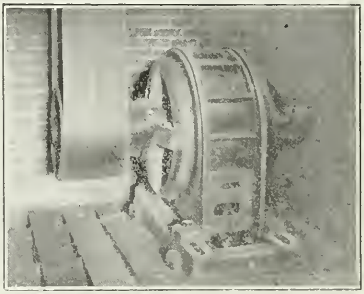


Fig. 1—2200-Volt, 100-hp Motor Driving Grain Elevator.

The motor, one of the first 2200-volt machines operated from the primary circuit to be installed, fulfils all expectations. Whereas the engine previously operating the elevator was frequently out of service and unable to carry the load the 100-hp motor now handles easily all the load occasioned by the grinding, elevating and storing of the grain. Among the machines driven by the motor are a 30-in. Trition mill grinding 20,000 lb. of corn per hour; a roll for corn; a roll for barley; a cockle machine; screens; a 24-in. elevator; thirteen 10-in. elevators; a freight elevator; a scoop for unloading cars, and a car winch. The Trition mill requires from 50 hp to 60 hp; the rolls from 10 hp to 15 hp each; the 24-in. elevator 9 hp, and the other machines from 20 hp to 30 hp.

As a result of central-station drive, greater efficiency, decreased operating expense, greater output, more uniformly ground product and the elimination of some line shaft losses are noted. Two boilers now operate the mill with ease, the third one becoming a spare unit. The 22-kw engine-driven generator is now out of commission, all the lighting throughout the mill and elevator being supplied from the central station. A 300-lamp roof sign now operates upon central-station service from dusk to midnight each night in the year advertising the

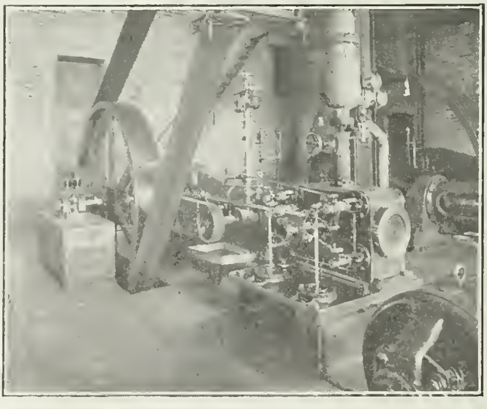


Fig. 2—100-hp Corliss Engine Replaced by Motor for Driving Grain-Elevator Machinery.

brand of flour manufactured in the mill and testifying to the value of central-station service supplied by the Denver company. Lastly, as a result of the change, this mill, designed for 600-bbl. capacity, now produces 700 bbl. of flour per day.

ACID FUMES CAUSE REPLACEMENT OF ARC LAMPS BY TUNGSTENS.

For a number of years arc lamps were used to illuminate the plant of the Alan Wood Iron & Steel Company, at Conshohocken, Pa., but, owing to the sulphur fumes liberated in some of the reduction processes, much trouble was experienced with the feeding mechanism for the electrodes. Recently it was decided to substitute incandescent lamps, following the advent of high-efficiency large units. Four-lamp tungsten fixtures finished in porcelain-enameled steel were installed, and since that time no further illumination trouble has been noted.

Wiring and Illumination

WIRING OF FINE HOUSES WITHOUT DISTURBANCE.

At a recent meeting of the Commonwealth Edison Branch of the National Electric Light Association in Chicago Mr. J. C. Manley commented on the fact that the construction department of his company had wired many of the finest residences in Chicago without disturbing the occupants by any general tear-up of the house. In many cases they had wired under the finest hardwood floors, and after they had left it had been impossible for any but an expert to determine where the boards had been removed and how the work had been accomplished.

SIMPLIFYING CONCEALED CONDUIT WORK.

By T. W. Poppe.

It seems strange that after several years' use of rigid conduit in a progressive and inventive country the bending of conduit for concealed work is still adhered to. Special fittings are manufactured which greatly simplify the installation of exposed conduit. But no genius has turned his talent toward simplifying the installation of concealed conduit. There is no doubt a great saving of time would be effected if a fitting could be manufactured which would obviate the necessity of bending the several conduits which go through the concrete floor to the lamp outlet on the ceiling below.

For example, when installing conduit in a fireproof building where the arches or bays are made of concrete, the plan now followed is to run the conduit from outlet to outlet while the concrete mixture is still soft. This means that one conduit must enter the outlet and one must leave it. As the wooden forms which support the concrete mixture must necessarily remain in position until the concrete mixture has hardened, a hole must be cut through the wooden form at the position where the outlet is to be located and the bent ends of the conduits placed therein. It is manifestly impossible to place the outlet box in position at this time owing to the wooden form. The laying of the conduit while the concrete filling is being placed saves much time, as it is a laborious process cutting through the concrete after it has hardened. With the present system of bending conduits it is also a bad method, as the wheeling of barrows and the traveling of laborers and mechanics over the loose conduits throw them out of position and produce the condition shown in Fig. 2.

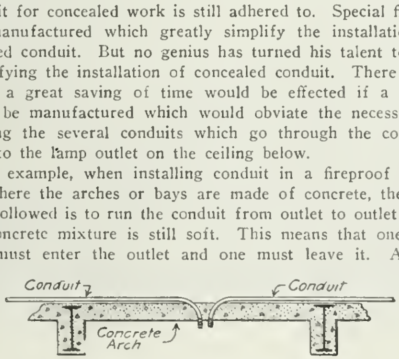


Fig. 1—Correct Installation of Bent Conduit.

Where such a condition exists it is an expensive job to cut the hardened concrete around the displaced conduits and bend them into a position where an outlet box can be attached to them. It also invariably means that the outlet is moved from its correct position and the symmetry of the entire work destroyed.

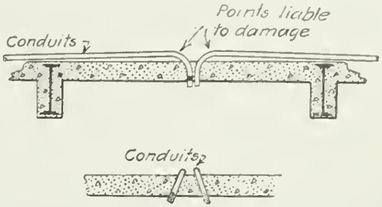


Fig. 2—Improper Position of Conduit and Bends.

The bending of conduit is also a laborious, time-consuming process, as the bends must be made about 5 in. from the end of the conduit because the concrete arches are seldom made more than 4 in. thick. If a larger bend is made the conduit projects upward and is more liable to damage from wheelbarrows and other causes. Figs. 1 and 2 show a correct and an incorrect installation of bent conduits.

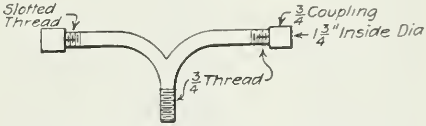


Fig. 3—Fitting Designed to Avoid Bending of Conduits.

In exposed work the bending of conduit by the use of fittings on the market can be wholly eliminated if desired and the work made as satisfactory as by the older method of bending the conduit. The drawing in of the wire becomes a simple task also. Fig. 3 shows a fitting the use of which will obviate the bending of conduits and which also provides a strong, substantial fixture support. The fitting, which can be made of malleable iron to withstand rough handling, is equal in external diameter to the standard ¾-in. conduit. At each horizontal end the inside diameter is enlarged to 13/16 in. to a depth of 1¼ in. This allows the standard ½-in. conduit to slip into it. On each horizontal end a ¾-in. pipe thread is cut to a point 1½ in. from the end. Each end is then cut its entire threaded length, the cut being 1/16 in. wide. The thread will allow a standard coupling to be screwed upon it. When the coupling is screwed on it compresses the sections of the thread divided by the one-sixteenth cut and grips the ½-in. conduit, which is pushed into the fitting. After the conduit is pushed

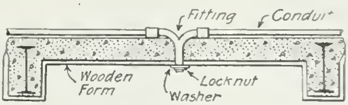


Fig. 4—Fitting in Position in Conduit.

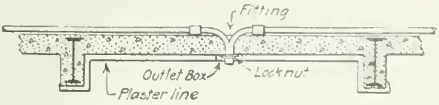


Fig. 5—Fitting and Outlet Box in Place.

into the fitting and before the coupling is screwed on an application of white lead or other water-resisting compound should be made to the thread. When the coupling is screwed on the thread it forces the white lead or other compound into the crevice formed by the cut and makes a waterproof joint as required by the Underwriters.

The use of this fitting not only obviates the bending of the conduits, but it also saves the cutting of many threads. Under the present system the conduits are bent as desired, then measured and taken to a vise, where they are cut and threaded. With this fitting the conduit can be cut where the fitting is being installed and as no thread is required the conduit can be pushed into the fitting, white lead applied and the coupling tightened. A hole 1¼ in. can be bored through the wooden form sustaining the concrete mixture and the vertical portion of the fitting placed therein. A washer can be placed over it and by screwing a locknut on the vertical end, which is also threaded, the fitting and conduit can be firmly clamped to the arch. Fig. 4 shows a fitting in place.

When the wooden forms supporting the concrete are removed the locknut and washer can be removed and an outlet box placed in position by slipping it over the fitting, using the center of the box and forcing it against the concrete by means of a locknut. After the plastering is finished the rigidity of the box is greater because of the hardening of plaster surrounding the box. Fig. 5 shows a fitting and outlet box in position.

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DAMAGE TO CHESTNUT POLES BY WOOD-BORING INSECTS.

The Bureau of Entomology of the Department of Agriculture has recently determined through special investigations that serious damage is being done to the bases of standing chestnut poles in certain localities by the grub or larva of a wood-boring beetle. The character and extent of the damage under different conditions of site in several localities have been determined, and the poles treated with various preservative substances have been inspected to compare the efficacy of both chemicals and methods of treatment. These investigations have resulted in the determination of practical methods of preventing injury to poles by wood-boring insects.

In May, 1910, in addition to the study of the insects involved, investigations were conducted in co-operation with telegraph and telephone companies in the District of Columbia, Maryland, Virginia, Pennsylvania, New York and New Jersey. Through the courtesy of the Western Union Telegraph Company several telegraph lines were inspected in Virginia where the poles were being reset or replaced. The butts of over 200 poles set under different conditions of site were thoroughly examined for insect damage, and sometimes the entire pole was split open. In one line, ten to twelve years old, approximately thirty chestnut poles per mile, 25 ft. long, 6 in. diameter at the top and 10 in. at the base, and apparently of second quality, serious damage by the chestnut borer rendered from 15 per cent to 20 per cent of the poles unserviceable. In another line examined serious damage by this borer on 30-ft. poles averaged about 10 per cent or 15 per cent; and, according to a lineman, 50 per cent of the poles between Boykins, Va., and Welden, N. C., are badly decayed near the surface of the ground. Much of this damage, however, is due to fungous heart rot.

The chestnut-pole borer is a creamy white, elongate, stout, cylindrical, so-called round-headed grub or wood worm which hatches from an egg deposited by an elongate, flattened, shiny, mahogany-brown winged beetle from 2/5 in. to 4/5 in. in length. The eggs are probably deposited from August to October in shallow natural depressions or crevices on the exterior of the pole near the surface of the ground. Often the young larvæ enter the heartwood through knots. The young borers hatching therefrom eat out broad, shallow galleries running longitudinally in the sapwood and then enter the heartwood, the mines being gradually enlarged as the larvæ develop. As they proceed, the larvæ closely pack the fine excreted boring dust behind them. This débris, which is characteristic of their work, is reddish or dunnish yellow in color and has a clay-like consistency. The mines eventually end in a broad chamber, entrance to which is plugged up by the excelsior-like fibers of wood chiseled out by the strong mandibles of the larva. Here in the resting stage the pupa is formed, and in this chamber the perfect adult spends considerable time before emerging. The insect is very widely distributed, ranging from Ontario, Canada, to Texas, eastward to the Atlantic Coast and westward to Arizona and southern California. It is common throughout the natural range of the chestnut.

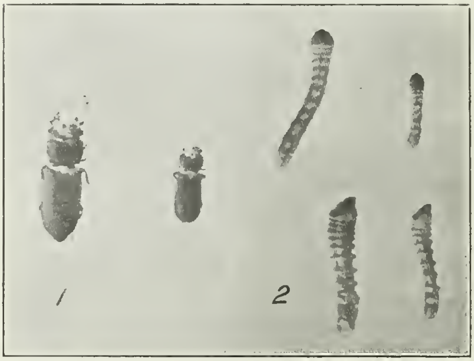


Fig. 1—Chestnut-Pole Borers; Male and Female Beetles and Larvae.

The injury to the poles consists in large mines in the wood near the line of contact of the pole with the ground, necessitating the frequent resetting or even replacement of the damaged poles. These irregular galleries of the grub run both horizontally and longitudinally throughout the heartwood and are sometimes 7 in. long, but vary with the individuals, which show great differences in size. The borers usually work in the outer layers of the wood at the base of the pole for a distance of from 2 ft. or 3 ft. below, but sometimes from 1 ft. to 2 ft. above the line of contact of the pole with the surface of the ground. The greatest damage is to that area just below and just above the surface of the ground, where the conditions of air and moisture are most favorable. Often the entire butt up

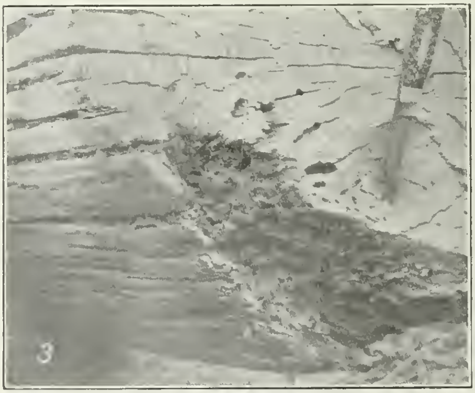


Fig. 2—Damage to Untreated Chestnut Pole Near Ground.

to a distance of from 4 ft. to 6 ft. and higher, according to the depth of setting, is mined. The numerous galleries, often very close together, completely honeycomb the wood in a zone 3 in. to 4 in. in from the exterior of the poles, and this so weakens the poles that they break off close to the surface of the ground. Even if the damage is not serious enough to cause the poles to break off under strain, they are likely to come down during any storm and thus put the wire service out of commission. The beetle will attack poles that are perfectly sound, but evidently prefers to work where the wood shows signs of incipient decay. It will not work in wood that is soggy (wet rot) or in very "doty" (punky) wood. It has not yet been determined just how soon the borers usually enter the poles after they have been set in the ground, but poles that had been standing only four or five years contained larvæ and adults of this borer in the heartwood, and poles that had been set in the ground for only two years contained young larvæ in the outer layers of the wood. Poles that appear sound on the exterior may have the entire basal interior riddled; the work of the borers is not noticed until the poles break off During August the young adults may be found in shallow depressions on the exterior of poles below the ground surface.

As more than one-fourth of the 3,500,000 round poles exceeding 20 ft. in length used annually by the telephone, telegraph and other electric companies are chestnut, and as this borer has seriously damaged as high as from 10 per cent to 40 per cent, varying with the conditions of site, of the chestnut poles which have been set in the ground for from ten years to twelve years in lines in the states above enumerated, it is evident that this insect is an important factor in decreasing the normal length of service of the poles. The damage is apparently greatest and the borers are most abundant where the poles are set in high or level dry ground under good conditions of drainage. Where the poles are in wet sites there is usually but little injury by wood-boring insects except to that portion near the surface of the ground. Conditions of drainage are more important than different soil combinations, and the condition of the soil is more important that its composition; that is, where the soil is hard-packed there is apparently less damage then where it is loose. The quality and condition of the poles before setting is a very important factor to consider before arriving at any conclusion as to the relative longevity of poles under various conditions of site.

It is not to be concluded that this wood-boring beetle is the only insect that injures standing chestnut poles. Indeed, the most common injury is by the wood lice or white ants. In lines from ten to twelve years old these insects have seriously damaged as high as 15 per cent of the poles, and their work is even present, at least superficially, in as high as 75 per cent of the poles under all conditions of site. However, the damage is usually to the outer layers of the wood, where it is moist and there is incipient decay and is more superficial and localized than that of the chestnut-pole borer.

Through the courtesy of the American Telephone & Telegraph Company and the Forest Service about forty chestnut poles set in a test line near Dover, N. J., were inspected to determine the relative merits of various methods of preventing damage by wood-boring insects to the bases of poles. In this line, less than eight years old, variously treated poles alternated with untreated poles in order that each chemical preservative and method of treatment might receive an absolutely fair test under the same conditions of site. The poles were 30 ft. long, 7 in. at the top and 33 in. in circumference 6 ft. from the base. In the inspection the earth was removed to a depth of about 1 ft. from the base of the pole and then the pole was chopped into to determine the rate of decay. This method of inspection for insect damage is not very satisfactory. The various methods experimented with in this test line were brush treatments with a patented carbolineum preservative and spiritine, charring the butt, setting the pole in sand and setting it in small broken stone. It was found that, although these methods may temporarily check the inroads of wood-boring insects, they will not keep the insects out of the poles The most serious damage to the poles in this line was by white ants. Other insect damage was by a large black carpenter ant and the larvæ of a round-headed borer.

An inspection was made last September of the bases of over 400 chestnut poles set in a similar test line near Warren, Pa., and Falconer, N. Y. These poles were treated by the creosote open-tank method of impregnation and brush treatments of creosote, wood creosote, creolin, two different carbolineum preservatives and tar. They had been set in the ground for a period of five years. All of these treatments, except the brush treatments with creolin and tar, were efficient in preventing the attacks of wood-boring insects, and for at least a five-year period in this northern climate there was but little damage by insects to the poles in this test line. The most common injury to the untreated poles was by large black carpenter ants, which widen the longitudinal weathering checks and hence induce more rapid decay. The work of the chestnut-pole borer was found in several poles, but this beetle was evidently just beginning to attack these poles. There was some damage by a round-headed borer No white ants or termites were present as the location was evidently too far north for these destructive borers. A report by inspectors of the American Telephone & Telegraph Company and the Forest Service on the remainder of the poles in this test line showed that these conclusions can be applied to all of the poles in the line, with the exception that there was superficial injury by small black ants to two poles treated by brush treatments of carbolineum avenarius and to two treated with wood creosote. Also, as the inspection progressed injury by the chestnut-pole borer became more abundant and serious, and the borers seemed to be established in the poles. Poles treated by the creosote open-tank method of impregnation and by brush treatments with creosote, and with "S. P. F." carbolineum remained uninjured

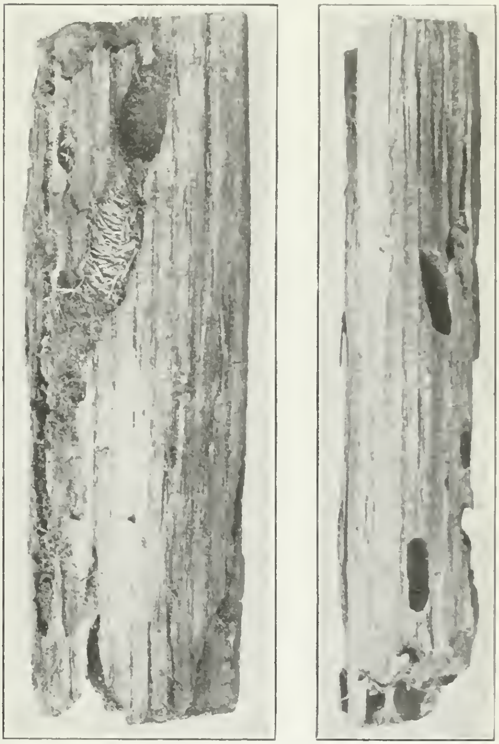


Fig. 3—Work of the Pole Borers.. At Left, Chamber Closed with Wood Fibers.

Methods of treating poles superficially by brushing with various preservatives have proved to be temporarily efficient in keeping out wood-boring insects if the work is thoroughly done and not only the butt but also the base is treated. When the base is left untreated the insects enter the pole from below ground. It is thus evident that impregnating the poles with creosote by some standard process, either the open-tank or the cylinder-pressure processes, will keep wood-boring insects out and preserve the poles for a much longer period than they would last untreated. In the open-tank method the area most subject to the attacks of wood-boring insects and deterioration in general, that is, the basal 8 ft., is treated, while by the cylinder-pressure processes the entire pole is impregnated. Alternating less susceptible juniper (red cedar) poles or pine poles, thoroughly impregnated by some standard process, in the line with the chestnut poles would be a safeguard in holding up an old line where the damage is found to be serious on resetting.

LETTER TO THE EDITOR.

The Basis of Comparison of Illuminants.

To the Editor of Electrical World:

Sir:—The proper basis for comparing the efficiency of two illuminants, leaving aside such facts as cleanliness, divisability of units, color, heat, fumes, etc., is a subject of much importance since one frequently desires to ascertain the relative average performance of two different illuminants. There was a time when each maker would rate his illuminant in that particular candle-power unit which would indicate the highest candle-power value. Thus it was advantageous for the carbon-filament incandescent lamps to be rated in mean horizontal candle-power; Nernst lamps in mean lower hemispherical candle-power; upright gas lamps in upper hemispherical values, etc. This condition undoubtedly had something to do with the introduction of the term "lumen," which relates to the total light flux emanating from a source. Although the mean spherical candle-power unit, which bears to the lumen the numerical ratio of 4π to 1, was sufficiently definite, its possible confusion with other candle-power units made desirable the coining of the term "lumen." The lumen is also a more convenient unit when one is considering the light flux in a particular zone.

Of equal importance with the candle-power rating of lamps is the variation in the candle-power of the source during its useful life or its average candle-power in service. If the results of the careful tests of Dr. Louis Bell and Messrs. Preston S. Millar, J. R. Cravath, V. R. Lansing, Ward Harrison and other electrical men on gas lamps be accepted, the average performance of the gas mantle should be taken as from 60 per cent to 70 per cent of the initial laboratory value. The same condition seems to apply to the mercury-vapor tube lamps. Tests on tungsten lamps show that their average candle-power bears a high ratio to the initial, being about 95 per cent thereof. If the peak in the candle-power curves be included, the value reaches quite near unity.

Consideration should also be given to such factors as depreciation, interest on the capital invested, maintenance and renewals. Where the first cost of the installation is high, as in the case of the mercury-vapor tube lamp, the interest and depreciation become large factors. Another feature which is sometimes overlooked is that of considering for what particular purpose the illuminant is intended to be used. With some illuminants the eye can see detail better than with others. There are, therefore, two ways of comparing illuminants with each other.

On an illumination basis one illuminant may prove cheaper than another, while on an acuity basis the reverse may be true. The color of the illuminants may affect the acuity. A black letter on a white background would give a high acuity value for the mercury-vapor lamp, but a black letter on a red background would produce a lower acuity. The contrast effect which exists between an object and its background under a particular type of illumination may show up in favor of a particular illuminant.

One feature which is often overlooked in connection with gas lamps is the gas consumed by the pilot flames. It is stated that the pilot flames consumes only ⅛ cu. ft. per hour. If the main burner consumes 3⅓ cu. ft. and burns for three hours a day, the pilot flame burning twenty-four hours a day would consume about 30 per cent of the total gas used.

In considering two different illuminants one should determine, first, the mean spherical candle-power value under ideal laboratory conditions; second, the relation existing between laboratory conditions and the average performance throughout useful life; third, the total consumption, including that of auxiliary devices; fourth, interest, depreciation, maintenance and renewals.

Having decided to compare the illuminant upon either the foot-candle intensity basis or the acuity basis, and considering all of the other facts mentioned, one is in a position to determine the relative economy of one illuminant over another when used so as to produce equal average illumination for a given period of hours.

The above has been written in the hope that it will stimulate discussion, and that it will result in the publication of more definite information of a research character on the performance of various types of illuminants.

Harrison, N. J. Sydney W. Ashe.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Synchronous Single-Phase Machines.—F. Niethammer.—An article on some difficulties in the design of large 25-cycle, single-phase machines with reference to a recent investigation by M. Wengner, in which the armature reaction of the single-phase synchronous machine was emphasized especially as the chief feature distinguishing it from the polyphase machine. The present author gives a simple method for calculating a single-phase generator and especially the important damping (amortisseur) winding.—*Elek. u. Masch.* (Vienna), Jan. 22.

Alternators in Parallel.—J. W. Van Dyke.—For the investigation of the phenomenon of surging of alternators operating in parallel the author has devised an optical method for determining the angular displacement of the machines from their synchronous position. The results of tests made with this method are given in diagrams and tables.—*Elek. Zeit.*, Feb. 2.

Induction Motors.—W. E. Highfield and R. Livingstone.—A mathematical paper setting forth the considerations which affect the design of induction motors. The paper is divided into two parts, one being devoted to technical and the other to commercial considerations in order to show the relative importance of the two.—Lond. *Electrician*, Feb. 10.

Circular Diagram.—A. Thomaelen.—A brief paper illustrated by diagrams showing a simple method of deriving the Ossanna circular diagram from that of Heyland.—*Elek. Zeit.*, Feb. 9.

Lamps and Lighting.

Metallic-Filament Lamp.—A note on a recent British patent (11,107, Feb. 2, 1911) of O. Krause (Deutsche Gasglühlicht Ges., Auergesellschaft). It has been found that the lamp foot containing the platinum leading-in wires is liable to burst when the binding materials of the tungsten filament are volatilized by raising it to a high temperature. To avoid this the leading-in wires are temporarily shunted by thicker wires outside the foot, or connection is made above the foot.—Lond. *Elec. Eng'ing,* Feb. 9.

Tungsten Lamp.—A note on a recent British patent (15,879, Feb. 2, 1911) of K. Schroeter. When filaments are drawn from a mixture of alloy of tungsten with a soft metal the latter is expelled by raising the filament to incandescence after it has been wound on the supports. A deposit of the volatilized metal may be formed on the supports, and, to make its removal easy, these are covered with a film of collodion, or wax, which is dissolved afterward in a solution and carries the deposit away with it.—Lond. *Elec. Eng'ing,* Feb. 9.

Generation, Transmission and Distribution.

Water-Power in Switzerland.—According to a statement recently issued by the Swiss Industrial Water Union a greater portion of the water-power now available in Switzerland is utilized than in any other country. The total water-power of that country is estimated at 1,200,000 hp, of which 400,000 hp was employed at the end of 1908, while 700,000 hp, or 60 per cent of the whole, will be in use for generating electrical energy early this year. The union intends to devote special attention to the question of government reservation of power for railways, while it will promote schemes for increasing the power economically available by the erection of storage reservoirs. Agitations against the taxing of electrical energy by the cantons will be set up, while a scheme showing the various prices charged for service will be prepared.—Lond. *Electrician,* Feb. 10.

Tendencies in the Design of Modern Power Plants.—G. W. MEYER.—The author gives instances from modern practice to discuss the following three tendencies in the design of electric power plants. First, the use of steadily increasing transmission voltages; second, the use of few generating sets of large rating; third, the operation of various plants in parallel to a common high-tension network.—*Elek. u. Masch.* (Vienna), Jan. 15.

Traction.

Three-Phase Freight Locomotive.—A description of a new design for three-phase locomotives, forty of which are now being constructed for use on the electrified main sections of the Italian state railways. There are five coupled driving axles and the two three-phase motors are mounted between the second and third and third and fourth axles. They are eight-pole motors, each rated at 1000 hp on the one-hour rating. Two running speeds of fourteen and twenty-eight miles per hour, obtained by cascade and parallel connections of the motors respectively, are provided for. The speeds of the motors in the two cases are 112.5 r.p.m. and 225 r.p.m. For accelerating water resistors are used.—Lond. *Elec. Eng'ing,* Feb. 9.

Installations, Systems and Appliances.

Static Substation Design.—P. V. HUNTER.—An illustrated paper read before the Newcastle Section of the (British) Institution of Electrical Engineers. After discussing general considerations, such as reserve plant and the effect of size on cost, the arrangement of apparatus in a substation where naturally cooled transformers are installed is described. Artificially cooled transformer substations are next considered and finally a discussion is given of a special type of station not coming entirely under either of the above heads.—Lond. *Electrician,* Feb. 10.

Ward Leonard Control.—A note on a recent British patent (10,370, Feb. 2, 1911) of E. C. Marks (Felton and Guilleaume-Lahmeyer Werke). In order to make the variation in speed of the motor exactly proportional to the regulation of the shunt field of the generator and independent of residual magnetism and the *IR* drop in resistances the generator is compound-wound and its shunt-field current is controlled automatically by an auxiliary generator coupled to the motor.—Lond. *Elec. Eng'ing,* Feb. 9.

Switchboard Construction.—W. FUHRMANN.—An article discussing various details of the design and construction of switchboards. He strongly recommends the greater use of recording instruments and also of frequency meters. He discusses some methods of mounting the instruments and switches and especially the correct mounting of the fuses.—*Elek. u. Masch.* (Vienna), Feb. 5.

Calculations of Starters.—F. NATALIS.—A description of a simple method for determining the different steps of the starters for direct-current, shunt and polyphase induction motors. The method is based on the use of logarithmic paper. *Elek. u. Masch.* (Vienna), Feb. 5.

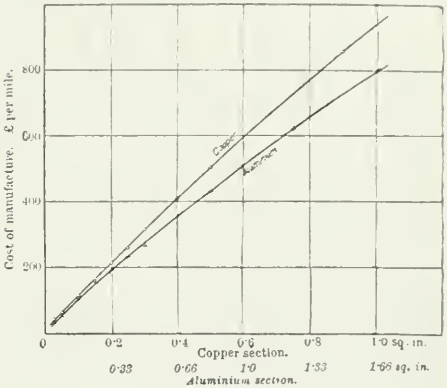


Fig. 1—Manufacturing Cost of Copper and Aluminum Single-Core Paper-Insulated Cables.

Damping of Turbine Regulators.—KROENER.—The author discusses under what conditions a correctly designed reciprocating hydraulic regulator for turbines will oscillate for a considerable time before coming to rest and tries to determine in which cases an oil brake is to be recommended for getting rid of these oscillations.—*Elek. u. Masch.* (Vienna), Jan. 15.

Protective Devices for Electrical Apparatus.—A. G. HEATHER. —A paper read before the South African Institute of Electrical Engineers. The author confines his remarks mainly to alternating-current circuits. After discussing the features of fuses, he considers alternating-current relays, describing various types. Finally, the Cowan-Andrews and the Merz-Price systems are explained.—Lond. *Electrician,* Feb. 10.

Wires, Wiring and Conduits.

Aluminum Versus Copper Cables.—F. C. RAPHAEL AND J. B. SPARKS.—An article in which the authors compare the relative cost of copper and aluminum single-core, paper-insulated cables. The results of their estimate of manufacturing cost are given in Fig. 1. It is seen that for all sections aluminum cable is cheaper to manufacture than copper cable, and that for the larger sizes the difference is very considerable. The costs given are not those at which cable can be bought. They represent the bare manufacturing costs, including material, labor, etc., and no allowance is made for establishment charges, profit or transport and other general charges. Several methods of jointing are described. One of these is the straight-through joint of Fig. 2. A three-part stepped clamp is used on the aluminum cable, the clamping pieces being screwed onto the flat lug of a thimble into which the copper cable is sweated.—Lond. *Elec. Eng'ing,* Feb. 9.

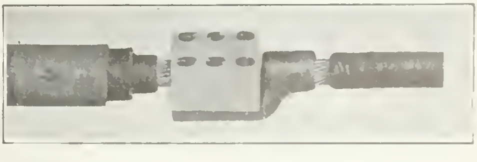


Fig. 2—Straight-Through Joint with Stepped Clamp on Aluminum Cable.

Dielectric Losses in Insulators.—H. Jordan.—The first part of a paper giving the results of an investigation carried out in the German Telegraph Research Bureau on the measurement of dielectric losses in insulated fibers. After a theoretical introduction and a description of the method of measurements the author gives the results for cotton and paper cables and also deals with the absorption of water by these materials. The paper is to be concluded.—*Elek. Zeit.*, Feb. 9.

Electrophysics and Magnetism.

Origin of Magnetic Storms.—A. Schuster.—A note on a (British) Royal Society paper giving a critical examination of the theory that magnetic storms are caused by streams of electrified corpuscles ejected from the sun. If the electro-kinetic energy of such storms be calculated it is found that when the magnetic field produced is comparable with that observed in magnetic storms the energy is enormously great compared with that obtained by mere addition of the energies of the separate corpuscles. Even if during violent storms, when the magnetic force may be of the order 0.004 c.g.s. units, the corpuscles had an initial velocity nearly equal to that of light, the energy required to establish the magnetic field would be sufficient to reduce the speed to less than 4 km a second before the swarm reaches the earth, the passage between the sun and the earth taking about a year. In this calculation the cross-section of the swarm is assumed to be determined by the effective duration of the magnetic disturbances which it is supposed to produce. If the swarm be reduced in cross-section the energy belonging to it would be diminished, but for a given magnetic force the density of the corpuscles in the swarm must then be correspondingly greater. This leads to the consideration of the effects of electrostatic repulsion between the particles. It appears that if H be the magnetic effect the electrostatic acceleration at the edge of a swarm of electrons must be greater than 5×10^{17}H. This acceleration would be sufficient to drive a corpuscle in the first second through a distance equal to more than the diameter of the earth. It follows that, even taking account of electromagnetic attractions between the corpuscles, a swarm of corpuscles, when sent out from the sun in a definite direction, would soon be dissipated to such an extent that no sensible magnetic disturbance could be produced. Finally the electrostatic effects which could be observed on the surface of the earth in each magnetic storm are discussed, and here the calculation also leads to the conclusion that the theory criticised is untenable. If magnetic disturbances are produced by rays emanating from the sun it can, therefore, only be in an indirect manner. We may imagine that the injection of corpuscles ionizes the upper portions of the earth's atmosphere and consequently renders the already existing e.m.fs. more effective, or we may imagine the approach toward the earth's magnetic field of highly conducting material containing ions of both kinds acting as induction. The effect of such induction would primarily be an increase in the horizontal and a diminution in the vertical forces, while the currents induced in the earth, tending to diminish the horizontal forces, owing to their inertia would die out more slowly so that a semi-permanent effect would be left after the storm. This agrees with observation, but there are at present not enough data available to test the sufficiency of the explanation.—Lond. *Electrician*, Feb. 10.

Edison Effect.—M. Goly.—The author describes the well-known Edison effect in carbon-incandescent lamps and deals in general with the same effect as observed with other incandescent bodies. He gives a review of the various investigations which have been carried out with respect to this phenomenon and concludes that the theory of Richardson if not complete is at least approximately true.—*La Lumière Elec.*, Feb. 4.

Graphical Representation of Power.—L. Berger.—An article illustrated by diagrams giving a description of the new method of F. Punga (different from that of Steinmetz) for the representation of power and energy in alternating-current vector diagrams.—*La Lumière Elec.*, Feb. 4.

Electrochemistry and Batteries.

Determining the State of Charge of a Storage Battery.—In an article on instruments exhibited at the Brussels World's Fair a method is described for determining the charge of the plates in a storage battery by means of the arrangement shown in Fig. 3. A small portable voltmeter with a scale reading from —0.5 volt to +2.5 volts has as one terminal a flexible rope with a pure cadmium electrode at its end, which is inclosed in a perforated rubber cover. This cadmium electrode is inserted into the solution of the storage battery. The other terminal of the voltmeter makes direct contact with the plate, the condition of charge of which is to be determinated as shown in the illustration. When a battery has been discharged to 1.8 volts then the measurement of the potential difference between the positive plate and the cadmium electrode gives a reading of 2.05 volts, while the voltage difference between the negative plate and the cadmium electrode is 0.25 volt. The voltage of the cell is 2.05 — 0.25 = 1.80 volts. When the same test is made during charging the potential difference between cadmium and positive plate is 2.32, and that between the negative plate and the cadmium electrode is —0.18 volt (in the other direction). The e.m.f. of the cell is 2.32 + 0.18 = 2.5 volts.—*Elek Zeit.*, Feb. 2.

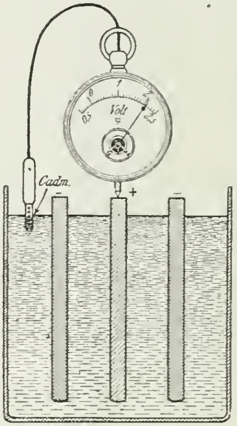


Fig. 3—Cadmium-Electrode Test of Storage-Cell Condition.

Units, Measurements and Instruments.

Clark and Weston Standard Cells.—H. L. Bronson and A. N. Shaw.—A British association paper in which the authors give the results of setting up Clark cells according to the specifications of Wolff and Waters. Certain modifications were also made in the preparation of materials. Good agreement was obtained with Clark cells at the Bureau of Standards, and somewhat better results with Weston cells. The importance of purity in the mercurous sulphate is emphasized. The ratio of the Weston to the Clark cell was determined and found to agree closely with that given by Wolff and Waters. The conclusion is reached that the Weston cell is much more satisfactory than the Clark cell. The authors state that their tests strongly support the claim of the Weston cell for adoption as one of the two legal electrical standards. The preparation of the cell for absolute work is far simpler than that of the coulometer, and it has the great advantage of being quite easily constructed if an accuracy of not more than 100 microvolts is desired. The cell is, to a certain extent, portable, and, if the mean of a batch of about ten is taken, there does not appear to be any chance for the uncertainty which was formerly associated with the standard cells.—Lond. *Electrician*, Feb. 10.

Demonstration of Phase Difference Between the Primary and Secondary Currents of a Transformer.—F. T. Trouton.—An abstract of a (British) Physical Society paper. The apparatus is a primitive induction motor consisting of two horseshoe electromagnets with their axes coincident and vertical and their planes at right angles. Above the poles a copper disk is pivoted. The primary current from a transformer is sent through one magnet and the secondary current through the other. With a suitable phase difference a rotating magnetic field is thus obtained. The phase difference between the current is $\Theta = \frac{\pi}{2} + \tan^{-1} \frac{Lp}{R}$, L and R being the inductance and resistance of the secondary circuit. By increasing L, Θ tends to approach 180 deg., and consequently the torque acting on the disk becomes small. Increasing R makes Θ tend to approach 90 deg. and a larger rotation is obtained. Inserting an iron core into the transformer diminishes the speed of rotation owing to the increase of L and also to the fact that the hysteresis in the iron causes the secondary circuit to lag still more behind the primary. Lags greater than 180 deg. may be obtained when the rotation is in the opposite direction and may be reduced to nothing by increasing the resistance. A steel core will produce a greater negative rotation than an iron one. To demonstrate the hysteresis effect it is necessary that the core should consist of a bundle of fine wires, otherwise the eddy currents set up will introduce a lag. The effect of eddy currents can be shown by introducting another coil within the transformer in place of the iron core and closing its circuit with a variable resistance when lags larger or smaller than 180 deg. may be obtained according to the resistance. The hysteresis is greatly modified by subjecting the core to a permanent magnetic field by means of an additional coil on the transformer. Moderate fields increase the hysteresis, though large fields decrease it. This is due to working on the knee of the hysteresis curve in the first case, while in the second case the core is permanently saturated and acts as a non-magnetic substance.—Lond. *Electrician*, Feb. 10.

Ohmmeter.—In an article on instruments at the Brussels exhibition there is described an ohmmeter of French make which belongs to a general class of instruments in which two instruments are combined with the needles placed in such a way that they cross each other and that the position of the crossing point is the measurement of a quantity which can be mathematically derived from the two quantities given by the two instruments respectively. One instrument of this kind exhibited was a wattmeter, being a combination of a voltmeter and an ammeter. Another instrument of this kind is a frequency meter, consisting of two hot-wire milliameters in parallel, one being in series with a non-inductive resistor and the other in series with a reactor. A third instrument of this kind is an ohmmeter, shown in Fig. 4, for measuring resistances from 0.1 megohm to 10 megohms. It is a combination of a voltmeter and an ammeter. The voltmeter measures the voltage drop in the resistor, the resistance of which is to be determined, while the ammeter measures the current passing through the resistor. The crossing point of the needle of the voltmeter and the ammeter gives directly the resistance in ohms. In order to neglect the errors due to power consumption of the voltmeter and the ammeter themselves two methods of connection are provided, as shown in Fig. 5. For determining high resistances the first arrangement, and for determining low resistances the second connection, are used. The very extended scale of this instrument and its independence of the voltage are special advantages.—*Elek. Zeit.*, Feb. 2.

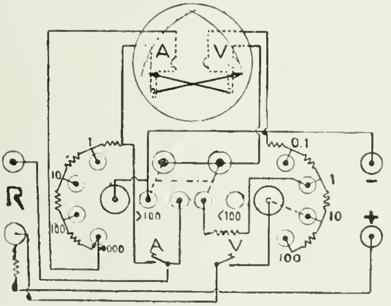


Fig. 4—Ohmmeter for Direct Measurement of Resistance.

High-Frequency Resistance of Wires.—J. A. Fleming. An abstract of a (British) Physical Society paper on the experimental measurements of the high-frequency resistance of wires. The author uses an apparatus consisting of a differential air thermometer having tubular bulbs into which similar wires can be placed, and by means of which a comparison can be made of the high-frequency resistance R' of a straight wire and its steady or ohmic resistance R. If through one of two equal wires is passed the steady current A and through the other the high-frequency current A_1, then if these currents are adjusted until the rate of heat evolution in each case is the same, $A^2R = A_1^2R^1$. Certain precautions are described in the paper for eliminating inequalities, but by means of correct reading high-frequency ammeters as devised by the author the ratio of the resistance R^1/R can be determined from the ratio of the mean square currents A^2/A_1^2. The high-frequency currents used were obtained by condenser discharges and the equi heating steady current determined by means of the differential thermometer arrangement having two equal wires in the two tubular bulbs. It is then shown that the results for straight wires agree very well with the formulas given by Lord Kelvin and A. Russell for the ratio R'/R for wires of different sizes and for different frequency. It is pointed out that the correction to be applied for damped oscillations as compared with persistent oscillations is at most 1 per cent in the cases measured and that the correction for the heating effect of the condenser-charging current is negligible. The case of spiral wires is then discussed. The resistance R'' of a spiral is greater than that of the same wire R' stretched out straight. In the case examined the ratio R''/R exceeds R'/R by from 50 per cent to 80 per cent. Experiments are also described on the high-frequency resistance of wires of magnetic metals, and it is shown that in this case the observed value of R'/R can be used to determine the permeability for small high-frequency magnetizing forces.—Lond. *Electrician*, Feb. 10.

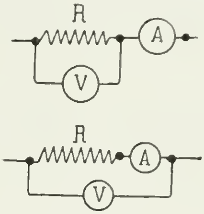


Fig. 5—Circuits for Eliminating Errors Due to Instruments.

Exhibition of Instruments.—A. Schwartz.—The first part of an illustrated description of the technical and scientific instruments exhibited at the World's Fair in Brussels in 1910. —*Elek. Zeit.*, Feb. 2.

Telegraphy, Telephony and Signals.

Simultaneous Telegraphy and Telephony—K. Fuchs—A long article describing briefly the different systems of simultaneous telegraphy and telephony. The author finally describes the methods employed on the Austrian telephone lines, in which all communications between customers and between the centr and customers are by telephone, while communications between the different officials in different centrals are made simultaneously by telegraph.—*Elek. u. Masch.* (Vienna), Jan. 15, 22 and 29.

Conference of Telegraph and Telephone Engineers.—F. F. Petritsch.—The first part of a full account of the recent Paris international conference of telegraph and telephone engineers, the proceedings of which have already been reviewed in the Digest.—*Elek. u. Masch.* (Vienna), Feb. 5.

Miscellaneous.

Magnetic Separation.—H. Hermanns.—An illustrated article on methods of magnetic separation for removing particles of iron from form sand, slags and other materials.—*Elek. u. Masch.* (Vienna), Jan. 29.

Patent Law of Holland.—A. Kuhn.—An article giving the principal features of the new patent law of Holland in comparison with the German patent law.—*Elek. Zeit.*, Feb. 9.

Testing Electrical Machines.—C. F. Guilbert.—A discussion of the differential methods of Kapp and Hutchinson for testing machines and of their recent modifications by Drysdale and Clinton, which were described in the Digest.—*La Lumière Elec.*, Jan. 2.

Syntony of a Quenched Spark.—W. H. Eccles and A. J. Makower.—A letter referring to a recent paper of Galletti and criticising his methods of calculating the efficiency of transference of energy from a primary circuit containing a quenched spark to an aerial as secondary. They suggest that the efficiency found by him is apparently too high.—Lond. *Electrician,* Feb. 3.

Wireless Telegraphy.—H. Poincaré.—A continuation of his highly mathematical paper in which he now takes up the predetermination of wave-length and damping coefficient of an exciter of given form.—*La Lumière Elec.*, Jan. 2.

Book Reviews.

Mechanical World Pocket Diary and Year Book. Manchester: Emmott & Company, Limited. 332 pages, illus. Price, 6d.

In the twenty-fourth annual issue of this useful handbook the contents have been increased by the addition of material on cutting tools and speeds; wheel gearing; annealing, hardening and tempering; details of gas-engine construction; steam-fitting, etc. The subject matter contains many reference tables and brief explanations of mechanical appliances, steam apparatus, etc. Blank diary and memoranda pages are included in the binding.

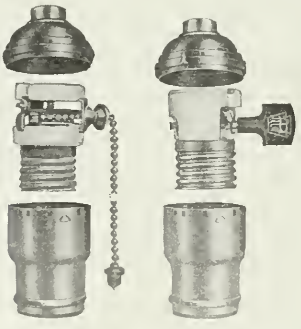
Elektro-Ingenieur Kalender for 1911. By A. H. Hirsch and Max Barth. Berlin: Oscar Coblentz. 322 pages. Price, 2.50 marks.

The 1911 edition of this little handbook, which the German-speaking electrical man may find more convenient to consult than the excellent manuals available in English, presents with characteristic completeness a mass of useful electrical information, reference tables, construction data, specifications, etc., but all generally of more theoretical than practical significance. As a reference volume it has a varied range of contents and also the scattered character to be expected in the space limitations of its pages. The book is specially bound for pocket use.

New Apparatus and Appliances

SNAP-SHELL INCANDESCENT-LAMP SOCKET.

The snap-shell incandescent-lamp socket made by the H. T. Paiste Company, Philadelphia, Pa., is illustrated herewith. On the shell are two heavy catches which slip into a formed channel running like a ring around the cap. The supporting edge of the channel where the catches grip is not flat, but is formed on an angle so that the ordinary strains and pulls on the shell only cause the catches to hold tighter. To guard against the shell turning in the cap both are locked together by two small lugs which enter the square recesses in the shell and prevent it from twisting. By pressing the shell at the point marked on it and by a motion such as is employed in opening a book the cap and shell are readily disengaged. Sockets of this type are, of course, above all else time savers; the cap is first screwed to the fixture and secured by the set screw in usual manner and after the movement is wired the shell is inserted into the cap about 1/16 in. and then rotated to the position desired. A further push on the shell causes it to lock itself in that position.



Figs. 1 and 2—Snap-Shell Lamp Sockets.

ELECTRIC VEHICLES AT CLEVELAND AUTOMOBILE SHOW.

A very successful automobile show was held in the Central Armory, Cleveland, Ohio, during the week Feb. 18 to Feb. 25, inclusive. The building was tastefully festooned in green, with vari-colored lamps on all the pillars and at various other points. This, with the well-planned general lighting scheme and clusters of vines and flowers here and there, produced a very pleasing effect. Huge electroliers in novel shapes hung from the high ceiling in the main portion of the building, while the balconies were lined with smaller lamps. The arrangement of the displays brought out the good points of all the cars well. Displays of electric vehicles were made as follows:

Euclid Automobile Company, Columbus, electric coupé and four-passenger stanhope or open electric.

The Broc Electric Vehicle Company showed its new coupé and roadster. These vehicles are provided with silent-chain transmission, inclosed in dust-proof, oil-retaining cases. Exide batteries are used, but other types may be substituted.

The Cleveland branch of the Anderson Carriage Company, of Detroit, showed a gentleman's underslung roadster and a four-passenger extension brougham. These cars have a shaft drive operating in an adjustable bevel gear on the axle and without gear reduction. The roadster has a long wheelbase, is hung low and somewhat resembles a racing car.

The display of the Rauch & Lang Carriage Company, of Cleveland, consisted of a forty-cell, large extension four-passenger coupé and a small extension four-passenger, shaft-driven, twenty-four cell coupé, with chassis showing the chain cover and other strong points. All cars are provided with Exide battery standard equipment.

The Cleveland branch of the Hupp-Yeats Electric Car Company, of Detroit, showed one of its coupés. This car hangs low between the axles, with running board on a level with the floor. The motor is attached directly to the rear-axle gear housing and drives through bevel gears of Hecla steel. The batteries are carried over the front axle and concealed by the hood. The absence of reduction gears does away with the usual strain of a shaft, it is claimed, and makes a very satisfactory operation.

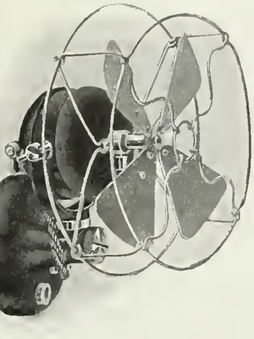
The Baker Motor Vehicle Company had on display an extension four-passenger coupé, a special extension four-passenger coupé, a Queen Victoria and a chassis, showing the working parts of all its cars. This company has adopted the shaft-drive exclusively, with bevel-gear transmission.

The Studebaker Automobile Company showed a single electric car, a four-passenger, single-chain inclosed, with full floating-type rear axle and twenty-cell, eleven-plate Exide standard equipment. The interior was finished in whipcord and the car was provided with a full equipment of accessories for the use of ladies. Westinghouse motor and controller are used in the car.

Mr. J. H. Greenwald displayed a four-passenger Waverley of the latest-design coupé body.

CARLETON DESK FAN.

The Carleton Company, of Boston, Mass., has brought out a 6-in. fan for standard direct-current and alternating-current circuits and also wound for 7-volt battery circuits. While the fan is primarily intended for desk use, by means of an ingenious device it is readily convertible to a bracket fan, and this with the trunnion suspension permits adjustment at any desired angle. The bearings of the fan are of bronze and are of ample size. The oil cups are large and the commutator is built up with mica insulating strips punched to shape and held rigidly in place under pressure. The brushes are of carbon with a core of copper. The fan is finished in black and the bright parts are finished in copper or are nickeled. The manufacturer claims that the fan is suitable for use where a ceiling fan is not required and is well adapted for general home and office use. It is said to be almost noiseless in operation and to deliver a breeze surprisingly large for so small a fan.



Six-Inch Bracket Fan.

FURNACE CEMENT THAT WILL RESIST 3000 DEG. FAHR.

Engineers have experienced difficulty in the proper maintenance of brick settings of furnaces of all types, having had to depend very largely upon the ordinary fireclay as a bonding material. As this fuses at a comparatively low temperature, the bond between the bricks is rapidly destroyed, with the result that cracks are opened up between the bricks through which the gases of combustion enter, eventually weakening the brick and causing the walls to collapse.

Another objectionable point of settings has been that refractory bricks become porous on the surface and very soon the clinkers from the coals attach to the surface of the brick, and in removing these with tools the bricks are broken.

After several years devoted to research work on refractory cements to overcome these troubles the H. W. Johns-Manville Company, New York, has developed a line of cements called "J-M Refractory Cements" for furnace setting of various types, cupolas, lining brass furnaces, assayers, crucibles, oil-burning, tilting and rotary furnaces, and for patching and facing bricks in place in the fire zone under various conditions.

These cements resist temperatures as high as 3000 deg. Fahr. The same company has also developed a coating for walls known as "J-M Brickline Cement," which seals the pores of the brick and prevents clinkers from adhering.

REDUCED ENERGY CONSUMPTION OF AN EIGHTEEN-HOUR ICE-MAKING PROCESS.

Of special interest to central stations desiring to increase their plant incomes are the operating results recently obtained with a new ice-making process first described in the *Electrical World*, Nov. 21, 1908, the notable features of which are eighteen-hour ice manufacture at an energy consumption less than one-half that of other systems. The installation of such ice-making equipment provides a profitable and controllable load which fits the "hollow" of the central-station daily load curve; produces an increased quantity of ice for the same energy expenditure; makes use of raw water, avoiding the necessity of distilled water, part of which must be made up in the average plant by the condensation of live steam; and requires a minimum of ice-making equipment and investment, since the entire tank capacity produces its rated amount of ice every twenty-four hours.

By the center-freezing process the freezing is done about "grids" or combs of 1-in. tinned pipes, suspended in the freezing tanks and traversed by brine circulation at a temperature of 15 deg. to 20 deg. below zero, Fahrenheit. From each pipe as a center the formation of ice proceeds in all directions, the effects of adjacent pipes (at 5-in. intervals) combining to produce solid plates 20 ft. x 14 ft. in size and 11 in. thick, with the pipe grid as a core. To produce such an 11-in. cake it is obvious that the extracted heat has to be withdrawn through only 5 in. of ice thickness, instead of the entire 11 in. as in the plate process. Ice is a poor thermal conductor and the lessened distance of heat travel by the center-freezing process is chiefly responsible for the higher rate of ice production obtained. Again, as the pendent pipes carrying the brine are entirely inclosed in the water to be frozen the losses are a minimum, accounting for the high tank efficiency secured. Raw water is used as the ice-making material, being agitated by air blown from the bottom of the tank. Due to the centrifugal freezing action, all impurities are pushed ahead and to the outside of the forming ice cake, leaving the ice itself as solid and pure as that frozen naturally under perfect conditions. After ice of the desired thickness has been reached the grid is raised, carried to the harvesting device, and warm brine passed through the pipes, releasing them from the ice, which is then cut up into cakes of the proper size. The series of small holes left in the ice thus frozen are not found to impair its storage qualities, or to be objectionable to customers. They serve as a virtual trademark, distinguishing this process from any other. The holes may be filled with water and frozen closed if desired.

After thorough tests made by Mr. Edward N. Friedmann, president of the American Society of Refrigerating Engineers, acting as consulting engineer for the purchasers of the patents, Mr. Friedmann concluded as follows:

"The Centerfreeze system has been shown in the tests above described to be an absolute success, and taking into consideration that in test No. 2 12 in. of commercial ice was made in twenty-one hours makes it certain that this system has a great commercial future."

Tests on a thirty-ton absorption plant on Long Island, using this system, were made by engineers acting for the Centerfreze Ice Process Company, the results of which further indicated a great improvement in the efficiency of ice manufacture. Interested parties wishing to satisfy themselves in their own way employed Messrs. L. B. Stillwell and Herbert S. Putnam, consulting engineers, New York, for the purpose of confirming the reports of the Centerfreze Company's engineers, which showed 14.9 tons of ice per ton of coal. In the report of these tests, covering both twenty-four-hour and forty-eight-hour ice-making cycles, Mr. Stillwell and Mr. Putnam conclude as follows: "Further, we find by calculation that if the forecooler were operated in the manner above suggested . . . [the plant] efficiency would approximate 92 per cent and the production of ice would be further increased . . . to 15.74 tons per ton of coal burned."

To quote further from Mr. Stillwell's and Mr. Putnam's report: "As compared with competing processes the Centerfreze process requires materially less ground space, smaller buildings and less refrigerating equipment. These differences imply a material reduction in first cost. The ice produced is clear and of excellent quality, superior to that produced by the can process and equal in quality to plate ice. In our opinion the holes left in the cakes are not materially objectionable as increasing the exposed melting surface, and we think they should not reduce the market value of the ice. The grids afford very convenient means of lifting the ice cake from the freezing tank and carrying it to the harvesting table. . "

In June, 1910, an exhaustive test of the 200-ton absorption type Centerfreze ice-making plant at Oklahoma City, Okla., was made under the supervision of Dr. Edwin DeBarr, of the University of Oklahoma, who was employed by the Oklahoma City company to determine whether the plant's efficiency fulfilled the guarantee made by the Centerfreze Company of fourteen tons of ice per ton of coal; E. E. Gainer, of New York City, representing the Centerfreze Company, and H. W Garlington, of Louisville, Ky., representing the Henry Vogt Machine Company, which furnished the refrigerating machinery. Oil having a calorific value of 19,864 b.t.u. per pound was used as fuel. As a result of the sixty-hour test 279.17 tons of ice were made at the expenditure of 21,835 lb. of oil, or 433,730,440 b.t.u. This, it is seen, is equivalent to producing eighteen tons of ice per ton of coal having a fuel value of 14,000 b.t.u. per pound. The extraordinary significance of this figure will be realized when it is recalled that the practical ice-making output of the average ice plant is about five tons of ice per ton of coal.

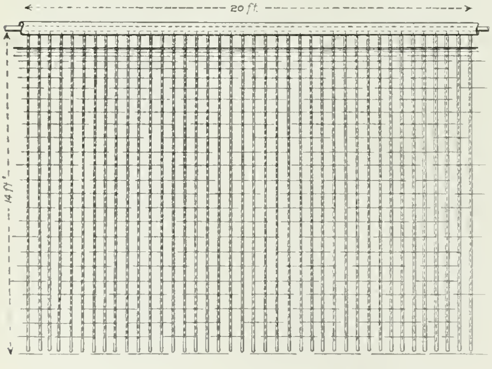


Fig. 1—Centerfreze Grid of Brine-Carrying Pipes Immersed in Freezing Tank.

In the Oklahoma City plant, during the forty-eight-hour test, the brine entered the grids at an average temperature of 9.07 deg. Fahr. above zero and left at 11.36 deg. The condensing-water temperature obtainable was unusually high, far above that for which the plant was designed. Entering the cooler at 88.33 deg. Fahr., this water was heated to 104 deg., the average temperature of the outside air meanwhile being 84.6 deg. The tank temperature at the beginning of the freeze was 62.8 deg The steam boiler pressure used was 126.3 lb. per square inch, generating in the ammonia system a pressure of 218.5 lb. per square inch. An average expenditure of 11.6 kw was required to supply the agitating air pressure at 43 lb. per square inch. This agitation outlay, enabling raw water to be used, amounted to about 2.5 kw-hours for each ton of ice produced. During the Oklahoma tests, notwithstanding the high temperature of the cooling water, the investigators were nevertheless enabled to make 11.25 in. of ice in one tank in twenty-four hours and 10.25 in. in another tank in twenty-one hours.

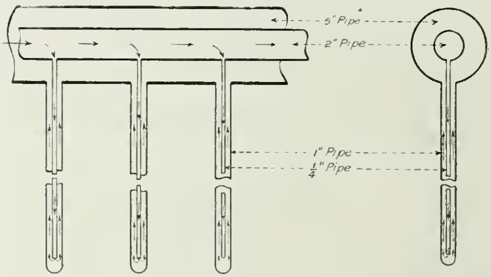


Fig. 2—Sections of Grid and Pendent Pipes, Showing Brine Circulation.

Where the central-station equipment is of the less efficient non-condensing type it will in general be found advisable to install absorption apparatus to take the fullest advantage of the heat-energy contents of the steam. Where the steam-using apparatus, however, is of modern, highly efficient, compound condensing type, the generating machinery being loaded during only a few hours of the day, the compression system, using motor-driven compressors, may then be found most advantageous, the eighteen-hour period of the Centerfreze process enabling its demand to be kept clear of the lighting peak of the station. In either case the use of sweet or undistilled water in Centerfreze ice-making avoids the expensive condensation of live steam for augmenting the supply of distilled water obtained from the plant exhausts.

The preceding figures, which are taken from duly substantiated reports of actual tests by engineers of high standing, indicate that the novel center-freezing principle of operation employed by the system described promises some remarkable results for central-station as well as other ice-making plants Combination ice and electric plants, even using the older can and plate systems, have proven extremely profitable, as is shown on other pages of this issue. Office and engine-room forces do double duty and a single set of fixed costs is substituted for the separate expenses of purely ice or electrical plants. With the system just described it would seem, however, that the central station is better equipped than ever before to enter the field of profitable ice manufacture. The Centerfreze Ice Process Company, 17 Battery Place, New York, is the owner of the patents covering the Centerfreze system of ice making.

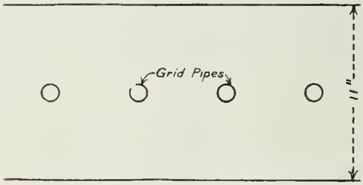


Fig. 3—Horizontal Section Through Centerfreze Ice, Showing Holes Left by Grid Pipes.

AN OLD-TIME CENTRAL STATION.

Those who believe that the proper place for out-of-date machinery is the scrap pile will find their prejudice challenged by the experience of some of the smaller central stations which are yet operating successfully with what some modern manufacturers may consider archaic equipments which should have been scrapped long ago. Still more of a shock is it to discover that these same old types are still giving satisfaction.

The municipal electric plant at Oxford, Ohio, is an example in point, since it is operating a plant installed twenty-two years ago, with, it is claimed, a maintenance charge as low as that on modern apparatus.

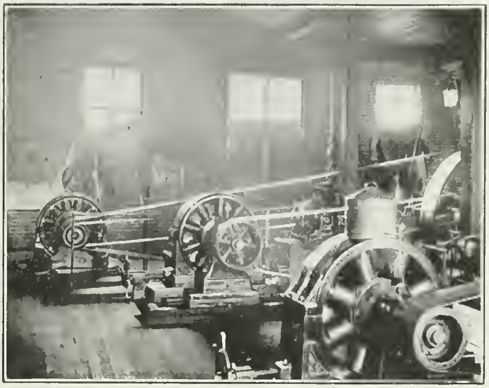


Fig. 1—Belted Alternators at Oxford, Ohio, Installed in 1889.

This entire plant, including generating apparatus, station equipment, power house and lines, was installed by the Westinghouse Electric Company in 1889. Since that time it has been operating regularly and from present indications will continue to do so for a good many years. Part of the original generating equipment still in use consists of two duplicate units, each a Westinghouse 500-lamp, 1000-volt, 133-cycle, 2000-r.p.m. generator driven by a vertical automatic 350-r.p.m. engine. The revolving armatures have been rewound, but the field coils, except one or two, remain as originally installed. The original oil cups have been supplemented by a reservoir on the top of each generator feeding by gravity. One of the engines has its original cylinder and has never been rebored. The other engine had a new cylinder shortly after installation.

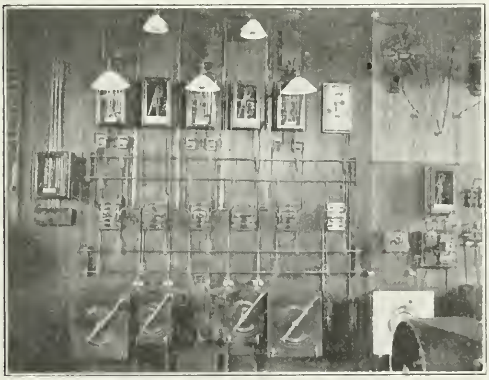


Fig. 2—Old Wooden Switchboard in Oxford Station.

There is also a Westinghouse series arc generator, installed in 1889, running at 750 r.p.m. The operators of the plant state that this generator operated for fifteen years without one cent of repairs. At the end of that period the original brushes were still in use and the bearings had not required rebabbitting. This machine was originally wound for 9.5 amp, but in 1905 was changed for 6.6-amp lamps. This generator was rated at forty lamps, but has been regularly carrying forty-five lamps.

In 1900 the equipment was increased by the addition of a 60-kw, 1100-volt, single-phase generator, driven by a 100-hp, 180-r.p.m. Buckeye engine, which also drives the arc generator

The switchboard is archaic according to modern notions, but efficient and serviceable. The wiring and connections are of the old surface type on wooden backing, with the switches mounted on wood bases. The meters, too, have wood cases and are of the Westinghouse-Lange type with compensators. The coils of some of these meters have been open-circuited in several cases by lightning, but have been reconnected by the attendant. A portable voltmeter of modern design is kept at the station for checking the feeder voltmeters. As the photograph shows, the switchboard wiring was done in an exceptionally neat manner.

No doubt a large measure of the success of the machinery is due to the care taken in operating it. Nevertheless, this and other old-time plants like it show that machinery is not necessarily worthless because it is old.

ELECTRIC ROCK DRILL.

The electric rock drill built by the Fort Wayne Electric Works, Fort Wayne, Ind., is the result of several years' development and testing under the severe and unfavorable conditions of actual working operations. Contrasted with designs making use of flexible shafts, solenoids, springs, etc., the Fort Wayne drill is simple, rugged and effective. The drill is of the rotary hammer type, operated by an electric motor mounted on the frame of the drill proper. The mechanism of the drill comprises a revolving helve containing the hammers and a chuck mechanism for holding and rotating the drill steel. An idler is arranged in connection with the flexible belt between motor and drill, which provides a means of regulating the speed of the drill. Thus the advantages of hand drilling are obtained without the disadvantages usually incident to machine drilling. The drill steel is held in the chuck by means of several spring steel plates and when not striking rock the blow from the hammer is absorbed by these buffer plates, which also retain the steel in the chuck while "backing out" of deep holes or in broken and uneven ground. The drill casing, striking mechanism, chuck and buffer plates are simple and substantial. The floating hammers in the helve are of special steel and are cushioned by air chambers so that the jar of the impacts is reduced to a minimum. The drill steel cannot be jammed into a fissure or cleavage crack as a result of several conditions. Should a fissure be encountered the buffer head prevents the drill steel from being plunged forward. The drill steel is not reciprocating and before it can be fed far enough into a fissure to wedge it has hammered for itself a square shoulder or face.

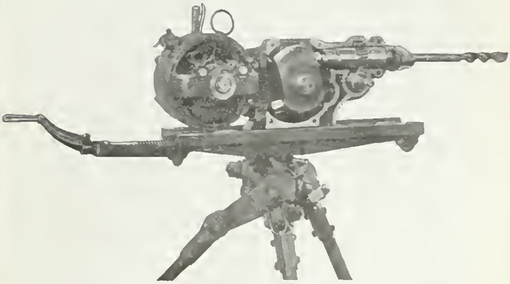


Fig. 1—Electric Rock Drill, Showing Revolving Helve.

due to the rapidity of the blows in connection with the constant and positive rotation of the drill steel. The resultant effect approaches that of boring. Another point of merit in the drill is the method employed for the removal of cuttings from the hole being drilled. A specially designed steel removes the cuttings by a boring action and does away with the use of hollow drills or water under pressure. Thus the item of pressure systems, including tanks, hose, water lines, etc., is eliminated, to say nothing of the cost of maintenance and the inconvenience incident to such systems. While the drills are ordinarily used in a horizontal position they can be used in any position and will drill holes at any angle. The ease with which energy can be transmitted throughout the workings by wire and the rapidity with which the lines can be changed enable the operator to advance his work more rapidly than could be done when using other types of drills. It is claimed that the electric drill described requires about 1½ hp to 2 hp, including transmission loss, while an average air drill requires from 12 hp to 18 hp for the same work. This is attributed to the design of the drill, the greater efficiency of the electric motor and the small loss in transmitting power to the drill. The simplicity and ruggedness of the design presage low cost of maintenance.

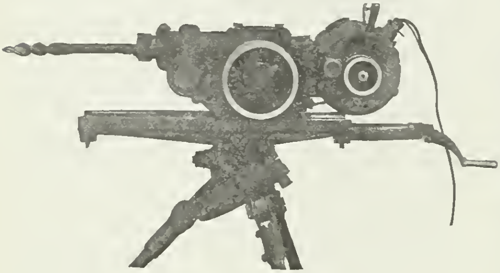


Fig. 2—Electric Rock Drill with Case Closed.

The drill can be operated with either an alternating-current or a direct-current motor, and since the motor is entirely independent of the drill the change from one to the other is easily made.

ELECTRIC VEHICLE ECONOMY.

The following case illustrates a common but too little appreciated electric vehicle problem: On April 25, 1910, the Balbach Smelting & Refining Company, of Newark, N. J., installed a 44-cell, 25-plate Gould storage battery in its old 5-ton electric. Up to the middle of February, 1911, when the inspector of the Gould Company visited the garage, this battery had run every day except Saturdays and holidays without a single cleaning, repair or plate renewal. The inspector found that the sediment in the jars was only within ⅝ in. of the top of the bridges, but a cleaning was recommended as a general precaution. The Balbach people, however, stated that they could not spare the vehicle from service for that purpose and ordered an extra tray of cells to permit the cleaning of the battery at leisure, a tray at a time, thus giving a tray ready at all times for emergencies.

The incident suggests that in every case where a vehicle owner does not have one or more reserve batteries beyond the full number required by his vehicles he should obtain at least an extra tray of cells for the following reasons: 1. It permits thorough cleaning of the batteries at stated intervals, a tray at a time, with no delays or interference with service. 2. It permits the regular and frequent equalization of acid density and testing to be done during the days, instead of making a rush job of the work at night. 3. It is a cheap form of service insurance, providing a reserve at all times in case of failure of a cell or tray from any cause. 4. It promotes the proper maintenance and care of batteries, which are factors of inestimable importance in prolonged battery life.

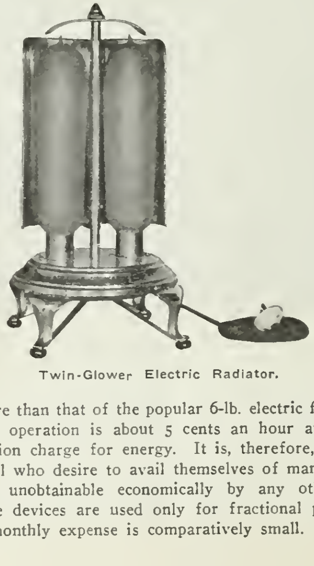
It is advisable that there be an extra tray for at least every two batteries in service. When it is possible to employ duplicate storage batteries, so that they may be exchanged at the main garage or convenient substation about the middle of the day's work, a fresh battery replacing that discharged by the morning's work, the electric vehicle immediately becomes a competitor of the gasoline truck for long-distance delivery and transfer work—a service which it will perform with much greater reliability and considerably less cost than the latter. Or, viewed from another standpoint, the relatively small increase in the investment of a duplicate battery doubles the earning capacity of the vehicle, which represents by far the greater proportion of the total investment. While all service conditions do not permit the use of duplicate batteries, where they can be used great economy results.

TWIN-GLOWER ELECTRIC RADIATOR.

Until it becomes customary to include special heating circuits in the wiring of our homes the most successful heating devices will be those which are readily attachable to the lighting circuit in place of a lamp. In the twin-glower electric radiator recently developed by the General Electric Company the feature of ready applicability appears to have had first consideration in that the heating elements are designed for a maximum energy consumption of 500 watts, thus permitting the operation of the radiator on any lighting circuit.

Extreme lightness of weight permits of the radiator being easily moved from room to room or to any other desired place. Thus it can be readily used for increasing the temperature of the bathroom preparatory to the bath, for making the bedroom comfortable in the early morning when the regular heating system has a low tone, and for adding to the comfort of reception halls, libraries, studies and other rooms which usually are of temporary occupancy. Furthermore, the absence of carbonic-acid-producing open flames renders its use particularly desirable in rooms containing valuable paintings and beautifully bound books, which rapidly deteriorate when exposed to injurious burnt gases or products of combustion.

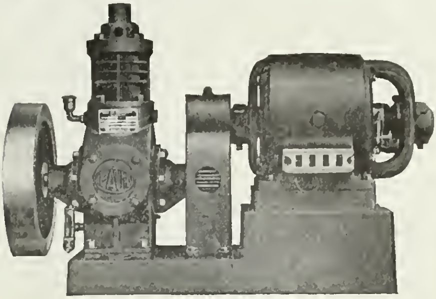
The price of the twin-glower electric radiator is only about a third more than that of the popular 6-lb. electric flatiron, and its cost of operation is about 5 cents an hour at the usual central-station charge for energy. It is, therefore, within the reach of all who desire to avail themselves of many comforts which are unobtainable economically by any other means. Since these devices are used only for fractional parts of an hour the monthly expense is comparatively small.



Twin-Glower Electric Radiator.

ELECTRIC VACUUM PUMP.

The vacuum pump illustrated is a single-cylinder machine direct-geared to an electric motor. It is of the "Paul" type made by the Fort Wayne Engineering & Manufacturing Company, of Fort Wayne, Ind., and is substantially the same machine as the air compressors made by the same company. The efficiency is given by the manufacturer as from 90 per cent to 95 per cent. This makes these compact sets well adapted for vacuum drying and evaporating processes, as well as for use in connection with heating systems. In vacuum systems of steam heating it is intended to maintain a certain degree of vacuum or a pressure of steam below that of the atmosphere in the boiler and radiators. This may be accomplished by connecting the automatic air valves of the system to a common air line in which a sufficient vacuum is maintained by a vacuum pump. Electric drive is well adapted for the operation of this pump, as the machine may be controlled by an automatic switch, making the consumption of energy very economical, it being in proportion to the work done. The size of the vacuum pump for a heating system depends on the amount of radiating surface and the tightness of fittings. One rule is to allow 50 cu. ft. of displacement per hour of pump operation for every 1000 sq. ft. of radiating surface. The ordinary commercial sizes of pumps are driven by motors rated at from 0.25 hp to 2 hp.



Single-Cylinder Direct-Geared Vacuum Pump.

AN ELECTRICALLY OPERATED GAS METER.

A useful laboratory method for measuring the passage of a quantity of gas of any kind is to insert an electric heating coil in the pipe, measuring the temperatures of the stream of gas before and after passing the heater. Knowing the specific heat of the gas—that is, the heat necessary to raise 1 cu. ft. of it 1 deg. in temperature—and having measured the electrical energy converted into heat by the coil, the volume of gas passed can easily be computed. Again, if with the same arrangement we vary the current flowing in the heater so that the difference in temperature shown by the two thermometers remains constant, the electrical energy taken by the heater and measured by a watt-hour meter will be exactly proportional to the gas which has passed.

A practical meter designed for measuring the flow in large gas mains which accomplishes automatically the regulation of the heating current to keep the temperature difference of the two thermometers constant at 2 deg. Fahr. is the invention of Prof. C. G. Thomas, of the University of Wisconsin. The stationary measuring element, Fig. 1, which is inserted in the main pipe carrying the gas or air to be measured contains an electrical heating coil *B*, and on each side of the heater are two screens of fine resistance wire *EE* having the function of thermometers, arranged as the arms of a Wheatstone bridge. Variations in the temperature difference between these two screens cause deflections in a galvanometer needle, making contacts to close magnetic clutches and by means of a motor-driven ratchet wheel and rheostat increasing or diminishing the energy flowing into the heater. The recording watt-hour meter which measures this energy input into the heater is calibrated to read directly in cubic feet of gas. The electrical energy to operate the meter is approximately 1 kw per 75,000 cu. ft. of illuminating gas, with the screens set for 2 deg. Fahr. difference in temperature. This figure varies, of course, for different gases measured.

The principle of the meter thus enables it to measure gas or air at any temperature and at any pressure, its accuracy not being affected by fluctuations of either, since in heating gas or air the temperature rise depends upon the mass of the gas, not its volume. Whether 1 lb. of air occupies 10 cu. ft. or is expanded to 100 cu. ft. the amount of electrical energy taken to raise its temperature 2 deg. is identical, and whether the gas is moving rapidly or slowly through the meter exactly the same amount of energy will be required. If the gas enters the meter at 60 deg. its temperature will be raised to 62 deg. If it enters at 100 deg. Fahr. its temperature will be raised to 102 deg., so that, as stated above, neither temperature nor pressure has any effect on the accuracy of the meter's measurements.

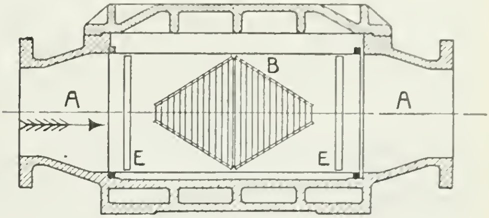


Fig. 1—Heater and Thermometer Element of Thomas Gas Meter.

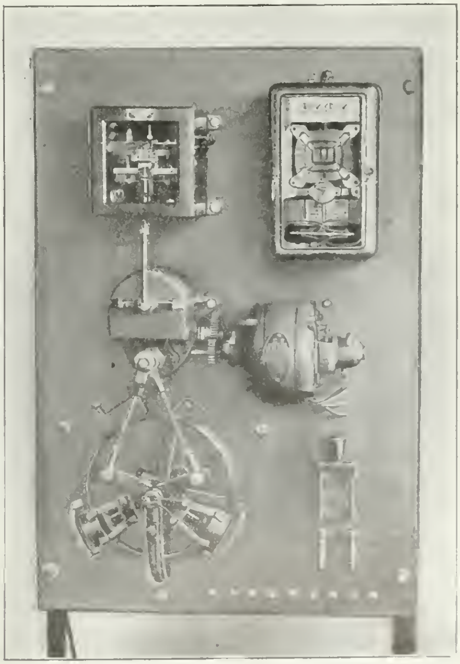


Fig. 2—Switchboard and Recording Mechanism of Thomas Electric Gas Meter.

The important features of the meter are: There are no moving parts inside the gas main. This meter measures weight or mass of gas instead of volume as do other meters, and will read directly in standard cubic feet regardless of temperature or pressure, its operation being independent of temperature or pressure and of fluctuations in either. Meters of very large capacity occupy but little space, and since the parts are connected electrically they can be located at any distance from each other. The recording mechanism, for instance, may be placed in the general offices of a gas company, which may be a mile or more from the gas works.

The principal applications of the Thomas meter are measuring illuminating gas, natural gas, blast-furnace gas, compressed air, air flow in ventilating or forced-draft systems, etc. Since in the operation of the meter about 1 kw-hour is consumed for the passage of each 75,000 cu. ft. of gas the device becomes a desirable load for the central-station company to have on its lines. The consumption is largely long-hour business, while, due to the superior inherent characteristics of this meter, it is applicable to a large number of other uses besides the eminently satisfactory one of making a central-station customer of the competing gas company.

The Thomas meter is manufactured by the Cutler-Hammer Company, Milwaukee.

WESTINGHOUSE FANS FOR 1911.

The 1911 line of fans of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., includes all of the types furnished in 1910 with the addition of several designs. The line built by this company now includes alternating-current and direct-curent fans for all purposes; desk and bracket fan motors of the swivel-and-trunnion, mechanically operated oscillating and air-operated oscillating types with 12-in. and 16-in. blades; 12-in. six-blade residence-type fan motors; 8-in. desk and bracket fan motors; 8-in. telephone-booth fan motors; a complete assortment of ceiling, counter, column and floor-column fans, and 12-in. and 16-in. exhaust fans with either Westinghouse standard or Blackman blades. The alternating-current fans are designed for 25 cycles, 30 cycles, 40 cycles, 50 cycles, 60 cycles and 133 cycles, 110 volts or 220 volts; the direct-current fans are designed for 30 volts, 50 volts, 110 volts or 220 volts, except the ceiling and column types, which are not desk and bracket swivel-and-trunnion fans are adjustable through a wide angle and are clamped firmly in any position. An adapter is furnished for bracket use, which can be inserted between the motor body and the base without opening the circuit. The 12-in. and 16-in. mechanically operated oscillating fans are additions to the Westinghouse line. The fan is of the same construction as the swivel-and-trunnion type, having a wide adjustment above and below the horizontal. The oscillator mechanism consists of a double worm reduction and a single oscillating lever. The gears are inclosed in a case packed with grease. The arc of oscillation is adjustable within 90 deg. These fans can be quickly arranged for wall mounting by means of an adapter similar to that used with the swivel-and-trunnion fans. Air-operated oscillating fan motors are still furnished in 12-in. and 16-in. sizes for use where oscillation in the horizontal plane is sufficient. The angle of oscillation is adjustable by means of movable stops in 30-deg. steps. If desired the stops can be removed and the fan allowed to revolve continuously. The use of contact rings to conduct the energy to the motor makes this possible A substantial bracket is furnished for wall mounting. The Westinghouse 12-in. residence fans are particularly applicable for hospitals, libraries, sleeping-rooms or other places where quiet is essential. The fans operate at low speed, but have six blades set at a high pitch instead of four. Otherwise they are the same as the desk and bracket types. The 8-in desk and bracket fans have become very popular for use where the strong breeze of a large fan is undesirable The bodies and bases of these motors are of pressed sheet metal, finished in black oxide, mottled copper, polished brass or brushed brass. The 60-cycle, 110-volt motors of this type can be used with a special converting base on 25 cycles to 50 cycles or on direct current of the same voltage. A swivel arrangement in the base makes it possible to mount the fan either in a vertical position or on the wall and makes vertical angular adjustment possible. The 8-in. telephone booth fan is identical with the 8-in. desk and bracket type, except that the motor body is suspended from a bracket by four springs, which prevent vibrations being transmitted to the telephone The ceiling and column fans for alternating-current circuits are built with 56-in. blade sweep, one-speed fans finished in black japan and three-speed fans finished in mottled copper The direct-current fans are built in 32-in., 54-in and 57-in sizes, with various finishes. Ceiling fans and column fans are identical except for the method of mounting. The counter-column fan motors have 36-in. to 48-in. clearance between blades and base, and floor-column fans about 7 ft. All of these fans have substantial blades of hard wood with mahogany finish. An addition to the Westinghouse line is a design of 12-in. and 16-in. exhaust fans with Blackman blades. These fans are furnished with six blades of a special shape designed to operate efficiently against pressure. The slow speed enables these fans to exhaust with a minimum of noise. Either standard blades or Blackman blades can be furnished with th exhaust fan motors.

Westinghouse Mechanically and Vane-Oscillated Desk Fans and Bracket Fans for 1911.

built for the battery voltages. With the exception of the 8-in. fans the alternating-current motors are of the induction type starting on the split-phase principle. In the desk and bracket types the starting winding is automatically cut out by means of a switch when the motor attains speed. The direct-current motors and the 8-in. alternating-current motors are designed for high efficiency and sparkless commutation. The armature cores are built of laminated steel with the coils inclosed in slots, and the well-designed commutators and rectangular brushes cut down operating troubles. Most of the fans are lubricated by grease cups feeding through wicks, and the ceiling fans have in addition ball bearings. The 12-in. and 16-in.

DEVELOPMENT OF ELECTRICAL DRIVE IN COTTON MILLS.

The Proximity Manufacturing Company, of Greensboro, N. C., operates two large cotton mills for the manufacture of indigo-blue denims. The company was organized in 1895 by Messrs. Moses H. and Cæsar Cone and associates. The Proximity Mill was erected and started in 1895, its equipment including 20,000 spindles and 1000 looms. A double spinning shift was instituted and the looms were operated only in the day time. According to the custom at that time the power house closely adjoined the mill, a 750-hp Corliss engine being belted directly to the head shaft in the spinning-room and separately belted to jack shafts between engine-room and weave shed.

As the business of the concern increased additions to the equipment were made until it was found that the engine was carrying about 20 per cent overload and to get satisfactory draft a fan had to be installed in the stacks. In 1900 the owners determined that better results could be obtained by restoring the engine to its rated load, and after a thorough investigation, decided to install a separate engine with generator to drive the weave-room. This was the first step taken by the company tending toward its present extensive system of electric drive.

The equipment consisted of a 250-kw, 100-r.p.m., 600-volt, three-phase, 40-cycle generator direct-coupled to a Corliss engine, the set being erected in the power house alongside of the first engine. Three 100-hp motors were installed in the basement of the weave-room, each motor being belted to four shafts. In ten years' continuous service the total expense chargeable to these motors has not exceeded $100. The only change made in the motor equipment was that automatic oil switches were substituted for the air-brake switches and fuses originally installed.

Before this installation was made careful readings were taken on the engine to determine the amount of power used in the weave-room. Similar readings were taken after the motors were installed (the number of looms having been increased 10 per cent in the meantime), which showed that almost exactly the same amount of power was required as before, but with an increased production of 15 per cent, it having been found possible to operate the looms faster with the motor drive. It was also found that for the same total output formerly car-

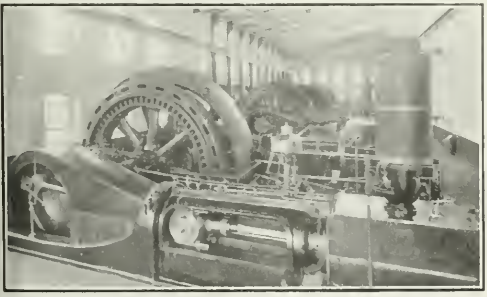


Fig. 1—View of Interior of the Genarating Station of the White Oak Mill.

ied on one engine the two engines consumed less steam and required less coal, and incidentally the fan was not required in he stack.

In 1902 the owners decided to build a larger mill about two iles from Proximity, this mill now being known as the White ak Mill. The site is an ideal one, being well elevated and sur-ounded by a thick growth of pine and oak. A considerable ract of woodland is set aside as a park for the benefit of the operatives. This mill has 60,000 spindles and 2000 looms, with the necessary preparatory machinery and dye house. The main buildings comprise a two-story picker building, 312 ft. x 78 ft.; a two-story spinning building, 750 ft. x 155 ft.; a weave shed, 904 ft. x 180 ft.; a dye house, 312 ft. x 105 ft., and a power house, 264 ft. x 136 ft., with two radial brick stacks 176 ft. high, one being equipped with a 12-ft. flue and the other with a 9-5-ft. fine.

The owners' experience at the Proximity Mill had convinced them of the advantages of electric drive, and the White Oak Mill was, therefore, laid out for that system of power distribution. The power house was placed to the west of the other buildings, as the land slopes in that direction, giving good facilities for the delivery of coal to the boilers and for handling the condensing water. One-half of the building is devoted to the boiler-room, which contains twenty-six Heine water-tube boilers, sixteen of 200 hp and ten of 250 hp. The other half of the building, which is separated from the boiler-room by a fire wall, is the engine and generator-room, with a considerable offset for the switchboard. Two generating units were installed when the mill was built, each unit consisting of a 1250-kw, 600-volt, three-phase, 40-cycle generator direct-coupled to a 2000-hp Corliss engine operating at 75 r.p.m. At the same time there was also installed one motor-driven and one steam-driven exciter, each of 50 kw and each capable of exciting the two generators. All feeder circuits are carried in an underground tunnel running from the switchboard to the several buildings.

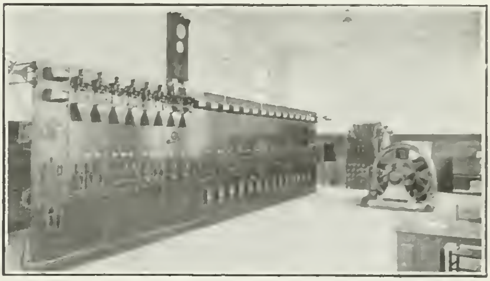


Fig. 2—Interior View of Substation.

Fig. 3 is a view in the second story of the picker building. The two motors shown are each of 200-hp rating and are directly connected to the line shaft by two flexible couplings. In the first story there are three motors totalling 200 hp which operate the openers, etc. The first story of the spinning building contains two motors, each rated at 200 hp, which operate the cards, drawing frames, slubbers and speeders. The second story contains spinning frames aggregating 60,000 spindles, together with warpers, etc., all of which are driven by four motors, each rated at 200 hp, mounted on the ceiling and belted to countershafts, as shown in Fig. 4.

The looms in the weave shed are driven from below, the motors and shafting being located in the basement. In this building there are four motors, each of 150 hp, belted to four shafts. Fig. 5 shows some of the motors in basement of weave-room. It is noteworthy that this building is equipped in precisely the same manner that the weave-room at Proximity was equipped five years before—good evidence that the owners were well satisfied with their first experience. The dye house of this mill is unusually large and admirably appointed. The dyeing machinery is operated by a 100-hp motor, a similar motor being used for driving the slashers in another section of this building. This mill is operated single shift.

In 1907 it was decided to enlarge the power house at White Oak and drive the Proximity Mill therefrom, abandoning the mechanical drive, which had been retained there, except for the weave-room. At the same time it was concluded to abandon night work at Proximity. This necessitated doubling the capacity of the yarn-making machinery at that mill, a new two-story building, 430 ft. x 130 ft., being erected for the purpose. A new dye house was also constructed and other improvements made, bringing the equipment of this mill up to 45,000 spindles and 1500 looms.

In the power house at White Oak there were added two 1500-kw, 600-volt, 40-cycle, three-phase General Electric generators, each coupled to a 2500-hp Corliss engine. The four units are shown in Fig. 1. The auxiliary equipment includes both motor-driven and steam-driven exciters. When this last enlargement was made a motor-driven exciter of 125-kw capacity was installed.

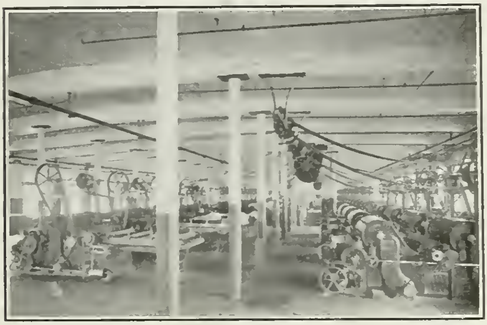


Fig. 3—Induction Motor Connected by Flexible Couplings to Shafts in Picker-Room.

To transmit the required energy to Proximity it was necessary to step-up the voltage at White Oak and to step it down at Proximity. Consequently three single-phase, 40-cycle, 1000-kw, 600-15,000-volt, water-cooled transformers were installed in a brick building just outside of the switchboard-room at White Oak and a steel tower transmission line was erected to Proximity.

A substation for transformers and switchboard was also erected at Proximity, the building covering a ground area of 75 ft. x 30 ft. One end of this building is partitioned off by a heavy brick wall, and in the section so inclosed are placed three 40-cycle, 1000-kw, 15,000-600-volt, single-phase transformers and the lightning arresters, the transformers being located on a level with the ground. This section is full height of the building, giving ample room for high-voltage connections.

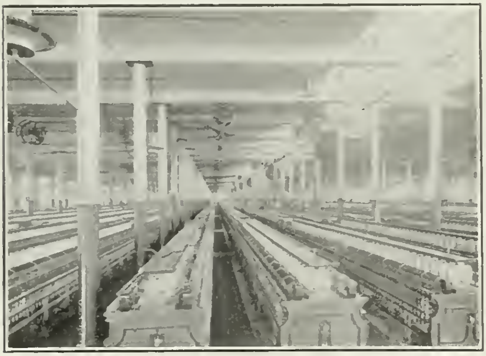


Fig. 4—Six 200-hp Induction Motors Belted to Shafts in Spinning-Room.

Fig. 2 gives an interior view of the main section of the substation building. Besides the switchboard, a 250-kw rotary concerter is installed, which furnishes energy for the direct-current arc lamps formerly served by a separate engine-driven generator. The handle of the 15,000-volt automatic oil switch controlling the primary of the transformers is also shown at the end of the switchboard, the switch being located in the transformer section.

The switchboards in the power house are of black-enameled slate and are of standard General Electric design, each generator-panel equipment including a watt-hour meter, as does also the panel controlling the line to Proximity Mill. On each feeder panel is an indicating wattmeter, and at the end of the board is a generator voltage regulator. These meters are read daily and a careful log is kept, by means of which the engineers are enabled to check the energy output against coal consumption, and also against the production of the mills. Very interesting and useful data are thus secured.

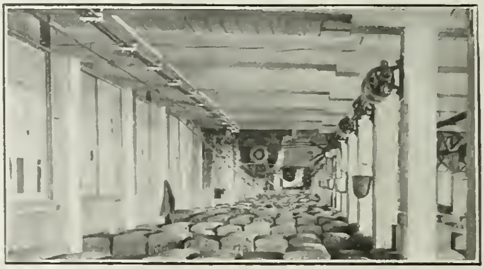


Fig. 5—Induction Motors Located in Basement of Weaving Building.

The complete electrical equipment includes: Two 1250-kw, two 1500-kw and one 250-kw, 600-volt generators: one 50-kw, 125-volt marine set: one 50-kw, one 25-kw and one 15-kw, 125-volt motor-driven generator sets; six 40-cycle, 1000-kw water-cooled transformers: one 250-kw, 250-volt, three wire rotary converter; 819 arc lamps, and the following standard 40-cycle, wound-rotor, 550-volt motors: ten 200 hp, nine 175 hp, three 150 hp, four 125 hp, five 100 hp, two 75 hp, one 60 hp and one 50 hp.

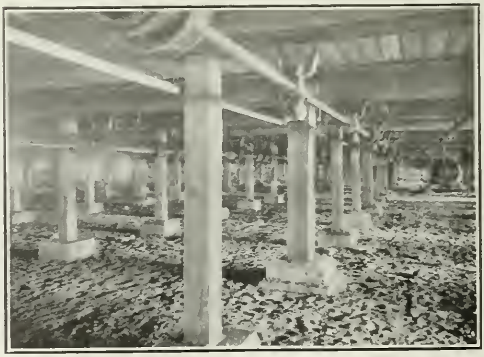


Fig. 6—Four 150-hp Induction Motors in Basement of Weave-Room.

The mills use approximately 60,000 bales of cotton per annum. All mechanical and electrical problems are under the supervision of the general superintendent, Mr. R. G. Campbell, and his assistants, Messrs. U. S. Greer, steam engineer, and W. J. Dorwith, electrical engineer.

Industrial and Commercial News

THE WEEK IN TRADE.

BETTER conditions prevailed in commercial business last week than at any time since the beginning of the year This was probably due for the most part to the better weather which was experienced in the South and West. Both jobbing houses and retail trade reported larger sales, and the former are in receipt of quite an encouraging volume of inquiries. This improvement, however, is purely seasonable and does not compare with that of the same seasons in ordinary years. There is still apparent a slow and cautious sentiment that makes small-lot buying the rule. The activity which has prevailed for some weeks past in materials for agricultural purposes is still in evidence, and implements are especially active. Although there have been some unfavorable reports concerning crops from the South and West, it is not believed that any serious damage has been done to fruits, and preparations for a large planting of leading crops are being reported. Traffic over the Western railroads is reported as being light, and the number of idle cars has considerably increased. Favorable reports continue to be received from the iron and steel industry. Shipments from the mills are increasing and new orders are coming in much more rapidly than heretofore. In this improvement the lighter finished lines are leading in activity. The mills are now turning out tin plate and wire to something like 90 per cent of their capacity. Better reports are being made in regard to pig iron and negotiations are pending for moderate purchases of railroad supplies. This improvement was somewhat checked at the end of last week by the unsettling news of the Interstate Commerce Commission's decision refusing to allow higher freight rates. Immediately upon hearing this decision quite a number of railroads intimated that their buying would be curtailed. Reports as to collections are not much changed. They are still regarded as from slow to fair, being affected in some places by the comparative failure of reduced-price retail sales. Business failures for the week which ended Feb. 23, as reported by *Bradstreet's*, were 228 as against 235 the previous week, 254 in the same week in 1910, 244 in 1909, 311 in 1908 and 194 in 1907.

THE COPPER MARKET.

LAST week showed some improvement in the local copper market. It is estimated that contracts for between 8,000,000 and 10,000,000 lb. of electrolytic copper were placed by domestic wire drawers and electrical equipment manufacturers. Most of these contracts were taken by one independent producing interest, which made concessions of from 5 to 10 points from the asking price of the Amalgamated. The total sales of these producers in February have been in the neighborhood of 30,000,000 lb., which includes some export business. Indications at the present time are that the total deliveries of copper during February, which is a short business month, will not exceed 90,000,000 lb., which, in spite of the fact that production will show considerable reduction, points to an increase in surplus of about 10,000,000 lb. As a rule, the quoted prices of copper during the past week have been a trifle firmer. While electrolytic is still quoted around 12½, the same as at the end of the previous week, it is general knowledge that fewer concessions have been made to purchasers. Standard copper on the Metal Exchange is quoted a trifle higher. Export business during the week improved slightly, and foreign consumers took advantage of the present prices, fearing that the apparent reduction in output would put the market in such a condition that such figures could not be again obtained. Much of the copper sold during the week to domestic consumers and for export was for delivery in April and May. Exports for the month, including Feb. 27, were 15,836 tons. The daily call on the Metal Exchange Feb. 27 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.10	12.20	. . .
February	12.10	12.20	12.15
March	12.10	12.20	12.15
April	12.10	12.20	12.15
May	12.10	12.20	12.15

The London market, Feb. 27, was as follows:

	Noon. £ s d	Closing. £ s d
Standard Copper, spot	54 15 0	55 8 9
Standard Copper, futures	54 13 9	55 7 6

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.30c	11.87½c
London, spot	£56 15 0	£53 15 0
London, futures	57 12 6	54 10 0
Best selected	60 5 0	58 10 0

INDUSTRIAL AND COMMERCIAL NOTES.

Public Service Corporation Purchases.—The Public Service Corporation of New Jersey has ordered from the General Electric Company the following substation apparatus: For the City Dock station, a switchboard and regulators; for the Coal Street station, a switchboard; for the Paterson station, transformers and switchboard; for the Passaic substation, transformers, regulators and switchboard; for the Marion station, a switchboard; for the Metuchen station, a switchboard; for the Garfield Avenue substation, oil switches and switchboard apparatus; for the Hudson River substations, constant-current transformers, high-voltage lightning arrester equipment; for the Trenton station, induction regulators and switchboard apparatus; for the Rutherford substation, a constant-current transformer and switchboard; for the Englewood substation, constant-current transformers and switchboard; for the New Brunswick substation, high-voltage lightning arrester equipment and switchboard apparatus; for the Rahway station, high-voltage lightning arrester equipment and switchboard apparatus; for the Lincoln substation, switchboard apparatus; for the Plainfield station, switchboard apparatus; for the Montclair substation, switchboard apparatus, and for the Plank Road substation, feeder regulator and switchboard apparatus

Westinghouse Electric Sales.—Among the recent sales made by the Westinghouse Electric & Manufacturing Company were four 3750-kva generators to the Oconee Construction Company for installation in the Eastern Tennessee Power Company, Parksville, Tenn. J. G. White & Company are engineers of this hydroelectric development. The Westinghouse company also sold all of the switchboard and auxiliary apparatus. The water-wheels were purchased from the S. Morgan Smith Company. The Westinghouse company has also sold to the Public Service Corporation of New Jersey three 5000-kw, 13,200-volt, 60-cycle turbo-generator units for installation in the new power house which is now nearing completion at Perth Amboy, N. J. In the same order were included three 100-kw exciters, switchboards and other apparatus. There was also purchased for the same station a rotary converter for the local service.

Washington Water Power Company.—Among the many improvements which the annual report of the Washington Water Company, of Spokane, refers to as being contemplated in 1911 are the completion of the hydroelectric plant at Little Falls; the construction of a new power plant at the same place; obtaining more water rights in the Spokane River and Lake Cœur d'Alene; placing wires in Spokane underground; extending light and power system; completing storage battery station and installing additional substation machinery in Spokane; building transmission line from Pend Oreille to Newport, Wash., and buying new railway equipment and minor apparatus. Quite a large amount of new construction was done during 1910 and considerable equipment was added.

Electric-Gasoline Car Test.—Representatives of the General Electric Company, together with officials of the New York Central Railroad, made trial trips last week in a new high-speed electric-gasoline car, which has just been completed by the former company. While no detailed report of the results of the test have been given out, it is said that a speed of seventy miles per hour was attained and that the apparatus worked in a thoroughly satisfactory manner.

Walpole Rubber Company.—The Walpole Rubber Company of Walpole, Mass., reports that the demand for insulating and friction tape, and all other insulating materials, has been exceedingly brisk since the first of the year, and that the factory has been kept busy Over 10,000 lb. of insulating tape is turned out daily at the Walpole plant, which it is claimed is the largest output in the world from one establishment.

Power Station Equipment for the Minneapolis General Electric Company.—The principal equipment for the new power station of the Minneapolis General Electric Company to replace the station destroyed by fire on Jan. 7, 1911, has been ordered by the Stone & Webster Engineering Corporation, which has charge of the design and construction. There will be two 6000-kw, 2300-volt Allis-Chalmers turbo-generators, which will be stepped up to 13,000 volts by 2500-kw Allis-Chalmers transformers, of which six will be installed. The boiler equipment consists of ten 600-hp Babcock & Wilcox boilers supplying steam at 180 lb. working pressure. The steam will be superheated to 125 deg. by Foster superheaters. The turbine-room will be supplied with a four-motor Cleveland Crane & Engineering Company traveling crane, with a 60-ton main hoist and a 15-ton auxiliary hoist. The building will be of steel frame and brick construction and the stacks will be of steel.

Proposals for Sanitary District.—Sealed proposals for furnishing and installing an alternating-current generator (with motor-operated field rheostat), transformers and cables will be received by the board of trustees of the Sanitary District of Chicago, room 1500, American Trust Building, until noon on March 9. The generator will be an addition to the Lockport (Ill.) hydroelectric generating station. It must be of the water-wheel type, wound for 4000 kw. at 6600 volts, three-phase and 60-cycle. Three single-phase step-up transformers and three step-down transformers are required to be used with the new generator, raising the machine voltage in the power house from 6600 to 44,000 volts and reducing it to 13,200, 12,000, 9000 and 6600 volts at the terminal station in Chicago. Underground lead-covered cables of varying sizes and to conduct from 5000 to 12,000 volts, through from one to eight wires, are specified.

Westinghouse Sales.—The Natomas Consolidated of California, Marysville, Cal., has ordered about 1000 hp in motors from the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., to be used in operating a gold dredge. The use of 2200 volts direct on the motors has proved successful on an electric dredge that the company already has in operation, and the new motors will operate on the same voltage. The company has also received an order from Chalchuapa, Salvador, Central America, for generating apparatus and the lamps necessary for a small lighting and industrial service, including a 100-kva, three-phase, 60-cycle, 2200-volt waterwheel generator with exciter and switchboard; eighteen 1½-kva and four 2-kva transformers, single-phase, 60-cycle, 2200/110 volts; six 6.6-amp and twenty 6-amp alternating-current multiple inclosed arc lamps.

Allis-Chalmers Company.—The Allis-Chalmers Company reports that sales during February have improved to a considerable extent over the average of January. As yet they are nothing to boast of, but they offer more encouragement for the future than previously. The company is hardly operating at more than 50 per cent of capacity, and the bulk of the sales seems to be in flour-mill and mining machinery. Quite a number of turbo-generator sets have recently been sold, but none of very unusual size. An official of the company stated last week that the talk of a merger with the American Steel Foundries Company was absolutely ridiculous. He said that this was true if for no other reason than from the fact that such a merger would be of no benefit to either company.

National Lead Company.—The annual statement of the National Lead Company for 1910 has not yet been given out, but preliminary figures show ample justification for the reduction of the common dividend from the 5 per cent to the 3 per cent rate last July. The company is at present earning enough to pay the 3 per cent dividend, but could not have maintained the old rate without intrenching upon its surplus. The officials state that the company hopes to do a large spring business durin gthe present year.

Westinghouse Insulating Material Products.—The Westinghouse Electric & Manufacturing Company has recently placed upon the market a complete line of standard insulating material products. This includes both treated and untreated fabrics and papers, a complete line of friction tapes and rubber-splicing compounds, together with the various types of insulating glues, cements and gums, all of which are used in its works at East Pittsburgh in the manufacture of its standard electrical products.

Westinghouse Machine Company Sales.—The Westinghouse Machine Company has sold to the Northern Indiana Gas & Electric Company, of Chesterton, Ill., two 3700-kva steam turbines. These turbines will operate on a steam pressure of 175 lb. (100 deg. superheat) and will exhaust into a vacuum of 28 in. These turbines will be connected to 750-kva, 13,200-volt, three-phase, 60-cycle generators. The company has also sold to the Bradford (Pa.) Electric Light & Power Company one 17-in. x 36-in., 375-hp horizontal engine, which will operate on natural gas. The engine will be connected with a 250-kva, 2500-volt, 60-cycle, three-phase generator.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Herkimer, N. Y.; Waco, Tex.; Minot, S. D.; Elgin, Ill.; Miles, Tex.; Doerun, Ga.; Nortonville, Ky.; Tylertown, Miss.; Durant, Okla.; Bay Minette, Ala.; Live Oak, Fla.; Smithfield, N. C.; Albertville, Ala.; Portland, Ore.; Fairbury, Neb.; Franklin, Neb.; Baltimore, Md.; Etna, Pa.; Kansas City, Mo.; Auburn, Ind.; Moline, Ill.; San Antonio, Tex.; Monticello, Ark.; Ogden, Utah; Joliet, Ill.; Wheeling, W. Va.; Conneaut, Ohio, and Webster, Ia.

New Westinghouse Foundries.—A contract has been given to the American Bridge Company for the structural steel to be used in the erection of the new foundries of the Westinghouse Electric & Manufacturing Company at Trafford City, Pa. The work will begin within a few weeks. The contract calls for steel for two buildings, one 250 ft. x 50 ft., and the other 200 ft. x 65 ft. In all over 3000 tons of steel will be necessary The Westinghouse company has purchased thirty acres at this location and it is planned to have all the castings for the various companies produced in one series of foundries.

Idaho Hydroelectric Plants.—C. A. Reid, of Spokane, Wash., with whom are associated a number of Canadian capitalists, will erect a dam and a 4000-hp hydroelectric plant, costing in all $850,000, at Bruce's Eddy, on the North Fork of the Clearwater River, northern Idaho. W. C. Weeks, who has built piers in the North River, New York, N. Y., will have charge of construction. Thomas J. Humbird, of Spokane, has announced that his company, the Clearwater Tuner Company, will construct a hydroelectric plant at Orofino, northern Idaho, at the mouth of Whisky Creek.

St. Louis & Kansas City Electric Railway.—A contract has been let to the L. C. Smith Construction Company, of Kansas City, to build twenty-eight miles of the proposed St. Louis & Kansas City Electric Railway. It is said that bonds for the entire enterprise have been underwritten to the amount of $12,000,000 by French bankers.

United States Production of Platinum.—The Geological Survey has just issued a report of the production of platinum for the year 1909. Platinum in this country is produced only as a by-product of placer gold mining. The product in 1909 was 672 Troy oz., reported to be worth $12,803, a trifle over $19 an oz.

Financial.

The Week in Wall Street

WALL STREET market last week received one of those sudden blows which, while it had been more or less anticipated and presumably prepared for, caused a violent break in prices of railroad securities, and incidentally in the prices of those industrial securities which largely depend upon the railroads as customers. The decision of the Interstate Commerce Commission refusing to permit the scheduled advance in rates should have been anticipated. For months past there has been every indication that such a conclusion would be reached, and every expression that has come from members of the commission indicated this determination. The decision was not given out until after the close of the market on Thursday, and from that time until the opening of the Exchange on Friday morning the cables to London were loaded with orders, both to buy and sell. Timid holders attempted to protect their Wall Street interests by sales in the London market, while large banking interests came gallantly to the rescue in an effort to sustain prices in this market by liberal purchases in London. Taken altogether, the result was not so demoralizing as might have been anticipated. While in the first two hours of trading on Friday there was some excited selling and prices broke violently, the reaction came quickly and the close for most of the important stocks was only a few points below the close of the previous evening. In general terms, it may be stated that Wall Street stood the blow in a very satisfactory manner. It also more fully demonstrated what had been fairly well known for many months, that the large financial interests centered in Wall Street do not intend to permit any demoralization of the market, if money can hold it up. Trading was not exceedingly heavy, and there was nothing at any time approaching a condition of panic. The net changes in prices for the week were mostly declines, the railroads, of course, leading in these recessions. From 3 to 5 points represented the most serious of these declines. United States Steel Common showed a net change of 3¼ points. This is largely due to the assumption that railroad managers will curtail their orders for rails and equipment to the point of absolute necessities. It has not as yet been given out what course the railroads affected by this decision will pursue, but it is the general belief in Wall Street that no appeal will be taken from the decision of the commission to the new Commerce Court. It may be that an effort will be made to test the validity of the law empowering the Interstate Commission to interfere with rates. The money market continues to be comparatively easy, and the bond market is fairly good. Rates for money Feb. 27 were: Call, 1 @ 2½ per cent; 90 days, 3¼ @ 3½ per cent. The quotations in the table are those of the close of Feb. 27.

NEW YORK.

	Feb. 18.	Feb. 27.	Shares Sold.		Feb. 18.	Feb. 27.	Shares Sold.
Al. Ch......	7⅞*	7⅞*	—				
All. Ch., pf.	32*	31*	1,000	Int. Met., pf.	54	52½	5,675
Amal. Cop...	65¼	63⅝	35,400	Mackay Cos..	92½	91½	110
Am. D. T...	20½*	20½*	—	Mackay C., pf	76	76½*	100
				Man. Elev...	139¾*	139¾*	200
Am. Loco...	41¼	38	3,150	Met. St. Ry.	15*	15*	—
Am. Loco. pf.	110*	109¾	176	N.Y.&N.J.Tel.	139¼*	139¼*	—
Am. Tel. & C.	84½*	84¼*	—	Steel, Com...	80⅞	77⅝	486,410
Am. T. & T.	146¼	144⅝	1,640	Steel, pfd....	119⅜	118¾	5,360
B. R. T....	78½	77⅞	15,900	W. U. T....	74½	73⅞	1,800
Gen. Elec....	153½*	152¼	2,600	West'h, com.	70	69⅝	1,000
Int. Met.....	19⅞	18¾	4,700	West'h, pfd..	119*	120	—

PHILADELPHIA.

	Feb. 18.	Feb. 27.		Feb. 18.	Feb. 27.
Am. Rys...........	45	44⅞*	Phila. Elec.........	16½	16⅛
Elec. Co. of A.....	12⅛*	12⅛	Phila. R. T.........	19¼	20⅜
Elec. St. B'ty.......	55	53½	Phila. Trac........	85*	85
E. S. B'ty., pfd....	30*	30*	Union Trac.........	47	47½

CHICAGO.

	Feb. 18.	Feb. 27.		Feb. 18.	Feb. 27.
Chi. City Ry.........	185*	185*	Chi. Tel Co.......	121	123
Chi. Rs., Ser. 1.....	93*	92½	Met. El. Co........	20¼	20
Chi. Rs., Ser. 2.....	24½*	23½	Met. El., pfd.......	65½*	66½*
Com. Edison.......	116*	120	Nat'l Car..........	117*	118¾*
Chi. Subways.......	4*	4⅜	Nat'l Car, pfd......	118*	118½

BOSTON.

	Feb. 18.	Feb. 27.		Feb. 18.	Feb. 27.
Am. T. & T.........	146¼	144⅝	Mex. Tel..........	4¾*	4½*
Cum. Tel............	149*	149*	Mex. Tel., pfd.....	6*	6⅛*
Edison E., Ill.......	290¼	290	N. E. Tel..........	142	142
Gen. Elec...........	153½*	152½	W. T. & T..........	20½	20
Mass. E. Ry.........	17¼	17*	W. T. & T., pfd.....	95	94
Mass. E. Ry., pfd...	87½*	88			

*Last price quoted.

Shares sold for week Feb. 20 to Feb. 25.

Financial Notes.

Independent Telephone Merger.—The negotiations continued last week, which were referred to in our last issue, looking to the merging of the leading Independent telephone companies in the Central West with the Bell system. No definite information was given out concerning the progress of these negotiations further than the announcement that they were proceeding satisfactorily. It is confidently predicted by all of the interests represented at the conference that they will be brought to a successful conclusion. It is also stated that the plans for the consolidation that are being worked out will in no way infringe the Sherman law. Both the Bell and Kinloch —Independent long-distance—companies of St. Louis held their annual meetings last week and re-elected their old boards of directors. No statements concerning consolidation were given out W. D. Orthwein, president of the Kinloch, has stated that his company is not a party to any negotiations.

Massachusetts Lighting Companies.—At the annual meeting of the stockholders of the Massachusetts Lighting Companies last week the trustees were authorized to issue 6800 shares of capital stock, $100 par, the proceeds to be used to purchase new property and also to make further additions and betterments to the present property. Not more than $250,000 of the new stock will be issued during the present year. It was also suggested at the meeting that the remaining shares be offered to shareholders at a subsequent date. The following trustees were elected: William M. Butler, two years; Percy Parker, one year; H. M. Whitney, three years; Alfred Clark, four years, and Arthur E. Childs, five years.

New Receiver for Chicago & Milwaukee Electric Railroad.—Judge Grosscup, of the United States Circuit Court in Chicago, has appointed W. O. Johnson, a director of the Western Trust & Savings Bank of that city, receiver of the Chicago & Milwaukee Electric Railroad Company. The three former receivers, Messrs. D. B. Hanna, George G. Moore and W. Irving Osborne, are retained in an advisory capacity. It is said that Mr. Johnson was appointed receiver because of his experience in previous receiverships. He is expected to bring the Chicago & Milwaukee Electric Railroad to a place where it can show what there is in the property, both in the way of earning power and as a public utility.

Washington, Baltimore & Annapolis.—Judge Morris, of the United States District Court at Baltimore, has signed a decree foreclosing the first and second mortgages on the Washington, Baltimore & Annapolis Electric Railway Company, amounting to $3,361,057 and $1,120,352, respectively, held by the Cleveland Trust Company, which is appointed trustee in the decree to conduct the sale under bond for $100,000. The decree orders that at the sale no bid under $2,500,000 shall be accepted. The receivers for the company declare that the foreclosure proceedings will not affect the schedule of the corporation in the operation of its system until after the sale which has been ordered for March 20.

Philadelphia Rapid Transit.—A majority of the stock of both the Philadelphia Rapid Transit and the Union Traction companies has been placed in the hands of a proxy committee to vote in favor of the E. T. Stotesbury refiancing plan. The only thing that remains to be done is to have the $10,000,000 loan which is proposed properly authorized by the City Council of Philadelphia, as the city is a quasi-partner in the properties. The business of the Rapid Transit company has shown considerable improvement since the first of the year over the same months last year. For the first half of February the receipts were about $40,000 ahead of those for a similar period in 1910.

Cumberland Telephone & Telegraph Company.—The Cumberland Telephone & Telegraph Company closed the most favorable year in its history Dec. 31. Liberal gains were shown in gross and net earnings, and the surplus was considerably increased. The balance available for dividends, after paying all fixed charges and a liberal amount for maintenance and depreciation, was equal to 12.23 per cent on the capital stock. The net for the year increased about $250,000. During the past few years the company has made vast extensions throughout the South, and at the present time its wires form a complete network from Nashville to New Orleans.

Wayne County Gas & Electric Company.—The Public Service Commission of the Second District of New York has given preliminary consent for the consolidation of the Wayne County Gas & Electric Company and the Geneva-Seneca Electric Company, the latter of which has recently purchased the J. Q. Howe's Sons property at Phelps, N. Y. The fact that this application had been made was referred to in our issue of Feb. 2. The final approval of the merger has not yet been formally made. With the completion of this consolidation it is planned to construct a transmission line from Newark through Phelps and Wayne County to Geneva.

Colorado Telephone Company.—At the annual meeting of the Colorado Telephone Company in Denver last week it was stated that the company's assets Jan. 1, 1911, were $3,971,450 in excess of the capital stock outstanding and that the gross revenue of the company increased $252,000 in 1910. At the end of the year the company was serving 80,967 subscribers in Colorado and New Mexico and in addition was connected with 8004 stations. The total mileage of wire was 188,384, of which 35 per cent was under ground. In Denver alone there are 31,600 subscribers.

Pacific Power & Light Company.—Clark, Dodge & Company and White, Weld & Company, both of New York, are offering $2,898,000 of 5 per cent bonds of the Pacific Power & Light Company to the public at 94 and interest. This company was organized last year by the American Power & Light Company as the holding concern for the properties in northern Idaho, western Washington and Oregon which had been gathered by H. M. Byllesby & Company, of Chicago, and were held by the Northwest Corporation.

Southern New England Telephone Company.—The financial report of the Southern New England Telephone Company, of New Haven, for 1910 shows total income of $2,706,012, an increase of $232,066 over the previous year. During the year, the plant account was increased $925,548, bringing the total up to $10,005,011. At the end of the year the company had connected 82,883 telephones.

General Railway Signal Company.—The balance sheet of the General Railway Signal Company of Dec. 31, 1910, shows assets as follows: Cash, $83,181; accounts and bills receivable, $742,671; Bouck C. T. C. Company, $85,550; inventory, $686,126; contract construction work, $156,245; miscellaneous, $9,106; factory plant, $136 962; machinery, fixtures, tools, etc., $748,230; patents and good will, $3,088,076; Young system, $260,000; prepaid items, $4,959; bond discount and taxes, $48,649; total, $6,649,757. Liabilities: Bills payable, $382,802; accounts payable, $141,898; employees' bond payments, $5,131; accrued interest, $1,360; bonded debt, $608,000; common stock, $3,000,000; preferred stock, $2,000,000; reserve, $95,656; profit and loss surplus, $314,909; total, $6,649,757.

Tampa Electric Company.—An offering has just been made of $300,000 of first-mortgage, 5 per cent bonds of the Tampa (Fla.) Electric Company. This company is controlled by Stone & Webster, of Boston. The net earnings of the company are now over five times the interest charges on all of the bonds, including the new offer, and the gross receipts show considerable expansion. The company does practically all of the electric railway, lighting and power business in Tampa, and operates an electric line between Tampa and Port Tampa. It operates more than forty miles of track, and has two power stations with a total capacity of 4425 kw.

Pacific Telephone & Telegraph Company.—While the gross earnings of the Pacific Telephone & Telegraph Company for 1910 amounted to $14,667,112, as compared with $12,885,018 for the previous year, the balance left available for dividends was less than in the previous year, owing to the fact that the special maintenance reserve account was largely increased. On Dec. 31 there was charged to this account $4,190,567. This charge was largely increased during the last four months of the year and indicates that a special effort is being made to put the property in the highest state of efficiency.

Connecticut River Power Company.—The first annual report of the Connecticut River Power Company gives the gross receipts for the year 1910 as $270,202. The net earnings, after paying operating expenses and taxes, were $161,134, which was a little more than enough to pay the interest on the bonds. It is stated that contracts have now been closed for the sale of practically all of the energy that is at present available. The company is at present distributing in Worcester, Gardner, Marlboro, Clinton, Fitchburg, Brattleboro and West Boylston.

Dominion Power & Transmission Company.—At the annual meeting of the Dominion Power & Transmission Company, of Hamilton, Ont., recently, the president, J. R. Moodie, announced that the directors thought it advisable to withhold the back dividends due on the preferred stock for the two years ending July 1, 1910. The dividend, at the rate of 7 per cent per year, was paid for the last half of 1910. The financial statement of the company showed gross earnings for the year of $1,922,398 and net earnings of $533,757.

Northern Ohio Traction & Light Company.—The directors of the Northern Ohio Traction & Light Company met last week and called a special meeting of the stockholders to authorize an issue of $3,000,000 of 6 per cent preferred stock Of this issue $1,000,000 will be sold at once to provide funds for the new power house to be built at Cuyahoga Falls. The new stock will probably be offered to the shareholders, but it is understood that tentative arrangements have already been made with a banking firm to underwrite it.

National Carbon Company.—The annual report for 1910 of the National Carbon Company shows that the net earnings were $1,303,296, as compared with $1,211,438 in the previous year. After allowing for the regular 7 per cent dividend on the $4,500,000 preferred stock, the balance is equal to 17.9 per cent on the $5,500,000 common stock. It will be remembered that in addition to this an extra dividend of 15 per cent was paid on Nov. 7, 1910, out of the profit and loss account. All of the old officers were re-elected.

Pacific Telephone & Telegraph Company.—The Pacific Telephone & Telegraph Company has made its report for 1910 in which it shows gross earnings to be $14,667,111, an increase of almost $2,000,000. The total number of stations operated by the company on Dec. 31, last year, as set forth in the report—including private lines—was 446,622. The business of the company has developed rapidly within the last few years.

Montreal Street Railway-Canadian Power Merger.—It is stated in Montreal that the negotiations leading to a consummation of the Canadian Light & Power Company merger with the Montreal Street Railway Company will be concluded within about ten days. C. H. Cahan, K.C., is now on his way back from London, England, and the securities of both companies have had a sharp advance of several points as a consequence.

American Light & Traction Company.—The officials of the American Light & Traction Company expect the company to show as large an increase in earnings this year as it did last, which was approximately $475,000. This would bring the net for 1911 up to about $4,188,000, which is equivalent to about 32 per cent on the common stock. In regard to stock dividends Emerson McMillin, chairman of the board, says that they will continue to be paid by the company even after the present treasury stock is used up, by increasing the capital, if the earnings of the company justify their payment. These dividends are being paid out of earnings, and Mr. McMillin says they represent money that is put back into the property. The American Light & Traction Company plans, during the present year, to spend 50 per cent more in improvements than last year or any recent year. The improvements will likely include two or three large gas holders.

Capital Traction Company.—The Capital Traction Company, of Washington, D. C., showed gross earnings in 1910 of $2,226,150, an increase of more than $200,000 over the previous year. The total number of revenue passengers carried was 51,307,792, an increase of 5,000,000. During the year the company expended $360,988 on roadway, $106,269 on equipment and $2,682 for general purposes.

Cleveland Electric Illuminating Company.—The Cleveland Electric Illuminating Company has disposed of $500,000 in new bonds and more than $1,300,000 new stock. The bonds were handled by an Eastern bank. Expenditures for improvements this year will reach $2,500,000.

DIVIDENDS.

Canadian Westinghouse Company, Ltd., quarterly, 1½ per cent, payable April 10.

Chicago Telephone Company, quarterly, 2 per cent, payable March 31.

Laclede Gas Light Company, quarterly, 1¾ per cent, payable March 15.

Louisville Traction Company, preferred, semi-annual, 2½ per cent; common, quarterly, 1 per cent, both payable April 1.

Mackay Companies, quarterly, preferred, 1 per cent; common, 1¼ per cent, both payable April 1.

New England Telephone & Telegraph Company, quarterly 1½ per cent, payable March 31.

Philadelphia Electric Company, quarterly 1½ per cent, payable March 15.

Portland (Ore.) Railway, Light & Power Company, common, quarterly, 1 per cent, payable March 1.

REPORTS OF EARNINGS.

Period.		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
BELL TELEPHONE COMPANY OF CANADA.						
Year,	1910	$58,510,685	$3,963,060	$1,547,125	$1.000,000	$547,125
"	1909	4,949,197	3,480,308	1,468,889	1,000,000	468,889
BUFFALO GENERAL ELECTRIC COMPANY.						
Year,	1910	$1,085,311	$665,523	$463,235	$133,887	$329,348
"	1909	967,455	599,722	408,361	123,299	285,061
FEDERAL LIGHT & TRACTION COMPANY.						
Year,	1910	$761,736,	$447,190	$314,546	......	......
"	1909	697,157	465,293	231,864	......	......
GEORGIA RAILWAY & ELECTRIC COMPANY.						
Year,	1910	$4,040,886	$1,908,444	$2,132,442	$847,605	$1,330,691
"	1909	3,673,007	1,700,142	1,902,865	845,242	1,095,677
KANSAS CITY RAILWAY & LIGHT COMPANY.						
Jan.,	1911	$656,606	$355,486	$301,120	$188,071	$113,049
Jan.,	1910	611,919	324,451	287,168	169,632	117,836
KEYSTONE TELEPHONE COMPANY.						
Jan.,	1911	$96,091	......	$47,756	......	$23,318
"	1910	94,314	......	44,407	......	18,049
7m., Jan.,	'11	668,571	......	335,153	......	163,646
7 " "	'10	645,367	......	321,375	......	143,855
KINGS COUNTY ELECTRIC COMPANY.						
Jan.,	1911	$447,910	$199,991	$247,919	$118,052	$129,867
"	1910	393,217	168,304	224,913	106,271	118,642
NORTHERN OHIO TRACTION COMPANY.						
Jan.,	1911	$186,271	$106,904	$79,367	$44,429	$34,938
"	1910	164,944	94,500	70,444	43,292	27,152
SHAWINIGAN WATER & POWER COMPANY.						
Year,	1910	$991,029	$127,386	$863,643	$456,388	$407,255
"	1909	819,171	118,048	701,123	379,816	321,307
TOLEDO RAILWAYS & LIGHT COMPANY.						
Year,	1910	$2,985,382	$1,868,600	$1,116,782	$926,381	$190,401
"	1909	2,733,178	1,627,337	1,105,841	778,286	327,555

General News

Construction News.

ALBERTVILLE, ALA.—At an election held Feb. 20 the proposition to issue $7,000 in bonds, the proceeds to be used for the installation of an electric light plant, was carried. J. W Taylor, of Albertville, Ala., is engineer in charge.

BAY MINETTE, ALA.—Hampton D. Ewing, of the Bay Minette Land Company, and W. H. Isabell, of Bowling Green, Ky., are reported to be interested in a project to establish an electric light plant in Bay Minette. The cost of the proposed plant is estimated at $20,000.

BIRMINGHAM, ALA.—Arrangements are being made by the People's Home Telephone Company for improvements and extensions to its system, which will involve an expenditure of about $50,000, including the establishment of a new exchange in Woodlawn and extensions of its lines into every suburb of the district.

MONTICELLO, ARK.—Proposals will be received at Monticello, Ark., until March 15 for the installation of an electric-light plant to replace the plant that was recently burned. The equipment for the proposed plant will include two 72-in. x 16-ft. return tubular boilers; one 75-kw and one 100-kw alternating-current generators, direct-connected, with switchboards, wiring, piping, fittings, boiler-feed pumps, feed-water heater and all accessories for a complete electric plant, with exception of building. Plans and specifications are on file at the office of the commissioners, Monticello, Ark. N. C. Roe is chairman.

CHICO, CAL.—The Sacramento Valley Power Company has extended its transmission lines to the Butte Creek dredges, east of this city. It is said that the company contemplates many other extensions and improvements to its system.

CORCORAN, CAL.—The San Joaquin Light & Power Company is reported to be preparing to erect a transmission line to Angiola in addition to the extensions on the Waukens line. Ralph Beardon is local manager.

EL CAJON, CAL.—It is reported that the City Club is considering the question of installing an electric light system in El Cajon. It is proposed to extend the system from La Mesa to this city.

FRESNO, CAL.—It is reported that the Fresno Traction Company is planning to extend its car lines to the cemetery, Arlington Heights and Fresno Avenue toward Kleinhurst.

FRESNO, CAL.—The San Joaquin Light & Power Company has purchased the distributing system of the West Side Light & Power Company. This makes the third system the San Joaquin company has taken over in the last six months, the first being the Merced Gas & Electric Company, the next the Power Traction & Light Company and West Side Light & Power Company. At present all the power for Maricopa and Taft is generated by a steam plant in Maricopa. A. G. Wishon is general manager.

GERBER, CAL.—Arrangements are being made to organize a company to be known as the Gerber Water & Light Company. The company will be capitalized at $50,000 and the principal place of business will be located at Sacramento. The company proposes to own and control water rights and to supply water for domestic, mining, irrigation and other purposes; also to supply electricity for lamps and motors, which will be purchased from one of the large electrical companies. Artesian wells will be bored in Gerber for the local water supply. Edward H. Gerber, George W. Pelton, F. W. Peltier and F. W. Kiesel, all of Sacramento, are interested in the project. Gerber has not a post office.

GILROY, CAL.—The Coast Counties Power Company is reported to have submitted a proposition to the City Council offering to make several extensions to the transmission lines of the municipal electric light plant on a percentage basis. S. W. Coleman, of Santa Cruz, Cal., is manager of the Coast Counties Power Company.

HAYWARD, CAL.—I. B. Parsons, president of the Bank of Howard, purchased the franchise sold by the Board of Trustees on Feb. 15 for a street railway to run from the Southern Pacific station via Front, C, Commercial and B Streets to the eastern city limits. Under the terms of the franchise work is to begin on construction of the railway within three months.

MANTECA, CAL.—The new substation of the Sierra & San Francisco Power Company at Manteca has been put into operation, and the transmission line from station to Modesto, twenty miles in length, which will supply electricity in Modesto and Oakdale and in the South San Joaquin Irrigation District, has been completed. At Manteca and Ripon arrangements are being made to light the towns with electricity, and as the demand arises secondary lines will be erected into the farming districts to furnish electrical service.

MARTINEZ, CAL.—Initial steps to secure the installation of a municipal electric-light plant in Martinez have been taken by the Martinez Business Men's Association, which has appointed a committee to confer with the officials of the Great Western Power Company and also with the City Electric Company, of San Francisco, Cal., in regard to supplying electricity for same. The committee will also visit the municipal electric-light plant at Palo Alto and report at a mass meeting of citizens. The action taken is the outcome of the raise in rates and the refusal of the Pacific Gas & Light Company to pay 3 per cent of its gross receipts to the town. The Contra Costa Lighting & Power Company, which formerly supplied the town, paid a similar proportion of its gross earnings. When the Pacific company purchased the plant last July it refused to continue to pay this percentage to the town under a ruling of the United States Supreme Court.

MARTINEZ, CAL.—The Great Western Power Company has applied to the Board of Trustees of Martinez for a franchise to supply electricity in Martinez. The company has extended its transmission lines from the Sierra to the bay cities along its main line, which extends across Contra Costa County. The company has been supplying electricity to operate the works of the Cowell Cement Company at the base of Mount Diablo, where it has erected a substation. Recently the company erected a transmission line to the plant of the Peyton Chemical Company, near Martinez, and is now furnishing energy to operate the plant. The promoters of the Oakland & Antioch Electric Railway have contracted with the company to furnish electricity to operate the proposed railway. A number of contracts have recently been signed calling for service in the fall. From Peyton the transmission line will extend down the bay shore through all the towns there and on to Richmond, to which a line has already been built from Oakland. Martinez will be the first city to be supplied from this branch line.

OAKLAND, CAL.—Preparations are being made by the Oakland Gas, Light & Heat Company for the installation of a steam-heating system in Oakland at a cost of about $100,000. The company has already secured permission from the Board of Public Works to lay pipes in the streets of the city.

OAKLAND, CAL.—The large power plant of the Southern Pacific Railroad Company was put in operation Feb. 13. The plant has an outfit of 12,000 kw and will supply electricity to operate the suburban system of the company. Provision has been made to increase the output to 30,000 kw if necessary. Another substation is to be constructed in West Oakland, at a cost of $150,000. Transmission lines will be extended from the main plant carried on steel bridges, supported across the tracks, with two steel towers, 216 feet high, carrying the cables across the estuary. Current will be transmitted at 13,000 volts.

ORLAND, CAL.—The Board of Trustees has granted C. R. Wickes a franchise to erect and maintain transmission lines over the streets and highways in Orland for the distribution of electricity for lamps and motors.

PLACERVILLE, CAL.—Notice of appropriation of 100,000 in. of water in the middle fork of the Cosumnes River at a point near the mouth of Perry Creek has been filed by C. F. Peters. It is understood that the water is to be used for power, irrigation, municipal and domestic purposes.

PRINCETON, CAL. C. R. Wickes and A. S. Linstrom, of Willows, representing the Superior California Power Company, a subsidiary company of the Northern California Power Company, have been in Princeton making investigations with a view of placing contracts for electrical service with the company. Plans are being made by the company to extend a transmission line here and one to Butte City, the latter to supply electricity in that place and to several large land companies on the east side for pumping water for irrigating purposes.

RED BLUFF, CAL.—Notice of appropriation of 10,[illegible] in. of water of Mill Creek has been filed by Fred T. Horton, of Berkeley, Cal., to be used for generating electricity and power purposes.

SACRAMENTO, CAL.—John A. Britton, vice-president and manager of the Pacific Gas & Electric Company, has submitted a schedule of reduced rates for electricity for lamps to the executive committee of the Retail Merchants' Association. The prospect of cheaper rates for lighting follows an investigation of the subject recently by a committee of the Association. C. W. McKillip is general manager.

VALLEJO, CAL.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until March [illegible], for furnishing at the Navy Yard, Mare Island, Cal., two turbo-generator sets, a motor generator set and switchboard, as per schedule 335[illegible].

YREKA, CAL.—Notice of appropriation of 150,000 miners' inches of water of Klamath River has been filed with the County Recorder by the Siskiyou Electric Power & Light Company.

GREELEY, COL.—In the issue of Feb. 9 an item was published stating that the Denver, Greeley & Northwestern Railroad Company had secured rights-of-way and important terminals for its proposed [illegible] railway between Denver and Greeley, giving the name of J. D. Houseman as general manager of the company. George J. Spear is president of the Denver, Greeley & Northwestern Railroad Company, with which company Mr. Houseman has no connection whatever.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until March 21 for furnishing and installing lighting fixtures in the United States buildings at Aiken, S. C., Cleveland, Tenn.; Concord, N. C.; Griffin, Ga.; High Point.

N. C.; Newman, Ga.; Rome, Ga.; Catlettsburg, Ky.; Danville, Va., and Frankfort, Ky., in accordance with plans and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

WASHINGTON, D. C.—Sealed proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Feb. 28, for furnishing at the various navy yards and stations the following supplies: Brooklyn, N. Y., schedule 3307, wireless telegraph sets; schedule 3348, carbons for arc lamps; schedule 3349, condenser tube pipe fittings, etc. Norfolk, Va., schedule 3348, vibrating bells, night signal lanterns, lamp fixtures and interior fittings and branch junction boxes. Applications for proposals should designate the schedule desired by number.

WASHINGTON, D. C.—The Senate Committee on Commerce on Feb. 19 directed a favorable report on the bill authorizing the Long Sault Development Company, of New York, to construct a power dam across the St. Lawrence River, south of the international boundary line, near Long Sault Island, N. Y. The bill was amended by the committee. The life of the franchise was reduced from ninety-nine to fifty years, and provision was made that before any work is done the plans must be approved by the International Joint Commission, to be approved in accordance with the treaty of 1910, or by such other tribunal as may be agreed upon by the governments of both the United States and Canada. Actual construction work must begin within two years and be completed within fifteen years.

LIVE OAK, FLA.—The Live Oak Electric Company is contemplating extensions to its plant, which will involve an expenditure of about $5,000. Bids for the proposed work will be received about April 1. C. E. Jones is vice-president and general manager of the company.

BARNESVILLE, GA.—The City Council has authorized Mayor T. W. Cochran to enter into a contract with the Central Georgia Power Company to supply electricity to the city. A site has already been selected for the station in Barnesville and it is expected that work will soon begin on the installation of the system. The company will also supply power to various manufacturing plants.

DOERUN, R. F. D. MINTON, GA.—Bonds to the amount of $15,000 have recently been voted by the city, the proceeds to be used for the installation of an electric light plant and erection of school building.

BOISE, IDAHO.—The installation of cluster lamps in the business section of the city is reported to be under consideration.

ALGONQUIN, ILL.—The Council has granted D. W. Thomas, owner of the local electric-light plant, a new franchise for a term of twenty years. It is said that the plant will be remodeled.

BUSHNELL, ILL.—Application has been made to the City Council by Rufus Lybarger, acting for A. L. Florey and F. W. Copeland, for a twenty-five-year franchise to install and operate a telephone system and exchange in Bushnell.

CARLINVILLE, ILL.—The contract for installing a lighting plant in the Macoupin County Almshouse, bids for which were opened Feb. 7, has been awarded to Fairbanks, Morse & Co., of St. Louis, Mo. W. C. Seehausen is county clerk.

CHICAGO, ILL.—Proposals will be received by the Board of Directors of the Chicago Public Library, Chicago, Ill., until March 4, for electric and gas fixtures for the Hiram Kelly Branch Library, at the corner of Normal Avenue and Sixty-second Street. Specifications are on file in the office of the secretary of the board, and copies may be obtained at the office of Frost & Granger, architects, 181 LaSalle Street, Chicago, Ill. H. G. Wilson is secretary.

DECATUR, ILL.—Property owners on five blocks of North Main Street have petitioned the City Council for permission to erect cluster lamps, the city to supply electricity to maintain them.

ELGIN, ILL.—The City Council has practically decided to install an electric light plant at the pumping station plant and will probably appropriate $5,000 to make a beginning on the work. The lease of the old municipal electric light plant to the Aurora, Elgin & Chicago Railroad Company will expire in 1915, when it is expected that the city will take over the street lighting system again. It is also expected by that time that State legislation will allow cities to supply electricity for general consumption. At present municipalities are allowed to supply electricity only for municipal purposes.

FREEBURG, ILL.—Sealed proposals will be received by the Village Board until March 6 for furnishing 150 electric meters. Charles Kessler is village clerk.

JOLIET, ILL.—The Illinois Valley Gas & Electric Company has purchased the electric plants at Havana and Mendota, Ill., making over forty towns supplied by the company. The Illinois Valley Gas & Electric Company secures electricity from the power plant of the Commonwealth Edison Company, at Chicago, and its transmission lines extend 165 miles into the center of the State.

JOLIET, ILL.—The Economy Light & Power Company is contemplating extensive improvements to its systems, involving an expenditure of about $500,000. The work includes extending and rebuilding its lines at Coal City, Braceville, Gardner, Streator, Ottawa, Sparland, Chillicothe, Dwight, Odell; building water tower and laying new water mains at Chillicothe; laying and improving gas mains and systems at Ottawa, Marseilles and Morris.

LINCOLN, ILL.—The installation of a municipal electric light plant in Lincoln is reported to be under consideration.

LITTLE YORK, ILL.—A movement has been started by residents of Little York to purchase the local telephone exchange and county lines and form a farmers' company. Charles Cooper is chairman of the committee formed to take charge of the project.

LYNDON, ILL.—A bill granting H. S. Green, Edward Smith and John J. Hurlburt, of Morrison, to construct a power dam at Lyndon, near Sterling, was recently passed by the House of Representatives at Washington, D. C. It is understood that the Sterling-Moline Traction Company is interested in the project. The cost of the proposed dam and power plant at Lyndon is estimated at approximately $450,000. The plant when completed, will supply electricity to Morrison, Lyndon, Erie, Prophetstown and Tampico and other towns and villages within a radius of fifty miles.

MACOMB, ILL.—The Illinois Western Telephone Company has been reorganized under the name of the Western Illinois Telephone Company. The capital stock of the company has been increased from $200,000 to $2,000,000. The company has filed a trust deed in favor of the Western Trust & Savings Bank to secure an issue of $2,000,000 in bonds, the proceeds to be used to enlarge and improve its service. The company now owns and operates about 1600 miles of toll lines.

MOLINE, ILL.—It is reported that the Tri-City Railway & Light Company is contemplating extensive improvements to its systems in Moline, Rock Island, Ill., and Davenport, Ia., which will involve an expenditure of about $750,000. It is understood that the greater portion will be spent for street railway extensions in Moline.

ROCK ISLAND, ILL.—The Tri-City Independent Home Telephone Company, having failed in an attempt to purchase the property of the Union Electric Telephone & Telegraph Company, has applied to the City Council for a franchise to construct and operate a telephone system in Moline.

AUBURN, IND.—Plans are being considered by the City Council for the installation of a complete new municipal electric-light plant. The present plant was installed twelve years ago and has more than paid for itself.

BEDFORD, IND.—The Bedford Power Company, which is erecting a large dam across White River at Williams, ten miles west of Bedford, is making rapid progress with its work. The company is installing an emergency plant to be operated by steam until the hydraulic plant is completed. The company proposes to supply electricity for lamps and motors in this vicinity and has already entered into a contract to supply power to operate the pumping station of the Bedford water works and also to several stone quarries and factories in and near Bedford. Eventually the company expects to extend its transmission lines to supply electricity to all stone quarries and mills in the stone district, covering a distance of about 100 miles.

COLUMBIA CITY, IND.—Preparations are being made to equip the municipal electric light plant to furnish a twenty-four-hour service, to cost approximately $10,000. Bids will be received for the work about March 27. F. T. Schultz is superintendent.

ELKHART, IND.—Plans are being prepared by the Home Telephone Company for the construction of a new telephone exchange building and the installation of an automatic switchboard. The company has applied for a new franchise.

INDIANAPOLIS, IND.—Representative Cravens has introduced a bill in the Legislature providing for the construction and equipment of a heat, light and power plant to be owned and operated by the State, to furnish light, heat and power to the State institutions, the Capitol building and the State Soldiers' Monument. A bill has been introduced by Senator White for the regulation of the price of light, heat and power in cities where the same is not fixed by ordinance.

LAFAYETTE, IND.—The Lafayette Telephone Company is contemplating installing a telephone system in West Lafayette, plans and specifications for which will be prepared at once.

NEW PARIS, IND.—The New Paris Mutual Telephone Company is fitting up a new exchange building, in which considerable new equipment will be installed.

PORTLAND, IND.—The report of Prof. C. F. Harding, of the electric department of Purdue University, employed by the City Council to make an examination of the municipal electric-light plant, recommends the installation of a soft-water feeding device for boilers, rewiring of switchboard and service lines; other improvements were also recommended.

COUNCIL BLUFFS, IA.—The Bell Telephone Company is reported to have secured the control of the Council Bluffs Telephone Company, one of the largest independent telephone systems in the West. The Council Bluffs company owns, in addition to the city exchange, long-distance lines extending into Missouri, east in Iowa, and northward into Minnesota.

HUMESTON, IA.—It is reported that the proposition to grant a franchise for the construction of an electric light plant in Humeston will be submitted to a vote.

WEBSTER CITY, IA.—It is reported that bids will be received by the City Council for construction of an electric-light and power plant, the cost of which is estimated at $40,000.

KANSAS CITY, KAN.—At an election held Feb. 15 the citizens voted in favor of the proposition to issue $350,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant.

KANSAS CITY, KAN.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until March 20 for an electric passenger elevator in the extension of the United States post office at Kansas City, Kan., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

MULBERRY, KAN.—The City Council is reported to be considering the question of calling an election to submit the proposition to install a municipal electric light plant to a vote. The cost of the proposed plant is estimated at $20,000.

SEVERY, KAN.—The City Council has granted a franchise to W. H. and Earl J. Mathis, of Wichita, Kan., to erect and operate an electric light plant in Severy, for a period of twenty years. Work will begin on the proposed plant in the near future.

NORTONVILLE, KY.—It is reported that the Nortonville Coal & Coke Company is planning to install an electric plant and will supply electricity for lighting the city.

MANCHESTER, MAINE.—The Kennebec Light & Heat Company, of Augusta Maine, has applied to the Selectmen for a franchise to erect its transmission lines in the town of Manchester.

BALTIMORE, MD.—Plans are being prepared by the Consolidated Gas Electric Light & Power Company for the construction of a storage-battery plant at a cost of about $300,000.

SYKESVILLE, MD.—The board of managers of the Springfield State Hospital for the Insane is reported to have approved the plans for power house and two additional cottages. Dr. J. Clement Clark is superintendent.

BOSTON, MASS.—The stockholders of the Massachusetts Lighting Company have authorized the trustees to issue 6800 shares of capital stock at par, making the total capitalization $4,212,800. The trustees were also given authority to purchase the stock of any corporation engaged in engineering or construction work, in order to secure the supervision in which they are authorized to invest, and to borrow funds temporarily to acquire stock of such corporation.

OAK BLUFFS, MASS.—The Vineyard Lighting Company is reported to be contemplating moving its plant from Eastville to a point near the Vineyard Haven Beach wharf, where it will build a new plant and wharf.

PITTSFIELD, MASS.—The Berkshire Street Railway Company has applied to the Legislature for permission to sell electricity. The primary reason is to supply electricity for operating trains through the Hoosac Tunnel.

SPRINGFIELD, MASS.—The State Board of Gas and Electric Light Commissioners has granted the United Electric Light Company permission to issue 2500 shares of new capital stock at $200 per share, par value $100 per share, the proceeds of 1875 shares to be applied to the cancellation of obligations of the company outstanding on Sept. 30, 1910, and the proceeds of 625 shares in payment of obligations incurred on account of additions to the plant since Sept. 30.

STOW, MASS.—The residents of Stow lower village have petitioned the Board of Public Works of Hudson to extend the transmission lines of the municipal electric plant to supply electrical service in this village. The town of Hudson has a franchise to install an electric system in Stow and has already extended its lines to Gleason, part of Stow, furnishing electricity there for three years. The extension asked for would involve an expenditure of about $5,000. If the town of Hudson refuses to furnish the service it is expected that a franchise will be given to the American Woolen Company, of Maynard.

WEBSTER, MASS.—Announcement has been made by the Webster & Southbridge Gas & Electric Company of a reduction in the prices for gas and electricity in the towns of Webster, Southbridge, Oxford, Dudley and Sturbridge, the new rates to go into effect March 1. Electricity will be furnished at a net rate of 13 1-2 cents per kw-hour and gas at $1.25 per 1000 cu. ft. The present rate for electricity is 15 cents per kw-hour. The reduction was voluntary on the part of the company H. S. Shaw is superintendent of the company.

WORCESTER, MASS.—The Coughlin Electric Company has been awarded the contract for supplying the electric lighting fixtures for the new union station, to cost about $7,000.

MANISTEE, MICH.—The plant and holdings of the Manistee Light & Traction Company will be sold on March 15. The property includes the electric and gas plants and street railway system.

MARQUETTE, MICH.—The Light and Power Commission has decided to ask the City Council to submit the proposition to issue $100,000 in bonds, the proceeds to be used for enlarging and improving the municipal electric light plant, to a vote of the people at the spring election to be held April 3. The proposed improvements include the construction of two new dams, one at Silver Lake, and the other one at the head of the flume, and acquisition of the necessary flowage rights. The cost of the Silver Lake dam with flowage rights is estimated at about $26,000 and replacing the dam at the head of the flume with a new dam ten feet higher, with flowage rights, is estimated at about $75,000. The raising of the Silver Lake dam will increase the output of the plant by 150 hp.

LANESBORO, MINN.—It is reported that a company has been formed to build a telephone system in Lanesboro. M. W. Williams is president and A. M. Hanson secretary.

ST. PAUL, MINN.—A bill has been introduced in the Minnesota Legislature by Senator Hackney giving the cities of the first class the right to enter into lighting contracts for terms not exceeding two years.

SWANVILLE, MINN.—A new telephone company has been organized by the farmers in Bruce Township.

McCOMB, MISS.—The City Council is reported to have decided to establish a municipal electric light plant to be operated in conjunction with municipal water works system. The contract for street lighting with the McComb City Electric Light & Power Company will soon expire.

TYLERTOWN, MISS.—The City Council is reported to be considering a proposition submitted by Xavier A. Kramer, of Magnolia, Miss., for the installation of an electric light plant and water works system in Tylertown.

KANSAS CITY, MO.—The St. Louis-Kansas City Electric Railway Company has awarded the contract for the construction of an electric railway between Kansas City and St. Louis to the L. J. Smith Construction Company, of Kansas City. The contract calls for the construction of 140 miles of road at a cost of about $10,000,000. Work will begin as soon as the weather permits. A ten-mile branch is to be built from Columbia to Harrisburg.

ST. LOUIS, MO.—Plans are being prepared by the Easton Avenue Business Men's Protective Association to install new electric lamps on Easton Avenue between Leffingwell and Grand Avenues and also on a portion of Franklin Avenue.

GREAT FALLS, MONT.—The City Council has decided to install two additional 2,000,000-gal. electrically driven centrifugal pumps, bids for which have been received.

YAKT, R. F. D., TROY, MONT.—J. H. Ehlers, of Spokane, Wash., is reported to have located a water power site at Yakt Falls, where he proposes to erect a hydroelectric power plant capable of developing 5000 hp. It is also proposed to erect a transmission line from the gold camp to a point on the Great Northern and also one to the Sylvanite mine.

FAIRBURY, NEB.—Bids will be received at the office of the City Clerk, Fairbury, Neb., until March 9, for furnishing material and labor for extensions to water-works system and electric light plant, for which separate bids will be received as follows: 1. For furnishing material (except as outlined in subsequent items) and extending water works and electric lighting systems). 2. For furnishing cast-iron pipe and special castings. 3. For furnishing hydrants and valves. 4. For furnishing and erecting one 2,000,000-gal. Meyer gear pump. 5. For furnishing generator, switchboard and 100-kw steam turbine set. 6. For furnishinig surface condenser and feed water heater. Plans and specifications are on file at the office of the City Clerk, Fairbury, Neb., and at the office of Burns & McDonnell, engineers, Scarritt Building, Kansas City, Mo.

FRANKLIN, NEB.—At an election held recently the citizens voted to issue $8,000 in bonds, the proceeds to be used for the construction of an electric light plant. W. E. Donner, of Grand Island, Neb., is engineer. H. A. Chitwood is Mayor.

HOLDREGE, NEB.—Proposals will be received at the office of the Board of Supervisors of Holdrege until March 14 for furnishing and installing furniture and fixtures in accordance with drawings and specifications prepared by W. F. Gernandt & Company, architects, Fairbury Neb., as follows: No. 1, 2, 3 and 4 for furniture; No. 5 for electric lighting fixtures, and No. 6 for enameled steel vault fixtures. Plans and specifications may be obtained from the architects. C. Hedlund is clerk.

PLATTSMOUTH, NEB.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until March 20 for a conduit and wiring system in the United States post office building at Plattsmouth, Neb., in accordance with drawings and specifications, copies of which may be obtained at the above office or at the office of the superintendent at Plattsmouth, Neb. James Knox Taylor is supervising architect.

MANCHESTER, N. H.—The city Water Department has recently purchased a 5,000,000-gal. turbine pump from the De Laval Steam Turbine Company for pumping service in connection with its reservoir system. The pump will be operated by a 200-hp, three-phase, 60-cycle, 2000-volt motor.

SOMERSWORTH, N. H.—A bill has been introduced in the State Legislature asking for the right to equip and maintain a municipal electric light plant in the City of Somersworth. Electrical service in this city is now furnished by the Twin State Gas & Electric Company, of Dover, N. H.

ATLANTIC CITY, N. J.—The Board of Utility Commissions has approved the application of the Atlantic City Electric Company to issue $10,000 in bonds.

TRENTON, N. J.—Arrangements are being made by the lamp committee to call for bids for lighting the streets and public buildings with electricity for terms of one, three and five years. The Public Service Corporation of New Jersey now supplies the service, the contract for which will soon expire

UNION, N. J.—The question of lighting the streets of the town by electricity is now under consideration.

FARMINGTON, N. M.—The City Council is considering the question of submitting the proposition to issue bonds, the proceeds to be used for the installation of a water-works pumping plant and distributing system and a municipal electric-light plant. A local company is also being formed to install an electric-light and power plant in Farmington.

FARMINGTON, N. M.—Announcement has been made that the Rockwood Power Company, which has a large plant at Durango, contemplates extending its transmission line down the Animas River Valley to Farmington to supply electricity for operating irrigating pumps for farmers and also to furnish electricity for lamps and motors in the towns of Aztec, Flora, Vista, Kirtland, Fruitland and Farmington.

FORT BAYARD, N. M.—Sealed proposals will be received at the office of the constructing quartermaster, Fort Bayard, N. M. ,until March 18 for furnishing, including installation, one motor-driven submerged-type centrifugal or impeller-type pump having a capacity of not less than 200 gal. per minute. Plans, specifications, blank proposals and other information furnished on application. Captain J. R. McAndrews is constructing quartermaster.

BINGHAMTON, N. Y.—The ordinance introduced by Alderman Hastings providing for a special election to be called by the city to vote on the proposition to issue $158,000 in bonds for the installation of a municipal electric light plant was defeated in the City Council.

BROOKLYN, N. Y.—The Kings County Electric Light & Power Company has applied to the Public Service Commission for permission to issue $5,000,000 in convertible debenture bonds.

BUFFALO, N. Y.—The Public Service Commission, Second District, has authorized the Buffalo General Electric Company to issue bonds to the amount of $420,000, to be sold at not less than 95, the proceeds to be used for the acquisition of certain property at the corner of Washington and Huron streets, in Buffalo, and for the erection of a building upon the same.

DUNDEE, N. Y.—E. L. Bailey, owner of the local electric-light plant, writes that the plant may supply electricity for three small adjoining towns at an early date. He also states that the property is for sale, as he is interested in other business. A day service is furnished for both lamps and motors.

EAST AURORA, N. Y.—The East Aurora Electric Light Company is comtemplating improvements to its system and establishing a day service, plans for which have not yet been completed. C. G. Persons is manager.

FONDA, N. Y.—The Cayadutta Generating Company is making arrangements to establish a day service, for which plans have not yet been completed. J. S. Wilson is treasurer and manager.

FULTON, N. Y.—The City Council has decided to grant the franchise for the distribution of electricity for lamps, heat and motors in Fulton, as applied for by the Oswego River Power Transmission Company, of Syracuse, N. Y., to be sold to the highest bidder. The Bureau of Public Works will place a minimum price for which the franchise is to be sold.

HERKIMER, N. Y.—It is reported that the City Council is contemplating extending the transmission lines of the municipal electric light system to North Ilion, N. Y., for the purpose of supplying electricity for lamps in that town. It is understood that application for a franchise will soon be made.

MOUNT MORRIS, N. Y.—Contracts have been awarded by the Livingston-Niagara Power Company for the construction of its main receiving station, to be erected at Golah, to the Alexander, Shumway & Utz Company, of Rochester, N. Y. The building will be 40 ft. x 30 ft., and will be equipped with transforming apparatus to change the current from 66,000 to 11,000 volts for transmission to Avon, Lima, Livonia, Honeoye Falls, Caledonia, Geneseo and other places in this vicinity.

NEW YORK, N. Y.—Sealed bids will be received by Kingsley L. Martin, Commissioner of Bridges, Department of Bridges, 13 to 21 Park Row, New York, N. Y., until March 9, for the installation of electrical equipment of the conduit tracks and the construction of the track extension on the Plaza extension of the Queensboro Bridge over the East River. Blanks, forms and specifications may be obtained at the above office.

OLEAN, N. Y.—The City Council has engaged Horace B. Sweet, of Utica, N. Y., to prepare plans and estimates for the construction of a municipal electric light plant.

LENOIR, N. C.—It is reported that the Lenoir Chair Company will equip its new factory for electric motor drive.

SMITHFIELD, N. C.—At an election held Feb. 21 the proposition to issue $55,000 in bonds, the proceeds to be used for the installation of water works, electric light plant and sewerage system, was carried. Gilbert White, of Durham, N. C., is engineer in charge of the work. H. L. Skinner is town clerk.

MINOT, N. D.—The Commercial Club is reported to be considering the question of installing an ornamental street-lighting system in the business district of the city.

MINOT, N. D.—Investigations are being made by Burns & McDonnell, of Kansas City, Mo., consulting engineers, with a view of establishing a municipal electric light plant in Minot.

OAKES, N. D.—A franchise is reported to have been granted to Ernest Marshall to install an electric-light plant in Oakes.

RUGBY, N. D.—Bids will be received at the office of Henry Albertson, county auditor, Rugby, N. D., for heating and ventilating, plumbing, electric wiring and conduits for the new Pierce County court house and jail until April 4. Plans and specifications are on file at the office of the county auditor and at the office of Buechner & Orth, architects, Shubert Building, St. Paul, Minn.

ALLIANCE, OHIO.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until March 30, for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office building in Alliance, Ohio, in accordance with plans and specifications, copies of which may be obtained from the above office or from the custodian of site, Alliance, Ohio. James Knox Taylor is Supervising Architect.

COLUMBUS, OHIO.—Mayor George S. Marshall has recommended to the City Council that such action be taken as will enable the municipal electric-light plant to supply electricity for lamps at the rate of 5 cents per kw-hour. Mayor Marshall believes that a good profit may be obtained from the business rate and that the cost of operating the municipal plant may be reduced.

CONNEAUT, OHIO.—It is reported that the Nickel Plate Railroad is contemplating the construction of an electric-light plant to supply electricity for lighting the yards, offices, shops and roundhouse in Conneaut. At present the company secures electrical service from the municipal electric plant.

MANSFIELD, OHIO.—The City Council has adopted a resolution authorizing plans and estimates prepared for the construction of a municipal electric light plant. The cost of the proposed plant is estimated at from $100,000 to $175,000.

SANDUSKY, OHIO.—The Sandusky Gas & Electric Company has submitted a proposition to the city offering to supply electricity for commercial lighting at 8 cents per kw-hour instead of 10 cents per kw-hour, the present rate, and to reduce the price of arc lamps from $77.50 to $66 each per year. The reduction in the price of arc lamps means a saving to the city of $2,346 annually. The City Council has taken steps toward municipal ownership, having secured estimates of the cost of installing a plant in order that the question of a bond issue might be submiitted to a vote of the people.

DURANT, OKLA.—The City Council is reported to have adopted plans and specifications for the construction of a municipal electric light plant and has instructed the City Clerk to advertise for bids for same.

RAVIA, OKLA.—The Ravia Mining & Milling Company, recently incorporated with a capital stock of $100,000, is reported to be contemplating the installation of a power plant. E. W. Rose, of Dallas, Tex., is president and J. E. Harris, of Ravia, Okla., vice-president.

SENTINEL, OKLA.—At an election to be held early in March a proposition to issue $15,000 in bonds will be submitted to a vote. Of the proceeds of the bond issue, $3,000 will be used for extensions to the water-works system and $12,000 for the construction of a municipal electric light plant.

MEDFORD, ORE.—It is reported that Dr. J. F. Reddy will apply to the City Council for a franchise to construct and operate an interurban electric railway in Medford.

MEDFORD, ORE.—It is reported that the Rogue River Electric Company has practically decided to erect a power plant at Prospect. The proposed plant will have an output of 10,000 hp. C. R. Ray is president of the company.

PORTLAND, ORE.—Announcement has been made by the Portland Railway, Light & Power Company that contracts will soon be awarded for the construction of the third and the largest of the power plants on the Clackmas River. The proposed plant will be located about three miles above the present one and will cost about $3,000,000. B. S. Josselyn is president of the company.

PORTLAND, ORE.—Negotiations have been completed by the Washington-Oregon Corporation for taking over the plants and holdings of the Kalama Light & Power Company, of Kalama, Wash.; the Ranier Light & Power Company and the Kelso Light & Power Company, of Kelso, Wash. The company is planning to develop 10,000 hp at the Kalama plant, enlarging the present head of 40 ft. to 160 ft. and transmitting power to Kalama, Ranier, Kelso, Chehalis and Centralia, Wash., and a number of towns in Oregon. Work will begin at once on the erection of heavy transmission lines and other extensive improvements throughout southwestern Washington.

SALEM, ORE.—The Salem Board of Trade is reported to have authorized the executive committee to prepare plans for the installation of a cluster-lamp lighting system in this city.

PANAMA.—Bids will be received at the office of the Central Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until March 24 for furnishing rack railway material for the Panama canal locks, including rack, steel cross-ties, bolts and nuts, tie clips, washers, steel channels, copper conductor rails, steel conductor rails, insulators, bumpers, frogs, switches, etc. Blanks and general information may be obtained at the above office or at the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; 55 National Realty Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing officer.

ETNA, PA.—Sealed proposals will be received at the office of J. C. Armstrong, borough clerk, until March 13, for construction of power-house and furnishing equipment, including boilers and lamps, for the new borough light plant. Copies of plans and specifications may be obtained on application to the borough clerk.

MAUCH CHUNK, PA.—The Lehigh Coal & Navigation Company is contemplating establishing an electric light and power plant in Nesquehoning. The company proposes to utilize the waste cuim washed away from the breakers for fuel.

POTTSTOWN, PA.—Steps have been taken with a view of establishing a municipal electric light and gas plant in Pottstown. Petitions have been circulated asking the Council to purchase the local plant of the Philadelphia Suburban Gas & Electric Light Company. It is proposed to have the Council and the company fix the price on the property, and in case of failure to have the court of Montgomery County appoint appraisers.

COLUMBIA, S. C.—The City Council is considering the question of establishing a municipal electric light plant, at a cost of about $40,000. A committee has been appointed to make investigations for same and report to the Council.

COLUMBIA, S. C.—A bill is now before the State Legislature asking for a charter for the Piedmont & Northern Railway Company, to be capitalized at $5,000,000. The charter provides for merging the Duke & Southern Power Company interurban interests on the South Carolina end of the line, including the Greenville, Spartanburg and Anderson Interurban Electric Railway, 100 miles in length, to the North Carolina line. The company proposes to operate electric railways between towns and to build street car lines in towns through which the main line may pass.

DEADWOOD, S. D.—The Nebraska Telephone Company is reported to be contemplating extensive improvements and extensions to its system in the Black Hills, involving an expenditure of $100,000, of which $85,000 will be spent for new work.

DRAPER, S. D.—It is reported that Dr. W. M. Hunt is planning to install an electric light plant this year.

ELLINGSON, S. D.—The question of erecting a telephone line to Grand River is reported to be under consideration.

HAYTI, S. D.—S. M. Ellis and J. A. Snyder, of Watertown, are reported to be contemplating the installation of an electric light plant in Hayti.

WESSINGTON, S. D.—C. E. Wright, of Wessington, S. D., is reported to have petitioned the Board of County Commissioners for a franchise to erect a telephone system in this county.

BIG SANDY, TENN.—The construction of a municipal electric light plant in Big Sandy is reported to be under consideration.

JACKSON, TENN.—The committee on street lighting has recommended the City Council to continue to operate the municipal electric-light plant. It is expected that the Council will adopt the report of the committee and that improvements will be made to the plant at once. The cost of rebuilding the plant is estimated at about $20,000. The Jackson Railway & Light Company submitted a proposition to the City Council offering to light the streets of the city for $9,000 per year. With the new plant, which will supply 150 street lamps, it is estimated that the street lamps can be maintained at a total cost of $6,000 per year.

BEAUMONT, TEX.—James F. Wood, receiver of the Beaumont Traction Company, is reported to have negotiated for the sale of $125,000 in receivers' certificates, the proceeds to be used for extensions and additions to the local street car lines.

BRYAN, TEX.—The Bryan-College Interurban Railway Company, which operates an electric railway between Bryan and College, has received authority from the State Railroad Commission to issue bonds to the amount of $72,000.

FLATONIA, TEX.—The Flatonia Ice, Water & Electric Light Company is installing an engine and other machinery in its plant.

GEORGETOWN, TEX.—Contracts have been awarded by the City Council for improvements to the municipal water and light plant, to cost about $35,000. The distributing system of the water works will be extended and new generators installed in the electric plant and other improvements made.

MILES, TEX.—S. M. Farmer and associates are reported to be contemplating rebuilding the local electric light plant recently destroyed by fire.

SAN ANTONIO, TEX.—J. A. Logwood, of San Antonio, and associates, who are constructing an electric interurban railway between San Antonio and San Jose, are reported to have sold the same to A. D. Powers, who it is said will complete the proposed railway.

SAN ANTONIO, TEX.—At a joint meeting of the directors of the San Antonio Gas & Electric and the San Antonio Traction companies, held recently, both of which are owned by the American Light & Traction Company, plans for improvements for both systems, involving an expenditure of $250,000, were adopted. It is understood that improvements to the electric-lighting department will cost $50,000, exclusive of the reconstruction and remodeling of the power plant at an additional cost of $35,000. Additional boilers and machinery will be installed in the gas plant and other improvements made at a cost of about $58,000. The San Antonio Traction Company will expend about $100,000 in double-tracking its lines and $50,000 for new electric cars.

WACO, TEX.—At an election held Feb. 14 the citizens voted to issue $250,000 in bonds, the proceeds to be used for the installation of a municipal electric-light and power plant. Plans will be prepared immediately for the proposed plant.

OGDEN, UTAH.—Plans and specifications are being prepared by the Merchants' Light & Power Company, which recently obtained a franchise from the City Council, for the erection of an electric power plant in Ogden. As yet it has not been decided whether a hydroelectric power or a steam plant will be installed.

SALT LAKE CITY, UTAH.—Initial steps have been taken by the City Council toward the installation of a municipal electric light plant. The city engineer has been instructed to furnish the Council with data concerning the city's facilities for installing such a plant, together with probable cost of same.

RICHMOND, VA.—The finance committee has recommended to the Council an appropriation of $9,000 for extension of the lighting system on Broad Street.

SMITHFIELD, VA.—The question of issuing bonds to the amount of $55,000, the proceeds to be used for the installation of a municipal electric light plant and sewerage system is reported to be under consideration.

WAVERLY, VA.—The local electric light plant has been purchased by A. H. Morfeld. It is understood that improvements will be made to the plant soon.

KELSO, WASH.—The Washington-Oregon Corporation, which has taken over the property of the Kelso Electric Company, is reported to be negotiating for the property of the Kalama Electric Light & Power Company. It is said that the company proposes to develop 8000 hp at the falls of the Kalama River, the erection of a transmission line to Centralia and Chehalis and also other improvements.

MARCUS, WASH.—The Marcus Commercial Club is reported to be considering the question of securing an electric light plant and waterworks system in Marcus. H. V. Gates is reported to be interested in the project.

TACOMA, WASH.—Bids will be received at the office of the Commissioner of Public Safety, City Hall, Tacoma, Wash., until March 9 for the following material: 5600 lb. No. 10 double-braid, weather-proof iron wire; 607 No. 9 pony insulators, 4 dozen rolls friction tape, 2000 ft. No. 14, rubber-covered copper wire, 300 3 x 4 storage battery couples, G. W or B. T. type, five amp-hours capacity, 20 terminal plates, 10 positive and 1[illegible] negative, 100 2 x 7 x 4 double-groove battery jars, according to specifications on file in the office of the Commissioner of Public Safety. Bids must be made on printed form furnished by the commissioner.

BUNGERS, W. VA.—Plans are being prepared by S. S. Tuckwiller, of Lewisburg, W. Va., for the installation of an isolated electric plant to develop 12 kw, which will be transmitted from two to five miles to supply electricity to farmers and stockmen in this vicinity. The work will include the construction of a concrete dam, 100 ft. long and 4 ft. high, a 400-ft. conduit; 300 ft. 10-in. hydraulic pipe; water motor, with a rating of 25 hp.

WHEELING, W. VA.—It is reported that the Y. & O. Coal Company will erect a new power plant to replace the plant recently burned. It is said that the new power house will be located about half a mile above the old building.

CLIFTON (R. F. D. OAKDALE), WIS.—The State Railroad Commission has authorized the Clifton Light & Power Company to issue $200,000 in bonds, the proceeds to be used for the purpose of purchasing additional pole lines, right-of-way and real estate upon which to construct another dam in the town of Clifton and other work necessary in connection with the operation of a hydroelectric plant.

HORICON, WIS.—The Horicon Light & Power Company has been granted permission by the State Railroad Commission to issue $10,0[illegible] in bonds and 100 shares of capital stock of par value of $100. The entire issue of stocks and bonds, to an amount not to exceed $[illegible], is to be issued to the Beaver Dam Light & Power Company in exchange for a transmission line constructed by it between Beaver Dam and Horicon and a substation and distributing system in Horicon, the balance to be sold for money only at not less than 80 per cent of their par value.

SPONNER, WIS.—The City Council has voted to purchase a site on the Namekagon River, on which it proposes to erect a power plant.

WATERLOO, WIS.—It is reported that bids have been called by the city clerk for the installation of an electric generator for the municipal electric light plant.

LUSK, WYO.—M. E. Shipley, of Hooper, Neb., has applied to the City Council for a franchise to install a telephone plant in Lusk.

CALGARY, ALTA., CAN.—The city has passed a by-law providing for an expenditure of $38[illegible] for extensions to the municipal electric light plant and $60,[illegible] for installation of underground conduit for electric wires.

CALGARY, ALTA., CAN.—Bids will be received by the City Commissioners until March 22 for machinery for the municipal electric-light plant, as follows: One 15[illegible]-kw turbo-generator set with condenser, etc., one 100 kw exciter and switchboards, complete, three 1000-kva, single-phase transformers, [illegible]-3[illegible] volts, with switching gear, etc. W. D. Spence is city clerk.

EDMONTON, ALTA., CAN.—The Edmonton Heat & Power Company has submitted a proposition to the city offering to build an electric-light and power plant with an output of 20,000 hp and turn the same over to the city after three years for $3,000,000. It is said the offer is being considered as preferable to the city building a plant.

PINCHER CREEK, ALTA., CAN.—The by-law providing for the purchase of the local electric-light plant, owned by the Pincher Creek Brick, Light & Power Company, by the municipality was carried on Feb. 13.

VANCOUVER, B. C., CAN.—The City Council has authorized William M. Northcutt, purchasing agent, to call for bids soon for 300 iron lamp standards to be used in the extension of the cluster lamp lighting system.

ST. BONIFACE, MAN., CAN.—Terms and conditions have been decided upon by the City Council and the E. B. Reece Engineering Company, under which the company is to supply electricity for lamps, heat and motors in St. Boniface. The contract, which provides that the work shall be completed and power turned on by Nov. 1. 1911, will be executed as soon as the company deposits a check for $50,000 as an interim bond. Under the terms of the contract the company is to supply electricity on a sliding scale of rates, ranging from $18 to $15 per horsepower per year. An additional charge of $2 per horse-power per year will be made if the company installs a step-down transforming station. The contract is for a period of ten years, subject to renewals, and a revision of prices may be had every seven years, as provided in the Dominion water-power regulations. There is also a clause in the contract binding the company to meet any reductions which may be made by the City of Winnipeg, across the river, in its rates, to enable St. Boniface to compete for contract with companies that may wish to take power. The City of Winnipeg submitted a proposition to supply electricity at $18.50 per horse-power per year, at 2200 volts, thus eliminating the $2 charge, which the City of St. Boniface would have to pay in transforming energy purchased from either the Reece company or under the proposition submitted by J. D. McArthur on behalf of another company, both of which were declined.

OTTAWA, ONT., CAN.—Announcement has been made that the price for electricity supplied from the municipal plant for lamps will be reduced 19 per cent and rates for electricity for motors will be reduced from $25 to $23.50 per horsepower.

KRONAU, SASK., CAN.—The Kronau Rural Telephone Company, recently organized, will erect thirty-four miles of pole line at once. J. W. Irwin, of Kronau, Sask., is secretary and treasurer.

PRINCE ALBERT, SASK., CAN.—The Dominion government has signified its intention of granting the City of Prince Albert permission to develop the water power at Lacolle Falls on the Saskatchewan River. Arrangements will be made at once by the city for the construction of a 20,000-hp hydroelectric power plant. For further information address James McKay, of Prince Albert, Sask.

SALTSCOATS, SASK., CAN.—The Saltscoats Telephone Company has decided to sell its telephone system within the town limits to the Saskatchewan government. The company will retain control of the rural lines.

SOUTHERY, SASK, CAN.—The Buffalo Hill Rural Telephone Company, recently organized in Southery, is planning to erect fifteen miles of pole line at once.

SHERBROOKE, QUE., CAN.—The by-law authorizing the City Council to provide funds to the amount of $100,000 for the development of the Drop Off power, near Rock Forest, was carried. Ross & Holgate, of Montreal, Que., Can., are engineers.

GUANAJUATO, MEX.—The Providencia Mining & Milling Company is installing electrical equipment to operate its new ore-reduction mill and cyanide plant near Guanajuato. Forty motors will be installed, aggregating 600 hp.

PARRAL, CHIHUAHUA, MEX.—The Veta Colorado Mining & Milling Company has recently installed additional equipment in its plant, increasing the output of the plant to about 1500 hp.

SIERRA JUAREZ, OAXACA, MEX.—Plans are being made by the Compania Minera de Natividad y Anexa for the installation of a 1000-hp hydroelectric power plant at its mines near Sierra Juarez.

New Industrial Companies.

THE AMERICAN SMOKE FUEL COMPANY, of Louisville, Ky., has been incorporated with a capital stock of $2,000 by A. D. Jones, Frank Dunn and C. B. Jones. The company proposes to develop patents on smoke-consuming machinery.

THE BRIGGS MANUFACTURING COMPANY, of Augusta, Maine, has filed articles of incorporation with a capital stock of $200,000 for the purpose of manufacturing magnetos, automobile and electrical supplies. R. S. Buzzell is president; M. M. Farrar, treasurer, and C. L. Andrews, clerk, all of Augusta, Maine.

THE ELECTRIC CURRENT CIGAR LIGHTER COMPANY, of Morristown, Tenn., has been chartered with a capital stock of $5,000 to manufacture cigar lighters. The officers are: T. S. Myers, president; C. M. Cain, vice-president; Herbert Jarnagin, secretary and treasurer, and S. P. Harris, general manager.

THE HYDRO CONSTRUCTION COMPANY, of Buffalo, N. Y., has been chartered with a capital stock of $25,000 by H. M. Gall, H. M. Cowper and H. W. Cowper, all of Buffalo, N. Y. The company proposes to do a general contracting and engineering business.

THE KNOX TEREZONE COMPANY, of Elizabeth, N. J., has been chartered with a capital stock of $250,000 by J. W. Knox, L. H. Rogers and W. A. Sherman, of Elizabeth. The company proposes to manufacture generators, equip hospitals with ventilating and heating appliances, etc.

THE MARCO ELECTRIC MANUFACTURING COMPANY, of Boston, Mass., has filed articles of incorporation with a capital stock of $25,000 to manufacture and deal in electrical machinery. A. H. Martin, of West Roxbury, Mass., is president and treasurer.

THE MELLEN CONSTRUCTION COMPANY, of Portland, Maine, has been incorporated with a capital stock of $50,000 for the purpose of manufacturing water wheels and machinery of all kinds. E. T. Fenley is president and H. L. Cram, treasurer and clerk, both of Portland, Maine.

THE POWER CONSERVATION COMPANY, of New York, N. Y., has been incorporated by M. M. Bamberger, F. L. Page and C. H. Meader, all of New York, N. Y. The company is capitalized at $25,000 and proposes to manufacture engines, machinery, etc.

THE SAUER MOTOR COMPANY, of Rainfield, N. J. (not a post office), has been incorporated with a capital stock of $1,600,000 by D. W. Yeckley, of Arlington, N. J.; H. B. Banken, of Port Washington, N. Y., and C. S. Fallows, of New York, N. Y. The company proposes to manufacture motors, engines, machines, etc.

THE WALKER-MIDDLEBROOK COMPANY, of Birmingham, Ala., has been incorporated with a capital stock of $15,000 to deal in electrical equipment. The officers are: J. M. Middlebrook, president and general manager; W. M. Mays, vice-president, and J. B. Danforth, secretary and treasurer.

New Incorporations.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Sierra Nevada Water & Power Company with a capital stock of $25,000 by C. A. Wright, Frank Smith and E. McGettigan. The company proposes to own water rights, construct reservoirs, canals, flumes, etc., and to generate and sell electricity for lamps and motors.

SONORA, CAL.—Articles of incorporation have been filed for the Yosemite Power Company with a capital stock of $10,000,000. The directors are: Albert Raymond, Lester B. Wiley and John C. Hayes.

DOVER, DEL.—The Wyoming Electric Company has filed articles of incorporation with a capital stock of $25,000. The incorporators are: H. K. Berry, F. T. Herbert, of Wyoming, and A. M. Daly, of Dover, Del.

NEW ORLEANS, LA.—The Southwestern Traction & Power Company has been incorporated to construct an electric railway from New Iberia to Lafayette, a distance of seventy-five miles. Other lines from Morgan City to Jeanerette may also be built. It is understood that financial arrangements have been made for construction of the proposed railway and that surveys will begin within a few weeks. F. W. Crosby, of New Orleans, La., is president.

FORT KENT, MAINE.—The Fort Kent Electric Company has been organized with a capital stock of $50,000 for the purpose of generating and supplying electricity in Fort Kent. The officers are: Alexis O. Robbins, of Fort Kent, president, and Edna M. Rollins, of Lincoln, Maine, treasurer.

LIBBY, MONT.—The Milwaukee Electric Power Company has filed articles of incorporation for the purpose of developing the water power on Yahk River in the western part of Lincoln County. The company, it is said, has secured a site on the Yahk River, where it will erect a power plant and supply electricity to the mines in that locality, including the Sylvanite mines.

MONROE, N. C.—The Monroe Telephone Company has been incorporated with a capital stock of $125,000 by W. H. Black, George S. Lee and others.

BRITTON, OKLA.—The Britton Telephone Company has been incorporated with a capital stock of $3,000 by G. E. Crawford, S. S. Shintaffer, E. S. Rose and others.

MUSTANG, OKLA.—Articles of incorporation have been filed for the Mustang Telephone Company with a capital stock of $1,500 by C. H. Mahr, R. L. Brownlee and others. The company proposes to erect rural telephone lines.

Personal.

MR. OSCAR H. PERKINS has resigned from the Stuart-Howland Company, Boston, in order to rejoin the Westmore-Savage Company, of the same city.

MR. EDWARD B. ELLICOTT, electrical engineer of the Sanitary District of Chicago, has been re-elected to this position by the new board of trustees, a portion of which was chosen at the last general election.

MR. RICHARD WILDER, of Evansville, Ind., has been appointed manager for the Central Union Telephone Company to succeed Mr. G. C. Treadway, who becomes commercial agent for the same company at Peoria, Ill.

MR. J. H. SCHUMACHER, electrical engineer, for several years with the Chas. L. Pillsbury Company, consulting engineer, of Minneapolis and St. Paul, has resigned from that company to take up the management of the Mitchell-Gray Electric Company, at Winnipeg.

MR. JOSEPH BUEHLER has, owing to recent bereavements, retired from the firm of Hatzel & Buehler, electrical engineers and contractors, New York, after a partnership extending over twenty-one years. Mr. John C. Hatzel will continue the business under the firm name as heretofore.

MR. W. R. PUTNAM, whose resignation as superintendent of the Menominee & Marinette Light & Traction Company was recently announced, has been appointed electrical engineer of the Dakota Power Company, Rapid City, S. D., in charge of the construction of the hydroelectric plants of the company on the Rapid River.

MR. F. A. KETCHAM, acting manager for the Western Electric Company in Chicago, has been appointed chairman of Subdivision Committee No. 31 of the Chicago Association of Commerce. This committee is made up of men interested in the sale of electrical goods, and Mr. Ketcham succeeds Mr. Thomas I. Stacey, who has resigned.

MR. T. F. HOLMGREN, the well-known Swedish electrical engineer and general manager of the Royal Trollhättan Power System, is on a visit to this country in order to inspect some of our more important hydroelectric transmission systems. Mr. Holmgren is accompanied by Mr. Knut W. Bildt, electrical engineer of a large mining company in Lapland.

MR. W. W. FREEMAN, president of the National Electric Light Association, is to address the local section of the Toronto Electric Light Company on March 24. It will be remembered that Mr. Freeman is a Canadian. The Toronto section is large and growing rapidly, while there are vigorous National Electric Light Association sections also in Montreal and Vancouver.

MR. W. K. BIXBY has been elected president of the Laclede Gas-Light Company, of St. Louis, which distributes electrical energy purchased from the Union Electric Light & Power Company. Mr. Charles L. Holman, vice-president and general manager of the company, will be retained in his present capacity. Mr. John I. Beggs was the last president of the Laclede company.

MR. JAMES R. CRAVATH, of Chicago, will receive the sincere sympathy of his friends on the occasion of the death of his mother, long a highly esteemed resident of Grinnell, Iowa, where she died on Feb. 25. As Western editor of the *Electrical World* for a number of years and now as a practising engineer and special contributor to this journal, Mr. Cravath has a wide circle of friends and acquaintances, who will extend their condolences.

MR. F. H. ENSIGN has resigned as manager of the Pacific Gas & Electric Company, Phœnix, Ariz., in order to devote his time to personal interests. He will assume the management of the New State Electric Supply & Fixture Company and the New State Auto Aerial Company, in which he is financially interested. His successor as manager of the Pacific company will be Mr. R. G. Whitmark. Mr. Ensign will continue to serve as consulting engineer for this company.

MR. F. P. CATCHINGS, who has for the past ten years been electrical engineer of the North Georgia Electric Company and the Etowah Power Company, has been appointed manager of the Georgia Power Company at Atlanta, Ga., which is a consolidation and reorganization of the old companies. The Georgia Power Company is now engaged in building a 100,000 hp plant at Tallulah Falls, Ga., the Northern Contracting Company being the constructor.

MR. GEORGE A. McKINLOCK, president of the Central Electric Company, of Chicago, who is a great traveler, has been interviewed in Paris and is reported to have said that, while he sees many things to admire in London and Paris, Chicago is not, after all, so bad by comparison. Europe tolerates many abuses, he says, because they are the custom. In American cities a similar reverence for tradition does not obtain and therefore these old crusted inconveniences do not exist.

MR. LEONARD J. BOTTING, secretary of the Central Station Development Company, has been appointed general manager, succeeding Mr. W. H. Wissing, the rapid growth of the company having necessitated a division of the duties of vice-president and general manager, which have hitherto been assumed by Mr. Wissing. Mr. Wissing will concentrate his energies largely upon the investigation of successful central-station methods throughout the country and the collection of information and data pertaining to the results accomplished under various conditions.

MR. CHARLES F. GRAY, for four years past superintendent of construction for the Canadian Westinghouse Company, with headquarters at Hamilton, Ontario, has been transferred to the Winnipeg office of the above company to take charge as chief engineer of the Canadian Westinghouse Company's construction staff, erecting switching and transforming apparatus at the City of Winnipeg's 60,000 hp hydroelectric plant at Point du Bois, Manitoba, and the terminal station and substations in the City of Winnipeg. Mr. Gray's headquarters will be in the Westinghouse Building, Winnipeg.

MR. M. S. ALLEN, who has been in charge of the telephone sale department of the Western Electric Company's Atlanta house for three years, has been appointed manager of the Omaha house of the same company. Mr. Allen was connected with the Rocky Mountain Bell Telephone Company for ten years, entering the employ of the Western Electric as manager of its Salt Lake City house in 1905. A year later he became manager of the San Francisco house, from which he was transferred to Atlanta in 1908. While in the South Mr. Allen has been closely identified with the spread of the rural telephone movement in that section.

MR. HENRY FLOY has recently purchased from the estate of the late Mr. William H. Bryan, of St. Louis, the complete collection of data and references on the subject of depreciation gathered by Mr. Bryan. This collection is the result of years of work of Mr. Bryan and his assistants. Mr. Bryan's experience in making appraisals and valuations made him a recognized authority on questions of depreciation. His paper "The Appraisal and Depreciation of Water Works and Similar Properties," read before the Engineers' Club of St. Louis about three years ago, is recognized as a classic on the subject. The collection purchased by Mr. Floy includes duplicates of the references collected by the American Water Works Association committee on depreciation, in addition to similar data on electric railway and lighting plants, water-power plants, telephone systems, etc. The addition of Mr. Bryan's collection to Mr. Floy's data makes an unusually extensive and authoritative reference library on depreciation.

JOHN I. BEGGS.

MR. JOHN I. BEGGS, president of the Milwaukee Electric Railway & Light Company, of Milwaukee, Wis., announced his retirement from the presidency of that company last week. Mr. Beggs will remove about April 1 to St. Louis, where he will take charge of the St. Louis Car Company, of which he will become president and general manager. Mr. Beggs has been identified with the management of public-service corporations for many years and is recognized as one of the leading and most forceful men in the electric railway and electric lighting industries. He is no stranger to manufacturing and selling enterprises, for twenty years ago he was Western manager for the old Edison General Electric Company. Since then he has been connected with electric lighting or electric railway companies in Cincinnati, St. Louis and Milwaukee. He took full charge of the predecessor of the present Milwaukee Electric Railway & Light Company in 1897. The property had then just emerged from bankruptcy, but Mr. Beggs has built it up until it is now recognized as one of the most prominent and successful of the combined central-station and electric-railway companies of the country. Mr. Beggs has been president of the American Electric Railway Association and is a man of varied and extensive interests. The St. Louis Car Company is at present one of the largest car-building concerns in the country and Mr. Beggs is reported to have acquired a controlling interest in it. The retiring president of the Milwaukee company is a man of remarkable versatility and of unshrinking courage. President James Campbell, of the North American Company, of New York, which is interested in the Milwaukee Electric Railway & Light Company, says that Mr. Beggs retires from the management of the Milwaukee company against the wishes of every one interested. He paid this tribute to the retiring president: "Mr. Beggs is an ideal executive of a great company. He is a wonderful executive; he has vision; he not only can tell others how to do things, he can do them himself. I never have known a man who combined so many qualities of leadership. He is an engineer, an administrator, an accountant and a financier. The Milwaukee Electric Railway & Light Company is a monument to his ability as a manager and his devotion to duty as a man." Mr. Beggs became connected with the electrical industry in its early days, being manager of an electric-lighting plant in Harrisburg, Pa., in 1884. After that he became connected with the Edison Company, as stated. While retiring from the management of the Milwaukee property, Mr. Beggs will retain his financial interest in the company and remain as one of the directors. His removal to St. Louis is no doubt influenced by other than business reasons, for that city is the home of his daughter and grandson and his family ties are there.

Obituary.

MR. J. McM. SMITH, the traction expert, first general manager of the Elkhart-South Bend Line, died in South Bend, Ind., February 6, as the result of a nervous breakdown. When stricken several weeks ago he had just accepted the position of general manager of the Fort Wayne-Kendallville traction line. Mr. Smith was born in Tennessee in 1853 and after an early career as telegrapher he served twenty years as private secretary to George M. Pullman, of the Pullman Car Company. About twelve years ago he became active as a traction promoter in northern Indiana, and it was he who induced Arthur Kennedy and D. C. Dilworth, of Pittsburgh, to take hold of the then projected Elkhart-South Bend line, from which the Northern Indiana System has developed. The Dilworth interests were acquired by the Kennedy and Murdock syndicate, which then bought Mr. Kennedy's interests. Soon after this Mr. Smith's resignation was submitted and he became manager of the South Bend and St. Joseph line, which later was absorbed by the Murdocks.

Trade Publications.

ARC LAMPS.—The Western Electric Company is distributing Bulletin No. 5500, relating to direct-current and alternating-current inclosed-arc lamps, designed for both outdoor and indoor service.

EXCITER SWITCHBOARDS.—Switchboards intended especially for use with exciter generators employed in connection with alternators are described in Bulletin No. 4782 of the General Electric Company.

SWITCHBOARD WATT-HOUR METERS.—The Machado & Roller Company, Pittsburgh, Pa., has issued a well-illustrated booklet devoted to Columbia shunted astatic watt-hour meters designed for switchboard mounting.

VOLTAGE REGULATORS.—Bulletin No. 4602B of the General Electric Company, Schenectady, N. Y., contains complete wiring diagrams and engineering descriptions of automatic voltage regulators for direct-current generators.

WIRE ROPE.—A. Leschen & Sons Rope Company, 920 North First Street, St. Louis, Mo., has issued a strikingly illustrated catalogue covering wire rope and aerial wire rope tramways. The illustrations relate to numerous installations in which wire rope is employed.

ADJUSTABLE-SPEED MOTORS.—The Reliance Electric & Engineering Company, 312 Huron Road, Cleveland, Ohio, is distributing an illustrated mailing folder giving in condensed form much information concerning adjustable-speed motors for use with machine tools.

PLANT TESTING.—In a booklet entitled "Economical Power Plant Operation," the Richard D. Kimball Company, 437 Fifth Avenue, New York, describes in detail the various economies that can be effected in the operation of power plants in the proper as compared with the improper manner.

TELEPHONE SWITCHBOARD.—Bulletin No. 1014 of the Western Electric Company contains much detailed information relating to central-battery non-multiple switchboards with magnetic signals. These switchboards are used in exchanges where the ultimate number of lines will not exceed 500.

INCANDESCENT LAMPS FOR STREET LIGHTING.—High-efficiency metallic-filament lamps designed particularly for street lighting service are fully described in Bulletin No. 4781 of the General Electric Company, which contains many valuable data relating to the cost of operating lamps of this type.

RECORDING THERMOMETERS.—Bulletin No. 127 of the Bristol Company, Waterbury, Conn., is a 40-page publication dealing with recording thermometers designed for temperatures between 60 deg. below zero and 800 deg. Fahr. Detailed descriptions are given of the thermometers suitable for use under various conditions considered.

THREE-WIRE GENERATORS.—Direct-current generators in which 125 volts and 250 volts are produced simultaneously in one machine are described fully in Bulletin No. 441 of the Triumph Electric Company. The neutral point of the three-wire system is obtained by means of three transformer balancing coils connected to three collector rings joined to appropriate points on the armature winding.

BUSINESS NOTES.

THE AMERICAN CONDUIT & MANUFACTURING COMPANY has appointed Mr. Milton Mill, 915 Olive Street, St. Louis, as Southwestern agent for its products.

THE ASBESTOS PROTECTED METAL COMPANY, Canton, Mass., has established a Western office at 613 Fisher Building, Chicago. Mr. Wilmot W. Burritt is in charge of this office and territory as district manager.

THE RELIANCE ELECTRIC & ENGINEERING COMPANY, Cleveland, has moved into its new plant at Collinwood Station, near Cleveland. The mail address to Cleveland should, for prompt delivery, include "Collinwood Station."

MR. GEORGE A. JOHNSTON, of Los Angeles, Cal., has moved his office to 551 South Los Angeles Street, where he will continue to act as sub-agent for Wagner line of alternating-current motors, generators, transformers and instruments.

NEW COOPER HEWITT WORKS.—The new works of the Cooper Hewitt Electric Company, Eighth and Grand Streets, Hoboken, N. J., have been completed. The general offices have been removed to the works from 220 West Twenty-ninth Street, New York.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, of Chicago, has opened a branch store at 25 Jackson Boulevard. (By a new system of street numbering this store will be 62 East Jackson Boulevard after April 1.) A full line of electrical supplies for the retail trade will be carried at the new location, which is in a section of smart shops.

THE UNION ENGINEERING COMPANY has been organized with offices at Columbia, S. C., in order to conduct the business of designing and installing lighting, power and water plants. The staff of the company includes well-qualified electrical and mechanical engineers, with Mr. J. M. O'Brien as managing engineer. The field of work extends to the several neighboring states.

THE HEMMING MANUFACTURING COMPANY has had to double the capacity of its plant, the additions having just been completed. The company has moved its main office to the factory at Garfield, N. J., but the sales office still remains at 2 Rector Street, New York, in charge of Sales Manager Butler Keys, who will as well look after the interests of the company in New York City.

BETTS & BETTS.—In our issue for January 5, on page 55, appeared a description of a large industrial electric sign being built for the Edison Electric Illuminating Company of Boston, Betts & Betts, of New York, being credited with its building. Our attention has been called by this firm to the fact that it merely furnished the flasher and the color caps for the sign, which was built by the Federal Sign System Electric, of New York. The firm of Betts & Betts has discontinued manufacturing electric signs and devotes its entire time to flashers, color caps and electrical specialties for the use of sign manufacturers.

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, Ohio, has found it necessary to work a night shift three nights a week in order to keep pace with orders. Among recent sales have been thirty-eight induction motors in sizes up to 50-hp to Bishop & Babcock, ten induction motors of various sizes to the Davis Knitting Mills, one 150-hp induction motor to H. T. Lloyd, Spokane, and twenty-five direct-current motors to the American Window Glass Company. Generator sales include three 75-kw, one 100-kw and one 50-kw direct-connected generator, three 50-kva belted alternators and one 35-kva motor generator set.

THE VALENTINE-CLARK COMPANY, of 1001 McCormick Building, Chicago, will on March 15 remove its general offices to 932 Security Bank Building, Minneapolis, Minn. The above company for twenty years has been identified with the cedar trade in Chicago and, recognizing that the successful operation of any business depends greatly on the producing end, is making this change in order that it may be in closer touch with its woods operations. Cedar is practically cleaned out of Michigan and certain portions of Wisconsin, and it is estimated that in the future 90 per cent of the poles, ties and posts will be produced in upper Minnesota and in the West. The company has a large yard at Minnesota Transfer, Minn., where a plant for the treatment of cedar poles with C. A. wood preserver is located, which is to be extended, thus necessitating closer personal attention than in the past. The company will also carry at this yard quantities of Western cedar produced in its own operations at St. Maries, Idaho. It is the intention of the company to increase not only its Minnesota but its Idaho operations. Northern white cedar poles will be carried in large quantities as usual at the company's Prentice and Green Bay (Wis.) yards—the latter yard being particularly well located for Eastern shipments.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Geo. S. Emery, 11 N. Royal St., Mobile, Ala.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next semi-annual meeting, New York City, April or May, 1911.

American Electro-Therapeutic Association. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York. Next meeting at Philadelphia, Pa., Sept. 5, 6 and 7, 1911.

American Institute of Consulting Engineers. Secretary-Treasurer, Eugene W. Stern, 103 Park Ave., New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Electric Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Electric Railway Engineering Association. Secretary, Norman Litchfield, Interborough Rapid Transit Company, New York.

American Electric Railway Association. Secretary, H. C. Donecker, Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark.

Association of Iron and Steel Electrical Engineers. Secretary, James Farrington, Steubenville, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Boston, Mass., June, 1911.

Association of Railway Electrical Engineers. Secretary, J. Andreucetti, Chicago & Northwestern Railway, Chicago. Next annual meeting Chicago, November, 1911. Semi-annual meeting, Washington, 1911.

Association of Edison Illuminating Companies. Secretary N. T. Wilcox, Lowell, Mass.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, 220 King St. West, Toronto, Can.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Allen H. Royce, 48 King St. West, Toronto, Ont.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, A. L. Neereamer, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Acting Secretary F. D. Morris, 323 Hagerman Building, Colorado Springs, Col.

EASTERN STATES INDEPENDENT TELEPHONE ASSOCIATION OF PENNSYLVANIA, NEW JERSEY, MARYLAND AND DELAWARE. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

ELECTRIC VEHICLE ASSOCIATION OF AMERICA. Secretary, Harvey Robinson, 124 West 42d St., New York.

ELECTRIC CLUB, CHICAGO. Secretary, F. S. Hickok, 824 Marquette Building, Chicago. Meets every Wednesday noon, 303 Wabash Ave.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

ELECTRIC TRADES ASSOCIATION OF PHILADELPHIA. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursday of each month.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

ELECTRICAL CREDIT ASSOCIATION OF CHICAGO. Secretary, Frederic P Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of directors meets second Thursday of each month.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, Engineering Societies Building, 29 West 39th St., New York.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, C. H. Lemhower, Reading, Pa.

FLORIDA ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, H. C. Adams, West Palm Beach, Fla. Next meeting, Jacksonville, Fla., April 4 and 5, 1911.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago. Annual convention, Chicago, 1911.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, I. V. Zartman, Indianapolis, Ind.

INTERNAL COMBUSTION ENGINE ASSOCIATION. Secretary, Chas. Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex. Next meeting, St. Paul, Minn., 1911.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Seecretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Dubuque, Ia. Next meeting, Davenport, Ia., April 19, 20 and 21, 1911.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Davenport, Ia., April, 1911.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting Independence, Kan., Sept. 21 and 22, 1911.

MAINE ELECTRICAL ASSOCIATION. Secretary, Walter S. Hyman, Waterville, Maine.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, Herbert Silvester, Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, T. C. Gordon, Little Falls, Minn. Annual meeting, St. Paul, Minn., March 14, 15 and 16, 1911.

MISSISSIPPI ELECTRIC ASSOCIATION. Secretary, A. H. Jones, McComb City Light and Power Co., McComb City, Miss. Annual convention, Gulfport, Miss., June 20-21, 1911.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, N. J. Cunningham. Next meeting, St. Louis, April 13-15, 1911.

NATIONAL ARM, PIT & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Third convention, Pittsburg, June 6-8, 1911.

NATIONAL ELECTRIC CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Niagara Falls, July 19, 1911.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive Secretary, T. C Martin, Engineering Societies Building, 33 West 39th St., New York.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEW ENGLAND SECTION. Secretary-Treasurer, L. D. Gibbs, 39 Boylston Street, Boston, Mass.

NATIONAL ELECTRIC LIGHT ASSOCIATION, PENNSYLVANIA SECTION. Secretary-Treasurer, Van Dusen Rickert, Pottsville, Pa.

NATIONAL ELECTRIC LIGHT ASSOCIATION, NEBRASKA SECTION. Secretary-Treasurer, S. J. Bell, David City, Neb.

NATIONAL ELECTRIC LIGHT ASSOCIATION, GEORGIA SECTION. Secretary-Treasurer, H. M. Corse, Columbus Railroad Company, Columbus, Ga.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn. Next meeting, New York, March, 1911.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P Vose, 343 Marquette Bldg., Chicago.

NATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary Joseph B. Ware, Grand Rapids, Mich.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary Frank McMaster, Beatrice, Neb.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, L. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July 25-28, 1911.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting at Youngstown, May 18 and 19, 1911.

OKLAHOMA PUBLIC UTILITIES ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.

ORDER OF REJUVENATED SONS OF JOVE. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Building, Chicago, Ill.

PACIFIC COAST ELECTRIC VEHICLE ASSOCIATION. Secretary, A. H. Halloran, 604 Mission St., San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary Treasurer, Van Dusen Rickert, Pottsville, Pa.

PENNSYLVANIA STREET RAILWAY ASSOCIATION. Secretary, Henry M. Stille, Harrisburg, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, F. A. Sawyer, Colorado Springs, Col. Meetings, second Saturday of each month.

PITTSBURG ELECTRIC BOOSTER CLUB. Recording Wattmeter, O. R. Rombach, 919 Liberty Ave., Pittsburg, Pa. Meetings, fourth Monday of each month.

RAILWAY ELECTRIC SUPPLY MANUFACTURERS' ASSOCIATION. President, A. C. Moore, Safety Car Heating & Lighting Co., Chicago.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. D. Forbes, Box 63, Brant Rock, Mass. Monthly meeting, first Monday of each month.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, D. G. Fisher, 1316 Commerce St., Dallas, Tex. Annual convention, Houston, Tex., April 27-29, 1911.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, C. G. Reel, Kingston, N. Y.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary Electrical committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1911.

VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester Center, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 145 Monroe St., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

WIRELESS INSTITUTE. Secretary, Alfred N. Goldsmith, College of the City of New York, New York.

WISCONSIN ELECTRICAL ASSOCIATION. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 21, 1911.

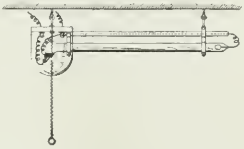
[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City]

984,534. MULTIPLE ELECTRIC LIGHT SWITCH; G. D. Brookins and J. C. Vetter, Cleveland, Ohio. App. filed April 21, 1910. Rotary snap switch, one member cone shaped and carrying a contact strip and the other member cupped to receive the cone and carrying a plurality of circularly adjustable contacts.

984,547. CENTRAL ENERGY TELEPHONE SYSTEM; F. W. Dunbar, Chicago, Ill. App. filed March 22, 1901. The circuit for energizing the relay comprehends a portion of the talking circuit with return through a third conductor.

984,558. MOUTHPIECE FOR SOUND TRANSMITTERS; J. Graham, Philadelphia, Pa. App. filed April 22, 1910. A removable cup-shaped mouthpiece for telephones and a carrier for attaching the mouthpiece to the transmitter, the mouthpiece being destroyed when removed from the carrier.

984,559. LIGHTNING ARRESTER; E. R. Harding, Chicago, Ill. App. filed July 5, 1907. Two parallel coils of wire with a cylindrical length of carbon between the coils in proximity to the convolutions the carbon being adjustable endwise and longer than the coils and rotatable relatively thereto.



984,707.—Vapor Electric Apparatus.

984,561. LAMP RECEPTACLE AND HOLDING MEANS THEREFOR; H. T. Hochhausen, Brooklyn, N. Y. App. filed July 25, 1907. An apertured plate with lamp receptacle in the plate having a plurality of openings, a grooved hub on the receptacle and a clamp ring engaging the grooved hub with an inturned end projecting through the plate and engaging in one of the openings in the receptacle to lock the latter against rotation.

984,582. ALTERNATING-CURRENT MOTOR; B. McCollum, Lawrence, Kan. App. filed Dec. 22, 1909. Inductive motor of the squirrel-cage type with a short-circuiting ring of tungsten steel forming part of the circuit of the motor.

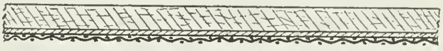
984,590. PROCESS OF PURIFYING AND REFINING IRON; J. B. Nau, New York, N. Y. App. filed Sept. 16, 1909. Refining pig iron in an electrical furnace by immersing the lighter ore in the heavier liquid iron and heating the partially refined iron with an electric current.

984,605. METHOD OF PRODUCING NITROGEN AND CARBON DIOXIDE FROM GASEOUS PRODUCTS OF COMBUSTION; M. Reichel & H. Braun, Berlin, Germany. App. filed Sept. 8, 1909.

984,651. CONTROL SYSTEM FOR ELECTRIC MOTORS; A. C. Eastwood and J. F. Schnabel, Cleveland, Ohio. App. filed March 18, 1910. A motor with field and armature and two resistances, the armature and field being in parallel circuits and connected in a dynamic breaking circuit for low speeds, resistance being inserted in the field circuit, cut out of the armature circuit and then inserted in the dynamic-breaking circuit for higher speeds.

984,655. COMMUTATOR; F. C. Fischer, Philadelphia, Pa. App. filed Sept. 8, 1910. Forms a mechanical incision of variable shape in a defective part of the commutator bar and then puts in a plug and secures it in position.

984,673. CLOTHES-PRESSING TOOL; T. M. House, Weldon, N. C. App. filed Jan. 12, 1910. Pivotally connected hand levers with opposing pressing heads carried by the outer ends of the levers, a pivot connecting one of the heads to its lever and a spring bearing against the pivotally mounted head and carried by the lever which supports the head with means for electrically heating one of the heads.



984,915.—Diaphragm Construction.

984,677. PLAYING APPARATUS FOR PIANOS AND OTHER MUSICAL INSTRUMENTS; J. F. Kelly, Pittsfield, Mass. App. filed May 14, 1908. A plurality of rotating friction drums with different surface velocities, with friction surfaces connected to operate the tone-producing device and thrown into engagement with the drum by electrical means.

984,679. AUTOMATIC ADJUSTABLE HOLDER FOR TELEPHONE RECEIVERS; S. O. Lancaster, London, Ont., Can. App. filed March 14, 1910. Stand for telephones with pivoted arms having clasps to hold the receiver, the arms being secured to the telephone stand.

984,686. INTERCOMMUNICATING TELEPHONE SYSTEM; R. H. Manson, Elyria, Ohio. App. filed May 29, 1907. Common battery system with indicating keys for the parties and their bells and for cutting off ringing current and switching on talking current. The keys assume three positions, the lowest position closing a master contact, the intermediate position establishing talking and the third position being the disconnected position.

984,703. PROCESS OF MAKING SULPHURIC ACID AND ELECTROLYTIC IRON; A. S. Ramage, Detroit, Mich. App. filed Jan. 9, 1909. Dissolves the ferric ore in sulphuric acid and reduces to ferrous sulphate the sulphur dioxide and electrolyzes by means of an insoluble anode and depolarizes the anode.

984,707. VAPOR ELECTRIC APPARATUS; M. von Recklinghausen, New York, N. Y. App. filed Nov. 10, 1903. A horizontal bar to which the lamp is clamped and in which clamps the lamp may be rotated, for giving it the shock for starting, when lamp has to be mounted on ceiling with limited space.

984,712. TROLLEY RESTORER; W. H. Stebbins, Jr., Buffalo, N. Y. App. filed Jan. 14, 1910. Trolley restoring member with arms on opposite sides of the trolley wheel pivoted to the upper end of the trolley pole with piston connection to the restoring member operated by compressed air.

984,719. METHOD OF ELECTRIC WELDING; E. Thomson, Swampscott, Mass. App. filed July 10, 1909. Fixes the two pieces together, wedges in a piece of metal and passes an electric current through the joint.

984,726. VACUUM TUBE; W. A. Winter, New York, N. Y., and C. M. Peabody, South Orange, N. J. App. filed April 14, 1910. Has a conducting element on one surface to hold the charge, a second element on the other surface of the tube, a terminal passing through the tube and carried by one of the elements and a terminal connected to the other element so as to provide a path for static discharges.

984,738. ANTI-INDUCTION APPARATUS FOR TELEPHONE SYSTEMS; A. Barrett and W. Condon, Kansas City, Mo. App. filed Dec. 28, 1908. A main circuit with two branches inductively related to each other, but not to the main circuit, the main circuit intermediate the branches having low resistance to all currents and a telephone receiver in one of the branches.

984,748. ELECTROMAGNETIC APPARATUS; J. P. Coleman, New York, N. Y. App. filed Nov. 2, 1910. For operating a pin valve of a pneumatic signaling apparatus by means of an alternating-current electromagnet, including an energizing coil, two pivoted armatures, with two paths for magnetic flux therethrough, one operating to move the armature and the other to hold it closed.

984,759. SWITCH AND FUSE SUPPORT AND COVER; W. J. Gibbons, Philadelphia, Pa App. filed July 2, 1910. A base with electrical connections carrying a cover having cavities into which the connections extend when the cover is in place with a separating wall between the cavities.

984,760. PROCESS FOR PRODUCING ARTICLES BY ELECTRODEPOSITION; F. I. Gibbs, Birmingham, England. App. filed Sept. 23, 1909. Electrically deposits metal on a glazed metallic luster surface of pottery ware and then removes the model.

984,762. APPARATUS FOR RECEIVING ELECTROMAGNETIC WAVES; F. A. Hart, New York, N. Y. App. filed May 6, 1910. Syntonic receiver which may be used for receiving with group frequency waves by means of an arrangement of ballast and selective circuits and non-inductive resistances for eliminating undesired wave lengths, there being two alternative paths to earth from the antenna, one path consisting of an inductance and a capacity and the other of a capacity and two inductances, with a portion in parallel.

984,767. AUTOMATIC TROLLEY POLE; J. W. Lang, Los Angeles, Cal. App. filed Aug. 11, 1909. Pneumatic means for moving the pole controlled by a valve, which is controlled by a hydraulic device or dashpot with restricted passageway to cause the pole to follow the wire in ordinary operation and to act upon the pneumatic device to drop the pole on a quick jump of the wheel.

984,769. ELECTROCHEMICAL PRODUCTION OF PHOSPHATIC FERTILIZERS; G. Levi, Rome, Italy. App. filed Aug. 14, 1909 Heats certain phosphates in an electric furnace.

984,771. OUTLET BOX; N. Marshall, Newton, Mass. App. filed June 1, 1909. An outlet box with insulating base, carrying conductor bars providing four pairs of attaching devices, the conductors crossing each other at right angles, and having their ends separated by radial ribs extending from the center of the base.

984,842. APPARATUS FOR OBTAINING PRECIOUS METALS; J. R. Parks, Spokane, Wash. App. filed June 24, 1907. A plurality of extraction pans supported at different levels, the liquid flowing through the pans in succession and being subjected to electrolysis while in the pans, each pan being removable for cleaning without intererupting the flow of liquid through the remaining pans.

984,851. FORGING MACHINE; C. E. Reed, Chicago, Ill. App. filed Sept. 24, 1910. The blank is placed between forming dies which constitute electrodes to supply current to heat the blank.

984,902. PULL SWITCH; G. W. Goodridge ,Bridgeport Conn. App. filed Dec. 14, 1910. To prevent loosening of the end ball of the chain by means of a spring which holds the end ball in its socket.

984,905. PROCESS AND APPARATUS FOR THE ELECTROLYTIC DECOMPOSITION OF ALKALINE SALTS; J. Greenwood, London, England. App. filed Nov. 22, 1909. Causes the liquor to pass through a series of superimposed and concentric cells, each comprising a hollow anode andl a cathode, and regulates the flow of liquor into the first hollow anode and through the apparatus in accordance with the current density.

984,915. DIAPHRAGM CONSTRUCTION; W. S. Heltzen, Davis, W. Va. App. filed May 19, 1910. Diaphragms for cathodes impervious to liquid, but permitting soda to pass through, consisting of a composition of cement and ground asbestos fibre placed on asbestos cloth, which cloth is heated and the resulting diaphragm hardened by silicate of soda.

984,925. PROCESS OF OXIDIZING NITROGEN OF AIR BY MEANS OF ELECTRIC DISCHARGES; K. Kaiser, Wilmersdorf, near Berlin, Germany. App. filed March 25, 1910. Adds ammonia to oxygen and nitrogen and subjects the mixture to an electric discharge.

984,945. TELEPHONE SYSTEM; O. M. Leich, Genoa, Ill. App. filed Nov. 13, 1909. A telephone system with metallic line circuit, a plurality of windings bridged across the metallic circuit, magneto ringer for each winding, connected between the return circuit and the associated winding, and a telephone talking set bridged across the ringer.

984,958. TELEPHONE EXCHANGE SYSTEM; J. G. Mitchell, Cleveland, Ohio. App. filed July 15, 1909. Telephone exchange system with operators' positions and trunk line, inductive terminal at the second position, and also a self-locking signal passable for alternating ringing current only, the inductive terminal being disconnected and the signal unlocked by the operator.

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THE FEDERAL LAMP SUIT.

Elsewhere we print an abstract of the complaint in the federal suit instituted last week at Cleveland against practically all of the incandescent-lamp manufacturing companies of this country on the charge of combination in restraint of interstate commerce. It has been common rumor for several years that such a suit was in preparation, so that the announcement of the action in Cleveland was not entirely unexpected. Until the defendants have presented their side of the case comment on the specific charges made in the Cleveland petition would have to rest on strictly *ex parte* presentation of facts and conclusions, and therefore appears uncalled for at the present moment. We may nevertheless here point out that two issues of great importance, aside from the bearing on the defendants, are presented in the petition of the Attorney-General. One of these is the extent to which the monopoly awarded by a patent may be extended in various directions. Another is whether any limitation can be imposed upon a manufacturer in the purchase of patents to fortify his interests, or if in such purchase there is a discrimination between acquiring domestic and foreign patents. Other questions of importance are involved, such, for example, as whether several different patent monopolies can be combined to form one of greater strength than any of its constituent monopolies. Aside, therefore, from the final outcome of the suit as it affects the principals to it, the Cleveland case is fraught with issues of the highest interest to all who are brought into contact with patent matters.

THE BOSTON ELECTRIC VEHICLE CAMPAIGN.

The campaign inaugurated last week in Boston to advance the interests of the electric vehicle has more than a local significance. In general plan and in detail—in the combination of shrewd commercial sense and breadth of view toward the public to be served—it should be an inspiration to every large central station, many of which have been deterred from wholehearted exploitation of the electric vehicle through indecision as to the best means to that end. Moreover, the electric vehicle art and industry in general will benefit largely from the work to be done in Boston. Through an arrangement with the Massachusetts Institute of Technology there will be an accompaniment of research work, which will probably deal largely with matters of standardization, and might well include the collection and discussion of operative data, both stable and garage. There is a crying need for data from disinterested sources as to the actual cost of horse vehicular service, for which information the prospective users of electric trucks are now dependent upon those interested in retaining horse service, or upon those commercially engaged in displacing such service. Of the highest value to the electric industry will be the data to be systematically recorded relating to the operation of the electric vehicles in the service of this company, which will eventually displace not far from 150 horses and include every type of vehicle from the light runabout to the heavy truck. Of great interest will also be the working of the inspection service, through which users may be assured that the equipment of their vehicles is always in serviceable condition; while the establishment of a public garage with a flat monthly rate for charging and maintenance, including minor repairs to equipment, meets a situation that is a crucial one in any campaign for the introduction of the electric vehicle and may result in a general solution of the bothersome garage problem. The liberality of spirit which characterizes the Boston Edison company is indicated by its action in placing the garage under the supervision of the Electric Vehicle Association of America, which will act as an agent in securing for the public the most efficient service.

One of the most important features of the Boston movement is that which aims at securing the close co-operation of the electric vehicle manufacturers and the co-ordination of the interests common to them and to the central station. One of the weak points heretofore in the exploitation of the electric vehicle has been the neglect of the central-station factor by the vehicle manufacturers in the extension of their business. One of the objects of the formation of the Electric Vehicle Association of America was to overcome this obstacle, and the work in Boston will, without doubt, develop in detail how this end may best be secured. The astonishing lack of co-operation between the two interests at present was illustrated in the remarks at Boston of President Blood, of the Vehicle Association, who had been appealed to by two prominent central-station companies for aid in making purchase of electric vehicles. In one case a central station in the market for three vehicles had been unable even to obtain replies from inquiries of manufacturers. The other was that of a central station desiring to expend $15,000 for vehicles, but which found itself practically ignored by the makers. This extraordinary condition does not appear to be the result of any antagonism, but simply due to entire lack of co-operative relationship, which deficiency now happily promises soon to be a thing of the past. This journal has, from the earliest days, been a warm advocate of the electric vehicle, and has closely followed every development, technical and commercial, in its entire history. We, therefore, are not indulging in uninformed statement in saying that the work inaugurated in Boston last week is the most important thus far undertaken to forward the commercial interests of the electric vehicle; and, in view of the ripeness of the situation everywhere and the broadness of the Boston plans, it can safely be predicted that the results of the work in that city will be of national effect. It is fortunate that an undertaking of such import should have at its head one so competent as President Edgar, of the Boston Edison company, and for conducting its details the staff of men of exceptional executive, technical and commercial ability which he commands.

GAIN IN ELECTRICAL EXPORTS.

With the figures for December we were able to show a most satisfactory gain for the year 1910 in electrical exports over 1909. The statistics for January show that the current year has started out at a very brisk rate to excel its predecessor; in fact, we can hardly recall any month so bright in promise or so excellent in itself. The exports of electrical instruments reached no less than $965,936, as compared with $621,469; and exports of heavy electrical machinery reached $687,536, as compared with $565,838. This is a notable gain in both classes. The total is $1,653,472, against $1,187,307, or an increase of $466,165. The expansion in electrical export trade can no longer be questioned, after figures like these, and if the pace can be maintained any previous figures should be left far in the rear.

Just at this juncture, when the talk about reciprocity is so general, it may be well to note that Canada is brilliantly to the fore as a customer, giving decided evidence of a desire to patronize the products of our markets. She increased her consumption of lighter electrical goods from $174,781 to $330,851, and of heavy goods from $77,651 to $139,630. Other purchasers did well, but not at all in the same proportion. All told the United Kingdom took barely $100,000, or only a fifth of what was required by the Dominion.

THE AMERICAN INVADER IN ITALY.

Italy has for so long been the scene of high-tension alternating-current work, and particularly has been so distinguished in the pioneer installations of alternating-current tramway motors, that it is a matter of considerable technical interest to note the introduction of a 1200-volt, direct-current system on what is likely to be an important Italian railway network. The installation is the more interesting since the car equipments are furnished by an American company which has in a measure standardized such apparatus for use on some of our lines. In another column will be found a full account of the technical details of the line, which is in point of fact very much like some of the American high-voltage, direct-current tramway lines. The chief advantage of the system, which seems to have made itself strongly felt in this Italian instance, is, of course, the ease with which an old tramway system may be changed over so as to use the ordinary 600-volt current for city work, especially at old termini, while retaining the 1200-volt connection for all the cross-country operation.

There is nothing unusual about the overhead construction of the line, which is merely a simple form of catenary construction such as has proved its utility over and over again. Ordinary grooved trolley wire is employed. One interesting feature of the suspension is that it is carried out to a considerable extent in towns by cross spans carried from the buildings, a type of construction perfectly familiar in some parts of the Continent, but the apearance of which in our own country would be heralded by such a display of scare headlines as would make even the veteran newspaper man open his eyes. The power is derived from the high-tension hydroelectric network of which Brescia is the center, a network operating mostly at 40,000 volts. The line at present in operation is thirty-three and one-half miles long and is fed from two transforming stations, each provided with a pair of synchronous motor-generators and a storage battery. Two types of cars are employed, one of the ordinary four-axle variety equipped according to ordinary American practice in such cases, with four motors in series in groups of two, with provisions for parallel running. The others, two-axle cars which have not been extensively employed in this country on such lines, have the two motors connected permanently in series with rheostatic control. The motors are all of 45-hp rating, wound for 600 volts, but insulated for double that amount.

The introduction of this type of railway into Italy is not only an evidence of the American activity which has often been exercised in Italy, but is particularly interesting from an engineering standpoint, because as a result one will find running side by side in similar territory, serving similar communities, the single-phase system with commutating motors and a 1200-volt, direct-current system. In this country comparisons between the two are extremely difficult, because, although both are in use, the roads of the two kinds are wide apart and they operate on the whole under radically different conditions and give very little opportunity for unbiased comparative judgment of the merits of the two systems. Unbiased judgments on this question are so rare that the opportunity afforded by these two Italian lines is very welcome. Of course, even here the conditions are not exactly alike, since the alternating-current Italian roads represent as a whole a somewhat heavier type of traction. The system is likely to be rapidly expanded in the next year or two and will then be in operation on a big enough scale to admit of pretty accurate information as to its working properties. The one feature of the installation which may tend to confuse the situation, however, is that the same company owns the transmission network and operates the tramways under contract with the Province of Brescia. The situation, therefore, is not exactly parallel with the case of the ordinary electric railway line, and it will probably take some pretty keen accounting to get at the real facts of cost of operation, which are necessary for the discussion of the engineering situation. This much is certain, however, that the 1200-volt, direct-current system has been so thoroughly worked out in this country that it is quite safe to predict that from an operating standpoint it will do excellent work. Its appearance in Italy will in part repay the debt which American engineers owe to their Italian confrères for many clever innovations in high-tension work. A genius for the applications of science has, indeed, pervaded Italy from the days of Galileo and Leonardo da Vinci, and the technical invader must have, as in this case, much that is both novel and good to make clear his title for a hearing.

ENERGY LOSSES IN INCANDESCENT-LAMP FILAMENTS.

When the power consumed by an incandescent lamp is measured at lamp terminals it is very important to know where the power goes, and how. If we neglect the power expended in the leading-in wires all the power goes to produce heat in the filament. So far as is known, the transformation from electric power to thermal power is perfect. None escapes conversion into heat. The heat produced in the filament must, in the steady state, escape at the same rate as it is generated. The escape, or heat dissipation, from the filament must occur in radiation, convection and conduction. The radiation is believed to be an electromagnetic process whereby electromagnetic waves are set up in the space surrounding the filament and transmitted outward in all directions at the velocity of light. All the light usefully delivered by the lamp is due to this radiation and depends on how much radiation is produced within the limits of the visible spectrum. Most of the radiation given off by the filament is non-luminous—that is, it has too low a frequency to be perceived by the eye. Moreover, some of the radiation, in passing through the glass walls of the lamp, is absorbed and heats the glass, so that this lost radiation is given off finally in air convection from the hot glass bulb. Some heat, too, escapes from the filament into the surrounding gas by convection. If the bulb contained air at ordinary barometric pressure this convection loss would be very large, but in the highly exhausted lamp chamber it is reduced to small dimensions. Finally, some heat escapes from the filament conductively at the ends and also at such anchor or anchors as may support the filament.

The amount of heat lost in conduction at the ends and supports of the filaments has been a matter of some debate. It is not an easy matter to compute, because, while the thermal conductivity of cold glass is fairly well known, that of hot glass has not yet been determined experimentally, and the heat escaping conductively from the filament leaves the lamp through the glass as well as through the metallic wires. The matter is also not easy to settle by direct experiment. In our article on page 624 this week an interesting indirect experimental investigation, by Messrs. E. P. Hyde, F. E. Cady and A. G. Worthing, is described. The method consisted in superposing the optical image of the filament to be tested upon the image of part of a large tungsten filament whose brightness could be varied at will. Throughout the greater part of the length of the filament under test its bright image called for a substantially uniform brightness in the background image of the comparison tungsten filament, in order to reach a color and brightness match in the observing telescope. Near the end of the test filament, however, the brightness fell off, owing to cooling by conduction, and the background comparison lamp had to be diminished correspondingly in brightness in order to maintain a match. In this way the whole length of the filament under test could be measured for brightness, millimeter by millimeter. From separate measurements on the background comparison lamp the diminution in radiation and the loss of power by conduction were determined.

The above method of measurement is closely related to that of the Morse and Holborn-Kurlbaum optical pyrometers for determining furnace temperatures. In this case the incandescent lamp became virtually the furnace and its temperature was indirectly measured from point to point by matching its brightness with a comparison lamp of known behavior in regard to temperature and current. The results of the test go to show that in the case of a 115-volt carbon-filament lamp of 3.1 watts-per-candle specific consumption the power lost in conduction through supports was 2 per cent, the corresponding loss in luminous efficiency being 4 per cent. These are the smallest losses reported. On the other hand, the greatest losses were in a 110-volt tantalum lamp, which lost conductively 7 per cent in power and 13 per cent in luminous efficiency. The reason for the much greater conductive loss in the tantalum than in the carbon-filament lamp is attributable not only to the higher temperature, but also to the greater number of mechanical supports in the latter. At each point of support the filament is cooled by conduction. Midway between the carbon and tantalum lamps came the tungsten 110-volt lamps, which lost conductively 4 per cent in power and 7 per cent in luminous efficiency. The article points out that, although it may be necessary to support and anchor a metallic filament at several points, yet the expedient is expensive, both in power and in luminous efficiency. The anchors also add to the cost of construction of the lamp, so that while we are at present compelled to use them, it is very desirable to dispense with them.

Federal Suit Against Incandescent Lamp Companies.

The Attorney-General of the United States on March 3 brought suit through United States District Attorney W. L. Day in the United States Circuit Court for the Northern District of Ohio, at Cleveland, Ohio, against thirty-five electrical and other manufacturing companies on the charge of engaging in "unlawful contracts, combinations and conspiracies to restrain the trade and commerce among and between the several States and Territories of the United States in incandescent lamps and to monopolize the same." There have been well-defined rumors for some months of proposed federal prosecution of an alleged electrical trust, but these related more particularly to several of the larger electrical manufacturing companies, Chicago being named as the place where action would be begun; the filing of suit at Cleveland was, therefore, unexpected.

No official statements by the companies named in the suits have yet been made beyond a short one by the General Electric Company, which says that it has not yet been able to study the petition, adding that the other lamp companies named have been operating under licenses granted under patents of its ownership covering the manufacture of incandescent lamps.

Attorney-General Wickersham has issued the statement that "the defendants have already indicated a disposition to conform to the requirements of the government, and the department hopes that a dissolution of the company will be effected without prolonged litigation." Other actions relating to alleged similar electrical combinations have, it is said, been under preparation by the Department of Justice, and whether they will be brought into court depends upon the outcome of the Cleveland suit. The petition has simply been filed at Cleveland and no date set for the next step in the case, which probably will await action by the defendants. It is understood that the Cleveland case was prepared by Mr. W. S. Kenyon, assistant to the Attorney-General, and Mr. Wade H. Ellis.

The petition filed at Cleveland comprises forty-three typewritten sheets, the matter being equivalent to that contained in about eight of these pages. The following condensation includes the essential points of the petition except those of a purely formal legal nature.

COMPANIES CITED IN THE SUIT.

Of the companies named in the suit seven are not engaged directly in the manufacture of incandescent lamps, as follows: York Electric Machine Company and Dwyer Machine Company, which manufacture machinery for making lamps; the Corning Glass Works, Fostoria Bulb & Bottle Company, Libbey Glass Company and Phœnix Glass Company, which manufacture glass bulbs and tubing; and the Providence Gas Burner Company, which manufactures lamp bases. The remaining twenty-eight companies are as follows:

General Electric Co.,
Westinghouse Elec. & Mfg. Co.,
Westinghouse Lamp Co.,
National Electric Lamp Co.,
Ætna Electric Co.,
American Incand. Lamp Co.,
Banner Electric Co.,
Brilliant Electric Co.,
Bryan, Marsh Co.,
Buckeye Electric Co.,
Capital Electric Co.,
Colonial Electric Co.,
Columbia Incand. Lamp Co.,
Economy Electric Co.,
Fostoria Incand. Lamp Co.,
Franklin Elec. Mfg. Co.,
General Incand. Lamp Co.,
Independent Incand. Lamp Co.,
Kentucky Electrical Co.,
Liberty Elec. Mfg. Co.,
Munder Electric Co.,
New York & Ohio Co.,
Shelby Electric Co.,
Standard Elec. Mfg. Co.,
Sterling Elec. Mfg. Co.,
Sunbeam Incand. Lamp Co.,
Warren Elec. & Specialty Co.,
Gilmore Electric Co.

FORMAL CHARGES.

Below are given the specific charges of the suit as embodied in a prayer to the court asking for action by order, adjudgment and decree:

1. That the defendants are, and for some time past have been, engaged in such unlawful agreements, combinations and conspiracies to restrain the trade and commerce among the several State and Territories of the United States in incandescent electric lamps, and to monopolize the same; and the court is asked perpetually to enjoin and restrain them from doing any act in pursuance of or for the purpose of carrying out the same.

2. That the association of "Incandescent Lamp Manufacturers" of 1896 was unlawful and a combination and conspiracy in restraint of interstate trade and commerce in incandescent electric lamps, in violation of the act of July 2, 1890.

3. That the National Electric Lamp Company is itself an unlawful combination in restraint of interstate trade and commerce in incandescent electric lamps; that it is now attempting to monopolize, is in combination and conspiracy with others to monopolize, and has monopolized, parts of such trade and commerce in violation of the act of July 2, 1890; and the court is asked that the National Electric Lamp Company be restrained from voting the stock of or receiving any dividends from the various defendant companies and corporations unlawfully acquired and controlled by it, and from exercising any control whatsoever over them.

4. That the shares of the capital stock of each and every one of the defendant companies or corporations acquired by defendant National Electric Lamp Company were unlawfully acquired pursuant to said combination or conspiracy and are now unlawfully held; and it is asked that the issuing companies or corporations be enjoined from paying or permitting to be paid to the National Electric Lamp Company any dividends upon such stock.

5. That the shares of the capital stock of the defendant National Electric Lamp Company held by the defendant General Electric Company were unlawfully acquired and used by it and are now being unlawfully used by it: and it is asked that the General Electric Company be enjoined from further using or exercising the rights and powers incident to the shares so held by it as to bring about concert and co-operation between the National Electric Lamp Company and the other defendants or to obstruct trade and commerce in incandescent electric lamps or in such a way as to aid in the preservation of or attempt to secure a monopoly.

6. That the agreements between defendants General Electric Company, National Electric Lamp Company, Westinghouse Electric & Manufacturing Company and other defendants constitute and are contracts, combinations and conspiracies in restraint of trade and commerce in incandescent electric lamps, in violation of the provisions of said act of July 2, 1890; and it is prayed that the said defendants, parties to the said agreements, combinations and conspiracies, be enjoined perpetually from engaging therein, and from any like or similar agreements, combinations and conspiracies.

7. That the defendants General Electric Company and National Electric Lamp Company unlawfully, and in violation of the provisions of the said act of July 2, 1890, acquired and now hold the patents, applications and inventions covering the tantalum-filament and tungsten-filament incandescent electric lamps; that they were so acquired by said defendants for the purpose of suppressing all competition in the sale of such lamps in interstate commerce; that their acquisition by the defendants has resulted in restraining the trade and commerce among the several States and Territories of the United States in said incandescent electric lamps; and it is asked that they be restrained from exercising any such control over said patents, applications and inventions, or from so using the same as to suppress competition between said defendant companies and the other defendants, or others, or to obstruct trade and commerce in said incandescent electric lamps, or in such a way as to aid in the preservation of or attempt to secure a monopoly in the incandescent lamp trade.

8. That the contracts which the defendants General Electric Company, National Electric Lamp Company and its controlled companies have made and are now making with the dealers

and jobbers who buy from said defendants the tantalum-filament and tungsten-filament lamps, and are compelled to agree to buy all of their carbon-filament lamps from said defendants, are in restraint of interstate trade and commerce, and in violation of said act of July 2, 1890; and it is asked that the defendants be restrained and forbidden from enforcing or carrying out the provisions of said contracts, and from making with said dealers and jobbers or others any like or similar contracts, arrangements or agreements whereby the manufacture and sale of carbon-filament incandescent electric lamps in interstate commerce is restrained.

9. That the contracts which defendants General Electric Company, National Electric Lamp Company and its controlled companies have made and are now making with the defendants York Electric & Machine Company, Elmer F. Dwyer, doing business as Dwyer Machine Company, Corning Glass Works, the Fostoria Bulb & Bottle Company, the Libbey Glass Company, the Phœnix Glass Company and Providence Gas Burner Company were made for the purpose of furthering said unlawful combination, and with the effect of hindering and destroying the competition of independent lamp companies, and are contracts in restraint of interstate trade and commerce in violation of the aforesaid act of July 2, 1890; and it is prayed that the defendants be restrained and forbidden from so enforcing or so carrying out the provisions of said contracts as to obstruct trade and commerce in said incandescent electric lamps, or in such a way as to aid in the preservation of or attempt to secure a monopoly in the incandescent lamp trade.

The charges of the suit are elaborated in detail under a number of different heads. In a brief statement of the incandescent lamp business it is said that of the total number of lamps sold and used in the United States at the present time approximately 60 per cent are of the carbon-filament type. Approximately 80,000,000 incandescent lamps are manufactured, sold and used annually in the United States of an aggregate value of about $18,000,000; and of these the defendants control the manufacture and sale of over 97 per cent.

THE CARBON-FILAMENT LAMP.

Under this head the details are given of the alleged combination and conspiracy of the defendants to monopolize the manufacture and sale in interstate commerce of the carbon-filament lamp. The patent covering this lamp expired in 1894, and very shortly after, in August, 1896, some of the defendants of the suit effected a combination to control the manufacture and sale of the carbon lamp. On that date the General Electric Company, the Bryan-Marsh Company, the Buckeye Electric Company, the Columbia Incandescent Lamp Company and the Sunbeam Incandescent Lamp Company, together with the Adams-Bagnall Electric Company and the Perkins Electric Switch Manufacturing Company—which last two have since retired from the lamp busines—organized an unincorporated association known as the "Incandescent Lamp Manufacturers." The object of the association was, the petition states, to fix prices, to prescribe allotment of business and customers, and terms, rules and regulations for the sale of lamps of standard voltage and candle-power, except those manufactured and sold for the export trade.

The combination was made effective by means of fines imposed for violation of regulations and the requirement from each member of a large cash deposit, as a guarantee to abide by the requirements of the association. The agreement was for a term of three years and was from time to time extended until May 3, 1901, when another combination was formed. After its organization the following members joined the combination, between 1896 and Jan. 4, 1901: The New York & Ohio Company, the Davis Electrical Works, Aylesworth & Jackson, Bernstein Electric Company, Shelby Electric Company, Fostoria Incandescent Lamp Company, Colonial Electric Company, General Incandescent Lamp Company, Munder Electric Company and the Warren Electric Specialty Company. The Adams-Bagnall and the Perkins company, original members of the combination, and the Davis Electrical Works, Aylesworth & Jackson and the Bernstein Electric Company shortly after joining went out of the lamp business. The Shelby Electric Company, which joined Oct. 20, 1897, and the Bryan-Marsh Company, which joined Aug. 4, 1896, resigned shortly after joining, but rejoined the combination Jan. 4, 1901.

On Dec. 18, 1896, and from time to time thereafter, several members of the combination executed separate agreements with the Westinghouse Electric & Manufacturing Company whereby the latter agreed that its subsidiary company, the Sawyer-Man Electric Company (afterward succeeded by the Westinghouse Lamp Company), would maintain the prices fixed and established by the combination.

On Jan. 4, 1901, which was the last date on which any of the defendants joined the combination, there were still engaged in the manufacture of carbon filaments in competition with the companies operating in combination the Franklin Electric Manufacturing Company, the American Incandescent Lamp Company, the Kentucky Electric Company, the Standard Electric Manufacturing Company and the Sterling Electric & Manufacturing Company.

It is charged that on or about Jan. 4, 1901, the leading members of the combination not only determined to make it more permanent and enduring but so to extend it as to crush absolutely all competition then existing.

ORGANIZATION OF THE NATIONAL ELECTRIC LAMP COMPANY

To accomplish the end just referred to the National Electric Lamp Company was incorporated on May 3, 1901, as a holding company, to include all members of the then existing combination except the General Electric and Westinghouse companies, and as many more as possible of the independent companies then actually competing with each other and with the combination.

The capital stock at organization of the National Electric Lamp Company was $650,000, consisting of $500,000 common and $150,000 preferred stock, together with an authorized issue of $2,000,000 in bonds. The total amount of preferred stock was issued to the Fostoria Bulb & Bottle Company and the Fostoria Incandescent Lamp Company as part payment for all their stock, and $30,000 in cash. Of the common stock, $104,000 was issued to the same companies as part payment for their stock, and $30,000 in cash; $360,000 to the General Electric Company for payment of $120,000 in cash, and $20,000 to F. S. Terry as part payment for all the capital stock of the Sunbeam Incandescent Lamp Company. Only $1,314,000 of the total authorized issue of $2,000,000 of bonds was issued at the time of the organization, this amount being distributed as part payment for all the stock of the Fostoria Bulb & Bottle Company, the Fostoria Incandescent Lamp Company, the Bryan-Marsh Company, the Sunbeam Incandescent Lamp Company, the Buckeye Electric Company, Columbia Incandescent Lamp Company and the General Incandescent Lamp Company.

The control of the stock of the other companies in the combination, except the General Electric and Westinghouse companies, was later secured as follows: Warren Electric & Specialty Company, Oct. 1, 1902, the consideration being notes; the Columbia Electric Company, same date, consideration being notes; New York & Ohio Company, same date, consideration being cash and bonds; Shelby Electric Company, Dec. 1, 1903, consideration being notes; Munder Electric Company, Nov. 1, 1907, consideration being bonds. Control was acquired of other competing companies previously mentioned, except the Franklin Electric Manufacturing Company, the Kentucky Electric Company and the Gilmore Electric Company, as follows:

Economy Electric Company, Oct. 1, 1902, consideration being notes; Sterling Electric Manufacturing Company, Nov. 5, 1905, consideration, notes; Standard Electric Manufacturing Company, March 4, 1907, consideration, notes: American Incandescent Lamp Company of New York, April 1, 1909, consideration, cash

After the organization of the National Electric Lamp Company a number of active competitors to it came into existence as follows:

Brilliant Electric Company, Jan. 3, 1902; Capital Electric Company, Sept. 23, 1902; Independent Incandescent Electric Lamp Company, Dec. 9, 1902; Banner Electric Company, April 14, 1904; Liberty Electric Manufacturing Company, Dec. 9, 1907; Ætna Electric Company, July 3, 1908. These companies and the National Company obtained complete control of the Incandescent Lamp Company Oct. 20, 1905, consideration, cash; Brilliant Electric Company, Nov. 24, 1905, consideration, cash; Banner Electric Company, Jan. 1, 1907, consideration, cash.

From time to time the General Electric Company advanced cash to the National Company, and later, at the instance of the General Electric Company, the National Company from time to time issued to the General Electric Company bonds to liquidate such cash advances. For this purpose the bond issue of Aug. 22, 1905, was increased from $2,000,000 to $4,000,000. The officers of the National Electric Lamp Company did all in their power to induce the acceptance by the companies acquired of bonds and notes to as great an extent as possible, the General Electric Company advancing money only when absolutely necessary to accomplish the end in view.

On Dec. 14, 1908, the preferred stock of $150,000 was retired and the authorized issue of $500,000 common stock was increased to $2,500,000. Of the $2,000,000 increase $500,000 was issued Jan. 18, 1909, to stockholders of the National Company in proportion as they held capital stock in that company; and $1,500,000 was issued on the same day to the same stockholders as a stock dividend and as part of the then accrued profits of the company. On July 1, 1909, the authorized issue of capital stock was increased to $4,000,000, the $1,500,000 of increase then being issued to stockholders as a stock dividend and as part of the then accrued profits of the company. On March 11, 1910, the authorized issue of capital stock was increased to $5,000,000, the $1,000,000 increase being issued to the stockholders as a stock dividend and as part of the then accrued profits of the company. The National Company has paid cash dividends since its reorganization as follows: In 1904-5, $50,000; in 1908, $100,000; in 1909, $260,000; in 1910, $300,000. On Nov. 30, 1910, the National Company had an undivided profit of $1,439,158.93.

The General Electric Company owns 75.2 per cent and Messrs. B. G. Tremaine, H. A. Tremaine, J. B. Crouse, J. Robert Crouse and F. S. Terry, all officers of the National Company, own 24.8 per cent of the capital stock of the latter. The General Electric Company has throughout had an option on the stock issued to these holders, but has never held any of the stock of the company in its own name, and the National Company has been represented to be an independent company.

It is charged that the General Electric and the National Electric Lamp Companies entered into unlawful agreements with companies which the National Electric Lamp Company has failed to absorb, these agreements relating to the maintenance of prices on incandescent-filament lamps fixed and established by the General Electric and National Electric Lamp Companies and other controlled companies. The companies with which such agreements were made are: The Westinghouse Electric & Manufacturing Company; the Capital Electric Company (April 1, 1909), and the Kentucky Electric Company (Oct. 26, 1904); also, on April 1, 1909, with the Ætna Electric Company, Franklin Electric & Manufacturing Company and the Gilmore Electric Company.

This section of the petition concludes with the charge that the defendants in organizing the National Electric Lamp Company, and in making the unlawful agreements set forth, combined and conspired to perpetuate and extend the original combination of 1896, and to destroy all competition in the sale in interstate commerce of carbon-filament incandescent lamps, and have thereby combined and conspired to restrain trade and commerce in violation of the act of July 2, 1890.

THE TANTALUM AND TUNGSTEN LAMP.

A section of the petition sets forth the unlawful acquisition by the General Electric Company and the National Electric Lamp Company of the patents covering tantalum and tungsten filament and other filament lamps. It is related that on Feb. 10, 1906, and thereafter from time to time, contracts were entered into between the Siemens & Halske Company, of Germany, and the General Electric Company and National Lamp Company, whereby the latter two acquired the exclusive right to manufacture and sell throughout the United States and its dependencies the tantalum-filament lamp under the patents of the German company. The consideration was a cash payment of $250,000, 6 per cent being supplied by the General Electric Company and 40 per cent by the National Company; also a certain share of the profits on tantalum lamps sold by the defendants in the United States, all filaments for such lamps to be purchased of the Siemens company.

On Aug. 17, 1906, the General Electric Company made an agreement with the Auer Gesellschaft, of Berlin, Germany, whereby the former secured an option on the exclusive rights for the United States on tungsten-filament lamps under applications and inventions controlled by the said Auer company, the consideration being $100,000 in cash and a certain royalty per lamp manufactured and sold in the United States. The General Electric Company thereupon sold to the National Electric Lamp Company a 40 per cent underlying interest in said option. On April 19, 1909, the General Electric Company secured an option on the United States patent applications and inventions owned and controlled in the past and up to July 1, 1919, by the Bergmann Electricity Works and Mr. Sigmund Bergmann, of Berlin, Germany, relating to the manufacture of incandescent electric lamps and filaments of whatever character, together with the processes and machinery therefor and other products of the Bergmann Company or Mr. Bergmann's incandescent lamp factories. This option was exercised April 10, 1909, and a payment aggregating $170,000 made by the General Electric Company to the Bergmann Company, Mr. Bergmann agreeing to cease selling and delivering incandescent lamps in the United States and their possessions from and after May 10, 1909. At a later date the National Company purchased a four-tenths undivided interest in the rights under this contract.

The General Electric Company and the National Electric Lamp Company then proceeded to buy the patent applications and inventions for the Just-Hanaman and Kuzel lamps, paying on Aug. 15, 1909, for the former $250,000 and for the latter $240,000. These various patent applications and patents covering the tungsten-filament lamp are stated in the petition to comprise all valuable applications and inventions covering tungsten-filament lamps known by the defendants.

By this acquisition it is charged that the defendants succeeded in forestalling the possibility of any competition whatever in the manufacture and sale of the said lamps in interstate commerce until the expiration of the patents issued and to be issued covering the same, and have thereby succeeded in effecting their purpose in establishing a monopoly in the incandescent-lamp business of every character; and it is charged that the General Electric Company and the National Electric Lamp Company in acquiring in the manner aforesaid the said patents, applications and inventions combined and conspired to restrain trade and commerce in said lamps in the several States of the United States, and to monopolize the same in violation of the act of July 2, 1909. It is further charged that the General Electric Company and the National Company are unlawfully attempting to use such patents in such a way as to make it practically impossible for any competition hereafter to spring up and exist between the defendants and others in the manufacture and sale of carbon-filament incandescent lamps, the patent covering which has expired. To this end the defendants have caused the dealers and jobbers in incandescent lamps throughout the United States to enter into a contract with them and their controlled companies, wherein it is agreed that the tungsten and tantalum-filament lamps will be sold to dealers and jobbers, and the latter will purchase from the defendants for the controlled companies all of the carbon-filament lamps required to meet the demand of their trade. Inasmuch as the three types of lamps aforesaid are all competitive in form and use the said jobbers and dealers are compelled, in order to meet the demands of their trade, to have all three types of lamps, so that the natural result of these contracts is to compel dealers and jobbers to buy the carbon-filament lamps from the defendants, with the further result of making it practically impossible for any outside company to engage successfully in the manufacture and sale of carbon-filament lamps.

SECRET METHODS AND UNLAWFUL ACTS.

Under this head it is charged that the General Electric Company falsely represents itself to be a competitor of the National Electric Lamp Company and its controlled companies, although it was not only the chief factor in organizing and financing the National Electric Lamp Company, but since its organization has controlled that company through ownership of a large majority of its capital stock.

Unfair competition is charged through the sale of inferior lamps to customers of independent customers at greatly reduced prices, such lamps being sold under a special name; and also in the sale of lamps under false brands to customers of independent companies. It is stated that as early as 1897 the defendants formed a company known as the Royal Incandescent Lamp Company, which represented itself to be an independent company, but which in fact was nothing more than a selling agent, and instrumentally devised to sell for the defendants under the brand "Regal" their lamps at any price necessary to deprive the independent companies of their customers. It is charged that this scheme was carried out, and its expense borne by large contributions from time to time from the various defendants. Similar companies, it is asserted, were subsequently organized by the defendants having the same unlawful purpose.

It is also charged that unlawful contracts were made with the manufacturers of lamp machinery and for material from which lamps are made. Contracts were entered into with the York Electric Machine Company and the Dwyer Machine Company, by which the National Electric Lamp Company acquired all the inventions, patents, applications for patents, patterns, jigs and all machinery on hand of these companies, which were required to refrain from engaging in the business of making lamp-making machinery for sale to others than members of the combination. It is charged that in order to suppress and hamper the competition of independent companies, by placing them at a disadvantage in the purchase of material from which incandescent lamps were made, the defendants have from time to time entered into unlawful contracts with substantially the only manufacturers of bulbs and tubing in the United States, whereby the defendants agreed to buy their entire supply of bulbs and tubing from such companies in consideration of said companies selling bulbs and tubing to independent companies only at prices greatly in excess of those at which the defendants buy. As the defendants now do more than 97 per cent of the lamp business, the bulb companies are compelled to make and continue agreements made virtually upon the defendants' own terms, at great loss not only to the bulb companies, but to the independent lamp companies, who are thus compelled to pay excessive prices for said material and be placed at a wrongful and unfair disadvantage as competitors with the defendant lamp companies.

It is further charged that the defendants, in order to suppress and hamper competition of independent companies, have entered into unlawful contracts with the only lamp base manufacturer in the United States, by which the defendants buy all their bases from this company in consideration of the latter selling its bases to independent companies only at prices greatly in excess of those at which defendants buy. Such agreements are virtually made upon defendants' own terms with great loss not only to the defendant base company but to the independent lamp companies, which are thus compelled to pay excessive and unfair prices for material and be placed at a wrongful and unfair disadvantage as competitors with the defendant lamp companies.

EFFECT UPON THE PUBLIC OF UNLAWFUL COMBINATION.

In this section the subject of the price of lamps is considered. It is stated that while the carbon-filament incandescent lamp patents expired in 1894, and the public without doubt has been entitled to the benefits naturally derived from competition, it is absolutely at the mercy of the combination, which since the time of its original formation in 1896 has levied an unlawful tax for the use of such lamps upon the people of the United States. The price charged by the combination for the carbon lamp is 17 cents apiece, while at the same time such lamps are selling to-day in foreign countries for approximately 10 cents apiece. Furthermore, the combination by virtue of its acquisition of the patents covering tantalum and tungsten lamps has acquired the power to levy an additional tax upon the people of this country during the life of those patents and thereafter if the combination is not dissolved. It is charged that but for such unlawful combination there would now be active competition not only in the sale of carbon-filament lamps, but also in the sale of tantalum and tungsten lamps. All three of these lamps are naturally competitive with each other in form and use, and the public would derive the benefits which would naturally flow from such competition but for the unlawful combination existing.

As an illustration of the alleged unlawful tax now being levied, it is related that in May, 1908, of fourteen bids for supplying 340,000 lamps of various kinds for the United States Navy, thirteen were uniform and identical in amount, the bid of each being $50,631.23. These thirteen bidders were either direct or indirect parties to the combination at the time the bids were made, and the uniform prices which their bids disclosed were the prices fixed in advance of the combination. It is asserted that this system of fixing by combination among bidders prices which the government has been compelled to pay for incandescent lamps of various kinds has continued for many years and had its inception in the organization of the combination described in the petition.

The petition closes with a résumé of the charges made or implied in the several sections here abstracted and with the formal prayer given near the commencement of this article.

The Other Side of the Cleveland Case.

While not entirely unexpected, the lamp manufacturers cited in the Cleveland suit are naturally not prepared at short notice to make any statement as to their action in defending the charges brought against them. It is gathered, however, that the petition is considered in no small degree not so much an attack on the electric lamp manufacturers for the methods they have employed, but rather as a suit to determine the rights of owners of patents. It is pointed out that the right of the holder of a patent to establish the minimum price at which an article covered by that patent shall be sold has been repeatedly established by decisions of the United States courts. As to the carbon-filament lamp, it is observed that while the broad Edison patent covering the carbon-filament lamp expired in 1894, it has been impracticable to manufacture commercially a carbon-filament incandescent lamp of a standard of quality acceptable to the trade without infringing one or more other patents in force since that date.

Surprise is expressed at the implication that a manufacturer is debarred from purchasing patents which would enable him to improve an article which he is manufacturing. The purchase of the tungsten patents from the several foreign manufacturers, for example, was primarily for the purpose of obtaining the experience and processes of each one, and the knowledge gained from the work that was done by all, together with the experience of the American manufacturers in lamp manufacturing, enabled the American manufacturers to make a better tungsten-filament lamp than that made by any other manufacturers in the world.

Concerning the assumption that restrictions in competition result in an article of equal value being sold at a higher price, the fact is recalled that the absence of price competition may enable the manufacturers so to develop manufacturing methods and facilities as to result in an improved article, and thus give to the purchaser more in value for the same expenditure than would otherwise have been the case. This is claimed to be particularly true with respect to incandescent electric lamps. Willingness is expressed to afford every possible aid to the government in placing before the courts the true facts, while no effort will be made to evade the law when established.

Turin International Electrical Congress.

As previously noted in these columns, an International Congress of the Applications of Electricity will be held in Turin, Italy, from Sept. 9 to 20 of the present year, under the auspices of the Italian Electrotechnical Association and of the Italian national committee of the International Electrotechnical Commission. The congress will be held during the period of the Turin International Exhibition of Industry and Labor.

A committee of organization has been appointed to complete the plans for the congress. The president of the committee is Prof. L. Lombardi, of the Naples Polytechnic School, who was a delegate for Italy to the International Congress of St. Louis in 1904. The secretaries of the committee are Sig. Guido Semenza and Sig. C. A. Curti. Sig. Semenza has many friends in this country, which he visited some years ago, and is well known as the originator of the flexible transmission pole-line system. The organization committee includes in its membership several members of the council of the Italian Electrotechnical Association and of the Italian national committee of the International Electrotechnical Commission, the chairmen of the various national committees of the latter body, and the chairmen and directors of several important industrial associations. The executive committee includes the chairmen and several members of the Turin Section of the Italian Electrotechnical Association and representatives of the principal local manufacturing and other industrial companies. There is an honorary committee under the patronage of the Duke of the Abruzzi, which includes the Italian ministers of public construction, public works, agriculture and commerce, war, navy, posts and telegraphs, and also the principal local civil authorities, the rectors of universities and engineering colleges, presidents of the Academy of Science and other principal scientific and technical societies, president of the Italian Electrotechnical Association and the honorary secretary of the International Electrotechnical Commission. As will be seen below, the program of the congress has had given to it a decidedly international character. In connection with the congress will be held the first meeting of the standardization committee of the International Electrotechnical Commission, at which will be present delegates of the national electrotechnical committees representing the different countries which support the commission.

The subscription for membership to the congress has been fixed at 25 lire ($5), payable in advance. The membership carries with it the right to attend all meetings of the congress and of the various sections, to vote and receive a copy of the printed *Transactions*. On payment of an additional fee of 10 lire ($2) family connections of members may attend the congress without a vote and take part in all of the entertainments and visits of interest. Those desiring to contribute papers to the *Transactions* should communicate with the secretary of the committee. All papers must be forwarded not later than June 30. Papers may be written in French, English, German or Italian, and those not in the first-mentioned language should be accompanied by a summary in French. All papers will be printed in the *Transactions* of the congress in the original language, those in English, German and Italian being accompanied by a French translation or summary.

All communications to the congress should be addressed to the secretaries, 10 via San Paolo, Milan, to which address should also be forwarded any inquiries relating to the submission of papers. Following is a list of the official subjects that will be discussed at the congress:

1.—Electrical and mechanical characteristics of modern electric generators, with special reference to very high-speed machines. 2.—Present state of technical progress in the manufacture of stationary and traction storage batteries. 3.—On the simultaneous running of several generating plants, all feeding the same system of network. 4.—The selection of transmission and distributing pressure and design of switchboards and substations in large electrical installations, taking into account both economy in first cost and continuity of service. 5.—Underground high-tension networks in metallic connection with overhead lines. 6.—Present state of research with reference to abnormal rises in pressure, means of prevention and the protection of the system. 7.—Construction and use of automatic circuit-breakers. 8.—Methods of cooling transformers of moderate power. 9.—Converters, rectifiers and motor-generators. 10.—The problem of frequency transformation. 11.—Technical and economical influence on the lighting industry of the new metallic-filament and graphitized-carbon arc lamp. 12.—Three-phase, variable-speed motors, with special reference to rolling and paper mills. 13.—Single-phase versus three-phase traction on main lines. 14.—High-tension direct current versus single-phase traction on suburban lines. 15.—Overhead line construction for electric railways. 16.—Direct production of steel from ores by means of the electric furnace. 17.—Sterilization of water by processes employing electricity. 18.—Electricity meters with special reference to different kinds of loads. 19.—Government control of meters. 20.—Rational methods of commercial measurement of electric power. 21.—The problem of increasing the load-factor of central stations. 22.—Application of electricity to submarine boats. 23.—Long-distance wire telephony. 24.—Wireless telephony. 25.—Automatic telephone exchanges as a means of economy and improvement in telephonic communication in large cities. 26.—Secrecy in wireless telegraphy. 27.—Present and future development of electric heating. 28.—Comparative study of the direct and indirect methods of taxing electricity in different countries. 29.—Government regulations with reference to the electric transmission of power. 30.—Distribution of electric power for agricultural purposes. 31.—The various systems of multiple telegraphy.

A. I. E. E. Report on Bill for Licensing Engineers.

At the meeting of the executive committee of the American Institute of Electrical Engineers, held on Feb. 28, the following resolution was adopted:

"*Resolved,* That the executive committee of the American Institute of Electrical Engineers hereby approves the action of its special committee in reporting against the adoption by the New York Legislature of any bill or bills requiring the licensing of professional engineers in the State of New York."

At a hearing on the proposed bill, held at Albany, March 1, the following officers and members of the Institute were present: Messrs. D. C. Jackson, president; Frank J. Sprague and L. B. Stillwell, past-presidents; S. D. Sprong, manager and chairman of special committee on proposed legislation for licensing engineers, and Ralph W. Pope, secretary. There were also present several engineers representing other societies. In the course of the hearing it developed that the conception of the idea of a State license for engineers was due to a secret organization known as the "Technical League," which was represented at the hearing by counsel. Although the question was directly put, the name of neither the president, the secretary, nor any of the members was revealed. Mr. Boller, president of the American Institute of Consulting Engineers; Col. Meier, president of the American Society of Mechanical Engineers; Mr. Spilsbury, representing the American Institute of Mining Engineers, and Mr. Frank J. Sprague and Mr. L. B.

Stillwell, of the American Institute of Electrical Engineers, opposed the bill. About two hours were devoted to the hearing. The opposition was vigorous and weighty, but the bill may have political support which is not apparent on the surface. Another bill with a similar purpose, known as the McGrath bill, is in the hands of the committee on public education, which is entirely distinct from the committee on general laws, which conducted the hearing of March [illegible]. Chairman Shortt stated that he had made an unsuccessful attempt to bring about a joint hearing on the two bills. It is expected that a second hearing will be held on March 14. The opposition of the Institute is based on the fact that the passage of the bills would have a deadening effect upon the profession of electrical engineering and would prevent the healthy growth and development of the practical applications of electricity.

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Industrial Safety Association.

An organization to promote safety from accidents in factories and shops has been formed, called the Industrial Safety Association, with headquarters in the Engineering Societies Building, 29 West Thirty-ninth Street, New York City. As stated in the constitution, among the objects of the association are to "prevent accident to life, limb or body of persons engaged in productive industry, and in the occupations contributory thereto in which mechanical or other sources of power are employed," and "to promote the health and well-being of persons engaged in the wage-earning processes and other occupations of life by disseminating knowledge of sanitation and hygiene." These objects will be served by the association through the collection of knowledge on the subjects and its distribution among the members and the public generally by means of publications, lectures and other educational processes.

A collection of safety devices, models, photographs, etc., will be maintained on exhibition in the museums in New York and other places. The principal agency for carrying the ideas noted into practical effect is to be a monthly publication known as the *Journal of Industrial Safety,* which is to present designs of safety apparatus and do a general educational work in hygiene and sanitation for factories. The first issue of the *Journal,* dated February, has appeared, and in addition to a salutatory by the president of the association, contains descriptive articles on a number of safety attachments and devices. Following are the officers of the association: President, Prof. F. R. Hutton, formerly secretary of the American Society of Mechanical Engineers; vice-presidents, Messrs. T. Commerford Martin, Charles Kirchhoff and Henry R. Towne; managers, Messrs. Philip T. Dodge, Frank E. Law, Arthur Williams and Ira H. Woolsen; treasurer, Mr. Robert A. Franks, president of the Home Trust Company.

The annual membership fee is $10, and the income of the association, aside from that necessary to carry on its routine work, will be devoted to the issue of safety manuals in various industries and the upbuilding of a museum of safety in New York City. The standardization of design for safety attachments to machines will be a function of committee work of the association.

Among the prominent members of the body are Mr. Andrew Carnegie, Mr. Henry R. Towne, president of the Merchants' Association in New York; Col. E. D. Meier, president of the American Society of Mechanical Engineers; Mr. Philip T. Dodge, past-president of the American Society of Mechanical Engineers; Mr. Frank E. Law, vice-president of the Fidelity & Casualty Company; Mr. Robert A. Franks, financial agent of Mr. Andrew Carnegie; Dr. Alexander C. Humphreys, president of Stevens Institute; Mr. E. A. Stephens, Hoboken; and Mr. David Williams, formerly publisher of the *Iron Age;* and among electrical men, Messrs. Arthur Williams, L. B. Stillwell, T. C. Martin, the Commonwealth Edison Company of Chicago, and Herr Hirschberg, director of the Allgemeine Elektricitäts-Gesellschaft, of Berlin.

Boston Electric Vehicle Campaign.

As announced in these columns last week, the Edison Electric Illuminating Company of Boston has made ready for a campaign in the interest of the electric vehicle which, in breadth and expenditure involved, is the most important work of the kind yet undertaken by a central station in this country. The campaign was formally inaugurated on Friday evening, March 3 at a banquet held at the Hotel Thorndike, President Charles L. Edgar, of the Boston Edison company, presiding, at which full details were made public. Almost 100 guests of the Boston Edison company were present, including local and other representatives of practically every electric vehicle manufacturing company in the country, together with representatives of electric manufacturing and storage battery companies and of the electrical press. Among others present were Mr. W. H. Blood, Jr., president of the Electric Vehicle Association of America; Mr. Louis A. Ferguson, vice-president of the Commonwealth Edison Company, Chicago, and Prof. D. C. Jackson, of the Massachusetts Institute of Technology.

The details of the work undertaken were outlined by Mr. E. S. Mansfield, of the Boston Edison company, and by President Edgar in his opening remarks and in introducing the various speakers of the evening. A strong appeal for co-operation was made to the manufacturers of electric vehicles, and there is every promise that this will be secured in Boston, and from there will extend to other cities and over the country generally, thus removing one obstacle which in the past has retarded the exploitation of the electric vehicle under the auspices of the central station.

The Boston Edison company has already placed orders for thirty-four electrical vehicles of various kinds and has announced that, as soon as practicable, all the horse vehicles used by the company and a small number of gasoline vehicles it now has will be displaced by electrics. At present there are not far from 150 horses in use. Arrangements have been completed for an extensive and systematic advertising campaign, which was inaugurated on Saturday, when all the daily newspapers printed an advertisement on the subject almost a full page in size, a reproduction of which is given elsewhere.

A staff has been organized to represent to merchants and manufacturers the advantages of electric vehicles, and an inspection staff will be organized which will be at the service of the users of vehicles. A public garage has been opened at 474 Atlantic Avenue where cars may be stored and will be charged at a flat rate. This rate will include also the care of vehicles and their maintenance in serviceable condition except in the case of extensive repairs. The service of the garage will be under the supervision of the Electric Vehicle Association of America, which will see that an efficient service is given. It is not the intention of the Boston Edison company to conduct this garage indefinitely, but to dispose of it after being well established to private interests if it is thought that this will be to the advantage of those interested in the success of the electric vehicle. The company will also co-operate with others in the establishment of similar garages throughout Boston and the suburban territory. Every endeavor will be made to secure the close co-operation of the electrical vehicle manufacturers and their representatives. To this end regular conferences will be held for exchange of ideas between these and members of the staff of the Edison company. The latter company also will aid in securing competent representatives in Boston of electrical vehicle companies not having any office there at present.

A very complete system for recording operative data will at once be put into effect and will be applied to all electric vehicles operated by the company. In addition special investigations will be made of the cost of operating various types of vehicles. An arrangement is under consideration by the Massachusetts Institute of Technology whereby research work relating to technical points connected with electric vehicles will be made in its laboratories, and tests of vehicles conducted at the factories or elsewhere. During the evening President Edgar announced that his company will appropriate $2,000 a year for three years for the expense of this work.

Mr. William H. Blood, Jr., president of the Electric Vehicle Association of America, was called upon by President Edgar, and in the course of his remarks gave some observations made during a recent trip as to the ruggedness of the electric vehicle. He found many electric vehicles in Keokuk, Ia., which has perhaps the steepest grades of any city in this country. In the southern part of Illinois and Missouri the electric vehicle was successfully operated in sections where during certain periods of the year the roads were almost impassable for horse vehicles, while in the vicinity of Savannah 6 in. of sand in the roads did not discourage the users of electric vehicles. One of the problems, he said, which the electric vehicles had to face was that of proper garages, and he thought that the plan devised by the Boston Edison company would furnish a solution for this. The question of rates for charging had in many cases been a serious one, but he considered that this matter was being successfully met. In most cases, even now, it is not necessary to make a special rate for vehicle charging, as the power rates of most of the large central stations are quite low, ranging from 5 cents per kw-hour downward. Some Eastern cities, like Boston, are seriously handicapped by the street traffic regulations, which, on account of the narrow streets, do not allow owners to leave their cars standing at the curb. This disadvantage does not apply in Western cities, and possibly some arrangement may be made in Eastern cities whereby automobiles may be left by their owners at certain designated stands.

Mr. Blood spoke of the extreme desirability of closer co-operation than in the past between central stations and electric vehicle manufacturers. As an illustration of the present lack of such co-operation he referred to a recent case in which a central station had written to him asking for aid in the purchase of three electric vehicles, the inquirer having not even received an acknowledgment of letters sent to manufacturers stating that he was in the market for vehicles. In another case one of the largest central stations in the country telegraphed him that they wished to expend $15,000 for electric vehicles, but had been unable to secure attention from manufacturers.

Mr. Louis Ferguson, vice-president of the Commonwealth Edison Company of Chicago, spoke enthusiastically of the future of the electric truck. A recent investigation which had been made in Chicago in the case of both users of gasoline and electric trucks showed conclusively, he said, that the latter are the more economical. He compared the fields of the two types of vehicles with high tension for transmission and low tension for distribution—the gasoline truck being adapted for long hauls at high speed, while the electric truck is ideal for short hauls at lower speed. He directed attention to the great profit that there should be to central stations in electric vehicle service. The experience in Chicago had shown that the average income from a 1-ton truck is five times greater than that from the average electrically lighted city apartment, while the income from a larger truck was comparable with that from an important lighting installation. As to the question of rates, he considered that this was not one of any magnitude in the larger cities, where the power rate is found quite satisfactory by electric vehicle users, who made no demand for a special vehicle rate.

Prof. D. C. Jackson, of the Massachusetts Institute of Technology, referred to the desirability of standardization in the electric vehicle industry and of the same co-operation among scientific men, engineers and manufacturers which had been such a powerful aid in the development of the electrical industry at large. The present superb condition of that industry was, he said, in no small part to be ascribed to the close co-operation on the part of every element engaged in it. He thought that the time had arrived when more systematic attention should be given to the application of the principles underlying the correct design and operation of electric vehicles. He pledged his own aid and that of the Massachusetts Institute of Technology in assisting in research work and investigation in the factory and garage that would tend to advance the art and secure standardization where this was an important factor in success.

Among others who addressed the meeting were Mr. Herbert Lloyd, president of the Electric Storage Battery Company; Mr. Frank L. Dyer, president of the Edison Storage Battery Company; Mr. Robert McA. Lloyd, vice-president of the General Vehicle Company; Mr. Hugh M. Wilson, of the *Electrical World*, and Mr. Charles W. Price, of the *Electrical Review*.

A. I. E. E. Reception.

Everyone who attended the reception and ball held by the American Institute of Electrical Engineers at the Hotel Astor, New York City, on Feb. 28 voted the affair a complete success and much more enjoyable than the dinners which the Institute has held annually for some time past. Abundant opportunity was afforded for the members and guests to renew old acquaintances and form new ones.

The major portion of the evening was devoted to dancing, the program for which called for twenty-four numbers. Early in the evening the dancing was interrupted for a time to permit of the formal presentation of badges to the past-presidents, which was the most prominent feature of the function. President D. C. Jackson, who made the speech of presentation, outlined briefly the history of the Institute by decades and mentioned the predominating characteristics of each of his predecessors. The speech of acceptance was made by Mr. T. Commerford Martin, the senior living past-president, who acknowledged the great honor bestowed upon each one selected for the presidency and expressed the loyalty of the past-presidents to the Institute. In addition to Mr. Martin there were present Messrs. Frank J. Sprague, Louis Duncan, Carl Hering, Charles P. Steinmetz, Bion J. Arnold, John W. Lieb, Jr., Schuyler S. Wheeler, Samuel Sheldon, Henry G. Stott and Lewis B. Stillwell. Letters of regret at their enforced absence were received from others, the list of other living past-presidents including Messrs. Edward Weston, Elihu Thomson, Alexander Graham Bell, Edwin J. Houston, Francis B. Crocker, A. E. Kennelly, Charles F. Scott and Louis A. Furguson. The badge is similar in general design and proportion to the badges of the associates and members of the Institute, but differs therefrom in size and color. It occupies about one-fourth the area of the other badges and consists of gold letters on a background of white instead of maroon for associates and dark blue for members.

A. I. E. E. Meetings.

The monthly meeting of the American Institute of Electrical Engineers, which will be held in the Engineering Societies Building, New York, on March 10, will be devoted to the industrial application of electric motors. Mr. John C. Parker, of the Rochester Railway & Light Company, will present a paper containing comments on the fixed cost of industrial generating stations, while the cost of industrial-motor service will be discussed in a paper by Mr. A. E. Hibner.

A section meeting of the Institute will be held in Toronto on March 10, when the papers presented at the New York meeting on the same date will be abstracted and discussed. A local meeting of the Institute will be held in Toronto on April

7. At this meeting a paper will be presented by Mr. W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad Company, entitled "Analysis of Electrification and Its Practical Application to Trunk Lines for Freight and Passenger Operation."

A new section of the Institute has been formed at Detroit and Ann Arbor, to be known as the Detroit-Ann Arbor Section. Prof. C. L. de Muralt has been elected chairman of this section and Prof. Benjamin F. Bailey secretary-treasurer.

Proposed Changes in National Electrical Code.

The electrical committee of the Underwriters' National Electric Association will meet in the rooms of the New York Board of Fire Underwriters, 123 William Street, New York City, on March 22 and 23, for the purpose of considering committee reports, proposed changes in rules and miscellaneous suggestions bearing on the code. It has always been the aim of the electrical committee to make only such changes as are made necessary by progress in the art or such as have been shown by some field experience to be necessary to safeguard against hazard. The longest report to be brought up for consideration is that of the committee on theater wiring. Much of the report is written around the existing rules, which have been modified slightly in places. The clause defining a theater to be a place capable of seating at least 400 persons has been eliminated for the reason that there are thousands of moving-picture theaters holding less than half that number. The fine-print notes calling attention to the fact that many of the stipulations are solely a matter concerning the protection of the person and should therefore be left to the discretion of the assured have also been eliminated. The number of receptacles in borders and proscenium sidelights has been limited to twenty-four in addition to the limit of 1320 watts to one cutout. The rating of stage and gallery pockets has been cut down from 50 amp to 35 amp for arc lamps and 15 amp for incandescent lamps, and different plugs must be employed.

A set of rules has been formulated governing the installation of low-voltage transformers used in connection with low-voltage lamps. Where the voltage does not exceed 27.5 the installation of fifty receptacles for a two-wire sign lighting circuit is permitted provided the rated capacity of the wire is not exceeded. For interior lighting 6 amp and twelve sockets are the limits set for fixture work with flexible cords; but where No. 14 wire is carried directly to sockets and no flexible cords are likely to be attached the limits are 12 amp and twenty-four receptacles. The total watt input for any one transformer must not exceed 2000 watts and the primary leads must be fused for not over the full-load current. The committee on cabinets suggests making the present second, third and fourth fine-print notes following No. 54-a mandatory. Two rules are added and others are modified slightly.

Rule 1-d, on the installation of protective devices on three-wire direct-current generators, has been changed to read as follows: "Protection for three-wire direct-current generators must consist of a safety device placed in each armature direct-current lead; or a double-pole, double-trip circuit-breaker placed in each outside generator lead and corresponding equalizer connection; or a triple-pole, triple-coil circuit-breaker connected so as to protect the neutral, and the current and equalizer leads on one side of the machine; circuit-breaker to be so designed that any one of the three actuating coils will completely disconnect the three poles of circuit-breaker."

In addition, committees on fixtures and fixture wiring, autostarters, wiring and fusing of induction motors, switches and cut-outs, fitting and materials, wireless telegraph apparatus, laboratory, and Rule 14-b, have recommended changes of more or less importance. The suggested changes other than those made by committees are quite numerous and have to do with installation rules chiefly. These will be considered by the electrical committee at a preliminary meeting, and when brought before the general meeting the recommendation of the committee will be given.

The meetings begin at 10 in the morning and all interested in the installation, manufacture and inspection of electrical equipment, etc., are welcome.

Organization of a N. E. L. A. Section of Pittsburgh.

A banquet to the employees of the Allegheny County Light Company was given by the officers at the Hotel Duquesne, Pittsburgh, at 6:30 p. m. Tuesday, Feb. 28. The total number of employees of this company is 615, and 150 of these employees accepted the invitation.

A section of the National Electric Light Association was formed, to be known as the Allegheny County Light Section, and approximately 150 of the employees joined the section. Prior to this time about thirty-five of the employees were already Class B members and therefore the section started with 185.

Mr. H. N. Müller, superintendent of distribution of the Allegheny County Light Company, acted as temporary chairman; Mr. W. H. Donkin, general contracting agent of the same company, acted as temporary secretary, and Mr. James M. Graves as temporary treasurer.

Mr. H. H. Scott, chairman of the membership committee of the N. E. L. A., gave a history of the organization, telling of its growth and the objects for which the association was striving.

Mr. A. R. Granger, of Chester, Pa., president of the Pennsylvania Electrical Association, followed Mr. Scott and told of the work the company sections were doing, particularly the Philadelphia Section, and also dwelt on the work of the Pennsylvania association.

Mr. R. S. Orr, general superintendent of the Allegheny County Light Company, Mr. W. A. Donkin and Mr. F. Uhlenhaut also spoke briefly and pledged their best efforts to make this section a success.

Phenomenal Day Peak on New York Edison System Due to Snowstorm.

The Weather Bureau's forecast for March 2 for eastern New York and New England was "fair, except probably snow flurries in extreme north portion," while the local forecaster intimated that the weather in New York City would be fair with brisk west winds. As a matter of fact, the predictions in the main were not amiss, and the wind was northwest from nine in the morning until two, when it shifted to west and blew from that direction until late in the afternoon. There were no lowering clouds on the horizon, nor were there any indications of an atmospheric disturbance. About 3:40, however, the system operator of the New York Edison Company, scanning the heavens, discerned what to his practised eye indicated an approaching storm. As was his wont under the conditions, he signaled to have a certain number of boilers and engines got under way in anticipation of the increased load.

With most remarkable rapidity and fury the storm broke over the lower portion of Manhattan and within the next few minutes darkness set in accompanied by a heavy fall of snow. The signal whistle in Waterside Station No. 1 shrieked out its orders, and whereas a few minutes' time is usually allowed for turning over the engines, the signals were to throw in five 4000-kw reciprocating units and one 7000-kw turbine unit immediately. Over in Waterside No. 2, where all of the large steam turbines were a few minutes before comfortably loaded, every unit was overloaded. The substation operators all over the city in endeavoring to keep up the voltage picked up every feeder available and in many cases were ordered by telephone to throw in the batteries. The Duane Street substation, in addition to the rotary converters and battery, started up a reserve 3500-kw steam unit to tide over the peak.

The load on the system piled up with most astonishing rapidity. At 3:45, when the first reserve units were thrown in, the total load was 74,500 kw. The other units went in at intervals of a minute, but the system absorbed the energy as fast as it was generated. Within five minutes after the storm broke and while it was still at its height the total load on the system had leaped to 124,500 kw. In other words, the peak piled up at the rate of 10,000 kw a minute for five minutes and then stopped. In less than half an hour after this 40,000 kw had been dropped, and at 5:30, just before the evening load came on, the total load was 82,000 kw. The evening peak was fully 20,000 kw less than the peak thrown on the station by the storm of a few minutes.

The extra load (50,000 kw) caused by the suddenness and blackness of the storm was the largest ever thrown on the system in so short a time and under such circumstances, and the ease and certainty with which it was met speaks well for the efficacy and management of the New York Edison system. The company is at present rebuilding Waterside Station No. 1, replacing the 4000-kw reciprocating units by 20,000-kw turbines. Waterside Station No. 2, therefore, has every turbine in operation carrying the day load and the reciprocating units in the older station are merely used during the peak. With large turbines available it is not so difficult to take up 50,000 kw in five minutes, but with reciprocating engines of the size mentioned it is a remarkable feat.

Electrical Contractors Entertained by Brooklyn Edison Company.

The annual dinner extended to the electrical contractors of Brooklyn by the Edison Electric Illuminating Company of Brooklyn was held in the Montauk Club, that borough, on Feb. 25. The large banquet-room of the club was none too spacious for the 200 or more guests of the company and a spirit of harmony and good will was everywhere apparent. After partaking of an elaborate menu, rendered more appetizing by a number of popular songs interspersed between courses and in the singing of which all joined, speechmaking was in order. Mr. T. I. Jones, the company's general sales agent, acted as toastmaster. Mr. Jones reviewed the past and present relations of the Edison company with the electrical contractors and voiced the desire of the company for close and harmonious dealings between the two. The company welcomed complaints and promised to go over any grievance with the contractors themselves looking to an amicable settlement of any differences which might exist.

Mr. W. W. Freeman, vice-president and general manager of the company, then addressed the contractors and, reiterating what had previously been said about the company's desire for close co-operation with the contractors, suggested that the old idea of electricity being a luxury be dispelled and in its stead the idea of electricity as a modern indispensable be substituted. Continuing in this vein, he said that if this idea could be rooted in the minds of owners of the unwired houses of the city it would not be long before they would enjoy the comforts of electricity as well as those who owned more modern houses. Incidentally, he pointed out that the business thus obtainable would represent $7,500,000 to the Brooklyn contractors and $2,000,000 to the Brooklyn Edison Company. The amount involved was, he felt, sufficient to warrant the united and best efforts of both the company and the contractors.

Mr. E. J. H. Thiemer, president of the Kilowatt Club, spoke on the electrical contractor and was followed by Mr. J. C. Forsythe, chief inspector of the New York Board of Fire Underwriters, whose topic was "The Fire Underwriters." Mr. Forsythe pointed out that in New York at least no extra premium is charged the owner of a dwelling because of the extra hazard due to the presence of electric wires. He deprecated any movement of the Underwriters to withdraw their supervision of electric installations and to protect themselves by means of an extra charge, although he intimated that such a course had often been thought of. Mr. C. W. Price, of the *Electrical Review,* in a short speech prophesied that soon the coal pile in the cellar, the furnace and the ash man would be relics of the past and that electrically stored heat would come into vogue. He said that experiments with this end in view are now being made. The last speaker of the evening was Mr. Andrew McLean, editor of the *Brooklyn Citizen,* who, after a reminiscent speech, dwelt on the future of Brooklyn. His address was a rousing and an inspiring one and was well received.

Boston Automobile Show Opens.

The Boston Automobile Show of 1911 was opened in the Mechanics' Building, on Huntington Avenue, on the evening of March 4 and will continue throughout the present week. As in former years, the show is under the auspices of the Boston Automobile Dealers' Association and under the management of Secretary Chester I. Campbell, of that organization. At the opening on Saturday evening many thousands of invited guests viewed the exhibition, which is the largest motor-vehicle display ever made in the city, occupying literally every square foot of area available in the halls, corridors, basement and galleries of the building and requiring overflow space in Horticultural Hall. The electrical decorations are unusually beautiful, the focus of attention being the main hall. In former years the decorations have sometimes been so substantial as somewhat to obstruct the larger views, but this year lightness of ornamentation has been secured without sacrifice of artistic attractiveness. The chief decorative features of the main hall are rows of fluted columns, those in the center being surmounted by gold eagles and those at the sides being surmounted by baskets of greenery and entwined with electrically illuminated artificial flowers. Festoons of frosted-lamp bulbs are liberally used. Baskets of these flowers also depend from the roof, which is concealed by a blue canopy. The balcony fronts are of marbleized material draped with greenery and flowers; the floor covering is of a light shade, and red tints are used on the side walls with effectiveness. In the smaller exhibition spaces in other parts of the building a large use has been made of electrically illuminated flowers, including well-disposed maidenhair fern, and along the walls are many paintings of motoring scenes in this country and Europe.

About 400 exhibitors are showing their products, which include all the principal pleasure and commercial gasoline, steam and electric vehicles, and the widest range of accessories. A special feature of the show is the extent to which small motors are employed to operate automobile mechanisms, both in the open and under glass. Many motor-driven frames are in use in connection with the demonstration of auxiliary apparatus, and even electric heating has been pressed into service to produce artificial adverse conditions in the testing of speedometer calibration. A great increase in the side, tail and head-lighting of cars by tungsten lamps is noticeable, and many exhibits disclose a tendency to improve the sparking equipment of the automobile by the more thorough study of magneto and coil design. Special emphasis is given at the show to the recent opening of an electric vehicle campaign by the Edison Electric Illuminating Company of Boston, with provision for the widest publicity of the company's aims in this direction. The principal makers of electric trucks and pleasure vehicles are showing their 1911 models under conditions certain to arouse a larger popular interest in what has been accomplished in electric vehicle service in Boston, and particularly in other cities where extensive applications of this type of car and truck are constantly demonstrating the flexibility, safety and efficiency of the service given by electricity. Special attention has in some instances been given to the improved lighting of electric motor-truck exhibits, so that the adaptability, finish and mechanical perfection of these machines can be more quickly appreciated. Another point particularly emphasized in this show is the separate classification of electric vehicles in the bulletin-directory of exhibitors and in the prominent location given to some of the most noted makes of electric pleasure vehicles. The public is also being more fully acquainted with the number and location of electric charging stations in the eastern Massachusetts field, and there is evidence that before the show closes the gospel of electricity will be effectively brought home to many who have formerly failed to recognize that the gasoline-vehicle field has certain limitations which electricity alone can overcome. In spite of the short interval of time which has elapsed since the automobile shows in New York and Philadelphia a number of new developments in apparatus are displayed for the first time at Boston, and those of electrical interest are mentioned elsewhere in this issue.

A. I. E. E. High-Tension Papers.

During the Pittsfield-Schenectady mid-year convention of the American Institute of Electrical Engineers, held on Feb. 14, 15 and 16, one of the technical sessions was devoted exclusively to the presentation and discussion of papers relating to high-tension transmission problems. The four papers read were written by Messrs. J. H. Cunningham, E. E. F. Creighton, G. Faccioli, and E. I. Buckholder and R. H. Marvin.

Mr. J. Cunningham described the design, construction and test of an artificial transmission line built in the laboratory of Union College, Schenectady. The line consists of 400 glass tubes, each 6 in. in diameter, 1/8 in. thick, 4.5 ft. long, wound with 240 turns of No. 8 copper wire. The tube is lined with tinfoil to provide the requisite capacity. The complete line capacity is 1.135 microfarads; inductance, 0.3944 henry, and resistance, 936 ohms. It has a natural vibratory period of 360 cycles per second and an equivalent length of 130 miles; its resistance causes it to correspond to a 130-mile line of conductor between No. 1 and No. 2 copper wire.

The object in building the line was to investigate and study the various transient and other phenomena in connection with switching, sudden change of load, etc. The paper contains a number of oscillograms taken during such tests.

In his paper entitled "Protection of Electrical Transmission Lines" Professor Creighton described a device developed for suppressing the arc found between an ungrounded transmission line and the ground. When such an arc is formed by lightning or otherwise it persists indefinitely unless special means are taken to suppress it. The suppressor is a device which automatically connects to the ground any conductor between which and the ground an arc may be formed. It consists merely of a three-point switch, one point of which is automatically closed when the voltage between one conductor and ground on a three-phase system becomes considerably lower than that between either of the other two conductors and ground. It is operated by either an electrostatic or electromagnetic selective relay. Interlocks are used between the three independent single-phase switches to prevent two switches from being closed simultaneously and thereby causing a short-circuit. In case a second arc is formed after the single-phase switch is closed and then opened, the switch is automatically closed again and locked shut until opened by hand.

In addition to describing the arcing-ground suppressor the author reported the results of observations made upon the suppressor in service by means of oscillographs. He stated that a collection of a considerable amount of data shows conclusively, on analysis, that the greatest number of interruptions in lightning-infested localities are due directly and indirectly to the single-arcing ground around an insulator, or in cable systems to a single puncture from one phase to the cable sheath. The arcing-ground suppressor, backed up by aluminum arresters, will prevent interruption of service and damage to apparatus in the majority of these cases. This improvement should in general bring the service above the existing standards or requirements.

The paper by Messrs. Burkholder and Marvin contained a report of tests made upon the type of arcing-ground suppressor described by Professor Creighton as used on the 44,000-volt system of the Southern Power Company. The tests were made to determine the time required for the operation of the relay and the various operations of the switch; the total time an arc would exist over an insulator; the time required to extinguish the arc after the switch had closed; the current to ground through the arc over an insulator; the current to ground through the grounding switch, and to ascertain whether the arc could be extinguished soon enough to prevent breaking or injuring the insulator.

Observations which were made by means of oscillographs showed that the current in both the arc and the grounding switch depends upon the extent of the lines on the system. This result was expected, as these currents are flowing into a capacity, this capacity being proportional to the length of the lines.

The arc was extinguished in a time not exceeding one-half second from the time of starting.

The insulator was uninjured, thereby showing that even the very heavy arcs produced when the entire system is on will not injure the insulator when extinguished in one-half second.

When the arc was extinguished in such a short time there was no disturbance on the lines or interruption of service either from the arc or the operation of the grounding switch.

Mr. Faccioli presented a paper in which were described tests made on the 100,000-volt system of the Central Colorado Power Company. The measurements were made at the generating station at Shoshone, the observations being made on the primary side of the transformers. From the measured total loss the corona and insulator losses were determined by subtracting the known value of transformer loss at each value of voltage.

The following table gives an idea of the relative importance of the transformer losses and line losses as observed on the 153-mile line between Shoshone and Denver:

Kilovolts at Shoshone.	Transformer Losses. Kilowatts	Corona and Insulator Losses Kilowatts.
80	24	109
90	36	341
95	43	598
100	52	1003
105	64	1623

It was found that the corona and insulator losses over the 63.5-mile section between Shoshone and Leadville were much less than proportional to the reduction in the length of line. Thus at 80 kv, 90 kv and 100 kv the losses were only 10.6 kw, 37.9 kw and 152.0 kw respectively. The author attributed the enormous increase in the loss throughout the longer line to the fact that the e.m.f. at the distant end was much higher than that at the station end, while the measurements were made at only the station end.

An analysis of the variation in loss with change in voltage showed that with a fair degree of accuracy the loss may be said to vary directly as the square of the excess voltage above a certain critical value. The tests covered a range of atmospheric conditions from 24.1 in. to 24.7 in. barometric pressure and from 21 per cent to 35 per cent humidity. There was no observable influence of the so-called "vapor-product" on the line losses.

Discussion.

The discussion was opened by Mr. R. D. Mershon, who expressed some doubt as to the probability of the law of corona loss at e.m.fs. above a certain value varying with the square of the excess e.m.f., as suggested by Mr. Faccioli. He expressed the opinion that when the e.m.f. exceeds a certain value loss is produced during the peak of the wave and should bear a certain definite relation to the excess of the peak above a certain value. Thus the excess loss would not vary with the square of the excess voltage, but as a more complicated function thereof. He stated that until the test data obtained by him some years ago at Niagara Falls had been modified by taking into consideration the so-called "vapor-product" unaccountable discrepancies were found in the results. However, when the vapor-product was properly considered the results were thoroughly consistent, even when obtained under extremes of atmospheric conditions.

Mr. L. C. Nicholson described a form of device employed by the Niagara, Lockport & Ontario Power Company for short-circuiting a line to ground when an arc forms between this line and the ground across an insulator. Use is made of an inclosed fuse about 6 ft. long, composed of No. 16 copper wire, which is placed in circuit whenever an arc forms across an insulation. The action of the fuse is to reduce the potential across the insulator until the arc disappears, after which the arc across the fuse extinguishes itself. Since this device has been used the number of insulator breakages has been reduced to about 2 per cent of the former number.

Mr. T. Reed called attention to the convenience and adaptability of the oscillograph in making high-tension tests, as shown more particularly by the results reported by Mr. Faccioli. As developed at the present time the oscillograph can no longer be looked upon merely as a laboratory instrument, since it can be transported to systems in actual service and employed under any conditions to show the performance in actual use.

Mr. F. W. Peek, Jr., called attention to the fact that although the amount of moisture in the atmosphere may have little effect upon the corona losses on a high-tension transmission line, yet the losses are enormously affected during actual storms, and this fact cannot be ignored in considering the total losses.

Central-Station Rates Discussed at Boston.

At a recent legislative hearing in Boston before the committee on public lighting various aspects of the central-station rate problem were discussed by Mr. Everett W. Burdett, counsel for the Boston Edison company, in connection with House Bill 1131, which provides that all electricity furnished to any customer except a municipality shall be separately metered and charged per kw-hour at a single uniform rate for heat or motors and at another single uniform rate for lighting to all customers without regard to the quantities furnished them respectively. The advocates of the bill claimed that large differences exist in the kw-hour rate which consumers in Boston pay for electricity, contrasting the low unit charges which large establishments obtain with the higher kw-rates resulting from the consumption of electricity under the conditions prevailing in smaller organizations. It was contended that if a reduction of 3 cents or 4 cents should be made in the maximum net price for electricity the company could still maintain the present rate of dividends.

Mr. Burdett pointed out that the bill is an attack upon a system of doing business which is well-nigh universal in the central-station field. He stated that there are no preferences whatever shown among the customers of the Boston Edison company. At the time of the consolidation of the Edison company with the Boston Electric Light Company, in 1902, there were in existence over 2500 special contracts in Boston, and to-day, after nine years of competition, there are less than twenty-five special contracts in existence. Under competition the companies were forced to give discriminatory rates or lose business. Since the consolidation not a single special contract has been renewed or made.

Taking up the differential system of rates, Mr. Burdett agreed that it is complex and difficult to understand, but said that it is much less of a problem than the differential system of the railroads. The rates of the Edison company are made up by experts who study every question in connection with them, and whose only object and hope is to arrive at a figure which can be applied in all cases of a similar character. The prices vary only with the conditions. The advocates of the bill brought up the schoolhouse-lighting finding of the Massachusetts Gas and Electric Light Commission, pointing to the different prices paid by the class of consumers covered in the educational work of the city. Mr. Burdett emphasized the point that in the summer a schoolhouse consumes no energy for lamps, being closed for three or four months of the year, and in the winter season the hours of use are ordinarily short. The department store is just beginning to use its lamps when those in the schools are being cut off, and the mercantile use of energy for lamps is of great volume.

Mr. Burdett said that inquiries sent to about 1300 central stations in America and to 300 in Europe disclosed only twenty-six in America and ten in England where there was not positive evidence of the use of a differential system of some sort. Whether the customer pays one amount per kw-hour or another depends entirely on how much he uses the property at his disposal. A man having ten lamps in his store will pay precisely the same price per kw-hour as the man with 1000 lamps if he will burn them the same length of time. The company makes its money principally from the people who pay the lowest price per kw-hour. Mr. Burdett closed with the statement that a reduction in the maximum net price of from 11 cents to 7 cents per kw-hour would be a gross injustice, causing the company to be obliged to raise the price per kw-hour of electricity to large users, with the further result that loss of business would entail further raises. The only reason why the company can afford to sell energy to a large majority of its customers at a flat rate of 11 cents is because those who pay less than 11 cents give the company enough profit to enable this to be done.

Suggested Public-Service Commission Law.

The National Independent Telephone Association, which maintains headquarters at 193 Michigan Avenue, Chicago, has issued in pamphlet form the suggested public-utilities law, for consideration in various States, recommended at the recent convention. The proposed form of statute provides for the formation of a public-service commission and defines its duties as well as those of public utilities. The rights of a public utility are also set forth. The suggested law provides for the compulsory physical connection of telephone properties so situated as to make such connection practicable, should public convenience require it.

Proposed Public-Service Commissions in Illinois.

Senator S. A. Ettelson, of Chicago, has introduced a bill in the upper house of the Illinois Legislature providing for two public-service commissions for the State of Illinois, after the example of the State of New York. These commissions are to have control of railroad, interurban and street-railway, gas, electric service and telephone companies and all other corporations engaged in furnishing public-utility service. One of them is to have supervision of such companies in the City of Chicago, its members to be appointed by the Mayor of that city, and the other is to perform a like service for public-service enterprises in the remainder of the State, the members of this commission to be appointed by the Governor. The bill is modeled after the New York law, and, with the exception of the double-commission feature, is very similar to the one introduced at a previous session of the Legislature by Senator Ettelson, but which failed to become a law. This bill was summarized in the *Electrical World* of April 8, 1909, page 851.

As announced in the issue of this journal of Feb. 23, 1911, page 475, a bill has been introduced in the lower house of the Illinois Legislature by Mr. Rawleigh to give the existing Railroad and Warehouse Commission jurisdiction over public utilities in all cities not having a population of 200,000 or more, thus exempting Chicago. It is understood that an effort will be made to combine the Ettelson bill in the Senate and the Rawleigh bill in the House.

It is also asserted that a public-utility-commission bill drawn by some of the experts in corporation law at the University of Illinois will be introduced in the upper house of the Illinois Legislature this week by Senator John M. Chamberlin, Jr., of East St. Louis.

St. Louis Commission Report on Rates.

The St. Louis Public Service Commission submitted to the Municipal Assembly on Feb. 17 its report on the subject of rates for electric energy supplied by the Union Electric Light & Power Company. The report follows a valuation of the property of that company. A summary of the conclusions and recommendations is as follows: Maximum rate, 9½ cents per kw-hour. Minimum bill for consumers paying maximum rate, 50 cents per month. Minimum bill for all other consumers, $1 per month. Guarantees abolished except in cases necessitating special investment. Depreciation charge, 5 per cent per annum. Net return above depreciation charge on property in service of general consumers, 8 per cent per annum.

The earning value of the property in the service of general consumers was computed by the commission at $13,441,360. The earning value of the property in the service of the United Railways Company of St. Louis was figured at $2,693,033. The total earning value assumed by the commission, therefore, was $16,134,393. In addition the company has submitted a statement of addtitions to property from the date of the commission's inventory to Jan. 1, 1911, which make the total value as of that date, undepreciated for condition, $17,857,078.

Wisconsin Commission News.

In the matter of the complaint brought by members of the National Travelers' Association against the Wisconsin Telephone Company, in which it was contended that the extra charge of 5 cents for outgoing telephone calls from hotel rooms in the City of Milwaukee was a discrimination and in violation of the published tariffs of the Wisconsin Telephone Company, the commission has rendered a decision in favor of the petitioners. Under this ruling hotels cannot levy an extra charge for the use of room telephones and the telephone company has been ordered to cancel all contracts entered into with hotelkeepers subsequent to April 1, 1907, in which is contained the 10-cent outgoing-message charge.

The case of Mr. J. J. Lamb versus the Eastern Wisconsin Railway & Light Company was dismissed by the Railway Commission. The petitioner alleged that the fares over the respondent's interurban line between Fond du Lac and Oshkosh were excessive; that the fare zones were not equitably apportioned. Until recently the territory served by the interurban line was divided into six fare zones with a fare of 10 cents for each and an additional charge of 5 cents for each additional zone entered. Recently the number of zones has been increased to eight, with a fare of 5 cents for each. The petitioner alleged that the new arrangement had increased the total fare from his territory to the City of Oshkosh inasmuch as this territory is now located in the middle of a zone instead of at the end of one as formerly. The commission, however, found no evidence of discrimination in the location of the new zones. In this connection the commission called attention to the fact that this system was the only feasible one upon which to base a schedule of interurban fares, provided, of course, that the zone limits are fixed without discrimination and that a certain overlapping of fare zones is permitted.

The commission has authorized the Lake Geneva & Lake Delevan Electric Company to issue stock and notes or bonds as follows: Two hundred thousand dollars par value of notes or bonds, to bear interest at the rate of 7 per cent per annum and to mature in two years from date. 500 shares of cumulative 7 per cent preferred stock, of the par value of $100 each; 1170 shares of common stock, of the par value of $100. The funds to be derived from the sale of the stock and bonds are to be used for the purpose of paying organization expenses and all other expenses incident to the construction and equipment of a line of electric railway between the village of Walworth and the City of Delevan, all in Walworth County, Wisconsin.

Massachusetts Commission News.

The Massachusetts Railroad Commission has received a petition from Mayor John F. Fitzgerald, of Boston, asking for an investigation and readjustment of the transfer facilities in use on the system of the Boston Elevated Railway Company. A number of subsidiary petitions are transmitted to the board by the Mayor with his communication. It is probable that an exhaustive study will be made of the transfer situation in Boston, which is one of the most elaborate and complete in the world. A provisional hearing date, March 28, has been assigned by the commission. The Railroad Commission has approved the issue by the Boston & Worcester Street Railway Company of 3972 shares of additional capital stock at a price of $110 per share, to be used for payment of outstanding stock of the company, for land damages incurred in the double-tracking of the company's line in Framingham and for the payment of the cost of various additions and improvements

A hearing was given on March 2 by the special committee of the Legislature on public utilities upon various bills providing for changes in the organization or administration of the public-utility commissions of the State. Secretary J. B. Eastman, of the Boston Public Franchise League, made the principal argument, and urged the passage of legislation which would determine the advisability of forming a public-utilities commission through an investigation of the work and methods of the present tribunals. He contended that the decisions of the Wisconsin and New York commissions, particularly in railroad and electric railway matters, are more thorough than those issued in Massachusetts; pointed out the tendency in the latter State to refer important merger, transit and electrification questions to special short-lived tribunals, and urged the need of authorizing the present bodies to retain more expert assistance. Representative Cushing spoke briefly in opposition, pointing out that conditions in Massachusetts are radically different from those in other States, and that the practice of the Massachusetts tribunals is and long has been entirely satisfactory to the public.

Maryland Commission News.

The Maryland Public Service Commission has received an application from the Consolidated Gas, Electric Light & Power Company, of Baltimore, for permission to issue $1,500,000 in bonds. The revenue derived from the sale of these bonds will be devoted to the purchase and cancellation of $700,000 preferred stock, the market value of which is $105, and to purchase property for the expansion of the plant.

The Cambridge Board of Trade has submitted a complaint to the commission requesting an investigation of the methods of the Diamond State Telephone Company. It is specifically charged that J. G. Mills, president of the complaining Board of Trade, receives private line service for $12 a year, while George B. Pfeiffer and others are required to pay $24 for the same service. The Board of Trade especially directs the commission's attention to the difference in the rates at Cambridge and at Salisbury Service to residents of Salisbury, it is charged, is at the following rates Business service, $25 per year; private line telephone, $15 per year The Cambridge rates are: Business service, $36 per year; private line telephone, $24 per year, and party line, $18 per year.

A protest has been laid before the commission against the rates charged for supplying electric energy to the Profesisonal Building on North Charles Street. It was asked that the protest be made a part of the general complaint which the City of Baltimore is expected to file against the company in the near future.

It has been rumored that Governor Crothers will appoint James M. Ambler, chairman of the Public Service Commission, to a vacancy on the Supreme Bench of Baltimore. There are many who would regret to see Mr. Ambler leave the Public Service Commission just as the commission is getting in touch with the important work which it is called upon to do.

New York Commission News.

The Public Service Commission, Second District, has served upon the Black River Telephone Company the complaint of the village board and citizens of Lowville alleging that the rates now charged by that company in the village of Lowville are in violation of the terms of a franchise granted to the company. The franchise in question was granted in 1900 and provided for a rate of $15 per year for business places and not to exceed $10 per year for residences. The complaint alleges that the new tariff provides for rates in Lowville at a maximum of $3 per month for business houses and $1.75 per month for residences, scaled down to $3 per month for four-party business lines and $1.25 for four-party residence lines. The company has been given twenty days in which to answer the complaint.

A hearing will be given at Albany this week on the application of the Richfield Springs Electric Light & Power Company for authority to issue a mortgage for $100,000 and to issue $50,000 in 5 per cent bonds to be secured by said mortgage.

The transfer has been authorized by merger to the New York Telephone Company of all the property and rights of the Jefferson County Telephone Company. As a result of this transfer and merger the City of Watertown will have one telephone system instead of two as at present.

The commission has approved of the transfer by the New York Telephone Company to the Otsego & Delaware Telephone Company of certain franchises or rights of the Central New York Telephone & Telegraph Company assigned to the New York Telephone Company in the City of Oneonta, villages of Unadilla, Laurens, Cooperstown and Richfield Springs, in the county of Otsego, and village of Walton, in the county of Delaware. The sum of $98,000 was paid for the property and rights conveyed. The commission holds that its approval of the transfer of the physical properties was not required by the Public Service Commissions law, and has dismissed the joint petition of these companies so far as it relates to the approval of the transfer of the physical properties.

The transfer by merger to the New York Telephone Company of all the property and rights of the Trumansburg Citizens' Telephone Company has been approved The Trumansburg Company was engaged in conducting a telephone plant and system in the village of Trumansburg, Tompkins County.

The transfer by the New York Telephone Company to the Allegany County Telephone Company of franchises or rights granted to the New York & Pennsylvania Telephone & Telegraph Company by the Board of Trustees of the villages of Wellsville and Andover has been approved. The commission holds in this case also that the consent of the commission is not required for the transfer of the physical properties. The Allegany County Telephone Company is to pay $35,000 to the New York Telephone Company for the property and rights conveyed.

The commission has dismissed the joint petition of the Amsterdam Automatic Telephone Company and the New York Telephone Company for the approval of the transfer of the real estate, physical plant and property of the Amsterdam Automatic Telephone Company to the New York Telephone Company. The commission holds that it has no power or jurisdiction to consent to or forbid the transfer of the physical property of one telephone company to another, its power being limited to controlling the transfer of franchises from one such company to another such company. The proposition submitted to the commission did not propose that the corporate existence of the Amsterdam Automatic Telephone Company should be surrendered or merged or to transfer to the New York Telephone Company any of its franchises.

CURRENT NEWS AND NOTES.

Minnesota Convention Next Week.—As previously announced, the annual convention of the Minnesota Electrical Association will be held in the St. Paul Hotel, St. Paul, Minn., on March 14, 15 and 16.

Electric Meter Tests.—Of 8314 tests of electric meters reported during December, 1910, to the New York Public Service Commission, Second District, 6745, or 81.13 per cent, were accurate; 485, or 5.83 per cent, were fast; and 1084, or 13.04 per cent were slow.

Electric Sign Ordinance in Los Angeles.—Los Angeles has an ordinance prohibiting overhead electric signs of a height greater than 20 ft. Owners of electric signs have questioned the validity of the ordinance, but the law has been upheld so far, although not passed upon by the highest court.

Voltage Regulation.—An investigation by the Wisconsin Public Service Commission developed some striking instances of voltage non-regulation, but a central station in Canada appears to hold the record for haphazard voltages. In this case the company is allowed a variation of 5 volts either side of normal, but the city electrician has reported that tests show a voltage range from 98 to 134.

Municipal Plant in Pasadena.—The municipal electric lighting plant at Pasadena, Cal., has made a report to the City Council for the six months ended Dec. 31, 1910. This report shows the plant to have gained over 50 per cent in "net receipts," compared with the corresponding period of the year before. This is notwithstanding the fact that in the earlier period the base rate was 7 cents a kw-hour, while it was only 5 cents for the period covered by the present report. The average number of customers for the period was 3273, as compared with 1420 for the year before.

Electricity in Rural Districts.—The recently appointed committee of the National Electric Light Association on "electricity in rural districts" consists of Messrs. John G. Learned, North Shore Electric Company, 205 LaSalle Street, Chicago, chairman; E. P. Edwards, General Electric Company, Schenectady, N. Y.; J. E. Schuff, Lincoln Gas & Electric Company, Lincoln, Neb.; S. M. Kennedy, Southern California Edison Company, Los Angeles, Cal.; J. B. Lukes, Stone & Webster Boston; H. L. Montgomery, Auburn Light, Heat & Power Company, Auburn, N. Y.; Herman Russell, Rochester Railway & Light Company, Rochester, N. Y., and H. J. Buell, Northern Colorado Power Company, Denver, Col. This committee held a meeting in Chicago on Jan. 23 and outlined its work, making each member responsible for the collection of data in a certain territory. The members of the committee have already collected many valuable data and there is no doubt that they will make a useful and instructive report. Chairman Learned asked all central-station men to co-operate with the committee and send to the nearest member of it any information that they may possess in relation to the subject. The committee is particularly desirous of securing data and pictures of electrical farm installations.

The Electric Vehicle on the Slope.—About 700 electric vehicles are now in use in various cities and towns of the Pacific States. The largest number is in Los Angeles, where there are between 350 and 400 pleasure vehicles.

Hydroelectric Development in India.—The Tata Hydroelectric Power Supply Company has been organized at Bombay, India, to construct a hydroelectric plant at Lanavla at the top of the Western Ghats to transmit energy ninety miles to Bombay. The initial installation will consist of three 10,000-hp units, the final equipment being five 10,000-hp units to be installed at a total cost of $3,000,000.

London Electrical Exhibition.—What will be the largest event of its kind ever held in England will take place from Sept. 23 to Oct. 21 in the Third Triennial Exhibition of Electrical Engineering and Machinery at Olympia, London. The exhibition, which will be international in character, is being promoted by the large English electrical manufacturers, through their association, the National Electrical Manufacturers' Association.

Electric Light for Dry-Cleaning Establishments.—Dry-cleaning establishments, where gasoline, naphtha, benzine or other volatile oils are used to clean clothing or other fabrics, are regulated in Chicago by a recently adopted ordinance. One provision of the law requires that every building used for a dry-cleaning plant shall be lighted by incandescent lamps having keyless sockets and protected by vapor-tight outer globes. No open light or flame of any kind is allowed.

Neighborhood Steam Supply in Chicago.—The Adams Generating Company, of Chicago, has been permitted by an ordinance of the City Council of Chicago to lay a 12-in. steam pipe and a 5-in. return pipe across Adams Street, between State and Dearborn Streets, and 5 ft. below the surface of the street. These pipes are to be used solely for conveying steam for power and heating from the plant of the Adams Generating Company in the rear of 74-78 Adams Street to the building of The Fair department store.

Wireless Telegraphy for the Falkland Islands.—Situated in the South Atlantic, remote from the customary lines of ocean travel, the Falkland Islands are seldom visited and have only infrequent communication with the rest of the world. However, it is announced that a wireless-telegraph station is to be erected in Stanley, the capital of the islands, so that communication will be established with ships passing at considerable distances and possibly with some of the land wireless stations. Thus the use of this modern invention will go a long way to relieve the isolation of the Falklanders.

Electrical Waterworks Pumping in Chicago.—The Bureau of Engineering of the City of Chicago is making an inquiry, under the direction of the commissioner of public works, into the subject of using electrically operated centrifugal pumps as a part of the municipal water-supply equipment. In the meantime, and as a practical demonstration, the City Council has appropriated $60,000 for the installation of two electric pumps at the West Side pumping station on Ashland Avenue near Twenty-second Street. Energy to operate these pumps is to be obtained from the hydroelectric plant of the Sanitary District.

Industrial Electrical Engineering.—The Worcester Polytechnic Institute is offering an elective course in industrial electrical engineering during the last half of the senior year. It is intended in this course to take up the proper method of applying motors, the size and type of motors best suited to specific conditions, the cost of operation, the load factor of the manufacturing concern, energy rates and other items which influence the application of the motor to the work to be done. In addition to motor drive, consideration will be given to special applications of electricity, including welding, electric furnaces and electric vehicles.

National Electrical Credit Association.—The next annual meeting of the National Electrical Credit Association will be held in the King Edward Hotel, Toronto, Ont., June 1 and 2. Mr. F. P. Vose, 1343 Marquette Building, Chicago, is secretary of the association.

Opening of New York Chemists' Building.—Exercises in connection with the formal opening of the Chemists' Building in New York will be held on March 17, 18 and 19. Addresses will be made by Prof. Charles Baskerville, as chairman of the New York Section of the American Chemical Society; Mr. E. A. Sperry, as chairman of the New York Section of the American Electrochemical Society, and Dr. Charles F. McKenna, as chairman of the New York Section of the Society of Chemical Industry. Addresses and lectures will also be delivered by Prof. R. B. Moore, Prof. Jacques Loeb, Dr. W. R. Whitney, Prof. E. F. Smith, Dr. W. P. Mason and Dr. Charles F. Chandler.

Operating Agreement Between Chicago Suburban Railways.—The Southern Street Railway Company and the Chicago, Riverside & La Grange Railroad Company have entered into an agreement whereby the Southern line may operate its cars over the Riverside tracks in Twenty-second Street, Chicago, between South Fortieth Avenue and South Forty-sixth Avenue. The Southern company agrees to rehabilitate the tracks under the direction of the Board of Supervising Engineers, Chicago Traction. It also agrees to furnish all the electrical energy necessary for the operation of cars on these tracks. It will render a bill to the Riverside company for this energy, crediting thereon that proportion of the amount which its total car-miles shall bear to the total number of car-miles of both roads.

Enterprise of Denver Electrical Men.—The meeting of the Electric Club of Chicago on March 1 was in charge of the entertainment committee. Mr. Thomas H. Bibber, of New York, who was present and who is an enthusiastic advocate of co-operation in the electrical industry, congratulated the club on its success. He also referred in complimentary terms to the "get-together" spirit of the electrical men of Denver. That city has about 10 per cent of the population of Chicago, yet the average attendance at the weekly meetings of the Colorado Electric Club is 110, while that of the Chicago club is fifty. President Niesz, of the Chicago club, commented on this comparison and said that the members of the Chicago organization should emulate the fine example of their Denver colleagues. Messrs. Charles E. Gregory and Frederic P. Vose also spoke briefly.

Toronto Electric Vehicle Campaign.—The Toronto Electric Light Company inaugurated a campaign for the sale of electric vehicles about a year ago, the result being that Rauch & Lang have an agency there. At the Automobile Show now being held this company has a coupé on exhibition. The Gibson Electric Carriage Company shows Babcock roadsters, coupes and victorias. The Baker Motor Vehicle Company shows a chassis, a brougham and a victoria. The Canadian Vehicles, Limited, are exhibiting a Lansden truck, with Edison batteries, and two coupes. The Edison Storage Battery Company has an exhibit, as well as the Tait Accumulator Company, which manufactures a bi-functional plate. The Toronto Electric Light Company is giving every encouragement to the sale of electric cars, quoting special rates for this class of service. Numerous inquiries lend much encouragement to the campaign.

Abolition of Extra Charge for Milwaukee Hotel Telephone Calls.—The Wisconsin Railroad Commission has issued an order directing the Wisconsin Telephone Company not to connect with the private-telephone systems of Milwaukee hotels unless the charges for outside calls from hotel rooms are no larger than those from other public pay stations. The order does not apply to contracts entered into before April 1, 1907.

No Electrical Show in St. Louis This Year.—After giving the matter careful consideration, the electrical interests of St. Louis have decided not to hold an electrical show this year. The project of holding one in the spring of 1912 is under consideration. However, a number of electrical concerns of St. Louis have arranged to exhibit at the coming Household Show in that city, which will be held at the Coliseum for two weeks beginning March 20.

Low Rate for Electrical Energy.—In connection with the organization of the Stavenger (Norway) Electro-Staalverk Company for making high-grade steel electrically it is stated that electrical energy will be purchased from the plant at Jorpeland at the low price of $6.70 per hp-year for the first 1500 hp and $5.35 per hp-year for 1000 additional horse-power. The company will have available 10,000 hp when needed. The full yearly output of the plant, which will be completed by August, 1911, will be 1400 tons high-grade steel billets, 600 tons castings, 300 tons hammered steel and 700 tons refuse for resmelting.

Verdict Against Insurance Company in Boiler-Explosion Case.—In the suit brought by the Pabst Brewing Company against the Hartford Steam Boiler Inspection & Insurance Company growing out of the disastrous boiler explosion in the power plant of the former in Milwaukee on Oct. 25, 1909, a jury in the United States District Court for the Western District of Wisconsin has awarded the plaintiff a verdict of $97,400, with interest from Dec. 1, 1909. This amount was for direct damages under a contract for boiler insurance. Experts for the plaintiff gave it as their opinion that the initial rupture in the Munoz boilers occurred along the center line of a reinforcing plate riveted to the drums of the boilers. For the defense other experts testified to their belief that the initial rupture came in the main steam line. An appeal has been taken.

Power Plant Testing.—The Armour Institute of Technology Branch (Chicago) of the American Institute of Electrical Engineers at a meeting held on March 2 listened to an interesting and instructive talk by Mr. Erik Fenger, testing engineer of the Sanitary District of Chicago. Mr. Fenger spoke on the subject "Theory and Engineering in Power-Plant Testing." He first sketched the development of power-plant work and showed that with the increase in size of individual plants the extension of transmission and the interconnection of different systems there comes a great need for careful testing of all kinds. This work naturally belongs to the testing engineer. A number of examples of this kind of work were mentioned to show the reasons for considering features which the operating engineer would not be likely to think of.

Association of Railway Electrical Engineers.—Officers of the Association of Railway Electrical Engineeers and the affiliated association of supply men have appointed a committee, consisting of Mr. Hutchinson, of the Chicago, Rock Island & Pacific Railway Company; Mr. Andruecetti, of the Chicago & Northwestern Railway Company; Mr. Atkin, of the Electric Storage Battery Company, and Mr. Ballantine, of the Willard Storage Battery Company, to fix the time and place of the next annual meeting of the association. This committee held a meeting in Chicago on March 2 and decided that the convention should be held at the Hotel LaSalle, Chicago, Nov. 6 to 10, 1911. This association is growing in importance with the rapidly increasing use of electrical apparatus by the steam railroads. It is also probable that it will have not a little to do later on with the much-discussed question of electrifying steam-railroad terminals. An important convention is anticipated.

Cost of Department of Electricity of Chicago.—The amount appropriated for the department of electricity of the City of Chicago for the current calendar year is $1,244,216. Some of the items of more particular interest are as follows: Salary of city electrician, $6,500; fire and police telegraph, including repairs, replacements and operation, $98,159; electrical inspection, $52,124; municipal electric lighting system, $140,324 (including $101,636 for 100 arc-lamp trimmers and $31,063 for carbons); rental of electric arc lamps, $68,600; rental of gasoline lamps, $200,000; gas for street lighting, $188,000. In addition, provision is made for the gradual taking over of the electric street-lighting service of the city by the Sanitary District, under the provisions of a contract recently executed. For this purpose $137,742 is appropriated for the purchase of electrical energy by contract or open order. Also $13,366 is set aside for operating substations, $7,500 for payment of interest to the Sanitary District under the terms of the contract and $5,000 for repair work done by the Sanitary District.

Execution Stayed by Telephone Reprieve.—At the recent Independent telephone convention of Chicago the story was told of the exciting experience of state officials and a Western telephone company in getting a reprieve to a sheriff in time to delay an execution of a convicted murderer. The reprieve was not signed until about 4 o'clock in the afternoon and the man was to be executed at sunrise the next day. As the county seat was not on a railroad and had no telegraph office, the telephone furnished the only possible way of getting notice of the stay to the sheriff from the Governor in time to prevent the execution. It happened, however, that a severe sleet storm had crippled the telephone service on this particular day and most of the regular routes were out of commission. Ordinary messages were only accepted subject to delay. However, this was an extraordinary message and a careful study was made of the circuits still in service to see what could be done. It was found that by using the lines of another company for part of the distance it might be possible to get a repeated message through. After several hours' work this was done successfully and notice of the reprieve was given to the sheriff in time. The local newspapers made extended mention of this fact, and in that way the telephone company obtained an amount of publicity that probably more than offset the extra effort required, to say nothing of the humane considerations involved.

Possible St. Lawrence Hydroelectric Developments.—Possibilities of water-power development along the streams making up the St. Lawrence River drainage system received special consideration in a report on the surface water supply of the basin prepared by Messrs. C. C. Covert, A. H. Horton and R. H. Bolster for the United States Geological Survey and published by the survey as Water-Supply Paper 264. The report shows that streams in northern Wisconsin and Michigan are as yet very little utilized and afford excellent chances for the development of water-power. Along the Escanaba, Menominee, Peshtigo and Oconto Rivers there are many storage sites. It has been estimated that 32,000 hp awaits development along the Peshtigo. In New York the State Water-Supply Commission has many important projects under way. Perhaps the most important of these is the contemplated dam across the Genesee River at Portage, which will provide a storage reservoir with a capacity of 18,000,000,000 cu. ft., 11,000,000,000 cu. ft. of which will be available for commercial purposes. The commission has favored the building of the dam and has advanced as an argument in its favor the fact that the reservoir would provide a means of regulating the flow of the Genesee and of preventing the disastrous floods that occur on that stream. Another important project is the Tupper Lake reservoir in the Raquette River basin, which, if the commission's plans are carried out, will have a capacity of 10,000,000,000 cu. ft.

DOMINION POWER AND TRANSMISSION COMPANY.

Outdoor Switching Station at Bartonville for Controlling the High-Tension Circuits Leading from DeCew Falls to Hamilton, Brantford, Dundas and Oakville.

THE Dominion Power & Transmission Company, of Hamilton, Ontario, owns one of the most economical and valuable hydroelectric plants in Canada—that at DeCew Falls in the Province of Ontario. The greater part of the energy wrested from the waters of the Welland Canal at that point is transmitted to the "Electric City of Canada," more generally known as Hamilton, the enterprising manufacturing city of over 70,000 inhabitants on Lake Ontario, about midway between Niagara Falls and Toronto. The electrical development at DeCew Falls was described in these columns some years ago, but in order to render what follows more intelligible a brief account of the development is given.

The Dominion Power & Transmission Company controls the following properties: Hamilton Cataract Power, Light & Traction Company, Ltd., of Hamilton; Hamilton Electric Light & Power Company, Ltd., of Hamilton; Dundas Electric Company, Ltd., of Dundas; Lincoln Electric Light & Power Company, Ltd., of St. Catharines; Western Counties Electric Company, of Brantford; Welland Electrical Company, Ltd., of Welland; Hamilton Street Railway, of Hamilton; Hamilton & Dundas Railway Company, of Hamilton; Hamilton Radial Electric Railway Company, of Hamilton; Hamilton, Grimsby & Beamsville Electric Railway Company, of Hamilton; Brantford & Hamilton Electric Railway Company, of Hamilton, and the Hamilton Terminal Company, Ltd., of Hamilton. The generating stations comprise the main hydroelectric station at DeCew Falls, two hydroelectric plants of 600 kw and 200 kw respectively at Brantford and St. Catharines and two steam stations of 2800 kw and 300 kw respectively at Hamilton and Brantford. At present the station at DeCew Falls is capable of carrying a steady load of 28,800 kw and a peak load of 36,000 kw, and during the year the company will install another 6400-kw, 2400-volt generator and a 7100-hp Voith turbine.

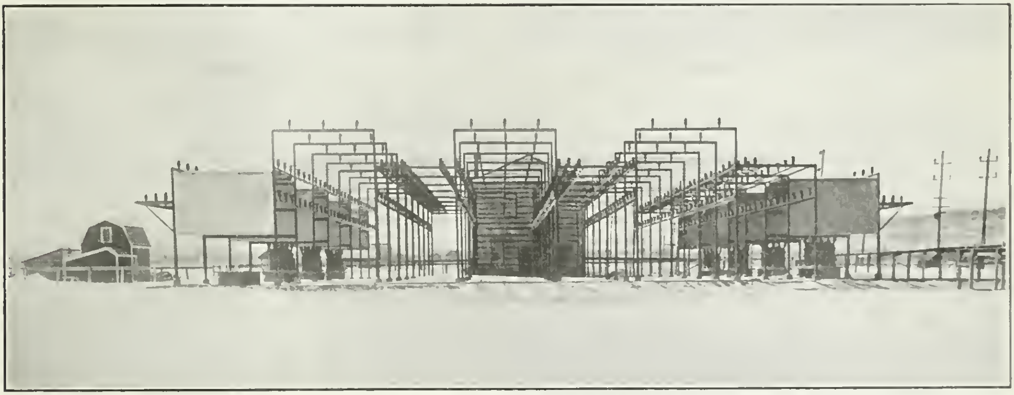


Fig. 1—End View of Outdoor Switching Station at Bartonville, Ont.

The power at DeCew Falls is derived from the precipitous change of level between Lake Erie and Lake Ontario formed by the Niagara escapement. The water is diverted from the Welland Canal at the Lake Erie level into a large storage basin of some 500 acres in extent. This reservoir forms a perfectly quiescent lake which in the winter time freezes over and eliminates the very serious difficulties which water-power plants have in those latitudes with floating and anchor ice, all of the plants at Niagara Falls suffering more or less during the course of each winter. From interruptions of this character and, indeed, from any interruptions whatever from hydraulic causes the company has been entirely free during its whole history. The water leaving the reservoir plunges through steel penstocks, 940 ft. long, against turbine wheels in the hydraulic station. The impulse wheels are approximately 20 ft. above the level of Lake Ontario. The water charges against them under a static head of 269 ft., or 120 ft. greater than at Niagara Falls, and is then returned to the Welland Canal at the Ontario level

The physical conditions at DeCew Falls, where the power house is situated, are very much in favor of the development of power, no very extensive engineering work or tunneling being necessary, the company's penstocks merely being laid down a natural grade on the hill and connected to the turbines. The tailrace is natural, being what is known as the Twelve-Mile Creek, and required no dredging or development. As a result of this the cost of developing electricity per unit is probably as low as, if not lower than, that of any plant in America.

The energy generated is transmitted to Hamilton, a distance of thirty-five miles, and the neighboring cities, towns and villages, and besides supplying the needs of the light and power companies at these places supplies the energy to operate a network of electric railways that tap the entire country round about Hamilton for a radius of thirty to forty miles.

The electrical energy at potentials of 10,000 volts, 20,000 volts and 45,000 volts is transmitted from DeCew Falls in five different directions. One line feeds St. Catharines at 10,000 volts; a second line of this potential also runs to Thorold, where the energy is used by the government for operating locks and bridges on the Welland Canal. A 20,000-volt line reaches Welland, where two substations are located, and two 45,000-volt lines extend west, one following the Grand Trunk Railway to Hamilton and being tapped at Grimsby and the other extending to Bartonville, a suburb of Hamilton. These lines feed Hamilton, Dundas, Oakville, Brantford and the intervening towns.

OUTDOOR SWITCHING STATION.

Possibly the only high-tension switching station of any magnitude in existence in which both selector and oil switches are placed entirely out of doors has been erected by the company at Bartonville. In this work the company is the pioneer in Canada, if not in America, for certainly the station in question is the only one operating under climatic conditions so severe, the temperature varying from 100 deg Fahr. in July to 10 deg. below zero, with 2 ft. to 3 ft. of snow in the winter months.

As will be seen from the engravings, the entire 44,000-volt system is placed out of doors, the selector switches (132 in number) being mounted with the bus on structural steel framework and the oil circuit-breakers on concrete platforms raised 3 ft. above grade. The station consists of three separate 44,000-volt buses, clearly shown in Fig. 1, to which both incoming and outgoing lines may be connected by means of three-pole, swivel-type, selector switches operated through a system of levers from the ground. Each line is controlled remotely by an automatic circuit-breaker, equipped with selective relays of the inverse time-element type, so that the several outgoing lines may be set to open at varying time intervals.

In addition to the line circuit-breakers and mounted so that it may at any time be used in place of any one of them is a similar breaker which is used for paralleling any two lines or groups of lines. The method of connecting this circuit-breaker can be seen by noting the end switch shown on the control panel (Fig. 2) and really constitutes the key to the successful operation of the station. Under normal conditions the two incoming lines, or trunk lines as they are called, are tied together through this breaker, so that in the event of line trouble on one of them it is automatically cut free from the switching station when the paralleling switch opens.

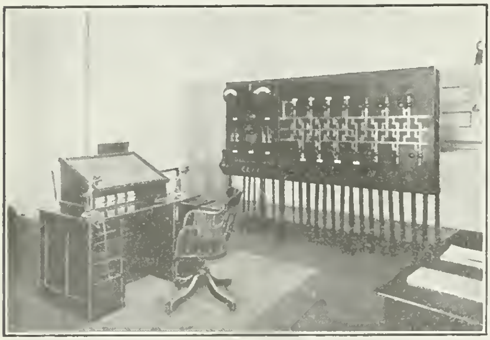


Fig. 2—Control-Room of Outdoor Station.

As can be seen from Fig. 3, the station is built on a unit principle, so that any number of new lines may easily be taken care of by simply adding a corresponding number of bays with auxiliaries, etc. Fig. 4 shows a line entrance and also gives a good idea of the type of selector and oil switches used. The selector switches are perhaps novel in some particulars, although the swivel idea is not entirely original with this company. They are made as a three-pole unit, all three poles opening simultaneously, the center insulator being capable of rotation through an arc of 70 deg. and carrying the blade with it. A bell crank and shaft arrangement operated by a detachable lever and locking device controls the switches from below. The selectors were designed and made by the company at but a fraction of the cost asked by manufacturing concerns. The oil circuit-breakers were specially designed for this plant by the Canadian Westinghouse Company and are similar to the regular type G. A. switch described in the A. I. E. E. *Proceedings* for April, 1909, with the exception that additional insulation and porcelain rain shields are placed on the condenser bushings. They are rated at 300 amp and 44,000 volts. The toggle mechanism is, of course, housed in a weatherproof casting. A special grade of oil, the result of much experimenting, was supplied with the switches and has given remarkably good

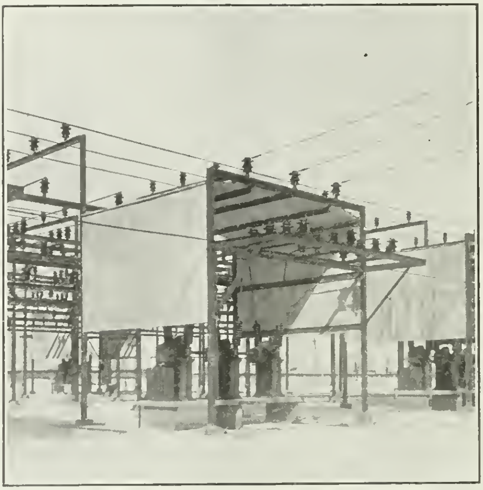


Fig. 4—Line Entrnce and 44,000-Volt Switches.

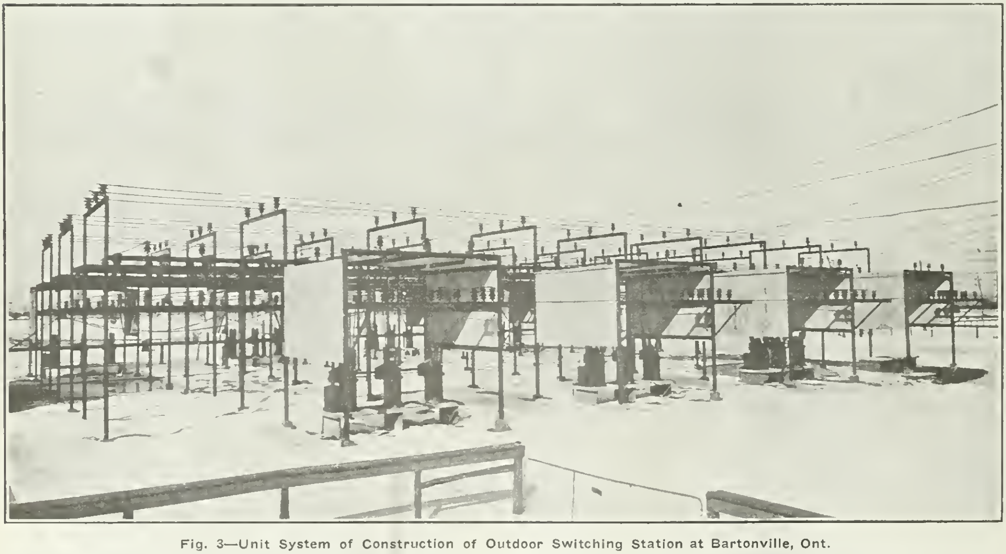


Fig. 3—Unit System of Construction of Outdoor Switching Station at Bartonville, Ont.

results to date. The oil switches are operated from the control-room shown in Fig. 2, situated in the attendant's residence, lead-covered multiple conductor cables running underground through galvanized conduit to each switch.

The bus is constructed of 1 5/16-in. diameter seamless brass tubing mounted on the standard cone and insulator used on the transmission lines of the company. Arcing rings placed on the insulators next to the lines and on the topmost points of the framework comprise the only attempt at lightning protection, the lines all having grounded guard wires throughout their entire length and lightning arresters at some nearby station to the plant.

The cement plaster hoods over each breaker form, with an attachable canvas, sufficient shelter for men making repairs in bad weather. Besides that shown in Fig. 2 the only apparatus housed indoors is a storage battery for emergency control and lamps. The entire transmission system of the company is operated from this station by private telephone. A miniature line system is mounted on the operator's desk, indicating the condition of all the high-tension switches by small colored lamps. The station has now been in operation for some ten months, during which time it has given every satisfaction under some very extreme conditions.

CENTRAL-STATION DEVELOPMENT AT MARLBOROUGH, MASS.

How a Large Motor Load Was Built Up and a District and Rural Service Established.

ELECTRICAL supply in manufacturing and farming communities well illustrates the universality of modern central-station service when energy is supplied throughout a diversified area by a single corporate management. A representative system supplying both urban and rural customers over an extended territory is that of the Marlborough Electric Company, of Marlborough, Mass. Two points of special interest characterize the development of this company in the past few years—the subsidence of its functions as primarily an electric generating agency and a progressive cultivation of a diversified electric motor-load business. Under the management of the late Mr. Wallace G. Webber, of Boston, and his associates the business of the company has shown remarkable gains; the organization has been perfected on the basis of active solicitation of motor and lighting patronage, rather than continued on the old plan of waiting for new customers to seek the company, and the applications of electricity to industrial, farming and residential uses have been greatly stimulated by the introduction of rates which bring the benefits of electrical service within the reach of isolated consumers no less than to the doors of urban establishments.

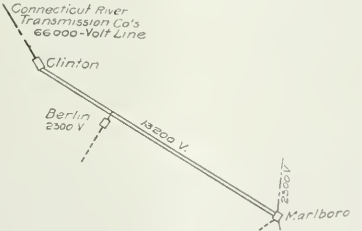


Fig. 1—Map of Marlborough Electric Company's System.

In common with several other central stations in Worcester County, the Marlborough company derives the larger part of its electrical supply from the circuits of the Connecticut River Transmission Company, whose well-known hydroelectric system transmits energy from a 20,000-kw plant on the Connecticut River at Vernon, Vt., to all the principal centers of population in northern and central Worcester County. The Connecticut River organization is essentially a wholesale dealer in electricity, although by decisions of the Massachusetts Gas and Electric Light Commission it is permitted to seek motor customers in the cities of Worcester and Fitchburg, provided the connected load in each case reaches 300 hp, or provided the annual consumption of energy reaches 450,000 hp-hours per installation. The circuits of the Connecticut River Transmission Company pass through the City of Clinton, thirteen miles northwest of Marlborough, there being a substation in the former city of 4500-kw rating located in the Lancaster Mills, a prominent motor-load customer of the Connecticut River system. Energy is transmitted from the Vernon power house to Clinton over a 66,000-volt, 60-cycle, three-phase line carried on steel towers, and is stepped down at the Lancaster Mills substation to potentials suitable for local distribution. The Marlborough Electric Company has contracted for the right to take 1000 kw from the substation at Clinton, and this supply is transmitted to Marlborough over two three-phase trunk transmission lines thirteen miles long at 13,200 volts. At Marlborough a reserve steam plant is maintained in the old station of the company on Florence Street, and from this point the greater part of the company's distribution is effected.

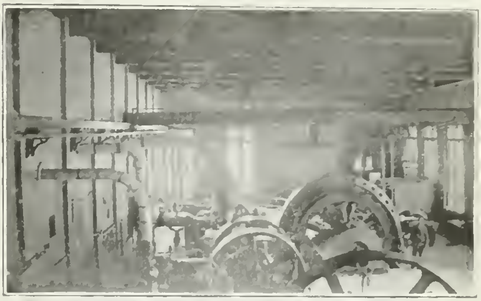


Fig. 2—Engine-Room of Reserve Steam Plant.

The Marlborough company now serves a population of about 27,000, residing in general in a semi-circular area of about seven miles radius on the south and west of the city. Marlborough, the center of the company's service, is a prosperous manufacturing city of about 15,000 inhabitants located thirty-eight miles west of Boston on the New York, New Haven & Hartford and Boston & Maine railroads. It is the home of various industries, chief among which is the production of shoes. In addition to Marlborough the company now supplies electricity to the five small outlying towns of Southborough, Northborough, Westborough, Berlin and Shrewsbury.

The 13,200 volt lines of the company between Clinton and Marlborough consist of two three-phase circuits of No. 4 copper wire installed on 35-ft to 60-ft chestnut poles in equilateral triangles of 20-in spacing. About one third of the line construction is on private right-of-way. The poles are in general spaced from 100 ft to 105 ft apart and the wires are carried on Knowles No. 1 triple-petticoated Crown porcelain insulators. Lightning protection on the line proper is afforded by a No. 6 B W G. galvanized-iron ground wire carried from pole to pole at the top and frequently grounded. At Berlin taps from the line are carried into a substation equipped with a 50-kw transformer which reduces the potential to 2300 volts for local distribution. This transformer is of the single-phase, oil-cooled type and is connected with the local street-lighting service, residential and commercial customers' loads. The distance from the Vernon power plant to Marlborough is about seventy-five miles, and the limit of transmitted power from the Connecticut River to southeastern Worcester County is the village of Cordaville, about ninety-two miles from Vernon, including the conversion at Clinton and a further reduction in voltage at Marlborough.

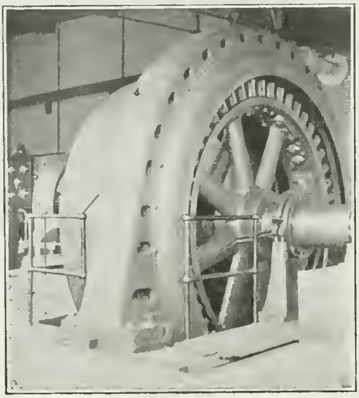


Fig. 3—600-kw Reserve Generator in Florence Street Station.

From Marlborough to Southborough a 2300-volt, three-phase circuit supplies lighting and motor service to the town of Southborough and the villages of Fayville, Southville and Cordaville. Northborough and Shrewsbury are supplied by a 6600-volt transmission line of No. 4 copper installed in a three-phase circuit, the distance of transmission from Marlborough being about five miles to the center of Northborough and five miles from Northborough to the center of Shrewsbury. The incoming service from Clinton is reduced to a potential of 6600 volts at the Florence Street station in Marlborough. The Westborough service is supplied by a 6600-volt tap, consisting of a three-phase circuit of No. 4 copper about three and one-half miles long, which runs directly from a junction with the Marlborough-Northborough line at Bartlett Pond to the old station of the Westborough Gas & Electric Light Company used as a distributing center for Westborough. Thomas porcelain insulators are used on the Northborough-Shrewsbury line, those on the Westborough line having been of glass in the original installation.

At Northborough a small substation is in service, containing about 30 kw in step-down transformers. In this town the original service was mainly given by 220-volt multiple circuits, and to save investment the Marlborough company operates the local street-lighting incandescent lamps from this type of circuit through a 5.5-amp constant-current transformer. At Shrewsbury another very small substation is in operation owned by the town. The street lighting in the small towns served by the company is handled by tungsten lamps and the circuits are operated by Campbell time switches in Westborough, Northborough and Berlin, thus reducing the attendance to the minimum. Automatic induction regulators of the General Electric motor-operated type are installed on all circuits with the exception of an off-peak motor circuit in use in Marlborough. This circuit is in service from 6 a. m. to 6:30 p. m. on week days and has an average load of 200 kw. To customers using this circuit is granted a rate varying between 4 cents and 2 cents per kw-hour on a sliding scale. From the same circuit an off-peak lighting service is supplied for factories, the rate being from 10 cents to 5 cents per kw-hour, with hand regulation at the Marlborough station. The majority of factories on the company's lines, however, are provided with twenty-four-hour lighting service. The avoidance of losses on the off-peak motor circuit on Saturday afternoons, Sundays, holidays and nights has been favorably noted by the company's officials. A Tirrill regulator is installed on the main switchboard at Marlborough to provide automatic voltage adjustment when the local steam plant is in operation.

The Marlborough station at present contains working electric generating equipment of about 800-kw rating, there being seven generators varying in size from 100 kw to 600 kw. The steam-engine equipment consists of six machines varying in size from 90 hp to 850 hp, with a total rating of 1761 hp. All the engines are of the simple, non-condensing type. The two principal units held in reserve are a 325-hp Allis-Chalmers outfit and an 850-hp Hewes & Phillips engine, both being direct-connected to generators of the alternating-current type. The boiler plant contains three Cunningham and two Babcock & Wilcox units with a total rating of 835 hp, and the machinery is housed in a brick building 118 ft. x 89 ft. in dimensions. A 24-ft. x 86-ft. coal shed is also provided. City water is used in the plant. One boiler is always kept banked in the station to meet emergencies.

The transformer installation at Marlborough consists of three 250-kw, 13,200-2300-volt Westinghouse oil-cooled units for reducing the potential from the incoming Clinton line to that required for local distribution. Three 100-kw transformers are installed for the Northborough-Shrewsbury and Westborough service, the potential being raised by them from 2300 volts to 6600 volts. The two 13,200-volt incoming lines enter the station on the south side of the building through knife-connector switches and are brought together in a common set of three-phase busbars. Beyond the busbars, which are mounted on the wall at the end of the engine-room, the incoming service passes through choke coils with lightning arrester taps and thence through an oil-switch installation, operated by bell-crank levers from the floor below, to step-down transformers. The secondaries of the transformers are connected with the main buses of the distributing switchboard by cables carried beneath the floor of the engine-room.

The switchboard at Marlborough consists of eighteen blue Vermont mable panels facing the engine and generator equipment, and is divided into three principal sections, the first taking care of reserve generating machinery in the plant, the second handling the outgoing feeder circuits, and the third controlling the incoming lines from Clinton. The board is about 35 ft. long over all. The incoming service panel contains three 400-amp ammeters, a 3000-volt voltmeter, a 1600-kw indicating wattmeter, a frequency indicator, power-factor indicator and watthour-meter, all of Westinghouse make. A Bristol recording voltmeter for busbar service is also attached to the panel on a bracket. The energy purchased by the company is metered at both ends of the line, the charges of the Connecticut River Transmission Company being based upon the meter records at Clinton. The rest of the switchboard consists of five machine panels, two exciter panels, two local lighting panels, a Tirrill regulator panel, with synchronizing and exciter connections, a panel for the Northborough line and several panels controlling street lighting service in Marlborough and Southborough, motor and lighting service in Marlborough. All the switchboard equipment outside that on the Clinton service panel was supplied by the General Electric Company. Most of the instruments on the switchboard are of the edgewise type and are illuminated by two 100-watt tungsten lamps carried on an iron-pipe bracket attached to the station engineer's desk in front of the board. Bowl reflectors mounted upon a horizontal axis throw the light in the direction of the panels, which are about 12 ft. distant on the average. This arrangement, which has greatly improved the facility with which instruments may be read, is shown in Figs. 4 and 5 The attachment of the pipe framing to the desk permits considerable flexibility in the use of the lighting equipment. A vertical outlet in the framing equipped with a cord and drop lamp provides the illumination of the desk proper.

The commercial motor service of the company has increased enormously during the past three years. In the year ended June 30, 1908, the company sold only 149,794 kw-hours to electric motor users; in 1909 it sold 547,267 kw-hours and in 1910 1,282,521 kw-hours for this service alone. Thus there was an increase of 265.3 per cent in 1909 and an increase of 134.3 per cent in 1910 over 1909, making a total increase of 760 per cent in the amount of energy sold for motor service in the period of two years between 1908 and 1910. The revenue earned from motor-service sales increased from $5,797 in 1908 to $31,979 in 1910, or a gain of 450 per cent. From a central station with an insignificant motor load the company has thus in two years stepped into the ranks of plants serving communities of much greater population with a highly cultivated motor business equal in magnitude to that employed by some of the most progressive central stations in the State. The community has shared with the company the benefits of this expansion, since the average income per kw-hour sold for motor service was only 2.5 cents in 1910, compared with 3.9 cents in 1908. It would be difficult to find a better example of the quick response which an enterprising manufacturing community will make to a vigorous canvass on behalf of electric service at rates within reach of the small as well as the large consumer. The company's connected load on June 30, 1910, was 2428 kw, made up as follows:

CONNECTED LOAD, MARLBOROUGH ELECTRIC COMPANY, JUNE 30, 1910.

Character of Load.	Kilowatts.
Commercial arcs	1
Municipal incandescents, 731 50-watt tungstens	37
Municipal incandescents, 270 75-watt tungstens	20
Commercial incandescents	1,556
Total commercial lighting load	1,614 kw
Electric motor load, connected	814
Total connected load of company	2,428 kw

The company has 822 customers using electricity for lighting only, seventeen for motors only and sixty-one customers on both lamps and motor circuits.

Among the principal motor-load customers of the company are the St. Mark's School, Southborough, which uses energy in the operation of fans, laundry machinery and elevator equipment; the Fay School, Southborough, which pumps about 10,000 gal. of water daily by electricity; the famous Deerfoot Dairy and Deerfoot Farm companies, of Southborough; the Lyman School, Berlin; the S. H. Howe Shoe Company, Marlborough; the Electric Weld Company, Marlborough, and others. The Deerfoot Dairy Company has a total connected load of 117 hp, comprising seventeen motors varying in size from ½ hp to 35 hp. Energy is used for the operation of hoists in connection with the slaughtering of hogs, for the driving of air compressors, for chopping machines for sausage manufacture, pumping machinery, bottle washers and refrigerating equipment. Much of this is distinctly long-hour business. The Deerfoot Dairy Company utilizes electricity in cutting ensilage and for refrigeration. The S. H. Howe shoe concern has fifty-nine motors with a total rating of 197 hp in its "Diamond M" factory, six motors of 29 hp rating in its "Diamond O" factory, and will shortly have forty-eight motors of 170 hp rating in its "Diamond F" factory. The shoe machinery is mainly group-driven in this plant, as in each department the tendency is to operate a large number of small machines of similar character practically simultaneously. The Electric Weld Company, manufacturing lamp guards and toaster fittings, uses about 15 hp. Seven motors aggregating 63 hp are used by the Marlborough Grain Company, the heaviest business being in the fall before the annual lighting peak comes on. The Rice & Hutchins Shoe Company utilizes nineteen motors with a total rating of nearly 90 hp; the Sawin Grist Mill uses 45 hp in motors, in Southborough, and Mr. C. H. Andrews, builder, Marlborough, uses 22 hp.

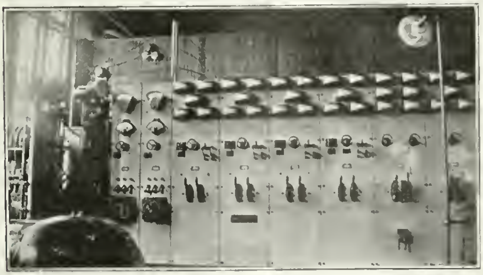


Fig. 4—Section of Switchboard in Florence Street Station.

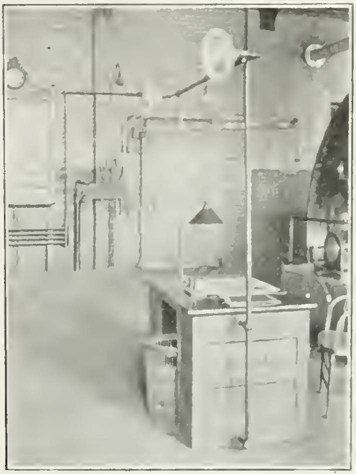


Fig. 5—Arrangement of Bracket Lamps for Lighting Switchboard.

The company has eighteen customers on farms who use electricity in pumping. For this service the usual installation consists of a ½-hp motor automatically controlled by float attachment, driving a pump by belting. Wagner and Century single-phase motors are chiefly used on the lighting lines, the largest size allowed being 5 hp. The cost of farm pumping usually runs from $2 to $3 per month. A test at the Lyman School, Berlin, showed that the cost of raising 1000 gal. of water about 27 ft. was 15 cents. The pump is of the double-acting, single-plunger type gear-driven by a ½-hp motor mounted on the same base. At the Fay School hospital all the cooking is done electrically, the connected load being 4 kw; one prominent residence customer has a complete electric cooking outfit, and at the Southborough High School the domestic-science department utilizes six 8-in. electric stoves.

On June 30, 1910, the company had in service 630,546 ft. of municipal lighting wire; 1,056,890 ft. of alternating-current primary lighting wire; 362,983 ft of secondary wire; 40,106 ft. of primary power wire; 7009 ft. of secondary power wire; or a total length of wire of 2,097,534 ft., compared with 1,642,038 ft. in 1909. The company owns 3827 poles varying in length from 35 ft. to 60 ft; 151 transformers from 0.6 kw to 100 kw in rating, the most common size being 15 kw; and 916 meters on consumers' premises, varying from 3 amp to 250 amp each. The 5-amp size is the most common, there being 473 of these in service. The company's investment in plant on June 30 last was as follows: Land and buildings, $26,447; steam plant, $61,756; electric plant, $75,488; overhead lines, $162,827; underground lines, none in service; transformers, $22,053; meters, $19,680; arc lamps, $6,144; total, $374,305. In 1909 the company replaced the Marlborough street-lighting system, which consisted of inclosed alternating-current arc lamps, by substituting five 60-cp. 75-watt tungsten incandescents for each arc and one 40-cp, 50-watt tungsten for each 32-cp, 110-watt carbon lamp, with the result that more territory was lighted and the illumination of the streets greatly increased, making Marlborough one of the best-lighted cities in the State.

By this change the company was able to reduce the kw-hours furnished for street lighting 4.2 per cent after adding enough extra street lamps to increase the income 22 per cent.

The company had on June 30 last 902 customers, of which 713 were in Marlborough, 113 in Southborough and fifty-two in Northborough. The price of street lamps in Marlborough is $17.50 per lamp per year for a 1-o'clock and every-night service.

MARLBOROUGH ELECTRIC COMPANY, MARLBOROUGH, MASS.

Year Ended June 30.	1908.	1909.	Per Cent Increase.	1910.	Per Cent Increase.
Rated generating capacity of station, kw.	500	600	. . .	800	. . . . .
Total kw-hours bought or generated	790,460	1,303,528	. . . .	2,312,033	. . . .
Total kw-hours accounted for	604,987	1,070,518	. . . .	1,881,296	. . . . .
Kw-hours sold for motors	149,794	547,267	265.3%	1,282,521	134.3%
Kw-hours sold for commercial lighting	260,128	336,417	29.3%	409,742	21.8%
Kw-hours sold for street lighting	195,065	186,834	4.2%*	189,033	. . . . .
Total income	$51,424.29	$70,554.30	37+%	$93,199.25	32+%
Income from power	$5,796.95	$15,789 42	172.5%	$31,978.83	100.2%
Income from commercial lighting	$33,686.08	$40,193.04	19.4%	$44,699.72	11.2%
Income from street lighting	$11 941.26	$14,571 84	22.0%	$16,520.70	13.5%
Per cent income expended for operating, excluding interest and depreciation	74 4%	65.5%	. .	66 3%	. . .

* Decrease

Income per capita, Marlborough, $4.50

Residence consumers, per 100 population, Marlborough, 2.42.

Residences in Marlborough, Jan. 1 1911, 2378.

Residence consumers in Marlborough, Jan. 1, 1911, 477

Consumers per 100 inhabitants, Marlborough, Jan. 1, 1911, 4.04.

Per capita plant investment, $14.80

Yearly load-factor, per cent., 31.4.

Kw-hours accounted for per 100 generated (including losses on transmission lines), 81.3.

Population, Marlborough, 1905, 13,609.

Population Marlborough, 1910, 14,579.

The company's regular motor rates are based on the use of the Wright demand system. An initial monthly charge is made of 12 cents per kw-hour for an amount of energy equal to twenty-five hours' use of the maximum demand. The average monthly maximum readings of the demand indicator between Nov. 1 and March 1 each year are taken as the basis of charging. In no case is a maximum demand of less than 1 hp figured. All energy used in excess of the above maximum demand is paid for at the rate of 6 cents per kw-hour until an amount of electricity equal to fifty hours' use of the maximum demand has been billed at 6 cents for the month. All energy used in excess of the foregoing is then billed at 3 cents per kw-hour, with a discount of 33⅓ per cent when the bill exceeds $20 per month. In case service is discontinued for non-payment of bills the company reserves the right to make a charge of $1 for again connecting the service and to require a deposit equal to one month's use of energy.

The regular lighting rates of the company are also based on the demand system. One schedule provides a rate of 15 cents per kw-hour per primary usage and a rate of 12 cents per kw-hour for secondary usage, the minimum bill being $1 per month. The primary usage is obtained by multiplying the kw-hour equivalent of the amount shown on a demand indicator by the following number of hours each month: January, 60; February, 50; March, 40; April, 40; May, June, July and August, 30; September, 40; October, 50; November, 60; December, 60.

Another schedule which provides a rate for a guaranteed yearly patronage starts with a demand rate of 20 cents per kw-hour for primary usage and a secondary rate is maintained of 6 cents per unit for the remaining consumption. The primary usage in this schedule is determined by multiplying the kw-hour equivalent of the amount shown on the demand indicator by the following number of hours each month: January, 50; February, 40; March, 30; April, 30; May, June, July and August, 20; September, 30; October, 40; November and December, 50.

On the day circuit, which operates between 6 a. m. and 6:45 p. m., a scale of lighting rates is in effect which varies from 10 cents per kw-hour with a consumption of 200 units to 300 units per month for 100 16-cp equivalents connected to 5 cents per unit from 2500 kw-hours to 3000 kw-hours per month for 1000 lamps connected. The minimum charge in the first case is $3 and in the latter $20 per month.

In the fiscal year 1910 the company purchased 1,791,400 kw-hours from the Connecticut River Transmission Company which transmits energy generated at the hydroelectric station at South Vernon, Vt. The bare expense of production at the reserve steam plant, omitting all fixed charges and cost outside of mere fuel, labor and plant repairs, was $17,681. At its steam plant the company produced 520,633 kw-hours at a bare station cost of 3.4 cents per unit. The company burned 1832 tons of coal at an average cost of $4.52 per ton, and its labor cost at the station was $5,630. Three engineers and one fireman were listed on the plant payroll. The total energy accounted for on the system was 1,881,269 kw-hours and the maximum load was 830 kw (Nov. 22, 1909).

The accompanying table shows some of the recent work of the company from the standpoint of earnings during the last three years.

Mr. Josiah Q. Bennett is president and Mr. Paul B. Webber is treasurer of the company, with offices in the Shawmut Bank Building, Boston, and the general manager is Mr. C. S. Davis, Marlborough.

ELECTRICAL FEATURES OF THE BRESCIA-SALO-TOSCOLANO 1200-VOLT DIRECT-CURRENT RAILWAY.

By Mario Stoppoloni.

THE railway line which unites Brescia and Salò, Gardone and Toscolano, on the Lake of Garda, passing through a populous region of high industrial activity, constitutes an important opening toward one of the finest Italian lakes, which for its numerous attractions and mild climate has become a center for the tourist at all times of the year. The line forms part of a network of steam tramways, such as Brescia-Soncino, Brescia-Gardone, Val Trompia-Brozzo and Tormini-Vestone, constructed by the Compagnie Générale des Chemins de Fer Économiques, of Brussels, and operated by that company till the end of 1906.

For a long time the necessity of electrifying the steam tramways had been felt, but it was only in 1907 that this project was finally realized. The Società Bresciana in 1907 acquired all the network of steam tramways from the Belgian company so as to be able to carry out the electrification of some of these lines and its vast program of electric enterprises, utilizing all the great quantity of power of the Chiesi and Oglio torrents in the Brescian district.

In July, 1907, the Società Elettrica Bresciana concluded the new contract with the province, acquiring the right of electrifying the tramway lines and a prorogation of the old concession of operation (1932) till the end of 1960. In May, 1909, the electrified lines Brescia-S. Eufemia and Brescia-Stocchetta commenced regular service. The first of these lines forms part of the Brescia-Salò line. From a technical point of view this line is of interest in that it is the first line constructed in Italy using direct current at 1200 volts. It constitutes a typical example of the other lines constructed or under construction which use the same system and from which it varies only in a few points due to the special conditions of the locality. The first decisive step in raising the e.m.f. of direct-current trolley lines was made with 1200 volts, not so much because of any obstacle that might be encountered with higher e.m.fs. as from the fact that, being just double the ordinary 600-volt tension, it presented itself as the most convenient, using the same material as for 600 volts and slightly modifying it, without having to construct all new material. Moreover, by a simple change of connections the cars running on the new 1200-volt lines can run on the old 600-volt lines, and this arrangement is very convenient where the lines must enter towns where a lower tension on the trolley wire is necessary.

The rapid success of the 1200-volt system is due to the above facts; that is, that it was able from the very first to assume a definite practical use without many experiments or changes of material. A 1200-volt-tension trolley line was recognized at once to be the most convenient also for an eventual extension of these lines and the electrification of the other steam tramways belonging to the system.

The line follows the southwestern outskirts of the town, passing by the railway station, from Porta Trento to Porta Venezia, and from these points runs toward Stocchetta and toward S. Eufemia respectively. The total length of the line is 33.5 miles; that is from Porta Trento to Stocchetta, 2.5 miles; from Porta Venezia to S. Eufemia, 2.5 miles, and from Porta Venezia to Toscolano, 28.5 miles.

The line is all single track, composed of rails 50 lb. per yard length, on wooden sleepers, except in the town and other inhabited parts of the road, where girder rails of 92 lb. per yard length are used. The track gage is 4 ft. 9 in. The track is nearly all on the provincial road, except for about 2.5 miles between Tormini and Salò, where it runs on the company's ground, and on this part of the track is the maximum grade of the whole line, which is 2.5 per cent. The minimum radius of the curves is from 130 ft. to 170 ft.

The Società Elettrica Bresciana owns an extensive network of high-tension distribution lines which cover all the Brescian province, with branches to Cremona and Mantova, fed from a great number of small hydroelectric generating stations and also by a steam-generating station at Brescia which is kept as a reserve in case of a failure in the water supply. The tension of the distributing lines is principally 40,000 volts, but in some places some of the lines are at 8000 volts and 3600 volts, while all the secondary lines have a tension of 220 volts

For the 1200-volt trolley line two transforming substations were constructed, one in the same building as the steam-generating station at Brescia and the other close to Salò. The latter serves also for the light distribution for Salò and the surrounding district.

The substation at Brescia contains two transforming groups, each composed of a three-phase, 8000-volt, 42-cycle synchronous motor directly coupled by means of a flexible coupling to a 200-kw, 1200-volt direct-current generator having commutating poles and separate excitation. One of these groups is kept as reserve. The excitation is furnished by two small groups (one for reserve) each composed of a 220-volt, 42-cycle induction motor and of a direct-current shunt generator at 115 volts between brushes.

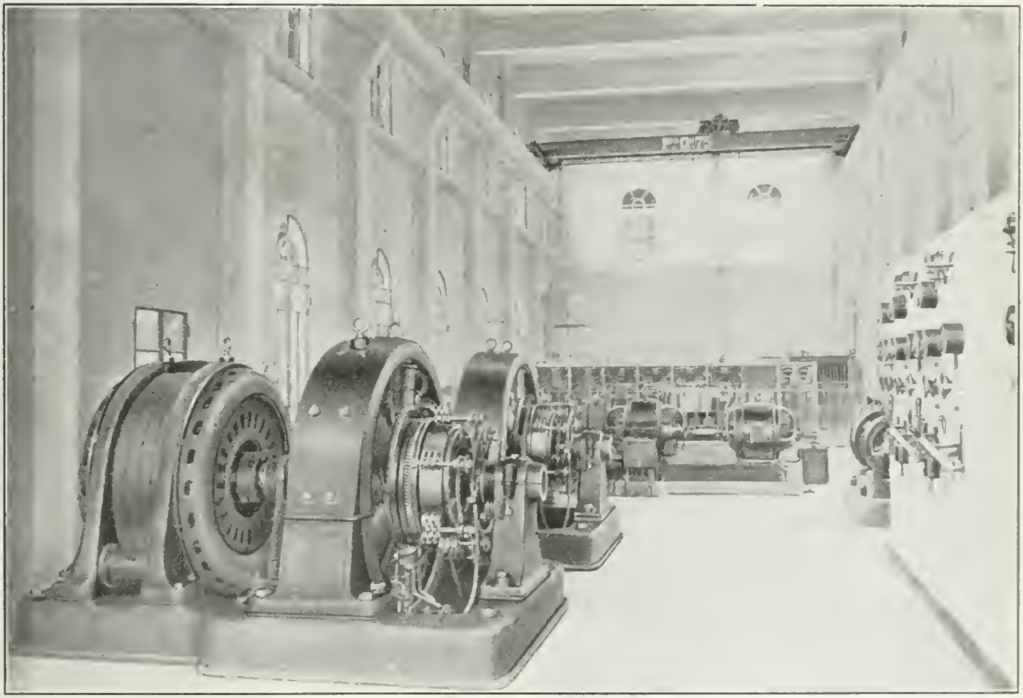


Fig. 1—The Salò Substation.

The substation also contains a battery of accumulators composed of 582 elements of 148 amp-hour rating, which works continuously in parallel with the generator, taking all the fluctuations of current on the 1200-volt trolley line. The generator works at practically constant load and, therefore, in good condition on account of the use of a Pirani booster, which assures automatically the charge and discharge of the battery at every slight difference of load on the trolley line.

The booster is composed of a double-commutator generator driven by a 220-volt, 42-cycle synchronous motor.

The battery is provided with special insulation due to the high tension which is reached on some of the elements. The walls of the battery-room near these elements are lined with specially treated wood covering.

The switchboard is composed of ten panels. The three-phase high-tension apparatus is kept completely separate from the low-tension apparatus.

All of the high-tension switches are inclosed in imitation stone cells with iron doors in the basement just underneath the switchboard, on which are fixed only the handles for the distant control, which is accomplished by means of a mechanism made of gas pipe.

The substation at Salò is constructed on the same lines as that at Brescia. The Salò substation groups are of 300 kw rating and the battery is of 108 amp-hour rating. In case of an increase in traffic a battery of equal rating will be added in parallel to the battery already installed in this substation. Two feeders go out from each substation at 1200 volts to two points on the trolley line close to the substation.

Of the two feeders from the substation at Brescia one feeds the trolley line at Porta Venezia and the other at a point close to the substation. Of the two feeders from the Salò substation one feeds the line close to the substation and the other feeds the line at Tormini. The line is divided into four independent parts insulated from one another by section insulators interposed between these feeding points.

The overhead 1200-volt line is constructed according to the catenary system throughout the whole route, even in the inhabited districts. With the greater security which the catenary line presents, the line at high tension does not cause any greater dangers in the towns than ordinary low-tension lines.

The trolley wire is groved and is of 95 sq. mm area except on the Tormini-Salò and Brescia-Stocchetta sections, where the area is reduced to 65 sq. mm.

The line is suspended in the town, or where there are buildings on which hooks can be fixed, by cross-spans; on the other part of the road by brackets on iron poles. A fairly good idea of the construction can be obtained from the accompanying illustrations. The line is anchored every 0.62 mile from iron poles similar to those with brackets, but of a heavier type.

The catenary system consists of a slack messenger wire of about 75 sq. mm cross-section carried by porcelain petticoat insulators on the bracket arm, and in cross-span construction the messenger is insulated by wooden strain insulators introduced in the span wire.

The trolley wire is supported from the messenger cable by special hangers consisting of screw-clamp ears, adopted for grooved-trolley wire. These hangers are provided with sister-hooks or clamps for engagement with the messenger cable. The ear and sister-hook grips are slotted to receive flat steel connecting strips or a stem to which they are riveted.

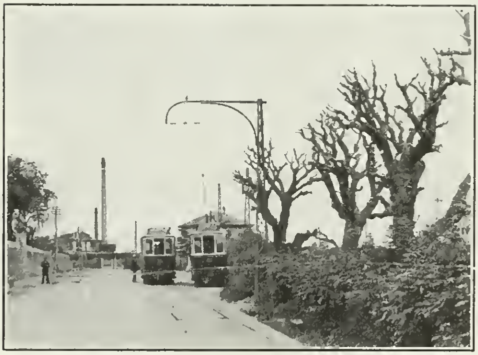


Fig. 2—Catenary Line Construction.

In span construction and also in bracket construction where the pole line is on the outside of the curve the alignment of the trolley wire with respect to the center line of the tracks is maintained by bridle pull-offs acting upon both the trolley and the messenger cable.

In bracket construction the alignment of the trolley wire is maintained either by the use of pull-off guys between poles in conjunction with bridle pull-offs or by the closer spacing of the poles and the use of steady braces. This latter method is used where the poles carrying the brackets are on the inside of the curve.

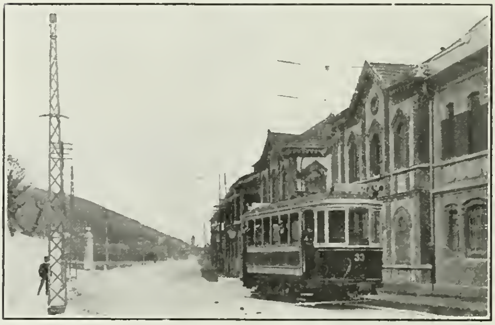


Fig. 3—Catenary Line Construction.

The principal characteristics of the catenary system are its simplicity and its elegant appearance. It also provides ample insulation surface for the highest potentials, and incidentally affords marked mechanical improvements, which is important with the high speeds of modern suburban and interurban operation.

Mention should be made of the special wood strain insulators. These insulators are of selected hickory split into sticks before being turned to insure straight grain and put to a special treatment to exclude moisture and thereby raise their insulating properties.

There are two types of trolley cars, the type for the service between Brescia and Toscolano being larger than those for the local service between Brescia-Stocchetta and Brescia-S Eufemia. The first type, of which there are ten, are four-axle cars built by Carminati Toselli, of Milan, and have seats for fifty and standing room for ten passengers.

The cars of the second type, of which there are eight, were constructed by the Maschinenfabrik Augsburg-Nürnberg; they have been designed for twenty persons sitting and twenty standing in the vestibules. The weight of the four-axle cars is 22 tons without passengers and the two-axle cars weigh 9 tons.

The electric equipments of the cars have been furnished by the General Electric Company, of Schenectady, N. Y. The two-axle cars are equipped with two motors connected permanently in series with rheostatic control. The four-axle cars are provided with four motors divided into two groups of two motors in series. These groups are arranged in series and parallel respectively, for accelerating and free running.

The motors are of the commutating-pole, 45-hp type wound for 600 volts, but insulated for 1200 volts. The commutating-pole windings are permanently connected in series with the armature, which arrangement insures a variation of excitation and commutating field strength in proportion with the load of the motor.

The control is, practically speaking, a standard automatic relay control for 600 volts insulated for the higher potential on the motor circuit. Its important elements are the master controller, situated in the vestibules, and the reverser, contactors and dynamotor located under the car. The action of the master controller, which is provided with a single-cylinder and direct-connected handle, is automatic in cutting off the supply and applying the air brakes should the motorman release his grasp on the handle. The reversing is accomplished by a 600-volt electrically operated reverser, which controls the direction of current in the field coils.

A commutating switch permits either pair of motors to be cut out of circuit. It is provided with contacts in series with the control wiring to prevent the controller being operated beyond the series position if two motors have been cut out of service.

The contractors are similar to those used for standard 600-volt operation, but are provided with additional insulation to suit the higher potential; that is to say, the parts subjected to 1200 volts are specially insulated from the operating coils and interlocks carrying the 600-volt current.

The contactors are supported in the box by insulated bolts, and the supporting plate is insulated from the box.

All of the protective devices are similar to those used on 600-volt equipment, with the exception that an additional blow-out is provided for the motor fuse to make it more effective.

A dynamotor provides 600 volts for operating the control circuits, thereby insuring greater personal security than if 1200-volt energy passed through the operating apparatus. This machine can be described as a motor-generator with two sets of windings wound on the same core and in the same slots. It is provided with a commutator at each end. The 600 volts for operating the control circuit is obtained as follows: The trolley is connected to one set of brushes on the first commutator, the other set of brushes on commutator No. 1 being connected to a set of brushes on commutator No. 2, while the remaining set of brushes on commutator No. 2 is grounded. As one set of windings is always generating while the other set is motoring it is obvious that the potential across the brushes of commutator No. 2 will be half of the applied voltage, namely, 600 volts.

The dynamotor has a rated output of 12 kw and furnishes energy not only for the control system, but also for the car illumination, for which there are seven lamps on the two-axle cars and twelve lamps on the four-axle ones, and also for the air-compressor motor.

A special point in this equipment will be found in the fact that the method of attaching the electrical apparatus to the underside of the car is novel and possesses some advantageous features.

All of the apparatus is hung from specially constructed wrought-iron frameworks, which, in their turn, are bolted to and insulated from the underside of the car. For example, the large contactor box, circuit-breaker, reverser, control rheostat for the dynamotor and small contactor box for the dynamotor, together with the rheostats, are hung from one metal framework, while the dynamotor is supported from another and the compressor outfit from a third. These metal frameworks are built up and drilled to template and the apparatus is also drilled to template. The principal advantages secured by the adoption of this method of installing the apparatus under the car are the following:

The number of holes drilled on the under framework of the car is minimized, and, therefore, the car structure is not weakened in any way; the apparatus is interchangeable from one equipment to another, everything being drilled to template; greater clearance is left above the apparatus for the installation of the cable conduits and the brake rigging; the apparatus can be installed in a much more compact manner, and thus more available room is left on the underside of the car.

Both the four-axle and the two-axle cars are equipped with hand brakes which can be operated from each vestibule, and a compressed-air brake of the Westinghouse type. On the four-axle cars the air for the brakes is compressed by a motor-driven pump fixed underneath the car floor. On the two-axle cars the air compressor is of the Kontinental Bremsen Gesellschaft type driven directly from the car axle.

SHORT CUTS IN HIGH-TENSION TRANSMISSION-LINE ESTIMATES.

By Clarence P. Fowler.

In these days of strenuous engineering activity any method of calculation which tends to lessen the time and labor of arriving at the desired result is welcome. It will be the purpose of these paragraphs to explain briefly the derivation and use of a method which the writer has found useful for quickly approximating the cost of transmission-line structures, and while it is susceptible to some error, yet it is sufficiently accurate for preliminary estimates, such as would precede a more careful study, which could only be made after a final survey of the best line location.

ESTIMATE OF COST OF CONDUCTOR MATERIALS

As is well known, the law which connects the relation of the weight of the conductor material in any transmission line with the distance, power used in transmission, line voltage and loss is that the weight of the conductor varies directly as the square of the distance and directly as the kilowatts and inversely as the square of the voltage and power-factor and inversely as the per cent of power lost in transmission.

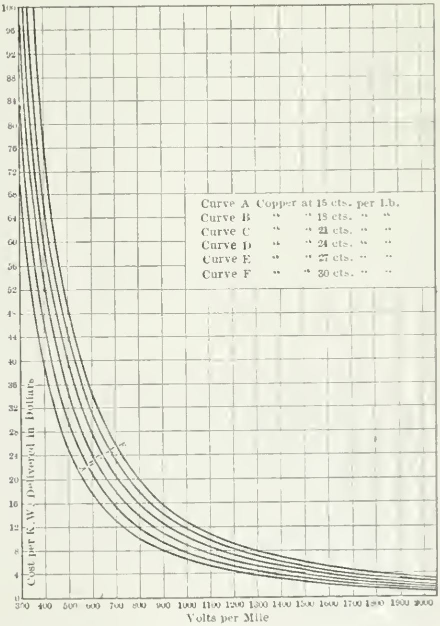


Diagram Showing Cost of Conductors in Three-Phase Circuits with 10 per Cent Energy Loss and 80 per Cent Power Factor.

This law for a copper three-phase line may be conveniently expressed algebraically as follows:

$$\text{Weight of copper} = \frac{(\text{distance})^2 \times \text{kw} \times C}{\left(\dfrac{\text{line voltage}}{1000}\right)^2 \times \text{per cent loss}}$$

the weight of copper being expressed in pounds and the distance in miles. C is a constant depending upon the system and power-factor. For 100 per cent power-factor and single or two-phase system $C = 363$ and for the same power-factor, but for three-phase system, $C = 273$. As high-tension transmission lines are universally three-phase, attention will be confined to this system in the preparation of the data which are included in this article.

Assume for the factors in the above formula the following values:

Transmission distance	1 mile
Power to be transmitted	1 kw
Line voltage	1000 volts
Loss in transmission	10 per cent
Power factor	100 per cent

Then the equation for weight of copper will become:

$$\frac{(1)^2 \times 1 \times 273}{\left(\frac{1000}{1000}\right)^2 \times 10} = 27.3 \text{ lb.}$$

From the weight of the copper above obtained the weight at 80 per cent power-factor, which is more commonly encountered in practice, may be obtained as follows:

$$27.3 \times \left(\frac{100}{80}\right)^2 = 42.58 \text{ lb.}$$

Figuring the cost of copper at 15 cents per pound, the cost of the conductor will be about $6.40 per kilowatt transmitted.

The above example shows the method used in calculating the data from which the accompanying curves were plotted and which give directly the cost of copper in a three-phase line under following conditions: Power-factor assumed to be 80 per cent, energy loss 10 per cent of the actual power delivered, line voltages ranging from 300 volts to 2000 volts per mile, and the price of copper varying from 15 cents to 30 cents per pound, by 3-cent increments. Values covering intermediate unit prices for copper can easily be taken from the diagram.

For other values of energy loss the cost varies inversely as the loss expressed in per cent, and can thus be obtained by multiplying the curve value by $\frac{10}{L}$ where L is the actual energy loss. For other power-factors, ranging from 100 per cent to 50 per cent, values are given in Table I, which, multiplied by values taken from the curves, will give the cost of conductors for respective power-factors. The following example will illustrate the use at the curves:

TABLE II.—COST OF THREE-PHASE LINE PER MILE FOR VARIOUS SIZES OF CONDUCTOR.

Size of Wire.	Weight per Mile of Three-Phase Line in Pounds.	COST OF CONDUCTOR PER MILE OF THREE-PHASE LINE.					
		15 Cents per Pound.	18 Cents per Pound.	21 Cents per Pound.	24 Cents per Pound.	27 Cents per Pound.	30 Cents per Pound.
No. 6 B. & S.	1,260	$189	$227	$265	$303	$341	$379
" 5	1,587	238	286	334	382	430	478
" 4	2,002	300	360	420	480	540	600
" 3	2,523	378	454	530	606	682	758
" 2	3,186	478	573	668	763	858	953
" 1	4,011	602	722	842	962	1,082	1,202
" 0	5,061	759	911	1,062	1,215	1,367	1,519
" 00	6,381	957	1,148	1,339	1,530	1,721	1,912
" 000	8,046	1,207	1,448	1,689	1,930	2,171	2,412
" 0000	10,143	1,521	1,825	2,129	2,433	2,737	3,041
250,000 circ. mil	12,078	1,812	2,174	2,536	2,898	3,260	3,622
300,000 " "	14,493	2,174	2,609	3,044	3,479	3,914	4,349
350,000 " "	16,908	2,536	3,043	3,550	4,057	4,564	5,071
400,000 " "	19,326	2,899	3,479	4,059	4,639	5,219	5,779
450,000 " "	21,741	3,261	3,913	4,565	5,217	5,869	6,521
500,000 " "	24,156	3,623	4,348	5,073	5,798	6,523	7,248

TABLE I.—MULTIPLIERS FOR CURVE VALUES FOR OTHER POWER-FACTORS THAN 80 PER CENT.

Per Cent Power Factor.	100	95	90	85	75	70	60	55	50
Multiplier	0.64	0.71	0.79	0.89	1.14	1.30	1.78	2.12	2.55

Let it be required to find the cost of copper per kilowatt delivered for a fifty-mile three-phase line operating at 40,000 volts with 10 per cent loss and 100 per cent power-factor, the price of copper being 15 cents per pound.

$$\text{Volts per mile} = \frac{40,000}{50} = 800.$$

From the diagram it will be seen that the line of 800 volts per mile intersects curve A (copper at 15 cents per pound) at a price slightly below $10 per kilowatt transmitted, which is the value for a power-factor of 80 per cent. However, the power factor assumed in this example is 100 per cent and, by referring to the table of multipliers, it will be noted that 64 per cent of the above figure represents the true cost per kilowatt transmitted, which gives a cost slightly under $6.40 under the above-stated conditions as to loss, power-factor and line voltage. When the kilowatts to be transmitted are known the total cost is at once obtained by multiplying the same by the figure read from the curves. While the above process gives the cost per kilowatt transmitted, it does not give any clew as to the approximate size of wire which such cost implies, and which, of course, is desirable knowledge in making preliminary calculations on line regulation. This, however, may be obtained from Table II, which gives the cost per mile for various sizes of conductors in a three-phase line at the same range of prices per pound of copper as used in connection with the curves.

In demonstrating the method of using Table II, assume that it be required to transmit 6000 kw in the case of the previous example, from which the total cost for conductors is calculated to be $6.40 × 6000 = $38,400. Thus the cost of copper per mile is

$$\frac{\$38,400}{50} = \$768.$$

By recourse to Table II in column corresponding to copper at 15 cents per pound it will be found that the nearest standard-size copper wire corresponding to the above cost is that of No. 0 B. & S. Similarly, any other of the many combinations that may arise may be quickly handled with sufficient accuracy for all practical purposes in any preliminary study. It should be noted that no allowance is made in the above for sag, waste, etc., which may add from 2 per cent to 3 per cent to the cost as obtained above.

When the size of wire is determined a preliminary calculation should be made by any of the well-known methods to ascertain what line regulation may be expected. In the example before us, when using three No. 0 B. & S. copper conductors, having a spacing commonly met with for voltages of the order of magnitude assumed in the problem and a frequency of 25 cycles per second, the total drop is in the neighborhood of 10 per cent of the delivered voltage, which is well within limits prescribed by the best practice.

ESTIMATE OF COST OF TRANSMISSION-LINE STRUCTURES AND STRINGING OF WIRES.

While, as previously pointed out, no exact determination of line cost can be ascertained until a detailed study of all the local factors affecting same has been made, yet there are various typical forms of construction which may be taken as averages from which an approximate idea of the cost may be determined which will serve sufficiently well the purposes of a preliminary estimate and which may not be so very wide of the mark for any given type of construction assumed.

With the above idea in mind, the writer has prepared the following estimates covering several typical transmission-line structures which will be found useful as representing average cost per mile in lines commonly used in this country. These typical estimates do not cover the suspension type of insulator, which can hardly be said to be in general use as yet, and the potentials considered here do not exceed 60,000 volts, at which voltage and below which the pin-type insulator serves its purpose well.

ESTIMATED COST OF TRANSMISSION LINE, EXCLUDING COST OF RIGHT-OF-WAY AND CONDUCTOR MATERIAL.

(A) WOODEN POLES, THREE-PHASE, 2000 VOLTS.

	Cost per Mile.
50 poles at $10, erected	$500
50 crossarms at $2, erected	100
Telephone wire	30
Pins and insulators for telephone line	12
Installing transmission-line wire	100
Installing telephone wire	50
155 transmission-line pins and insulators at 20 cents	31
Guying and miscellaneous	35
Total for pole structure (exclusive of transmission-line wire and right of way)	$858
Add 22 per cent for engineering, contingencies and contractor's profit, making a total of approximately	$1,050

(B) WOODEN POLES, THREE-PHASE, 13,000 VOLTS.

	Cost per Mile.
50 poles at $10, erected	$500
50 crossarms at $2, erected	100
Ground wire No. 8	35
Telephone wire No. 10	30
Pins and insulators for telephone line	12
Installation of transmission line and ground wire	100
Installation of telephone wire	50
155 transmission-line pins and insulators at 40 cents	62
Guying and miscellaneous material	50
Total cost per mile (exclusive of transmission-line wire and right-of-way)	$939
Add 22 per cent for engineering, contingencies and contractor's profit, making a total of approximately	$1,150

(C) WOODEN POLES, THREE-PHASE, 40,000-60,000 VOLTS.

	Cost per Mile.
50 poles at $12, erected	$600
Ground wire No. 8	35
Telephone wire No. 10	30
Pins and insulators for telephone line	12
Installation of transmission line and ground wires and distribution	125
Installation of telephone wire	50
100 crossarms with brackets installed	500
155 insulators for transmission line at $3.50	543
150 pins for transmission line	125
Guying and miscellaneous	50
Total cost per mile (exclusive of transmission-line wire and right-of-way)	$2,070
Add 22 per cent for engineering, contingencies and contractor's profit, making a total of approximately	$2,500

(D) SINGLE-CIRCUIT STEEL TOWERS, THREE-PHASE, 40,000-60,000 VOLTS.

	Cost per Mile.
12 single-circuit steel towers, erected (including foundations) at $150	$1,800
36 insulators at $3.50	126
Ground wire	80
Telephone wire	70
Pins and insulators for telephone line	2
Installation of transmission line and ground wires	180
Installation of telephone wire	50
Miscellaneous material	23
Total cost per mile (exclusive of transmission-line wire and right-of-way)	$2,331
Add 22 per cent for engineering, contingencies and contractor's profit, making a total of approximately	$2,850

(E) DOUBLE-CIRCUIT STEEL TOWERS, THREE-PHASE, 40,000-60,000 VOLTS.

	Cost per Mile.
12 double-circuit steel towers, erected (including foundations) at $200	$2,400
36 insulators at $3 50 (for one three-phase circuit only)	126
Ground wire	80
Telephone wire	70
Pins and insulators for telephone line	2
Installation of transmission line and ground wires and distribution	180
Installation of telephone wire	50
Total cost per mile (exclusive of transmission-line wire and right-of-way)	$2,908
Add 22 per cent for engineering, contingencies and contractor's profit, making a total of approximately	$3 550

If we adhere to our original problem of transmitting 6000 kw fifty miles under the conditions assumed, the total approximate cost of conductors, stringing of same and supporting structures (assuming wooden-pole construction), exclusive of cost of right-of-way, would be as follows:

	Cost per Mile.
Conductors, three, No. 0 B. & S. copper wire at 15 cents	$760
Engineering, contingencies and contractor's profit, 22 per cent	165
Wooden-pole line, as per estimate C, including 22 per cent for engineering, contingencies and contractor's profit	2,500
Total cost per mile approximately	$3,400
From which the total cost of line, exclusive of right-of way, is 50 × $3,400	$170,000

To arrive at the total cost of the line structure it is, of course, necessary to add to the above figure the cost of the right-of-way, which varies between such wide limits in different localities that it is impracticable to use any general average here that would be of value. The figures covering this item, together with the final solution of the line as a mechanical and electrical structure, can be determined only after a careful study of all the local factors, such as climate, topography, etc., peculiar to any given line location.

Central Station
Management, Policies and Commercial Methods

ELECTRIC COMPANY NOT LIABLE FOR INJURY BY ELECTRICITY TRANSMITTED THROUGH CLOTHESLINE.

In a recent action brought against an electric light company in the State of Pennsylvania it appeared that the plaintiff's wife was killed by an electric current that passed from the defendant company's feed wire to a guy wire and thence to a clothesline in her yard on which she was at at the time hanging clothes. The guy wire extended from the top of the electric light pole along the division line and was fastened to the pole in the alley about 7 ft. above the ground. At the time of the accident the clothesline was wrapped around the guy wire and around the post. It did not appear who did this, but there was no evidence to warrant an inference that it was done by the defendant company's employees when the guy wire was renewed. A cross-arm, carrying an electric wire, broke, causing the wire to come in contact with the guy wire and bringing about the death of the plaintiff's wife. The jury found the defendant company negligent in not maintaining its wire in a safe condition, but the trial judge disregarded the verdict and gave judgment in favor of the company on the ground that, if the company was negligent, its negligence was not the proximate cause of the accident. This judgment was affirmed on appeal. The guy wire was not in itself a danger to anyone even if it became accidentally charged with electricity. The only danger in the situation was created by the deceased, or someone acting for her, in making an unauthorized and manifestly unsafe use of the pole and guy wire.

FLAMING-ARC ORNAMENTAL STREET LIGHTING.

The Edison Electric Light Company, of York, Pa., recently completed the installation of about forty regenerative flaming-arc lamps in the business district, this special lighting being paid for by adjacent merchants. The lamps are of the Adams-Bagnall type and are hung at about 100-ft. intervals at a height of 20 ft. over the center of the street. After nightfall the districts thus illuminated present a brilliant appearance.

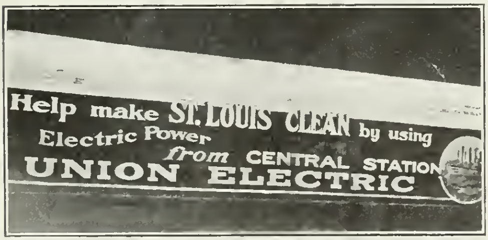
For each lamp installed the electric company collects from adjacent merchants $6 per month. This amount is made up in various instalments, each merchant paying from $1 to $1.50, as he feels willing, but for each lamp the company obtains a guarantee from some responsible property owner in the neighborhood that the entire $6 will be paid or that he will himself make up the difference. The company's representative makes the collections, appealing to the guarantor only in case of non-payment, and then the intervention of a fellow-citizen is usually effective in bringing the tardy one to time. The flaming-arc lamps are of the 110-volt multiple type, but are operated during the same hours as the regular lighting circuit, from dusk to 10 p. m. York citizens are well pleased with the extra illumination.

ST. LOUIS DOWNTOWN LIGHTING ASSOCIATION.

St. Louis is one of the best lighted cities of the country, so far as the general street lighting of its "downtown" district is concerned. Magnetite arc lamps are used, as described in the *Electrical World* of May 19, 1910, page 1284. Much of the credit for this state of affairs is due to the Downtown Lighting Association, which, having accomplished its object, wound up its affairs on Feb. 24, 1911. The records of the association were sent to the Missouri Historical Society. The amount collected from members and subscribers was $29,214, and with this money 429 handsome lamp-posts, each equipped with a 500-watt lamp, were installed at a cost of $25,740. The sum of $2,728 was paid for salary and expenses. The small balance remaining in the treasury was given to a hospital fund. Before dissolving the association adopted resolutions thanking the Board of Public Improvements, the Union Electric Light & Power Company and the Civic League for co-operation in its work.

CENTRAL-STATION BILLBOARD ADVERTISING IN ST. LOUIS.

The Union Electric Light & Power Company, of St. Louis, is doing considerable billboard advertising, and two examples of signs of this character are illustrated herewith. The newspapers in St. Louis are making a campaign against the smoke nuisance, and in line with this agitation the central-station company has recently erected a large signboard bearing the legend, "Help make St. Louis clean by using electric power from central station." Above is a panoramic view of the city, and a picture of the Ashley Street generating station is also given. This large board is illuminated at night (indeed, the photograph reproduced herewith is a night picture) and makes a conspicuous piece of advertising.



Billboard Advertisement.

Other signs of this general character have been erected. They carry the following announcements:

"The St. Louis industrial campaign established here last year 135 factories. Cheap power had much to do with it. The Union Electric sells it."

"The things St. Louis factories made last year were sold for more than $300,000,000. They would have cost the people more but for the cheap electric power sold by the Union Electric."

"The factory product of St. Louis has increased nearly 50 per cent in ten years. There are reasons. One is cheap power sold by the Union Electric."

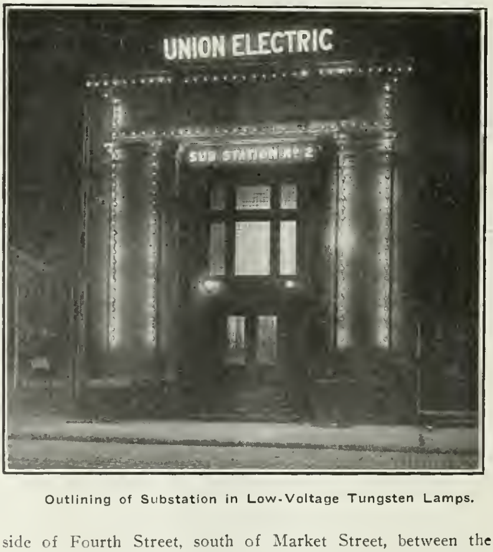
"St. Louis is becoming a world manufacturing city. Nearly $40,000,000 worth of goods made here were exported last year. Our manufacturers meet competition in foreign markets. Union Electric cheap power helps to do it."

It will be noted that by these billboard advertisements the company identifies itself with the industrial advancement of the city and is continually "boosting" St. Louis. Incidentally, the industrial advantages of electric drive are pointed out The statistics given were obtained from the Business Men's League of St. Louis, which co-operates with the central-station company in this campaign and is pleased to have the powerful assistance of the Union Electric Company in exploiting the industrial advantages of the city.

An automobile sign, arranged to be illuminated at night, has been erected on Lindell Boulevard, a thoroughfare largely used by automobiles. The sign is very prominent and brings to attention in a striking way the convenience of electric pleasure cars, particularly for ladies.

ILLUMINATED ST. LOUIS SUBSTATIONS.

The accompanying illustration is a night view of the street front of substation No. 2 of the Union Electric Light & Power Company of St. Louis. This substation is located on the east side of Fourth Street, south of Market Street, between the Planters' Hotel and the Southern Hotel. This is a conspicuous downtown location, where many out-of-town people congregate. The prominent "Union Electric" sign is also seen by St. Louisans who live in South St. Louis and use the Fourth Street car line. The dignified architectural features of the façade are outlined in 5-watt tungsten lamps. The sign on the roof



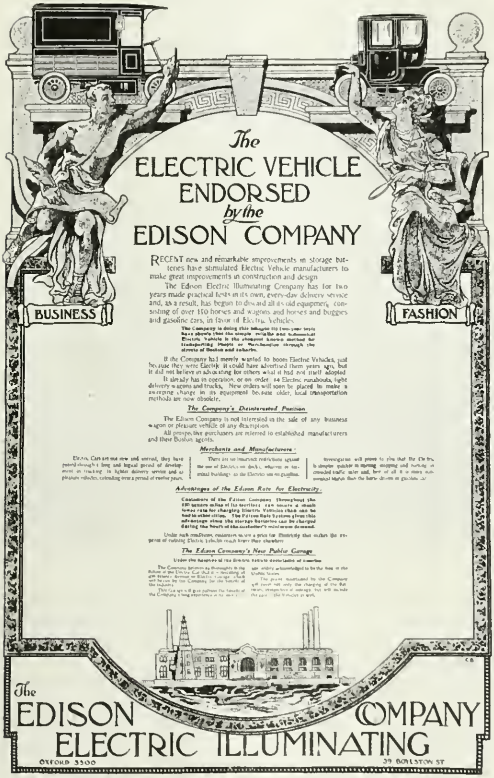
Outlining of Substation in Low-Voltage Tungsten Lamps.

consists of letters 2 ft. high, while the sign above the main entrance, "Substation No. 2," is made of letters 1 ft. high. There are 210 5-watt tungsten lamps in these signs. They are wired in series multiple and operated on the 115-230-volt, three-wire, direct-current mains of the company.

Substation No. 1 of the Union Electric Light & Power Company is located at Fourth Street and Lucas Avenue and is also made conspicuous with electric signs and outlining similar to substation No. 2, shown in the illustration. The company is thus enabled to utilize the locations of its downtown substations for advertising purposes after dark.

BOSTON ELECTRIC VEHICLE CAMPAIGN.

The accompanying illustration is a reproduction to small scale of an advertisement inserted in all Boston daily newspapers on Saturday, March 4, to mark the beginning of a systematic campaign by the Boston Edison Company in the interest of the electric vehicle, an account of which appears elsewhere. As printed, the announcement was full-page length, and while somewhat short of full-page width the effect was even better than if all of the space on a page had been occupied. The appearance of the advertisement also coincided with the opening of the annual Boston Automobile Show on Saturday evening. The show is the most successful automobile exhibition ever held in Boston, but the gasoline cars so predominate that the electric vehicles are overshadowed, these, unfortunately, not being gathered into one section, where they would have commanded attention in the aggregate, as well as individually.



The ELECTRIC VEHICLE ENDORSED by the EDISON COMPANY

RECENT new and remarkable improvements in storage batteries have stimulated Electric Vehicle manufacturers to make great improvements in construction and design.

The Edison Electric Illuminating Company has for two years made practical tests in its own, every-day delivery service and, as a result, has begun to discard all its old equipment, consisting of over 150 horses and wagons and horses and buggies and gasoline cars, in favor of Electric Vehicles.

The Company is doing this because its two-year tests have shown that the simple, reliable and economical Electric Vehicle is the cheapest known method for transporting People or Merchandise through the streets of Boston and suburbs.

If the Company had merely wanted to boom Electric Vehicles, just because they were Electric it could have advertised them years ago, but it did not believe in advocating for others what it had not itself adopted.

It already has in operation, or on order, 44 Electric runabouts, light delivery wagons and trucks. New orders will soon be placed to make a sweeping change in its equipment because older, local transportation methods are now obsolete.

The Company's Disinterested Position

The Edison Company is not interested in the sale of any business wagon or pleasure vehicle of any description.

All prospective purchasers are referred to established manufacturers and their Boston agents.

Merchants and Manufacturers:

Electric Cars are not new and untried, they have passed through a long and logical period of development in trucking, in lighter delivery service and as pleasure vehicles, extending over a period of twelve years.

There are no insurance restrictions against the use of Electrics on docks, wharves or terminal buildings, as the Electrics use no gasoline.

Advantages of the Edison Rate for Electricity.

Customers of the Edison Company throughout the 500 square miles of its territory can secure a much lower rate for charging Electric Vehicles than can be had in other cities. The Edison Rate System gives this advantage since the storage batteries can be charged during the hours of the customer's minimum demand.

The Edison Company's New Public Garage

The Edison ELECTRIC ILLUMINATING COMPANY

OXFORD 3500

39 BOYLSTON ST

Newspaper Advertisement for the Electric Vehicle Campaign.

The electric vehicle newspaper advertising of the Boston Edison Company during the period of the exhibition should, to a considerable extent, overcome the relatively poor showing in electric vehicle exhibits at Mechanics' Hall.

CENTRAL-STATION ADVERTISING METHODS AT ROANOKE, VA.

The Roanoke Railway & Electric Company, which supplies electricity for lighting and motor service to the City of Roanoke, Va., has conducted an aggressive advertising and new-business campaign during the last twelve months, as a result of which an increase of 22 per cent has been shown in its total number of customers, 22 per cent increase in lighting load, 54 per cent increase in connected motor load, 25 per cent in electric irons and about 27 per cent on other electrical appliances. In Roanoke, which has a population of 35,000, about 3000 electric irons are now in use on the lines of the company.

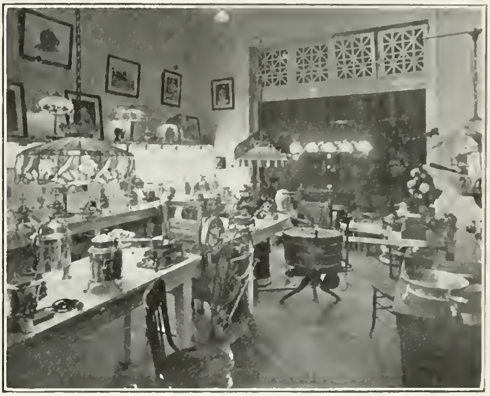


Fig. 1—Interior of Electric Appliance Salesroom.

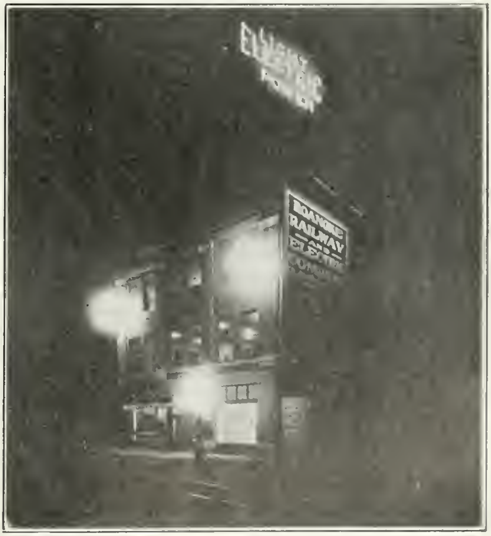


Fig. 2—Illumination of Central-Station Office at Roanoke, Va.

Besides its electric service the company also operates the local street-railway system and uses car-space advertising effectively in increasing its sales of electricity and appliances. On the front and rear ends of the cars 22-in. x 28-in. cards are employed to exploit the use of tungsten and other high-efficiency lamps. Attractive advertising cards inside the cars are changed frequently and are used to call attention to electric irons, sewing-machine motors, fans and other household devices. The backs of the street-car transfers are also used to advertise tungsten lamps.

Although there is a diversity of opinion on the subject of the advisability of advertising on the backs of monthly bills, the Roanoke company uses this space to explain the convenience and advantages of various electric appliances on sale in its exhibition-room, an interior view of which is shown in Fig. 1. All local mail matter sent out also contains literature describing electrical apparatus for sale by the company. In the three daily newspapers of Roanoke the company runs a 10-in. space which is changed weekly and is used exclusively to advertise tungsten lamps.

The campaign has been directed especially toward the exploiting of high-efficiency electric illuminants, particularly as the result of the presence of a very active gas company in the city, which offers to pipe any store free of charge and furnish the latest type of inverted gas "arc lamp" at a rate of $1.12 per 1000 cu. ft. Nevertheless, the sale of tungsten lamps has been very satisfactory. Practically every window in the business district is illuminated by electric lamps, and at least 80 per cent of the stores use electricity for furnishing all or part of their lighting needs.

During the 1910 local fair week the company equipped an attractive booth in one of the exhibit buildings with all kinds of electrical lamps and display of various electrical devices. Thousands of pamphlets covering every piece of apparatus on sale were also distributed to the public.

Up to the present time no particular campaign on electric signs has been made, but a number of attractive displays, including several large roof signs, have been sold. Fig. 2 shows the brilliant night illumination of the Roanoke company's own building, 38 ft. above the roof of which is its sign, 30 ft. x 18 ft. Mr. F. T. William's is sales and contract agent for the company.

ANOTHER SCHOOL OF INSTRUCTION FOR NEW YORK EDISON COMPANY EMPLOYEES.

The recent opening of a new laboratory in the Bronx marks another step of progress in the effort of the New York Edison Company to provide educational opportunities to its employees. The new laboratory is as complete in every manner of equipment as it can possibly be made and is even larger than the original one at the Twenty-seventh Street substation, which was opened in 1908.

With the opening of the new laboratory the company's educational work is so arranged that there are now night courses for day workers, day classes for night workers, an uptown division for the men living there and the Twenty-seventh Street Laboratory for employees who find that more convenient. In fact, there is no excuse for anyone in the company's employ failing to gain a fair amount of technical knowledge if he really wishes to do so.

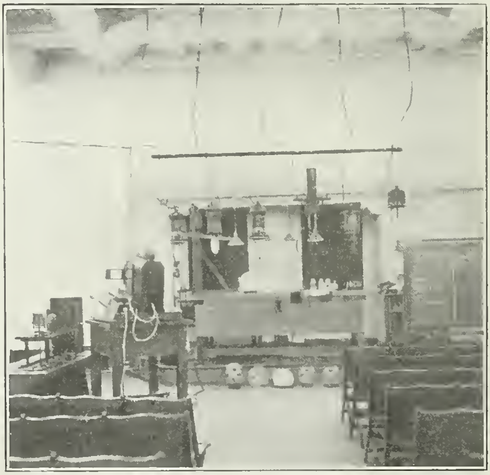
This situation represents the further development of the company's plan to extend to its employees a chance to obtain the technical information necessary to advance themselves entirely without personal expense. The classes are open to every employee, whether he be a clerk in one of the offices or a helper in a workshop.

To encourage the men to do good work in their studies at the end of each course a number of prizes are given to those who have been regular in attendance and have submitted complete reports on their work. At the end of the last year eighteen men won prizes. These consisted of cash or a high-grade slide rule, such as is used by electrical engineers. Every prize was accompanied by a personal letter from the general manager. It was found that in many instances the letter was really more valued by the recipient than the prize. It brings directly home to the man the assurance that he can actually by earnest and self-denying effort accomplish a worthy task and that his endeavors are noted by those in authority.

This encouraging of the individual importance of each man in a great machine where thousands are employed, so that each one will feel that in his own little sphere he is doing as much to forward the interests of his employers as is the head of his department, is fully as valuable as the technical knowledge expounded to the men in the laboratories.

Some four years ago the New York Edison Company started its educational work on systematic lines. In 1906-7-8 a series of lectures were given by Prof. Sydney W. Ashe. There then developed a demand for laboratory work and in 1908 a laboratory was fitted up at the Twenty-seventh Street transforming station. Apparatus was obtained from the storerooms of the company and altered in the shops to suit the demands. Tables and wiring and all kinds of currents were provided. The work started by a single series of experiments being performed, instruction being furnished by members of the technical staff of the company.

In 1909-10 three distinct courses of work were planned. First, an elementary course in the principles of electricity; second, a course in direct-current machinery, and third, a course on alternating-current usage, each course consisting of fifteen experiments. The first grade was for employees with no previous electrical instruction. The second was for more advanced men and consisted of tests, practical operation and connections of direct-current motors and generators. The third course included both elementary tests in alternating-current circuits and the study and operation of apparatus similar to that used in the system. Some new apparatus was acquired last year and the afternoon classes were instituted.



Auditorium.

It has been found possible and practicable to bring to the laboratory any apparatus in the company's possession which could be handled without a crane, and the educational committee has stopped at nothing short of this. Oftentimes considerable ingenuity is required to adapt apparatus to the needs of the occasion; for instance, a series of interesting tests was made using an induction motor of the wound-rotor type as an induction regulator, while transformer connections of great variety have been set up.

This year work was started along the same lines on a considerably enlarged scale. The course this year covers all the "meat" of a college course and in text-books. Another improvement this year is the distributing of printed instruction papers a week in advance of the test, with complete diagrams of the apparatus to be used. A binder is also provided to keep the instruction papers in and regular stationery is furnished to the men to report their tests on. Papers are handed in to the instructor and afterward are returned to the different students properly corrected.

The scheme in part is to lay out the principles and practical application and then explain the details and further application on the blackboard. No matter how large the classes are enough instructors are provided so that individual attention is the rule. Both last year and this year the registration has approximated 300. A reference library with all current domestic and foreign scientific publications is continually at hand. The company looks upon this work as proof of a man's ability and it is of considerable weight in judging his qualifications for advancement, since the courses laid out cover company work and the instruction is given entirely by technical men who are perfectly familiar with company conditions and problems. In addition to heads in the various departments men of such prominence as Dr. Charles P. Steinmetz lecture to the men taking the educational courses. Men from the testing department, both meter and general sections, and from the inspection, engineering, operating and distribution departments, have given interesting lectures of practical value. Mr. V. R. Greiff, who was formerly general tester for the New York Edison Company, now devotes his entire time to instructing classes, preparing the lesson courses, correcting papers and supervising the preparation of the laboratories.

Laboratory for Lecture Courses.

It is, of course, of importance that every man should have some technical knowledge, and the instruction has been found useful to men from the highest to the lowest stations. A chief in the collection department was one of the men registered in the course. Although laboratory work began in 1908, already in a number of instances men who have done well in the classes have made more than a little progress in bettering their positions.

There was one instance of a telephone boy who raised himself through this course of instruction to the position of an assistant tester in a station, his immediate superior being a college graduate. Another case of advancement was that of a laborer who is now a cable splicer. It is the object of the company that every man shall have the opportunity to advance himself by this work. The only thing that can possibly stand between him and his advancement is himself.

The educational committee consists of Mr. Alexander Maxwell, chief of the laboratory; Mr. W. J. Donshea, superintendent of the first district; Mr. W. H. Lawrence, superintendent of the Waterside generating stations; Mr. A. H. Lawton, assistant chief electrical engineer; Mr. A. Rabe, general foreman of distribution; Mr. J. C. Van Duyne, fiscal department; Mr. W. H. Hill, assistant superintendent of construction; Mr. F. B. Magalhaes, superintendent of meter department, and Mr. Clarence Selden, assistant superintendent of the Bronx office of the company.

Wiring and Illumination

DOWNWARD LIGHT VERSUS EYE STRAIN.

In planning the artificial lighting of audience rooms and other places where it is especially desirable to avoid injurious light shining in the eyes illuminating engineers have been proceeding along two general lines. One has been to get the illumination from sufficiently large diffusing surfaces so that the surface brightness of the globes or diffusing surfaces is low enough to be unobjectionable. This has been done sometimes by the use of diffusing globes placed over the lamps; in other cases by the use of lamps placed above skylights of diffusing glass; and in still other cases by indirect illumination by the reflection from light-colored ceilings and walls. Another general remedy which has been applied has been that of causing the rays of light to come from the primary or secondary sources mainly in downward directions—that is, at angles near the vertical. An exaggerated case of this was described in these columns some time ago where very concentrating opaque reflectors were used high above an audience room to the exclusion of any other source of light, with the result that while the illumination on a horizontal plane was very high because of the general downward direction of the light the vertical illumination was very low. The practical effect of this was an illumination more than ample for reading, while at the same time it was difficult to recognize persons a short distance away on account of the absence of horizontal rays of light. It is seldom that illumination by means of downward rays of light is carried to such an extreme, but this case serves to illustrate a principle.

The fact is the illuminating engineer at the present time apparently has to choose between two evils. If he illuminates the faces of persons in a room fully, where walls and floor are dark in color, he must place lamps so low as to be near the ordinary range of vision. If he places lamps high and protected with shades and reflectors, or if in rooms with dark walls he uses indirect lighting with most of the illumination coming from central ceiling areas, most of the rays of light will come in nearly vertical directions and a condition will obtain which is very comfortable as far as the eyes of the occupants are concerned. But under such circumstances the illumination of upright objects and the faces of persons will be surprisingly low. As already intimated, the color of the floor and walls of the room will have much to do with the effect on faces. In other words, if in a certain room the principal visible source of illumination is either lamps with efficient reflectors placed high or a ceiling highly illuminated from concealed lamps the illumination received on faces of persons in that room from either of these sources may be satisfactory if the floor and walls are light and unsatisfactory if the floor and walls are dark.

Several audience rooms have been recently lighted from high light sources in a manner most acceptable and comfortable to the audiences. Illumination on the faces of speakers, however, left much to be desired. Theater-stage lighting is a good example of the absolute necessity of having light come from many directions if speakers' faces are to be fully lighted. On the stage the actor has light directed on him from above and below and from the sides. The results are decidedly trying to the eyes of the actor, but satisfactory as far as the audience is concerned.

From what has been said it is evident that the illuminating engineer must in many cases (where walls and floors are dark) choose between the evil of eye discomfort and the evil of insufficient vertical illumination fully to illuminate faces. His ability properly to illuminate faces with downward light as the principal primary source of illumination will depend largely on how much light can be obtained by diffused reflection from floors and walls.

INVESTIGATION OF THE ENERGY LOSSES IN INCANDESCENT LAMP FILAMENTS.

In a paper presented before the Boston Section of the Illuminating Engineering Society recently Messrs. E. P. Hyde, F. E. Cady and A. G. Worthing described certain investigations of the energy losses by thermal conduction in incandescent-lamp filaments. The authors stated that in studying the radiating properties of substances which can be formed into filaments and mounted in exhausted bulbs it is frequently desirable to know what proportion of the power supplied to the lamp is radiated by the filament and what fraction is lost by thermal conduction and convection. Several investigators[1] have assumed that the losses by thermal conduction and convection are relatively small, and this assumption seems to be borne out by the experience of lamp manufacturers.

On the other hand, the various investigations[2] that have been pursued in a direct study of these losses have led to values ranging in general from 20 per cent to 40 per cent. In these investigations the method employed has always consisted in an attempt to measure directly the energy received in radiation from the lamp, usually by means of a bolometer. In this way that part of the energy absorbed by the glass bulb which is dissipated by thermal conduction and convection of the surrounding air does not reach the bolometer or other measuring instrument. Whatever may be the explanation of the large values recorded in the literature of the subject, the inference at times has been made that a large part of the loss is due to conduction of heat at the leading-in and anchoring wires, resulting in a cooling of the filament in the neighborhood of these supports. It has seemed, therefore, a matter of some importance to institute a further investigation of the energy losses, using some new method which would give a positive indication of the thermal conduction losses at the leading-in wires and the supports of the filament.

Of the power supplied to an ordinary incandescent lamp only a very small fraction, well under 1 per cent in normal commercial lamps, is dissipated by the I^2R loss in the base and stem of the lamp. Measurements on a number of carbon, tantalum and tungsten mounts gave this loss as approximately 0.1 per cent. The rest of the power supplied to the lamps is transformed into heat in the filament itself, and if the losses by thermal conduction and convection are subtracted the remainder must be radiated by the filament. A preliminary experiment showed that, although the losses by convection and conduction of heat by gas inclosed in the lamp bulb may be very large if the pressure is high, the quantity of gas in good commercial lamps is so small that the heat losses due to this effect are negligible.

It remained, therefore, to study the losses by conduction away of heat at the leading-in and anchoring wires. The method employed in this study is a modification of that involved in the Morse and Holborn-Kurlbaum optical pyrometers. The image of a large tungsten filament was projected by means of a lens in the plane of the filament of the ordinary commercial lamp under investigation. A telescope supplied with a red glass over the eyepiece was focused on the image of the large filament and, therefore, on the filament of the test lamp, which was in the same plane. The filament of the test lamp when viewed through the telescope appeared as either a bright line or a dark line across the bright image of the large filament, depending upon the brightness of this background image, which could be controlled by varying the current through the background lamp. By properly adjusting the background current the test filament could be made to disappear against the background.

The test lamp was mounted in a socket which could be moved either sideways or up and down, thus permitting any portion of the test filament to be seen against the image of the background filament. As successive portions of the test filament were brought into coincidence with the background image current measurements of the background lamp corresponding to a disappearance were made. In this way the entire test filament was explored, measurements being carried as close to the supports as the reduced luminosity would permit. The results of such measurements on a 60-watt, 110-volt tungsten lamp are shown in Fig. 1, in which abscissas are distances from a leading-in wire to successive points on a filament up to the welded end, and ordinates are background current values. The effects of cooling at the two ends and at the anchor, 80 mm from the leading-in wire, are plainly shown.

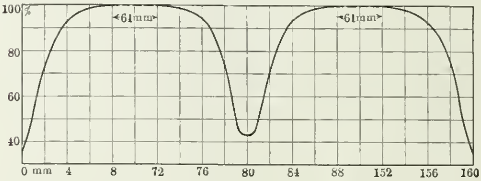


Fig. 1—Relation Between the Current Required in the Background Lamp for Intensity Match with Successive Filament Elements of a 60-Watt, 110-Volt Tungsten Lamp.

Having determined this background-current curve for the whole length of filament, the method employed consisted, in brief, in determining from this curve the power supplied, the power radiated and the luminous flux from every element of filament. To do this the watts supplied to the test lamp were reduced so that some element of the filament, away from the cooling effects of the ends, was reduced in luminosity to correspond with that of some end element of the filament when the test lamp was at normal wattage, as determined by the background current for a disappearance. The assumption was then made that the ratio of the watts supplied to the test lamp at the reduced voltage to the watts at normal operation was the same as the ratio of the radiation from the central element of the filament at the two voltages to within second order corrections. In this way a curve showing the relation between background current and test-lamp watts was obtained, and from it, by reference to Fig. 1, the radiation from every element of filament of the test lamp was determined.

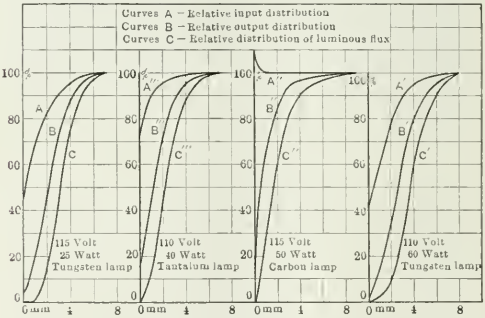


Fig. 2—Average Curves, Showing Conduction Losses for Various Types of Lamps at Normal Operation.

In a similar way the resistance and the luminous flux of every element of filament were determined. From the former the power supplied to each element of filament was obtained. Having determined, therefore, the power supplied, the power radiated and the luminous flux for every element of filament, it was a very simple matter to compute the percentage losses in power and in efficiency due to the cooling effect of the leading-in and supporting wires. Fig. 2 shows the average results obtained for a normal 115-volt, 3.1-w.p.c. carbon lamp; a 110-volt, 40-watt tantalum lamp; a 115-volt, 25-watt tungsten lamp, and a 110-volt, 60-watt tungsten lamp, all at normal operation. Thus curves are given for each lamp showing the power supplied, the power radiated and the luminous flux of each element of filament—the curves being plotted in arbitrary units so chosen that the value at the center of the filament is unity. In Fig. 3 corresponding data for the same lamps at reduced voltages are given. These low voltages are such that all the lamps are at approximately the same color.

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[1] Hyde, Cady & Middlekauff, *Elec. World* 53, p. 439; 1909.
" " " Trans. Ill. Eng. Soc. 4. p. 334; 1909.
Drysdale, *Jour. de Phys.* (4) 7, p. 872; 1908.
" *Lond. Ill. Eng.* 1, p. 642; 1908.
Ferry, Bul. Soc. Int. des Elec. (2) 9, p. 673; 1909.

[2] Helmholtz, *Beiblaetter* 14, p. 589; 1890.
Lux, *Lond. Ill. Eng.* 1, p. 98; 1908.
Leimbach, *Zs. f. wiss. Phot.* 8, p. 333; 1910.

The numerical results are compiled in the accompanying table. In the first column are given the various lamps used; in the second and third columns the voltages and the watts per mean horizontal candle at normal operation and at reduced voltages; in the fourth and fifth columns are given the percentage losses in watts and in efficiency at normal operation and at reduced voltages, and in the sixth column are given the lengths of filament between two successive points of support for the various lamps. It will be observed, first, that the power losses (fourth column) in the case of ordinary lamps at normal operation are relatively small, amounting to only about 7 per cent even for the tantalum lamp, which shows the largest loss. As the voltage is decreased the loss becomes relatively larger for every lamp, but even at the very low voltages used and for the worst case of 14 per cent loss in the tantalum lamp operating at 11 watts per mean horizontal candle, the power losses are still considerably less than the values given by Leimbach for normal operation.

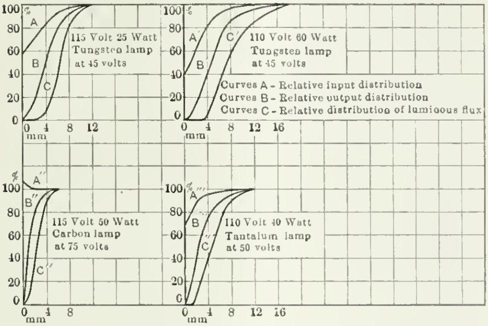

Fig. 3—Average Curves, Showing Conduction Losses for Various Types of Lamps at Reduced Voltages.

The efficiency losses (fifth column) are considerably larger than the power losses owing to the fact that the luminous flux decreases several times as fast as the power when the temperature is lowered. At normal operation the efficiency losses owing to the cooling effect of the supports range from 4 per cent for the carbon lamp to 13 per cent for the tantalum lamp. At the reduced voltages at which measurements were made the efficiency losses range from 5 per cent for the carbon to 27 per cent for the tantalum lamp. It is perhaps well to explain the exact significance of the efficiency loss. By this is meant the difference between the average efficiency of the filament as a whole and the efficiency of its hottest, central portion. If there was no conduction of heat at the supports these two quantities would be the same, but owing to the reduced efficiency of the parts of the filament near the supports the central portion must be operated at a higher efficiency than would otherwise be necessary to secure a given average efficiency of the filament as a whole.

It should be emphasized that the results given above were obtained on single specimens of each type of lamp, and that the types of lamps were the standard types in commercial usage. The carbon lamp had an anchored oval filament with two leading-in wires and one support; the tantalum lamp had two leading-in wires and twenty-one loose anchors. Each tungsten lamp had four distinct filaments, there being, therefore, two leading-in wires, six other welded junctions and four loose anchors. Although it is thought probable that the percentage losses for other specimens of similar types would exhibit no marked differences in the magnitude of the losses, it would seem quite certain that other types of lamps would in general show different lossses.

SUMMARY OF POWER AND LUMINOUS-EFFICIENCY LOSSES IN VARIOUS TYPES OF LAMPS DUE TO THE CONDUCTION OF HEAT AWAY FROM THE FILAMENT AT THE LEADING-IN AND ANCHORING WIRES

Lamp	Voltage.	Watts per Mean Horizontal Candle-Power	Power Loss per Cent	Efficiency Loss per Cent	Distance Between Successive Contacts.
Tantalum 3	110	2	7	13	33 mm
	50	11	14	27	
Carbon 53	115	3.1	2	4	106 mm
	75	18.	3	5	
Tungsten 45	115	1.25	4	7	69 mm
	45	12	9	15	
Tungsten 47	110	1.25	4	7	80 mm
	45	11	8	16	

From a consideration of the curves given in Fig. 2 and the numerical results collected in the table it would seem that the relatively large loss for the tantalum lamp is to be ascribed to the large number of supports and the correspondingly short lengths of filament between successive supports. Although this is unquestionably the case, one is not justified in concluding *a priori* that the life of the tantalum lamp would be improved by reducing the number of supports and increasing the free length of filament. Other considerations of a practical nature enter, and these must receive due weight in determining the most efficient construction. It is a matter of interest, however, to know specifically the magnitude of the losses in various types of lamps due to the conduction away of heat at the leading-in and anchoring wires.

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RECENT TELEPHONE PATENTS.

BRIDGING TELEPHONE SYSTEM.

Under this title Mr. H. F. Joeckel, of Camp Point, Ill., has patented a system in which three line wires are used. All talking is done on a metallic circuit, but signaling is done over the third wire and ground. With such a system one cannot through-ring past the central to a distant station at the termination of a connection. Neither can the signals be interfered with by receivers off the hook, as in two-wire systems.

LOCKOUT SYSTEM.

Mr. A. Swenson, of Willmar, Pa., has obtained a patent for a lock-out system for party lines. He arranges his signal apparatus so as to respond to turns of the magneto cranks forward, while a reverse turn serves to lock-out all save the selected station.

MOUTHPIECE.

Mr. L. Steinberger, of New York City, has obtained a patent for a mouthpiece for transmitters. The lip is turned down so as to leave a cylindrical portion terminating in a shoulder. The cylindrical portion is threaded. A ring of metal or other suitable substance is arranged to screw down upon the threads so as to provide a rounded lip for the mouthpiece. When this ring is down tight over the mouthpiece it does not quite reach the shoulder at the base of the turned-down part of the mouthpiece. This groove, therefore, provides a mounting for a flat-ring legend plate upon which may be written a directory of special names. The legend plate is not clamped, but is free to be turned so that any desired name and number may be brought to the top.

ACCESSORIES FOR INSTRUMENTS.

Ball-bearing telephone receiver has the sound of novelty. Yet it might not be a misnomer for the invention of Mr. S. K. Rothschild, of Detroit, Mich. This consists of a metallic shell or holder for a receiver having ball races at each end. The receiver is slightly smaller than the shell and is supported by rings of balls in the ball races. The receiver is thus free to revolve about its longitudinal axis. This arrangement is designed to prevent the receiver cord from becoming twisted.

The device of Mr. G. T. Hadley, of San Francisco, is a sanitary appliance for transmitter mouthpieces. A ring-shaped holder is mounted upon the lip of the regular mouthpiece, which in turn carries a globular cap of sheet metal. This cap has a diameter slightly greater than that of the mouthpiece lip. Disinfectant may be placed within the auxiliary mouthpiece and numerous holes in its upper parts permit the entrance of sound waves.

TELEPHONE SYSTEM.

Mr. F. C. Unger, of St. Louis, has patented a local battery exchange system with automatic signaling. The magneto generator is thus made unnecessary at the subscriber station. The line drops are fed from a direct-current generator one pole of which is grounded. At the substations the hook switches are arranged momentarily to ground the lines when actuated. The line drops respond to the resulting momentary currents. In order to operate the clearing-out drops the connecting cord pairs are divided by repeating coils. The clearing-out drop is connected between the generator and the middle or neutral joint of one side of the repeating coil.

LETTERS TO THE EDITOR.

Duplex and Multiplex Telephony.

To the Editor of Electrical World:

SIR:—Apropos of the subject of duplex and multiplex telephony, and with particular reference to the article in your issue of Jan. 12 on the subject, I beg to state that I have received another letter from Mr. Bion J. Arnold which makes a very proper and necessary correction to that quoted in the above-mentioned article. In this second letter it is explained that during the duplex telephonic transmission exhibited by the writer to Mr. Arnold on Nov. 4, 1908, the "No. 2" voice-message (additional voice-message) was sent in only one direction over the single circuit that was at the same time carrying an ordinary "to-and-fro" telephone conversation.

It is my desire to claim only that degree of merit to which this accomplishment is justly entitled, therefore the publication in your columns of this correction also will be appreciated.

Chicago, Ill. FRANK L. PERRY.

Reactive Power.

To the Editor of Electrical World:

SIR:—Referring to the discussion in your columns on a proper term for that component of the volt-ampere which does not represent actual power, it will be of interest to know that the United States national committee of the International Electrotechnical Commission and the standardization committee of the American Institute of Electrical Engineers have at their last meetings standardized the term *reactive power* as the proper designation for the quantity above referred to.

Schenectady, N. Y. CHARLES P. STEINMETZ.

Meter Torque-Weight Ratio.

To the Editor of Electrical World:

SIR:—In the discussion at the recent convention of the Wisconsin Electrical Association on the subject of electric meters, reported in your issue of Feb. 9, Prof. C. M. Jansky is quoted (page 377) to the effect that an extremely light moving element is one of the most desirable points in a meter. It is true that the torque-weight ratio is an *indication* of the true worth of the meter, but the moving element may, on the other hand, be too light. To illustrate, we will suppose that we have two meters of the same make and torque-weight ratio, one with a moving element of twice the weight of the other. Now, if there is an equal amount of friction set up in each meter, it will be found that the meter with the lighter moving element will be slow by a larger per cent than the one with the heavier element. The pressure of a toothpick would have little effect on a wagon wheel, but it would certainly stop any meter. One of the serious troubles with jewels in alternating-current meters is the constant vibration of the meter shaft, which is aberrated in some meters by placing the series coils parallel to the shaft. Anyone in doubt as to this being a good practice can get some idea of the protection to the jewel by short-circuiting the load side of the different types of meters and noting the results. In the case of the meter where coils are parallel to the shaft it will be found that the cup will be bent sideways, but the jewel unharmed, while in the type with the series coil set at right angles with the shaft the disk will be bent down and the jewel damaged from the sudden pressure.

In my opinion, practically all moving elements in alternating-current meters are really lighter than they should be. With the moving element of proper weight there is not so great a tendency for the shaft to hammer the jewel. The wear caused alone by the disk shaft is not serious and can easily be taken care of, but, as pointed out above, there are other elements that cause the greatest losses.

Washburn, Wis. F. W. DOWNS.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Surging of Synchronous Machines.—E. J. BERG.—A paper giving briefly the theory of the phenomenon of surging of synchronous machines. The author concludes that as far as the electrical side of the surging problem is concerned it can be solved by either one or more of the following alternatives: By reducing the ohmic resistance between the machines, or by excluding all external reactances and putting field-damping devices on machines of laminated field cores and quick magnetic circuit, especially if the synchronous impedance is great—that is, if they, as generators, have poor regulation—or by adding extra reactance in high-speed machines having good mutual inductance between field and armature circuits and sluggish magnetic circuit, or by changing the natural period by change of air-gap or addition of flywheel, etc. While thus something can be done by changing the electrical constants, it is but seldom that this is necessary. Ninety-five cases of every 100 can be traced back to some mechanical defect of the prime mover. Usually the governor is too sensitive, or there is some play in the various links connecting the governor proper with the steam-admitting valves. In the extended discussion which followed various instances were quoted in which surging troubles had been experienced in the West.—*Jour. of Western Soc. of Engrs.,* February.

Direct-Current Machines with Rotary Field System and Rotary Armature.—O. ADAM.—An abstract of a thesis on direct-current machines in which both the field system and the armature rotate, but in opposite directions, the motions of the two being transmitted to the same body by special gearing. The author considers the use of such a machine for hoisting and discusses its advantages over a machine in which only the armature is rotary. For a hoist raising a load of 16,000 kg (35,000 lb.) with a speed of 0.3 m per second (1 ft. per second) the author gives the following comparative figures if in the driving motor both the field system and the armature are revolving or if only the armature is revolving:

	Armature Alone Revolving.	Both Armature and Field System Revolving.
Effective motor output, hp.	83	81.5
Mechanical efficiency, per cent	77.2	78.5
Power given off directly by field system, per cent	....	13
Wear and tear of rack and pinion, relative	1.00	0.87
Transmission	1÷9.8	1÷8.8
Area required, sq. meters	Not given	2.8
Weight, kg	Not given	6250

—From thesis for degree of Dr. Ing., Hanover, 1909, abstracted in *Elek. Zeit.*, Feb. 16.

Repulsion Motor.—F. Rusch.—The first part of a mathematical paper, illustrated by diagrams, giving the theory of the repulsion motor. In the present instalment the vector diagram is developed and the conditions of starting and short-circuit, output and torque are discussed. The paper is to be concluded. —*Elek. Zeit.*, Feb. 16.

High-Frequency Alternator.—R. Goldschmidt.—An English translation of his German paper recently abstracted in the Digest on an alternator for direct production of electric waves for wireless telegraphy.—Lond. *Electrician*, Feb. 17.

Mercury-Vapor Converter.—W. Hechler.—An English translation of his German paper recently noticed in the Digest on the latest types of mercury-vapor rectifiers.—Lond. *Electrician*, Feb. 17.

Lamps and Lighting.

Pentane Lamp as a Primary Light Standard.—E. B. Rosa and E. C. Crittenden.—An abstract of a paper read before the American Physical Society. The primary photometric standard of Great Britain is the 10-cp Harcourt pentane lamp. This lamp has been investigated at the (British) National Physical Laboratory and the (German) Reichsanstalt, and the ratio of light given by it to the hefner has been many times determined. The Bureau of Standards has been carrying on an investigation for some time on primary flame standards, including the study of the pentane lamp. It has been found that pentane lamps as made from the same specification by different manufacturers differ by several per cent in candlepower, and hence any determination of the ratio of the pentane to the hefner, or other primary standard, amounts only to a determination of the ratio of particular lamps. In this investigation not only has the difference in lamps been studied, but also the difference in different kinds of fuels, and there has been devised a new form of pentane lamp which has some advantages over the Harcourt form. Results of measurements on various lamps and with different kinds of fuels, under varying atmospheric conditions, will be communicated and suggestions will be made as to the important characteristics of a primary standard, these suggestions being based upon a considerable experience with lamps of different types and also with lamps of different makes of the same type.—*Phys. Review*, February.

Ductile Tungsten Filament.—A note on a recent British patent (23,499, Feb. 9, 1911) of the British Thomson-Houston Company, Ltd. (General Electric Company of this country). This specification relates to the mechanical treatment of tungsten while hot in order to render it ductile. Pure tungsten powder is compressed into sticks about 8 in. long and ⅜ in. square in heated steel molds. After heating in hydrogen to dispel any impurities the sticks are sintered so as to become dense and hard by passing an alternating current of about 1400 amp through them for several minutes. They are then rolled or worked in a special swaging machine described in the specification, and after repeated and prolonged working the crystalline structure is said to change to a pronounced fibrous structure, so that the sticks are pliable, ductile and very strong. Drawing is begun when the diameter is reduced to 35 mils, and is continued in successive stages until the diameter is 1 mil or less, as is required. It is found that the tungsten wire can be drawn at ordinary room temperatures after prolonged mechanical working.—Lond. *Elec. Eng'ing*, Feb. 16.

Generation, Transmission and Distribution.

High-Tension Transmission Lines.—An account of the very long discussion which followed the recent papers of Taylor and Matthews and Wilkinson on the design and construction of high-tension transmission lines. Mr. J. S. Peck described the raising of the voltage limit with the development of insulators. The suspension type now makes possible pressures of from 120,000 volts to 150,000 volts. Doubtless future types of insulators will raise the limit to 200,000 volts. Mr. A. A. Campbell Swinton considered that the real limit of pressure for overhead lines is the point at which the air breaks down. The curve in Matthews and Wilkinson's paper shows that with a conductor ¼ in. in diameter a pressure of 100,000 volts can be used with very little loss by brush discharge, but at 120,000 volts the loss becomes much greater. With a larger conductor, however, the bend in the curve took place at a very much higher voltage. Thus by using aluminum instead of copper a higher voltage can be employed. He said that he did not know whether anyone had considered the feasibility of going back to iron or steel wires, with which long spans would be obtained. The resistance would, of course, be much higher, but at very high voltages the resistance is of smaller importance.—Lond. *Electrician*, Feb. 17.

Turbo-Generators in Gas Plants.—C. Richter.—The first part of a paper in which the author discusses the advantages of using steam turbo-generators as a reserve and for furnishing the peak load in large gas-electric stations combined with coke-oven or blast-furnace plants. The advantages of steam-turbo sets over additional gas engines for supplying the reserve or the peak load are pointed out and are considered to result in a considerable saving. The paper is to be concluded.—*Elek. Zeit.*, Feb. 16.

Pumping Sewage.—L. F. Mountfort.—An illustrated paper read before the Birmingham Section of the (British) Institution of Electrical Engineers on the electrical undertaking of the Birmingham, Tame and Rea district drainage board. A description is first given of the electric energy transmission scheme installed in 1905 by the drainage board, and, secondly, of the plant recently erected for raising large quantities of sewage and storm water for distribution on the surface of the filter beds. The torque requirements of large squirrel-cage motors for driving low-lift centrifugal pumps are finally considered.—Lond. *Electrician*, Feb. 17.

Traction.

Electric Traction in Switzerland.—A note stating that there are at the present time eight standard-gage lines and thirty-six narrow-gage lines electrically operated in Switzerland. The narrow-gage lines are either mountain railways or absolutely local in character. Electrical energy is supplied from forty-nine hydroelectric stations. The standard-gage lines are very short, though this is likely to be changed during the next four years, when owing to the opening of the Lotschberg tunnel electric operation will be in force from Spiez to Iselle. Moreover, the electrification of the Gotthard line will be completed. —Lond. *Electrician*, Feb. 17.

Installations, Systems and Appliances.

Automatic Voltage Regulator.—An illustrated description of a new automatic voltage regulator devised by H. M. Taylor and R. H. Scotsen. The need of it was felt by them in connection with the operation of a feeder booster for regulating the voltage of supply to a long feeder. The apparatus consists essentially of a small shunt-wound generator in series with the exciter field circuit. The field circuit of this generator is divided into two equal windings, fed from any suitable direct-current supply and arranged so that the two halves are in opposition. These field coils are supplied with energy through lamp resistors in order to eliminate sparking in the operation to be described. The armature can thus give either an opposing or an assisting boost to the terminal pressure on the exciter field circuit, according to the half of the coil winding which is placed in circuit. This effect is produced by short-circuiting the terminals of either half of the auxiliary field winding by a solenoid-controlled switch, the connections of which are shown in Fig. 1, where E is the main exciter, A the auxiliary generator armature under the influence of the divided field winding and C is the controlling solenoid. This solenoid is a pressure coil placed across any point on the main supply at which it is required to maintain constant potential, and the position of the core depends, therefore, on the current in the solenoid C. This short-circuit method does away with all sparking at the points of contact.—Lond. *Electrician*, Feb. 17, and *Elec. Eng'ing*, Feb. 16.

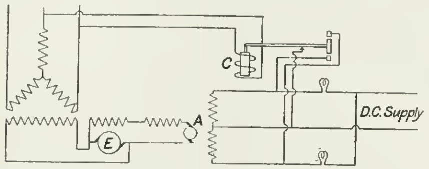


Fig. 1—Diagram of Connections.

Voltage Regulation.—J. Schmidt.—The first part of an illustrated article on the use of the Thury regulator as an automatic regulator for storage batteries in direct-current and alternating-current systems, for instance for the purpose of changing automatically the number of cells connected to a system, etc. The article is to be concluded.—*Zeit. f. Beleucht.*, Feb. 10.

Use of Electricity in Mines.—A full account of the report of the departmental committee appointed in October, 1909, by the British Home Secretary to consider the working of the existing special rules for the use of electricity in mines, with a set of special rules as revised by the committee.—Lond. *Electrician*, Feb. 17.

Brazil.—C. Benoit.—Statistical data taken from an official report on the electrical industries in Brazil, with special reference to telegraphy and telephony, hydroelectric plants and electric lighting.—*La Lumière Elec.*, Feb. 11.

Wires, Wiring and Conduits.

Dielectric Losses in Fiber Insulators.—H. Jordan.—The conclusion of his paper giving the results of tests of cotton, paper and various cables. The influence of moisture, frequency and temperature are determined.—*Elek. Zeit.*, Feb. 16.

Electrophysics and Magnetism.

Elementary Quantity of Electricity.—E. Regener.—A discussion of the recent work of Millikan and Ehrenhaft on the isolation of ions and a description of some experiments of his own made to explain the discrepancy between the results obtained by Millikan and Ehrenhaft. He calls attention to two possible sources of error in measuring the charge of single mist particles. His results confirm the result of Millikan that the value of the smallest electric charge is about 4.90×10^{-10} electrostatic units.—*Phys. Zeit.*, Feb. 15.

Electrochemistry and Batteries.

Storage Battery.—F. Loppe.—A brief article describing how to calculate quickly the density and the volume of sulphuric acid solution required for a lead storage battery.—*L'Industrie Elek.*, Feb. 10.

Carbon Electrodes.—W. Clacher.—A description in some detail of the methods employed in a British aluminum company for the manufacture of carbon electrodes, with special reference to the chemical problems involved.—*Met. and Chem. Eng'ing*, March.

Electroanalysis.—R. C. Benner.—An article on a new form of gauze electrode for the rapid electrolytic determination of lead and copper.—*Met. and Chem. Eng'ing*, March.

Units, Measurements and Instruments.

Induction Coil.—W. Salomonson.—An abstract of a Röntgen Society paper giving a summary of his oscillographic research upon the behavior of an induction coil under varying working conditions, the high-frequency pattern of Duddell's instrument being employed for the purpose, together with various well-known coils, and, for the most part, a gas-mercury-jet interrupter of the turbine pattern. In the final part of the paper the author dwelt upon the importance of the number of interruptions per second with respect to the maximum secondary effect. In the case of an induction coil worked by a small storage battery and taking a very small number of interruptions per second, the time during which the current passes before each interruption might be supposed to be so large that the current would have sufficient time to attain its highest possible value. In that case evidently an increase in the number of interruptions would be of advantage, as the available energy per second depends on the current strength just before the rupture of the current and the number of interruptions per second only, and a slight lessening of the duration of each closure does not diminish the final current intensity. On taking the case of a very large number of interruptions per second it is necessary to consider the first part of the ascending line, and during this part the final current strength depends on the primary self-induction and the duration of the contact. If the contact is made twice as long the current will also be twice as large, but the available energy will be four times as large. In that case, the number of interruptions being reduced to half, there is finally obtained twice as much available energy per second as with double the number of interruptions. With very rapid interruptions it is of advantage to reduce the number of interruptions and with very slow interruptions to make them more frequent. Consequently, there is some intermediate number which gives the best results. He concludes that for coils of from 10-in. to 12-in. sparking distance the average number is from twelve to thirteen interruptions per second, which gives a maximum of secondary energy. Of course, this number is possible only with very small pressures, say, up to 18 volts. If the voltage is increased there is some danger to the coil in reducing the number of interruptions so greatly and it will be safer to work with the larger number. For higher voltages the author formulates the empirical rule that the most advantageous number of interruptions per second for small induction coils is given by the number representing the voltage if the time-economy of the interrupter is 0.5. With large coils the number is smaller.—Lond. *Electrician*, Feb. 17.

Lecture Electroscope for Radioactivity.—J. Zeleny.—An abstract of a paper read before the American Physical Society. The electroscope consists of a vertical charged plate near which hangs a gold-leaf suspended from one of two horizontal plates, the other of which is earthed. The space between the two plates forms the ionization chamber. The radiations may enter this chamber from the side or the radioactive substance may be placed in a shallow dish on the lower plate in the usual way. The vertical charged plate is pushed so near to the gold-leaf that the latter is attracted to it and after receiving a charge from the plate is repelled. The charge given to the leaf produces a field between the two plates, and when an ionization current flows the leaf gradually sinks until it is again quite suddenly pulled to the plate, again repelled and so on in pendular fashion. Between two contacts with the plate the leaf system has lost a definite quantity of electricity, and the times between such contacts under different conditions are a measure of the corresponding ionizations. When the whole is projected upon a screen the effects are readily followed by a class.—*Phys. Rev.*, February.

Variable High-Resistance of India Ink on Paper.—F. A.

Aust.—A description of a paper read before the American Physical Society. India-ink rulings on a strip of paper make a convenient form of resistor for regulating the voltage or current from a static machine and for other small-current high-potential work. The maximum resistance is limited by that of the paper used. A range from 0.01 megohm to 20,000 megohms is readily obtained on a single strip of paper 3 cm x 45 cm. The paper strip is stretched between two insulating supports, at one of which the high-potential terminal is attached. A slide giving a metallic contact with the paper strip forms the second terminal. When the strip is made of drawing paper the current which may be passed through it is limited to about 0.2 milliampere, but if asbestos paper is used currents as high as 25 milliamperes may be employed with strips only 3 cm wide.—*Phys. Rev.*, February.

National Physical Laboratory.—A review of recent researches at the (British) National Physical Laboratory upon the e.m.f. of the Weston cell, the Lozenz apparatus, the Ayrton-Jones current balance, the accurate measurement of inductance and capacities, etc. In the electrotechnics division an investigation of general interest is in progress as to the effect of transport by rail and carrier on electricity meters. A joint investigation, in conjunction with the Electrical Testing Laboratories of New York, has been made to determine how close an agreement would be obtained by different laboratories in life tests of incandescent lamps. The tests indicated that such measurements can be carried out on the basis of the engineering standards committee's specification within an accuracy of ± per cent for carbon lamps.—Lond. *Electrician*, Feb. 17.

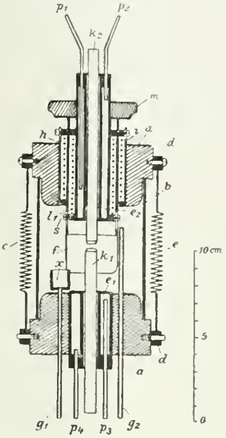


Fig. 2—Cross-Section of Generator.

Induction Meter.—A. Iliovici.—The first part of a mathematical paper on the theory of induction meters containing a disk of copper or aluminum. He shows some inaccuracies in the usual theory of the induction meter and discusses especially the reaction of the disk on the magnetic field.—*La Lumière Elec.*, Feb. 11.

Measuring Alternating Currents.—A. Larsen.—An illustrated English translation of his German paper recently noticed in the Digest on an apparatus for the measurement of weak high-frequency alternating currents by the compensation method.—Lond. *Electrician*, Feb. 17.

Instruments.—A. Schwartz.—The conclusion of his illustrated article on scientific and technical instruments at the World's Fair in Brussels in 1910, giving descriptions of the Duddell oscillograph, the thread electrometer, the Joly meltometer for determining melting points, the compensation apparatus of Carpentier, the magnetic balance of Borgesius, a torsion balance and various other apparatus.—*Elek. Zeit.*, Feb. 16.

Telegraphy, Telephony and Signals.

Arc Generator of Undampened Oscillations.—F. Kock.—An illustrated description of a simple arc generator for laboratory work for the production of undampened oscillations. It is shown in Fig. 2. The chamber for the arc is formed of two fiber plugs *a* which by means of the steel springs *c* and *e* are pressed tightly against the blackened brass tube *b*. The steel springs *c* and *e* are insulated by means of hard-rubber pieces *d*. The chamber is thus closed air-tight. A small window *f* is provided for the observation of the arc. In the lower plug the carbon k_1 is arranged in a small double cooling tube e_1. There are also provided two tubes, g_1 and g_2, for introducing gases such as alcohol vapor into the arc chamber. The upper electrode k_2 is also provided with a cooling tube e_2. The position of the upper electrode can be regulated very carefully by means of a screw and nut *m* and the spring l_1. The two electrodes are water-cooled. In case of an explosion, which sometimes happens with hydrogen, etc., the end plugs are simply thrown off and then thrown back onto the brass cylinder.—*Phys. Zeit.*, Feb. 15.

Wireless Telegraphy.—A note on a recent lecture of H. R. Sankey on the principles of wireless telegraphy. The author exhibited a complete portable wireless-telegraph set capable of being carried by four horses and designed for army service. The set consisted of a two-cylinder gasoline engine with an alternator mounted on a special saddle and carried by one horse; two masts, each 30 ft. high and made in five lengths, and the necessary transmitting and receiving apparatus, including the aerial, earth mat, etc. The set had a range capacity of about twenty miles. In connection with this latter point a table of the approximate range of different powers over sea and land was presented.—Lond. *Eng'ing*, Feb. 17.

Power Required Kilowatts	Wave Length, Meters	RANGE IN NAUTICAL MILES.			
		Over Sea.	Over Land.		
			Flat	Hilly.	Mountainous
0.31	300	100	77	30	13
	1200	100	95	73	52
1.5	300	220	170	67	28
	1200	220	210	160	115
3.0	300	280	220	84	76
	1200	280	270	200	147
5.0	300	340	260	[illegible]	43
	1200	340	325	240	175
10	300	470	360	[illegible]	59
	1200	470	450	330	[illegible]

Wireless Telegraphy.—An article on the singing-spark system of wireless telegraphy as worked out by Count Arco with a description of the apparatus used.—Lond. *Elec. Review*, Feb. 17.

Miscellaneous.

Electrification of Crops.—Oliver Lodge.—A lecture in which the author gives an account of the experiments which he started some five years ago and in which he could increase the yield of crops some 30 per cent by electrification. The expense is not great. A 2-hp engine is sufficient for a twenty-acre plot. Sugar beets seem to grow more sugary under electrical treatment and strawberries are brought to maturity earlier and are sweeter. It is principally the tops of plants rather than the roots which appear to be beneficially affected, although leguminous plants seem to be an exception. The lecturer explained the apparatus used for producing a suitable continuous current of positive electricity to be given off by wires stretched at a height of several feet above the ground upon which the crops are grown.—Lond. *Electrician*, Feb. 17.

Book Reviews.

Practical Alternating Currents and Alternating-Current Testing. By Charles F. Smith. Third edition. Manchester. The Scientific Publishing Company. 455 pages, 235 illus. Price, 6 shillings.

This is an elementary text-book of alternating currents and alternating-current machinery, based essentially upon graphical methods and ordinary algebra. The book is divided into thirteen chapters as follows: Alternating e.m.f. and current; impedance; power and power-factor; virtual value of an alternating current; effect of capacity; the transformer; alternators; synchronous motors; the polyphase circuit; the rotary converter; the polyphase induction motor; single-phase motors; the composition of waves. Nineteen experimental tests on machinery are also outlined in the book with instructions how to carry them out. These are such as might be carried out in a technical school. The book is well adapted for elementary instruction in alternating-current machinery as carried on in technical schools.

The Indicator Handbook. By Charles H. Pickworth. New York: D. Van Nostrand Company. 140 pages, 93 illus. Price, $1.50.

The important uses of the indicator in analyzing steam-engine performance, as well as the construction and operation of the instrument itself, are treated quite exhaustively in this English publication, in which, it is interesting to note, American authorities are several times cited. The history of the steam-engine indicator, its development and specialized forms are described in detail in the treatise, and methods of connecting, reducing motions and card taking are outlined in the section devoted to this instrument. A valuable chapter deals with errors of indicator mechanism, connections and reducing gear.

New Apparatus and Appliances

INSTRUMENT FOR TESTING INDICATOR SPRINGS.

The indicator is unquestionably a most necessary instrument for the operating engineer, as the indicator diagram is the only means by which to ascertain the action of the steam in the engine cylinder, to determine the efficiency of an engine and to detect internal wastes. It is, therefore, of vital importance that the indicator be accurate. Unless the exact tension of the spring is known errors will result from its use and the determinations made with the indicator will be of little or no value. An instrument for testing indicator springs is illustrated herewith. This apparatus, which is made by the Schaeffer & Budenberg Manufacturing Company, Brooklyn, N. Y., consists essentially of a closed vessel made of cast iron, capable of resisting internal steam pressures up to 200 lb. per square inch. The steam pressure in the vessel is measured by a gage of special construction consisting of a piston of $\frac{1}{2}$ sq. in. area, free to move in an inclosing cylinder. The lower portion of the piston is pointed and rests in a yoke which is suspended on the knife-edge of a pair of scales mounted on top of the closed vessel. If the scales are previously balanced, before admitting steam into the vessel, it is evident that the reading of the scales will give the pressure acting on each element of the vessel as equal in area to that of the piston. The scales are graduated to fiftieths of a pound. In testing indicator springs steam is turned on into the vessel to warm it gradually and allowed to blow through the connections and indicator cocks to remove any particles of dust or grit which may have accumulated there. The steam is then shut off again and the indicator screwed in place, with paper on the indicator drum. The indicator pencil is pressed against the drum and a horizontal line *QQ* drawn at the point thus marked. The poise of the scale is set at, say, 5 lb. and steam admitted into the vessel, gradually rising in pressure until the scale floats. When the pressure is exact the line *RR* is drawn, and so on for successive pressures of 5 lb. until the limit of the scale is reached. During this operation the motion of the indicator pencil is continuously kept upward; if at any moment the pressure rises too high it is lowered by manipulating the valves below the required amount and then gradually raised to the desired point. When the indicator pencil has reached its highest position the steam pressure is allowed to fall gradually and a series of similar lines, as *WW*, *XX*, *YY* and *ZZ*, drawn during the descent of the piston, the motion being continuously downward. The distance between any two of these lines, as *Z-R*, *Y-S*, indicates the loss due to friction of the indicator. The indicator-spring testing apparatus serves also for testing pressure gages, which can be connected to the three openings in the front side of the vessel provided for that purpose, and the readings are verified by the indications on the scales and the test gage shown in the illustration.

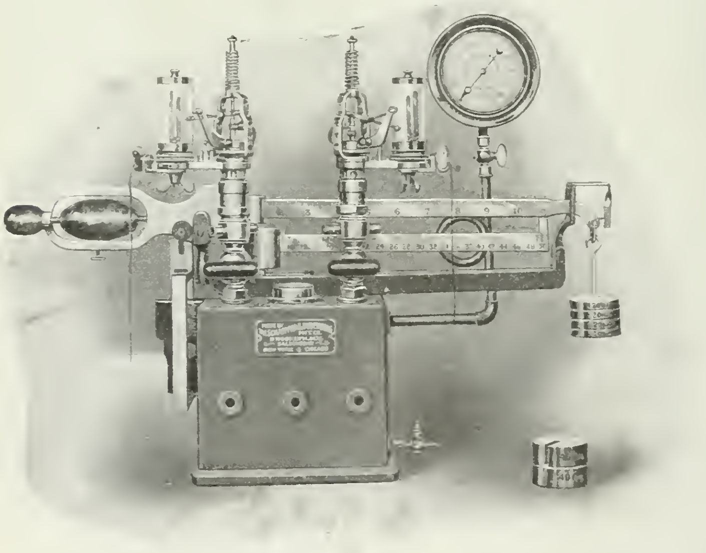


Fig. 1—Instrument for Testing Indicator Springs.

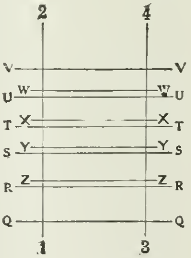


Fig. 2—Indicator Test Card.

ELECTRICAL EXHIBITS AT THE BOSTON AUTOMOBILE SHOW.

Electric pleasure vehicles, trucks and auxiliary equipment occupy a prominent place in the 1911 Boston Automobile Show, which was opened to the public on March 4. The exhibits of electrical interest are located mainly in the Mechanics' Building, with an overflow display in Horticultural Hall. The names of the electrical exhibitors and the main features of their displays are given below.

The Atwater-Kent Manufacturing Company, Philadelphia, is showing its standard battery equipment and instruments for accurate portable work on the sparking apparatus of the gasoline car.

The Edison Electric Illuminating Company of Boston, Mass., occupies a booth in which attention is specially called to the charging facilities now available for electric automobiles within the company's territory, a large wall map having been installed with starred cities and towns having reliable charging points within their borders. About forty municipalities inside the Edison system are now so provided, there being as a rule from one to six charging points in each town. Mr. LaRue Vredenburgh's well-known "Ode to the Electric Carriage" is conspicuously displayed, and photographic reminders of Thomas A. Edison's work in the storage-battery and vehicle field are shown.

The United States Light & Heating Company, New York, shows its well-known line of "National" storage batteries in various sizes and a new connector for use on vehicle batteries which has never before been exhibited. The connector is a lead structure with threads, nuts and washers which permit a purely mechanical contact to be made between cells. The lead is of antimonious type, with a central brass stud and made and female connections which fit together in a recess filled with grease, the latter being a demonstrated protection against rusting. The company states that the Couple-Gear Wheel Company has adopted the connector as a standard for all its battery service.

The Holtzer-Cabot Electric Company, Brookline, Mass., is showing a line of small shop tools of the motor-driven type, horns, magnetos and a new tire pump direct-connected to a ½-hp motor. The pump is of the reciprocating type and operates at a pressure of 150 lb. per square inch maximum. A new departure in the company's display is a variable-speed dynamo for automobile and motor-boat sparking and lighting service.

The General Vehicle Company, Boston, Mass., is showing a five-ton truck chassis with mechanism driven by the propelling motor of the outfit; a one-ton emergency wagon, one of twenty-four which are immediately going into the service of the Edison Electric Illuminating Company of Boston; a 1000-lb. wagon and a 700-lb. wagon. The Edison wagon is equipped with a Sangamo ampere-hour meter. A feature of the truck is the use of a covered chain drive in grease lubrication between the motor and the main shaft, reducing the noise of operation practically to the zero minimum. The exhibit is specially illuminated by a quadrangle of 100-watt tungsten lamps with diffusing shades, supplied with current from a small plant located on the spot.

The Boston Electric Garage Company is exhibiting a 1500-lb. Anderson delivery wagon with express body, built for fast suburban service, and equipped with sixty cells of Edison "A-6" battery. Four pleasure cars of Anderson manufacture are also shown, including a four-passenger coupé, two-passenger victoria, roadster and stripped chassis.

The Electric Storage Battery Company, Philadelphia, is displaying a full line of "Exide" cells, including batteries for vehicle propulsion, illumination and spark service. A special display is made of the company's new "Iron-clad Exide," in which the activity of the plate material is well maintained and the loss of active material diminished. The plate consists of metal top and bottom bars connected by vertical rods. Each rod is surrounded by active material, which is protected and held in place by a horizontally laminated hard rubber tube. Each tube carries a vertical rib on each side, and these ribs take the place of the usual wood separators and perforated rubber sheet separators used with the "Exide" type of positive plate. A thin, flat wood separator spaces the iron-clad positive plate from its corresponding negative, the latter being somewhat thickened to provide increased capacity and longer life.

The Automatic Appliance Company, Boston, exhibits a system of electric lighting in connection with the operation of acetylene gas headlights which eliminates the use of matches, including a double adjustment valve by which the lights are kept under close control from the seat under all conditions.

The National Carbon Company, Cleveland, Ohio, shows a full line of "Columbia" multiple batteries for motor ignition, including cells operating under water in circuit with side, head and tail lamps.

The K-W Ignition Company, Cleveland, Ohio, is showing a high-tension magneto of the inductor type and electric headlighting equipment, including a lighting dynamo for fast road service.

The Apple Electric Company, Dayton, Ohio, is displaying electric lighting equipment for general automobile service, including a new dynamo which is designed to replace the magneto and to provide energy for both ignition and car illumination.

The Burn-Boston Battery & Manufacturing Works, Boston, are displaying a new liquid battery for the first time. The manufacturers state that this battery occupies one-fifth the space in cubic inches of one of the most popular glass jar cells; that it delivers three times the ampere-hour capacity of the glass cell, with one-third the weight of the latter; that the discharge rate is three times that of the best dry cell; and that the life of the battery is far in excess of anything previously experienced with glass or dry cells in anything like comparable service. The battery is a combination dry and wet cell with a reservoir of liquid. One set of six is shown which have run 14,000 miles on a four-cylinder car without exhaustion.

The American Storage Battery Company, Cambridge, Mass., is displaying the "Harvard" storage cell for ignition and lighting service, a special feature being the equipment of the cell with non-spraying and non-leakable vent tubes.

The Electric Speedometer Company, Washington, D. C., is showing a new speedometer consisting of a small magneto generator of the gear-driven type, with an indicating voltmeter calibrated in terms of speed for dashboard service.

The Connecticut Telephone & Electric Company, Meriden, Conn., is exhibiting quick detachable terminals, current indicators and dash coils, with steering-wheel switches, timers and distributors.

Gray & Davis, Amesbury, Mass., are displaying a full line of electric lamp equipment for head, side, tail and interior service.

The Heinze Electric Company, Lowell, Mass., is exhibiting dash coils, switches, timers and spark plugs.

The Remy Electric Company, Anderson, Ind., is showing a new combined lighting and ignition system, including a constant-current magneto with a 70-deg. timing range.

The Bosch Magneto Company, New York, is showing complete equipments in the line of ignition apparatus, with illustrations of its product used in aviation and automobile service.

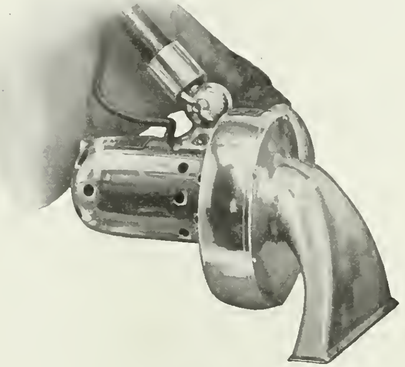
The Pittsfield Spark Coil Company, Pittsfield, Mass., is showing a dual system magneto without moving wires, including push-button starter and self-contained transformer coils.

The Electric Renovator Manufacturing Company, Pittsburgh, Pa., is exhibiting a new [illegible] vacuum cleaner for [illegible] service, the apparatus being mounted on a truck with ball-bearing wheels. The receiving tank is fitted with a cloth strainer.

The Edison Storage Battery Company, represented by S. R. Bailey & Company, Boston, Mass., shows a complete line of the latest products of the organization, including cells for ignition, lighting and car-propulsion service.

A COMPACT SUCTION CLEANER.

The accompanying picture shows the working parts of the vacuum cleaner made by the Electric Vacuum Cleaner Company, of Detroit, Mich. This is a small, compact suction cleaner, light in weight and easy to handle. It is designed as a practicable machine for the homes of people of moderate means. The cleaner is driven by a small electric motor hung on the under side of the cleaner, where it is out of the way. The switch controlling it is conveniently placed at the end of the handle. The machine is of the fan type, and the fan can be used either for suction or as a blower, as desired. The motor is of the universal type and will operate on either direct-current or alternating-current circuits within limits of 90 volts to 120 volts and 20 cycles to 60 cycles. The construction of the device throughout is marked by simplicity and is the result of much experimental work.



A Compact Suction Cleaner.

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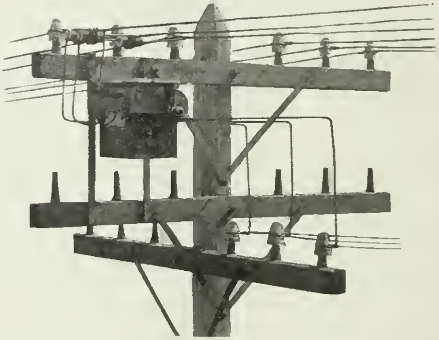
OIL-BREAK POLE-LINE SWITCH.

Owing to the magnitude and complexity of the present electrical distribution systems it is important in many cases to provide means for cutting portions of the circuit in or out of service at points which necessarily must be remote from the station. The device for this purpose should be designed for installation out of doors and for operation under load, and would find application in sectionalizing feeder systems, cutting in and out transformers and in similar service. In many cases the use of this switch in connection with a transformer will obviate the necessity of bringing high-tension lines into the building. To meet this demand the General Electric Company has designed an oil-break switch which is simple, introduces no complications in wiring and, on account of the very convenient construction of the frame and method of supporting, is very easily installed. It can be mounted on a flat surface or, by use of strap-iron hooks, on transmission-pole cross-arms in a manner similar to that usually employed for mounting pole-type transformers. This oil-break pole-line switch is thoroughly weatherproof. It is entirely inclosed in a cast-iron frame fitted with a removable cover, grooved on the under side to fit closely to the edge of the frame and supplied with a suitable gasket to prevent damage to the mechanism due to weather conditions. A detachable oil vessel, with insulating line and barriers between the switch poles, fits around a flange at the bottom of the frame. The stationary contacts consist of flared fingers of drop-forged copper, supported from the contact blocks of the copper current-carrying studs by a heavy, flat steel frame. The studs are supported by and insulated from the frame by porcelain insulators. The movable contacts are wedge-shaped copper blades hinged at one end. They are actuated by specially treated wooden rods connected to the shaft, which in turn is operated by the crank and handle outside of the frame. The construction of the stationary and movable contacts is such that any burning, due to rupturing the arc, is confined to the tips of the stationary contact fingers and the upper extremity of the movable contacts, preserving the actual current-carrying surfaces. This feature of construction insures clean contact surface and uniform contact pressure without retarding the opening of the switch. The switch is built in sizes up to 200 amp at 15,000 volts. The method of bringing the leads to the switch varies somewhat according to the voltage, but in every case they enter through porcelain bushings protected from the weather by the overhang of the frame The switches up to 4500 volts are designed for use with insulated wire, while for voltages between 4500 and 15,000 bushings are furnished which allow the use of bare wire.



4500-Volt Pole-Line Oil Switch.

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BAKELITE : ITS ELECTRICAL PROPERTIES.

By Alfred Williams.

Bakelite is the familiar trade name of the extremely interesting synthetic substance, oxybenzylmethylenglycolanhydrid, a new organic insulating material produced by Dr. L. H. Baekeland after a brilliant series of research experiments. After the first laboratory work suggested the directions in which the discovery could best be utilized, initial commercial tests were made, and, though little has been published on the subject until recently, two years of commercial use have now proved the value of bakelite in the arts, realizing the fullest expectations.

That the engineer may realize the wide scope of usefulness of bakelite the following general statements are offered:

Bakelite is an organic substance which may be applied as a liquid or used as a solid. As a fluid, even when cold, it penetrates wood and other porous material with the ease of water, and then in the presence of a catalytic agent it "freezes" under the action of heat to a compound that is insoluble and infusible. Thus treated soft poplar, basswood, etc., become harder than ebony.

From its fluid state a simple act of polymerization—that is, molecular rearrangement under heat and pressure—converts bakelite into a hard, insoluble material of great strength, known as "Bakelite C." In this form it is unaffected by water, high-pressure steam solvents, oils and almost all chemicals. Heat neither melts nor softens it; its destruction necessitates a relatively high temperature.

Applied superficially liquid bakelite serves as an organic enamel of great hardness, more resistant to physical and chemical influence than the most expensive Japanese or Chinese lacquers.

As a binding agent, compounded with asbestos, sawdust, wood pulp or like materials, it can be molded accurately into articles of great strength, impervious to atmospheric or other influences. Or it may be made into articles as transparent as glass, as translucent as amber, or as opaque and variegated as the marbles. In fact, bakelite may take on an almost infinite variety of color and beauty in various forms, all combined with a remarkable immunity from corrosion and disintegration and a resistance to temperatures as high as 300 deg. C. or 572 deg. Fahr. Compounded with emery it forms excellent grinding wheels; with graphite it makes self-lubricating bearings, gaskets, pump valves, etc. It even serves as a splendid adhesive cement and offers a strong material for the manufacture of phonograph records.

The electrical uses of bakelite and its insulating and dielectric properties are equally interesting and important. The following table shows the position of bakelite in the series of the specific inductive capacities of the better-known insulators, the determinations being those of the most recent investigators:

Substance.	Observer.	Spec. Ind. Cap.
Glass, plate	Arons, Rubens	5.37 to 6.20
Glass, flint	Hopkinson	6.61 to 9.90
Glass, Jena	Lowe	5.05 to 5.52
Glass, crown	Lowe	6.20 to 7.96
Glass, chrome—high refract.	Lowe	9.14
Paraffine	Boltzman, Lampa, Hornell	2.32 to 1.92
Shellac	Winkelman, Gordon	3.10 to 2.70
Celluloid	Elsas	1.19 to 2.66
Resin	Boltzman	2.55
Porcelain	Curie, Starke	4 38 to 6.84
Paper	Pirani	2.00 to 2 25
Hard rubber	Boltzman and others	2.55 to 3.15
Mica	Klemencic	6.64 to 5 66
Bakelite Sample No. 1	Electrical Testing Laboratories, New York	8.85
Bakelite Sample No. 2		6 05
Bakelite Sample No. 3		6.30
Bakelite Sample No. 4		5.95
Bakelite Sample No. 5		5.60

Thus it will be seen that bakelite's specific inductive capacity is greater than that of hard rubber and shellac, and comparable only to mica and the best qualities of glass. With the material prepared more especially for such purposes the figures will doubtless be higher. Experiments outlined to test bakelite for static hysteresis are not yet complete, but from all indications it is expected that the tests will place the substance in a high place in the scale of dielectrics.

With a view to comparing bakelite with shellac a well-known engineering firm carried out certain puncture tests. The substances under consideration were impregnated into paper, several thicknesses of which were pressed together until a standard of 1/16 in. was obtained. The results are given below, although the value of the comparison was minimized by the use of ordinary commercial paper with its metallic and other impurities, the puncture point being probably dominated by the presence of foreign bodies in the paper. Shellac, whose dielectric capacity approximates that of dry paper, would suffer less in comparison. The voltage of puncture for shellac varied from 38,500 to 58,000, while that for bakelite ranged from 42,000 to 62,000. The average voltage at which the material broke down ranged from 40,500 to 50,000 for shellac, and from 39,000 to 58,500 for bakelite, the respective averages being 50,460 volts and 53,700 volts.

To test bakelite as an insulator it was compounded with filling substances, asbestos, wood pulp, etc., and compressed into various forms of insulators, the qualities of these being compared with similar articles made from hard rubber, shellac, porcelain and other familiar dielectrics. After satisfactory laboratory tests and encouraging observance of the dielectric properties of these bakelite insulators, together with the vastly important fact that they were free from deterioration by oils, water, solvents, chemicals and weather influences, several electrical manufacturers of international reputation tried them out in active service, the new insulators being critically observed to detect weaknesses and defects. Some such imperfections were noticed.

For instance, test-pieces of transparent bakelite used for fancy goods possessed lower dielectric quality than others especially prepared for electrical use. Bakelite insulators molded with asbestos were found inferior to those containing wood pulp or mica, the low dielectric value of commercial asbestos and its inevitable content of iron or magnetic particles reducing its normal capacity. The presence of these impurities in commercial asbestos is readily detected with a magnet. Still their existence is not prohibitively detrimental for most purposes, as has been proved by the long service given by insulators of this type. In structural strength asbestos, as a filler for bakelite, will always be superior to mica, but wood pulp with bakelite gives even stronger compositions than asbestos, though less adapted to high temperatures.

Although bakelite withstands a temperature of 300 deg. C. or 572 deg. Fahr., it has, in common with rubber, shellac and other organic compounds, the property of final charring under sufficient heat, but, unlike the substances named, it does not soften and melt before charring. Charring simply means the liberation of carbon, which when released from combination becomes a conductor. In this respect bakelite, like rubber and shellac, is inferior to glass and porcelain. An intensely hot spark passed over glass or porcelain may cause a fracture, due to unequal expansion, or possibly a portion of the surface may be fused. With organic insulators a hot spark of short duration may affect the material little, but prolonged discharge is liable to carbonize its path, leaving a black conducting streak which on high-potential circuits might cause trouble. This characteristic organic drawback can be mitigated in the case of bakelite by a reduction in the amount of binding material, which might give it a further advantage over rubber and the resins, for the extraordinary penetrative power of bakelite permits of molding mixtures where very small amounts of binder are ample to provide a strong insulator.

Further experimental work is being done to ascertain the practicability of bakelite for use on transmission lines of 60,000 volts to 100,000 volts. As an insulator for high potentials bakelite has already acquitted itself satisfactorily in tests on transformer construction involving pressures as high as 275,000 volts, and at 110,000 volts and 220,000 volts it has been in practical operation.

After over two years of practical use bakelite-molded insulators have fulfilled all reasonable laboratory expectations based on early observations, and this in the most diversified fields of electrical engineering, embracing generators, motors, elevators, signals, switches, induction-coil spools, precision measuring instruments, overhead trolley and third-rail insulation, etc. Brush holders for small dynamos, formerly made of metal and provided with intricate insulating devices, are now wholly molded from bakelite-asbestos compositions. Paper impregnated with bakelite compared with that made with shellac shows superior strength and rigidity, especially at increased temperatures, and is, furthermore, unaffected by oil or solvents.

The bakelite synthesis has added a new and interesting member to the considerable and versatile family of resins, but notwithstanding its resinous birthmarks bakelite displays certain qualities that set it apart, for it is also endowed with many remarkable accomplishments entirely foreign to its kin and rather resembling certain inert inorganic substances.

While the initial condensation during the manufacture of bakelite, called "Bakelite A," shows unmistakable resinous properties, the final or polymerized and hard product, "Bakelite C," is not a resin and, although it has the appearance of amber, it misses all of the characteristics of a resin. Bakelite C, therefore, does not hydrolize or show the destructive whitening surface effect which causes incipient disintegration in resinous insulators.

Bakelite-molded objects can be heated for hours to 395 deg. Fahr. (202 deg. C.) in steam at 235 lb. pressure per square inch without showing any alteration. Many varieties of glass submitted to such drastic treatment would turn brittle and opaque, and the resins would collapse immediately Sticks of unmixed Bakelite C have been kept at boiling temperature in a 10 per cent solution of sulphuric acid for 29 days and nights and showed no sign of attack.

Articles of a special variety of Bakelite C made to stand caustic alkalies were kept for a year at a temperature of 140 deg. Fahr. to 176 deg. Fahr. (60 deg. C. to 80 deg. C.) in a 10 per cent solution of caustic soda. At the end of that time the samples showed no decided alteration, although the glass container had to be replaced repeatedly owing to the destructive action of the alkali. These experiments, together with two years of actual service, warrant the belief that bakelite is preeminently adapted to stand weather conditions. Any difficulty noted has been with filling materials, for those heretofore noted are not possessed of bakelite staying powers. The acid test mentioned surely proves the resisting quality of bakelite, yet when asbestos is used as a filler a white crystalline efflorescence becomes more or less apparent, due to a slow attack of the asbestos by the acid, and has been mistaken by inexpert observers for a corrosion of the bakelite itself.

One installation of bakelite-asbestos petticoat insulators on a 10,000-volt traction line shows not the slightest sign of deterioration after more than two years' operation. Similar results were obtained in third-rail service on an important electrified railroad system exposed to very severe passenger and freight service. Several of these insulators were subjected to a test of an even more convincing nature, an apparatus with electrically operated valves being arranged so that the insulators could be flooded alternately by hot and cold water. After 60,000 rapid changes of extreme temperature the insulators were unaffected.

These qualities, added to the extreme accuracy with which the material can be molded and the ease with which metallic parts can be embedded, as well as its toughness, strength and capacity to resist shock, give bakelite marked advantages over fragile glass and porcelain insulators. Moreover, it lends itself to free machining, since it can be milled, cut, threaded, sawed and polished. Where extra ease in machining is desired a bakelite composition is specially made for this purpose.

For delicate electrical instruments, in addition to its superior heat-resisting qualities, bakelite shows some decided advantages over rubber. Containing no sulphur it liberates no "bloom." This characteristic "sweating" of rubber not only blackens and corrodes delicate metallic parts, but under the oxidizing action of moist air and light forms minute amounts of sulphuric acid. Although almost imperceptible, this spreads in a microscopic film and becomes a factor of uncertainty in delicate measurements. All volatile products or traces of water which might be contained in bakelite are easily and permanently expelled by careful drying.

It has also rendered important service in the impregnation of coils for dynamos, motors, solenoids, etc. As a liquid it permeates coil windings with the ease of light oil and without the use of heat. Full penetration takes place at ordinary temperatures. Bakelite impregnation merely requires that the coils be first heated to drive off moisture when they are immersed in or flooded with the liquid. Vacuum may be applied to expel the air if desired, though this is not essential. Air pressure is used to insure thorough impregnation. The permeation complete, the coils are transferred to a "bakelizer" where they are heated in a chamber under an air pressure of about 100 lb. to 150 lb. per square inch. The heat causes the polymerization alluded to and the hardening process is complete. After leaving the bakelizer the coils are oven-dried at 266 deg. Fahr. to 320 deg. Fahr. (130 deg. C. to 160 deg. C.) for from twelve to twenty-four hours or longer. This removes all traces of water. If desired the coils can be given a second coating of thick liquid bakelite, being painted or dipped while warm and then reheated to harden the additional coating; or a coating of bakelite protective enamel may be applied and heat employed to harden.

Instead of using a bakelizer the coils can be heated in an oven, starting at 167 deg. Fahr. (75 deg. C) and increasing until the liquid begins to harden. Then the temperature is raised slowly until it reaches 266 deg. Fahr. to 284 deg. Fahr. (130 deg. C. to 140 deg. C.). This process requires more time, is not quite so reliable, and a too rapid increase of temperature is apt to give a porous texture to the material.

The process before described is in use for the manufacture of coils and armatures of small dimensions. Whether it is being used on large units the writer is not aware. Possibly some difficulty might arise in treating large dynamos and motors. For instance, in the process of hardening Bakelite A, the process of converting it into the insoluble, inert, resistant form, C, a small amount of water is chemically liberated, hence the drying after-treatment. For smaller windings this presents no difficulty, but in case of units of unusually large dimensions it may be different. There it may be simpler or more suitable to use bakelite varnish in place of the liquid A. The wires might be coated with the varnish, which is a form of liquid A, the alcohol allowed to evaporate and the wire slightly heated to convert the fusible A into the infusible but soft B. This eliminates any chemical water, the unit being then made up by winding the wire in place while still warm, after which the whole can easily be submitted to the polymerization process, changing B into C. Possibly some manufacturers of large units may be using such methods; in any case, the difficulty is not insuperable and modern shop practice is probably competent to handle such questions as they might arise.

Interesting experiments made with arc-lamp coils illustrate the possibilities of the bakelite process. Treated coils were heated by current for two weeks, a temperature of 150 deg. C. being registered on a thermometer outside, although, naturally, the internal temperature was much higher. The windings consisted of double-cotton-covered 0.032-in. copper wire. On opening the coils the interior was found to be completely charred. They were then submitted for one minute to a voltage of 600. The insulation did not puncture. After the test the coils were sawn through and dielectric capacities tested between the turns. The breaking strain between the various turns read, in volts, 1700, 1600, 1560, 1840 and 1500—an average of 1640 volts. Other lamp coils were tested by being first subjected to a temperature of 160 deg. Fahr. for two weeks. Then a 120-cycle potential was applied, the voltage being raised slowly. At 550 volts one coil commenced to smoke; half a minute later the other. The insulation of neither was punctured. Owing to the brittle nature of the insulation and the fineness of the wire no dielectric tests were attempted.

Considering what has actually been accomplished in the field and the drastic methods of testing, it seems as if bakelite varnish will displace, for electrical purposes at least, shellac and other kindred forms of varnish and impregnating compounds. It is easily applied, dries rapidly, and, most important of all, the application of heat instead of exerting a softening influence converts it slowly but surely into an infusible material.

In very dilute form mixed with special solvents it becomes a splendid lacquer which needs but a drying stove or any further exposure to heat to transform it into an excellent protective enamel or coating for metallic objects.

With its many excellent qualities bakelite has the shortcoming of rather limited flexibility. Though it is hard and strong, it cannot replace rubber and gutta percha where flexibility is imperative. Paper coated or impregnated with bakelite may be more or less flexible, but in this respect it behaves very much like shellac. Though certain bakelite compositions have been made showing considerable flexibility, the other great qualities of the synthetic compound have had to be greatly sacrificed. For the moment there is very little probability of its replacing rubber or gutta percha for construction such as cable work, but further research in this line is still in progress.

As the matter now stands a new and valuable synthesis has placed a remarkable material in the hands of the engineer. Like the discovery of a new principle in physics, much time and patience are needed to find out its full scope of usefulness. And for the first time in the history of the art a synthetic material has been available for insulation.

Industrial and Commercial News

The Week in Trade.

While there has been some expansion in spring jobbing trade, the improvement comes very slowly. All retailers are apparently imbued with conservatism, and the buying is almost entirely in small lots. If the hard times which succeeded the financial panic of 1907 did nothing else, they have certainly educated the majority of the business men of the United States into a policy of conservatism and retrenchment. While business has at times been good since that financial demoralization, there has at no time been any disposition to expand or to undertake speculative risks. The result of this policy on the part of the retail merchants of the country has been that, while they are not doing as much business as they did formerly on occasions, they are in better financial and trade positions than ever before. The majority of the retail merchants of the country are in excellent condition. Their lines of credit have been curtailed, and their cash sales have been somewhat increased. Book accounts are not being carried to the extent they were a few years ago. In the industrial world there is still a great deal of irregularity and uncertainty among the textile manufacturers. Neither the price of raw materials nor the orders from outsiders warrant anything that approaches expansion. In the iron and steel trades the condition is different. There has been a decided increase in orders for steel products, and the mills have put on new hands during the past week, which probably increases their operations to about 65 per cent of normal. All of the expressions from iron and steel authorities are optimistic. It is not believed that the rate decision will very seriously curtail the railroad buying, although many railroads have taken occasion at this time to hold up orders that were pending. Prices of pig iron and other crude material remain firm, but show no disposition to go higher. This is, of course, advantageous to the iron and steel manufacturing industry. Collections show little improvement in any part of the country. They are better in the South and West than elsewhere, but even in these sections are reported to be only from "slow to fair." Business failures for the week ending March 2, as reported by *Bradstreet's*, were 256 as against 258 the previous week, 184 in the same week in 1910, 219 in 1909, 287 in 1908 and 172 in 1907.

The Copper Market.

Dullness characterized the copper market during the past week and the price continues to trend downward in Europe with freer offerings for nearby delivery and at slight concessions. In this country interest is still centered in the active competition in some manufacturing lines which continue to develop a fair amount of business, upon which electrolytic copper continues to be sold at from 12¼ cents to 12.30 cents cash, and from 12⅜ cents to 12.40 cents delivered thirty days. The tendency, however, seems to be downward, although there is no pressure to sell, while the largest interests apparently have made no change in their selling prices, although all the business of importance thus far developed has gone to independent interests. A fair amount of business is being done in lake copper in small lots, and some of the smaller producers have disposed of their March output and some sales have been made into April. The imports during January reported by the government were 10,600 tons, but the actual arrivals were much heavier, the government being dependent upon the reports from refineries, which accounts for the smaller returns. In January last year the imports were 13,800 tons. The total foreign shipments since March 1 have been 3064 tons. Exports of sulphate of copper in January were 508 tons, against 400 tons in the corresponding month last year. As we go to press it is predicted that the report of the Copper Producers' Association, to be issued during the present week, will show an accumulation in stock amounting to between 5,000,000 and 10,000,000 lb. The daily call on the Metal Exchange, on March 6, quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.90	12.00	.....
March	11.90	12.00	11.95
April	11.90	12.00	11.95
May	11.90	12.00	11.95
June	11.90	12.00	11.95

The London market, March 6, was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	54	6	3	54	6	3
Standard copper, futures	55	0	0	55	0	0

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.30c	11.87½c
London, spot	£56 15 0	£53 15 0
London, futures	57 12 6	54 10 0
Best selected	60 5 0	58 0 0

Industrial and Commercial Notes.

Wisconsin Engine Company.—The Wisconsin Engine Company, Corliss, Wis., has just made a very considerable addition to its equipment and working capital in order to allow it to enter extensively into new lines of manufacture. Up to the present time this company has been controlled by strong Pittsburgh interests. On account of the location of the plant it became desirable to bring Milwaukee capital into the company and two of the new directors will be prominent business men of the latter city, and as Mr. Adams, the new president of the company, is a Milwaukee man, the controlling interest will be at Milwaukee. The plant of the Wisconsin Engine company is located at Corliss, a growing manufacturing center about twenty miles from Milwaukee and seven miles from Racine, Wis. The principal business of the Wisconsin Engine Company has been the manufacture of Wisconsin Corliss engines. It is the purpose of the new organization to foster and to build up the existing Corliss engine business, but the additions of new capital and new equipment are chiefly for the purpose of enabling the company to enter extensively into new lines of manufacture. Chief of these will be the Adams gas engine, which will be manufactured in sizes from 200 hp to 3000 hp in a single unit. The company has already secured orders for upward of 10,000 hp of the Adams engines, and increased shop facilities and new equipment are now being installed to permit the rapid and economical production of these. E. T. Adams, the new president of the company, has been identified with this line for many years, dating back to the early days of the Edward P. Allis Company in Milwaukee, where he was connected with the design and installation of many of the important power and pumping installations in the country.

Excello Arc Lamp Company.—The demand for flaming-arc lamps was considerably better in February than in January, according to the report of the Excello Arc Lamp Company January, it was stated, was a lighter month than January, 1910, but February showed considerable improvement. The principal demand comes from factories, railroads and other business concerns. Just at the present time there are no contracts being made by municipalities for street lighting. Some negotiations are pending between commercial bodies in various cities for street lamps, but the cities themselves hesitate to take up this problem. The new long-burning Excello lamp, which is guaranteed for seventy hours on one trim, is meeting with a decidedly favorable reception. The company has recently established a branch office in Philadelphia, which is in charge of Arthur F. Saloman, and also a branch office in Boston, in charge of A. J. Thompson.

Foreign Orders for Ship Electrical Equipment.—Messrs Workman, Clark & Company, large shipbuilders located at Belfast, Ireland, have recently placed an order with the General Electric Company for electrical equipments for three steamers which they are building for the United Fruit Steamship Company. The total equipment for these three steamers includes: Twelve 35-kw turbo sets; forty-two motors for the refrigeration and ventilating system, aggregating 520 hp; three controlling switchboards; motor-controlling panels, etc., and three searchlights. Ten steamers have already been similarly equipped and have been in operation for some time, the present order thus bringing the total up to thirteen steamers.

New Fixture Company in Los Angeles.—The Phœnix Lighting Fixture Company, of Los Angeles, Cal., has been incorporated with authorized capital stock of $100,000 to manufacture fixtures for electric and gas lighting. The incorporators are: Philip Forve, president of the Forve-Pettebone Company; C. E. Packman, president of the Mission Fixture Company, and W. G. Hutchison, president of the W. G. Hutchison Company. The three companies represented by these gentlemen are now engaged in the manufacture of fixtures, and they will dispose of this part of their business to the new company and engage exclusively in the business of selling fixtures at retail. The new company will confine itself exclusively to the manufacture and wholesale disposal of fixtures. A three-story brick building at the corner of Fourth and San Pedro Streets, Los Angeles, has been leased by the Phœnix company, and it is expected that the plant will be in operation some time in April. About 150 men will be employed, and it is said that this will be the largest factory for the manufacture of fixtures on the Pacific coast.

Electric Companies Sales.—It was given out in financial circles last week, after investigation among the electrical manufacturing companies, that sales for both January and February had been lighter than last year. The volume of orders in all of the companies was larger, but the average size of individual orders was very much smaller. In other words, there has been a fairly good business in small apparatus and very little done in large apparatus. It is stated that the Westinghouse Electric & Manufacturing Company and the General Electric Company are now working at about 73 per cent of normal output. The General Electric Company's report for February showed some increase, and indicated that the average monthly ratio would mean a yearly basis of $58,000,000. This is regarded as a distinct improvement in February, because the January orders were at the rate of only about $48,000,000 per year. The average for the two months was at the rate of about $53,000,000 per year, which compares with about $60,000,000 for the same period a year ago. An official of the General Electric sales department says that the orders since the beginning of the year are distinguished by the vast number of small individual orders and the small number of orders for large equipment. The General Electric Company is said to be well supplied with crude copper. Neither this company nor the Westinghouse Electric & Manufacturing Company is likely to be in the market for copper in the near future. Either one of the companies may be if the market price of copper goes below what is considered normal, but neither company will be compelled to buy in order to fill requirements.

Growth of New York Edison Business.—In 1910 the New York Edison Company gained more than 1,000,000 50-watt equivalents over the new business of the preceding year. The new business amounted to 3,690,187 50-watt equivalents, against 2,643,113 in the preceding year, or almost a 40 per cent increase. There were above 185 times as many new contracts signed in 1910 as the total business of the company in 1883. When the Edison Company started its Pearl Street station Jan. 1, 1883, there were 231 customers with 3477 lamps. Since 1900 the gain in customers of the New York Edison Company has aggregated 512 per cent and the increase in 50-watt units is 482.5 per cent. To-day the company is obtaining five times as large a gain in new business as was the case in 1900. In the borough of the Bronx growth of electrical business has more than kept pace with the great gains in population recorded by the census. Increase in Bronx population in ten years has been approximately 115 per cent, while the corresponding gain in electrical consumption has been over 1000 per cent. The customers on Nov. 30, 1910, numbered 10,929 in this district, against 555 on Dec. 31, 1900. The gain in business in the Bronx to a considerable extent has been for motor service in the new large factories springing up all through the territory. Nevertheless, new apartment houses north of 160th Street are practically all equipped with electric lighting facilities.

Allis-Chalmers Bookings.—The bookings of the Allis-Chalmers Company in February were almost double the record in January and, with very few exceptions, were larger than in any previous month in its history. From August last to January, inclusive, new business averaged about 50 per cent less than in the corresponding previous period, but for the month just closed the record was approximately 50 per cent better than in 1910. In December and January the Allis-Chalmers Company had under active negotiation a larger amount of business than ever before, and the fact that a large percentage of it was closed in February does not necessarily indicate substantial improvement in the general situation, although inquiries continue to be of an encouraging nature. Operations at the company's plant now average about 60 per cent of capacity, which, owing to extensions made during the past three years, is equal to between 75 per cent and 80 per cent of what was formerly considered normal.

Equipment for East Creek Electric Light & Power Company.—Messrs. Vielé, Blackwell & Buck, New York City, who are acting as engineers and contractors for the East Creek Electric Light & Power Company, St. Johnsville, N. Y., expect to have the hydroelectric station at that point in operation next fall. Orders have been given to the Pelton Water Wheel Company of New York for two 4000-hp, Francis-type wheels, which will operate under a 125-ft. head. The electrical equipment will be furnished by the General Electric Company, and will consist of three-phase, 25-cycle, 4400-volt units. The energy will be transmitted at 60,000 volts to a substation at Tribes Hill and the output will be used chiefly by the Fonda, Johnstown & Gloversville Railroad. The development is capable of giving from 8000 to 12,000 hp, and will resemble very much the installation designed by the same engineers for the Schaghticoke station of the Hoosac River Electric Light & Power Company, which is controlled by the Schenectady Power Company.

Eastern Tennessee Power Company.—The Legislature of Tennessee has passed an act amending the charter of the Eastern Tennessee Power Company of Polk County, increasing its capital stock from $3,750,000 to $4,000,000. The fact that this company had purchased from the Westinghouse Electric & Manufacturing Company four generators for installation in its new hydroelectric plant on the Ocoee River was published in our last issue. The company is composed mostly of Chattanooga capitalists, but the Chattanooga Light & Power Company, owner of the street-car system of that city, is one of the largest stockholders. The company has already begun to make contracts with manufacturing concerns for the supply of energy. It is predicted that within a few years the majority of the manufacturing concerns of Chattanooga and the surrounding territory will be customers of this company.

Brooklyn Rapid Transit.—The Brooklyn Rapid Transit Company has submitted to the New York Public Service Commission a plan which provides for a comprehensive and connected system of subways and elevated lines in Brooklyn, Manhattan, Queens and Richmond boroughs. The proposition is that the city construct the subways proposed and the company equip and operate them. The cost to the company of carrying out its part of the plan is estimated at from $50,000,000 to $60,000,000. An important feature of the plan is the construction of a new tunnel under the East River connecting the Montague Street line of the proposed new subway system in Brooklyn with a new subway in Manhattan, running under Church Street with a spur through that thoroughfare over the Queensboro Bridge.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Buffalo, N. Y.; Eufala, Ala.; Darbyville, Va.; Merced, Cal.; Ely, Minn.; Redmond, Ore.; Poughkeepsie, N. Y.; Toledo, Ohio; Dayton, Ohio; Turlock, Cal.; St. Charles, Mich.; Portola, Cal.; Minneapolis, Minn.; Spooner, Wis.; Rouleau, Sask., Can.; Hopkinsville, Ky., and Youngstown, Ohio.

Chicago & Milwaukee Electric.—Judge Grosscup has appointed W. O. Johnson, a director of the Western Trust Company, of Chicago, receiver for the Chicago & Milwaukee Electric Company. The former receivers are retained as advisers. The security holders of the company have agreed to accept any settlement which Judge Grosscup makes. They are assured that a strong committee, including John J. Mitchell, will provide the necessary funds.

Westinghouse Arc Lamps in Italy.—The Westinghouse Electric & Manufacturing Company recently received the contract for 65 direct-current series metallic-flame 6.6-amp lamps and one "65-light," oil-cooled, constant-current rectifier, with control panel to be used in lighting the Turin International Exposition of Industry and Labor, which will open at Valentine Park on the River Po, Italy.

West Penn Railways.—The West Penn Railways Company is planning for the construction of additional generating stations and about 50 miles of new track. Details of its plans for extension and improvements have as yet not been announced.

Financial.

The Week in Wall Street

CONSERVATISM has been the dominant note sounded in financial circles during the past week, based on the expectation that there will be an overhauling of the tariff under Democratic auspices and that, in the course of this, business will languish and the earnings of corporations supporting dividends, and therefore the prices of securities, will decline. Moreover, the probability of an extra session of Congress to take action on the Canadian reciprocity measure has caused a certain feeling of uneasiness. The possible results of the anti-trust suits are now being predicted, and adverse findings of the Supreme Court might prove displeasing to Wall Street. While such findings will affect finances only moderately in the end, yet a period of readjustment such as that foreshadowed in the event of drastic findings by the court must involve a considerable unsettlement of both sentiment and business. The condition of winter wheat has improved markedly in the last few weeks, and a very fair report is looked for in April. Produce markets inclined to this belief quite obviously, for the process of deflation continues there, as it does in cotton and in a wide range of commodities essential to the well-being of the country at large. The shock predicted by pessimists as a certain correlative of the railroads' defeat by the Interstate Commerce Commission was not in evidence, nor is it likely to materialize at this late date. Spring jobbing trade gave good indications of a substantial expansion; and, generally speaking, trade is much brighter and more buoyant than a month ago, although, compared with last year's volume of transactions, it is not quite up to expectations. The week was one of small and inconsequential changes upon money markets at home and abroad. Ease still promotes the flotation of a substantial volume of securities, although the return which the investor demands is greater than of old. The rates for money on March 6 were: Call, 2 @ 2½ per cent; 90 days, 3 @ 3¼. The quotations in the table are those at the close of March 6.

NEW YORK.

	Feb. 27.	Mar. 6.	Shares Sold.		Feb. 27.	Mar. 6.	Shares Sold.
Al. Ch.	7⅞*	7⅞*	60	Int. Met., pf.	52½	52¼	7,550
All. Ch., pf.	31*	30½	200	Mackay Cos.	91½	91⅞	500
Amal. Cop.	63⅝	62½	45,300	Mackay C., pf.	76½*	76¾	545
Am. D. T.	20½*	20½*	——	Man. Elev.	139¾*	139	300
Am. Loco.	38	37½	5,700	Met. St. Ry.	15*	15*	——
Am. Loco. pf.	109¾	109¾*	210	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & C.	84½*	84½*	——	Steel, com.	77⅝	76⅛	537,200
Am. T. & T.	144⅝	144¾	6,860	Steel, pfd.	118¾	118	3,845
B. R. T.	77⅞	78	20,750	W. U. T.	73⅞	73	600
Gen. Elec.	152¼	149	7,100	West'h, com.	69⅝	69⅝*	2,900
Int. Met.	18¾	18⅛	7,687	West'h, pfd.	120	117½	500

PHILADELPHIA.

	Feb. 27.	Mar. 6.		Feb. 27.	Mar. 6.
Am. Rys.	44⅞*	43¾	Phila. Elec.	16⅛	16⅛
Elec. Co. of A.	12⅛	12⅛*	Phila. R. T.	20⅜	20½
Elec. St. B'ty.	53½	53¾	Phila. Trac.	85	85½
E. S. B'ty., pfd.	30*	30*	Union Trac.	47½	47½

CHICAGO.

	Feb. 27.	Mar. 6.		Feb. 27.	Mar. 6.
Chi. City Ry.	185*	190	Chi. Tel. Co.	123	121
Chi. Rs., Ser. 1	92½	91½	Met. El. Co.	20	22
Chi. Rs., Ser. 2	23½	24½	Met. El., pfd.	66½*	68
Com. Edison	120	118½	Nat'l Car	118¾*	118¾*
Chi. Subways	4⅜	4⅜*	Nat'l Car, pfd.	118½	118½

BOSTON.

	Feb. 27.	Mar. 6.		Feb. 27.	Mar. 6.
Am. T. & T.	144⅝	145	Mex. Tel.	4½*	4
Cum. Tel.	149*	149*	Mex. Tel., pfd.	6⅛*	6
Edison E., Ill.	290	289½	N. E. Tel.	142	142
Gen. Elec.	152½	149½	W. T. & T.	20	20⅞
Mass. E. Ry.	17*	17*	W. T. & T., pfd.	94	94½
Mass. E. Ry., pfd.	88	88			

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*Last price quoted.
Shares sold for week Feb. 27 to March 6.

Financial Notes.

Colorado Telephone Company.—During the past year the Colorado Telephone Company gained in every branch of activity. There was an increase of $252,000 in gross revenue, which included a gain of $170,000 for exchange service and $58,000 for toll service. The total resources of the company are $12,471,450, an increase of $1,727,290 over a year ago. The company's resources include real estate, $811,806; exchange construction in service, $7,182,024; toll construction in service, $2,541,300; construction in process, $690,775; office furniture and fixtures, $54,917.91; supplies, $156,058.46; tools and vehicles, $47,322.20; stocks and bonds, $136,562.12; bills and accounts receivable, $570,697.16; cash, $240,102.97; prepaid express, $30,702.98. Total, $12,471,450.67. The capital stock outstanding is $8,500,000. The company received in revenue during the year, from exchange service, $2,424,911; toll service, $685,161; dividends and interest, $45,504; miscellaneous, $3,839. Total, $3,159,417. Expenses were $2,472,090, leaving a revenue balance of $687,325.

Washington Water Power Company.—During 1910 the outstanding capital stock of the Washington Water Power Company, Spokane, was increased on April 1 from $7,223,200 to $9,390,100, and to $11,737,600 on Jan. 3, 1911. A regular dividend of 7 per cent was paid in 1910, and an extra dividend of 1 per cent was paid on Jan. 3, 1911. A quarterly dividend of 2 per cent has been declared payable April 1 to stockholders of record March 15, 1911. The company is planning to install four 12,500-kw hydroelectric generating units at its Long Lake Station. Two of the units, which will be the largest in existence, will be in service by the fall of 1912.

Massachusetts Lighting Companies.—The trustees of the Massachusetts Lighting Companies have voted to offer shareholders of record March 3 the right to subscribe to 1767 additional shares of capital stock in the ratio of one new share for each 20 held, at $110 per share. Subscriptions must be filed on or before March 30, payments in full to be made before March 30, or on payment of $25 per share payment of balance will be extended to not later than June 30.

Minneapolis General Electric.—The Minneapolis General Electric Company is beginning the expenditure of $1,414,000 on improvements to its system, which will be completed by Oct. 1. The principal expense will be in connection with the replacing of the Main Street generating station that burned recently, entailing a loss of about $650,000. The work of construction is being accomplished by the Stone & Webster Engineering Corporation.

Workmen as Westinghouse Stockholders.—According to reports from Pittsburgh, the Westinghouse interests, employing about 30,000 men, are preparing to take their workmen in as stockholders. The plan is similar to one put into operation by the United States Steel Corporation. It is said the first move in the matter will be made at a meeting of the stockholders of the Union Switch and Signal Company to be held on March 14.

Rio de Janeiro Tramway.—The Rio de Janeiro Tramway, Light, Heat & Power Company has disposed of $3,000,000 5 per cent second mortgage bonds to Baring Bros. and J. S. Morgan & Company, of London, Eng. The company has considerable new construction work under way, and the proceeds of the sale will be used to carry out the work during the next year, as well as to pay off outstanding obligations to the banks.

Havana Electric Railway.—The Havana Electric Railway Company has sold to Speyer & Company $1,846,000 consolidated mortgage 5 per cent bonds due Feb. 1, 1952. Of the proceeds $1,146,000 is to retire the first mortgage bonds and $700,000 is for improvements. On Jan. 1 the consolidated mortgage bonds become the only lien on the entire property. Speyer & Company will place the bonds abroad.

Lake Geneva Electric.—The Wisconsin Railroad Commission has authorized the Lake Geneva & Lake Delavan Electric Company to issue $200,000 in bonds and $167,000 in capital stock, the proceeds to be used for the purpose of paying organization expenses and other expenses incident to the construction and equipment of an electric railway between the village of Walworth and the City of Delavan.

Lake Superior Corporation.—A special meeting of the stockholders of the Lake Superior Corporation was held last week, and the financial plans for the completion of the Manitouin & North Shore Railway were approved. T. J. Drummond, president of the corporation, is very optimistic with regard to the business of 1911 and expects the returns to be largely increased

Charleston Electric.—The stockholders of the Charleston Consolidated Railway Gas & Electric Company will vote on March 22 on increasing the capital stock by an issue of $100,000 of common stock, making the maximum capital stock $3,000,000, including the present common of $1,500,000, and the preferred of $500,000.

Baltimore Gas & Electric.—The stockholders of the Consolidated Gas, Electric Light & Power Company, Baltimore, have ratified the increase in the common stock from $6,300,034 to $8,500,000, and also the cancellation of $700,000 of first lien stock.

Edison Companies Merger.—The recent filing in Trenton by the National Phonograph Company of an amended certificate changing the name of the company to Thomas A. Edison, Incorporated, is the first step in a movement to combine under one head all of the companies now engaged at the Edison plant in the manufacture and sale of Edison phonographs and moving pictures. The Edison Business Phonograph Company will be absorbed by the new corporation and later on the larger concern will also take in the Edison Manufacturing Company, which makes and sell moving pictures and films, and the Edison Phonograph Works. The Edison Portland Cement Company, the Edison Storage Battery Company and some other smaller companies which have to do with the marketing of Mr. Edison's products will continue as they now are. Mr. Edison does not figure as a stockholder in the new company. Mrs. Edison holding the control. The names of the stockholders are Mina M. Edison, Ernest J. Berggren, Frank L. Dyer, Carl H. Wilson, William Pelser and Harry F. Miller, the last name being that of the private secretary to Mr. Edison. The authorized capital stock of the new concern is $2,000,000.

New England Telephone Company.—The stock of the New England Telephone Company is now selling almost as high as that of the American Telephone & Telegraph Company. This advance in price is due, it is said, to the largely increased earnings for the year 1010. It is understood that for this period the gross returns were between 11 per cent and 12 per cent larger than in 1909, and the share earnings were somewhat better than 9 per cent. The year 1911 will be one of smaller property expansion than 1910. This fact will make it possible to go through the year without recourse to the issuance of any new securities. The last block of stock sold by this company was in March, 1900, when $3,562,400 was offered to the shareholders. The new $600,000 building in Boston was provided for financially long ago and will be ready for occupany in June.

Northern Ohio Traction & Light Company.—The directors of the Northern Ohio Traction & Light Company have authorized an issue of $3,000,000 of 6 per cent cumulative preferred stock, $1,000,000 of which will be sold and has already been underwritten by W. E. Hutton & Company, of Cincinnati. A meeting of the stockholders will be called shortly to confirm the action of the directors The proceeds from the sale of this new stock will be used to build a new power house a few miles north of Akron, Ohio. This will enable the company to close several of its present small power plants and largely to increase the electric lighting and power business in Akron. The officials of the company believe that a very large decrease in operating expenses will result. The company is now earning about ten times the preferred-dividend requirements.

Commonwealth Edison Company.—The stock of the Commonwealth Edison Company of Chicago has been strong on the Chicago Stock Exchange and the price has advanced several points. This is taken to mean that there is little fear that the city government will force a reduction in rates. If last year's ratio of increase in gross sales is duplicated this year the earnings will exceed $16,000,000, and if the operating ratio is the same as in 1909, namely, 62 per cent, the net will be about $6,000,000, or 18 per cent on the outstanding stock. Last year's operating ratio was 65 per cent, but this was attributed to the abnormal cost of fuel. The council committee on gas and electric light will begin an investigation of the Edison Company with a view to regulating prices as soon as the gas investigation is completed.

Otis Elevator Company.—The recent advance in the Otis Elevator Company stock, which has carried it up over ten points in the past two weeks, is accompanied by a renewal of the talk that the common dividend will be increased at the March meeting of the directors to the basis of 4 per cent. The earnings of the company seem to justify such an increase. Since the sale of $3,500,000 of debenture bonds last year the company's financial condition has been especially satisfactory. The earnings for the year 1910 are expected to show much better figures than those for 1909, although the official report has not yet been made. Up to the last two months of the year the business had been unusually large, but in November and December there was a decided falling off.

Tri-City Railway & Light Company.—President J. F. Porter, of the Tri-City Railway & Light Company, of Davenport, Ia., reports that his company is in excellent condition and that the earnings for 1910 will show a considerable improvement over those of 1909. Both the traction and the power business recorded large improvement and the physical condition of the company compares favorably with that of any company serving a similar community. During the past year the steam-generating plants of the company have been increased by the addition of a 15,000-hp Parsons turbine. The new Sears hydroelectric plant will be ready for service Oct. 1, 1911. A number of other improvements have been planned for the coming year.

Philadelphia Rapid Transit.—At a special meeting of the stockholders of the Philadelphia Rapid Transit and Union Traction Companies last week the proposition of the directors to increase the indebtedness of the companies from $5,000,000 to $15,000,000 was approved unanimously. The vote was overwhelming in both companies. This carries out the Stotesbury refinancing plan. The stockholders were presented at the meeting with reports from the expert accountants, which showed that the income from operation during the last six months of 1910 was: Gross, $10,279,031; expenses, $5,346,425; total operating profit, $5,379,476; fixed charges, $5,178,731, leaving a net operating profit of $200,745.

Electric Bond & Share Company.—The report of the Electric Bond & Share Company for the year 1910 shows surplus earnings, after paying all expenses and charges, of $354,597. This is a decrease of $113,300 from the eleven months which ended Dec. 31, 1909. At the annual meeting of the company last week it was announced that in addition to its regular business of buying and selling issues of bonds and preferred stock of light, gas and power properties for its own account a department had been established for the buying and selling of such issues on a strictly commission basis. The company is now in a position to furnish quotations and execute such orders as its customers may desire.

Northwestern Pennsylvania Traction Deal.—It is given out that a group of Cleveland and Eastern capitalists have closed a deal for the acquisition and control of the Meadville & Conneaut Lake Traction Company, the Meadville Traction Company and the People's Incandescent Light Company, of Meadville, Pa., and Oakwood Park, a forty-acre amusement place near Meadville. The companies will be merged into a corporation called the Northwestern Pennsylvania Railways Company. It is planned to extend the suburban lines and to increase the equipment and capacity of the lighting plants.

Northern Indiana Gas & Electric Company.—Articles of incorporation for the Northern Indiana Gas & Electric Company, with a capital stock of $5,000,000, have been filed in the various counties of Indiana in which the corporation will do business. The new company is a merger of the South Shore Gas & Electric Company, of Indiana Harbor, Indiana Harbor & East Chicago Electric Company, Plymouth (Ind.) Lighting Company and the Whiting (Ind.) Electric Light Company. C. H. Geist, of Philadelphia, is president; Samuel T. Bordine, vice-president, and Lewis Lillie, secretary.

Union Switch & Signal Company.—The 1910 report of the Union Switch & Signal Company, which has just been made public, shows gross earnings of $6,259,093 as compared with $2,625,133 in 1909. The surplus after paying all charges was $1,231,507 as compared with $325,983. This is equal to 30.78 per cent on the capital stock of the company. The business of the company has been very large for the past six months and the plants are running at full capacity at the present time.

Interborough Brooklyn Sales.—The Public Service Commission has reported that the number of tickets sold by the Interborough Rapid Transit Company at its four stations in Brooklyn in 1910 was 33,378,518. This compares with 30,221,985 in the previous year and 21,611,295 in 1908. For the year 1910 the sales in Brooklyn amounted to 12.4 per cent of the total traffic of the system.

REPORT OF EARNINGS.

UTICA & MOHAWK VALLEY RAILWAY COMPANY.

Period.		Gross. Earnings,	Operating. Expenses,	Net. Earnings,	Fixed. Charges,	Net. Surplus.
Year,	1910	$315,266	$172,268	$142,999	$72,836	$70,103
“	1909	295,517	173,528	121,989	73,723	48,266

LAKE SHORE ELECTRIC RAILWAY SYSTEM.

January,	1911	$84,560	......	$35,212	......	$3,815
January,	1910	78,994	......	30,455	......	584

CUYAHOGA TELEPHONE COMPANY.

Year,	1910	$887,617	$520,566	$367,051	$250,153	$116,898
Year,	1909	850,034	493,005	357,028	240,650	116,378

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*Deficit.

General News

Construction News.

EUFALA, ALA.—The Eufala Gas, Electric Light & Power Company has engaged W. L. Upton, of Birmingham, Ala., consulting engineer, to prepare plans and estimates of cost for the construction of an electric light system. It is proposed to erect a new building 50 ft. x 75 ft.

DOUGLAS, ARIZ.—The transmission line being erected from the power plant of the Copper Queen smelter, at Douglas, Ariz., to El Tigre, Sonora, Mex., sixty-five miles in length, will soon be completed. Electricity will be transmitted at 45,000 volts and will be used to operate the machinery in the mines and ore reduction mills of El Tigre district. Power will also be supplied for industrial plants at Fronteras Ysabel and other places. The Mexican government has decided that the electric energy should be admitted free of duty.

ARKADELPHIA, ARK.—The local electric light plant, which was owned by J. W. Wilson, has been sold by his executors to W. P. Wilson.

IMBODEN, ARK.—It is reported that the local electric-light plant has been leased to J. W. Philpot, who, it is said, will make many improvements. Mr. Philpot will take over the plant at once.

AUBURN, CAL.—A project is on foot to build a dam at the junction of the Middle Fork and North Fork of the American River, two miles east of Auburn. H. C. Whitman, who is reported to be interested in this enterprise, has filed an appropriation of 100,000 in. of water, 4-in. pressure, flowing in the American River in El Dorado and Placer counties at a point on the left bank where the Middle Fork and North Fork of the river join, from which place he proposes to conduct the water down the left bank, a distance of about four miles, following the channel of the stream to a point about 100 ft. above the channel, where the water will be utilized to generate electricity. The proposed dam will be about 200 ft. high.

BISHOP, CAL.—The business men of Bishop have organized a company for the purpose of constructing an electric railway from Laws to Bishop and to develop a large tract of orchard land. H. N. Beard is general manager.

CALLAHAN, CAL.—The power house of the Scott River Dredging Company was destroyed by fire recently, causing a loss of about $7,500. The plant supplied electricity for lighting the town.

FRESNO, CAL.—The Board of Supervisors has adopted a resolution calling for bids for certain franchises along the proposed route of the Fresno, Hanford & Summit Lake Railroad between this city and Kingsburg and Centerville, applied for by the Fresno, Hanford & Summit Lake Interurban Railway Company.

IMPERIAL, CAL.—A proposition has been submitted to the City Council by C. S. Chestnut, of Redlands, Cal., representing capitalists of Redlands and Los Angeles, to construct and operate an electric light plant in Imperial. If given the contract for street lighting the company agrees to have the plant in operation within five months.

JACKSON, CAL.—Notice of appropriation of 110,000 in. of water in the streams of Amador County has been filed by Edward Records. The filings comprise 25,000 in. in Panther Creek, 25,000 in. in Mill Creek, 25,000 in. in Tiger Creek, 25,000 in. in East Tiger Creek, 25,000 in. in East Panther Creek and 10,000 in. in Antelope Creek. The water is to be utilized for irrigation, domestic, municipal and agriculture purposes and also for generating electricity in Amador, Sacramento, Calaveras and San Joaquin counties.

LOS ANGELES, CAL.—Bids will be received by the Board of County Supervisors until March 27 for installing a vacuum cleaning and scrubbing plant, electric lighting fixtures and lamps in the new hall of records, Los Angeles. H. J. Lelande is clerk.

LOS ANGELES, CAL.—Bids will be received by the Board of Supervisors until March 27 for a franchise granting the right to erect and maintain transmission lines for the distribution of electricity on Central Avenue, Sycamore Avenue and Lindon Street for a term of forty years. H. J. Lelande is county clerk.

LOS ANGELES, CAL.—Mayor Alexander has sent a message to the City Council recommending the construction of a municipal electric railroad between the central part of the city and the harbor, as recommended by the Harbor Committee, the Harbor Commission, the Board of Utilities and City Engineer Homer Hamlin. It is proposed to use a large part of the reserve fund, which at present is $550,000, and to begin work on construction of the proposed railway as soon as the right of-way can be secured.

MERCED, CAL.—The power house of the Exchequer Mining & Power Company, located in the Merced River Canyon, was recently destroyed by the floods. Plans are being made to build a new power station, which will be located below the present plant, work on which will begin as soon as possible. Dr. F. S. O'Brien is secretary and manager of the company.

PALMS, CAL.—A petition is in circulation asking the Board of Supervisors to call a special election to vote on the question of installing a street lighting system in Palms.

PORTOLA, CAL.—It is reported that a company has been organized to construct and operate an electric light plant in Portola, work on which will begin as soon as the weather will permit. C. H. Gardner is president and D. L. Ty e vice-president and general manager. Portola has not a post office.

RIVERSIDE, CAL.—The Riverside light and power plant of the Southern California Edison Company has been sold to the Southern California Gas Company. The new owners, it is said, will make extensions to the system. The price paid for the plant is said to be $350,000.

SAN FRANCISCO, CAL.—It is reported that the Great Western Power Company has practically closed negotiations for the purchase of the property of the City Electric Company.

SANTA PAULA, CAL.—The Ventura County Power Company is reported to have submitted a proposition to the City Council offering to sell the water-works plant, including the distributing system, to the city for $104,230. The company controls various electric, gas and water-works plants throughout the county, and furnishes electricity for street lighting and other purposes in Santa Paula. The headquarters of the company are located in Oxnard.

TURLOCK, CAL.—The La Grange Water & Power Company, of La Grange, Cal., it is said, is planning to install an electric light system in Turlock. A. Scott, of La Grange, Cal., is superintendent.

WILLOWS, CAL.—The People's Power Company, recently organized by local business men, is planning to supply electricity in this county and in the northern part of Colusa County. In the country sections the company will supply electricity for operating pumps for irrigating purposes exclusively. The company will install electric lighting systems in Willows and Orland. Energy for operating the system will be obtained from the Sacramento Valley Power Compayn.

FRUITA, COL.—The City Council is reported to have granted the Grand Junction & Grand River Electric Railway Company a franchise to install an electric light system in Fruita.

MONTEZUMA, COL.—Announcement has been made that arrangements have been completed by the Automatic Transportation Company, of Buffalo, N. Y., for the construction of an elevated electric railway from Montezuma to Keystone, work on which will begin as soon as the weather will permit. The proposed railway will be twelve miles in length and will connect with the Colorado & Southern Railroad at Keystone.

MONTROSE, COL.—Preparations are being made by the Uncompahgre & Gunnison Valley Railroad Company for the construction of an electric railway in the Uncompahgre Valley, with Montrose, Delta, Olathe and Cedaredge as the principal points. It is expected to have twenty miles of the proposed railway completed before next fall. It is proposed to provide both passenger and freight service. The cost of the railway, including power plant, is estimated at from $500,000 to $1,000,000. The company also proposes to supply electricity for lamps and motors. Work will begin at Cedaredge and extend south. G. B. Townsend, of Denver, Col., is president of the company and L. N. Pepper, of Montrose, is vice-president.

WASHINGTON, D. C.—Proposals will be received until March 22 at the office of the superintendent of prisons, Department of Justice, Washington, D. C., for furnishing material and installing electric light and telephone wiring, conduit work, etc., in the administration building, in accordance with specifications, copies of which may be obtained on application to the above office. R. V. Ladow is superintendent of prisons.

WASHINGTON, D. C.—Sealed bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until March 27 for supplying and installing lighting fixtures in the United States buildings at Appleton, Wis.; Carrollton, Mo.; Hot Springs, Ark., Oklahoma City, Okla.; Rochester, Minn., and Greenville, Ill., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is Supervising Architect.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C. until March 30 for supplying and installing lighting fixtures in the United States buildings at Delaware, Ohio; Greencastle, Ind., Haverbill, Mass.; Jeffersonville, Ind.; Middletown, N. Y.; Pawtucket, R. I.; Peru, Ind., and Sewickley, Pa., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is Supervising Architect.

MICANOPY, FLA.—The installation of an electric light plant and water works system in Micanopy is reported to be under consideration.

ATLANTA, GA.—Application has been made for a charter for the Kimball Mining Company by F. H. Peck, M. S. Baughn and J. M. Bishop. The company will be capitalized at $[illegible] and proposes to engage in a lumber, woodwork and ironwork business and the development and transmission of electricity.

ATLANTA, GA.—The contract for furnishing light, heat and power for the new city hall has been awarded to the Georgia Railway & Electric Company. The cost for the service is estimated at $3,700. Electricity for lighting the building will be supplied at 5 cents per kw-hour and for motors at 3 cents per kw-hour. The cost of heating the building is estimated at $1,100. The committee, it is said, will also recommend to the General Council the appropriation of $1,500 for the purchase of all the old machinery now in the building.

CARTERSVILLE, GA.—The Blue Ridge Electric Company has filed a mortgage in favor of the Knickerbocker Trust Company, to secure a bond issue of $1,370,000. The Blue Ridge Electric Company will soon begin work on development of its water-power on the Etowah River.

COLUMBUS, GA.—The Meritas Mills have been completed and will soon be put in operation. The plant is equipped for electrical operation and will require about 450 hp. Alvin Hunsicker, manager of the Standard Oilcloth Company, is president of the Meritas Mills.

MARIETTA, GA.—It is reported that the proposition to issue $20,000 in electric light bonds will be submitted to a vote at an election to be held in May.

PELHAM, GA.—The City Council is contemplating submitting the proposition to issue $25,000 in bonds, the proceeds to be used for improvements to the municipal electric light system, to a vote of the people.

ILO, IDAHO.—It is reported that Z. A. Johnson, president of the Nez Perce Water & Power Company, of Nez Perce, has applied to the Council for a twenty-year franchise to supply electricity for lamps and motors in Ilo.

ORFINO, IDAHO.—Arrangements are being made to erect a telephone line to the interior country to tap the Red's prairie section and extend as far as Big Island, thirty miles from Orfino.

ORFINO, IDAHO.—With the passage of the Clearwater dam and reservoir bill in the State Legislature announcement has been made by the representatives of the Clearwater Timber Company that upward of $1,000,000 will be expended in the construction of a large sawmill in Orfino, a large power plant at the mouth of Whiskey Creek and Orfino Creek, three miles above Orfino, and the erection of auxiliary plants in close proximity to the large tracts of white timber land owned by the company. J. A. Humbird, of Little Falls, Minn.; T. J. Humbird, of Sandpoint, Idaho, and E. H. Brown, of Orfino, Idaho, are interested in the company. It is estimated that about 100,000 hp can be developed. The cost of the dam alone is estimated at from $350,000 to $400,000. In addition to the above project C. A. Reid, of Spokane, Wash., with Toronto associates, is contemplating the construction of a large dam at Bruce's Eddy, and a power plant below the dam, at a cost of about $500,000. About 4000 hp will be developed.

ELGIN, ILL.—Walter Mills, of Chicago, Ill., is reported to have purchased the property of the Elgin Merchants' Lighting Company, of Elgin, for $37,500.

MATTOON, ILL.—The Central Illinois Public Service Company is planning to build an extension between Charleston and Paris, a distance of thirty miles, during the present year.

MONMOUTH, ILL.—The Monmouth Public Service Company is reported to have purchased the property of the Kirkwood Electric Company in Kirkwood.

SYCAMORE, ILL.—The Woodstock & Sycamore Traction Company is contemplating the construction of an extension to Marengo.

ELKHART, IND.—The directors of the Elkhart Industrial Association have decided to take steps to secure an ornamental street-lighting system on Main Street from Tyler Avenue to Jefferson Street.

EVANSVILLE, IND.—It is announced that the Evansville Gas & Electric Light Company will erect a new building on the site of the recent fire.

FORT WAYNE, IND.—The General Electric Company, of Fort Wayne, Ind., is preparing to make extensive improvements to the power plant of its factory on Holmes Street. Two of the large turbine engines will be overhauled and repaired. Electricity for operating the factory will be furnished by the municipal electric plant while the engines are out of commission.

FORT WAYNE, IND.—The Fort Wayne & Northern Indiana Traction Company has applied for a charter for the purpose of taking over the property of the Fort Wayne & Wabash Valley Traction Company. The company will be capitalized at $8,000,000. The officers of the company are: Henry J. Bowerfind, president; James Haberley, vice-president; Arthur Mohr, secretary, and Henry E. Vordemark, treasurer, all of Fort Wayne, Ind.

GARRETT, IND.—The City of Garrett has instituted legal proceedings against the Toledo & Chicago Interurban Railway Company to enforce a contract to light the city in compliance with a provision of the franchise granted the company. The city claims the agreement has not been kept and is making an attempt to recover the amount it has expended for street lighting because of failure of the specific performance of the contract.

INDIANAPOLIS, IND.—The Mars Hill Realty Company is reported to be negotiating with electric companies for the installation of an electric-light and power plant for a new industrial city adjacent to Indianapolis. John N. Carey is president.

KENDALLVILLE, IND.—The City Council is reported to be considering the question of installing an ornamental street-lighting system.

LADOGA, IND.—H. Kessler, of Ladoga, Ind., and associates are reported to be interested in a project to construct an electric railway from Ladoga to Jamestown, a distance of ten miles.

LAPORTE, IND.—The Northern Indiana Gas & Electric Company has filed articles of incorporation in various counties of Indiana in which the corporation will do business. The new company is a consolidation of the South Shore Electric Company, the Indiana Harbor & East Chicago Electric Company, Plymouth Lighting Company and the Whiting Electric Light Company. Clarence H. Geist, of Philadelphia, Pa., is president; Samuel T. Bodine, vice-president, and Lewis Lillie, secretary.

SULLIVAN, IND.—The Vandalia Coal Company is equipping the machinery in its coal mines for electrical operation. Electricity will be used for haulage and hoisting purposes and operating mining machinery.

ADAIR, IA.—Bids will be received at the office of the Town Clerk, Adair, Ia., until March 10 for the construction of the water and lighting system in accordance with plans and specifications prepared by the W. K. Palmer Company, consulting engineers, Dwight Building, Kansas City, Mo. The work will include construction of power house and steel stack, two 60-in. x 16-ft. tubular boilers and accessories, one 50-kw, high-speed generating unit, one 25-kw vertical marine engine direct-connected generating unit, switchboard, heater, feed pumps and piping, tower and tank, cast-iron pipe and hydrants, poles, wire and tungsten lighting system, deep well and pumping equipment.

ATLANTIC, IA.—Arrangements are being made by the City of Atlantic for improvements to the municipal electric light plant and water-works system, bids for which have been received. The equipment required will include one 250-kva alternating-current generator direct-connected to a tandem compound Corliss engine, one 150-kva, high-speed generating unit, one 100-kva, high-speed generating unit, two 72-in. x 18-ft. tubular boilers and settings, switchboard, piping and condensing equipment and improvements in the electrical distributing system. The W. K. Palmer Company, Dwight Building, Kansas City, Mo., has charge of the engineering work. S. W. Straight is Mayor.

DES MOINES, IA.—The City Council has adopted a resolution accepting the proposal of the Des Moines City Railway Company to sell its stock to the city. Owing to the lack of legislative power it is impossible to fix a date to submit the proposition to the voters for their acceptance or disapproval.

FERTILE, IA.—It is reported that Harry J. Folts is interested in a project to erect an electric line to Forest City.

SHENANDOAH, IA.—The Shenadoah Heat & Light Company is reported to be contemplating the construction of an ice-manufacturing plant, to cost about $12,000.

WEBSTER CITY, IA.—Bids will be received by P. M. Banks, city clerk, until March 21 for construction of a power house, 58 ft. x 104 ft., one story high, for the proposed municipal electric light and power plant.

HOPKINSVILLE, KY.—Preparations are being made by the Kentucky & Tennessee Traction for the construction of a power house and substations for its railway, contracts for which will soon be awarded. Charles Vanden Burgh, of Hopkinsville, Ky., is general manager.

LAGRANGE, KY.—The City Council is reported to have granted a franchise to J. C. Emmick, of Lewisport, Ky., to construct and operate an electric light plant in Lagrange.

GRETNA, LA.—The construction of an electric railway from Gretna to Avondale, a distance of about nine miles, is reported to be under consideration. It is understood that the power house will be located in this vicinity and it is proposed to supply electricity for lamps and motors. It is understood that both a passenger and freight service will be provided.

BALTIMORE, MD.—At a special meeting of the stockholders of the Consolidated Gas, Electric Light & Power Company the action of the board of directors increasing the capital stock from $6,300,034 to $8,500,000 was ratified. The proceeds will be used to retire $700,000 in preferred stock and the remainder for extensions and improvements.

FREDERICK, MD.—The Washington, Fredericksburg & Gettysburg Railway Company has filed an application with the Maryland Service Commission for authority to construct an electric railway from Brentwood, Md., via Prince George's, Montgomery, Howard, Frederick and Carroll Counties, to the Pennsylvania line and thence to Gettysburg. The company has also petitioned the commission for permission to issue $100,000 in capital stock, and, in addition, $35,000 in bonds and $6,000 in preferred capital stock for each mile constructed.

BOSTON, MASS.—Plans have been announced for carrying out a project of a steamship terminal in South Boston, Mass., involving an expenditure of about $20,000,000. The plans call for the erection of eleven warehouses and factory buildings, a 5000-hp power plant and terminal docks, 1500 ft. in length.

LAWRENCE, MASS.—Work is progressing rapidly on the construction of the new Uswoco mill of the United States Worsted Company, at South Lawrence. The building will be 310 ft. long and 68 ft. wide and six stories high. The plant will be driven by electricity and will require about 800 hp.

BUCHANAN, MICH.—The Bainton Electric Steel Company, recently organized, is reported to be preparing plans for the erection of a plant.

FLINT, MICH.—The State Railroad Commission has approved of the proposed issue of $1,250,000 in bonds by the Economy Power Company, the proceeds to be used for acquiring the Flint and Kalamazoo power plants and the development of the Au Sable water-power system.

HARRISON, MICH.—It is reported that the proposition to issue bonds for the construction of a municipal electric light and water works plant will be submitted to a vote at the spring elections.

SAGINAW, MICH.—The Valley Telephone Company, of Saginaw, Mich., has applied to the State Railroad Commission to issue $150,000 in bonds, the proceeds to be used for new construction work.

ST. CHARLES, MICH.—Bids will be received by the Village Board of St. Charles until March 9 for machinery and equipment for an electric light plant and water-works system. Charles Krause is president.

BRAINERD, MINN.—The National Light, Heat & Power Company will supply electricity to the City of Brainerd for operating the municipal electric light plant as contracted for by the Toltz Engineering Company, of St. Paul, Minn., for a term of ten years. The company was incorporated in Dakota, and Pierre is its principal place of business in that State. The main office in Minnesota is St. Paul.

BRECKENRIDGE, MINN.—Arrangements are being made by the Wahpeton-Breckenridge Street Railway Company for extending its railway to Hankinson and other points southwest of Wahpeton.

CLINTON, MINN.—At a mass meeting held recently the citizens decided to establish an electric light plant in Clinton, either by granting a franchise to private parties or installing a municipal electric plant. The former plan seemed to be favored.

ELY, MINN.—The White Iron Lake Iron & Water Power Company is planning to develop the water-power at White Iron Rapids. It is proposed to utilize the falls at the output of White Iron Lake, where it is estimated that 25,000 hp can be developed. It is expected that the company will supply electricity to the mines and sawmills in this vicinity.

MINNEAPOLIS, MINN.—A report has been made to the Twentieth Avenue North Publicity Club that nearly all the merchants from Washington Avenue to Dupont Avenue are in favor of installing an ornamental lighting system.

MINNEAPOLIS, MINN.—In addition to other improvements contemplated by the Minneapolis General Electric Company during 1911, the company proposes to erect a transformer station, to cost $150,000, for which a site has been purchased on Sixth Street between Third and Fourth Avenues.

MINNEAPOLIS, MINN.—We are informed that the proceeds of the $300,000 in bonds recently voted by the city will be used for extending the municipal water-works system and light plant, which supplies water and gas to the city, instead of the construction of a municipal electric-light plant and improvements to the water works, as published in our issue of Feb. 23. There is now pending in the State Legislature a bill to authorize the City of Duluth to issue $700,000 in bonds for the purpose of purchasing or constructing a municipal electric-light plant. C. S. Palmer is city clerk.

ST. PAUL, MINN.—It is said that changes in the electric-lighting system in the State Capitol buildings are included in the estimate for the annual appropriations submitted to the Legislature by Governor Eberhardt.

STARBUCK, MINN.—At the annual meeting of the White Bear Lake Telephone Company, held Feb. 25, the stockholders voted to increase the capital stock of the company from $8,000 to $15,000. The company will extend its lines this spring. The following officers were elected: B. M. Tessem, president; G. H. Kjorstad, secretary; Carl Lingen, treasurer, and A. H. Dreyer, manager.

KANSAS CITY, MO.—Plans are being prepared by Smith, Rae & Lovett, of Kansas City, Mo., for the construction of a factory building for the Forester-Nace Box Company, to be erected at Twenty-fourth and Penn Streets, Kansas City, for the manufacture of wooden boxes. The plant will be equipped for electric motor drive.

ST. JOSEPH, MO.—The City Council is considering the question of establishing a municipal electric light plant in St. Joseph, to cost about $350,000. The proposition to issue bonds for the proposed plant will be submitted to a vote of the people. D. L. Lawlor is city engineer and W. E. Gorton city electrician.

HELENA, MONT.—The Helena Light & Railway Company has decided to double-track its railway to the Montana State Fair grounds.

BEATRICE, NEB.—The Commercial Club is considering a proposition for the construction of an electric railway from Adams to Diller, via Beatrice, forty-four miles in length.

CHAPPELL, NEB.—At an election held Feb. 18 the proposition to issue bonds for the construction of an electric light plant and water-works system was carried.

NEVADA CITY, NEV.—George W. Downey is reported to have offered to give to the city the water rights owned by him on the South Yuba River, provided the city will build a municipal electric light plant.

VERDI, NEV.—The Truckee River General Electric Company, of Virginia City, Nev., has commenced work on the construction of a new power plant north of Verdi. The plant will supply electricity in Wanhaska and to mines, smelters and mills in other parts of the State.

PORTSMOUTH, N. H.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 1, for furnishing a flue, heaters, meter, valves, piping, etc., installing this with other material and equipment furnished by the government and rearranging piping and equipment now in place at the navy yard, Portsmouth, N. H. Plans and specifications may be obtained on application to the bureau or to the commandant of the navy yard named. R. C. Hollyday is chief of bureau.

CALDWELL, N. J.—Plans are being made by the Pine Brook Electric Railway Company for the construction of its proposed electric railway, which will extend from the present terminus of the line of the Public Service Corporation of New Jersey in Caldwell to Denville, a distance of twelve miles, where it will connect with the railway of the Morristown Traction Company. The company has decided to equip the railway with storage-battery cars. S. William Kerris, of Pine Brook, N. J., is interested in the project.

NEWTON, N. J.—The contract for the construction of the new power-house for the Newton Gas & Electric Company has been awarded to O'Donnell & McManiman, of Newton, N. J., for $15,000. The plant will be moved from Water Street to a site on Sparta Avenue. William L. Keplinger is receiver.

BROOKLYN, N. Y.—The Board of Estimate and Apportionment has granted a franchise to the Nassau Electric Railroad Company to construct a street car line along Georgia Avenue, Brooklyn, between Liberty and Atlantic Avenues, and to connect its lines in Atlantic and Flatbush Avenues by a loop line through Flatbush, Fourth and Atlantic Avenues.

BUFFALO, N. Y.—Plans are being prepared by Miller & North, architects, 1003 Mutual Life Building, Buffalo, N. Y., for the construction of a power plant in connection with the new Technical High School and a grammar school adjoining, at Bennett Park, Eagle and Clinton Streets.

BUFFALO, N. Y.—It is reported that the equipment for the new water-works pumping station at the foot of Porter Avenue, Buffalo, N. Y., will include five 30,000,000-gal. triple expansion pumps, eight 750-hp water-tube boilers and steam mains, with feed pumps, coal and ash-handling machinery and an electric overhead crane. It is understood that contracts have not yet been placed for the machinery.

GLOVERSVILLE, N. Y.—Sealed proposals will be received by the City of Gloversville, N. Y., until March 21 for furnishing and maintaining electric street arc lamps for a period of five and ten years, beginning March 1, 1912. Not less than 132 arc lamps will be required and also 194 incandescent electric lamps or more will be required. For further information address Morrell Vrooman, city engineer, Gloversville, N. Y.

NEW YORK, N. Y.—Specifications have been issued by the Third Avenue Railroad Company for one 1500-kw rotary converter and three 550-kw transformers.

NEW YORK, N. Y.—The Board of Estimate and Apportionment has approved the application of the Union Railway Company for a franchise for a street surface railway extension in Manhattan and the Bronx. The proposed extension is to run from Madison Avenue and East 136th Street, at the westerly approach to the Madison Avenue bridge, along and over the bridge and its approaches to 138th and Exterior Streets in the Bronx connecting there with the existing tracks of the company.

NEW YORK, N. Y.—Work has commenced on equipping the Harlem River branch of the New York, New Haven & Hartford Railroad, from New Rochelle along the shore of Long Island Sound to the Harlem River, for electrical operation, extending over six tracks. This will add about 150 miles of electrically equipped trackage to the present system. The Ely Construction Company has the contract. Electricity for operating the railroad will be supplied by the power house at Cos Cob, Conn.

NORTH TONAWANDA, N. Y.—The Niagara Radiator & Boiler Works are reported to have awarded contracts for extensive additions to their plant at Olive Street, Ninth Avenue and the Erie Railroad, which will double the output of the plant. Eight new buildings will be erected at a cost of about $100,000; an additional cupola and new blowers will be installed; several thousand feet of electric overhead track will be erected with necessary carriers and cranes. Grinding and polishing machinery will be provided later on.

POUGHKEEPSIE, N. Y.—Sealed proposals will be received by the State Commission in Lunacy, Capitol, Albany, N. Y., until March 15 for an electric generating plant and for feeders and transformers, series outside lighting system, motors and power-house lighting at the Hudson River State Hospital, Poughkeepsie, N. Y. Drawings and specifications may be seen and blank forms of proposals obtained at the Hudson River State Hospital, Poughkeepsie, and at the office of Franklin B. Ware, state architect, Albany, N. Y., where plans and specifications can be obtained. T. E. McGarr is secretary of the State Commission in Lunacy.

SYRACUSE, N. Y.—Plans have been prepared by the Beebe electric railway system for extensive improvements on the Buffalo, Lockport & Rochester Railway, recently acquired by the company, work on which will begin at once. Among the improvements are included the double tracking of a five-mile section of the road on its extreme eastern end, and the installation of an additional stationary transformer of [illegible] hp in the Brockport substation to transform current from the high-tension line for use for operating the railway.

MOUNT AIRY, N. C.—Arrangements are being made to supply electricity from the municipal electric plant to operate the Mount Airy Cutting Company's plant, which is located near the corporate limits of the town. It is expected to begin the service about April 1. About 100 hp will be required to commence with. I. W. Barber is superintendent.

AKRON, OHIO.—A meeting of the stockholders of the Northern Ohio Traction & Light Company will soon be called to vote on the proposition to issue $3,000,000 in capital stock, of which $1,000,000 is reported to have already been sold subject to the approval of the stockholders. The proceeds will be used for the construction of a new power house to be erected a few miles north of Akron. When completed several small power plants now operated by the company will be closed down.

BARBERTOWN, OHIO.—The contract for installing a new switchboard for the new plant of the Barberton Light & Power Company has been awarded to the Youngstown Armature & Construction Company, of Youngstown, Ohio.

DAYTON, OHIO.—It is reported that the Oakwood Street Railway Company and the Troy Electric Railway are contemplating building a joint power plant near Dayton, and that the present power house will be used as a car barn.

DAYTON, OHIO.—The Dayton & Troy Electric Railway Company is reported to be contemplating the reconstruction of its power plant at Tippecanoe City and building a new substation near Dayton and another at Piqua, Ohio, in the near future.

LANCASTER, OHIO.—Preliminary arrangements are being made for the construction of an electric railway from Lancaster to Buckeye Lake, a distance of twenty miles. John H. Littrell, of Lancaster, Ohio, is interested in the project.

MARIETTA, OHIO.—The capital stock of the Athens Heat, Light & Power Company has been increased from $25,000 to $50,000.

TOLEDO, OHIO.—Plans are being prepared by the Dayton & Western Railroad Company for improvements to its property and additions to its power facilities, which will involve an expenditure of about $75,000. This company is controlled by the Toledo Railways & Light Company.

TOLEDO, OHIO.—Plans have been completed by the Toledo, Port Clinton & Lakeside Railway Company for the extension of its railway from the present terminus at Marblehead to the sandbar on the south side of the peninsula, where a dock and waiting station will be built for the accommodation of boats between Marblehead, Cedar Point and Sandusky.

WARREN, OHIO.—The equipment to be installed in the addition being erected to the plant of the General Fire Extinguisher Company, of Providence, R. I., in Warren, Ohio, will include ten new pipe-threading machines, two cutting-off machines, a 60-ft. electric traveling crane, a 5-ton crane with a 25-ft. lift, and about thirty individual motors for driving the pipe machines.

YOUNGSTOWN, OHIO.—Plans are being considered by the Mahoning & Shenango Valley Railroad & Light Company for extensive improvements to its system, which will involve an expenditure of about $500,000, and include improvements over the entire system from Leavittsburg to Newcastle, including Youngstown, and double-tracking some of the existing lines.

QUINTON, OKLA.—The question of installing a municipal electric light plant and water works in Quinton is reported to be under consideration.

TULSA, OKLA.—The City Council has granted a franchise to Charles Page to construct an electric railway from Tulsa to a large amusement park to be built by him.

ALBANY, ORE.—G. E. Fosbroke, of St. Paul, Minn., and Mr. Valerius, of Albany, Ore., are reported to be interested in a project for opening coal deposits and timber lands eighteen miles east of Sutherlin, including the construction of an electric railway extending down the valley to Albany.

OREGON CITY, ORE.—The Mount Hood Railway & Power Company has applied to the City Council for a franchise to erect transmission lines and install conduits for the transmission of electricity for lamps, heat and motors in Oregon City.

REDMOND, ORE.—The Crook County Water, Light & Power Company is reported to be preparing plans for the development of a water-power at Cline Falls, on the Deschutes River, five miles west of Redmond. Transmission lines will be extended from the plant to this city and to Prineville, twenty miles distant, to supply electricity for lamps and motors.

CONNELLSVILLE, PA.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until April 10, for construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office at Connellsville, Pa., in accordance with plans and specifications, copies of which may be obtained from the above office or from the custodian of site at Connellsville, Pa. James Knox Taylor is Supervising Architect.

CORRY, PA.—The Corry City Electric Light Company has been reorganized and proposes to change its entire system from single-phase, 133 cycles to three-phase, 60 cycles. Contracts have been placed for part of the equipment. It is expected to have the improvements completed by May 1, when a twenty-four-hour service will be established. B. E. Waltz is secretary and treasurer.

McKEESPORT, PA.—The Highland Grove Traction Company has been granted a franchise by the Commissioners of the North Versailles Township, which will enable the company to extend its railway from its present terminus in North McKeesport to the Turtle Creek Valley and to East Pittsburgh. The railway will eventually be extended to Wilmerding.

PITTSBURGH, PA.—The West Penn Railway Company is reported to have taken steps for financing two extensions, one of which will extend from Masontown up along the Monongahela River and parallel to it to Point Marion, a distance of twelve miles. The other will extend from Fairchance to Point Marion, where it will connect with the first named extension.

POTTSTOWN, PA.—It is reported that negotiations have been completed whereby the Pottstown & Reading Street Railway Company will take over the electric railway connecting Spring City and Phoenixville, which is operated by the Montgomery & Chester Electric Company. The link from Spring City to Pottstown will be built this spring and will connect with the Pottstown & Reading Company's line at Sanatogo.

READING, PA.—The capital stock of the Reading Transit Company has been increased from $500,000 to $5,000,000.

STRASBURG, PA.—The Strasburg Electric Light, Heat & Power Company has filed an amendment to its charter increasing its capital stock from $50,000 to $85,000.

TACONY, PA.—Contracts have been placed by the Frankford, Tacony & Holmesburg Street Railway for two Murray boilers for its power house in Tacony.

WASHINGTON, PA.—The Borough Council has awarded the contract for lighting the borough to the Washington Electric Light & Power Company, of Washington, Pa. The Council has not yet decided whether to accept the five or ten-year contract. John Griffith is borough clerk.

WOODLAWN, PA.—The Woodlawn & Southern Street Railway Company, of Woodlawn, Pa., will apply for a charter for the purpose of building an electric railway. The proposed railway will be seven and one-half miles in length and will connect Woodlawn, Aliquippa, Hopewell and South Heights. The incorporators are: Alexander B. Sheppard, John L. Moore, Ralph E. Reymer, John W. Adams and Walter L. Copeland.

PEACE DALE, R. I.—The Peace Dale Manufacturing Company has applied to the General Assembly asking for an amendment to its charter permitting the company to increase its capital stock to $2,000,000 and for permission to engage in the lighting business.

WICKFORD, R. I.—The controlling interest of the Sea View Railroad Company, which operates an electric railway between East Greenwich and Wakefield, by the way of Wickford and Narragansett Pier, has been purchased by a number of Providence men, headed by D. F. Sherman, president of the Providence & Danielson Railway Company. The general offices of the company will be moved from Bridgeport, Conn., to Providence, R. I.

WELLFORD, S. C.—Arrangements are being made by the Enoree Power Company for furnishing electricity to the town of Fountain Inn, S. C., for street and commercial lighting. The street-lighting system will consist of twenty-five arc lamps. J. E. Groce, of Wellford, S. C., is vice-president.

ESMOND, S. D.—Howell Thompson, of Carthage, S. D., is reported to have secured the contract for the installation of the electric equipment at the electric light plant.

McLAUGHLIN, S. D.—The question of establishing an electric light plant in McLaughlin is reported to be under consideration.

RAPID CITY, S. D.—Contracts have been awarded by the Dakota Power Company for equipment for its power plant at Big Bend, on Rapid Creek, to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa. The contract includes three 3800-hp water-wheels.

JACKSON, TENN.—The Mayor and Board of Aldermen have adopted the recommendation of the committee on street lighting to install a new electric light plant. The number of street lamps will be increased from 80, which are in use at present, to 150. It is proposed to issue $20,000 in bonds to pay for the plant, which will be operated in connection with the water-works system.

LYNNVILLE, TENN.—The Lynnville Mill & Elevator Company, which recently purchased the mill of the Evans-Kerr Milling Company, is rebuilding the plant. It is understood that the new company proposes to install an electric light system in Lynnville.

MANCHESTER, TENN.—The City of Manchester is reported to have been authorized by the State Legislature to issue bonds to the amount of $25,000, the proceeds to be used to install an electric light plant and water works system.

MEMPHIS, TENN.—The Memphis & Rugby Railway Company has applied for a charter in Tennessee to build an electric railway between Chelsea Avenue, Memphis, and the new suburb, Rugby. The capital stock of the company is placed at $50,000. The incorporators are: E. H. Coapman, vice-president and general manager of the Southern Railway, Washington, D. C.; Charles T. Doerr, of Birmingham, Ala.; Henry Wetter, Luke Seawell, of Charlotte, N. C.; James H. Malone and W. J. Francis.

NASHVILLE, TENN.—Plans are being considered for the construction of an interurban electric railway connecting Nashville with the Hermitage. A proposition has been submitted to the Nashville Railway & Light Company providing for the extension of its Fairfield car line from its present terminus at Greenwood Lake to the Hermitage. The cost of the proposed extension is estimated at about $250,000.

PARKSVILLE, TENN.—The capital stock of the Eastern Tennessee Power Company has been increased from $3,750,000 to $4,000,000. The company is building a hydroelectric power plant on the Ocoee River and will supply electricity in Chattanooga, forty miles distant, and other cities. It is expected to have the plant completed within eight months. Contracts are already being made by the company for electrical service. Machinery for the plant has already been purchased.

DALLAS, TEX.—Plans are being made by the Texas Traction Company, operating an interurban railway from Dallas to Denison, for the construction of an extension from Waxahatchie, which later will be extended to Hillsboro and eventually to Waco.

JOURDANTON, TEX.—Plans are being considered by the Bonita Valley Rapid Transit Railway Company for the construction of an electric railway between Jourdanton and Pleasonton, Tex., for which most of the right-of-way has been procured. C. S. Young and H. B. Haley are interested in the project.

LOCKHART, TEX.—A new ice manufacturing plant is being installed in Lockhart by the Lockhart Water Works & Power Company. It is understood that motors and other equipment will be required.

PLAIN CITY, UTAH.—The citizens of Plain City are considering the question of erecting a telephone line, to be owned by the residents of Plain City, to connect with the system of the Independent Telephone Company, at Ogden.

SALT LAKE CITY, UTAH.—A bill has been introduced in the Legislature providing for an appropriation of $40,000 for the construction of an electric light and power plant in Logan Canyon to supply electricity for lamps and motors for the Agriculture College, including the experiment station, the Industrial School, the school for deaf and blind, the University of Utah, also the State Normal School and state prison. The bill gives the board of trustees of the Agriculture College authority to select the site and to prepare plans for the plant; also authority to enter into contract with individuals and with private or municipal corporations for the sale of electricity needed by the State institutions mentioned.

DARBYVILLE, VA.—The Darby Coal Mining Company, recently incorporated, is reported to be preparing plans for the development of coal lands. It is proposed to develop 1500 acres with a daily output of 600 tons. The machinery to be installed will include direct-current electric generators and motors for haulage and pump for washer and machine shops. R. E. Hill, of Darbyville, is engineer in charge. James R. McDowell is president. The main office of the company is in Knoxville, Tenn.

RICHMOND, VA.—The Common Council has adopted the annual appropriation ordinance, which provides $9,000 for the extension of the Broad Street lighting system.

HILLYARD, WASH.—The Panhandle Electric Company has applied to the City Council for a franchise to supply electricity in Hillyard for a term of fifty years. If granted a franchise the company promises to supply electrical service within six or eight months.

OAKESDALE, WASH.—Steps have been taken by the Oakesdale Commercial Club toward the organization of a telephone company to furnish a telephone service in Oakesdale and surrounding country. The proposed company is planning to connect with the Farmers' Exchange in Oakesdale to establish connections with Rosalia and Thornton.

RIVERSIDE, WASH.—Arrangements are being made by the Okanogan Telephone & Telegraph Company for the erection of a telephone line from Riverside north through Tonasket and to Oroville.

SEATTLE, WASH.—The City Council, it is said, will appropriate $13,000 for the installation of electric lamps on streets in Georgetown, South Seattle and Ballard.

SEATTLE, WASH.—The City Council has passed an ordinance providing for the installation of cluster lamps and water system on a portion of Third Avenue, according to plans on file at the office of the Department of Public Works.

TACOMA, WASH.—The Sterling Telephone Company, it is reported, has applied to the Pierce County Commissioners for a franchise to erect telephone lines in the southern and western portions of Pierce County. C. N. Judges, of Puyallup, Wash., is president of the company.

TACOMA, WASH.—Arrangements are being made by the Carstens Packing Company for improvements to its plant, which will involve an expenditure of about $50,000, of which $30,000 will be utilized for the installation of an electric light and power plant. Contracts for machinery have already been placed.

TACOMA, WASH.—The contract for completing the Nisqually power plant was awarded Feb. 23 to Hans Pederson, of Seattle, Wash., for $1,074,918. The generating equipment includes four 8000-hp Francis type, single discharge turbines each direct-connected to a 5000-kva, 6000-volt, 60-cycle, three-phase generator, and two 375-hp impulse wheels direct-connected to a 200-kw exciter manufactured by the Allis-Chalmers Company, of Milwaukee, Wis.; eighteen 1500-kw, 6600-volt-55,000-volt, single-phase transformers to be furnished by the Fort Wayne Electric Works, Fort Wayne, Ind. The balance of the electrical equipment is to be supplied by the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa. Hamilton F. Gronen is chief engineer of the Nisqually power plant.

WHITE BLUFFS, WASH. It is reported that the installation of an electric light and power system in White Bluffs is under consideration.

MIDDLEBOURNE, W. VA.—The Middle Island Railway Company has awarded the contract for construction of the first fourteen miles of its proposed sixty-mile electric railway to connect Sisterville, Kidwell, Middlebourne, Shirley and Clarksburg to Shumway & Dean, of Pittsburgh, Pa. John F. Shore, of Middlebourne, Ky., is secretary.

WHEELING, W. VA.—Work will soon begin on the construction of the new power plant to be erected by the Consumers' Electrical Company at Forty-second and Water Streets. Sargent & Lundy, engineers, of Chicago, Ill., have the contract for construction of the power house. It is said that contracts have been placed for six 500-hp Babcock & Wilcox boilers, to be equipped with Murphy stokers; steam turbines are to be supplied by the General Electric Company. Contracts will soon be placed for wells and intake pipes.

AMBERG, WIS.—Plans are being made to organize a company to develop the water-power at Davis Falls on Pike River. The capital stock of the company will be placed at $100,000. S. Duquaine, of Green Bay, Wis.; H. S. Duquaine, of Crivitz, Wis., and H. I. Norton, of Marinette, Wis., are interested in the project.

BARABOO, WIS.—It is reported that the property of the Baraboo Lighting Company, which has been in the hands of a receiver for the past three years, will be sold at public auction in the near future. The property includes both electric and gas plants, and the company has the contract for lighting the streets and public buildings for the city.

SPOONER, WIS.—Plans are being considered by the City of Spooner for the construction of a municipal power plant on the Namekagon River, to cost about $90,000. Oscar Claussen, of St. Paul, Minn., is engineer in charge.

SUN PRAIRIE, WIS.—The question of issuing bonds to the amount of $9,000, the proceeds to be used for the installation of an electric light plant in Sun Prairie, is to be submitted to a vote of the people.

CALGARY, ALTA., CAN.—Bids will be received by W. D. Spence, city clerk, until March 14 for civic supplies, including electric-light materials.

CALGARY, ALTA., CAN.—It is reported that City Engineer Childs finds that it is impossible to develop 4000 hp on the Elbow River as proposed by the city. It is probable that the city authorities will either accept the propositions made by the two local companies or seek a site at a greater distance.

WINNIPEG, MAN., CAN.—The E. B. Reese Engineering Company, which has recently closed a contract with the City of St. Boniface to supply electricity to that city, is negotiating with Brandon and Portage la Prairie. Plans are being prepared by the company for the erection of a large plant on the Winnipeg River at Point du Bois, where it has concessions.

OTTAWA, ONT., CAN.—Announcement has been made that the Province of Ontario will borrow at once $5,500,000, of which $2,500,000 will be spent on the hydroelectric power project.

ALAMEDA, SASK., CAN.—The residents of the Dalesboro district who have talked of organizing a rural telephone company have decided to amalgamate with the Alameda Rural Telephone Company

MOOSEJAW, SASK., CAN.—The West Pioneer Rural Telephone Company is planning to build a telephone system at once. George W. Ross is secretary.

MOOSEJAW, SASK., CAN.—Bids will be received by W. F. Heal, city clerk, until April 10 for furnishing two electrically driven centrifugal pumps and auto starters complete.

ROULEAU, SASK., CAN.—Sealed tenders will be received by W. H. Stewart, secretary and treasurer, Rouleau, Sask., Can., until April 4, as follows: "Contract F"—Electric machinery, pole line, etc "Contract F"—Pumping machinery, compressed air system. "Contract G"—Producer gas plant. Plans and specifications may be seen at the office of the secretary and treasurer and at the office of J. Darlington Whitmore, consulting engineer, 104 Willoughby and Duncan Block, Regina, Sask., Can. Copies of plans and specifications may be secured from the engineers, for which a deposit of $10 will be required.

SASKATOON, SASK., CAN.—Plans and specifications are being prepared by the City Commissioners for an addition to the municipal electric plant, to cost about $60,000.

SWIFT CURRENT, SASK., CAN.—Rural telephone companies are being organized in the Stewart Valley and Prairie Field districts near Swift Current. Charles Reid and J. T. Stewart, of Swift Current, are interested.

New Industrial Companies.

THE ANDERSON-MARTIN ELECTRIC COMPANY, of New York, N. Y., has filed articles of incorporation for the purpose of [illegible] a general electrical contracting and engineering business. The incorporators are: J. B. Martin, R. S. Anderson and others. The office is located at 1 Madison Avenue, New York, N. Y.

THE BRINDLEY COMPANY, of New York, N. Y., has been chartered with a capital stock of $[illegible] to do a general engineering and contracting business. The incorporators are: O. T. [illegible], J. S. Primrose and A. Perry, of New Brighton, N. Y.

THE ELCHLMCO MANUFACTURING COMPANY, of Jersey City, N. J., has filed articles of incorporation with a capital stock of $[illegible] to manufacture electric motors, dynamos, electrical machinery, etc. The incorporators are [illegible] I. Dait, of Rutherford, N. J.; A. H. Martin, of Short Hills, N. J., and A. A. Lyall, of New York, N. Y.

THE ELECTRIC FIRELESS COOKSTOVE COMPANY, of Buchanan, Mich., has been incorporated by Charles Bishop, Charles Fears, Clyde Baker and John W. Beistle, all of Buchanan, Mich. The company is capitalized at $14,000 and proposes to manufacture electric and cooking apparatus.

THE F. B. STEARNS COMPANY OF NEW YORK, New York City, has been incorporated with a capital stock of $25,000 by V. H. Smith, W. L. MacGready, of Brooklyn, N. Y., and W. A. Lesser, of New York, N. Y. The company proposes to manufacture, repair and deal in motors, engines, etc.

THE GINDER CONSTRUCTION COMPANY, of Trenton, N. J., has filed articles of incorporation with a capital stock of $100,000 to do a general engineering, construction and architectural business. The incorporators are: J. Ginder, C. Ginder and E. Ginder, of Trenton, N. J.

THE HARRIS INTERNATIONAL LAMP COMPANY, of Cooperstown, N. Y., has been incorporated by L. W. Groat, F. A. Bunn and J. D. Andrews, of New York, N. Y. The company is capitalized at $25,000 and proposes to deal in lamps, lighting plants, fixtures, etc.

THE HURON MOTOR CAR COMPANY, of Detroit, Mich., has been incorporated with a capital stock of $50,000. The company proposes to manufacture gas engines and gas engine parts as well as automobiles.

THE IDEAL ELECTRIC VEHICLE COMPANY, of Jersey City, N. J., has been incorporated by H. E. Tufel, R. G. Chace and C. A. Elliott, of Jersey City, N. J. The company is capitalized at $250,000 and proposes to manufacture automobiles, mechanical and electrical appliances, devices, etc.

THE NATIONAL ELECTRIC CREMATORY COMPANY, of Los Angeles, Cal., has been chartered with a capital stock of $500,000 by J. L. Brown, J. E. Youtz and others.

THE NATIONAL ELECTRIC DISPLAY COMPANY, of Dayton, Ohio, has filed articles of incorporation with a capital stock of $10,000. The incorporators are: E. P. Ridgeway and others.

THE PHŒNIX LIGHTING FIXTURE COMPANY, of Los Angeles, Cal., has been incorporated with a capital stock of $100,000 by P. Forve, C. E. Packman and W. G. Hutchinson.

THE SAN FRANCISCO MOTOR SUPPLY COMPANY, of San Francisco, Cal., has filed articles of incorporation with a capital stock of $25,000. The incorporators are: J. J. Whitman, J. P. Brophy and L. L. Burnham.

New Incorporations.

SKIATOOK, OKLA.—The Osage-Cherokee Corporation has filed articles of incorporation with a capital stock of $100,000. The company proposes to acquire franchises for construction of water works, electric-light systems and other public utilities. The incorporators are: C. H. Cleveland, A. W. Lucas, J. H. Craig and others.

HARRISBURG, PA.—Articles of incorporation have been filed with the Secretary of State for the Banks Township Electric Company, the Dorrance Township Electric Company, Lehigh Township Electric Company, Lausanne Township Company and the Packer Township Electric Company. Each company is capitalized at $5,000 and the directors are: Calvin Pardee, Jr., of Hazleton, Pa., treasurer; Alfred D. Pardee, Calvin Pardee, both of White Marsh, Pa.; John S. Wise, Jr., of Hazleton, Pa., and A. W. Drake, of Lattimer Mines, Pa.

TEXAS CITY, TEX.—The Texas City Electric Light & Power Company has been chartered with a capital stock of $100,000 by R. C. Trube, F. M. Danforth and William Dossett.

BARCROFT, VA.—The Washington & Barcroft Traction & Power Company has been incorporated to build and operate an electric railway, seven miles in length, through Alexandria and Fairfax counties. The officers are: F. C. Handy, of Barcroft, president; W. W. Wright, of Barcroft, vice-president, and C. B. Munson, of Arlington, secretary.

IRELAND, W. VA.—Articles of incorporation have been filed for the Kanawha District Telephone Company with a capital stock of $10,000 by F. B. Eurit, Lee Bull, John F. Bull and others.

Personal.

MR. W. R. BONHAM, well known in Chicago electrical circles as a manufacturer's agent, has recovered his health entirely, after a long illness due to typhoid fever.

MR. GEORGE W. HUBLEY, superintendent and engineer of the Louisville Lighting Company, Louisville, Ky., has been elected president of the Louisville Engineers' and Architects' Club.

MR. L. P. ZIMMER, formerly general electrician of the Bath (N. Y.) Electric & Gas Light Company, has been appointed general manager of the Addison (N. Y.) Electric Light & Power Company.

MR. A. L. KENYON, formerly chief engineer of the Empesas Electricas Associadas, at Lima, Peru, has been appointed chief of construction for the Georgia Power Company at Tallulah Falls, Ga.

MR. C. H. RICKER, who has been electrical engineer of the Cleveland Construction Company, Cleveland, Ohio, for several years, has been appointed chief engineer and assistant general manager of the Havana Electric Railway Company, Havana, Cuba.

MR. CALVIN WHITELEY, JR., who was connected with the Virginia Railway & Power Company, Richmond, Va., for the past eleven years, serving as its chief engineer, has resigned to become engineer for the United Railways & Electric Company, Baltimore, Md.

MR. RODERICK D. DONALDSON, traveling power expert of the United Gas Improvement Company, of Philadelphia, is spending some time in Chicago and vicinity, making his headquarters at the office of the Northern Indiana Gas & Electric Company in Hammond, Ind.

MR. H. L. PARKER, illuminating engineer of the Consolidated Gas, Electric Light and Power Company, lectured on "Interior Illumination" last week at the regular meeting of the Baltimore Section of the National Electric Light Association in the physical laboratory of the Johns Hopkins University.

MR. EDWIN A. BARNITZ has been appointed treasurer and M. G. Stees secretary of the Edison Electric Light Company of York, Pa., succeeding the former secretary-treasurer, Mr. Joseph J. Bowser. Mr. Arthur Holland, of Concord, Mass., also succeeds Mr. J. C. Dawson on the board of directors of the company.

MR. EUGENE CREED has been appointed a member of the transportation committee of the National Electric Light Association, and will attend to the transportation arrangements for Toronto and surrounding territory in connection with the convention to be held in New York City during the week beginning May 29, 1911.

MR. FREDRIK JONSON, engineer of the Royal Engineering Corps of Sweden, is on a visit to this country to inspect the new hydroelectric power stations. Mr. Jonson designed the hydroelectric station at Porjus, Lapland (80,000 hp), which is now under construction, and the proposed station at Alfkarleby (40,000 hp), the plans of which have recently been submitted to the government for approval.

MR. J. Y. HARING, formerly superintendent of the electrical department of the Sioux City Gas & Electric Company, has been appointed superintendent of the electrical department of the Northern Indiana Gas & Electric Company, with office in Hammond, Ind. Mr. Haring, who was previously located at Charleston, S. C., is a man of wide experience in the operation of public-utility enterprises.

MR. WILLIAM S. TAUSSIG, of the power and mining department of the Chicago office of the General Electric Company, is about to remove to Dallas, Tex., to become connected with the office of the General Electric Company of Texas in that city. Mr. Taussig, who graduated from the Armour Institute of Technology in the class of 1903, is a former secretary of the Electric Club. He is a popular member of the electrical fraternity in Chicago, and his departure will be regretted.

MR. H. A. STRAUSS, vice-president and chief engineer of the Falkenau Electrical Construction Company, of Chicago, has been appointed consulting engineer of the Merchants' Light & Power Company, of Ogden, Utah, to design a complete system for electric lighting and motor service for the City of Ogden, Utah. The Merchants' Light & Power Company has recently had granted to it broad and general franchises covering the entire City of Ogden, and has obtained the city contract for arc lighting.

Obituary.

MR. ISAAC McMICHAEL, vice-president of the Great Northern Telegraph Company and a resident of Toronto, Canada, died at Johns-Hopkins Hospital in Baltimore on Feb. 22. Mr. McMichael, who was seventy-one years of age, suffered from a cancer on the face, and his death followed an operation. He was one of the prominent telegraph men of Canada. He had been a patient at the Baltimore hospital for three weeks. The body was taken to Toronto for burial.

Trade Publications.

ELECTRIC FANS.—The Westinghouse Electric & Manufacturing Company has issued three publications devoted to this year's line of fan motors. Catalogue No. 1165 illustrates and describes the complete line, and folders No. 4100 and 4101 describe and illustrate the alternating-current fans and the direct-current fans respectively.

WATER-POWER DEVELOPMENT.—The Western Power & Irrigation Company, Oklahoma City, Okla., has prepared a handsomely engraved booklet describing the group of water-power sites acquired by it on the Washita, Mountain Fork, Verdigris, Kiamichi, Illinois and Little Rivers in Oklahoma, which will be developed to supply hydroelectric energy to the rapidly growing neighboring communities. The plans of the company also include irrigation projects for reclaiming lands in western Oklahoma. The first power-plant installation will be at Mountain View, on the Washita River, where an Ambursen hollow reinforced-concrete dam will be built and Trump water turbines installed to drive Westinghouse generators.

BUSINESS NOTES.

MR. PERCIVAL ROBERT MOSES moved his engineering offices on Feb. 27 to 366 Fifth Avenue, New York City, rooms 1006-1008.

MR. FRED COLLINS has become connected with the Dearborn Drug & Chemical Works, of Chicago, with offices at 299 Broadway, New York City.

THE ENTERPRISE ELECTRIC CONSTRUCTION & FIXTURE COMPANY has opened new salesrooms at 6509 Euclid Avenue, Cleveland.

EDWARD B. STOTT & COMPANY, electrical and mechanical engineers and contractors, have moved into offices at No. 227 Fulton Street, New York.

THE ENGINEERING SUPERVISION COMPANY moved its offices on Feb. 27 to 366 Fifth Avenue, southwest corner of Thirty-fifth Street and Fifth Avenue, New York City.

CROCKER-WHEELER COMPANY.—Mr. Clarence E. Delafield, formerly sales engineer for the Crocker-Wheeler Company, with headquarters at Ampere, N. J., has been appointed district manager of the Boston office of the company.

BRITISH THOMSON-HOUSTON COMPANY.—Rud Chillingworth, of Nurnberg, Germany, has made arrangements for the sale of the Chillingworth patent pressed-steel gear cases in the United Kingdom, and for export therefrom, to be handled by the British Thomson-Houston Company, Ltd., Rugby, exclusively.

ELLIOTT COMPANY. Mr. C. S. Roosa, who for many years has been connected with the Liberty Manufacturing Company, has been appointed manager of the New York office of the Elliott Company and the Liberty Manufacturing Company, 90 West Street, New York City. These companies are manufacturers of Liberty boiler-tube cleaners and Elliott power accessories.

THE BOWMAN-BLACKMAN MACHINE TOOL COMPANY, 720 North Second Street, St. Louis, has superseded the firm of Albert B. Bowman, dealer in machine-shop equipment, due to the entrance into the firm of Mr. G. H. Blackman. Mr. Blackman is a graduate of the mechanical engineering department of the Missouri State University and is an experienced machine-tool man.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED, FEB. 21, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

984,970. FURNACE FOR METALLURGICAL PURPOSES; W. Rodenhauser, Volkingen, Germany. App. filed Nov. 3, 1908. Electric means heat the surface of the charge and independent electric means below the surface pass a heating current through the body of the charge.

984,984. ELECTRIC HAMMER; H. F. Whalton, Key West, Fla. App. filed May 26, 1910. A hammer operated by an electromagnet with hammer shaft and tapper, one of the magnets being attached to the moving hammer and the other fixed adjacent thereto so that their attraction actuates the hammer.

985,009. VARIABLE SFLF-INDUCTION COIL; A. C. Hovey, Pittsburgh, Pa. App. filed Oct. 20, 1909. A magnetic member carrying a winding with yoke and hooks for supporting it, a screw extending through the yoke and resting upon the magnetic member for raising and lowering the yoke and winding.

985,018. BATTERY LAMP SOCKET; G. N. Eastman, Riverside, Cal. App. filed March 23, 1909. Portable socket for small incandescent lamps which can be directly secured to the binding post of an ordinary battery cell to serve as a standard for the lamp.

985,021. ANTISEPTIC TELEPHONE MOUTHPIECE; W. M. English, Sausalito; L. E. Boukofsky and S. M. Lichtenstein, San Francisco, Cal.. App. filed Aug. 29, 1910. Mouthpiece with antiseptic perforated wall with absorbent ring packing for preventing condensation of moisture on the diaphragm and for supplying antiseptic liquid.

985,045. SEPARATOR FOR SECONDARY STORAGE BATTERIES; A. F. Madden, Newark, N. J. App. filed March 7, 1908. A sheet with a multiplicity of parallel slits cut through it with the material between the slits inclined, so that the separator contains a vast number of minute slits without the removal of material.

985,069. AUTOMATIC SWITCH; J. B. Schug, Detroit, Mich. App. filed June 26, 1908. Centrifugal switch for generators charging storage batteries to disconnect the generator when its speed slackens and its voltage falls below the required amount. Details.

985,082. RECHARGEABLE SAFETY FUSE; H. Wallace and F. A. Swanson, Chicago, Ill. App. filed May 7, 1910. A casing with bushings in the ends, a terminal cap secured to each bushing, a fusible element with ends in the openings of the bushings, plugs in the openings with means on the caps for connecting the fuse in circuit.

985,083. ELECTRIC FURNACE; E. Wassmer, London, England. App. filed Dec. 10, 1910. For treating gases such as oxidizing nitrogen. The arc is established between electrodes in a reaction chamber in which the gases are introduced, the arc impinging upon an incandescing grid, which is perforated and over which the arc spreads to form separate jets.

985,101. PUSH BUTTON; C. Auth, New York, N. Y. App. filed Dec. 18, 1909. Has a button with a stem, a stud, a wire and a screw for securing the wire to the stud, so that the wires cannot become separated from the terminals of the flush push button while in circuit, or replaced in the cavity which holds the button.

985,109. AUTOMATIC VOLTAGE REGULATOR; G. A. Burnham, Essex, Mass. App. filed Aug. 23, 1909. Regulates by means of a pile of carbon disks which is in shunt with a rheostat in circuit with the field of the generator, the resistance of the disks being rapidly fluctuated by a motor and the resistance being automatically changed at intervals in response to changes in the circuit whose voltage is being regulated.

UNITED STATES PATENTS ISSUED FEB. 28, 1911.

985,120. TELEPHONE INSTRUMENT; W. Aitken, Liverpool, England. App. filed March 1, 1909. For adjusting the transmitter to any desired height, keeping it perpendicular to the plane of the transmitter diaphragm by means of a pivoted arm surrounding a cylindrical casing upon which it may rotate and pivot.

985,127. PORTABLE TELEPHONE POLE. G. J. Bayless, Oakland, Cal. App. filed Nov. 8, 1910. A pole carrying conductor arms pivotally connected with its head, insulated from each other, from which the circuit wires lead.

985,144. ELECTRIC OVEN; J. V. Chown, Oakland, Cal. App. filed Nov. 29, 1909. A shell with an insulating lining inclosing an oven chamber with an electric heating coil for the oven. Details.

985,169. TELEPHONE TRANSMITTING CUT-OUT; C. M. Hartnett, Malden, Mass. App. filed May 31, 1910. Provides a switch for short-circuiting a transmitter so as to cut out the transmitter but leave in the receiver, so that conversation at the transmitter end will not be overheard when the transmitter is cut out.

985,173. ELECTRIC SWITCH; J. H. A. Normandeau, Montreal, Quebec. App. filed June 4, 1910. A quick action switch operated by a pole chain which rotates a drum carrying contacts including a reversible insulated lock pivotally mounted upon the drum, the lock being swung and reversed to close the circuit.

985,186. TELEPHONE SYSTEM; O. M. Leich, Genoa, Ill. App. filed Nov. 13, 1909. Provides a metallic line with a second set of telephones whose talking currents traverse the two lines in parallel.

985,101. ORDER WIRE KEY; F. R. McBerty, New Rochelle, N. Y. App. filed Sept. 5, 1908. Keys for telephone switchboards including a plurality of parallel rows of contact springs with keys for pressing the springs of different rows into contact with each other.

985,193. CONTACT FOR INDUCTION COILS; J. McIntyre, Jersey City, N. J. App. filed Nov. 17, 1908. The adjusting screw has a seat and a contact attached to a spring, removably fits the seat, a platen point being permanently secured to the other end of the contact.

985,215. MOTOR CONTROLLER; A. Simon, Milwaukee, Wis. App. filed June 1, 1909. A plurality of accelerating switches with interlocks between them for insuring the opening of each switch prior to the operation of the next switch and means for checking the operation of devices responsive to excessive surges of current in the motor.

985,221. AUTOMATIC LIMIT STOP MECHANISM; C. W. Spear, Muskegon, Mich. App. filed June 17, 1909. For hoisting cranes and the like, including gears, engaging fingers carried by said gears, the engagement of the fingers effecting movement of the gears toward and from each other.

985,226. ELECTRIC SMELTING FURNACE; E. R. Taylor, Penn Yan, N. Y. App. filed July 7, 1910. Of the stack type with hearth and superposed metallic shell inclosing a working chamber with feed passages discharging into the working chamber, stemless horizontal electrodes of the required size rectangular in cross-section extending into the working chamber above the hearth, rectangular metallic electrode collars insulated from the shell with movable sections for closing the opening around the electrodes.

985,233. PRINTING TELEGRAPH; J. J. Vermeer, Oakland, Cal. App. filed Feb. 9, 1910. Printing telegraph transmitter of a single closed line with typewriting keyboard at the sending end, including commutator segments and gravity-actuated brushes movable over the segments so that on the depression of the key a corresponding printing member is operated.

985,234. ELECTRIC LIGHT SWITCH; C. Wagner, New York, N. Y. App. filed March 9, 1910. An electric switch with conductors, an insulating cylinder through which the conductors pass and a rotatable conducting cylinder about the insulating cylinder bearing spring contacts.

985,241. ELECTRICAL CONNECTION; J. M. Andersen, Boston, Mass. App. filed Dec. 19, 1910. A socket and plug member for cables, including a metal casing containing an insulator and a head between the members of the insulator and a contact member with shank extending through both members of the insulator, the nut engaging the shank to hold the members together.

985,246. SOCKET CAP; W. McK. Black, Waterbury, Conn. App. filed Dec. 29, 1910. For electric light sockets, the cap having a hub hole, surrounded by a flange with a circular washer encircling the flange and a flanged hub in the hole, the thickness of the washer and the length of the hub flange being equal to the depth of the cap flange and the three being united by lateral flanges.

985,252. SOCKET CAP; C. Doescher, Waterbury, Conn. App. filed Dec. 29, 1910. Metal cap for electric light sockets, the cap having an inward circular flange surrounding the hub and a polygonal recess surrounding the flange containing a washer which fits it, the hub having a flange located within the hub opening and flange of the cap.

985,288. SPRING FASTENING DEVICE; J. Schade, Jr., New York, N. Y. App. filed Aug. 12, 1910. For a terminal of an electric battery, the zinc shell of the battery having a spring secured to it which is bent to form an attaching leg and is bent at its other end to form a loop that engages the wire conductor.

985,344. ELECTRIC HEATER; A. H. Harvie and W. G. Davis, Dallas, Texas. Aop. filed Sept. 3, 1910. For immersing in a vessel to cook the contents. The cylindrical casing contains the heating element with narrow spaces between the inner and outer walls of the casing and openings to allow the fluid to circulate therethrough.

983,368. ELECTRIC SECONDARY BATTERY; P. Rabbidge, North Sidney, New South Wales, Australia. App. filed Sept. 20, 1907. Absorbent filler for dry batteries consisting of copra (dried kernel of cocoanut).

985,387. METHOD OF MANUFACTURING METALLIC ILLUMINATING BODIES FOR ELECTRIC INCANDESCENT LAMPS; F. Blau, Berlin, Germany. App. filed Sept. 14, 1906. Makes refractory metal filaments by subjecting a plurality, each in a separate chamber, to heat and passes gas over the filaments, and prevents the formation of steam.

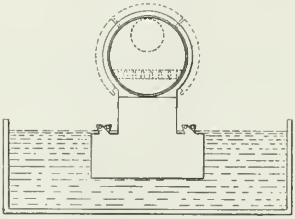
985,388. THIRD RAIL; C. A. Bluhm, Michigan City, Ind. App. filed June 9, 1909. Guard rail on chairs with reinforced concrete slabs extending from chair to chair forming the outer walls of conduits.

985,395. LAMP SOCKET FASTENINGS; H. Christensen, Seattle, Wash. App. filed June 27, 1910. A hollow body with long and short fingers, the long fingers being bent to oppose the supporting elements for the lamp socket and a shoulder on the body to secure the body to the supporting element of the lamp socket.

985,399. MICA INSULATION; J. L. Cooper, Wilkinsburg, and A. J. Sweet, Pittsburgh, Pa. App. filed Oct. 18, 1905. Sheets of thin fabric, interposed sheet mica and a binder of varnish, wood alcohol and castor oil.

985,400. ELECTRIC LOCOMOTIVE; W. Cooper, Pittsburgh, Pa. App. filed July 26, 1909. Employs a jack shaft at one side of the driving wheel with belt crank lever forming driving connection between motor and shaft, the other arm forming a connection between the shaft and a horizontal connecting rod, the latter being secured to the driving wheel.

985,413. MOTOR CONTROLLING SYSTEM; C. T. Henderson, Milwaukee, Wis. App. filed May 20, 1907. The current in working circuit during the acceleration of the motor is automatically controlled to prevent it from rising above a limit, and also during the stopping of the motor. Automatically regulates the field of a generator, which generator drives the motor, the regulation preventing the motor current from rising above a predetermined limit.



985,426.—Thermoelectric Battery.

985,420. WIRE COIL; W. Keller, Frankfort-on-the-Main, Germany. App. filed June 8, 1905. An electrical instrument coil of the D'Arsonval type consisting of a frame of soft material around which insulated wire is wound, the wire and frame being molded and compressed into a solid mass, leaving no air spaces between the windings.

985,421. SNAP SWITCH; C. J. Klein, Milwaukee, Wis. App. filed May 11, 1909. Push button snap switch with cams or cone between the buttons of the switch, the cone being surrounded by a coiled ring spring, which produces a snap action as the cone is forced through the ring.

985,422. INCANDESCENT LAMP; A. S. Knight, Newark, N. J. App. filed July 19, 1909. An incandescent lamp to withstand shocks, the end of the filament being connected to a spring, which spring is connected to an anchoring wire.

985,426. THERMOELECTRIC BATTERY; J. Marschall, Dresden, Germany. App. filed July 10, 1908. The two parts of the cells have the same resistance, the separate cells being ring-shaped to be pushed over the cylindrical surface of a heater, making a convenient arrangement.

985,430. SHOE FOR THIRD RAIL ELECTRIC CARS; L. A. McCoubrie and C. F. Raydure, Philadelphia, Pa. App. filed April 24, 1909. Details in the construction of a shoe yieldingly mounted on a pivoted support for third rails.

985,456. ELECTRICAL MEASURING INSTRUMENT; M. C. Rypinski, Pittsburgh, Pa. App. filed Nov. 15, 1907. An instrument pointer of sheet material with an index arm and base having a seat in one side to receive the supporting member and recesses in the base to receive material for balancing the pointer. Also improvements in the mounting of the pivot bearings.

985,457. MEASURING INSTRUMENT; M. C. Rypinski, Pittsburgh, Pa. App. filed Nov. 18, 1907. A conducting front plate connected to a supporting stud supports the operating parts of the instrument which is of the permanent magnet and movable coil type.

985,474. ILLUMINANT FOR ELECTRICAL INCANDESCENT LAMPS; O. M. Thowless, Newark, N. J. App. filed May 13, 1909. Makes a glower vitrified throughout from refractory metals by heating the glower with a cathode discharge and then reducing it.

985,486. ELECTRIC LIGHTING APPARATUS; A. A. Wohlauer, New York, N. Y. App. filed July 16, 1907. A vapor tube containing a filament lamp and an anode on the lamp connected to the filament.

985,502. APPARATUS FOR MAKING METALLIC FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS; F. Blau, Berlin, Germany. App. filed Feb. 17, 1908. A rotary support carrying a plurality of filament chambers through which gas may be passed successively and a valve operated by the rotation of the support to vary the connection between the chambers.

985,509. SWITCH; C. E. Carpenter, New York, N. Y. App. filed May 9, 1907. Solenoid operating switch for bridging a plurality of contacts successively for controlling a motor.

985,510. CONTROLLING DEVICE; C. E. Carpenter, New York, N. Y. App. filed May 9, 1907. For starting and controlling motors for trunks controlled by a pressure gage.

985,524. TRANSMISSION OF SOUND; E. Gray, deceased, Highland Park, Ill. App. filed Feb. 21, 1906. A series of receptacles or transmitter casings facing in different directions so as to form air-tight chambers which may be submerged in water and the carbon transmitters connected to listening telephones.

985,628. TRAIN CONTROLLED HIGHWAY SIGNAL; R. D. Peters, Knox, Ind. App. filed Aug. 6, 1909. Railway signal of the semaphore type with normally open circuit and spring retracted switch for opening and closing it, a second normally opened circuit and a motor including a movable core for operating said semaphore, a signal lamp in the first circuit and a projection carried by the core to close the switch upon the energization of the motor.

985,629. RECEPTACLE FOR ELECTRIC LAMPS; J. G. Peterson, Hartford, Conn. App. filed Nov. 10, 1910. An insulating base with recessed U-shaped boss containing a center contact with wing over the sides of the boss and a terminal plate connected to the center contact.

985,638. TELEPHONE MOUTHPIECE; L. Steinberger, New York, N. Y. App. filed Aug. 20, 1910. A sleeve with a concavity, a body connected with the sleeve with an inner surface in registry with the concavity, the sleeve having sound passages.

985,654. TROLLEY STAND; B. B. Bowers, Macon, Ga. App. filed March 16, 1910. Self-releasing trolley retainer for releasing the tension of the spring and allowing the trolley pole to drop when the wheel leaves the wire.

985,676. ELECTROMAGNETIC DEVICE; W. K. Howe, Rochester, N. Y. App. filed Feb. 12, 1910. Solenoid magnet with resilient stop engaged by the armature at the limit of its movement, the stop being cushioned on its return.

985,678. SEWING MACHINE ELECTRIC MOTOR; F. P. Huyck, Toledo, Ohio. App. filed June 7, 1907. A shaft, a sleeve detachably secured thereto, an armature driving the shaft, a frame supported by the sleeve, a field embracing the armature carried by the frame, the frame being held against rotation.

985,680. TELEGRAPHIC RECEIVING ORGANISM; I. Kitsee, Philadelphia, Pa. App. filed Oct. 15, 1909. For cable telegraphy in which selenium cells are actuated by light beam projected from a mirror operated by the receiver.

985,685. TROLLEY CIRCUIT CLOSER; G. R. Livergood and B. C. Donnelly, St. Joseph, Mo. App. filed May 1, 1909. Trolley harp with hollow shaft for the wheel, a stud key secured to the end of the shaft to engage key slots in the harp.

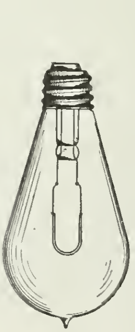
985,697. DIRECT-CONNECTED ELEVATOR; C. Q. Pearson, New York, N. Y. App. filed Oct. 12, 1908. An internal combustion engine is used as motive power and is controlled from the power generated by the engine by means of a pressure pump. An electric generator is connected to the engine with a fluid pressure starter for the engine and electric means for connecting the fluid pressure supply with the starter.

985,699. ELECTRICALLY CONTROLLED ELEVATOR; C. O. Pearson, New York, and A Sundh, Yonkers, N. Y. App. filed Oct. 23, 1908. Hoisting apparatus with reversible combustion engine, the engine driving a dynamo, the current stored by a storage battery, a reversing switch connected with the dynamo running the latter in either direction as a motor and thus running the engine, the reversing switch also controlling the sparking circuit. Manual switches control the reversing switch and connections.

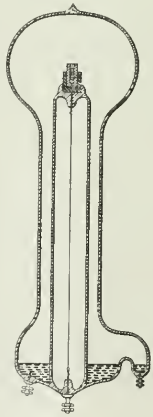
985,701. ELECTRIC SWITCH; C. A. Pfanstiehl, Highland Park, Ill. App. filed April 18, 1910. For automobiles, for locking the receiver when out of use, consisting of a bolt and spring plate with bushing for guarding a plug to engage the free end of the plate and move the bolt out of engagement with the switch.

985,705. RELAY; W B. Rice, Rochester, N. Y. App. filed July 11, 1910. Alternating-current relay for railway signal system with polyphase field, stationary core and rotor comprising a conductive shell surrounding the core, contact devices and mechanism connecting the rotor with the contact device to actuate the latter by the rotation of the rotor.

985,707. INSULATOR SUPPORT; A. Scheible, Oak Park, Ill. App. filed Sept. 25, 1909. Glass insulator with support consisting of a pair of metal leaf springs attached to an arm which pass into the screw-threaded portion of the insulator to fit various sized threads.



985,474.—Illuminant for Electrical Incandescent Lamps.



985,486.—Electric Lighting Apparatus.

985,720. BURGLAR ALARM; A. Ambuhl, San Francisco, Cal. App. filed May 12, 1910. Vertically spaced metal members connected with opposite terminals of an electric circuit, a metal tube depending from one of the members and swinging thereon, a metal rod swinging from the other member within the tube and normally spaced from the side walls thereof.

985,758. CONTROLLER FOR ELECTRIC MOTORS FOR SEWING MACHINES; F. P. Huyck, Toledo, Ohio. App. filed Dec. 28, 1907. An electric motor with a rotor and stator one about the other, an eccentric switch connected to the stator, a brake between rotor and stator and a common connection for brake and switch.

985,760. TELEGRAPHIC RECEIVING ORGANISM; I. Kitsee, Philadelphia, Pa. App. filed Jan. 27, 1910. For cable telegraphy in which a mirror galvanometer acts as a receiver to throw light upon selenium cells.

985,899. AUTOMATIC TELEPHONE SELECTOR OR RINGING DEVICE; R. R. Hobbs, Louisville, Ky. App. filed Aug. 11, 1909. A polarized relay operating on positive and negative impulses actuates a ratchet wheel carrying a pin which closes the contact to ring an alarm.

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AN ELECTRICAL FORECAST.

An address by Mr. Westinghouse on technical topics is always full of vital enthusiasm which is both suggestive and stimulating, and his paper before the Southern Commercial Congress at Atlanta recently is no exception to the rule. We fancy that no one will be disposed to deny his thesis that the application of power has been the great fundamental factor in bringing about the characteristic conditions of the era in which we live, nor will anyone hesitate in agreeing that the epoch in the dawn of which we now live is likely to be known as the age of electricity. The particular thing to which he directed the attention of his audience was the enormous possibilities for the South that lie in electric energy transmission with all that that implies of cheap distributed energy. The industrial possibilities of the South are just beginning to be realized. A purely agricultural territory for many years, it is just effectively awakening to a large and wonderfully promising industrial future, and in this energy transmission is to play a very large part. In fact, as many of our readers know, electrical energy transmission has already made a tremendous record in the South; the first electrically driven cotton mills were there located, and it must not be forgotten that the first electric railway of any importance was in Richmond.

There are several important networks intended for the complete distribution of energy over a very large territory, but the startling fact is that in spite of this activity the resources of the great southern Appalachian territory in the way of water power have as yet hardly been touched. Mr. Westinghouse states that the ultimate horse-power developable during the dry season in the Appalachian range is safely estimated at from 5,000,000 to 7,000,000, and incidentally he speaks a good word for the policy of conservation that is necessary to make the most of these natural resources. The Appalachian country is curious in one respect, that it has extremely few lakes, but it is not without natural facilities for storage in the deep mountain valleys, which can be utilized, fed, as such artificial reservoirs would be, by large drainage areas and heavy rainfall. Mr. Westinghouse's enthusiasm therefore is not overdrawn, and the opportunity of the South is a very great one. It is worth noting that even now the lowest prices for electrical energy which are found anywhere in our own country, and perhaps the lowest in the world, have been reached in some of the Southern plants. Many of the water powers have been comparatively easy to develop, and there is a large prospect for a vast increase in the available energy to be transmitted for industrial works of various kinds. Mr Westinghouse does not exaggerate the possibilities of the South as an industrial region in the slightest degree. As a further study is made of industrial problems its prospects brighten. Mr Westinghouse, for example, calls attention to the immense possibilities of the electric furnace in steel manufacture, utilizing as it can ores not so readily treated by other methods. With coal and iron in abundance and electric energy readily available the chance for large production is obvious.

Another interesting point brought out in the address under consideration was the bearing of the electrical situation on agriculture. Some portions of the South are specially favored in that they combine a very rich agricultural territory with large industrial resources. The agricultural possibilities can be greatly reinforced by the artificial production of fetilizers through the fixation of atmospheric nitrogen. Coal and lime in almost unlimited quantities, with cheap electric energy, make a formidable combination for carrying out such electrochemical operations, the more so since such works can be effectively carried on by utilizing surplus power so as to secure the advantages of large and steady load. Every cubic foot of water that runs over a dam is, from the dynamic standpoint, net waste; and beyond the limits of easy storage profitable utilization of the surplus is all-important. The suggestion, too, that transportation should be strengthened by electric roads operated from water power as feeders for the great trunk lines is a very important one. It is by no means new, since there have been many projects for such roads, some of which have been fortunately carried out. More of them have waited, to grow at even pace, we hope, with the industrial centers which will furnish them freight and passengers.

Turning from these more obvious things, Mr. Westinghouse looked forward toward some of the developments now in sight, but not yet realized on a commercial scale. Among these he recounts the wonderfully suggestive, though still inconclusive, work carried out under the direction of Sir Oliver Lodge a few years since on the stimulation of plant growth by electrical energy applied to the soil, and emphasizes the remarkable possibilities of the quartz lamp in the cheap and thorough sterilization of food products, to say nothing of purification of water. The additional suggestion that the same rays had been successfully applied to the artificial aging of wine will, we fear, be received with small enthusiasm by the advocates of prohibition. They might be better pleased if Mr. Westinghouse could suggest some method of rendering alcohol hopelessly unpalatable over large areas by the surreptitious use of potent and far-reaching radiations. It is particularly interesting to note that Mr. Westinghouse expresses strong faith in the very great possibilities of wireless telegraphy and telephony. These arts have been through so serious a period of stress in the last few years that there is something reassuring in this expression of abiding faith. Altogether this address of Mr. Westinghouse is worthy of careful reading and the South will certainly do well to heed some of the advice he has given.

CHEAPER CONSUMERS' METERS.

For several years past there has been an increased pressure put upon manufacturers to bring out less expensive meters for the smallest class of consumers. As central-station companies have developed the business possibilities in their fields more nearly to the saturation point they have found that the fixed investment per consumer in the case of small residences is so high that it constitutes the limiting factor in taking on this class of business. In other words, there are thousands of residences in our large cities and a proportionately great number in small towns the occupants of which could afford to pay for electricity for lighting purposes if only the necessary fixed expenses in the shape of a minimum bill or readiness-to-serve charges could be done away with. It is useless, of course, to expect to eliminate any large percentage of these fixed expenses, but every reduction helps. In looking for opportunities where a reduction can be made the first thing with which the central-station man is confronted is the high cost of meters per kilowatt connected in small-residence business. The cost of meters being the largest single item on the investment list, consequently it is the item which the central-station man will make the most effort to reduce, and hence the pressure brought to bear on manufacturers for cheaper meters.

Doubtless an added incentive for bringing such pressure to bear has been the feeling that the profits on consumers' meters have been higher than on similar goods sold in like quantities. Among arguments on this point current in the central-station field is the fact that meters are usually sold on a yearly contract basis whereby the selling expense is reduced to the work of getting the yearly contract. Added to this is the further fact that there is always a disinclination on the part of the central-station company to change types of meters on its lines, with the result that once a yearly contract is made and a considerable number of meters of a certain type are connected no more selling expense is involved in keeping a central-station company's meter business. Business of this kind, the central-station men feel, should be conducted on a narrow margin of profit, especially in view of the fact that the meter investment is so heavy for small consumers. It is the high meter investment plus the expense of maintaining central-station meters that has brought so many companies to consider and try out the plan of a flat rate with maximum demand limited by some cheap device. At any rate, the situation is one which the central-station man who is after the small-residence business is watching very closely.

VALUATION IN ST. LOUIS.

Between the values claimed by the Union Electric Light & Power Company and the Public Service Commission of St. Louis in the appraisal of the property of the company there is so wide a difference as to indicate at once that the cause of the discrepancy lies in the intangible elements. In the estimates of the "cost of construction and equipment," which included the larger items of the purely physical property, the difference was about 5½ per cent, or, in round figures, $700,000. The great discrepancy in the total values computed on behalf of the company and the commission may be indicated by a few figures. Two engineering estimates which the company advanced in its testimony placed values of respectively $30,888,000 and $30,780,000 as the total cost of the property and the business. Both of these estimates included some costs which were wholly disregarded by the commission in its computation. The commission computed the estimated cost of the present property at $16,590,000 and the earning value of the present property, after the deduction of depreciation, at $16,134,000. Each of the totals advanced varies materially from the outstanding capitalization of the company, which aggregates $25,544,000, divided between $15,559,000 bonds and $9,985,000 of stock. In some of the minor items of physical property there are differences which indicate that the tendency of all the values reached by the commission was lower than the figures determined by the company. For instance, in power plants and substations the commission's figures of cost of construction aggregated $7,424,000, or 4.8 per cent less than those of the company. The overhead system was figured by the commission at $1,413,000, or 8.5 per cent less than the estimate of the company. The cost of the underground system, placed by the company at $3,013,000, was reduced 4.8 per cent by the commission.

Further light upon the extent of values other than the cost of construction and equipment may be had by reference to the estimates advanced by the corporation. Of the total cost fixed for the property and business, $4,408,000, or about 14 per cent of the whole, was stated as the cost of establishing the business; $2,637,000 and $2,407,000 were the two engineering estimates of the cost of financing. Of the total cost of reproduction of $24,000,000, the value remaining after deduction of these two items, the cost of construction and equipment amounted to $13,290,000, or about 55 per cent. Of course, a number of items in addition to the cost of construction are composed of tangible as well as of intangible elements. Interest during construction, although necessarily an assumed expense in the case of a property already built, is an expenditure that would become seriously tangible if an attempt were made to reproduce the property.

The valuation of the commission in this case is not the valuation of a State regulating authority, but of a local body which has jurisdiction only in the City of St. Louis. The commission is appointed by, and reports to, the Municipal Assembly, which is composed of two bodies. While the report includes a recommendation of the commission, based upon its valuation and investigation, for a new schedule of rates, the company is subject to reasonable regulation only directly by the Municipal Assembly, and any definite action that may be taken as a result of the valuation will be the decision of that body. In this respect the St. Louis commission is unlike the various State commissions which are given definite power by legislative act to order changes in rates. Whatever the result may be, the company has developed needed principles for the calculation of the costs of public-utility properties. Either for State or for other commission purposes or for the information of the officials of the company, valuations of all the elements of property should be undertaken by electrical corporations and every effort made to reach bases of computation that will protect the proper investment of security holders and assure reasonable conditions of service.

CHEMICAL ACTION IN THE WINDINGS OF HIGH-VOLTAGE MACHINES.

All known solid materials have a certain strength to resist longitudinal stress, and if this critical stress is exceeded they will break. Similarly, all known solid materials have a certain dielectric strength to withstand electric stress, and if this critical electric stress is exceeded they break down. Gaseous materials also come within the electric case. If air is overstressed electrically it breaks down. The break-down may or may not be accompanied by an arc discharge, according to the conditions governing the particular electrostatic circuit as a whole; but air which has been ruptured electrically is found to contain ozone. The theory is that an oxygen molecule consists of two oxygen atoms tied together. If the two constituent single atoms become torn asunder each is likely to attach itself to some neighboring oxygen molecule, to form a three-atom group, the so-called ozone molecule. An ozone molecule consists, then, of oxygen in a somewhat unstable triple atomic state, and very little persuasion will be needed to make the ozone molecule hand over the extra oxygen atom to a neighboring substance, leaving the two remaining oxygen atoms in stable equilibrium as a normal oxygen molecule. This lavish benevolence on the part of an ozone molecule, whereby it is so eager to give away an oxygen atom, on the principle that "two are company but three are a crowd," makes ozone so excellent and active an oxidizing agent.

An article by Messrs. A. P. M. Fleming and R. Johnson, referred to in this week's Digest, and recently published in *Engineering*, discusses the chemical action which is sometimes found to occur in the windings of high-voltage machines. It happens occasionally that a high-voltage generator will develop a short-circuit between adjacent turns in a slot. On opening the slot the insulating material is found to be chemically decomposed, the cotton rotted away, hard varnishes made soft and sticky and the copper conductors superficially corroded. The authors trace the action to air contained in pockets, or air spaces, within the slot. The air must first be subjected to a sufficient electric stress to effect its break-down. The ozone formed then presumably acts as an oxidizer on the insulating materials in the vicinity. These materials are ordinarily strong enough to resist stable oxygen at ordinary working temperatures, but their resolution to resist oxygen breaks down in the presence of ozone. According to laboratory experiments the authors find that air hermetically sealed in occluded pockets does not do any marked chemical harm. It is to be supposed, then, that such occluded air soon exhausts its oxidizing power and perhaps becomes reduced to inert nitrogen. But if the pocket remains open to the atmosphere, whereby fresh air can soak in, the chemical destructive action goes on steadily.

The deduction from such experiments is not, of course, that blind air spaces may be tolerated in high-voltage windings. The deduction is that there should be no unfilled spaces in the slots of a high-voltage winding, but that if there should be any, they should not have free access to the outside air. One inference from the research is that the designer of high-voltage machinery has many properties of materials to become acquainted with. He should work his mechanical materials up to a good mechanical stress, leaving, however, a proper factor of safety for contingencies. He should also work the dielectric materials at a good electric stress, leaving a factor of safety for surges and long service. He should work his magnetic materials at a good magnetic stress, leaving a suitable extra range for contingencies. He should also work all his parts at a good thermal intensity, so as to carry off heat rapidly, with a suitable margin against overheat and overload. He should finally work all his conductors to a suitably high current density, leaving a proper margin for overload. Plainly, unless he works his various materials up to proper limits of mechanical, magnetic, dielectric, thermal and conducting stresses he will not be getting full output from his machines; whereas if he overstresses any the machine may fail. The demands upon the designer for both experimental knowledge and practical experience tend to become more numerous and exacting in every decade. The article finally discusses the methods of construction best suited for avoiding chemical deterioration. These relate partly to avoiding break-down electric stresses in the winding space, partly to eliminating air spaces and partly to preventing short-circuits, even if chemical corrosion should be produced

Plans of N. E. L. A. Hotel Committee.

The N. E. L. A. hotel committee, through its chairman, Mr. Frank W. Smith, of the United Electric Light & Power Company, of New York City, announces the practical completion of the routine as to the arrangements for hotel reservations for the convention in New York, May 29 to June 3. Each member of the association will receive in due time a carefully compiled schedule of hotel accommodations and rates available for the members in attendance at the convention. The general convention headquarters will be in the Engineering Societies Building, 25-29 West Thirty-ninth Street, New York, where the business sessions and meetings of the association will be held and where the association offices are located. Therefore, no individual hotel has been designated as headquarters.

The schedule to be issued will take the form of an attractive circular with a complete and comprehensive map of the City of New York, showing transit facilities, subway and other stations and their relation to the Engineering Societies Building. A return post card addressed to the hotel committee will accompany this schedule, on which request for reservations may be made. As soon as the required accommodation has been secured the member will be notified by means of a reservation card which will have on it the member's name, address and accommodations held for him. This card, which will be numbered serially, is to be retained by the member and presented at the hotel desk when registering.

The hotel committee has also arranged for taxicab service during the week of the convention. A uniformed agent of the taxicab company will be in attendance at the Engineering Societies Building. Those desiring to arrange for reservations or those wishing to obtain information in advance of the mailing of the general announcement may communicate with Mr. Smith at 1170 Broadway, New York City.

Westinghouse on Federal Incorporation.

In an address delivered last week at Atlanta, Ga., on "Electricity in the Development of the South," Mr. George Westinghouse discussed the subject of federal incorporation, introducing his remarks with the statement that he had long held that a federal incorporation act, which the President advocates, under which all companies doing an interstate business could organize, would be a solution of the difficulties which are now almost insurmountable, and which are being added to in an alarming manner in the endeavor of the Legislatures of the several States to curb a few of the tens of thousands of companies and firms doing an interstate business.

After having read and carefully studied the bill providing for federal incorporation which was introduced in the long session of the present Congress he felt, however, that he would prefer to see a federal law in terms more easily comprehended by business men and devoid of those provisions which would give to a privileged few a practical control of a corporation by expedients which have been skilfully developed and which are now looked upon as a matter of course. He referred particularly to the depriving of minority owners of possible representation by the formation of voting trusts and the election of directors in classes, methods which can, and often do, defeat the purposes of laws which have provided for cumulative voting, whereby a substantial minority can insure the election of at least one member of a board of directors.

In his opinion, each director of a corporation should be required actually to own a substantial interest in the shares of the company the affairs of which he aids to control, and the term of office be only from year to year. To make the meaning clearer, he illustrated by supposing that a company had, by appropriate by-laws, established a board of five directors, only one of whom could be elected each year. Obviously, the provision of the law for cumulative voting would have no meaning in the government of the affairs of such a company.

Mr. Westinghouse stated that it may be unorthodox to say this, but it is his conviction that the conduct of a business without profit is disadvantageous to the community at large because of its demoralizing effect on the industry and its influence upon others. A federal incorporation act should provide for a statement, on prescribed forms, of the assets and liabilities of each corporation taking advantage of its provisions. This statement should be available to all who are asked to extend credit to the corporation. The disadvantage to a company of doing business at a loss under such conditions need not be enlarged upon.

In conclusion he said that each of the great corporations of to-day had its origin in a business established by an individual or small company based upon the skill and efforts of one or more individuals. The development of the South must be more or less rapid according as the work of such men is appreciated and encouraged, especially during the period of strenuous effort necessary to the building up of large and prosperous industries from small beginnings.

German Bureau for the Extension of Use of Electricity.

About eighty representatives of the electrical industries in Germany, manufacturers as well as central-station men, met in Berlin on Jan. 28 and organized a Bureau for the Utilization of Electricity. The main object of the bureau will be to promote the use of electricity in all its applications. Berlin has been made the headquarters of the new society and Mr. Einar Wikander, formerly a director of the Auer company and a well-known central-station expert, has been chosen for manager. The address of the society is: Geschäftsstelle für Elektricitäts Verwertung, Potsdamer Str., 68, Berlin W. 57.

Einar Wikander.

The Institute of Operating Engineers.

The Institute of Operating Engineers, with headquarters in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, which was started with a temporary organization on March 17 of last year, has now 234 charter members, with some eighteen or twenty branches already formed or in process of formation. Among the objects of the institute are to unite in an organization those directly interested in operating engineering, the body also to serve as an educational institution for promoting acquisition of the skill, knowledge and personal qualities that render the operating engineer and the machinery operator efficient in their duties; to further a spirit of practical co-operation among the various grades of plant workers and between them and plant owners, as well as others interested, such as manufacturers, designing and consulting engineers, etc.; to establish in engineering and business colleges scholarships for successful student journeymen; to advocate and adopt a uniform apprenticeship system, that men may be systematically educated and trained as efficient journeymen machinery operators and operating engineers; to award apprenticeship and operating-engineer diplomas; to formulate standards and recommend to members and apprentices means for acquiring practical skill and technical knowledge. Among the means for carrying out these objects will be the selection and registration of young men as apprentices, urging the introduction in public-school courses of general industrial training by competent men to all boys over twelve years of age; encouraging systematic preparatory courses either for home or evening instruction; arranging with local technical schools or colleges for the adoption of technical evening courses in operating engineering, leading to class certificates; establishing relations between the school, shop and power plant in order that men may have an opportunity of serving a regular period as student apprentices under qualified journeymen and operating engineers and thus receive simultaneous and systematic vocational training in the practice as well as in the theory and principles of operating engineering. Many other means to the ends in view are given in detail in the proposed constitution.

The membership consists of honorary members, associates, members, junior members, journeymen and apprentices. The honorary members are limited to twelve; the associates consist of individuals, firms and corporations operating power plants, machinery manufacturers, consulting and other engineers, instructors, lecturers, etc.; members are confined to master operating engineers who have a creditable record extending over fourteen years; junior members, known as operating engineers, shall have had not less than nine years of acceptable practical experience. The institute will grant certificates to the various classes of qualified members, maintain an employment bureau, hold meetings for the reading and discussion of papers, arrange visits to industrial plants, etc.

Columbia University has adopted the institute work in its extension course at the Teachers' College and it is expected that similar arrangements will be made with other colleges. The Williamson Free School has entered into an arrangement whereby its graduates will receive from the institute the certificate of journeyman. The secretary of the institute is Mr. M. W. Rice.

Prizes for an Experimental Study on Grounding and for a High-Tension Line-Disconnecting Device.

Marchese di Cambiano, president of the international prize competition committee of the International Exposition of Industry and Labor, to be held in Turin, Italy, this year, has notified the American Museum of Safety that the Italian Minister of Agriculture, Industry and Commerce and the National Board of Workmen's Insurance of Italy have offered a prize of $2,000 for the best experimental study on making earth grounds for electrical circuits and apparatus. The study must deal especially with the phenomena occurring when any point of an electric circuit comes in contact with the ground; with the influence of the composition and nature of the soil at which connection is made; with the influence of the form of the currents and their voltage; with the protective efficiency of earth grounding, either permanently or temporarily or in case of abnormal voltage, and with means for maintaining and testing grounds. The paper, which may be written in Italian, French, English or German, should also consider both the cases of normal régime and of disturbances from internal and external causes, and should include sufficient experimental data to support the treatment of the subject.

Another prize, of $1,600, is offered for a device by which an electric current at high potential may be cut out upon the breaking of a conductor. The apparatus should be such as can be mounted at any generating station or substation without requiring any important alteration in the installation of overhead wires or disturbing in any way the working of the plant. The competition for the above prizes closes on Sept. 30.

A number of other prizes are offered under the same auspices, as follows: A prize of $1,000 for the best device for shifting a belt, competition to close on April 30; a prize of $1,000 for a portable apparatus for moving pulleys with different diameters and mounted on shafts of different diameters, competition to close April 30; a prize of $500 for means to prevent accidents in rolling metals of any kind, competition to close April 30; a prize of $2,500 for devices lessening the danger of infection to which tannery employees are subjected in working with hides, competition to close Sept. 30. The American Museum of Safety, 29 West Thirty-ninth Street, New York, may be addressed concerning further details of the conditions of the prizes.

Electrical Shops in Europe.

By Captain Godfrey L. Carden, U.S.R.C.S.*

The European electrical works are large users of American machine tools. The installation at the Brown, Boveri & Company shops is tantamount almost to an exhibition of high-grade American machines. The same statement might be made of other electrical plants abroad, but the Baden shops are especially conspicuous in the use of the best grades of American tools.

In the Nonnendamm shops of the Siemens & Halske-Siemens-Schuckert Works there is at present turned out a very high class of electrical equipment, and the tools employed are nearly all of American or German origin. In the tool-hardening department at the Wernerwerke branch of this company the only ones in use are those of the American Gas Furnace Company, of Elizabeth, N. J. The opinion is held at Wernerwerke that the American-made gas furnaces are superior to any made in Germany.

The Siemens & Halske-Siemens-Schuckert Works employ about 13,000 people in all in the various shops located in Nonnendamm, and of this number fully 6000 are carried on the rolls of the branch plant known as Wernerwerke. All told Siemens & Halske-Siemens-Schuckert give employment to approximately 25,000 men and women.

The French Thomson-Houston Works were at the time of the writer's visit engaged in the manufacture of material both for the State and for commercial purposes. A large part of the government telephonic apparatus is handled by this firm, and in addition all kinds of electrical equipment are handled The Curtis turbine is manufactured in France by the Thomson-Houston Company, its principal competition being with the makers of the Rateau, Parsons and Zoelly turbines. In the building of the Curtis the Thomas-Houston people have had recourse to Leflaire & Company. This latter firm is located in St. Étienne. It is understood that Leflaire & Company are looked to to produce the castings and machine all parts, leaving to the Thomson-Houston Company the supply of the electrical equipment. The Curtis turbo-generator sets are manufactured at Lesquin, near Lille, in the north of France. This plant was equipped especially for the manufacture of these Curtis turbo-generators and all large electrical units. The manufacture of small dynamos and motors is undertaken at another branch shop located at Neuilly-sur-Marne. The work here is for both direct current and alternating current up to about 30 hp. The Paris shops employ generally under 1000 persons, more often 750, this force being regulated by the state of the trade. At Neuilly about 200 persons are carried on the rolls, and at Lesquin about 100.

The Thomson-Houston Company is understood to have a working agreement which withdraws the General Electric and the Allgemeine Electricitäts Gesellschaft from competition on French territory At the same time all new designs, plans and developments are exchanged freely between the three firms mentioned. The arrangement leaves only the French Westinghouse as an active competitor

The Thomson Houston was using malleable-iron gear covers for tram cars which had been ordered from a Buffalo (N. Y.) firm, but it was to substitute aluminum. The latter metal is, of course, more expensive, but the aluminum of a broken

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*Captain Carden served during a period of eighteen months abroad as special agent for the Department of Commerce and Labor, and during that time visited many of the important plants in Europe. His reports are on file in the Bureau of Manufactures, Washington, and those which appeared in the Daily Consular and Trade *Reports* have been reissued in pamphlet form.

gear box can be sold, it was pointed out, for at least 50 per cent of its original value.

The Swiss electrical works have long held claim to high excellence. Zurich is the center of industrial Switzerland, and close by are the Oerlikon Electrical Works and Brown, Boveri & Company. The latter firm is located at Baden, about forty-five minutes run by train out from Zurich.

To understand properly industrial Switzerland it must be borne in mind that the country produces no coal and no iron ore. For the manufacture of machinery raw material is brought in for the most part from Germany, and the traffic is largely by river as far as Mannheim, and thence by train into Switzerland. In the winter season, when river navigation is not always possible, the transportation cost often advances from 25 per cent to 30 per cent.

While Switzerland is lacking in ore and coal the country can boast of an enormous amount of water-power, and in the development of the power the Swiss have gained worldwide renown. The firm of Escher, Wyss & Company, of Zurich, may be regarded as one of the first houses of Europe in water-turbine building. It was this house that was called upon for designs for some of the original water turbines for Niagara Falls, and it was from these same shops that turbine shipments were made direct from Zurich for installations on the Canadian side of Niagara Falls.

Hand in hand with water-turbine development one finds practically the superlative in electrical engineering, and to-day Swiss machinery is being sent to all parts of the world—that is to say, other than America. For much of their technical skill the Swiss have to thank their engineering institutions. They can lay claim to much practical experience and were among the first to participate in long-distance transmission.

The opinion prevails at Oerlikon that it will not be long before the single-phase system will be found in operation on a majority of the Swiss State railways. The Brown, Boveri & Company house, however, leans to the three-phase alternating current for railway work, and it is the opinion of the Baden firm that the advantage of the three-phase system is its exceptionally long life when applied to traction material. This, it is said, is a consequence of the simple construction of three-phase motors To those acquainted with direct-current traction work and who know how often motors have to be repaired the importance of this feature will be appreciated.

At the Paderno central station, installed as far back as 1898, Brown, Boveri & Company demonstrated that it was practicable to switch out a fully-loaded 2200-hp generator under the very high-tension of 15,000 volts in a safe and reliable manner. This firm now builds single-pole high-tension oil switches which are capable of cutting out a total power of 75,000 kw at 60,000 volts if required.

Brown, Boveri & Company undertook, it is understood, the electrifying of the Simplon Railroad at their own expense, that is, the tunnel portion, and it was not until after the success of the work was demonstrated that the equipment was taken over by the Federal Railways of Switzerland. The Baden firm was among the first to succeed in adapting the polyphase motor in a practical manner to traction work, and in addition the motors of this firm are very much in use in Europe for such work as driving cranes, turntables, rolling-pins, pumps, locomotives and other machines.

Brown, Boveri & Company have taken up the building of blast-furnace blowers and of high-pressure compressors—the latter up to 100 lb. per square inch. One of these Brown, Boveri & Company blowers affords 16,000 cu. ft. of free air per minute, delivered against a terminal blast pressure of 7 lb. per square inch gage. The set runs at 3200 r.p.m. Just now Brown, Boveri & Company are making a specialty of electrifying textile plants, particularly for driving ring frames, and there has been developed a special type of motor of the single-phase repulsion type which permits of speed regulation in the simplest manner by merely shifting the brushes, and which results, it is understood, in affording an increased output of the ring frame and better quality of yarn.

When the Geneva water-works power station was installed by Brown, Boveri & Company the motor assigned was reported as the largest polyphase induction motor in existence. This is a 1000-hp, 5000-volt, two-phase motor direct-coupled to a centrifugal pump, which it drives at a speed of 455 r.p.m. The Baden people have designed a special type of generator, with vertical shafts for direct-coupling to turbines, and in the Olten-Aarburg central station is one of these vertical-shaft hydroelectric sets running at a speed of only 28 r.p.m.

The shop efficiency at Brown, Boveri & Company is very high, and the machine-tool department management is what one is accustomed to see, to a very large extent, in America. The superintendent of the machine-tool installation worked for some time in the shops of Pratt & Whitney, Hartford, Conn. Among the American machine tools in service were machines from the following houses: Brown & Sharpe, Ingersoll Milling Machine Company, Cincinnati Milling Machine Company, Norton Grinding Company, G. A. Gray Company, Whitcomb Machine Tool Company, Mark Flather Planer Company, Warner & Sevasey, Hendey Machine Tool Company, Putnam Machine Tool Company, Baker Brothers, Baush Machine Tool Company, Gisholt, Lodge & Shipley and "Acme."

Brown, Boveri & Company write off yearly many of their machine tools, and the practice is followed of selling the discarded tools to the small shops. While American chucks are bought the firm undertakes to make its own taps and dies, twist drills and gages, and it is understood that the firm is able to save fully 100 per cent through making its own taps and dies.

At the Oerlikon Works many American machine tools are in service, and here, too, the installation is a remarkably fine one.

The Oerlikon shops are working about 2000 people.

The American machine-tool firms represented on the Oerlikon floors include the following houses: Jones & Lamson, Brown & Sharpe, Potter & Johnston, Prentiss Brothers Company, F. E. Reed Company, Pratt & Whitney, G. A. Gray Company, Niles Tool Works, E. W. Bliss Company, Colborn, Landis Tool Company, Lodge & Shipley, Cincinnati Milling Machine Company, W. F. & J. Barnes Company, Gisholt, National-Acme, Cleveland Automatic Machine Company and Dresses Machine Tool Company.

One of the directors at Oerlikon remarked that the Lodge & Shipley engine lathes were regarded at that plant as superior to any foreign lathe, and it was their experience that this type of American lathe yielded a saving of 30 per cent in cost of production over any European-made lathe, barring only Darling & Sellers (English) make. The Darling & Sellers lathe, the writer later learned, sells for $145.80 more than the Lodge & Shipley of the same size.

In view of the high opinion entertained on the Continent of Darling & Sellers lathes the writer made it a point to visit that plant. It is a small establishment located in Keighley, England, having a very limited output, but doing really fine work. A full report (with the permission of Messrs Darling & Sellers) was made of this machine and can be secured through the Bureau of Manufactures at Washington.

There is hardly any line of electrical equipment that is not handled by the Oerlikon shops, and this statement applies especially with reference to power and traction apparatus. Special gear turned out embraces electric pumping and rolling mill installations, winding gears and electric locomotives, and electrically driven overhead traveling and revolving cranes. The last mentioned work constitutes one of the most important in Oerlikon's list.

Oerlikon is building turbines after the Rateau patents. Brown, Boveri & Company handle the Parsons, and Escher, Wyss & Company control the Zoelly. The last named originated with Escher, Wyss & Company and is the design of Director Zoelly of that firm. While at the Escher, Wyss & Company shops there was observed the 20,000-hp Zoelly turbine for the German scout cruiser *Cöln*. The advent of Escher, Wyss & Company in the list of steam-turbine builders is in itself an interesting fact, inasmuch as this firm has in the past confined its attention largely to water turbines. The Zoelly turbines are being built for both land and marine purposes.

Good machinists at the Oerlikon Works earn between 96 cents and $1.35 per day, but the tendency is toward higher wages. The living cost of workmen in Zurich in proportion to the cost of living in America is roughly in the proportion of 1 to 2½ or 3. In general terms the cost of production in European shops exceeds the cost in the United States. This statement is not made with direct reference to electric plants, but to machinery-producing works as a whole. As is well known, the practice in many American machine-tool establishments and other works is to keep a record of the production per man per year, basing the same on a record of all material produced within a given twelve months, taking the value at the net price received by the manufacturer and dividing this sum by the total working force, exclusive of the office help. Resulting figures of $1,850 per man, and higher, are not unusual in American shops. At a well-known plant in Prague, one of the best of its kind in Europe, the corresponding figure was 1784 crowns ($362). The highest earning rate found at any European shop visited was $1,186 per man per year.

Electricity in the Development of the South.

In an address before the Southern Commercial Congress, Atlanta, Ga., Mr. George Westinghouse outlined the part being played by electricity in the development of the South. He remarked that the coming epoch, the dawn of which is now here, will be known as the "Age of Electricity." This condition he attributed to the development of the alternating-current system, which overcame certain limitations in the direct-current system. The latter was first introduced and its advocates bitterly opposed the introduction of alternating-current apparatus because of its alleged danger to life.

In view of the fact that the rivers of the Appalachian Mountains can be developed for from 5,000,000 hp to 7,000,000 hp during the dry season of the year it can be seen that hydroelectric installations are destined to assume a universal and fundamental part in the life of future generations in the South. A noteworthy beginning has been made by the Southern Power Company, which furnishes energy for lighting forty-five cities and towns and for operating six street-railway systems.

Mr. Westinghouse expressed the opinion that the industries most likely to be developed and to increase because of peculiar suitability to conditions now existing in the South are textile mills, fertilizer works, cement plants, coal, iron, copper and gold mining, ore-reduction plants, iron and steel mills, agricultural implement works, canning factories, road building, furniture manufacture, lumber plants, paper mills, shoe and leather factories and oil refineries, in all of which industries electric power service increases the production.

Equal in importance to the development of the water-power resources are the existing restrictions which make it difficult and expensive for a small corporation to carry on conveniently and in a simple manner its business with ramifications in several states. Mr. Westinghouse expressed his desire for a federal incorporation act under which all companies doing interstate business could organize in order to overcome the difficulties which are now almost insurmountable and which are being added to in an alarming manner by the separate Legislatures of the several states.

Cost of Industrial Motor Service.

At the joint meeting of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers held in the Engineering Societies Building, New York, on March 10 three papers dealing with the general subject of the cost of industrial motor service were presented and discussed. Two of the papers were by Mr. John C. Parker, mechanical and electrical engineer of the Rochester Railway & Light Company, and one by Mr. Aldis E. Hibner, industrial engineer of the Toronto Electric Light Company.

In a paper entitled "Comments on Fixed Costs in Industrial Power Plants," Mr. Parker discussed in detail the various costs of industrial motor service which are not closely a function of the energy output. These costs include the interest on the investment, taxes, insurance, depreciation, obsolescence, supervision, fair profit and rental of building space. He called particular attention to the so-called marginal principle as being of critical importance. He showed that it is not always advantageous to increase the equipment of, say, a hydroelectric plant even when the cost of the final installation is within the value assigned for the permissible cost per unit of equipment rating. This condition is attributable to the fact that the "marginal unit" last added to make up the total is much more costly than the average, and hence than the permissible, cost, and therefore it could advantageously be omitted. He contended that the point at which to stop development is that where the marginal investment produces a marginal profit of not less than the fair profit which will satisfy the financiers.

In his second paper Mr. Parker showed that the various elements entering in the total cost of the energy output from a generating station during any stated period can be expressed in the form of an equation containing three terms, one being a certain constant, the second another constant multiplied by the rating of the station and the third a different constant multiplied by the kw-hours generated during this period. He discussed each element of cost separately and stated in which terms of the equation the element should appear.

Mr. Hibner gave an outline of the different factors to be considered in the cost of industrial motor service, discussing particularly the relative economies of generating the required energy locally or purchasing it from a central station. He said that the three general factors entering into the problem are the investment charges, the operating charges, the cost of heating or use of low-pressure steam. He gave estimates of the cost of a certain 100-kw combined steam-heating and electric generating plant and showed that the actual cost per kw-hour was 2.5 times as great as the owner had supposed. This discrepancy is attributable to the fact that this owner, as is true of most manufacturers, did not know the load-factor on his factory, while the load-factor is one of the most important elements in the cost of industrial motor service.

Discussion.

Mr. N. T. Wilcox called attention to the fact that few people know the cost paid by them for each hp-year in industrial service, and cited two cases where the actual costs were from 50 per cent to 100 per cent higher than the supposed costs.

Mr. P. R. Moses claimed that Mr. Parker had exaggerated each item in the cost of isolated-plant service and gave figures to modify the values specified by Mr. Parker.

Mr. D. B. Rushmore remarked that reliability is one of the most important factors in industrial motor service. With most hydroelectric installations it is necessary to provide steam relays for use in case of interruption. In recent years conditions have so improved that at present a steam turbo-generator can be started from rest and placed under load in about one-half a minute.

Mr. R. P. Bolton remarked that the demands for exhaust steam for heating and electricity for industrial service do not coincide as to time, and this fact greatly complicates the problem of determining the advantage or disadvantage of substituting central-station for isolated-plant service.

Mr. H. W. Peck called attention to the fact that the lack of simultaneous demand for exhaust steam heating and load on the engines for industrial purposes may easily result in a coal consumption from 50 per cent to 75 per cent in excess of the amount that would be required if the two demands occurred simultaneously.

Mr. John H. Norris presented estimates made on a number of gas-engine-driven electric generating stations tending to show low cost of service. The costs ranged from 0.7 cent to 3.8 cents per kw-hour, the former being for a 200-kw equipment and the latter for a 15-kw equipment.

Mr. Stonewall Tompkins gave an analysis of the equipment and operating costs of delivering energy at the Coney Island Railway substation and showed the total to be 0.77 cent per kw-hour.

Mr. Arthur Williams called attention to the fact that a certain investigation has shown that the coal actually consumed by isolated plants in three apartment houses, three hotels and three clubs in New York averaged 17.3 lb. per kw-hour, the maximum reaching 25 lb. In spite of this showing the coal consumption is customarily put at from 6 lb. to 7 lb. in preliminary estimates.

Mr. Parker H. Kemble remarked that 10 lb. of coal per kw-hour is a fair estimate for a 100-kw plant.

Mr. H. H. Edgerton showed that the cost of service from an isolated plant is greater than 3 cents per kw-hour when only interest and depreciation are considered, so that all production and distribution costs would be saved by purchasing energy at this rate from a central station.

Mr. C. M. Ripley stated that the Commonwealth Edison Company of Chicago owns and operates at least three isolated plants in the basements of buildings and argued that the owners could depend on such plants if the central station finds it advantageous to do so.

Mr. George L. Fowler said that isolated plants are run by methods that will not bear analysis and the costs are so erratic that they cannot be predetermined.

In reply to the criticisms of Mr. Moses, Mr. Parker showed that the estimates made by him were not theoretical, but were taken from an actual case within his own experience.

A. I. E. E. Papers on Transformer Problems.

One of the prominent features of the mid-year convention of the American Institute of Electrical Engineers, held on Feb. 14, 15 and 16, was a trip from Schenectady, N. Y., to Pittsfield, Mass., where the transformer factory of the General Electric Company was inspected and four papers relating specifically to transformer problems were presented and discussed. The authors of these papers were Messrs. F. C. Green, C. E. Allen, J. M. Weed, and J. J. Frank and H. O. Stephens. A paper by Dr. C. P. Steinmetz entitled "Mechanical Forces in Magnetic Fields," which contained many data of value to transformer designers, was also read and discussed. Abstracts of these papers and discussions are given below.

In the paper by Mr. Green many interesting problems encountered in the operation of transformers were discussed in detail. The author stated that abnormal voltage conditions are responsible for almost all transformer failures. The total abnormal voltage impressed is not in itself dangerous; the damage is caused by the disturbance of the voltage equilibrium within the windings. This fact is shown by the small percentage of punctures between the coils and core as compared with the punctures between turns of the same winding. The present small percentage of transformer failures can be reduced to an inappreciable value by increasing the effective insulation between parts of the winding most liable to damage.

Although formerly it was considered desirable to build transformers with minimum voltage regulation, it is now appreciated that low impedance means high short-circuit current and enormous stresses under short-circuit conditions. The troubles arising from this cause have been cured by inserting separate reactance in circuit with transformers having low inherent reactance, by designing for higher inherent reactance and by increasing the surfaces of coil-supporting strips.

The author showed that it is a mistake to assume that a so-called self-cooling transformer will operate at a satisfactorily low temperature regardless of the surroundings that do not admit of the free escape of the heat. So far as the production of heat is concerned a transformer is similar in every respect to the furnace of a boiler and adequate circulation of air around the transformer is necessary to insure low temperature during operation.

The author described in detail numerous combinations of transformer connections in polyphase systems that may cause trouble either immediately upon being placed in service or subsequently under peculiar conditions.

In his paper on regulation Mr. Allen called attention to the discrepancies in the results obtained with the various methods used in calculating the voltage regulation of transformers. He assumed the case of a transformer having a resistance drop of 1.5 per cent, a reactance drop of 2 per cent and a magnetizing current equal to 5 per cent and showed that the calculated regulation at unity power-factor load would vary from 1.50 per cent to 1.62 per cent according to the method selected. and at 50 per cent power-factor would vary from 2.48 per cent to 2.58 per cent. Much of the difference in the calculated regulation is attributable to the neglect of the effect of the exciting current, which was of no importance in the older transformers, but is of some importance in the modern silicon steel transformers. However, since the exciting current exists at both no-load and full-load it has relatively little effect upon the regulation expressed as the ratio of the rise of secondary terminal voltage from rated full-load to no-load, to the secondary terminal voltage at rated load.

The paper by Mr. Weed was devoted to a detailed analysis of the temperature gradient in oil-immersed transformers. The author mentioned the unsatisfactory results obtained in certain instances when the temperature rise in a transformer is based on an analysis of only the watts per square inch at the surface of the transformer and the surface of the tank. The rules based upon this analysis are not always safe when applied to new types of transformers.

The paper contained a discussion of the fall of temperature as the internally generated energy passes from the hottest part of the coil to its surface, within the insulating covering, if the coil is covered; through the insulating covering on the surface of the coil to its outside surface; from the surface of the solid insulating covering, or coil, into the adjacent oil; through the oil from a point adjacent to the coil, to a point adjacent to the tank for a self-cooling transformer, or to a point adjacent to the cooling coil for a water-cooled transformer; from the oil to the metal of the tank or the cooling coil; through the walls of the tank or the cooling coil; from the external surface of the tank to the surrounding air, or from the inner surface of the cooling coil into the water.

Distinct consideration was given to radiation, conduction and convection. As compared with perfect radiation having a value of 3.425, lampblack radiates 3.29, terne plate 0.535, rusted iron 2.75, new cast iron 2.61, polished sheet iron 0.189, ordinary sheet iron 2.275. With a rise of 40 deg. C. the total heat discharged by both radiation and convection from an ordinary boiler tank with plain surface is ordinarily about 0.25 watt per square inch. Of this total about 60 per cent is lost by radiation. Since radiation is not increased by corrugation except in so far as the external dimensions of the tank are increased the increased cooling with a corrugated tank is due mainly to the increase in convected heat. Hence a corrugated surface is very ineffective as compared with a plain one of the same developed area. Comparing a plain tank with a corrugated one of equal dimensions, but with four times the developed surface, if all parts of the corrugated surface are equally effective for convection with the plain surface, and if 40 per cent of the heat thrown out from the plain tank is convection and 60 per cent radiation, the total heat thrown out by the corrugated tank will be 40 per cent $\times 4 + 60$ per cent $= 220$ per cent of that thrown out by the plain one, so that the watts per square inch thrown out by the corrugated tank, at the given temperature, are $220 \div 4 = 55$ per cent of the watts per square inch from the plain one, and the radiation from the corrugated tank is $60 \div 2.2 = 27.3$ per cent of the total heat thrown out.

The relative merits of the most commonly used designs for self-cooled transformers, and oil-filled transformer tanks were presented in the paper by Messrs. J. J. Frank and H. O. Stephens. Mention was made of a recent development along the line of corrugated surface consisting of a tank with compound corrugations. It is obtained by double-corrugating the surface so that it will be made up of major and minor corrugations. When the circulation of the oil within a tank is confined to a definite path down along the cooling surface of the tank local eddy currents in the oil are avoided and the circulation is much more effective.

Reports were given of tests made on tanks of plain cast iron, plain boiler plate, corrugated cast iron with 4.2-in. pitch and corrugated steel with 3.2-in. pitch. At 0.20 watt per square inch of radiating surface the temperature rises were 29 deg. C., 31 deg. C., 35 deg. C. and 45 deg. C. respectively. Tests were also reported to show that of two tanks otherwise similar one having 88 per cent greater radiating surface radiated only 19.6 per cent more losses at an equal temperature of 40 deg. C.

The nature of the radiating surface has considerable effect upon its radiating properties. In addition to the material itself the color and character of the paint has some effect upon the radiation of tanks, especially when they are exposed to the direct rays of the sun. Tests indicate that tanks painted with white enamel or aluminum paint run several degrees cooler in the daytime and slightly warmer at night than tanks painted with black paint.

One item of primary importance in designing transformer tanks is the cost. The following table gives average comparative costs of tanks designed to radiate from 1 kw to 3 kw loss at 40 deg. C. rise in the oil, plain cast-iron tanks being used as the standard of comparison:

Plain cast iron	100
Plain boiler plate	97
Corrugated cast iron	93
Corrugated steel	61

The above figures do not include the cost of oil, and if this were added the difference in cost between the plain and corrugated tanks would be greater. For larger losses a similar comparison would show an increased advantage in favor of the corrugated-steel tank and other more complicated surfaces, and if the losses are still further increased the plain tank becomes quite out of the question.

Dr. Steinmetz's paper dealt with the mechanical force produced upon a conductor carrying current when placed in a magnetic field. The treatment employed was based on a study of the energy stored in the magnetic field, the mechanical energy produced by motion in the magnetic field being equal to the difference between the electric energy consumed by the induced e.m.f. and the increase of the stored magnetic energy. The mechanical force is determined by dividing the mechanical energy by the distance traveled. Even where motion is not produced the force may be determined by assuming an infinitesimal movement and calculating the change in energy produced thereby.

The author applied the above method to the pull of constant-current electromagnet, the pull of constant-potential alternating-current electromagnet, the stresses in stationary transformers, and the repulsion between parallel conductors.

The author stated that the problem is not entirely determined by the two end positions of a plunger magnet, but the function by which the current and the inductance are related to each other must also be given.

Discussion.

In discussing Dr. Steinmetz's paper Dr. A. S. McAllister stated that the equations for determining the mechanical force in magnetic fields are directly applicable only when the coefficient of self-induction is constant. When this coefficient is not constant, the equations become so complicated that resort must ordinarily be had to graphical methods. In the case of a plunger magnet the change in energy when the plunger moves represents a change in energy of condition rather than energy of position, and hence is analogous to kinetic rather than to potential energy. The movement of the plunger is incidental to the change in energy, but the change in energies cannot be treated directly as due to the change in position.

Mr G. Faccioli called attention to the fact that mechanical forces in transformers can most readily be reduced by increasing the reactance in the transformer circuit. This reactance can be either external or internal, but the reduction in the forces is greater when the reactance is external on account of the simultaneous reduction in the main magnetic field of the transformer.

Mr. J. M. Weed outlined a mathematical formula for expressing the forces between transformer coils and derived results identical with those of Dr. Steinmetz.

Mr. C. Davis described a graphical method for determining the change in magnetically stored energy in solenoids with the movement of the plunger. His treatment was based essentially on the product of the elements of two areas representing the current increasing with time and the induced e.m.f decreasing with time.

Mr. W. Harper gave a physical analysis of the mechanical forces exerted on transformer coils, with special reference to the warping parts. He stated that the values of forces given by Dr. Steinmetz had been verified by numerous tests to within from 2 per cent to 7½ per cent, according to the mechanical arrangement of the conductors investigated.

Mr. F. C. Green described in detail the repelling forces existing between parallel flat coils in transformers.

Mr. J. Barrow showed that when the calculation of the mechanical forces between two parallel flat bars is based on the assumption of currents concentrated at the center of the bars the discrepancy between the calculated values and the observed values varies considerably with the distance between the bars. When the bars are relatively close together the discrepancy is quite large, but when they are separated by a considerable distance the calculated values agree quite accurately with the observed values.

Mr. A. H. Pikler explained the apparent increase in destructiveness of the mechanical forces in modern transformers as compared with the older transformers. This increase he attributed to the decrease in the reactance of modern transformers as compared with transformers of the earlier types, the current under short-circuit conditions being much greater in modern transformers than in transformers of the older type. He expressed the opinion that transformers are not constructed with proper regard for the mechanical forces produced during short-circuiting.

Mr. J. J. Frank stated that the increase in the destructive forces in modern transformers can be attributed largely to the greater concentration of power in modern electrical systems as compared with the older systems. That is to say, although transformers at the present time more frequently show results of distorting forces in the coils, this fact is not attributable solely to the change in the design of the transformers, but would be found in older transformers if used under modern conditions.

Mr. C. F. Scott stated that by far the best conception of the magnitude of the forces which transformers are called upon to withstand can be gained by examining some of the transformers destroyed by such forces. He cited a certain case where destruction had been produced by a short-circuit between the turns on one coil, which thereby made of itself a closed secondary carrying enormous current in its local circuit Under such conditions destruction is almost sure to result

Mr. W. S. Moody called attention to the great importance of the investigation of temperature gradient in oil-immersed transformers, as described by Mr. Weed. Investigations of this kind result in the elimination of the old "cut-and-try" methods by increasing the knowledge of the individual elements which are involved in the total temperature drop.

Mr. A H. Pikler stated that of equal importance with the proper design of transformers is the proper installation of the units in the equipment with which they will be employed He expressed the opinion that, although a temperature rise of 40 deg., as now specified for transformers, was proper with the older types, this limiting temperature is too low to be applied to modern transformers In view of the improvements that had been made in core material and insulation it is permissible, and highly desirable, to increase the temperature limit to as much as 60 deg. C.

Mr. E. G. Reed mentioned the fact that the methods employed for causing a transformer to cool itself automatically have been so much improved in recent years that at the present time transformers provided with cases having pipes attached for causing the cooling are now being built for ratings as high as 3000 kva.

Mr. E. A. Wagner expressed the opinion that the formula for determining the regulation of transformers should be standardized in order to eliminate the confusion which exists at the present time. He said that there is a limit to the depths to be employed in corrugating tanks of transformers beyond which a further increase produces no appreciable increase in the cooling effect. It is preferable not to use corrugations having a depth greater than about twice the opening.

Prof. C. A. Adams showed by means of vector diagrams the conditions under which third harmonics can be produced or can be eliminated from a three-phase system. In a delta-connected system the exciting current has a triple-frequency component, while the voltage is sinusoidal. In a star-connected system the exciting current is sinusoidal, while the voltage to the neutral point contains a triple frequency, so that the neutral e.m.f. point rotates around the true geometrical vector point.

Mr. R. D. Mershon questioned the advisability of constructing transformer cases with the same amount of area exposed to the air as to the oil on account of the fact that oil can more readily transfer its heat to the case than can the case discharge its heat into the air.

Mr. C. W. Stone stated that at the present time there is less need for good voltage regulation than was true in former years, and hence it is not only not disadvantageous but is advantageous to allow the transformers to possess considerable reactance.

Mr. E. F. W. Alexanderson outlined the results of tests showing the cooling effect of air at different velocities. In a certain case cited it was found that when the velocity of the cooling air was specified in feet per minute the watts per square inch for a certain temperature rise had a value which could be represented by the quantity 1 plus one-thousandth part of the velocity. Thus, for example, the cooling effect of air moving at 1000 ft. per minute was just twice that of air at rest.

Mr. H. O. Stephens called attention to the fact that in any self-cooling transformer the temperature is much higher at the top than at the bottom, so that incorrect conclusions are drawn when one bases his conclusions on the assumption that the radiation is uniform throughout the height of the transformer.

Dr. C. P. Steinmetz stated that reactance is of greater advantage in short, low-impedance lines than in long, high-impedance lines. Series reactance not only does not tend to increase the wave distortion, but has the opposite effect of wiping out the higher harmonics, in view of the fact that the effective reactance increases directly with the frequency. A series reactance intended for protecting a transformer on short-circuit should be built without an iron core. When iron is used in the circuit it becomes saturated with an abnormal increase in the current and ceases to be effective at the very time when needed.

Report on St. Louis Rates and Valuation.

A summary giving the conclusions in the report of the St. Louis Public Service Commission on the Union Electric Light & Power Company was published in the issue of the *Electrical World* for March 9, 1911. As the valuation of the property was designed to furnish a basis for rate-making, additional extracts outlining the suggestions made by the commission and explaining its position are given herewith.

The commission states that the company co-operated in every way in the investigation, affording access to books and papers giving all information at the command of the company, presenting much testimony at the public hearings and also having prepared a complete financial history.

The accountants for the company in their first presentation of claims for value of the investment on which earnings should be computed presented tables, of which a summary is given in the report. The value of the total tangible property as of Dec. 31, 1908, was stated therein to be $23,411,867 and of the intangible property $4,104,428, making a final total before deductions for depreciation of $27,516,295.

TABLE I.—ESTIMATED COST OF REPRODUCTION NEW AS EXISTING OF THE PROPERTY OF THE UNION ELECTRIC LIGHT & POWER COMPANY AS OF OCT. 31, 1909, BY FORD, BACON & DAVIS.

	Item.	Total.
I. Development		
1. Development period (obtaining rights and capital).		
a. Time and expense of development organization (3 per cent of item II)	$724,365	
b. Interest on expenditures during development period (computed)	138,355	$862,720
II. Construction		
1. Time and expense of permanent organization (inventory price)		428,905
2. Cost of reproducing real estate (as per appraisal)		3,449,220
3. Cost of construction and equipment based partly on labor and material and partly on subcontracts.		
	Inventory Price.	
a. Building and improvements	$2,787,343	
b. Piping	335,825	
c. Power-plant equipment	3,365,535	
d. Substation equipment	661,757	
e. Switchboards	332,596	
f. Series arc apparatus	61,234	
g. Storage batteries	259,061	
h. Distribution system, underground	2,869,323	
i. Distribution system, overhead	1,471,624	
j. Transformers	182,534	
k. Meters	361,711	
l. Arc lamps	116,521	
m. Nernst lamps	45,163	
n. Motors	19,288	
o. Isolated plants	30,969	
p. Steam-heat lines	12,650	
q. Teams, wagons and automobiles	45,589	
r. Tools	32,724	
s. Furniture and fixtures	44,938	
t. Incidentals and contingencies (5 per cent of items 3h-3s)	253,308	$13,289,693
4. General contractor, overhead charges and profit (10 per cent of item 3)		1,328,969
5. Cost of engineering (5 per cent of items 3-4)		730,933
6. Interest on construction expenditures (computed)		2,490,749
7. Taxes and insurance on construction (computed)		276 365
8. Working capital		
a. Stores and supplies (actual per records)	$391,246	
b. Cash or equivalent (actual as per auditor)	484,578	
c. Incidentals (10 per cent of item 8a)	39,124	914,948
9. Edison licensee agreement (estimated)		200,000
10. Kinloch pole right agreement (estimated)		100,000
Total cost of reproduction as of Oct. 31, 1909 (subject to exceptions noted below)		$24,072,502

Note—The above estimate does not include any:
(a) "Going concern" value of the character recognized by authoritative decisions.
(b) Profits of promotion.
(c) Discounts and commissions on securities.
(d) Special value of existing franchises.
(e) Assets not included in estimated cost of reproduction.
(f) Net investment in superseded property.

In reaching these figures the accountants built up a figure of the cost of the property on the continuous-property theory. The results of the application of this theory are given in several tables which show the investment in the property, the income actually earned thereon, and the deficiency in return added to the investment, in accordance with the practice adopted by the Railroad Commission of Wisconsin in the Antigo Water Company case. The return was calculated in the various tables at the different rates of 6 per cent, 7 per cent, 8 per cent, 9 per cent and 10 per cent. These calculations are based upon assumptions of cost as selected from the records of predecessor companies and the present company, and upon the theory that a public-service corporation is entitled to earn and distribute in interest and dividends from its beginning a certain percentage upon the investment above all charges, including a proper allowance for depreciation.

The conclusion of the commission is that the more study is given to this theory the less does it appear to be a safe or reasonable guide to a value upon which the company should be allowed to earn returns. The commission adds that the report was founded in part upon items taken from the books of extinct companies and that some of the items treated on the same basis as cash transactions are the result of stock and bond operations, in which the assigned value of the securities may or may not represent real values.

In rejecting these figures the commission states that it intends no reflection upon the sincerity of the accountants for the company or upon the company. It says that a great part of the items are undoubtedly correct, but the necessarily problematical basis of some of the items renders them unavailable for the present purpose. The commission believes that the period during which a deficit should be allowed to be capitalized as the cost of establishing a business should be limited to a reasonable time at the beginning of a new business, that it must also be assumed that there is a reasonable demand for a utility when built, and that the property was well managed during the period of deficit.

The theory of the cost of reproduction new as presented by the company means, the commission states, that the value upon which it should be permitted to earn a fair return should be the estimated cost of reproduction at the present time of the property as it now exists. This theory is rejected by the commission on the ground that it disregards the actual conditions under which the property was produced, and sets up a purely hypothetical case. A summary of the estimated cost of reproduction new as existing of the property of the company on Oct. 31, 1909., based upon an appraisal made by Messrs. Ford, Bacon & Davis and presented by the company, shows a total value of $24,072,502, distributed as shown in Table I.

Some of the items correspond closely to the figures obtained by the commission, while others, the report says, appear unreasonable in amount and vary greatly from the corresponding figures of the commission. In discussing the methods followed in its appraisal of the physical property the commission states that its representatives, whenever possible, inspected and listed personally in detail each item of property, and the record of the buildings of the company was made from actual measurements and from plans and data. The equipment of each generating plant and substation was inspected and listed.

In making the inventory of the overhead system the commission had working maps prepared from the records of the company, showing the location of each individual pole and giving the size and length of each run of wire. These maps were checked by inspectors of the commission.

In making an inventory of the underground system of conduits and cables the commission separated the proportional ownerships as between the Union Electric Light & Power Company and the Phœnix Light, Heat & Power Company, and also assigned the costs of the city ducts in proper proportion to each of the present joint owners. In addition to the joint-conduit systems there are conduits owned wholly by the Union Electric Light & Power Company, and another system in which that company has an interest. Each system was inventoried separately. The cables were mapped, inventoried and inspected.

After the completion of the inventory of the entire physical property the engineers of the commission assigned to each item, as nearly as possible, its original cost in place and ready for service. When possible these costs were taken from actual signed contracts in the files of the company. Where such contracts did not exist cost estimates were made from data for similar work calculated by the engineering staff.

After the completion of the tentative valuation of the physical property an opportunity was given the company to go over the work in detail. The report says that the estimate of construction costs made by the company does not show any greater difference in results from that made by the commission than could be expected from two appraisals, both honestly made, but from slightly different points of view, and that the entire difference in estimated cost of the present existing valuation of the property is not great enough to affect materially any rates which might be based upon either estimate. The most difficult point of agreement is in certain items of labor.

The plant of the company includes three large generating stations with full equipment, seven substations and equipment, and a number of other buildings. In the overhead system there are approximately 13,000 poles with 24,000 cross-arms, besides 32,000 cross-arms owned by the company but located on other poles. The wire in the overhead equipment amounts to approximately 3800 miles. In the underground distribution equipment there are about 350 miles of cable of different sizes and approximately 700 miles of ducts of different types. Added to this are innumerable smaller items.

In determining the earning value of the property the commission states that its aim has been to arrive at a fair and reasonable present value of the property in the service of the public at the time of its investigation.

TABLE II.—PRESENT PROPERTY—ESTIMATED COST AND ESTIMATED EARNING VALUE, AS COMPUTED BY THE COMMISSION.

	Estimated Earning Value.	Estimated Cost.
I. Organization—		
1. Expense of organization.	$125,500	$125,500
2 Interest on organization expense	32,944	32,944
II. Construction—		
1. Real estate	800,000	414,240
2. Cost of construction.	12,586,741	12,586,741
3. Cost of engineering	629,337	629,337
4. Interest on construction expenditure	725,780	725,780
5. Taxes and insurance during construction	130,203	130,203
III. Working capital	865,520	865,520
IV. Kinloch pole contract	80,000	80,000
V. Allowance for cost of establishing business	1,000,000	1,000,000
	$16,976,025	$16,590,265
Deduct depreciation for present condition	841,632	
	$16,134,393	$16,590,265

Table II, published herewith, shows the estimated cost of the present property of the company as determined by the commission, before deduction is made for depreciation for present condition and before addition is made for present value of real estate, and also the estimated earning value.

While the commission holds that the company is entitled to have recognized as part of its assets some expenses of organization, it says that expenses preliminary to the organization of a corporation, in prospecting the field and interesting prospective stockholders, and promoters' profits are not under the laws of the State proper items for consideration.

In the determination of the value of the land it seemed necessary to the commission, in order to be consistent, to follow the same rule as in the case of the other property of the company and take the present value. All the land belonging to the company was held in fee except three pieces. In these cases the company holds ninety-nine-year leases, in which the expired portions are so short as not to affect the value.

There was a difference of 5.51 per cent in the respective estimates of the company and the commission of construction cost. The difference between the commission and company estimates of construction cost of the overhead system was 9.33 per cent, and of the underground system 5.005 per cent. For a general contractor's profit the company claimed 10 per cent. The commission took the position that, as a matter of fact, there was no general contractor's profit, and that in the creation of such plants as the one under consideration, as they are generally created, there is seldom such an expenditure. The commission and the company were agreed in adopting 5 per cent as the proper percentage for engineering costs.

There was a wide difference between the figures of the commission and of the company on the subject of interest on construction expenditures. The commission holds that the item of interest and insurance during construction is entirely legitimate as an element of value and that the only question is as to the reasonableness of the amount claimed.

The commission could see no substantial pecuniary value in the contract with the General Electric Company. It held that if the Union company had a right to receive discounts from the General Electric Company it was not by reason of the Edison licensee contract. which seemed to the commission to do no more than to protect the licensee against discrimination in favor of other licensees of the General Electric Company.

Regarding the cost of establishing the business, the commission considers that that amount of the cost of establishing the business of the predecessor companies by which the present company and the present consumers are being benefited is a justly allowable element in the present earning value of the property. The commission held that the element of going value in valuation for rate-making purposes was identical with the cost of establishing the business.

The accountants for the company insisted that discount on bonds was properly chargeable to cost of construction, and the company asked that such discount, irrespective of the purpose for which the proceeds were used, be recognized by the commission as part of its capital invested. The commission does not see that any principle can be invoked which will justify the distinction suggested by the books of the company, nor does it believe that discount on bonds in any case should be treated as part of the capital invested. In its opinion the discount should be treated as interest, to be paid out of the fair rate of return allowed upon the earning value of the property. The commission has not taken into consideration any property on which the company is entitled to earn a return on franchise rights for the reason that, in its opinion, the company is not entitled to a return on such franchises. The commission does not consider that abandoned property enters into the calculation of a fair value of the property at present in the service of the public, except so far as it affects the cost of establishing the business.

Indiana Railroad Commission.

That when the new laws go into effect the Indiana Railroad Commission will have greater powers than any similar commission in the country is the belief of the members of the commission. With the exception of a bill to punish trespassers walking on railroad tracks all of the measures championed by the commission become law. A new era in the work of the commission is predicted since the limitations that hampered it in its work heretofore have been removed. Within the field of its jurisdiction the Indiana commission will have power almost equal to that conferred upon the Interstate Commerce Commission.

The commission regards the new act giving it power to compel interurban companies to install one of the three recognized systems of block signals—the manual, the manual controlled, the automatic—or any other system now or hereafter invented, as the most important. This was an amendment to a law passed in 1907 giving the commission power to compel steam roads to install "proper blocking" systems. Because the roads and the commission could not agree on what constituted "proper blocking" nothing has been done, although suits are pending to that end.

The new Senator Netterville wire law regulating the manner of suspending telephone, telegraph and electric light wires over railroad tracks is held to be important by the commission. The law provides that all such wires crossing one another and suspended over tracks must be of either aluminum or copper between two posts on either side of the crossing point; that the span must not be more than 100 ft. long and suspended at least 21 ft. above the tracks. The act will not affect wires already in use if found in safe condition.

Massachusetts Legislative News.

Hearings have recently been continued on the project of the Boston & Eastern Electric Railroad Company, which desires to build a high-speed interurban line between Boston, Lynn and Salem. Evidence brought out at the latest hearing tended to show that the building of the Boston & Worcester Street Railway Company's line parallel to the Boston & Albany Railroad had resulted in mutual benefits and a larger tide of travel in the territory covered. Chief Engineer Bickford, of the Boston & Eastern, stated that the local street-railway service north of Boston cannot handle the traffic from the standpoint of through service as quickly as the proposed road, and said that in the past five years there had been no reduction of moment in the running time of the local trolley systems. Opposing counsel contended that the financial backing of the proposed line has never been made public, and urged that the traffic possibilities in the territory are insufficient to justify the construction of the road. It was argued that serious injury would be done to the existing systems of steam and street-railway lines if the road should be built. The promoters of the road are trying to secure legislation compelling the Railroad Commission to grant them a certificate of exigency.

At a hearing given last week by the committees on railroads and street railways of the Massachusetts Legislature Mr. T. E. Byrnes, vice-president of the New York, New Haven & Hartford Railroad Company, outlined the plans for electrification which are to be put into effect in case the State permits the New Haven interests to purchase the Boston, Revere Beach & Lynn Railroad. Mr. Byrnes said that if the merger is permitted a tunnel will be built under Boston Harbor which will permit the operation of long-distance through trains in the Boston district by electricity. The Revere Beach road would be electrified. Rapid transit will be provided in electric trains between the heart of Boston and the North Shore district, including the cities of Lynn and Salem. It is also proposed to make a connection between the electrified Revere Beach & Lynn system and the Boston Elevated Railway Company's system through the existing East Boston tunnel.

Wisconsin Commission News.

Representatives of the Argyle Telephone Company appeared before the Railroad Commission on March 6 in an application for an increase in rural rates from $3 per subscriber per year to $6 per subscriber per year. There was no opposition.

In the case of Sarah M. Cawker and others against the commission the Circuit Court has decided that the plaintiff's heat and lighting plant in Milwaukee is not a public utility and therefore not subject to commission control and regulation. This case was carried to the court in answer to the threat that the commission would cause the Cawker Heating Company to be prosecuted if it failed to comply with the requirements of the Public Utilities law. The plaintiffs own and operate a heating plant in connection with the Cawker Building, which furnishes heat, light and power to the building. The plant was installed and maintained by the plaintiffs to meet their own demands, and finding that it created more energy than was necessary for their needs they entered into an agreement with three tenants to furnish them with power. The question of whether or not this constituted a public utility, subject to commission control, was decided in the negative by the court.

This decision has shown the necessity of a more definite law as to what constitutes a public utility or an act which will give the commission authority to determine for itself the facts in any particular case. Although in the present case, considered as an isolated one, question might arise as to the plant being in reality a public utility, when it is considered that in the City of Milwaukee, for example, there is a considerable number of just such cases, and that, furthermore, the individual tenants may be large consumers, as was true in the Cawker case, and that every case takes the form of competition with an existing utility which is under commission control and must obey the Public Utilities law, it is evident that the question takes on an entirely different aspect.

Where the line must be drawn seems to hinge upon the motive which prompted any individual to sell his surplus energy. A case might be mentioned of where an individual a couple of years ago supplied his neighbor with energy. This was not considered a public utility. Soon, however, he supplied two neighbors and now he is supplying two entire blocks When did the plant become a public utility?

The commission has granted the petition of the Bloomer Electric Light Plant for authority to put into effect a new schedule of rates. This case has been before the commission on several previous occasions. At the last appearance the commission insisted that the petitioner proceed to take the necessary steps to make the service reasonably adequate before any serious consideration could be given the question of rates. The defects in the system were due in a large measure to the plaintiff's poor power facilities. Acting upon the commission's advice the Bloomer plant has been incorporated, an indeterminate permit secured from the commission and a transmission line constructed to the plant of the Chippewa Falls Valley Railway, Light & Power Company, at Chippewa Falls, from which company power is now being received at Bloomer and supplied to the consumers by the petitioner. The inspectors reported the service to be entirely satisfactory. The rates granted are as follows:

Lighting Rate.—Twelve and one-half cents per kw-hour for the first fifty hours' use of the active connected load; 8 cents per kw-hour for all in excess. In Class A, consisting of residences, the active load is to be considered as 60 per cent of the total connected load when the total connected load is equal to or less than 500 watts nominal rated capacity; when the installation exceeds this value 33⅓ per cent of such part of the total connected load over and above 500 watts is to be considered active. In Class B, consisting of offices, business houses, etc., 80 per cent of the connected load is to be considered active In Class C, consisting of certain designated consumers, 55 per cent is to be active.

Power Rate.—Six cents per kw-hour for the first fifty hours' use of the maximum demand and 3 cents per kw-hour for excess. The maximum demand is to be taken as the rated capacity of the motors installed, unless the consumer desires to install an approved maximum-demand indicator at his own expense.

Municipal Lighting.—When 32-cp tungstens are to be used the rate is to be $18 per lamp per year for a service of approximately 4000 hours. For 6.6-amp inclosed arcs the rate is to be $85 per arc per year on the basis of approximately 4000 hours' burning.

The minimum bill is to be 50 cents. The new schedule amounts to a decrease in rates for commercial consumers as a whole and an increase for municipal lighting.

New York Commission News.

The Public Service Commission, Second District, has received a complaint from the village officials of the village of Lyons directed against the Wayne Telephone Company on account of the raise in rates made in that village on March 1. Up to that time the rate had been $15 per year for residence telephones and $18 for office or business places. The rate for office and business houses has been raised to $24 for four-party line, $27 for two-party line and $30 for single-party line The complaint has been served upon the company and an answer required on April 15.

An application has been filed by the Long Island Lighting Company, a new corporation, asking for approval of the purchase of the entire property and franchises of the Amityville Electric Light Company, the Sayville Electric Company, the Northport Electric Light Company and the Islip Electric Light Company, and their merger into the Long Island Lighting Company, and for leave for the new corporation to execute a mortgage covering the properties of the constituent companies and to issue stocks and bonds thereunder. The companies in question operate in the town of Oyster Bay, village of Amityville, town of Babylon, village of Sayville, town of Islip, village of Northport and town of Huntington. The aggregate price to be paid for the property is $308,672. It is proposed to issue capital stock amounting to $300,000 at par and first-mortgage bonds to the amount of $370,000 at a price not less than 85. The proceeds of the sale of the securities are to be used for the purchase of the property and new construction, additions and betterments to the amount of practically $300,000 The proposition is to build a high-tension transmission line from Northport to Islip and there branch off to the west, connecting with Bay Shore, Babylon and Amityville; also to the east, connecting with Sayville, and later on to construct a branch line from Northport through Commack to Smithtown and St. James. It is also proposed to construct a line connecting with Brentwood, Central Islip, Ronhonkoma, Bohemia and Commack, none of which towns are now supplied with electricity; also to construct street-lighting systems in Islip, Central Islip, East Islip and Brentwood. Important improvements are proposed for the Amityville, Islip, Sayville and Northport stations

New Jersey Commission News.

The Board of Public Utility Commissioners for the State of New Jersey has received a complaint from E. C. Hinck, Mayor of Montclair, N. J., alleging that the charge made by the New York Telephone Company for four-party-line service is $2.50 per month while in White Plains the charge for similar service is $2 per month. It is claimed that there are approximately 4000 subscribers in Montclair as compared with 2200 in White Plains.

Following a hearing upon the complaint of the City of Trenton the board has issued an order to the Trenton Street Railway Company requiring a large amount of reconstruction and repairs to be done.

The board has given conditional approval to leases of the Trenton Street Railway Company, Trenton, Hamilton & Ewing Traction Company, Mercer County Traction Company and Trenton, Pennington & Hopewell Street Railway Company to the Trenton & Mercer County Traction Corporation.

The board has granted the following certificates of approval: Shore Electric Company, issuance, sale and delivery of $341,500 bonds; Bogota Water & Light Company, ordinance, township of Teaneck, granting a franchise; Delaware & Atlantic Telegraph & Telephone Company, ordinance, borough of Woodbine, granting a franchise.

Maryland Commission News.

The Maryland Public Service Commission has granted permission to the Consolidated Gas, Electric Light & Power Company, of Baltimore, to issue $1,500,000 new stock, $735,000 to be used in taking up prior-lien preferred stock and $765,000 to be used for acquiring additional property, construction, completion, extension and improvement of its plant, subject to an order requiring the company to report to the commission each step in the use of the funds. Mr S Gross Horwitz, appearing as an individual, entered a protest on the ground that the grant would have the effect on the public mind of a sanction by the commission of the previous issues of the company and also embarrass the commission when the city's complaint is filed, as the company might plead such implied sanction, while the stock, being mingled with the previous issues would be put at a disadvantage through representing an actual cash investment. The commission did not take this view, as the funds were for legitimate purposes and the sanction of the commission in authorizing this issue carried with it no sanction beyond its approval of the purposes for which this issue was asked. The investor would purchase the stock, said the commission, with the knowledge of the impending complaint of the city and of the consequences that flowed from it. The order required that the corporation shall report to the commission upon the sale for cash of the common stock authorized and approved, or any part thereof, the fact of such sales, the terms and conditions thereof and the amount realized therefrom; and that at the termination of each period of six months from the date of the order the disposition and use made of the proceeds of the stock and the facts and circumstances as to the property acquired and the construction, completion, extension and improvement of its facilities be reported.

The Consolidated Gas, Electric Light & Power Company has filed a reply with the commission to a complaint charging refusal to extend gas mains except on the payment of $200 toward the expense of construction. The company's reply states that the house in question is 650 ft. beyond its terminus and that but two uncompleted houses lie between. A proposition was made by the company whereby it would bear the expense for 100 ft. for each cottage, provided the complainant would deposit $200 with the company to be refunded to him upon the erection of several other cottages in that block.

City Solicitor Poe has conferred with Chairman James M. Ambler, of the Public Service Commission, in order to arrange for the commission to make a valuation of the Consolidated Company's physical investment in the electric and gas business. This action by the city solicitor was made necessary for the reason that Prof. Charles E. Munroe, the city's gas expert, in preparing his report as to the proper gas rates for Baltimore, was unable for lack of sufficient authority to get this information from the books of the company. While the commission has taken no steps on the request of Mr. Poe, it is understood that it will agree to gather the information desired.

Canadian Hydroelectric Commission News.

The negotiations which have been carried on since last fall between the representatives of the City of Toronto and the Toronto Electric Light Company relative to either the purchase by the city of the company's plant or an arrangement for harmonious working between the company's plant and the city's new hydroelectric system, consequent upon the introduction of Niagara power to the city, have culminated in an offer being made by the city corporation to purchase the company's property and effects at the rate of $125 per share of the company's stock, of the par value of $4,000,000, as well as the assumption of the bonded debt of $1,000,000, making a total purchase price of $6,000,000.

In an official statement by Mayor Geary, on March 10, it was stated that the proposition was subject to the consent of the Hydroelectric Commission and to such a rearrangement of the city's obligation to the commission and other municipalities as will enable the city to take a maximum of 15,000 hp and a minimum of 7500 hp from the Electrical Development Company; and a rearrangement of that company's contract with the Toronto Electric Light Company so as to limit the liability of the latter and of its successor to the city to take only a minimum of 7500 hp at the contract rate up to the expiration of the company's franchise in 1919. Comptroller Ward dissented and would not consent to negotiate further with the company.

The Toronto Electric Light Company has issued a statement in which it states that, in order to meet the wishes of the city, the company will agree to forego the rest of its franchise period, which expires in 1919, and to sell out to the city at a price to be decided by arbitration. It pointed out that the H. M. Byllesby Company, of Chicago, and W. F. Wells, of New York, had placed the value of the physical assets of the company at $7,500,000, and the value of the stock at $200 per share. Mr. Alexander Dow, of Detroit, then made an investigation for the city and found that, admitting the value of the physical assets to be $6,000,000, the value of the stock to the company was $150 per share. Finally, the experts for the Hydroelectric Commission, and Mr. R. A. Ross, of Montreal, made an investigation and found that the replacement value of the company's property was $6,500,000, the value of its stock being placed at $125 per share. The company states that in the case of a property like that in question it is impossible that there should be a divergence in real values to such an extent as between $200 and $125 per share. The company offers to arbitrate either by the usual arbitration contemplated by the existing agreement between the city and the company, or by a speedy arbitration by three independent parties, one to be selected by the city, one by the company and one by the government, or by reference to three of the most noted American engineering firms, namely, Westinghouse, Church, Kerr & Company, of New York; Stone & Webster, of Boston, and Sargeant & Lundy, of Chicago, or any other engineering firms of high standing to be named jointly by the president of the American Institute of Electrical Engineers and the president of the University of Toronto.

CURRENT NEWS AND NOTES.

Public-Service Commission for Kansas.—It is reported from Topeka, Kan., that the State Senate has adopted the conference report, making it practically certain that the bill creating a board to have charge of all public utilities in the State will become a law.

Meetings of Electrical Inspectors.—A movement is on foot in the Rocky Mountain territory to have regular meetings of the electrical inspectors of the various cities for the purpose of securing to the greatest possible extent uniformity in the interpretation of the National Electric Code and for the suggestion of additional rules for the promotion of construction methods.

Chicago Party to Electrochemical Convention.—It has been arranged that Chicago visitors to the semi-annual meeting of the American Electrochemical Society in New York on April 6-8 may leave on special cars on the Michigan Central Railroad at 5 p. m. on April 4, stopping over the next day at Niagara Falls and arriving in New York at 7:50 a. m. on April 6. Mr. Arba B. Marvin, secretary of the Chicago Section, 950 Commercial National Bank Building, is making the arrangements.

Engineering Society of Wisconsin.—The third annual meeting of the Engineering Society of Wisconsin was held at Madison, Wis., on March 8, 9 and 10. Among a number of papers was one by Mr. O. M. Rau, of Milwaukee, on "Use and Maintenance of Joint-Pole Lines by Public-Service Companies." Mr. J. N. Cadby discussed the methods of the Wisconsin Railroad Commission, and Prof. J. W. Shuster, of the University of Wisconsin, presented a very brief report on electrical engineering. Mr. F. G. Simmons, superintendent of way of the Milwaukee Electric Railway & Light Company, was elected president of the society.

The Power-Factor.—A regular meeting of the Boston Edison Company Section of the National Electric Light Association was held at the Edison Building, Boston, March 7, with Mr. R. E. Curtis in the chair. Dr. Louis Bell gave an interesting talk on "Power-Factors," describing early induction-motor designs, giving reminiscences of subsequent motor development with the reasons for the abandonment of former types of machinery, and closing with a graphic treatment of the effect of power-factor on alternating-current systems, including means of correcting a poor power-factor, and also touching upon the tendency of companies in some sections of the country to adjust their rates with regard to the power-factor of the consumer. Following Dr. Bell's address a short discussion was participated in by Messrs. R. S. Hale, L. L. Elden, J. H. Vahey, F. C. Hard and T. E. Penard.

Liberia-Brazil Cable.—The laying of a cable between Monrovia, Liberia, and Pernambuco, Brazil, began on March 6. This cable represents the final stretch in the line which is to connect Germany directly with South America.

Corporation Tax Enforcement.—The Supreme Court has handed down a unanimous decision affirming the constitutionality of the corporation tax law. Public service corporations are held to be within the scope of the statute in spite of their quasi-public nature.

Test of Electric Meters.—The total number of electric meters tested upon complaint by the New York Public Service Commission during February was seventy-seven. Of these 2.6 per cent were more than 4 per cent fast, 3.9 per cent more than 4 per cent slow, and 93.5 per cent within the law requirements of between 4 per cent fast and 4 per cent slow.

Safety in Railroad Travel.—According to reports issued by the Pennsylvania Railroad Company giving accident statistics for the years 1908, 1909 and 1910, not one passenger of the 136,000,000 carried in 1910 was killed in a train accident. During the three years mentioned 371,858,277 passengers were carried and only one was killed as a result of a train wreck.

Destruction of Generating Station by Snowslide.—According to reports from Carson, Nev., the generating station of the Hydroelectric Company at Jordan, Mono County, Cal., has been destroyed by a snowslide which wrecked the building, killed eight men and injured several others. The plant, which was not fully completed, was to furnish electrical energy to Rawhide, Aurora and other central Nevada mining camps.

A. I. E. E. Nominations.—The following ticket has been slated by the board of directors of the American Institute of Electrical Engineers as a result of a canvass of the membership, the figure after each name indicating the number of votes received by each nominee: For president, Mr. Gano Dunn, 993; Mr. Ralph D. Mershon, 590; for vice-presidents, Mr. D. B. Rushmore, 536; Mr. C. W. Stone, 499; Mr. W. G. Carlton, 399; for managers, Mr. F. S. Hunting, 340; Mr. Farley Osgood, 245; Mr. N. W. Storer, 155; Mr. W. S. Lee, 109; for treasurer, Mr. G. A. Hamilton, 1294; for secretary, Mr. Ralph W. Pope, 1309. The officers to be elected are one president, three vice-presidents, four managers, a treasurer and a secretary.

A. S. M. E. Meeting in Pittsburgh.—Extensive preparations are being made by the local committee for the spring meeting of the American Society of Mechanical Engineers to be held in Pittsburgh May 30 to June 2. An attractive booklet will be issued containing full information as to the program, excursions and the industrial plants to be visited. Messrs. E. M. Herr, vice-president of the Westinghouse Electric & Manufacturing Company, and E. K. Hiles, secretary of the Society of Engineers of Western Pennsylvania, are chairman and secretary respectively of the local committee in charge of the arrangements. The society has in the neighborhood of 200 members in the Pittsburgh district and a large attendance is anticipated at the meeting.

Wireless Interference with Lighting.—The wireless telegraph outfit of two Denver boys has been putting the electric lighting fixtures of their neighborhood up to queer capers for several weeks. About 3 o'clock in the afternoon, or just as the boys got their wireless apparatus working, the fixtures in nearby houses would sputter and sizzle and pop, and sometimes in the evening there would come a loud bang and out would go the lights. This mystified inhabitants of that part of the city, who carried complaints to the Denver Gas & Electric Company, the result of which was an investigation and the discovery of the wireless apparatus. The Gromm machine derived its power from one of the electric company's feed wires and the "kick-back" current from the apparatus is supposed to have caused the trouble in other folks' houses. One of the wireless operators, Mr. William S. Gromm, won first prize in the last Denver electrical show last year for a wireless outfit.

Lectures on Electricity.—The Department of Education of the City of New York has included among its public lectures a number on electricity which will be delivered during March and April. Mr. Charles L. Harrington will deliver at the public school at 320 East Twentieth Street nine lectures on "Magnetism and Electricity" on consecutive Fridays, beginning March 3. Mr. W. Wallace Kerr will deliver the same number of lectures on "Principles and Practices in Electrical Engineering" on nine consecutive Thursdays, beginning March 2. There will be a series of lectures on electricity also in Queens County by Mr. J. Newton Gray, on Fridays, at the New Town High School; by Mr. W. Wallace Kerr at Public School No. 58 on Wednesdays and by Mr. F. W. Huntington at Public School No. 8 on Fridays. Mr. Huntington will also deliver lectures at Public School No. 14, Stapleton, S. I., on Fridays. In each case the lectures begin promptly at 8:15 p. m. The lectures are intended for the benefit of the general public, school children not being admitted.

Meeting of New York Companies Section, N. E. L. A.—The fourth regular monthly meeting of the New York Companies Section of the N. E. L. A., embracing employees of the New York Edison Company, United Electric Light & Power Company, Westchester Lighting Company, Yonkers Electric Light & Power Company, Bronx Gas & Electric Company, Peekskill Lighting & Railroad Company, Richmond Light & Railroad Company, Flatbush Gas Company, New York & Queens Electric Light & Power Company, Northern Westchester Lighting Company and Queens Borough Gas & Electric Company, will be held in the Edison Auditorium, 44 West Twenty-seventh Street, New York, on March 20. Mr. Walter R. Addicks will deliver an illustrated lecture similar to one recently delivered at Johns Hopkins University entitled "The Story of Gas from the Coal in the Mines to the Finished Product," including a description of various systems of distribution. At the conclusion of the lecture there will be music, entertainment and refreshments.

Canadian N. E. L. A. Commercial Section.—Mr. Eugene Creed, chairman of the Commercial Section of the Canadian Electrical Association (in affiliation with the N. E. L. A.), has appointed the following as chairmen of the several commercial committees: Mr. W. F. Dean, Canadian General Electric Company, Toronto, committee on heating, refrigeration and kindred appliance sales; Mr. N. A. Braden, Westinghouse Company, Hamilton, Ont., committee on the functions of a sales department; Mr. L. W. Morden, Canadian Westinghouse Company, Toronto, committee on electrical vehicles; Mr. R. G. Black, Toronto Electric Light Company, committee on improved wiring and improved standards; Mr. A. E. Fleming, Nernst Lamp Company, Toronto, committee on residence business; Mr. A. M. Fisher, *Electrical News*, Toronto, committee on advertising; Mr. S. G. Redway, Toronto Electric Light Company, Toronto, committee on sign lighting; Mr. F. A. Chisholm, St. Johns Electric Lighting Company, St. Johns, Que., committee on electricity in rural districts; Mr. H. G. Nichols, Factory Products, Limited, Toronto, committee on industrial lighting; Mr. R. F. Pack, Toronto Electric Light Company, committee on membership; Mr. W. L. Bird, Kaministiquia Power Company, Fort Williams, Ont., committee on power; Mr. Thomas F. Kelley, Hamilton Electric Light & Power Company, committee on street lighting; Mr. Edward B. Pike, Tungstolier Company, Toronto, committee on competitive illuminants

Lighting of County Buildings in Los Angeles.—It is suggested that Los Angeles County install an electric plant to supply energy, principally for lighting, to the new Hall of Records, Hall of Justice, court house and jail. By utilizing steam from the 600-hp boiler plant in the Hall of Records it is estimated that the plant could be erected at a cost of about $18,000. The Board of Supervisors has the matter under consideration.

Electricity Kills a Wire Thief.—An unidentified man was found dead on a bank of the North Channel of the Chicago Drainage Canal on March 8. He had been killed apparently by electric shock. The body lay near a pole supporting a transmission line from which about 300 ft. of copper wire had been stolen. The police believe that the man was assisting others to cut the wire and that his accomplices abandoned him when he received the fatal shock.

Municipal Plant for San Bernardino Proposed.—The City Council of San Bernardino, Cal., is considering the advisability of purchasing an electric lighting plant for municipal service. As a result of the offer of the Lytle Creek Power Company to sell its generating plant and distributing system to the city the bids for street lighting recently asked will be held in abeyance until a definite decision is reached in relation to the possibility of the city's owning its own plant.

Association of Railway Electrical Engineers.—The semi-annual convention of the Association of Railway Electrical Engineers will be held June 16 and 17 in Washington Terminal Station, Washington, D. C. The annual convention will be held in Chicago from Nov. 6 to 10. The entire nineteenth floor of the La Salle Hotel, Chicago, has been reserved for the meeting and exhibits by members of the Railway Electrical Supply Manufacturers' Association. Mr. Joseph A. Andreucetti, 323 Kinzie Street, Chicago, is secretary of the association.

Fire in Racine Central Station.—The Racine (Wis.) station of the Milwaukee Electric Railway & Lighting Company was damaged by fire on the evening of March 10. The origin of the fire is not known. The roof of the building was burned off, but the remainder of the damage was mainly to the switchboard. The loss is estimated at $15,000, newspaper accounts of the fire being exaggerated. From this station energy is distributed for commercial electric service in Racine, as well as for the operation of the local electric railway, and these utilities were suspended on the night of the fire. Temporary connections were made, however, which enabled the resumption of service within twenty-four hours.

Colorado 18,000-hp Hydroelectric Plant.—The large plant of the Colorado Electric Power Company at Nederland, in Boulder County, Col., will be placed in commission April 1, according to present plans of the company. This plant is capable of generating 18,000 hp, and is one of the largest in the West. The only plant of the company now in operation is that at Shoshone, on the Grand River, just above Glenwood Springs, which generates 20,000 hp. Plans for making numerous extensions of the company's transmission lines throughout western and central Colorado have been approved by President G. H. Walbridge. These will be begun this summer and will cost eventually between $300,000 and $400,000, or approximately $1,000 a mile.

Proposed Public-Service Commission in Illinois.—The Rawleigh bill in the lower house of the Illinois Legislature giving the State Railroad and Warehouse Commission jurisdiction over public utilities in cities having less than 200,000 population is in charge of the municipal corporations committee, of which Representative L. I. Butts is chairman. The first hearing of the committee was held on March 7. Mr. I. C. Vopley, of Aurora, president of the Western United Gas & Electric Company, which is said to have franchises in thirty-nine towns, and Mr. Frank J. Baker, of Chicago, vice-president of the North Shore Electric Company, which serves a territory including seventy-one cities and villages, appeared among others to favor the bill. A representative of the mayors' organization of Illinois opposed the bill on the ground that it would take even the control of municipal waterworks from the city councils and vest it in the commission. Other hearings on this bill will be held.

Telharmonium in Operation.—Arrangements are now being completed for the removal to New York in the near future of the Cahill telharmonic plant for the production and distribution of music electrically which has been erected at Holyoke, Mass. A description of this plant was given in our issue for April 28, 1910, while descriptions of the former New York plant, which the present plant supersedes, appeared in our issues for March 10, 1906, and Jan. 5, 1907. On March 3, 1911, the plant transmitted music from Holyoke to Springfield, Mass., to the very evident delight of an audience of about 650 persons gathered at a banquet of the Board of Trade. On March 3 music was again transmitted to Springfield for an audience at the Winthrop Club. Transmitted music was a prominent feature of a banquet given by the Board of Trade of Holyoke to Governor Foss, on March 6, when the telharmonium in a different part of the city was used with striking success to accompany the singers who entertained the guests.

University of Illinois Contemplates New Engineering Building.—The University of Illinois, of Urbana, Ill., is asking the State Legislature for an appropriation of $5,500,000 to provide for the needs of the university in all departments for two years. Of that sum $600,000 is asked specifically for the engineering department, although some of the expenses of this department will be paid from the general university fund. Of the $600,000 asked for the engineering department $300,000 is for operating expenses and maintenance for the two years, while $300,000 is asked to provide money for a new engineering building and its equipment. Much valuable research work is carried on at the engineering experiment station of the university, and the authorities of the institution feel that the State should deal liberally with its university if its greatest usefulness to the people of the State is to be attained. If the tax rate were increased to add $3,000,000 to the revenue of the State, the increase in the tax rate in Cook County, including Chicago, would be about 1 per cent of the present rate. The appropriation made for the university two years ago was $2,250,000, although $3,500,000 was asked. The much increased amount now sought is due largely to the needs of the agricultural department.

Commercial Relations with Japan.—At the mid-week lunch of the Colorado Electric Club on March 9 Dr. A. L. Bennett, Japanese consul, gave a talk on possibilities for the advancement of the commercial relations between the United States and Japan. By the presentation of figures and quoted statements from Japanese merchants Dr. Bennett showed our little chance of gaining trade in the Orient so long as we depend on English catalogs and slow extension of credit in the face of the active campaign through traveling salesmen and rapid investigation of credit by foreign manufacturers. In the face of poor methods, he stated that we now hold second place in total exports to Japan and first in electrical goods, but that we cannot retain this position with present methods, though we might easily improve it by adoption of better commercial attitude since, other things being equal, our goods are the most sought after. This talk was followed by a short statement from Mr. N. Tatsukawa, who spoke of the recently issued report of the Japanese Commercial Commission on its trip among United States manufacturers, and the especially good impression given by the extensive development of electrical power and illumination in Denver particularly. One hundred and two were present at the lunch.

LEHIGH VALLEY TRANSIT COMPANY.

Steam Turbine Station at Allentown, Pa., Supplying Energy to Lighting and Railway Circuits in Allentown, Bethlehem, Nazareth, Slatington and Contiguous Country.

THE Lehigh Valley Transit Company operates in a country rich in historic interest and embracing not only cities with wide and varied manufactures, but also the heart of the cement and slate industry. The company is a consolidation of the Lehigh Valley Traction Company, Allentown & Slatington Street Railway Company and Coplay, Egypt & Ironton Street Railway Company, and owns outright and operates 126 miles of electric railway in addition to twenty miles under lease. The company also owns a majority of the capital stock of the Allentown Electric Light & Power Company, which operates under lease the Bethlehem Electric Light Company and the South Bethlehem Electric Light Company. The central-station business of Slatington and Emaus is managed by local companies of which the Lehigh Valley Transit Company owns all the stock. The central-station field has been developed by a carefully organized commercial and soliciting force, which brings the company into close touch with its present and prospective customers and provides careful supervision of the business, which has increased largely during the past year as a result of this organization. The generating station for the entire system is located on the Lehigh River at Allentown. It is equipped with modern steam-turbine generators having a maximum rating of 11,625 kw, and a 6000-kw unit (6700 kw maximum) is at present being added, which will bring the total maximum rating of the station to 18,325 kw by July of this year. Two additional boilers are also being installed to take care of the extra load. There are eight substations on the railway system, all modern, well equipped and advantageously located.

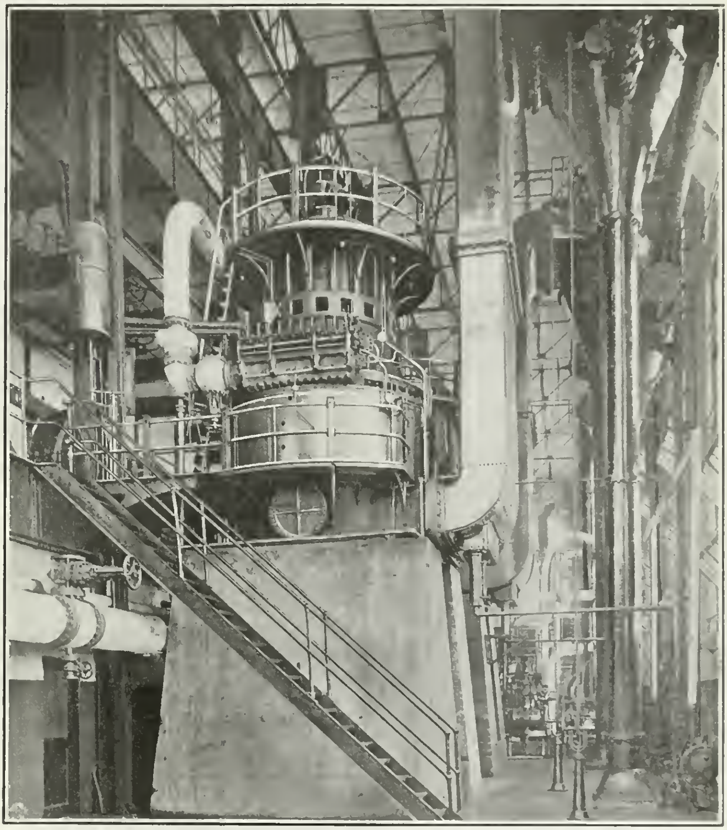


Fig. 1—General View of Turbine-Room, Lehigh Valley Transit Company.

As a result of the successive growths of the various companies the generating stations prior to the erection of the central plant were widely scattered and the equipment not at all uniform. Railway stations were operated at Allentown (2500 kw), Quakertown (350 kw), Souderton (350 kw), Ambler (350 kw), Broadheads (400 kw) and Slatington (600 kw). Lighting stations were located at Slatington (100 kw), Allentown (1000 kw) and Bethlehem (500 kw). In addition there was a 200-amp battery station at Rocky Ridge and a 300-amp station at Allentown. The existing incandescent lighting systems were operated at 133 cycles and the street-lighting circuits fed in the main open-arc lamps supplied with energy by 9.6-amp Brush machines in the Allentown and Bethlehem stations.

In the choice of distributing and operating systems and frequency for the generating plant certain considerations largely determined the choice for the respective services. On the service lighting system, for instance, most of the transformers installed were suitable for operation at 60 cycles, although then used at 133 cycles. To discard these would have entailed a loss, and furthermore would have resulted in great inconvenience when changing over from the old system to the new. The necessity of maintaining the service and of bettering it as rapidly as possible was more than ordinarily important The arc-lighting situation was somewhat complicated by reason of existing contracts which definitely specified the type and form of lamp. These were of such a nature as to make it desirable to retain the existing system for that service even at the expense of some complication in the station equipment.

On the railway system all of the existing lines were operating at 500 volts and the character of the service and the existing construction determined the retention of this system for the operation of the railways. Some of the local motor users in Allentown were equipped with 500-volt drives, which required the provision of a 500-volt metallic circuit, the intention being gradually to reduce this service to a point where it could be discontinued and the apparatus provided for that service be subsequently converted to the use of the railway system. The unfavorable location of the stations outside of Allentown as regarded both fuel and water supply (which in most cases had resulted in their operating non-condensing) determined the choice of a single centrally located station at Allentown, on the south bank of the Lehigh River, with railroad connection from the Lehigh Valley Railroad providing an ideal situation as regards both the coal and water supply

The three phase, 25-cycle, 13,200-volt transmission to the railway substations was settled upon because of the contemplated connection with the transmission of adjacent systems operating at this frequency. The importance of this over-balanced the desirability of having a single frequency in the generating station.

For the lighting system of Bethlehem and Slatington independent three-phase, 60-cycle, 13,200-volt transmission lines are carried to the respective substations, a single copper line being installed for Slatington and a double line for Bethlehem. In the construction of the various lines bare copper wire, ranging from No. 2 to No. 00, is employed, the insulators being triple-petticoat porcelain, 70,000-volt test, with locust pins. For the majority of crossings the standard strain-insulator construction is employed, the belief being that the simplest possible arrangement will give the greatest security from trouble.

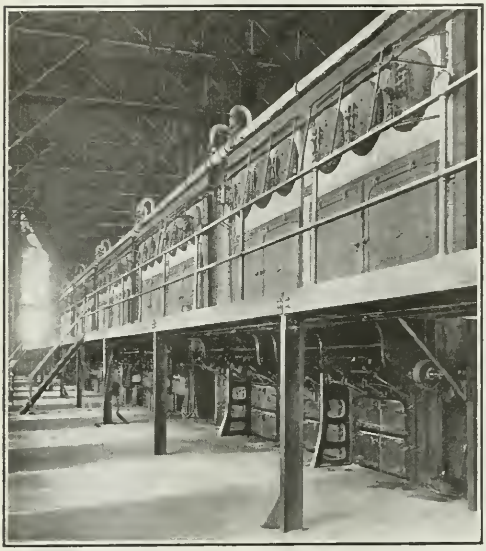


Fig. 2—Main Floor of Boiler-Room.

In the selection of the power-house site at Allentown there were a number of governing features to which consideration had to be given. The necessity of supplementing the existing station by the use of such new equipment as could be quickly placed in service limited the choice of location to a plot adjacent to the then existing railway station, while the character of the site necessitated the overlapping of both stations. Moreover, the great quantities of coal dust, mud, etc., brought down at times of high water by the Lehigh River and deposited in its old basins was a factor in considering the water supply. Another consideration to which some weight had to be given by reason of numerous coal strikes at the time the station was designed was the provision of a large reserve coal storage. As the railroad connection crosses one of the city streets, some system of receiving coal whereby frequent shifts would not be required was necessitated. The extended system of coal pits capable of receiving a train of cars was, therefore, determined upon and there was installed an electrically operated gantry crane with one end traveling on the coping of the building wall for handling the coal from the pits to the storage bins or stokers.

As shown in Fig. 3, the crane carries at the building end a suspended hopper into which a clam-shell bucket discharges. Immediately beneath this hopper and entirely inclosed from the weather are duplicate electrically driven coal crushers. The fuel is then discharged into the lower hopper, provided with cut-off valves, one of which is located for loading into a charging larry traveling on bracket runway at the side of the building, while the other valve discharges into an emergency storage pile of crushed coal. The bulk of the coal is, of course, stored uncrushed, the area provided being sufficient to accommodate a three-month supply. One man ordinarily attends to the coal handling.

On account of the character of the soil it was necessary to carry the entire building and the machine foundations on piles. The latter were cut off below minimum water level. At the same time the great variation in the river level necessitated very deep foundations in order to raise the lower floor of the station to a point which is secure against floods. The building is of skeleton-steel construction, with monolithic concrete walls, roof and floors. It is fireproof in every regard, as the doors and windows are of metal glazed with ribbed wire glass. The efficient lighting and ventilation of all portions were carefully considered, and practically every portion of the building, including the switch galleries and the boiler-room, is open to the full lighting of the main windows. Monitors are provided for the full length of the building for both the boiler-room and turbine-room to insure efficient ventilation.

An auxiliary coal skip hoist is provided in one corner of the boiler-room. This is arranged to receive coal from the crushed-coal storage previously referred to and to discharge the same into a small hopper at one end of the boiler-room; this is so arranged as to discharge into the same larry car as the discharge hopper on the gantry crane. The charging larry passes along the front of the boilers at the level of the stoker hoppers. This car is a Hunt storage-battery locomotive, the special dumping valve being so arranged as to discharge the coal directly into the stoker hoppers. These hoppers are provided with folding bins, arranged when in the open position to receive a considerable quantity of coal and closing in order to clear the tube doors when open for the removal of tubes. The stokers are of the Roney type, made by the Westinghouse Machine Company.

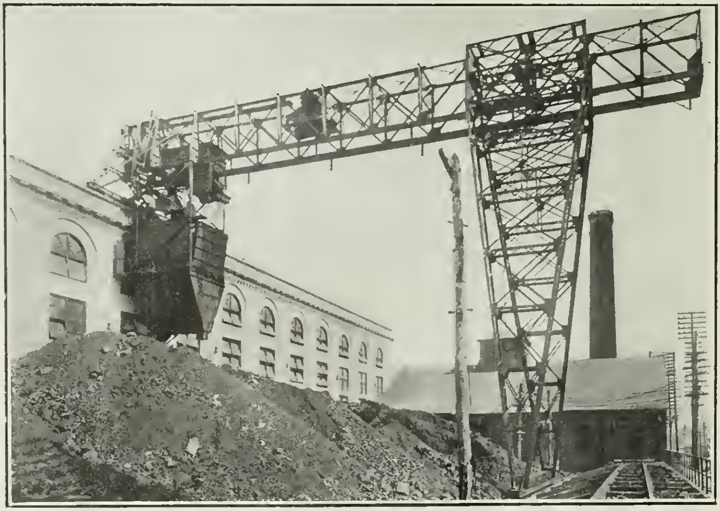


Fig. 3—Coal-Receiving Pits and Gantry Crane Outside Boiler-Room.

The boilers consist of six 150-hp batteries of Babcock & Wilcox steel-header type, equipped with two-stage superheaters, designed to give a normal superheat of 200 deg. Fahr. at 200 lb. working pressure. A separate saturated steam system is provided for the station auxiliaries. The boilers connect to a single flue which has dampers at each end of the building and a sectionalizing damper at the center, the design being such that economizers can readily be added without material change at any future time. Two new boilers of similar make and rating are at present being installed at one end of the boiler-room. The boilers are carried on steel and concrete supports, the construction including reinforced-concrete ash hoppers, which discharge directly into cars at the ground level. The steam-piping system of the boiler-room comprises individual connections from the respective boilers into the main steam loop located in the ground story, and similar connections to a central loop system for the auxiliaries. At present a single Custodis radial brick stack 11 ft. x 200 ft. is located at one end of the station; the future stack will be located at the opposite end.

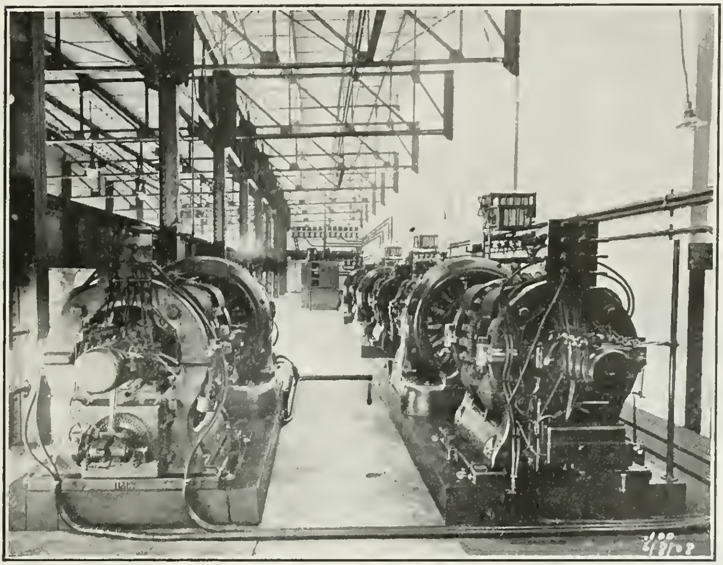


Fig. 4—Upper Gallery of Turbine-Room, Showing Motor-Driven Arc Machines and High Tension Switches and Lines.

The generating equipment consists of two 2000-kw, three-phase, 25-cycle, 13,200-volt railway turbo-generators and one 2250-kw, one 1000-kw and one 500-kw, 2300-volt, three-phase, 60-cycle lighting turbo-generator of the vertical Curtis type, with provision at one end of the station for additional units. The exciting current is provided by two 75-kw horizontal Curtis turbo-generators, which also furnish energy for the station lighting. Provision is made for future motor-driven exciters and frequency changers, one large frequency-changer set being at present installed. There is also provided a storage battery floating on the exciter bus as a guarantee against interruption in the excitation.

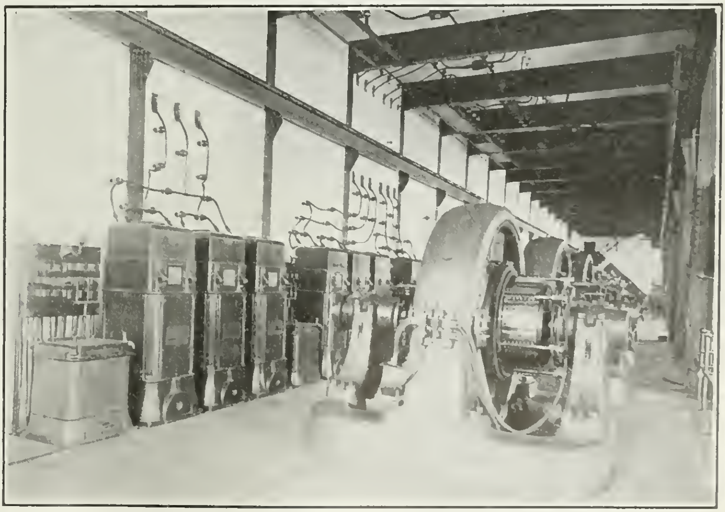


Fig. 5—Railway Apparatus on Lower Gallery of Turbine-Room.

The turbines are each equipped with independent Worthington barometric jet condensers, at present supplied from a central centrifugal pumping plant which is located at the center of the station.

The center-crank rotary dry-vacuum pumps, located at the center of the station, are also of the Worthington make. The various pumps for constant-service, boiler-feed, step-bearing and oil-pressure systems are located in the open pumproom immediately beneath the lower switchboard gallery on the main floor. This arrangement secures an extremely light station with the machines accessible. These pumps are of outside, end-packed plunger type and are controlled by automatic governors, the speed of the pump being automatically regulated in accordance with the varying demand. All of the auxiliaries are centrally located on this floor, requiring a minimum of attendance and simplicity of pipe connections. The auxiliaries exhaust into duplicate open Cochrane feed-water heaters located in the boiler-room basement. They embody the Sorge-Cochrane system of feed-water purification. The remaining portions of the ground floor are divided for storage-battery, toilet, lamp-testing and storage-rooms, and the air-blast compartment for the substation transformers.

The center-bay arrangement of circulating pumps for the condensers is at present undergoing modifications, and a part of the bay will be occupied by a 6000-kw Westinghouse double-flow turbine equipped with Leblanc condenser driving a 25-cycle generator. The air leakage in the large cast-iron pipe line connected to the circulating pumps and running along the side wall of the turbine-room near the tops of the condensers was excessive, and in cutting it down to within reasonable limits the vacuum was reduced a number of inches. The modifications at present being carried out consist in providing independent pumps driven by 90-hp Terry turbines on each of the large units and reclaiming the center space in the generating station for turbo-generators instead of for auxiliary condenser equipment. The new unit now being installed occupies part of the space made available by this change, being placed between the large vertical turbine sets.

On the first gallery of the turbine-room, corresponding in elevation to the main floor of the boiler-room, are located the controlling switchboards, offices and local substation. This gallery connects directly to the lower operating galleries of the respective turbines, the upper galleries of these units being reached from the corresponding lower gallery by means of stairways on each. Suitable platforms also are provided for access to the condenser-control valves, etc.

The substation apparatus for the local Allentown railway service consists at present of three 500-kw rotaries with corresponding banks of step-down air-blast transformers and reactances, the machine and railway feeder panels being located at the adjacent end of the main panelboard as will be noted from one of the accompanying illustrations.

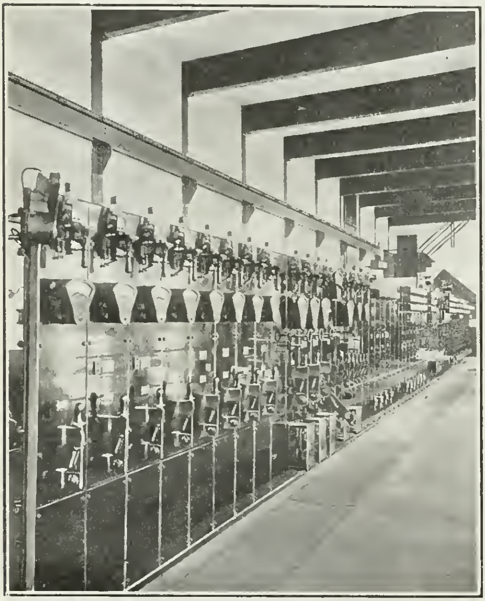


Fig. 6—Main Switchboard for Railway, Transmission and Lighting Circuits.

The upper switchboard gallery is devoted to high-tension switch compartments located at the respective ends of the station, the railway lines being carried out at one end of the station and the lighting lines at the opposite end to terminal towers. The lightning arresters are located on the upper gallery opposite the respective line oil switches. The central portion of the upper gallery is occupied by the motor-driven arc machines, space being provided for future additions, and for step-up transformers that will be needed for additional transmission lines.

The railway substations are all built on a uniform plan, differing only in the number of units provided and in the provision for the lighting distribution in the special cases where this is required. The Bethlehem substation has provision for four railway converters. Those at present installed there are of 300 kw capacity. The layout, however, is such as to provide ample room for 500-kw units should future load requirements demand increased capacity. This station has provision for lighting equipment, a three-wire rotary being provided to meet the requirements of the local metallic circuit direct-current service, which, as above noted, will be sooner or later eliminated. The incoming duplicate high-tension railway lines are carried through remote manually operated oil switches in independent cells to the sectionalized high-tension bus, from which the respective step-down banks of transformers for the rotaries are supplied through corresponding oil switches. The control panels for the alternating-current lines are located opposite the respective switches on that side of the station, while the railway machine and feeder panels, together with the lighting distribution, are located in a group on the opposite side of the building.

The incoming duplicate high-tension lighting lines are handled in a manner similar to that above described for the railway lines, as they are carried through three-phase step-down transformers to a 2300-volt lighting bus, the local motor circuits being distributed at three phase and the lighting at single phase. The transformers in all the substations are of the air-blast type, duplicate blowers being provided in all cases. The arrangement of the straight railway substations is similar to that described excepting only for the omission of the lighting equipment.

The system of connections employed in the main station at Allentown is as follows: There are two 2000-kw, 25-cycle Curtis turbo-generators supplying the railway system, with provision for future installation. These are Y-connected with ungrounded neutral and are each connected through a single remote-control motor-operated oil switch to the 25-cycle high-tension buses, which are sectionalized at the center. The various 25-cycle transmission lines are supplied from this high-tension bus, the duplicate lines on the corresponding divisions being taken from the respective halves of the bus. The 60-cycle, 2300-volt turbo-generators for the lighting system, of which there are one 2250 kw, one 1000 kw and one 500 kw, are similarly connected to the 2300-volt main bus. The single-phase Allentown lighting and three-phase local motor circuits are supplied directly from this bus through remote-control, solenoid-operated oil switches in independent brick compartments. The lighting transmission lines for Bethlehem and Slatington are supplied through 23,000-13,200-volt, three-phase step-up transformers, delta-connected with induction regulators in the more important lines. All of the electrical equipment is of the General Electric Company make.

The arc lighting is supplied by 125-light, 9.6-amp Brush arc machines connected in pairs to three-phase, 60-cycle synchronous motors operated from the 2300-volt, 60-cycle bus. The 600-volt metallic motor circuit in Allentown is supplied from a rotary converter operating from the same bus through step-down transformers, a tie connection being provided between the direct-current bus and the railway buses in the local substation, which is situated in the same building, provision being made for starting this rotary from either end. The substations are all operated at 13,200 volts with delta-connected transformers. The railway system is operated on a twenty-hour schedule, the metallic circuit rotary which operates from the 60-cycle system being cut on to the railway feeders during the four-hour shutdown of the 25-cycle system, thus providing for emergency operation and specials. This permits repairs throughout the system without interruption in any of the services, duplicate lighting lines being provided as above noted wherever the continuous lighting service is required.

The officers of the company are as follows: Mr. R. P. Stevens, president and general manager; Mr. John C. Dawson, vice-president; Mr. Charles N. Wagner, secretary-treasurer, and Mr. C. M. Walter, auditor. The station and system were designed and erected by the Scofield Engineering Company, Philadelphia, Pa. The additional equipment mentioned is being installed under the engineering supervision of Messrs. Ford, Bacon & Davis, New York City.

AN EXPERIMENTAL DETERMINATION OF THE STRENGTH OF FULL-SIZED TELEPHONE POLES.

By Laurence S. Winchester.

A SERIES of experiments upon the strength, the deflection and the characteristics of failure of some full-sized cedar and chestnut telephone poles, as they are usually set in the ground, was conducted by the author last spring. These experiments were carried out in connection with the author's graduate work at the Massachusetts Institute of Technology and under the directions of Professors Jackson and Pender, of the electrical engineering department of that institution.

APPARATUS AND METHOD.

One end of a steel cable was attached to a pole by means of an eyebolt which passed through the pole. Into the other end of this cable was linked the hook of the load chain of a Harrington 3-ton duplex-chain hoist and the other hook of this hoist was slipped into one end of the large spring dynamometer which was used to measure the load. The other end of this dynamometer was then connected to an anchor pole by means of a short piece of the cable. The dynamometer was mounted on a dinkey to facilitate its removal from the field between the experiments. However, during the experiments it was rigidly blocked into a horizontal position. The deflection of the point where the load was applied, the movement of the butt, and any torsional movements were obtained by means of transit readings. This transit might have been read to less than a minute, but as each minute corresponded to approximately ¼ in. movement at the pole greater accuracy was needless. No torsional effects were noticed or expected on account of the manner in which the pole was loaded.

These experiments were conducted on a field just outside the Tech Field at Brookline, Mass. This field was originally a knoll, a part of which had been dug away for the sand and gravel available. In some places this digging had been carried to depths considerably below the present level and filled in with rubbish and loam. However, most of the soil consisted of the original sandy gravel. That portion of the knoll which had not been dug away had an elevation of about 6 ft. above where the poles were erected and, therefore, it formed an excellent position for the anchor pole, which consisted of an old pole set 7 ft. into the ground and projecting 4 ft. above it. Just ahead of this pole a trench was dug and a 7-ft. length of the same pole was laid in it and against the anchor in order to obtain a greater bearing surface. The dynamometer had been calibrated in the rope-testing machine at the Massachusetts Institute of Technology by applying a horizontal load, and, therefore, in the position in which it was to be used. The horizontal load may be taken as the total force acting on the pole without introducing an error of more than 1 per cent when the column effects and the like are taken into account. This, moreover, was negligible as compared with the accuracy of the dynamometer itself, which was about 3 per cent. The possibility of neglecting this vertical component was due to the long cable used and the elevation of the anchor, as will be readily appreciated after an examination of Fig. 1, where the relative positions of the various pieces of apparatus at both 1000 lb. and 1500 lb. load are represented to scale. The conditions shown in Fig. 1 were found to hold when the load was approximately 1000 lb. at the dynamometer. The point *A* moves over toward the right as the load increases until the cable becomes practically a straight line at 1500 lb. load as indicated by the dotted line.

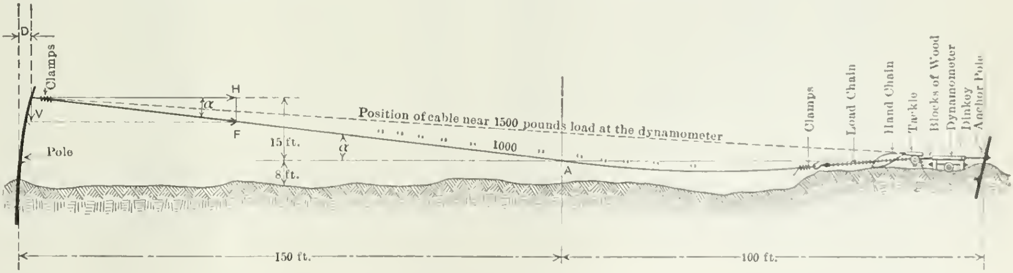


Fig. 1—Method of Loading the Poles.

HISTORY OF THE POLES.

In all, twelve white cedar poles from Maine and twelve chestnut poles from Connecticut were tested. The cedar poles were very green and were cut, as nearly as was ascertainable, about five months previous to the tests. The sap was still in them and the bark was left on. According to the results of some tests which Mr. Henry Grinnell published in the *Electrical Review*, New York, of Aug. 17, 1907, these should have had about 30 per cent moisture in them at that time. The chestnut poles were called virgin timber and had been held in a storage yard in Boston for about a year. These poles were, therefore, very dry and well seasoned. The bark was left on these poles also, only enough of it being removed to get the necessary measurements and to make the climbing sufficiently safe. Some worms had got under the bark of the chestnut poles, but they had not done any noticeable damage.

TABLE I.—SUMMARY OF THE RESULTS

	White Cedar	Chestnut
Modulus of Rupture.	Pounds per Square Inch	
Average	4,000	6,600
Maximum	5,600	9,780
Minimum	3,200	4,500
Modulus of Elasticity.	Inch Units	
Average	427,000	710,000
Maximum	974,000	1,260,000
Minimum	239,000	374,000
Position of Fracture	Inches Above the Ground	
Average	30	15
Maximum	115	70
Minimum	0	0

DESCRIPTION OF THE EXPERIMENTS.

The first ten poles and the anchor pole were set the day before Christmas. At that time there were 5 in. of frost in the ground. One of these poles was broken on Feb. 25 and the remaining nine were tested on March 17, 18 and 19. On March 22 and 23 ten more poles were erected and two of the first lot, Nos. 7 and 8, which had pulled out instead of breaking, were reset, poles Nos. 17 and 18 being set in concrete. This second lot of poles was tested on March 31 and April 1 and 2. On April 12 and 13 the four unused poles remaining and five from the second lot which had pulled out of the ground were set, two of these also being set in concrete. These poles were broken on April 28 and 29.

None of the first ten poles were keyed at either the top or the bottom of the butt, but they were set at least 5 ft. deep. Most of the remaining poles were keyed, but it is very doubtful if this added anything to the strength of the setting unless very large rocks were used. Those poles which were set in

TABLE II.—CHESTNUT POLES.

Pole Number.	Maximum Load, Pounds.	Modulus of Rupture, Pounds per Square Inch.	Position of Rupture, Inches Above Ground.	Maximum Theoretical Stress, Pounds per Square Inch.	Position of Maximum Stress, Inches Above Ground.	Deflection, Inches.[1]	Modulus of Elasticity, Inch Units.[1]	Remarks.[2]
1	1,590	6,100	70	6,750	0	60.0	595,000	B
2	1,785	7,100	0	7,100	0	38.8	950,000	B
7	1,765	Pulled out		7,700	0	44.3	811,000	E
8	2,125	Pulled out'		5,650	0	32.6	606,000	E
10	2,555	7,900	0	8,000	—	47.1	605,000	F
11	2,730	6,620	0	6,620	0	34.0	635,000	F
13	2,460	6,570	0	6,570	0	32.3	682,000	F
14	2,045	9,780	0	9,780	0	49.1	978,000	(7) C
15	1.830	5,170	24	5,200	0	66.2	374,000	(8) C
17	2,200	Pulled out		6,400	0	21.8	1,260,000	F
18	2,270	Pulled out		5,040	0	35.3	512,000	F
20	3,200	Pulled out		7,820	0	31 6	669,000	E
34	2,460	5,780	37	6,000	0	39.8	520,000	(20) F
35	2,450	5,230	0	5,230	0	29.6	553,000	(18) C
36	1,540	4,500	0	4,500	0	55.8	392,000	(17) F[3]
37	3,240	8,600	12	8,600	0	18.6	1,180,000	B
38	1,880	5,800	36	5,850	0	36.3	755,000	B
Average		6,600	15	6,680	0		710,000	
Maximum		9.780	70	9,780	0		1.260,000	
Minimum		4,500	0	4,500	0		374,000	

Other published results:

	Modulus of Rupture, Pounds per Square Inch.	Modulus of Elasticity, Inch Units.*
Rankine	10,660	
Standard Handbook	5,000	1,000,000
Forest Service Bulletin Number 70	6,200 (green lumber)	1,064,000
Forest Service Bulletin Number 70	11,300 (kiln-dried)	1,439,000
Foster's Handbook	5,950 to 12,870	

[1] At 1110 pounds load.

[2] The letters indicate the movement of butt at the ground: $A=0$ in. to 2 in.; $B=2$ in. to 4 in.; $C=4$ in. to 6 in.; $D=6$ in. to 8 in.; $E=8$ in. to 10 in., $F=10$ in. to 15 in.; $G=15$ in. to 20 in.; $H=$over 20 in.

[3] Deflection and modulus taken at 870 lbs. load instead of 1110 lbs.

TABLE III.—CEDAR POLES.

Pole Number.	Maximum Load, Pounds.	Modulus of Rupture, Pounds per Square Inch.	Position of Rupture, Inches Above Ground.	Maximum Theoretical Stress, Pounds per Square Inch.	Position of Maximum Stress, Inches Above Ground.	Deflection, Inches.[1]	Modulus of Elasticity, Inch Units.[1]	Remarks.[2]
3	1,830	3,500	0	6,000	115	27.3	974,000	B
4	1,495	3,600	0	3,700	61	43.1	495,000	F
5	1,590	3,800	12	4,100	74	51.3	449,000	B
6	1,830	5,600	14	5,900	0	45.1	600,000	E
9	2.350	4,300	0	4,300	0	31.6	399,000	E
12	1,977	4,520	50	4,780	137	59.9	379,000	C
16	1,235	3,430	0	3,510	62	103.5	265,000	B
19	2,075	4,320	0	4,330	15	63.9	283,000	E
21	2,025	Pulled out		3,860	58	44.6	393,000	E
22	1,880	Pulled out		4,010	104	34.6	309,000	C
31	2,175	4,010	78	4,010	74	27.5	554,000	B
32	2,095	3,780	115	3,890	55	45.0	391,000	D
33	1,340	3.200	66	3,330	90	89.5	248,000	B
39	2,650	Pulled out		3,600	98	41.1	239,000	(22) H
Average		4,000	30	4,350	65		427,000	
Maximum		5,600	115	5,900	137		970,000	
Minimum		3.200	0	3,330	0		239,000	

Other published results:

	Modulus of Rupture, Pounds per Square Inch.	Modulus of Elasticity, Inch Units.[1]
Rankine	7,400	
Standard Handbook	5,000	700,000
American Telephone & Telegraph Company	4,000	
Foster's Handbook	6,310 to 9,530	

[1] At 1110 pounds load.

[2] The letters indicate the movement of butt at the ground: $A=0$ in. to 2 in.; $B=2$ in. to 4 in.; $C=4$ in. to 6 in.; $D=6$ in. to 8 in.; $E=8$ in. to 10 in.; $F=10$ in to 15 in; $G=15$ in. to 20 in.; $H=$over 20 in.

concrete only had a ring of it at the top and the bottom of the butt, because here is where the greatest bearing pressure comes, while somewhere in the middle the bearing pressure is zero. This ring of concrete was made about 1 ft. thick and 1½ ft. wide. In order to increase the rate of application of the load and give the poles less time to give in the ground some of the transit readings were omitted. The poles were also set with a slight lean backward so that they would be more nearly vertical at the breaking loads and there would be less tendency to pull out.

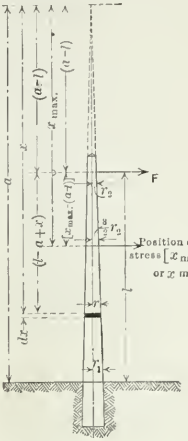


Fig. 2—Diagram of Forces and Points of Application.

TABLE IV.—DIMENSIONS AND OTHER DATA.

Pole Number.	Wood.	Total Length of Pole, Feet.	Length of Butt in Ground, Feet.	Distance from Ground to Point of Application of Force, Inches.	Circumference at Ground, Inches.	Circumference at Point of Application of Force, Inches.	Circumference at the Top. Inches.	Kind of Setting.[1]	Same Pole as Number.
1	Ch.	30.5	5.5	273	27.25	20.60	19.50	G	
2	Ch.	30.0	5.5	276	28.00	20.75	20.00	R	
3	Ce.	29.3	5.3	275	37.25	19.50	19.25	S	
4	Ce.	29.5	5.0	278	33.25	21.25	21.00	S	
5	Ce.	30.3	5.3	278	32.75	19.50	18.50	S	
6	Ce.	30.4	5.3	272	29.90	20.50	17.00	L	
7	Ch.	31.4	5.3	278	27.25	21.75	18.25	L&S	
8	Ch.	30.0	4.6	267	31.75	22.25	21.25	L&S	
9	Ce.	30.3	5.0	275	36.60	24.75	24.50	G	
10	Ch.	30.3	5.0	273	30.40	18.75	19.00	G	
11	Ch.	31.2	5.0	303	34.50	24.00	24.50	G	
12	Ce.	30.2	5.0	290	35.00	18.50	17.95	R	
13	Ch.	30.3	5.25	289	32.50	23.60	23.00	S	
14	Ch.	31.4	5.0	306	27.25	21.75	18.25	S	7
15	Ch.	30.0	5.0	288	31.75	22.25	21.25	S	8
16	Ce.	29.9	5.0	287	32.00	19.50	19.00	L	
17	Ch.	31.00	5.0	300	32.00	22.25	22.50	C_1	
18	Ch.	31.0	5.1	300	35.00	25.75	23.00	C_1	
19	Ce.	29.75	4.2	295	35.50	23.25	21.75	G	
20	Ch.	31.3	5.0	304	34.00	25.00	23.75	GR	
21	Ce.	31.6	4.4	316	38.00	23.50	23.00	G	
22	Ce.	29.75	4.8	287	41.5	23.25	22.50	FS	
31	Ce.	30.2	5.6	284	37.00	22.00	21.00	S	
32	Ce.	31.6	5.6	313	38.00	23.50	23.00	S	21
33	Ce.	29.7	5.5	279	33.50	19.25	18.25	L	
34	Ch.	31.4	5.1	302	34.00	25.00	23.75	GR	20
35	Ch.	31.0	5.9	290	35.00	25.75	23.00	G	18
36	Ch.	31.0	4.8	302	32.00	22.25	22.50	L	17
37	Ch.	31.0	5.2	300	33.0	25.25	24.00	C_2	
38	Ch.	30.5	5.25	294	31.00	23.00	21.25	C_2	
39	Ce.	29.9	5.4	281	41.50	23.25	22.50	S	22

[1] Kind of setting: G = gravel with no rocks; GR = gravel with small rocks; R = many small round rocks. S = sand with small rocks. FS = very fine sand with no rocks; L = loam; C_1 = first lot of concrete (this lot was not properly mixed); C_2 = second lot of concrete (this lot was properly mixed

RESULTS.

The results of these experiments are seen in the accompanying tables. It is rather surprising when one really stops to think how far wood is from being a homogeneous material that the individual results do not vary more from the average. Then, too, the modulus of rupture is a fictitious quantity because it assumes that Hooke's law holds up to the time of breaking. The values given by other authorities were obtained in the majority of cases from small specimens and under artificial conditions. These factors alone are sufficient to account for the higher values and show the unreliability of such data so far as its value in actual construction is concerned.

The way that the cedar poles failed is well shown in Fig. 4, and Fig. 5 shows the characteristic failure of a chestnut pole. Many a chestnut pole still supported a part of the load after the first failure, but the cedar poles usually snapped right off short. This characteristic is a point decidedly in favor of the chestnut poles and is due to a greater freedom from small knots and a straighter and tougher grain than the cedar has. Often the grain of the cedar will spiral around the pole.

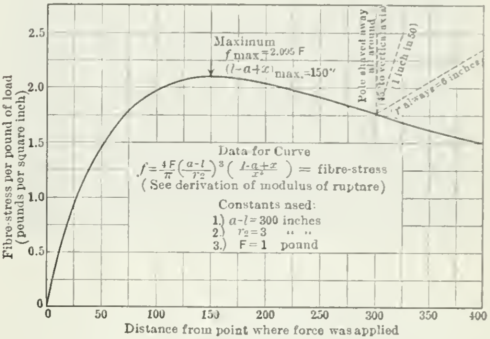


Fig. 3—Variation of Fiber Stress with Distance.

The large variation of the deflections of the individual poles and the corresponding variation of the modulus of elasticity shows the effects of the various settings. The deflection of the top of the pole due to a small give of the butt in the ground was quite large, and still there was no practical way of eliminating it or allowing for it. (See Fig. 6.) Greater speed in applying the load would have helped. Concreting would also have helped, but the effect of the normal soil was desired. This was rather a rigorous test of the various settings. Fine sand and loam were found to be very weak. Even keying was but little help unless the keys were enormous. Gravelly soil with small rocks was the best. Where the cement was properly mixed and used in rings about 1 ft. thick it held the poles as firmly as if in a vise. The torsional readings were omitted after the first few experiments, but while this just about doubled the speed it was not sufficient to eliminate the give of the butt in the ground. The values for the modulus of elasticity are undoubtedly much too low on this account.

Fig. 4—Cedar Pole.

In the scanty literature on this subject the article of greatest interest is a paper read by Mr. Wade before the Institution of Electrical Engineers describing some experiments which he carried out. He used red fir and therefore the numerical results are not particularly interesting at this time. The tests were principally upon "A" poles held in a horizontal position. His greatest difficulty came in devising a suitable manner of joining the poles at the top. In actual practice, however, considerable trouble would be experienced in obtaining suitable anchorages. These "A" poles showed four times the strength across the line and twice the strength along the line that single poles had. This is a very desirable property and is now being introduced into steel-tower construction. With the rapidly decreasing supply of large-sized poles that now confronts the industry it soon will be necessary to devise some means of employing lighter construction or using a substitute for wood.

DERIVATION OF FORMULAS.

The assumptions which it is usually customary to make in dealing with the properties of materials are given in Lanza's "Applied Mechanics," page 268, as:

(1) A plane cross-section remains a plane after bending takes place,

(2) Hooke's law must hold, and

(3) The position of the neutral axis remains unchanged.

On these three assumptions the common theory of beams is based, and therefore the fundamental formula for the fiber-stress is directly applicable. This formula is:

$$f = \frac{My}{I}$$

where

f = the fiber-stress in pounds per square inch.

M = the bending moment in inch-pounds,

y = the distance of the fiber under consideration from the neutral axis in inches, and

I = the moment of inertia of the section taken about the neutral axis and expressed in inch-units.

Now y and I are both functions of r, the radius of the section in question, assuming a circular section, of course, i. e.:

$$y = r \text{ and } I = \frac{\pi r^4}{4} \text{ or } \frac{y}{I} = \frac{4}{\pi r^3}$$

Then let $(l - a + x)$, whose significance will be shown later, be the distance from the point where the force is applied to the section in question, when

$$M = F\,(l - a + x) \text{ and } f = \frac{4F\,(l - a + x)}{\pi r^3}$$

In Bulletin No. 53 of the Bureau of Forestry, entitled "Chestnut in Southern Maryland," the author found a table giving the diameters of a large number of growing trees of different ages and at different heights above the ground, from which he made a plot and showed that the nearest simple geometrical shape for the poles was really a truncated cone. Then if a is the total length of the complete cone of which the pole is a fustrum, and if l is the distance from the point where the force is applied to the ground, then if x is the distance from the apex of the cone to the section under consideration, $l - a + x$ is the distance from the point where the force is applied to that section, and (see Fig. 2) these equations follow:

$$\frac{r}{r_2} = \frac{x}{a - l} \text{ and } \frac{r_1}{r_2} = \frac{a}{a - l} \text{ or } a - l = \frac{r_2 l}{r_1 - r_2}$$

$$\therefore f = \frac{4F\,(a - l)^3\,(l - a + x)}{\pi r_2^2 x^3}$$

where f is now expressed in terms of the one variable x. The fictitious distance $a - l$ may now be eliminated, but this substitution is not especially desirable, as the formula is of little use in its present form. What is desired is the maximum value of f, and this is readily found after differentiating the above with respect to x to find the condition for a maximum. This condition is found to be either:

$$x\,(\text{max.}) = 1.5\,(a - l) \quad \text{or} \quad r\,(\text{max.}) = 1.5\,r_2$$

$$\therefore f\,(\text{max.}) = \frac{4F\,[l - a + 1.5\,(a - l)\,]}{\pi\,(1.5 r_2)^3} = \frac{16F\,(a - l)}{27\,\pi\,r_2^3}$$

$$= 0.1887 \quad \frac{Fl}{(r_1 - r_2)\,r_2^3}$$

Fig. 5—Chestnut Pole.

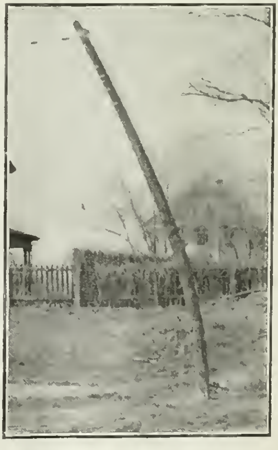


Fig. 6—Give of Pole in Ground.

and since this maximum occurs at the point $x = 1.5\,(a - l)$ the distance from this point to the ground is $\frac{(2r_1 - 3r_2)l}{2\,(r_1 - r_2)}$ inches. While this work is correct mathematically the problem is actually limited by the condition that the formula for the fiber-stress applies only between the ground and the point where the force is applied. Therefore, if $r_1 \leqq 1.5 r_2$ the position of the maximum stress comes at the ground level and that maximum stress is $f\,(\text{max.}) = \frac{4\,Fl}{\pi\, r_1^3}$. In Fig. 3 a plot of the variation of the fiber-stress with the distance from the point where the force is applied is shown. The condition that $r_3 \leqq 1.5 r_2$ simply means that the pole is set in the ground up to the point where $l - a + x = 150$ or further respectively. Thus we see why the maximum stress comes at the ground when $r_1 \leqq 1.5 r_2$. The dotted lines in this figure at the point where $l - a + x = 300$ show how very rapidly the fiber-stress would increase if the pole was to be shaved away, beginning at this point and going downward at the rates indicated, or as in actual practice often results from decay at the ground line.

The formula for the deflection of the point of application of the force is subject to the same assumptions as the formulas for the fiber-stress. The fundamental equation in this case is:

$$D = \int\!\!\int \frac{M}{EI}\,dx\,dx$$

where E = modulus of elasticity (assumed constant).

We already had $M = F\,(l - a + x)$ and $I = \frac{\pi\, r^4}{4}$

$$\therefore D = \int\!\!\int \frac{4\,F\,(l - a + x)}{E\,\pi\, r^4}\,dx\,dx$$

but

$$r = \frac{r_2 x}{a - l}$$

and

$$a - l = \frac{r_2 l}{r_1 - r_2}$$

whence

$$D = \frac{4\,F\,(a - l)^4}{\pi\, E\, r_2^4} \int\!\!\int \frac{(l - a + x)}{x^4}\,dx\,dx$$

Now

$$\int\!\!\int \frac{(l - a + x)}{x^4}\,dx\,dx = \int \left[\frac{l - a}{-3\,x^3} + \frac{1}{-2\,x^2} + c_1\right] dx$$

$$= \left[\frac{l - a}{6\,x^2} + \frac{1}{2\,x} + c_1 x + c_2\right]$$

The slope is represented by $\frac{d}{dx}\,(D)$ and is zero at the point $x = a$. Whence we have the condition:

$$\frac{l - a}{-3\,a^3} + \frac{1}{-2\,a^2} + c_1 = 0 \text{ or } c_1 = \frac{2\,l + a}{6\,a^3}$$

The deflection is likewise zero at this same point $x = a$ and

$$\therefore \left[\frac{l - a}{6\,a^2} + \frac{1}{2\,a} + \frac{2\,l + a}{6\,a^2} + c_2\right] = 0$$

$$6\,a^2 c_2 = a - l - 2\,l - a - 3\,a \text{ or } c_2 = -\frac{(a + l)}{2\,a^2}$$

and

$$D = \frac{4\,F}{\pi\, E}\left[\frac{a - l}{r_2}\right]^4 \left[\frac{l - a}{6\,x^2} + \frac{1}{2\,x} + \frac{(2\,l + a)\,x}{6\,a^3} - \frac{(a + l)}{2\,a^2}\right]$$

What is really desired is the deflection of the point where the force is applied or where $x = a - l$.

$$\therefore D\,(\text{max.}) = D\,(\text{top}) = \frac{4\,F}{\pi\, E}\left(\frac{a - l}{r_2}\right)^4 \left[\frac{-(a - l)}{6\,(a - l)^2} + \frac{1}{2\,(a - l)} + \frac{(2\,l + a)\,(a - l)}{6\,a^3} - \frac{(a + l)}{2\,a^2}\right]$$

$$= \frac{4\,F}{3\,\pi\, E}\,\frac{l^4}{(r_1 - r_2)^4}\left[\frac{1}{a - l} - \frac{(a^2 + al + l^2)}{-a^3}\right]$$

$$= \frac{4\,F}{3\,\pi\, E}\,\frac{l^4}{(r_1 - r_2)^4}\,\frac{1}{(a - l)\,a_3} = 0.424\,\frac{F\,l^3}{E\,r_1^3 r_2}$$

The following formulas, which apply to a pole subjected to a single horizontal load, were used to calculate these results from the data obtained from the tests.

Modulus of Rupture:

(1) When $r_1 \geqq 1.5\, r_2$, $f\,(\text{max.}) = 0.1887\,\frac{F\,(\text{max.})\,l}{(r_1 - r_2)\,r_2^2}$

(2) When $r_1 \leqq 1.5\, r_2$, $f\,(\text{max.}) = 1.273\,\frac{F\,(\text{max.})\,l}{r_1^3}$

Modulus of Elasticity:

$$E = 0.424\,\frac{F l^3}{D r_1^3 r_2},$$

where

r_1 = radius of the pole at the ground expressed in inches.

r_2 = radius of the pole at the point where the force is applied expressed in inches;

l = distance from the ground to the point where the force is applied expressed in inches;

f (max.) = modulus of rupture, or the breaking strength expressed in pounds per square inch;

D = deflection of the point where the force is applied expressed in inches;

E = modulus of elasticity expressed in inch-units, and

F = horizontal force or load expressed in pounds.

* * *

ARC-LAMP ELECTRODES.

Their Composition, Method of Manufacture and Impregnation for Various Classes of Service.

BY A. MAHLKE.

THE development of arc-lamp electrodes has taken place chiefly in Germany, from which country more than 10,000,000 lb. of carbon electrodes are exported annually. Much of the product finds its way into the United States, although the electrodes manufactured in this country have improved very much during the last few years. Since the raw material necessary for the manufacture of arc-lamp electrodes is found in abundance in this country, and inasmuch as it is also very much cheaper here than abroad, it may be predicted confidently that in the near future all the carbon electrodes burned in this country will also be manufactured here.

If one does not take into account the usual homogeneous carbon electrodes for direct-current inclosed arc lamps, which are expected to disappear in the near future, arc-lamp electrodes may be said to consist of a shell made of different kinds of carbon material and a core containing principally metallic salts for supporting the arc. The shell is intended as a conductor of electricity, the core usually being a bad conductor and sometimes even an insulator when it is cold; but when the core is raised to a high temperature it becomes conducting. For this reason at the hot end of the electrode the current has to jump from the shell to the core, forming the arc as indicated in Fig. 1.

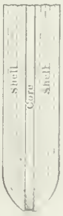


Fig. 1—Cored Electrode.

It is of the greatest importance, if steadiness of light is desired, that the arc be not fed from any point other than the end of the core. If there is any dirt in the shell which could support the arc the latter would jump to it from the core and there would be a variation in the light and in the voltage of the lamp. Therefore, it is necessary to exercise the greatest cleanliness in making arc-lamp carbon electrodes, although one would not be so impressed with the necessity for cleanliness from cursory inspection of a carbon factory. Especially in working up the raw materials for the carbon shells must great care be exercised to keep them pure. This is somewhat difficult, because these materials have to undergo a long sries of processes. The material must first be ground very fine; then the powder has to be mixed with some binder, and the resulting mixture must be stamped and pressed into the shape of the carbon shells. These carbon shells, being yet in a green state, are next packed into a furnace and baked at a high temperature; then they are shaped into various forms, and finally provided with a core.

COMPOSITION OF SHELL.

Of the raw materials for arc-lamp electrode manufacture lampblack is the most important. The lampblack used for electrodes is made by burning suitable derivatives of tar in a pan, to which no more air is admitted than is necessary for supporting the flame. Usually for this purpose tar oils are employed which have been distilled from tar at temperatures between 240 deg. C. and 270 deg. C. The dense vapors arising from the pan are conducted through a series of chambers, where the lampblack is deposited on the walls and ceilings. After the run is finished the lampblack is collected from the chambers. But there are different kinds of lampblack in the different chambers, which must be kept separate, the various kinds being of lower or higher weight, according to their fineness or to the amount of water and oil contained in them.

Lampblack for arc-lamp electrodes should not contain more than 0.5 per cent of water and oil. If this amount is exceeded the excess has to be evaporated by heating the lampblack. The limit for ash which the lampblack may contain is much lower. For first-class electrodes lampblack containing more than 0.02 per cent of ash cannot be used. In this country much lampblack is produced from natural gas. This lampblack is generally used for making printing ink and paints. Although it would be very valuable for making arc-lamp electrodes, the author does not know whether it has ever been tried for this purpose.

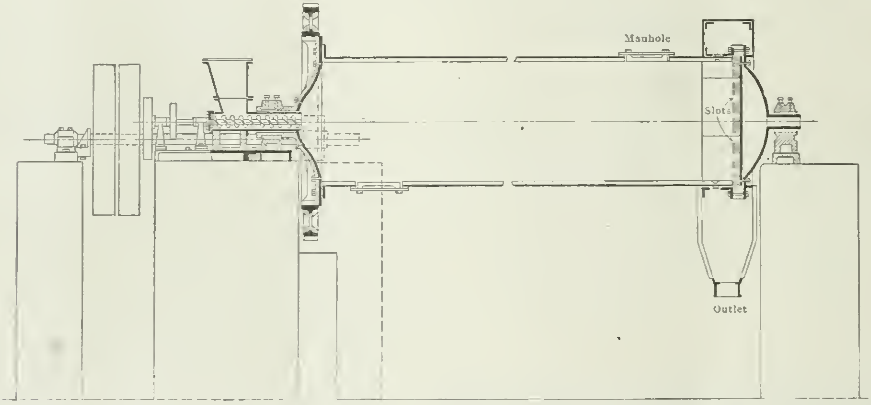


Fig. 2—Tubular Mill for Grinding Electrode Material.

Tar is another material of great importance in the carbon industry. Usually coal tar is employed, but petroleum tar may also be used. The tar sold by the gas companies must be first cleaned if it is not supplied in a pure state. This cleansing is performed by filter presses, in which the tar is forced under a pressure of about 100 lb. per square inch through a filter cloth. For rendering the tar more viscous it is either heated or diluted with benzole. In this way the tar is separated from all solid particles contained in it. In Germany revolving separators are sometimes used to effect the same end.

The tar thus prepared should not contain more than 0.02 per cent of ash if it is to be used for making arc-lamp electrodes. But before being available for that purpose it has to be freed from water and from those components having a low boiling point. The evaporation of these is effected by heating the tar by steam coils for several hours in a vessel open to the air. The actual time will depend on the amount of tar to be treated. If the tar be kept at a temperature a little below the usual boiling point of water, it will be freed from nearly all the water, from the oils which volatilize at low temperatures and also from naphthaline, which condenses like snow around the vessel. After this operation the tar will contain less than 1 per cent of water. By being distilled up to 300 deg. C. about 20 per cent of volatile matter will pass off, and after being heated to red heat, when no more vapors are given off, there will be a solid residue of about 30 per cent of the original bulk. These figures may vary by several per cent for different kinds of tar.

Besides tar, pitch is also used as a binder in making carbon electrodes in this country. The pitch is made from tar, which is cleaned by forcing it through a filter press. By heating this tar much of its volatile matter is evaporated, so that it becomes solid on cooling. The temperature to which the tar is raised is about 300 deg. C., this value changing according to the degree of hardness which the pitch is to have. The melting point of the pitch varies from 40 deg. C. to 90 deg. C., depending on the kind of pitch, and the ash content is about 0.04 per cent, or a little higher than that of the pure tar.

While the materials described above are used only for first-class arc-lamp electrodes, lower-grade electrodes may be made partly out of retort coke or of petroleum coke. These materials, having a much better electric conductivity, are to be preferred by far to lampblack if they are obtainable in the same state of purity. In Europe retort and petroleum coke containing less than 0.25 per cent of ash can be produced, but in this country the percentage of ash contained in these materials is usually much higher.

PREPARATION OF MATERIALS.

The first step in making carbon electrodes after having prepared the materials is to mix lampblack and tar in suitable proportions, usually from 135 lb. to 138 lb. of tar to 100 lb. of lampblack. The mixture is molded by hydraulic presses into cubical or cylindrical plugs nearly 1 ft. in diameter, which are then baked in a furnace at a temperature of at least 1000 deg. C. By raising this temperature to 1300 deg. C. or 1400 deg. C. better results are obtained. The plugs after having been cooled are crushed and ground to a fine powder or flour, which is called baked lampblack.

In factories where work has to be carried on for some time there is always a large amount of broken electrodes or carbon scrap. This scrap, when kept pure enough, after having been ground to a fine flour, is the best material for making new electrodes and can be used instead of the baked lampblack. Both kinds of carbon flour when used for first-class electrodes must be fine enough to pass through a 200-mesh sieve.

The grinding of these materials is done in different kinds of mills, such as conical iron mills, like coffee mills or stone mills, similar to corn mills; but the best machines for this purpose are large tubular mills, like that shown in Fig. 2. In this grinder the cylindrical tube is about 25 ft. long and 5 ft. wide. It is revolved at the rate of from 25 r.p.m. to 30 r.p.m. by gearing. The cylinder is lined with soft wood and filled about one-third full with the material to be ground by means of the hopper arrangement shown at the left of the engraving. The grinding is performed by flint stones about the size of goose eggs, which are mixed with the material and grind the carbon between their surfaces as the cylinder revolves. Such material as may be ground by itself may be milled without such stones, but the process of grinding is in this case a little slower. After the mill has been used for some months the lining is renewed, and for that purpose manholes are provided in the cylinder.

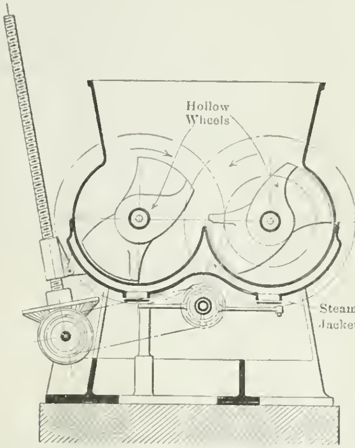


Fig. 3—Machine for Mixing Electrode Material.

A good mixture for first-class arc-lamp electrodes consists of 100 lb. of raw lampblack, 100 lb. of baked lampblack of 200-mesh made either of carbon scrap or of the plugs described above, 1 lb. boric acid and about 160 lb. of tar. The proportion of tar is changed according to the thickness of the electrodes to be made. When making thin electrodes less tar is used.

For mixing these materials a machine like that shown in Fig. 3 is used. Two hollow steam-heated wheels provided with wings revolve in opposite directions in a receptacle fitted with a steam jacket at the bottom. The dry powders are first poured in and mixed, and afterward the tar is added, the wheels and receptacle being heated all the while by steam. After the lapse of an hour's operation the mixture is dumped, the receptacle being tilted around the shaft beneath the steam jacket by the mechanism shown at the left of the engraving.

In this country another mixture containing no raw lampblack, but consisting of baked lampblack only and pitch, is often used. In order to make the mixture workable a suitable amount of tar oil is added. Electrodes made from this mixture can be baked in a horizontal position in the furnace, while those electrodes containing a larger amount of raw lampblack must be baked in a vertical position, as they crack when baked in a horizontal position.

A mixture for good coke electrodes is made up of 100 lb. of 100-mesh coke flour, 100 lb. coke-electrode scrap flour of the same fineness, 60 lb. 200-mesh baked lampblack, 40 lb raw lampblack, 3 lb. boric acid and about 155 lb. of tar.

Before the mixture can be shaped into final form it must be kneaded, and this operation is performed either by rolling mills or by pan rolls. Fig. 4 shows one of the latter. Two rolls about 5 ft. in diameter and weighing about 2000 lb. each turn in a pan containing the mixture to be kneaded. Two pairs of boards or scrapers keep the mixture in the path of the turning rolls. Most of the pan rolls used in this country are constructed so that the pan turns while the rolls and the boards remain stationary. This construction is not so effective because the pan yields somewhat, so that there is not the same pressure brought on the material to be kneaded as there is in the construction described above. After being well kneaded the mixture is placed in cylinders suited for a hydraulic press, in which it is shaped into carbon shells. A shovelful of the mixed material is put into a cylindrical mold and rammed down by a tamping press. Then another shovelful of the material is added and rammed down, and so on until the mold is filled and a homogeneous, solid cylinder of the mixed material obtained. The cylinders are then placed in a hydraulic press like that shown in Fig. 5.

MANUFACTURE OF ELECTRODES.

The press consists of two parts A and B connected together by two steel shafts. The part A contains the nozzle n out of which the electrodes are forced, while the part B contains the hydraulic cylinder and the piston k. Fastened to the piston k is the piece g bearing on its lower end the toothed segment s. Connected to the piece g is a hollow pressure cylinder c supported by the piece d sliding on the lower shaft. The pressure cylinder adjoins the piece bearing the dented wheel z meshing in the toothed segment s, by means of which the hollow pressure cylinder can be turned out of its position around the lower shaft so that it is open at its left side for the reception of the carbon cylinders. The lever h performs this movement and the counterbalance makes it easier to place the hollow pressure cylinder in its former position.

The operations of the press are regulated by the toothed rod z' having stops y and y' which move the part g to the right or left, while its teeth engage the little cogwheel b, moving by a toothed segment the valve v. Above this valve a pressure gage is placed. The cogwheel b can also be turned by the handwheel r'. When by these means the valve v is opened the material contained in c is forced through the hollow pipe i, which is heated by a steam jacket, and out of the nozzle n as a continuous rod.

When hollow electrodes are desired instead of the nipple p a mouthpiece like that shown in Fig. 6 is fixed on the end of the pipe i. By means of the ring r and three rods s the rod d is kept in the center of the orifice m, which is fitted with a transition cone u for decreasing slowly the cross-section of the carbon material moving from right to left around the rod d and emerging from the orifice m as a continuous hollow cylinder with a hole corresponding to the end of the rod d.

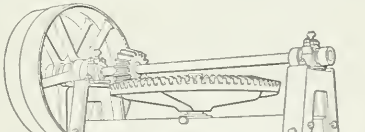


Fig. 4—Pan-Roll Kneading Machine.

The diameters of the orifice m and the rod d must be a little larger than the corresponding dimensions of the electrodes to be made so as to allow for shrinkage when baking in the furnace. The pressure necessary for making tar carbons is about 1500 lb. to 1800 lb., and the temperature about 80 deg. C. For pitch carbons the pressure as well as the temperature is somewhat higher. When making the latter carbons it is usually necessary to heat the mouthpiece of the press by a gas flame, but this is not necessary in the case of tar carbons.

The carbon rod from the hydraulic press is cut by hand into pieces 4 ft. to 5 ft. in length and these pieces are bound together into hexagonal bundles about 10 in. in diameter. The bundles then lie in storage for some days before they are put into the furnace. When ready the bundles are put in a vertical position in saggers of the form shown in Fig. 7, closed by a cover. These saggers are usually made in the carbon factory itself with much care so that they may be used for a number of runs. The materials used for their manufacture are thirty parts kaolin and twenty parts of highly refractory clay mixed with fifty parts grog (scrap of broken saggers ground to a coarse flour). This is mixed with water, molded into shape and then allowed to dry by standing in the open air. When thoroughly dried the saggers are covered with a glazing material and baked in a furnace at a temperature of at least 1300 deg. C. A well-made sagger, if handled properly, can be used about fifteen times for baking electrodes.

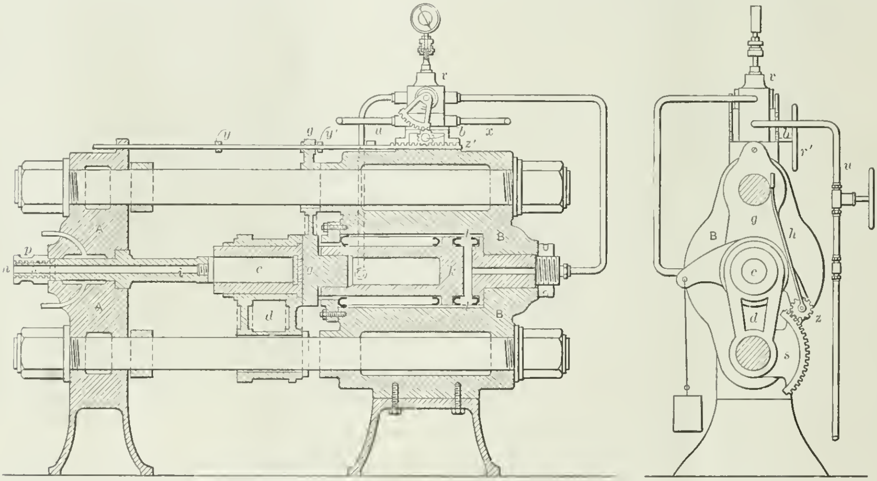


Fig. 5—Hydraulic Press for Making Electrodes.

Into these saggers the hexagonal carbon bundles are put, while the space between the bundles and the wall of the sagger is filled with a coarse coke product, which is also placed on top of the bundle to replenish the whole sagger. The cover is then fixed on top of the sagger by means of a clay paste.

FURNACES FOR BAKING ELECTRODES

For economy and ease of baking all material at the same temperature ring furnaces are best suited. These furnaces, like similar brick furnaces, consist of a series of chambers or compartments, thirty-two being usually connected to a ring by flues so that the heat can pass through all chambers one after the other in continuous movement. Suitable dimensions of chambers are: Length, 9 ft.; width, 5 ft., and depth, 6 ft. to 7 ft.

By building the whole furnace below the level of the floor and making the depth of the chambers larger than the width, since only the heat radiated from the covers is lost, the heat losses are reduced as much as possible. The fire progresses daily in the series of chambers by four such compartments, so that the whole furnace takes about eight days to heat, after which time the fire is working again on the same chamber as at the beginning. The chambers ahead of the fire are heated by the combustion gases, which leave the furnace at the eighth or tenth chamber beyond the fire before going to the stack, when their temperature is about 200 deg. C. The air necessary for supporting the fire is conducted through the heated chambers which the fire has left, cooling these chambers and producing a very high temperature (1400 deg. C.) in the chambers under fire. Thus nearly all the heat produced in the furnace is used for its proper purpose and a very small part of it lost.

The fire progressing by four chambers a day, it is necessary to open four cooled chambers to take the electrodes out and to fill the chambers up again. In a furnace of the dimensions given above about 3000 kg (3 tons) of electrodes can be baked in twenty-four hours. If producer gas were employed in this furnace it would require nearly 1500 kg (3306 lb.) of fuel producing 7000 calories per kilogram (12,600 lb.-Fahr. units per pound). In many places natural gas can be burned in the ring furnaces, making the operation of the furnace much easier, because natural gas has a greater heating power and does not clog up the flues in the furnace with tar vapors, which in producer gas are contained in so large an amount that after some months' working the flues of the furnace are closed by the deposits of the gas, necessitating the shutting down of the furnace and the cleaning of the flues. The draft in the furnace should be kept as low as possible in order to prevent the cracking of the hot saggers. The author has found a draft of 2 mm water pressure in the chambers of the furnace sufficient.

The baked electrodes are now cut to proper length for arc lamps and assorted, the crooked and cracked electrodes being rejected and scrapped. After that one end of the carbon is pointed, while the other is finished off smooth. The electrodes thus prepared can be cored. This operation is performed by little presses consisting of a hollow cylinder into which the coring material is to be filled. The latter is forced out of a little hole with which the hollow cylinder is provided and against which one end of the carbon to be cored is held.

The operation of coring can be done either by automatic machines utilizing a weight on a piston or by hydraulic pressure, or it may be performed by hand, the piston in the hollow cylinder containing the coring material being moved by a screw and hand-wheel. Short electrodes having thick shells can be cored best by automatic machines, while longer electrodes with thin shells must be cored by hand, it being easier by this means to regulate or proportion the pressure to the strength of the shell.

COMPOSITION OF CORING MATERIAL.

The coring material for common arc-lamp electrodes burnt in open-arc lamps, projector lamps and other similar lamps is made of two parts of baked lampblack and one part of potassium silicate. The baked lampblack is of 200 mesh and the potassium silicate is applied as a solution made with steam and hot water and has a density of 24 deg. Baumé for direct-current electrodes and a little lower density usually for electrodes for alternating-current lamps. The potassium silicate acts as a binder for the material of the core, and the potassium, when burnt in the arc, reduces its counter e.m.f. An arc consuming carbon alone requires a much higher voltage, so that an arc at the lower voltage for which the lamp is regulated can exist only at the end of the core. Thus the arc is maintained at that place so long as there are no impurities in the shells which could reduce the voltage of the arc, like the potassium of the core.

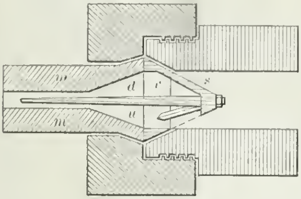
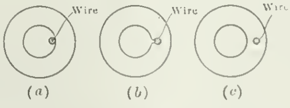


Fig. 6—Mouthpiece for Hollow Electrodes.

Fig. 7—Sagger.

The coring mixture for flaming-arc lamp electrodes is more complicated, containing as it does metallic salts for feeding the arc. When Bremer first introduced this kind of lamp the same sort of electrodes in which the core had a diameter of about one-third of the shell were used for the positive and negative as well as for the alternating-current lamps. At the author's proposal different kinds of electrodes have been made for these different purposes. In direct-current lamps the positive electrodes have a core with a diameter about half that of the shell, while in the negative electrodes and those used for alternating-current lamps the diameter of the core is about one-third that of the shell. The reason for this construction is because in operation particles of the positive electrode are carried over and deposited on the negative electrode. The positve electrode, therefore, must contain as much metallic salts as possible, while the negative electrode usually contains no such salts and is made in the same manner as common carbon electrodes, its core consisting of lampblack and potassium silicate only. But for very many lamps it is usually best to provide the negative electrodes with metallic salts also.

The composition for the core of positive electrodes for direct-current lamps, as well as the material for the electrodes of alternating-current lamps, consists of 40 per cent of baked lampblack and 60 per cent of metallic salts. The metallic salts for electrodes giving a yellow flame are calcium fluoride and calcium phosphate, which latter must be calcined. For alternating-current lamps less phosphate is used than for direct-current lamps and the phosphate may even be omitted. A German firm adds to the calcium salts about 10 per cent of cerium salts, which makes the yellow light more whitish.



(*a*) (*b*) (*c*)

Fig. 5—Wired Electrodes.

The cerium salts, which are a by-product of the Welsbach mantle industry, are the principal ingredients of the electrodes giving a white light. Usually cerium fluoride forms two-thirds of the core mixture contained in these electrodes, the other third being mostly calcium salts.

The powders out of which the core is to be made must be sifted very well and be mixed very carefully, else the core of the finished electrode will have white spots which cause disturbances of the light when burned in the flame. As a binding material potassium silicate, which is made alkaline by adding some potassium hydroxide, is used. In certain flaming-arc electrodes potassium silicate is not used as a binding material, but some organic substance, like glucose. In such a case there is added to the core a small amount of potassium salts or boric acid. These materials may be necessary for starting the arc because metallic salts like calcium and cerium fluoride have high melting and boiling points.

When the electrodes have been cored they must be dried at a temperature of about 150 deg. C. This must be done very slowly so that the core fills up the inside of the shell, leaving no hole anywhere. If there is no connection between the core and the shell in any part, the current cannot pass from the shell to the core, which fault will cause a disturbance in the light when that part comes near to the burning end.

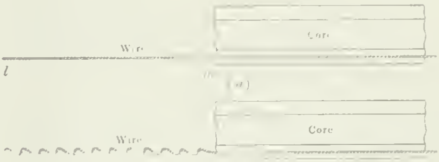
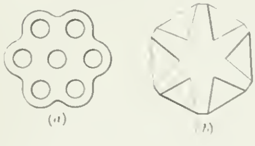


Fig. 9—Wired Electrode.

The flaming-arc electrodes destined for long-hour burning having a length of more than 16 in. have to be provided with a wire to reduce their electrical resistance. Such long electrodes without wires would entail a drop in voltage of about 10 volts or more, so that the arc would burn with different voltages during a single run depending on the length of the electrodes. In order to reduce this difference wires are inserted in the electrodes, as shown in the cross-sectional view, Fig. 8. In *a* the wire is embedded in the core and pressed against the wall of the shell by coring the carbon. In *b* a special groove is provided for the wire in connection with the core hole, so that it is filled up with impregnating material when coring the electrode. In *c* there is also a special hole for the wire, but separate from the core hole. It is, therefore, necessary to provide a good contact between the wire and the wall of the hole and this is done in the manner indicated in Fig. 9. The wire is first drawn through the hole till it projects out quite a distance. Then the part *l m* is crimped into the form shown in *b* by pressing it between two toothed wheels The crimped wire is then drawn back into the shell, pressing against the wall of the hole and making good contact. In electrodes of the construction shown in Fig. 8*c*, where the wire is not prepared in the manner just described, the wire is of little or no use whatever because there is not sufficient electrical contact between the wire and carbon.



(*a*) (*b*)

Fig. 10—Electrode for Regenerative Lamps.

At the upper end, where the electrode is to be fixed in the holder, the wire is flattened and wound around the end of the electrode, thus causing a better contact with the electrode holder. A firm in this country electroplates and solders the end of the electrode to obtain the same result. Zinc, brass and tin wires are employed for this purpose. Brass wires can be used only in the construction shown in Fig. 8*c*, where the wire is separated from the core. When this wire is surrounded by the core, as in the constructions shown in Fig. 8*a* and *b*, brass cannot be used on account of the copper contained in it, which on oxidizing covers the economizer of the lamp with a brown deposit. Aluminum wire has also been tried, but is found to be unsuited for this purpose, its surface soon being covered with a layer of oxide which insulates the wire from the carbon. The thickness of these wires varies from ½ mm to ¾ mm according to the thickness of the electrode.

The vertical electrodes for lamps of the Blondel type are distinguished by the thickness of their core, the latter forming about two-thirds of the entire diameter. These cores being too thick to be heated enough by the arc must, even when cold, be as good conductors of electricity as possible so that the arc can move easily around the whole cross-section. For that reason organic binders, such as glucose, are used. The metallic salts in the core form 30 per cent of the mixture only, while the carbon material comprises two kinds of baked lampblack of different mesh; one-third being a coarse flour passed through a sieve of 30 mesh per inch on a sieve of 50 mesh, and the other two-thirds being the fine flour generally used for coring. The coarse flour is intended for making the core electrically better conducting as well as preventing the shrinkage of the core when dried. The metallic salts used for these electrodes are the same as those used in the flame-arc electrodes described above. Potassium salts and boric acid are added for supporting the arc and take the place of the potassium silicate. The boric acid may be chemically compounded with the metallic salts.

Electrodes of quite another form are used in the regenerative lamps, Fig. 9 showing characteristic cross-sections. The negative electrode, represented by *a*, contains seven cores made of the same material as the cores of common electrodes, while the shell consists of pure, first-class carbon material. The positive electrode, shown by *b*, contains a star-shaped central part, containing about 75 per cent of carbon flour and 25 per cent of calcium and alkaline salts mixed with boric acid. The triangular grooves between the ridges of this part are filled by a mixture of calcium, tungsten and alkaline salts to which boric acid is added.

A pair of these electrodes has a life of seventy hours or more. The other flame-arc lamps have also been modified to give a longer electrode life, and since the shortness of life of the electrodes has been the chief obstacle to the extended use of flame-arc lamps in this country a large development in street lighting by these lamps may be expected in the near future

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SMALL MUNICIPAL HYDROELECTRIC STATION AT THURMONT, MD.

The attractive and well-designed power station shown in the accompanying illustrations stands as a highly practical monument to the progressiveness and generosity of certain public-spirited citizens of Thurmont, Md. This charming little town, situated at the foot of Catoctin Mountain on the Western Maryland Railroad, claims the distinction of being one of the best lighted towns in the State. Last fall a stock company was formed by a few of the leading citizens and with the generous co-operation of owners of several water rights affected by the proposed development, the necessary funds were raised and construction begun Nov. 4. The plant was completed July 1, 1910, and purchased by the town at cost.

Power is obtained from Big Hunting Creek. A substantial concrete dam 213 ft. in length was built at a suitable point in the mountain gorge through which the stream flows. The water is conveyed from the dam to the power house, a distance of 4350 ft., through a 28-in. wood stave pipe. The head on the wheels is 115 ft., making it one of the highest in Maryland.

The town is lighted with sixty-three 60-cp tungsten lamps and the citizens are justly proud of their clean, well-kept and well-lighted streets. A flat rate of 10 cents per kw-hour has been fixed for residence lighting. This charge is based on the estimated sale of energy and is subject to modification, a lower rate being contemplated as the load factor on the station increases. Twenty-four-hour service is given, so that during the day nearly 100 hp is available not only for the small mills whose individual water-powers were destroyed or diminished by the municipal development, but also for numerous minor industrial applications.

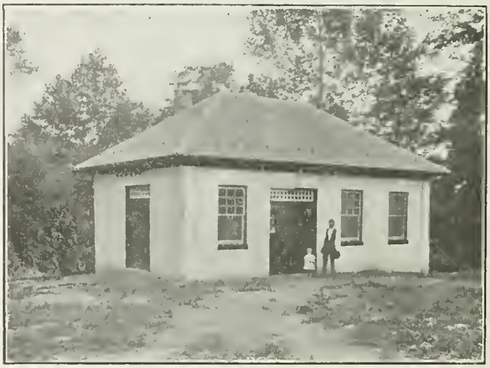


Fig. 1—Exterior of Power House.

The power-house equipment consists of two complete alternating-current generating units as follows: A 50-kw, 2400-volt, three-phase, 60-cycle generator with a 2-kw exciter, and a 30-kw generator with a 1.5-kw exciter. The generators are particularly well suited to the service. They are light in weight yet of rugged construction, well ventilated, simple in operation, with high efficiency and exceptionally low maintenance charges. Each generator is flange-coupled to a Trump high-head turbine of 90 hp and 50 hp respectively. The exciters are coupled to an extension of the generator shaft by means of an R. D. Nuttall flexible coupling. All the electrical equipment, including the switchboard, was furnished by the Westinghouse Electric & Manufacturing Company

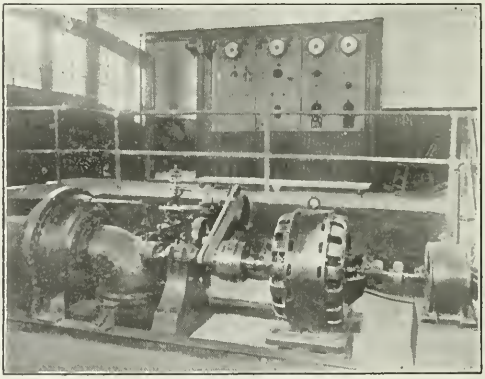


Fig. 2—Electrical Equipment.

The turbines are designed for operation under a 100-ft head, and are supplied from the single-pipe line which terminates in a cast-iron Y at the power house. Each branch of the Y is provided with a gate valve so that either unit can be operated independently of the other. An interesting feature in the design of these wheels is the provision for taking up the end thrust by means of a water cushion instead of the usual wooden thrust blocks or rings

A Woodward water-wheel governor of the compensating type is installed with each generating unit. This type of governor is especially designed to compensate for the fluctuation in pressure caused by the changing velocity of the water in the pipe line, as the gate opening is automatically adjusted under varying loads. The pipe line is also provided with a 6-in. Woodward pressure relief valve which acts positively on an increase of 2 per cent in pressure and closes with certainty when the pressure drops to its normal value. The rate of opening and closing of the relief valve is so adjusted that its operation will not cause shocks to the pipe line, and its capacity is such that no matter how quickly the gates are closed the pressure will vary but a few pounds from normal. This valve effectually protects the pipe line from excessive pressure and greatly facilitates the smooth operation of the governor and consequently of the entire system

The plant has now been in operation for some months and is thoroughly satisfactory. As an example of what intelligent enthusiasm can often accomplish in the way of advantageous development of local resources Thurmont is an object lesson to many a small town with equal opportunities but less progressive public spirit

Central Station
Management, Policies and Commercial Methods

ORNAMENTAL STREET LIGHTING IN REDLANDS, CAL.

Plans have been completed by City Engineer Hinckley, of Redlands, Cal., for the installation of a system of ornamental street lighting, using tungsten lamps supported by artistic posts, for several streets in that city. At a cost of $1.80 per front foot it is proposed to erect the posts and place the lamps and globes on portions of Orange Street, Cajon Street, State Street and Citrus Avenue at a total cost of about $15,000.

OFF-PEAK POWER SERVICE AT UXBRIDGE, MASS.

Mr. T. Russell Robinson, superintendent of the Worcester Suburban Electric Company, which operates in Uxbridge, Douglas, Whitinsville, Northbridge, Sutton, Millbury, Grafton and Upton, Mass., writes that the company has two installations of water-works pumping plants which are electrically driven. One plant requires 70 hp and the other 50 hp, and in each case the motor-driven pumps are the only apparatus in service. These installations are allowed to run only between the hours of midnight and 4 p. m., although in order to cover insurance requirements for protection against fire the company arranges to carry the pumping plants between 4 p. m. and midnight in cases of emergency, upon proper notice, and for an extra charge. One of the plants has been in operation four years, and during that time it has practically never been necessary to operate the pump after 4 p. m. The rates for these customers are divided up on a service connection charge and a running charge, and, since in some seasons of the year not as much water is needed as in others, this method of charge is equitable for both the consumer and the company

COAL MINING BY CENTRAL-STATION ENERGY.

Certainly no more convincing demonstration of the efficiency of the central-station idea of energy supply could be given than the successful operation of coal mines and breakers from coal-burning central stations several miles distant. This is actually being done in the anthracite region of Pennsylvania, where certain mine properties, in spite of having almost free fuel and producing large quantities of culm refuse, have nevertheless found it to their own advantage to install electric motors and purchase energy from central stations in nearby towns. In the same region a number of coal mines and breakers having their own power plants are electrically driven, and the operators have already learned the convenience and flexibility of motor drive. To these advantages central-station service adds relief from heavy plant investment and first cost and from the annoyance of mechanical and labor troubles.

While the principal hoisting load, in the instances of the mines and breakers referred to, has drawbacks from a central-station viewpoint on account of its heavy demand and occurrence in peaks, the service required by pumping and blowing motors is essentially twenty-four hour business, improving the load factor of the installation.

In the same anthracite field there are also a number of textile mills and other manufacturing plants which employ central-station energy for motor drive, although many of these factories are virtually built on culm piles and this material of an indifferent fuel value can be purchased at 30 cents a ton anywhere in the neighborhood.

The steaming mixture used under the boilers of the central-station plants in this region costs about $1.30 a ton. The energy which it produces large power consumers, such as the mines and mills, can purchase for 2 cents per kw-hour, or less At such a rate certain mining operators, especially those having smaller holdings and lesser resources, appear to find operation with central-station service more advantageous than by an isolated plant with practically free fuel but heavy investment costs per unit of work done.

Mine-mouth generating plants with transmission lines into neighboring cities, eliminating coal haulage, have been proposed frequently, but no instance comes to mind where such a system has actually been installed—probably because careful figures did not disclose the great saving anticipated, after transmission losses and line investment and maintenance were considered. But it is nevertheless surprising to find the order now reversed and energy being delivered *from* the city generating station *to* the mine. Central-station energy has already been made use of for the operation of metallic-ore mines. examples being the interesting systems in the zinc and lead districts near Galena, Ill., and Joplin, Mo., and at other places in the West, which have been described in the *Electrical World* In some cases, too, hydroelectric energy has been utilized for coal mining, the low cost at which the water-power could be purchased making it even cheaper than consuming coal to operate the mine. Electric drive has, of course, many advantages which the large coal companies have been keen enough to recognize in equipping their properties for operation from central private plants of large size

But it will be hard to find more convincing evidence of central-station efficacy over isolated-plant operation than these instances in which central power plants in coal-mining regions can purchase fuel at current prices, convert it into electrical energy in their highly efficient large generating units and then dispose of this energy to the mines again, to the mutual advantage of all concerned. Although this operation is strikingly reminiscent of "carrying coals to Newcastle," it seems, indeed, that the last logical position of the isolated plant has been effectively invaded by central-station service. To the central-station solicitor having isolated-plant troubles on his hands the examples that have been cited should supply a moral well worthy the thoughtful consideration of even the most obdurate customer

EIGHTEEN HUNDRED ELECTRIC VEHICLES IN CLEVELAND, OHIO.

Cleveland, Ohio, with its 500,000 inhabitants and its miles of well-paved, level streets, has 1800 electric automobiles in daily use, or one battery-propelled vehicle for every three gasoline cars. Not only is this the largest ratio of electric automobiles per capita for any city in the United States, but the actual number of vehicles, except for Chicago with its 2400 cars, is greater than in any other city in the country. The reasons for this splendid showing of electric automobiles, besides Cleveland's natural advantages of level plateaus, are assignable to several causes, chief of which, however, are the presence of several large automobile manufacturers in the city and the satisfactory low rate at which the local central-station company supplies energy for charging batteries. As might be expected under such circumstances, the cars of Cleveland manufacture practically dominate the local field in point of numbers. This condition has arisen, of course, owing to the nearby outlet which the Cleveland market affords, the special trained selling skill and enthusiasm which it has thus been possible to direct at this retail field, and the city pride and interest which Clevelanders feel for home-made products in the manufacture of which some of their friends may have an interest. In these respects alone has the electric vehicle situation in Cleveland been different from that in any other average prosperous American city, and with the same intelligent directive effort there is no doubt that similar results could be produced in other communities. Well-paved and level streets, good garage facilities and low cost of energy supply are the other qualities, which are probably equally shared by many other American cities. All of the principal makes of electric automobiles are represented in Cleveland, the Baker, Rauch & Lang, and Broc cars being manufactured there.

At least 75 per cent of the electric automobiles in Cleveland are stabled and recharged in private garages. Individual mercury-arc rectifier sets are installed, and for the energy used in replenishing the vehicles the Cleveland Electric Illuminating Company receives 5 cents a kw-hour, without demand or peak-hour limitations. As is well known, the Cleveland company employs a rate schedule charging 12½ cents per kw-hour for the first thirty hours' use of four-tenths of the principal lamp load of the residence installation. For all energy consumed above this amount, whether by the principal lamps or the so-called "unrated" load, such as lamps in back porches, back halls, bathrooms, yards, barns, cellars, etc., cooking and heating appliances, or storage-battery charging, the rate is 5 cents a kw-hour. By connecting the garage line under the same meter as the house, but without recording the automobile-battery charging demand in figuring the demand element, charging energy is obtained for the battery at the satisfactory rate of 5 cents a kw-hour without requiring a separate meter or customer's account.

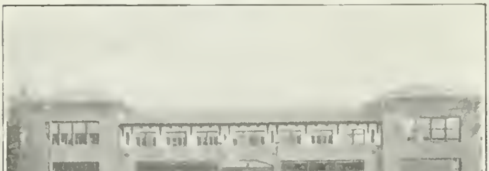


Fig. 1—Seventy-first Street Electric Garage, Euclid Avenue, Cleveland.

The average private-garage installation in Cleveland brings the illuminating company a return of from $60 to $70 a year at the 5-cent per kw-hour rate. With each car consuming about 1400 kw-hours per season it is evident that the 1800 electric automobiles in Cleveland make use of more than 2,500,000 kw-hours per year, which, coming principally as off-peak demand, is no mean factor in the central-station load. In addition to the numerous private small garages at owners' residences there are about twenty public garages in Cleveland which do charging. Purchasing central-station energy, as they do, in large quantities, these establishments obtain rates varying from 2½ cents to 2¼ cents per kw-hour. The garage rates for stabling electric cars, including charging, delivering, inspection, washing and minor adjustments, range from $25 to $35 a month, depending on the size of the equipment, average daily use made of the car and delivery service required.

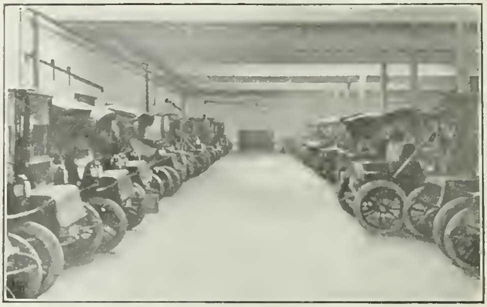


Fig. 2—Interior of Electric Automobile Garage, Cleveland.

To supply the needs of electric vehicle owners who prefer to keep their machines in public garages where they will have the benefit of expert attention several very fine exclusively electric garage buildings have been erected along the famous Euclid Avenue. These garages are attractive architectural ornaments of the high-class residential districts in which they are located, being placed back along the building line with broad green lawns and flower beds in front. The front show windows and rooms are in part used as sales offices for gasoline cars, but the large garage areas in the rear are employed entirely for stabling electric automobiles.

One of the best equipped of these public garages is that operated by the Baker Electric Vehicle Company at 7100 Euclid Avenue for the benefit of the large number of Baker car owners in Cleveland. This garage, the front of which is shown in Fig. 1, has facilities for caring for 100 automobiles, charging plugs being provided for replenishing sixty-six machines simultaneously, beside the battery-charging equipment in the battery-room. The front of the building is given over to handsome sales offices for the Baker and several gasoline automobiles, while above these are high-class bachelor apartments. Just within the main automobile entrance to the large 160-ft. x 200-ft. garage space in the rear, used exclusively for electric machines, is a hand-operated turntable onto which the cars can be run and turned for entrance to either aisle, or if necessary reversed without precarious maneuvering in the restricted space of the garage. The energy for charging the cars is obtained from the alternating-current distribution system of the Cleveland Electric Illuminating Company, being converted into direct current at 75 volts and 150 volts by 15-kw and 75-kw motor-generator sets. These pressures enable the cars to be charged with the minimum waste of energy in resistors, although rheostats are, of course, provided for regulating the current flow. By an ingenious arrangement of switch contacts a number of advantageous connections of one or more cars in series with the rheostats can be effected. The repair department of the garage is equipped to make any kind of repairs needed by electric vehicles, including lead-cell burning, etc. The rates for regular "boarding" of cars at this garage are: $25 per month for Imperials and stanhopes; $27.50 for victorias; $30 for runabouts and coupes, and $35 per month for roadsters. At least 60 per cent of the electric vehicles in Cleveland are coupés, while about 80 per cent of all the new cars manufactured in the city are of this type.

The Rauch & Lang Company, whose factory is also located in Cleveland, has a large four-story garage building on Superior Street in the heart of the downtown district. While a limited amount of regular boarding of cars is done at this place, the establishment is operated principally as a convenience to electric vehicle owners who wish to leave their cars downtown while attending business or the theater. At the same time, the cars can be inspected and adjusted, the batteries charged, or the chains boiled, without delay in the owner's use of the car. The Superior Street garage can accommodate 10 cars on the first floor alone, overflow storage being furnished on the upper stories of the building. Charging facilities are provided for 126 cars. Half the upper floor is given over to the battery department.

While this special inspection service was inaugurated as part of the manufacturer's sales guarantee, and is furnished free to owners during the first year, it is also extended after this period to owners of these and other makes of automobiles, by the payment of $2 monthly. This amount entitles the car to the same inspection service and storage during business or theater hours, minor repairs, etc., and is a great convenience to electric owners, especially since a city ordinance of Cleveland makes it a misdemeanor to leave an automobile standing more than thirty minutes in the downtown streets. A number of drivers are on hand about the garage at all times to bring in or deliver cars to their owners, for which service a nominal charge is made, depending on the distance traveled.

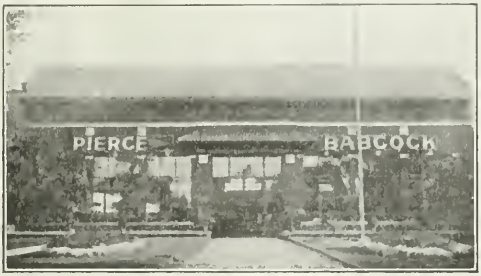


Fig. 3—Electric Garage Located at Sixty-sixth Street and Euclid Avenue, Cleveland.

Another one of Cleveland's handsome electric garages on Euclid Avenue is shown in Fig. 3. In this establishment all kinds of electric cars are handled and a few gasoline cars taken. Like the Seventy-first Street garage, the building is a pleasing one, roofed with red tile, and is surrounded by a broad lawn with flower beds.

As has been pointed out in the foregoing, the electric pleasure-vehicle business in Cleveland has been established on a substantial scale, and large investments have been made for carrying it on.

Electric pleasure vehicle owners are pleased with their machines, and the battery-charging loads provided by the cars represent substantial off-peak sales for the central-station company. As already intimated, the especially successful campaign in Cleveland, resulting in 1800 cars, has been due to the combined intelligently directed action of newspaper and theater-program advertising, personal solicitation, and, above all, the satisfaction given by the automobiles themselves. While the chief part of this work of introducing the cars has fallen on the representatives of the manufacturers, the electric company has co-operated by giving a low rate for energy, and by devoting some of its regular advertising space in the daily papers to pushing electric vehicles, thus stamping this type of automobile with its own approval.

Wiring and Illumination

THE PROFESSION OF ILLUMINATING ENGINEERING.

The last issue of the *Transactions* of the Illuminating Engineering Society contains the inaugural address of President A. E. Kennelly, which deals with the profession of illuminating engineering. Dr. Kennelly pointed out that illuminating engineering is the only profession which is in intimate relation with all of the arts and sciences underlying the various professions, namely, physiology, mathematics, physics, economics, business and esthetic arts. He stated that the public will not accept illuminating engineering as a profession unless there be a consensus of acknowledgment that illuminating engineering repays its cost abundantly. Each and every individual is prone to believe that he or she can light a street or a building as well as need be, without aid or suggestion, and nothing short of absolute demonstration that a trained illuminating engineer will do it not only much better than an untrained haphazard man, but also manifestly better, will satisfy the incredulous. However, the competent, trained illuminating engineer can light a street, dock, office, art gallery, theater or home very much better than can an untrained, haphazard man; moreover, he can demonstrate that there is by design ample light where it is wanted and little or none wasted where it is not wanted, that there is no needless glare, that the cost of the lighting is moderate and in harmony with the cost of the structures in other respects. Above all, he will be able for this expenditure to produce a much more graceful and pleasing illumination, in tones, intensities, colors, shadows and harmonies, than the haphazard man.

Dr. Kennelly stated as a general rule that any artificial lighting which forces itself upon the undirected attention of the observer is esthetically bad; good lighting is harmonious and satisfying, but unobtrusive. A good illuminating disposition will so blend with an esthetic environment as to enhance the sum total of pleasing so that the visitor is incited to admiration, but it usually takes some little examination to perceive the share of merit due to the lighting.

The illuminating engineer should maintain an unassertively co-operative attitude in the esthetic side of his work, but he is bound to maintain a vigorously assertive attitude in regard to its hygienic or physiological side. In every disposition of light sources that the engineer makes or examines it is his duty to point out and remove excessive luminous intensities from the lines of ordinary vision.

The good appearance of a room can be enhanced by bringing into stronger illumination the more beautiful or interesting portions of it. Prominent among the brightly illuminated and clamorous objects are apt to be the lamps themselves. Hence it follows that the observer is constantly apt to be reminded of the existence of a bright lamp in the room, if it lies near the level of his eyes. If the lamp, as a whole, has pleasing form and color, and these suit the environment, the perpetual stimulus to reconsider the lamp as a bright point on the retina may not be unpleasant. Unless the lamp is too bright and its visible surface has too high an intrinsic brilliancy there may be either a conscious or subconscious pleasure in its returning to the gaze. If, on the contrary, the lamp is unesthetic either in itself or in relation to its environment, the frequent stimulus to review it as a bright object may be a source of either conscious or subconscious distress.

A large and promising field open to illuminating engineering is the production of luminous colored decorative effects, both out of doors and within. The training of the public eye toward the appreciation of the beautiful in luminous display is probably slow, just as is true of the training of the public ear to the beautiful in sound. In the interior decoration of large public buildings relatively large expense in sources and patterns of colored light may be more than repaid to the community if esthetic pleasure is produced, just as a fine symphony orchestra is an intellectual and emotional asset to a large city far beyond its cost. As time goes on we may look for closer co-operation between the architect and illuminating engineer in producing color poems during times when the landscape has been forbidden by the setting sun to steal away the gaze of admiration.

Dr. Kennelly stated that it is the duty of the illuminating engineer to aid the oculist and medical man in preserving at all times the hygiene of the eye, to see that the eyes of the student receive adequate light with no unnecessary glare or specular reflection from the studied page, and to check all unnecessary waste of energy in lamps uselessly employed.

STREET LIGHTING AT GRINNELL, IA.

By J. R. Cravath.

In the *Electrical World* of Oct. 14, 1909, page 923, an article described the plans which had been accepted by the City Council of Grinnell for a complete change in the street lighting system of that town. The system has now been in operation for some time and the results are worthy of comment for the benefit of other towns of 5000 population similarly situated.

The old system consisted of inclosed multiple 6.6-amp constant-potential arc lamps, each lamp being operated from a small transformer located in one of the nearby alleys and supplied from 1100-volt alternating-current primary feeders These lamps were located usually at every other street intersection. The new system has a 100-watt, 110-volt multiple tungsten lamp on each street intersection. The small arc-lamp transformers are still located in the alleys as before, but each transformer, instead of feeding one arc lamp, feeds six of these 100-watt tungsten lamps. This system was selected rather than the series system, first, because of the lower cost of making the change from the existing system, and, second, because it avoided the use of high-voltage lines between the alleys and the street corners where the lamps were located. The problem of getting through shade trees with lines is especially difficult in this town. The company operates with a continuous grounded neutral wire in each alley and this neutral serves as a common return wire for both street lighting and commercial lighting purposes, though these services are supplied from different transformers.

The result of the change has been a remarkable transformation of the appearance of the town at night. One peculiarity of the new system, as compared with some others which have been installed, is that the lamps are located, not in the center of the street suspended from span wires, or at the curb line, as in some other cases, but directly over one of the sidewalk intersections at each corner. At first thought this might seem a peculiar location because the lamp is brought so far to one side of the street. The results amply demonstrate the correctness of the position of the lamps for these peculiar conditions, however, as most of the streets are lined with trees having very large trunks. With a lamp located in the center of the street, as were the old arc lamps, a considerable portion of the sidewalk was in shadow from the tree trunks. By locating the tungsten lamps over one of the sidewalk intersections at each corner the sidewalks in line with the intersection where the lamp is placed receive unobstructed light. The sidewalks on the opposite sides of the streets, of course, have the shadows of the tree trunks across them, but these shadows are much less objectionable and occupy less space on the whole than if the lamps were in the center of the street.

A very interesting point to be noted in connection with this installation is the great difference in the effective illumination of the sidewalks as compared with the roadways. While the sidewalks may be called very well lighted for pathfinding purposes, the roadways, although much better lighted than with the old arc lamps, still leave much to be desired as to illumination. The reason for this is the important fact, first prominently brought to the attention of illuminating engineers by Mr. Preston S. Millar in his paper at the 1910 convention of the Illuminating Engineering Society. This is, that we depend on the illumination of the street surface and the light background which it affords, rather than on the illumination of pedestrians and vehicles. The illumination of the street surface furnishes a light background against which we see objects approaching or obstructions as silhouettes. In other words, one of the first essentials is this light background. Applying this principle to the present case, the illumination of the sidewalks is good because they are of cement or wood and gray in color. The roadways on the unpaved streets are black Iowa soil, on which it requires a very high intensity of illumination to produce a background light enough for satisfactory street lighting.

The effect of "glare"—that is, the reduction of a person's ability to see, as caused by the presence of a lamp near the line of vision—is notably greater on the Grinnell unpaved streets when driving than when walking along the sidewalks. The glare of a lamp which one is approaching causes much more annoyance to the driver than to the pedestrian, for the reason that the contrast between the lamp and the black roadway surface is greater than the contrast between the lamp and the gray sidewalk surface. In other words, the effect of glare by reducing the ability to see is very greatly influenced by the surroundings of the lamp and the illumination received in the eyes from these surroundings. The greater the contrast between the lamp and its surroundings the more annoying is the glare effect. On the paved streets of the town, when they are dry, the glare effect is much less annoying than on the unpaved streets, because these streets are, like the sidewalks, gray in color.

The lamps are flexibly mounted in bracket fixtures with radial wave reflectors. The flexibility is obtained by packing hemp in between the socket and socket cover. No trouble has been experienced from abnormal breakages of lamps. The only serious trouble has been the stealing of lamps, not in the poor districts, but in the college section of town

THE LIGHTING OF A LARGE STORE.

The New York Section of the Illuminating Engineering Society held its March meeting in the auditorium of Gimbel Brothers' department store on Thursday, March 9, at which time a paper was presented by Messrs. Clarence L. Law and Albert Jackson Marshall giving a description of the selection, installation and test of the lighting equipment of this store The lighting equipment was described in our issue dated Sept 29, 1910.

The authors described the lighting equipment in each room, gave photometric curves of each type of lighting unit employed and reported the results of tests of the illumination obtained at stated places throughout each room. In each case the measured illumination was somewhat less than the calculated value, the difference ranging from 1 per cent to 34 per cent. The tests showed that the absorption of light by the accumulated dust ranged from 6 per cent for the prismatic reflectors to 16 per cent for ground-glass balls.

When all lamps were in service the mean tested horizontal illumination varied from 1.9 ft.-candles in the restaurant on the eighth floor to 9.3 ft.-candles on the main first floor

Discussion.

In opening the discussion Mr. P. S. Millar stated that from every point of view the illumination of the store could be considered good. Beyond doubt the density is adequate and the quality is as satisfactory as could be obtained with a single type of light source. However, it is possible that better results could be obtained by employing several different types of lamps in a department store in order to duplicate both daylight conditions and the different night conditions under which the various materials purchased may be used. He expressed the opinion that, from the point of view of lighting proper, the illumination on the first floor is excessive, but probably is justified in view of the advertising value of excessive brilliancy

Mr. J. S. Codman agreed with Mr. Millar concerning the excessive brilliancy on the first floor and expressed the opinion that the phenomenon of glare is too prominently in evidence.

Mr. H. T. Owens stated that the glare noticed in certain of the rooms is attributable not so much to the density of the illumination as to the arrangement of the fixtures. That is to say, the glare depends more upon the reflecting surface of the ceiling and the arrangement of the lighting units than upon the density of light flux obtained from the lamps.

Mr. G H. Stickney said that, although there can be no doubt that tungsten lamps produce the best general effects for the illumination of all floors above the first, yet it is possible that the so-called intensified arc lamps may be better suited for the illumination of the first floor. Arc lamps are more efficient and have a greater advertising value.

In reply to questions by Messrs. S. W. Ashe and Norman Macbeth, Mr. Marshall stated that the tests reported in the paper were made about five months after the lighting equipments had been installed. Some of the lamps were old and some of them were new, and in the tests so specified the dust collection had been that resulting from five months' use. The tests were based on an assumption of 120 volts at the lamps. The actual voltage varied from this value, but the variation was very slight and the corrections were relatively inappreciable. He stated that in arranging the lighting equipment for the first floor much more attention was paid to the advertising value than to the illumination. This fact accounts for the excessive illumination employed. He expressed the opinion that, although the lighting of the Gimbel store is satisfactory, even better results could be obtained by concentrating the light over the counters, with a corresponding decrease in light along the aisles, which method is preferable to employing uniform illumination throughout the whole area lighted.

NEW TELEPHONE PATENTS.

SELECTIVE SYSTEMS

Two four-party selective systems have been patented by Mr. J. Erickson, of Chicago. In each system the selection is based upon the use of two generators with shafts coupled and oppositely poled. In one system the ringer magnets are supplemented by a locking magnet which exerts its pull directly upon the bell clapper, which is made of magnetic material. At one station the bell is connected to ground from one side of the line and the lock from the other side. At station No. 2 these conditions are reversed. At stations Nos. 3 and 4 the two sets of coils are in series and grounded at the middle, but the relative direction of the windings upon the different magnet limbs is changed. Station No. 1 responds to current from one generator upon one side of the line. Station No. 2 receives no current at this time. Stations Nos. 3 and 4 have their lock magnets energized. If current be applied to the other side of the line, Station No. 2 responds and No. 1 fails. Stations Nos. 3 and 4 fail as before. For station No. 3 one generator is connected to both sides of the line simultaneously. The locks of stations Nos. 1 and 2 become effective. Station No. 3 responds, the locking magnet coils acting differentially. Station No. 4 fails, as the lock is effective. For station No. 4 both generators are used. Stations Nos. 1 and 2 are locked, and No. 4 responds.

In the second system there is substituted an electrical locking device, the contacts of which maintain the bell short-circuited at each station except when that current combination is sent which tilts the armature.

LOCK-OUT DEVICE.

A lock-out device has been patented by the same inventor. This is an apparatus including a selector, hook switch and control magnet such that the hook-switch springs are ineffective if the magnet be energized. With automatic systems using party lines such an arrangement prevents one station from interfering with the connections established to another station on the same line.

BUSY-TEST SYSTEM.

A busy-test circuit forms the subject of a patent issued t Mr. C. S. Winston, of Chicago. The circuit is used with a two-wire common-battery system. The calling-plug tip is connected through an auxiliary back contact of the supervisory relay, thence through an auxiliary contact of the listening key and through a retardation coil to ground. A tertiary winding of the operator's induction coil is connected from the retardation coil through a condenser to the live pole of the battery This patent has been assigned to the Kellogg Switchboard & Supply Company

LETTER TO THE EDITOR.

Capacity of Condensers in Parallel.

To the Editor of Electrical World.

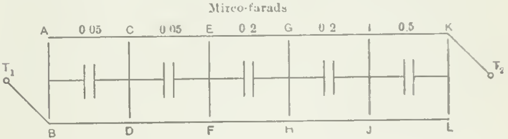
SIR:—In his communication to the *Electrical World* for Feb. 16, 1911, Mr. B. O. Lenoir endeavors to explain the behavior of his condenser under the conditions shown in his Fig 1 by electrostatic induction on the unused plates. As a matter of fact, no such assumption is necessary if his diagram is carefully studied. The 0.1-mf and the 0.2-mf sections are in series with each other, the combination being in parallel with the remaining sections. He states that a throw of ten was observed under these conditions, while only eight deflections occurred for the 0.3-mf condenser used as a standard

By assuming that the capacities are directly proportional to the deflections, which is true if other conditions remain constant, it is possible to calculate the capacity observed and compare it with the capacity computed. Thus, $8:10::0.3:x$; $x = 0.375$ mf (observed capacity). The equivalent for the capacities in series is: $1/C = 1/0.1 + 1/0.2$; $C = 1/15 = 0.067$ mf. Hence the computed capacity in the condenser is:

$$0.01 + 0.02 + 0.02 + 0.05 + 0.067 + 0.2 = 0.367 \text{ mf.}$$

It is quite possible that the reason for observed and calculated values not checking is a slight inaccuracy in reading the galvanometer deflections; it is rather difficult to read the ballistic swing of a galvanometer to tenths of a centimeter or large deflection, as the case may be.

In order to make clear the principle of action of a variable condenser, the following combinations and galvanometer readings are appended. How accurate the various sections are may be determined from the recorded readings. The sections were merely compared against each other.



Arrangement of Condenser Sections.

Referring to the accompanying illustration, with the plugs in *E*, *H* and *I*, or 0.2 mf and 0.2 mf in parallel, C is 0.4 mf, and the observed galvanometer reading was 14.3. With the plugs in *E*, *H* and *K*, or 0.2 mf in parallel with 0.2 mf and 0.5 mf in series, the galvanometer reading was 12.3. By ratio of deflections $(12.3/14.3) \times 0.42 = 0.344$ mf is the observed capacity, while $0.2 + \dfrac{1}{1/0.2 + 1/0.5} = 0.343$ mf is the computed value

With the plugs in *E*, *J* and *K*, or 0.5 mf in parallel with 0.2 mf and 0.2 mf in series, the galvanometer reading was 21.4 The plugs might also have been placed in *F*, *I* and *L* with the same result. By calculation $0.5 + \dfrac{1}{\dfrac{1}{0.2} + \dfrac{1}{0.2}} = 0.6$ mf is the capacity With the plugs in *A*, *D*, *E*, *I* and *L*, or $0.05 + 0.05 + 0.5$ in parallel, *C* is 0.6 mf and the galvanometer deflection was 21.4. The plugs might also have been placed in *B*, *C*, *F*, *J* and *K* with the same result.

The last two sets of readings check exactly with each other, although the capacities in the two cases were obtained in entirely different manners. The one is a series-parallel arrangement of the sections and the other a simple parallel connection.

It is seen from the foregoing that the condenser illustrated offers a range of capacities from 0.0194 mf to 0.1 mf.

Philadelphia. CHESLEY H. JOHNSON.

[Our correspondent intimates that the explanation by Mr. Lenoir based on "electrostatic induction" is incorrect, but fails to explain how condensers in series can be charged other than by induction.—ED.]

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Chemical Action in the Windings of High-Voltage Machines. —A. P. M. FLEMING AND R. JOHNSON.—A paper read before the (British) Institution of Electrical Engineers giving the results of tests and investigations on the failure of machines due to chemical action. No case of chemical action has been observed on windings having a voltage lower than about 3500 to ground, as, for instance, 6000-volt, three-phase, star-connected machines. Chemical action occurs only where air-pockets are present, and then only when the voltage across them is high enough to produce a discharge. While the action commences on the surfaces of the insulation exposed to air-pockets, the gases produced by the discharge may be carried beyond the zone where they are formed and produce action on other portions of the insulation outside the slots. While a discharge undoubtedly occurs between the outside of the insulation and the laminations, very little chemical action is to be expected on the exposed surface, since the gases formed can freely escape, and, further, the insulation is not usually of a kind readily affected. The action of the products of the air-gap discharge—whether these be ozone, oxides of nitrogen, nitrous or nitric acid—on the insulation is most commonly one of oxidation, and the effects produced on different materials are as follows: Untreated cellulose materials have their fibrous structure readily destroyed and disintegration follows. The oils and gums used in the preparation of insulating varnishes are practically all subjected to superoxidation, and as a result yield organic acids. Of these materials linseed oil is most readily affected. Certain asphaltum compounds are attacked only to a limited extent, and paraffine wax appears to be quite unaffected. Mica is itself unaffected, but the cements used in building it up are liable to attack on exposed surfaces. The production of nitric acid is not essential for deterioration of the insulation to occur, although when it is produced the action is greatly accelerated. The final disintegration of varnish-treated materials is greatly accelerated by the action of the released organic acids. Failure due to chemical action is almost invariably the result of a short-circuit between turns, and not, as is sometimes supposed, of a breakdown of the slot insulation between windings and ground. The short-circuit is caused either by a destruction of the insulation on the conductors, which allows the turns to make actual contact, or by the hygroscopic, and therefore conducting, matter formed between conductors when nitric acid is present. Unless the air in the cavities of the winding is replenished by "breathing" the chemical action will cease. When the stress on insulation is very high deterioration other than that due to chemical action may be produced. Thus, if the insulation is made up partly of materials of high specific inductive capacity, such as mica, and partly of materials of low specific inductive capacity, such as paper, the insulating value of the latter may be destroyed without the insulation as a whole breaking down. The precautions to be taken are then discussed under the following three heads: Potential gradient, safe working stress for any method of insulating and special methods of insulating for very high stresses. The final conclusions reached by the authors are as follows: For the range of voltages at present used failure of machines from chemical action is not to be expected when the average stress across the slot insulation is less than about 35 volts per mil with any of the methods of winding and insulating commonly employed. With windings having an e.m.f. of less than 4000 to ground the stress is usually kept below this limit by the ample thickness of insulation required for mechanical reasons. An average stress much larger than 35 volts per mil of slot insulation is safe when the size and number of conductors permit the best method of grouping and insulating to be employed, and when special precautions are observed as to the kind of materials used and the proper filling of interstices. Failure due to chemical action is almost invariably the result of a short-circuit between turns of the windings and not of a breakdown through outer insulation to ground. On this account mica or other material which is unaffected by chemical action should be used between turns whenever this action is likely to occur. While failure due to chemical action may be prevented by proper precautions, even when very high stresses are employed, there is in such cases some risk of producing a partial breakdown of the slot insulation when the ordinary pressure tests are applied. Such weakening is likely to occur when layers of material of high and low specific inductive capacity are used together, the insulation value of the latter being destroyed. In this connection it should be noted that a pressure test affords no criterion as to the safety of windings against chemical action, since the stress at which the latter takes place is usually far below that at which disruption of the insulation occurs. The green discoloration which frequently occurs on coils of any voltage treated with linseed-oil gum varnishes should not be confused with the chemical action due to the products of the air-gap discharge which takes place in high-voltage windings only. Such discoloration is quite harmless with the best makes of varnish.—Lond. *Electrician*, Feb. 24; Lond. *Eng'ing*, Feb. 24.

Sliding Contacts.—J. E. NOEGGERATH.—The first part of a paper giving the results of an extended investigation on the possibility of collecting currents by brushes from a revolving slip-ring at very high speeds. It was formerly considered that the maximum possible peripheral speed was 30 m per second (6000 ft. per minute). In his unipolar machine the author needed higher speeds and the investigation carried out as to the maximum permissible speed showed that it is possible to collect currents with a brush from a slip-ring revolving with

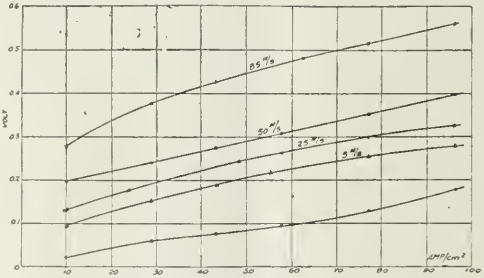


Fig. 1—Voltage Drop at Contact for Various Speeds in Meters per Second.

a peripheral speed of 100 m per second or more. The author found that the phenomena in the sliding contact have some similarity with certain phases of electric arcs. He used in the tests chiefly rings of rolled hard copper and of soft steel. He first discusses the electric phenomena in the sliding contact. The effect of current density and speed on the voltage loss in the contact for a copper-ring with a brush pressure of 0.15 kg per square centimeter is shown in Fig. 1. The lowest curve refers to the case in which the ring is at rest and simply represents Ohm's law. The higher curves refer to speeds of 5 m, 25 m, 50 m and 85 m per second respectively. These are also practically straight lines, but no longer pass through the zero point. In other words, besides the ohmic voltage drop there is an additional voltage drop which is given by the distance of the different curves from the curve referring to the slip-ring at rest. The relation which determines the value of this additional voltage drop is exceedingly complicated. Among other things, it depends upon the mechanical condition of the sliding surfaces, lubrication, etc. The author then gives the results of determinations of the losses, giving both the contact loss and the friction loss and also the sum of the two. For high speeds the total brush losses are practically independent of the speed. The author then discusses "primary mechanical effects." When the slip ring is rotating the forces which exist tend to remove the brush from the slip-ring. Often the degree of unevenness of the slip-ring surface has only a small influence on the losses at high speeds. With a well-constructed brush it is not necessary to employ a high pressure. The limit of permissible speed is not set by the brush losses, but by the wear and tear and the high centrifugal force acting on the ring, although air friction is also of importance. From present experience it may be estimated that the upper limit of the speed is 200 m per second (40,000 ft. per minute). The paper is to be continued.—*Elek. Kraft. u. Bahnen,* Feb. 14.

Unipolar Dynamo.—E. Grote and F. Davison.—A paper read before the South African Institution of Electrical Engineers describing "a suggested commutatorless direct-current generator." It is intended to generate direct current at high tension in the armature without the aid of commutation and with only two or four slip-rings and is believed to be an improvement on existing unipolar machines. The machine has not yet been tried experimentally. In the discussion which followed several speakers expressed the opinion that the machine would not work.—*Trans. So. African Inst. Elec. Eng.,* September, October and November, 1910.

Alternators in Parallel.—J. R. Barr.—A paper read before the Glasgow Section of the (British) Institution of Electrical Engineers in which he discusses the various causes which lead to unstable operation and an examination of what precautions must be taken in the design of an alternator in order that it may work satisfactorily in parallel with other sets.—Lond. *Electrician,* Feb. 24.

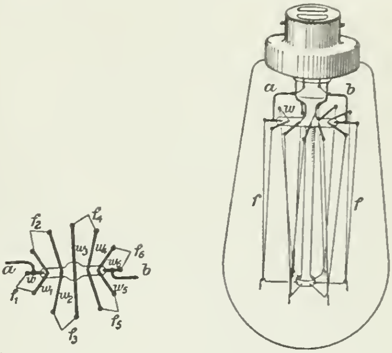
Induction Machines.—R. Rüdenberg.—An English translation of his German paper in which he shows how the vector diagrams for stator and rotor of a machine with a rotary field can be combined by giving different velocities to the time lines of the two diagrams. He then points out that above synchronism the rotor leakage is negative and therefore the reactance drop is in advance of the current.—Lond. *Electricion,* Feb. 24.

Construction of Electrical Machinery.—L. Berger.—Abstracts and discussions of various recent papers which have already been noticed in the Digest, among them that of Fischer-Hinnen on construction of electrical motors with vertical axles; a paper by Czepek on the mechanical stresses on the windings in high-speed machines, and a paper by Czepek on iron losses.—*La Lumière Elec.,* Feb. 25.

Repulsion Motor.—F. Rusch.—The conclusion of the paper in which the author applies his theory to the calculation of a 200-hp traction motor.—*Elek. Zeit.,* Feb. 23.

Lamps and Lighting.

Metallic-Filament Lamp.—L. Murphy.—A letter on the breaking of filaments in metallic-filament lamps. The author has found that in many cases the filaments break at, or close to, one of the leading-in wires, due to the discharge which must take place across this narrow gap when the pressure is applied and the filament heated. When an attempt is made to repair such a filament it will often be found that either the filament is too short to reach its correct position or if broken a little way from the support, it will catch across the adjacent filament owing to electrostatic attraction, and the lamp is short-circuited and ruined. The writer suggests that the leading-in wires should be joined to the filament at the opposite ends of a diameter of the lamp, and this may be achieved by connecting the filament loops as shown in the diagrams, of which Fig. 2 indicates the path of current, while Fig. 3 shows how the construction would be carried out in practice. The leading-in wires are shown at *a* and *b*, and the filament loops at f_1, f_2, etc., while w_1, w_2, etc., are wires embedded in the glass support for the purpose of connecting the filament loops in series. It will be noted that the current crosses the lamp between the end of each loop and the commencement of the next, so that the maximum pressure existing between any two adjacent parts is the fall of pressure in one loop only. If this construction were adopted there would be much less tendency to rupture and greater likelihood of a repair when this does occur.—Lond. *Electrician,* Feb. 24.



Figs. 2 and 3—Lamp with Improved Arrangement of Filament.

Arc-Lamp Globe.—A note on a recent British patent (9209. Feb. 16, 1911) of the Allgemeine Elektricitäts-Gesellschaft. To prevent the deposit on the inside of the globes of inclosed-flame lamps the upper portion is provided with an air jacket of glass to keep it hot. The fumes are thus condensed only on the lower portion of the globe, where a deposit does not interfere with the light radiation. A device for regulating the air pressure in such a jacket is described.—Lond. *Elec. Eng'ing,* Feb. 23

Generation, Transmission and Distribution.

Turbo-Generators in Gas Stations.—C. Richter.—The conclusion of the paper in which the author shows that in a plant driven by gas engines the use of a few steam turbo-generators is advantageous. On account of their lower first cost and lower cost of operation this method can result in considerable saving if at periods of low load some of the excess gas is employed for heating boilers for the steam turbines, since the higher efficiency of the gas engine would then be of no account. It is also shown that turbo-generators may be used in a rational way to carry the intermitting peak loads in a gas-driven plant Complete figures are given of the saving which may be expected under certain assumed conditions.—*Elek. Zeit.* Feb. 23

Northeast Coast of England.—The first part of an illustrated article on electric developments on the northeast coast of England. A review is given of the industries in this district and the history of the chief generating stations. Five of the newer stations produce electricity from waste heat, three of these, with an aggregate rating of 15,000 hp, utilize coke-oven gas, and two, of 9000 hp total rating, use exhaust steam.—Lond. *Eng'ing,* Feb 24

Isolated Plant.—An illustrated description of the new generating station built by the Midland Railway Company in England for supplying electric energy to its Derby works. There are two 1250-kw steam turbo-generators supplying three-phase currents at 440 volts directly to the works. For crane driving direct current at 440 volts is obtained by rotary converters.—Lond. *Eng'ing,* Feb. 24.

Dangerous Rises in Voltages.—J. Giles.—A paper illustrated by diagrams presented before the International Society of Electricians in Paris discussing the protection of networks against dangerous rises of voltage or increases of current, both from external causes and from causes within the network itself.—*La Lumière Elec.,* Feb. 18.

Traction.

Controller.—A note on a recent British patent (29,785, Feb. 16, 1911) of the British Thomson-Houston Company, H. C. Hastings and W. L. Wise. This is a reversing controller for series-parallel control and permits of a faulty motor being cut out without interfering with the remaining motors. A separate drum is provided for each motor or group of motors. These are mounted loosely on a common spindle with means for locking them so as to rotate with the spindle. Each drum carries three sets of contacts; one set engages the fingers when the handle is in the "reverse" position, another when the handle is set for forward running, and the third set engages with the fingers in such a manner that the corresponding motor or group of motors is cut out. Thus, to cut out a motor the corresponding drum is fixed in this position, while the others are free to rotate with the spindle.—Lond. *Elec. Eng'ing,* Feb. 23.

Railless Traction.—E. Kindler.—A fully illustrated description of a railless traction system for running omnibuses in the City of Bremen in Germany. Energy is supplied by means of two trolley wires vertically above each other at a distance of 27.5 cm (11 in.), the positive wire being below the negative wire. This method is claimed to simplify construction. The equipment of the cars is described in great detail.—*Elek. Zeit.,* Feb. 24

Installations, Systems and Appliances.

Limit Switch for Direct-Current Installations.—Numerous schemes have been put forward whereby the domestic consumer is enabled economically to take a constant demand from the network instead of throwing a peaky load on the station. The usual proposition comprises a resistance which allows a current equal, or nearly equal, to the maximum demand of the house—that is, inclusive of any lighting, heating or cooking apparatus that may be fitted—to flow all day and to perform useful work in heating water when not otherwise needed. At a time when none of the electrical apparatus is in circuit all of the current is used for heating water by means of the main resistance. As a demand arises for light or heat, other than for the water supply, more or less resistance is cut out so that the total demand always remains the same. A method for this purpose, devised by P. Good and Toulmin-Smith, makes use of three resistors connected in parallel across the mains of the City of London Electric Lighting Company. These provide the constant demand for which the supply company charges at the rate of 14 cents per watt per annum. They are immersed in a cistern at the top of the house, where the domestic hot-water supply is obtained. The cistern is lagged, but is otherwise unaltered. This arrangement allows enough hot, not boiling, water to be obtained for ordinary domestic purposes, together with one hot bath a day. During the evening, when, of course, the resistors are not in circuit for any long continuous period, the temperature of the water drops slightly, but otherwise remains fairly constant. The switch by means of which these resistors are cut out consists essentially of a long, round iron core over which, but at some distance away, is placed a cylinder of sheet iron. Between these two and surrounding the iron core are placed the coils, one fixed at the top of the core and the other at the bottom, with a third in the center, which is free to move up and down the inner core round which it is wound. The fixed coils are in series with the resistors and the movable coil is in series with the lamps or other apparatus on the installation. When a lamp is switched on the movable coil becomes slightly energized and is attracted up the core a certain distance. This movement cuts out one of the resistors. Switching on more lamps cuts out another resistor, while a third movement cuts the last resistor out. Of course, with such an arrangement it is impossible to keep accurately to the stated demand. On the other hand, it is quite possible to keep within the limits laid down by the supply company, and this is all that is needed. A fourth contact switches in a dimming resistor and comes into action when the standard demand is much exceeded. As the lighting demand decreases the switch falls back by gravity.—Lond. *Electrician,* Feb. 24.

Wires, Wiring and Conduits.

Network Analysis.—J. R. Dick.—A paper fully illustrated by diagrams in which the author discusses two methods of network analysis, both of which are ultimately dependent on Kirchhoff's laws, to discover whether a conductor is being overloaded and to find the exact voltage at a point where there are no pilot wires. The two methods given are the current and voltage methods. These are analyzed and examples showing how they are employed in practice are worked out.—Lond. *Electrician,* Feb. 24.

Electrophysics and Magnetism.

Hysteresis Loss.—R. Jouast.—The author reviews the recent paper of Richter, who prefers the formula $aB + bB^2$ to Steinmetz's formula $cB^{1.6}$ for the hysteresis loss. The present author states that the Steinmetz formula represents the facts for all steels for which with an induction of 10,000 the Steinmetz coefficient is above 0.002. On the other hand, for steels with low hysteresis loss a formula containing two constants is preferable, or even necessary. He believes that a more general formula, such as that of Richter, is better adapted for the general purposes of electrical engineers.—*La Lumière Elec.,* Feb. 25.

Electrochemistry and Batteries.

Refining of Pig Iron in the Electric Furnace.—J. B. Nau.—An article on the use of the electric furnace for the preliminary refining of pig iron, more especially of phosphoretic pig iron too high in silicon to be treated directly and economically in the open-hearth furnace. This method consists of running the liquid iron from the blast furnace through a column of heated ore and letting a bath of metal accumulate on the bottom in such a way that the lower part of the refining ore column is kept immersed in the liquid iron. In order to obtain the correct temperature the process can best be carried out in an electric furnace. The author gives a balance sheet of the materials and a heat balance sheet of the process and calculates the electrical energy required.—*Met. and Chem. Eng'ing,* March.

Electrolysis in the Paint and Varnish Industry.—F. M. Perkin.—A paper read before the (British) Paint and Varnish Institute in which the author discusses the application of electrolytic methods to materials used in the paint and varnish industry. White lead and certain metallic pigments can be made by electrolytic means, but the subject has not been very thoroughly worked out as yet. There is room for research, and such research would prove of great value to the paint and varnish trade. Electrical energy can now be produced at a very low rate, so that the cost of energy is not the hindrance it would have been some years back. The actual energy cost might be almost negligible, provided the pigments obtained were better either in color and shade, or in state of division, than those made by other methods or, again, if certain pigments which are not readily obtained by other means could be more easily made electrochemically—Lond. *Electrician,* Feb. 24.

Aluminum.—W. Clacher.—Some notes on the manufacture of aluminum as carried out by the British Aluminum Company. The allocation of cost is given as follows:

	Per Ton.
Energy	$25.00
Carbon	32.50
Alumina	140.00
General expenses and profits	140.00
	$337.50

Some notes are added on the purification of bauxite.—*Met. and Chem. Eng'ing,* March

Manufacture of Carbon Electrodes.—W. Clacher.—An illustrated description in some detail of the method of the manufacture of carbon electrodes in use at the works of the British Aluminium Company, with special reference to the chemical problems involved and the machinery used.—*Met. and Chem. Eng'ing,* March.

Electro-Analysis.—R. C. Benner.—An illustrated article on a new form of gauze electrode for the rapid electrolytic determination of lead and copper.—*Met. and Chem. Eng'ing,* March.

Units, Measurements and Instruments.

Measurement of Permeability in Low Fields.—E. Gumlich and W. Grogowski.—The measurement of the permeability of iron in very small fields has recently become of importance for practical purposes, for instance, in connection with Pupin coils, instruments, etc. For this purpose it is absolutely necessary to have a method by which the sample under test can be completely demagnetized, since even traces of remanent magnetism can cause considerable errors. The authors have found by experience in the Reichsanstalt that the least trace of magnetism can be removed if the demagnetizing alternating current is decreased with absolute uniformity, without any sudden changes, such as always occur with commercial rheostats The authors have devised an apparatus in which this result is obtained and give the results of tests of various iron and steel samples in a table.—*Elek. Zeit.,* Feb. 23.

Induction Meter.—A Iliovici.—The conclusion of his paper on the theory of the disk induction meter. In the present instalment the author gives some practical conclusions and experimental verifications. Among his practical conclusions are the following. On the one hand, it is necessary that the thin-wire coil represents as nearly as possible an ideal reactance coil—that is, it should have a relatively low ohmic resistance. On the other hand, the disk should fulfil the opposite condition and have a high resistance and a low inductance. The author concludes that aluminum disks are preferable to copper disks and that a large air-gap is required.—*La Lumière Elec.,* Feb. 18.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—G. E. Petit.—The author shows how it is possible by means of two vertical wires to determine at a receiving station the direction from which a wireless message is received. He uses an arrangement which he calls radio-phase meter.—*La Lumiere Elec.,* Feb 25.

Miscellaneous.

Heating Apparatus.—A note on a recent British patent (10,595, Feb. 16, 1911) of Evershed & Vignoles, A. Schneider and W. Clark. A heating element consists of a resistance wire wound longitudinally or spirally in grooves on a tube of soapstone or steatite. An envelope of copper entirely surrounds the coil and has an extension passing up the center of the core The insulation between the copper and the wire may be mica, but is preferably air only. The copper envelope is in direct contact with the body or vessel to be heated.—Lond *Elec Eng'ing,* Feb. 23.

Book Review.

The Watt-Hour Meter. By William M. Shepard and Allen G. Jones. San Francisco: The Technical Publishing Company. 184 pages, illus. Price, $2.

The purpose of this book is to supply the central-station manager, the practical meter man and the student with information relating to the watt-hour meter, its installation, testing and maintenance. Four of the eight chapters are descriptive of various types of meters. One chapter treats of the selection of meters and various points affecting their accuracy, and the remaining chapters relate to measurement of energy, maintenance and testing, and rates. An appendix contains definitions of some electrical terms and several pages on testing and adjustment that appear to belong in the body of the book. We fear that the mathematical treatment of the effect of power-factor and on the use of single-phase meters on polyphase circuits will be found rather difficult reading by the practical meter man. Otherwise the information given is quite practical in character, and the book as a whole will be found useful by everyone having to do with the installation, testing and maintenance of watt-hour meters.

New Apparatus and Appliances

HIGH-VOLTAGE CABLES.

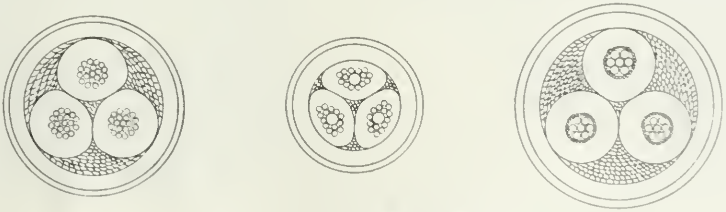
The cables illustrated herewith have been built for high-voltage operation and hence possess features of much interest from the point of view of insulation. The main insulation consists of a specially prepared impregnated paper which is capable of withstanding about 2.5 times as great a "puncture" voltage as the American manila paper frequently used for a similar purpose.

Fig. 1 is a sectional view of a cable designed for a normal working e.m.f. of 20,000 volts, the test e.m.f. being 60,000 volts and the puncture e.m.f. in excess of 200,000 volts. Each conductor has a cross-sectional area of 100 sq. mm (about 200,000 circ. mils).

Fig. 2 relates to a 10,000-volt cable tested at 30,000 volts. Each conductor section is 70 sq. mm (140,000 circ. mils).

Fig. 3 shows a section of a cable which has been tested at 150,000 volts and is intended for operation normally at 60,000 volts. Each conductor has a cross-sectional area of 100 sq. mm (200,000 circ. mils).

These cables have been built for the market by the Siemens-Schuckert Werke. Berlin, Germany



Figs. 1, 2 and 3—Cross-Sections of Cables.

AUTOMATIC FUEL-OIL REGULATION.

Practically all oil-fired boiler plants are controlled by hand. Steam as well as oil is regulated at each individual burner and the dampers are also subject to hand control. Results obtained are hardly ever satisfactory, thereby lowering the efficiency of the boiler plant. The first notable step in advance of hand firing was at the plant of the Pacific Electric Railway Company, Los Angeles, Cal., where, under the directions of the chief engineer, one man stationed near the oil pumps, running at practically constant speed, controlled eighteen boilers, or fifty-four burners, by opening or closing a bleeder valve on the oil-pump discharge line, thereby increasing or decreasing the pressure in the oil main and simultaneously the rate of firing of all the boilers. After this it was a simple matter to substitute automatic regulation for hand control, thereby developing the Moore automatic fuel-oil regulating system, built by Charles C. Moore & Company, San Francisco, Cal. This system controls the supply of oil to all burners, the supply of the atomizing agent to all burners and the supply of air for combustion for any number of boilers all from a central point. The results are increased boiler-plant efficiency, the practical prevention of smoke and the decrease in the maintenance cost of boiler equipment due to a more uniform manner of firing. A system of this kind was first installed at the Redondo plant of the Pacific Light & Power Company in 1907, where the regulating system is used to control the entire plant of eighteen boilers of 600-hp capacity each, and the increased economy, due to uniform rate of firing, is very evident. Under actual operating conditions this system of regulation has been found absolutely reliable.

COMBINATION SOLDER AND FLUX.

The Solderall Company, 143 Liberty Street, New York, has brought out a new form of solder for general electrical work. The compound consists of a pulverized tin solder combined with a special non-corrosive flux made into paste form and put up in convenient collapsible tubes. The advantage of the compound is its convenience in handling, being complete and ready for instant use. A little is squeezed from the tube on the parts to be joined and the application of heat completes the job For joining wires and small work an ordinary match is said to suffice, while for larger work a hot iron or torch is recommended. The collapsible tubes are of such size as to be readily carried about in the pocket, and as they have a pointed screw top the material is easily applied without wasting. The replacement of the cap makes evaporation of the flux impossible, thus keeping the compound in its plastic or pasty condition.

Collapsible Tube Containing Solder.

STARTING SWITCH FOR INDUCTION MOTORS.

The accompanying illustrations show a switch for controlling induction motors put on the market by the Midland Electric Manufacturing Company, Midland, Mich. The device is applicable for motors rated as high as 10 hp. In its first position the switch places in circuit fuses heavy enough to protect the motor at starting, and in its final position fuses of smaller rating are in circuit to protect the motor against any possible overload in operation. The switch is first moved forward to the position shown in Fig. 1, which places into circuit the larger fuses located at the entrance of the building at the meter loop, or in a large installation at the distribution panels. A further push places the switch in the running position, as shown in Fig. 2. The switch blade proper has now passed out of contact and the circuit is formed through the smaller fuses mounted above the blades of the switch. When stopping the motor the switch is pulled out of contact just as an ordinary knife switch. A feature to which the manufacturer draws attention is that there is no appreciable interruption of the circuit in changing from the starting to the running positions, since the blade of the switch and the contact member of the fuse are so close together that one or the other is in contact during the operation, thus preventing any tendency to arcing.

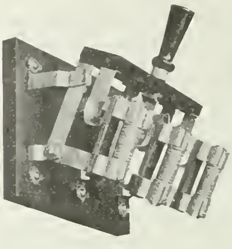


Fig. 1—Starting Switch in Starting Position.

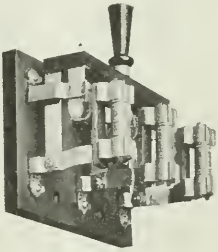
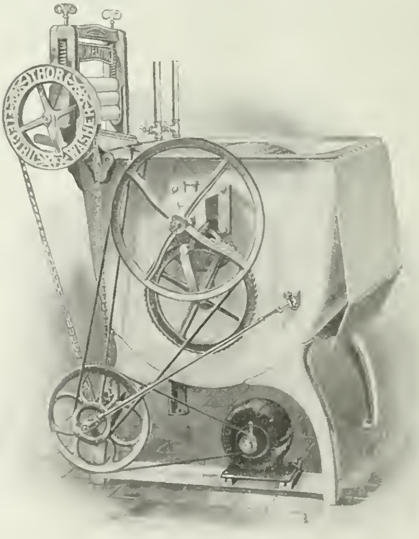


Fig. 2—Starting Switch in Running Position.

STATIONARY ELECTRIC LAUNDRY MACHINE.

To meet the demand of architects and owners of homes for a permanent stationary electric laundry machine, the Hurley Machine Company, of Chicago, has devised the machine known as the Thor Electric No. 3 and shown in the accompanying illustration. The body of this machine is made of solid porcelain or white enameled cast iron. It is fitted with a wooden cylinder in which the clothes are washed, and which is arranged to make several revolutions in one direction and then reverse automatically. A ¼-hp Westinghouse electric motor furnishes the power to operate the washer and also a three-roll reversible wringer which is attached to the body of the machine. The principle of the automatically reversing washing machine is covered by patent, and the reversible wringer is also patented.

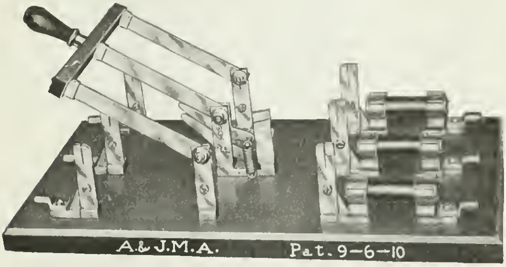


Electric Laundry Machine.

All mechanisms are made of bronze, nickel-plated, with the exception of the reversing gears. The cover of the machine is of highly polished German silver, and nickel plated brass connections for hot and cold water are fitted to the machines. The drain is provided with a standard brass flange coupling which may be easily connected to the regular laundry tub drain. The machine presents a notably clean and attractive appearance, and is designed for permanent use in the better class of residences and apartments.

INDUCTION MOTOR-STARTING SWITCH.

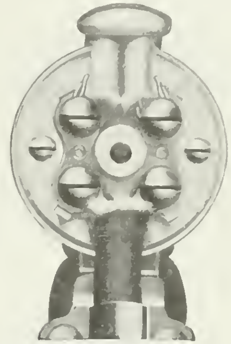
The motor-starting switch illustrated herewith was designed to secure protection of motor and starting compensator without the use of a very complicated mechanism. The most important advantage sought is to prevent the connection of the motor across the mains at full voltage without first connecting it to the compensator. This is accomplished in positive manner by a blade stop, which allows the switch to be thrown to a running position only after it has first been cut into the compensator side. Another important safeguarding feature is that the switch will remain in the compensator clips only so long as it is held there by hand, two powerful springs being used in such a manner that on releasing the handle the switch immediately flies open. This feature is considered important, as a careless operator is liable to leave the switch as soon as he sees the motor running without throwing it over to the running side, which would result in the burning out of the compensator. The over-all dimensions of this type of switch are only slightly greater than those of the standard double-throw switch of like capacity. The designer and manufacturer of this switch, Albert & J. M. Anderson Manufacturing Company, Boston, Mass., is prepared to furnish switches of this type in 25-amp, 50-amp, 75-amp, 100-amp and 150-amp sizes.



Induction Motor-Starting Switch.

TERMINAL BOX IRON.

The Diamond Electric Company, Binghamton, N. Y., has brought out an electric flatiron having a terminal box attached to the rear upright of the handle strap, together with an improved clip for gripping and supporting the cord at the back of the handle. By this arrangement two desired results have been obtained—easy cord renewal and cool connections. This first feature will be greatly appreciated by repair departments of institutions and business houses where a large number of irons are in use. The only connections in this iron are within the terminal box, and those versed in the art know that every hot electrical connection is a seat of trouble. A porcelain block supporting binding screw plates is inclosed in an insulated pressed-metal box located away from the heat of the iron. The removal of one screw frees the cover and exposes the entire box with connections. The cord clip is a pressed-metal bracket so shaped and supported as to allow the cord to leave the iron at a convenient angle and terminates in two diameters, one gripping the cord, the other gripping the protecting spring, a thread being pressed into its inner surface for this purpose. The removal of two screws separates the gripping end and frees both cord and spring. That the ends of the resistance wire, comprising the heating element, shall not conduct heat to the terminal block they are folded back upon themselves and twisted tightly their entire length, thereby greatly decreasing their resistance and producing mechanically strong and cool terminals. These ends are then brought out of the body of the iron and fastened to the binding screw plates on the terminal block, to which are also attached by separate screws the ends of the attaching cord. The parts are in full polished nickel plate and neatly designed, giving the iron an attractive and pleasing appearance



Terminal Box Attached to Handle of Flatiron.

ELECTRIC TOASTER, STOVE AND GRIDDLE.

In the toaster, stove and griddle manufactured by the Pelouze Electric Heater Company, Chicago, the principle known as "radiant suspension" of applying heat is employed, the object being to utilize radiant heat with the greatest possible speed and with the smallest loss. By suspending the conductors in the air above a proper reflector these results are said to be obtained, but not without mechanical difficulties. As the conductor expands rapidly under the influence of the heat, tension devices must be provided to take up the slack in order to avoid short-circuits. This difficulty has been overcome in the apparatus illustrated herewith. The power consumption of the toaster, stove and griddle is said to be 450 watts The device is said to be capable of toasting the first piece of bread in fifty seconds and each piece thereafter in forty-five seconds. The heating element is complete in one piece with the contacts and is supported from underneath by one screw. Moreover, the elements are interchangeable. Being of the horizontal type, it

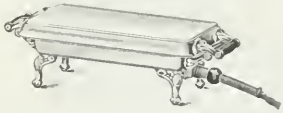


Fig. 1—Toaster Used as Griddle.

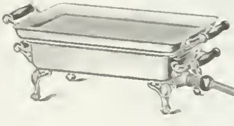


Fig. 2—Toaster Used as Stove.

is necessary to collect crumbs, or otherwise there would be objectionable smoking. In the toaster under discussion there is a nickel-plated tray, removable from one end, provided for this purpose. The stove attachment, or chafing dish, used in connection with the toaster provides a practical, useful cooking device, combining successfully an efficient toaster, stove and griddle. The toaster includes also an upper rack provided for keeping the toast heated, or to act as a plate warmer. This rack may be removed when the toaster is used as a chafing dish or griddle. A feature of the Pelouze devices is a quick break-switch block. The operator grasps a ball attached to a tempered spring, which permits of a jump or quick break, thus avoiding arcing or contact troubles

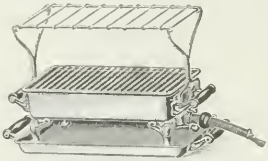
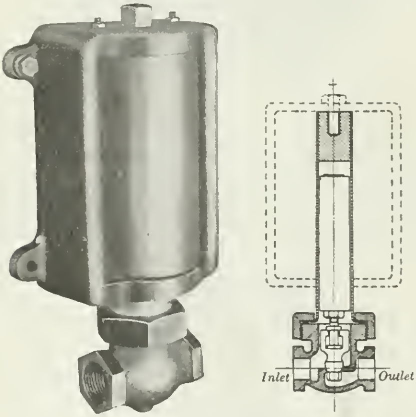


Fig. 3—Pelouze Toaster.

SOLENOID-OPERATED VALVE.

A very interesting and uncommon solenoid application is employed in a device just developed by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. This is a solenoid-operated valve shown in its final design in the accompanying illustration. The construction employed permits of the placing of the plunger inside the piping system and entirely eliminates stuffing-box frictions. The energizing of the coil lifts the solenoid plunger through a short, free travel, unseating the valve by a hammer blow. After the valve is started the pressure becomes nearly balanced. The coil circuit can be run wherever desired so that the valve can be operated from any location or series of locations according to the arrangement. These devices find many uses in hydraulic or pneumatic systems, with self-starters, for remote control of valves used for setting the brakes in a pneumatic brake-control system, etc. When arranged with a thermostat in a heating system they can be made to control automatically the flow of steam as desired. In signal systems where air-operated whistles are used these valves save piping and enable the ready control from a central location. In garages the air in compression tanks used for inflation of tires can be controlled by these devices with operating switches placed where convenient. The employment of this device as air unloader in connection with a double-acting compressor relieves the difficulty found in starting under compression. The arrangement consists of a by-pass automatically operated by the valve which permits the pressure to be released from the cylinder (preventing compression) until the desired speed has been reached, when this by-pass is automatically closed, loading the compressor. The valves are built in four standard sizes—3/8 in., 1/2 in., 3/4 in. and 1 in., threaded for standard iron pipe and having an area of opening approximately equal to that of pipe of same rated size. The standard coils are wound for voltages of 115, 230 and 500



Solenoid-Operated Valve.

WESTINGHOUSE BANQUET.

On Saturday evening, March 11, the Fort Pitt Hotel, Pittsburgh, was the scene of a banquet attended by nearly 450 men representing the Westinghouse interests in the vicinity of Pittsburgh. The banquet was held under the auspices of the Westinghouse Club, which draws its members from these interests, which include: The Westinghouse Electric & Manufacturing Company, the Westinghouse Machine Company, the Westinghouse Air Brake Company, the Union Switch & Signal Company, the Nernst Lamp Company and one or two other subsidiary companies.

The object of the gathering was to promote a feeling of good fellowship and afford a means for social intercourse among the employees of the various establishments.

Mr. E. M. Herr, vice-president and general manager of the Electric company, was toastmaser. Before introducing the speakers he gave a brief history of the Westinghouse Club, its purpose and its wonderfully increased activities of late, its membership having increased 150 per cent in the last six months. The first speaker was Mr. L. A. Osborne, who responded to the toast "A Young Man's Outlook," and told of the wonderful opportunities of a young man and also of his responsibilities.

Mr. F. R. Babcock, president of the Pittsburgh Chamber of Commerce, spoke in an interesting manner of Pittsburgh and the Westinghouse industries, telling what a tremendous factor these industries have proved in the rapid growth of the greatest machinery-making city in the world.

Mr. C. A. Terry, of New York City, first vice-president of the Electric company, spoke of "Ye Olden Times" and in a most instructive and illustrative address told of the early struggles of Mr. George Westinghouse and traced briefly the manufacture of electrical apparatus from the early days down to the present time. He took occasion to advise the young men before him to master thoroughly all engineering details and devote themselves by close and energetic application to their respective duties.

Mr. H. T. Herr, general manager of the Westinghouse Machine Company, spoke on "Prime Movers," giving brief accounts of some of those who have helped the Westinghouse industries attain their prominence in the industrial world.

"Short Stops" was the subject assigned to Mr. W. V. Turner, chief engineer of the Air Brake Company. Mr. Turner related briefly the history of the development of the air brake by Mr. Westinghouse. He also spoke of the young men and their opportunities, stating that "Short Stops" by older heads were often necessary to prevent the young man's enthusiasm carrying him too far.

Mr. H. E. Longwell, consulting engineer of the Machine company, proved to be the humorist of the evening and in discussing "Perplexities" soon had his audience highly amused by his witty remarks.

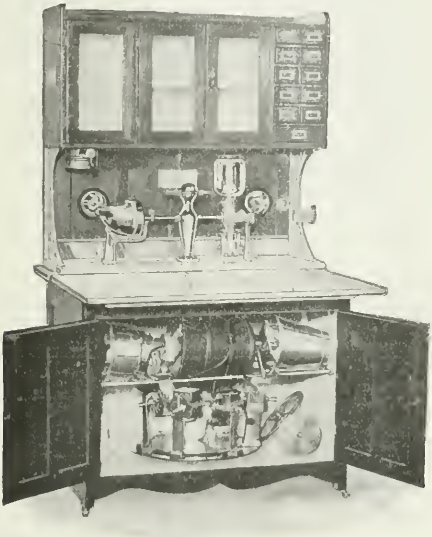
"Resonance" was assigned to Mr. J. J. Jackson, of the legal department of the Electric company, and the speaker, at the beginning of his remarks, confessed his ignorance of such a technical subject and his chagrin at having had such a subject assigned him. His hearers, however, soon felt that the legal mind really was quite well versed in the meaning of resonance, as he neatly turned it into a plea for co-operation between fellow workers, producing harmony all along the line.

Mr. Walter G. Cary, manager of the Westinghouse Lamp Company, Bloomfield, N. J., in a few well-chosen, happy remarks concluded the speaking with an address on "The Brighter Side of Life."

The banquet proved to be such a great success that steps will be taken to make it an annual event.

ELECTRIC KITCHEN CABINET.

Domestic applications of electrical energy have brought many conveniences in their train, but perhaps the most compact and elaborate combination of electrically operated culinary devices is the electric kitchen cabinet made by the Federal Electric Company, Chicago, and shown in the accompanying illustration. In the base of the cabinet is a ⅛-hp electric motor connected to a shaft-head on the table bed, where the two ends of the shaft are available for connection to various appliances. The motor is placed in a separate compartment where it cannot be tampered with or cause injury to persons unfamiliar with the use of machinery. It is controlled by a conveniently placed switch on the inside of the back wall of the cabinet. The revolving ends of the shaft arms are protected by swivel collars so that the clothing or fingers of the user will not be caught even when the devices are operated at full speed. Furthermore, all gears on the various pieces are protected by guards to prevent accident. In addition to the mechanical features the cabinet serves the purpose of the ordinary kitchen cupboard in the various operations of preparing food for cooking or for the table. Eleven distinct appliances make up the complete equipment of this cabinet. When not in use they are kept on the racks in the lower part of the cabinet. These attachments consist of a bread mixer, a cake mixer, an egg beater, a vegetable slicer, a coffee grinder, a meat cutter, a potato or lemon grater, a cherry pitter, a knife sharpener, a knife polisher and an ice-cream freezer. A special extension shaft is provided to operate a pulley at the right-hand side of the cabinet, to which the ice-cream freezer or even a sewing machine or other household device may be belted.

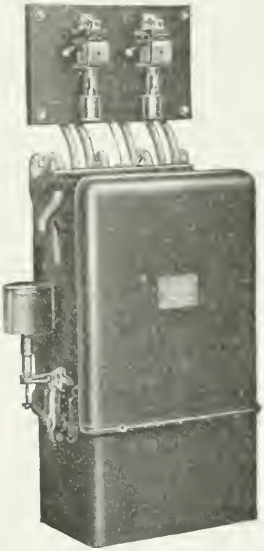


Electric Kitchen Cabinet.

The various utensils are provided with a standard base with beveled edges, this base fitting into the grooved channel under either power arm. The piece to be used is slipped into the groove up against the power shaft and clamped in place by a lever at the front of the grooved channel. Any piece can be put on or taken off without stopping the motor and two utensils can be operated at the same time. Excepting the wooden tub of the freezer all appliances are nickel-plated and easily taken apart for cleaning. The cabinet is made of oak, in golden oak finish, and stands 5 ft. 10 in. high, occupying a floor space of 30 in. x 44 in. It is mounted on casters. An attachment cord with standard-base plug is provided for connecting the motor to any convenient socket. The upper part of the cabinet is divided into compartments for flour, tea, coffee, sugar, spices, etc. This cabinet is particularly adapted for use in hotels, restaurants or boarding houses, where it is said that it will save its cost in a year's time by reducing the cost of labor in the kitchen.

AUTO-STARTERS FOR INDUCTION MOTORS.

A line of alternating-current starting devices for use with squirrel-cage induction motors, and known as the auto-starter, has just been placed on the market by the Wesern Electric Company. The line has for its features a no-voltage release, relay protection from overloads and a foolproof switch. They are made for standard two-phase and three-phase circuits, and in both wall suspension and floor types. The core and windings, the cable clamp and switch are assembled in a substantial iron case. Each phase is provided with an inductive winding on separate legs of a laminated core, each winding being provided with several taps in order that the auto-starter can be adjusted to individual starting requirements. As all parts are readily accessible these taps can be easily changed. Perhaps the most important feature of this auto-starter is the foolproof switch. This switch, which is oil-immersed, is located at the bottom of the case, which arrangement permits of the removal of the inclosing oil tank for inspection or removal of the oil or contacts without taking the auto-starter from its mounting or disconnecting any of the leads. The current-carrying parts of the switch are of the railway-controller type, the contacts being of heavy copper. To keep the attendant from throwing the motor directly on the line instead of going first to the starting position, an automatic latch is provided, so arranged that the lever at "off" position can be thrown into



Auto-Transformer Starter for Induction Motors.

the "starting" position only. This latch also prevents going from "starting" to "running" in any manner save with a quick jerk, thereby avoiding any appreciable drop in the speed of the motor and a consequent increase in current while passing between the two latter positions. A no-voltage release, consisting of an ironclad solenoid with a movable core, shunted across the line is a simple device which opens the starter switch when the voltage drops below an allowable low-voltage value for which the release is set. This causes the starter switch to return to the "off" position and disconnects the motor from the circuit.

The auto-transformer starters are provided with a flat fuse block on which are mounted cartridge-type fuses separated by barriers. These fuses are connected on the running side of the starter circuit, and are not in circuit when the auto-starter switch is in the "starting" position. If preferred, an overload-release panel can be substituted. The overload release consists of two solenoids with movable cores which at a predetermined value of line current pick up and open-circuit the no-voltage release coil, which in turn causes the switch to return to the "off" position. The use of these relays also prevents the motor from running on single-phase, for the increased load due to the motor running on single phase will cause the relay to trip and return the switch to the "off" position.

MERCURY-ARC RECTIFIERS FOR MOTION PICTURES.

One of the most important factors contributing to the success of a motion-picture theater is the quality and brilliancy of the light projected from the lamps. For pleasing effect motion pictures require a steady, white light of sufficient intensity to bring out the natural light and color values of the films, and the theater having the best quality of light stands the best show of getting the biggest patronage. It is well known that the light obtained from direct current is much superior to that from alternating-current arc lamps. However, until recently all those who could obtain only alternating-current supply have got along with the poorer quality of light simply for the lack of apparatus for economically converting alternating current into direct current.

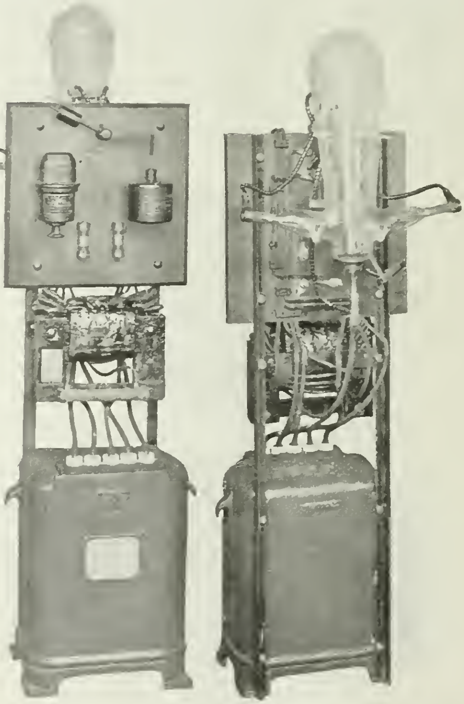
In the accompanying illustrations is shown a mercury-arc rectifier developed by the General Electric Company for furnishing current of the desired character at a cost less than that of the most economically operated alternating-current arc lamp.

There are certain facts which should be borne in mind while making an analysis of the cost of producing a given intensity of projected light from alternating current, direct current and rectified current with the most approved devices applicable in each case. For instance, the best class of motion pictures require a light intensity of upward of 8000 cp, and as 5000 cp is the maximum obtainable from alternating current with the best auto-transformers or the highest current values practicable, it is evident that the use of alternating current under such conditions is entirely unsatisfactory owing to the insufficiency of the light. Where direct-current supply is obtainable some have found relief by using it, but their experience has served to emphasize the prohibitory effect of the additional cost entailed by the loss of at least 60 per cent of the energy drawn from the line in the resistance or rheostat employed to regulate the current in the arc.

These facts serve to define the limitations of both the alternating-current and the direct-current arc relative to motion-picture lighting, but in order to give the various alternating-current methods a fair basis for comparison, assume that a light intensity of 5000 cp is required. From actual determinations carefully made it is found that to obtain 5000 cp from a 110-volt alternating-current circuit with rheostat requires 7 kw; a 110-volt direct-current circuit with rheostat requires 2.25 kw.; any alternating-current circuit with auto-transformer requires 2.1 kw; any alternating-current circuit with mercury-arc rectifier requires 1.7 kw.

Since auto-transformers are extensively used in alternating-current supply systems to obtain a substantial reduction in energy consumption, the method of using alternating current with rheostats may be considered as obsolete, and since a prohibitory amount of energy is wasted in using direct current with a rheostat that method also can be omitted from present consideration. This fact enables a direct comparison to be made between the results obtained from alternating current with the use of economizers on the one hand and mercury-arc rectifiers on the other.

The figures given above show a difference of 400 watts in favor of the mercury-arc rectifier. This means that on the basis of an average daily run of seven hours at a cost of 6 cents a kw-hour the use of a mercury-arc rectifier provides a light having all the advantages of that given by a direct-current arc at a cost at least $60 per year less than that obtained from alternating current with the best type of auto-transformer.



Front and Back Views of Mercury-Arc Rectifier for Moving Picture Machine.

Furthermore, it is evident that when the light intensity required exceeds 5000 cp, thus rendering the alternating-current method inapplicable, the saving effected by the use of the mercury-arc rectifier as compared to the cost of using direct current with a rheostat is much more significant. For instance, to obtain 7500 cp requires 3.1 kw from direct current with rheostat and 2.15 kw from alternating current with mercury-arc rectifier. The difference in favor of the mercury-arc rectifier is 950 watts, which means a saving of at least $145 per year.

In addition to the positive money-saving capability of the device the excellent light of practically any candle-power obtainable from alternating-current supply and the reliability, ease and safety of operation render the mercury-arc rectifier particularly desirable for making pleasing and successful "photo plays."

Industrial and Commercial News

The Week in Trade.

NUMEROUS buyers have been present in the principal distributing markets during the past week, which has produced a moderate degree of improvement in the house trade done by wholesalers and jobbers. There has been apparent during the past week some slight check to the forward movement in the iron and steel industry. This is attributed principally to the uncertainties engendered by the calling of an extra session of Congress and to the general feeling of apprehension developed by the disturbances along the Mexican border. It is not, as a rule, believed that the passage of the reciprocity agreement with Canada will seriously affect our iron and steel mills. It is known that the Canadian plants are well supplied with orders, and it is hoped that with reciprocity there may come a considerable demand upon the mills of this country from the Dominion. Our own railroads, however, are still buying material along very conservative lines—in fact, are only filling insistent requirements. Special machinery is in very light demand and at many points hundreds of skilled mechanics are out of employment. Wire products have been advanced $1 per ton, and this branch of the industry is being operated at almost full capacity. Building operations have not as yet become as active as was hoped for, although better reports are anticipated as the weather grows more favorable. Collections are reported as being only from fair to slow. Failures for the week ended March 9, as reported by *Bradstreet's*, were 230, as compared with 256 the previous week, 250 in the same week of 1910, 254 in 1909, 278 in 1908 and 186 in 1907.

The Copper Market.

KEEN competition for business among the large wire-drawers of the country made a very much better demand for copper last week than the ordinary market has experienced in recent months. While sales were not large, and there will be no records made, manufacturers from all parts of the country seemed eager to lay in limited stocks. It seems apparent that the demand for copper wire is extending, and this speaks well, of course, for the general electrical industry. It is stated that owing to this competition among manufacturing interests the sales of bare copper wire and cable strands have been made in recent weeks at very close to the cost of manufacture. Such prices have brought out numerous inquiries from traction and lighting companies all over the country, and manufacturers are preparing themselves for prospective orders. Most of the sales made last week were in lots of 1,000,000 lb. or more at 12¼ cents delivered for electrolytic. On the other hand, the demand for casting and other grades of copper is comparatively dull. The majority of the recent sales have been made by independents, the Amalgamated apparently not caring to reach the lower level of prices. The report of the Copper Producers' Association for February, which was made public last week, shows an increase in the surplus stock of copper amounting to 14,198,280 lb. The production was 109,828,297 lb., as compared with a production of 115,696,591 lb. in January, but the decline was entirely due to the fewer number of working days in February. The rate per day was higher. Domestic deliveries were 50,518,998 lb., an increase of more than 8,000,000 lb. over the previous month, and exports were 45,111,019 lb., a decrease of about 8,000,000 lb. For the two months the total deliveries were almost at the same figure. The surplus at the end of February amounted to 156,637,770 lb. Exports last week were fairly active. The total for March, up to and including March 13, was 10,547 tons. The daily call on the Metal Exchange March 13 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.85	11.95	.....
March	11.85	11.95	11.90
April	11.85	11.95	11.90
May	11.85	11.95	11.00
June	11.85	11.95	11.90

The London market, March 13, was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	55	1	3	54	16	3
Standard copper, futures	15	15	0	55	10	0

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.30c			11.87½c		
London, spot	£56	15	0	£53	15	0
London, futures	57	12	6	54	10	0
Best selected	60	5	0	58	0	0

Industrial and Commercial Notes.

American Gas & Electric Company.—The American Gas & Electric Company has set apart $3,000,000 to be spent this year upon improvements to its various properties. Of this amount $1,000,000 will be spent in improving the generating plants and transmission lines of the Scranton Electric Company. For this company the generating station known as the "suburban plant," which is located just outside of Scranton at Green Ridge, will be practically rebuilt. At this plant a new 5000-kw turbo-generator set and a 1700-kw engine-driven unit will be installed. This will give the plant a total capacity of about 12,000 kw. This apparatus has been purchased from the General Electric Company. The power house will be largely rebuilt and considerable will be expended upon fireproofing the building. A large electric crane will also be installed. This will be the principal power plant of the company, although the station known as the Lackawanna River station will largely attend to the lighting business of Scranton. At this latter station a new 2000-kw engine-driven set will be installed. A large steam main will be constructed from the suburban station for the heating department of the company. Four stations which belonged to companies absorbed by the Scranton Electric Company when it was formed in 1907 will be turned into substations. They are known as the Dix Court, Jefferson Avenue, Ridge Road and Carbondale stations. A high-tension transmission line from the Green Ridge station to Forest City will be constructed, where energy will be transmitted at 23,000 volts. In addition to this, the Scranton Electric Company will construct a tie line with the 10,000-kw station of the Delaware, Lackawanna & Western Railroad, in the nature of an emergency service. The American Gas & Electric Company has also ordered for the Wheeling (W. Va.) Electrical Company a 10,000-kw General Electric turbo-generator set, and it has drawn plans for adding to the Canton (Ohio) Electric Company a 6000-kw generating set. It will also construct a new building for this plant. In addition to these outlays, quite a number of small transmission lines will be constructed and a considerable amount of small apparatus has been ordered.

Electric Heat Storage Company.—The Electric Heat Storage Company, which was organized Nov. 15, 1910, under the laws of New York for the purpose of acquiring the patents and other rights to manufacture and sell electrical apparatus and devices under the "Therol" system in the United States, has opened offices at 165 Broadway, New York. The capitalization of the company is $1,500,000. William C. Hall is president. It is the purpose of this company to manufacture and sell electric cooking ranges and hot-water heaters and other domestic appliances employing the "Therol" system of heat storage, and also to develop heating systems for residences, factories, cars, etc. The features of this system were fully described in the issues of the *Electrical World* of Sept. 30 and Nov. 18, 1909. Speaking of the outlook for the company, President Hall said: "We believe that the field for the employment of this principle is very large in this country, and that the co-operation of electric generating companies is insured by the increased consumption of current at hours when their plant is otherwise not being employed, and that the consumer will give a ready welcome to all household appliances which furnish heat for useful purposes and without the accompanying disadvantages of unnecessary radiation. We will soon be ready to furnish prices and accept orders."

Trade Catalogues Wanted.—The Wilmington Institute Free Library, in extending its department of applied science, will add a department of trade catalogues, and desires to be placed on the mailing list of manufacturers of electrical and allied apparatus. A. L. Bailey is librarian.

Big Electrical Project of Lehigh Coal Company.—In a full statement authorized by W. A. Lathrop, president of the Lehigh Coal & Navigation Company, the details of an immense electrical project which is to be undertaken by that company have been made public. It is given out in this statement that the plans of the company are to spend $10,000,000 in establishing great power plants at its anthracite mines, and to transmit energy instead of hauling coal. The project has been worked out by the officials of the company in connection with the engineering firm of Lewis B. Stillwell, 100 Broadway, New York. The general idea of the plan is based upon the principle that it is a waste of energy to transport coal in order to generate power, when the power can be generated at the mines and transmitted to any point desired. In addition to this, Mr. Lathrop's statement points out the fact that there is a waste of 500,000 tons of anthracite coal dust every year at the mines of the Lehigh Coal & Navigation Company. It was the desire to use this unmarketable product that first caused the company to employ engineers to make the scientific investigation. The coal dust will be used either in special fire boxes which are being experimented with or by molding it into briquettes. The first power plant which it is contemplated to build will be located ten miles west of Mauch Chunk at a town called Hauto. This is right at the mouth of a tunnel leading from the main body of anthracite coal owned by the company. The location is also selected because of an abundant supply of water, which will be impounded by the construction of a dam, forming a reservoir with a capacity of more than one billion gallons. The initial power plant will have a capacity of 20,000 kw. To insure this three generating units of 10,000 kw each will be installed. Gradually it is expected to enlarge the plant to 100,000-kw capacity. To run such a plant, it is estimated, will require 1,000,000 tons of coal a year, a quantity of anthracite which, it is pointed out, would require 20,000 of the largest freight cars to transport to market. The company contemplates the expenditure of $3,000,000 at first, and eventually $10,000,000. Within a year the Navigation company management expects to have the first section of the Hauto plant in operation. The plant is to supply energy first to the cement and slate industries in Lehigh and Northampton counties, in Pennsylvania. These are in a territory from twenty to forty miles from the proposed plant. A complete power census of the district has been made, and the exact amount of power these industries require and also their expenses of manufacture are known. In this one district more than 100,000 hp is now being used. Knowing these facts, the company has made a schedule of prices which will deliver energy quite materially under the cost at which these industries can produce and at a figure which will yield it a considerable profit. These prices run from 8 mills per kw-hour up to 2½ cents, according to the amount contracted for and how steadily it will be used. From the Hauto plant alternating current of very high voltage will be carried by transmission lines to four substations at Slatington, Nazareth, Bath and Bangor, where it will be stepped down for distribution. The transmission lines will be constructed largely along the Lehigh Navigation canal and on the right-of-way controlled by the Lehigh & New England Railroad. Mr. Lathrop began investigating the commercial merits of this project in 1908. Since then a thorough investigation has been made along both commercial and engineering lines. The officers of the company are entirely satisfied with the practicability of the plan. It is expected ultimately to carry the energy to Allentown and Easton, Pa., and Trenton, N. J., and it may be possible also to reach Philadelphia. As the right of an electric company operating with steam to distribute energy is, under the laws of Pennsylvania, confined to a single township, it will require a large number of small companies to enable the large central power plant to reach the industrial centers as contemplated.

Recent Bids for Alternator, Transformers and Cables.—Bids were opened by the trustees of the Sanitary District of Chicago (operating the Chicago Drainage Canal with its hydroelectric plant) on March 9 for an alternating-current generator and rheostat, six transformers and lead-covered undergound cables. This apparatus is needed for an additional generating unit at the Lockport (Ill.) power house and for corresponding extensions. The generator to be furnished and installed is of the water-wheel type capable of delivering 4000 kw with a power factor of 85 per cent at a normal speed of 164 r.p.m. The effective voltage is 6600, three-phase, 60-cycle. A suitable motor-operated field rheostat is included in the specification. Two bids were received. One, from the W. A. Jackson Company, of Chicago, is $24,443. This, no doubt, contemplates a General Electric machine. The other, from the Crocker-Wheeler Company, is $24,900. The existing generators are of the Crocker-Wheeler type. Three single-phase step-up transformers and three single-phase step-down transformers are specified. The former are to be placed in the Lockport power house to operate on 60-cycle current, and the bank of three must have a capacity of 4600 kva. The secondard voltages shall be 44,000 and 41,800; the primary voltage shall be 6600. The transformers are to be of the oil-immersed, water-cooled type. The three step-down transformers are of the same type and must transform voltages of 40,000 and 38,000 volts to 13,200, 12,000, 9000 and 6600 volts. They are to be installed at the Western Avenue terminal station in Chicago. The five bids received are as follows: Westinghouse Electric & Manufacturing Company, $15,800; Crocker-Wheeler Company, $16,000; Moloney Electric Company, $17,000; W. A. Jackson Company, $17,492; Wagner Electric Manufacturing Company, $18,400. In every case except that of the Jackson company the proposal was accompanied by explanatory letters, drawings or specifications. The lead-covered cables required are to be placed in underground conduits to transmit 60-cycle, three-phase alternating current and for single-phase series arc service. Various sizes and voltages were specified and prices per foot were asked. Manufacturers were required to furnish a sworn statement that 30 per cent of pure Para rubber had been placed in the rubber compound used. The exact amount of each size of cable required was not specified, the Sanitary District reserving the right to order as required within six months from date of contact. Five concerns made bids. For varnished-cloth cable having three conductors of No. 6 B. & S. gage, designed for operating voltage of 12,000, with varnished-cloth wall of 7/16 in., rubber wall of 7/64 in., insulating jacket of 3/16 in. of varnished cloth and lead covering of ⅛ in. (to enumerate one size only), the proposals were as follows: Waterbury Company, 67.4 cents per foot; American Steel & Wire Company, 66.38 cents; Standard Underground Cable Company, 66.62 cents. For rubber-covered cable having eight No. 6 conductors, operating voltage of 7000, thickness of wall of ⅛ in., insulation jacket of ⅛ in. and lead covering of ⅛ in. (to enumerate only one size here, also) these bids were received: Waterbury Company, $1.23 per foot; American Steel & Wire Company, 99 cents; Standard Underground Cable Company, $1.327; Safety Insulated Wire & Cable Company, $1.67; Simplex Electrical Company, $1.386.

Electrically Operated Flour Mills in Louisville.—According to *Chained Lightning*, the organ of the Louisville (Ky.) Lighting Company, the majority of the up-to-date flour-milling concerns in Louisville use electric drive, the motors being operated by energy furnished by the Louisville Lighting Company. It is asserted that the product of flour mills is much better where electric drive is used, this fact being accounted for by the evenness and regularity with which the machinery is driven when operated by electric motors. Another advantage of the use of electric energy is that the grain elevators can be operated at any time, say on Sunday, irrespective of the rest of the plant, as it sometimes happens that it is desired to store or handle grains at times when the rest of the plant is not running.

Westinghouse Foreign Orders.—The Rio de Janeiro Tramway, Light & Power Company has placed an order with the Westinghouse Electric & Manufacturing Company for a duplication of the equipment purchased about a year ago, which consisted of a 2000-kw motor-generaor set. Walter Brothers & Company, of Rio de Janeiro, Brazil, have just placed an order with the same company for one 110-kw and one 100-kw, three-phase, 60-cycle, 11,000/2200-volt transformer, and one 110-kw, three-phase, 60-cycle, 2400-volt, 900-r.p.m. water-wheel type generator.

Extension of Time Limit of Contracts.—The time limit of the contract of the City of Chicago with the National Carbon Company for the delivery of arc-lamp carbons to the city, dated April 15, 1910, has been extended for ninety days from Dec. 31, 1910. The time limit of the contract with the Western Electric Company for furnishing arc-lamp globes, material and supplies, dated Feb. 17, 1910, has been extended likewise ninety days from Dec. 31, 1910

Crocker-Wheeler Company Sales.—Twelve carloads of dynamos, motor and other apparatus were recently shipped in one special train from the Crocker-Wheeler Company to the United States Steel Corporation's plant at Gary, Ind. The shipment weighed over 735,000 lb. and represented a value of almost $250,000. It included almost 6300 hp of motors and 2000 kw in generators. The equipment consisted of a 2000-kw motor-generaor set, the flywheel of which weighed almost forty tons, and four motors of 1200 hp each. This generator will convert the alternating current that is used at the plant of the American Sheet & Tin Plate Company into direct current which will be used, through the four 1200-hp motors, to drive the machinery of two rolling mills. The motors will be operated at the low speed of 21 r.p.m. and will be required to reverse from fourteen revolutions in one direction to the same speed in the other within one second of time. This shipment is in addition to 14,200 hp in motors and 4500 kw in generators heretofore installed by the Crocker-Wheeler Company in the same plant.

Western Electric's Heavy Business.—According to reports given out by the Western Electric Company's officials, the concern has no cause to complain of the first two months of 1911. Some of the other manufacturing concerns have reported a smaller volume of orders than for the same months in 1910. Not so with the Western Electric. Its February business was not only 20 per cent greater than for the same month of 1910, but constituted a new high record for February. The rate of orders for January and February indicates a total business for the year 1911 of approximately $71,000,000, which will be in excess of even the highest record of the company, made in 1906, when the sales amounted to $69,000,000. The total sales last year were $61,000,000 and in 1909 were $46,000,000. Favorable weather and crop conditions in the West and South indicate that the demand for telephone equipment from the agricultural districts will be particularly heavy this season and the company is fully prepared to meet any demand that will be made.

Platinum at Top Price.—Platinum has advanced very rapidly within the last few weeks, and is now selling in the neighborhood of $45 an oz. This is the highest price at which the material has ever been sold. There seems to be no explanation forthcoming as to the sudden advance, and it cannot be attributed entirely to the demand. Although there has been a satisfactory demand for platinum, much better indeed than last year, it is not such as to warrant this enormous increase in price. In the fall of 1908 platinum could be purchased in this market at $19 an oz. That period marked the low level of recent years. If there has been any manipulation of the market by Russian bankers, who practically control the output of the world, it has not been made plain to the New York dealers.

Westinghouse Gas Engines and Producers.—The Roswell Gas & Electric Company of Roswell, N. M., has just placed a large order for gas engines and producers with the Westinghouse Machine Company. The new equipment includes three single-crank gas engines, of capacities 300, 715, 113 hp respectively. The six gas producers are of the Westinghouse type W and will have a capacity of 250 hp each. Three generators will be supplied by the Westinghouse Electric & Manufacturing Company, having capacities of 600, 250 and 100-kw each, and will generate 2300-volt, three-phase, 60-cycle energy. The new equipment will be used in lighting and power service.

Chicago Electrification.—It is said that the railroads of Chicago have practically concluded that the electrification of their terminals is bound to come, and have already tentatively drawn plans for a new system of freight-distributing yards on the outskirts which will be the greatest freight-handling system in the world. A. S. Baldwin, chief engineer of the Illinois Central, says that while such a plan is being considered it is not entirely with the idea that the roads will be forced to electrify. Such yards would be of great advantage under any circumstances, but would be almost necessary in the case of electrification.

Electricity for the Snead Power Building in Louisville.—The new Snead Power Building in Louisville is designed to furnish quarters for a large number of tenants engaged in small manufacturing enterprises. The building has a frontage of 184 ft. and is 90 ft. deep and consists of eight stories and a basement. Ample provision for natural lighting is made, the front of the building being a mass of windows. Electricity for lighting and for the operation of electric motors for the building service, as well as for the use of tenants, is supplied by the Louisville Lighting Company.

Pittsburgh Electrical Contractors.—The electrical contractors and fixture houses of the Pittsburgh district on March 8 formed a permanent organization under the name of the Electrical Contractors' Association of Allegheny County, with the following officers: President, H. M. Raphael, Raphael Electric Company; Secretary, R. N. Young, Craig Electric Company; Treasurer, James L. Thompson, James L. Thompson Company. A charter will be applied for and permanent quarters secured.

New Fire-Alarm Equipment for Chicago.—On recommendation of City Electrician Carroll, the committee on finance of the Chicago City Council has recommended that the bid of the Western Electric Company of $1,328.50 for lead-covered cables for use in connection with the fire alarm office in the new City Hall be accepted; also the bid of the Holtzer-Cabot Electric Company of $1,628.88 for sixty-six dynamos for the same purpose.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Mayville, Ky.; Brunswick, Ga.; Graham, Va.; Cincinnati, Ohio; Sandpoint, Idaho; Crystal City, Tex.; Alvin, Tex.; Fulton, Ill.; Mission, Tex.; Terre Haute, Ind.; Scranton, Pa.; Greenville, Ohio; Yowell, Ky.; Logansport, Ind.; Raymondville, Tex., and Webster, Ia.

Westinghouse Turbo-Generators.—The Oliver Chilled Plow Company, South Bend, Ind., has just placed an order for two Westinghouse turbo-generators. One of the units will have a capacity of 750-kw and the other a capacity of 1125-kw; 440-volt, three-phase, 60-cycle energy will be generated. The turbines will take steam at 150 lb. and exhaust into a vacuum of 27 in. to 28 in.

Financial.

The Week in Wall Street

Without any semblance of activity the stock market maintained prices very firmly last week. Trading was at about low ebb, there being only 1,172,864 shares sold. The more sanguine element of the street points to the fact that the stock market has withstood the adverse decision in the rate case, the calling of an extra session of Congress at which the revision of the tariff will be considered, and the mobilization of the army on the Mexican border without any serious break. The truth of the matter is that there is not enough activity in the market for any serious break to be caused, and there stands ready at all times a powerful syndicate of financial interests to see that no break becomes dangerous. Prices, as a rule, at the close of last week were fractionally lower than at the close of the week previous. In no instance was there any notable advance. The bond market is

NEW YORK

	Mar. 6.	Mar. 13.	Shares Sold.		Mar. 6.	Mar. 13.	Shares Sold.
Al. Ch.	7⅓*	7⅞*	—	Int. Met., pf.	52¼	51½*	3,184
All. Ch., pf.	30½	30½*	500	Mackay Cos.	91⅞	93½*	500
Amal. Cop.	62½	63⅛	22,225	Mackay C., pf	76¾	75⅞	700
Am. D. T.	20½*	20½*	—	Man. Elev.	130	138½*	250
Am. Loco.	37½	38⅝	900	Met. St. Ry.	15*	15*	—
Am. Loco. pf.	109¾*	109¾*	—	N.Y.&N.J.Tel.	130¼*	130¼*	—
Am. Tel. & C.	84½*	81*	100	Steel, com.	76⅞	76⅞	225,700
Am. T. & T.	144¾	145	3,522	Steel, pfd.	119	118½	3,205
B. R. T.	78	76¾	4,700	W. U. T.	73	72¾*	1,800
Gen. Elec.	149	149	1,010	West'h, com.	60⅝*	67*	1,400
Int. Met.	18⅜	18⅜	1,840	West'h, pfd.	117½	120*	300

PHILADELPHIA.

	Mar. 6.	Mar. 13.		Mar. 6.	Mar. 13.
Am. Rys.	43¾	43½	Phila. Elec.	[illegible]	6¼
Elec. Co. of A.	12⅛*	12⅛*	Phila. R. T.	20	19⅝
Elec. St. B'ty.	53¾	54¼	Phila. Trac.	86½	86½*
E. S. B'ty., pfd.	30*	30*	Union Trac.	47½	47⅜

CHICAGO.

	Mar. 6.	Mar. 13.		Mar. 6.	Mar. 13.
Chi. City Ry.	190	185	Chi. Tel. Co.	121	[illegible]*
Chi. Rs., Ser. 1	91½	91½*	Met. El. Co.	22	21½*
Chi. Rs., Ser. 2	24½	24½*	Met. El., pfd.	68	[illegible]*
Com. Edison	118½	[illegible]	Nat'l Car.	118¾*	118½
Chi. Subways	4⅜*	5	Nat'l Car. pfd.	[illegible]	[illegible]*

BOSTON

	Mar. 6.	Mar. 13.		Mar. 6.	Mar. 13.
Am. T. & T.	145	144⅞	Mex. Tel.	4	[illegible]
Cum. Tel.	149*	151¼	Mex. Tel., pfd.	6	[illegible]
Edison E., Ill.	289½	291	N. E. Tel.	142	[illegible]
Gen. Elec.	149½	140	W. T. & T.	[illegible]	[illegible]
Mass. E. Ry.	17*	17*	W. T. & T. pfd.	94	[illegible]
Mass. E. Ry., pfd.	88	88			

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*Last price quoted.

Shares sold for week, March [illegible] to March [illegible] satisfactory, although it could hardly be called active. Large banking houses apparently are willing to take every good issue that is offered when there is a fair margin of profit, and as a rule they let it be known shortly after buying an issue of bonds that the outside public has absorbed the entire lot. The money market continues to be very easy, with the banks almost overstocked with cash. The same condition is apparently existing abroad. Quotations for money March 1 were: Call, 2@2½ per cen; 90 days, 2¾@4 per cent. The quotations in the table are those of the close March 13.

Financial Notes.

Detroit Edison Company.—The full pamphlet report of the Detroit Edison Company for the year 1910 has just been issued. Preliminary figures were published last month, but the detailed figures show gross earnings of $3,030,207, an increase of $831,064 over the previous year; net earnings $1,310,083, a gain of $385,518, and surplus $708,383, which was an increase of $295,519. C. W. Wetmore, president of the company, says in his report: "The number of customers increased 28.6 per cent during the year, and the total connected general light and power load was 92,429 kw, an increase of 28.4 per cent for the year. This does not include the loads of customers supplied in bulk, such as the Detroit United Railway, which buys current for the operation of city and interurban car lines, and the Michigan Central Railroad, which buys current for the electric locomotives used in the Detroit River tunnels. Capital charges during the year 1910 for the development of the company's properties amounted to $2,156,803. The largest item of these expenditures was for the extension and additional equipment of Delray power house No. 2."

Northern New York Telephone Merger.—The Friendship Telephone Company of Syracuse, N. Y., a Bell concern, has made an offer to purchase the outstanding stock and bonds of the Rochester Telephone Company, the Rochester, Syracuse & Utica Telephone Company, the Onondaga Independent Telephone Company and the Utica Home Telephone Company, all of which are Independents. These companies control all of the Independent companies in that section of the State. Negotiations looking to this merger have been going on for some time, and in an official statement given out last week by the Friendship company it was announced that the directors of all the Independent companies had indorsed the sale. The statement also says that when the combination is completed the Bell company will have 20,000 additional subscribers and the service will be much more satisfactory. The combined capital of the companies to be taken over is about $3,100,000.

Commonwealth Edison Stock in Demand.—Shares of the Commonwealth Edison Company, of Chicago, sold up to 124 on the Chicago Stock Exchange on March 10. The stock pays 6 per cent, and the price mentioned is probably the highest reached since the organization of the present company, succeeding the Chicago Edison Company, which paid 8 per cent. The newspapers repeat the rumor that the dividend rate may be increased to 7 per cent, and it is also asserted that the proposed merger of the elevated railway companies of Chicago, which has been brought to the front again, will benefit the central station company by increasing, probably, the demand for purchased electrical energy for railway operation. It is interesting to note that the People's Gas Light & Coke Company pays 7 per cent, Chicago Telephone Company 8 per cent, and Chicago City Railway Company 10 per cent.

Western Union Earnings.—The net earnings of the Western Union Telegraph Company for the quarter ended March 31, the month of March being estimated, are given out as $1,470,000, as compared with actual net earnings for the same quarter last year of $1,794,900. Surplus for the quarter is estimated at $289,098, a decrease of $325,127 from last year. The total surplus of the company is now $9,361,969, a decrease during the year of $9,836,753. The company's surplus account was thus heavily reduced by the large amount charged off due to the comprehensive revaluation which was referred to in the last annual report of the company.

Chicago Elevated Merger.—Henry A. Blair, who is at the head of the syndicate of New York financiers which is attempting to merge the elevated lines of Chicago, announced last week that the plans were practically completed and that he expected the details to be made public by March 15. It is said that the syndicate will make substantially the same cash offers for the stocks of the various companies that were made last fall, but the offer will probably embrace alternative propositions to exchange for securities of the new corporation. The present plan does not contemplate anything beyond the merging of the elevated properties, but the new company, which will be both a holding and an operating concern, will be built on such broad lines that it will be able to acquire other properties at some future date without the necessity of a reorganization.

Cleveland Railway Company Bonds.—Harris, Forbes & Company, of New York, have purchased a $5,000,000 issue of 5 per cent bonds from the Cleveland Railway Company, which controls the entire railway operations of that city. The proceeds of the bonds will be used to retire existing indebtedness. The bankers have offered the bonds to the public at par.

DIVIDENDS.

Chattanooga Railway & Light Company, quarterly, preferred, 1¼ per cent, payable April 1.

Engineering Securities Corporation, cash, 100 per cent, payable March 15.

General Motors Company, semi-annual, preferred, 3½ per cent, payable April 1.

Houghton County (Mich.) Electric Light Company, semi-annual, preferred, 3 per cent, common, 2½ per cent, both payable May 1.

Houghton County (Mich.) Traction Company, semi-annual, preferred, 3 per cent, common, 2½ per cent, payable April 1.

Interborough Rapid Transit Company, quarterly, 2¼ per cent, payable April 1.

Mexican Telephone & Telegraph Company, semi-annual, preferred, 2½ per cent, payable May 1.

National Gas, Electric Light & Power Company, Detroit, quarterly, preferred, 1½ per cent, payable April 1.

New York Edison Company, quarterly, 1½ per cent, payable March 14.

Otis Elevator Company, quarterly, preferred, 1½ per cent, common, 1 per cent, payable April 15.

Phelps, Dodge & Company, quarterly, 2½ per cent, payable March 30.

Safety Car Heating & Lighting Company, quarterly, 2 per cent, payable April 1.

St. Joseph Railway, Light, Heat & Power Company, quarterly, preferred, 1¼ per cent, payable April 1.

United Gas Improvement Company, Philadelphia, quarterly, 2 per cent, payable April 15.

Western Union Telegraph Company, quarterly, ¾ of 1 per cent, payable April 15.

Westinghouse Air Brake Company, quarterly, 2½ per cent, extra, 1½ per cent, special, 1 per cent, all payable April 10.

West Jersey & Sea Shore Railroad Company, semi-annual, 2½ per cent, payable April 1.

REPORTS OF EARNINGS.

Period.	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
BELL TELEPHONE COMPANY OF CANADA.					
Year, 1910	$5,510,685	$3,107,560	$1,547,125	$1,000,000	$547,125
Year, 1909	4,949,197	3,480,308	1,468,889	1,000,000	468,889
BELL TELEPHONE COMPANY OF PENNSYLVANIA.					
Year, 1910	$18,349,425	$13,813,518	$4,535,907	$245,886	$4,290,021
Year, 1909	16,171,839	11,690,058	4,481,781	304,280	4,177,501
BLACKSTONE VALLEY GAS & ELECTRIC COMPANY.					
Jan., 1911	$113,030	$51,597	$61,433	$30,198	$31,235
Jan., 1910	96,529	49,018	47,511	29,367	18,144
DETROIT EDISON COMPANY.					
Year, 1910	$3,030,207	$1,720,124	$1,310,083	$601,701	$708,382
Year, 1909	2,199,143	1,274,578	924,565	511,702	412,863
EDISON ELECTRIC ILLUMINATING COMPANY, BOSTON.					
Feb., 1911	$515,933	$1,90,255	$325,678	......	......
Feb., 1910	453,111	185,492	267,617	......	......
FEDERAL TELEPHONE & TELEGRAPH COMPANY.					
Year, 1910	$889,061	$371,866	$517,195	$249,756	$267,439
Year, 1909	763,820	354,559	409,261	236,847	172,415
NEW YORK STATE RAILWAYS COMPANY.					
Qr., Dec. '10	$878,374	$486,223	$302,150	$145,832	$382,882
Qr., Dec. '09	792,542	505,242	287,300	112,103	211,760
PIONEER TELEPHONE & TELEGRAPH COMPANY.					
Year, 1910	$1,844,654	$1,385,515	$459,139	$38,617	$420,522
Year, 1909	1,534,180	1,147,053	387,127	112,721	274,405
SEATTLE ELECTRIC COMPANY.					
Jan., 1911	$478,729	$276,670	$202,059	$110,404	$91,655
Jan., 1910	467,700	310,391	157,309	105,648	51,661
UNION RAILWAY GAS & ELECTRIC COMPANY.					
Year, 1910	$2,981,711	$1,633,954	$1,347,757	$796,257	$551,500
Year, 1909	2,820,349	1,468,415	1,351,934	773,664	578,270
WASHINGTON (D. C.) RAILWAY & ELECTRIC COMPANY.					
Year, 1910	$4,123,560	$2,151,828	$1,995,041	$1,280,398	$714,643
Year, 1909	4,080,064	2,110,579	1,980,087	1,230,292	749,795
WESTERN UNION TELEGRAPH COMPANY.					
Qr. Mch. 31, '11	......	......	$1,470,000	$433,062	$1,036,937
Qr. Mch. 31, '10	......	......	1,794,998	433,062	1,361,936

General News

Construction News.

EUFAULA, ALA.—The City Council has adopted a resolution authorizing the construction of a municipal electric light plant, plans for which will soon be prepared.

PHOENIX, ARIZ.—Contracts have been awarded by the Secretary of the Interior for equipment for the Salt River irrigation project as follows: To the Wagner Electric Manufacturing Company, of St. Louis, Mo., for furnishing motors and transformers for operating pumps, for $7,778, and to the Westinghouse Electric & Manufacturing Company, for switchboards, for $1,411; to the Bryan Jackson Iron Works, of San Francisco, Cal., for furnishing centrifugal pumps, at $7,845.

SONORA, ARIZ.—The Sunset Development Company, which is developing the coal fields at Barrencia, is planning to install a producer gas plant with gas engines to drive electric generators at its works. Electricity generated at the plant will be transmitted to all points in this vicinity, including San Javier, Las Goteras, Las Barranca, Toledo and other towns and cities.

YUMA, ARIZ.—H. W. Blaisdell has applied to the Council for a franchise to construct and operate an electric light and power plant in Yuma. The proposition will be submitted to the people for referendum vote.

HELENA, ARK.—The property of the Helena Gas & Electric Company, of Helena, has been sold to a Philadelphia (Pa.) syndicate for $135,000, which, it is said, will immediately take charge of the system, and will also begin work at once on extensive improvements. The new owners are reported to have already secured a site for the proposed new power house, the cost of which with equipment is estimated at $350,000.

FRESNO, CAL.—Work has commenced on the construction of the interurban electric railway from Fresno to Kingsburg and Sanger. The main power station will be located just east of this city and a substation will be erected at Fowler.

FRESNO, CAL.—The headquarters of the San Joaquin Light & Power Company have been removed to Los Angeles, Cal. It is understood that the change will not affect the general officers in Fresno. A. G. Wishon, of Fresno, is general manager.

LOS ANGELES, CAL.—The Board of County Supervisors has called for plans and estimates of cost of the installation of a generating set in the new hall of records to supply light and heat for the county buildings, to cost approximately $20,000.

LOS ANGELES, CAL.—The Los Angeles-Pacific Railway Company is reported to have leased from the Southern Pacific Company that portion of its steam road which extends west from Clements Junction to the city limits of Los Angeles. The Los Angeles-Pacific Railway Company has applied to the City Council for permission to operate it by electricity.

MODESTO, CAL.—The Modesto Board of Trustees has sold a franchise for an electric railway through Modesto to the San Joaquin Valley Electric Railway Company, for which it paid the sum of $500.

OROVILLE, CAL.—Application has been made to the Board of Trustees by H. M. Bennett, representing the Butte County Independent Telephone Company, for a franchise in Oroville. The company, which is a subsidiary of the Home Telephone Company, proposes to spend about $200,000 in Butte County and also agrees to place its wires underground in this city.

OROVILLE, CAL.—A trust deed has been filed transferring 90,000 miners' inches of water on the middle fork of the Feather River to George H. Tully, H. B. Lind and M. P. Barnes, all of Sacramento, Cal. The rights were sold by M. E. and H. O. Lague, of Sparks, Nev. The rights are to be held in trust until the Central California Hydro-Electric Power Company is organized and financed to develop the water rights.

SACRAMENTO, CAL.—The Truckee River General Electric Company, which has been involved in the Lake Tahoe dispute, has decided to drop the matter and has yielded up its claims. The hearing of the President which was to have been held has been called off and the champions of California's rights to the waters of the lake have won the victory without a battle.

SACRAMENTO, CAL.—Adding two more members to the committee appointed to investigate the electric light service in Sacramento the Retail Merchants' Association has refused to accept the schedule of rates submitted by the power company, and has directed the committee to demand a maximum rate of 4 cents per kw-hour and a minimum rate of 3 cents per kw-hour.

SANTA ANA, CAL.—The Board of County Commissioners will soon ask for bids for the installation of an electric lighting system for the Tustin lighting district.

STOCKTON, CAL.—Arrangements are being made by the Western States Gas & Electric Company, which is a consolidation of the Stockton Gas & Electric Company and the American River Electric Company, taken over by the H. M. Byllesby Company, of Chicago, Ill., for extensive improvements to both the electric and gas service. Henry E. Adams is manager.

GREELEY, COL.—President Taft has signed a bill authorizing the Greeley-Arizona Irrigation Company to construct a diversion dam across the Colorado River at Parker, Ariz. The project will involve an expenditure of about $1,000,000.

WILMINGTON, DEL.—The City Council has applied to the State Legislature for authority to install an electric plant to supply electricity for municipal purposes and to issue bonds to the amount of $150,000 to pay for same. It is proposed to install electrical machinery in the present pumping station and to utilize the exhaust steam from the engines that operate the pumping machinery. The larger part of the bond issue will be utilized for erecting the distributing system

BRUNSWICK, GA.—The Southeastern Yaryan Naval Stores Company, of Toledo, Ohio, is reported to be planning to erect a wood distillery for turpentine, etc. The work will include the construction of concrete buildings to cost about $60,000 and installation of machinery costing about $180,000. The equipment will include boilers with a rating of 2000 hp, two 500-hp Corliss engines, condensers and duplicate hogs, with shredders, to cost $20,000; yard tanks and electric generators and motors, at a cost of $10,000; piping, valves and fittings costing $30,000; pumps, machine shop, etc. James S. Brailey Jr., is president of the company, present address, Hotel Oglethorpe, Brunswick, Ga.

CUTHBERT, GA.—It is reported that the Cotton Belt Telephone Company is contemplating issuing $50,000 in bonds, the proceeds to be used for improvements and extensions to its system.

DALTON, GA.—Contracts have been awarded by the City Council for extensions of electric light and water works plants, to cost about $49,424. The equipment includes one 150-hp boiler, a 300-hp feed-water heater two turbine pumps with direct-connected induction motors, two compound condensing engines with condensers, two 150-kw alternating-current generators with five-panel switchboard, and thirty-five arc regulators. The contract for concrete reservoir, clear-water well filters, reinforced concrete power house, electric light and pumping station and installation of machinery was awarded to John W. Ash, of Austell, Ga., at $16,500. The H. S. Jaudon Engineering Company, of Savannah, Ga., has charge of the engineering work.

WASHINGTON, GA.—Plans are being prepared by the Washington Telephone Company for improvements to its system, involving an expenditure of about $2,500. W. A. Slaton is general manager.

SANDPOINT, IDAHO.—The Idaho Power & Concentrating Company is reported to be planning to erect a power and concentrating plant at Trestle Creek, eight miles from Sandpoint, this spring, to cost about $52,000.

WEISER, IDAHO.—Arrangements are being made by the Crane Creek Irrigation, Light & Power Company to begin active work on an irrigation project, which will irrigate more than 20,000 acres in this vicinity. The dam will be located on Crane Creek, fifteen miles from Weiser, and will store sufficient water to irrigate 100,000 acres.

CHICAGO, ILL.—The Chicago Railways Company is contemplating the construction of ten miles of new track during 1911.

FULTON, ILL.—The Fulton Electric Light & Power Company is reported to be contemplating the installation of a gas generating plant. The company recently increased its capital stock to secure funds for same.

TAMPICO, ILL.—The Dixon, Rock Falls & Southwestern Electric Railway Company is planning to build twenty miles of new track during the coming year.

TUSCOLA, ILL.—It is reported that plans are being considered to install an electric light plant in Tuscola, Ill.

COLUMBUS, IND.—The Indianapolis, Columbus & Southern Traction Company is contemplating the construction of a power dam in Driftwood River for the purpose of generating electricity to operate its cars between Indianapolis and Seymour. The company has purchased the old Tawne hill mill and mill race and with a new concrete dam it is estimated that the plant can supply sufficient power to operate the cars for at least six months in the year.

FORT WAYNE, IND.—We are informed that the General Electric Company did not arrange with the municipal electric light plant for service while making improvements to its power plant as stated in the issue of March 9, but has entered into a contract with the Fort Wayne & Northern Indiana Traction Company to supply electricity for lamps and motors for a term of years.

INDIANAPOLIS, IND.—The Commissioners of Marion County are making arrangements to abandon the plant which supplies light, heat and water to the county buildings and proposes to enter into contracts with private corporations to furnish the service The county power plant, which was erected and equipped in 1901, will be closed down, as better service can be obtained from private plants at a much less cost than to maintain the county plant.

INDIANAPOLIS, IND.—The last session of the State Legislature has passed the following bills: Giving lighting and heating companies the privilege of placing poles and transmission lines along the highways with the permission of the County Commissioners; providing for the referendum of franchise ordinances in cities and towns, and amending the present law giving the County Commissioners the right to relocate telegraph and telephone poles on the public highway.

KENDALLVILLE, IND.—It is estimated that it will cost the city about $25,000 to rebuild the municipal electric light plant. It is reported that the Toledo & Chicago Interurban Railway Company has offered to furnish electricity to operate the system at a less cost than the city can generate it.

LOGANSPORT, IND.—Plans have been adopted by the Wabash Power Company for the construction of a power house at Georgetown, four miles south in the Wabash River. The company proposes to generate and transmit electricity to towns and cities within a radius of twenty-five miles Quincy A. Myers, W. Omer and others are interested in the project.

MUNCIE, IND.—The American Gas & Electric Company has put into operation its lighting system in Eaton, twelve miles distant. Electricity for operating the system is transmitted from the Muncie power house. The company is planning to eventually supply electricity to all towns and villages in Eastern Indiana.

NATIONAL MILITARY HOME, GRANT COUNTY, IND.—Sealed proposals will be received at the office of the treasurer, Marion Branch, National Home Disabled Volunteer Soldiers, National Military Home, Grant County, Ind., until March 27 for furnishing one electric motor-driven pump, having 500,000 gallons capacity in twenty-four hours, in accordance with plans and specifications, copies of which with blank proposals and other information can be obtained upon application to J. W. Sanderson, treasurer.

RICHMOND, IND.—The Elliot & Reid Company, of Richmond, Ind., is constructing a new warehouse, 175 ft. x 300 ft., which will be equipped with an electric traveling crane having a capacity to handle 200 tons of wire products in ten hours.

TERRE HAUTE, IND.—The Terre Haute Traction Company has secured a renewal of its contract for street lighting for a term of five years at the rate of $67 per lamp per year.

TERRE HAUTE, IND.—Announcement has been made by the Citizens' Mutual Heating Company that it proposes to erect a new power plant between Fifth and Sixth Streets, south of the Vandalia Road, the cost of which is estimated at about $100,000.

VINCENNES, IND.—The Vincennes & Washington Transit Company is contemplating extensions to its system during the present year calling for the construction of about twenty miles of new track.

AMES, IA.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until April 17 for the construction complete, including plumbing, gas piping, heating apparatus and electric conduits and wiring, of the United States post office at Ames, Ia., in accordance with drawings and specifications, copies of which can be obtained at the above office or from the custodian of site at Ames, Ia James Knox Taylor is supervising architect.

CEDAR RAPIDS, IA.—The Peerless-V-Belt Company, of Chicago, Ill., is reported to have closed negotiations with the Commercial Club of Cedar Rapids, Ia., for the removal of its factory to this city. Plans are being prepared for the erection of a factory building, 100 ft. x 200 ft., two stories high, work on construction of which will begin at once. The company will purchase complete equipment for its machine shop and a 60-hp boiler for heating purposes. It is understood that a number of motors will also be purchased.

DENISON, IA.—The East Boyer Telephone Company, it is reported, will increase its capital stock from $5,000 to $10,000. The company is contemplating making extensions to its lines.

DODGE CITY, IA.—At an election held recently the citizens are reported to have voted against the proposition to issue bonds for the construction of a municipal electric light plant.

ELDORA, IA.—The City Council is reported to be considering the question of installing a municipal electric light plant in Eldora.

EMMETSBURG, IA.—Plans are being considered by the Emmetsburg Telephone Company for the installation of a new switchboard and other improvements during the summer.

FORT DODGE, IA.—The Fort Dodge, Des Moines & Suburban Railway Company is reported to be contemplating extending its railway to Gowrie to connect with the steam railroad in that place.

WEBSTER, IA.—Bids will be received by the City Clerk, Webster, Ia., until March 29 for furnishing equipment and material for improvements to the municipal electric light and water works systems, in accordance with plans and specifications on file at the office of the city clerk. Item 1—One battery of horizontal tubular boilers, with settings, fittings and steel smoke stacks. Item 2—One Corliss engine suitable for working under a steam pressure of 150 lb. gage and driving one 300-kva, 60-cycle, 120 r.p.m., engine type generator and belted type exciter. Item 3—One Corliss engine suited for working under a steam pressure of 150 lb. gage and driving one 200-kva, 60-cycle, 120 r.p.m., engine type generator and belted type exciter Item 4—One Hoppes open feed water heater and purifier of 500 hp capacity, with pipe, pipe fittings, valves, etc. Item 5—One 300-kva, 60-cycle, 3-phase, 2300 or 2400-volt, 120 r.p.m., engine type generator and separate exciter. Item 6—One 200-kva, 60-cycle, 3-phase, 2300 or 2400-volt, engine type generator with separate exciter. Item 7—Switchboard with one exciter, two generator panels and feeder panels for one 3-phase power, and four single-phase lighting circuits. The city also has equipment of present plant to dispose of, including three return tubular boilers, with stacks and all fittings; one Norberg Corliss engine; two 60-kw, 125-volt, direct-current generators with instruments; one 100-kw, 125-250-volt, direct-current Fort Wayne three-wire generator direct connected to an Ideal engine with switchboard and instruments; one Smedley duplex pump; one Knowles single pump, line shaft, pulleys, belts, etc. There is about 250 hp in direct-current motors, from ½ to 40 hp, also a quantity of small power and fan motors and twenty direct-current arc lamps. P. M. Banks is city clerk.

LA CYGNE, KAN.—The City Council is reported to have adopted the ordinance providing for an issue of $30,000 in bonds, the proceeds to be used for the construction of an electric light plant and water-works system in La Cygne. The proposition will be submitted to the voters on April 3.

LONE OAK, R. F. D., PADUCAH, KY.—The citizens of Lone Oak have decided to erect a telephone system and will connect it with either the system of the Home Telephone Company or that of the East Tennessee Telephone Company.

MAYSVILLE, KY.—The Maysville Public Service Corporation, recently incorporated with a capital stock of $150,000, it is reported, will take over the plants and holdings of the Maysville Gas & Electric Light Company and the Maysville Street Railway & Transfer Company. It is understood that the new company proposes to establish a new street railway system, to be equipped entirely with new rolling stock, and enlarge the electric light plant and possibly erect a new gas house.

PADUCAH, KY.—Preparations are being made by the Paducah Traction Company for the construction of an extension to Mechanicsburg

WHITESBURG, KY.—It is reported that arrangements have been completed for the construction of an electric light plant in Whitesburg. It is understood that a site for the power house and machinery for same have already been purchased. Eastern capitalists are said to be interested in the project.

YOWELL, KY.—The Wisconsin Steel Company, which is erecting large coke ovens at Yowell, Ky., is reported to be in the market for considerable equipment. It is reported that the company is now receiving bids for eight tubular boilers with a rating of 150 hp each, two 250-kw generators, one 100-kw generator, two 160-hp engines, to be used to drive coal crushers, and a 150-hp wide crank engine to operate the ventilating system.

PRESQUE ISLE, MAINE.—The Aroostook Valley Railroad Company is planning to build an extension from Washburn to New Sweden, a distance of twelve miles, during 1911.

ATHOL, MASS.—Arrangements have been made whereby the L. S. Starrett Company will supply electricity to operate the plant of the Athol Machine Company. The Starrett company has leased the transmission line of the Athol Gas & Electric Company, extending from Crescent Street to the Athol Machine Company's plant.

BROCKTON, MASS.—The City Council has appointed a committee to look into the question of establishing a municipal electric light plant in Brockton.

GEORGETOWN, MASS.—It is reported that the proposition to improve the present lighting system will be submitted to a vote.

GREENFIELD, MASS.—The Connecticut Valley Railway Company is contemplating the purchase of a 500-kw rotary converter for its power house in Greenfield, Mass., within the next few weeks.

NORTHAMPTON, MASS.—The city government, it is said, will appoint a commission to investigate the question of establishing a municipal electric light plant. The Massachusetts Lighting Company now controls the gas and electric light companies in Northampton.

SOUTH FRAMINGHAM, MASS.—The question of municipal ownership of the electric lighting and power systems is reported to be under consideration.

SPRINGFIELD, MASS.—The Street Lighting Department has decided to replace the arc lamps now in use on Main Street from Carew to Mill Street with new magnetite lamps. The new lamps will be installed by the United Electric Light Company without additional cost to the city.

ROCKLAND, MASS.—At a town meeting held recently a committee was appointed to consider the advisability of establishing a municipal electric light plant in Rockland.

ADRIAN, MICH.—The Citizens' Light & Power Company, of Adrian, Mich., is reported to be in the market for a 500-hp boiler and a new smokestack.

HARRISON, MICH.—It is reported that an election will be held in the spring to vote on the proposition to issue bonds for the construction of an electric light plant and water-works system.

KALAMAZOO, MICH.—It is reported that the city engineer has been instructed to secure estimates of the cost of the construction of a municipal electric light plant in Kalamazoo.

BACKUS, MINN.—The Backus Rural Telephone Company is contemplating improvements and extensions to its system.

BLUFFTON, MINN.—The Leaf River Rural Telephone Company is reported to be planning to erect a telephone line north of Bluffton.

DULUTH, MINN.—It is reported that plans are being prepared by the Zenith Telephone Company for the erection of a telephone exchange in West Duluth capable of handling 10,000 telephones. The cost of the building and equipment is estimated at from $25,000 to $30,000.

EVELETH, MINN.—Plans are being considered for the installation of an ornamental lighting system during the coming summer to cost about $4,500.

FERGUS FALLS, MINN.—It is reported that three plans have been prepared by L. P. Wolff, of St. Paul, Minn., engineer, for the reconstruction of the city dam, recently washed out by the floods, the cost of one of which is estimated at $91,000, and that of the other two at $72,000.

ST. LOUIS PARK, MINN.—The Village Council has granted the Minneapolis General Electric Company a twenty-five-year franchise to supply electricity in this village. The Council has contracted with the company for street lighting for a term of five years, under which the company is to supply seventy-five incandescent street lamps at an annual cost of $1,500. It is expected to have the system completed within two months.

ST. PAUL, MINN.—The St. Paul Promotion Company is reported to have completed surveys and secured most of the right-of-way for the construction of an electric railway, which will extend from St. Paul to Military Camp Grounds, passing through Oakland, Highwood, Red Rock, Newport, St. Paul Park and Langdon, where it will cross the Mississippi River to Hastings, continuing to Etter, Eggleston, Redwing, Wacouta, Frontenac and Lake City, a distance of fifty-seven miles. Philip W. Herzog is president, and W. L. Sonntag, general manager, Metropolitan Opera House Building, St. Paul, Minn.

BYHALIA, MISS.—It is reported that the City Council is contemplating the installation of electric light and water plants, for which bonds to the amount of $10,000 will be issued. C. M. Henry is Mayor.

GULFPORT, MISS.—Contracts will be placed by the Gulfport & Mississippi Coast Traction Company during the next two weeks for the erection of a high-tension, three-phase, 13,200-volt transmission line, fifteen miles in length. W. F. Gorenflo, of Gulfport, Miss., is general manager.

JOPLIN, MO.—The Clifford Mining Company is reported to have awarded the contract for the construction of a 200-ton reduction mill to be erected on Shaft No. 2 of the Clifford property. The mill will be equipped for electric drive and an electric hoist installed. The Clifford Mill, No. 1, will be rebuilt and equipped for electric motor drive. B. L. Van Hoose is manager.

ST. LOUIS, MO.—Arrangements are being made by the St. Louis, Lakewood & Grant Park Railway Company for the construction of a two-mile extension in St. Louis, work on which will begin at once.

EUREKA, MONT.—Steps have been taken to organize a company to erect a telephone system for this valley. F. P. Garey, county commissioner, and J. W. McCalder are interested in the project.

LAVINA, MONT.—B. F. Fullmer, of Lewiston, Mont., is reported to be interested in a project to install an electric light plant in Lavina.

MALTA, MONT.—Application has been made to the Council by H. E. Wharton for a franchise to install an electric light plant in Malta.

LIBERTY, NEB.—The City Council is reported to be considering the question of installing an electric light system in Liberty.

TRENTON, N. J.—The Public Utility Commissioners have approved the lease whereby the Trenton & Mercer County Traction Corporation is to take over the system of the Trenton Street Railway Company. Under the terms of the lease the Trenton & Mercer County Traction Company must make certain improvements to the railway system.

RUTHERFORD, N. C.—At an election held recently the citizens voted to issue $55,000 in bonds, the proceeds to be used for the construction of an electric light plant and water-works system.

DEVILS LAKE, N. D.—It is reported that investigations are being made by parties representing Eastern interests, with a view of installing a new plant to cost about $54,000. The present plant is not able to meet the demands made upon it.

HANKINSON, N. D.—It is reported that H. G. Squires, of Galesburg, Ill., has applied to the City Council for a franchise to construct and operate an electric light plant in Hankinson.

MOTT, N. D.—The Village Council has granted a twenty-year franchise to J. Blaine to operate an electric light plant within the ctiy limits. It is understood that the present plant, operated by Lee & Thorpe, will be enlarged and improved in the near future.

AMITYVILLE, N. Y.—The Long Island Lighting Company, recently incorporated, has applied to the Public Service Commission for its approval of the purchase of the entire property and franchises of the Amityville Electric Light Company, of Amityville; the Sayville Electric Company, of Sayville; the Northport Electric Light Company, of Northport, and the Islip Electric Light Company, of Islip, to be taken over and merged into the Long Island Lighting Company; the company also asks for permission to execute a mortgage covering properties of the constituent companies and to issue stocks and bonds thereunder. The aggregate price paid for the property is $308,672. It is proposed to issue capital stock amounting to $300,000 at par and bonds to the amount of $370,000 at not less than 85, the proceeds to be used for the purchase of the properties and for new construction, additions and improvements, amounting to about $300,000.

BROOKLYN, N. Y.—The Board of Estimate is considering the proposition of allowing the Brooklyn, Queens County & Suburban Railroad Company, a subsidiary of the Brooklyn Rapid Transit Company, to build an extension of its railway to Forest Hills, in Queens County. The company agrees to build the extension if the city will allow it to do so without paying for the franchise.

GLOVERSVILLE, N. Y.—Plans are being made by the Fonda, Johnstown & Gloversville Railroad Company, electric division, for the construction of about four miles of track in Amsterdam during 1911.

HEMPSTEAD, N. Y.—The New York & Long Island Traction Company, of Hempstead, N. Y., is in the market for one 750 kw rotary converter and three transformers.

LIBERTY, N. Y.—Contracts will be placed during the next few months by the Liberty & Jeffersonville Electric Railway Company for the construction of twelve miles of track. William Craig, of Orange, N. J., is president.

UTICA, N. Y.—It is reported that the Friendship Telephone Company, acting for the New York Telephone Company, has made an offer to purchase the outstanding stock and bonds of the system of independent telephone lines operating from Rochester, Syracuse, Utica, Canandaigua, Brockport, Weedsport, Baldwinsville, Rome, Clinton, Herkimer, Mohawk, Frankfort and surrounding territory. The deal involves over $5,000,000 in securities and payments of $2,500,000 in cash payments to security holders. It is said that the board of directors of each company has indorsed the proposition.

BARBERTON, OHIO.—A petition is reported to have been submitted to the City Council asking that electrical equipment be installed at the pumping station to supply electricity for municipal lighting.

BROOKVILLE, OHIO.—Proposals will be received by the village of Brookville, Ohio, for furnishing electricity in Brookville for street and commercial lighting and for power purposes. For further information address H. E. Wheaton, corporation clerk.

BURGOON, OHIO.—The Village Council is reported to have granted the Fostoria & Fremont Railway Company a franchise to construct and operate an electric railway in Burgoon. J. W. S. Reigle, of Findlay, Ohio, is chief engineer.

CINCINNATI, OHIO.—The Ohio Traction Company is reported to be preparing plans for the construction of a new power house at Pendleton.

CINCINNATI, OHIO.—Plans have been prepared for the erection of a sterilization plant and turbine station at the California water works, to cost not more than $25,000. Estimates submitted by Superintendent Laidlaw are as follows: For sterilization plant, $6,000; two wash water pumps, $6,000; two water turbines, with electric generators, $5,500. Estimates were also submitted for a turbine generator at the Western Hills pumping station, to cost $1,000.

GREENFIELD, OHIO.—The Board of Public Works is reported to have advertised for bids for the reconstruction of the municipal electric light system, to cost about $20,000.

GREENVILLE, OHIO.—The Greenville Electric Light & Power Company is reported to be preparing plans for extensions to its plant. The company recently increased its capital stock from $30,000 to $50,000.

NELSONVILLE, OHIO.—The Hocking-Sunday Creek Traction Company, of Nelsonville, Ohio, has purchased material to equip its railroad for electrical operation. Electricity for operating the railway will be supplied by the Nelsonville Electric Light Company. New equipment is being installed in the power plant of the Nelsonville Electric Light Company to provide for the additional service.

SPRINGFIELD, OHIO.—The City Council is considering the question of installing a municipal electric light plant.

DURANT, OKLA.—The contract for construction of the proposed municipal electric light plant has been awarded to Smith & Whitney, of Dallas, Tex., for $17,155. W. S. Shannon is city clerk.

HEAVENER, OKLA.—The Board of Trustees have granted an electric light franchise to Messrs. Moore, Cooper and Hudson, of Wilburton, Okla. which will be submitted to a vote of the people. The company agrees to furnish electricity for lamps and fans for the city hall free of charge, and to build its plant within the city limits.

WAUKOMIS, OKLA.—It is reported that work will soon begin on the construction of the proposed municipal electric light plant, for which bonds were recently voted.

BROWNSVILLE, ORE.—The Oregon Power Company has secured an option on the property of the Brownsville Electric Light Company. If the plant is taken over by the Oregon company a transmission line will be erected to Halsey, where it will connect with the line now being erected from the power plant on the McKenzie River to Albany, to supply electricity for lamps and motors in this city

FOREST GROVE, ORE.—The City Council has granted the Independent Electric Company a twenty-five year franchise to erect and maintain transmission lines for the distribution of electricity over certain streets in Forest Grove.

GASTON, ORE.—The Lovegren Lumber Company is reported to be working on an extensive development near Gaston, Ore., which includes the construction of a railroad five miles in length, for which contracts have been awarded, a large sawmill and a hydroelectric power plant.

MEDFORD, ORE.—Steps have been taken by the City Council for the installation of cluster lamps in the business section of the city.

PORTLAND, ORE.—The contract for furnishing electricity for operating the new mill of Balfour-Guthrie Company in Portland has been awarded to the Mt. Hood Railway & Power Company. The mill will be equipped for single motor drive throughout and will require about 500 hp.

ALLENTOWN, PA.—Plans have been filed with the Recorder giving notice that application will be made to the Governor of Pennsylvania by W. A. Lathrop, Rollin H. Wilbur and H. F. Baker, of Philadelphia, Pa., for charters for about sixty electric companies. This is the first public move in connection with the large power scheme of the Lehigh Coal & Navigation Company, which proposes to supply electricity in the eastern portion of Pennsylvania, including Philadelphia. The company is planning to erect large power houses at Lansford, where coal will be used as fuel which heretofore has been allowed to go to waste. The main transmission lines will extend to Philadelphia, with branches to all industries, towns and villages in the districts along the route of the line. It is said that the company proposes to make a specialty of supplying electricity to cement plants in the Lehigh region.

CORAOPOLIS, PA.—Contracts have been awarded by the Town Council for equipment for the municipal electric light plant as follows: To the Buckeye Engine Company, for one 225-hp engine, and the Struthers Wells Company for two engines, one of 150-hp and the other 175 hp; for three generators to the Crocker-Wheeler Company and for switchboard to the Westinghouse Electric & Manufacturing Company.

KANE, PA.—The American Plate Glass Company, of Kane, Pa., has purchased a Westinghouse 700-hp horizontal gas engine for its power plant at James City. The engine will operate on natural gas. The engine will be connected to a Westinghouse 625-kva, 600-volt, three-phase, 25-cycle alternating-current generator, and will supply electricity for lamps and motors. The new equipment will operate in parallel with three 16 x 26 twin tandem and two 23½ x 33 single crank horizontal Westinghouse gas engines, which drive three 400-kw and two 500-kw Westinghouse generators respectively.

LANCASTER, PA.—A company has been organized by a number of influential residents of the northern part of the county under the name of the Ephrata & Denver Telephone & Telegraph Company to construct and operate a telephone line from Brickerville to Churchtown and to the Berks and Lebanon County lines. W. S. Brossman is president and H. F. Jacoby, treasurer.

MT. GRETNA, PA.—The Mt. Gretna Light & Power Company has filed an amendment to its charter increasing its capital stock from $5,000 to $25,000.

ROYERSFORD, PA.—The Council is considering the question of establishing a municipal electric light plant in Royersford.

SCRANTON, PA.—Announcement has been made by the Scranton Electric Company of extensive improvements to be made to its plant and system, which will involve an expenditure of about $1,000,000. At present the company is operating several power plants in this city and proposes to centralize its generating system in the suburban plant in Green Ridge and at the plant on the banks of the Lackawanna River. The improvements include the installation of large engines, complete condenser system, system of trackage for hauling coal to the plant and purchase of several coaling dumps. It is said a new electric plant will be erected at Carbondale.

LONSDALE, R. I.—The Lonsdale Company is reported to be contemplating installing new equipment in its power house.

PROVIDENCE, R. I.—At a special meeting of the stockholders of the Narragansett Electric Lighting Company, held March 1, the directors were authorized to issue $1,500,000 in convertible debentures, increasing the capital stock from $4,500,000 to $6,000,000. Of the proceeds $750,000 will be used to liquidate outstanding indebtedness, and the remainder will be used for extensions and future improvements.

DILLON, S. C.—Preparations are being made by the Electric Light Commission to rebuild the electric light plant, for which bonds to the amount of $15,000 have been voted. J. C. Cottingham is a member of the commission.

HONEA PATH, S. C.—The City Council is considering the question of issuing bonds to the amount of $11,000, the proceeds to be used for the construction of an electric light system.

JOHNSTON, S. C.—An additional 125-hp Corliss engine is being installed in the local electric light plant owned by F. M. Boyd.

LEXINGTON, S. C.—The proposition to grant a franchise to the Lexington Electric Light & Power Company to supply electricity in Lexington will be submitted to a vote of the people on March 28.

HILL CITY, S. D.—The Hill City Lumber Company is reported to be erecting a building in which it will install an electric power plant.

MILLER, S. D.—The Miller Electric Company is planning to install a tungsten-lamp street-lighting system at once, a new 100-hp boiler soon, erecting additional lines in several parts of the city and establishing a day service with motor load this season. Lewis Kellough is secretary and manager.

MITCHELL, S. D.—The Dakota Central Telephone Company is reported to be contemplating the installation of an automatic telephone system.

MOBRIDGE, S. D.—The Council has granted the Mobridge Electric Light, Power & Heating Company a franchise to install an electric light plant in Mobridge.

MOBRIDGE, S. D.—The Missouri Valley Telephone Company has petitioned the Council for a franchise to install and operate a telephone system in Mobridge.

CHATTANOOGA, TENN.—The Citico Furnace Company is reported to be contemplating building a new blast furnace, to cost $400,000, the installation of hot-blast stoves and probably an electrical power plant. It is understood that plans for the proposed improvements are being prepared by David G. Baker, engineer, of Philadelphia, Pa.

GALLATIN, TENN.—The Portland Mutual Telephone Company, recently organized, will take over and operate the system of the Sumner County Telephone Company. The new company has purchased the entire northern section of the system, extending to Rock Bridge. S. H. Roark is president and C. W. Kerley, secretary and treasurer.

NASHVILLE, TENN.—The installation of a new steam turbine and other improvements to its system is reported to be under consideration by the Nashville Railway & Light Company.

SHELBYVILLE, TENN.—Plans are being made by J. F. Boyd, owner of the local electric light plant, to install a new 500-kw steam turbine between now and next July.

ALVIN, TEX.—Plans are being made by H. P. Rhodes, of Houston, Tex., and associates, for the installation of an electric light plant, water works system, ice plant and bottling works in Alvin.

AUSTIN, TEX.—It is reported that C. J. Hardy, engineer, representing the firm of Ford, Bacon & Davis, of New York, N. Y., and New Orleans, La., has been making investigations in Austin with the view of submitting a proposition to the city for the reconstruction of the large dam across the Colorado River and the installation of a hydroelectric power plant in connection with the proposed water storage reservoir.

BAIRD, TEX.—It is reported that T. A. Ward, of Comanche, Tex., is contemplating the installation of an electric light system in Baird.

BEAUMONT, TEX.—The Beaumont Traction Company expects to purchase one 250-hp boiler for its power house in Beaumont in the near future. C. H. Kretz is general manager.

BROWNSVILLE, TEX.—The new machinery for the new municipal electric light and water-works plans has arrived and will soon be installed. The equipment consists of pumps having a capacity of 1,000,000 gal. per day, two Corliss engines, one of 250 hp direct connected to a 175-kva, alternating-current generator and the other a 160 hp connected to a 125-kva generator, one 210-hp water-tube boiler and two tubular boilers of 100 hp each. The cost of the improvements is estimated at about $40,000.

CANYON, TEX.—The Canyon Power Company, recently incorporated with a capital stock of $25,000, is reported to have purchased the property of the Canyon Ice & Light Company, and proposes to install additional ice machinery, to cost $7,500. C. R. McAfee is president and manager.

CRYSTAL CITY, TEX.—Arrangements are being made by E. C. Robinson, of St. Louis, Mo., for the installation of an electric light and ice plant in Crystal City, Tex.

DENTON, TEX.—Plans are being made by the Denton Traction Company for the construction of about two miles of new tracks, contract for which will be awarded in the near future.

GALVESTON, TEX.—The State Legislature has passed a bill granting the County of Galveston the right to sell or lease a right of way for an electric or steam railway over or upon the sea wall that has been constructed along the Gulf. The sea wall is about five miles long.

HOUSTON, TEX.—Preparations are being made by the Bay Shore Traction Company, of Houston, Tex., for the construction of its proposed interurban electric railway, which is to extend from South Houston to La Porte, work on which is to begin within ninety days.

HOUSTON, TEX.—Proposals will be received unil March 21 by Edgar Odell Lovett, president, 1110 Scanlan Building, Houston, Tex., for electric wiring and electrical installation. Plans and specifications can be obtained at the office of Cram, Goodhue & Ferguson, architects, Scanlan Building, Houston, Tex.

MISSION, TEX.—The Mission Cotton Oil Company, recently organized by Brownsville and Mission business men and the Hubbel-Slack Company, of Houston, Tex., proposes to build a plant in Mission to manufacture cottonseed oil and install an electric plant to generate and supply electricity in Mission and also supply water for municipal purposes. It is expected to have the plant ready for operation by the middle of next August.

RAYMONDVILLE, TEX.—It is reported that S. L. Gill and James Lagro, of Raymondville, are contemplating the installation of an electric light plant and water-works system in this town.

SAN ANTONIO, TEX.—The Terrell Well Company, recently chartered with a capital stock of $100,000, is reported to be contemplating the construction of an electric railway system between San José and San Antonio, a distance of five miles. C. D. Garrett, of St. Louis, Mo., is president; A. L. Matlock, of San Antonio, Tex., secretary, and Dr. Frederick Terrell, of San Antonio, Tex., treasurer.

ST. AUGUSTINE, TEX.—Bids will be received until March 21 by the Mayor and City Council of St. Augustine for construction of water works system, including electric motor or gasoline engine, triplex pumps, steam pumps, boilers, etc. The O'Neil Engineering Company, 1503 Praetorian Building, Dallas, Tex., has charge of the engineering work.

TEXARKANA, TEX.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until April 3 for an electric passenger elevator in the United States court house, Texarkana, Tex., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

TRINITY, TEX.—The Trinity Light Company is contemplating overhauling its plant and installing a 50-hp gasoline, oil or gas producer engine. A. R. MacDonald is owner.

TYLER, TEX.—The Tyler Electric Company is planning to increase its motive power and change the system to polyphase, alternaitng-current. A. E. Judge is president and manager.

SALT LAKE CITY, UTAH.—Preparations are being made by the Utah Light & Railway Company for the construction of an extension from Salt Lake City to Holliday, calling for about five miles of single track.

SALT LAKE CITY, UTAH.—Preparations are being made by the Payson Electric Railroad Company to build an electric railway between Salt Lake City and Payson. Application will soon be made for franchises from the City Council of Salt Lake City and from the County Commissioners.

GRAHAM, VA.—The Graham Electric Railway Company is reported to be contemplating the construction of a power plant. It is understood that the development of a water-power near Burkes Garden is under consideration.

RICHMOND, VA.—The Council Committee on Electricity has revoked the contract of the city with Storms & Company, of Newark, N. J. for the construction of the overhead system for the municipal electric light plant in Richmond. The contract called for an expenditure of about $65,000. The committee has authorized E. W. Trafford, engineer, to secure prices on wire, mast arms and other supplies and submit a report of the cost of completing the work as soon as possible. It is estimated that the company has completed about one-third of the contract.

ELLENSBURG, WASH.—The City of Ellensburg is reported to be considering extensive improvements to the municipal electric light plant, which will involve an expenditure of about $30,000.

ELMA, WASH.—The City Council is reported to be contemplating the construction of a municipal hydroelectric plant, to cost about $12,000

HUSUM, WASH.—Plans are being prepared by the Husum Power Company for the erection of a large dam across the White Salmon River, near the present intake of the power plant. It is estimated that the new dam will develop about 1000 hp, and it is expected that the present power plant will be enlarged.

SEATTLE, WASH.—The Board of Public Works has rejected all bids for the installation of cluster lamps on subdivision No. 1 on Third Avenue, in this city.

SPOKANE, WASH.—The Spokane & Inland Empire Railroad Company is planning to build sixty-five miles of new track during 1911.

WASHOUGAL, WASH.—The City Council has granted a franchise to the Mount Hood Railway, Light & Power Company to supply electricity for lamps and motors in Washougal.

ALBANY, WIS.—It is reported that the local electric light plant was recently destroyed by fire.

BELOIT, WIS.—The Home Telephone Company has awarded the contract for its new central station to Cunningham Brothers, of Beloit, Wis.

EAU CLAIRE, WIS.—The Chippewa Valley Railway, Light & Power Company is contemplating the purchase of one 300-kw motor-generator set for its power plant at Eau Claire. George B. Wheeler, of Eau Claire, Wis., is general manager.

LOMIRA, WIS.—The Lomira Electric Light & Power Company, recently incorporated with a capital stock of $12,000, has been granted a franchise to construct and operate an electric light plant in Lomira. P. J. Zeidler is president.

OCONOMOWOC, WIS.—The City Council has accepted the proposition, recently submitted by Henry Schoelkopf, of Milwaukee, Wis., to sell to the city the entire output generated at his new hydroelectric power plant to be erected at Okauchee Lake.

PLYMOUTH, WIS.—The Spring Telephone Company, recently organized, is planning to erect a rural telephone line southwest from the city limits, five miles in length.

RACINE, WIS.—It is reported that the local electric power plant of the Milwaukee Electric Railway & Light Company was recently destroyed by fire, causing a loss of about $125,000. It is expected that power for operating the system for the present will be secured from the Milwaukee plant.

RICHLAND CENTRE, WIS.—Plans are being made for the erection of a brick or reinforced concrete chimney, 125 ft. high and 3 ft. 6 in. in diameter, if round, and 3 ft. 4 in. if square, at the municipal electric light and water plant. W. G. Kirchoffer, of Madison, Wis., is engineer.

ROCK FALLS, WIS.—Steps have been taken toward the organization of a telephone company. It is proposed to erect an exchange in Rock Falls and connect with the telephone system in Eau Claire, Wis.

SABIN, WIS.—The Mill Creek Telephone Company has filed amendments to its charter increasing its capital stock from $3,000 to $1[illegible],000.

SUN PRAIRIE, WIS.—At a special election held recently the citizens voted to issue $9,000 in bonds, the proceeds to be used for the installation of an electric light system in Sun Prairie.

ST. VITAL, MAN., CAN.—The municipality of St. Vital is reported to have decided to install an electric street railway system, work on which will begin this spring.

TORONTO, ONT., CAN.—The Canadian Pacific Railroad Company is reported to be contemplating making arrangements for large extensions to its telephone service.

TORONTO, ONT., CAN.—Plans are being made to extend the telephone dispatching system on the Grand Trunk Railway, which will call for the erection of between 250 and 300 miles of wire between Toronto and Sarnia.

UNDERWOOD, ONT., CAN.—Sealed bids will be received by D. McNaughton, president of the Bruce Municipal Telephone System, Underwood, Ont., Can., until March 18 for the construction of a telephone system in the townships of Bruce, Saugeen, Greenock, Kincardine and Elderslie. Plans and specifications may be seen and forms of tender obtained at the office of W. L. Bland, Kincardine, Ont., and at the office of George J. Beattie, 72 Victoria Street, Toronto, Ont., Can.

MONTREAL, QUE., CAN.—It is reported that a syndicate is being formed to build an elevated railway fourteen miles in length, extending along Craig Street to St. James from the western to the extreme eastern limits of Montreal.

MONTREAL, QUE., CAN.—The Quebec Legislature has granted an extension of forty-two years to the franchise of the Montreal Street Railway and has passed a bill authorizing the company to amalgamate all lines under its jurisdiction under the name of the Montreal Tramways Company, with a capital stock of $2,000,000.

SHERBROOKE, QUE., CAN.—Contracts for machinery for the new municipal electric light plant have been awarded as follows: For electrical equipment, to the Canadian Westinghouse Company, of Hamilton, Ont., Can., for $33,007, and for hydraulic machinery, to the Jenckes Machine Company, of Sherbrooke, Que., for $14,000.

REGINA, SASK., CAN.—Arrangements are being made for the construction of the municipal street railway system in Reginia, work on which will begin as soon as the weather will permit. The proposed railway will be six miles in length. The power plant and car shops will be located in Regina. Six cars will be operated and electricity will be supplied for lamps. L. A. Thornton is city engineer.

SASKATOON, SASK., CAN.—Proposals will be received by the city clerk until April 3 for a street railway franchise. For further information address James Clinkskill, Mayor.

SASKATOON, SASK., CAN.—Bids will be received until March 27 by James Clinskill, Mayor, as follows: (a) For one 750-kw, 2200-volt, 60-cycle, 150 r.p.m., two-phase generator exciter, switchboard, installed complete (alternate bids on the above are asked in three-phase); (b) one 1250-hp, 120 r.p.m. vertical cross-compound Corliss engine with necessary condensing apparatus and feed-water heaters installed complete; (c) direct-connected exciter engine to drive the exciter for a 750-kw generator, (d) one steel smokestack, 100 ft. high, and inside diameter of 80 in., together with corresponding connection to boilers, installed complete Specifications will be furnished on applicatiun to Mayor or City Commissioners.

MATAMOROS, TAMAULIPAS, MEX.—The Santema Agriculture Syndicate, which is constructing a large irrigation system in the State of Tamaulipas, near Matamoros, has completed the first series of dams for creating water storage reservoirs. The main canal of the proposed system will be ninety-six miles long, and it will have several hundred miles of laterals, and when completed will irrigate about 600,000 acres of land. Large pumping plants will be installed. The main water supply will be obtained from the San Juan River. Antonio G. Canalizo, of the City of Mexico, is at the head of the enterprise.

MEXICO CITY, MEX.—Surveys are being made by the Mexican Traction Company, of the City of Mexico, for its proposed interurban electric railway to extend from this city to Puebla, a distance of [illegible] miles. It is understood that work on construction of the road will soon begin. The company, it is said, also contemplates the construction of an electric railway from this city to Cuernavaca, about seventy-five miles in length.

MEXICO CITY, MEX.—The federal government has entered into a contract with the Ericsson Telephone Company, of Mexico City, for the construction of a long-distance telephone line between this city and Puebla, a distance of 160 miles, connecting with the local system of the Ericsson company in this city, and with the telephone system of Juan Lavin in Puebla. Under the terms of the contract the government is to supply the wire and other construction material, and the proceeds from the operation of the line shall be divided between the government, the Ericsson Telephone Company and Mr. Lavin. Work will soon begin on the construction of the line. The Ericsson Telephone Company is contemplating the construction of other long-distance lines in the States of Puebla and Vera Cruz.

SALTILLO, MEX.—Herculnao Cerda and Vicente Garcia Fuentes, of Saltillo, are reported to be interested in a project to install a hydroelectric plant near this city, to supply electricity for lamps and motors for towns and industries in this region.

New Industrial Companies.

THE AUTOMATIC ELECTRIC RAILWAY BLOCK SIGNAL COMPANY, of Birmingham, Ala., has been chartered for the purpose of manufacturing a device to be used by steam, electric and motor railroads for prevention of collisions. The officers are: A. C. Foster, president; M. R. Julian, vice-president; L. J. Haley, secretary and attorney, and E. F. Enslen, treasurer.

THE CENTRAL ELECTRIC SUPPLY COMPANY, of South Bend, Ind., has been chartered with a capital stock of $10,000 by John W Arnold, E. F. Hart, of South Bend, Ind., and Earl H. Arnold, of Gary Ind. The company proposes to manufacture and sell at wholesale and retail all electric supplies and metal articles; also to furnish and install and use any kind of motive power pertaining to electrical business, and to take contracts for all kinds of electric wiring, electric appliances, fixtures, etc.

THE CODY MOTORS COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 by Arthur McMullen, Jr., 143d Street and Riverside Drive; Reginald L. Kelly, 239 West 109th Street, and John C. Mullin, Hotel Woodward, all of New York, N. Y. The company proposes to manufacture automobiles, electric motors, etc.

THE EVANSVILLE MARINE MOTOR & FOUNDRY COMPANY, of Evansville, Ind., has been incorporated by B. F. Duery, C. F. Donnelly, C. I. Bloomer and B. M. Mitchell. The company proposes to manufacture engines, boilers, machinery, parts and patterns and to do a general electric motor and repair business.

THE FIDELITY INVESTMENT COMPANY, of Nashville, Tenn., has been incorporated with a capital stock of $200,000. The company proposes to construct electric railroads, electric power houses, etc. H. H. Mayberry, of Nashville, Tenn., is interested in the enterprise.

THE GAS & ELECTRIC IMPROVEMENT COMPANY, of Boston, Mass., has been incorporated with a capital stock of $100,000 by C. Frank Whittmore, George F. Howland, Cyrus N. Burnill and Jeremiah J Hourin.

THE HANDLESS TELEPHONE RECEIVER COMPANY, of Camden, N. J., has been incorporated with a capital stock of $125,000 to acquire letters patent granted on a handless telephone receiver attachment and to do a general electrical business. The incorporators are: J. B Fellheimer, J. G. Donohue and D. C. Reed, of Camden, N. J.

THE HYDRAULIC DRIVE COMPANY, of Indianapolis, Ind., has been incorporated by Fred H. Cheyne, Charles S. Walker and Thomas H Endicott. The company is capitalized at $50,000 and proposes to manufacture machinery and devices for the transmission and regulation of all kinds of power.

THE IDEAL ELECTRIC VEHICLE COMPANY has been chartered under the laws of New Jersey with a capital stock of $250,000. Herman A. Tufel, of Maplewood, N. J., is one of the incorporators.

THE MACBETH ARC LAMP COMPANY, of Philadelphia, Pa., has been incorporated with a capital stock of $12,000. The directors are: Norman Macbeth, 3104 Midvale Avenue, Philadelphia, Pa., treasurer; James H. Hill, of Philadelphia, Pa., and James Coutts, of Glen Olden, Pa.

THE MORTON MOTOR COMPANY, of Detroit, Mich., has been organized for the purpose of manufacturing motor engines. Charles N. McNaughton is president.

THE MOTOR & MANUFACTURING COMPANY, of Indianapolis, Ind., has filed articles of incorporation with a capital stock of $300,000 by W. S. McDonald, J. O. Vanier and G. R. Brown. The company proposes to manufacture gasoline engines and motors of all kinds and parts of all kinds of self-propelling vehicles, all kinds of machinery and devices.

THE NATIONAL GOVERNOR COMPANY, of New York, N. Y., has been incorporated with a capital stock of $2,000,000. The company proposes to introduce economies in the manufacture and consumption of gas and electricity for light, heat and power purposes. The directors are: Frederick G. C. Lyon, Henry S. Reynolds and Graham Smith, of New York, N. Y.

THE ROTH-MURPHY ENGINE STARTER COMPANY, of Indianapolis, Ind., has been chartered with a capital stock of $50,000 for the purpose of manufacturing a patented device known as the Roth-Murphy starter. The incorporators are: David R. Murray, of Indianapolis, Ind.; Gilson W. Roth, of Morgantown, Ind., and others.

THE RUSH MARINE SIGNAL COMPANY, of New York, N. Y., has been incorporated with a capital stock of $500,000 to manufacture and deal in engines, machinery, etc. The incorporators are: W. S. Rush, Captain J. W. Edwards and C. Wagner, of New York, N. Y.

THE SOUTHERN EQUIPMENT & SUPPLY COMPANY, of Bedford, Ind., has been chartered for the purpose of manufacturing all kinds of equipment and supplies for electric power, heating, gas and water plants, quarries and other concerns using machinery. The directors are: Horace C. Stilwell, C. F. Fletcher and others.

THE STEEL CONDUIT COMPANY, of Penn Yan, N. Y., has been chartered with a capital stock of $75,000 by W. T. Morriss, H. M. Short and E. R. Ramsey, of Penn Yan, N. Y. The company proposes to manufacture electrical conduits and insulating devices.

THE TELLER AIR-BURNING FURNACE COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $300,000 by F. A. Wineke, J. Morfit Mullen and W. A. Duvall, all of Baltimore, Md. The company proposes to manufacture furnaces, boilers, engines, machinery, etc.

THE UVALDE CONTRACTING COMPANY, of New York, N. Y., has been incorporated by J. D. Marston, of Yonkers, N. Y.; F. S. Brown, of Brooklyn, N. Y., and J. J. Ahearn, of Bronx. The company is capitalized at $100,000 and proposes to do a general contracting and engineering business.

THE VACUUM CLEANER MANUFACTURING COMPANY, of Camden, N. J., has been incorporated with a capital stock of $100,000 to manufacture vacuum dry-cleaning machines. The incorporators are: F. A. Kuntz, J. P. Murray and N. G. Wiltshire, of Camden, N. J.

THE WESTERFIELD GAS & ENGINE COMPANY, of Indianapolis, Ind., has been incorporated by G. G. Westerfield and A. H. Nordyke. The company is capitalized at $50,000 and proposes to do a general gas engine and traction manufacturing business, including the manufacture of accessories pertaining thereto.

THE WILSON ELECTRIC COMPANY, of Canton, Ohio, has been incorporated with a capital stock of $10,000 by J. B. Wilson, Ellen C. Wilson and others to take over a partnership which has been known as the Wilson Electric Company.

New Incorporations.

GREENVIEW, ILL.—The Greenview Electric Light & Power Company has been incorporated with a capital stock of $10,000 by James — Bracken, Alvin H. Cleveland and John Larson.

LEXINGTON, ILL.—The Lexington Telephone Company has been incorporated with a capital stock of $6,000 by J. L. Vawter, G. K. Elder an J. J. Withers.

PEORIA, ILL.—The St. Louis, Peoria & Northwestern Railway Company has been incorporated with a capital stock of $25,000 to build an electric railway from a point in or near Peoria through the counties of Peoria, Tazewell, Mason, Menard, Sangamon and Macoupin to a connection with the Macoupin County Railway at a point about two and one-half miles south of Girard. The directors are: Marvin Hughitt, Chauncey Keep, Byron L. Smith and B. Conway, of Chicago, Ill.; John V. Farwell, of Lake Forest; William A. Gardner, of Evanston, and John D. Caldwell, of Oak Park, Ill.

VIRDEN, ILL.—Articles of incorporation have been filed for the Virden Telephone Company with a capital stock of $25,000 by U. G. Tucker, N. Shell and Charles H. Snell.

BYRON, IND.—The Byron Telephone Company has been incorporated with a capital stock of $10,000 by H. I. Demeree, C. A. Morgan and T. M. Garland.

WASHINGTON, IND.—The Citizens Light & Fuel Company has filed articles of incorporation with a capital stock of $75,000 for the purpose of constructing and operating electric and gas plant and supplying electricity and gas for lamps, heat and power purposes. The incorporators are Paul M. Taylor, Thomas Burns and L. P. Boyle.

COIN, IA.—The Buck Creek Mutual Telephone Company has been incorporated with a capital stock of $5,000 by M. H. Meyers, Frank Annan, H. D. Ellis, W. L. Annan, Herman Seifering, Henry Muler and J. H. Myers.

SOMERSET, KY.—The United Water, Light & Traction Company has filed articles of incorporation with a capital stock of $100,000 by William Waddle, C. F. Smith, A. A. Tuttle, M. O. Curd and B. L. Waddle, all of Louisville, Ky.

AUGUSTA, MAINE.—Articles of incorporation have been filed for the Dirigo Power Company with a capital stock of $500,000. The company proposes to generate electricity. S. S. Lancaster is president and H. M. Shaw, treasurer, both of Augusta, Maine.

RUMFORD, MAINE.—The Andover Power Company has been incorporated with a capital stock of $50,000 for the purposes of developing water powers in the town of Andover and supplying power for manufacturing purposes. The directors are: Richmond L. Melcher, James McGregor and Waldo Pettingill, all of Rumford. Mr. McGregor is president of the company.

WINTHROP, MAINE.—The Alamo Power Company has been organized with a capital stock of $50,000 for the purpose of developing and distributing power. E. M. Leavitt, of Winthrop, Maine, is president and treasurer.

BOSTON, MASS.—The Jacksonville Traction Company has filed articles of incorporation with the Secretary of State with a capital stock of $1,500,000.

LAUREL, MISS.—The Laurel Light, Heat & Power Company has been incorporated with a capital stock of $30,000 by J. T. Pullen, of Laurel, Miss., and F. F. Young, of Jackson, Miss.

CLEVELAND, OHIO.—The Star Electric Company has been incorporated with a capital stock of $10,000 by D. H. Tilden, A. A. McCaslin, M. Ferrell, J. M. Brog and Elmer G. Derr.

CLEVELAND, OHIO.—Articles of incorporation have been filed for the Whitney Power Company with a capital stock of $50,000 by Donald McBride, T. M. Kirby, Ellis R. Diehm, C. Cowne Ownes and W. B. Whitney.

EAST LIVERPOOL, OHIO.—Articles of incorporation have been filed for the Tri-State Railway & Electric Company with a capital stock of $10,000 by W. J. Phelp, F. J. Brady, W. R. Griffin, B. E. Pollock and W. B. Moore. The company proposes to operate an electric railway between East Liverpool and Steubenville.

HARRISBURG, PA.—Articles of incorporation have been filed with the Secretary of State for the following companies: The Hellam Township Light, Heat & Power Company, the Spring Garden Township Light, Heat & Power Company and Springetsbury Township Light, Heat & Power Company. Each company is capitalized at $5,000 and the directors are: Charles A. Greenawalt, treasurer; Harrison B. Waltman and James J. Gerry, all of York, Pa.

Personal.

MR. CHARLES MURRAY has been appointed general manager of the Northwestern Railways Company which controls the lighting and railway companies at Meadville, Pa.

MR. F. G. WATERS, who has been general manager of the Municipal Electric Light Plant, Jewett City, Conn., for the past four years has tendered his resignation to take effect on May 1.

DR. S. W. STRATTON, director of the Bureau of Standards, Washington, delivered an illustrated lecture before the Westinghouse Club, Wilkinsburg, Pa., on March 8, his subject being the work of the bureau.

MR. FRANCIS A. J. FITZGERALD, M. I. T., '95, consulting chemical engineer, Niagara Falls, will present a paper on "An Electric Furnace for Zinc Smelting" before the Congress of Technology to be held in Boston April 10-11.

MR. GEORGE A. CAMPBELL, research engineer with the American Telephone and Telegraph Company, will present before the Congress of Technology to be held in Boston April 10-11 a paper under the title "Cisoidal Oscillations."

MR. JAMES A. MATTHEWS has resigned his position as manager and superintendent of the Moore & Deller Electric Light & Power Company, Pagosa Springs, Col., and has accepted a similar position with the municipal plant at Del Norte, Col.

MR. JAMES D. MORTIMER, vice-president and secretary of the Milwaukee Electric Railway & Light Company, will temporarily assume the presidency of the company, made vacant by the resignation of John I. Beggs, who has accepted the presidency of the St. Louis Car Company.

MR. C. W. STONE, of the General Electric Company, will speak before the Electrical Engineering Society of Columbia University on Friday evening, March 17, at 8:15 o'clock, on the subject of "Electric Lighting." The lecture will be held in the Engineering building of the university and is open to the public.

MR. P. N. GOLDEN, who was employed by the Middletown (Conn.) Electric Light Company when its new plant was being installed last summer, has been appointed superintendent of the plant to relieve Mr. L. C. Whitney, who will devote his whole time to the management of the general affairs of the company.

MR. W. J. TROTT, of the Fostoria Incandescent Lamp Company, Fostoria, Ohio, addressed the Kalamazoo branch of the Michigan State Society of Stationary Engineers at a recent meeting. Mr. Trott spoke on the use of electric lamps in industrial illumination, and illustrated his talk with stereopticon views.

MR. H. M. WINTER has resigned as manager of the Seattle office of the General Electric Company to become sales manager of the Seattle Electric Company. He is succeeded by Mr. C. M. Bliven, sales agent of the General Electric Company in San Francisco, who in turn is succeeded in San Francisco by Mr. William M. Shepard.

MR. J. C. ROCKWELL has been retained by J. G. White & Company as superintendent of transportation and general superintendent of the Manila Electric Railroad & Light Company, Manila, Philippine Islands. Mr. Rockwell is a graduate of Cornell, and was formerly superintendent of the Charleston Interurban Railroad, Charleston-Kanawha, W. Va.

MR. WALTER L FISHER, who as special traction counsel to the Chicago City Council drafted the present street-railway franchises, under which full protection is given to the bondholders and which assure the City of Chicago 55 per cent of the net profits, has been appointed by President Taft Secretary of the Interior, to succeed Mr. R. A. Ballinger, who has resigned.

MR. N. M. ARGABRITE, who resigned as manager of the Public Service Operating Company, Belvidere, Ill., to become connected with the American Gas & Electric Company, has been placed in charge of the Hartford City (Ind.) Lighting Company. Mr. Argabrite was formerly connected with the Ashland Electric Light & Power Company, Ashland, Ky.; Ohio Valley Electric Company, and the Winona Railway & Light Company, Winona, Minn.

MR. W. H. BEATTYS, who for the last five years has been connected with Westinghouse interests in the Chicago office, has become Western district manager for the National Brake & Electric Company, with offices in the First National Bank Building, Chicago. The territory covered by this office extends from Detroit to the Pacific Coast. Previous to his five years with the Westinghouse interests, Mr. Beattys was connected with the company to which he has now returned.

MR. HENRY W. THORNTON has been elected president of the Northwestern Railways Company, which has recently taken over the Meadville & Connaught Lake Traction Company, Meadville Traction Company and the People's Incandescent Light Company, Meadville, Pa. Mr. Thornton is assistant general superintendent of the Long Island Railroad and will assume his new duties without relinquishing his present connections in Long Island City.

MR. A. PAWLING, president of the Pawling & Harnischfeger Company, crane manufacturer, Milwaukee, has gone with his family on an extended automobile trip through the Southern and Pacific Coast States and will return to Milwaukee next June. At a recent meeting of the board of directors of the company, Mr. S. H. Squier was elected secretary, while Mr. W. H. Hassenplug, sales manager, was made second vice-president. These gentlemen, together with Mr. F. P. Breck, were also elected to the board of directors.

MR. F. F. ESPENSCHIED, formerly general manager of the Interstate Light & Power Company at Galena, Ill., is now with the Hydroelectric Power Commission of Ontario, with headquarters in Toronto. At present Mr. Espenschied is engaged as assistant engineer, acting in a consulting capacity with several municipalities which have contracted with the commission for large blocks of Niagara energy. For four years after graduating from Cornell, in 1905, Mr. Espenschied was with the West Penn Railways Company, at Connellsville and Pittsburgh, Pa.

Trade Publication.

AUTO-TRANSFORMER.—Bulletin No. 534 of the American Transformer Company, Newark, N. J., is devoted to auto-transformers for use with low-voltage tungsten lamps. These transformers are particularly well suited for sign-lighting, as well as house-lighting installation.

BUSINESS NOTES.

ORNAMENTAL STREET-LIGHTING POSTS WITHSTAND SEVERE FIRE.—The severe fire in the business section of Minneapolis on March 5, which, for a time, threatened to destroy almost the entire retail business district of the city, tested out the ornamental street lighting posts within the territory swept by the fire. The scorching heat would have seriously damaged the ordinary post, but those placed here withstood the test without damage. These posts were supplied by the Flour City Ornamental Iron Works, which firm is naturally very proud of the manner in which they withstood this severe test.

TRIUMPH ELECTRIC COMPANY.—A delegation of about seventy-five shop superintendents and managers from Chicago attended the annual meeting of the Cincinnati Metal Trades Association on Thursday, March 2. During the course of the day the entire party inspected the plant of the Triumph Electric Company, and were very favorably impressed with the modern methods employed in the shops. The Triumph Company is exceptionally busy at the present time, and in addition to the ordinary day shift is working a night shift three nights a week. A banquet was held in the evening at the Business Men's Club, and a thoroughly enjoyable time was spent.

WESTINGHOUSE LAMPS.—The Westinghouse Lamp Company, of Bloomfield, N. J., has just added the 40 and 60-watt sizes of its line of wire-type tungsten lamps. These sizes will now be listed regularly in the line of continuous filament lamps that have overcome the objections made to tungsten lamps on account of their fragility. Among several large lamp contracts recently made, one is with the Harriman interests for $140,000 worth of lamps for the various railroad and steamship lines, and another one is with the Schoepf-McGowan electric railways in Ohio and Indiana for $35,000. Other recent contracts are as follows: J. R. Lehmer, Omaha, Neb., $17,000; J. P. Coghlin, Worcester, Mass., $10,000; Elliott Lewis Electrical Company, Philadelphia, Pa., $10,000; Pennsylvania Railroad lines, east and west, Philadelphia, $70,000.

DIAMOND RUBBER COMPANY.—The Diamond Rubber Company, Akron, Ohio, has recently received visits from representatives of a number of electrical jobbing houses that handle Diamond rubber-covered wire and cable, and it is stated that almost without exception the visitors were considerably surprised and deeply impressed with the size of the Diamond factories, and particularly that portion devoted to the manufacture of wire, which occupies a large five-story building and portions of another building. The factories contain a complete and up-to-date line of rapid braiders and stranding machines and two enormous lead presses, one made by Krupp and recently imported from Germany. Arrangements for handling Diamond rubber-covered wire and cables have been made with the National Electrical Supply Company, Washington, D. C.; James Clark, Jr., Electric Company, Louisville; Stuart-Howland, Company, Boston, Mass.; Miller-Selden Electric Company, Detroit, Mich.; Post-Glover Electric Company, Cincinnati, Ohio; Erner & Hopkins Company Columbus, Ohio, and Julius Andrae & Sons Company, Milwaukee.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 28, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City]

985,775. ATTACHMENT PLUG; T. A. C. Both, New York, N. Y. App. filed Sept. 2, 1910. For lamp sockets, including a metal screw shell carrying an insulator with a spring contact in the opening in the body, a center contact connected to the spring, and a detachable cap with central stud co-operating with the spring contact.

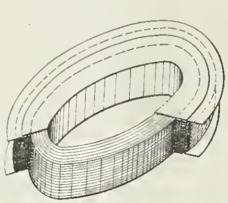
985,791. JUNCTION BOX FOR SPARKING PLUGS; J. Dubail, Delle. France. App. filed June 1, 1910. A washer with lateral opening for the introduction of a conductor carrying wires which are spread and clamped by a tightening nut, the device being secured to the sparking plug.

985,819. ELECTROMAGNETIC BRAKE; J. N. Mahoney, Wilkinsburg, Pa. App. filed July 29, 1909. For braking electric motor-driven vehicles, the motors being connected as generators to give the braking action, the main field of one motor being cross-connected with the armature of another in each group, and an equalizing connection connecting a main motor field of one group with that of another.

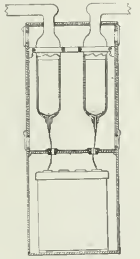
985,820. PARTY LINE RINGING KEY; R. H. Manson, Elyria, Ohio. App. filed April 17, 1909. A frame-carrying switch operating means and switch springs with their contacting ends open at the rear, the other ends being connected to the frame.

985,821. ELECTRICAL TERMINAL CONNECTOR; R. H. Manson, Elyria, Ohio. App. filed Nov. 17, 1909. A movable resilient member with terminal recess into which a terminal is inserted and a bent wire clip with registering apertures through which the terminal plug passes.

985,838. AUTOMATIC ELECTRIC WELDING MACHINE; A. F. Reitzel, Lynn, Mass. App. filed Oct. 25, 1905. The work-supporting belt carries the work beneath a reciprocating tool, and current is passed between the tool and the work, the links of the belt being cut away to afford passage for the current.



986,291.—Construction of Coils for Electrical Apparatus.



986,304.—Vacuum-Tube Lamp.

985,854. COHERER; W. E. D. Stokes, Jr., New York, N. Y., and G. W. Davis, Galilee, N. J. App. filed Oct. 9, 1908. The contact faces of two blocks of galena and arsenical copper ore for an automatic coherer.

985,932. ELECTRIC MOTOR REGULATION; A. F. Pieper, Rochester, N. Y. App. filed April 26, 1905. Alternating-current commutator motor with a small number of active turns in the armature circuit producing a much lower counter e.m.f. under speed than the impressed e.m.f., so as to avoid sparking at the commutator, the rotation of the armature controlling a governor for interrupting the motor circuit at a certain speed.

985,942. CIRCUIT-CONTROLLING APPARATUS; J. Sachs, Hartford, Conn. App. filed April 5, 1907. For controlling a switch near-by or at a distance by means of an electro-magnetic device operating a spindle with two coils, one in circuit with the source of supply, and the other in shunt to the main, with circuit closers in the circuits.

985,951. BRUSH HOLDER; L. H. Sparks, Warren, Ohio. App. filed Feb. 5, 1910. Current connections are made directly with the brushes to avoid heating the brush holders by means of a stud mounted upon insulation, to which the brush is connected.

985,981. MAGNETO DYNAMO ARMATURES; R. H. Cunningham, New York, N. Y. App. filed Dec. 30, 1909. Armatures for high-tension magneto, with two segmental portions joined by a connecting web which is divided between the segmental portions.

985,983. ELECTRIC HEATER FOR INCUBATORS, BROODERS AND THE LIKE; G. M. Curtis, Buffalo, N. Y. App. filed April 30, 1907. A flat plate with yielding means for closing a recess between the plate and an electrical heating device, which may consist of a plurality of electrical lamps on a frame, carried by the support inside of the incubator.

986,023. THERMOSTAT; H. Y. Norwood, Rochester, N. Y. App. filed Nov. 29, 1909. Prevents breaking the platinum wires of a thermostat in which the circuit is closed by mercury thermometer with platinum inleads by securing the wires to the casing by electro-deposit.

986,028. COMMUTATOR TYPE DYNAMO ELECTRIC MACHINE; W. H. Singer, West Allis, Wis. App. filed June 13, 1910. For preventing movement of conductors by centrifugal force, the winding having cross connectors and the retaining member comprising concentric rings mounted on the commutator supporting the cross connectors.

986,030. ROSETTE; J. S. Stewart, New York, N. Y. App. filed Oct. 5, 1909. A porcelain housing having grooves to receive the wires and metal clips for the terminal screws. Details.

986,033. INDUCTION COIL; R. Varley, Englewood, N. J. App. filed May 8, 1909. Loads the primary winding with a few turns directly at the pole which actuate the trembler, these coils being in series with the main coil.

986,034. SAFETY FUSE AND LINE DISCONNECTING SWITCH; S. B. Way and J. L. Fay, St. Louis, Mo. App. filed April 12, 1909. An insulated block in a casing with lateral stud secured to the base beyond the contacts and an insulated body pivoted and removably mounted on the stud, carrying resilient contacts for receiving the fuse.

986,037. ELECTRIC WATER-HEATER; A. Albert, San Francisco, Cal. App. filed May 21, 1910. An insulated handle with passages for the supply wires, a perforated electrode secured thereto and an inner electrode leaving a water-circulating passageway between the electrodes.

986,039. SYNCHRONIZING INTERRUPTER FOR ELECTRIC CURRENTS; E. Bachelet, New York, N. Y. App. filed Feb. 4, 1909. For wireless telegraphy and for interrupting alternating currents by means of a double throw switch, with one series of contacts for alternating current, another series for direct current, an interrupter in the main circuit in series therewith when direct current is employed, and in shunt therewith when alternating current is employed.

986,064. ELECTRIC BATTERY; C. Jaeger, Seattle, Wash. App. filed July 13, 1910. Provision is made for introducing fluid to moisten the dry cell by means of a liquid holder of telescoping sections, one having a destructible portion and the other having an opening opposite thereto.

986,091. SYSTEM OF MOTOR CONTROL; W. Siebenmorgen and S. H. Keefer, Plainfield, N. J. App. filed Feb. 8, 1910. A motor with a field which is automatically weakened when the current is supplied for starting and restored to normal strength at speed.

986,138. INCANDESCENT LAMP SOCKET; L. J. Castonguay, Bridgeport, Conn. App. filed Jan. 21, 1910. A key socket with a switch block and spindle, an insulating body, a key handle having a lost motion connection with the switch block spindle.

986,179. ELECTRIC FURNACE; C. A. Keller, Paris, France. App. filed Feb. 26, 1904. A plurality of hearths connected by channels with a plurality of electrodes, one for each hearth vertically movable and supplied from the same source of energy.

986,194. WATER-STERILIZING APPARATUS; C. D. Meeker, East Orange, N. J., and C. F. Wallace, New York, N. Y. App. filed Aug. 4, 1910. Sterilizes water by means of ozone, has a tank containing oil with an ozonizing element submerged in the oil, a transformer in the oil connected to the ozonizer.

986,203. POWER ARRESTER; J. W. Novak, Pittsburg, Pa. App. filed Feb. 21, 1910. Power arrester for overhead trolleys to break the circuit, and to give a signal at the power plant for locating the break. Carries contacts to a signaling circuit and is inserted in the trolley wire at the break.

986,213. INSULATING CAP; J. C. Phelps, Springfield, Mass. App. filed Sept. 16, 1909. For the end of tubes carrying wires, the cap having angular outlets through which the wires extend.

986,216. LIFTING MAGNET; H. Poth, Wilkinsburg, Pa. App. filed April 8, 1910. The lifting stroke of the armature is subdivided into a plurality of air gaps which are successively traversed and closed by the magnetic flux during the lifting period, each succeeding gap being reduced to a size to form the path of least resistance for the flux after the preceding gap is closed.

986,243. ALTERNATING-CURRENT ELEVATOR SYSTEM; A. Sundh, Yonkers, N. Y. App. filed Oct. 2, 1907. A motor with a sectional starting resistance, a manual switch, a plurality of fixed and movable contacts in the circuits of relay magnets which are operated successively upon operation of the switch, the switch being automatically retarded.

986,260. SELECTIVE LOCKOUT TELEPHONE SYSTEM; F. W. Adsit, St. Paul, Minn. App. filed Nov. 17, 1909. The party selector with magneto, impulses being sent from the magneto at the calling station to the distant selectors, the selectors at the stations being connected to the transmission lines by one of the distant telephones with means for automatically reversing the current in the line when calling telephone is restored to calling condition.

986,267. TELEPHONE SIGNAL; C. L. Chisholm, Marysville, New Brunswick, Canada. App. filed Sept. 7, 1909. The mouthpiece is used as a call, the hammer actuated by an electro-magnet striking it.

986,277. MOTOR CONTROL SYSTEM; E. L. Gale, Sr., Yonkers, N. Y. App. filed June 20, 1910. Particularly for starting under load by means of a sectional starting resistance, parts of high and low temperature coefficients, which are cut out gradually as the motor increases in speed, this action being accelerated upon increase of drop in the high coefficient resistances.

986,279. AUTOMATIC FIRE ALARM; J. W. Griffith, Greenfield, Tenn. App. filed March 28, 1910. A normally open electric circuit with a spring actuated circuit closing rod having one end in engagement with one of the conducting wires, a casing containing an explosive, a keeper within the casing and engaged by the circuit closing rod to hold it inoperative.

986,291. CONSTRUCTION OF COILS FOR ELECTRICAL APPARATUS; Gottlieb Honold, Stuttgart, Germany. App. filed Dec. 3, 1910. A plurality of groups of coils consisting of layers of insulated wires with an insulating trough inclosing each group and extending on the sides so as to inclose superjacent coils, increasing protection against edge discharge.

986,303. ELECTROPLATING MACHINE; C. C. Miller, Chicago, Ill. App. filed Nov. 23, 1908. The work is carried through the bath by a chain, which carries cathodes from which the articles depend, the articles being carried through the bath between anodes arranged in the bath.

986,304. VACUUM-TUBE LAMP; D. McFarlan Moore, Newark, N. J. App. filed November 26, 1904. An internal electrode vacuum tube containing a gas-evolving organic substance with a heat-conserving envelope.

986,355. AUTOMATIC FIRE ALARM; J. H. Bruhn, Jr., Spirit Lake, Iowa. App. filed Oct. 4, 1910. A telephone circuit with service battery and relay inoperative under the influence of the battery, a signal circuit controlled by the relay, a subscribers' station, an auxiliary battery and a two-point thermostat in the telephone circuit with its points connected to the subscribers' station and the auxiliary battery.

986,382. THERMAL CIRCUIT CLOSER; F. C. Guptill, Elgin, Ill. App. filed May 22, 1909. An expansible two-part bi-metal thermostatic member rigidly attached to a base at one end and having spring contacts at the other moving adjusted terminals, which latter are mounted upon a pivoted lever which forms a pointer which can be set over a gage.

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NEW YORK ELECTRICAL SOCIETY.

Last week the New York Electrical Society, the oldest body of the kind in this country, held its three hundredth public meeting, devoted very opportunely to electrical development in Mexico and very appropriately convened in the beautiful hall of the Hispanic Museum. The society has had a career of uninterrupted usefulness and is to be congratulated on its vigor and its prosperous outlook. Established definitely in 1881, it now enters upon its fourth decade with the same characteristics that have always marked it. Never a publishing society, it has made a feature of visiting and debating, and has aimed to interest and instruct the younger men in the field. Although a local body, it has had a line of presidents almost equal in caliber to that of the Institute, and has been served throughout with intelligent devotion by its officers, particularly the secretary and the treasurer. Quick to recognize the fact that few topics are now without some relation to electricity, the society has of late in its constitution and practice so modified its program as to embrace matters of widest range in the sciences and arts, and is now finding in this way a field of unsuspected utility and value to a very large class in the community that wants themes treated "popularly," but also precisely and accurately. The highly successful course of meetings this year is a very good illustration of just how to do it, and we can but commend heartily the wisdom and breadth of view thus manifested in the selection of topics and speakers. The society will, we trust, long enjoy a career of such efficient service in the city whose name it bears and in the advocacy and promotion of electricity. Amid the upgrowth of other societies it holds its own with a definite place, a distinct mission and a growing membership.

THE PATENT SITUATION.

Elsewhere we print an excellent exposition of the patent law situation, which is particularly worthy of attention as coming from one of the leaders of the American patent bar, Mr. Charles A. Brown, of Chicago. The chaotic condition now existing in this branch of jurisprudence is well illustrated by the citations which Mr. Brown gives of patent decisions. After reading these citations one cannot but long for the appearance on the scene of a Jeremy Bentham, or, in lack of such a great personal force, at least earnestly hope for early action by Congress on the measure before it constituting a Patent Court of Appeals. But even such a court, however ably manned, would not in itself be able to modify fundamentally the patent situation which has grown up during the period of great industrial development extending over the past quarter century. While the direction, if not extent, of this development has been largely influenced by the patent element, the patent system has in turn been scarcely less influenced, particularly as relates to the great change in the status of the actual inventor. The remedy appears rather to lie in the direction of a complete statutory overhauling of the entire existing body of patent law, accompanied by such a definition of the patent monopoly that two courts cannot in the future hold such diametrically opposite opinions as those, for example, expressed by the United States Court of Appeals in the seventh and in the third circuit, cited by Mr. Brown. It certainly indicates an extraordinary condition to find on the one hand judges holding that the patent monopoly is as absolute as a royal grant of privilege in France prior to the French Revolution, and, on the other hand, judges who would so closely regulate the use of patents as largely to deprive them of their constitutional character as monopolies.

It is to be noted that the former view is the older one, and descended from the period when the inventor himself received more or less directly the monetary benefit involved in his invention; while the "insurgent" view is of more recent origin, coinciding with the change in industrial conditions under which the patentee is usually a salaried employee enjoying no property right in his work. This latter period also marks the gradual passing of the typical inventor of by-gone days, who was inspired with the ambition of founding or revolutionizing an art, or sustained in his work by visions of wealth to come as a reward for privations undergone while pursuing his ideal. Under the conditions of modern manufacturing organization and standardization of product, the inventor of revolutionary type is apt to meet with least encouragement where he most expects it; and, with protective patents covering many of the important arts, the commercial realization of even a fundamental invention in such arts would involve litigation so expensive and so uncertain in final result that, regardless of intrinsic merit, capital would turn a deaf ear to the inventor.

The foregoing naturally leads up to the inquiry: Upon what foundation has the great patent structure of to-day been reared? By what fundamental criterion can the stability of that structure be measured? The answer to both questions appears to lie in the following quotation of the clause of the Constitution of the United States which established the patent monopoly: "The Congress shall have power to promote the progress of science and useful arts by securing for limited times to authors and inventors the exclusive rights to their respective writings and discoveries."

AMERICAN WIRELESS ENGINEERING.

Although wireless-telegraph waves, if they could only be encouraged to carry around the world, might be expected to make a complete circuit in less than one-seventh of a second, and although with relatively sluggish wire telegraphy the victory of Manila Bay was announced to Washington by local time before the battle occurred, yet it takes many weeks by mail to the more distant islands of the Philippine group before our readers there can comment upon our publications. This week we print a comment by Mr. O. C. Roos upon an article that appeared in our issue of Sept. 29 last. The article in question was a little hard upon American wireless-telegraph engineers, as we commented editorially at the time, and Mr. Roos takes up the cudgels in their defence. There is doubtless much force in his contention. The time is rapidly approaching, however, when the world will be too small to be separated into different countries. What with wireless telegraphy itself, the ever increasing tide of commerce, travel, shipping, tunnels, the mail and the aeroplane, languages themselves will have a struggle for existence, and, in the civilized world, men will tend to lift mountains and dry oceans until in applied science all advance will be made collectively.

TRANSMISSION-LINE TROUBLES.

A correspondent this week gives a heartfelt account of the asperities of energy transmission from the standpoint of the fellow who purchases the energy at the receiving end of the line. His story is a tale of woe for which ample sympathy will be extended by some of his fellow sufferers. The situation described was certainly an unpleasant one—that of a plant carrying a city lighting contract and a large amount of miscellaneous service and buying energy from a long-distance transmission plant apparently afflicted with about all the ills that transmission plants are heir to. The record of interruptions of service for a single year ran to 120, most of them short, but nevertheless aggregating ninety hours of suspended operations. This is a much worse record than would be shown by most plants engaged in transmission business, but happily the record is one of several years ago and has been lived down by progressively improved service. The fact is unfortunately that, while short interruptions of half a minute or a minute or two do not look bad upon the record, they are peculiarly exasperating to the station operator and sometimes become unpleasantly numerous. They are quite long enough to throw synchronous apparatus out of step, interfere with the lighting service in a very exasperating way and cause all manner of kicks from the ultimate consumers. It is a fact, however, as our correspondent states, that most of these interruptions are due, not to failure of service at the generating station nor to the breaking down of the main transmission line, but to the failure of subsidiary apparatus and of branch lines. As a rule a good deal of money is spent on the main lines and they are fairly well protected against lightning by grounded guard wires and banks of lightning arresters. Structurally they are generally first class, and the actual breaking down of a main transmission line is a rather rare accident. Troubles come chiefly on branch lines where the main-line construction is not duplicated and in subsidiary apparatus of various kinds. These are the things that require more careful attention than they generally get. Every branch line is a weak spot and should be strengthened accordingly. Its junction with the main line is quite likely to be a point of electrical disturbance and needs to be guarded accordingly. The branch itself, if operated at main-line voltage, requires main-line construction and insulation. A punctured insulator on a branch is just as bad as if it were on the main line, and there should be no reduction of the factor of safety merely because the branch is a short one. In the case here cited not even the installation of a duplicate transmission line remedied the difficulties, since the same storm would occasionally interfere with both lines and put the receiving plants temporarily out of business.

We fancy that if the solemn truth were told the records of interruption on many transmission lines would not make pleasant reading, yet it is certainly true that some of them, by the exercise of eternal vigilance, succeed in getting through the year with remarkably clean records. Many a plant keeps the voltage at its busbars with a continuity that would do credit to a first-class steam-driven central station. In fact, if one could critically examine the record of troubles in stations of this latter class he would generally find a series of local interruptions of service sufficient to comfort somewhat the operators of transmission systems. The lesson to be drawn from the situation is, we think, chiefly the necessity of rigorous attention to apparently unimportant branch lines and supposedly unimportant details of construction. Automatic protective apparatus for transmission service has not received the attention that is fairly its due. Not infrequently, too, purely local troubles may be reflected back to the system with most unpleasant results. It would often lead to better service were the transmission lines so guarded with cut-outs as to afford pretty complete protection against this particular cause of trouble. By and large, a well-built transmission line as a whole can be made very reliable; but to insure continuity of service the same care that is exercised on the main line must extend clear through the system, including generally the local distributing systems that suffer most keenly in case of failure.

VECTOR NOTATION.

An interesting communication from Dr. Steinmetz will be found in our correspondence columns this week on the vexed subject of alternating-current vectors. Dr. Steinmetz takes the position that the question at issue between the two different existing schools of alternating-current vector representation is not one of rotation, but of notation, and he criticises a former editorial article of ours on this particular. From one point of view Dr. Steinmetz's proposition is unassailable, but from another and equally good point of view it is open to assault. As is usual in such deadlocks of controversy, the dispute arises over the precise subject of disputation, and each party mistakes the contention of its opponent. As we are all most unfortunately aware, vector diagrams appear in alternating-current literature with two mutually inverted representations. If we look at a clock and conceive the hour-hand as denoting a vector e.m.f. impressed upon a simple alternating-current circuit containing a choking coil, or resistance plus reactance, then, in either representation, the hour-hand at 3 o'clock may indicate the e.m.f. vector in the horizontal position of reference or standard phase. If now the minute-hand on the same clock dial represents the alternating current in the circuit, this current will lag, say, 30 deg. behind the impressed e.m.f. One school of vector writers designates this by putting the current or minute-hand on one side of the e.m.f. hand, making the clock read 3:10; while the other school puts the current hand on the other side of the e.m.f. hand, making the clock read 3.20. Consequently, when we see 3:20 on the vector clock face of a textbook page we cannot tell whether it means a lag or a lead of 30 deg. in the current unless we know to which school the writer belongs or gather from the accompanying context, if there be any, which way his diagram should be interpreted. The unfortunate beginner in alternating-current vector notation is apt to be discouraged by this ambiguity and to exclaim with Mercutio: "A plague on both your houses." Electrical engineers should not rest contented until 3:20 means one thing and stands for one phase representation all over the alternating-current world.

It is, of course, admitted, on all hands that both those who represent a lagging current by 3:10 and those who represent it, on the contrary, by 3:20 nowadays derive their representation from a fundamental positive or counterclockwise rotation by polar co-ordinate geometry and by trigonometry respectively. If, as Dr. Steinmetz does, we rotate a time vector uniformly counterclockwise and take instantaneous intercepts thereon, and if a simple sinusoidal alternating e.m.f. or current be so graphed, the graph will be a circle. If, further, we adopt the convention with Dr. Steinmetz that the diameter of this circle shall be the fixed vector representing that quantity, then we are led inevitably to 3:10 for a lagging current when both current and e.m.f. are vectored simultaneously If, on the other hand, we plot a sinusoidal quantity as the ordinary textbook on trigonometry plots it, with a counterclockwise rotating crank diagram, then if we take the direction of maximum positive amplitude as a fixed vector representing the quantity, we are led inevitably to 3:20 for a lagging current, if both current and e.m.f. are vectored simultaneously. From the standpoint, therefore, of fundamental rotation Dr. Steinmetz's contention cannot be disputed that there is no difference between the two schools as to direction of rotation and that the only question is as to how the vectors in question have been derived. From another point of view, however, the two rival vector methods involve different rotations, because in the 3:20 clock face the minute-hand of lagging current is shown as lagging in phase behind the hour-hand of impressed e.m.f. in the order of positive rotation; whereas in the 3:10 clock face the lagging current takes a position ahead of the impressed e.m.f. in the direction of positive rotation. Or, to express the facts in another way, if we look at a clock face and understand that time is to advance counterclockwise we would naturally expect that a vector at 3 would precede a vector at 4, or would be the leading vector. According to the 3:20 school this would be true, but it would be just the reverse with the 3:10 school. From this standpoint the question at issue is one of rotation, that is, rotation in the direction of phase advance.

As to polar co-ordinate plotting versus trigonometrical projection the only advantage that is unchallenged for the polar system is that when a complex harmonic wave is plotted the circle of equal area has a radius that measures to scale the root-mean-square value. On the other hand, the trigonometrical projection method is the one almost invariably used when the complex wave has to be analyzed into harmonic components. Consequently, engineers must be familiar with both methods of plotting. Of course, only one conventional vector diagram representation should be selected and standardized. Whichever diagram is selected by the International Electrotechnical Commission, whether for a lagging current, the 3:10 or the 3:20 clock picture, the result can be harmonized with the other method of plotting by a suitable change in what is mere graphic convention and not fundamental mathematics. Dr. Steinmetz points out that in his heart shaped polar diagram the five extrema indicate a fifth harmonic. The corresponding trigonometrical projection, however, to rectangular co-ordinates also shows five extrema, and gives a similar indication. We agree very heartily with Dr. Steinmetz that two different representations of alternating vectors exist and that it would be very desirable to reach an agreement on vector notation. We have no fear, however, concerning the possibility of reaching a decision by international discussion and agreement. It is a mere matter of convention and will mean the cessation of a sad brain-wearying dissension that has been running on for nearly a quarter of a century.

New York Electrical Society Meeting.

The three hundredth meeting of the oldest American electrical association, the New York Electrical Society, was held on March 16 at the Hispanic Society Building. Mr. F. O. Blackwell delivered an illustrated lecture on hydroelectric development in Mexico in which he outlined the early plants brought into existence by reason of the excessive cost of fuel, especially in the mining districts. He described briefly the electrical equipment at Guanajuato, and in detail the Necaxa plant of the Mexican Light & Power Company. The equipment at the latter plant has been so far extended recently that 150,000 hp can be developed. The paper was not discussed. The 200 members and guests who were present were afforded an opportunity to inspect the museum of the Hispanic Society, which contains many features of historical interest, including rare paintings, wood carving, silver work, plaque collections, mosaics, ancient manuscripts, ecclesiastical sculpture and various other antiquities.

During a short business meeting of the society the treasurer reported that the heavy load of debt which the society had incurred during the last few years, in its endeavor to develop its work and increase the advantages of its membership, has been paid off, and the finances of the society are now in a prosperous condition. Twenty-eight members and thirty-two life members were elected. The society now has over 800 members.

Conference on the Conservation and Utilization of Water-Power.

A public conference will be held in the United Engineering Building, New York, on Saturday, April 8, under the auspices of the Power Transmission Section of the National Electric Light Association, to consider the important subject of the relation of the national and state governments to the conservation and utilization of water-powers. Two sessions will be held, afternoon and evening, and papers and addresses will be delivered by several well-known men. Invitations to the conference are being sent to members of engineering societies as far east as the Mississippi River, and the meeting has the hearty co-operation of national engineering bodies.

Among the list of topics for discussion are the following:

Shall the federal government continue in control of the water-power sites or transfer them to the respective states wherein they are located?

If the latter, shall they turn them over without reservation or endeavor to impose restrictions?

Shall the water-power sites, whether controlled by federal or state government, be transferred outright to the locaters thereon for a consideration or without a consideration other than that they agree to develop them within a reasonable limit of time; or shall the water-power sites, whether owned by federal or state authorities, be leased to the locaters, and, if so, shall there be a time limit and a basis of charge?

If a charge, shall this charge be an annual rental for the property or based on the possibility of development or the actual development?

If on the actual development, shall the charge be arrived at on the basis of the minimum flow of water, or the actual amount of power generated and delivered therefrom, or the installed capacity in the generating station?

Contemplating, as is generally the situation, that the majority of the water-power sites, whether controlled by either federal or state government, cover only a very small proportion of the property as a whole utilized in the development of these propositions, shall or shall not this feature be taken into consideration in fixing the charges, if any?

If it is thought that it is best to grant a tenure for a definite time limit, what provision should be made in the original agreement as to the basis for renewing the rights to occupy the land?

In adjustment, what consideration should be given to the fact that the individual, company or corporation occupying the site has a positive and individual ownership in the water, which ownership has been acquired direct from the state and in fee simple?

If it is finally concluded that the government should retain ownership in the land, granting only an easement with a time limit and at the end of this time limit either the lease be renewed or the new owners take possession of the property, what provision should be made as to the proper valuation, the latter to include that portion of the development located on the government property, the ownership in the water, the pole lines which are or are not on government land, the substations wherever located, as well as the distributing circuits and motor installations therefrom? Shall they be valued on the basis of a replacement charge or on earning capacity?

Would it not be better that either the federal or the state government, whichever it is concluded should own these sites, should grant them in fee to the parties who will take and develop them within a certain given time and depend upon the public service commissions to regulate the rates and service, the same as is being done now in certain states with street-railway and lighting companies?

Meeting of New York Companies Section, N. E. L. A.

The Edison Auditorium, in West Twenty-seventh Street, New York, was packed to the doors on March 20 to hear Mr. Walter R. Addicks, vice-president of the Consolidated Gas Company, deliver an illustrated lecture on the manufacture and distribution of illuminating gas. Mr. Addicks described the various processes of making water gas, coal gas and coke and the modern methods of ridding the gas of ammonia, tar, sulphur, etc. He described in detail the immense plant of the company at Astoria, Long Island, whence the entire New York system will eventually be supplied. There are located the largest coal gas units and the largest gas holder in the world, the latter having a capacity of 15,000,000 cu. ft. The illuminating gas from this plant is brought to New York by a tunnel under the East River. Mr. Addicks not only enlightened his hearers on a subject with which few were familiar, but also surprised them by showing to what a great extent electricity is employed in the gas works for driving conveyors, charging machines and other apparatus employed in the manufacture of gas. The distribution of the gas to holders in New York, thence to the consumers, and the methods employed for increasing the sale of gas were all treated at length in an interesting way, void of technicalities. The speaker was frank in his admission of the superiority of electricity for illuminating purposes, especially in show windows; but showed the immense use to which gas was put in cooking and heating appliances in New York. Many of the gas stoves are leased to users at nominal yearly rentals ranging from $1 to $3.

Mr. Arthur Williams, chairman of the meeting, stated that the membership of the section had increased in number and was now only surpassed by that of the Chicago Section. It is expected that at the April meeting Mr. Nikola Tesla will give a lecture and demonstration on high-frequency currents. The meeting will probably be held in the Engineering Societies Building, which has a greater seating capacity than the Edison Auditorium. After the lecture and announcements there was an entertainment followed by refreshments. The attendance at the meeting was over 600.

New York Electrical Show.

This year's electrical show in New York City, which will be called the New York Electrical Exposition, will be held in the New Grand Central Palace, Lexington Avenue, Depew Place, Forty-sixth and Forty-seventh Streets, Oct. 11 to 21. The change has been made from Madison Square Garden, where the previous shows have been held, in order to secure greater exhibition space. The main floor of New Grand Central Palace has 100,000 sq. ft. of space available for exhibition purposes as against 30,000 sq. ft. in the arena of Madison Square Garden, and in addition the two upper floors are more suitable for the purposes in mind. The second floor of the New Grand Central Palace will be given over to manufacturing exhibits, and there will be shown in miniature the entire processes employed in the manufacture of candy, cigarettes, fountain pens, etc. The third floor will be converted into an automobile track with model garage and charging equipments, so as to enable manufacturers of electric vehicles exhibiting on the main floor to show the automobiles in operation. The decorative scheme has not as yet been finished, but a number of decorators are at present engaged in working on plans for beautifying the exhibition structure, for housing the exhibits and to evolve a setting unlike anything heretofore tried in the numerous shows given in New York yearly.

Licensing Professional Engineers.

As previously noted in these columns, a hearing before the committee on general laws of the New York Assembly was held March 1 upon the so-called Hoff bill, which was based upon a draft prepared by a committee of the American Society of Civil Engineers and introduced with the understanding that while the society did not advocate the licensing of civil engineers, if legislation to that effect was imperative the Hoff bill was suggested. Another bill has been introduced at the suggestion of the Technical League and is known as the McGrath bill. This was referred to the committee on public education, and at a hearing held on March 14 the American Institute of Electrical Engineers was represented by Past-president Frank J. Sprague, Messrs. Charles W. Stone, H. H. Barnes, S. D. Sprong, managers; Mr. E. A. Baldwin, chairman of the Schenectady Section, and Mr. Ralph W. Pope, secretary. The National Electric Light Association was represented by Mr. W. W. Freeman, president, and prominent officers and members of the American Society of Mechanical Engineers, American Institute of Mining Engineers and American Society of Civil Engineers were also in attendance, all being opposed to the McGrath bill, which was championed only by the counsel and president of the Technical League.

The statement was made that the league is composed of approximately 1000 members scattered throughout the country, about 250 being employed in the State of New York. The object of the bill was stated to be the elevation of the profession and the protection of the people against incompetent civil engineering in public works. Messrs. Sprague and Stone spoke against the bill in behalf of the American Institute of Electrical Engineers and were supported by President Freeman, of the National Electric Light Association; Col. Meier, president of the American Society of Mechanical Engineers; Mr. Spilsbury, representing the American Institute of Mining Engineers; President Boller, of the American Institute of Consulting Engineers, and Mr. Francis, of the American Society of Civil Engineers. After the hearing it was reported from various sources that the bill was not likely to be pushed in opposition to the practically unanimous disapproval from engineers of standing. Unless engineers are on their guard similar legislation in other states may be adopted detrimental to the interests of engineers, who have heretofore been practically free from interference of this nature. Several states have already enacted legislation of this nature.

New Freight-Distributing Yards in Chicago May Hasten Electrification.

It is said that the railroads entering Chicago are considering the establishment of large freight-distributing yards on the outskirts of that city to combine and systematize the interchange of freight in possibly two or three yards, where nearly thirty yards are now in use scattered along the belt railroad that encircles the city. This plan of outer yards has an important bearing on the proposed electrification of the Chicago railroad terminals. If the freight switching could be done in these yards it would be a comparatively simple matter to electrify the passenger terminals, while the sorted freight cars could be pulled in by electric locomotives.

Railroad officials are reported to have said that the plan of outer distributing yards is conceded to be the solution of the freight problem in case the terminals are electrified. It is declared that the railroads are not willing to admit that they expect to lose in the fight for immediate and universal electrification. The plan of building extensive freight-exchange yards has been in contemplation for years, and to some extent the idea is carried out now. Nevertheless, the fact that the very large expense involved is now considered seriously leads to the belief that the imminence of electrification has brought the plan from the realm of things hoped for to the category of things that will probably be actually accomplished.

Toledo Electric Lighting Rates.

Last week at a meeting of the Council of Toledo a subcommittee report fixing the residence lighting rate at 6 cents per kw-hour, with a minimum monthly charge of 50 cents, was adopted. A discount of 1 cent per kw-hour is to be allowed if the bills are paid within ten days after being rendered. The present rate is 9 cents per kw-hour and a minimum charge of $1 with a discount of 10 per cent.

President Albion E. Lang, of the Toledo Railways & Light Company, was emphatic in a statement that the rate could not be accepted, as it would mean a loss and final confiscation. He said the only thing that could be done would be to cut off those who are at present paying 9 cents and furnish the downtown houses and buildings at 6 cents, which could probably be done with profit.

During the Council meeting Mr. Lang in reply to a question said that the cost of producing electrical energy was between ¾ cent and 1 cent per kw-hour at the switchboard. When asked to give the cost delivered to the consumer he said that the transmission system is so complicated and so many things enter into the cost that he could not give the figures, and added that the company is losing money on the 9-cent rate. The average receipts, it was said, are 3¾ cents per kw-hour.

Attorney Rathbun Fuller called the attention of the committee to the attempt at Columbus to enforce a 5-cent rate five years ago. The city was enjoined from enforcing the ordinance and the United States Court sustained the company in its contention that the rate would be confiscatory. It was shown at that time that the cost of energy to the rush consumer was 5.394 cents, without considering interest and depreciation, and 8.594 cents, including these charges. A rate of 8 cents per kw-hour was finally fixed after the city had expended $26,000 in litigation.

Members of the committee contended that great improvements had been made since that time and that production costs much less now. President Lang said that the progressive ideas of Toledo had greatly increased the cost of production. This city has the sixth largest underground conduit system in the United States, he said, and, with the exception of Boston, it is the only city fully equipped with magnetite street lamps.

Mr. Fuller stated that the statute under which the old franchise was drawn gives the company the right to make its own minimum and meter charge in the absence of any provision relating to these points in the contract. President Lang proposed to the committee that engineers be employed to go over the books of the company and estimate the cost of production and that the rate be based upon this estimate. He said that this is the only equitable manner in which to arrive at anything like a correct figure.

In order to give the public an idea of the situation the company is now running a series of talks in all the Toledo papers. In these talks the company seeks to bring out all the salient points affecting the production of electricity and the benefit to the city in its use for power purposes.

Grounded Secondaries in Denver.

The secondaries of the Denver Gas & Electric Company are now all grounded throughout the city. Several initial grounds on the interconnected secondaries from each primary have been made to water mains direct from the network neutral, and every new or rewired installation is being independently grounded to a water pipe on the street side of the meter. As all new wiring installations in Denver are in iron conduit and all conduit grounded to water pipes by cable at least one-half the size of the largest wire in the building, all that is necessary is a thorough ground of the neutral wire inside the main cabinet This is required by ordinance.

An additional ordinance requirement, recently effective, prohibits any service connection until the installation is reported ready for service by the city electrician. The service company is now pursuing a careful inspection by a special inspection force of all basements, toilets, kitchens and like places throughout the entire city and mailing notices to owners, occupants and the city electrician of brass shell sockets or cord conditions tending to possible personal injury. These cases will all be followed up and corrections secured by the city department. This is probably the first thorough campaign for safeguarding against personal injury from electric wiring undertaken in this country, and in connection with the requirement for conduit installation in all cases will place Denver in the very first rank in protection of both property and life from electrical accidents.

An unusual degree of co-operation between the city electrician and the service company is responsible for the remarkable advance within some four or five years from the promiscuous interior and exterior wiring methods formerly in vogue and still practised too often in other cities.

Relation of Patents to Pooling Agreements.

At the midwinter dinner of the Electric Power Club in Chicago early this year, as mentioned in these columns at the time, Mr. Charles A. Brown, of the Chicago patent bar, made an address on "The Relation of Patents to Pooling Agreements." Mr. Brown, from his long familiarity with electrical patent litigation and the study which he has given to the situation both as a citizen and as a professional man, is well fitted to discuss this subject of importance. Readers of this journal will be interested, therefore, in the following abstract giving the substance of Mr. Brown's speech.

After referring to the tendency toward price pools and combinations, which is said by some writers to be as fundamental and inevitable in its operation as any law of nature, and which is opposed by a contrary force which seems equally powerful, namely, the public interest in competition, he said that the race between the means adopted for the legal defense of combinations on the one hand and the legal attacking ordnance on the other is something like the race between the progressively increasing resistance of protecting armor of war vessels and the progressively increasing power of the attacking guns.

So far the legal armor of combinations has failed to prove impenetrable to the legal projectiles hurled against it. Contracts, trusts for holding stocks, holding corporations, etc., have been tried with confidence that they would each afford absolute legal safety. But the decisions of the courts, getting more vigorous from the power of public opinion back of them, have penetrated one device after another until now patents are, or may soon be, about the only legal shelter for a combination agreement affecting prices.

By statute the United States gives to an inventor a patent by which he has the exclusive right to make, use and sell his invention for seventeen years. By the statute of July 2, 1890 (Sherman act), every contract, combination or conspiracy in restraint of trade or commerce among the several states is made illegal. Here are two legislative enactments of equal validity. One of them grants a monopoly for a specific time: the other forbids any monopoly based on any contract, combination or conspiracy.

Mr. Brown stated that under the patent law, as it had been interpreted by the courts, the patentee has legal authority to make and sell the invention and to restrict its use in respect of territory, time, business or purpose as he shall deem fit. In the Dorsey Revolving Harvester Rake Company versus Bradley Manufacturing Company case Judge Blatchford says: "The right of the patentee to confer upon others such qualified privilege, whether of making or selling to others or of using as he sees fit, whether within special limits or under limitations of quantity or number of restricted uses, does not seem deniable."

This early enunciation of the law by a celebrated judge has been followed in a long line of decisions which have held that the exclusive right granted by a patent to make, use and sell an invention may be parceled out and distributed among any number of licensees. Under such decisions a patentee may withhold his invention from the public absolutely and completely, and he has the right, extending all the way from this complete exclusion of the public to a complete abandonment of the invention to free use by the public, to name the conditions—any conditions—under which the public may have the benefit of his invention during the seventeen years of the life of his patent.

Mr. Brown stated that it is not disputed that under the law a patentee may license others—no matter how many others—to make, sell or use the invention, and may make the license conditional on the licensees all maintaining a fixed price, and may make such conditions as to the regulation of business and prices as the patentee may deem proper, and that it is not disputed that an individual or a corporation can acquire title to any number of patents, and with respect to each patent so acquired have and exercise all the rights belonging to any patent owner Such owner would have a right to grant licenses covering them all and prescribing like prices for all the patented articles in all the patents.

It has been held legal for the owner of a patented machine for fastening buttons to shoes to sell such machines subject to a condition that they shall be used only with fasteners manufactured by the seller, title to revert on breach of the condition. Even though the fasteners are not patented and the result of the restriction is to give the owners of the machine patent a monopoly of the manufacture and sale of these unpatented fasteners, still this does not make the condition void as in restraint of trade. (Heaton Peninsular Button Fastener Company versus Eureka Specialty Company.) It has been held that under the patent laws patented articles are not articles of trade or commerce among the several states in which the people are entitled to freedom of trade, nor are they instrumentalities of commerce in which the people are entitled to free competition, nor when restrictions are placed upon the making. selling or using of such articles are the people deprived of anything to which they have a right. (Rubber Tire Wheel Company versus Milwaukee R. W. Company.)

It has been held that where there were a number of licenses without restriction of output or fixing of prices, and where each of the licensees under his license enjoyed a portion of the patent monopoly subject only to the payment of royalty and might freely compete with any other licensee, nevertheless, since the public could not have the patented article except by permission of the licensor or licensees, and, since the licensor had retained a certain interest in the invention, a combination subsequently entered into between the licensor and licensees which restricted output, fixed prices and made other restrictive provisions was valid. (Goshen Rubber Works versus Single-Tube A. & P. Tire Company.)

It has been held that independent and competing patents, although representing separate inventions which under separate control might be given to the public in competition with each other, were still not something to which the public was entitled, and consequently the combination of the separate monopolies in one ownership or control by which competition between them was restrained or destroyed was not in violation of the Sherman act. (Indiana Manufacturing Company versus J. I. Case T. M. Company.)

In holding that the owner of a patent could impose as a condition of the use of a patented machine the provision that it must be sold at a certain price and any violation of that condition made both the seller and user of the machine an infringer, the Circuit Court of Appeals for the Seventh District said: "Within his domain the patentee is czar. The people must take the invention on the terms he dictates or let it alone for seventeen years. This is a necessity from the nature of the grant. Cries of restraint of trade and impairment of the freedom of sales are unavailing because for the promotion of the useful arts the Constitution and statutes authorize this very monopoly."

From the foregoing, Mr. Brown stated, it is apparent that combinations and contracts which otherwise would be obnoxious to the Sherman law become bathed with immunity under the sanctifying influence of the patent law. The other side of the issue is then presented.

It has been repeatedly held that patentees must enjoy their monopolies in obedience to law and the rules of public policy. A patented oil which did not comply with the state law requirement as to test was found not exempt from the provisions of the state law. Patented sewing machines have been held to be taxable under state license laws, and so has patented oleomargarine.

The late Justice Brewer said that "There is no peculiar sanctity hovering over or attaching to the ownership of a patent."

Other courts have set forth the following views:

"The patent laws of the United States give to inventors the exclusive right to their inventions, but do not give to them the right to disregard laws enacted to promote the welfare of the whole people.

"The property of an inventor in a patented machine, like all other property, remains subject to the paramount claims of society.

"The patent laws do not authorize the patentee to employ his invention for a purpose or in a manner that may be forbidden to all other persons in the use of their unpatented property or discoveries."

These are some of the general expressions of courts on this subject, and in National Harrow Company versus Hench the Circuit Court of Appeals for the Third Circuit decided that the owners of or licensees under different patents controlling patented articles of similar use which would compete in the market if such competition were unhindered—like sewing machines, or typewriters, or automobiles—cannot lawfully form a combination under the protection of their patents to uphold their prices; that each patentee has his own monopoly of his own invention, but that two or more patentees cannot unite to form a new monopoly; that the public is entitled to the benefit of competition between articles covered by different patents as well as between different unpatented articles.

It will be seen that there is a direct conflict between the decisions of the different courts upon this subject, and the Supreme Court of the United States has not yet spoken.

No one can say with certainty where the Supreme Court will draw the line. The situation is as between the contending forces something like that which arises where an irresistible force encounters an immovable body. There is bound to be some wabbling. This much, however, Mr. Brown said, can be asserted with some certainty: The perfectly worthless patent employed as a mere cloak to cover a combination cannot save that combination from condemnation under the Sherman law. Under the present law a test of legality may be laid down in the following interrogatory: "Is the arrangement under consideration substantially an exercise of the patentee's right of exclusion, or is it essentially a combination in restraint of trade?"

Where there is a combination to sustain prices of a patented article it is a subject of inquiry whether the real purpose and result of the combination are to uphold and protect a valid patent monopoly or to uphold and protect an unlawful trade monopoly.

Whatever is, in fact, a reservation from the patent grant is legal. Whatever is not a reservation from the grant, but depends on contract, whatever be the form, is likely to be found obnoxious to the Sherman law.

In conclusion Mr. Brown pointed out that there is a consideration which passes beyond the mere question whether or not a combination fixing prices is or is not within the law as it shall be finally settled by the Supreme Court.

Our patent system is the creature of statute. Already we hear grumblings regarding even the undisputed legal monopoly granted by a patent.

Whatever the courts may decide, we may be sure that monopolies protected by the patent law will be trimmed by the legislature, if not by the courts, until they fit easily upon the disposition of the public.

It is not wise, therefore, to strain the protecting force of the patent statutes, but to keep well within the factor of safety, not only with reference to the decisions of the courts, but with reference to possible future legislation.

Resuscitation from Electric Shock.

An interesting case of resuscitation from apparent death caused by electric shock is reported in a recent issue of *Badische Gewerbe Zeitung*, which case was also referred to and discussed by M. d'Arsonval at a recent meeting of l'Académie des Sciences in Paris. In the place where the accident occurred the three-phase wires of a 7500-volt, 55-cycle circuit were placed on a bracket fastened to the wall about 20 ft. above the ground. A lineman had climbed up to this bracket in order to work on some telephone wires and accidentally took hold of one of the high-tension wires. It was several minutes before the line was disconnected, about fifteen minutes before the man was found and half an hour before he was brought to the ground; that is, about fifty minutes elapsed from the time of the shock until the first efforts at resuscitation were made. When brought to the ground the victim of the shock did not give any sign of life, and attempts were made to produce artificial respiration by movements of the arms, etc., principally following the Sylvester method, but without effect. As hope was about to be abandoned it was recalled that instructions relating to the tongue had been neglected, whereupon the mouth was forced open and the tongue pulled out and allowed to recede rhythmically. Almost at once the patient responded and commenced to breathe, and after two hours the man not only had regained consciousness, but, with the exception of a few burns, was in normal condition.

Modern Transmission Problems.

Mr. D. B. Rushmore, of Schenectady, N. Y., delivered an address before the local section of the A. I. E. E. at Pittsburgh on March 14 on some aspects of modern energy transmission.

The speaker began his remarks by referring to the work of the high-tension transmission committee of the Institute and the fact that the art was constantly changing, due to new conditions arising. High-tension systems, a few years ago a novelty, are now very prevalent over the country, particularly prominent ones being located in California, Colorado, Montana, Michigan, Canada, New York, Pennsylvania and North Carolina. Energy transmission formerly meant high-tension systems obtaining energy from waterfalls alone, but now such a system usually consists of a water-power station with steam plants tied in to relay in case of trouble. This has necessitated a change in the design of apparatus to conform to the new requirements. Unfortunately many high-tension systems have proved to be financial failures, and this has been caused in a large measure by the fact that the market for same has not been controlled. Success depends upon the control of the market. The general tendency now is for the local companies in the district to receive energy to combine, thereby assuring a market for the output, and form a high-tension network.

Another feature tending to discredit these systems is the number of interruptions to which they have been subjected. A few years ago many of these lines now operating continuously were subjected to so many interruptions that it was impossible to rely on the transmitted energy for commercial uses. At the present time, however, the magnitude of the loads carried and the reliance placed by manufacturing industries demand continuity of service. This development has brought about changes in the engineering features of construction, both of the generating and transmission system, resulting in an increased cost per unit. As an example may be noted the replacing of the old wooden flume for carrying the water by a tunnel under the mountain.

The speaker described briefly some of the more prominent high-tension transmission systems, mentioning their distinctive features and showing some illustrations pertaining thereto. He said that the Grand Rapids-Muskegon Power Company, Michigan, which operates at 100,000 volts, experiences no trouble from interruptions. The system operated by the Southern California Edison Company was referred to as the greatest in the world, being veritably a high-tension busbar running the length of the State. When any trouble occurs in one of the power houses it can be immediately disconnected from the system and the others supply the energy. Considerable trouble was experienced at first by reason of spray from salt fog lodging on the insulators. This company is now operating at 100,000 volts and actually experiences less trouble than with the lower voltages. The frequency is 50 cycles. Its use well illustrates the influence on any future developments of a selection made in the beginning. This frequency was selected several years ago, and as the present system is simply an outgrowth of the earlier one the same frequency had to be maintained. The frequency of 40 cycles used by the Hudson River Power Company in eastern New York is another example of this influence.

Different geographical conditions affect the design and operation of systems, as is well illustrated by the Central Colorado Power Company, which operates some of its lines at an altitude of 13,000 ft., crossing the continental divide three times. Some portions of the lines are so inaccessible that in winter it takes from two to three weeks to reach them from the base of supplies.

A feature which promises to be a very important factor in the future development of high-tension transmission systems is that of corona loss, which in some cases on the lines mentioned is as high as 1000 kw. In the opinion of the speaker the study of corona loss is the most important subject now to the fore in connection with high-tension transmission and the voltage will be limited to 150,000 on account of corona loss unless some other form of conductor is used.

A great deal of the success of operation depends on the manner in which the apparatus is placed in the stations. For higher voltages the wiring is usually open, as the large clearance distances required would necessitate inclosing structures of excessive dimensions.

Mr. Rushmore showed a great many lantern slides illustrating various forms of generating, transforming and protective apparatus developed for high-tension service, explaining in brief the special characteristics of each. Generators and transformers are both undergoing radical changes necessitated by new conditions they have to meet. In rating of steam turbines there seems to be no limit—units of 20,000 kw are now being built. In the design of water-wheel-driven generators allowance must be made for a possible increase in speed of 100 per cent should the water-wheel governor become disabled. Another very important point to be considered is the amount of energy capable of being delivered to a short circuit. External reactance coils are now frequently employed to protect the machines by limiting the short-circuit current.

Large apparatus must frequently be constructed so that it can be shipped in small pieces, on account of the lack of proper transportation facilities. For example, generators and switchboards have been transported on mules.

The speaker, in conclusion, predicted a consolidation of the existing systems into a few large syndicates which would operate them advantageously. There seems to be no limit to expansion except the market. The voltage in the near future will not exceed 200,000.

Transmission of energy at high potentials presents a large field for investigation and serious work. The success thus far attained has been, in a great measure, due to the active cooperation between the manufacturers and users of apparatus, the latter realizing that newly developed apparatus must of necessity be thoroughly tested in actual practice before being perfected.

The transmission of electrical energy generated by waterpower which would otherwise be wasted is the most important work engineers of the present day have accomplished.

Use and Maintenance of Joint-Pole Lines.

One of the papers presented at the third annual meeting of the Engineering Society of Wisconsin at Madison, Wis., on March 10 was by Mr. O. M. Rau, chief electrician of the Milwaukee Electric Railway & Light Company, and was entitled "Use and Maintenance of Joint-Pole Lines by Public-Service Companies." Pointing out that the existence of public-service commissions has an important bearing on the question of joint-pole lines, Mr. Rau said that the general tendency of a commission is to bring about elimination of competition. Ultimately this tendency will result, no doubt, in one telephone company, one electric service company and one railway company in a community, with a possible consolidation of the latter two. With the elimination of direct competition the value of the pole-line right on streets is of little importance, and a more favorable feeling should exist toward a policy of joint-pole construction and maintenance.

The writer's object was to point out a standard method which may be adopted for joint-pole ownership and maintenance between different companies. The pole line for the light and power company should receive first consideration on account of the high potentials carried on its transmission lines. The poles for this service should be of good quality and not less than 35 ft. high. They should be rigidly set and suitable for the mounting of transformers. Upon the top cross-arms the high-potential transmission lines should be placed. Next come cross-arms required for arc-lighting circuits and below them the cross-arms for the distributing system. This will bring the lowest cross-arm not less than 20 ft. above the ground. Poles should be spaced from 100 ft. to 125 ft. apart.

With the lighting and power lines so installed that portion of the pole not used will meet the requirements of a railway company exactly. The height of railway span wires is not more than 19 ft. above the ground. Below this point could be placed a cross-arm for railway feeders.

For the joint use of electric service and telephone companies the poles should be somewhat higher, say, 40 ft. Beginning at the top of the pole, the cross-arms should be, in turn, for the power-transmission lines, the arc-light lines, the telephone wires and cables, and the distributing circuits of the lighting company. The high-tension lines, which require infrequent visits and which are most dangerous, are placed nearest the top of the poles. They are usually installed with every precaution for reliability and safety, and rarely break.

Four arguments in favor of joint-pole lines were enumerated by Mr. Rau. These are, first, saving in initial cost of construction; second, saving in cost of maintenance; third, avoiding ill-will of the public, and, fourth, improving the appearance of the street.

To arrange an equitable basis for the installation and maintenance of joint-pole lines between the different companies depends materially on local conditions. In some cases each of two companies might bear 50 per cent of the expense of installation, the maintenance to be at the expense of the individual company so far as attachments are concerned. Renewals of poles might be made by the company best equipped for doing the work in each particular case, the other company being billed for one-half the cost. This plan, however, would not be equitable on main pole lines or where the poles are not used to an equal extent by the different companies. A contract that will be fair to all interests can be drawn, however. Mr. Rau has given considerable attention to the subject and has been successful in bringing about a number of important pole-line combinations, avoiding the introduction of ordinances compelling underground construction.

Influence of Glare on Effective Illumination.

At a meeting of the Car Lighting Club in Chicago, March 15, this club being a subsidiary organization of the Association of Railway Electrical Engineers, some discussion was given to the subject of the effect of lamps within the field of vision and the reduction in the effective illumination which results.

Mr. Arthur J. Sweet, of Newark, Ohio, spoke of the well-known experiments which he carried out demonstrating that with a certain given light source the ability to see is not reduced when the source is more than 25 deg. from the direct line of vision. He also made an interesting statement in connection with the effect of diffusing globes in reducing the glare. He said that the results obtained by him, as well as by several other recent investigators of the subject, indicated very strongly that with a source of light giving the same candle-power in the eye of the observer in each case it makes no difference whether the light comes from a large opal diffusing globe in which almost perfect diffusion is obtained, or from a bare unshaded lamp. This is on the assumption that the candle-power entering the eye is the same in both cases. However, he said that even though there might be no measurable difference in the effect on the eye the diffusing globe was the most comfortable to face.

Mr. J. R. Cravath, following Mr. Sweet, emphasized the fact that while the measurable difference between the effects of the bare lamp and the lamp in its diffusing globe might be nothing, the comfort of the eye was considerably more with the diffusing globes. He then pointed out how in practical car lighting the effect of glare can be much reduced. Take, for example, a day car in which a row of lamps is placed over the seats along each side. If these lamps are bare and unshaded a considerable candle-power from each lamp enters the eye of any passenger looking the length of the car. By putting reflectors of diffusing glass over each lamp the candle-power in the direction of the passengers' eyes is much reduced, while the candle-power in downward directions is much increased. Thus not only is the glare in the passengers' eyes much reduced, but the intensity on a passenger's reading page is increased. The effect of the proper glassware over the lamps, therefore, is twofold, both effects being beneficial.

Transmission and Distribution Systems in Chicago.

The chief worriment of the officers of the Commonwealth Edison Branch of the National Electric Light Association in Chicago is caused by the difficulty of finding a suitable hall large enough to accommodate all the members who desire to attend the meetings. The membership of the branch is now 841, which is an increase of 73 per cent over the corresponding figure on Nov. 1, 1910, when the present officers were elected. At the meeting held on the evening of March 2 in Recital Hall, Auditorium Building, there was an attendance of 410, and it was announced that the next meeting would be held in Handel Hall, Randolph Street and Wabash Avenue, on April 4.

There were two papers read at the meeting of March 2, and the first speaker was Mr. Paul F. Williams, assistant general inspector of the Commonwealth Edison Company, whose subject was "The 60-Cycle Distribution System." Mr. Williams illustrated his paper with lantern-slide maps and diagrams showing the locations and characteristics of the company's 60-cycle circuits. It was shown that the nature of the territory served naturally modifies the characteristics of the service. A new substation is to be erected on Whipple Street near the new Northwest generating station at the intersection of North California Avenue and the North Branch of the Chicago River. There are sixty-five four-wire distributing circuits in the 60-cycle system. The maximum load carried on these circuits last year was 28,555 kw. The number of transformers connected to the 60-cycle system is 9565, with a total rating of 76,500 kw. The losses on the 60-cycle system last year amounted to 23.5 per cent, including losses in transformers, measuring instruments, etc.

The hardest work of the distributing engineer is to develop new territory, giving satisfactory service without undue expense to the company. All customers' complaints are answered by a personal call made at the time when the customer's consumption is at the maximum. Nearly all feeders in the 60-cycle system are now underground, and Mr. Williams gave several interesting diagrams illustrating the emergency switching equipment. The rather elaborate routine of making extensions was described. In many cases joint pole lines are used by the Commonwealth Edison Company and the Chicago Telephone Company, and where extensions are planned the preparations, involving the surveys, estimates, planning and correspondence between the two companies, take some time. If the extension costs less than $200 it is carried out under what is known as a "petty line order," but if the expense involved is over that amount it is necessary to obtain a "work order" with a number of additional signatures.

Mr. M. R. Rich, of the engineering department, read the second paper of the evening, taking as his subject "The Transmission System and Low-Tension Distribution." This paper was also illustrated by lantern-slide diagrams. Mr. Rich gave considerable attention to the method of making and preserving records of operating circuits. He described briefly the overhead distribution maps, the "location book" of the low-tension district, the cable records and the conduit and manhole records. In carrying on the business of a large system like that in Chicago the existence of carefully kept records of this sort is an imperative necessity.

Mr. Rich devoted some attention to the very heavy "downtown" low-tension direct-current load, and mentioned the interesting fact that several 1,500,000-circ. mil cables are sometimes needed in the case of a single customer. The kw-hour consumption in the central low-tension direct-current district in Chicago increased 18 per cent in 1910 compared with 1909. The total loss in this low-tension distribution is about 13 per cent, or about as much as is lost by conversion in substations.

Considering the 60-cycle, 12,000-volt transmission system, Mr. Rich remarked that electrical transmission of this description is comparatively recent in the history of the company's operations. The 60-cycle, 12,000-volt energy is produced by two turbo-generators at the Quarry Street station. (See the *Electrical World*, Jan. 5, 1911, page 35.) A map was exhibited showing the extent of this system. This system is connected to the hydroelectric plant of the Economy Light & Power Company on the Desplaines River at Joliet, Ill., some thirty-three miles from Chicago. The Joliet plant in turn is or soon will be connected to the widely extended system of the Illinois Valley Gas & Electric Company, so that it is computed that the connections of this system of transmission will be about 200 miles long within a few months.

The 25-cycle, 20,000-volt transmission system was also described briefly and the speaker exhibited curves showing the increase in the amount of copper installed for the low-tension, 25-cycle and 60-cycle systems. These curves show that the amount of 25-cycle copper is increasing at the greatest ratio. Another interesting fact mentioned by Mr. Rich is that 2,640,000 duct.-ft. of conduit were installed in the last year. This large amount of new work was due to the building of the Northwest generating station and also to the tearing up of "downtown" streets incident to street-railway rehabilitation It was also mentioned that the new railway substation in Edgewater, on the North Side, and, in fact, most of the North Side substations, will be connected with the new Northwest station when that is in operation the latter part of this year. Tie lines will connect the Northwest and Fisk Street stations.

There was no discussion except that Mr. George Harvey Jones was called upon as the first chairman of the branch, and spoke briefly. Resolutions extending the sympathy of the branch to the relatives of Mr. E. R. Stuart, of the contract department, who died recently, were adopted.

The latter part of the evening was given over to a very enjoyable entertainment, including music by an orchestra of twenty-seven pieces led by Mr. Harold Wright and Mr. C. H. Bucher. This was followed by a minstrel show, at which Mr. H. A. Seymour was interlocutor and Messrs. H. P. Smith, W. H. Childs, M. F. McGovern and T. J. O'Brien were blackface endmen in costume. The music was well rendered and the minstrel show was cleverly executed with snap and ginger Every man who took part in this creditable performance is an employee of the company.

Minnesota Electrical Association at St. Paul.

The fourth annual convention of the Minnesota Electrical Association opened in the roof-garden sun-parlor of the Hotel St. Paul, St. Paul, Tuesday morning, March 14, with nearly 100 present. The membership of the association has now reached 125, twenty-five having been added during the last year. Following the report of Mr. T. C. Gordon, secretary of the association, and those of various committees, President R. W. Clark, of Minneapolis, delivered his official address, reviewing the progress of the central-station industry during the last twelve months. Mr. Clark mentioned the beneficial results of the new high-efficiency incandescent and arc lamps and the introduction of energy-consuming devices for increasing the day load. He paid tribute to the broad-minded, aggressive men in the electrical industry, commended the commercial and publicity campaigns that have been inaugurated and congratulated electrical manufacturers, supply dealers and lighting companies on the co-operation with which these three interests have worked to extend the use of electricity and electrical devices. Mr. Clark also mentioned the improved attitude toward electricity supply companies, which grows as the conveniences of electricity are more and more appreciated, and he referred to the teaching of elementary electrical subjects in the public schools. Well-organized commercial departments, said the president, are now considered a necessity by every progressive company. Taking up certain live central-station subjects in order, Mr. Clark discussed ornamental street lighting, the use of signs and special lighting, post lighting in residence sections, ice-making auxiliaries for central stations in the Northwest, electric vehicles and trucks, gasoline competition and commission regulation of public utilities. The president urged against local or city public-service commissions, declaring that a regulation policy if installed should be state-wide in extent, and administered by men of the most able character whose decisions would be based on the best engineering data. Commission laws are now in force in twenty-two states, said Mr. Clark, Kansas being the latest to adopt regulatory measures. Mr. Clark also referred to plans under way for holding an electrical educational exhibit at the next Minnesota State Fair.

Resolutions of respect were passed by the association in connection with the death of Mr. C. A. Yergen, of Owatonna, Minn., formerly an active worker in the organization, who was killed several months ago in the discharge of his duties.

Mr. Ludwig Kemper, of Albert Lea, Minn., opened the regular program with a paper on "Curb Lighting." After tracing the great growth of tungsten-post decorative illumination since the first system was installed in St. Paul, only a few years ago, Mr. Kemper quoted a tabulation of facts and figures of various such installations from the *Electrical World* of Sept. 15, 1910. These data showed the range of costs of installation and operation per front foot of street curb, income to company, etc. The average load-factor of curb-lighting systems, said Mr. Kemper, is 30 per cent, ranging from 22.5 per cent for dusk-to-midnight to 45 per cent for all-night lighting. The average income is about 5 cents per kw-hour. Curb illumination, properly treated as decorative lighting, he insisted, stimulates the use of signs and show-window illumination. Mr. Kemper discouraged, however, the use of any type of globe for post lamps which, even though increasing the effectiveness of street-surface illumination two or three times, presents complex surfaces to collect dust, or which requires the cleaning of more than one piece of glassware. Curb lighting, he reminded the association, is first of all decorative in purpose. The globes themselves should present an attractive and brilliant appearance, and if too high an intensity is produced in the downward direction neighboring show windows may receive such effective illumination as to eliminate the need and use of their own lighting. The speaker offered suggestions on the best plans of introducing such curb lighting into new towns and cities, advising that local civic or business organizations be first interested, illustrations of other installations exhibited and perhaps a sample block equipped. All individual contracts with merchants should preferably be made through the civic or business men's organization, to avoid trouble for the electric company. Such installations may be financed by the city, the merchants or the company, in the last case the company adding the capital charges to cover this investment to its rates for the service. Mr. Kemper advised keeping such installations within the financial capacity of the community, but assured his audience that curb lighting is an excellent and profitable load for the central-station company and one that is without gasoline or other competition, even in Mr. Kemper's own city of Albert Lea, where 30,000 gasoline-lighting outfits are made annually. Mr. Henry Schroeder, of Harrison, N. J., said that the General Electric Company is completing a collection of lantern slides and data on curb-lighting installations, copies of which it will be pleased to loan to central-station companies for furthering interest in special street lighting. Mr. Schroeder mentioned this in line with the suggestion of Mr. Kemper that the association should make such a collection. Mr. J. B. Crane, of Duluth, described the tungsten curb lighting in that city, and explained the method by which a committee of citizens there carried through the entire plans, installed the equipment and contracted with the lighting company for service. Mr. Crane also mentioned the peculiar coincidence that a number of the multiple tungsten lamps used on the Duluth posts had been found broken on certain mornings, while on other days no breakages occurred. The cause of this acute trouble was afterward traced to a flat-wheeled owl car operated during the early-morning hours. Mr. R. W. Clark, of Minneapolis, spoke of the staggered spacing of posts as limiting the intensity at street intersections where most illumination is needed.

At the afternoon session of Tuesday Mr. H. G. Winsor, of the Minneapolis General Electric Company, read a paper on "Safety in Line Construction," specifying the construction used by the Minneapolis company, and pointing out features of inspection, arrangement of equipment on poles, and grounding of secondaries which conduce to the safety of the public. An abstract of this paper will be presented in the *Electrical World*.

"Show-Case Lighting, Display-Window Lighting, Outline Lighting and Sign Lighting" were the subjects discussed by Mr. T. R. Wilwerschied, of St. Paul, who sought to remind electrical solicitors of the uncultivated fields in which they may still find rich central-station business. This paper and the discussion it provoked will be abstracted in a future issue.

Mr. F. R. Cutcheon, of the St. Paul Gas Light Company, spoke next on the testing of watt-hour meters. In general, he said, customers' tests have superseded shop tests of watt-hour meters, the meters now being tested after being installed and connected up. Routine shop tests are carried out, however, in the case of new meters or those long out of service, or when it is desired to obtain certain data about the instrument. Mr. Cutcheon spoke of testing a number of meters simultaneously, their fields being connected in series and their shunts in parallel. He also described the use of transformers for testing large alternating-current meters and storage batteries for large direct-current meters. In the use of the many light-weight test resistances offered on the market, he said, it is a choice between portability and durability. The lighter apparatus is sure to get hotter and to be more rapidly destroyed, but a heavier outfit may require a second man to carry it, the latter's wages exceeding the cost of burning up a number of resistances during the year. In St. Paul polyphase meters are being used on the three-phase lines of Mr. Cutcheon's company, avoiding errors due to unbalancing of the phases. The speaker also referred to the use of clock meters to determine the diversity factor of a customer's installation. On account of the thefts of energy which are accomplished by opening the neutral fuse of a three-wire system, de-energizing the shunt, Mr. Cutcheon suggested the use of some device in circuit with the shunt connection, such as an electrolytic or thermal cell, to show whether the shunt had been disconnected for any period during the month. In the case of 72 per cent of the direct-current meters tested on the St. Paul company's lines the meters were found running slow, favoring the customers, while 86 per cent of the meters were within 5 per cent of accuracy.

Mr. J. T. Crane, of Duluth, told of the requirement of the New York Public Service Commissions regarding meter testing, and Mr. E. T. Street, of St. Paul, spoke of the use of a 500-amp, 5-volt direct-current generator by the Northern Heating & Electric Company for testing large direct-current meters. Mr. M. B. Beattie, of Fort Wayne, Ind., suggested that manufacturers will be pleased to furnish meter experts in cases where meter testing is the subject of controversy between an electric company and the local authorities or others.

Mr. E. T. Street, new-business manager of the Northern Heating & Electric Company, opened Wednesday morning's session with a paper on the subject of "Day Loads for the Central Station." After proposing a rate schedule based on maximum demand added to a given charge per kw-hour consumed, Mr. Street mentioned the subjects of water pumping, mechanical refrigeration, wood-working establishments, grain elevators, laundries and electric heating appliances as good day loads, several of which have the advantage of requiring most energy during the summer months. Strange as it may seem, said Mr. Street, mechanical refrigeration in the cold climate of St. Paul is cheaper than ice refrigeration, even though the customer stores his own ice and is near the source of natural supply. A number of refrigerating plants are already installed in St. Paul and more are being put in each year.

Mr. J. B. Crane, of Duluth, declared that a rate of the kind described, though satisfactory for average power-factor customers, may become unjust for those installations having extreme high or low power-factors. Mr. Ludwig Kemper, of Albert Lea, said that in comparing mechanical refrigeration with ice cooling at least 40 kw-hours per ton of refrigeration must be allowed, besides considering the cost of water, repairs, ammonia charges, interest and depreciation. Mr. J. D. A. Cross, of Chicago, recounted interesting results of electric iron campaigns in establishing partial and, later, full-day service.

The paper on "Residence Lighting," by Mr. C. E. Van Bergen, of the Duluth Edison Electric Company, was read by Mr. C. W. Higgins, of Duluth. Mr. Van Bergen's paper presented some interesting figures on electric service in Duluth and referred to the profitable development which residence lighting may obtain when properly viewed. The mistakes often made in residence illumination were also pointed out, and central-station companies were urged to keep the subject of proper lighting before architects, builders and contractors to make household electric service of permanent satisfaction.

Mr. H. J. Gille, of Minneapolis, declared that residence lighting presents greater possibilities than any other field now before the central station. Hardly 12 per cent of the total residences of the country use electric light, he said. It has been shown that while the revenues per kilowatt of customer's demand are low for residences, this business still yields at least the average revenue per kilowatt of station demand. Only about 35 per cent of the residence load overlaps with the afternoon peak. Mr. Gille advised the appropriation of association funds to establish an electrical exhibit at the state fair. Mr. A. H. Dickerson, of Windom, also referred to the importance of residence business in the smaller towns.

"Incandescent-Lamp Improvements" was the subject of a paper read by Mr. Henry Schroeder, of Harrison, N. J. After tracing the history of filament lamps up through the carbon graphitized-filament, tantalum and tungsten types, Mr Schroeder presented some surprising figures on the number of standard styles and sizes of incandescent lamps in regular use. declaring that the figure exceeds 100,000 different kinds of lamps. Mr. H. G. Gille, of Minneapolis, referred to the Twin City region as the original "stamping ground" of the tungsten lamp, and asked questions regarding expected future efficiencies, costs, etc. Mr. Schroeder said that the drawn-wire type lamp will shortly be ready for marketing, after preliminary experience in car-lighting work, the success of which has surprised even manufacturers. Manufacture in large quantities will tend to lower the price of tungsten lamps, said the speaker, while the cheaper processes of making the wire-drawn lamp, the filament strength of which is increased in strength about four times, also contribute to this cheapening. Mr. Gille and Mr. Dickerson advocated the use of all-frosted tungsten lamps for residence work.

On Thursday morning a paper by Mr. A. W. Wagner, manager of the Huron Light & Power Company, Huron, S. D., recounting the experience of his company with its 400-hp gas producer plant, was read by Mr. E. T. Street in Mr. Wagner's absence. The paper contained many valuable observations on the subject of producer operation for central stations, and an abstract of it will be presented in a later issue of the *Electrical World*.

Mr. R. L. Daniel, of the Minneapolis Underwriters' Bureau. read a paper on the subject of insurance as affected by electrical installations, both in central-station properties and in premises wired for electricity. Mr. Daniel discussed the base rate for electric plant risks, and enumerated the conditions which affect this charge by adding penalties and credits. The speaker urged better protection where high-tension wires cross other lines or highways. He declared that there are few instances where the replacement of a gasoline-lighting outfit by electric service, or a gasoline engine by an electric motor. will not make a reduction in the fire hazard and in the cost of insurance.

Mr. Eugene Holcomb, general manager of the Northern Heating & Electric Company, St. Paul, exhibited some useful form blanks for keeping the engine and boiler-room records of plants up to 250-kw capacity. Mr. Holcomb's paper referred less to the form than to the items to be recorded on these record sheets, and enumerated the principal data that should be given, including: Date, coal on hand, coal used, feed water used, evaporation per pound of coal, time of boiler and engine operation, cylinder oil used, labor on repairs, labor on operating, total output, and pounds of coal per kw-hour.

A paper on "Gasoline Competition" by Messrs. Ward Harrison and H. H. Magdsick, of Cleveland, Ohio, was read by the former. The principal kinds of gasoline-lighting plants were clearly described, and a comprehensive summary was presented of the shortcomings and dangers of gasoline-lighting systems. An abstract of this material will be given later in these columns. Mr. R. W. Clark and Mr E. Holcomb discussed means of combating gasoline competition.

Mr. Robert Ferris, of Yankton, S. D., explained the elements of his system of uniform accounting for central-station companies having receipts of from $10,000 to $50.000 a year. Mr Ferris proposed to arrange the books under the heads of four accounts, liabilities, assets, receipts and expenses, and to any small central station desiring them he offered to send copies of his accounting system on request

Messrs. E. Holcomb, H. J. Gille and R. Brown, appointed by President Clark to nominate officers for the succeeding year, reported the following, who were unanimously elected by the association: President, Mr. Ludwig Kemper, Albert Lea; first vice-president, Mr. C. E. Van Bergen, Duluth; second vice-president, Mr. E. A. Aspnes, Montevideo; secretary-treasurer, Mr. E. T. Street, St. Paul.

A discussion and demonstration of the elementary theory of the rotating-field alternating-current motor, which had been prepared for presentation before the convention by Prof George D. Shepardson, of the University of Minnesota, was given by his associate, Professor Ryan, of the university, on account of Professor Shepardson's enforced absence in the East owing to the serious illness of his sister.

On Wednesday afternoon the members of the convention made up an inspection party through the power plants of the Northern Electric & Heating Company and the St. Paul Gas Light Company and were also conducted on a twenty-six-block tour of the extensive sand-rock tunnels of the latter company underlying the business district of St. Paul. In the evening a Dutch lunch, smoker and vaudeville entertainment was tendered the delegates at the Nordin Club. Mr. H. J. Gille was toastmaster, and called upon President R. W. Clark, Messrs. J. Barnard, R. Smith, J. B. Crane, J. D. Cross, Ludwig Kemper and others for speeches. Mr. A. A. Anderson was in charge of arrangements for the affair.

Electrification of Steam Railroads.

At a meeting of the New York Railroad Club held in the Engineering Societies Building on March 17 the general subject of the electrification of steam-railway systems was discussed. Mr. W. J. Harahan, assistant to the president of the Erie Railroad, as chairman of the electrical committee, explained that this committee had considered it unnecessary to submit a formal report during the present year in view of the fact that the report submitted one year ago covered conditions as they now exist, almost no changes having been made in systems or methods of operation during the past few months. He stated, however, that experience had shown that all of the systems have points of merit. Each one seems particularly well adapted for certain service requirements. Although no formal papers were presented, Mr. Harahan read a communication from Mr. J. A. McCrea, general superintendent of the Long Island Railroad, giving an outline of the experience of this railway with electrical operation. Electricity has been substituted for steam on this system gradually during the past five years. Mr. McCrea stated that if steam were now to be substituted for electricity enormous difficulties would be encountered on account of the changes and improvements that electrical operation has allowed to be introduced. A considerable number of the changes incident to electrical operation were attributed by him to the multiple-unit system. By means of this system the trains can be run into the terminal station and made ready for the return journey with the minimum of delay. During rush hours a train is sent out on the return trip with only the delay attributable to the change in passengers. Moreover, the use of the higher platform has resulted in minimizing the time of emptying the trains and reloading. Therefore, the final result has been that a much smaller amount of terminal trackage is required for electrical operation than would be used with steam locomotives. Electrical equipment has proved thoroughly reliable, and trains are operated rigidly upon schedule time.

Prof. George F. Swain, of the department of civil engineering of Harvard University, gave an exceptionally clear explanation of the action of the committee which submitted a report to the Massachusetts Legislature relative to compulsory electrification of steam roads in Boston. He stated that the conditions around Boston are very different from those around New York. For example, complete electrification would involve twenty-one roads and branches around Boston, while in New York only three are involved. Thus the total cost would be enormously greater for Boston than for New York. Moreover, the need for electrification is much less in Boston, there being at present no tunnel problem to complicate matters. It was found that in order to equip electrically merely the most important of the railroads in metropolitan Boston would cost about $40,000,000 for the passenger traffic alone. An expenditure of this amount would not be justified by the returns received from it by the railroads, on account of the fact that the cost for maintaining the steam equipment for operation over the roads would not be decreased, while the electrical operation would represent an added cost over and above the interest on the money invested. If one were permitted to assume the Legislature to have the power to compel railroads to invest money in electrical equipment, he must admit that the roads should be permitted to increase the traffic rates, if such an increase were found necessary in order to obtain a proper return on the money invested. In the case just mentioned the only improvement in service would be to passenger traffic, and hence the only increase in rates should apply to passenger service. In view of the fact that the steam roads are paralleled by electric roads it is highly probable that an increase in rates would not result in an increase in revenue on account of the deflection of travel to the competing electric roads. The committee held, first, that the investment of the money required was not justified; second, that if such investment were made the roads would be justified in increasing the rates, and even with an increase in rates the return on the investment would be inadequate. Moreover, it expressed the decided opinion that electrification at the present time should be looked upon as a luxury and not a necessity, and that it was improper for the Legislature to dictate to the railway corporations what type of motive power should be employed, unless the employment of such equipment would result in greatly improved service of much benefit to the community. It is proper for the government to regulate the issuance of securities by public-service corporations, to determine what equipment should be employed for insuring the safety of passengers and to dictate concerning the rates asked for service, but it is improper for the government to force corporations to supply what may properly be looked upon at the present time as a luxury. Professor Swain remarked that the railroad corporations around Boston will settle the problem eventually to the satisfaction of all parties concerned, which fact is being shown by the recent petition of the New York, New Haven & Hartford Railroad for permission to construct a tunnel under Boston, in which event electrical operation would be insured.

Mr. H. Gilliam, of the New York, New Haven & Hartford Railroad, outlined the results now being obtained by this railroad with its single-phase equipment. He called attention to the frequently neglected fact that during quite a considerable portion of the time the electric trains coast, even along a level stretch. For example, the power is applied to the average train of the New York, New Haven & Hartford Company's system for only twelve of the thirty-three and one-half miles of travel. The distance is traversed in fifty minutes, during only seventeen of which is energy used. These facts have considerable bearing on the estimate of the cost of operating with electricity as compared with steam. When steam locomotives are used coal is consumed continuously, even when a locomotive is coasting down hill or on the level.

Mr. William McClellan discussed quite fully the relative merits of steam and electric operation, and mentioned particularly the fact admitted at present that electric equipment is much more reliable than steam. When the substitution of electricity for steam on railroads was first adopted many railroad men questioned the advisability of depending upon a single stationary source of energy, rather than a large number of portable power houses, because the crippling of a single locomotive would not interfere seriously with the operation, while the crippling of a single generating station would bring the whole system to a standstill. However, the electric generating equipments have proved absolutely reliable in service. Mr. McClellan called attention also to one of the most encouraging features of electric railway operation, namely, the fact that the most ardent advocates of each system are those most familiar with the particular system advocated. He claimed that the time had arrived for looking forward definitely to the selection of a single system for standardization in order that rolling stock may be properly interchanged between interconnected railroads.

Mr. Frank J. Sprague remarked that at the present time the contention is not one between different systems, but rather the broader fight between electricity and steam. All of the electric systems advocated are good, and it cannot be stated definitely that any one system is better than another for general adoption. Each system possesses peculiar merits for certain local conditions, and the different systems must be considered competitive in order that the proper choice can be made when selecting the system best suited for the problem in hand. What is most needed at the present time is active and sincere co-operation between the engineers and the railroads. It can safely be stated that the time has not yet arrived for the general electrification of steam railroads. The improvements which can easily be introduced into the trunk line railroads, such as the elimination of grades, the lessening of curves, increasing of trackage, etc., have not yet been exhausted.

Mr. W. S. Murray, electrical engineer for the New York, New Haven & Hartford Railroad, stated his definite conviction that the single-phase system has been proved by actual experience to be thoroughly well suited for trunk-line operation. It possesses just those features which in the development of electrical engineering have always served to distinguish long-distance from local transmission of energy. An exactly similar difference exists between trunk-line and terminal electrification. That the single-phase system has proved satisfactory to the New York, New Haven & Hartford Railroad is conclusively proved by the fact that arrangements are now being completed for increasing the electrified track mileage from 100 miles to 373 miles. He stated that the reliability has now reached such a high degree that on an average a length equivalent to eleven times the distance from New York to San Francisco and return is traveled by each locomotive for each minute of train delay.

Mr. W. B. Potter described briefly the self-propelled type of railway car, which consists of a gasoline engine driving a variable-voltage generator, which supplies energy to standard 600-volt railway motors. On account of the reduction in voltage of the generator at starting, with the accompanying elimination of the losses in the starting rheostats, a 200-hp gasoline engine is capable of producing that amount of torque which would necessitate a 1000-hp engine if the generator were of the constant-voltage type. A self-propelled car of this type carries fuel sufficient for 200 miles, and operates with the same independence of connection to the power house as does the steam locomotive, but with the economy and flexibility of control of the electrical equipment. Moreover, for branch service the self-propelled car equipment is cheaper, both in first cost and operation, than is an equipment run by a steam locomotive.

Mr. A. H. Armstrong reported the results of some observations made by him upon steam locomotives under service conditions. A certain small steam locomotive was found to consume 40 lb. of steam per hp-hour delivered at the rim of the wheels, the consumption of fuel being 8 lb. of lignite coal per hp-hour. The values just given relate to the steam locomotive during a haulage period. However, during the standby period this locomotive consumed continuously 500 lb. of coal per hour, the final result being that the total consumption of coal throughout each day reached 12 lb. per effective hp-hour utilized. He stated that the steam locomotive carries sufficient coal for a journey of about 150 miles, at the end of which it must be replaced by a second locomotive if the journey is to be continued at the maximum speed. An electric locomotive, on the other hand, can travel at least 1000 miles before it need be replaced. In a haul of 1000 miles, on account of the unavoidable delays as compared with the electric locomotive, the time consumed by the steam locomotive would be thirty-six hours longer than with the electric locomotive.

Investigation Into Value of Telephone Properties in Seattle, Wash.

Messrs. C. H. Judson and Frank B. Hall have made a report to Mr. A. L. Valentine, superintendent of public utilities of Seattle, Wash., in reference to the value of the properties and cost of service in that city of the Independent Telephone Company and the Pacific Telephone & Telegraph Company. The report is the result of an investigation made for the purpose of ascertaining the probable cost to the companies of the existing plants; the probable present value after allowance for depreciation; the actual cost of operation, including all reserves and charges; the approximate dividend earned on the investment in the various classes of telephones, and the efficiency and adequacy of the service.

Although a complete detailed inventory of the entire properties was not made, use was made of a large amount of information obtained from the companies and from observation of their operations, as well as of data obtained from other companies and from the knowledge of the engineers of operating costs in detail. The area of the city is eighty-five square miles and the line property of the companies consists of over 500 miles of pole lines, 228 miles of underground conduits, about 85,000 miles of wire in cables and 8900 miles of open wire on poles. In the valuation of the property of the Independent Telephone Company prices on all materials used were procured from manufacturers, agents and dealers f.o.b. Seattle. To present prices and the cost of labor allowances were made of 10 per cent for engineering and superintendence, 10 per cent for general expenses and 6 per cent for interest. A unit schedule of cost was prepared covering all parts of the plant except central-office equipment, real estate and buildings, and the valuation was figured from the itemized inventory.

The cost of the plant of the Independent Telephone Company, as determined by partial inventory and from company records, was placed at $2,091,672, and the depreciation at $607,559, leaving a depreciated value of $1,484,113. A total allowance of $175,000 was made for intangible assets, as follows: Discount on bonds, as per the company's records, $100,000; working capital, estimated, $50,000; cost of obtaining stations during the early construction period, $25,000.

The total amount expended on the construction of the plant of the Independent Telephone Company from Jan. 26, 1901, to Sept. 1, 1910, was $2,056,984. To this amount there should be added the first cost of real estate, buildings, furniture and fixtures, and supplies on hand, a total of $192,048, or a final total of $2,249,032. Certain items, including discount on bonds, are also specified, with the statement that the engineer of the Railroad Commission in his report on the property held that they did not properly enter into the first cost of the plant and should not be so considered. If these are deducted the cost would be $2,249,032, less $282,428, or $1,966,604. If it is desired to deduct additional expenditures of $25,959 for the replacement of conduits and $60,154 for the cost of moving poles on account of regrades, the first cost would be reduced still further. The total determined in this way would not include, however, any charge for interest during construction. The total earnings of the Independent company to Aug. 1, 1910, were $2,130,902, and total expenses $1,721,115, leaving a balance of $409,787. After provision for other charges and for dividends the surplus as of Aug. 1, 1910, was $73,489.

The portion of the report which relates to the Independent Telephone Company goes into details as to costs of various classes of service and the expenditures which enter into such costs. The report in reference to the Pacific Telephone & Telegraph Company, however, is not intended to cover actual service costs.

The population of Seattle in 1909 is stated as follows: School census, 39,866; names in directory, 123,750; estimated population, 252,000. The total number of telephones of the Independent Telephone Company was 18,027, and the number of main stations 12,414. The gross expenses were $276,471, or an average of $15.57 per telephone and $22.36 per main station.

A report furnished by the Pacific Telephone & Telegraph Company on May 12, 1909, showing the business of the Seattle exchange, indicated a total of 23,914 telephones and 18,413 main stations. The gross expenses were $589,014, or $24.63 per telephone and $31.99 per main station. The expenses include maintenance, operation, general expenses, insurance and taxes.

The cost of the Seattle plant property of the Pacific company was figured at $2,981,180, and the depreciation at $758,635, leaving a depreciated value for the tangible property of $2,222,545. Intangible assets aggregated $100,000, of which $75,000 was an estimate of the working capital and $25,000 the estimated cost of obtaining stations during the early construction period.

Rate Question as Affected by Competing Telephone Companies in Chicago.

An interesting resolution was introduced into the Chicago City Council at its meeting of March 6 by Alderman W. J. Pringle, chairman of the committee on gas, oil and electric light, which has in charge the matter of revising telephone rates. This resolution, after referring in general terms to the consolidation of public-service corporations, recites that the Illinois Tunnel Company has made a large investment in land, buildings, conduits and cables and is continuing to make such investment by the rapid enlargement of its plant. However, there is already a telephone utility in the City of Chicago—the Chicago Telephone Company—with a plant extending over all portions of the city and well developed in the territory now being occupied by the Illinois Tunnel Company. Thus the facilities of the Chicago Telephone Company, which are now ample, or can be made ample, will be duplicated.

After setting forth this condition the resolution makes the following declaration: "It is the sense of this Council that in all consolidations and combinations of public-service corporations in this city the construction account of the purchasing company shall be charged only with the cost of the property actually used by and useful to the purchasing company in the furnishing of the service involved, and in any negotiations hereafter looking to the determination of a reasonable rate or schedule of rates for such service the valuation to serve as the basis of such rate determination shall embrace only such property as has been constructed at the actual cost price and as is not an unnecessary duplication of the property of the purchasing utility, including an allowance for engineering, supervision and interest, taxes and insurance during the construction, plus 8 per cent since the date of construction, less profits which have been taken out of the property, not to exceed 8 per cent."

The Council appeared to be doubtful about the exact effect of adopting the resolution, and it was referred back to Alderman Pringle's committee. The latter is reported to have said that no one doubts that the Illinois Tunnel Company ultimately will be absorbed by the larger company. In that contingency the valuation of the older company will be much larger, and it is desirable that the rights of the public as to rates based on valuation of property be protected.

Public Utilities Before California Legislature.

A new draft of the constitutional amendment putting the control of all public utilities in the hands of a State commission in California has been made and will become a committee substitute in both houses of the California Legislature for the measures now pending. As a result, all the duties of a public-utilities commission will be imposed on the Railroad Commission, whose membership is increased from three to five members, the present elected members to continue in office. The other two members will be appointed by the Governor. The term of office is made six years. The Legislature may remove one or more members by a two-thirds vote for dereliction of duty, corruption or incompetency. The Railroad Commission receives power to establish all rates, a plenary power of investigation and power to require uniform accounting. A provision gives the City of Los Angeles the right to vote on what powers it will retain in preference to State control of its public utilities.

Hearing on Massachusetts Municipal-Ownership Bills.

A hearing was given at Boston on March 8 by the legislative committee on public lighting upon six bills now before the General Court in connection with municipal ownership of gas and electric lighting plants. Three of the bills (Senate 36, House 407 and House 942) are designed to modify the procedure in case a municipality desires to engage in the business of gas or electric lighting and their general intent is to make it much easier for municipal ownership to be undertaken than under the existing statutes. Three other bills (House 216, 1342 and 1447) are more radical in character, and besides cutting down the number of votes required to enable a municipality to engage in lighting supply they attack the compulsory purchase feature of the existing law, and, if passed, would permit cities and towns to assume the responsibilities of municipal ownership without anything like fair compensation to the established company or companies for the plant and business existing. Counsel present at the hearing included A. E. Pillsbury, Esq., and Frank E. Dunbar, Esq., for the Massachusetts Gas Companies, and Everett W. Burdett, Esq., for the Massachusetts Electric Lighting Association.

Mr. Pillsbury submitted a vigorous argument against municipal ownership, pointing out that it is inconceivable that any Massachusetts Legislature will ever repeal the compulsory purchase feature of the statutes controlling the entrance of cities and towns into the municipal lighting field. For twenty years the policy of the State has been to require municipalities to purchase the plants of existing companies before entering the lighting field. Mr. Pillsbury emphasized the small growth of municipal lighting in Massachusetts in the past twenty years by stating that out of 356 municipalities in the commonwealth only twenty-eight had established city or town plants since 1891. This means that the business of municipal lighting has not become popular and for the reason that it has never been genuinely successful. Not in any single instance has the price of gas been reduced or the service improved unless at the expense of the public treasury.

Closing, Mr. Pillsbury said that there is no evidence to-day that any municipality is getting cheaper or better electricity or gas than is sold by the private companies. The underlying principle is not appreciated by the public, but it is an unquestioned fact that much of the burden of municipal plant operation is being sustained by taxpayers of small means who are in many cases not consumers of the service. This is a fact not realized by the man in the street, and such a condition is grossly unjust. At the bottom of the entire question lies the point that the government can never, or at least will never, do business to advantage in comparison with private enterprise, on the ground of financial comparison. Wherever governmental ownership and operation enter hours are voted down, wages are pushed up and places made for political reasons. Regarding the charge that gas and electric companies are to-day making extortionate profits, Mr. Pillsbury said that the public is perpetually confusing par value and market value. On the par value the rate of dividend may be high, but on the market value, which represents the total money put into the purchase of stock, the return runs between 4 per cent and 5.5 per cent. An inquiry addressed some time since to the Massachusetts Bureau of Statistics of Manufactures resulted in the information that a profit of at least 6 per cent was expected after an interest charge is made against the invested capital, which means a return of from 11 per cent to 12 per cent on the money in the business. The argument that gas and electric light companies are monopolies is ridiculous in view of the existence in many places of the most acute competition between gas and electricity, and especially in view of the regulation of rates in the hands of the Gas & Electric Light Commission of the State. The restriction of price does away with the monopoly consideration. The hearing was continued to enable further arguments to be submitted.

Public-Service Commission Bills in Illinois.

In addition to the Rawleigh and Ettelson bills creating public-service commissions in Illinois and now pending in the Legislature of that State a third public-utility bill, which has the support of Governor Deneen and the State administration, has been introduced by Senator Chamberlin. This bill, like the Rawleigh bill, extends the powers of the Railroad and Warehouse Commission to embrace all public utilities.

Another hearing in relation to the Rawleigh bill was held at the capital on March 15. The proposed law seems to be favored generally by representatives of the public-service companies, while the Mayors and other officials of some of the smaller cities of the State are doubtful about it, as it curtails their powers. The Rawleigh bill does not affect Chicago. Mr. H. E. Chubbuck, of Peoria, vice-president executive of the Illinois Traction System; Mr. David Davis, manager of the United Gas & Electric Company, of Litchfield, and other representatives of electric service companies appeared at the hearing of March 15 to favor the general plan of the Rawleigh bill It was announced that the next hearing would be held on March 22.

Proposed Ohio Public-Service Commission.

At a hearing of the Winters public utilities bill before the committee on codes of the Ohio House of Representatives last week representatives of the Joint Civic Committee of Cincinnati appeared and pointed out a number of weaknesses that, in the opinion of the members of the organization, should receive attention, and Mr. Albert Bettman, their spokesman, objected to the plan of fixing charges for service on the basis of capital stock, which in many cases, he said, is largely water, and argued that they should be fixed according to the true value of the property. If the commission is compelled to take into consideration the market value of the stocks of corporations it will be greatly handicapped, as it will have to fix charges that will cover dividends upon a large amount of water.

Another objection to the bill is the provision that corporations may issue bonds covering expenditures for the five years preceding. It is claimed that the bonds may thus be made to include wages paid out during those years, whereas wages are never included in the capital investment under ordinary conditions. Mr. Bettman stated that, in its present form, the bill does not apply to public lighting companies in their service to municipalities and that there is no authority to compel the extension of feed wires or gas mains. He believes that municipalities should have such authority, limited by evidence showing that such extensions would prevent the company from deriving a fair profit from the whole system, including the extensions.

Attorneys representing the Cincinnati Gas & Electric Company and the East Ohio Gas Company argued that the contracts for lighting should not be placed in the hands of a State commission, but should be left with the city councils, as such a provision would be unfair to the people which the companies serve. This argument was presented, not because the bill now provides for such a change, but for the reason that strong effort is being made to incorporate it in the proposed law.

Mr. Frank Woods, author of a similar bill before the Legislature last year, spoke in favor of this measure as being better than nothing, even if it does not contain all that could be desired. He said that with the multiplication of commissions their duties would soon so overlap as to become confusing and that one commission should have charge of all utilities.

Representative Calvey, of Cleveland, has presented a bill giving municipal councils the authority to fix rates for telephone service by amending the general code giving councils power to fix a maximum rate for electric light, gas and water Neglect to furnish service at rates fixed by council will subject the corporations concerned to the danger of losing all charter rights. Mr. Calvey claims that this bill will not interfere with the Winters public utility bill, as a State commission under that bill can only act as a board of arbitration in the matter of rates and does not attempt to fix the prices for service.

While the Winters bill extends to all public utilities, with the exception of city street-railway lines, it provides for merging corporations only in the case of telephone companies Judge Winters contends that this right can be extended to other utilities later on if it is found to work well with the telephone companies, and that if a mistake has been made then the privilege can be taken from these companies.

It is said that the corporations affected will make their contest against the Winters bill in the Senate. Many of the provisions of the bill are not satisfactory to them, although many of their number favor a law that they consider to be fair

Massachusetts Legislative News.

The reports of various committees which are now being sent in to the two branches of the Legislature indicate little willingness at the present session to pass statutes inimical to the fair interests of the railway and lighting companies. The efforts of the Bagley interests to secure legislation respecting the price of gas in East Boston have met a severe setback in the adverse report of the committee on public lighting upon House Bill 499, which is an attempt to reduce the price of gas in the above community. A similar adverse report has been sent in upon House Bill 744, which attempts to reduce the price of gas in the City of Woburn, and both reports have been accepted. A resolve has been passed to a third reading in the Senate to provide for an investigation of the cost of supplying electricity to the State House building by the Boston Edison Company in place of the existing isolated plant. A number of bills tending to hamper the operation of street-railway companies have also been sent back to the House or Senate with adverse reports from the committee sessions.

Widespread interest has been aroused at Boston as a result of the statement of plans for the construction and electrification of a tunnel under Boston Harbor given out by Vice-president Byrnes of the New York, New Haven & Hartford Railroad Company at a recent hearing. Closely related to the New Haven tunnel project is the campaign which the promoters of the Boston & Eastern Electric Railroad Company are making to secure the passage of a bill requiring the Railroad Commission to issue the latter a certificate of exigency permitting the construction of a high-speed electric line between Boston and the North Shore. As a result of the latest proposals of Mr. Mellen and his associates regarding the purchase of the Boston, Revere Beach & Lynn Railroad and the tunnel construction under the harbor with electrification accompanying, the outlook for the success of the Boston & Eastern plan appears more and more doubtful. The willingness of the New Haven interests to undertake the handling of the North Shore suburban traffic, as well as the operation of through service, in large measure appears to determine whether or not the Boston & Eastern project will be permitted to become a reality. An incidental result of the publication of the New Haven tunnel project has been a subsidence of a considerable portion of the adverse criticism which was brought to bear upon a majority of the Board of Railroad Commissioners at the time the board refused to issue a certificate to the Boston & Eastern Company. An initial electrification of a part of the Boston suburban service appears highly probable in the very near future.

The Ware Electric Company has petitioned the Gas and Electric Light Commission for authority to issue additional capital stock to the amount of $10,000 to meet the cost of improvements in the property. The Charlemont Electric Light & Power Company has also petitioned the board for authority to buy the property of Mr. G. H. Turner, its present controlling interest.

New York Commission News.

The Public Service Commission, Second District, has approved of an agreement whereby the Geneva-Seneca Electric Company and the Wayne County Gas & Electric Company consolidate into and form the Central New York Gas & Electric Company. The consolidated company is authorized to issue its common and preferred stock in accordance with the terms and provisions of the consolidation agreement—one share of preferred stock and two shares of common stock in exchange for each three shares of the present outstanding stock of the constituent companies. The new company is authorized to issue $150,000 of additional preferred stock, to be sold at par, to execute its mortgage to secure an issue of $2,000,000 in bonds, and to issue presently $650,000 5 per cent bonds, which shall be sold at not less than 85. The company is also authorized to issue a second mortgage to secure an issue of $150,000 6 per cent five-year notes, to be sold at par and for cash. The proceeds of the $950,000 bonds and stock to be issued are to be used for the purchase of the plant of J. Q. Howe's Sons at Phelps at a price not exceeding $15,000; for the construction of a transmission line from Geneva and Newark via Phelps and for the construction of a substation at Phelps; for the retirement and cancellation of the existing outstanding bonds and mortgage debts, notes and unsecured indebtedness of the Geneva-Seneca Electric Company and the Wayne County Gas & Electric Company, and for the completion of the improvements to the plant of the consolidated company which have been authorized by the commission. The new company is in control and will operate a number of lighting companies in Wayne and Ontario Counties.

Massachusetts Commission News.

The Massachusetts Gas & Electric Light Commission has issued an order approving the issue by the Gardner Electric Light Company of 850 shares of preferred capital stock at $100 per share and of 200 shares of common stock at $150 per share. The proceeds of the issue are to be devoted to the cancellation of notes and bonds and to the payment of the cost of the extension of the distribution system of the company into Westminster, Hubbardston, Barre and Winchendon. The Colrain Electric Light & Power Company has petitioned the board for authority to consolidate with the Greenfield Electric Light & Power Company, on the basis of an exchange of stock share for share. The Shelburne Falls Electric Light & Power Company has also petitioned the board for the right to consolidate with the Greenfield company, upon a share for share basis. The Greenfield company has petitioned the board for the right to issue additional stock of the par value of $175,000. The proceeds of this issue are to be devoted to the purchase of the Colrain and Shelburne Falls companies and to meeting the cost of improvements that are soon to be undertaken in the company's system.

Governor Foss has appointed Mr. Walter Webster, of Boston, as expert investigator of the principal public-utility and administrative commissions of the State. A study will be made of the accounts and administration of the various boards, and a report submitted to the executive office upon the general conduct of their affairs.

Maryland Commission News.

The Maryland Public Service Commission last week granted permission to the Towson & Cockeysville Electric Railway Company for the construction of an electric road between the two towns named in its title, and work will begin on the new line within thirty days. The commission has authorized an issue of $100,000 capital stock, to be used in the purchase of the necessary rights of ways, constructing material and rolling stock, and for the actual work of building the road as far as Timonium. Most of this stock has already been subscribed for and options have been obtained on most of the properties over which the line will pass. The Towson & Cockeysville Electric Railway Company has declared its intention to apply to the commission for permission to increase its capital stock when the road has been extended to Timonium.

Without a single objection to the action the application of the reorganization committee of the Washington, Baltimore & Annapolis Electric Railway and Baltimore Terminal Company was approved last week by the commission. The sale of the road will proceed as under the terms of the United States District Court in the proceedings of the foreclosing of the mortgages at the Naval Academy Junction. It is expected that the Annapolis Short Line may make an effort to secure it at a reasonable figure.

Canadian Hydroelectric Commission News.

The Hydroelectric Commission is to call for tenders for material for from seven to eight miles of transmission line from a point on the Severn River to the towns of Midland and Penetanguishene, including the transformer station apparatus. The actual work of construction will be carried out by the commission under the direction of Chief Engineer P. W. Sothman, and it is hoped to supply these municipalities with energy by June 1.

The town of Midland some time ago decided to buy out the local plant, and a by-law will be submitted to the ratepayers giving authority to raise $16,500 for this purpose, and also to enable the town to enter into a contract with the Simcoe Power Company for a supply of energy from its development at the Big Chute Falls on the Severn River. The company already has a contract with the Hydroelectric Commission for 1500 hp on what are considered reasonable terms, and this power will be transmitted by the commission on the line to be constructed by it to the above towns, which will in turn distribute the energy through the municipalities.

On March 14 Niagara energy was turned on at Galt in the morning and at St. Mary's in the afternoon. Both tests were satisfactory in every way.

CURRENT NEWS AND NOTES.

German Society of Consulting Electrical Engineers.—Dr. R. Blochmann, of Kiel, is president of the Verein Beratender Ingenieure für Elektrotechnik, having succeeded Dr. E. Mullendorff, of Berlin, on Jan. 1. The present headquarters of the society is at 24 Lornsen-strasse, Kiel.

Institute of Operating Engineers.—A New York branch of the Institute of Operating Engineers was organized March 18, at which the following officers were elected: Chairman, Mr. Willis Lawrence, chief operating engineer of the Interborough Rapid Transit Company; secretary-treasurer, Mr. W. P. F. Hill, chief operating engineer of the Woman's Hospital; chairman of committee on educational requirements, Mr. F. C. Flickinger, E.E.; chairman of committee on apprenticeship requirements, Mr. L. M. Glodell, chief operating engineer of the United States Express Building. The branch starts with eighty members. At a meeting of the Mississippi Branch on March 11 papers were presented on "Water Rheostats" and "The Four-Cycle Gas Engine."

Domestic Use of Telephone Receiver Interrupts Service.—The Pacific Telephone & Telegraph Company upon investigating complaints of interruption of service on a farmers' line found that a woman on the line had been in the habit of taking the receiver off her telephone and using it for a darning ball in mending socks.

Mechanical Device for Artificial Respiration.—It is reported that a machine known as a pulmotor, or lung motor, has been brought to this country from Germany by the United States Bureau of Mines to be used in cases of apparent drowning or death by asphyxiation, as in mine accidents. The machine is designed to cause the natural movements of inhalation and exhalation by mechanical means, at the same time giving a carefully measured supply of oxygen to the lungs of the patient. This apparatus should be useful in cases of prostration from electric shock.

Squirrel-Cage Rotor with Automatically Varying Resistance.—In a patent issued on Feb. 21, 1911, to Mr. Burton McCollum a description is given of a squirrel-cage secondary for an induction motor so built that it possesses high effective resistance at starting and low resistance under running conditions, the change in resistance taking place automatically as the speed increases. The end-rings are constructed of an alloy of steel with more than 2.5 per cent tungsten. The inventor states that this material has a low resistance for low-frequency currents and a high resistance for high-frequency currents by reason of the magnetic hysteresis loss and skin effect.

Municipal Ownership Defeated at South Framingham, Mass.—By a failure to muster the necessary two-thirds vote a proposition on behalf of the municipal ownership of the street-lighting system of the town of South Framingham, Mass., was defeated at a special election on March 15. About a year ago the town appointed a special committee to investigate the question of municipal ownership of street-lighting equipment, and at a regular town meeting on March 13 the report, which was favorable to municipal ownership, was accepted by a show of hands. It was necessary, however, to pass upon the issue by Australian ballot, and as a result the previous action was nullified. Under the law the town cannot again vote upon the question for two years. The existing service is supplied by the Boston Edison Company, which owns and operates the equipment.

Completion of Roosevelt Dam.—The Salt River (Arizona) reclamation project was opened officially by Col. Theodore Roosevelt on March 18. The most prominent feature of this government irrigation project is the Roosevelt dam across a canyon through which the upper Salt River flows. The dam, seventy-six miles east of Phœnix, is one of the largest in the world. It is built of masonry and is 225 ft. long at the bottom and 680 ft. long at the top, arching upstream. Its height is exceptional, being 220 ft. The dam is 16 ft. thick at the top and 170 ft. thick at the bottom, containing 339,400 cu. yd. of masonry. The stones are laid in cement which was made on the spot. The dam creates what is said to be the largest artificial lake in the world, and the water-power created is utilized for the generation of electrical energy, to be used largely for operating irrigation pumps to supplement the flow of irrigating water by gravity, as previously described in this journal.

Swedish Telephone Industry in 1910.—The Allmänna Telefon Company, in Stockholm, Sweden, during 1910 increased the number of its subscribers and those of its affiliated companies to 118,000, an increase for 1910 of 14,841, against 11,802 for 1909. The number of subscribers in Stockholm has risen to 58,470, an increase of 4030, against 3511 during the record year of 1906. The value of the output of the L. M. Ericsson works in 1910 was $2,000,000. In this year Ericsson material was supplied for a new main exchange in Paris, two in Baku, Russian Transcaucasia, one in Rotterdam, and orders are on hand for an exchange in Helsingfors, Finland, for 10,000 subscribers, and one in Cape Town, in South Africa. The stations in Calcutta, Singapore, Hong Kong, Buenos Ayres, Santiago and Mexico have been extended. The affiliated companies have now 30,599 subscribers in Moscow, an increase of 4459; 22,445 in Warsaw, an increase of 3466, and 6667 in Mexico, an increase of 2876. The number of workmen employed at the factories in Stockholm, London, St. Petersburg and Buffalo was at the close of the year 1,250, 800, 630 and 200 respectively.

Grounding the Secondary.—Mr. W. L. Puffer, recently professor of electrical engineering at the Massachusetts Institute of Technology, has made a report to the municipality of Hingham on the subject of grounding the secondary. He stated that if all water pipes were of iron he would advise the immediate grounding of the secondary system to such water pipes, as near the transformer as possible, and also at service entrances where it can conveniently be done; but the use of cement water pipes prevents the adoption of this plan except in the very small districts where there are iron pipes. In districts through which the town brook flows, and in any other locality where there are no iron pipes, but where it is known that there is a subterranean water supply, he advises the use of a number of driven pipe grounds all connected to the secondary system. The pipes should be driven well into the moist earth and tested before being used. In other districts he would not advise grounding until such time as tests could be made to determine the practicability of getting a sufficiently good ground connection.

New Officers of National Independent Telephone Association.—At a meeting of the directors of the National Independent Telephone Association held in Chicago on March 14 officers were elected as follows: President, Mr. Manford Savage, Champaign, Ill.; first vice-president, Mr. E. B. Fisher, Grand Rapids, Mich.; second vice-president, Mr. N. G. Hunter, Wabash, Ind.; secretary and treasurer, Mr. J. B. Ware, Chicago. Mr. Savage is a practising lawyer in Champaign and president of the Home Telephone Company of that city. The directors adopted resolutions favoring laws "to compel the interchange of telephone service between different companies and to fix and establish the terms and conditions under which the same may be done." A resolution was also adopted instructing the officers to endeavor to defeat the effort of the Bell company to acquire control of Independent companies in Rochester, Syracuse and Utica, N. Y. Monthly meetings of the directors of the association are to be held hereafter. Mr. F. N. Kondolph, of Rochester, N. Y., resigned as a member of the board of directors and was succeeded by Mr. A. A. Gordard, of Topeka, Kan.

Terminal Electrification and the Chicago Mayoralty.—The campaign for the election of a mayor of Chicago is in full blast, and it appears that the agitation for the electrification of steam-railroad terminals has become involved in it to some extent. One of the two leading candidates is represented to be lukewarm on the proposition, and it is said that many railroad employees are supporting him on that account. Engineers, firemen and switchmen of steam railroads are opposed to electrification, some of them fearing that they will lose their jobs, others doubtless carrying out the wishes of their employers, and some perhaps in genuine fear that electrically equipped railroad tracks would endanger them in performing their daily tasks. It is pointed out, however, that opposition to the improvement on these grounds is due partly to ignorance and partly to the reactionary human tendency that has been a bar to the adoption of all new inventions and all improvements. Electrical operation of Chicago railroad terminals is coming without doubt. But the change will be a slow one, and the operatives will have time to adjust themselves to the new order of things. Furthermore, the danger to life apprehended by the switchmen is greatly overestimated, if it exists at all where modern safety appliances are used.

Electric Heat to Cure the Baby's Croup.—A central-station man has discovered that the croupy coughs of his young son can be relieved in short order by inclosing the baby's crib and placing inside an electric water heater, the steam rising from which moistens the air within and soon cures the croup.

Control of Telegraph and Telephone Companies.—On March 20 the Interstate Commerce Commission announced that all telegraph and telephone companies doing an interstate business are to be regulated under the interstate commerce act and that these companies must file all their tariffs of rates on interstate business and will be held liable for discriminations.

Meter Tests.—During the month of March 669 gas meters were tested on complaint by the New York City Public Service Commission, of which 48.8 per cent ran fast and 10.9 per cent ran slow. Of seventy-seven electric meters tested upon complaint during the same month 2.6 per cent ran fast and 3.9 per cent ran slow, 93.5 per cent being correct within the prescribed limits.

Souvenir of Boston Edison Twenty-fifth Anniversary.—Through the initiative of President C. L. Edgar a souvenir of the twenty-fifth anniversary of the organization of the Boston Edison Company was recently presented to each employee. The souvenir consists of a paper-weight model of the first Edison bipolar generator used on the system, and its completeness of detail, with appropriate inscription, has attracted much favorable comment.

A Telephone Auto Horn.—To the terrors of the automobile horns there are now added those of the phonograph. Mr. A. C. H. Dalley, of Minneapolis, has arranged an indestructible phonograph record in combination with a loud-speaking telephone to be mounted on the front of the automobile, a touch of the chauffeur's button causing the new auto horn to hurl in raucous notes at fleeing pedestrians the name of its car or any other phrase desired.

Proposed Ohio Hydroelectric Plant.—The Miami Power Company, of Hamilton, Ohio, recently incorporated, proposes to erect a 5000-hp hydroelectric plant on the site of the old Chatfield & Woods paper mill at Woodsdale. The plant, it is said, will cost about $500,000, and energy will be furnished to Hamilton, Middletown, Miamisburg and Franklin. The incorporators of the company are Messrs. H. L. Hanley and J. W. Durfue, of Chicago; W. D. James, of Detroit, and William Bergen and John Reif, of Overpeck, Ohio.

Electric Service for Ranches.—Contracts have been closed at Grand Junction with the Grand Valley Interurban Company by ranchmen residing in the Pomona district northwest of Denver for electricity for lighting and heating their homes and reclaiming hundreds of acres on Pomona Heights, on which no water can be secured at present. The ranchmen have contracted for enough energy from the trolley wires to secure a low rate, and a transformer will be installed to reduce the voltage so that it can be used for domestic purposes.

South Side Park and Boulevard Lighting in Chicago.—The South Side park commissioners of Chicago announce that they will accept the proposal of the Sanitary District to supply electrical energy for lighting the South Side parks and boulevards. The existing steam-generating plant in Washington Park, which is of recent design, will be shut down and held as a reserve. The Sanitary District, which operates the hydroelectric plant of the Chicago Drainage Canal, supplies electricity to Lincoln Park, on the North Side, at the present time.

Institute of Operating Engineers.—The second monthly meeting of the Institute of Operating Engineers was held March 9 in the Engineering Societies Building, New York, at which a paper was presented by Prof. W. D. Ennis. At the regular monthly meeting in April, Mr. J. C. Jurgensen will present a paper on "Economical Aspects of the Institute of Operating Engineers."

Denver Electric Show.—The chairmen of the various committees having in charge the conduct of the annual Denver electric show have reported the appointment of members for their committees and definite arrangements have been made to secure the Denver Auditorium for the exhibition from Oct. 14 to 21, inclusive. The publicity committee consists of Mr. L. T. Greenewalt, publicity representative of the Colorado Telephone Company, chairman; Messrs. John M. Connelly, publicity representative of the Denver Gas & Electric Company, and W. J. Canada, electrical engineer of the Rocky Mountain Fire Underwriters' Association.

Railroad Conventions in Chicago.—A stated meeting of the Railway Signal Association was held in the Congress Hotel, Chicago, on March 20. Committee reports on signal symbols and on detailed specifications for material were discussed, while papers were presented on portable storage batteries for automatic signals and on the principles governing the selection of alternating-current signaling apparatus. On March 21, 22 and 23 the American Railway Engineering and Maintenance of Way Association held its convention. The Railway Appliances Association is holding its annual exhibition of railroad appliances at the Coliseum, Chicago, during the week ending March 25.

Relative Globe Surface of Large Tungsten Lamps.—A partial explanation of the tendency of very large tungsten lamps to blacken more than the medium-sized units was offered by Mr. H. Schroeder, of Harrison, N. J., in a discussion at the St. Paul convention of the Minnesota Electrical Association, March 15. The 25-watt tungsten lamp has a globe surface of about 25 sq. in., or 1 sq. in. per watt of power dissipated. The 500-watt unit, however, would require a globe about 13 in. in diameter to secure the same ratio. The 8-in. size, in which the lamps are made, requires the dissipation of about 4 watts per square inch of globe surface, and this greater intensity of action on the surface of the large-size globes is in part held accountable for the tendency to discolor.

Value of Illinois Engineering Experiment Station.—Before the Western Society of Engineers in Chicago on March 15 Prof. W. F. M. Goss, dean of the College of Engineering, University of Illinois, read a paper on "The Illinois Engineering Experiment Station in Its Relation to the Public." The work done by the experiment station at Urbana was outlined and illustrated by lantern-slide pictures showing various types of testing apparatus and equipment. Forty-four bulletins had been issued by the experiment station, and there seems to be no question of their value to the technical interests of the State. The paper, therefore, dealt with the subject from the viewpoint of the general public. The two main investigations outlined for the future relate to fuel and its utilization and to materials of construction. Other questions to be investigated are the utilization of electricity for agricultural and mechanical purposes, gas production and gas power, transportation, pneumatics and aeronautics. So far the laboratory has not undertaken to make tests for private enterprises, and it is not the intention to enter into competition with established testing laboratories. The Legislature is asked to appropriate sufficient funds to enable the work of the station to be increased, as the present laboratory facilities are inadequate. Messrs. W. L. Abbott, Albert Scheible, W. E. Symons, A. Bement, W. Morava, Charles F. Burgess and E. E. R. Tratman took part in the discussion. It was pointed out that unbiased experiments undertaken to settle technical questions are of great economic importance.

Electrical League of Cleveland to Give a Smoker.—The Electrical League of Cleveland will give a smoker and entertainment in that city on Saturday, April 1. An interesting program is in preparation.

Electrical Talks for Boys.—Talks on technical subjects have been a feature of the work of the children's department of the Fort Wayne (Ind.) Public Library during the winter season now closing. Two of them related to electricity, the lecturers using non-technical language and giving demonstrations. It is observed that the boys take a real interest in these talks and that the number reading electrical books has been sensibly increased.

Chicago Section of Illuminating Engineering Society.—Mr. James R. Cravath read a paper on "Tests on Lighting of a Small Room" at the meeting of the Chicago Section of the Illuminating Engineering Society held on March 16. The next meeting of the section will be held on April 20, when Mr. C. R Gilman, of the Chicago, Milwaukee & St. Paul Railway Company, will read a paper on "Recent Developments in Car and Train Lighting."

Chicago Aldermen Watching Commission Legislation.—A special committee of the Chicago City Council has been appointed by the Mayor to protect and advance the powers of the City of Chicago in the regulation of public-utility corporations as they are affected by bills now pending before the State Legislature. The committee consists of Alderman W. J. Pringle, chairman of the City Council committee on gas, oil and electric light, and six other aldermen.

Intermittent Lighting Service Caused by Atmospheric Disturbance.—According to the newspapers a severe electrical storm near Bakersfield, Cal., affected the transmission lines of the Southern California Edison Company in such a manner that at intervals of from fifteen seconds to two minutes the lights on customers' premises in Los Angeles were put out, flashing on again an instant later. This phenomenon is said to have lasted from about 9 o'clock until midnight on the night of March 2.

Treasure Trove to the Extent of 50 hp.—County officials in Los Angeles recently discovered a provision in an old but still valid franchise by which the Pacific Light & Power Company is required to supply to Los Angeles County 50 hp in electrical energy in perpetuity. The attention of the company was called to the matter and General Manager A. C. Balch responded by saying that the company stood ready to meet the condition. The Board of Supervisors, at the last account, was considering where to make use of this "find" of electrical energy.

Ohio Ice-Making Auxiliaries.—Credit was inadvertently given to Ohio in the article on central-station ice-making auxiliaries, printed in the issue of March 2, for only a single plant having an ice-making auxiliary. There are at least four such plants in that State, two of which have been described in these columns, namely, that of the Marysville Light & Water Company, Marysville, Ohio, and the Loveland Citizens' Electric Company, Loveland, Ohio. Other plants are operated by the Hillsboro Light & Fuel Company and the Maumee Electric Company.

Electric Furnaces at the Universtiy of Illinois.—There have recently been installed at the University of Illinois, through the combined efforts of the department of electrical engineering, the engineering experiment station and the department of chemistry, two electric furnaces. One of these is a Hoskins resistance furnace and the other a Colby induction furnace Both are of 20-kw rating. The furnaces will be used for the purpose of studying the changes that can be brought about in the chemical and physical characteristics of cast iron through the influence of the soaking process which it is possible to maintain by their use

Gary Aldermen Object to High-Potential Railway Wires.—By vote of the City Council of Gary, Ind., on March 13, the Mayor of the city was directed to cause the removal of the overhead wires and cables of the Chicago, Lake Shore & South Bend Railway Company within the city limits. This company, operating a single-phase alternating-current railway system, employs a transmission voltage of 33,000 and a trolley voltage of 6600. Its line runs from Pullman, in the southern part of Chicago, to South Bend, Ind., passing through Gary The officials of that city consider that the high-potential wires are dangerous.

Electric Club of Chicago.—Mr. Charles E. Merriam, professor of political science in the University of Chicago and a candidate for Mayor of that city, addressed the Electric Club of Chicago at its luncheon on March 15. Over 100 members and guests were present. Mr. Merriam made a non-political speech on "The Needs of Chicago," speaking of the "graft," political favoritism and lack of business methods which, he said, have characterized the city government for a number of years back and asserting the need of intelligent attention to matters of administration as well as of legislation. The entertainment committee of the club was authorized to arrange for a smoker to be held at the Illinois Athletic Club some evening next month.

An Unexpected Test for "Wireless."—The disastrous powder explosion at Pleasant Prairie, a hamlet fifty-five miles north of Chicago, on the evening of March 9 caused a tremor over a wide area, including Chicago. The hundreds of "wireless" operators in and near Chicago "got busy" at once. Messages were exchanged between Chicago and Milwaukee and with boats on the lake. At first it was thought that an earthquake had happened, but soon the operator of the United Wireless Telegraph Company at the Congress Hotel station, Chicago, sent out a newspaper bulletin stating that the "shake" was due to the explosion of powder mills. The excitement was thus allayed so far as those who had access to the "wireless" reports were concerned. Many extra calls, probably amounting to thousands, were made by telephone in Chicago and other cities and villages as the result of this accident. The operators of the Chicago Telephone Company were informed quickly of the cause of the trouble and anxious subscribers were told that there was a powder explosion near Kenosha, Wis.

Extension of Plant of Utah Light & Railway Company.—The Utah Light & Railway Company, Salt Lake City, is completing a steam-reserve power station at Jordan River, which will serve as a reserve against breakdown or other interruptions, the plant not to be operated continuously. The present equipment consists of a 6800-kw Westinghouse turbo-generator having a twenty-four-hour overload capacity of 7500 kw and a temporary overload capacity of 8500 kw. The cubical capacity of the plant is a little over 56 cu. ft. per kilowatt, against an average of between 75 cu. ft. and 80 cu. ft. for similar plants The line connecting the plant with the general electrical system of the company is of the latest steel-tower construction. At present the Utah Light & Railway Company is supplied with electrical energy principally from the Pioneer power station in Ogden Canyon, thirty-seven miles north of Salt Lake, the Cottonwood Stairs station, sixteen miles southeast of Salt Lake; the Cottonwood Granite station, fourteen miles southeast of Salt Lake; the Bear River station, eighty-five miles north of Salt Lake, and from the Telluride hydroelectric system. In addition the company has three steam plants in Salt Lake City During the past year there was added to one of these, the old Jordan station, a low-pressure turbo-generator, utilizing the exhaust steam from the old reciprocating engine, thereby practically doubling the output for the same fuel consumption

The Ohio Society of Mechanical, Electrical and Steam Engineers.—The semi-annual meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers will be held in Youngstown, Ohio, on May 18 and 19. Mr. Oscar F. Rabbe, Toledo, Ohio, is president and Prof. Frank E. Sanborn, Columbus, Ohio, secretary-treasurer.

Felling Trees Electrically.—The name of the inventor of the method of felling trees electrically, described in the issue of Feb. 2, 1911, is Hugo Gantke, and his address is 52 Heidestrasse, Berlin, N. W., Germany. He has no representative in this country. This information is given owing to the apparent interest in the article as indicated by inquiries where the apparatus employed in this method of tree-felling may be obtained.

Damage from Transformer Oil.—The Edison Electric Illuminating Company of Boston is the defendant in a suit for damages brought as the result of a very unusual combination of circumstances. Oil from a pole transformer in the residence section of Chelsea by some peculiar accident ran out along the wires and was blown against the residences, forming spots of various sizes. The owners have asked for $5,000 in damages.

Electrical Jobbers' Convention.—Arrangements have been completed for a special train from Chicago to convey the members of the Electrical Supply Jobbers' Association to Del Monte, Cal., where the association will hold its convention on April 25, 26 and 27. The train will leave the Dearborn Station, Chicago, at 8 p. m. on April 18 over the Atchison, Topeka & Santa Fé Railway. Stops will be made at Albuquerque, N. M., the Grand Canyon of Arizona and Los Angeles, Cal. Mr. Franklin Overbaugh, general secretary of the association, will take personal charge of the train party.

New Method of Producing Vector Diagrams.—At a special meeting of the Boston Section of the American Institute of Electrical Engineers, held in Pierce Hall at Harvard University on Saturday, Feb. 25, Dr. A. E. Kennelly, assisted by Messrs Crane and Doggett, gave a lecture demonstration on a new direct method of producing vector diagrams of an alternating-current circuit experimentally. By means of a suitably arranged alternating-current circuit containing apparatus designed by Dr. Kennelly the voltage and impedance diagrams of the circuit were produced visually. An account in detail of the new method will appear in a later issue of this journal.

Illumination Club of St. Paul.—Employees of the Northern Heating & Electric Company, of St. Paul, Minn., and the St. Paul Gas Light Company, together with a number of local architects, engineers, draftsmen and contractors have formed the Illumination Club of St. Paul, which holds monthly meetings for the discussion of papers on illuminating engineering subjects. Mr. A. L. Abbott is president of the club and Mr. C. M. Converse, of the St. Paul Gas Light Company, is secretary-treasurer. On Monday evening, March 13, Mr. Converse presented a paper on "Theater Lighting." On April 10 Mr. E. T. Street will lead a discussion on the subject of "Indirect Lighting."

N. E. L. A. Commercial Section.—The climax of the wide campaign for new members which is being waged by the Commercial Section of the National Electric Light Association will take place on Monday evening, June 1, at the Hotel Martinique, New York City, where a banquet will be tendered by Mr. George Williams and Mr. J. Robert Crouse to all who have had a part in the campaign. The main feature of the banquet will be a presentation of a sterling silver loving cup donated by Mr. Crouse to the person who succeeds in securing the largest number of new members. The contest for the cup will not cease until midnight on May 31. Each contestant's name, together with the number of members he has secured, will be posted at one end of the banquet hall. All the committee men of the Commercial Section have been enrolled ex-officio as participants in the cup contest. The list of new members grows steadily from day to day, and the committee is particularly gratified at the way in which men of the highest standing in the electrical manufacturing and central-station industries are falling into line.

Winnipeg Electrical Property Offered to the City.—As a means of settling the questions in dispute between it and the city, the Winnipeg (Man.) Electric Railway, through its president, Sir William Mackenzie, has offered its railway, electric light and gas properties to the city as a going concern. The basis on which control is offered is said to be $250 a share, whereas the present market quotation is $190. The cost to the city would, therefore, be over $15,000,000. The Mackenzie interests agree to purchase from the city 15,000 hp as soon as the hydroelectric station now being erected at Point Du Bois Falls is completed on condition that the Winnipeg Electric Railway be permitted the exclusive right to engage in commercial lighting. It is claimed that the price offered for the energy will pay interest on the city's entire investment in the municipal plant mentioned.

Annual Meeting of New England Section, N. E. L. A.—The annual meeting of the New England Section of the National Electric Light Association was held at the Edison Building, Boston, on March 17. In accordance with a vote cast by members all technical features were omitted, the reason being the proximity of the New York convention of the national organization at the end of May. The following officers were nominated and elected for the ensuing year: President, Mr. Howard T. Sands, Malden Electric Company, Malden, Mass.; vice-president, Mr. A. B. Lisle, Narragansett Electric Lighting Company, Providence, R. I.; treasurer, Mr. Welles E. Holmes, Cambridge Electric Light Company, Cambridge, Mass.; secretary, Miss O. A. Bursiel, Boston, Mass. The following members of the executive committee were elected: Messrs. J. A. Fleet, Portland Electric Company, Portland, Maine; J. S. Whitaker, Rockingham County Light, Heat & Power Company, Portsmouth, N. H.; A. F. Townsend, Woonsocket Electric Machine & Power Company, Woonsocket, R. I.; R. W. Rollins, Hartford Electric Light Company, Hartford, Conn.; George S. Haley, Rutland Railway, Light & Power Company, Rutland, Vt.; L. D. Gibbs, Edison Electric Illuminating Company, Boston, Mass., and, ex officio, Past-president A. J. Campbell, New London Gas & Electric Company, New London, Conn.

Electrification of Railroads Discussed at Boston.—At the annual meeting of the Boston Society of Civil Engineers, held at the Boston City Club on March 15, steam-railroad electrification was discussed by Prof. George F. Swain, of the Boston Transit Commission; Mr. W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad Company, and President Dugald C. Jackson, of the American Institute of Electrical Engineers. Professor Swain reviewed the recent report of the Joint Commisison on Metropolitan Improvements, and discussed the reasons which led the majority of the board to advise no legislation compelling the adoption of electric motive power at the present time. Mr. Murray exhibited a large number of lantern slides showing the evolution of electric traction on the New Haven system, and gave a number of instances to show the advantages of high-voltage transmission in trunk-line service. Professor Jackson doubted if electricity is a luxury in handling heavy transportation, when all factors are considered, including the economic loss due to the smoke nuisance. All the speakers agreed that the proposed purchase of the Boston, Revere Beach & Lynn Railroad Company and the building of a tunnel under Boston Harbor by the New Haven interests will, if permitted by the Legislature, mark the beginning of electrification at Boston, since the tunnel and its approaches must of necessity be electrically operated.

ELECTRIFICATION OF THE PULLMAN PASSENGER-CAR SHOPS.—I.

The Modern Plant That Has Superseded the Famous "Centennial" Corliss Engine.

By George W. Cravens.

The Pullman Company is too well known to require extended introduction, as it is the largest institution of its kind in the world, but the recently completed general electrification of its principal car shops at Chicago is worthy of especial notice, not only owing to the intrinsic interest of the new equipment itself, but because of the remarkable mechanical transmission system formerly in use in these extensive shops.

When the late George M. Pullman founded this organization it was for the purpose of building his patented sleeping-cars. To-day practically every known type of car for steam-railroad passenger service is built by the Pullman Company, both of wood and of steel, together with electric, street-railway and freight cars and cabooses. The use of steel for car-building has spread until a majority of cars now have steel sills, many have steel frames with wood finish and an increasing number are entirely of steel except cushions and windows. This growth and change have demanded increased power and space and a reorganization of methods.

GENERAL DESCRIPTION OF SHOPS.

The principal works of the Pullman Company are located in the southern part of the City of Chicago and lie between the main line of the Illinois Central Railroad on the west and Calumet Lake on the east, a distance of about one-half mile, and from Ninety-eighth Street on the north to 117th Street on the south, making the length approximately two and one-half miles. This covers most of what was formerly the town of Pullman. Aside from a few sheds all buildings are of brick with slate roofs, the later ones having steel frames, and some of them being provided with concrete slab roofs.

The passenger-car shops constitute over half of the plant, the principal buildings being so placed that transfer tables run between them and serve the buildings on each side. These transfers are steam-driven and will probably remain so. Extensive trackage is provided throughout the yards and into all of the main buildings. The buildings comprise steel and wood car-building shops, carpenter, machine, brass-finishing, foundry, wheel and axle shops, storerooms, upholstery pipe, paint, glass and miscellaneous shops and lumber and metal storage buildings, together with offices and power plants. The new central power house, to be described later, is shown in Fig. 2, a general interior view being given in Fig. 1. There are about 12,000 men employed in the passenger-car shops at present, and the capacity of this portion of the plant is 150 cars a month, of which about one-half may be all-steel cars. The passenger-car shops occupy most of the territory between 140th Street and 111th Street, one corner still containing some of the buildings forming the town of Pullman. There are still occupied by shop men and their families.

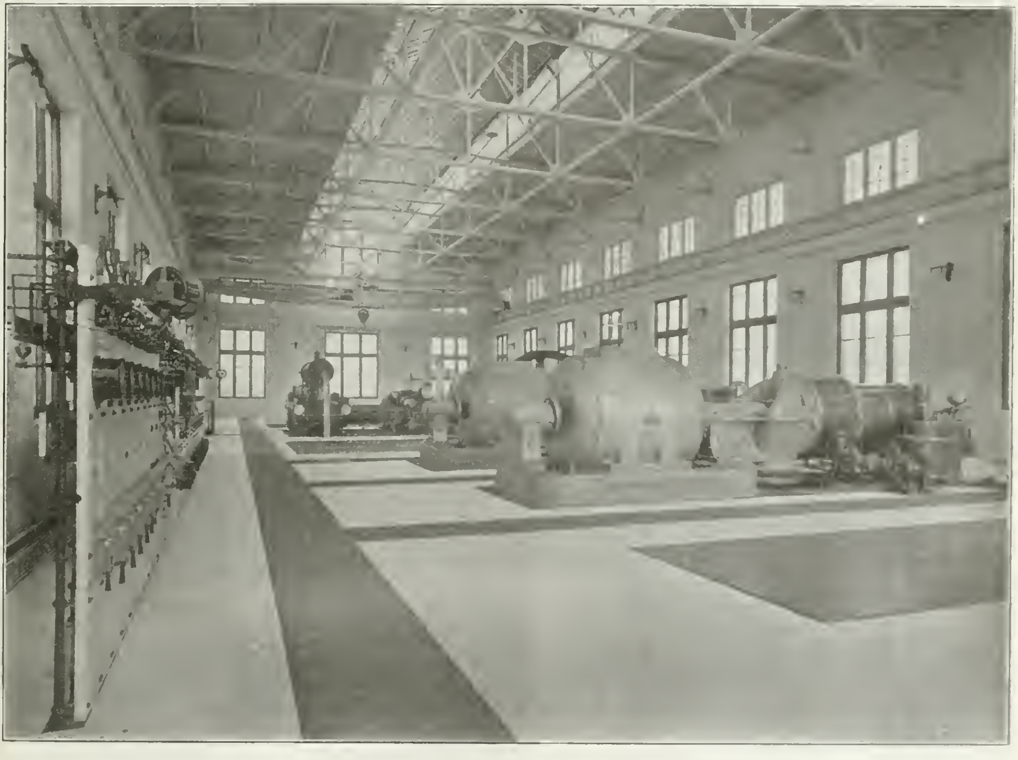

Fig. 1—General Interior View of New Central Power Plant, Pullman.

The new steel freight-car shops have been built just north of the older passenger-car shops and occupy the space between Ninety-eighth Street and 104th Street. Up to date these consist of three buildings and some sheds, the main building being 400 ft. wide (four bays of 100 ft. each) by 1175 ft. in length, with the roof composed largely of glass. In these shops will be placed the necessary equipment for making steel freight cars of all types, and about 3000 men will be required when running full. At present only a few machine tools are in place and about seventy-five men are employed on steel passenger-car parts. The wheel-and-axle shop at this plant is located next north of the main shop and the power and mechanical building next south of it.

This power plant for the steel freight-car shops (distinct from the central power plant) contains two Westinghouse 1000-kw, 440-volt, 60-cycle, three-phase turbo-generators of the horizontal type, with space for a third one. One steam-driven and two induction-motor-driven exciters are provided for, together with two 500-kw motor-generator sets for supplying 220-volt direct current. Most of this direct current will be for the cranes, of which there will be over a dozen in these shops. This plant also contains two air compressors, each delivering 4000 cu. ft. of free air per minute at a pressure of 100 lb. per square inch, with space for a third one, and a hydraulic pump delivering water at a pressure of 1000 lb. per square inch to the hydraulic presses in the main machine and car shop. This water passes through a steel pipe 1500 ft. in length, laid in a tunnel and fitted with an accumulator and shock absorbers.

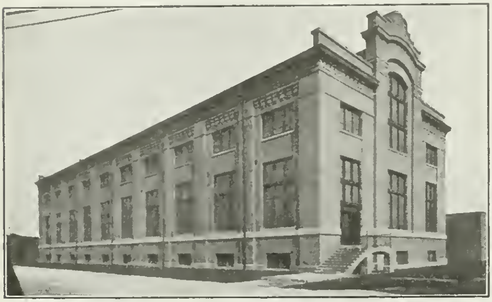
Fig. 2—New Central Electric Power Plant at Pullman.

In addition to the usual steam auxiliaries required there is an oil-switch and bus compartment in the basement. The oil switches are mounted on pipe framework and operated by hand from the main switchboard, which is directly above in the main engine-room. The board is of white marble and, together with the switches, was built by the Westinghouse Electric & Manufacturing Company and installed by Kohler Brothers, of Chicago. The main buses are of bare copper bars carried on insulators suspended overhead in the basement and in a special framework overhead in the switch compartment. Connections to the feeders are through insulated cables laid in conduits.

The power plant at the steel freight-car shops is not yet completed and the power generated is controlled from a temporary switchboard. Most of the power is now transmitted to the passenger-car shops through 440/2300-volt step-up transformers and a temporary tie-line. This tie-line consists of some old No. 4 B. & S. weatherproof wire mounted on wooden poles with glass insulators. Further reference will be made to this tie-line in describing the new 2300-volt power plant, or central plant, at the passenger-car shops, to which the present article is devoted principally.

The Calumet repair shops are located just south of the passenger-car shops and extend from 111th Street to 117th Street. A part of this territory is also occupied by some of the old town of Pullman. It is here that all repairs are made to the cars operated by the Pullman Company, and as many as 2000 men may be employed here in busy seasons. The equipment is similar to that of the passenger-car shops, but on a smaller scale. Electrical energy for these shops comes from the new central power plant, the cables being laid in conduits. Further details of this equipment will be given later.

The new central power plant is located at the passenger-car shops and near the "center of gravity" of the load. Just at present the load is largely to the south of the power house, due to the burning of the old freight-car shop, but it is expected that more energy will be sent north later. Before describing this plant, however, a description of the old power equipment will be given in order better to contrast the old and the new.

OLD POWER EQUIPMENT.

The Pullman Company shops were started before the days of practical electrical transmission of power, so the machinery in the various buildings was driven by steam engines with power supplied from boiler plants located throughout the grounds. As the plant expanded new boilers were added until finally there were twenty of them, of various kinds and sizes, scattered about the shops. This was so wasteful and inconvenient that a new central boiler plant was built in 1906 to concentrate steam generation in one place and increase efficiency. This is located near the center of the passenger-car shops and it is housed in a brick building 80 ft. x 131 ft. in size, provided with a 250-ft. circular brick stack just outside the east end of the building. This stack produces a draft equal to 1¾ in. of water at its base, with a minimum equal to 1½ in. of water in the breechings. Fig. 3 is an interior view in the central boiler house.

All coal and ashes are handled by automatic conveyors, the coal being delivered in cars on a track alongside the building, dumped into a hopper, conveyed to the continuous steel bunker overhead in the central section of the building and thence through 16-in. steel chutes to the hoppers of the stokers on the furnaces below. The bunker is built with sixteen hopper bottoms, in two rows of eight each, twelve of which are for coal, two for shavings and two for ashes. The building is equipped with four shaving separators on the roof for feeding one of the present boiler furnaces, and about 60,000 cu. ft. of shavings is burned each twenty-four hours. The coal-handling apparatus has a capacity of forty tons of coal per hour.

At present there are installed eight 400-hp Stirling water-tube boilers in a single row, along one side of the building, facing the center of the room. Space is provided for as many more on the opposite side of the room, and three of these boilers will be installed at once. These are now in the boiler-room of the old freight-car shop, which burned about a year ago, but are being dismantled preparatory to moving. Six of the boilers now in place have Green automatic chain stokers, the other two having straight fixed grates, with ½-in. air-space openings, and being used for burning shavings.

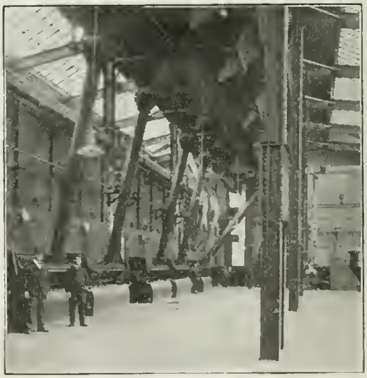
Fig. 3—Interior of Central Boiler House, Pullman.

The water for this boiler plant may be taken from the city mains or from the company's own supply system. The feed water is heated in a Cochrane 4000-hp heater and supplied through an automatic tandem-compound 16-in. x 25-in. x 12-in. x 20-in. pump built by the American Steam Pump Company. The supply to each boiler is controlled by a Murray automatic valve, this in turn being actuated by a float in the water column of the boiler.

From each boiler an 8-in. connection runs to a 20-in. main steam header which runs along the wall at the back of the boiler settings. In each connection there is an 8-in. gate valve and an 8-in. automatic stop and check valve, the latter to prevent back pressure reaching the boilers. There are also two 4½-in. blow-off valves on each boiler. All of the valves on the steam and feed-water pipes may be reached from an iron-slat walk which extends along over the rear of the boiler settings just in front of the 20-in. heater. Before the new central power house was built steam was supplied to the various engines about the shops through overhead mains from this plant. Some of these steam pipes were 1000 ft. long and all of them were covered with double thicknesses of 85 per cent Keasbey & Mattison magnesium pipe covering.

This boiler plant has been described because it will continue in use for the new central power plant, and after the three other boilers are installed it will supply all of the steam for use in the passenger-car shops and offices. Messrs. R. W. Hunt & Company were the consulting engineers when this plant was built, and the engineers of the Pullman Company are handling the changes and extensions. In addition to the three old boilers mentioned these extensions will also include coal and ash conveyors and other auxiliary equipment.

THE CENTENNIAL CORLISS ENGINE.

In addition to the steam engines located at various places about the shops there has been in use also a remarkable system of underground shafting for power transmission. This was actuated by the old upright Corliss two-cylinder engine originally exhibited at the Centennial Exposition held at Philadelphia in 1876. This faithful worker stands in its own room, at the north end of shop No. 2, quite near the office building, silent, waiting to be destroyed, giving mute testimony of times passed away. It is illustrated in Fig. 5.

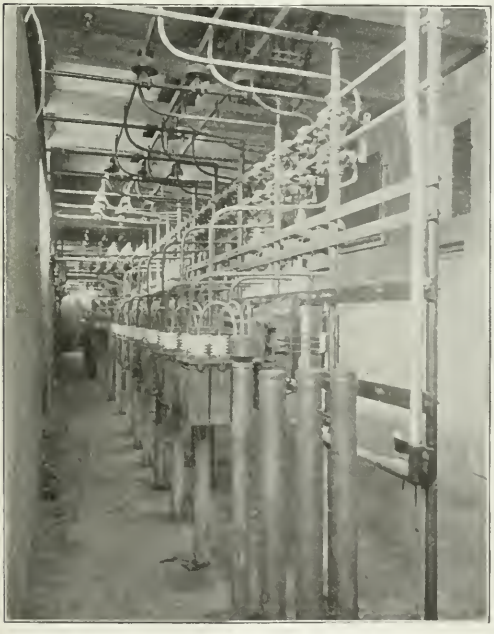

Fig. 4—High-Tension Compartment.

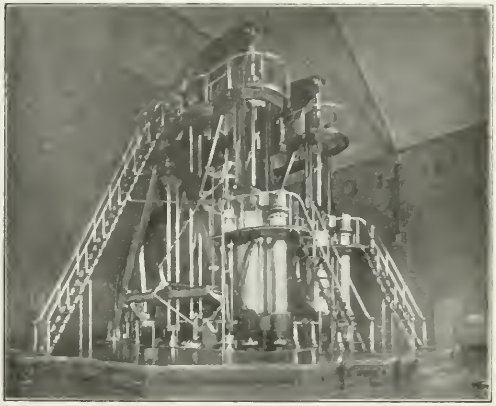

Fig. 5—The Famous "Centennial Corliss," Now Superseded.

This engine is of the walking-beam type, the cylinders each being 40 in. diameter with 10-ft. stroke. It is provided with air pumps and condensers and may be worked either condensing or non-condensing, and was designed to work at a pressure ranging from 25 lb. to 80 lb. Each cylinder was designed to develop 700 hp at 36 r.p.m., nominal, giving 1400 hp total, but the engine has delivered over 2000 hp at times.

The height of this engine is 39 ft. from the floor to the top of the walking beam and it weighs complete over 800 tons. The beams are made of cast iron, 9 ft. wide in the center and 27 ft. long, and weigh eleven tons each. The cross-head guides extend from the upper heads of the vertical cylinders to the gallery around the top and may be lifted off with the cylinder heads for access to the pistons. The piston rods are of steel 6¼ in. in diameter and the connecting rods are 24 ft. long. The main frame is A-shaped, with the journals for the beam shafts on top and with one leg resting on the cylinder base and the other on the main crankshaft journal-box pedestal.

The flywheel is 30 ft. in diameter with 2-ft. face and weighs fifty-six tons. It has gear teeth in the center of the face and meshes with a pinion 10 ft. in diameter weighing eight and one-half tons. This pinion is mounted on a 14-in. steel shaft below the floor and is the beginning of the underground transmission line already mentioned.

In the same building is a 150-kw, 2300-volt, three-phase Westinghouse generator direct-connected to a horizontal engine. This is no longer used, as it also has been superseded by the new power plant. The 4000-cu.-ft. air compressor formerly in this building has been moved to the new power plant.

OLD ELECTRICAL AND MECHANICAL EQUIPMENT.

Near the central boiler plant is the old electrical building, in which were installed ten fifty-light and two thirty-five-light, 7½-amp Wood direct-current arc machines, two Edison bipolar 60-kw, 110-volt direct-current generators for three-wire 110/220-volt operation, and a 250-kw Bullock 2300-volt alternating-current generator. All of the Wood arc and Edison machines were on a gallery and driven by belts coming up through the floor from a countershaft with clutches below. This shaft was driven by three upright Corliss engines, through belts, and the Edison and Bullock generators were belt-driven from this shaft without clutches. The arc and direct-current switchboards were on the gallery and all wiring was open.

From the large pinion driven by the Centennial Corliss engine (Fig. 5) a steel line shaft extended for approximately two miles through tunnels to all parts of the plant. This shaft ran at a speed of 108 r.p.m., nominal, and transmitted as much as 2000 hp at times. This shafting was of various sizes, there being 6-in., 8-in., 10-in. and 14-in. diameters at different places. At every right-angle turn there was a pair of bevel gears 6 ft in diameter (Fig. 6), there being eight pairs of these all together. Belts ran up into the various shops, from pulleys on the underground shaft, for driving the miles of countershafting. These belts were of all sizes up to 48 in. in width, and idlers were used as tighteners instead of having clutches for throwing them in and out of service. It has been estimated that nearly 350 hp was lost in this underground transmission system.

The old electrical distribution system consisted of both lead-covered and rubber-covered cables, of various sizes up to 500,000 circ. mil, a portion being underground. There was one 500,000 circ. mil overhead direct-current line for the shops and a line for the 2300-volt alternating current overhead, carrying 250 kw from the Bullock generator. Nearly all of the old lighting was with series arc lamps, both in the shops and in the yards, although a large number of incandescent lamps on flexible cords were used in the car shops. Throughout the shops there were about thirty-five direct-current motors and fifty-five alternating-current motors of various sizes.

From the foregoing general description of the old equipment it will be easy to see that a very radical and comprehensive change of power system was desirable. Not only was the old system inadequate to meet demands for extension, but it was inefficient as to generation, transmission and utilization. It was also expensive to operate and maintain, inaccessible in case of breakdown, and there was an inherent lack of co-operation between the different elements all along the line. On the other hand, this equipment was the best of its kind when installed, and the good service rendered is proof of the sound judgment of those responsible for its selection and care.

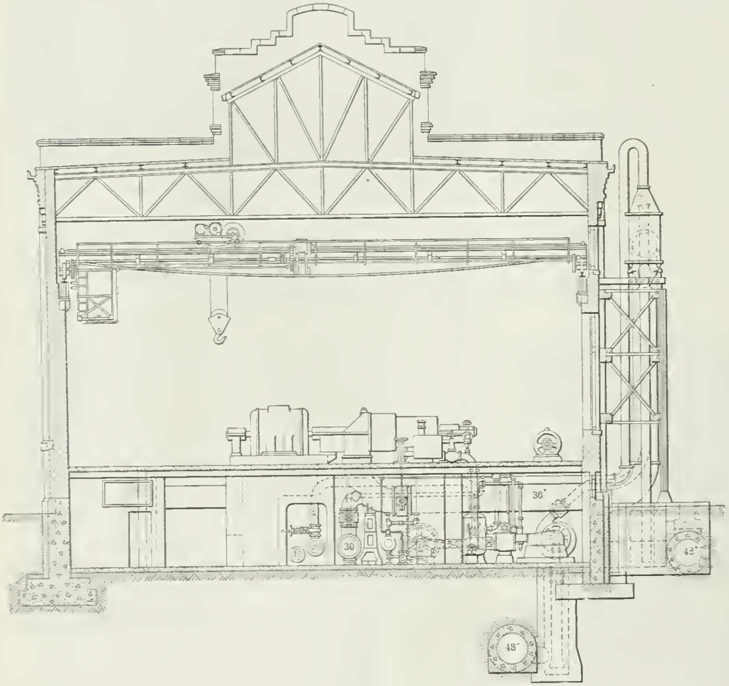

Fig. 6—Cross-Section Through Power House.

THE NEW CENTRAL POWER PLANT.

The new central power plant for the passenger-car shops, shown in cross-section in Fig. 6, is located near the load center and about 200 ft. from the central boiler plant. The building is of red brick, 65 ft. x 180 ft. inside, on a concrete foundation, and has a grass plot all around it. The foundation is very heavy and extends 6 ft. above grade with openings from tunnels into basement at each end. The foundations for turbo-generators and air compressors are also of concrete, very massive and with openings for piping, etc., as are also those for the numerous steam auxiliaries in the basement.

Along the west side of the basement, extending half the length of the building, a room has been partitioned off by a wall of concrete for use as a high-tension compartment (Fig. 4). In this room are the oil switches and 2300-volt buses. At the south end of this compartment a large opening has been made for the entrance of a galvanized-steel duct. This brings in fresh air, which passes from this room through ducts leading up to the turbo-generators for ventilation, the rotors acting as the fans and creating a strong draft.

Built into the walls and floors of the basement are conduits for wires. These lead from the generators and auxiliaries to the high-tension compartment and slot under switchboard, and extend above the floor of the basement up to the level of the oil switches and their supports. These conduits are of iron for small wires and fiber for large cables. Two pits have been constructed in the floor of the high-tension compartment, into which all cables are carried, making convenient places for changing connections, etc. These pits have sectional cast-iron covers.

The superstructure of the power house is of red brick with stone trimmings and is dignified and attractive in design. The walls are faced inside with glazed white-enameled bricks, and the windows are large and glazed with frosted glass. The floors are finished with white tiling laid on the concrete body, and strips of rubber matting have been laid along the principal passageways. The steel work and roof have been painted a light blue and the window casings a very dark color, so the interior of the building is very bright and pleasing.

The floors are of reinforced concrete on steel I-beams and the roof is of concrete slabs on steel purlins. The roof trusses are of steel and a large skylight extends the full length of the building. This skylight has glazed swinging sash in the sides and runs along the center of the roof. The crane girders are mounted on a corbeled shelf along each side wall and windows are placed above them.

Just outside the west wall of the foundation, and alongside the high-tension compartment, there is a large manhole, or vault, which forms the starting point for the underground electrical distribution system. From this manhole there start three sets of ducts, two of Orangeburg fiber and one of tile, each with sixteen ducts running to other vaults about the plant. There are also two sets of Orangeburg ducts from this vault through the basement wall, each composed of twenty-four ducts, leading to one of the pits in the floor of the high-tension compartment. From here conduits run to the other pits, oil switches, generators, etc., as will be described in detail later.

As mentioned above, there is also a tunnel entering each end of the basement. This is approximately 6 ft. high by 10 ft. wide and carries steam and water pipes for all purposes. This runs to the power house from the boiler house and then on to the steel passenger-car shops "A" and "B," about 1000 ft. in total length. There are all told about eight miles of tunnels of various kinds throughout the shops, most of which have been used for many years.

[Mr. Cravens' article will be concluded by Part II, to be published next week.]

PROTECTION AFFORDED BY ARCING RINGS ON TRANSMISSION LINES.

By L. C. Nicholson.

A PAPER read before the American Institute of Electrical Engineers at Charlotte, N. C., in March, 1910, described the effects of lightning upon the 60,000-volt transmission lines of the Niagara, Lockport & Ontario Power Company and showed the marked degree of relief obtained by applying metal arcing rings to the insulators, as shown in Figs. 1 and 2.

The object of these rings is to save the insulator from injury by the power arc following a flashover by lightning. They are placed in position to attract the arc and hold it sufficiently removed from the porcelain to prevent breakage by the heat engendered. The rings also tend to prevent puncture of insulators without lowering the effective insulation of the line.

At the time the above-mentioned paper was read experience with this device was limited to the results obtained on about one-half the transmission system (200 miles of line) during one lightning season, that of 1909. There are now available the results of the season of 1910, which was a severe one and during which practically the entire system (410 miles of line) was equipped with arcing rings.

The conditions in 1909 were that one line, containing about 12,000 insulators, was reinsulated—that is, all insulators were removed, tested at dry flashover (200,000 volts) and returned to the line. The failures, 40 per cent of the total, were replaced by a shorter four-part 14-in. insulator, shown in Fig. 2, installed on the top wire. Arcing rings were put on all the retested and new insulators on this line. The insulators of the other line were not retested or protected by rings or otherwise.

The season of 1909, which was rather below normal in point of severity, disabled fifty-four insulators on the old line and one on the retested protected line. The single failure on the protected line was caused by the power arc not properly transferring to the ring, which was improperly installed. The breakage on the old line was practically in duplication of that obtaining in previous years, the number of insulators destroyed being a fair index to the quantity of lightning.

These entirely satisfactory results recommended placing arcing rings on the second line, which was done before 1910. The insulators, however, were not retested, the rings being applied to the insulators in place on the line.

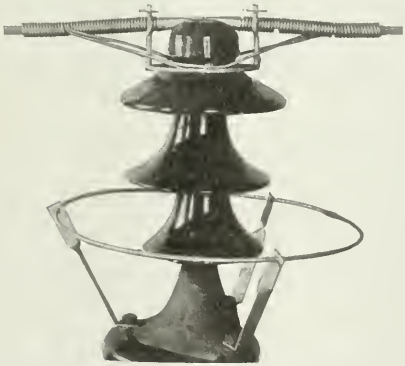

Fig. 1—High-Tension Insulator Equipped with Arcing Ring.

The season of 1910 proved to be equivalent to that of 1908, both of which were severe, so that a direct comparison of the results of the two years indicates the effectiveness of the protective measures adopted. In 1908 220 insulators were destroyed, thirty-one, it was determined, from direct lightning strokes, judging from the characteristic manner in which they were broken up; 114 were punctured, and eighty-one were destroyed by power arc following spillovers. In 1910 twenty-six insulators were lost, seventeen by direct stroke and nine by puncture. None was destroyed by power arcs on either line and none by puncture on the reinsulated line. The loss by direct stroke was practically equally divided between the two lines. Momentary voltage disturbances and line trip-outs accompanying discharges on the line have not been increased by the introduction of the arcing rings.

These results show that the destruction of insulators by power arcs has been eliminated; that sound insulators protected by arcing rings fail only by direct lightning stroke, and that arcing rings greatly reduce the tendency to puncture by induced potential effects and do not prejudice the effective insulation of the line.

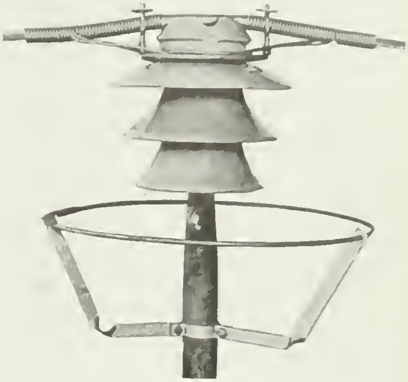

Fig. 2—Protected Insulator on Top Wire.

TRANSMISSION-LINE TROUBLES.

IN view of the rapidly increasing growth of high-tension transmission lines and the consequent interest taken in them by engineers and central-station men throughout the country, some trouble experienced in one state, with a brief description of the line, may not prove amiss.

The transmission line in question runs across a fairly rolling country. The first line constructed was built on the right-of-way of a railroad and consisted of aluminum cables strung on what is known as "A"-frame wooden poles—that is, two poles set at an angle and having a common cross-arm. One insulator is placed on the top of the two poles and the others on the ends of the cross-arm.

The energy transmitted is generated by water-turbines and the design and construction of the power plant were carefully carried out with a view of preventing any possibility of interruption to service. The record of continuity of service during the period covered by this article from the generating station log sheets is an enviable one. The troubles were not "generating," but "transmission" ones.

In the spring of 1907 a company with which the writer was connected began to take electricity from the transmission company and then the troubles began. The reasons leading to the decision to purchase electrical energy were as follows: The existing plant consisted of a lot of old 133-cycle, 1100-volt, single-phase generators about ready for that "electrical hereafter"—the junk dealer. The capacity of the plant was exceeded and it was necessary to build a new plant and put in a different system, as, of course, it was not desirable to enlarge the 133-cycle system. An opposition company was operating a 60-cycle circuit in the city, and so it was essential to put in a modern system if the company was to secure any new business or hold what it already had. At that time the transmission company was building its line within a few miles of the city, so a contract was made with it for electrical energy. At that time the plan was to use the transmitted energy exclusively and practically abandon the old steam plant, but it was afterward decided to use the old plant as a distributing station and to install a reserve generator which could also be used to take some of the peak load and thereby reduce the rate charged for energy, which was based on a sliding scale depending on the load factor.

The energy transmitted had a frequency of 25 cycles, and, inasmuch as the major portion of the connected load consisted of incandescent lamps, it was deemed advisable to install 60-cycle frequency changers. This, of course, involved changing the entire system throughout the city, while at the same time maintaining service.

Energy was first taken from the transmission line in the early summer and used for motors to which were belted generators supplying energy to the existing city circuits. It was then that trouble began, and for the next two years it never stopped.

Every central-station operator can appreciate what it means and how it feels to have the line dead. But, fortunately, comparatively few have to undergo the torture of mind incident to a failure of supply from outside sources, especially when one realizes his utter inability to do anything to restore the service. If an accident in a generating plant cripples the system the man on the job has at least the satisfaction of going to the seat of trouble and, if necessary, pulling off his coat and helping to repair the difficulty. This, at any rate, affords him a safety valve for his bottled-up feelings. But when one purchases transmitted energy that boon is denied him, and he can only stand around with his hands in his pockets and swear or occupy his time by trying to give diplomatic answers to irate customers.

As stated before, the trouble began as soon as the meter commenced to measure the energy delivered. The interruptions varied from those of momentary duration to others several hours in length. The large majority of them were officially known as "one-half-minute interruptions," a very short time ordinarily, but exceedingly long when the town is in darkness or without service and a great many machines have to be restarted and synchronized.

At first the chief causes of interruptions were the blowing of fuses at the junction of the branch and main lines, the breaking of insulators on the line and occasionally discharges over lightning arresters. At that time the line was equipped with simple horn-type arresters. These were subsequently removed and no protection was provided on the line, reliance being placed in the arresters at the various stations. These were of different types, some being of the low-equivalent, multigap type and others of a combination horn-gap and high-resistance type. The operation of the line was certainly no worse and possibly a little better after the arresters were removed.

About this time a second transmission line, located on the right-of-way purchased outright by the company and consisting of copper wire strung on steel towers, was built and put into operation. The completion of this line, which paralleled the first, was looked forward to and heralded as the remedy for all the ills to which the transmission line was heir. But it proved to be a snare and a delusion. Of course, a duplicate line was somewhat better than one line alone, but it frequently happened that a storm that would put one line out of commission would also seriously affect the other one. The distance between the two parallel lines varied from about four and one-half miles to twenty miles. They were connected at two or three points along the route, so as to permit a defective section to be cut out and still furnish energy to the end of the line.

Quite frequently it was necessary to shut down the line for purposes of inspection and repair, and as far as possible this was done on Sundays and in the early hours of the morning, but even then work of this kind subjected the distributing company to censure.

Other serious troubles were the frequent surges on the line or sudden fluctuations of the voltage, which would be of such magnitude as to throw the synchronous machinery out of step and make it necessary to start the plant again—a matter of three or four minutes' interruption at the very least, as there were several machines.

Elaborate and carefully planned methods were employed to detect and locate trouble when it occurred, but when there are hundreds of miles of line to be taken care of there is an unavoidable time element in the repair work that cannot be overcome by precision instruments or human agents. An instance illustrating this is recalled. Once the circuit-breaker opened and the instruments showed a leakage to ground. Resistance measurements indicated the trouble to within several hundred feet and troublemen were sent to this location. They investigated, but could find no semblance of anything wrong—all the insulators appeared to be intact, and this fact was reported to the chief operator. Measurements were again taken and they showed that the trouble was within the zone previously indicated.

This time a close inspection was made of every insulator and finally the trouble was discovered in a pinhole puncture through an insulator starting in the groove on the top in which the cable lay. The puncture was not visible except on close inspection after having removed the cable. Of course, during all this time the line was dead—a matter of several hours—and the customers were getting along as best they could.

Another instance is vividly recalled of a disastrous interruption of long duration. The local company soon learned that it was absolutely essential to keep fires under the boilers and throughout the major portion of the day kept the reserve engine turning over. It might be here remarked parenthetically that the engineer had so much practice in doing this "stunt" that he could get his engine up to speed and take the load within three-quarters of a minute from the time he noted from the signal lamps that the transmission line was dead. At the time in question it was necessary to make some essential repairs to the main steam header in the plant, which repairs had been postponed from time to time awaiting an opportune moment. Finally one Sunday in July was chosen. The change necessitated drawing the boiler fires and required five or six hours' time. The transmission company was notified and asked to do all possible to make a record for itself, as the city would be absolutely without light or motive power should the transmission circuit fail. Work was started early Sunday morning and the header dismantled. The work was progressing nicely when a storm came up. To make a long story short, the supply went off at 11:15 a. m. and was not re-established until 6:15 p. m., an interruption of seven hours. The work on the steam main was not completed until after 6 o'clock, and the result can be imagined. The feelings of the superintendent on that day can better be imagined than written. It is certain they were not conducive to Christian living and thinking. Frequently one of the fuses in the branch line would blow, resulting in single-phase energy being delivered. This, of course, was equivalent to an interruption, as the motors were too fully loaded to run satisfactorily on single-phase current.

Some of the most vexatious delays occurred during the transition period or when the old system was being changed to conform to the new and no reserve unit was available. These interruptions, of course, occurred at the most inopportune times, usually in the evening about the time of peak load. The street-lighting circuits were fed with this transmitted energy, and, of course, any interruption to them was disastrous from more points of view than one. The city fathers lost no chance to inform the superintendent in terms more explicit than polite just what they thought. One councilman who was defeated for re-election even went so far as to tell him that he (the superintendent) was the cause of his defeat because he had voted to give the company the contract for lighting some years previous.

A glance over the record of interruption, varying in length from one-half minute to eight hours, for a period of nearly two years shows various causes assigned, but the majority of them seem to be lightning storms, repairs to lines and fuses blowing. For a period covering one year there were 120 interruptions, with a total of over ninety hours. This was not a record for a central-station man to emulate, and quite a contrast to one pointed to with pardonable pride by a superintendent, whose company also purchases some of its energy from this transmission company, who said: "The current has not been off the Edison three-wire busbars for over twenty-two years."

It did not take very much of this service to impress the company with the fact that if it wanted to hold its customers or secure new ones it was essential to proceed immediately to build a new steam plant capable of taking the entire load and using the transmitted energy as the auxiliary. This was done and the company is now doing well, but not until it had learned its lesson through the medium of bitter experience.

CONCERNING AMERICAN WIRELESS ENGINEERING.

By O. C. Roos.*

The wireless art in America has been ever since its exploitation by the promoter's rule a center of turmoil, with the Patent Office as a flanking column and the "yellow" scientist and half-baked "expert" as strategic centers.

Deadly ambuscades of well-concealed assumptions have made a clean patent victory possible solely by cutting a combination Gordian knot of most routine wireless claims. International commercial jealousy has until lately stifled the efforts of scientists to aid the art to a greater degree of precision by publishing long-known results of practical tests. It would take several millions of dollars to disentangle the logical priority of invention in this art when freed from legal quibbles and adroit technicalities. Strange to say, in no department of electrical testing measurements has America excelled more than in high-frequency work, and yet in no department has there been more general public ignorance in other countries of the results accomplished, commercial distrust being a prime factor here.

In view of the fact that Dr. Seibt in writing about wavemeters in general and his patented wavemeter in particular in the issue of the *Electrical World* of Sept. 29, 1910, has made some invidious comparisons and assumptions, I feel that a little inside history from the American standpoint by one who saw this "new" meter developed and tested will clear the air to some degree.

We undoubtedly owe much to Continental contemporaries, and if the Germans have been painstaking in the finer details of experiment, there is equal credit to be given to the clearness and elegance of French interpretive contributions to the art. Moreover, as shown below, England's mathematical contributions to the art through Thomson, Heaviside and MacDonald have had practical results in America second to none in originality or importance. To America's work on the computation of inductances and capacities, as carried on by Rosa at the Bureau of Standards, has in some cases been paid the flattering compliment of almost verbatim insertion in the "Jahrbuch," and the essential methods used by Stone and the author in treating the linear oscillator before 1905 are but now being employed by advanced European physicists and engineers.

There are undoubtedly those to whom German technical progress in the "wireless" art represents the forefront thereof. A halo of confident superiority to commercial exaggeration of performance has even been ascribed to concerns whose thoroughness in experiment has often been achieved at the expense of fairness in regard to prior rights established in the development of similar principles. Leyden jars have been "stretched" into "inductive couplings" and there has been a general "transmigration of ideas," in some cases almost amounting to a rebirth as far as patent claims are concerned. Though with less bombast than the American promoter indulges in, "business is business" in Germany under a centralized wireless movement just as much as it is over in the States with their "laisser-faire" wireless policy.

As one who has been in intimate contact with the art from its practical beginning in America, I may state that the controversies concerning priority of invention among German investigators have been just as acrimonious as those in the States. In the matter of measurements and analysis of performance they have been more so, and perhaps have thus better disseminated technical progress among German engineers and physicists. Be this as it may, the net results in their effect upon comprehensiveness and accuracy of measurement have never approached until very recently the achievements of certain American wireless organizations.

Among others, there have been two companies never under suspicion of the least connection or even association with stock jobbing, which are unapproached as far as concerns their experience respectively in selection of proper measuring conditions and methods and in making possible and practical what the leading engineers of Europe called a "chimera," the high-frequency alternator. The Stone Telegraph & Telephone Company, of Boston, Mass., and the National Electric Signaling Company, of Washington, D. C., have contributed to the art, if not to the published literature of the subject, in a degree unexcelled anywhere in performance predetermination and long-distance work.

To be more specific it may be noted that in the domain of pure analysis there is a much closer agreement between theory and practice of vertical antenna predetermination using Stone's analysis than Drude's or Mandlestam's. The two latter are based on the theory of the "counterpoise" ground and have to be corrected near and above the fundamental of the vertical by constants or "coefficients of ignorance."

Stone's and Cram's analysis by Heaviside's operational methods (which Stone was the first to use in America) of the mean average inductance of an oscillator was followed by a reconsideration by the writer in 1905 of the problem, taking into consideration as a refinement of analysis the inductance of the displacement currents of the "rational current element." These methods of treatment have been overlooked by European engineers.

There soon followed the predetermination for all frequencies of the American engineering concepts, the resistance equivalent of radiation from a transmitter and re-radiation from a receiver, which may be something considerably different quantitatively.

Antenna reactance at the "driving point" in a transmitter was shown to be a periodic function of the frequency—in fact, sometimes an inductance—as early as 1902, long before it could be quantitatively implied by Continental engineering treatment from the "counterpoise" standpoint. The results of tests covering months during 1903 and 1904 at the Boston Navy Yard showed an average error of less than 1.5 per cent between theoretical uncorrected formulas and practical results.

We may consider then, among others, as unique American contributions to wireless the early performance prediction of radiation and re-radiation, the calculation of the mean average inductance with varying current distribution of a linear oscillator composed of an infinity of "rational current elements," the analysis and engineering use made of the concepts of "selectivity" and its converse, "persistency": the prediction and verification of commercial wireless circuits with three degrees of freedom, receiving three predicted frequencies simultaneously within 2 per cent. This last work is incorporated in United States patent applications as a mere side issue to the major problem of relieving "static" troubles.

Touching upon the question of refinement of investigation in measurement, I may say that since 1902 a circuit of the "latest type," as stated by Dr. Seibt, has been used by the Stone company, said circuit having the best selectivity and wire spacing to avoid distributed capacity effects: it therefore dates some time before the imperfect Tesla, Slaby and Seibt apparatus. In this apparatus the skin effect was kept, for measuring open circuits, well below 10 per cent of the resistance equivalent of radiation or re-radiation, which were themselves measured directly more than seven years ago, before Simon, by Mr. E. R. Cram, the discoverer of the speaking arc. The selectivity or $\sqrt{\frac{L}{R^2C}}$ was kept at the best value for different ranges, thus anticipating Scheller's measuring patents, based on constant L to C ratios. Hence, in 1903, capacities were measured to 1 part in 800 and inductances to less than one part in 1800 at high frequency.

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*The long interval between the publication of this communication and the appearance of the article upon which it comments is due to the residence of the author in the distant Philippines, where he is attached to the Bureau of Posts as wireless telegraph engineer.

The so-called "impact" and other excitation for testing by means of a buzzer, used both with and without a "weeding-out" circuit as "flywheel" and reservoir and adopted by Austin, Eichorn, M. Wien, Seibt, and others, was known as early as the date of Stone's patent covering the prior use of the so-called "Zwischenkreischaltung" of the Germans.

The operational solution of the reactions in the so-called "Braun" coupling was calculated by Stone and computed in 1902 by a whole corps of assistants, taking into consideration both skin effect and "resistance" of attached antenna. The treatment is, of course, much more exhaustive than anything before or since undertaken. The phase relations, with their sudden critical reversals of sign, are unexampled in interest for their bearing on many recent measuring methods, the recently developed critical methods of measurement used by Fisher and criticised by Makú in the "Jahrbuch" being related thereto.

The above American contributions, among others, are of fundamental importance and have been adapted to measurement with the same certainty in most practical cases that attends the use of Ohm's law, but they unfortunately are only to be found in commercial, engineering and laboratory records, or in the unpublished proceedings of the Society of Wireless Telegraph Engineers; furthermore, the only two public contributions thereon did not, in fact, appear in the technical American press until Oct. 15, 1904, and July 4, 1908. European engineers have the less excuse for ignoring these contributions, as they are admitted to be, as a class, better linguists than Americans, few of whom read the technical literature of foreign countries.

The most striking engineering departure in the points of view of advanced American and European wireless engineers is the fact that the former have for years engineered on the basis of continuous, though unrealized, harmonic waves. These have finally been made possible by Fessenden, Alexanderson and associated engineers in America. Very persistent oscillations gave close results years ago with high selectivity circuits, but the interesting point is the fact that we are now able to do with the certainty of "60-cycle" engineering and with greater quantitative confidence what was prophesied and closely approximated by fundamentally different methods of excitation more than five years ago.

It is the manufacturing weaknesses and lack of a consistent construction policy in the race for cheapness and "fool-proofness," inspired by the growing amateur interests in the States, which have made until recently the American art a chaos.

Direction-finding methods have been more widely experimented with in the States than in Europe, where to-day there are used crossed loop antennas originally intended for asymmetrical "magnetic" oscillators, but now modified to constitute a composite combination of Brown, Blondel and Stone verticals.

The difference between the current distribution of a receiving and transmitting linear oscillator, indicated by Stone in his classic paper on "The Theory of Wireless Telegraphy" before the International Congress at St. Louis in 1904, was solved, in 1907 and 1908 respectively, by the writer and Stone independently.

In regard to the development of the Seibt wavemeter in America, this should be regarded as the result of careful experiments with it in an American laboratory, as it has been made a success solely by following up defects which developed during the writer's use of it in its first trial in practical field work, in Toledo and Cleveland, Ohio, during the summer of 1909. Reports were made indicating improvements and showing the "fatigue" of the crystal detectors employed therein. To-day this type of meter, when fine stranded wire is used with low-resistance inductances, is the best all-around instrument of its kind on the market, though its defects as a "decremeter," implied in Dr. Seibt's article, are still to be reckoned with. It is scarcely an epitome of modern improvements as implied, since the same defects were long ago circumvented by the Stone company, which used the bolometer of Langley and Rubens in a specially sensitive form to get comparative tests in measuring oscillation phenomena. The Gesellschaft für Drahtlose Telegraphie in using the Hartmann Braun H.W.A. was, therefore, not introducing a real innovation in meters for station testing.

This wavemeter problem has become very involved owing to "overlapping" domestic and foreign patents, since Stone first pointed out the dependence of sharpness of tuning on loose coupling and persistency. The practical application of the former has been long patented in the United States and other countries and has been widely copied by concerns who formerly advocated close coupling. One firm formerly advocating its use to the highest possible degree, so as to transform even the upper harmonics from antenna to oscillation circuit, is now using loose coupling.

The work of Stone in analyzing from the engineering standpoint the linear oscillator into an infinite series of Hertz oscillator in 1902 complements the work of Poincaré, MacDonald and Brillouin, not to mention Max Wien, Abraham and Uller ("Jahrbuch," 1909). The latter has adopted and Fleming has quoted as "well known" the above classic contribution of Stone.

The epoch-making monograph of Bjerknes referred to by Dr. Seibt is well known to be limited in scope when decrements are being measured to very loose coupling, a correction, as first shown by Max Wien, always being necessary. Thus we encounter another confirmation of the thoroughness of early American insight into the practical significance of the most elusive factors in wireless measurement. Both in point of time and initiative American workers have more than held their own at least in laboratory testing measurements.

It is indeed high time for American physicists and engineers in the university, shop and factory to unite with responsible societies organized in the interest of wireless engineering for the much-needed publication of an American equivalent to the justly admired "Jahrbuch" of our foreign contemporaries. Commercial jealousies and bad faith in prosecuting research for temporary ends in the past have frequently rendered it inexpedient to publish matter of the most profound interest and value for future unity of effort and progress. Some of the most valuable work ever done has been "buried" since 1902.

In the matter of continuously generated electric waves I would digress for a moment to call attention to the fact that the editorial reference (Sept. 29) to the magnetic forces in a hypothetical electromagnetic wave, "at a standstill" and thus examined, is misleading. A "stopped" wave has no magnetic component—in fact, is a contradiction in terms, all its energy being stored as dielectric flux. To carry out the proposed examination we should have to imitate Lagrange's bird and fly along *with the wave* at the velocity of propagation (light) to observe the magnetic forces in any "phase" therein. Under these circumstances we could witness the phenomena described. Finally, as a means for generating these waves we cannot fail to be struck by the practical development of the high-frequency alternator, the "ignis fatuus" of dozens of well-equipped foreign inventors. The present utilization of high-frequency harmonic ether waves has been made possible solely by the scientific imagination and commercial daring of the engineers associated with the National Electric Signaling Company, of Washington, D. C., under the direction of Prof. R. A. Fessenden, a pioneer and leader in really large wireless engineering undertakings. With the rapid development of this machine, methods of multiplex, "secret" and "interference-proof" telegraphy and telephony which have been successfully tested in the laboratory by numerous experts will be rendered practical everyday facts—the signals of the wireless promoter's imminent quietus.

ELECTRICITY IN FARMING IN SWEDEN.

During the past several years the use of electricity has been a subject of considerable interest in Sweden, as the increasing cost of labor has been felt particularly by the farmers. At the agricultural institutes at Alnarp and Ultuna and at a number of large farms experiments have been made on the use of electric power for stationary and moving machines and for transportation purposes. The results are stated to be very successful, and installations have been made in several places, especially in the southern part of Sweden.

A strong factor in the awakened interest in Europe in the application of electricity to farming was the International Congress for Motoculture held in Amiens, France, in September, 1909. At this congress an international society, the Fédération Internationale de Motoculture, was organized for introducing mechanical and electrical power and appliances for agricultural purposes. The scope of the society includes the collection and publication of data obtained with experimental and actual installations and service, thus supplying a free information bureau for suggestions or advice in regard to mechanical or electrical applications in farming, and, in general, the encouragement of the use of electrical and mechanical power on the farm. The headquarters of the society are in Paris, and local sections are being established in several European countries. In October, 1910, the first national section was founded in Sweden. The work of the Swedish section will be conducted by the representatives of Sweden at the international congress, Baron Carl C:son Bonde and Dr. J. Tinsberg, of the Ultuna Agricultural Institute. Local independent societies are established in several provinces in Sweden for investigating the demand for electrical energy among farmers and to secure such energy at the lowest rate.

In the Province of Skane the farmers have founded a central-station company for the purpose of building generating stations and furnishing their own farms with electrical energy. In other cases farmers have formed a distribution company, the purpose of which is to buy energy at the central-station switchboard, erect transmission lines and transformer stations and sell energy delivered at the farmers' premises. In such cases the distribution company pays about 2½ cents per kw-hour and sells to the consumer for 5½ cents per kw-hour. If the distribution company is a stock company the stock is usually divided among the stockholders proportionately to the size of the farm in acres of cultivated land owned by each stockholder, or the stock may be divided according to the amount of energy used by the respective farmers.

Experience in Sweden and Germany shows that the average energy consumption is about 15 kw-hours per acre of cultivated area for lighting and various small motors, not including plowing, which requires about 36 kw-hours per acre per year. Considering the case of a farm of 150 acres of cultivated land, the energy consumption would be $15 \times 150 = 2250$ kw-hours per year. With the above assumed prices the earnings for distribution companies from such a farm would be $67.50 per annum. Experience has shown that for a distribution company an annual sale of energy amounting to 10 per cent of the cost of the installation will cover all the expenses and give a fair interest on the capital. Therefore, a farm of 150 acres could profitably invest $675 in a transmission line whether it be in a distribution company or an individual line. Of this amount about one-third will cover the cost of transformers and two-thirds remains for the transmission line proper. The cost of building such a transmission line in Sweden is about $1,000 per mile. That is, a farm of 150 acres can build a transmission line somewhat more than a half-mile long with a good economical result. In case electrical energy is used for plowing a longer line can be erected. However, experiments have shown that plowing is only profitable at a cost of 3 cents per kw-hour for the electrical energy. Such low rates have been obtained in some places in Sweden, or even lower for small consumers, and it is expected that farmers' distribution companies using about 2,000,000 kw-hours will receive such rates from the central stations all over the country. In fact, one of the largest central-station companies offers energy to farmers at 2 cents per kw-hour.

A TYPICAL SMALL CENTRAL STATION.

The Wooster Electric Company, of Wooster, Ohio, operates a small plant which typifies both in its history and in its business the average small central station in the United States. The company was organized in 1885 as the Wooster-Schuyler Electric Company and in 1890 a stock company was formed as the Wooster Electric Company, the stock being owned by Wooster people. At the time the plant consisted of one 50-kw Thomson-Houston generator. In 1900 a 75-kw Fort Wayne single-phase generator was installed to replace the Thomson-Houston set, and from time to time small generators were added to take care of additional load as business grew. In November, 1909, a 75-kw Westinghouse alternator was substituted and in March, 1910, a 250-kw Westinghouse alternator was added to the plant.

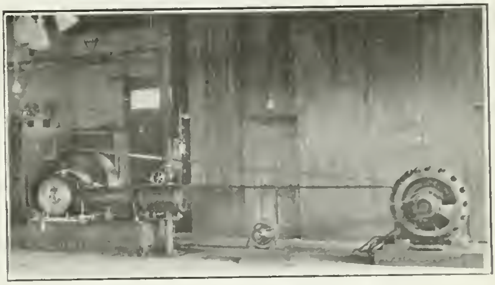


Fig. 1—75-kw Belt-Driven Alternator.

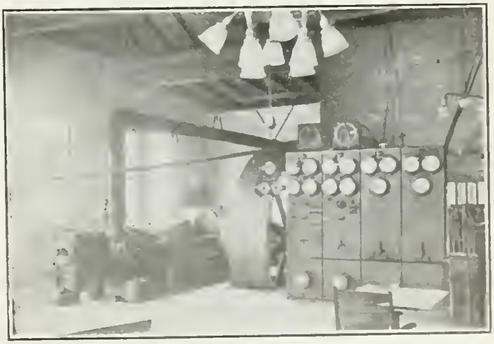


Fig. 2—Large Engine and Switchboard.

Wooster is a college town and does not boast of many manufacturing industries, nevertheless the company has found it profitable to provide a 220-volt motor service in addition to the 110-volt lighting service. The motor load averages about 25 kw during the day and has doubled since the installation of the large generator in the spring of 1910. The load is made up of motors in small machine shops, blacksmith shops, harness shops, bakeries, ice-cream establishments, plumber shops and one garage, and there are a few motors connected to house pumps. The lighting circuit supplies lamps for residences and there is in addition a series circuit for street lighting, direct current being obtained by means of a Cooper Hewitt mercury rectifier. The street circuit consists of ninety-six arcs. The lighting and motor circuits are fed from 2200-volt, three-phase lines. In addition there is a separate line supplying the Wayne County Children's Home, two miles distant, and a line supplying the Wayne County Infirmary, one and one-half miles distant.

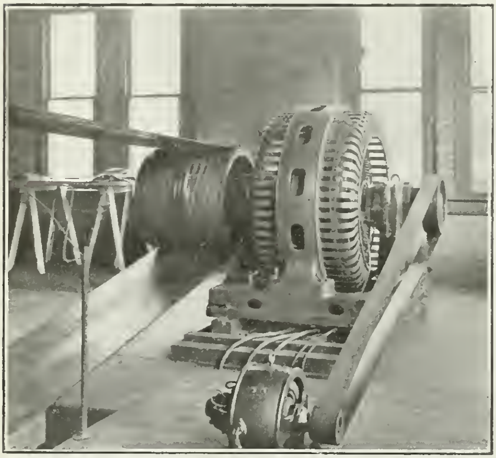


Fig. 3—250-kw Belt-Driven Alternator.

The power-house building is of brick and has a slate roof. The building is divided into an engine-room, two offices and the boiler-room. The boiler plant consists of two 150-hp Russell boilers, hand-fired. City water is used, and the fuel burned is Massillon slack. Steam is carried to the 75-kw set by means of a 4-in. pipe and to the 250-kw set by means of a 6-in. pipe.

The smaller set is a 75-kw, 2400-volt, 900-r.p.m., three-phase, 60-cycle Westinghouse type generator belted to an 80-hp Russell automatic cut-off engine installed on a stone and brick foundation. The foundation of the generator is of framework. The larger set consists of a 200 kva, 2400-volt, 600-r.p.m., three-phase, 60-cycle generator of the same type as the smaller unit. It is belted to a 250-hp Buckeye engine with automatic cut-off. The engine foundation is of stone and the generator foundation is of wood on brick set in cement. Both engines use steam at 100-lb. pressure.

The wiring between the generators and the switchboard is all concealed under the flooring. The four-panel switchboard contains two generators and two feeder panels, as can be seen in the photograph. The alternating-current voltmeters and a synchroscope are mounted on a frame bracket at one end of the board. An ammeter is provided in each leg of each circuit and the field rheostats are mounted above the top of the board. All circuits entering the building are protected by Westinghouse lightning arresters. The 75-kw machine is used to carry the day load and the 250-kw machine for the night load. During the heavy winter load both the machines are sometimes required.

Central Station
Management, Policies and Commercial Methods

UPKEEP COSTS OF ELECTRIC PLEASURE VEHICLES.

Records obtained by the Rauch & Lang Company, Cleveland, Ohio, from twenty owners of its electric pleasure cars, these having been in use for various periods, show that the twenty cars sustained $2,687 battery, tire and adjustment expense during last year. This represents an average yearly expenditure of $134.35 per car, or $11.19 per month, or $0.37 per day. At the basis of thirty miles travel per car per day, these figures indicate an upkeep cost of 1.2 cents per mile, to which, of course, must be added the cost of energy.

CENTRAL-STATION EXPERT TO INSTRUCT ELECTRIC TRUCK OPERATORS.

The Cleveland Electric Illuminating Company has secured the services of an expert electric vehicle man to supervise the operation of commercial electric trucks using its service, assisting the regular attendants in getting the best performance out of the trucks. The services of this man are furnished free to the electric truck customers of the central station, in the case of the larger truck garages the expert spending a few days or a week in each place explaining the proper operation of the truck mechanism and the charging and care of storage batteries. While this plan of technical assistance has been only recently carried out, truck customers are already showing their appreciation and satisfaction with the new arrangement, which will be conducive to even more successful operation of the electric trucks already in use in Cleveland.

NATURAL-ICE SHORTAGE INCREASES ACTIVITY IN ARTIFICIAL PRODUCT.

From all parts of the country there come reports that the winter season has been a poor one for harvesting natural ice and that the natural crop will be correspondingly small next summer. Ice is usually cut in January and February, but among the peculiarities of the season now coming to a close were cold snaps in December, while January and February were comparatively mild. This unusual condition was in no sense local, but seems to have been widespread over the United States, and ice dealers report that it will be possible to fill few ice houses during the short period of freezing weather yet possible in some sections. A number of natural-ice storage companies have sent in hurry-up orders to manufacturers of artificial-ice machinery for apparatus with which to supplement their supply for next season's demand, and among these several combination ice and electric plants are also reported. For the electric company contemplating going into the combination-plant field in competition with local naturally frozen ice, the present season thus seems a specially timely one in which to make the start, and in view of the exceedingly profitable reports made by companies already operating ice-making auxiliaries, as reviewed in the *Electrical World* of March 2, the opportunity ought to be carefully considered. The experience of other companies has already shown that clean, pure, sanitary artificial ice commands an increasing market for itself in a way that is denied the natural product. In towns where the 1911 natural supply is limited, as above reported, central-station ice plants will enjoy a marked advantage for all time by getting under way the present season.

RATES IN ONTARIO, CAL.

At a meeting of the City Council of Ontario, Cal., on March 7 that body authorized the city attorney to draw an ordinance lowering the primary rate for electric lighting from 13 cents to 11 cents a kw-hour, with 10 per cent discount for prompt payment. The proposition came as a complete surprise to the Ontario Power Company, which had no time to present its side of the case. At the end of three hours' debate action was deferred until the company could present figures in defense. Representatives of the company say that the new rate would be very unfair, as the city is scattered over a large extent of territory, extensions being expensive and interest charges on transmission and distributing equipment high.

NEW BRANCH OFFICE OF THE NEW YORK EDISON COMPANY.

Largest and most notable among the new branch offices of the New York Edison Company is the one at 424 Broadway, just above Canal Street, which is rapidly gaining a place of prominence in the business life of the downtown section. It was opened as an office for the first district, also as a display-room for lighting and heating appliances, for which purpose it is admirably adapted.

Broadway Office of New York Edison Company.

Among the features which have gained for it special notice is its establishment of a precedent in that part of the town in night lighting. In the dark and dismal appearance that the business section presents at night the office stands out as an oasis of light. The office is lighted by sample fixtures of various types and sizes for display purposes. Both tungsten and arc lamps are used, the arc being the most general type.

In the window, the upper part of which consists of stained glass showing several famous "Edison People," by Cooper, are displayed handsome lighting fixtures and household appliances. This window is lighted by sixty-three 150-watt tungsten lamps with concentrating prismatic glass reflectors. The initial candle-power in this window is 7560, while the downward candle-power, increased many times by the reflectors, is approximately 37,800.

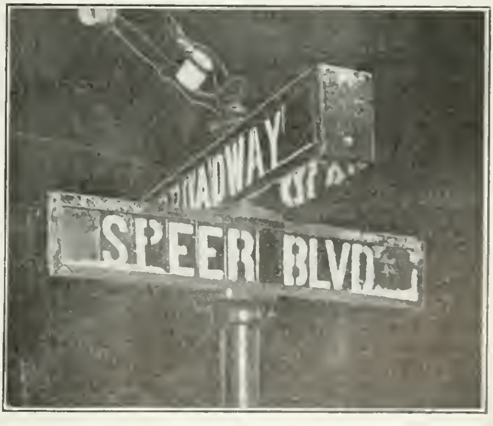
The main part of the office is very efficiently illuminated by arc lamps and tungsten lamps used with the Alba distributing ball. There are also different types and sizes of tungsten lamps being used with two-lamp and six-lamp fixtures. When totally lighted the office has an average of from 7 ft.-candles to 10 ft.-candles. The new 400-watt and 500-watt tungsten lamps used with large specially designed opal diffusing balls are also on exhibition.

There is a total of 4224 sq. ft. of open floor space in the new office, the front part of which is used for the showroom exhibits, while clerical departments do their work in the rear. So great, however, has been the expansion of Edison work that it has already become necessary to secure the second floor of this building, with approximately 4000 additional square feet of floor space. The intention is to move certain departments upstairs as soon as the necessary alterations can be completed and devote the greater part of the first floor to exhibition purposes. This floor is now occupied, in addition to the first district office, by the bureau of unused meters and apartment house statistics and by the editorial staff of the company, which will take the second floor when it is ready for use.

It is the intention of the New York Edison Company to make this branch office a display and demonstration room for all kinds of electrical apparatus which could be used by business and manufacturing concerns in that locality. The basement will be utilized for demonstrating heavier types of machinery, so that a prospective user of motor drive can see it in actual operation as applied to almost any kind of machinery. The showroom on the first floor, which now contains a very complete exhibit of household devices, such as vacuum cleaners, irons and all manner of heating and cooking devices, will be made to include everything for use in a business office. Among other things demonstrated will be the dictograph, adding machine, desk lamps, etc. At this office there is now a complete electric refrigerating plant in operation. Although household devices are not used in that locality, the object of displaying them here is to give the business man, who rarely gets an opportunity to take time to visit a department store, a chance to see electrical devices which will facilitate the household duties in his own home.

ILLUMINATED STREET SIGNS.

Denver is a progressive city in many ways, and one of the manifestations of its effort to keep abreast of modern improvements is shown in the matter of street signs. Ornamental bronze signs are used on Fifteenth, Sixteenth and Seventeenth Streets, and iron-pole signs with white-enameled letters in the residence districts. A new type of sign for street intersections is designed to be illuminated and is illustrated herewith. But one of these signs has been built, and it is placed at Speer Boulevard and Broadway. The sign was designed by Captain Phillips, of the highway department, who has applied for a patent for it. A concealed 8-cp incandescent lamp is used to illuminate both arms of the sign at night. The light is reflected to the sign from the interior, the letters being on a background of mica. The lamp is so arranged that it cannot be disturbed by



Illuminated Street Sign in Denver.

mischief makers, but can be removed for cleaning or renewal. The standard consists of iron piping, the signs being 7 ft. or 8 ft. from the ground. The present sign is an experiment. If adopted the signs will be placed only at prominent corners away from the brightly lighted central district and at street-railway transfer points. The cost of manufacture is but little more than that of the regular iron-standard sign, and the cost of wiring to near-by distribution wires is not large. The expense for the consumption of electricity would be slight, of course, and the light could be turned on and off from a central point.

SECURING A SUMMER MOTOR LOAD IN A LARGE MANSION.

The increasing tendency of men of great wealth to build large and costly country seats in rural, mountainous or seaside districts presents an interesting problem in electrical supply to the central-station organizations serving the territory. In some parts of the country a highly desirable summer business in both lighting and motor-service fields has been developed in connection with the yearly visits of prosperous cottagers. This class of customers is used to the best service and equipment of the urban companies. The persons composing it are appreciative, as a rule, of painstaking efforts to carry city comforts to their summer homes, and are generally willing to pay a liberal price for the facilities supplied. In the case of very large and elaborate country seats first cost is often a matter of little importance. The owner desires the best that money can buy, and consequently is frequently led into the purchase of all sorts of apparatus designed to promote the comfort of himself and his family. It frequently happens that the cost of operating such equipment is great, even for a part of the year, and there exists in not a few cases an excellent opportunity for the central station to undertake the supply of electricity with the prospect of making a substantial saving in annual cost and at the same time vastly improving the quality of the service rendered.

A representative instance of this character has recently come under notice through the courtesy of the motor-service department of a prominent central station. As a result of the investigation made in this case electrical service has been installed in place of steam-plant production on the estate. The estate is a very large one, there being a total connected load of 79 hp in motors and 2200 16-cp lamp equivalents. An extensive system of water supply is in service and electricity is used in the operation of pumps for elevator and greenhouse service, refrigeration, the handling of trunks in an underground tramway tube, dairy, repair shop and barn service. Other motor applications are concerned with the improvement of the house-heating service and the operation of laundry machinery. There are eleven motors on the premises, and in addition to the water service compressed air is used on the estate for various purposes.

Two artesian wells supply all the water used on the estate. One well is located in the base of a tower and the other in the greenhouse. In the top of the tower is a storage tank having a capacity of 50,000 gal. At the foot of the tower are located a high-pressure boiler, machine shop, steam pump and steam-driven air compressor. Air and water-pipe lines extend from the tower to the greenhouse. From the base of the tower to the mansion, 700 ft., a tunnel 6 ft. square is installed for the carriage of trunks, provisions and servants, and this tunnel is equipped with a car driven by a 5-hp motor. The air compressor delivers to a 2-in. pipe that extends to the greenhouse well. About 110 gal. of water is raised per minute and discharged into an open tank. An ordinary steam pump driven by compressed air forces water from the greenhouse tank into an open tank in the base of the tower, the lift being about 32 ft. About 30 gal. per minute is lifted by compressed air from the artesian well at the base of the tower and discharged into the open tank at the base of the tower. From here a steam pump elevates the water 78 ft. into a tank at the top of the tower. In the winter season the demand for water is comparatively small, even through a six-month period, and in the cold season the average consumption is about 3000 gal. per day. During the remaining six months the consumption averages about 15,000 gal. per day. This water is used for sprinkling lawns and gardens, and at times 100,000 gal. would be used were that amount of water available. The mansion is ordinarily closed for three months in the winter.

The mansion is equipped with about 1000 incandescent lamps, there being 514 in a boathouse on the premises and enough in other buildings to make about 2200 lamps of 16-cp equivalent. About 300 kw-hours are consumed monthly in the mansion and premises.

The motor load is analyzed as follows:

Mansion heating-system fan, 5-hp motor; not used in summer; used in the winter four months, 500 hours per month, at 4-kw load, or 8000 kw-hours total.

Mansion elevator pump, 3-hp motor; plunger, 6-in. diameter; two stories, 32 ft.; 47 gal. per trip and twenty trips per day. Consumption, 940 gal. of water per day, equivalent to one-half hour continuous running and calling for 1.2 kw-hours per day. The summer requirements are 36 kw-hours per month, or 216 kw-hours total; and the winter requirements are 18 kw-hours per month, or 108 kw-hours total.

Mansion refrigerating plant, 3-hp motor. In the summer the load is 1.8 kw for twenty-four hours per day, thirty days per month, or 1296 kw-hours per month, or 7776 kw-hours during the season. In the winter 0.9 kw is required twenty-four hours per day, the total energy for the season being 3888 kw-hours.

Tunnel tramway, 5-hp motor; the consumption is so intermittent as to be practically negligible.

Tower repair shop, 3-hp motor; 1.2 kw is required about twenty-five hours per month, say, 360 kw-hours per year.

Dairy, 2-hp motor; runs separator, milker, freezer and churn; 1 kw is required fifteen hours per day or 540 kw-hours per year.

Barn, 5-hp. motor; runs feed cutter and mill; 4 kw is required twelve and one-half hours per month, or 600 kw-hours per year.

Greenhouse pump, 3-hp motor; head, 32 ft.; 110 gal. per minute through 1700-ft., 4-in. pipe; friction head, 8 ft.; total equivalent head, 40 ft. Required, 2.2 kw for two and one-half hours per day, or 5.5 kw-hours. This pumps 15,000 gal. against a head of 40 ft. Summer operation, 165 kw-hours per month, or 990 kw-hours for season; winter operation, 33 kw-hours per month, or 198 kw-hours for season.

Laundry, 10-hp motor; consumption of energy thus far negligible, as the load is very intermittent.

Tower pump, 5 hp motor; head, 78 ft; 140 gal. per minute; power required, 4.6 hp with 60 per cent pump efficiency; 4.1 kw. Operation, one and four-fifth hours per day for 15,000 gal.; 7.3 kw-hours per day, or 219 kw-hours per month. Summer service, 1314 kw-hours; winter service, 263 kw-hours.

	Max. Demand in Kilowatts.
Mansio heating	4.0
Mansion elevator	2.4
Mansion refrigeration	2.4
Tunnel tramway	4.0
Tower repair shop	1.2
Dairy	2.0
Barn	4.5
Laundry	7.0
Greenhouse pump	2.4
Tower pump	4.1
Air compressor	37.0
Lighting load maximum	55.0
Total maximum demands (sum of all)	126.0
PRIVATE PLANT COSTS.	
Two 50-kw engine-generator sets, installed	$5,000
One 150-hp boiler (extra)	2,000
Total	$7,000

Air compressor, 40-hp motor; pressure at greenhouse, 80 lb.; at tower, 90 lb.; service, 110 gal. per minute with 80 lb. pressure. Required, about 1.5 cu. ft. of air per gallon per minute.

Total consumption, 165 cu. ft. per minute. Drop in air pressure, in 1700-ft. 2-in. pipe, about 4 lb. Total air required, 140 gal. × 1.5, or 210 cu. ft. per minute. About 0.2 hp required per cubic foot per minute, or 42 brake horse-power, say, 37 kw. This service lasts about one and four-fifth hours per day, and thus calls for 67 kw-hours per day. Summer service, 12,060 kw-hours; winter consumption, 2412 kw-hours.

The maximum demands of the above meters are given in the table on the preceding page.

Summer Coal Consumption.—4150 kw-hours per month, or 5.75 kw average load at bus; generator efficiency, 40 per cent, requiring 14.3-kw input, or 29 brake horse-power. Engine runs at 39 per cent normal load and consumes 56 lb. steam per brake hp-hour. Coal consumption, 7 lb. per brake hp-hour. The plant therefore consumes 203 lb. of coal per hour and in the summer 73 tons per month, or 438 tons for the six months.

Winter Coal Consumption.—2903 kw-hours per month, or 4 kw average load at the switchboard. With a generator efficiency of 35 per cent an input of 11.4 kw, or about 15.2 brake horse-power, is required. The load on the engine averages 20.3 per cent of normal and takes 70 lb. of steam per brake hp-hour. With a coal consumption of 8.75 lb. coal per brake hp-hour the coal consumption of the plant in winter averages 133 lb. per hour, 47.7 tons per month, or 286 tons for the winter season as a whole.

The total coal consumption for the year is about 724 tons.

At $4.75 per ton the fuel cost is about $3,440 per year.

A summary of the cost of isolated plant operation per year, including fixed charges, is as follows:

Interest and depreciation @ 10 per cent	$700
Repairs and renewals @ 5 per cent	350
Fuel	3,440
Oil, waste, etc	100
Labor, two men @ $900 each	1,800
Total	$6,390

The cost of handling the service of the plant on central-station circuits was figured as follows:

Summer Load.—3851 kw-hours per month for motor service at 3.8 cents per kw-hour, $146.54; 300 kw-hours per month for lighting at 11.4 cents per kw-hour, $34.20; the total for the six months being $1,084.44.

Winter Load.—2603 kw-hours per month for motor service at 4.2 cents per kw-hour, $109.33; 300 kw-hours per month for lighting at 11.4 cents per kw-hour, $34.20; the total for the six months being $861.18.

The total yearly cost of electricity, including free lamp renewals, $1,945.62, making a yearly saving of $4,444.38 in favor of central-station service.

Wiring and Illumination

THE LIGHTING OF A SMALL ROOM.

In a paper presented before the Chicago Section of the Illuminating Engineering Society on March 16 Mr. James R. Cravath described in detail certain comparative tests of illuminating equipments conducted in a living-room 16.5 ft. long, 12.0 ft. wide and 8.5 ft. high. The color of the ceiling is very light cream; the walls are covered with light-green rough paper. Red portières were placed over the door spaces and green window shades were drawn down over the windows during the tests. In the geometrical center of the ceiling was placed a single lighting unit provided during all tests with a 160-watt tungsten lamp operated at 78.9 mean horizontal candle-power, equivalent to 773 lumens.

Observations of the illumination obtained over a plane 3.5 ft. above the floor were made with the lamp variously equipped, with the results shown in the accompanying table.

The author expressed the opinion that the semi-indirect system with opal reflector is far preferable to the opal ball arrangement, because it is not only easier on the eyes, but more efficient. He said that the semi-indirect system occupies a place midway between the direct system using opal reflectors and the indirect with opaque reflectors; it is not as comfortable as the indirect, and it causes more pronounced shadow, but it is more efficient and does not hide the source of light entirely where some light is wanted for decorative effects.

Lighting Equipment.	Minimum Foot-Candles.	Average Foot Candles.	Lumens Effective per 100 Lumens Generated.
Bare lamp	0.698	1.597	40.9
Prismatic reflector, extensive, at ceiling	0.514	2.030	52.0
Opal reflector at ceiling	0.492	2.070	53.0
Indirect lighting, mirror reflector, below lamp	0.422	1.151	29.5
Semi-indirect, opal reflector, pointed upward	0.508	1.470	37.6
Roughened stalactite reflector at the ceiling	0.673	1.390	35.6
Opal bill, 8 inches, at ceiling	0.528	1.310	33.7

The author concluded from the tests that the ratio of measured efficiency between a direct system using efficient translucent reflectors and an efficient indirect system in a room of the kind used is as the ratio of 3 to 5. What the practical working efficiency or "efficacy" of the two systems is for different purposes depends on the particular conditions and uses of the room. The tests indicate that the measured efficiency of a direct system using inclosing globes is a little higher than an indirect system with opaque reflectors, although lower than a semi-indirect system with translucent reflectors.

Tests were also made to determine the effect of shadows thrown by an 8-in. disk placed 15 in. from the test plate between this plate and the light source. The shadow reduced the illumination on the test plate by 86 per cent when the opal reflector was used at the ceiling; 50 per cent with the indirect lighting arrangement with mirror reflector, and 61 per cent with the semi-indirect system with opal reflector pointed upward. Although there was a pronounced shadow with the indirect system, yet the shadow was less objectionable than with the direct system, by reason of the lesser contrast between the illumination in the shadow and the surrounding illumination.

Discussion.

Mr. George H. Stickney, of Schenectady, remarked that the question arises as to what use is to be made of the lighting in the room being studied. The tendency in illuminating engineering, as elsewhere, is to run to extremes. When the tungsten lamp was brought out much attention was paid to the efficiency of lighting units and this led to too great intensity of light, in many cases resulting in glare. At present engineers, while not sacrificing too much efficiency, are going back to some extent in the direction of providing greater diffusion of light. In household lighting an important question to be considered is how the illumination impresses the women of the household. Mr. Stickney said that perhaps the pleasantest example of illumination is found when a group of people is clustered around an open fireplace containing a wood fire. The unsteady, fitful lighting thus provided transgresses all laws of illuminating engineering, but it conveys an idea of comfort, of cheer, that it would be difficult to obtain in any other way. What is wanted in electric lighting for the household is to make it more homelike. The efficiency is perhaps secondary to securing a pleasing effect, for lighting may be manipulated in many ways to cause pleasurable sensations.

Mr. T. H. Aldrich expressed the opinion that the light of tungsten lamps is too strong and white to be used for household illumination, unless obstructed by colored shades. He is now using indirect lighting, which has many points in its favor; it is good to read by, but it is difficult to design fixtures for this method of lighting suitable for small rooms which will be artistic in appearance. For decorative purposes perhaps the semi-indirect system is preferable. For desk or table lamps he prefers tantalum to tungsten filaments, as the color of the light is less trying on the eyes.

Mr. A. J. Sweet commented on the differences in the uniformity of lighting and said that greater uniformity with the reflectors would have been obtained with a higher room. He believes the time will come when lighting effects will be used in interior decoration in a manner comparable to pictures made by artists. The strongest light should be on the points of most artistic importance. If a table is in the center of a room, light should be strongest on it; the sense of artistic proportion should be preserved in the lighting effects.

Dr. M. G. Lloyd commented on the relation of variation and efficiency of illumination. Apparent superiority in efficiency is not always real, owing to the variation in the intensity of illumination. The minimum is one of the determining factors. He concluded from the test results that the semi-indirect and direct are the best.

Mr. George C. Keech remarked that the habits of a family group have much to do with the illumination that should be supplied in the room. For instance, where there are school children who cluster about a central table in a living-room the lighting should not be the same as in the case where tables, couches and musical instruments are at the sides of the room and are in almost nightly use.

Mr. Cravath said that for reading purposes the straight indirect system is the best of the systems tested, although the semi-indirect system is nearly as good.

ORNAMENTAL EXTERIOR LIGHTING ON FEDERAL BUILDING, CHICAGO.

To illuminate the entrances and corners of the Federal Building, which occupies the block bounded by Adams, Dearborn, Jackson and Clark Streets in Chicago, a number of ornamental lamp standards have been mounted on granite pedestals which form a part of the building and were provided for that purpose. Two of these lamp standards are placed at each entrance, one on each side of it, and there are now two at each corner of the building, although it is proposed to add two more to each corner. There are thus sixteen standards in all at the present time. Each one is made of cast iron and stands about 8 ft. 6 in. high, weighing about 1600 lb. The posts are painted in rustless black, and were made by the Flour City Ornamental Iron Works, of Minneapolis. Each one supports a single spherical globe of white fish-scale glass about 26 in. in diameter. Mounted in this globe is a 500-watt Buckeye tungsten lamp inserted in one of the new type General Electric sockets made for lamps of this character. The glass globes are provided with hinged doors so that access may be had to the interior to clean or renew the lamp. The lamps are operated in multiple on 115-volt direct-current circuits, electrical energy being supplied by the Commonwealth Edison Company, which furnishes all of the electricity used in the Federal Building.

Lamp Standards at Corner of Federal Building.

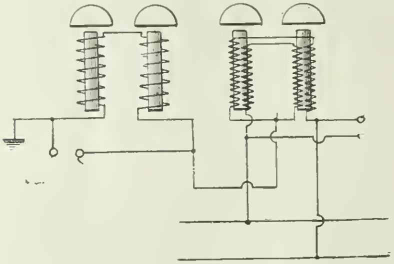
RECENT TELEPHONE PATENTS.

SELECTIVE APPARATUS.

A selective signaling system has recently been patented by Mr. E. Garretson, of Buffalo, which depends upon a changeable resistance member made of material having a negative temperature-resistance coefficient. As long as the impressed potential is such that the resulting current does not generate heat faster than it can be radiated the resistance remains fairly constant. With a heavier voltage the resultant current heats the resistance. This resistance lowers until a balance of heat generation and radiation occurs at a considerable current. It will thus be seen that here is a method of selection based upon difference of impressed voltage. A filament of argentite is suggested for the resistance.

PHANTOM SYSTEM.

A system designed for the dual use of lines, first as a metallic circuit and secondly as a phantom, both line wires being used in parallel with a grounded return, has been patented by Mr. O. M. Leich, of Genoa, Ill. His patent is assigned to the Cracroft-Leich Electric Company. The ringer at each station is wound with four coils, two upon each core. These are connected in series and bridged across the line, the arrangement being such as to give a balanced system with a neutral point available for connection of the auxiliary set. The accompanying illustration shows the arrangement clearly. The system is suitable for dispatch systems.



Phantom System.

CIRCUIT SYSTEMS.

Mr. F. W. Dunbar, of Chicago, has just had issued to him a patent for a modification of his well-known two-wire multiple system for which the application has been pending some ten years. The original system contemplated the winding of the "cut-off-cut-on" relay as bridged between the jack springs. The system of this patent bridges the relay from one spring to ground or a common return. This patent is assigned to the Kellogg Company.

A trunk, as for use between a private branch exchange and the central office, or between two central offices, forms the subject of a patent granted to Mr. J. G. Mitchell, of Cleveland, and assigned to the Worth Electric Company.

One exchange is signaled by a ring from the second, while the latter is signaled by the insertion of a plug at the first. To this end an open repeating coil at the outer end of the trunk is closed through auxiliary contacts in the trunk jack, in case a plug be inserted. Again, for the outward signal, a relay bridged in series with a condenser responds to the alternating current and becomes locked until the locking circuit is broken by the response at the trunk jack.

A patent granted to Mr. R. H. Manson describes an intercommunicating system with facilities for exchange connections.

Each station is provided with a bank of switching keys and with wires to every other station. Facilities are thus provided for intercommunication and in addition for receiving exchange calls at one station and for transferring them to any other one. The holding circuit for the exchange line is automatic, or self-releasing, upon the response of the second or desired station. The patent has been assigned to the Dean Electric Company.

AUXILIARY DEVICES.

In the strife for hygienic conditions small paper drinking cups have been introduced which may be thrown away after one use. The mouthpiece for transmitters patented by Mr. J. Graham, of Philadelphia, is along this same line. A sheet-metal holder is substituted for the hard-rubber mouthpiece of the transmitter and each user may take a paper mouthpiece from the rack and insert it in the holder. The holder has burrs to retain it in position. The stock of mouthpieces is formed into a nest, which nest is supported upon a rack.

An antiseptic mouthpiece has been patented by Messrs. W. M. English, L. E. Boukofsky and S. M. Lichtenstein, all of San Francisco. A metallic nipple is inserted between the mouthpiece and the transmitter casing. One end fits the transmitter and the other fits the mouthpiece. At the mouthpiece end the walls of the nipple are thickened so that a groove may be cut into and concealed within the wall, which groove is of size to carry considerable fibrous material. This is soaked with antiseptic solution and held in place by screwing home the mouthpiece.

Mr. E. O. Lancaster, of London, Ontario, has patented a receiver holder. This is in the form of lazy-tongs with upper and lower members geared together. The receiver is carried upon an adjustable clamp. A link attached to one of the members of the lazy-tongs is also attached to the hook switch and serves to depress the hook when the tongs are shut up and the receiver back out of use.

AUTOMATIC SELECTOR.

A step-by-step device for selecting a special station upon a line forms the subject of the patent obtained by Mr. R. R. Hobbs, of Louisville, Ky. A polarized magnet when energized in one direction serves to step forward a selector wheel. An adjustable pin in this wheel is set to correspond to the angular displacement corresponding to the station number. A reverse current over the line serves to permit the wheel to return to zero.

LETTER TO THE EDITOR.

Vector Notation.

To the Editor of Electrical World:

Sir:—It is regrettable that two different representations of alternating vectors exist, of which the one appears like the mirror image of the other. The difficulty extends to the symbolic representation of the vectors, as in the one, the time diagram, inductive impedance is represented by $Z = r - jx$, and in the other, the crank diagram, by $Z = r + jx$.

It would be very desirable to reach an agreement on vector notation, but this does not seem feasible owing to the apparent impossibility of getting an intelligent decision on the subject, for many of the men who discuss the subject and write on it are familiar with one representation only and never have taken the trouble to understand the other representation, but, since it appears like the image of the notation familiar to them, merely assume it to be rotation in opposite direction and then, Don Quixote-like, attack a creation of their imagination. All the briefs written on the matter do not seem to change the condition, since they do not seem to be read. It appears hardly fair and reasonable to accept the judgment of somebody on a subject which he has not taken the trouble to understand.

An illustration hereof is the title of the Institute discussion "On Vector Rotation," though it is not a question of rotation at all, as both methods rotate in the same direction, counter-clockwise, but a question of *notation*—that is, of the meaning of the vector. A still better illustration is afforded by the editorial in the issue of the *Electrical World* of Feb. 23. Apparently the writer of the latter is familiar with the crank diagram, in which the vector rotates counter-clockwise and the instantaneous values are the projections of the vector on the horizontal line, and he assumes that the time diagram is merely a vector rotation in opposite direction, but does not realize that in the time diagram the vector does not rotate at all, but is stationary, representing the phase of the polar curve, and the instantaneous values are the intercepts by the rotating time angle.

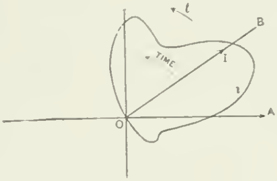


Fig. 1—Representation of Distorted Wave.

If the difference in the two representations were merely the difference in the direction of rotation, the symbolic representation would be the same. Since $+j$ mathematically represents an angle 90 deg. behind $+1$, $+j$ in the crank diagram represents a vector which is 90 deg. ahead in rotation, or leading the vector $+1$, regardless of whether the direction of rotation is counter-clockwise or clockwise, and in the time diagram $-j$ represents a vector of a phase which is 90 deg. later in time than $+1$; that is, lags by 90 deg., regardless, again, whether the rotation is clockwise or counter-clockwise. The mere fact that the symbolic denotations of the two representations are different will make it evident to anybody who will spend a few minutes to understand their meaning that the difference is not a mere difference in the direction of rotation, but a difference in the meaning of the vector.

In my opinion, the question is whether we should have one vector representation or two different forms of vector representations. Both the crank diagram and the time diagram represent sine waves about equally well. The crank diagram, however, is limited to the representation of sine waves, while the time diagram, which is nothing but the standard system of polar co-ordinates of analytic geometry, can also represent complex waves and even non-periodic phenomena as they exist in alternating-current circuits as electrical transients. As long as the electrical engineer shall have to deal with distorted waves and with electrical transients, in their graphic representations the polar co-ordinates—that is, the time diagram—will of necessity

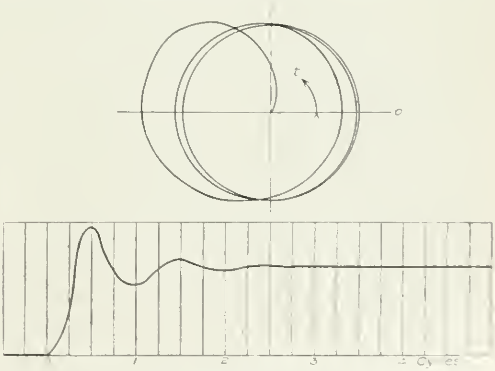


Fig. 2—Time Diagram of Starting Transient of a Polyphase Rotating Magnetic Field.

be used, and the question thus is whether the same diagram should also be used for sine waves or whether in the crank diagram the students shall be made to learn a second form of representation.

An illustration of the representation of a distorted wave by the time diagram is shown in Fig. 5 of my discussion of "Vector Power in Alternating-Current Circuits" in the November, 1910, *Proceedings* of the A. I. E. E., which cut is given herewith as Fig. 1. The polar curve shows five extrema (maxima and minima) and thereby the preponderance of the fifth harmonic.

As an illustration of the time representation of a non-periodic phenomenon in an alternating-current circuit the time diagram of the starting transient of a polyphase rotating magnetic field is given in Fig. 2 in vector and rectangular co-ordinates.

Schenectady, N. Y. CHARLES P. STEINMETZ.

Digest of Current Electrical Literature

ABSTRACT OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Chemical Action in Windings of High-Voltage Machines.—An account of the discussion which followed the reading of the paper by A. P. M. Fleming and R. Johnson abstracted in the Digest last week. C. J. Beaver said that cotton yarn or fabrics which are impregnated with a varnish made by dissolving, say, asphaltum in a suitable solvent withstand the effects of heat much better than do similar yarns or fabrics impregnated with the same compound in a molten state. This is probably due to the individual fibers being better impregnated in the former than in the latter case. In view of these considerations it appears better to use varnish and varnished fabrics and to keep the maximum stress within proper limits. W. Cramp emphasized that even with the silent discharge a certain amount of nitrogen oxides is produced and that the production of ozone alone does not account for all the effects observed. H. D. Symonds said in regard to the use of a metal sheath around the outside of the conductor and insulation that this is obviously difficult to accomplish, but he had made up a series of coils in which the varnished cotton covering of the conductors and the inside and outside of the insulating tubes were coated with aluminum powder such as is used in aluminum paint. The coils had been run at 6600 volts and the average life was greatly increased by the application of the aluminum. Furthermore, there was no destruction of the insulation or other corrosion and analysis showed no signs of the presence of nitric acid. In high-speed machines where ventilation is likely to be at all violent the aluminum powder might be objectionable, but a careful method of applying it might overcome the difficulty. J. S. Highfield believed that a pressure of 10,000 volts to earth is the maximum at which it is commercially sound to wind high-tension alternators, and then only when of large size. For machines of 3000 kw and under the maximum pressure to earth should not exceed 5000 volts. In the long run it is cheaper to wind alternators for a low pressure and use step-up transformers. In their reply the authors referred to the suggested use of aluminum paint; if this were to be effective it would, of course, be necessary to apply it, not to the surface of the group conductors, but to the outer surface of the air-gap—that is, inside the insulating tube or wrap—and contact made between this and one of the turns of the core. The risks of sparking or heating due to imperfect conductivity would be a serious objection to the use of a conducting paint. Regarding the maximum voltage to earth for which machines could be wound, this depends upon two factors, namely, that the conductors should be of such a number and size that a coil of sound construction free from internal weaknesses could be obtained and, further, that sufficient radial thickness of insulation could be used. For machines under about 1000 kw Highfield's figure of 2000 volts to earth as a maximum limit is probably right. The authors expressed the opinion that for larger sizes it would be possible to push the voltage much higher without incurring risks due to chemical action.—Lond. *Electrician,* March 3.

Single-Phase Induction Motor.—K. Krug.—A mathematical paper illustrated by diagrams in which by analysis using the symbolic method with complex quantities the circular diagram of the single-phase induction motor is developed and the conditions are established under which the circular diagram for the polyphase induction motor can be applied, also for the single-phase induction motor.—*Elek. u. Masch.* (Vienna), Feb. 19.

Lamps and Lighting.

Low Voltage for Direct-Current Lamps.—An article pointing out the advantages of low-voltage direct-current lamps. While with alternating current small transformers can be used to reduce the usual supply voltage, the problem involves greater difficulties in direct-current circuits. Two methods due to Neu are described. The first is as follows: If between an incandescent lamp and a direct-current network a rapid interrupter in the form of a vibrating tongue is employed, which permits the current to pass only for a fraction of the time, there will be at the lamp an apparent reduction of the voltage. This reduced voltage will equal the product of the voltage of the network by the square root of the ratio of the periods of time for which the current is closed and open respectively. If this ratio is 0.25, the voltage is reduced to one-half. It is not possible to go below 0.25 for the above ratio, and if it is desired to reduce the voltage to less than one-half it is necessary to combine the interrupter with a transformer. Special arrangements are necessary to prevent sparking of the interrupter, which would cause considerable wear and tear. At the Brussels exhibition an apparatus of this type was exhibited supplying current to a 10-cp, 10-volt metallic-filament lamp from a 220-volt direct-current circuit. The second method is based on the fact that the energy which is stored in a condenser and which, therefore, can be recovered during its discharge is proportional to its capacity and the square of the voltage of the charging current. If between the direct-current network and a low-voltage lamp a condenser and a rapid two-way interrupter are inserted in such a way that for one position of the two-way interrupter the condenser is charged from the network and it is discharged through the lamp for the other position of the interrupter it is possible to adjust the energy which will pass through the lamp in a certain time, because for a given voltage this energy will be a function of the capacity of the condenser and of the frequency of the commutator.—*L'Industrie Elec.,* Feb. 10.

Drawn Tungsten Filament.—A note on a recent British patent (2759, Feb. 23, 1911) of the British Thomson-Houston Company (General Electric Company of this country). Tungsten powder with a small percentage of carbon is made into a paste with an amalgam binder of bismuth, cadmium and mercury. This is extruded under pressure through a 40-mil die and cut into rods about 3 ft. long. After baking in a vacuum the rods are partially sintered in hydrogen. The final sintering is done at a temperature approaching the melting point of the metal in an atmosphere of hydrogen and nitrogen, and the current through the rods is reduced very gradually during several hours. It has been found that this very gradual cooling results in the tungsten rod being ductile even at ordinary room temperatures without the necessity for the prolonged mechanical working described in a previous specification.—Lond. *Elec. Eng'ing,* March 2.

Arc-Lamp Electrodes.—A note on a recent British patent (17,278, Feb. 23, 1911) of the British Thomson-Houston Company (General Electric Company of this country). Electrodes for plain arc lamps have cores containing about 35 per cent titanium carbide, 30 per cent calcium or barium fluoride, 15 per cent cryolite and 20 per cent carbon. Such compositions are particularly suitable for the positive electrodes in lamps in which the positive is situated below the negative electrode. A coreless electrode containing these chemicals can also be used.—Lond. *Elec. Eng'ing,* March 2.

Connections of Lamps.—An article giving various wiring diagrams which show how any one of a number of incandescent lamps or arc lamps can be lighted from a network while the others are out, the changing from one lamp to another lamp being done by a simple switch.—*Elek. Anz.,* Feb. 23.

Generation, Transmission and Distribution.

Steam Turbine.—E. D. Dreyfus.—The first part of a paper discussing some important improvements in construction that have developed in recent years with extended experience. High efficiencies and excellent operating performance have directly followed the introduction of the advanced designs. In the present instalment the author deals with subjects of speeds of rotation, details of design and extensions of the field of applications of the steam turbine.—*Elec. Jour.,* March.

Traction.

Weight Transfer in Electric Cars and Locomotives.—G. M. Eaton.—When the axles of an electric locomotive or car are independently driven—that is, when each axle is driven by its own motor—under maximum tractive effort conditions the wheels on certain of the axles will slip on the rails in advance of the other wheels. The author discusses the fundamental principles which go to produce this result and illustrates these principles by various diagrams.—*Elec. Jour.,* March.

Installations, Systems and Appliances.

Rates for Electrical Energy.—C. Kinzbrunner.—A paper read before the Vienna Electrical Society. The author regrets that the management of small and medium-sized central stations in Austria and Germany is still often in the hands of engineers who "lack in commercial sense." To be financially successful a central station should have a practical commercial manager and the selection of a proper and all around satisfactory rate is of importance. Ordinarily the energy is metered and paid for according to a certain rate per kw-hour in both Austria and Germany. The author thinks that this method is unjust, since every customer should pay for a certain part of the fixed cost of the station corresponding to the rating of his connections. The author has calculated for a great many typical American and English stations how much should be charged per kw-hour for consumers using electricity for greater or shorter periods per day if the total cost should be distributed justly among the different consumers. According to the figures given as average values, the cost of the kw-hour should be 2 cents for a consumption of energy during ten hours a day, 2.4 cents for eight hours, 3.2 cents for six hours, 4 cents for four hours, 7 cents for two hours and 12 cents for one hour per day. The ordinary meter rate is rendered even more unjust by allowing a discount according to the number of kw-hours used. In giving a special rate for the energy used for motor purposes it is often overlooked that many motors are also operated during hours of peak load. To overcome some of these difficulties a double tariff has been tried, but is considered to be too complicated. Another development has been a tariff based on metering energy and at the same time using a maximum-demand indicator. A flat rate has the advantages of simplicity, but the consumer may easily be led to waste energy and the determination of the proper basis of the flat rate meets with difficulties. To improve the present unsatisfactory condition in many plants the author recommends encouraging the following: Small consumers to make connections; well-to-do people should be encouraged to use electric energy for heating and cooking; for the motor load a lower rate should be allowed only when the motors will not run at times of peak load. The latter recommendation is very strongly advocated by the author. An account of the discussion which followed is also given.—*Elek. u. Masch.* (Vienna), Feb. 12.

Switchboard.—C. H. Sanderson and M. C. Turpin.—An illustrated description of the switchboard of the Congressional heat, light and power plant in Washington, D. C.—*Elec. Jour.,* March.

Electrophysics and Magnetism.

Aurora.—D. Owen.—A critical summary of recent investigations on the underlying cause of the aurora or "northern lights." In recent years two investigations have been made with the object of reproducing experimentally the phenomena actually observed on our globe. The first series of experiments was due to Professor Birkeland and was devised to support his theory that perturbations of the earth's magnetic field and polar auroras are both effects arising from the same cause, namely, the precipitation on the earth of streams of electric corpuscles shot out from the sun's surface, especially in the region of sunspots. The second series of experiments was due to P. Villard. By means of a beam of cathode rays moving in a magnetic field some of the chief auroral characteristics were strikingly reproduced. The source of the cathode beams which are thus regarded as causing the aurora is held to be terrestrial and not of solar or cosmic origin.—Lond. *Electrician* March 3.

Dielectric Stresses.—W. S. Franklin.—A paper discussing dielectric stresses from what is called the mechanical as distinguished from the atomistic or electronic point of view The discussion is based on two ideas, namely, (a) that dielectric breakdown occurs at a definite electric field intensity, and (b) that the line of dielectric breakdown is a conducting path. The author deals with the subject under the following headings: Gauss's theorem, electric stresses in plane layers of different dielectrics, mechanical analogies, the graded cable insulation, experimental effects dependent upon inductivity, dielectric hysteresis, concentration of electrical stresses by points.—*Jour. Franklin Inst.,* March.

Resonance Curves.—J. A. Fleming and G. B. Dyke.—A paper illustrated by diagrams of some resonance curves taken with impact and spark-ball discharges. These curves give an insight into the operations taking place in the secondary circuit in which oscillations are created by a primary circuit used both with the impact and with the ordinary spark-ball discharger. These curves confirm the ordinary theory of the oscillation transformer and exhibit the striking difference between the action of an impact and of an ordinary spark-ball discharger. —Lond. *Electrician,* March 3.

Röntgen Rays.—W. P. Davey.—The modern theory of Rontgen rays states that these rays consist of rays in the ether caused by accelerations received by negatively charged corpuscles during the time in which the cathode rays penetrate the target (or anti-cathode) of the X-ray bulb. In the present paper the author gives an account of experiments made to determine the mean depth at which Röntgen rays originate within a silver target. The chief result is that this mean depth is directly proportional to the potential employed in generating the rays.—*Jour. Franklin Inst.,* March.

Bending of Electric Waves.—J. W. Nickolson.—A fourth paper in his serial on the bending of electric waves around a large sphere. The present instalment deals largely with the solution of some mathematical problems involved.—*Phil. Mag.,* March.

Magnetostriction.—S. R. Williams.—An account of an experimental investigation of the Joule and Wiedemann magnetostrictive effects in steel tubes.—*Phys. Review,* March.

Electrochemistry and Batteries.

Automobile Storage Battery.—D. H. Flanders.—A paper read before the Franklin Institute on the so-called iron-clad battery for electric vehicles. The special feature of the battery is based on the observation of a Frenchman that if the positive material could be kept in position it would remain active. He accomplished this by utilizing a pencil of lead peroxide surrounding a conducting core and inclosed in a porous tube of such elastic quality that as the active material expanded and contracted, due to changes in its molecular structure, the circular tube compensated for these variations. Thus the positive material was protected and held in position. At the same time this form, comprising, as it does, a central conducting core embedded in a cylindrical pencil of peroxide of lead, provides excellent conductivity and increased accessibility for the electrolyte, thereby rendering it possible to obtain a relatively high output from a relatively small quantity of active material.—*Jour. Franklin Inst.*, March.

Electroplating.—An article on recent improvements in electroplating appliances and chemicals based chiefly on recent German patent specifications.—*Elek. Anz.*, Feb. 16 and 19.

Units, Measurements and Instruments.

Moving-Coil Galvanometers.—A. Zeleny.—A paper giving an account of an investigation of the causes of zero displacement and deflection hysteresis in moving-coil galvanometers. The zero displacement observed after a deflection in a moving-coil galvanometer is shown, for phosphor-bronze suspensions, to be due almost entirely to the change in the intensity and direction of magnetization of the magnetic impurities within the coil. The amount due to a true set in the fiber is negligible under ordinary conditions of use, and in the cases investigated the largest true set observed was less than 6 per cent of the whole zero displacement. The hysteresis curve of the magnetic impurities within the coil shows a very large coercive force sufficient to account for the observed deflection hysteresis in moving-coil galvanometers. The upper bend of the curve is at a field intensity of about 1600, which is great compared to the corresponding intensity for iron or steel. During the progress of the experiments several other properties of moving-coil galvanometers were investigated: (1) The relation of the zero displacement to the magnitude of the reversed deflection and the change of the zero reading with time were determined. (2) The amount due to the magnetism in the galvanometer coils was found to differ considerably even in instruments of the same type and from the same manufacturer. In the similar coils tested the magnetic moment, less the diamagnetic moment, in the same field varied from 0.129 c.g.s to 0.217 c.g.s. units. (3) The values of the damping factor for the same coil in fields of different intensities were determined. More than two-thirds of the damping on open circuit was found, for ordinary galvanometers, to be due to the resistance of the air and the internal friction of the fiber and less than one-third to the induced currents. (4) The change of sensibility with the intensity of the field was determined with a coil of known magnetic properties and a suspension of approximately known torsional moment.—*Phys. Review*, March.

Measuring the Slip.—A. Brückmann.—An article on difficulties in the use of the stroboscopic method of measuring the slip of an induction motor. A black disk with a white diameter or radius is driven by the armature and is lighted by means of an arc lamp operated by the alternating current supplied to the stator. The disk shows as many pictures of the radius as there are alternations per revolution. For synchronism the picture is stationary and the number of radii in the form of a star equals the number of pairs of poles of the stator. When the motor is loaded and begins to slip the star begins to rotate and from the number of revolutions the slip may easily be determined. A difficulty in this method is that when the number of poles is large the star consists of a great many radii and observation is rendered difficult. This difficulty can be overcome by reducing the number of radii to one-half. This is simply done by connecting an aluminum cell in series with an arc, as shown in Fig. 1, where L is the arc lamp operated by the alternating current of the primary. Al is the aluminum plate and Pb is the lead plate of the aluminum cell. This arrangement permits the current to pass only in one direction, so that only one-half of the alternating current is utilized. In this way the picture of the star becomes much clearer and the observation is greatly facilitated. A nearly saturated solution of bicarbonate of soda is a suitable electrolyte and the dimensions of the electrodes should be chosen to get a current density of 0.05 amp per square centimeter (0.33 amp per square inch).—*Elek. Zeit.*, March 2.

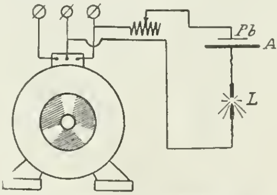


Fig. 1—Stroboscopic Slip-Meter.

Measuring Power in Three-Phase Systems.—A. Recke.—An article giving diagrams for the chief problems of measuring the power in three-phase systems in practice. After some brief notes on commercial wattmeters and series transformers the author discusses the connections for the following three cases: First, three-phase systems with equally loaded phases; second, three-phase systems with unequally loaded phases, and, third, three-phase systems with the neutral wire loaded.—*Elek. Anz.*, Feb. 9.

Standard Cells.—G. A. Hulett.—A paper on the construction of standard cells. The author gives detailed instructions showing how to prepare the materials needed in the Clark and in the Weston standard cells and how to put these cells together. He then emphasizes that for electrical measurements which make any pretense to accuracy an automatically controlled constant-temperature bath is indispensable for the Weston as well as for the Clark cell so that the temperature coefficient is of no consequence. He uses a thermostat which is an electrically heated and controlled kerosene bath which keeps well within 0.1 deg. for any desired length of time.—*Phys. Review*, March.

Compensation Apparatus.—K. Feussner.—The first part of a paper in which the history of the compensation apparatus as first devised by Poggendorf and as developed later by others is given with special reference to recent constructions which have been devised for use in commercial practice.—*Elek. Zeit.*, Feb. 23.

Miscellaneous.

Electric Heating.—An account of a recent electric heating and cooking demonstration at the Battersea Polytechnic Institute. There were exhibited numerous electric heating and cooking apparatus and also a portable apparatus for increasing the humidity of the air in rooms. The latter is shown in Fig. 2 The humidifier, which requires about 10 watts, comprises an evaporating basin containing a diaphragm of asbestos for increasing the surface of evaporation, while an electric fan in the upper chamber draws air through the perforated dome, seen in the illustration, and forces it out in a gentle stream through the asbestos fabric and perforated galley supporting the dome. In the lower parts of the humidifying vessel is suspended an electric heating unit for increasing the rate of production of water vapor and for controlling the temperature of the latter.—Lond. *Electrician*, March 3.

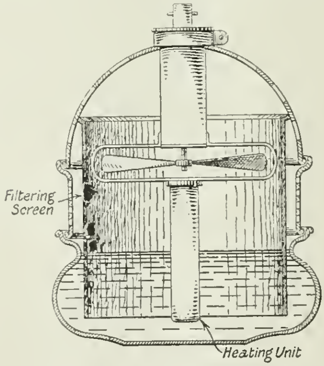


Fig. 2—"Electroyl" Humidifier.

Hot Bearing.—S. Lees.—A brief illustrated note referring to a recent test in which considerable trouble was experienced with a hot bearing while it was imperative that the test run should not be interrupted. The most successful remedy was found to be in a portable air compressor which was ordinarily employed for cleaning purposes. The blower was rigged up with its discharge nozzle about 2 ft. distant from the bearing and regulated so that the current of air projected would not interfere with the proper working of the bearing oil wells.—Lond. *Elec. Rev.*, March 3.

Telegraphy, Telephony and Signals.

Telegraphy and Earth Currents.—Berger.—An article illustrated by diagrams in which the author points out the disturbances which strong earth currents can produce in telegraph operations if a single conductor is used. The author shows how operation can be maintained even when strong earth currents occur by means of changing the single-conductor line into a loop. Not only may such loops be formed from single telegraph conductors, but also telephone conductors may be used for the purpose without causing any disturbance in telephonic transmission. Arrangements must be made so that at any time when strong earth currents may suddenly occur these changes in the connections from single-conductor to loop operation can be made at once.—*Elek. Zeit.*, March 2.

Automatic Telephone.—H. Marchand.—A long illustrated description of the chief features of the Strowger system of automatic telephony.—*L'Industrie Elec.*, Feb. '10.

Book Review.

A Treatise on Electrical Theory and the Problem of the Universe. By G. W. de Tunzelmann, B.Sc. Philadelphia. J. B. Lippincott Company. 654 pages, illus. Price, $4.50

This remarkable book is neither wholly a textbook on the physics of electricity nor wholly a book on the philosophy of the universe, but is a blend of the two. As a rule, the men who write on metaphysics are not physicists and the men who write on physics are not metaphysicists, so that the two subjects are kept out of bowing distance and certainly out of mutual acquaintance. In this case, however, the writer is a trained physicist, astronomer and mathematician by profession, as well as a speculative philosopher by choice.

Apart from the physics of the subject, which are very interestingly set forth by the writer, there are a number of philosophical subjects discussed; for instance, that "the external existence of an uncontrolled universe is infinitely improbable" and "the place of mind in the universe." To those who are versed both in mathematics and in speculative philosophy the book will be of great interest, but the reasoning will not be clear either to mathematicians alone or to philosophers alone. Whatever opinion may be held as to the philosophies deduced by the author, we heartily commend him for attempting to discuss these important and recondite subjects on strictly scientific lines of reasoning.

New Apparatus and Appliances

CO-OPERATIVE PUBLICITY FOR SMALL CENTRAL STATIONS.

Data recently compiled indicate that the average percentage of residences wired for electric lighting but not connected to central-station lines was about 15 per cent in the several cities investigated, while in some of these the percentage of "idle wiring" was much greater. When it is considered that in almost every community the percentage of *unwired* residences far exceeds the figures above mentioned the opportunities for the extension of residential service are at once seen to be large.

Recognizing these facts, and realizing that the lighting companies' gain necessarily involves the lamp manufacturer's gain and that their loss is his loss, the Shelby Electric Company, of Shelby, Ohio, is helping many of its central-station customers to build up their load by co-operating energetically with their new-business departments. To this end the Shelby company has prepared an extensive line of direct-by-mail advertising material which it furnishes to the lighting company at a figure considerably below cost.

The campaigns have been limited thus far to cities and towns of 15,000 inhabitants or less in the Middle Western and Southern States, but the indications are that there will be a demand for them in other states and in larger cities. The Shelby company is not attempting in any way to preëmpt the functions of the central station, but merely to place at its disposal the services and product of advertising experts, which are usually not available in the small towns except at a prohibitive cost.

Three separate lines of attack are followed in this co-operative publicity work—one being aimed at the merchants in an effort to obtain their store, window and sign lighting; another is directed at unwired residences, and the third is intended for residences wired but not using energy. Any one of these three, or any combination, may be used by the central station, according to local requirements. Furthermore, the general outline of each campaign is modified to meet special conditions, and is always made to include any new-business proposition which the central station may care to offer, such, for example, as a deferred-payment plan for residence wiring.

The mailings consist of a series of carefully prepared letters and attractive advertising inclosures. The low cost of electric lighting made possible by modern high-efficiency incandescent lamps is used as a strong argument to convince the prospective customer of his need of central-station service.

BURKE SHORT-CIRCUITED TYPE INDUCTION MOTOR.

The induction motor developed and built by the Burke Electric Company, of Erie, Pa., although of the short-circuited type, makes use of no conductor bars jointed to end rings as in the ordinary forms of these machines. Each rotor circuit, as shown in Fig. 3, is made from a single solid piece of copper, first cut as in Fig. 2 and then bent into the formed shape of Fig. 3. The heavy secondary currents induced in the rotor thus have a continuous solid metal path over which to flow and all possibility of joints to end rings heating and loosening, as in bolted or soldered rotors, is avoided. The absence of end rings in the Burke motor is also said to produce less leakage, giving higher starting torque.

The end brackets of the motor are fitted into the stator housing, insuring accurate centering in any position of the motor. Bolts enable the brackets to be withdrawn easily, without hammering or filing. The oil rings used in the bearings of these machines are made up of a number of thin flat rings, loosely hung in the shaft channel. Capillary attraction in the spaces between these flat rings causes a much greater quantity of oil to be brought up than with single-ring oiling bearings, insuring that the shaft shall be at all times supplied with ample lubrication. Accurate workmanship is a special feature of the Burke motors throughout, all parts being carefully built to standards so that they become interchangeable, resulting in convenience and economy. In general, the over-all dimensions are also the same as those for the direct-current machines of the same manufacture. These alternating-current induction motors are built in sizes up to 250 hp. For motors of over 7.5 hp resistance or auto-transformer type starters are furnished as standard equipment. The oil switch for the auto-transformer type is built separate from the auto-transformer itself, and can be mounted near the operator's hand, if desired, so that the machine can be started without the operator leaving his work. The oil-immersed switch contacts are of the knife-blade type, insuring solid contact when closed. The Burke Electric Company also manufactures slip-ring motors for adjustable-speed duty, and for use where high starting torque with small starting current is desired.

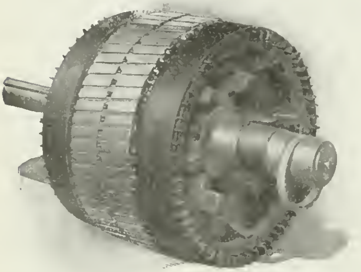
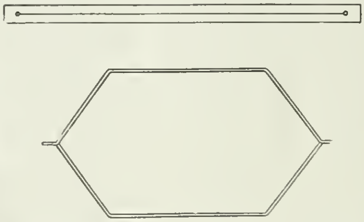


Fig. 1—Rotor of Induction Motor Complete, Showing Multiple Oil Rings.


Figs. 2 and 3—Rotor Bar Before and After Forming.

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MOTOR-STARTING PANELS FOR HEAVY DIRECT-CURRENT SERVICE.

The General Electric Company has recently designed and built a number of direct-current motor-control panels to meet the requirements of heavy service and safety. The accompanying illustrations show the rugged character of these panels.

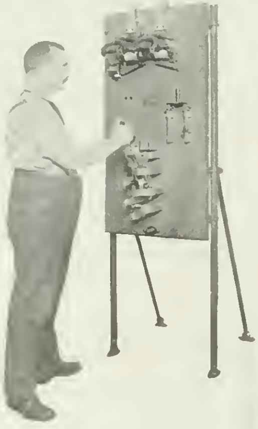


Fig. 1—Motor-Starting Panel.

The equipment consists of a slate panel mounted on 1¼-in. pipe supports and braced to the floor or wall by means of pipe braces. The panel carries a double-pole carbon-break circuit-breaker, a single-pole four-throw or nine-throw starting switch and an optional double-pole field switch, with necesary interlocks, connections and small resistors. The starting resistors are usually set on the floor and connected to the switch by means of leads. When the equipment is for a small motor suitable arrangements can be made for mounting the starting resistor on the panel pipe supports. It is impossible with this switch to operate otherwise than step by step. A pawl on the handle lever engages in teeth on a ratchet wheel rigidly attached to the contact blade. As the handle is operated back and forth with a sort of pump-handle motion the ratchet wheel is turned and thus the blade is moved from one contact to another. The circuit-breaker and starting switch are interlocked in such a manner that the circuit-breaker cannot be closed until the starting switch is in the "off" position. Also, if after the circuit-breaker is closed and the starting switch is in an intermediate position the operator removes his hand from the starting switch handle the circuit-breaker will immediately open. Where a field switch is supplied it is also interlocked with the circuit-breaker so that the latter cannot be closed unless the field switch is closed. The opening of the field switch causes the circuit-breaker to trip.

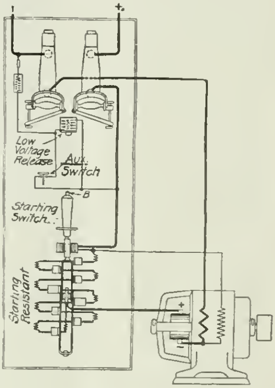


Fig. 2—Wiring Diagram of Direct-Current Motor-Starting Panel.

* * *

CONTINUOUS LUBRICATION OF SMALL ENGINES.

It was not thought necessary until recently to equip small engines with continuous oiling systems. The engineer or owner of a small power plant was content to lubricate his engine by the old hand method of oiling, and a continuous system was looked upon as a necessity in very large plants only. The economies effected by the use of continuous oiling systems in large plants have been so great, however, that no plant, large or small, is now considered complete unless proper provision is made for continuous lubrication of all bearings. The Pittsburgh Gage & Supply Company, Pittsburgh, Pa., has for many years made a specialty of lubrication, and in addition to manufacturing and installing oiling systems for the largest engines has designed a system for the continuous lubrication of the smallest plants. It is known as the "White Star" individual continuous oiling system, and is particularly well adapted for the continuous lubrication of steam and gas engines, ice machines, turbines, pumps, compressors and machinery of 500-hp capacity or smaller. The system consists of a "White Star" (engine-type) filter with pedestal for attachment to engine frame, automatic drain tank, pump, necessary sight feeds, compression fittings and steel tubing.

The system has the advantage of simplicity, and a copious supply of oil is furnished to the bearings. The manufacturer points out that the same oil may be used over and over without rehandling and the constant circulation prevents friction and wear.

AN IMPROVED "FLOODED" SYSTEM FOR FREEZING TANKS.

In the ordinary or so-called "dry" expansion system of ammonia refrigeration, in which the ammonia liquor is allowed to expand in expansion coils in contact with the brine to be chilled, the compressed liquid hardly passes the admission valve before its release in pressure allows it to convert itself into gas, continuing as such in its passage through the rest of the freezing pipes. This rapid conversion into gas near the beginning of its path through the expansion coils has several disadvantages. In passing from liquid to gaseous form the ammonia, of course, absorbs a quantity of heat of vaporization. Where the change is allowed to take place rapidly near one end of the expansion system most of the heat is abstracted at this point and a low temperature is there reached, while other parts of the freezing pipes are not worked to their full capacity. A second and most serious disadvantage of the dry system is due to the poor thermal conductivity of the expanded ammonia gas. Like air or any other gas it conducts heat slowly; consequently the pipes in the latter part of the expansion system are prevented from getting the full chilling effect of the gas passing through them, due to the insulating qualities of the gas itself.

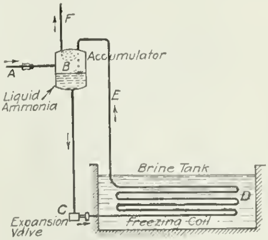


Fig. 1—Elementary "Flooded" Ammonia Freezing System.

To correct these drawbacks and improve the efficiency of the chilling apparatus the "flooded" system of operation was developed. In this scheme more liquid ammonia than can actually expand in its passage through the chilling coils is introduced into the system. As the liquor enters the expansion coils part of the ammonia vaporizes, but the rest of it remains liquid, the gas and liquid following each other through the pipes in the form of alternate slugs. During the passage through the coils more and more of the liquid is gasified, the liquid slugs becoming smaller. The quantity of ammonia is so adjusted, however, that a small amount of liquid will be carried unevaporated though to the end of the expansion coils. This surplus liquid is then allowed to drop back into the accumulator containing the liquid ammonia from which the coils are supplied, and undergoes another passage of the expansion coils, so that no compression work is lost. The expanded gas is meanwhile drawn off to the compressor and reliquefied.

Since alternate slugs of liquid and gaseous ammonia follow each other through the expansion coils, the liquid slugs evaporating during the passage, it is evident that expansion occurs more uniformly throughout the coils and the refrigerating action more nearly works all parts of the system at its rated capacity. Again, the liquid inside the coils produces wetted surfaces, which by the expansion taking place cool rapidly in intimate contact with the pipe material. The expansion of the liquid in other parts of the pipes is also able to extract heat more rapidly through the liquid slugs in contact with the pipe than were only the thermally insulating gas present.

The flooded system of operation thus enables the expansion coils to be worked at nearly 75 per cent higher thermal density and efficiency. About 60 per cent more ammonia is required to charge the flooded system, but as this material always remains in the pipes and the work required to compress the part expanding is the same as before, the flooded system of operation costs little more than the older dry-expansion system, while it secures many advantages.

In the usual forms of the flooded apparatus the ammonia accumulator which supplies the hydrostatic head for forcing the ammonia through the pipes is installed outside of the brine tank, as in Fig. 1, which shows the operating parts of an elementary flooded system. In the diagram the liquid ammonia comes from the compressor through pipe *A*, drops into the receiver *B*, where a liquid level is maintained sufficient to force it through the expansion valve *C* and into the expansion coils *D*. Here it expands, the gas and liquid slugs rising in the coils, which they leave at *E*. On their way back to the compressor they again pass through the accumulator *E*, the liquid part dropping into the liquid contents of the accumulator and the gas being drawn to the pump through *F*.

In a new and improved form of the flooded system recently developed by the York Manufacturing Company, York, Pa., makers of compression and absorption-type refrigerating apparatus, the liquid ammonia accumulator is partially immersed in the brine tank, thus conserving the expansion, which, as later explained, goes on here, applying it usefully to the brine to be cooled. The improved arrangement is shown in elevation in Fig. 2, the ends of the freezing coils being seen behind the upright accumulator. As shown in dotted lines, the incoming ammonia-liquor pipe from the compressor is brought through spiral coils in the accumulator, further serving to hold at a low temperature the liquid contents of this tank. But from the outlet end of the spiral the liquid ammonia passes directly to the expansion coil. The exit end of this coil opens into the accumulator tank, whatever slugs of liquid ammonia may come over being thus dropped to the bottom of the tank, while the gas is withdrawn from the top by the pump. The liquid ammonia which drops into the accumulator, however, is, of course, in the brine tank like any part of the expansion system and consequently soon evaporates, doing its part toward cooling the brine. In the gaseous form which it now assumes it, too, rises and is pumped back to the compressor, leaving any residuum of impurities in the bottom of the accumulator. From this they can be withdrawn through a special tap pipe provided for the purpose. The improved system is thus seen to effect a continuous purification of the ammonia, while the circulation of the liquid and gas slugs is not dependent upon gravity feed as in other systems, being propelled by positive pumping action from the compressor.

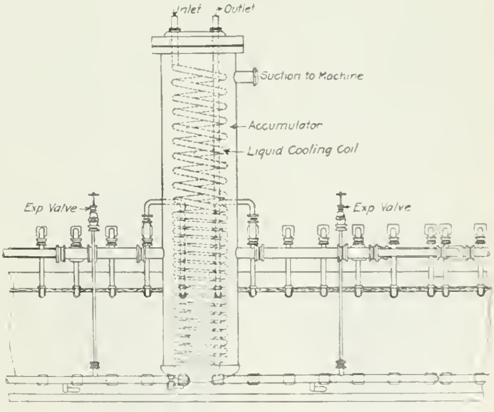
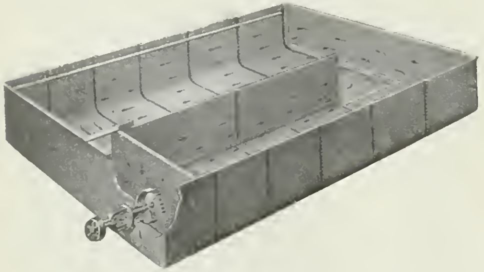


Fig. 2—Improved Accumulator Arrangement for Flooded System.

IMPROVEMENTS IN FREEZING-TANK EQUIPMENT FOR ICE PLANTS.

As has already been pointed out in these columns, the "flooded" system of ice-making, in which part of the ammonia traversing the expansion coils passes clear through the system without being expanded into gas, effects an increase in refrigerating efficiency of about 75 per cent. This is due to the superior thermal conductivity of the liquid ammonia, compared with the gaseous form, in extracting the heat from the brine, as well as to the intimate contact of the freezing pipes with the evaporating wetted surfaces of their interiors. The cooling is also more uniform, since evaporization of the ammonia liquor takes place all along the expansion pipes, instead of directly at the expansion valve, as in the ordinary dry system. This gain of 75 per cent in refrigerating efficiency is made with no other outlay than the addition of about 50 per cent to the ammonia charge put into the system. As the liquid ammonia which traverses the freezing pipes unevaporated is dropped back into an accumulator and returned through the coils again, no additional work of compression is imposed upon the compressor pump by flooded operation.


Freezing Tank, Showing Circulation of Brine.

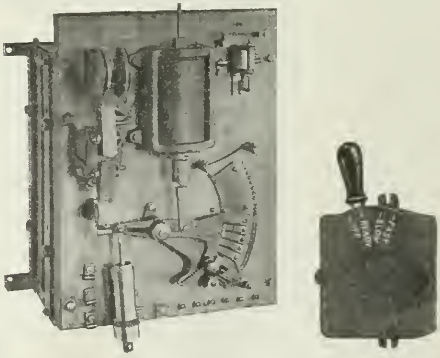
The Frick Company, of Waynesboro, Pa., makes use of several improvements in its flooded type of ice-making equipment, among which is a balanced check valve in the liquid return line from the accumulator to the discharge from the coils. Both ammonia gas and ammonia liquid come over to the compressor pump in more or less intimate quantities in a flooded system and means are required for separating these materials. The tank or trap provided for this purpose is technically known as an "accumulator," and through it there rises the suction line from the tank coils. This trap, or accumulator, should be of sufficient depth to permit the liquid to drop to the bottom while the gas is conveyed off at the top and thence travels to the machine. The liquid which finds its way to the bottom of the accumulator is carried back to the freezing coils in the tank by gravity by a connection between the bottom of the accumulator and the liquid feed header in the bottom of the tank. Here, again, however, the discharge from the tank coils tends to follow the line of least resistance, and the direction of the flow must be determined by some device at once automatic and positive. Without this there would exist the impossible condition of having gas and liquid connections at both ends of the accumulator and only one direction for both —toward the machine.

A balanced check valve was accordingly devised and placed in the liquid return line from the bottom of the accumulator to the liquid header in tank, thus obliging the discharge from the coils to flow in but one and the desired direction. The application of the balanced check valve to this use is being patented by the Frick Company.

A second important refinement of the Frick freezing-tank apparatus is the improved brine circulation obtained by the arrangement of bulkheads in the tank so as to secure the best circulation of the fluid. As shown in the illustration, the middle bulkhead is shortened at the far end of the tank, leaving a passage having a cross-section equivalent to that between the rows of cans themselves. Obviously, this free passage across the ends of the tank is imperative if satisfactory circulation of brine is to be secured. The propeller furnished for agitating the liquid is also of ample size, as experience has shown that a small propeller running at high speed tends simply to churn the water uselessly, giving low efficiencies of brine movement. With good circulation of the brine the blocks of ice freeze evenly throughout the cans, and all parts of the liquid are kept at more nearly even low temperature, the warmer brine being removed from the top and the colder liquid near the bottom being disseminated throughout the tank.

PRINTING-PRESS CONTROLLERS.

Recent developments in the control of printing-press machinery have been in the direction of automatic or magnetically operated devices. For some classes of work much better results can be obtained by magnetically operated devices, which permit of adjustments from several locations and insure safety to pressmen. One of the types recently standardized in sizes from 1 hp to 7½ hp by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., is shown in Fig. 1. This controller, particularly adapted for flat-bed presses, gives a speed reduction of 50 per cent below normal by armature resistance and an increase up to 2 to 1 by shunt-field resistance. A solenoid switch is used to break the motor circuit. The controller lever is divided into two parts, the rheostat arm and the operating arm, which latter is connected to the oil dash-pot and the solenoid plunger. The operating arm moves the rheostat arm by means of a spring-pressed pin which may be set in any one of a series of holes in the rheostat arm. In this way it is possible to adjust the travel of the rheostat arm and, therefore, the speed to which the motor will be brought by the self-starter. Adjustments are provided so that the rheostat arm may be left continuously on any of the armature or field contacts. When adjusted to any printing speed the press will always be brought to this speed. A lock may be added to the operating arm, locking the pin in place so that the press must then be operated at the speed determined by the foreman. The control switch, Fig. 2, is of the lever type inclosed in a substantial metal case. A centering spring holds the lever in the "ready" position Moving the lever to the left stops the motor, and if the lever is locked in this position by a latch provided for that purpose it is not possible to start the press from any point. This is the "safe" position. Moving the lever from the "ready" position one step to the right closes the main-line solenoid switch and starts the motor. If the lever is then returned to the "ready" position the motor will continue to run slow. Moving the lever to the extreme right energizes the self-starter magnet and the motor is automatically accelerated to the printing speed.


Figs. 1 and 2—Automatic Controller and Switch.

ELECTRIC HEATING PAD.

The heating pad made by the Phelps Manufacturing Company, Detroit, Mich., is 8 in. long by 5.5 in. wide and is covered with high-grade red felt and connected by 10 ft. of approved silk-covered conducting cord. When connected to a lamp socket the manufacturer claims it will heat up in from two to three minutes. An automatic regulator is provided to maintain an even temperature indefinitely and to render it impossible for the pad to become too warm. The pad is somewhat smaller than the usual pad, being more nearly comparable to the familiar hot-water bottle in size, but the latter is absolutely incomparable to the electric pad in service.

Electric Heating Pad.

INDUCTION WATT-HOUR METER.

The induction watt-hour meter brought out by the Sangamo Electric Company, Springfield, Ill., employs the well-known rotating-field principle. The simple field arrangements characteristic of the well-known Gutmann meters, with the additional improvements suggested by broad experience in the meter art, have been incorporated, thus securing a construction insuring high initial and permanent accuracy.

The complete meter is shown in Fig. 1 with cover removed and the principal elements indicated. Figs. 2 and 3 show the main grid removed from the base, giving a clear idea of the structural features.

The main grid is made of vanadium-aluminum alloy, having absolute freedom from tendency to crystallization and warping. The weight of the permanent magnets, series measuring element and return plate is carried on the main portion, the smaller projecting brackets of the grid carrying no weight except that of the moving system, adjustments and recording train. The moving element consists of a light aluminum disk mounted on a short shaft, the entire system weighing 18 grams. The disk is swaged under heavy pressure. The upper pivot is made of highly tempered steel wire and of such a diameter as to be quite flexible in the length between the top of the shaft and the guide ring in which it rotates. This guide ring, which has its bearing hole "olived" and burnished, has a long brass sleeve closely surrounding the upper pivot of the spindle, so that any blow against the moving system caused by accident or short-circuit will slightly deflect the shaft until the steel pivot touches against the side of the shell. This prevents danger of breaking off or bending the upper pivot, and offers a cushioning or flexible action between the shaft and the bearing shell, eliminating vibration, rattling or humming. The lower pivot arrangement consists of a hardened polished steel wire tip having both ends rounded and polished. This tip slips friction-tight into a hole drilled in the lower end of the brass shaft split so as to compress on and firmly hold the pivot. The lower bearing consists of a ring stone and end stone of sapphire and offers several advantages over the cup jewel.

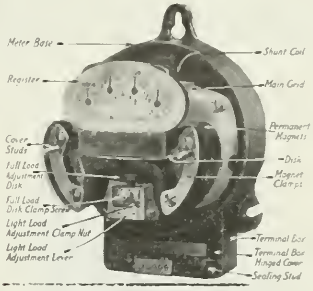

Meter Base
Shunt Coil
Register
Main Grid
Permanent Magnets
Cover Studs
Disk
Full Load Adjustment Disk
Magnet Clamps
Full Load Disk Clamp Screw
Light Load Adjustment Clamp Nut
Terminal Box
Light Load Adjustment Lever
Terminal Box Hinged Cover
Sealing Stud

Fig. 1—Induction Watt-Hour Meter.

As is generally known, the shunt or potential coil of an induction meter occasionally breaks down or burns out, due to abnormal line conditions or accident. In such cases the replacement of a coil is usually a difficult matter. With the new design the entire shunt magnet with its coil is held to the base by two dowel pins and four screws, enabling removal as a unit. A new core and coil may thus be substituted without removing and replacing laminations. The laminated core has but a single air-gap, in which the disk rotates. The laminations forming the core are laced into the shunt coil and then subjected to hydraulic pressure, the rivets being set at the same time, so that the whole forms a compact non-vibrating unit, eliminating humming. The series coils are mounted on a laminated iron structure having a laminated return plate forming an air-gap in which the disk rotates. The design of the curved magnetic return plate, with laminations placed edgewise to the field below, gives a maximum radius of action for both the series and shunt fields. The gap of the shunt field in which the disk rotates projects in between series magnet poles, the return plate curving so as to clear the shunt magnet. This gives the desired proximity of shunt and series fields, with a maximum radius of action for both sets of fields. Full load adjustment is effected by simply raising or lowering a micrometer-supported magnetic disk shunt in proximity to the permanent magnets.

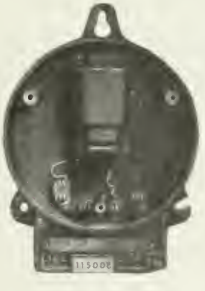


Fig. 2—Shunt Coil.

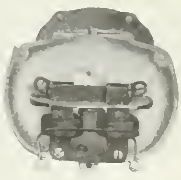
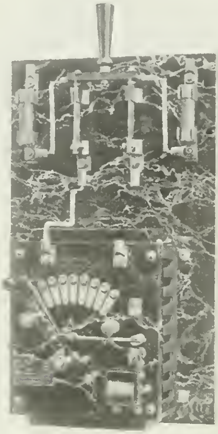


Fig. 3—Series Coils and Grid.

UNIVERSAL SPEED REGULATOR.

The motor speed regulator shown in the illustration is made by the Independent Electric Manufacturing Company, of Milwaukee. The regulator and its resistor are mounted as a unit on a marbleized slate panel. The resistor is contained in a substantial box, on the face of which the regulating device proper is mounted. This consists of a wrought-iron lever provided with a handle and having a contact shoe and a link to which a rack is attached. As the lever is moved over the contact segments the no-voltage release magnet, by attracting its armature (which carries a spring at right angles to it), forces the rack to engage a V-shaped pin. The notches on the rack are so spaced that the lever can remain in position only when the contact shoe rests squarely upon a segment. This pin-and-rack arrangement is believed to add materially to the efficiency of the controller. If the rack should become worn after a considerable period of service .it can be removed easily and a new rack attached to the link without discarding the entire lever. The back panel contains the usual knife switch and fuses. It is pointed out that this type of motor speed regulator is entirely self-contained.



Universal Speed Controller.

ALTERNATOR FOR HIGH-SPEED TURBINE DRIVE.

The three-phase turbo-alternator illustrated herewith has recently been constructed by the Electric Construction Company, Ltd., London, to the order of the Wolverhampton Corporation. It presents several interesting features of design, particularly in the construction of the rotor center and in the scheme of ventilation. The machine is designed to give 2000 kva at 85 per cent power factor, 6600 volts, 50 cycles, 1500 r.p.m., but it must also give 3000 kva continuously without excessive heating.

The most important feature of the machine is its rotor construction, the center being made from a solid block of steel. As will be seen from Figs. 2 and 3, the rotor winding consists of four coils per pole distributed in slots parallel to the pole axis. This arrangement obviates the necessity for deforming the coils, as is usually the case with former-wound coils when placed in radial slots. The end connections of the coils are also embedded in slots which lie in planes parallel to the shaft. The end connections of the outside coil of each pole are held in position by gun-metal brackets.

The stator winding is of the "bow" type, with coils lying in two different planes. This type of winding lends itself to a very rigid method of clamping. The machine is arranged for forced ventilation. Each of the inlet pipes which are placed at each end of the machine is subdivided into two different channels; one takes the air into an annular chamber, which delivers it through round longitudinal holes in the rotor and thence to the stator by means of suitable radial air ducts, while the other channel is mainly intended to convey the air for cooling the stator windings. The air passing through these two channels meets at the back of the machine, thereby cooling the iron and leaving by way of the outlet pipe below the stator. Each of the channels contains an air valve, which allows of proper regulation so that extravagant expenditure of power for ventilation purposes may be avoided. The quantity of air passing through the machine under the heaviest condition of load is estimated to be 10,000 cu. ft. per minute.

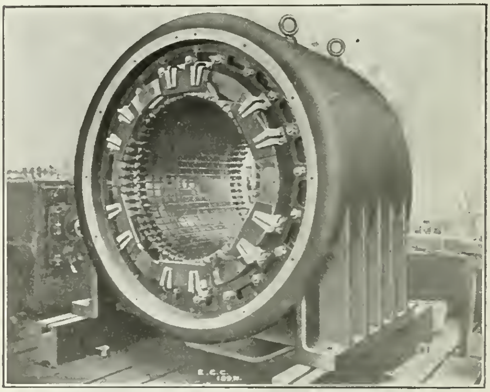


Fig. 1—Stationary Armature of Turbo-Alternator.

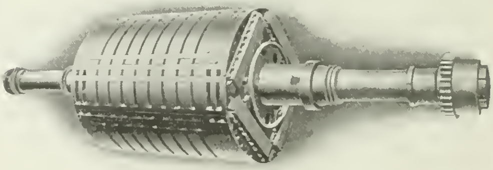


Fig. 2—Revolving Field Structure of Turbo-Alternator.

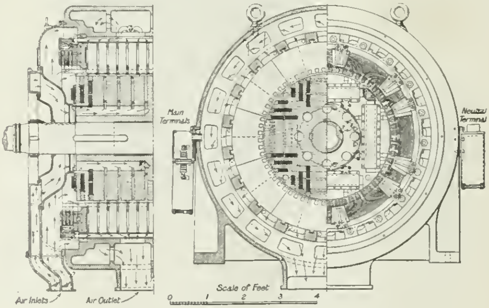


Fig. 3—Sectional Views of Turbo-Alternator.

Industrial and Commercial News

The Week in Trade.

Buying in the wholesale market was quieter last week and less encouraging than in any of the several weeks immediately preceding. Quite a number of the buyers who have been visiting the central markets returned home without placing orders to await more definite information as to the trend of spring retail trade. The latter was not such last week as to offer much promise, having been sharply checked by the cold snap which spread over the greater part of the country. All branches of the textile industry continue to be dull. From manufacturer to retailer reports are unsatisfactory. Crop conditions show no discouraging feature. The reports from the winter wheat area are optimistic, and it is the general opinion that the South will plant a largely increased acreage in cotton. All over the country there have been heavy purchases of fertilizers and implements, and these, it is believed, have done much to restrict rural buyers in general lines. In the iron and steel industry there has been some recession from the relatively active bookings of February, but still orders are being received at a much better rate than they were in the latter quarter of 1910. Rail orders for domestic account are small, but the promise of the export trade was never brighter. Railroads generally have not expressed a determination to curtail equipment purchases but are buying under an extremely conservative policy. Building materials and structural iron are not particularly active, especial dullness being exhibited in metropolitan districts. Many branches of industry are again disturbed by the prospective rearrangement of tariff schedules, which is adding greatly to the disposition to postpone making important commitments. Collections are irregular and can hardly be classed as fair. Business failures for the week which ended March 16, as reported by *Bradstreet's*, were 251, as compared with 230 the previous week, 208 the same week in 1910, 224 in 1909, 303 in 1908 and 157 in 1907.

The Copper Market.

Irregularity and unsettled conditions again marked the copper market last week. There were almost daily price fluctuations of from 5 points to 10 points in electrolytic and at the low points there was a fair amount of buying for April, May and June deliveries. The majority of these orders came from wire-drawers and manufacturers of electrical equipment, who were buying to cover orders for the manufactured product. Prices for lake copper were materially reduced during the week by outside producers and the Amalgamated interests were forced to meet the concessions in order to make sales. The big company, however, refused to meet the lower levels of prices on electrolytic and in consequence the majority of the sales were made by independents. It is reported that the price in the sales to the wire-drawers was between 12.20 cents and 12.25 cents per pound. Bare wire was reported to have been sold as low as 12½ cents, but the lowest price announced was 12¾ cents. In spite of this small flurry of activity in electrolytic and in wire, the market for casting copper has been extremely dull. The mills report a decrease in business of from 30 per cent to 50 per cent within the last few weeks and the brass founders have experienced a decrease of at least 25 per cent. The most important trade feature of the week was, of course, the absorption of the United Metals Company by the Amalgamated company. The United company has for years been the dominant selling feature of the market. It was the habit of this company to fix a minimum price and to hold to it tenaciously even when the independents were selling lower. This refusal to meet competition often meant that the big company did not get its full share of the sales. The Amalgamated copper interests have always been in favor of a free market and it is believed that the old policy of the United Metals Company will be abandoned and that the Amalgamated will sell copper according to condition of the market and meet competition without hesitation. Exports of copper are not heavy so far in March. Thus far, including March 20, they have amounted to 13,401 tons. The daily call on the Metal Exchange March 20 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.80	11.90	.....
March	11.80	11.90	11.85
April	11.80	11.90	11.85
May	11.80	11.90	11.85
June	11.80	11.90	11.85

The London market, March 20, was as follows:

	Noon. £ s d	Closing. £ s d
Standard copper, spot	54 17 6	54 18 9
Standard copper, futures	55 10 0	55 11 3

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.30c	11.85c
London, spot	£56 15 0	£53 15 0
London, futures	57 12 6	54 10 0
Best selected	60 5 0	58 0 0

Industrial and Commercial Notes.

Insulated Wire and the New Specifications.—Manufacturers of high grades of insulated wire are very much encouraged in a business way over the adoption of new specifications for rubber-covered wire by the New York City Building Department. These specifications were published in the *Electrical World* Feb. 2, and will take effect April 1. These specifications call for drastic tests of insulated wire which are far more thorough than any as yet provided. It is believed by the insulated-wire manufacturers that these tests are such that only the best of genuine Para rubber insulation will be able to pass them and that therefore the cheaper products which have been disturbing insulated wire prices for several years past will be driven from the market. It is charged that the insulation of these cheaper materials contains little real rubber and that the substitutes which are used will be unable to pass muster. The bi-annual rules of the National Fire Underwriters are also being prepared at this time and will be promulgated in April, although they will probably not become effective until August or September. These rules are expected to be fully as drastic as those adopted by New York City and to require practically the same tests. Speaking of the benefit to the insulated-wire trade in general, J. B. Olsen, of the Habirshaw Wire Company, said: "Wire trade is fair at the present time, and there are a great many inquiries looking toward future business. I believe that the adoption of the new rules by the New York department and the certainty that the National Board of Underwriters will follow the same general lines of rigid tests will do much to settle the present disturbed condition of the trade. It will certainly establish a standard of merit under which the makers of inferior material cannot compete. The established makers of insulated wire with high reputations have never been willing to cheapen their product and in consequence have been compelled to sell on a ruinously small margin to meet the prices of inferior materials which were able to pass the old rules. This will no longer be the case. I think also that the scale of prices for insulated wire will probably be advanced. Standard rubber-covered wire, No. 14, is now selling at about $6.80 per 1000 ft. The cheap and inferior product has been put upon the market at something like $5.45 and this made competition severe. Under the new rules I expect to see the price of standard No. 14 vary from $8 to $9, according to the price of crude rubber, and, as I said before, the inferior material will be shut out. Altogether, the prospect for the insulated-wire men is brighter at present than it has been for many months."

Tariff on Carbons.—It is the general impression among the carbon importers that the extra session of Congress which will convene next month will not go into the question of the tariff on lighting carbons. It is believed that if the tariff is taken up at all it will only be for the consideration of a few of the very important schedules. Carbons are comparatively a very small matter and there will be no organized effort among the importers to call this subject to the attention of Congress until after the regular term convenes next December.

Dissolution of Trade Associations.—The recent dissolution of the American Association of Electric Motor Manufacturers has been followed, according to rumor, by similar action on the part of associations representing, respectively, manufacturers of lamp sockets, safety fuses and flush and snap switches.

Electrical Water-Works Pumping in Chicago.—A contract for supplying and erecting the two electrically driven centrifugal pumps to be installed in the West Side pumping station of the Chicago water-works system has been awarded to the Platt Iron Works Company, of Dayton, Ohio, for $53,949. The plan of using electrical energy supplied from the hydroelectric plant of the Chicago Drainage Canal to operate pumping stations in Chicago has been alluded to previously in these columns. Each unit is a horizontal-shaft single-stage pump direct-connected to an alternating motor and capable of delivering 25,000,000 gal. daily under a total head of 115 ft. The contract includes starting apparatus, switchboard, instruments, oil switches, exciters and transformers to reduce the line voltage of 12,000 volts to 440 volts, which is the working potential. Synchronous three-phase, 60-cycle motors of 1000 hp or 8000 kva rating are specified. There will be seven 275-kva water-cooled, oil-insulated transformers, including two banks of three each and one spare transformer not connected. Each motor is provided with an exciter. It is expected that the installation will be ready for service about Sept. 1 of this year.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Sunbury, Pa.; The Dalles, Ore.; Salt Lake City, Utah; Cheyenne, Wyo.; Wausau, Wis.; Lethbridge, Alta., Can.; Springfield, Mass.; Elko, Nev.; Spokane, Wash.; West Sand Lake, N. Y.; Denver, Col.; Jacksonville, Fla.; Waukegan, Ill.; Kenton, Ohio; McDonough, Ga.; Bowling Green, Ky.; Ashtabula, Ohio; Kansas City, Mo.; Cincinnati, Ohio; Roland, Ia.; Southington, Conn.; St. Louis, Mo.; Kennett, Cal.; Fort Omaha, Neb.; Coldwater, Kan.; Hamilton, Ohio; Lethbridge, Alta., Can.; Ogden, Utah; Pulaski, Va.; San Francisco, Cal.; Evansville, Ind.; Columbia, Mo.; Cedar Rapids, Ia.; Kalamazoo, Mich., and Albany, N. Y.

Georgia Power Company.—Charles O. Lenz, chief engineer of the Georgia Power Company, says that construction machinery is now being installed and that work upon the plant at Tallulah Falls will be begun within a few weeks. A temporary water-power development has been arranged and an 1100-hp air compressor is being installed. It is necessary to drive a tunnel 6500 ft. through solid rock, and this will be done before work on the dam is pushed. The dam will not be an extensive affair, and will contain only about 30,000 yd. of masonry. From the mouth of the tunnel to the power house the water will be carried in a steel pipe, and the operating head will be 600 ft. It is not expected that the development can be completed in less time than two years.

Union Switch & Signal Company.—At the annual meeting of the stockholders of the Union Switch & Signal Company last week the profit-sharing plan proposed by the board of directors was unanimously indorsed. The directors are authorized to set aside or to sell 2000 shares, or any less amount, of the authorized and unissued common stock to or for the benefit of such employees as the board shall consider proper. The stock is to be sold to employees at a price fixed by the directors, not less than par, and upon terms of easy payment. The following were elected to the board of directors: John F. Miller, George Westinghouse, William McConway, George C. Smith, Thomas Rodd, H. G. Prout and James P. Donnell. The old officers were re-elected.

Yadkin River Power Company.—A charter has been granted at Raleigh, N. C., for the Yadkin River Power Company which will take over the unfinished development of the former Rockingham Power Company at Blewitts Falls on the Yadkin River. The new company has been formed by the reorganization committee of bondholders, represented by the Colonial Securities Company, of Boston, which took over the property under foreclosure last December. The capital stock of the new company is $4,000,000 and it is proposed to begin construction work immediately. Under the original plans of the Rockingham Power Company it was expected to develop 30,000 hp.

Manitou-Cripple Creek Electric Railway.—It is given out in Colorado that a group of Colorado Springs capitalists in conjunction with Eastern financiers have prepared plans for the construction of an electric railway from Manitou to Cripple Creek. The route was surveyed last summer, and it is claimed the average grade is not over 3 per cent, while the line will be several miles shorter than the present roads. The proposed road starts from Manitou and winds about the north side of Pike's Peak until it reaches a point about half way to the summit, where it will strike into the hills between Pike's Peak and the gold camp. When the route was surveyed a branch was located to run to the top of Pike's Peak, which will be operated for the benefit of tourists in the summer.

New Traction in Pittsburgh District.—Construction work will begin June 1 upon the line of the Pittsburgh, Butler, Slippery Rock, Grove City & Northern Street Railway Company, which was last week granted a charter in Pennsylvania. The construction of this road, which will be sixty miles long, will cost more than $3,500,000 and will make possible the linking of Pittsburgh with Buffalo and Cleveland by trolley. From Grove City a spur will be constructed to Meadville, Pa., where it will join lines connecting with Erie, Pa. Charles Gibson, Jr., who promoted the Pittsburgh & Butler Electric Railway, is president of the new company and J. H. Barrett will be the engineer in charge.

American Telephone & Telegraph Company.—It is given out by the American Telephone & Telegraph Company that its engineers have, within the past few weeks, perfected an improvement on the Pupin patent which adds to the carrying capacity of long-distance lines 40 or 50 per cent. It is also announced that a long-distance line is now perfected between New York and Denver, a distance of almost 2000 miles. Estimates of the construction requirements of the Bell companies for 1911 place the total outlay at about $60,000,000.

Electric Trucks for Brewers.—According to information given out by the General Vehicle Company, the big breweries of the city are just beginning to realize the economies and advantages to be derived from the use of electric power trucks. Since Jan. 1 the General Vehicle Company has sold fifty-five five-ton trucks to the city breweries, one customer alone having ordered twenty-two. Practically all of the big beer makers of the city are now using five-ton trucks for keg delivery and three and one-half-ton trucks for bottle delivery.

California Hydroelectric Development.—A project has recently been started in California to build a dam at the junction of the Middle Fork and North Fork of the American River about two miles east of Auburn. H. C. Whitman, of Stockton, has filed an appropriation for 100,000 in. of water, 4 in. pressure, flowing in the American River in El Dorado and Placer counties. From the dam, which will be 200 ft. high, he proposes to conduct the water about four miles down the stream to the power plant.

Bush Terminal Locomotive.—The General Electric Company has sold to the Bush Terminal Railroad Company a forty-ton electric locomotive for use at its yards and docks in South Brooklyn. This locomotive is a duplicate of one purchased last year by the same company. The Bush Terminal Railroad now employs four electric locomotives in its switching service. The recent sale is type "M" control with four General Electric 55-hp motors. It is operated by overhead trolley.

Power Project in Cobalt District.—A new power company for the Cobalt district of Canada has been chartered by the Provincial Secretary. The capital stock will be $7,500,000. It is to be known as the Northern Ontario Light & Power Company, and it is understood that it will take over the present light and power systems of Cobalt and Haileybury. It may also absorb the hydroelectric system now supplying power to the Cobalt mines.

J. G. White & Company.—J. G. White & Company, construction engineers, have undertaken to build an interurban line from Davenport to Muscatine, Ia. The line also will pass through the towns of Blue Grass, Pleasant Prairie and Sweetland. It will be 28 miles in length, and will operate in conjunction with the Tri City Railway & Light Company of Davenport.

Electric Pump Specified.—The City of Prescott, Wis., will receive bids up to March 30 on a 20-hp motor and duplex or triplex pump. Plans and specifications are on file in the office of the city clerk and with the Oscar Claussen Engineering Company, St. Paul, Minn.

Kiewert Lamps in San Francisco.—The Merchants' Association of San Francisco has purchased fifty Kiewert flaming-arc lamps for use in the business center. The cost of maintaining these lamps will be paid by the Merchants' Association and not by the city.

Financial.

The Week in Wall Street.

The stock market was extremely dull last week and traders were unusually nervous. For some reason the opinion became general that a trust decision would be handed down Monday, March 20. This caused general uneasiness and kept buyers out of the market. Nobody had any good reason for picking this exact date for this decision to be made except that it was the last decision date before the court takes its annual spring recess. When it was announced during the forenoon Monday that no decision would be handed down the stock market at once awakened to comparative activity and prices advanced on the active issues several points. Even with this encouragement, however, there were only 373,979 shares sold.

NEW YORK.

	Mar. 13.	Mar. 20.	Shares Sold.		Mar. 13.	Mar. 20.	Shares Sold.
All. Ch......	7⅞*	8*	250	Int. Met., pf.	51½*	54⅞	11,285
All. Ch., pf..	30½*	32½	700	Mackay Cos..	93½*	93½*	—
Amal. Cop...	63⅛	64⅝	35,500	Mackay C., pf	75⅞	75⅞	650
Am. D. T....	20½*	20½*	—	Man. Elev...138½*		138⅛*	100
Am. Loco...	38⅝	39¼	1,100	Met. St. Ry.	15*	15*	—
Am. Loco. pf.	109¼*	109¼*	200	N.Y.&N.J.Tel.	139¼*	139½*	—
Am. Tel. & C.	81*	81*	—	Steel com....	76⅞	79⅛	277,320
Am. T. & T.	145	146½	7,200	Steel, pfd....	118½	118⅞	4,900
B. R. T.....	76¾	77¾	9,930	W. U. T....	72¼*	72¾	2,100
Gen. Elec....	149	149½	1,400	West'h, com..	67*	68½	2,300
Int. Met.....	18⅜	19¾	5,487	West'h, pfd..	120*	120½*	100

PHILADELPHIA.

	Mar. 13.	Mar. 20.		Mar. 13.	Mar. 20.
Am. Rys..........	43½*	44	Phila. Elec....	16¼	16¼
Elec. Co. of A......	12⅛*	12⅛*	Phila. R. T.........	19⅝	19¾
Elec. St. B'ty......	54¼	55½	Phila. Trac.... ..	86½*	84
E. S. B'ty., pfd....	30*	30*	Union Trac..	47⅜	47¼

CHICAGO.

	Mar. 13.	Mar. 20.		Mar. 13.	Mar. 20.
Chi. City Ry.......	185	185*	Chi. Tel. Co.......	119½*	121*
Chi. Rs., Ser. 1.....	91½*	91½*	Met. El. Co........	21½*	23*
Chi. Rs., Ser. 2.....	24½*	24*	Met. El., pfd......	66*	69*
Com. Edison........	122¾	128	Nat'l Car..........	118½	119⅞*
Chi. Subways.......	5	4⅝*	Nat'l Car, pfd......	118½*	118½*

BOSTON.

	Mar. 13.	Mar. 20.		Mar. 13.	Mar. 20.
Am. T. & T........	144⅞	146½	Mex. Tel..........	4	3½
Cum. Tel...........	151¼	150*	Mex. Tel., pfd......	6	6
Edison E., Ill.......	291	290*	N. E. Tel..........	145	143¼
Gen. Elec..........	149	140	W. T. & T........	20*	20½*
Mass. E. Ry........	17*	17½*	W. T. & T., pfd....	93	93
Mass. E. Ry., pfd...	88	87¼			

*Last price quoted.
Shares sold for week, March 13 to March 18.

During the past week there has been little to chronicle in the Wall Street market beyond the remarkable display of apathy. The one feature of the week that was encouraging was the purchase by J. P. Morgan & Company and their Philadelphia associates of $13,850,000 of the bonds of the Public Service Corporation of New Jersey. This indicated that good bonds could still find a market and that the public was still investing. As a matter of fact, the bond market has been remarkable for several months, in view of the depressed condition of the stock market. This is taken to mean that the surplus wealth of the country, following the conservative business principles which have been instilled into the people within the past two years, is seeking gilt-edge investments rather than taking a chance in speculative ventures. The money market is still easy. Rates March 20 were: Call, 2@2⅜ per cent; ninety days, 2¾ per cent. The quotations in the table are those of the close March 20.

Financial Notes.

Chicago City Railway Company.—For the year ended Jan. 31, 1911, the Chicago City Railway Company reports total receipts of $10,105,443. The total expenses are $8,596,508, leaving net earnings of $1,508,934, which compares with $863,318 for the preceding year. According to franchise requirement, 55 per cent of the net earnings go to the City of Chicago, and this amounts to $829,914 for the year. The company's 45 per cent amounts to $679,020. To this is added the 5 per cent interest on capital invested, allowed by the ordinance and carried as an expense, making the company's total income from operation for the year $2,673,960. Other income makes the total $3,113,140. Deducting interest on bonds outstanding, the company's net income for the year was $1,985,431. Dividends of 10 per cent on the capital stock, amounting to $1,800,000, were paid, leaving $185,431 carried as surplus. The showing is thus an excellent one both for the company and the city under the partnership arrangement which exists by ordinance. The report for the year contained the following reference to the distribution of the surplus accumulated in the year ended Jan. 31, 1910: "Adequate provision being contained in the settlement ordinance under which we are now operating, insuring the establishment of reserves sufficient to effectively maintain the present physical excellence of the property, there remained in the opinion of the directors no reason for longer conserving the large treasury surplus as of Jan. 31, 1910, which exceeded the par value of the capital stock to the amount of $1,319,891 Distribution of a portion of the surplus has therefore been made during the year by the payment of extra dividends aggregating 6 per cent on the capital stock" The directors elected are E. R. Bliss L. A. Busby, Ira M Cole, R B. Hamilton, T E. Mitten, H. B. Riley and B L. Sunny. Mr. Mitten was reelected president.

Mississippi River Power Company.—There are now being offered to the public $15,000,000 first-mortgage 5 per cent sinking fund bonds of the Mississippi River Power Company which is building an immense hydroelectric development at Keokuk, Ia. The offer that is being made is one $1,000 bond with two shares of common stock for $875. Work has already been begun upon the great dam across the Mississippi River at this point. It is claimed that the initial development will deliver 120,000 hp, and it is known that of this 60,000 has already been contracted for in St Louis. The ultimate capacity of the plant is expected to be 200,000 hp. It is claimed that the company could have sold in St. Louis a much larger amount of energy, but refrained from doing so as other markets offered better prices. The company also recently sold $6,000,000 of preferred stock. The proceeds of this, together with the present bond sale, it is calculated, will complete the development up to the 120,000-hp stage. Of the above bond issue $3,500,000 was offered recently in London and immediately oversubscribed.

Des Moines City Railway Sold.—President G B Hippee announces the sale of the property of the Des Moines City Railway Company to N. W. Harris & Company, of Chicago It is said that J. R. Harrigan, who has been manager of the Columbus, Delaware & Marion Railway Company, with headquarters in Columbus, Ohio, will become manager of the Des Moines property. The system, which has been in the courts for some time and which the city has contemplated buying, will be improved immediately. The property was valued at $4,500,000, which, however, included 52 per cent of the stock owned by N. W. Harris & Company before the present transfer. The buyers also control the company's bonds, and it is said that the actual cash transfer in the present sale was about $600,000.

Amalgamated Copper Company.—The Amalgamated Copper Company has finally completed its deal by which it absorbs the United Metals Selling Company. The price paid for the stock of the latter company was $246 a share, or $12,300,000 for the $5,000,000 outstanding. With this transaction go the 40,000 shares of the International Smelting & Refining Company, which was owned by the United Metals company. The United Metals Selling Company, which was organized some years ago by the Lewisohns and which has handled the output of the Amalgamated and quite a number of other prominent copper producers, has been a remarkably profitable organization. Its profits last year were close to $1,250,000, or 25 per cent on its capital stock.

Kansas Gas & Electric Company.—Brokers announce the sale of $300,000 worth of first-mortgage 5 per cent gold bonds of the Kansas Gas & Electric Company. These bonds are dated March 1, 1910, and are due March 1, 1922. The total amount authorized is $6,000,000, of which $1,039,000 is outstanding. The bonds are secured by a first mortgage on all the property of the company, which controls the commercial gas, electric lighting and electric power business in the cities of Wichita and Pittsburg, Kan. The net earnings of the company for the year ended Jan. 31, 1911, are reported as $279,534 the bond interest, including that on the bonds now offered, being $96,950. The bonds are offered at 97 and interest, netting 5⅜ per cent.

Public Service Corporation Bonds.—J P. Morgan & Company, of New York, and Drexel & Company, of Philadelphia, have purchased from the Public Service Corporation of New Jersey $13,850,000 of its authorized issue of $50,000,000 5 per cent general-mortgage bonds It is said that these bonds will be offered to the public at 94 and interest A portion of the proceeds of this sale will be used to take up $4,000,000 notes which fall due Oct. 1, 1913, and the balance will go to pay for betterments and improvements This sale will provide all the financing needed by the corporation for the next two years and is pronounced by President McCarter to be the most beneficial and far-reaching event that ever happened in the history of the company.

Terms for the Telephone Merger.—The terms of the proposed purchase of Independent systems in northern New York by the Friendship Telephone Company, of Syracuse, which is owned by the New York Telephone Company, have been announced. Reference to these negotiations was made in our last issue. The New York Telephone Company offers to buy the stocks and bonds of the Independent companies, the purchase price to be paid in cash. For the Rochester Telephone Company the price will be $50 a share and the first mortgage bonds will be purchased at par. The general-mortgage bonds will be purchased at 90. The stock of the Rochester, Syracuse & Utica Telephone Company will be purchased at $75 per share, the Utica Home Telephone Company at $50 a share and the bonds of this company at 95; the Onondaga Independent Telephone Company at $45 a share.

Cleveland Electric Illuminating Company Bonds.—Spencer Trask & Company are offering to the public $1,000,000 5 per cent bonds of the Cleveland Electric Illuminating Company at 102 and interest, yielding to the purchaser a trifle over 4.85 per cent. These bonds are a portion of an authorized issue of $30,000,000, of which $5,000,000 are now outstanding. In the statement accompanying the offer it is set forth that the company serves a population of 560,000 and operates under unlimited franchises. It is also stated that the company is now constructing a generating station on the shore of Lake Erie, built upon the unit plan, with an ultimate capacity of 100,000 hp, of which 40,000 hp will be developed this fall. Additional issues of bonds are limited to 80 per cent of the amounts actually expended on improvements and extensions.

United States Steel Annual Report.—The annual report for the year 1910 of the United States Steel Corporation, made public last week, showed gross sales of $703,961,424, an increase over the previous year of $57,579,173. The net earnings for the year were $141,054,754, as compared with $131,491,414 the previous year. The total surplus for the year, after charging off all of the usual items of sinking fund and depreciation and after charging to new reconstruction $26,000,000, amounted to $10,772,383. The total profit and loss surplus of the company is $164,143,158. The report shows that the appropriation made from the surplus net income of the company for the construction of the Gary plant up to the close of 1910 amounted to $65,000,000.

Philadelphia Company Stock Listed in Paris.—The first American stock ever admitted to trading on the Paris Bourse is the common issue of the Philadelphia Company, of Pittsburgh, 200,000 shares having been listed March 20. This admission was brought about through the efforts of Ladenburg, Thalmann & Company, the New York bankers. The stock is quoted on the Philadelphia exchange at about 109, and has paid 6 per cent dividends since 1902.

Commonwealth Edison Increases Dividend.—The executive committee of the board of directors of the Commonwealth Edison Company, of Chicago, decided last week to make the next quarterly dividend 1¾ per cent, thereby putting the stock on a 7 per cent basis instead of 6 per cent. This probably explains the recent sharp advance in the price of the stock. It is probable that from $3,000,000 to $5,000,000 new stock will be issued next fall.

DIVIDENDS.

American Cities Railway & Light Company, quarterly, preferred, 1½ per cent, payable April. 1.

American Telephone & Telegraph Company, quarterly, 2 per cent, payable April 15.

Bangor Railway & Electric Company, quarterly, 1¾ per cent, payable April 1.

Butte Electric & Power Company, quarterly, 1¾ per cent, payable April 1.

Chicago City Railway Company, quarterly, 2½ per cent, payable March 30.

Cincinnati & Suburban Bell Telephone Company, quarterly, 2 per cent, payable April 1.

Cincinnati Gas & Electric Company, quarterly, 1¼ per cent, payable April 1.

Cities Service Company, monthly, preferred, one-half of 1 per cent; common, ¼ per cent, payable April 1.

Consolidated Gas, Electric Light & Power Company, Baltimore, quarterly, common, 1¼ per cent; preferred, semi-annual, 3 per cent, both payable April 1.

Cumberland Telephone & Telegraph Company, quarterly, 2 per cent, payable April 1.

Duluth Edison Electric Company, quarterly, 1½ per cent, payable April 1.

Louisville (Ky.) Home Telephone Company, 1½ per cent, payable April 1.

Manila Electric Railway & Light Corporation, quarterly, 1¼ per cent, payable April 1.

Massachusetts Lighting Companies, quarterly, 1¾ per cent, payable April 15.

Narragansett Electric Lighting Company, quarterly, 1 per cent, payable April 1.

Nebraska Telephone Company, quarterly, 1½ per cent, payable April 10.

Niagara Falls Power Company, 2 per cent, payable April 15.

Norfolk & Portsmouth Traction Company, quarterly, preferred, 1¼ per cent, payable April 10.

Pacific Telegraph & Telephone Company, quarterly, preferred, 1½ per cent, payable April 15.

Rubber Goods Manufacturing Company, quarterly, 2 per cent, payable March 25.

Sao Paulo Tramway, Light & Power Company, quarterly, 2½ per cent, payable April 1.

St. Joseph (Mo.) Railway, Light, Heat & Power Company, quarterly, preferred, 1¼ per cent, payable April 1.

Stark Electric Railroad Company, Alliance, Ohio, quarterly, ¾ per cent, payable April 1.

Syracuse Rapid Transit Company, quarterly, preferred, 1½ per cent, payable April 1.

Tri-City Railway & Light Company, Davenport, Ia., quarterly, preferred, 1½ per cent, payable April 1.

Union Switch & Signal Company, quarterly, preferred, 3 per cent; common, 3 per cent, both payable April 10.

Union Traction Company of Indiana, semi-annual, 2½ per cent, payable April 1.

United Traction & Electric Company, of Providence, quarterly, 1¼ per cent, payable April 1.

Western Electric Company, quarterly, 2 per cent, payable March 31.

REPORTS OF EARNINGS.

Period.		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
AMERICAN LIGHT & TRACTION COMPANY.						
February	1911	$358,908	$8,942	$349,966	......	......
"	1910	311,549	9,285	302,264	......	......
COLORADO TELEPHONE COMPANY.						
Year.	1910	$3,159,417	$2,472,092	$687,325	$595,000	$92,325
"	1909	2,907,726	2,226,466	681,260	595,000	86,260
DALLAS ELECTRIC CORPORATION.						
January,	1911	$139,374	$82,192	$57,182	$27,423	$29,759
"	1910	118,721	80,752	37,969	26,407	11,562
DENVER CITY TRAMWAY COMPANY.						
Year,	1910	$3,595,157	$1,859,251	$1,735,906	$1,065,833	$670,072
"	1909	3,374,133	1,678,834	1,695,299	991,940	703,359
DOMINION POWER & TRANSMISSION COMPANY.						
Year,	1910	$1,922,398	$1,061,075	$861,323	$327,566	$533,757
"	1909	1,691,696	963,949	727,747	332,774	394,973
ELECTRIC STORAGE BATTERY COMPANY.						
Year,	1910	$1,314,223	$442,650	$1,120,012	$649,964	$470,048
"	1909	1,218,483	384,021	933,492	528,092	405,398
GALVESTON-HOUSTON ELECTRIC COMPANY.						
January,	1911	$139,374	$82,192	$57,182	$27,423	$29,759
"	1910	118,721	80,752	37,969	26,407	11,562
INDIANA UNION TRACTION COMPANY.						
Year,	1910	$2,364,628	$1,239,314	$1,125,314	$1,023,574	$101,740
"	1909	2,102,019	1,118,429	989,590	948,756	40,834
KANSAS CITY RAILWAY & LIGHT COMPANY.						
February,	1911	$599,951	$321,764	$278,187	$190,263	$87,924
"	1910	553,543	286,727	266,815	164,810	102,005
MICHIGAN STATE TELEPHONE COMPANY.						
Year,	1910	$4,225,174	$3,280,420	$944,754	$258,039	$507,734
"	1909	3,819,630	2,964,115	885,515	240,727	381,991
MILWAUKEE ELECTRIC RAILWAY & LIGHT COMPANY.						
Year,	1910	$6,428,710	$4,382,611	$2,046,099	$1,278,719	$767,380
"	1911	5,709,946	3,680,420	2,029,526	1,257,974	771,552
MONTREAL STREET RAILWAY COMPANY.						
January,	1911	$370,124	$239,982	$130,142	$39,155	$90,986
"	1910	325,621	205,060	120,561	35,690	84,871
ROCKY MOUNTAIN BELL TELEPHONE COMPANY.						
Year,	1910	$2,053,502	$1,407,887	$645,615	$469,283	$176,332
"	1909	1,855,689	1,332,467	523,222	441,655	81,568
UNION ELECTRIC LIGHT & POWER COMPANY OF ST. LOUIS.						
Year,	1910	$3,371,520	$1,767,211	$1,604,309	$823,341	$780,967
"	1909	3,085,614	1,503,034	1,503,034	834,204	748,376
UNITED RAILWAYS OF ST. LOUIS.						
January,	1911	$920,919	$634,569	$286,340	$231,560	$58,916
"	1910	881,961	628,145	253,815	233,624	24,012
WESTERN TELEPHONE & TELEGRAPH COMPANY.						
Year,	1910	$2,294,946	$1,343,026	$926,405	$800,000	$126,405
"	1909	2,169,641	1,285,741	861,471	800,000	61,471

General News

Construction News.

VALDEZ, ALASKA.—Announcement has been made by the Alaska Water, Light & Telephone Company of extensive improvements to be made to its system this summer, including the erection of new transmission line, increasing the voltage from 2300 to 13,000 and other improvements.

TEMPE, ARIZ.—Two propositions have been submitted to the drainage committee of the Tempe Canal Company by Julius Beeman, of San Francisco, Cal., hydraulic engineer. One is to install two pumping plants complete, including engine and pump, at an estimated cost of $12,000 for each pump, other work extra; the second proposition is to install a generating plant, electricity to be transmitted to the pumping plants, to cost about $44,000. The second proposition seems to be favored.

HARRISBURG, ARK.—Morris Hayutin, of Harrisburg, Ark., is reported to have purchased the property of the Harrisburg Electric Light & Power Company. It is understood that the new owner will make extensive improvements to the plant.

HALF MOON BAY, CAL.—Application has been made to the Board of Supervisors by Benjamin Cunhaz for a franchise to install an electric light plant in Half Moon Bay.

KENNETT, CAL.—The transmission lines of the Sacramento Valley Power Company will be extended from Redding to Kennett within the next few months. The company has placed contracts for furnishing power which call for delivery by Sept. 25. The cost of extending the lines is estimated at about $50,000. It is said that the company will also extend its lines to Coram, eighteen miles north of Redding.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Company is reported to be contemplating extending its system to Altadena

LOS ANGELES, CAL.—A meeting of the stockholders of the Pacific Light & Power Company will be held May 8 for the purpose of considering the question of increasing the bonded indebtedness of the corporation by $35,000,000.

MORGAN HILL, CAL.—The Board of Trustees has granted the Coast Counties Light & Power Company a franchise to erect and maintain transmission lines over and across the highways in the town of Morgan Hill for the distribution of electricity.

OAKLAND, CAL.—The City Council has granted the Southern Pacific Company a franchise to operate a railway on Seventh Street for a term of thirty-five years. Under the terms of the franchise the company is to pay the city the sum of $5,000 annually for the first fifteen years and thereafter $8,500 per annum; to pave Seventh Street at a cost of $200,000 and also to light the street at a cost approximately of $[illegible],000 per year.

PASO ROBLES, CAL.—The Board of Trustees are reported to be contemplating calling a special election to vote on the proposition to issue bonds to acquire an electric light and water-works plant, to be owned and operated by the municipality.

QUINCY, CAL.—Deeds transferring 875,000 miners inches of water in Feather River and Butte Creek to the Great Western Power Company have recently been filed.

REDDING, CAL.—The Board of Supervisors of Shasta County has passed a resolution authorizing the sale of the franchise applied for by the Siskiyou Electric Light & Power Company to erect transmission lines, for transmitting electricity for lamps and motors on the highways of Shasta County, to be sold on May 8. The franchise was applied for by J. W. Churchill and Alex. Posborough.

SAN BERNARDINO, CAL.—The Chuckawalla Development Company is making investigations on the Colorado River with a view of locating a dam site. The company is planning to develop water-power to generate electricity which will be supplied to settlers in the Chuckawalla Valley to operate pumps for irrigating purposes. T. M. Teague is president of the company.

SAN FRANCISCO, CAL.—The San Francisco Gas & Electric Company is contemplating installing a steam-heating service, and will soon apply to the Board of Supervisors for permission to lay pipes for same.

SAN FRANCISCO, CAL.—The finance committee of the Board of Supervisors has decided to recommend granting the request of the Board of Public Works for the appropriation of $300,000 for the installation of a power plant and other construction work in the new city and county hospital. The committee will also recommend an appropriation of $[illegible]00,000 for furnishing ornamental metal work, decorations, lighting fixtures, plastering, etc., for the Hall of Justice and the new county [illegible]

VALLEJO, CAL.—The City Trustees have granted the National Electric Company a franchise to enter Vallejo and extend its line along the water to a connection with the San Francisco end.

WILLOWS, CAL.—The Northern California Power Company is contemplating extensive additions to its system in Willows and is planning to erect a transmission line from Hamilton to Princeton and thence to Williams and Arbuckle, work on which will begin at once. The company expects to be ready to deliver electricity in that territory within ninety days.

YREKA, CAL.—The Siskiyou Electric Light & Power Company has begun work on the construction of a large dam at the head of Ward's Canyon, sixteen miles above Hornbrook, on the Klamath River. The dam will be 250 ft. long and 90 ft. high and will develop 20,000 hp. Work will soon commence on the erection of the transmission lines to Klamath Falls and to the Butte Creek Valley.

BOULDER, COL.—Plans are being prepared by the Highland Power Company for the construction of a high-head hydroelectric power plant. H. von Schon, Wayne County Savings Bank Building, Detroit, Mich., is consulting engineer.

DENVER, COL.—Plans have been prepared by the Central Colorado Power Company for extensions to its transmission lines, covering a large portion of the central section of the State, which will involve an expenditure of between $300,000 and $400,000. The new transmission lines will extend to Alma, Fairplay and surrounding territory, to the Gilpin County mining district, toward Rollinsville and other sections, which at present have not electrical service. The new transmission lines will cost about $1,000 per mile.

DENVER, COL.—Supervisor George J. Kindel has authorized the city engineer to prepare plans and estimates for an electric light plant to light the city, securing energy from the falls at Chesman dam. This plan depends, of course, on the city's acquiring the plant of the Denver Union Water Company. At present it costs the City of Denver $185,000 annually for electric lamps, which are supplied by the Denver Gas & Electric Company. The question of the city undertaking the project is quite remote, as the water cases are in the United States courts. The citizens have voted to build an independent plant. If the city should acquire Cheesman Lake with the water-works plant the water power may be developed.

FORT COLLINS, COL.—James F. Vandewark, president of the Riverside Ice & Storage Company, and Jesse R. Wood, secretary of the Chamber of Commerce, have announced that they will apply to the City Council for a franchise to operate an electric light plant in Fort Collins. The promoters of the new plant propose to develop the water-power of Poudre River to generate electricity. A clause will be inserted in the franchise giving the city an opportunity to purchase the plant at intervals of five years. If the franchise is granted the plant will be built entirely by local capital.

GEORGETOWN, COL.—A contract has been awarded by W. E. Renshaw, manager of the Gem Electric Company, of Idaho Springs, Col., to George Keyes to raise the dam at White's Lake 5 ft., which will provide for storage of water for increasing the output of the American Sisters electric plant to 1700 hp. The American Sisters plant was purchased a few months ago by the Gem Electric Company. It is understood that the power station will be enlarged and additional machinery installed. The Gem company now controls four plants, two at Idaho Springs, one at Fall River and the other at Georgetown. It is proposed to connect up all the plants and supply electricity in all cities and towns in Clear Creek and Gilpin Counties. Mr. Renshaw, it is understood, will apply for franchises in both Georgetown and Silver Plume, and if granted will supply electricity to both towns within six months. The company also proposes to supply electricity for the mines in this vicinity.

NEW HAVEN, CONN.—The Connecticut Company is preparing plans for the construction of an extension to Staffordville, a distance of about four miles.

SAYBROOK, CONN.—The Shore Line Electric Railway Company is planning to build an extension to connect Guilford and New Haven, via North Branford, Totoket and Foxen during the year, which will require the construction of about fourteen miles of track.

SOUTHINGTON, CONN.—It is reported that plans are being prepared by the Peck, Stow & Wilcox Company, of Cleveland, Ohio, for the construction of a new plant in Southington, Conn., which will include the erection of several buildings and a power plant. An engine and generator having a rating of 750 hp will be purchased.

WILMINGTON, DEL.—The People's Railway Company is reported to be negotiating with the McCall Ferry Power Company, McCall Ferry, Pa., to supply electricity to operate the railway company's system. Announcement has been made by R. W. Creek, general manager of the People's Railway Company, that the company will supply electricity for lamps and motors in Wilmington as soon as arrangements are completed. The Wilmington & Philadelphia Traction Company now controls the entire electrical business in this city.

WASHINGTON, D. C.—Bids will be received until April 4 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Boston, Mass., Schedule 3422—17,0[illegible]0 lb. cast steel crucible wire. Schedule 3425—4[illegible],0[illegible]0 ft. steel enameled conduit. Brooklyn, N. Y., Schedule 34[illegible]5 8[illegible] lb. condenser tubes, etc. Mare Island, Cal., Schedule 33[illegible]2—2485 lb. hot rolled sheet copper; Schedule 3368—one roton, three-motor electric jib crane. Applications for proposals should designate the schedules desired by number.

JACKSONVILLE, FLA.—Arrangements are being made by the Stone & Webster Corporation for extensive improvements to the properties of the Jacksonville Electric Company, which will involve an expenditure of about $1,000,000 and include the construction and equipment of a new power house at a cost of about $525,000, addition to car barn, ten new cars and double tracking some of the most important street car lines in the city and other improvements.

CUTHBERT, GA.—The Cotton Belt Telephone Company has filed application with the State Railroad Commission asking for permission to issue $50,000 in bonds, the proceeds to be used for improvements and extensions to its system.

McDONOUGH, GA.—The City Council has engaged J. B. McCrary & Company, of Atlanta, Ga., to prepare plans for the installation of an electric light system in McDonough.

SAVANNAH, GA.—The capital stock of the Savannah Lighting Company has been increased from $500,000 to $2,000,000.

BELLEVILLE, ILL.—The Belleville & Mascoutah Traction Company, of Belleville, Ill., is contemplating extensions to its system, which will require the construction of about eleven miles of track.

CLINTON, ILL.—The National Telephone & Electric Company has applied to the City Council for a franchise to place its wires underground in this city. The company proposes to make improvements to its system, involving an expenditure of about $50,000, of which $15,000 will be used for the installation of a new switchboard and central energy system.

EAST ST. LOUIS, ILL.—The City Council has passed an ordinance providing for the installation of about 120 new arc lamps in the downtown district of the city.

GRIGGSVILLE, ILL.—The Union Electric Service Company is reported to have been granted a franchise by the City Council to install and operate an electric light plant in Griggsville. The franchise is for a term of twenty-five years.

JOLIET, ILL.—The Sanitary District of Chicago has applied to the Council for a franchise to erect transmission lines in Joliet. The company proposes to supply electricity to several large manufacturing plants in this town.

SPRINGFIELD, ILL.—The Sterling Business Men's Association has appointed a committee to secure estimates of the cost of installing a boulevard lighting system. Charles Stecker, A. B. Ahrens and M. C. Wharfield are members of the committee.

WAUKEGAN, ILL.—Plans are being prepared by the North Shore Electric Company for extensive additions to its Waukegan plant, increasing the output from 1000 hp to 1500 hp. This plant supplies the entire electrical service in Lake and McHenry Counties.

COLUMBUS, IND.—Plans have been completed by the Indianapolis, Columbus & Southern Traction Company for the construction of a canal seven miles long, 6 ft. deep and 60 ft. wide, which will furnish power to generate electricity to operate its cars between Indianapolis and Seymour for at least six months in the year. The company will build a power house north of here, and when completed the plants in Edinburg and Greenwood will be closed down. The cost of the canal and power house is estimated at about $200,000. The canal will be used as a pleasure water course.

EVANSVILLE, IND.—Arrangements are being made for the construction of an addition to the Evansville Gas & Electric Light Company's electric power station located at Division and Main Streets, to cost about $148,000, work on which will begin about April 1. The new equipment will include a new 2000-kw turbo-generator set, and provision will be made for another battery of boilers in the new extension.

GARRETT, IND.—The City Council is reported to be considering the installation of an improved system of street illumination in connection with enlarging the municipal electric light plant.

KOKOMO, IND.—The Haines Auto Company is planning to rebuild its plant, which was recently destroyed by fire. The new plant will be equipped for electrical operation. The company has increased its capital stock from $600,000 to $800,000 and collected $240,000 insurance on its plant.

PENDLETON, IND.—The bonds issued for the erection of a municipal electric light plant in Pendleton have been purchased by the Pendleton Banking Company.

WESTPOINT, IND.—The Westpoint Co-operative Telephone Company has increased its capital stock by $6,000. The company proposes to enlarge and make improvements to its property.

ADAIR, IA.—The contract for the construction of the combined electric light plant and water-works system in Adair, Ia., has been awarded to the Des Moines Bridge & Iron Company, of Des Moines, Ia., for $28,469.

ATLANTIC, IA.—The contract for improvements to the municipal electric light and water plant has been awarded to James Borlanger & Co., of Omaha, Neb., at $43,000, the company to take over the old equipment.

CEDAR RAPIDS, IA.—A site has been selected for the large powerhouse to be erected in Cedar Rapids by the Rock Island Railway Company, to cost about $50,000.

MANCHESTER, IA.—The proposition to grant a franchise to Joseph Hutchinson to install an electric light plant in Manchester will be submitted to a vote on March 27.

MANCHESTER, IA.—It is reported that the Manchester Light, Heat & Power Company is planning to enlarge its electric power plant, which will include the installation of an engine and generator.

REDFIELD, IA.—The Town Council is considering the question of installing a municipal electric light plant and water-works system at a cost of about $15,000.

ROLAND, IA.—The town of Roland is reported to be contemplating the installation of a municipal electric light plant, for which plans are now prepared. The cost of the plant is estimated at about $8,000.

WATERLOO, IA.—Preparations are being made by the Citizens' Gas & Electric Company, of Waterloo, Ia., for the erection of new power stations, to be used when the wires are placed in underground conduits in the business district. A site on Jefferson Street has been selected for one and two sites are being considered in East Waterloo.

ARKANSAS CITY, KAN.—The City Council is reported to be considering the question of installing an electric light system in Arkansas City.

COLDWATER, KAN.—Sealed bids will be received by W. F. Baker, city clerk, until March 30 for furnishing material and constructing waterworks and electric light system in Coldwater, Kan. Plans and specifications may be seen at the office of the J. S. Worley Company, Reliance Building, Kansas City, Mo., which has charge of the engineering work. J. Knecht is Mayor.

BOWLING GREEN, KY.—The Board of Public Works is contemplating asking bids for the installation of a new engine for the municipal electric light plant and the purchase of a new pump for the water-works system, to cost about $8,000.

JEFFERSONTOWN, KY.—The Jeffersontown Commercial Club is interested in a project to establish an electric light plant in Jeffersontown.

LOUISVILLE, KY.—The Board of Education has authorized twenty of the school buildings in Louisville to be wired and equipped for electric lamps at a cost of $14,490.

LOUISVILLE, KY.—The Kentucky Electric Company, of Louisville, has purchased a site, on which it proposes to erect its new power plant, at a cost of about $1,000,000.

ALEXANDRIA, LA.—It is reported that the Alexandria Street Railways Company's system has been taken over by J. A. White and others. It is understood that the company will be reorganized and improvements made by the new owners.

SHREVEPORT, LA.—The City Commissioners have submitted an ultimatum to the Shreveport Gas, Electric Light & Power Company asking for a reduction in the price of electricity for private consumers to 8 cents per kw-hour and $60 per lamp per year for street arc lamps for a term of six years. Unless the company agrees to these terms steps will be taken immediately to issue $250,000 in bonds for the establishment of a municipal electric plant. The company has offered to reduce the price of electricity to 9 cents per kw-hour to private consumers and to furnish street arc lamps at $69 each per year on a ten-year contract.

KENSINGTON, MD.—The Potomac Electric Company, of Washington, D. C., has applied to the Town Council for a franchise to supply electricity for lamps and motors. The franchise is for a term of thirty-five years and exempts the company from taxation for ten years,, after which it is to pay a tax of 1 per cent of its gross receipts.

COLRAIN, MASS.—The Colrain Electric Light & Power Company has applied to the Massachusetts Gas & Electric Light Commission for authority to consolidate with the Greenfield Electric Light & Power Company, of Greenfield, Mass., on the basis of an exchange of stock share for share.

GARDNER, MASS.—The Massachusetts State Board of Gas and Electric Light Commissioners has authorized the Gardner Electric Light Company to issue $105,000 in additional capital stock, the proceeds to be used to retire notes and pay for construction and enlargements to plants.

HUDSON, MASS.—Preparations are being made by George A. Brothers, superintendent of the municipal electric light plant, to substitute tungsten lamps for the arc lamps now in use.

LOWELL, MASS.—The Board of Aldermen has voted to authorize the inspector of buildings to secure estimates of the cost of installing an electric light plant in the basement of the city hall building to supply electricity for lighting the city hall, the Memorial Building and other public buildings located in that vicinity.

MALDEN, MASS.—The Malden Electric Company has purchased the lot adjoining its property, with a view of enlarging its plant.

SHELBURNE FALLS, MASS.—The Shelburne Falls Electric Light & Power Company has petitioned the Massachusetts Gas & Electric Light Commission for permission to issue additional capital stock to the amount of $175,000 per value, the proceeds to be used for the purchase of plants of the Colrain and Shelburne Falls companies and to pay for the cost of improvements to its system.

SPRINGFIELD, MASS.—Sealed proposals will be received by the Municipal Building Commission, Municipal Building, Springfield, Mass., until March 24 for furnishing equipment for power plant and electric wiring for the power plant to be erected by the City of Springfield between Court and Pychon Streets. Copies of plans and specifications may be seen at the Municipal Building and at the office of Kirkham & Parlett, architects, Carr Building, Springfield, Mass., or at the office of Hollis, French & Allen Hubbard, Albany Building, Boston, Mass., or may be obtained on application to the latter.

SWANSEA, MASS.—The town of Swansea has voted to appropriate $1,000 a year for forty electric street lamps for a term of five years, and the Selectmen were authorized to execute a contract with the Fall River Electric Light Company to supply the service.

KALAMAZOO, MICH.—The City Council has decided to make improvements to the municipal electric light system. It has not yet been decided whether the city will build an entire new plant or purchase energy from a private corporation. The Council committee has recommended the installation of an entire new plant at a cost of about $69,231, which would provide for the maintenance of 2000 arc lamps. The present plant supplies 400 arc lamps at a cost of $45 per lamp per year.

MILFORD, MICH.—F. S. Hubbell, owner of the Milford electric light works, has purchased the available water rights on the Huron River in Milford, and will begin work on the construction of a new power house at once. C. C. Sherk is superintendent.

BUFFALO, MINN.—A franchise has been granted to J. A. Bonner to construct and operate an electric light plant in Buffalo for a term of twenty years.

EVELETH, MINN.—Bids will be received at the office of the city clerk, Eveleth, Minn., until April 4 for furnishing and installing an ornamental street-lighting system on six blocks of Grant Avenue, according to plans and specifications now on file in the above office. It is estimated that about forty-six five-lamp posts will be required. D. P. McIntyre is city clerk.

GLENWOOD, MINN.—It is reported that a petition has been presented to the Village Council asking it to grant a franchise to parties who will construct a new electric plant, or to build a municipal electric plant. The service is now furnished by the Glenwood Milling Company and is not at all satisfactory.

MANKATO, MINN.—The Spooner bill, providing $40,000 for investigating the feasibility of a canal system from the Lake of the Woods to Mankato, thence to Duluth, through Minneapolis and St. Paul, Minn., taking advantage of the Minnesota and Mississippi Rivers and contemplating the construction of large dams for water-power purposes, as well as a 12-ft. barge canal, has been recommended for passage by the Senate committee on drainage.

MINNEAPOLIS, MINN.—The Segerstrom Piano Manufacturing Company, of Minneapolis, Minn., it is reported, is contemplating the construction of a new factory building, having a floor space of about 50,000 sq. ft. It is understood that considerable new equipment will be purchased. The plant will be equipped for electric motor drive.

WASECA, MINN.—At an election to be held in April the proposition to issue $15,000 in bonds, the proceeds to be used for improvements to the municipal electric light plant and water-works system, will be submitted to a vote.

GULFPORT, MISS.—The Supervisors of Harrison County have granted the Gulfport & Mississippi Coast Traction Company, of Gulfport, Miss., a franchise to construct and operate transmission lines over the county road between Gulfport and Biloxi, a distance of fifteen miles. The company will erect a three-phase, 18,000-volt transmission system through Handsboro and into Biloxi, Miss. The company has been granted a franchise by the City Council in Handsboro to construct and operate an electric light and power system in and through that city.

NEWTON, MISS.—At an election held March 6 the proposition to issue $11,000 in bonds, the proceeds to be used for the installation of an electric light plant, was carried. X. A. Kramer, of Magnolia, Miss., is consulting engineer.

COLUMBIA, MO.—The Water and Light Committee has been authorized to advertise for bids for the construction of a new power house and equipment, including chimney, boiler plant, stokers and breeching, coal and ash-handling machinery, steam turbo-generator set, exciter and switchboard, condenser and cooling tower; two motor-driven centrifugal service pumps, two boiler feed pumps, feed water heater, pipe work and wiring. The cost of the work is estimated at $69,600. John S. Bicknell is city clerk.

KANSAS CITY, MO.—Sealed bids will be received by Leo M. Gilday, County Clerk, until March 31 for furnishing one automatic cut-off steam engine and one 200-kw, 220-volt, direct-current generator for direct connection to engine, in accordance with plans and specifications.

ST. LOUIS, MO.—The Board of Public Works is reported to be considering the question of installing an electric plant in the basement of the city hall, to cost about $70,000.

ST. LOUIS, MO.—The Hempstead Structural Steel Company, of St. Louis, Mo., it is reported, is constructing a large bridge shop, which will be equipped for electric motor drive.

CHESTER, MONT.—At a special election held recently the citizens voted in favor of granting franchises for the installation of electric light, water works and telephone systems in Chester.

FORT OMAHA, NEB.—Sealed proposals will be received until April 10 at the office of the constructing quartermaster, Fort Omaha, Neb., for construction of an extension to the electric lighting system at Fort Omaha. For further information apply to Captain W. L. Clarke, constructing quartermaster.

GORDON, NEB.—It is reported that bonds have been voted for the installation of an electric light plant, water-works and sewer systems.

OMAHA, NEB.—Bids will be received by J. F. Burgess, secretary of the Board of Education, Omaha, Neb., until April 1 for construction of north and west wings and power-plant building of the Omaha High School and for the necessary alterations and connections with the present wings, including heating, ventilating, power apparatus, plumbing, electric wiring, etc. Plans and specifications can be obtained from the secretary of the board or from John Latenser, 622 Bee Building, Omaha, Neb.

ELKO, NEV.—Preparations are being made by the Thousand Springs Power Company, of Idaho, to supply electricity to the mining camp of Jarbridge, in the northern part of Elko County. Work will soon begin on the erection of the transmission line to the mining camp. W. D. Reynolds is president of the Thousand Springs Power Company.

ROSWELL, N. M.—The directors of the Rio Hondo Water Users' Association of Roswell are reported to have secured a government loan of $60,000 for the construction of a concrete irrigation system which will include sixteen miles of ditches and canals, together with reservoirs, power plants and pumping stations.

ALBANY, N. Y.—Sealed proposals will be received by the Secretary of the Trustees of Public Buildings, Executive Chamber, Capitol, Albany, N. Y., until April 20 for equipment of the Capitol power house and conduits, located on the corner of Sheridan Avenue and North Hawk Street, Albany. Separate proposals will be required as follows: 1. For steam power equipment. 2. For electrical equipment. Plans and specifications and blank forms of proposals may be obtained at the office of the State Architect, Albany, N. Y., after March 25. A deposit of $25 will be required for each set of plans. Plans and specifications will be on file after March 25 at the offices of Nygren, Tenney & Ohmes, 87 Nassau Street, New York, N. Y.; C. E. Knox, 76 William Street, New York, N. Y., and at the office of Franklin B. Ware, State Architect, Albany, N. Y.

BUFFALO, N. Y.—The Lehigh Valley Railroad Company is reported to be planning to build new iron and coal docks at its Tiff farm terminal at Buffalo to cost about $500,000. The company proposes to develop its coal and ore-handling facilities and will equip its new dock with unloaders, costing $40,000 each, which will be operated by electricity.

GENEVA, N. Y.—The Public Service Commission, Second District, has given its approval to the consolidation of the Geneva-Seneca Electric Company, of Geneva, and the Wayne County Gas & Electric Company, of Newark, N. Y., under the name of the Central New York Gas & Electric Company, to operate in Wayne and Ontario counties. The company is authorized to purchase the plant of J. Q. Howe's Sons, at Phelps, for $15,000. Permission has been given the company to issue $150,000 in capital stock and $650,000 in bonds, under a mortgage for $2,000,000, and $150,000 in five-year notes, the bonds to be sold at not less than 85 and the notes at par.

LONG ISLAND CITY, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, corner of Park Avenue and Fifty-ninth Street, New York, N. Y., until March 27 for installing additional electric equipment and making alterations in Public School 7, on Van Alst Avenue, Long Island City, N. Y. Blank forms, plans and specifications may be seen at the above office and at the branch office, 69 Broadway, Flushing, N. Y.

RICHVILLE, N. Y.—The question of lighting the streets of the village is reported to be under consideration.

WEST SAND LAKE, N. Y.—The Wynantskill Hydro-Electric Company, recently incorporated with a capital stock of $75,000, is planning to develop the water-power of the Wynantskill River at West Sand Lake to supply electricity for lamps and motors to the farmers in this section. It is proposed to erect a power house near the site of the present Troy & New England Railway generating station and install a steam plant for use during the low water period. The cost of the plant is estimated at about $10,000, work on which will begin about April 1. The company expects to be able to supply electricity in Averill Park and West Sand Lake by June 1.

ROCKY MOUNT, N. C.—W. H. Powell, of Scotland Neck, N. C., and Robert Donald, of Tarnore, N. C., representing Baltimore capitalists, are seeking a franchise to construct and operate an electric railway in Rocky Mount.

TIOGA, N. D.—It is reported that a company has been organized in Tioga to install an electric light plant.

ASHTABULA, OHIO.—The City Council is reported to have appropriated $10,000 for improvements to the municipal electric light plant, which will double the present output of the plant. Two boilers will be installed at a cost of about $6,300, bids for which will be called for in the near future.

CINCINNATI, OHIO.—Bids will be received until April 3 for the erection of a sterilization plant and turbine station at the California water-works station, to cost about $[illegible]. Robert Laidlaw is superintendent of water works.

COLUMBUS, OHIO.—Plans are being considered for replacing the arch-lighting system on High Street with the cluster lamp system.

HAMILTON, OHIO.—The Miami Power Company, recently incorporated, is planning to erect a hydroelectric power plant on the site of the old Chatfield & W[illegible] paper mill at W[illegible]. The proposed plant will cost about $5[illegible] and about [illegible] hp will be developed. Electricity generated at the plant will be transmitted to Hamilton, Middletown, Miamisburg and Franklin. The incorporators are: H. L. Hanley, J. W. Durfee, of Chicago, Ill.; W. D. James, of Detroit, Mich., William Bergen and John Reif, of Overpeck, Ohio.

KENTON, OHIO.—The Kenton Gas & Electric Company, of Kenton, Ohio, has engaged the Central Station Development Company, of Cleveland, Ohio, to prepare plans for a new generating plant, including the rehabilitation of the present lighting system. The output of the new plant will be about 1000 kw.

MARION, OHIO.—The capital stock of the Marion County Telephone Company has been increased from $150,000 to $300,000.

HOLLIS, OKLA.—T. G. Benge, who was recently granted a franchise to install an electric light plant in Hollis, will soon begin work on installation of same.

MUSKOGEE, OKLA.—It is reported that the Monticello Company, recently incorporated with a capital stock of $100,000, proposes to supply electricity and water in connection with the electric railway from Muskogee to Fort Gibson, Okla. Thomas P. Smith, Lillie E. Haskell and W. R. Eaton are interested in the company.

WOODWARD, OKLA.—The Council is reported to be considering the question of issuing $30,000 in bonds, the proceeds to be used for the installation of a municipal electric light plant.

BAKER CITY, ORE.—The City Council has authorized the city engineer to prepare plans for the construction of a pipe line from Ely Creek to Salmon Creek in connection with the proposed municipal electric light plant.

SALEM, ORE.—The Capital Trust Company, of Portland, Ore., has applied to the City Council for permission to erect electric transmission wires across the bridge at the foot of Center Street to supply electricity to a large tract of land which the company is opening up in that section for lighting purposes.

THE DALLES, ORE.—The Dalles Water Commissioners are contemplating improvements to the present water system which will involve an expenditure of about $20,000. Plans are also under consideration by the Commissioners for installing a power plant in connection with the water they control to supply electricity for lamps and motors in this city.

PANAMA.—Bids will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until April 14 for furnishing dynamite blasting caps, detonators, safety fuse, insulating tape, connecting and lead wire. Blanks and general information relating to this circular (No. 626) may be obtained from the above office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing officer.

BRISTOL, PA.—The Pennsylvania Railroad Company, it is reported, is contemplating the construction of an electric power plant in Bristol to supply electricity for lamps for its elevated line.

BUTLER, PA.—It is reported that options have been taken on about 1000 acres of land along Slippery Rock Creek, between Kennedy's Mills and McConnell's Mills, just west of Portersville, where it is said a large power plant will be erected. It is understood that the company proposes to supply electricity for lamps and motors in New Castle and Ellwood City.

CLEARFIELD, PA.—The Greene Heat, Light & Power Company has filed amendments to its charter increasing its capital stock from $10,000 to $15,000.

HAMBURG, PA.—The local electric light plant is reported to have been destroyed by fire, causing a loss of about $10,000.

HERSHEY, PA.—Plans are being considered by the Hummelstown & Campbellstown Street Railway Company for the construction of a power plant in Lebanon.

INDIANA, PA.—The Indiana County Street Railways Company is reported to have decided to erect a power plant at Two Lick, which, it is said, will be a duplicate of the present plant located there.

READING, PA.—Arrangements are being made by S. S. Miller, of Reading, for the erection of a new mill 36 ft. x 120 ft., three stories high, for the manufacture of men's hosiery. A separate power-house will be erected, which will be equipped with an engine and boiler of 100-hp and generator to supply electricity for lighting purposes.

SUNBURY, PA.—Plans are being prepared by the Middle Creek Electric Company for extending its service to other towns, the most important of which are Middleburg and Lewisburg. The company has submitted a proposition to the Middleburg Light, Heat & Power Company offering to supply electricity from the power plant at Selinsgrove. The transmission line is to be erected by the Middleburg company. J. Harris Leuker is president of the Middle Creek Electric Company.

NEWBERRY, S. C.—The Southern Power Company has applied to the City Council for a franchise to erect an electric system in Newberry.

WALTERBORO, S. C.—The question of installing an electric light plant in Walterboro is reported to be under consideration. John D. Glover, G. C. Brown, T. J. Blanchard and others are interested in the project.

LEXINGTON, TENN.—A. B. Lamb, of Paris, Tenn., and others are reported to have applied to the Council for a franchise to construct and operate an electric light plant and water-works system in Lexington. D. E. Aden, general manager of the Lexington Ice & Cold Storage Company, is also interested in the project.

CORPUS CHRISTI, TEX.—The County Commissioners have granted the Corpus Christi Street & Interurban Railway Company permission to extend its railway from Corpus Christi to the Epworth Encampment and the site of that large tourist hotel, to be built in the northern portion of the city.

CORPUS CHRISTI, TEX.—It is reported that plans are being prepared for the construction of a dam across the mouth of Nueces Bay by J. E. Franklin, president of the Uvalde & Crystal City Railroad Company. The proposed causeway will be about six miles long and from 200 to 250 feet wide across the top, in order to provide for interurban electric railway track, steam railroad, wagon road and automobile speedway. Spillways will be built to take care of the surplus flow of the stream which feeds the bay. The proposed reservoir would afford a perpetual supply of water for irrigating a large acreage of rich land and also provide sufficient amount of water to the City of Corpus Christi for all purposes. In connection with the water storage and irrigation project a hydroelectric plant will probably be installed to provide electricity for lamps and motors for this city and other towns. The cost of the reservoir is estimated from $750,000 to $1,000,000.

DENISON, TEX.—The Missouri, Kansas & Texas Railroad Company is planning to erect 674 miles of telephone lines to be used in dispatching trains. In addition, the company proposes to build about 2000 miles of telegraph lines, mostly in Texas.

FORT WORTH, TEX.—The Northern Texas Traction Company is reported to have prepared plans for the construction of a power house to be located on lower Calhoun Street, Fort Worth.

GALVESTON, TEX.—The Galveston-Houston Electric Railway Company has commenced work on the erection of its substation at South Houston.

KERRVILLE, TEX.—The contract for lighting the streets of the city has been awarded to the Kerrville Electric Light & Power Company.

SAN BENITO, TEX.—The interurban railway system, which is being built in the lower Rio Grande Valley by S. A. Robertson and associates, of San Benito, Tex., will be extended from this place to Mission, a distance of seventy-five miles.

OGDEN, UTAH.—Arrangements are being made by the Davis & Weber Counties Canal Company for the construction of a large power plant in connection with its irrigation system this year. The power house will be located south of Ogden, where 5000 hp will be generated. The stockholders have authorized an issue of $500,000 in bonds to provide funds for the work, which will include enlarging and lining of the main canal, building of a dam on Keber River at the upper end of the canal, erection of a power plant and enlargement of the East Cañon Creek reservoir. At present the system irrigates 12,000 acres and it is proposed to supply water to irrigate 30,000 acres.

SALT LAKE CITY, UTAH.—The State Legislature has passed the bill providing for appropriating $40,000 to install a power plant in Logan Canyon to furnish electricity for the state institutions and the Agriculture College.

RUTLAND, VT.—The Rutland Railway, Light & Power Company has made a slight reduction in the price of electricity for lamps. Under the new rate the price will be 14 instead of 15 cents for all energy consumed up to 2 kw-hours per month for each lamp and 7 cents instead of 7½ cents per kw-hour for all used in excess of that amount. The reduction was voluntary on the part of the company. The company is extending its lines north to the Scotch Hill and Bomoseen districts, a distance of six miles, and is also preparing to supply electricity in Pittsford for lamps. Plans are also being made by the company to extend its lines from Poultney to Granville through the slate quarry district in the near future, and for an extension of its electric railway from Fair Haven to Whitehall soon. The company also proposes to develop the Mill River properties in the near future. A 500-kw generator will be installed in the Carvers Falls plant within sixty days.

FALLS CHURCH, VA.—It is understood that a company has been organized with a capital stock of $100,000 to supply electricity for lamps and motors in Clarendon, Ballston, Cherryvale, Falls Church and other towns in Virginia. M. E. Church, of Falls Church, Va., is president, and L. L. Northrop, of Clarendon, Va., is secretary.

HAMPTON, VA.—The Newport News & Old Point Comfort Railway & Electric Company is reported to be contemplating making improvements to its power plant.

PULASKI, VA.—It is reported that plans are under way for the construction of a hydroelectric plant near Pulaski. It is understood that a tract of seventy-five acres embracing the site for a plant on New River has been purchased through O. L. Stearns, of Salem, Va.; options have also been obtained on other riparian lands. The syndicate which is interested in the development, it is stated, has agreed to purchase through Mr. Stearns, as agent, the electric plant located in Pulaski for a consideration of $25,000. The City Council will call for bids for a new franchise for lighting the city. The cost of the entire project is estimated at about $1,000,000.

RICHMOND, VA.—The Western Electric Company has been awarded the contract by the City of Richmond for supplying mast arms and other supplies for the municipal electric lighting system. The City Council recently revoked the contract held by Storms & Company for the overhead work.

CENTRALIA, WASH.—The Twin City Light & Power Company is planning to build an electric railway through the Chehalis and Big Balton section, which will require the construction of about ten miles of track

CHELAN, WASH.—The Chelan Water Power Company is contemplating extending its transmission line to the lake shore, a distance of seven miles, to supply electricity for lamps and irrigating purposes. L. V. Harper is manager.

ORIENT, WASH.—Walter Bryant, of Orient, Wash., is reported to be interested in the erection of a power plant at Boulder Falls, three miles below here.

SOUTH PRAIRIE, WASH.—Demerest & Miller, of Tacoma, are reported to have purchased a saw mill at South Prairie, Wash., in which new machinery is being installed. The mill will be equipped for electric motor drive.

SPOKANE, WASH.—Preparations are being made by the Panhandle Electric Railway & Power Company for the construction of a hydroelectric power plant on Priest River, in Northern Idaho, capable of developing 30,000 hp, and the erection of a transmission line, seventy miles in length, from Priest River to Spokane, which will involve an expenditure of about $2,000,000. The company will apply to the City Council of Spokane for a franchise and has submitted a proposition offering to supply street lamps at the rate of $48 each per year, which is $12 less than the city now pays for the service; also to supply electricity to operate the up-river pumping station at $28 per hp per year, for which the city now pays $48 per hp per year. Victor M. Smith, of New York, N. Y., is interested in the company. Application has been made to the City Council of Hillyard, a suburb of Spokane, by the company for a fifty-year franchise, which if granted will give the company entrance to Spokane with its high-tension power-transmission lines.

BARABOO, WIS.—It is reported that S. S. Howell, of the firm of Chamberlain & Howell, of Chicago, Ill., has been engaged to prepare plans for the construction of a new lighting plant, which is to be installed by the bondholders of the Baraboo Light Company.

MISHICOT, WIS.—The installation of an electric light plant in Mishicot is reported to be under consideration. Ira Beyer is understood to be interested in the project.

PRESCOTT, WIS.—Bids will be received by the City of Prescott, Wis., until March 30, for construction of a gravity water-works system, including a 100,000-gal. reinforced-concrete reservoir, pump-house, one 20-hp motor and duplex of triplex pumps, water pipes, valves, etc. Plans and specifications may be seen at the office of the city clerk, Prescott, Wis., and at the office of the Oscar Claussen Engineering Company, National German-American Bank Building, St. Paul, Minn., consulting engineers. R. H. Price is city clerk.

WAUSAU, WIS.—The City Council is contemplating the installation of an electric generating plant in connection with the water-works pumping station to supply electricity for municipal purposes only. The Wausau Street Railway Company supplies electricity for operating the municipal lighting system at present. H. E. Marquadt is comptroller.

CHEYENNE, WYO.—The Cheyenne Light, Fuel & Power Company is contemplating improvements to its power plant this spring, including the installation of one 600-hp Franklin water-tube boiler and one 1000-kw. 2300-volt, three-phase, 60-cycle generator, direct connected to a Corliss engine. A. G. Langenbach is local manager.

CALGARY, ALTA., CAN.—The Alberta Electric Railroad Company, recently incorporated with a capital stock of $10,000,000, will soon begin work on the construction of a system of electric railways in southern Alberta.

LETHBRIDGE, ALTA., CAN.—Plans are being considered by the City of Lethbridge to install a 75 lamp, direct-current rectifier, set with either luminous or metallic-flame arc lamps, and to handle heating devices. Preparations are also being made to begin work on a municipal street railway system. The power-house equipment for the street railway system will include new boilers, alternating-current generating unit of about 1500 kva capacity and rotary converter. Arthur Reid is superintendent.

VANCOUVER, B. C., CAN.—The British Columbia Electric Railway Company is planning to extend its railway on Vancouver Island from Deep Cove to Victoria, a distance of about twenty-two miles. The cost of the construction and equipment of the proposed extension is estimated at about $500,000. F. R. Glover, of Vancouver, is manager.

BRANDON, MAN., CAN.—The Brandon Electric Light Company has submitted a proposition to the City Council offering to supply the city with electricity at the rate of $25 per horse-power per year, the service to begin Dec. 1, 1911; the plan submitted gives the city the right to purchase the plant any time within five years. The Council also has an offer from the E. B. Reese Company, of Winnipeg, for electrical service under consideration.

WINNIPEG, MAN., CAN.—It is understood that the City of Winnipeg will soon advertise for a manager for the municipal electric light plant now nearing completion. For further information address Cecil B. Smith, civic power expert.

WINNIPEG, MAN., CAN.—The City Council is reported to have voted in favor of purchasing the plants and holdings of the Winnipeg Electric Company, which controls the street railway, light, power and gas franchises in Winnipeg. It is understood that the city will have to pay approximately $16,000,000 for the system.

WINNIPEG, MAN., CAN.—Sealed tenders will be received by the chairman board of control, Winnipeg, Man., Can., until May 1, for furnishing ornamental lamp standards of approved designs. Plans and specifications and form of tender, with other necessary information, may be obtained at the office of the City Electrician, City Hall, Winnipeg, Man., Can. M. Peterson is secretary.

GUELPH, ONT., CAN.—The annual report of the Light and Heat Commission presented to the Council shows a net profit of $39,271 out of a total income of $98,117. The commission has decided to eliminate the meter rental for the future and reduce the price of electricity for lamp from 10 cents to 9 cents per kw-hour.

SAULT STE. MARIE, ONT., CAN.—The Lake Superior Paper Company, recently incorporated with a capital stock of $8,000,000, has purchased a site of twenty acres in the heart of the city, for which it paid the sum of $325,000. The company proposes to erect a new plant adjoining the Lake Superior Corporation's pulp mills, work on which will begin in the near future. The Lake Superior Paper Company is also contemplating the construction of a water-power canal to develop 60,000 hp.

THESSALON, ONT., CAN.—The town of Thessalon is contemplating the erection of a new power-house and installation of a new boiler and generator. John Elliott is chairman of Electric Light Commission.

TORONTO, ONT., CAN.—A bill has been introduced in the Ontario Legislature by W. W. McNaught which gives the Ontario Power Commission jurisdiction over the location of poles, wires, conduits and all equipment of municipal and private plants, and all persons dissatisfied may invoke the aid of the commission. The commission will also have power to order municipal wires attached to existing poles of private companies and may fix renumeration.

TORONTO, ONT., CAN.—An important amendment to the Provincial Hydroelectric Act has been introduced to the Ontario Provincial Legislature by Adam Beck, chairman of the Hydro-Electric Commission, providing for the supply of power to unorganized villages and farming districts throughout the province by the agency of the commission. The measure embodies the local improvement principle, in that it provides the means whereby only the portion of the municipality benefiting thereby pays the expense. Under the terms of the bill any resident or number of residents may apply to the Council of a municipality to enter into negotiations with the Hydro-Electric Commission. The Council must, after taking certain steps, enter into a contract with the commission to supply power to the applicants. The prices charged for the service shall be sufficient to return to the municipality the interest and the sinking fund upon the debentures.

MONTREAL, QUE., CAN.—The Montreal & Southwestern Railway & Power Company has been given authority by the Provincial Legislature to construct an underground terminus in Montreal and to build and operate an underground railway in Montreal, subject to the supervision of the Public Utilities Commission.

PENSE, SASK., CAN.—Bids will be received until April 1 by the Rufus Rural Telephone Company for the construction of a complete telephone system. F. R. Groves is secretary.

GUANAJUATO, MEX.—The Guanajuato Power & Electric Company is installing irrigating pumps upon farms in the central part of the State of Guanajuato. In the vicinity of Siloa transformers and motors to operate the irrigating pumping plants are being installed upon a number of farms by the company under the direction of Pable Rocha, local manager. The company also supplies electricity for lamps and motors for residents of the rural districts.

New Industrial Companies.

THE AMERICAN CURRENT MOTOR COMPANY, of Birmingham, Ala., has been incorporated with a capital stock of $2,000. The officers are: F. P. West, president; L. K. Mackey, vice-president; J. B. Russell, secretary, and D. M. Inman, treasurer.

THE ARNOLD-WAGNER COMPANY, of South Bend, Ind., has been incorporated with a capital stock of $10,000 to manufacture electrical supplies. The directors are: Earl H. Arnold, John W. Arnold and Joseph W. Wagner.

THE HIBBARD INDEX COMPANY, of Worcester, Mass., has been chartered with a capital stock of $50,000 to manufacture telephone indexes. W. E. Allen, of Cambridge, Mass., is president; J. A. Comstock of Stoughton, Mass., vice-president, and B. F. Northbridge, of Worcester, Mass., treasurer.

THE MICA ELECTRIC SIGN COMPANY, of Cincinnati, Ohio, has been chartered with a capital stock of $10,000 by Hugh Mulholland, J[illegible] H. Wilson, Robert Scannell, E. B. Rogers and T. E. W[illegible]n.

THE NASSAU BURGLAR ALARM SERVICE, of New York, N. Y., has been incorporated with a capital stock of $[illegible] to manufacture and install alarm systems and apparatus. The incorporators are: J. [illegible] Conway, P. J. Muller, of New York, N. Y., and E. L. Vultee, of Rutherford, N. J.

THE PALO COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $5[illegible] for the purpose of doing a general contracting business and as electrical and mechanical engineers. The incorporators are: Edwin S. Lorsch, 2 West Eighty-ninth Street; Joseph P. Payor, 858 Hewitt Place, Bronx; Robert Steadle, 48 West Thirty-fifth Street, all of New York, N. Y

THE POWER LAND & IRRIGATION COMPANY, of Portland, Maine, has been incorporated with a capital stock of $500,000. The company proposes to construct reservoirs, dams, power plants, irrigation works, etc. C. E. Eaton is president and A. F. Jones, treasurer, both of Portland, Maine.

New Incorporations.

PAINTSVILLE, KY.—Articles of incorporation have been filed for the Paintsville Water & Light Company with a capital stock of $20,000 by H. M. Stafford, John E. Buckingham, S. Oppenheimer and others.

PORTLAND, MAINE.—The United Power & Light Company has been incorporated with a capital stock of $5,000 by M. S. Wells, H. L. Cram, C. E. McGlaulin, of Portland, Maine.

NEW YORK, N. Y.—The Westchester & Northern Railway Company has been incorporated to construct an electric railway from the White Plains terminal of the New York, Westchester & Boston Railway northward to Brewster and Danbury. A branch will also be built to Lake Waccabac and Lake Mahopac. Surveys have already been made for the proposed railway.

YONKERS, N. Y.—The Citizens' Electric Light, Heat & Power Company has been incorporated with a capital stock of $100,000 by Joseph L. Schwartz, Gideon H. Peck, Uriah Harris, Michael Lally, David J. Keith and others. The company proposes to construct and operate an electric light plant in Yonkers, N. Y.

Personal.

MR. FREDERIC GREER, president of the Harvard Electric Company, of Chicago, has been appointed a member of the Civil Service Commission of Cook County.

PROF. W. T. RYAN, of the electrical engineering department of the University of Minnesota, delivered an address on "High-Frequency Currents" before the Minneapolis Electric Club.

MR. W. S. LEE, chief engineer of the Southern Power Company, has been elected vice-president and chief engineer of the Greenville, Spartanburg & Anderson Railway, Greenville, S. C.

MR. FRANK K. SHUFF has resigned from Iowa State College to become superintendent of the Boone (Ia.) Electric Company, which operates the railway and lighting properties in Boone.

MR. LOUIS A. FERGUSON, second vice-president of the Commonwealth Edison Company, Chicago, is in Hot Springs, Va., with his family, enjoying an extended springtime vacation.

DR. S. W. STRATTON, director of the Bureau of Standards, will represent the United States government at an international convention on weights and measures to be held at Paris, beginning March 29.

MR. FRANK EASTON, recently deputy state engineer of Colorado, has become connected with the plant service department of the Western Union Telegraph Company, under Mr. Whitehead, division manager.

MR. J. S. KIRKPATRICK, formerly of the New York & Queens Electric Light & Power Company, Long Island City, has been appointed new business manager of the Eastern Pennsylvania Power Company, Easton, Pa.

MR. CLARENCE E. DELAFIELD has been appointed district manager for the Crocker-Wheeler Company in New England, with headquarters at 201 Devonshire Street, Boston. Mr. Delafield succeeds Mr. R. N. C. Barnes, who recently resigned.

MR. J. T. COWLING, head of the electrical department of the Westchester Lighting Company, Mount Vernon, N. Y., has been granted a leave of absence and will spend a month or more in Los Angeles, Cal., where he has gone for a much needed rest.

MR. RICHARD PAULING has arrived in Charlotte, N. C., from Germany to be present during the installation by the Southern Power Company of an equipment for manufacturing fertilizer by means of an electrostatic nitrogen fixation process in which he is interested.

MR. HENRY FLOY has just returned to New York from inspection of the Panama Canal. Mr. Floy was of the party made up by the American Society of Civil Engineers, which left New York on the steamer *Zacapa* for a three weeks' trip to Jamaica and the Canal Zone.

PROF. GEORGE ALFRED GOODENOUGH, for many years associate professor of mechanical engineering in the University of Illinois, has been promoted to be professor of thermodynamics. He is a graduate of Michigan Agricultural College and has written several text-books.

DR. GEORGE L. HOXIE, electrical engineer, New York, has been retained by the Board of Public Utilities of the City of Los Angeles to act as a member of a board of consulting engineers to advise on the fixing of rates for electrical energy for lighting and motor service.

MR. E. H. THORDARSON, of the Thordarson Electric Manufacturing Company, of Chicago, is on a visit to the East. Mr. Thordarson is taking advantage of the occasion to visit antiquarian book shops in order to make additions to his extensive collection of books on Iceland and the natural sciences.

MR. FRED HUME has been appointed superintendent of machinery of the Fort Dodge, Des Moines & Southern Railroad Company, Boone, Ia. Mr. Hume will have charge of the power house, transmission lines, substation and all matters pertaining to the operation and maintenance of electrical and mechanical equipment.

MR. FREDERIC W. HILD has been appointed general manager of the Portland Railway, Light & Power Company, Portland, Ore. Mr. Hild is a graduate of Union College, Schenectady, N. Y., and was until his present appointment chief engineer and assistant general manager of the Havana Electric Railway Company.

MR. H. B. STABLER, plant engineer for the Washington Division of the Chesapeake & Potomac Telephone Company, read a paper at the March meeting of the Baltimore Section of the American Institute of Electrical Engineers, held in the physical laboratory of the Johns Hopkins University, on "The Distribution System of a Telephone Plant."

MR. FRED E. GREENMAN, who had immediate charge of the construction and initial operation of the pioneer 110,000-volt transmission line of the Grand Rapids-Muskegon Power Company, Grand Rapids, Mich., left the electrical field in 1909, and is now assistant engineer for the Griffin Car Wheel Company, with offices at Chicago, Ill.

MR. GEORGE A. DAMON, of the Bion J. Arnold Engineering Company, lectured before the students of Throop Polytechnic Institute, on March 13, on the subject of "Transportation Problems," with special reference to the Pittsburg situation. Mr. Damon is at present engaged in an appraisal of the properties of the Southern California Edison Company.

MR. H. G. STOTT, past-president of the American Institute of Electrical Engineers and superintendent of motive power of the Interborough Rapid Transit Company, New York City, was tendered a banquet by the members of his staff recently at the Hotel Ansonia in commemoration of the tenth anniversary of his connection with the company.

MR. GEORGE D. PERRY, secretary-treasurer of the Great Northwestern Telegraph Company of Canada, has been appointed general manager of the company, succeeding Isaac McMichael, who died two weeks ago. Mr. Perry has been with the company since its organization, having filled the positions of stenographer, accountant, secretary, auditor and secretary-treasurer.

MR. WERNER F. VON SIEMENS, of Berlin, Germany, is on a visit to this country, during which he will inspect some of our more important metallurgical plants. Mr. von Siemens is accompanied by Chief Engineer Maleyka of the Siemens-Schuckert Werke and by Dr. J. Puppe. Dr. Puppe has been commissioned by the German Electric Railway Association to make a study during his visit of the causes of rail corrugation.

MR. S. E. DOANE, chief engineer of the National Electric Lamp Association, addressed the Engineers' Club of Cleveland on Tuesday evening, March 14, at the Chamber of Commerce. Mr. Doane spoke on "The Value of Co-operation in Engineering" and his talk was illustrated by lantern slides, showing how the standardization of materials in the incandescent-lamp industry has been made possible through co-operation.

MR. F. F. BARBOUR has been appointed assistant to the president of the Pacific Gas & Electric Company, San Francisco, Cal., in which capacity he will manage the railway system of the Sacramento Electric, Gas & Railway Company, Sacramento, Cal., and the commercial department of the Pacific Gas & Electric Company. Mr. Barbour was formerly assistant to the president of the Portland Railway, Light & Power Company, Portland, Ore., and was at one time special agent of the General Electric Company at San Francisco.

MR. ERNEST L. CLARK, president of the Valentine-Clark Company, was the guest of honor at a farewell dinner given in his honor on March 14 at the College Inn, Chicago, prior to his departure for Minneapolis, to which city his company has transferred its headquarters. Mr. Clark's popularity is shown by the fact that many of his principal business competitors attended the dinner and extended their good wishes. Mr. Clark, who is a former president of the Northwestern Cedarmen's Association, is a prominent figure in the cedar-pole industry.

MR. J. P. CLARK, vice-president and general manager of the Greenville, Spartanburg & Anderson Railway, Greenville, S. C., who has been acting as expert and consulting engineer to Mr. J. B. Duke, president of the company, in connection with the developments being carried out by Mr. Duke and his associates in North and South Carolina, will continue to act in the capacity of consulting engineer in this connection. Mr. Clark is also managing director of the North Carolina Public Service Company, Greensboro, N. C., and retains his connection with the Michigan United Railways, Lansing, Mich., as vice-president.

PROF. CHARLES RUSS RICHARDS, dean of the College of Engineering of the University of Nebraska, has been appointed professor of mechanical engineering, in charge of the department at the University of Illinois, effective September 1, 1911. Born in Indiana in 1871, Professor Richards graduated from Purdue in 1890. He received the graduate degree of mechanical engineer from the same university a year later and the degree of master of mechanical engineering from Cornell in 1895. He has been teaching at the University of Nebraska since 1892. A paper written by him on the heating value of corn and presented before the American Society of Mechanical Engineers some years ago when Western farmers were burning their corn attracted wide attention.

MR. P. T. GLIDDEN, formerly vice-president and general manager of the Binghamton Light, Heat & Power Company, Binghamton, N. Y., has been elected vice-president and manager of the Eastern Pennsylvania Power Company, Easton, Pa., which is controlled by the same interests. The Eastern Pennsylvania Power Company controls and operates the local companies formerly known as the People's Electric Light & Power Company and the Easton Steam Heating Company, and also the Bangor Electric

Light, Heat & Power Company, Bangor, Pa.; Dover (N. J.) Electric Light Company, Rockaway (N. J.) Electric Light & Improvement Company and the Warren County Power Company, Columbia, N. J. The company also operates the Monroe County Water Power & Supply Company, Stroudsburg and East Stroudsburg, Pa.

Obituary.

MR. FRANK KAISER, superintendent of the electric light company at Mott, N. D., was found dead in the plant Wednesday, March 15, alongside his dog, both having been asphyxiated as a result of inhaling gas fumes present in the station.

MR. JOHN B. McDONALD, the contractor who built the New York subway, died at his home in New York on March 17 after an illness of several weeks. Mr. McDonald was born at Fermoy, County Cork, Ireland, in 1844. He was brought to America by his parents in 1848. Almost all of his active life was spent at contracting, his earliest work along this line being with his father, who was a small contractor. In 1872 he was chief inspector of the Park Avenue tunnel work in New York. As contractor he conducted work for the West Shore, Illinois Central, Baltimore & Ohio, Boston, Hoosac & Western, Canadian Pacific, and Delaware, Lackawanna & Western railroads, the belt line in Baltimore, and the Jerome Park reservoir in New York. Although he never attended college, the honorary degree of Doctor of Science was awarded him by the University of Kingston, Canada, in 1905 shortly after the New York subway was opened.

Trade Publications.

INTERPOLE MOTORS.—Circulars Nos. 36, 37 and 38, containing revised information, descriptions, ratings and applications of interpole motors, have been issued in a single binding by the Electro-Dynamic Company, Bayonne, N. J.

ELECTRIC-VEHICLE METERS.—The Sangamo Electric Company, Springfield, Ill., has issued Bulletin No. 24, devoted to ampere-hour electric vehicle meters. The theory and application of these meters is discussed, and the pamphlet should prove of interest to central-station managers interested in the electric vehicle.

INSTRUMENTS AND METERS.—The Fort Wayne Correspondence School, Fort Wayne, Ind., has issued a catalog giving an outline of its course on instruments and meters, as well as a general statement of the purposes of the school. The course which the school gives on instruments and meters is said to be indorsed by the leading electrical men of the country.

DISTRIBUTION CURVES.—Distribution curves and full detailed reports of the Electrical Testing Laboratories of New York on four-lamp shop clusters and shop units, built by the American Arc Lamp Company, Kalamazoo, Mich., have been reproduced in book form by the latter company for distribution to electrical engineers, electricians and others interested in the subject.

ELECTRICAL SUPPLIES.—The Mohawk Electrical Supply Company, Syracuse, N. Y., has issued Booklet No. 2, stating in general the class of electrical merchandise which it carries in stock and for which it solicits orders. The line includes central station and line equipment, telephone supplies, bell wiring and automobile supplies, electric heating and cooking material, portable and stationary vacuum cleaners, etc.

FAN MOTORS.—The Robbins & Myers Company, Springfield, Ohio, has issued its fan catalog No. 94, devoted to "Standard" direct-current and alternating-current ceiling, desk, oscillating and exhaust fans. The "Standard" fans have now been marketed for fifteen seasons, and are noted for their qualities of durability, efficiency and artistic design. The line is complete in every particular, and includes fans for every purpose and purse.

SHOP-LIGHTING FIXTURES.—The American Arc Lamp Company, Kalamazoo, Mich., has issued Bulletin No. 44, comprising a catalog of clusters and fittings for shop lighting, and shock absorbers for tungsten lamps. The latter are interchangeable and may be used with any of the clusters or units. The former are of steel, with porcelain enamel or steel shades, and are fitted with tungsten lamps. They are fully wired and furnished with ceiling crowfoot or absorber.

LIGHTNING ARRESTERS.—The Electric Service Supplies Company Philadelphia, Pa., has bound into a single publication bulletins Nos. 48, 49, 50, 51, 53, 54 and 55, dealing with the Garton-Daniels lightning arresters for direct-current and alternating-current circuits. The bulletins have been revised, and not only contain very good descriptions of the operation and construction of the particular types of apparatus, but also give complete diagrams of installations for arc circuits, direct-current circuits of voltages up to 1300, alternating-current circuits of voltages up to 20,000 and railway circuits.

HYDRAULIC TURBINES.—Bulletin 102, issued by the S. Morgan Smith Company, York, Pa., manufacturers of water turbines, contains a quantity of information relating to the setting of water wheels, illustrating various applications of the turbines made by the company, to practical conditions of head, dam construction and intake flumes. Smith turbines are built to operate under a range of heads from 3 to 47 ft. and can be furnished in several speeds, and with cylinder or wicket gates. The installations described and illustrated in the bulletin relate to hydroelectric developments, mill drives, etc.

BUSINESS NOTES.

THE MITCHELL-RAND MANUFACTURING COMPANY will move on March 25 to its new offices in the Phelps-Dodge Building, 99 John Street, New York.

WALKER VEHICLE COMPANY.—The Automobile Maintenance & Manufacturing Company announces the change of its name to Walker Vehicle Company. The company manufactures electric commercial vehicles, using the Walker balance-drive gearing. Its address is 217 South Green Street, Chicago.

BUCKEYE LAMP MEXICAN OFFICE.—The office in Mexico City of the Buckeye Electric Lamp Company has been moved from Avenue 16 de Septiembre No. 5 to Avenue Juarez No. 14. Mail matter for the Buckeye Electric Lamp Company of Mexico City should be addressed Apartado Postal No. 746. Mr. Walter Ennes is manager of the Mexican office

THE RICHARDSON-PHENIX COMPANY, of Milwaukee, Wis., has recently opened a branch office in the Keystone Building, 324 Fourth Avenue, Pittsburgh, Pa., under the management of Mr. H. H. Laughlin, who has been with the Richardson-Phenix Company for several years. Questions concerning the economical lubrication of any kind of machinery can be given personal attention by Mr. Laughlin.

STUDENTS VISIT TRIUMPH WORKS.—A delegation of third-year students from the Kentucky State University, Lexington, Ky., visited the plant of the Triumph Electric & Ice Machine Company on Wednesday, March 15, and were conducted through the plant by employees, who explained the various methods of manufacture. The visitors were particularly interested in machine-tool design and had selected the Triumph company as part of their itinerary on account of the modern and up-to-date equipment employed in these shops. After a most instructive and pleasant time, the students left on a late afternoon train en route for Hamilton to inspect some of the large factories in that city.

BISSELL CHICAGO OFFICES.—The Bissell Motor Company has opened two offices in Chicago. Of these one is at 33 East Munroe Street, opposite the Palmer House, with E. J. Fisher in charge as manager. This is on the ground floor, and has a show window for demonstrations of the Bissell sewing machine motor. The other is at 512 Monadnock Block, from which a staff of canvassers will be directed. In the campaign thus opened in Chicago in the interests of the Bissell sewing machine motor, department stores and sewing machine dealers selling Bissell motors will be supported. Eugene Willoughby, recently with the Chicago Independent Telephone Company, has been appointed general manager of the Bissell Motor Company. Mr. Willoughby's headquarters are temporarily in Chicago, 512 Monadnock Building, but will be shortly moved to the factory at Toledo.

THE BURKE ELECTRIC COMPANY, Erie, Pa., marked the opening of a large new factory building, February 22, by tendering a complimentary dance and banquet to its employees and friends. The new building, 338 x 50 ft., which will be used for the storage of finished parts and for assembling, testing and shipping, was decorated in honor of the occasion and was used as the dancing pavilion. Exhibits of the varied lines of generators, motors, transformers, drills and apparatus manufactured by the Burke company were laid out in the other shops of the factory and were viewed by altogether about 3,000 people during the day. The officers of the Burke Electric Company are: President, James Burke; vice-president, George H. Winkler, Jr.; treasurer, G. Irving Blake; secretary, Charles H. Schum; works manager, E. F. G. H. Faure. Mr. Isidore Hernsheim is chairman of the board of directors.

THE FEDERAL ELECTRIC COMPANY, Lake and Desplaines Streets, Chicago, on March 1 completed arrangements whereby the sale of goods manufactured by the company will be handled exclusively by the Federal Sign System (Electric), as selling agents. The latter corporation has main offices at 501 Home Insurance Building, Chicago, and 229 West Forty-second Street, New York City, with branch offices in fourteen other large cities. The Federal Electric Company will in the future conduct the manufacturing end of the business exclusively. The company will continue the manufacture of Federal signs, fixtures, supplies, vacuum cleaners, electric kitchen cabinets and other Federal specialties. The regular representatives of the Federal Electric Company will continue as agents of the Federal Sign System (Electric), and the selling force of the Federal Electric Company will be transferred to the selling corporation.

NEW G. E. NEW YORK CITY WAREHOUSE.—A large and commodious fireproof warehouse building, of modern steel and concrete construction, has just been completed for the General Electric Company at the corner of Greenwich and Morton Streets in New York City. This handsome new building is more than twice the size of the present quarters at [illegible] West Street, where the company's warehouse has been located for the past twenty years. The building, which will be ready for occupancy about April 1, has nine floors, aggregating 90,000 square feet of floor space, [illegible] providing ample space for storing the numerous electrical appliances manufactured by the General Electric Company. Steel bins and racks, of a special pattern, have been installed for the accommodation of loose stock, etc. Two freight elevators will be used to handle the freight and express, insuring the speediest shipping facilities. Another elevator will transport passengers from floor to floor. The increased floor space and improved shipping facilities will enable the company to carry a much larger stock to meet the demands, which have grown far beyond present accommodations. The new building is located near the shipping center of New York and close to the principal steamboat piers.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 7, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City]

986,396. CABLE TELEGRAPH APPARATUS; I. Kitsee, Philadelphia, Pa. App. filed May 21, 1909. A telegraph relay with siphon recorder whose movable coil moves a delicate contact controlling a plurality of sources of energy causing reproduction of clear signals irrespective of the shifting zero.

986,405. TRANSMITTING APPARATUS FOR WIRELESS TELEGRAPHY; P. O. Pedersen, Copenhagen, Denmark. App. filed March 6, 1907. An oscillation circuit for producing continuous oscillations, an antenna circuit, a compensation circuit and a key to alternately connect the antenna and compensating circuit to the oscillating circuit.

UNITED STATES PATENTS ISSUED MARCH 14, 1911.

986,463. SELF-ADJUSTING FUSE; J. O. Holton, Jr., Monett, Mo. App. filed Jan. 20, 1910. Fuse and lightning arrester avoiding the cleaning out of carbon dust after electrical storms by providing a special form of fuse block and by replacing a fuse, the overcharge being conducted to ground during replacement of a fuse by means of a choke coil which deflects the overcharge to ground while the automatic successive fuse is operated.

986,488. ELECTRIC IRON; R. P. Moodie and C. W. Ball, Ottawa, Ontario, Canada. App. filed Aug. 14, 1908. Electric sadiron with cylindrical recesses for the heating coils, hollow cores carrying the heating conductors inserted therein.

986,505. PROCESS FOR PRODUCING ALLOYS OF TITANIUM WITH OTHER METALS OR THE LIKE; A. J. Rossi, Niagara Falls, N. Y. App. filed May 6, 1910. Produces on the surface of a bath of molten copper a covering comprising oxid of titanium, carbon and a chemical compound of calcium and raises to a temperature to reduce the oxide.

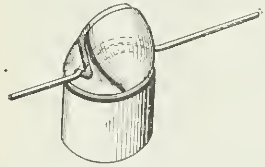
986,506. PROCESS OF COUPLING PIPES; F. Sargent, Chicago, Ill. App. filed Nov. 3, 1910. The joint is sealed by welding the abutting ends together, while held by a mechanical clamp.

986,554. MAGNETIC SEPARATOR; A. Dings, Milwaukee, Wis.. App. filed March 6, 1907. Electro-magnetic separator with a shaft connected to a carrier wheel which carries an annular series of magnetizable members serving as auxiliary pole pieces, a conveyor of less width than the diameter of the wheel extending across one face of it, and sets of electro-magnets straddling the conveyor and having polar projections extending inwardly and toward the conveyor.

986,558. METALLIC FILAMENT FOR INCANDESCENT ELECTRIC LAMPS; K. Farkas, New York, N. Y. App. filed Aug. 6, 1909. The filament has an inner conductor core and the coating is applied by decomposing with the electric current vapors of a compound of high refractory metal mixed with the vapors of a salt of a ductile metal and vapors of pyro gallol.

986,570. IRON-CLAD ELECTRIC SWITCH; V. Hope, Manchester, England. App filed Aug. 10, 1909. The switch blades act independently of the handle with a quick action by means of a coiled tension spring between blades and handle. Details.

986,606. TELEPHONE BODY SUPPORT; V. Tardieu, Arles, France. App. filed Nov. 29. 1909. For suspending microphones by means of a bridle mounted on the head. Details.



986,702.—Insulator.

986,639. SELECTIVE SIGNALING MEANS; I. F. Manny, Milwaukee, Wis. App. filed Nov. 29, 1909. For telephone systems operated from central to call a station, by means of a motor-driven mechanism detained by a magnet-controlled pawl, starting a step-by-step mechanism.

986,643. ELECTRIC RELAY; C. O. Poor, Rochester, N. Y. App. filed Aug. 10, 1908. For electric railways, all the parts being within a casing, excepting the fixed contacts which are removably mounted on top for cleaning.

986,651. SPACE TELEGRAPHY; J. S. Stone, Boston, Mass. App. filed March 12, 1908. Arranges an electrolytic receiver in a shunt to a condenser, forming a resonant circuit tuned to the wave frequency.

986,702. INSULATOR; D. H. Friend, Canton, Ohio. App. filed May 24, 1910. For supporting telegraph wires by insulator with an annular groove on its under surface and a cone-shaped slotted head.

986,706. ELECTROTHERMOSTATIC ALARM SYSTEM; A. Goldstein New York, N. Y. App. filed Aug. 6, 1910. Gives an audible alarm at station and central by producing a high-frequency current and actuating two alarm devices, one responsive to the said current, the devices being in the nature of loud-speaking telephones.

986,707. ELECTRICAL CIRCUIT CONTROLLER AND ALARM; A. Goldstein, New York, N. Y. App. filed Aug. 6, 1910. Imposes a frequency on the circuit for producing an audible alarm signal controlled by a thermostat, the apparatus upon increase in current giving a local alarm and producing the frequency for operating the distant device.

986,708. AUTOMATIC CIRCUIT BREAKER; A. E. Greene, South Boston, Mass. App. filed June 12, 1905. Switchboard circuit breaker operated manually with a single magnetic control responsive to overload and underload, there being a tripping armature for the catch and a latch operated by the armature, the armature and latch receiving the catch for retaining the circuit breaker between them.

986,714. ELECTRIC SWITCH; H. Hull, Denver, Colo. App. filed June 15, 1909. For animal traps to fire an explosive cartridge when the animal snaps the bait.

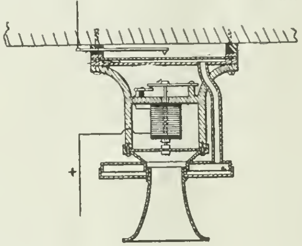
986,715. GAS ALARMS; A. B. Jacobus, Kansas City, Mo. App. filed Nov. 24. 1909. Gives an alarm when the room fills with gas by means of a battery and magneto controlled by chamber provided with a flexible diaphragm.

986,743. SOCKET FOR ELECTRIC GLOW LAMPS; T. E. Murray, New York, N. Y. App. filed July 24, 1909. The socket is cup-shaped and integral of a single piece of porcelain and has openings for the circuit wires so constructed as to prevent access thereto after the parts are in place.

986,744. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed Oct. 25, 1910. Cut-out box comprising a base block, a fuse case, a detachable cover for the block between the block and the case, contacts on base and cover and a fuse connected to the cover contacts.

986,748. DYNAMO-ELECTRIC MACHINE; C. M. Page, Chicago, Ill. App. filed May 2, 1910. The machine has an armature and can be used either as a generator or motor, there being two electrically independent field windings, either of which may be used for the particular purpose desired, with a double throw switch for controlling the windings.

986,787. TELEPHONE SYSTEM; A. H. Weiss, Chicago, Ill. App. filed March 30, 1907. Controls a central office signal by means of a single relay with an intermediate degree of actuation to display a signal when the subscriber calls central, which is completely actuated to efface the signal when the cord circuit is connected with the line.



986,707.—Electrical Circuit Controller and Alarm.

986,806. REFLECTOR FOR WIRELESS TELEGRAPHY; R. d'Antonio, Aquila, Italy. App. filed Jan. 27, 1910. The reflectors maintain a horizontal plane, irrespective of the angle of the deck of the vessel by means of ball bearings and counter weights.

986,823. ELECTROPLATING MACHINE; J. W. Heaphy, Philadelphia, Pa. App. filed June 30, 1910. Horizontally supported rotary casing for containing the solution, there being an anode in the casing rotatable in unison with the work support in opposite direction to the casing.

986,842. TROLLEY; J. S. McCabe, Bridgeville, Pa. App. filed Jan. 24, 1910. Trolley harp has a guard forming jaws between which the wire runs the jars being provided with frictional wheels which contact with the wire and special lubricating means and a hollow bearing for the trolley wheel.

986,843. HANGER FOR TROLLEY WIRES; W. A. McCallum, Cincinnati, Ohio. App. filed May 19, 1910. To provide a yielding upward structure for suspending the wire from the cable. The cable carries brackets from which toggle levers depend, at the joint of which is secured a support for the trolley wires.

986,845. ELECTRICAL WELDING MACHINE; E. E. McIntyre, Pittsburgh, Pa. App. filed Sept. 23, 1910. For welding pulleys; the welders are kept in engagement with the work under a state of compression.

986,887. LOCK FOR SWITCHES; G. Wuelser, New Kensington, Pa. App. filed June 18, 1910. Combination lock for switches. Details.

986,889. SECRET SERVICE TELEPHONE CIRCUITS AND SWITCHING MECHANISM; A. K. Andriano, San Francisco, Cal. App. filed March 15, 1905. A home line for each station, a common return for a plurality of stations, a primary circuit with line-selecting switch at each station and a circuit-connecting device connecting primary with current source through the home line and cutting out the home line and connecting the primary to the line-selecting switch in another position, a ringing circuit over the home line.

986,952. LOCKING DEVICE FOR TELEPHONES; W. A. Soles, New York, N. Y. App. filed April 22, 1910. Locks the hook for the receiver to prevent unauthorized use by means of a brace engaging hook and support and a lock for holding the brace against removal from the switch lever.

986,958. ELECTRIC SWITCH; C. Woods and W. H. Sayles, Peoria, Ill. App. filed Dec. 18, 1908. Door switch for elevator cars for breaking the motor circuit when the door is open by means of a pivoted arm controlling terminals and a push rod, operated by the door.

986,991. PULL CHAIN GUIDE FOR SOCKET. O. E. Kenney, Toledo, Ohio. App. filed Jan. 6, 1911. The chain guide may be attached radially to the socket shell, or tangentially.

987,036. SAFETY COUPLING FOR ELECTRIC CONDUCTORS; A. Belgoder, Mexico, Mexico. App. filed May 26, 1909. The sections of the wire are connected by a coupling which is automatically uncoupled when any section is broken to avoid danger to persons.

987,044. DYNAMO-ELECTRIC MACHINE; J. Burke, Erie, Pa. App. filed May 1, 1907. For supplying a three-wire, direct-current system by means of a direct-current generator, having a plurality of auxiliary dynamo windings on the armature core, each of the auxiliary windings having less than one-half of the conductors per circuit of the main winding, certain conductors of the auxiliary windings being located unsymmetrically to each other.

987,058. APPLE BAKER; W. F. Fowler and Charles H. Mead, Indianapolis, Ind. App. filed Nov. 22, 1909. An electrical apple baker with disk and vertical posts, the electrical resistance wire being embedded in the posts.

987,072. RAIL BOND; G. A. Humason, Shreveport, La., and E. F. Odell, Greenville, Tex. App. filed March 19, 1910. Rails with their ends close together and having contacts, a key inserted between them and resilient members between the contacts and the rail.

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WATER-POWER CONFERENCE.

As noted already in these pages, a conference is to be held in New York City in the Engineering Societies Building on April 8, under the auspices of the Power Transmission Section of the National Electric Light Association, on the subject of the relation of the national and state governments to the conservation and utilization of water-powers and other sources of natural energy. This is an important meeting, and, as members of other engineering bodies are being invited to participate, the discussion may reasonably be expected to throw light upon a vexed question and help to shape public opinion as well as guide legislation in the near future. The list of topics to be presented for consideration indicates how varied are the aspects of the matter, altogether aside from any engineering problems involved; and yet it is difficult to determine any engineering issues until some or all of these broader relationships are adjusted and settled. All recognize the fact that the only true policy of conservation lies in the utilization of natural sources of energy hitherto utterly wasted through thousands of years, while the finite sources have meantime been diminished or wiped out. With 5,000,000 hp developed out of a possible 35,000,000 hp—to name the lowest limit—and with much of the available power located on public lands, it is plain that the hour has arrived for working out a forward policy of the future, when by equitable laws and regulations capital can be invited to enlist and when the public can benefit from its own liberality exercised through its agents.

The National Electric Light Association has a vital interest in the fair and proper settlement of the questions now raised, for it includes in its membership practically all the large power companies, and central stations are more and more turning to distant sources of energy for their supply. We are glad to note, therefore, its action at the present time in promoting calm and thoughtful discussion of the subject and trust that a very general participation in the conference will aid in reaching conclusions of the highest usefulness to the nation.

THE STRENUOUS LINE BUILDER.

One of the most interesting of the line constructions which have been brought to our attention recently is that of the United States Reclamation Service in Arizona, described elsewhere in our columns. It covers in all something over eighty miles, including branches, and runs through what used to be known in our grandfathers' geographies as "the Great American Desert," now, thanks to effective reclamation, far on the way toward usefulness. The line is in general of the familiar tower construction, arranged to carry two three-phase transmission circuits, but a portion of it is formed by triangular steel poles of latticed construction. Both poles and towers are set in concrete bases wherever rock was not available. From the engineering standpoint the interesting feature of this line building was the systematic and workmanlike way in which it was carried out. Each tower was marked with its appropriate location, preparations were made to receive it, and all towers were as far as possible erected on the ground and pulled into position with gin poles. Carried out in this way the erection of towers was a comparatively simple task, a crew of six men averaging ten towers a day, which comes pretty near to being a record performance. The erection of the line itself was carried out with similar facility. The insulators were assembled in the field and the stringing gang of twenty-three to twenty-five men made good time over the line.

The completeness of the system of inspection and the thoroughness of the work are well in evidence from the fact that after completion the line when tested out showed no sign of trouble of any kind. In fact, the only source of acute trouble found later was the familiar one of large birds perching on the tower and short-circuiting the line with their wings. The only other material source of trouble—malicious injury to the line by throwing wire across it or "shooting up" the insulators—is not so easily remedied. A little popular education emphasized by the strong arm of the law may help matters. Altogether this transmission system presents a very clean, well planned and well executed example of modern line construction. It would be interesting to know the relative cost of the tower and pole construction respectively. We have always had rather a fondness for the steel pole of moderate height in transmission-line construction. It is going to be used in the future a great deal more than it has been in the past, and we trust that data as to its cost and performance will shortly be forthcoming.

EXAGGERATED FEARS.

In protesting against the electrification of steam railroad terminals in large cities, men employed by the railroads in the operating department have in several cases painted the alleged dangers of electric railway operation in language curiously exaggerated. Thus, representatives of the labor unions of switchmen, firemen and conductors in a recent communication authoritatively informed the Chicago City Council that "the study of electrical knowledge has not yet advanced far enough to apply to conditions as they exist in Chicago," and "that a change from steam to electricity, in the present state of the science, means the loss of thousands of lives every year." A table is given, attributed to the Interstate Commerce Commission, showing that in 1910 3383 employees were killed and 68,618 injured by railroad accidents in the United States. Following this showing of hazardous occupation, the committee goes on: "It is dangerous enough to cut cars on a dark night and obey the signals of a swinging lantern 100 ft. away. It will be three times as dangerous if the switchman, in addition to watching out for moving cars, shall have to protect himself against instant death from touching a charged rail or a swinging wire."

It seems improbable that these assertions could have been made honestly and in good faith by a body of intelligent men, and that they really believe the change from steam to electrical operation in Chicago will cause "the loss of thousands of lives every year." It is singular, also, that, while causes of deaths from "train accidents," "coupling accidents," "overhead obstructions," "falling from cars" and "other causes" are given, electricity is not mentioned. Deaths from electrical shock or burn would be an important hazard and would merit distinct classification by the Interstate Commerce Commission. Of course the statistics relate principally to steam operation, but not exclusively so. A table prepared by a committee of the American Railway Engineering and Maintenance of Way Association and dated Oct. 17, 1910, shows seventeen railroads using both third-rail and steam equipment. The list contains such roads as the Albany Southern, Baltimore & Ohio, Lackawanna & Wyoming Valley, Long Island Railroad, Northern Electric Railway of Chico, Cal., Pennsylvania Tunnel & Terminal, Philadelphia & Western, West Jersey & Sea Shore, New York Central terminal and New York Central (Utica to Syracuse). If the "deadly third rail" is really deadly, why are not the records set forth?

The truth is that, with protected contact rails and the conspicuously substantial, rigid construction adopted for overhead lines in heavy railroad work, the danger of serious injury, much less of death, is extremely slight, with the exercise of ordinary prudence. Furthermore, with electric railroading there is no possibility that the engineman and fireman will be scalded, in a wreck, by escaping steam, while the danger of fire is greatly lessened. The use of electrical energy for railroad operation is a step forward, not backward, and in the years to come this fact will be acknowledged freely by all railroad men. As a matter of fact, it is believed that the switching problem in Chicago will be met by the utilization of great freight-car sorting yards, outside the city, where steam locomotives will be used, electricity being employed in the city for the operation of passenger trains and freight trains made up in the yards for the several freight warehouses. So in this particular case the apprehensions of the switchmen are groundless, in large measure, for this reason.

THE WIRELESS AMATEUR.

Attempts to report the recent naval experiments in Chesapeake Bay by wireless met all kinds of trouble from the omnipresent amateur, with his often crude, but sometimes perniciously effective, sending apparatus. Apparently selectivity is rather the exception than the rule in spite of all the protests to the contrary which we hear. Certain it is that, although there have been within the last year or two some very wonderful wireless performances in point of distance, good communication is by no means a sure thing even at short range, for reasons unpleasantly practical instead of theoretical. This sort of thing is continually occurring, ranging from unintentional but none the less mischievous interference by casual experimenters to the malicious sending out of false news. It would be indeed unfortunate if experiments on improvements in methods of wireless communication had to be seriously checked by government regulations, but such will inevitably be the necessity unless the more gentle restrictive measures become effective. Just how far such restriction should go in order to give the maximum of liberty consistent with public policy it is rather difficult to say; but the number of wireless plants erected purely for amusement and without even the intention of serious experimenting is very large. One can scarcely go through a village without seeing evidence of this kind of activity, and around any of our large cities meddlesome antennæ can be counted by the score. Nothing short of government supervision is going to remedy the matter, and, unpleasant as this remedy is, it will certainly be applied after a few more experiences like that of last week. The government certainly will not allow promiscuous experiments on lighthouse lenses to be carried out along our seaboard, much less beacons extemporized without any intention of serious experimenting. The same kind of objection holds for the wireless meddler, and he will have to be repressed, gently and amiably we trust, but none the less effectively.

A TWO-DIMENSIONAL ALTERNATING-CURRENT POTENTIOMETER.

For visualizing alternating-current relations in order to impress them most forcibly upon the brain by way of the eye the well-known vector diagram possesses features which render it far preferable to the algebraic method. It seems almost like simplifying simplicity to combine with the diagram a scheme for causing the phenomena represented to take place in the very sheet of material upon which the diagram itself is located. Such a scheme, however, has been devised, and developed to a practical stage, by Messrs. A. E. Kennelly, H. G. Crane and J. W. Davis, as shown by an article appearing elsewhere in this issue. The scheme has for its foundation the production of a rotating electrical field by superposing within a thin sheet of conducting material two equal single-phase currents in quadrature in time and in space. The resultant current within the sheet possesses a constant strength and revolves synchronously, just as is true of two equal single-phase magnetic fluxes in time-quadrature when superposed in space-quadrature.

The problem of superposing two currents in space-quadrature within a sheet of conducting material in such a way that the terminal for introducing one current does not affect the path of the other current proved one requiring considerable care. Instead of connecting each terminal directly and thereby in effect short-circuiting the sheet in the path of the current of the other phase, the authors employed an ingenious "fringing" device, consisting of high-resistance wires through which the current was led to the sheet along definite lines. Even with the currents separately directed along definite flow lines the potential difference due to the presence of the one current affects the paths taken by the other current, the combined result being the rotation of the potential difference in the sheet: it is the rotating potential difference rather than the rotating current that is made use of directly in the two-dimensional potentiometer. In fact, special precaution had to be taken to minimize the large magnetic effect of the current in the sheet before the small rotating potential difference could be utilized with a sufficient degree of accuracy.

In utilizing the rotating potential difference for potentiometer purposes the alternating potential difference between two selected points on the sheet is used as the source of current for a certain resistance, and a second alternating potential difference between another point and one of the former is used as the source of current for an impedance. The adjustments are so made that the currents in the resistance and impedance are not only equal in value, but are directly in time-phase with each other. It is then known that the resistance bears to the impedance the direct ratio of the potential differences, while the resistance component of the impedance bears to the reactive component thereof a ratio equal to the ratio of that component of the potential difference between the terminals of the impedance which is in time-phase with the potential difference across the resistance to that component of the same potential difference which is in time-quadrature thereto. The ratios of the potential differences are measurable on the sheet as certain linear dimensions, while the time-phase angles are shown directly as plane angles on the sheet. Thus the complete vector diagram of the impedance is represented directly on the sheet, as explained in detail in the article in this issue.

WIRELESS TELEGRAPH WAVES IN THE EARTH'S CRUST.

Notwithstanding the fact that we now have abundant experimental evidence in laboratories concerning the nature and mode of propagation of electric waves through space, and that the mathematical theory of this propagation was worked out by Maxwell about half a century ago, yet the fundamental principles of wireless-telegraph wave propagation are either not known to or not acknowledged by many competent wireless-telegraph experimenters. The existing accepted theory of wireless-telegraph wave propagation is that an inverted hemispherical electromagnetic wave is thrown off from the sending antenna at each cycle of its oscillation, assuming that the surface of the earth or sea be regarded as perfectly conducting. The hemisphere spreads in three dimensions, with light velocity; or its radius in all directions above the horizon, as measured from the sending station, expands with light velocity The pole of the hemisphere lies vertically above the mast and is devoid of electromagnetic forces. That is, the hemispherical wave has a hole in it at the pole or zenith, but as we descend from the zenith in any direction the wave at given radius increases in intensity down to the equator. If the conducting earth were flat, as our ancestors believed a few centuries ago, the hemispherical form of the wave would go on to the end, but with a globular earth the wave bends over the surface, and the hemispherical form tends to resign in favor of a more nearly spherical form. What happens in the upper regions of the air is hard to find out and is open to debate, so that, except in a ring near the surface of the earth, we cannot gather experimental evidence of the wave development. The meridian lines of the hemisphere correspond, however, to electric flux paths and parallels of latitude to magnetic flux paths.

Actually the earth's surface is far from being a perfect conductor, so that instead of the electric flux terminating sharply on a charge ring or electric current moving over the surface the flux penetrates more or less deeply according to the dryness and electric constants of the soil, burying electromagnetic energy as it goes, and depleting the energy store in the air wave above. A mountain range, like the Alps, of dry and solid rock absorbs the waves down and forms a barrier to wave transmission. On the other hand, a mass of dry, solid rock would behave something like the air, and a wireless-sending station in a deep hole within such dry rock should emit spherical waves with little absorption, like a Hertzian oscillator in free space. An interesting experimental inquiry in this direction has recently been published by Dr. Gotthelf Leimbach in the *Elektrotechnische Zeitschrift*, as abstracted in this week's Digest. It was found that wireless waves generated in a mine pit were very speedily absorbed if the surrounding rock was wet, but in dry material waves could be sent through a mile of rock at a mean depth of some 1500 ft. below the surface from one mine to another and with relatively little absorption. These observations confirm the existing accepted theory of wireless-wave transmission. They account for the fact that over such districts as the high and dry rocky veldt of South Africa the ordinary wireless signals rapidly dwindle and disappear, whereas over moist, alluvial soil, and particularly over the ocean, they persist. Whether underground wireless exploration can lead to the detection of buried ore bodies remains to be proved.

President Vail on Public-Utility Regulation.

In the annual report of the American Telephone & Telegraph Company President Vail discusses in detail the subject of public control or regulation of public-service corporations by permanent commissions. Throughout the country the relations of his company and its associated companies with the public service commissions of the several states have, he says, been on the whole of a very satisfactory character, and there has been little difficulty in working in harmony with these commissions in solving the problems which in a growing business constantly demand attention.

Corporate organization and combination are stated to be the necessary and logical solution of the problem of caring for the wonderful development which has been going on all over the world, and particularly in this country, in the recent past. The proper use of corporate organization or combination under suitable regulation or control cannot be objected to, but what is and should be condemned, prevented and punished is the abuse made of corporate machinery to the detriment of public welfare, and for purely speculative and oftentimes swindling enterprises. It is largely because of such abuse, mostly on a small scale and by elements not in any way associated or connected with great business organizations or systems, that popular odium has attached to this necessary machinery of business.

After sketching the source and growth of the conflict between public-utility corporations and the public—between the "servers," and the "served"—President Vail expresses the opinion that public control or regulation of public-service corporations by permanent commissions has come and come to stay. Control or regulation exercised through such a body has, he says, many advantages over that exercised through regular legislative bodies or committees. The permanent commission will be a quasi-judicial body. It should be made up of members whose duty it will be, and who will have the desire, the time and the opportunity, to familiarize themselves with the questions coming before them. It should act only after thorough investigation and be governed by the equities of each case. It would in time establish a course of practice and precedent for the guidance of all concerned.

Experience also has demonstrated that this "supervision" should stop at "control" and "regulation" and not "manage," "operate" or dictate what the management or operation should be beyond the requirements of the greatest efficiency and economy. Management or operation requires intimate knowledge and experience, which can be gained only by continuous, active and practical participation in actual working, while control or regulation can be intelligently exercised, after judicial hearing, by those who have not the knowledge or experience to operate.

State control or regulation should be of such character as to encourage the highest possible standard in plant, the utmost extension of facilities, the highest efficiency in service, rigid economy in operation, and to that end should allow rates that will warrant the highest wages for the best service, some reward for high efficiency in administration, and such certainty of return on investment as will induce investors not only to retain their securities, but to supply at all times all the capital needed to meet the demands of the public.

President Vail considers that such "control" and "regulation" can and should stop all abuses of capitalization, of extortion or of overcharges, of unreasonable division of profits. But if there is to be state control and regulation, there should also be state protection—protection to a corporation striving to serve the whole community (some part of whose service must necessarily be unprofitable) from aggressive competition which covers only that part which is profitable. Governmental control should protect the investor as well as the public. It should insure to the public good service and fair rates. It should also insure fair returns to the investor.

President Vail says that state control and regulation, to be effective at all, should be of such a character that the results from the operation of any one enterprise would not warrant the expenditure or investment necessary for mere duplication and straight competition. In other words, the profits should not be so large as to warrant duplication of capitalization in the competition for the same business.

"Control" will give more of the benefits and public advantages which are expected to be obtained by state ownership than could be obtained through such ownership, and will obtain them without the public burden of either the public office-holder or public debt or operating deficit. It is conceded that as a rule private management is better, more economical and more efficient than public management, and much more advanced and enterprising. The economical margin between public and private management has been shown by experience to be more than sufficient to secure the best private administration. When through a wise and judicious state control and regulation all the advantages without any of the disadvantages of state ownership are secured, state ownership is doomed.

State control of public utilities should not prevent progress, should be sufficiently unrestricting to encourage the introduction and demonstration of the value of any new or novel enterprise, and should allow sufficient reward for the initiative, enterprise, risk and imagination of the adventurers behind such enterprises. It should discriminate between the useful adventurers or promoters, pioneers in fact, and those pirates or sharks who, on the strength of other successes, extravagantly capitalize undeveloped ideas and exchange worthless securities for the savings of deluded and credulous investors. Corporate control and restriction should always exist to a sufficient degree to prevent such speculative promoting and such stock-jobbing schemes.

The regulation or control of any new or novel thing which is a mere convenience and not a necessity can be left largely to the laws of trade; such a thing, if offered, must be offered at a price acceptable to the public, who are the customers, at a price which in the opinion of the purchaser leaves him a margin of profit either in convenience or enjoyment. Under such control private initiative can be depended upon for the introduction of everything believed to have beneficial possibilities.

State control or regulation, to be effective, should when exercised be accepted and acquiesced in by the public. If all the decisions not in exact accord with the desire or contention of the public are condemned, if it is expected and required that all decisions be against the utilities controlled, if politics and political effect are to govern decisions, if decisions go for nothing with and are not respected by the public, failure and disappointment are bound to follow, self-respecting men will refuse to act, the standard of appointments will fall, and state control and regulation will become a disgrace, and the evils which it was intended to correct will multiply.

If any company gives good service, meets all the reasonable demands of the public, does not earn more than sufficient to provide for the maintenance of its plant up to the latest standard and for reconstruction of plant when worn out or obsolete, pays only fair dividends to its shareholders—if a company is only doing this its rates and charges to the public cannot be unreasonable.

President Vail then takes up in detail the question of competition versus control or regulation. Effective, aggressive competition and regulation and control are, he says, inconsistent with each other and cannot both be had at one and the same time.

Control or regulation, to be effective, means publicity; it means semi-public discussion and consideration before action; it means deliberation, non-discrimination; it means everything which is the opposite of and inconsistent with effective competition.

Competition—aggressive, effective competition—means strife, industrial warfare; it means contention; it oftentimes means taking advantage of or resorting to any means that the conscience of the contestants or the degree of the enforcement of the laws will permit. To make competition effective great and uncontrolled latitude of action is necessary; action must be prompt and secret.

Aggressive competition means duplication of plant and investment. The ultimate object of such competition is the possession of the field wholly or partially; therefore it means either ultimate combination on such basis and with such prices as will cover past losses, or it means loss of return on investment and eventual loss of capital. Howsoever it results, all costs of aggressive, uncontrolled competition are eventually borne, directly or indirectly, by the public.

Competition which is not aggressive presupposes co-operative action, understandings, agreements, which result in general uniformity or harmony of action, which, in fact, is not competition but is combination, unstable but for the time effective.

Annual Report of the American Bell Telephone and Telegraph Company.

The annual report of the American Bell Telephone & Telegraph Company for 1910 is of particular interest, owing to the discussion therein by President Vail of a number of subjects of general interest, such as corporate organization and combination, public control, competing exchanges, etc. An abstract of the part of the report relating to public control will be found elsewhere.

At the end of 1910 the number of stations which constituted the system in the United States of the American Bell Telephone & Telegraph Company was 5,882,719, an increase of 740,027. Of these 1,852,050 were operated by local, co-operative and rural independent companies or associations having sub-license or connection contracts. The total mileage of wire used for exchange and toll service was 11,642,212 miles, of which 1,162,186 miles were added during the year. These figures do not include the mileage of wire operated by connecting companies. Including the traffic over long-distance lines, but not including connecting companies, the daily average of toll connections was about 602,500, and of exchange connections about 21,681,000, an increase over the previous year of almost 100,000 toll connections and almost 2,000,000 exchange connections.

During the year the cost of plant additions, including real estate, equipment, exchange and toll lines was $53,582,818, an increase of about $25,000,000 over the previous year, making total expenditures for additions to plant during the eleven years from 1900 $460,775,700. During the year $52,028,000 was applied out of revenue to maintenance and reconstruction purposes, the total expenditures for these purposes during the past eight years being over $283,500,000. It is estimated that about $60,000,000 will be required for additions to plant in 1911.

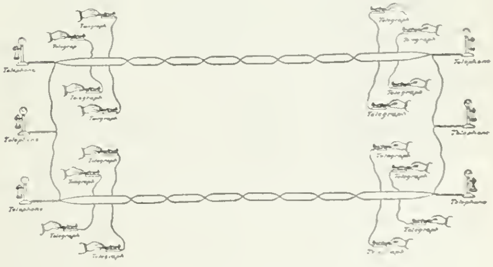
The subject of depreciation is discussed in detail. It is pointed out that the entire disregard or underestimating of depreciation and future replacement has been the cause of nearly all the financial disasters that have occurred in the telephone business and that it has been the common failing of newcomers in the field from the beginning to the present time. The present policy of the Bell system is to provide against every possible contingency, and to base the amount and extent of such provision on past experience, notwithstanding that the future will probably show a decrease in depreciation or reconstruction, owing to the general character of plant and methods assuming more permanency. Referring to building for future requirements, it is stated that expenditures on the Bell telephone system for future demands are, including construction in process, estimated at $180,000,000.

The gross revenue collected from the public in 1910 by the Bell telephone system, not including the connected independent companies, was $165,600,000, an increase of nearly $60,000,000 over the previous year. Of this operation consumed $54,000,000; taxes, $8,000,000; current maintenance, $25,700,000, and provision for depreciation, $26,200,000. The surplus available for charges, etc., was $51,000,000, of which $11,550,000 was paid in interest and $25,000,000 in dividends.

The total capitalization, including inter-company items and duplications of the companies of the Bell system, is $1,114,310,979. Of this $502,306,910 is owned and in the treasury of the companies of the Bell system. The capital stock, bonds and notes payable outstanding in the hands of the public at the close of the year were $612,000,000. The net permanent capital obligations of the whole system outstanding in the hands of the public were $580,100,000, against which the companies have property valued at $696,700,000, an excess of $116,000,000, or 20 per cent. There is an entry in the book accounts to represent intangible property, such as franchises, contracts, patents and rights-of-way, both public and private. In every case where public authorities have appraised the plant of the companies the valuation has been far in excess of the book valuation, and it is stated to be within the bounds of conservatism to say that the obligations of the companies outstanding in the hands of the public are represented by 150 per cent of property at a fair replacement valuation of the plants and assets, not including public franchises. The interest of the American Bell Telephone & Telegraph Company in its associated operating companies is over 80 per cent, in addition to which it has its own earnings. The companies' share of the surplus earnings of the Bell system is approximately 90 per cent.

During the year a great deal of attention was given in the interest of employees to some scheme for pension and savings, and at a conference of all the associated companies it was agreed that any plan adopted by the American Bell Telephone & Telegraph Company would also be adopted by them, thus making it comprehensive and covering the Bell system as a whole so that all changes of employees between companies would not affect the pensions or savings benefits. Until the solution of the problem is arrived at, all cases which would come under pensions or savings plans will be acted upon individually by the company, so that in effect, so far as employees are concerned, the delay does not postpone any benefit to them.

The report discusses the subject of independent and opposition companies, competing exchanges and physical connections. The idea of physical connection is criticised, being born, it is stated, of a desire to get for local and isolated competing or opposition exchanges, or comparatively limited exchange systems, the advantages of the more extensive and comprehensive Bell system. It is asked if there is anything in practice, law or precedent that can compel one system, built upon a comprehensive basis and trying to meet all requirements of the public, to turn over its physical property for the use of so-called competitors—opposition exchanges built in selected territory with selfish views or motives? Is there anything to compel one to share the prosperity of a business created by enterprise and advanced policy with those who wish to appropriate the benefits of such work? Can any public-utility company be compelled to divest itself of the operating control of its own property which was created for and may be needed at any time in the conduct of its own business? The conclusion is that this is not the kind of interchange of business contemplated by the rules governing common carriers, that it is not co-operation, but pure and simple confiscation.



Multiplex Telephone and Telegraph Circuits.

A section of the report is devoted to the telephone and telegraph. In this it is pointed out that these two services are complementary and not competitive; that each has its own proper place; that joint use and joint occupancy of wires will reduce operating expenses, maintenance charges and construction investment; that utilizing the unutilized facilities of both will make possible large economies and improvements in the wire service, as well as additional useful service of both the telephone and telegraph for the benefit of both the corporation and the public. The accompanying cut prefaces this section, with the caption "Two telephone circuits in daily use between New York and Chicago carrying three telephone conversations and eight telegraph messages simultaneously without interference with each other." No description in detail is given.

New York Electric Automobile Dealers' Association.

At a meeting held in New York City, March 27, the recently organized Electric Automobile Dealers' Association, including in its membership men interested in the sale of electric pleasure vehicles, batteries, tires and accessories peculiar to electric vehicles, determined on a publicity campaign to be pursued this spring and fall. The organization, it will be understood, is not connected in any way with the Electric Vehicle Association of America, although distinctly friendly to it. It is a purely local association organized to promote the adoption and use of electric vehicles in Greater New York. The officers and directors are as follows: President, Mr. Albert Weatherby, Anderson Carriage Company; vice-president, Mr. Harvey Robinson, New York Edison Company; secretary, Mr. C. Y. Kenworthy, Rauch & Lang Carriage Company. Directors: Messrs. R. R. Clayton, Studebaker Automobile Company; N. Platt, Baker Motor Vehicle Company; W. S. Brown, R. S. Bailey & Company; A. W. Blanchard, Jr., Waverley Company, and C. E. Humphrey, Woods Motor Vehicle Company. The organization is conscious of the fact that all concerned in the furtherance of the electric pleasure vehicle have been inactive for too long a period and has set for itself the task of informing residents of New York of the advantages of the electric over the gas car. It was proposed at the meeting on March 27 to raise a fund of $7,500 among fifteen or more contributors to be spent in advertising and general publicity. Of this sum $3,000 is to be spent in a ten weeks' campaign this spring and a similar campaign will be waged in the fall.

American Railway Engineering Association.

At the twelfth annual convention of the American Railway Engineering and Maintenance of Way Association the name was changed to American Railway Engineering Association. The attention paid to electrical matters by this conservative organization of steam-railway engineers was significant.

In his address as president of the association Mr. L. C. Fritch, chief engineer of the Chicago Great Western Railroad, Chicago, made the interesting statement that perhaps too much stress is laid upon the establishment of standards. In a progressive art there should be no such word as "standard." What is standard to-day may be obsolete to-morrow, for improvement and advancement are the order of the day. Mr. Fritch referred to the Pennsylvania Railroad terminal in New York, with the opening of the Hudson and East River tunnels, as perhaps the best example of progressive railway engineering during the year. This, he said, is the first large trunk-line railroad terminal complete in its operation and the use of electric traction.

"This installation," said Mr. Fritch, "awakens us to the sense of a new responsibility that is placed upon us as engineers, and that is, that we should prepare ourselves for the new problems that it will be our duty to solve. It will devolve upon the engineers of our railways to determine to what extent this new power is justifiable in heavy trunk-line service. The question of electrification of trunk lines, and its application to terminals in large cities, has assumed the proportions of a public question in the cities of Boston, Philadelphia, Baltimore, Washington, St. Louis, Chicago, and its extension in New York City to all classes of service is being considered. It is a problem of great magnitude and involves not only technical skill, but judgment of the highest order, and its solution must in the final analysis be made by railway men familiar with the intricacies of railway operation and its needs. My advice, therefore, would be that railway engineers prepare for this economic change that has already begun, in order that the problems that demand solution may be solved on a sound basis, and that costly mistakes which ignorance would otherwise impose may be avoided."

In relation to governmental regulations of the railroad industry, President Fritch said that some of these regulations are wise and beneficial while others are a positive menace to the public they are designed to benefit. It devolves upon railroad men to educate the public to a realization of the rights of the railroad industry.

The committee on "Electricity," of which Mr. George W. Kittridge, of the New York Central, is chairman, presented a progress report. In addition to Mr. Kittridge other members of the committee present were: Mr. J. B. Austin, Jr., of the Long Island Railroad, Jamaica, N. Y.; Mr. C. E. Lindsay, of the New York Central; Mr E. B. Katte, of the New York Central; Mr. A. O. Cunningham, of the Wabash Railroad, St. Louis, and Mr. George Gibbs, of the Pennsylvania Tunnel & Terminal Railroad, New York. The committee gave a résumé of its previous work from the time of its appointment two years ago. The scope of the work of the committee covers electric traction and transmission as affecting the design, construction, maintenance and operation of railways. A partial list of subjects considered is "Transmission Line Crossings," "Clearances" "Insulation and Protection," "Electrolysis," "Relation to Track Structures," and "Maintenance Organization." Sub-committees on these subjects have been organized.

The conclusions of the whole committee include the following definitions, which were adopted by the association:

Third-Rail Clearance Lines.—Lines beyond which no part of the third-rail structure shall project.

Equipment Clearance Lines.—Lines beyond which no part of the equipment shall project. Allowance must be made by equipment manufacturers of new equipment for wear on journals and brasses, on axle collars, on rail, on wheels, compression of springs, sagging of center of car, constructional variations and play, broken springs, etc.

Third-Rail Gage.—Distance, measured parallel to plane of top of both running rails, between gage line of running rail and gage line of third-rail.

Electrical Supervisor.—An officer on the division staff qualified to supervise the maintenance of the electrical transmission and working conductors outside of the power station and substation.

Bonders.—Employees qualified to maintain rail and other bonds and their appurtenances.

Traction Linemen.—Employees qualified to maintain wires and cables and their appurtenances for all railroad voltages.

Patrolmen.—Employees qualified to inspect and make minor repairs to track and third-rail structures, cables and wires, and to use hand signals for the protection of trains

Bond.—A metallic means for connecting two rails to permit of passage of electric current.

Cable.—A rope composed of wires for the transmission of electricity.

Further recommendations of the committee, adopted by the association, enunciated the principle that electric maintenance on steam roads should as far as possible be performed by the existing maintenance-of-way organization with such modification as may be necessary. Further, a maintenance-of-way organization was suggested as productive of efficient results and designed to include both electrical and steam operation. In this suggested organization the electrical supervisor reports to the division engineer, who in turn reports to the chief engineer of electric traction and the electrical superintendent as well as to the general superintendent and chief engineer. The electrical supervisor is on a par with the track supervisor and the superintendents of bridges and buildings. He has under him line-wire gangs and cablemen, as well as third-rail maintainers, bonders and patrolmen.

Diagrams to show the lines of third-rail clearance and equipment clearance have been prepared, but in order to await further action by the American Railway Association and the American Electric Railway Association, the committee reported the progress in relation to these diagrams and did not recommend them for adoption at the present time.

The report of the committee on signals and interlocking was presented by Mr. W. H. Elliott, of the New York Central, in the absence of the chairman, Mr. A. H. Rudd. Revised specifications for insulated wires and cables having various characteristics were adopted. New tables to show the B. & S. gage, number of strands and actual circular mils of stranded conductors and flexible conductors were adopted.

Mr. W. C. Cushing, of the Penn Line, Pittsburgh, was elected president of the association, and Mr. E. H. Fritch, 962 Monadnock Building, Chicago, was re-elected secretary.

Railway Signal Association.

A stated meeting of the Railway Signal Association was held in the Congress Hotel, Chicago, on March 20. Mr. C. E. Denney, of Cleveland, president of the association and signal engineer of the Lake Shore & Michigan Southern Railway, occupied the chair. Two sessions were held. At the morning session Mr. J. C. Mock, of Detroit, chairman of the subcommittee on standards, presented a code of symbols to be used for the representation of apparatus on signal drawings. This rather technical subject was discussed at some length. Mr. H. S. Balliet, of New York, remarked that symbols made necessary by the electrical operation of railways as indicating third-rail, overhead conductors, bonds, etc., are now needed on signal plans. The committee report on "Electric Signaling for Railways" came up in the afternoon, and the committee in charge of the matter, of which Mr. Balliet is chairman, was instructed to make further report on the various systems in satisfactory operation and to prepare specifications for alternating-current automatic signal installations on electric railways.

During the afternoon session Mr. A. H. McKeen, signal engineer for the Oregon-Washington Railroad & Navigation Company, read an interesting paper on "Portable Storage Batteries as Applied to Automatic Signals on the Harriman Lines." The paper was entirely favorable to the use of storage batteries for railroad signaling on this extensive system and evoked a lively discussion, in which the advocates of primary batteries undertook to show that the primary cells were better adapted for signaling work under many conditions. Mr. L. Frederick Howard presented a paper entitled "Principles Governing the Selection of Alternating-Current Signal Apparatus for Railroads," and this was discussed at some length. Among other things it was agreed that the term "impedance bond" was better than "induction bond," and there was also considerable discussion whether ground shields or the grounded secondary should be used in the case of transformers employed in alternating-current signaling. It was contended that the use of the grounded secondary was objectionable as involving the danger of false signals by grounding.

National Conference on Standard Electrical Rules Disbands.

At a meeting held in the Engineering Societies Building, New York City, March 24, the National Conference on Standard Electrical Rules, comprising delegates from the following national bodies, was formally disbanded: American Institute of Architects, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers, American Street and Interurban Railway Association, Associated Factory Mutual Fire Insurance Companies, Association of Edison Illuminating Companies, International Association of Municipal Electricians, National Board of Fire Underwriters, National Electric Light Association, National Electrical Contractors' Association, National Electrical Inspectors' Association and Underwriters' National Electric Association.

It is announced that the Underwriters' National Electric Association having been at its final meeting in March consolidated into the National Fire Protection Association so as to bring the work of fire-preventing engineering under one single head, and an electrical committee having been established as a part of a working association of national standing which can provide machinery for carrying out its work, the need for the national conference no longer exists. The N. F. P. A., it is understood, will add to the electrical committee representatives of some of its active members so as to give official representation to interests vitally concerned in its work but which hitherto have had representation only as a matter of courtesy and policy. The holding of general meetings of the electrical committee every two years, to which meetings all will be invited to participate in suggestions and discussions, is to be continued as in the past by the National Fire Protection Association.

Underwriters' Resolution on Grounding Secondaries.

At a meeting of the Underwriters' National Electric Association in New York City, March 22 and 23, an effort was made to have the underwriters pass some mandatory ruling on the grounding of alternating-current secondary circuits. The matter was brought to a head by a communication from Mr. Farley Osgood, chairman of the code committee of the American Institute of Electrical Engineers, making a formal request that the grounding of secondary circuits be made mandatory up to 250 volts. The Underwriters were not prepared to change Rule 13A as it now stands in the code, but passed resolutions which were indorsed by Mr. W. H. Blood, Jr., acting for the National Electric Light Association.

The preamble of the resolutions recites that the grounding of secondary alternating-current circuits having a normal difference of potential of not over 150 volts does effectually eliminate the life hazard of such circuits due to their accidental contact with circuits of a dangerous potential without introducing any hazard due to grounding: that there is a difference of opinion as to whether the grounding of such circuits having a normal difference of potential of over 150 volts introduces hazards due to such grounding, but that such grounding does not increase, but rather tends to decrease, the fire hazard. The several clauses of the resolution are as follows:

That municipal departments are urged to make the grounding of secondary circuits up to 150 volts mandatory as a necessary safeguard to life.

That the Underwriters' Inspection Departments be urged to recommend at all times such grounding as a proper and desirable precaution which introduces no fire hazard.

That the National Electric Light Association be urged to see that all of its member companies be brought to realize the necessity of such grounding for the protection of their customers.

That the departments in charge of water works be urged to allow the attaching of such ground wires to their piping system in the full confidence that the integrity of such piping systems will in no way be affected, whatever be the normal voltage.

That all concerned give careful thought to other methods of obtaining satisfactory grounds wherever metallic water pipes are not available, to the end that this most necessary precaution of grounded secondary circuits may be available in all localities and under all conditions.

That the American Institute of Electrical Engineers be urged to use its best endeavors to harmonize the present difference of opinion as to the limit of voltage at which grounding ceases to be desirable by determining a limit which shall meet with general approval.

The Sylvester and Schaefer Methods of Artificial Respiration in Germany.

(*From Our Berlin Correspondent.*)

The German National Board of Health in a recent report on methods of artificial respiration states that the new Schaefer method cannot be considered as effective as the Sylvester method, and that it does not consider advisable a change in the present rules for resuscitation employing the Sylvester methods.

In order to learn the situation in Austria I wrote to the well-known electropathologist, Dr. Jellinek, of Vienna, and he has informed me that the Schaefer method has not been introduced in Austria. Dr. Jellinek has by a personal investigation convinced himself of the superiority of the Sylvester method.

In a *Bulletin* issued by the Berlin Board of Health under date of March 25, 1909, it is stated that the Schaefer method solely affects exhalation and thus belongs to the so-called expiration methods which do not attach as much importance to filling the lungs artificially as do the so-called combined methods, such as that of Sylvester. With the Schaefer method, in which the patient is placed face downward, the weight of the body presses on the thorax, thereby lessening chest expansion. The smaller the expansion of the chest the smaller will be the quantity of fresh air entering the lungs, and consequently the smaller will be the effect upon the circulation of the blood and pulsation of the heart. For this reason and after thorough experiments as to the effectiveness of different methods of artificial breathing, the authors of the *Bulletin* report (Drs. Loewy and Meyer) disapprove the Schaefer method. They admit, however, that in cases of drowning the method of placing the patient face downward has an advantage, through facilitating the escape of water from the trachea, but hold that in other cases, as in suspended animation caused by electric shock, that advantage does not apply. "In such cases the most effective method is one that will cause ventilation of the lungs and increased circulation of the blood." This view is approved by the Board of Health. Drs. Loewy and Meyer conclude that in view of the above considerations "there seems to be no reason for replacing the Sylvester by the Schaefer method of resuscitation from apparent death from electric shock, and that it does not seem advisable to recommend both methods owing to the confusion that may result."

Further inquiry in Vienna brought out the information that the Voluntary Life Saving Corps of Vienna still uses the old Sylvester method, the Shaefer method not having been taken under consideration.

Large Texas Hydroelectric Property.

The waters of the Nueces and Medina Rivers are to be utilized for the operation of what it is stated will be one of the largest hydroelectric plants and systems of irrigation in the Southwest. The same British syndicate, headed by Dr. F. S. Pearson, of New York, that has more than $100,000,000 invested in hydroelectric plants, power systems, street railways and other large enterprises in Mexico is back of this big Texas project. For several months engineers and other representatives of the Pearson syndicate have been working on the preliminary plans for the power and irrigation scheme. Options have been obtained on more than 200,000 acres of rich valley lands which are to be served by the proposed irrigation canal system. Surveys have also been made for the proposed dams and reservoir sites, it being a part of the general plan to provide for the storage of an enormous quantity of water in order that there may be no shortage for the operation of the proposed hydroelectric plants and irrigation of the lands during the dry seasons. In carrying out this project the same plan will be followed as that of the Mexico Light & Power Company in the installation of its hydroelectric plants at Nexaca, Mexico, and the construction of a series of water-storage reservoirs. It is estimated by engineers who have made the surveys of the Nueces and Medina Rivers that it will be possible to generate more than 100,000 hp, and that by locating the dams for the reservoirs at favorable points there can be irrigated more than 500,000 acres of land. The canal systems will not be confined to the valleys, but will extend over the upper benches lying back from the two rivers. Energy-transmission lines will be constructed to San Antonio, Cotulla, Pearsall, Uvalde, Laredo and many other towns of that part of the State. Dr. Pearson is giving much personal attention to the big project. Mr. C. H. Carney, engineer and manager of the hydroelectric work at Nexaca, Mexico, is actively in charge of the preliminary work that is in progress on this Texas project.

Sale of Electricity to Parks.

As previously mentioned, the South Park commissioners of Chicago have agreed to buy electrical energy from the Sanitary District for lighting the South Side parks and boulevards, discontinuing their existing steam-generating plant. The South Park system embraces Jackson Park, Washington Park, Grant Park and several smaller parks, as well as the Midway, Drexel Boulevard, Grand Boulevard and other boulevards, the public-park system of Chicago involving boulevards as connecting links.

The proposition made to the commissioners by the Sanitary District, which will probably be accepted, is a flat rate of 0.75 cent a kw-hour for electrical energy delivered at the power house at Fifty-seventh Street and Cottage Grove Avenue. It is assumed that the maximum demand is about 900 kw and that energy consumption is approximately 2,000,000 kw-hours per year. The park commissioners will furnish the transforming apparatus in the station. The proposition is made with the provision that in case of necessity the Sanitary District may have the use of the steam plant during the peak load, provided such use does not entail any expense on the part of the South Park commissioners. However, the commissioners are to have the option of changing at the end of any year to the regular municipal rate of the Sanitary District, which is $15 a hp-year for lighting service (twelve hours a day) and $26.40 a hp-year for power service (twenty-four hours a day).

The Sanitary District agrees to furnish a regular and uninterrupted supply of electricity, except as it may be disabled by fire, lightning, strike or other cause not under its control. It is estimated that within ten or fifteen years the peak load of the South Side parks will be 3500 kw. Energy will be supplied to the parks through underground cables entirely. Energy will be measured at the South Park switchboard on the low-tension side of the transformers, the rate of 0.75 cent a kw-hour covering all charges.

Municipal Gas-Electric Plant Proposition a Failure.

A striking admission of the inability of a municipality successfully to install and operate a gas-electric generating plant in competition with central-station service came out in a recent hearing before the committee on public lighting of the Massachusetts Legislature. The committee was hearing remonstrants on several municipal-ownership bills, including Mr. E. N. Wrightington, vice-president of the Boston Consolidated Gas Company, who touched briefly upon the investigation made by the City of Boston under the administration of Mayor George A. Hibbard of the cost of lighting a group of schoolhouses in the North End, and also of lighting the block of municipal buildings focused around the Boston City Hall. The plan of the city was to install gas engines operated from the mains of the local gas company. The engines were to be direct-connected to generators and the lighting service of the block was to be furnished by the city instead of purchased from the Boston Edison company. Mr. Wrightington stated that his company was very anxious to secure the business in competition with the Edison company, and that the most exhaustive figures were made as to the relative cost of the city plant compared with Edison service. After all the estimates were made it was found that there would be an apparent annual saving of perhaps $565 by the city plant in the schoolhouse lighting, but at the city hall the cost of operating the municipal isolated plant would be absolutely prohibitive on account of the enforced service of three eight-hour shifts of men per day. The municipal proposition was thus killed by the weight of its own labor requirements, and the slight difference between the Edison and city estimates for the schoolhouse work did not warrant a change from central-station to municipal service.

The Approaching Completion of Hoosac Tunnel Electrification.

The electrification of the Hoosac Tunnel, in western Massachusetts, on the Fitchburg Division of the Boston & Maine Railroad, is rapidly approaching completion, and it is expected that an electric locomotive will be run through the tube within a fortnight. The work is being done by the New York, New Haven & Hartford Railroad under the supervision of Mr. W. S. Murray, electrical engineer. The electrified section will extend from Williamstown to a point a few miles east of the tunnel portal, the length of the tunnel proper being about five miles. Both tracks will be electrified and the single-phase system employed, with overhead distribution. Electrical energy will be generated at a steam turbo-alternator plant located at Zylonite. The construction work in the tunnel is handled by two gangs of seventy-five men each, and clusters of electric lamps are employed extensively on the skeleton cars which serve as construction trains. A small generating plant is installed on each train for lighting service; the train movements are controlled by electric signals, and continuous telephone connection is maintained between the trains and the tunnel dispatcher's office at North Adams. The overhead trolley will be located 15½ ft. above the track and supported at points 100 ft. apart.

Worcester Street-Lighting Case.

The Massachusetts Gas and Electric Light Commission gave a continued hearing on Feb. 27 at Worcester upon the appeal of Mayor James Logan for a reduction in the street-lighting prices charged by the Worcester Electric Light Company. Chairman Barker presided, and the full board was present. The entire day was devoted to cross-examination of the expert for the city, Mr. William D. Marks, of New York, by Mr. Everett W. Burdett, of Boston, counsel for the company. Mr. Marks admitted that the comparison of prices paid for street lamps in other cities was suggestive rather than controlling. He had cited the prices in Montreal and Springfield, Mass., but in the case of Montreal the available water-power was 53,000 hp and the steam power 6800 hp, and in Worcester the company had no water-power whatever. The Montreal Light, Heat & Power Company secured the street-lighting contract at a price of $63.15 per 4-amp magnetite-arc lamp per year. The Provincial Light, Heat & Power Company offered $54.80, but this did not provide adequately for depreciation. Mr. Marks' final figure as a fair price for Worcester was $64.83 per 4-amp magnetite lamp. The witness admitted that there were 1650 lamps concerned in Montreal, or about twice as many as in Worcester.

Taking up the Springfield conditions, Mr. Burdett brought out the point that the city owns and maintains the poles and fixtures, a fact which the witness did not know. The Springfield company estimates a saving of $6.50 per lamp per year on this account. The present price of arc lamps in Springfield supplied on underground service is $83 per year each, and on the overhead system, $71.50. The witness admitted that if the company paid all the expenses the equivalent price in Springfield would be $89.50 for underground service and $78 for lamps on the overhead lines. Mr. Marks also agreed that the 350-watt inclosed carbon-arc lamps used in Springfield were not as efficient and satisfactory sources of illumination as the Worcester magnetites. Mr. Burdett also brought out the point, using Mr. Marks' own figures, that the latter proposed to reduce the price of arc lighting to the city by about $23,000 per year, at the same time adding $42,000 in revenue for the company from private consumers, which produced a decided stir in the hearing-room. Mr. Marks admitted this, but said that under the price list of the company large users of electricity for motors and lighting obtain it at less than cost, while small users pay excessive rates. Mr. Marks had estimated that the value of the company's property used in street lighting was about $290,000, but he admitted that his estimate took no account of freight charges or expenses due to station reconstruction resulting from the change in the arc-lighting system, which was formerly of the open-arc type, with energy supplied by Brush machines. Mr. Burdett said that he would prove that the company was obliged to spend $1,045 for special wiring, $4,490 for an arc-distributing board, $1,224 for a concrete floor at the arc-lighting division of the plant, with further expense for a crane. A long discussion ensued over the cost of wire. Mr. Marks said that he considered the company's arc-lighting wire, No. 6 B. & S., to be worth about 4 cents per foot, the list price being about 16 cents. He could not give the price of wire to-day on account of the uncertainty of the discount. It was admitted by the witness that if the cost of the wire, with lead covering, was about 8 cents per foot the estimate which he had made would be about $50,000 out of the way. Mr. Marks said that he had no opportunity to make a physical examination of the company's property and that he considered the wire used in arc-lighting service had undergone a depreciation of about 50 per cent since the magnetite system was installed in Worcester. He figured the cost of ducts at 30 cents per foot, whereas Mr. Burdett said that the company would show that the cost was about 38 cents per foot.

Mr. Marks did not figure the cost of maintaining the free ducts used by the city as a factor in the expense of street lighting, nor did he take into consideration the fixed charges on such ducts. The company's ducts are divided as follows: Municipal arcs, 430,000 ft.; incandescent service, 430,000 ft.; motor service, 100,000 ft.; commercial arcs, 47,000 ft.; vacant ducts, 372,141 ft., and free city ducts, 352,000 ft., making a total of 1,731,141 ft. of duct on the system. The company considers the value of this equipment to be 29 cents per foot. The revenue-producing ducts of the company have a total length of 1,007,000 ft. Mr. Burdett brought out the point that Mr. Marks had neglected about $9,000 in insurance and taxes which would have to be borne by the municipal lighting department in determining the proper cost of lighting the streets. Mr. Marks made a general allowance of 7 per cent for depreciation, taking the life of generators at twenty years, boilers twelve to fifteen years, engines twenty years, buildings fifty years, underground and overhead wires about fourteen years each. In the absence of an appraisal he admitted that it was necessary to use a large amount of guesswork in the preparation of his report to the Mayor. Counsel for the city interjected that authority will be asked for the making of an appraisal to serve as a proper basis of inquiry. Mr. Marks further admitted that he had purposely taken no account of the investment now being made by the company in a new turbine station at the south end of the city, and Mr. Burdett emphasized the value of such a plant to the city as a basis for increased taxation. Mr. Marks said that the first price that he recommended for acceptance by the city was $75.72 per lamp. This was made up on an estimated investment of $300,000 for municipal lighting and allowed profit of 5 per cent, or $17.40 per lamp, and a depreciation of 7 per cent, or $24.36 per lamp. The cost of electricity was taken at 2 cents per kw-hour. Interest and depreciation, according to Mr. Marks, came to $41.76 per lamp per year. This left $23.07 to be expended for the lamps for all other costs of operation, assuming that the second price recommended by Mr. Marks, namely, $64.83, was substituted for the first. The hearing was adjourned to March 20 in order to afford the company time to prepare estimates of the cost of supplying the city with magnetite lighting.

The Single-Phase Railway in London.

At a meeting of the British Institution of Civil Engineers held on March 14 Mr. Philip Dawson presented a paper entitled "The Electrification of a Portion of the Suburban System of the London, Brighton & South Coast Railway." This road was opened for service in 1909. It is a 25-cycle, single-phase road, operated with a flexible overhead conductor at 6700 volts. The total length of route electrified is twenty-three miles, there being altogether sixty-two miles of single track in operation.

There are two sections to the line, an 8.7-mile section, known as the South London line, and an extension to Crystal Palace now nearing completion. The rolling stock of the South London line comprises sixteen motor-cars, each equipped with four 115-hp Winter-Eichberg compensated-repulsion motors and thirty-two trailers, the trains being made up in units of two, three or four coaches as required. The rolling stock for the extension comprises thirty motor-cars, each equipped with four 150-hp Winter-Eichberg motors and sixty trailers, the train units being composed of two, three, four, six or nine coaches.

No trouble has been experienced with the overhead conductors, owing to the flexibility of the construction employed. The trolley wire is 0.5 in. in diameter. Double insulation is used throughout and the only material employed for this purpose is porcelain.

Each motor has four poles and is fitted with six sets of brushes. The air-gap is 3 mm (⅛ in.). A gear ratio of 4.24-to-1 has been adopted as most suitable for the service. Each motor-car is equiped with two main transformers, one for each pair of motors. Under starting conditions the secondary current per motor is 210 amp at a power factor of 29 per cent. The multiple-unit system of speed control is employed.

During a trial run continuously for twelve hours, covering 174 miles, with twenty-second stops at each station, the total weight being 146 tons, the energy consumption was 73 watt-hours per ton-mile. For the first eight months of 1910 the average energy consumption used for all purposes was 75.4 watt-hours per ton-mile.

The author stated that, as regards the maintenance of the electrical apparatus, the first thirteen months' experience shows no reason why the maintenance of single-phase should be higher than that for direct-current apparatus. The system is certainly more economical than the direct-current system as regards energy consumption at the generating station, as well as regards first cost, and experience has shown it to be eminently suitable, not only for long-distance work, but also particularly for working in and out of large terminal stations with their necessarily complicated approaches, and for short-distance work, such as has had to be encountered on the South London line.

Proposed Terminal Electrification in Chicago.

Following the preliminary study of the question of electrifying the railroad terminals of Chicago by a committee of engineers working under its direction, the Chicago Association of Commerce now announces that a commission consisting of seventeen business men, city officials and railroad executives has been created under its auspices to make a complete and impartial investigation of the electrification problem. This investigation will go into all of the phases of the subject, including the engineering, practical and financial aspects of the situation. The personnel of this new commission is as follows:

Representatives of the city—Mr. Paul P. Bird, chief smoke inspector; Mr. T. E. Donnelley, chairman City Smoke Commission; Dr. W. A. Evans, commissioner of health; Mr. Milton J. Foreman, chairman local transportation committee of City Council.

Railroad representatives—Mr. W. A. Gardner, president Chicago & Northwestern Railway Company; Mr. H. G. Hetzler, president Chicago & Western Indiana Railroad Company; Mr. Darius Miller, president Chicago, Burlington & Quincy Railroad Company; Mr. C. E. Schaff, vice-president New York Central Lines.

Representatives of association at large—Dr. W. F. M. Goss, dean College of Engineers, University of Illinois; Mr. E. R. Graham, D. H. Burnham & Company; Mr. Richard C. Hall, president Duck Brand Company; Mr. Jesse Holden, attorney-at-law; Mr. Harrison B. Riley, president Chicago Title & Trust Company; Mr. John W. Scott, Carson, Pirie, Scott & Company; Mr. Francis T. Simmons, Francis T. Simmons & Company; Mr. Mason B. Starring, president Northwestern Elevated Railroad Company; Mr. Frederick H. Rawson, president Union Trust Company.

In addition to their representation on the commission the railroads have agreed to pay all of the expenses of the investigation. A chief engineer and a staff of assistants will be engaged to work out the engineering problems that will be involved. Permanent headquarters will be established for the technical staff, and the commission will hold regular meetings. Committees have been appointed as follows: To nominate officers and to fix date of meetings, Messrs. Scott, Donnelly and Gardner; to outline the scope of the investigation, Messrs. Foreman, Gardner and Riley; to select the chief engineer, Messrs. Goss, Graham and Hetzler; to select headquarters, Messrs. Gardner, Evans and Simmons.

In relation to the interest of the Chicago Association of Commerce in this important investigation, President H. A. Wheeler, of that body, says: "The problem of electrifying the complex freight and passenger terminals of Chicago railroads is of such great importance, and the question has been found to present so many difficulties and so many viewpoints, that there appears to be an urgent need for an investigation of the entire railroad-terminal situation, so conducted that its conclusions will be absolutely impartial, trustworthy and authoritative."

WESTERN RAILWAY CLUB DISCUSSION OF ELECTRIFICATION.

Mr. C. A. Seley, mechanical engineer, Chicago, Rock Island & Pacific Railway, read a paper on "Electrification of Chicago Railways" before the Western Railway Club on March 21. This club has 1486 members, of whom perhaps 200 attended the meeting. Mr. Seley's paper was a review of the situation from the steam-railroad man's point of view, and, while temperately expressed, its general tenor was opposed to the electrification of Chicago terminals on the ground that it was an unnecessary luxury—an improvement to be introduced cautiously and gradually if at all. The writer reviewed recent instances of railroad electrification and said that there seemed to be five or more methods of applying the motors on electric locomotives and that it may take some years to settle down to the best practice. He made the point that the total mileage of steam lines electrified in this country at the present time is considerably less than the mileage of the roads in the City of Chicago. He also quoted at some length from the recent reports of the Massachusetts Joint Board on Metropolitan Improvements, which recently, by a vote of nine to seven, recommended adversely in relation to the suggested electrification of the steam railroads in the Boston district. In commenting on the majority report, Mr. Seley declared that electrification would probably require an increase of passenger fares and perhaps of freight rates.

The paper was made up of quotations largely. The speaker said that there had been some criticism of the railway companies' estimates of the cost at Boston. One related to the expenditure for power houses, it being asserted that energy could be purchased without involving this expense. Mr. Seley said that the interest on the capital necessary for producing this energy must be included in the price to the user, no matter who produced it. Furthermore, in purchasing energy the railroad company would not have the same degree of assurance or control of facilities as with its own plant. On the other hand, local conditions might offer facilities that should receive consideration. One could hardly justify twenty-odd power houses for the railroad systems of Chicago in case they were electrified, said Mr. Seley. The paper included the text of the ordinance now pending in the City Council of Chicago, substantially requiring railroad electrification in that city by Jan. 1, 1913, as well as outline maps of Boston and Chicago.

The discussion was opened by Dr. W. F. M. Goss, of the University of Illinois, and a member of the new electrification commission of the Chicago Association of Commerce, who pointed out, among other things, that the through passenger and freight traffic, as well as the suburban traffic, of Chicago will be greatly increased in the coming years and that this increase in business, which would probably be aided by electrification, should be taken into account in considering the matter of expense. Referring to the formation of the newly appointed commission, he said that the movement was full of promise. It may be some time before the report is made, but it should be valuable when it is made. The fact that the railroad companies have agreed to co-operate in the investigation of this commission is a fact full of significance.

A number of other gentlemen favoring the steam-railroad side of the controversy took part in the discussion. One point brought out related to the difficulty in disposing of existing equipment. Another was the possibility of using fuel oil in locomotives, although there was objection to this on account of the unpleasant odor. Another suggestion was that automatic stokers if used on steam locomotives would diminish the smoke and cinder nuisance. Some of the speakers complained of the attitude of the daily press in discussing the smoke nuisance, and it was said that the people expect too much of the railroads and expect the latter to introduce improvements too quickly. One gentleman asserted that the steam locomotives in the city are not making half as much smoke now as when the agitation was first begun. He added that when it is demonstrated that electrification is an economic proposition the city will not have to fight to bring it about. Another contention made was that the people who benefit by the electrification—that is, the residents of the City of Chicago—should pay for it; if this were the case there would be less clamor for electrification. The most radical statement was made by the president of the club, who declared that there was not money enough in Chicago to pay for electrifying the railroads in the city; in fact, he asserted that it would "bust God Almighty."

The Engineer and War.

Mr. Caryl D. Haskins, of Schenectady, N. Y., delivered an address entitled "The Engineer and War" at a joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers at the rooms of the former in Chicago on March 22. Mr. Haskins presented an earnest and scholarly paper which was in effect a plea that engineers give intelligent study to the military situation of the country and organize a reserve corps of engineer officers to be available in time of war

Mr. W. L. Abbott indorsed Mr. Haskins' suggestion, and Dr. W. F. M. Goss, of the University of Illinois, said that it is a fine thing to open up to engineers the larger view of their duties to their country, not only in relation to military affairs, but also in relation to great economic problems. Prof. Morgan Brooks, of the same university, suggested that the government might send students to our own technical schools, particularly state university and land-grant colleges, and possibly also to foreign schools. Mr. F. J. Postel told of his experiences in the volunteer engineer corps in the Spanish-American war, and Colonel Green explained the arrangement for engineers in the Illinois National Guard. One company is authorized, he said, and an effort is now making to reorganize this company. Messrs. A. Bement, Fay Woodmansee and George M. Mayer also spoke briefly. Mr. G. T. Seely presided at the meeting, and on motion of Mr. R. F. Schuchardt the Electrical Section of the Western Society of Engineers recommended to the board of direction of the whole society that the question of furthering a reserve of engineer officers should have careful consideration.

Portable Storage Batteries for Railroad Signaling.

Mr. A. H. McKeen, of Portland, Ore., signal engineer of the Oregon-Washington Railroad & Navigation Company, presented a paper on "Portable Storage Batteries as Applied to Automatic Signals on the Harriman Lines" at the recent Chicago meeting of the Railway Signal Association. He stated that at the close of 1910 the entire main lines of the Union Pacific and Southern Pacific from Omaha, Neb., to Oakland, Cal., a distance of 1779 miles, were protected by automatic block signals, except for about 100 miles in the Sierra Nevada Mountains. Furthermore, the main lines of the Oregon Short Line and the Oregon-Washington Railroad & Navigation Company between Granger, Wyo., and Portland, Ore., are protected in like manner for the entire distance of 941 miles. Adding 60 per cent of the main lines of the Southern Pacific from Portland, Ore., to El Paso, Tex., and the Sunset Lines from El Paso to New Orleans, it is calculated that the total mileage of road of the Harriman lines protected by automatic signals on Dec. 31, 1910, was 6125 miles of single track.

The author described the methods of transporting batteries to and from the charging plants. Another arrangement consists of a charging plant built in a box car. This charging car is fitted up in three compartments, one containing a gasoline engine, generator, switchboard, etc., another serving as a battery room and the third being arranged as the living quarters for the battery man. The car is equipped with heavy draft gear in order to avoid any damage due to rough handling while in transit. During the three years that this car has been in service it has given good results, handling in one district 832 cells monthly in a territory having 150 miles of single-track signals.

In the case of the stationary charging plants, energy is obtained where practicable from local companies, a mercury-arc rectifier or a motor-generator set being installed to produce the direct current. Where central-station energy is not available a charging outfit consisting of a gasoline engine and a generator is installed.

Mr. McKeen went at some length into the methods of installing and charging batteries and also the special treatment required. He noted that the variety of temperatures experienced on different parts of the Harriman lines has no apparent effect on the batteries; no special housing is necessary to protect them from extremely cold or hot weather. On parts of the line the temperature frequently goes as low as 30 deg. below zero, but no trouble is experienced from the batteries failing to operate the signals. During the hot summer months it becomes necessary to replace the evaporation of electrolyte occasionally.

During the first six months of 1910 there were only sixty-one signal failures due to defective storage batteries and only thirteen failures from poor connections. This total of seventy-four failures on the entire system (in which there are [illegible] battery locations with a total of 48,516 storage cells in service) was less than 5 per cent of the total number of failures from all causes. The total number of signal movements during the same period was 48,758,000 and the number of movements per failure from storage battery causes amounted to 650,000, which is no doubt a more creditable showing, according to the author, than would be possible if primary batteries were used. In addition to the reliability of operation thus secured, the economical advantage of the portable storage battery over the primary battery is an important consideration.

The speaker gave a tabular statement showing that the cost of each cell of the storage battery, complete with connectors and electrolyte and including freight charges, was $5.34. For 48,516 cells this made a cost of $259,075.44. To this was added the cost of fifty-two charging plants at $450 each, $23,400, and the cost of 12,129 carrying cases at $2.60 each, or $31,535.40. This makes the total cost of the storage-battery system $314,010.84. Compared with this the cost of the primary cell, including freight charges, is $2.20. For 178,480 primary cells complete the cost is therefore $392,656. Adding the concrete battery wells, freight charges on these wells and the cost of unloading them and placing them in position makes the total cost of the primary-battery installation $893,586.

Considering now the cost of the maintenance of the two systems, including interest and depreciation, that for the storage-battery installation is said by Mr. McKeen to be $74,763.02 a year. The largest item of cost is the depreciation on the positive and negative groups, figured respectively at 22 per cent and 25 per cent of the cost of each. The cost of maintaining a corresponding primary-battery system per year is given as $235,652.90. Here the largest item is the renewal of 178,480 cells at $1 each.

The author states that with reasonable care the average life of the component parts of the portable cells is as follows: Positive elements, four and one-half years; negative elements, four years; rubber jars, covers and separators, ten years; wood separators, two years; carrying cases, ten years. The cost of energy for operating motor-generator sets or rectifier outfits varies from 0.5 cent to 5 cents per kw-hour, while the cost for generating electricity with gasoline generator sets is about 10 cents per kw-hour. Taking an average for the entire system, the actual cost for charging energy is 18 cents a cell.

In the discussion the advocates of primary batteries for signaling were active in presenting their side of the case. Mr. E. A. Everett, of Detroit, signal engineer of the Michigan Central, said that a few years ago several different types of portable storage batteries were tried on that road, but the cost of handling and transporting them was prohibitive. Caustic-soda primary batteries are used on the Michigan Central for signaling. Mr. E. E. Hudson, of the Edison Manufacturing Company, presented a detailed criticism of Mr. McKeen's paper. He said that there were apparent inaccuracies in the figures of costs given. For instance, his estimate of the cost of a primary-battery installation was $351,943 instead of $893,586, as given in the paper. As to maintenance Mr. Hudson figured $150,648 a year for the storage-battery plant as against Mr. McKeen's $74,763. The cost of maintenance of a primary-battery outfit, according to Mr. Hudson, would be $110,972 a year, whereas Mr. McKeen's estimate was $235,653. A number of members of the association took part in the discussion, the upshot of which seemed to be that the varying conditions of railroading affect the question so that it is impossible to give a hard and fast rule to determine whether storage batteries or primary batteries should be used for operating electric signals.

Invalidity of Workmen's Compensation Law.

The compulsory workmen's compensation law passed by the New York Legislature in 1910 was declared unconstitutional by the New York Court of Appeals at Albany on March 24 in that it takes property rights without due process of law. Judge Werner, who wrote the opinion of the court, stated that "the right of property has its foundation in the fundamental law, which can be changed by the people but not by the Legislatures." He is quoted also as saying:

"While the New York compensation act has been declared invalid, yet the justice of and necessity for some compensation system have never before appeared so urgent. The same Legislature which passed the compensation law enacted the new employers' liability act. That act still remains to plague the business men of the State who provide work and wages for employees. The burdens of that act, especially in hazardous employments, are infinitely greater than under the act that has been declared void. It would seem to be the duty of the Legislature to offer some reasonable and feasible elective compensation plan under which employers and employees could get together by mutual agreement and accomplish all the benefits that could possibly be acquired under a compulsory compensation law."

The law affected is one passed as a result of the work of the so-called Wainwright-Phillips commission and upheld by the Appelate Division of the Supreme Court. It is barely possible that the test case at issue, that of a switchman injured on the South Buffalo Crosstown Railway, will be appealed to the Supreme Court of the United States.

Proposed Ohio Public-Utility Legislation.

Many Ohio Independent telephone men appeared before the Senate committee on railroads and telegraphs at Columbus last Wednesday and Thursday to urge the passage of the Yount bill, permitting telephone companies to consolidate. Members of the committee told the telephone men that the Winters public utilities bill would provide for the authority they desire, and indicated by their questions that they are not in favor of the Yount measure.

Mr. Frank A. Davis, president of the Columbus Citizens' Telephone Company and manager of the Morgan interests in Ohio, said that they now occupy the unique position of asking the State to exercise a supervisory authority over their business in return for the right to consolidate companies. He explained that telephone men want the right to consolidate all the properties in each county under one company, and that the exchanges be connected with both the Bell and the United States long distance lines. He said that the passage of the bill would protect 30,000 small investors in Ohio. Mr. Davis asserted that the Morgan holdings are a very small part of the telephone interests of the State, estimating the investments of the former at $6,000,000.

Asked if the Morgan interests would not buy much more telephone property in the State if the bill was made a law, Mr. D. J. Cable, of Lima, said this is quite possible, but that they will pay a much higher price for it than if the bill does not pass. Both men said that it is not the intention to consolidate the long-distance companies under this law. Mr. Charles A. Otis, president of the Cuyahoga Telephone Company, of Cleveland, expressed himself in favor of the passage of the bill.

The Winters public utilities bill has been reported to the House and recommended for passage by the committee on codes, but it has been amended in such a way as to remove many of the stringent requirements. It still provides for the consolidation of telephone companies, supervision of the issue of stock and a review of the rates for service. The fixing of rates originally is, however, left as a matter of contract between the municipality and the company. The commission may examine the books of companies and enforce certain requirements that may be considered necessary. As a whole, it is said that the bill is much weaker with respect to all other utilities than when first introduced.

Indiana Employers' Liability Law.

The most drastic employers' liability law yet passed in the United States, with the exception of the State of Oregon, was placed on the statute books of Indiana on the last day of the Legislature, March 6. The real significance of the measure, which was passed in the last hours of the Legislature, apparently escaped notice, and now it is found that practically every employer of labor is included in its sweeping provisions. It is in effect a compulsory compensation measure, and if upheld by the courts will force employers to rely wholly upon protection through liability insurance since the law renders void any contract made by an employee to assume the risk of his employment.

The law makes a special distinction for employers operating electric power plants of whatsoever nature involving risk of danger to employees. In the transmission and use of electricity of a dangerous voltage full and complete insulation is required at all points where the public or any employee is liable to come into contact with the wires; live wires must be distinguished by color or other designation which is instantly apparent; wires carrying a dangerous voltage must be strung at such distance from the poles or supports as to permit repairmen to engage freely in their work without danger of shock, and safeguards to prevent injury to persons employed in or about cars or plants must be provided. Any person or corporation violating any of the provisions of the act is subject to a fine of from $10 to $500 for each violation of the provisions set out in the act. In addition a separate Senate bill renders the employer liable in damages to the employee with little or no right to a defense in court.

Decision of the Court in Public-Utility Capitalization Case.

A decision has been rendered by the Appellate Division of the New York State Supreme Court in a case in which the Binghamton Light, Heat & Power Company sought review of a decision of the Public Service Commission of the Second District. While the decision of the commission was reached on Aug. 4, 1909, it was not promulgated at that time because of the pending court proceedings regarding the case.

The decision of the majority of the court, written by Justice Smith, gives the history of the company, which purchased the property of the Binghamton General Electric Company in 1902 and made substantial improvements. The total expenditures for this purpose reached about $546,000, which the commission held had been expended substantially for replacement. A plan for the creation of a refunding mortgage and the issue of bonds thereunder was approved by the commission upon the condition that the company should credit to fixed capital the sum of $100,000.

The decision recognizes that certain betterments to property are properly chargeable to capital, but says that the commission has very properly disapproved of an effort on the part of the company to capitalize current expenses for repairs and replacements. As the bonds to be issued would go upon the market with the advertised approval of the Public Service Commission, the court holds that every care should be taken that those methods adopted by the law for the protection of the innocent purchaser should not become a trap to snare him.

The court states further that the mischief is just as great whether over-capitalization arises at the initiation of the corporation or whether it is the result of a process by which property has been replaced and the original capitalization is still carried on the books in addition to the cost of replacement. The statute should be so construed as to authorize a condition that the securities should not be sold over a misleading statement in the fixed capital account. Quoting the decision in which the powers of the commission were construed in an issue affecting the Delaware & Hudson Company, the court says that in that case there was no question of capitalization or of public protection, but a question simply as to the power of the commission to direct the policy of the corporation affecting only its own stockholders.

Justice Kellogg, in a dissenting opinion, declared that the discretion of the commission could not override the discretion of the officers of the company in the management of its affairs. If the corporation had been properly managed and its securities properly issued, the issue of new stock or bonds, if necessary for a corporate purpose for which securities might be issued, could not be denied solely upon the grounds that the capital liabilities of the company thus increased would exceed the value of its physical property. If the growth of the city and the demands of the service required equipment of much greater capacity, and consequently of much greater cost than that represented in the capitalization, the difference between the capitalized cost of the smaller equipment and that of the larger equipment which was used in replacement might properly be represented in the capitalization.

The decision of the commission in this case was written by Chairman F. W. Stevens. The application of the company was, in brief, for authority to execute a general extension and refunding mortgage upon all the property to secure an issue of $1,000,000 of 5 per cent, forty-year bonds; for authority to issue $500,000 of these bonds in order to refund a like amount of underlying bonds; for approval of the issue of $180,000 of the bonds to discharge $158,000 of outstanding notes and floating debt, and to issue $50,000 of 6 per cent cumulative preferred stock to provide funds for the retirement of outstanding notes and floating debt.

Examination of the affairs of the company disclosed, the commission says, that it commenced business in March, 1902, with a physical plant which was charged to fixed capital in an amount which, it is just to assume, was approximately $500,000. The physical properties had been practically rebuilt, and the engineer of the commission valued the part of the old structures remaining at $51,000. The company credited to fixed capital on account of the property thus displaced $15,617, the amount realized for junk. The remainder of the original charge was still carried as an asset. The proceeds of the outstanding $158,000 notes were used, the commission says, in whole or great part toward replacement of the plant destroyed. The value of the replacements was also charged to fixed capital.

It was held by the commission that while the greater portion of the fixed capital of a public-service corporation was worn out in performing the service required, the depreciation must be borne by the consumer. The practice of replacing worn-out plant with money derived from new issues of securities and of retaining in the fixed capital account as an asset the cost of the destroyed plant, and charging to such account the cost of the new plant, led to such disastrous results that it could not receive the approval of the commission.

The principle enunciated in the case of the application of the Niagara Light, Heat & Power Company, that the commission would not ordinarily permit an issue of securities for replacement of fixed capital without a proper readjustment of the accounts, was reaffirmed. The same principle applied in the case of an application to issue securities for the purpose of discharging an obligation incurred in making replacements.

It did not follow that the commission would not authorize the issue of stock or bonds for replacements. If such authorization was desired, the company must either credit to fixed capital the sum with which it stood charged on account of the displaced property or make such other readjustment of the accounts as would make a true showing of the affairs of the company. Upon the part of the case relating to the refunding of $158,000 of notes, the application was denied, but the proceeding was continued to enable the applicant, if it should so desire, to give proof as to how much of the indebtedness was incurred for additions and betterments, and as to the amount expended for replacements, and to make a proper adjustment of these accounts in accordance with the principles laid down in the opinion.

The commission reaffirmed the principle stated in another case, and denied authorization to issue stocks and bonds for the reimbursement of the treasury for money expended. The case was continued by the commission for further consideration along the lines suggested in the opinion.

Massachusetts Legislative News.

A hearing was given last week by the committee on taxation upon the Dean bill (House 1172), which provides that the corporation commissioner may levy an excise tax of 1 per cent on the gross earnings of all public-service corporations except street railway companies. Among the opponents of the bill were Messrs. Frank E. Dickerman, for the New England Telephone & Telegraph Company; Albert E. Pillsbury, for the Association of Massachusetts Gas Companies, and Everett W. Burdett, for the Massachusetts Electric Lighting Association. Mr. Dickerman pointed out that the telephone company furnishes to cities and towns in addition to the direct tax paid on real estate, conduits and wires a discount of from 25 per cent to 33⅓ per cent, amounting in Massachusetts to $73,000 per year. In addition, free city ducts are furnished and maintained on a bond at an annual expense of $109,542. About one-third of the pole-carrying capacity is furnished free to municipalities at a yearly cost of $196,560, and the direct taxes paid to the State are nearly $480,000 a year. The total direct and indirect taxes amount to $1,059,052 annually from the New England Telephone & Telegraph Company alone, or 9.27 per cent of the company's gross revenue in 1910.

Mr. Pillsbury said that the public-service corporations of Massachusetts are already heavily overtaxed and pointed out that Deputy Tax Commissioner Andrews had recently stated that "public-service corporations are, generally speaking, paying all the tax they can stand, for no other State in the Union had such a searching law as Massachusetts in respect to corporations." Mr. Pillsbury contended that the only justification for an additional excise tax laid upon the corporations is that they are not now paying their fair share of the tax. The bill is double taxation and as such is a gross injustice. The companies are already paying a franchise tax on the market value of their stock, including tangible and intangible property and future expectations as to earnings. Six per cent would be a liberal average for the earnings of the gas companies of Massachusetts upon the actual investment at work in the public service. The whole value of the franchise has been given back to the public in the recent reductions in the price of gas. If the gas companies had to pay for their locations gas would be selling in Massachusetts for $2 and not $1 as at present. There are seventy-nine gas companies in the State, seven of which do not pay expenses and twenty-one of which pay no dividends. The proposed bill fines these companies for their public spirit. The gas stockholder is actually receiving an average of 3½ per cent to 5 per cent on his investment.

Mr. Burdett reiterated the point that the franchise tax is a tax upon every possible element of value entering the corporation's affairs. Double taxation as proposed by the bill is unfair, unreasonable and disproportionate. The Massachusetts tax laws are anything but exact, equal or scientific, with the exception of the existing franchise law, which is correct in principle and if properly applied covers every species and element of property owned or possessed by the company. Recently the New York Edison Company paid taxes at the rate of 4.6 per cent upon the gross income, compared with 11.6 per cent in the case of the Boston Edison Company. The latter would have to pay taxes amounting to 12.6 per cent if the bill should be passed. Roughly, the Massachusetts corporations pay about double the tax percentage exacted in New York. The passage of the bill would tax the consumer in the end for the benefit of the public treasury. The policy of Massachusetts has always been that the customers of the public-service corporation shall have their service at as reasonable a rate as possible, and that the service shall be good, without undue augmentations of contributions to the public treasury. Already the cities have an income in the way of taxation on free ducts furnished them by the companies. In Worcester alone the company's free city ducts, valued at $102,000, are taxed for the benefit of the municipality.

Final arguments were heard last week by the joint committee on railroads and metropolitan affairs upon the Boston & Eastern Electric Railroad bill, which provides for the issuing of a certificate of exigency to the company by the Railroad Commission. In the course of the arguments it developed that the Boston & Northern interests do not desire the installation of any electrified rapid transit line in territory now occupied, but that the proposed New Haven tunnel under Boston Harbor, with electrified connections between the Boston & Maine and New Haven systems, is preferred to the Boston & Eastern plan. In closing, counsel for the Boston & Eastern stated that the real issue is not to compel a judicial board to render a decision a certain way, but to ask a commission which has already made a decision to issue a certificate and make its decision effective. He contended that public sentiment in the northern suburbs of Boston is almost unanimously in favor of the building of the proposed high-speed electric line of his clients, and argued that if the State refuses the road the right of building a deathblow will be dealt to future electric interurban railway construction in Massachusetts.

A series of hearings by the committee on mercantile affairs was lately concluded upon various bills bearing upon telephone rates in the Boston & Suburban district. In general, the object of the bills was either to reduce toll charges in metropolitan Boston or to multiply the number of rates available to the public. The New England Telephone & Telegraph Company submitted strong arguments on behalf of the present schedule of rates, which has been adopted only after exhaustive investigation by the Massachusetts Highway Commission and its expert advisers. Special emphasis was laid upon the large majority of subscribers who have voluntarily changed their contracts upon the basis of the new rates. In order to meet the requirements of the Boston situation in the most complete manner possible the company lately put in force a schedule of rates enabling subscribers located at points widely separated to communicate without being restricted by the zone system in general use.

Public-Service Commission Bills in Illinois.

There are now no less than five bills proposing the creation of public-service commissions pending in the Legislature of Illinois. These are the Rayleigh bill, based on the Wisconsin law, but not applying to Chicago; the Ettelson bill, proposing two commissions as in New York, but providing that the Chicago commission be appointed by the Mayor; the Chamberlin bill, extending the powers of the existing Railroad and Warehouse Commission and backed by the State administration; the Potter bill, contemplating a commission of seven members appointed by the Governor, and the Brown bill, proposing one State-wide commission.

The last bill mentioned was drafted by Mr. Frank F. Fowle, consulting engineer, Chicago, at the request of Senator William H. Brown. It provides for State-wide regulation by a single commission and embodies some of the features of both the Wisconsin and New York laws. It would abolish the existing Railroad and Warehouse Commission. A commission of three members is provided for. This commission would hear both formal and informal complaints and fix rates. Appeal to and review by the courts is provided for. The commissioners are to be appointed by the Governor and they or their employees must not have any financial interest in any public utility. Every utility in the State must be appraised, this work to proceed as fast as practicable.

A public hearing on the various public-service commission bills was held in the Senate Chamber at Springfield on March 22. Senator Ettelson, of Chicago; Representative Rawley, of Freeport; Senator Chamberlin, of East St. Louis; Alderman Pringle, of Chicago, and others spoke. There was a large attendance, including many representatives of public-utility companies.

New York Commission News.

During the present week the Public Service Commission, Second District, will give hearings as follows:

On the application of the Richfield Springs Electric Light & Power Company for authority to make a mortgage for $100,000 and to issue presently $50,000 in 5 per cent bonds. On the joint petition of the Amityville Electric Light Company, the Sayville Electric Company, the Northport Electric Light Company and the Islip Electric Light Company for authority to merge these properties into the Long Island Lighting Company and for authority for the merged company to issue $300,000 in capital stock, a first mortgage for $6,000,000 and a present issue of bonds to the amount of $370,000. On the petition of the Katonah Lighting Company asking for the approval of the commission for the construction of lighting systems in the towns of Poundsridge and Lewisboro, Westchester County, and for authority to issue capital stock. On the application of the Rockland Light & Power Company for permission to exercise franchises in the villages of Piermont and Grand View-on-the-Hudson. On the petition of the Orange County Lighting Company, of Middletown, for authority to issue its second mortgage for $200,000 and convert its bonds at present to the amount of $85,000 secured by this mortgage. On the application of the Wayne County Gas & Electric Company for approval to exercise franchises in the town of Manchester and the village of Newark. On the application of the Port Jervis Light & Power Company for the approval of the exercise of a franchise in the City of Port Jervis. On the complaint of residents of Sea Cliff, Nassau County, against the Nassau Light & Power Company as to alleged exorbitant rates for the use of electricity in the village of Sea Cliff. On complaint of residents of White Plains, Port Chester, East Chester, Tarrytown, North Tarrytown and Irvington as to the price charged for gas and electricity by the Westchester Lighting Company.

A complaint has been received from the president and Board of Trustees of the village of Ossining relative to the price charged for electric lighting in that village by the Northern Westchester Lighting Company. The complaint has been served upon the company and an answer requested within ten days.

The Public Service Commission, Second District, has received a petition from the Clinton Mills Power Company, which furnishes electric lighting for the streets of Cooperstown, Otsego County, asking for permission to increase its capital stock from $10,000 to $40,000 and to issue $60,000 coupon bonds payable in twenty years with interest at 5 per cent. The additional capitalization is asked for the retirement of coupon notes amounting to $22,000 and outstanding bonds amounting to $20,000, the balance being for the reconstruction and rebuilding of a dam on the Susquehanna River in the town of Hartwick and for improvements to the plant generally.

The commission has received a complaint from Mr. Archibald Douglas, of Spuyten Duyvil, asking for an order requiring the New York Telephone Company to cease charging subscribers having contracts dated prior to Nov. 10, 1910, and still in force, a toll for telephone service within the territory constituting the Kingsbridge central area as it was laid out prior to Nov. 10, and asking that the company be required to restore the rates covering such central-office area as it existed prior to that date. In November the company formed a new telephone-exchange territory within the territory of the old exchange called Kingsbridge and named the new exchange "Marble." Immediately upon doing this it commenced to charge for calls from points within the remaining territory embraced in the Kingsbridge exchange to points within the new "Marble" exchange, a toll charge of 5 cents per call being made.

Mr. John N. Carlisle, who was appointed by Governor Dix of New York to make an investigation of work and methods of the Public Service Commission of the First District, has announced that he will begin holding a series of public hearings on April 4 in the Engineering Societies Building, 29 West Thirty-ninth Street. For the past two weeks Mr. Carlisle has been devoting his entire time to investigating the books and records in the offices of the commission. Mr. Carlisle has stated that the point he is especially endeavoring to discover is why the expenses of the First District commission should be so much greater than those of the Second District, and to suggest retrenchments.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission has recently investigated the sale and installation of gas appliances by the Lowell Gas Light Company in connection with a complaint filed with the board by the Master Plumbers' Association of Lowell. In view of the practice of many electric lighting plants of selling energy-consuming devices at nominal prices in order more widely to introduce the service and increase operating revenue, the study which has been made at Lowell is of much interest to the managers of public utilities. It was claimed by the master plumbers that the practice of the company rendered the sale and installation of gas appliances by parties outside the company unprofitable, and that in consequence the petitioners are virtually excluded from what might otherwise be a remunerative branch of their business. It was further urged that the company's acts in selling and installing such appliances are unlawful. The commission has issued a finding in which it states that it is not satisfied that the acts of the company are beyond its corporate powers, and that the sale of gas appliances is incidental merely to its main business of making and selling gas in the manner that its sale of coke, tar and ammonia is incidental to it. The board points out that the company's policy is also important to the full accomplishment of this main business, for by having the company's customers install the greatest possible number of gas-consuming appliances, especially such as are designed to utilize gas during the portion of the year when very little is required for purely illuminating purposes, the sale of gas has been greatly increased. The finding states that the Supreme Court of Massachusetts has repeatedly given a liberal interpretation to what is reasonably incidental to the specific chartered powers of a corporation, and in Pennsylvania in a case similar to the one at Lowell the court expressly held that the sale of gas-consuming appliances and conveniences is within the corporate powers of a corporation organized to manufacture and supply illuminating and heating gas (Malone versus Lancaster Gas Company, 182 Pub. Sta., 309). The board points out that it would be a distinct menace to the public interest and a serious embarrassment to proper supervision and regulation if corporations engaged in the performance of a public service should extend their activities to other lines of private trade or business, but that so long as the companies keep within what is plainly subordinate and incidental to the performance of their public service no public interest seems to be injuriously affected or endangered, and the practice of selling and installing gas and electric appliances may often be of a distinct public advantage. In the case in point the board is satisfied that no public interest has suffered and that the acts of the company which have deprived the complainants of a possible profit have, on the other hand, operated to the immediate advantage of the purchasers of gas appliances and indirectly to the advantage of all gas consumers in the city. On these grounds the complaint was dismissed.

The board has sent a report to the Massachusetts Senate in reply to a request that the commission inform the upper legislative branch what progress has been made by the French King Rapids Power Company in the construction of plant authorized by the acts of 1908, with the probable time when the company will begin to generate and distribute electricity. The act incorporating the company provided for the construction of a power plant with dam across the Connecticut River between the towns of Gill and Northfield or Erving, with transmission of electricty to cities and towns in Worcester County The company is owned by the interests owning and operating the Connecticut River Transmission Company, which has for over a year been transmitting electricity from Vernon, Vt., to points in Worcester County, selling to large power users and electric light companies. Land purchased by the French King Rapids Power Company controls the site of the dam to be built by the latter; surveys and soundings have been made, and the necessary data for the preparation of plans and the construction of the plant are available. The company expects to begin construction during the coming summer, and the board is of the opinion that the company will not be in a position to generate and distribute electricity in less than eighteen months from the beginning of construction.

Wisconsin Commission News.

The Eagle River Light & Power Company has been authorized by the Railroad Commission to discontinue its present flat rate of $2.50 per consumer per month, and to substitute therefor a schedule of flat rates based upon the class of service and the size of the installation. The new schedule will result in no material increase of total revenue, but it will eliminate, to a great extent, the flagrant discriminations which have hitherto existed. An analysis of the company's financial condition revealed the fact that the total revenues fall far short of being sufficient to cover total operating expenses, including depreciation and a reasonable return on the investment. Inasmuch as this condition of affairs will undoubtedly result in a petition for an increase in rates in the near future, the commission granted the petition requested as a temporary expedient and postponed a more elaborate consideration of the rate question until a formal request is made for an increase in rates.

In an opinion involving the indeterminate-permit feature of the public utilities law the Supreme Court has upheld the virtual abrogation of a contract between the City of La Crosse and the La Crosse Gas & Electric Company, by which the company was to pay the city 2 per cent of its gross earnings under the terms of the franchise. The company received an indeterminate permit from the State in 1908 and had subsequently refused to pay the 2 per cent tax to the city on the ground that the conditions imposed by the city in the old franchise had been wiped out when the old franchise was surrendered for an indeterminate permit, under the terms and limitations of the public utilities law. The 2 per cent tax proposition was a condition engrafted by the municipal authorities upon the original State-given franchise held by the company. The court held that not only was this condition imposed without due authority, but that under no circumstances could the public utility law be so construed as to warrant the retention in the new franchise of any condition of the surrender franchise so obviously prejudicial to company and consumers alike as that contained in the 2 per cent tax provision of the case in question. The court took this occasion to elucidate very clearly the meaning and administration of the indeterminate-franchise law and to clear up certain perplexing questions as to its interpretation which have been bothering public-utility corporations ever since the law was passed. The fact was emphasized that one of the main objects of the law was so to disestablish existing conditions as to remove all special rates, favoritisms and burdens interfering with each consumer, as well as those conditions involving complications prejudicial to the utility, and to bring all old franchises under one system, so that the things formerly privileged might continue to be so, but solely under conditions and limitations referable to a single standard—the public utilities law.

The commission has ordered the Equitable Electric Light Company, of Lake Geneva, to cease from exacting a charge of 25 cents for meter rental from consumers who do not own their own meters. This practice is contrary to the provisions of the public utilities law.

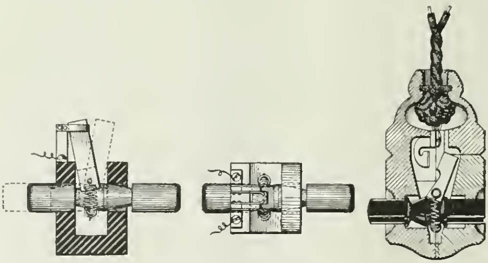
Maryland Commission News.

The Maryland Public Service Commission last week ordered an investigation of the physical properties of all the public-service corporations in Maryland, this action following the receipt of many complaints by the commission. Chief Engineer Charles E. Phelps had been authorized to organize the force necessary for the new work. It is understood that seven new inspectors will be engaged immediately and instructed in their work. With this addition the force of men available for the work will number twelve. Offices have been leased on the second floor of the old Builders' Exchange Building. Mr. William T. Russell, superintendent of inspectors, will be in charge of the work relating to the electric supply companies; Mr. Phelps will be directly over the men engaged in the investigation of the transportation companies, and have general charge of the entire working force.

Attorney Maurice A. Soper, counsel for the complainants in the action against the United Railways & Electric Company to restore commutation-rate privileges recently withdrawn, has pointed out to the commission that as the constitution provides that no legislation could impair the validity of a contract already established the railway company's stand is invalid and that the company is using the public-service law to escape an obligation. The withdrawal of the commutation privileges followed a complaint on the part of a number of suburbs not enjoying the privilege, in which they declared that they were being discriminated against. When the company was ordered by the Public Service Commission to answer the complaints it replied by withdrawing all commutation rates on the ground that they were a violation of the law. The company claimed to be anxious to restore the privileges provided it could do so legally, and a hearing was arranged on the matter before the Public Service Commission. While still maintaining its willingness to comply with the complainants' demands, the counsel for the company last week declared that they saw no legal way in which it could be done without making the commutation privilege universal.

Simple Snap Switch for Lighting Circuits.

Five patents issued on March 21 to Mr. Charles J. Klein, of New York, relate to an extremely simple and compact mechanism for operating the contacts of a snap switch. The fundamental principles of the device were disclosed in an application filed on Sept. 20, 1907, from which Figs. 1 and 2 have been taken. There are only three members to the mechanism. One of these is a stationary member carrying the switch contact; another is a cam, and the third is a tension member consisting of a helical spring engaging the cam and connected to the switch member. The parts are so arranged that when a relative movement between the cam and the spring is produced the spring is put under tension and moves quickly along the engaging face of the cam, thereby pulling on the switch member with a sudden jerk and causing the switch to open and close with a snap action.


Figs. 1, 2 and 3—Klein Snap Switches.

An application of the switch mechanism to a pendent socket casing is illustrated in Fig. 3, which is covered by an application filed on Feb. 20, 1908. The socket is composed of a number of sections so arranged that when they are assembled the switch may be mounted therein in compact form and be thoroughly protected.

CURRENT NEWS AND NOTES.

New N. E. L. A. Sections.—The executive committee of the National Electric Light Association has issued permission for the formation of sections at Scranton, Pa.; Birmingham, Ala.; Joplin, Mo.; Rock Island, Ill., and Hamilton, Canada.

Tests of Meters.—Of 7629 tests of electric meters made by the New York Public Service Commission, Second District, in January, 1911, 5947, or 77.96 per cent, were accurate; 481, or 6.30 per cent, were fast, and 1201, or 15.74 per cent, were slow.

Arkansas Association of Public Utility Operators.—It is announced that the annual convention of the Arkansas Association of Public Utility Operators will be held in Little Rock, Ark., on May 3, 4 and 5. Mr. E. Hardin, of Hot Springs, Ark., is secretary and treasurer of the association.

Minneapolis Electric Show.—The following officers of the Minneapolis Electric Show have been elected: President, Mr. S. G. Dustin; vice-president, Mr. H. J. Gille; secretary, Mr. W. E. Stephenson; treasurer, Mr. A. W. Leonard; trustees, Messrs. Theodore Hays, George Cadwell and Charles Wilkinson.

Large Turbine Unit for Cincinnati.—The Union Gas and Electric Company, of Cincinnati, has just completed the installation of a 10,000-kw Westinghouse-Parsons high-pressure steam turbine in its generating station, at Plum and Tenth Streets, Cincinnati. The remainder of the equipment in this plant is of the vertical, compound-condensing, engine-driven type.

Farmers Want Electricity.—The American Gas & Electric Company, of Maumee, Ind., is having difficulty in securing right of way for its line between adjacent towns and cities owing to the refusal of the farmers to come to terms unless they are guaranteed facilities for the use of electric light in their homes. As this would make necessary the installation of a transformer for each farmhouse supplied, the company will condemn and buy the land.

Underground Conduit Legislation.—The California Legislature has passed a bill regulating the construction and maintenance of electric wire conduits, measurements, subways, manholes and underground rooms, chambers and excavations. It provides that such of these spaces as men work in must be kept free from stagnant water, seepage or any offensive matter dangerous to health. The provisions concerning construction do not apply to works already laid.

Bonus to Steady Workmen.—The National Carbon Company, of Cleveland, has for more than a year had in force with satisfactory results a system for inducing employees to remain steadily in their positions. The company pays each one who remains on the payroll from March 31 to the end of the year for ten days extra, and those who hold their places from April, May or June to the end of the year for six extra days. Last year about 700 out of the 1500 employees received bonuses in that way. The company has lately introduced the same system in some of its other plants.

Key to National Electrical Code.—Mr. Washington Devereaux, electrical engineer of the Philadelphia Electrical Inspection Bureau, has compiled an electrical key for the use of electrical inspection bureaus in advising electrical contractors, wiremen, etc. The matter is contained in the form of numbered paragraphs and consists of recommendations which experience has shown correspond to requirements by the inspection bureau in the correction of installations not in harmony with the National Electrical Code or municipal requirements. The paragraphs indicate the remedy for defects which are most likely to be found upon inspection of an electrical equipment. After an inspection a postal card is sent to the contractor pointing out, by reference to the key, defects which should be remedied. The little pamphlet thus forms an admirable supplement to the National Electrical Code.

Western Society of Engineers and University of Illinois.—The Western Society of Engineers, having headquarters in Chicago, has adopted resolutions requesting the Legislature to make liberal provision for the College of Engineering and the Engineering Experiment Station of the University of Illinois. The university authorities have asked for largely increased appropriations from the Legislature, and the society takes advantage of the occasion to express its belief in the high character of the work of the engineering departments of the university and its recommendation that the Legislature deal liberally with the institution.

Large Electric Power Contract at Boston.—As a result of an exhaustive investigation of the cost of power production, the Walworth Manufacturing Company, of South Boston, Mass., a prominent house dealing in engineering specialties, has made a five-year contract for over 1000 hp with the Boston Edison company. By the use of Edison service five steam plants will be shut down. Twelve elevators will be remodeled for electrical operation, and a 150-hp isolated lighting plant discontinued. An extensive installation of electric motors has been laid out The plant of the Walworth company is located near the L Street station of the Boston Edison company, and the arrangements provide for the installation of special underground service and the erection of a private substation on the premises of the consumer.

City of Toronto Offer for Central-Station Plant.—The Council of the city of Toronto on March 20, by a vote of 19 to 5, approved the recommendation of the Board of Control that the city corporation buy the plant and property of the Toronto Electric Light Company, at the price of $125 per share of the company's stock of par value of $100, and the assumption of the bonded indebtedness of $1,000,000 The company's stock issue at present is $4,000,000, so that the city would be paying for the property the sum of $6,000,000. The shareholders of the Electric Light Company will meet shortly to decide whether or not to accept the city's offer. The city is making application to the Legislature for authority to appoint a commission of three members to supervise the operation of the civic electrical department, one to be appointed by the Hydroelectric Commission, one by the City Council, the Mayor to be ex officio the third member. The two appointed members will be paid a salary of not more than $4,000 each per annum.

Hearing Rain Squalls by Wireless.—The following item appears in the issue dated March 1 of the *Hydrographic Bulletin*, published by the Hydrographic Office of the United States Navy Department, and consists of a report to the branch hydrographic office, New York, by Second Officer E. Courteville, of the French steamship *Niagara*: "Mr. Magny, operator on board the French steamship *Niagara*, Captain Juham, referring to discharges of atmospheric electricity in a distant storm and the resulting trouble in receiving wireless messages, states that he can by this means hear the rain falling upon the sea at a great distance. The sound is like the pattering of rain on a zinc-covered deck, and its increasing or decreasing intensity tells him whether the squall is approaching or receding. 'I am so sure of this fact,' he states, 'that when I hear the pattering I go quickly to the top of my wireless station to grease the insulators.' We can give the following explanation: The night being clear and dry, we have an isolated cumulo-nimbus cloud loaded with electricity, positive for example, and the sea underneath it loaded with negative electricity. Every falling drop of rain is charged with positive electricity. At a certain instant, when the distance between the drop and the sea is small enough, a minute spark originates, giving a very small Hertzian wave. It is the superposition of these numerous rudimentary undulations that gives the pattering effect in the wireless receiver."

Symbol for Current.—The United States national committee of the International Electrotechnical Commission has suggested to the National Electric Light Association that the letter "C" be changed to "I" on the association's badge.

Compulsory Mine Telephone Service.—The Crow's Nest Pass Coal Company, Michel, Alta., Canada, has promised its employees to install telephones on every level, which was the only condition under which the men would agree to return to work after a recent strike.

Opening of Chemists' Building in New York.—The Chemists' Building, New York, was formally opened on March 17, 18 and 19 with exercises in which the American Electrochemical Society, the American Chemical Society, the Society of Chemical Industry and the Chemists' Club participated.

Subterranean Wireless Telegraphy.—According to reports from Berlin, Drs. Leimbach and Loewy have succeeded in sending wireless telegraph messages underground between the potash mines in the North Harz Mountains over a distance of about one and one-half miles at a level of 1600 ft. below the surface.

Automobile Standardization.—The Society of Automobile Engineers, numbering 800 members, has during the past year given much attention to the standardization of automobile details, and proposes to issue a pocket-book for the guidance of engineers and draftsmen which will contain dimensions, etc., of standard parts. Mr. Coker F. Clarkson, 1451 Broadway, is secretary of the society.

Steam Reserve for Drainage Canal Hydroelectric Plant.—It is reported that the Sanitary District of Chicago has in contemplation the future installation of one or more steam auxiliary plants to be used in the event of possible interruption of service from its hydroelectric generating plant on the Chicago Drainage Canal at Lockport, Ill. Electricity from this plant is transmitted thirty miles into Chicago for municipal and industrial requirements.

Purdue Branch, A. I. E. E.—At the recent dinner held by the Purdue Branch of the American Institute of Electrical Engineers, at Lafayette, Ind., brief addresses were given by alumni now stationed in various parts of the country. Prof. F. C. Harding, head of the Purdue electrical school, acted as toastmaster, and among the speakers were President W. E. Stone, of the university; Dean C. E. Benjamin, of the engineering schools; Mr. Frederick Riebel, of the Westinghouse company, Pittsburgh; Mr. L. J. Flint, of Chicago; Mr. E. E. Miles, of the Fort Wayne Electric Works, and Messrs. C. F. Pittman and R. H. Fitch for the undergraduates. Ninety persons attended the dinner.

Electric Light Bedims the Stars.—The experience of the astronomers of the Brooklyn Institute of Arts and Sciences has demonstrated that the shining orbs of heaven can no longer compete with the electric lamps of earth, and because the electric lights of downtown Brooklyn are so brilliant that they cause the stars to pale almost into obscurity the department of astronomy of the institution has resolved upon an active campaign for a new astronomical observatory on Mount Prospect, Brooklyn, near the institute building. For months the observers who make weekly pilgrimages to the roof of the Academy of Music and scan the sky through institute telescopes have been troubled with the increasing brilliance of Brooklyn's white-light district. The climax came when the Edison Electric Illuminating Company's "Brighter Brooklyn" slogan was lighted not far from the Academy of Music. Not only did Sirius pale into insignificance, but also the lesser candles of the southwest heavens. Only a few stars which selected a part of the heavens that has not yet been pre-empted by sky-grasping corporations managed to shine and be observed. The star cluster in Canis Major, the "beehive" in Cancer, whose stars are about the sixth magnitude, Hind's crimson star in Lupus and the star cluster in Cygnus manage still to send their rays into the telescope without being lost on the way. Not only does the direct light of signs affect the observations, but the sum total of the downtown lighting is said to be so great that it sets aglow the entire heavens.

New York N. E. L. A. Convention.—Mr. Charles H. Hodskinson, master of transportation of the National Electric Light Association, is already taking active steps to organize his important work in advance of the convention to be held in New York May 29-June 2. At the time of the St. Louis convention last year, when the membership was 5500, the registered attendance was 2780. The membership has now crossed the 7100 line and will not be less than 7500 at the time of the annual convention, so that on the same basis there will be from 3500 to 4000 present in registered attendance. This implies heavy transportation, and Mr. Hodskinson has therefore formed an active committee, which is taking up its duties in co-operation with him. By about the middle of April practically all the details will have been arranged as to trips, rates, etc., and will then be announced. The membership of the committee, which now numbers twenty-one, represents every section of the United States.

Colorado Electric Club.—At the mid-week lunch of the Colorado Electric Club on March 23 the talk was given by Mr. A. D. Parker, vice-president and general manager of the Colorado & Southern Railway Company, his subject being the relation of corporations to citizenship. He identified the corporation as a body of citizens and itself a citizen, and after outlining the history of the corporation in this country, he emphasized the growth in discipline, responsibility and mutual understanding which has resulted from the proper management of corporations. The attendance, 136, was the largest in the club's history. The prospectus of the second annual Denver electric show, given by the Colorado Electric Club, was distributed to members. Among rules which will govern the displays are one that all electric wiring installed must be in conduit and another that all decorations must be fireproofed. The ninth annual convention and "rejuvenation" of the Rejuvenated Sons of Jove will be held in Denver during the week of the show.

Philadelphia Electric Company N. E. L. A. Section.—The regular monthly meeting of the Philadelphia Electric Company Section of the N. E. L. A. was held in Philadelphia March 20. Dr. Edward Anthony Spitzka, professor of general anatomy, Jefferson Medical College, was the speaker. There were present at the meeting, numbering over 400, representatives of a number of medical societies, particularly of the hospitals of Philadelphia, physicians and engineers from Philadelphia and New York, as well as physicians connected with large industrial establishments. Dr. Spitzka covered in his lecture the full range of the effects of electricity on the human body from the effects of lightning to the usual current used for industrial and residential purposes. He brought out many new and interesting facts regarding the effect of electricity on the human system, which were fully illustrated by lantern slides. Dr. Spitzka gave many interesting experiences based on his own investigation of some fifty-seven electrocutions in the various States. He made the statement that the temperature of the body in many instances was raised as high as 129 deg. Fahr. immediately after electrocution. Many slides were shown of various types of electric burns and various methods of practising artificial respiration were explained. The lecture was discussed by many physicians and engineers, among the latter being Mr. Percy H. Thomas, of New York, and Mr. W. C. L. Eglin, of Philadelphia. Prior to the meeting an informal dinner was held at which all the out-of-town visitors were entertained, covers being laid for fifty. The table was decorated with festoons of electric flowers, an electric fountain and baskets of flowers illuminated by miniature electric lamps.

ELECTRIFICATION OF THE PULLMAN PASSENGER-CAR SHOPS—II.

The Modern Plant That Has Superseded the Famous "Centennial" Corliss Engine.

By George W. Cravens.

MECHANICAL EQUIPMENT OF POWER PLANT.

Steam for the central power house is carried through a tunnel in a 20-in. spirally riveted pipe laid on rollers, and comes directly from the central boiler plant under 150-lb. pressure. The steam, water and exhaust mains are all of riveted pipe, the steam and exhaust pipes being lagged with magnesia; they are grouped together along the center of the basement. Openings have been made in the turbine and compressor foundations for these pipes and other equipment, and the pipes all run through the power house and on to other places. The water main is 16 in. in diameter and the exhaust pipe 30 in. The exhaust steam from the air compressors and auxiliary engines is used to heat the shops.

Steam for each unit is taken direct from the main, that for the turbines going through 10-in. pipes to separators and up to turbines. From here the 36-in. exhaust pipes go along under the engine-room floor, through the east wall of the building, and up to the condensers outside. The vacuum, oil and condensing water pumps and other auxiliaries are grouped under each turbine, each group being complete and independent of the others, and all piping is very direct and simple, with valves accessibly located.

The steam turbines and 2000-kva generators were built by the Allis-Chalmers Company and operate at 1800 r.p.m. with 150 lb. gage of steam and a 28-in. vacuum. These units are horizontal and the steam turbines are of the Parsons type, direct-coupled to the generators, and with all steam connections on the lower side. The governors, valves and other controlling devices are located at one end, and the governors may be adjusted for speed while running in order to divide the load or synchronize more readily. This is done electrically from the switchboard.

AUXILIARY EQUIPMENT.

Just outside the east wall of the power house a steel framework is built to support the condensers (Fig. 7). These are Tomlinson barometric condensers, built by the Allis-Chalmers Company, and the condensing water comes from Lake Calumet. This water is not clean enough for use in the boilers, so a special intake tunnel and discharge sewer were built for this supply. These are about one-half mile long, the intake coming in below the basement floor and the sewer running just below grade outside the building and immediately below the condensers. Water for the condensers is supplied by rotary pumps driven by Chandler & Taylor 8-in. x 8-in. horizontal engines. These are direct-connected and the water pipes are 14 in. in diameter. From the condensers 12-in. pipes go down to the Union Steam Pump Company's 10-in. x 24-in. x 20-in vacuum pumps located in the basement.

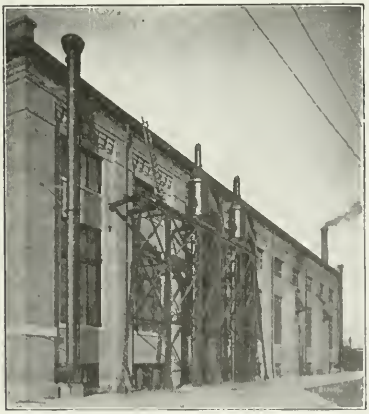


Fig. 7—Barometric Condensers

In addition to the foregoing there is a 4,000,000-gal. Canton-Hughes two-cylinder steam pump in the basement, which supplies water to the entire works. This provides a normal pressure of 50 lb., but can be increased to 100 lb. in case of fire. Space is provided for a second pump, and both will pump direct into the 16-in. water main previously mentioned. There are also some minor auxiliaries in the basement, such as oil pumps, drip-water pumps, etc.

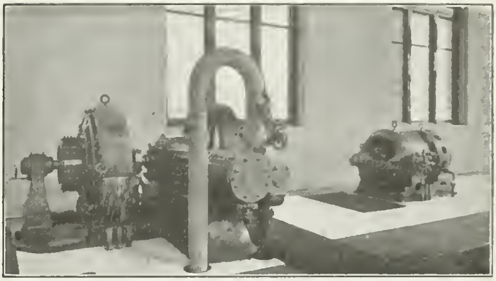


Fig. 8—Engine-Driven and Motor-Driven Exciters.

Space is provided in the main engine-room of this power house for three turbo-generators, four compound air compressors, two motor-driven exciters and one engine-driven exciter, and three motor-generator sets, in addition to the switchboard. The engine-driven exciter is direct-coupled to an A. L. Ide & Sons Ideal horizontal engine operating at 275 r.p.m., and stands just back of generator No. 3 near the east wall.

About 60 per cent of the space in the power house is given up to the four Fulton Iron Works Company's large two-stage air compressors, three of which are now in place. These are driven by direct-connected cross-compound steam engines with large flywheels, and each one delivers 4000 cu. ft. of free air per minute at a pressure of 90 lb. per square inch. These operate at 90 r.p.m. and draw their air through stacks on the outside of the building near the condensers. The air is strained twice, carried through a mixing and pressure-balancing compartment in the basement and thence to the primary compression cylinders through 16-in. pipes. The compressed air is sent through pipes in the tunnels to various shops for operating tools, forges, etc. The cylinders of these compressors are water-jacketed, the discharge going to the sewer. Provision is also made to by-pass this discharge into the condensers in case of emergency.

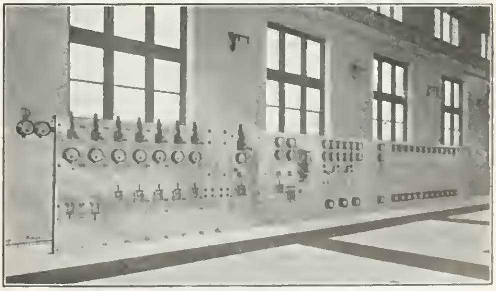


Fig. 9—Main Switchboard.

ELECTRICAL EQUIPMENT.

At present two of the three Allis-Chalmers turbo-generators are in place, these being Nos. 2 and 3. Space for No. 1 is provided, but no foundation has been put in and the opening in the main floor is boarded over with a varnished hard-wood floor. The generators are designed to deliver 1500 kva at 80 per cent power-factor and 2000 kva at unity power-factor. They deliver three-phase, 60-cycle current at 2300 volts, and are operating at present with a power-factor of 92 per cent. The main valves for the turbines are operated by 3-hp, 110-volt, 725-r.p.m. direct-current motors through Cutler-Hammer control panels mounted alongside the turbines. The governors are equipped with solenoid-operated control switches, actuated from the generator panels in the main switchboard by means of General Electric push-and-pull type engine-governor control switches.

Provision has been made for three exciters, two of which are now installed. One of these is driven by the Ideal engine mentioned above and is rated at 60 kw at 125 volts, 285 r.p.m., and the other is of the same capacity at 850 r.p.m. The latter is direct-connected to a 90-hp, 2200-volt induction motor and is the only one now running. These exciters are shown in Fig. 8. Direct current for operating certain motors in the shops is obtained from a motor-generator set consisting of a 300-kw, 250-volt, 600-r.p.m. generator direct-coupled to a 430-hp, 2200-volt synchronous motor. It was intended to have three such sets installed, but changes in plans have reduced the amount of direct current required, so it is doubtful if the others will be installed. At present this motor is operating at 97 per cent power-factor and helps bring up the power-factor of the generators in spite of the large number of induction motors used in the shops. All of the above-mentioned machines were supplied by the Allis-Chalmers Company.

MAIN SWITCHBOARD.

The switchboard for this station is composed of thirty-eight panels of 2-in. white Italian marble, polished front and back, mounted on iron pipes and located opposite the generators. A general view of it is given in Fig. 9. It stands 5 ft. from the west wall of the building and the space behind it is unobstructed, thus allowing free access to the rear of all panels. The board is 7 ft. 6 in. high, each panel being in two sections. The upper sections are 65 in. high and carry the instruments and switches, the base sections being 25 in. high and having integrating watt-hour meters on them for the alternating-current panels only. No high-tension current comes to the board, all instruments being operated through transformers and the oil switches electrically operated through push buttons. The switchboard rests on an 8-in. steel channel, laid flat and flush with the floor, and all wiring is brought from below through conduits. The direct-current buses are of polished and lacquered copper and are mounted on porcelain insulators carried on brackets.

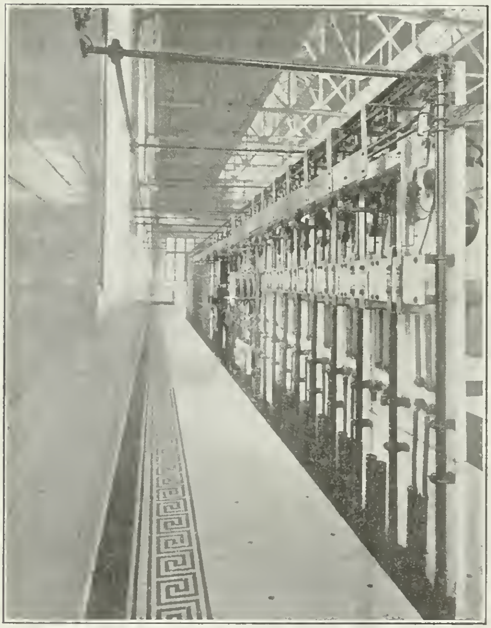


Fig. 10—Rear View of Switchboard from Direct-Current End.

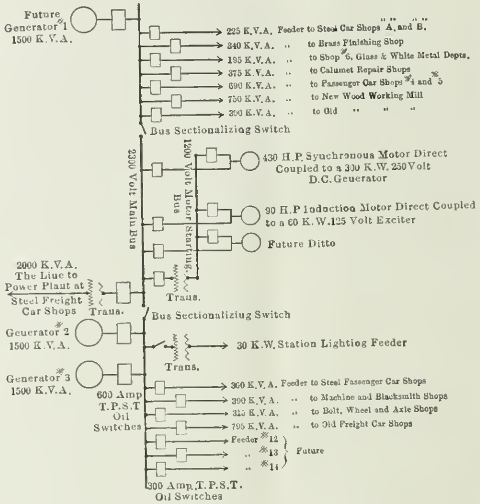

Future Generator #1 1500 K.V.A.
225 K.V.A. Feeder to Steel Car Shops "A" and "B."
340 K.V.A. " to Brass Finishing Shop
195 K.V.A. " to Shop #6, Glass & White Metal Depts.
375 K.V.A. " to Calumet Repair Shops
690 K.V.A. " to Passenger Car Shops #4 and #5
750 K.V.A. " to New Wood Working Mill
390 K.V.A. " to Old " " "
Bus Sectionalizing Switch
2300 Volt Main Bus
1200 Volt Motor Starting Bus
430 H.P. Synchronous Motor Direct Coupled to a 300 K.W. 250 Volt D.C. Generator
90 H.P Induction Motor Direct Coupled to a 60 K.W. 125 Volt Exciter
Future Ditto
2000 K.V.A. The Line to Power Plant at Steel Freight Car Shops
Trans.
Trans.
Bus Sectionalizing Switch
Generator #2 1500 K.V.A.
30 K.W. Station Lighting Feeder
Trans.
Generator #3 1500 K.V.A.
600 Amp T.P.S.T Oil Switches
360 K.V.A. Feeder to Steel Passenger Car Shops
390 K.V.A. " to Machine and Blacksmith Shops
315 K.V.A. " to Bolt, Wheel and Axle Shops
795 K.V.A. " to Old Freight Car Shops
Feeder #12
" #13
" #14
Future
300 Amp. T.P.S.T. Oil Switches

Fig. 11—System of Connections.

The switchboard is nominally in two sections, the left-hand portion being made up of direct-current panels and the right-hand of alternating-current panels, the division being marked by the voltage-regulator panel. At the extreme left is a swinging bracket carrying two direct-current voltmeters, one being tied direct to the 250-volt buses and the other to the potential buses for the 250-volt generators so it may be plugged in to indicate the voltage before paralleling. The 250-volt direct-current buses extend along the backs of the first ten panels only. The first panel controls a feeder controlling the crane and other station auxiliaries and the next six are for feeders for the shops using direct current. Then there are three panels for the direct-current generators, only one of which is equipped. Each of these panels contains a circuit-breaker, ammeter and main switch and has fuses on a marble base at the back.

The station-lighting panel stands between the 250-volt direct-current panels and the exciter panels and has twenty-one double-pole switches mounted on the upper section. Normally the lights will be operated on direct current, but provision has been made for throwing them on an alternating-current circuit. This is done through the double-throw main switch mounted on the base section, connections being made to the 125-volt exciter buses on one side and to a small 125-volt transformer in the basement. Three exciter panels are next provided, one of which is still blank. These contain the voltmeter, ammeter, rheostat-operating mechanism and main switch, the rheostat being mounted below the floor and operated by chains. The regulator panel contains a General Electric T. A. regulator for controlling three machines, the condensers and other auxiliary apparatus being mounted on the rear of the panel. Fig. 10 is a rear view of the switchboard.

The alternating-current section of the switchboard comprises the remaining twenty-three panels. Continuing toward the right-hand end, three generator panels come next to the T. A. regulator panel. One of these is still blank, the others each containing an alternating-current ammeter with three plug switches for connecting to any phase, an indicating wattmeter, a power-factor meter, a direct-current ammeter for reading the field current and an integrating watt-hour meter. In addition to the above instruments there are the usual field switch, rheostat-operating mechanism, eight-point potential receptacle, four-point synchronizing receptacle, oil-switch control and governor-operating switches. The rheostats are mounted in openings in the wall of the high-tension compartment downstairs and operated through a series of chains, shafts and sprockets from the panels above.

The tie-line panel stands to the right of the generator panels and controls the 2000-kw line running to the power plant at the new steel freight-car shops. This tie line is being operated temporarily at 2300 volts, but it is proposed to install step-up transformers and transmit energy at 11,000 volts over an underground line laid in conduit. The tie-line panel contains a power-factor meter, an indicating wattmeter, two alternating-current voltmeters, one of which indicates the main bus potential, an integrating, non-reversible watt-hour meter, two oil-switch operating switches, eight-point potential receptacle, and four-point synchronizing receptacle. One of the oil switches operated from this panel controls the half-voltage buses for starting the alternating-current motors and was placed here for convenience only.

The next three panels are to control the synchronous motors driving the 250-volt direct-current generators, but only one of these is equipped, as the other sets may never be installed. This panel contains a power-factor meter, an indicating wattmeter, an integrating watt-hour meter, and two oil-switch control switches in addition to the field switch and rheostat-operating mechanism. One of the oil switches is for starting up as an induction motor from the half-voltage bus and the other for throwing the motor on the 2300-volt bus for running.

Two induction-motor panels coming next are for the exciter-driving motors, one of which is now installed. The motor panel contains an ammeter, an integrating watt-hour meter and two oil-switch control switches. These are for two switches for the same purpose as described above. In both cases the oil switches are interlocked electrically to prevent tying the buses together.

The remainder of the board is composed of fourteen feeder panels, eleven of which are now equipped. Each of these contains an ammeter, three plug switches for reading the current on any phase, an integrating watt-hour meter and an oil-switch control switch. These panels control the lines running to the transformer vaults or substations in the shops. On the extreme right-hand end of the board is another swinging bracket containing two instruments. One of these is a synchroscope and the other is a frequency indicator. The switchboard wiring diagram may be consulted in Fig. 12.

The artificial lighting of the station is accomplished by the use of incandescent lamps entirely. Three 500-watt tungsten lamps hang from the roof, equally spaced along the center line of the building and above the zone of the traveling crane. In the center of each pilaster between the windows is an ornamental black-finish wall bracket, carrying three 40-watt tungsten lamps with frosted-glass shades. The illumination of the engine-room is excellent and is helped greatly by the glazed-tiling finish and light paint. The basement is lighted entirely by pendent 16-cp carbon-filament lamps.

HIGH-TENSION COMPARTMENT.

Compared with some other recent installations there is no very high potential current in the Pullman shops, but the 2300-volt apparatus, aside from the generators, is concentrated in one room, 90 ft. long, in the basement. This room is 8 ft. 8 in. wide for about one-half of its length and then widens to 10 ft 8 in. In the floor are the two pits or manholes previously

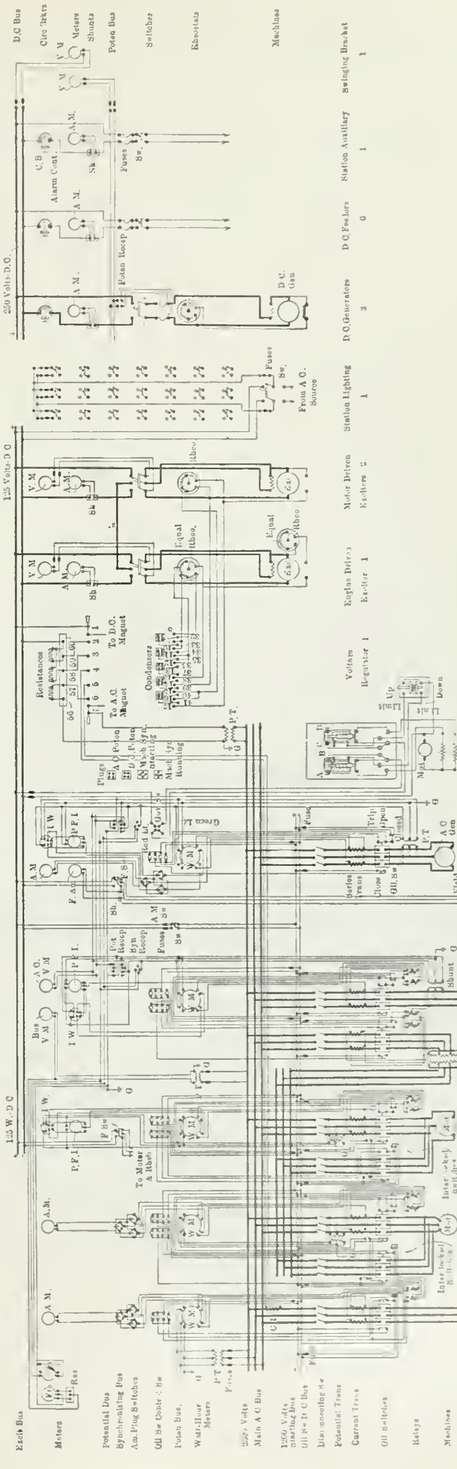


Fig. 12—Switchboard Wiring Diagram.

mentioned, through which all of the feeder cables pass. Orangeburg conduit is used very largely here, and no wiring is carried outside of conduits at any point except from the main busbars down to the oil switches, and this is heavily insulated.

There are two sets of busbars in this compartment, the main bars being the 2300-volt buses, mounted on 13,000-volt porcelain insulators above the pipe framework. The other bars form the 1200-volt buses and are used only for starting the alternating-current motors, as previously described. These bars are also carried on 13,000-volt insulators mounted on a lower set of pipes immediately under the 2300-volt buses and 22 in. away from them. The 2300-volt buses are spaced on 12-in. centers, and are laminated up to the required sizes by using several 2-in. x ¼-in. copper bars in multiple. The 1200-volt buses are spaced on 8-in. centers and consist of single 2-in. x ¼-in. bars.

LIGHT AND POWER DISTRIBUTION FOR PULLMAN SHOPS FROM CENTRAL ELECTRIC POWER PLANT.

Vault.	Location	Transformers in Vaults.		Lights				Motors	
		Light	Power	Carbon Inc.	Flame Arc	Enclosed Arc	250-Watt Tung.	No.	Total Hp
1	Shops A and B	3–75 kva	....	1008	42	.		...	.....
2	Brass-finishing shop	1–40 "	3–100 kva	65	36	..	.	18	475
3	Shop No. 6.	3–15 "	3– 50 "	.....	..	..	134	10	195
4	Calumet shops	3–25 "	3–100 "	500	....	....	80	..	300
5	Shops No. 4 and No. 5	3–30 "	6–100 "	630	78	.	..	..	600
6	New wood mill	3–50 "	6–100 "	700	...	53		32	1025
7	Old wood mill	3–30 "	3–100 "	752	...	59		11	340
8	Steel car shop	3–20 "	3–100 "	60	35	...		42	620
9	Machine shop.	3–30 "	3–100 "	98	...	52		33	540
10	Wheel and axle shop	3–30 "	3– 75 "	.....	39	.		12	300
11	Freight car shop	3–30 " 3–20 "	3–175 " 3– 40 "	50	...	120		42	820
	Totals	1105 kva	3 720 kva	3863	230	284	214	200	5215 hp.

The framework supports the alternating-current buses, electrically operated oil switches, current and potential transformers, relay and disconnecting switches, and consists of heavy iron piping with steel strips running horizontally to carry the oil switches and transformers. The disconnecting switches are mounted vertically on the front side of the framework, at the extreme top, with the current transformers just below them for convenience in wiring. There are no crossed wires in the station, all paths being short and direct, and the first impression one gets on entering this compartment is that of simplicity.

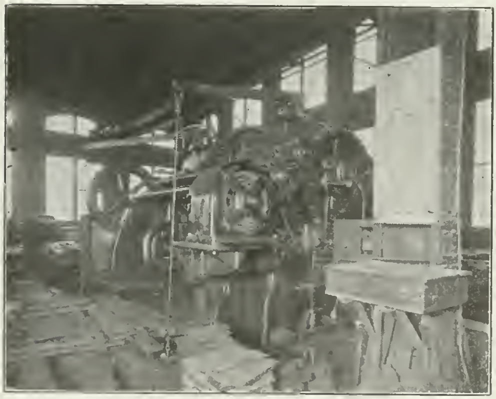


Fig. 13—Typical Direct-Connected Motor Drive.

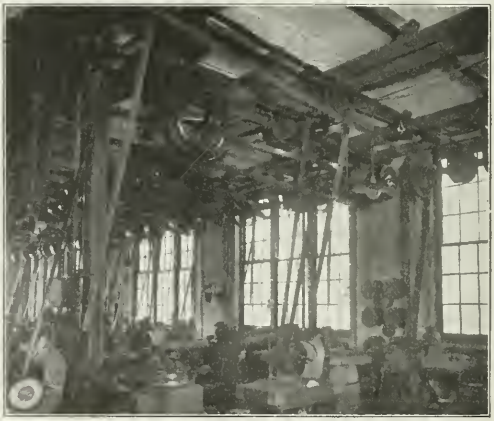


Fig. 14—Typical Belted Group Drive.

All of the small wiring is carried in loricated conduit right up to the taps, condulets being used throughout. The oil switches, operated by direct current from a set of special bus wires, are mounted on the rear of the framework with their frame casting 4 ft. from the floor. This makes them accessible and permits easy operation by hand in case of emergency. All conduits are carried well up through the floor so that conductors are protected until well above the danger zone. The oil-switch relays and all fuses are mounted on the front of the framework close to the parts protected, and the exciter rheostats are suspended from the ceiling just below the switchboard panels which carry their operating mechanisms.

On a steel shelf in this compartment are a 40-kw, 2200/1200-volt, three-phase, 60-cycle Allis-Chalmers transformer used to energize the motor-starting buses, and a 30-kw, 2200/110-volt, single-phase, 60-cycle Pittsburgh transformer for station lighting. Both of these are oil-cooled and are in service but a small part of the time. The general system of connections is shown diagrammatically in Fig. 12.

The preliminary layout for the switchboard and bus compartment was made by Mr. G. F. Chellis, at present with the J. G. White Company, and the final arrangement, details of design, manufacture and installation were done under the direction of the writer. Westinghouse instruments, circuit-breakers and oil switches are used throughout, with Delta-Star rheostat mechanisms, disconnecting switches and bus supports. The Delta-Star Electric Company built the switchboard and high-tension framework, the installation being done by C. E.

Doty & Company, they also having charge of other erection work that was undertaken for the Pullman Company at the same time.

DISTRIBUTION OF POWER.

The outgoing feeders are carried from their respective oil switches down through conduits to the main distribution vault just outside of the basement wall, as previously described, and thence to the eleven transformer vaults located throughout the yards. The conductors vary in size from No. 4 up to No. 00, and both varnished-cambric and lead-covered cables are made use of.

The transformer vaults are of concrete with steel-reinforced roofs and with the manholes in one corner. All buildings are served from these vaults through underground conduits, the cables being rubber-covered and ranging up to 1,000,000 circ. mil in size. The number of transformers in each vault, together with capacities and service, is given in the accompanying table.

Many makes of transformers are in use at the Pullman shops, and of various sizes and types, stepping down from 2300 volts to 440 volts, 220 volts or 110 volts as conditions may require, although most of the transformers feeding motor circuits were made by the Pittsburgh Transformer Company and most of the transformers feeding lamp circuits by the Allis-Chalmers Company. There are also six General Electric 100-kw transformers recently installed, three of which are in the steel passenger-car shop. These replace three 75-kw transformers which are now in use at the Calumet repair shops. There is an overhead 2300-volt, three-phase transmission line to the Calumet shops consisting of No. 4 wire, weatherproof insulation, on wooden poles with glass insulators, similar to the present temporary tie line to the new steel freight-car shops.

Electricity was adopted on account of its convenience and economy, and it is used for motors and lamps throughout the plant wherever practicable. The old indoor-lighting system consisted of nearly every sort of flame and inclosed-arc lamp available for general illumination, and carbon-incandescent lamps for local and portable use. The new installation comprehends the use of 250-watt and 500-watt tungsten lamps for all interior general illumination, with portables as before. Out of doors the arc lamps are being superseded by 200-watt and 400-watt series tungsten lamps operating at 7½ amp. Three constant-current transformers of 300-lamp capacity each are provided for this system, and will be moved into the new central power station later. The yard lamps are mounted on poles and on brackets from the buildings, according to the requirements of location.

A large variety of motors is used in the shops, about 40 per cent of them being direct-connected to machine tools and a majority of them being three-phase induction motors. The small tools in the machine shops and most of the wood-working tools are driven in groups by large induction motors, and direct-current motors are used for cranes and hoists excepting one crane in the steel passenger-car shop, which has an induction motor. Fig. 13 is an example of typical electric drive by individual motor, the driven machine in this case being a shear. Fig. 14 is a representation of a typical example of belted group drive.

No complete investigation has yet been made to determine the actual gain realized by electrification, but it is felt that marked improvements are noticeable already in output, maintenance and operating expense and ease of power control. The improvement in the lighting is especially noticeable, and extensions of both motor and lighting installations are being vigorously pushed.

All of the general engineering work was done by the mechanical department under the direction of Mr. T. Dunbar, manager, and it is through his courtesy that this description has been made possible. The new power station was erected by the R. & S. Sollett Company from plans of Mr. C. F. Jobson, architect, and the installation was done by the Pullman Company.

CONSTRUCTION OF UNITED STATES RECLAMATION SERVICE TRANSMISSION LINE IN ARIZONA.

Electricity generated at the Roosevelt hydroelectric station of the Salt River project of the United States Reclamation Service in Arizona is used partly for pumping water from wells in the Gila River Indian reservation and in Salt River Valley, south of Mesa, while the remainder is sold for industrial purposes at Phœnix. (See *Electrical World*, July 7, 1910.) When the plant is completed it will develop 4400 hp from a canal taking water at a diversion dam about eighteen and one-half miles above the storage dam and 5000 hp from the Roosevelt reservoir. A sixty-five-mile, 40,000-volt transmission line carries the energy from the station at Roosevelt to the Pacific Gas & Electric Company's plant at Phœnix. A branch circuit nineteen miles long is taken off at a switching station one and one-half miles northeast of Mesa and led to the pumping district south of Mesa and the Gila River Indian reservation.

The transmission line consists of two three-phase circuits of six-strand, hemp-core copper cable the equivalent of No. 1 wire in cross-sectional area. The wires are fastened at the angles of a 4-ft. equilateral triangle and both circuits are carried on the same towers. The standard span is 400 ft. and the maximum 800 ft. One circuit is transposed one-third of a spiral every two miles and the other every four miles. At four points along the line, namely, at Bush Corrall, Fish Creek, Tortilla Flats and Government Wells are towers fitted up so that by taking out a clamp the line may be opened for testing and repair.

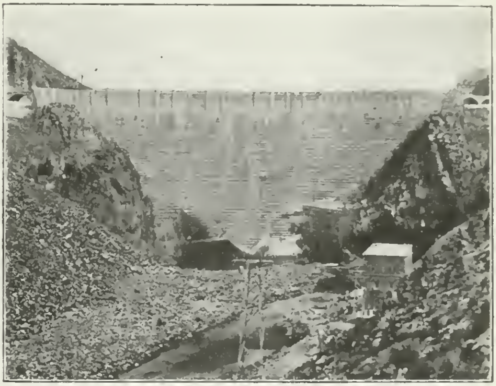


Fig. 1—Transmission Line Leaving the Transformer House at the Roosevelt Dam.

The wires are carried from Roosevelt to the Highland Canal on rectangular, angle-iron braced, galvanized-steel towers made by the United States Wind Engine & Pump Company. On the towers there are four wires on the upper cross-arm and two on the lower. The cross-arms are made of channel iron. The towers on straight-way sections of the line are single-braced and those on angles are double-braced. On the steel poles there are four wires on the lower cross-arm and two on the upper The cross-arms are made of a U-bar section similar to the ribs of the pole and have diagonal braces and vertical struts between the two cross-arms to brace them.

The line crosses the Salt River at Tempe in three spans of 800 ft. each. The two poles in the river bed are carried on steel cylinders 5½ ft. in diameter filled with concrete. One of them rests on bed rock and the other on hard pan at a depth of about 40 ft.

All towers in the section from Roosevelt to Goldfield are mounted on concrete bases or anchored in solid rock. The

418 towers in this section are from 15 ft. to 90 ft. high; fourteen are 50 ft. or more high and sixty-seven are double-braced and the balance single-braced. In the section from Goldfield to Highland Canal there are 192 towers 32 ft. high set on anchor plates about 2 ft. in diameter and buried from 4 ft. to 5 ft. in the ground. Tripartite poles, made by the Franklin Steel Company, 276 in number and practically all 30 ft. high, set in concrete one-tenth of their length, complete the line from Highland Canal to Phoenix.

A survey of the route of the line was made and a contour plan and profile drawn showing its relation to the road and other points of access for hauling purposes. The tower heights were chosen to give the minimum number and degree of vertical angles consistent with economical construction. The towers were ordered marked with the serial numbers of the locations, and were hauled and distributed according to a schedule furnished the commissary department of the Reclamation Service. With few alterations the towers were erected according to the numbers given. A few were shortened on one or more legs better to suit installation on the hillside.

A camp of from thirty-five to fifty men, mainly Indians, worked from Roosevelt toward Mesa excavating and concreting the tower bases, locating the anchor bolts by means of wooden templates. When this camp reached Weeks Station, eighteen miles from Mesa, it was separated into two camps, one going back toward Roosevelt setting up the towers and the other digging holes and setting the towers. When the towers and poles were up as far as the switching station, seventeen miles from Phœnix, a wire-stringing crew of twenty-three to twenty-five men worked toward Roosevelt stringing wire. The steel poles were erected by a separate crew which worked from the Highland Canal to Phœnix.

Where the lay of the ground would permit the towers were assembled on the ground and then raised into place with a gin pole. Where the ground was too uneven and rough they were assembled in position. A crew of six men erected an average of ten towers a day.

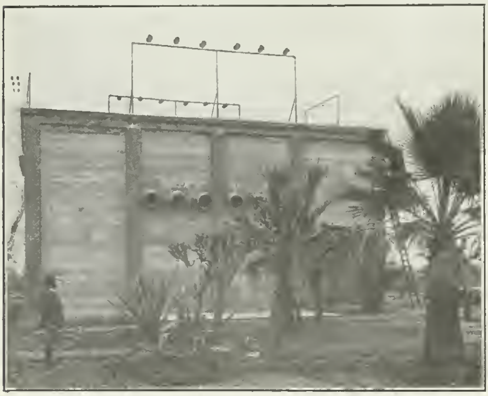


Fig. 2—Switching Station Near Mesa, Ariz.

The erection of steel poles on this line was often delayed pending the adjustment of right-of-way difficulties, so progress was slower than it would otherwise have been. The average rate when working with a crew of twenty-two men was from eight to twelve poles a day. The holes were first carefully dug to the dimensions of the concrete bases. The poles, after being provided with cross-arms, were raised by a derrick on a wagon and set in the hole. Four guy cables were used and drawn up with light tackle and the pole brought into alignment by sighting with plumb lines located over reference stakes set by the survey party. The guys were then secured to steel stakes and the wagon was moved to the next pole. Concrete, mixed on a portable board, was then placed around the base and carried, by means of a piece of sheet iron used as a form, about 6 in. to 12 in. above the ground level to protect the pole from flooding. The top is pointed to a conical shape. After the concrete had set the guys were removed and used again. The piers at the river crossing at Tempe were sunk by an orange-peel bucket and then filled with concrete.

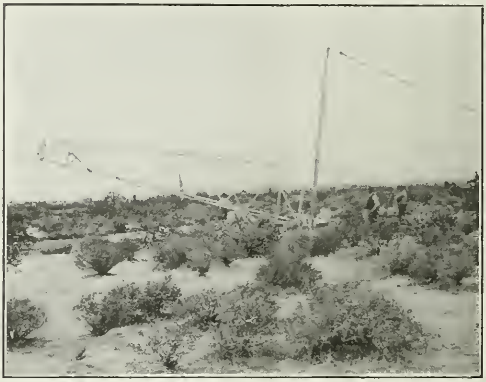


Fig. 3—Method of Raising Transmission Tower.

In stringing the wire on the level sections of the line in the valley it was drawn from the reels up over rollers on the towers and then pulled up to tension by horses. The wire all came in two-mile lengths and was strung the full length at a time. In the mountainous sections the wire was drawn in by means of a hoist mounted on a wagon, which carried two miles of 5/16-in. steel messenger wire. The messenger wire was carried from the hoist drum to the reels two miles away by mules and then the wire was pulled through. The messenger cable was then returned and the process repeated with each of the six wires.

The three-part insulators, shipped knocked down, were assembled in the field and the pins cemented by means of a special frame moved along with the stringing gang. The wire was tied to the insulators by two pieces of cable and two special brass clamps made for the purpose. A crew of twenty-three to twenty-five men made an average of seven miles per month in assembling the insulators and doing all work in connection with stringing the wire. The line was started July 4, 1907, and was tested Aug. 1, 1909.

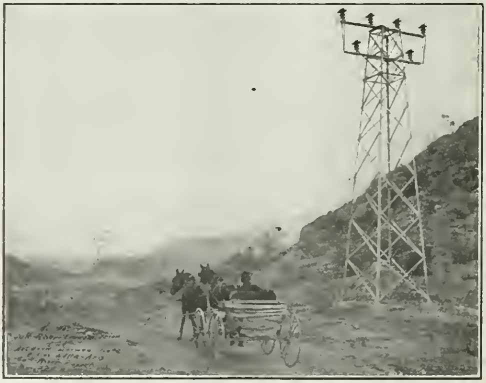


Fig. 4—View Showing Country Which Line Traverses.

After the wire was strung and before the energy was sent over it a crew of five men went over the line from one end to the other inspecting everything, tightening the bolts, cleaning insulators, replacing those that had been broken by the shots of hunters, putting in additional front and back guys that had been decided upon after stringing the wire, and making the line ready for service.

The first test showed no sign of trouble of any kind. After the line had been put into service it was found that a great number of short-circuits were caused at certain points by large hawks sitting on the towers and touching the wires with their wings or bodies. The wires were burned off several times and very bad service resulted from the many interruptions. A guard (Fig. 5) was designed, consisting of a cast-iron cluster clamped to the tower at certain points and holding pointed rods of 5/16-in. birch doweling in proper position to prevent the birds from touching the wires. These were installed on the twenty-three miles of the line between Government Wells and the switching station, where 90 per cent of the trouble was experienced. Since placing the guards not one interruption in the section protected has resulted.

This transmission line has now been in operation for fifteen months, and in that time there have been no interruptions due to any defect of material or construction, no breakage of cables, no creeping of cables through tie wires, no broken guys, settlement or buckling of towers or poles of any consequence. Every interruption that has occurred on the transmission line has been the result of interference by birds, bailing wire thrown across the wires or the shooting of insulators by hunters. There have been two occasions where the wire itself has been broken by rifle bullets.

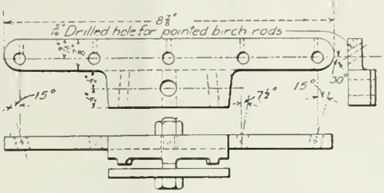


Fig. 5—Bird-Guard Cluster to Hold Pointed Birch Rods.

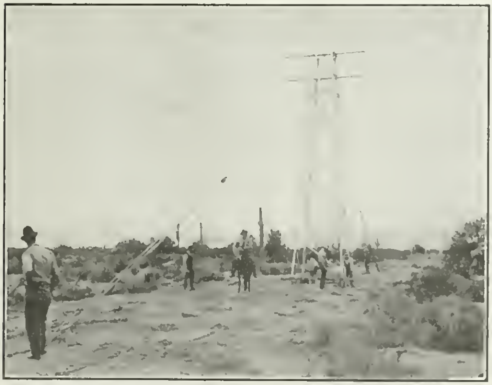


Fig. 6—Tower Being Bolted to Anchor at the Base.

The tripartite steel poles used between Highland Canal and Phœnix are not galvanized, as are the towers, but are coated with a black paint. These poles were painted at the factory, but the erosion due to shipping across the continent and erecting was such that those not immediately painted showed much rusting after the first rainy season. All poles are now painted immediately after erection, and are expected to be good for from three to four years without further attention. The painting proves to be slow and costly, and there is little doubt that one or at the most two paintings will cost more than the additional cost of galvanizing.

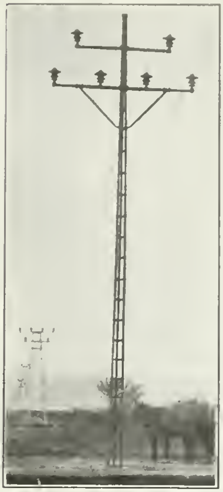


Fig. 7—Connection Between Pole and Tower Line.

The single-circuit branch line from the Mesa switching station is operated at 40,000 volts. The wires are of the three-phase line placed at the angles of a 4-ft. triangle, the upper wire being on the top of the pole and the two lower ones on a cross-arm. The poles are standard tripartite similar to those on the main line, though they are lighter and have cross-arms for a single circuit. They are 45 ft. long except at road crossings, where they are 50 ft. The methods of construction were the same as on the level section of the main line. The rate of progress in setting poles was about twelve a day for twenty-two men. The stringing of the wire over the fifteen miles of line took three weeks.

This line has been in operation since April, supplying energy to a well-sinking outfit in the Indian reservation. The same trouble from hawks has been experienced on this line as on the main line, but it has been somewhat worse, on account of the small size of the wire, which burns off much more easily in case of a short-circuit. Guards for keeping the birds off will be installed on this line as soon as they can be obtained.

This work is in the Southern Division of the United States Reclamation Service, Mr. L. C. Hill, supervising engineer. Mr. A. H. Demrick, electrical engineer, was directly in charge of the construction until his death in May, 1909, when he was succeeded by Mr. I. C. Harris. The electrical development of the work was carried out under the technical direction of Mr. O. H. Ensign, chief electrical engineer, Los Angeles.

A NEW AND DIRECT PROCESS OF PRODUCING ALTERNATING-CURRENT VECTOR DIAGRAMS EXPERIMENTALLY.

By A. E. Kennelly, H. G. Crane and J. W. Davis.

THE properties of the rotating magnetic field and their relation to two component quarter-phase magnetic fluxes are well understood. It seemed that analogous properties should be developed by a rotating electric field. Such a field should be capable of being produced either in a dielectric medium by two quarter-phase displacement currents or in a conducting medium by two quarter-phase conduction currents. Attempts to produce the latter, or voltaic, form of rotating electric field in a reliable manner were commenced in the electric engineering laboratories at Harvard University in April, 1910, using a thin sheet of acidulated water in a flat insulating tray as the conducting medium and a telephone receiver as the detecting instrument. Recently, however, very successful results have been produced with thin metallic sheets as the conducting media and a vibration galvanometer as the detecting instrument. The production of a recognizable rotating electric field in a conducting sheet lends itself to a variety of interesting purposes, and among them to the experimental production of alternating-current vector diagrams.

The metallic sheets used have been composed, at different times, of tinned iron and of zinc. The results have been essentially the same with both substances. Only the zinc sheet will be described in what follows.

The sheet was of commercial zinc 81.5 cm square and 0.46

mm thick. It is important that the thickness of the sheet should be nearly uniform over its entire surface. A plan view of the sheet is presented to scale in Fig. 1, at *p, q, r, s*. Its surface was marked off, with a graver, into centimeter squares—that is, into a system of rectangular co-ordinates by uniform steps of 1 cm. Only 5-cm squares are shown in Fig. 1. Commencing with zero at the middle of the sheet, it was marked off to —40 cm and +40 cm along one axis, which is here called the *reference axis*, and also to $+j40$ cm and $-j40$ cm along the perpendicular axis, which is called the *j-axis*.

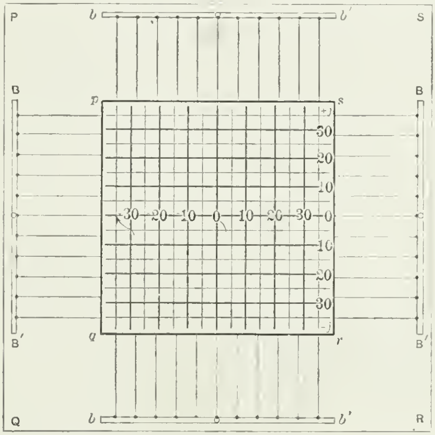


Fig. 1—Plan View of Metallic Sheet and Its Connecting Fringes.

Connections were made with the edges of this plate through a fringe of high-resistivity wires. Some high-resistivity fringing for the sheet is necessary in order to keep the electric current flow lines parallel to the edges. If the copper bars *BB′*, *bb′* were soldered directly on to the edges, they would act as partial short-circuits to the sheet and distort the flow lines from the proper rectilinear paths. As shown in Fig. 1, eleven wires, each 29.5 cm long, were soldered to each edge of the sheet at uniform intervals of 7 cm. These fringe wires were of *"Ia-Ia"* resistance metal, 0.45 mm in diameter. Their resistivity was roughly 45 microhm-cm, their linear resistance 0.0283 ohm per centimeter and the resistance of each wire 0.836 ohm. The joint resistance of all the eleven wires in one fringe was thus 0.076 ohm.

The entire flat arrangement of sheet and fringes was mounted on a wooden frame about 150 cm square, the outlines of which appear at *P, Q, R, S*. This frame was supported conveniently in a vertical plane against a wall.

The resistivity of the zinc sheet, at ordinary room temperature, was approximately 6.6 microhm-cm. The resistance across the sheet from edge to edge was 143 microhms, or 1.755 microhms per linear centimeter of full width. The resistance in 1 sq. cm of the sheet from edge to edge was 143 microhms.

When a continuous current of 10 amp was passed across the plate, say, along the reference axis, between the copper bars *BB′*, *BB′*, the drop of pressure between these bars was 1.5214 volts. Of this, 1.52 volts was in the two fringes, and only 0.00143 volt, or 1430 microvolts, in the plate. In 1 cm of the plate the drop would be 17.55 microvolts.

In order to produce a rotating electric field in the sheet, quarter-phase currents—that is, two single-phase currents differing 90 deg. in time-phase, of equal strength—were supplied to it, with one component single-phase current along each axis. The general connections are illustrated in Fig. 2. On the left is a quarter-phase alternator, with a rotor field frame *F* and a stator armature *WW*, indicated as a Gramme ring tapped at quadrants.* Quarter-phase currents were thus supplied to the primary coils *P, p* of two similar step-down transformers. The secondary coils *S, s* were connected to the two axes of the sheet through indicating alternating-current ammeters *A, a*. A reversing switch, not shown in the illustration, was included in each secondary circuit.

With two equal alternating currents in time-quadrature supplied to the sheet, as above, a rotating electric field is set up in the sheet. That is, the current density at any point in the sheet becomes a plane vector, rotating with the angular velocity of the alternating current. The frequency used being between 50 cycles and 60 cycles per second, the speed of rotation of the current density in the sheet would be, similarly, between 50 and 60 revolutions per second. Since the current-density rotated, the electric intensity, or volts per centimeter, at any point in the sheet, due to *IR* drop, was also a rotating vector. Assuming that the component single-phase currents supplied to the sheet were simple sinusoidal waves, the rotation of the current-density, and electric-intensity, would be everywhere a pure rotation of uniform angular velocity $\omega = 2\pi f$, where f is the alternating-current frequency. If, however, appreciable harmonics existed in the currents supplied to the sheet, the resultant rotation would be non-uniform in radius vector, as well as in angular velocity. The actual complex rotation would, however, in all cases be reducible to a pure uniform rotation of fundamental frequency, together with superposed pure uniform rotations of harmonic frequencies at harmonically increased angular speeds. Reversing the alternating current supplied to either axis of the sheet would inevitably reverse the rotation of the electric field system.

The instrument used to detect the rotating field was a Campbell bifilar vibration galvanometer, constructed by Mr. R. W. Paul, of London. It is illustrated in Fig. 3. It consists of a single-loop of wire and a minute d'Arsonval coil, supported between the poles of a ring permanent magnet and carrying a thin strip of mirror across the loop. The length of the loop and the tension of the loop are independently adjustable by means of projecting milled-headed screws. When the proper length and tension of the loop have been secured, so as to tune it to the frequency of an alternating current passed around the loop, the loop is set into resonant bifilar twisting vibration, and the spot of light reflected by the strip mirror, from an arc lamp onto a scale, is thrown into a long horizontal luminous band. If, on the other hand, the vibratory loop is not mechanically tuned into synchronism with the alternating current received, or with any of its components within the range from 50 to 1000 cycles per second, the spot of light remains motionless, or very nearly so. The instrument had a stationary resistance of about 33.5 ohms, but its apparent resistance is subject to some variation when the loop is in vibration, on the principle of a synchronous motor. Its resonant sensibility to currents, at or near 60 cycles per second, is very marked, and is much greater for such a frequency than that of the ordinary telephone receiver.

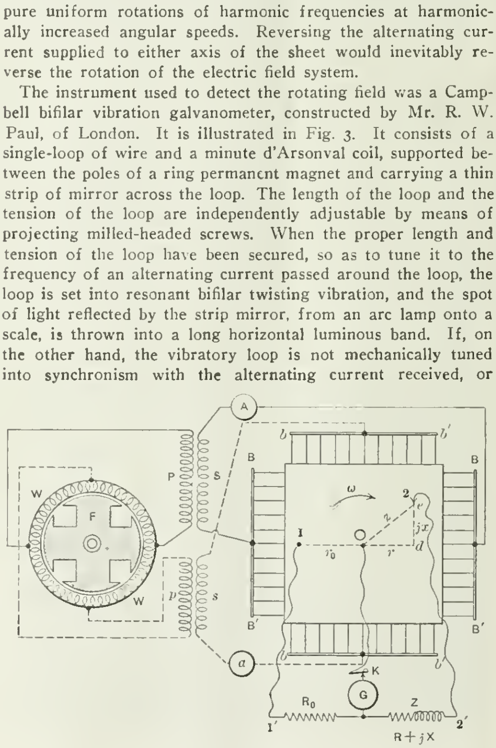


Fig. 2—General Connections of Metallic Sheet Indicating the Production of a Vector Diagram of Impedance.

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*The quarter-phase alternator connections in Fig. 2 can only be regarded as diagrammatic, since quadrantal quarter-phase taps from a Gramme ring, as shown, call for a bipolar field magnet.

It easily shows an effective (root-mean-square) current of a quarter microampere, and responds only to the fundamental component, the harmonics in the current having practically no effect. The instrument has to be carefully insulated from wall or floor vibrations, especially if the latter are of the frequency to which the loop is tuned.

In the arrangement of Fig. 2 a flexible conductor was soldered to the center of the sheet at *O*. This conductor led to a contact key *K* and the vibration galvanometer *G*. Another flexible conductor was permanently soldered to the point 1 on the reference axis, at the distance —35 cm. from *O*. This wire led to a substantially non-inductive standard rheostat R_0. For convenience in the measurement of low impedances, this rheostat was plugged for 3.5 ohms; for moderate impedances, 35 ohms, and for still higher impedances, 350 ohms. In this way each centimeter of distance along either axis of the plate represented either 0.1 ohm, 1 ohm or 10 ohms respectively.

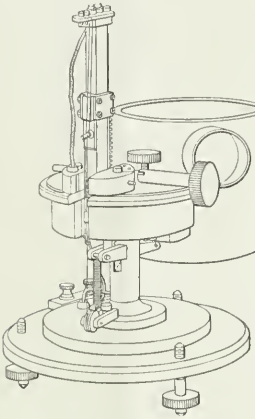


Fig. 3—Vibration Galvanometer with Cover Removed.

With the connections as shown, and the impedance *Z* to be measured, say, a magnetic impedance, or reactive coil, a roaming wire from the coil *Z* being led to the plate, there is found to be only one point on the plate at which the roaming wire can touch and show no current in the vibration galvanometer with the latter in tune and the key *K* closed. If the measured impedance *Z* happens to be reactanceless, the roaming contact must be made along the line 1*Od* of the reference axis, and the length *Od* of this line then measures to scale the resistance of *Z*. But with magnetic reactance in the coil, as shown, the roaming contact must be moved to a certain point *e* off the reference axis, and such that *Od* reads, to centimeter scale, the effective resistance of the coil *Z*, *de* reads to the same scale its effective reactance, and *Oe* to the same scale its impedance, all to fundamental frequency. This may be called the *simple-harmonic impedance* of the coil *Z*. If the coil has no iron core, there will usually be no appreciable difference between the ordinary complex harmonic impedance and this simple harmonic impedance. With an iron core present hysteresis tends to establish some difference between these quantities.

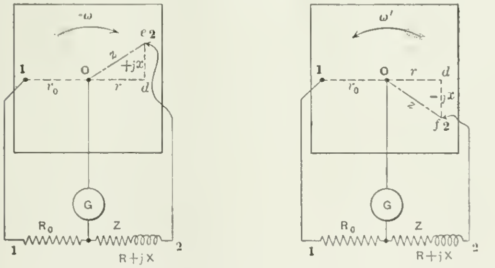


Fig. 4—Effect of Reversing the Rotating Electric Field in the Sheet Upon the Vector Diagram of a Magnetic Impedance

In all cases, whatever be the resistance represented by 1 cm on the sheet, the relation is

$$\frac{Z}{R_0} = \frac{z}{r_0}$$

where the ratio on the left-hand side of the equation is a complex number and is an impedance ratio. The ratio on the right-hand side is the same complex number, but is a distance ratio.

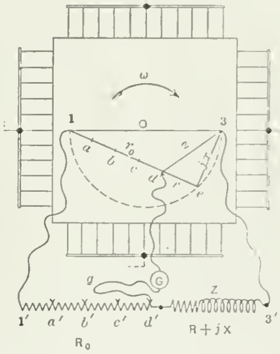


Fig. 5—Method of Connection with the Roaming Contact Between Two Fixed Contacts and a Circular-Contact Locus, Standard Resistance R_0 Variable.

If the direction of rotation of the electric field is as shown by the arrow in Fig. 2, then a magnetic impedance will lie on the $+j$ side of the reference axis, as shown, and a condensive impedance on the $-j$ side. But if the direction of field rotation be reversed, by reversing either of the main switches, the sign of the *j*-component, or reactive component, of the impedance will be reversed upon the sheet. This is indicated in Fig. 4.

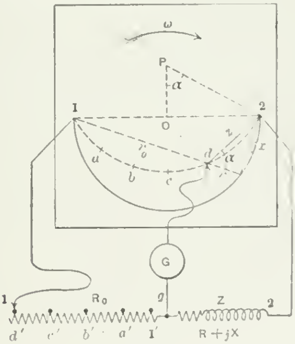


Fig. 6—Method of Connection with the Roaming Contact Between Two Fixed Contacts and a Straight-Line-Contact Locus.

The action in Fig. 2 may be explained as follows: With the electric intensity rotating clockwise, as shown by the arrow at ω, the potential difference along the line *Oe* on the sheet will be ahead in phase of the potential difference along *Od*, the reference axis. The current in R_0 is in time-phase with the potential difference 1*O*, or along r_0, if there is no reactance in the path $1'R_0$. The current in *Z* is delayed in time-phase by the reactance of the coil. The potential difference impressed on Z must, therefore, be advanced in time-phase by the angle eOd in order that the current in Z shall be in time-phase with the current in R_0. The identity of these two currents both as to magnitude and time-phase is disclosed by the absence of current in the galvanometer G when the key K is closed.

With 10 amp (effective) in each of the supply circuits to the sheet a displacement of the roaming contact-point from the true balance point to the extent of 1 cm, parallel to either axis, would introduce an effective voltage drop of 17.5 microvolts. With a fairly low resistance in the circuit 1, 1′, R_0, Z, 2′, 2 (Fig. 2) the effective resistance in the galvanometer circuit would be in the neighborhood of 50 ohms. The current introduced through the galvanometer by reason of the time-phase displacement would thus be about $17.5 \div 50 = 0.35$ microampere. The galvanometer easily showed ¼ microampere when in sharp tune to the frequency, and, moreover, the current used in each supply circuit was raised from 10 amp to 12 amp or 15 amp at different times. It might readily have been increased further. The result was that a balance point could be found to a precision of 1 mm or 2 mm, or, to express the same fact in another way, if a sharp zero balance was found at a certain point on the plate a deviation of the roaming contact from this point in any direction, to the extent of 1 mm or 2 mm, would reveal itself in the widening of the galvanometer spot.

A difficulty which soon presented itself in these experiments produced discrepancies that evaded analysis for some time. The magnetic field-intensity near the excited plate is relatively feeble. Nevertheless, a single effective maxwell of magnetic flux, threading any conducting loop including the galvanometer, develops at 60 cycles per second 3.77 effective microvolts, or equivalent to about 2 mm displacement on the sheet at 10 effective amperes of excitation. It is evident, therefore, that unless care be taken to remove all stray magnetic flux from the galvanometer circuit, the voltage induced by stray field may mask or dominate the voltage of potential difference rotating in the sheet. It was found necessary to bind the wires 11′, O, K, 22′ tightly into a queue from the center of the plate, to use twisted pairs for the supply wires, and to take other like precautions. An ideal arrangement, with this difficulty in view, would be to use a return-current sheet side by side with and of the same dimensions as the working sheet, the two being separated only by a thin layer of insulating cloth so that the two exciting circuits could be kept almost completely nonmagnetic. No such compensating return sheet was used, but even after all precautions were taken it was found desirable to make two readings at each measurement, the current being reversed in both supply circuits at each alternate reading. Reversing both supply currents simultaneously does not reverse the direction of rotation of the electric field in the sheet, but does reverse the direction of e.m.f. induced by stray magnetic field in the galvanometer circuit. The mean of each such pair of readings on the sheet is then the value to be accepted, as corrected for stray field.

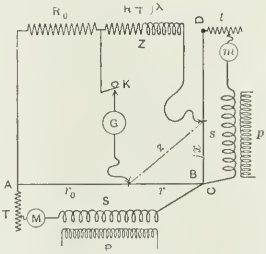


Fig. 7—Two-Dimensional Potentiometer, or Vector-Diagram Apparatus, on Two Straight Lines in Space Quadrature.

If the impedance Z, in Fig. 2, is a condenser instead of a reactive coil, the vector diagram on the sheet is thrown on the other side of the reference axis Od. If, as the impedance Z, a coil and a condenser be connected either in series or in parallel, the vector diagram on the sheet shows the preponderance either of magnetic or condensive reactance, as the case may be.

A number of interesting alternating-current phenomena of impedance can be demonstrated with the revolving electric sheet of current and potential. Thus if the impedance Z, Fig. 2, consists of the primary winding of a small induction coil, the effect of short-circuiting the secondary winding is to increase the resistance component Od of the resulting impedance and to diminish the reactance component de. Again, the increase of reactance in a reactive coil with increase of frequency is readily shown.

As may be easily demonstrated, the measurement is made with greater sensitiveness and precision as the standard R_0 and the unknown Z are reduced in impedance. The best results to begin with are obtained with a standard resistance R_0 of only a few ohms, a measured impedance Z of about the same magnitude, and with the galvanometer carefully tuned. After practice with such an arrangement the method may be extended, with reduced sensitiveness, to cover cases of higher impedance Z and a higher standard resistance R_0 to match.

There are various other ways of obtaining measurements and vector diagrams with the rotating-current sheet. Thus, in Fig. 5, the test circuit, R_0Z, is connected to two points, 1 and 3, soldered, say, 70 cm apart along the reference axis, one at $-35\,jo$, the other at $+35\,jo$. The balance is obtained by a roaming contact leading to the galvanometer. If the wire g, beyond the galvanometer, be brought successively into contact with the standard resistance at the equi-resistance points d', c', b', a', 1′ the balance point on the sheet will have its coordinates at d, c, b, a, 1 correspondingly, the locus being on a straight line, 1, e, assuming R_0 to be reactanceless. If, however, the test be made as in Fig. 6, with the galvanometer wire g fixed, but the contact 1 movable over the standard resistance R_0, then the roaming contact point will describe on the sheet the circular locus d, c, b, a, 1. Some beautiful geometrical relations and figures present themselves in these different tests and connections.

The vector diagrams obtained from the rotating-current sheet, particularly with the arrangement of Fig. 2, are concrete experimental realities, very different from the geometrical abstractions which vector diagrams have hitherto appeared to consist of in alternating-current literature, and any observer who with such an apparatus, actually experiences a vector diagram will probably carry away with him a lasting and a different impression of such a diagram from that set up in the mind merely from the perusal of textbooks. The rotating-current sheet is an ideal source of instruction in this respect.

Whether the rotating-current sheet can be made into an accurate piece of measuring apparatus, or two-dimensional potentiometer, is, however, an open question. It is swift to work with in measuring impedances, but in the form above described its precision is limited. Large sheets supplied with powerful currents using anti-induction precautionary devices may improve the precision, but since the currents are distributed broadcast over the whole sheet surface, the degree of precision per ampere of supply current must necessarily be small. Moreover, it may be difficult to secure a sufficient degree of mechanical uniformity in the thickness of large-surface metallic sheets, although corrections could be found, with sufficient care in the use of continuous currents and with a direct-current potentiometer.

A more promising method of obtaining a two-dimensional or victor-diagram alternating-current potentiometer, which has recently been tried by the authors, is shown in Fig. 7. Quarter-phase currents are supplied, of adjusted equal strength, to the two slide wires AB and CD, which are connected together at B. Using the standard reactanceless resistance R_0 in series with the impedance Z to be measured, balance at the two sliding contacts can be secured with no current in the vibration galvanometer, when

$$R_0/R = r_0/r = jX/jx.$$

The supply currents required in the slide wires are now comparatively small, and the precision of the apparatus as a measuring device is much greater. The balance adjustment is thrown on two sliders, which must be moved successively to a joint balance, whereas in the case of the rotating-current sheet there is only one roaming contact point, although the direction of motion for securing balance at any instant is uncertain, being of two degrees of freedom.

In the non-rotating current two-dimensional potentiometer of Fig. 7 it seems possible to secure the required two-phase voltages from a single-phase source by using a small transformer with no iron core. Experiments are being made in this direction. In the rotating-current sheet a plurality of polyphase supply currents from a polyphase source appear to be necessary.

When the current is rotating at full speed in the sheet it is not an easy matter to reveal its presence except with the aid of a vibration galvanometer, but if the quarter-phase alternator supplying the currents is slowed down to a frequency of only one or two cycles per second, a small compass needle supported over the sheet can be brought into synchronous rotation with the current, and so makes the rotation evident to the eye.

The working apparatus of Figs. 1, 2 and 3 was shown for the first time to an audience* at Harvard University on Feb. 25, 1911.

REGENERATIVE CONTROL FROM A COMMERCIAL VIEWPOINT.

By J. G. V. Lang.

The recovery of potential and kinetic energy of a vehicle is a problem far from new. Many attempts have been made to solve it by mechanical means, but no proposed solution has been of practical consequence and the waste due to the seeming non-convertibility of the potential and kinetic energy has continued. Even after the application of the dynamo-electric machine to traction very little progress has been made toward the elimination of this waste in spite of the fact that the dynamo-electric machine has been recognized as more or less unique on account of the possibilities it offers as regards reversibility—that is, its ability to transform electrical energy into mechanical as well as mechanical into electrical.

This lack of progress is largely attributable to the fact that the form of electric motor which experience has proved to possess the best qualities for propulsion, namely, the series motor, practically lacks the reversible characteristic in direct consequence of the fact that those qualities which make the series motor superior to the motor with shunt characteristic as far as traction is concerned are antagonistic to reversibility.

And such is the infallibility of the physical law of inertia, even as applied to thinking humanity, that electric traction has been allowed to develop during a score of years without any serious efforts to utilize the well-known reversible characteristic of the dynamo-electric machine.

This is even more inexplicable when one considers the great amount of effort made to effect energy savings in so many other directions where the possible saving is only trifling as compared with that held in store to reward the practical application of regenerative control to traction. The indifference in this line is no doubt due to the same causes as those exhibited in connection with the conservation of natural resources. The parties most interested lack the full appreciation of the value of the saving. It is of utmost importance to analyze and find an answer to the question: "How much at the best can be saved under certain known conditions?"

An attempt at such an analysis will be made below, and even if the method suggested for obtaining an answer to this question shall give only approximate values it may help those interested to realize the fact that regeneration is of far greater commercial importance than, say, condensers, superheaters and all the appliances devised to raise the efficiency of the power plant by a few per cent.

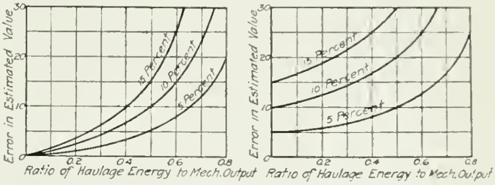
ESTIMATION OF POSSIBLE ENERGY SAVING.

The average energy consumption per car-mile on any system or route is as a rule a well-known quantity which is calculated from measurements taken at the power station. With knowledge of local conditions the losses in transmission lines can be fairly closely approximated. By subtracting this loss from the average energy consumption per car-mile the input to the motors is obtained. This electrical input is transformed into mechanical energy by the motors and delivered at the axles of the car. The efficiency of this transformation is the product of motor efficiency and gear efficiency, which quantities are capable of reasonably close estimation.

One part of the useful mechanical energy is used to overcome the car resistance—that is, car-journal friction, tractive resistance and wind resistance. Another portion is needed to accelerate the car, in other words, is stored up in form of kinetic energy, and the remainder serves to lift the car from the lower to the higher levels—that is, is stored up in form of potential energy.

If the route were entirely level and were covered at a constant speed only the first mentioned cause for energy expenditure would exist. On the other hand, should this route be up hill and the speed accelerated the car resistance would still absorb the same amount of energy as on the level route, but in addition the motors would have to supply the energy which is stored in the car as potential and kinetic energy.

It follows that if the energy supplied by the motors on the up-hill route, as well as on the level route, is known the potential and kinetic energies can be deduced, and if the average equipment efficiency (motor-plus-gear efficiency), as well as transmission losses, can be estimated, the average energy consumption per car-mile of this route will serve as a measure of the kinetic and potential energies and at the same time of the theoretical limit of regenerative saving inherent in this route under existing traffic conditions.



Figs. 1 and 2—Accuracy of Estimations.

In the same way the limit of regenerative saving can be found for any route. At a first glance this may not be quite apparent. It seems as if it would be necessary to consider three phases separately—when the motors supply as much or more energy than is needed to overcome the car resistance, when they supply less, and when they run idle with circuit open. During the second phase some, and during the third all, of the energy necessary to overcome the car resistance is drawn from the store of kinetic and potential energy of the car. This simply indicates that part of the car-resistance energy is first transformed into potential and kinetic energy before it is usefully employed. In any case, the fact remains that out of the known quantity of energy input a certain part is usefully employed in overcoming car resistance and the rest must be wasted at the brakes.

It follows from the above that it is feasible to estimate the theoretical limit of regenerative saving for any system from the average energy consumption per car-mile as soon as the following quantities are known: Average transmission line losses, equipment efficiency and car resistance. It is true that all these quantities are more or less difficult to estimate closely, perhaps particularly the latter, and it is therefore of interest to investigate to what extent an error in the estimate of any of these three factors would influence the result.

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*A demonstration lecture by Dr. A. E. Kennelly, assisted by Messrs. H. G. Crane, L. A. Doggett and E. A. Healey, before the Boston Branch of the American Institute of Electrical Engineers, Feb. 25, 1911.

Since the equipment efficiency and the transmission efficiency influence the result in a similar way they might as well be considered together as one quantity. If the total discrepancy in the estimate of the efficiency of transforming the electrical energy as measured at the busbars of the generating station to mechanical energy at the car axles be 10 per cent it follows that the mechanical output of the motors is either 10 per cent higher or 10 per cent lower than shown by the following calculation. Since the hauling energy is a constant, the error in output will influence the estimated potential and kinetic energies only. The degree of the influence naturally depends on how large a proportion the hauling energy is found to be of the total mechanical output. If, for instance, the hauling energy had been found to be 50 per cent of the output and there is a possible error in the determination of the latter it follows that the potential and kinetic energies, and thus the theoretical limit of regenerative saving, are subject to a possible variation of 20 per cent from the value obtained. To facilitate the determination of the influence of an error of certain percentage in the transformation efficiency on the theoretical limit of saving as found by the investigation a curve sheet is given for showing this influence in per cent of the original determination at different ratios of hauling energy to total mechanical output.

An error in the estimation of average car resistance will influence the saving to a less degree, since the numerical value of a certain proportion of error is so much smaller than when the proportion applies to the whole output. The influence of the saving depends on the ratio that the numerical value of the error bears to the original determination of the kinetic and potential energies. Consequently the ratio of hauling energy to total output is a determining factor. If, again, the error is assumed to be 10 per cent, but this time in the assumption of car resistance, it follows that if the hauling energy had been found to be 50 per cent of the total mechanical output, a 10 per cent increase in hauling energy would cause a 10 per cent decrease in kinetic and potential energies and thus in the estimated limit of regenerative saving. How different ratios of hauling energy to mechanical output modify the influence of an error in car resistance on the saving is indicated by the second set of curves.

With the help of the two sets of curves it is easy to form an idea of the maximum error that is likely to have been made in the ultimate deduction. To get an idea of the relative magnitude of the maximum limit of saving it may be as well to apply the above method to an actual case corresponding to average conditions. The energy consumption as measured at the generating station was 1.5 kw-hours per car-mile. The transmission losses will be assumed to be 5 per cent, the equipment efficiency 65 per cent. Consequently, the efficiency of transformation from electrical energy at the busbars to mechanical energy is 0.95 × 0.65, or about 0.62. The mechanical output is, therefore, equivalent to 1.5 × 0.62, or 0.93 kw-hour per car-mile. The hauling energy for a car of 12.5 tons weight, under the assumption of a car resistance of 19 lb. per ton, equals 19 × 12.5 × 5280 ft.-pounds per mile, or about 0.47 kw-hour per car-mile. Subtracted from 0.93 there is a remainder of 0.46 kw-hour that could be transformed more or less completely into electrical energy and be recovered. This would indicate that on the particular route or system a saving of 31 per cent would be the theoretical limit. If 65 per cent would be a practical regenerative efficiency the practical saving that could be expected would be about 20 per cent of the present energy consumption.

Since in the example the hauling energy is practically 50 per cent of the mechanical output, it follows that if a mistake is made in, say, the equipment efficiency and this should be close to 70 per cent instead of 65 per cent the mechanical output would be 1.00 instead of 0.93 and the kinetic and potential energies 1.00 — 0.47, or 0.53 kw-hour per car-mile, thus bringing up the limit of saving to 35 per cent and the probable practical saving to 23 per cent.

Central Station
Management, Policies and Commercial Methods

SALE OF ENERGY-CONSUMING DEVICES TO CENTRAL STATIONS.

An interesting decision of the Massachusetts Gas & Electric Light Commission bearing on the sale of energy-consuming devices by central stations will be found under the head of Massachusetts Commission News on page 773. It may here be remarked that, in addition to the value of the matter appearing in the department of Public Service Commission News with relation to the precedents established that will influence commissions to be formed later in other States, information of general interest is frequently contained relating to the principles of rate-making, interpretation of franchises, definition of satisfactory service, refusal to authorize competition by proposed new companies, etc.

FLAT-RATE RESIDENCE CAMPAIGN AMONG COAL MINERS.

The Scranton Electric Company, Scranton, Pa., has just started an energetic campaign among the miners in its territory looking toward the general introduction of electricity in their homes. The company has ten men working on this campaign for residence lighting in the mining districts and hopes within a year to have at least 3000 of the residences connected to its circuits. The scheme followed is similar to one already working wonders at Hazleton, Pa., among miners knowing little about English and much less about electricity. The cottages are connected to flat-rate circuits through excess indicators, the light flickering when the number of lamps in circuit is excessive. It has been found an easy matter to instruct the consumers that when such a condition exists, or when the light flickers, as one of the miners in the Hazleton district so aptly expressed it, "lika da moova de pikt," some of the lamps should be turned off.

MINNEAPOLIS COMPANY GETS FLOUR-MILL LOAD

The Minneapolis General Electric Company is arranging to supply 2700 kw in motor load in the great flour mills of the Washburn-Crosby Company at Minneapolis, supplementing the private steam-engine and turbine plants now in operation in these mills. An additional block of 1000 kw will be added later to the first 2700 kw, the central-station company supplying this service under a contract by which it can adjust the quantity of power delivered to the mills in accordance with its own surplus hydroelectric capacity after giving due notice to the customer. The great milling interests in Minneapolis owe their location there to the water-power site furnished by the Falls of St. Anthony at this point. Long ago, however, this water-power ceased to be sufficient to operate the growing mill plants and in later years most of the power used to drive the stones has been derived from steam. Several of the mills have recently added modern turbine-driven electric plants to their older engine equipment, using motor drive throughout the buildings. A number of these motor units are 1000-hp and above and have been used to take the place of isolated engine sets that were formerly scattered about the mills at the same points. It is interesting to note, however, that the mills are again having recourse to water-power, but this time through the means of hydroelectric generation and transmission from a falls site fifty miles distant.

ELECTRICALLY OPERATED GRAIN ELEVATOR.

An electrically operated grain elevator recently completed at the Gulf port of Texas City, Tex., for the Texas City Transportation Company is said to be one of the largest and most modern in the South. It has a storage capacity of 500,000 bushels and is expected to be an important factor in the upbuilding of Texas City as a grain exporting port. The building is 165 ft. high at the highest point, 170 ft. long and 58 ft. wide. The storage space is made up of twenty large circular steel tanks and eleven interspliced tanks, the latter taking up the space between the circular tanks.

The equipment of this elevator is modern in every respect. The elevator, conveyors and other machinery are operated by electric energy from a central plant of the company, situated adjoining the elevator. This new electric station also supplies energy for all the machinery upon the docks and lights the railroad terminals and the town.

The elevating capacity of the new elevator is 15,000 bushels per hour. It is equipped with 32-in. belts and cups and connects with a drier that handles 5000 bushels per hour. Embraced in the plant are also two modern separators, two cyclone blowers, scales and an electric signal system. The use of electricity is applied to the operation of a 2500-ft. conveyor that extends from the elevator along the north side of the pier and for handling the cars. Vessels are loaded directly from the elevator by means of a movable framework to which is attached the delivery spout.

NEW STREET-LIGHTING CONTRACT FOR BRATTLEBORO, VT.

The Board of Village Bailiffs of Brattleboro, Vt., has recently entered into a ten-year contract with the Twin State Gas & Electric Company for street lighting beginning March 1, 1911. Under the terms of the contract the 175 carbon incandescent lamps and the thirty arc lamps now in use will be replaced with 80-cp tungstens, of which 250 or more will be required. The company expects to have the necessary changes made within the next few weeks. All new lamps will be provided with 18-in. porcelain-lined "radial-wave" reflectors, and the company agrees to replace the present incandescent street-lamp reflectors with these reflectors at the rate of at least fifty per year. The contract price per lamp for all-night and every-night service is $20 per year with rebates as follows:

If any one of the lamps is not alight at any time that it is required to be in service, a rebate of 5/10 cent per hour shall be deducted after the company has been notified of such failure.

If any one of the lamps is operated with less than 100 true watts between its terminals, a rebate of 2/100 cent per hour for each watt that is lacking shall be deducted.

If any one of the lamps is operated with less than 80 watts, no compensation shall be paid for such lamp during the time it is so operated.

If any one of the lamps gives less than 72 mean horizontal candle-power without a reflector and with the amperes of the street circuit, a rebate of 3/10 cent per hour shall be deducted during the time it is so operated after written notice that the candle-power is below 72.

The provisions as to rebates do not imply a right on the part of the company to operate the lamps with less than 100 watts per lamp, nor to operate any lamp giving less than 72 mean horizontal candle-power without a reflector.

In case the company is unable to secure 80-cp, 100-watt lamps, on account of their being no longer manufactured, the company agrees to furnish and operate, as the bailiffs shall direct, either 60-cp, 75-watt lamps at the rate of $19 per year, or 100-cp, 125-watt lamps at the rate of $21.50 per year.

Provision is made for testing the lamps by a representative of the village at any time, and the company also agrees to run each of its series circuits carrying any of the lamps to the exterior wall of such building in the village as the bailiffs may indicate in order that the bailiffs may connect each circuit with a recording ammeter within the building.

The Twin State Gas & Electric Company obtains its energy from a water-power plant at West Dummerston, Vt., operated in conjunction with a steam plant at Brattleboro. It also has connections with the Connecticut River Power Company's transmission lines from South Vernon, Vt.

WHERE CONDENSING DID NOT PAY.

An interesting test was made at the central station at Iron River, Mich., owned by the Menominee Range, Power & Development Company, on the economy of condensing with a very lightly loaded small Corliss engine. The plant originally had a Lane & Bodley Corliss engine, 14 in. x 42 in., running at 95 r.p.m. The plant was later increased by the addition of a Buckeye tandem-compound engine, 13-in. x 25-in. x 21-in. stroke. Along with the Buckeye engine was purchased a Blake condenser of about the proper size for that engine. It was thought that perhaps some economy would result during the light-load hours of the plant to connect the small Corliss engine to the condenser of the large engine and operate the small engine condensing when the large engine was not in operation. The necessary piping connections were made and a test of several days was made both condensing and non-condensing with the small engine. It was found that about 8 per cent more coal was required to run condensing than to run non-condensing. The reason for this is, of course, to be found in the very light load which existed on the engine during most of the time. The company had just started giving day service and but very little load was on the engine. The lift of water to the condenser was about 14 ft. The power required to lift this water and operate the large condenser more than offset any advantages of economy gained in condensing. The test was made by Mr. J. S. Kresge, at that time superintendent of the plant.

TUNGSTEN-POST LIGHTING AT LA CROSSE, WIS.

The business district of La Crosse, Wis., is now lighted by fifty five-lamp tungsten standards of the type used at Minneapolis, each post carrying four 40-watt and one 60-watt lamp mounted upright and inclosed in frosted-ball globes. The entire installation burns until 11 p. m. every evening, after which the four 40-watt bracket lamps are switched off, leaving the single 60-watt lamps at the tops of the posts to burn all night. For supplying energy for this service and for renewals of the multiple-type tungsten lamps the La Crosse Gas & Electric Company receives $4 per post per month. The installation cost was originally paid by the abutting merchants benefited. Each guaranteed $1.50 per front foot for the cost of the posts, wiring and lamps complete, but the cost of erecting the posts at 75-ft intervals, or four to a block, actually reached only $1.30 per front foot.

The entire undertaking of securing this ornamental street lighting for La Crosse was inaugurated and carried through by a committee of citizens on its own initiative After interest had been aroused among the merchants, sample post installations were erected showing several different types of standards. All the merchants interested were then invited to inspect the patterns offered and express their choice by vote, which unanimously fell to the type of post described. A solicitor was then employed to close contracts with the individual merchants for their assessments to cover the first cost. The operation of the special lighting, including the maintenance of the equipment and renewal of lamps, is paid for by the city as part of the downtown street lighting in place of the arc lamps which have been removed.

SIGN AND BILLBOARD ADVERTISING OF BROOKLYN EDISON COMPANY.

The accompanying illustration shows the first of a series of display advertisements which the Edison Electric Illuminating Company of Brooklyn will erect throughout the Borough of Brooklyn, in conformance with an established policy of furthering its own and the city's interests. The company adopted for its slogan some time ago the words "Brighter Brooklyn" and launched a campaign for ornamental street lighting in the business districts with excellent results thus far. The less showy but more remunerative motor load, however, has been piled up with most remarkable rapidity by General Sales Manager Jones and his staff, who have been busy replacing gas and oil engines and steam-driven isolated plants with motors, besides caring for new industrial applications. A fair load about to be connected up is the Gowanus flushing station pumping plant, which will be used to pump the water from Gowanus Canal into the East River, thus ridding the canal of an objectionable odor arising from the pollution of the stream by the numerous manufactories on its banks. At present the rise and fall of the tides in New York Bay do not effect the necessary change of water in the canal for this purpose. The pump will be driven by a 400-hp, three-phase motor and will operate about sixteen hours a day.

BRIGHTER BROOKLYN
100 PLANTS REPLACED
WE'RE BOOSTING BROOKLYN WITH A LOW EDISON POWER RATE.
EDISON ELECTRIC ILL'G CO. OF B'KLYN
360 PEARL ST
EDISON POWER PAYS

Brooklyn Edison Sign and Billboard.

The sign shown is located on Atlantic Avenue and faces the termini of the Long Island Railroad and the present subway in Brooklyn. It is 80 ft. long and is a combination electric sign and billboard. The letters in the slogan sign are 3 ft. high and the billboard is 9 ft. high. It is contemplated to change the wording of the billboard monthly.

A MODEL ELECTRIC GARAGE FOR MINNEAPOLIS.

Minneapolis now has about 400 electric vehicles in use on her city streets, including a number of trucks in the employ of local business houses. While there, as in other cities, the pleasure car has found its own stabling most conveniently handled in the private garage of its owner, a number of public gas-car garages also "board" and charge electric automobiles. With the interest and appreciation that is thus beginning to open for the electric vehicle in the Northwest city, it is already significant, therefore, to observe the confidence in the future of the battery-propelled car which has impelled one local company to erect an exclusively electric garage which in appointments and equipment probably has no superior in the United States.

The building, at present a one-story structure but designed to carry three additional floors, has been treated in both architecture and interior decoration after a unique Art Nouveau style. All the visible portions of the walls are of tinted brick, with bright-colored tile ornaments marking the front pediment. The vehicle entrance is at the left, the big front show windows being given over to display purposes. This large open space also serves as the general reception room and is finished with buff walls and ceiling and trimmed with Oregon fir. Formal seats of the same material are provided for persons waiting for their vehicles to be made ready. This reception room is lighted indirectly from 750-watt tungsten clusters hidden in opaque-bottom baskets of the fir wood, paneled to harmonize with the ceiling. The floor is of genuine terrazi, marked by marble strips. Separated by opaline-glass partitions from the main room are two private offices furnished in fumed oak throughout and a ladies' dressing-room finished in white enamel and equipped with full-length mirror, dressing table, etc. Toilet facilities are also provided. The significance which the pleasing appointments above described have for the discriminating class, which is largely in the majority in the use of electric vehicles, cannot be lightly underrated. In a sense, these luxurious touches mean probably as much, or more, in the ultimate success of such an undertaking as the mere mechanical equipment, which too often is the only part considered.

The garage building, measuring 66 ft. x 165 ft., is of reinforced concrete, faced inside with white lime brick. The concrete roof is supported in six bays by central concrete columns designed to carry a four-story building. The garage space accommodates fifty cars, in four rows, the proper position of each being indelibly marked on the concrete floor. At the rear of the vehicle space are the washroom, the battery-room in its brick inclosure, which is ventilated free of the rest of the building, and the machine shop, where all kinds of repairs can be made.

There are plug-and-jack positions for charging forty-four cars simultaneously, the plug boxes being mounted along the side walls and in the central columns. The charging jacks are of the spring-contact type. From each plug outlet box a pair of No. 8 copper wires are led in conduit through a deep, concreted wall trench, with cast-iron covers, to the charging panels, equipped with no-voltage circuit-breaker release, rheostat and meters in the front basement. The conduit trench also carries the steam pipes and its raised ledge serves as a backing stop for the automobiles.

The energy for charging the cars is primarily delivered at the garage as 2300-volt, 60-cycle alternating current from the lines of the Minneapolis General Electric Company. A bank of three 20-kw transformers in a fireproof concrete cell in the basement steps this down to 220 volts for operating the 75-hp Westinghouse induction-motor element of a three-unit set, the other machines, of which there are a 20-kw, 115-volt General Electric direct-current generator and a 70-volt, 30-kw Holtzer-Cabot generator, being especially designed for vehicle charging. A similar but smaller three-unit set will also be installed for charging service when only a few cars are in circuit. Totalizing alternating-current motor and direct-current generator panels are installed for controlling these machines.

The charging panels, carrying circuit-breakers, rheostats and meter taps for each charging circuit ending in a contact jack on the floor upstairs, are mounted in double rows on steel framing around the other sides of the motor-generator-room. Mounted between them are 0.5-in. x 2-in. copper buses carrying 115-volt and 70-volt charging energy, contact jacks being tapped into these buses at each panel position. From these jacks cords are provided to plug across to the adjacent panel jacks, conveying the charging energy through the controlling rheostat, the Ward-Leonard no-voltage release circuit-breaker and the fuses to the conduit line leading to the car battery plugged to the corresponding wall jack above. In this way all control of the charging current is from the basement switchboard, in conjunction with local ammeters and voltmeters which can be plugged in to any panel. The garage floor attendant has thus only to connect his machine to the charging receptacle, the process of charging being regulated from the switchboard below. Each charging position on the garage floor is equipped with a hydrometer rack and several hydrometers.

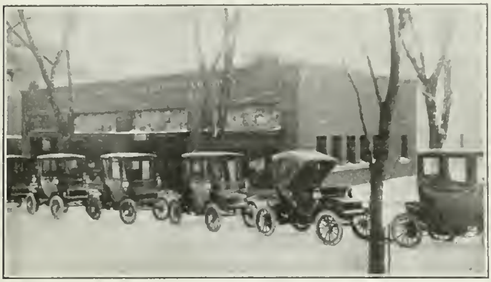

Fig. 1—Electric Vehicle Garage, Harmon Place, Minneapolis.

The garage interior is lighted by ten shower-pendant prism-glass fixtures, each containing five 40-watt tungsten lamps, in addition to forty-eight 40-watt ceiling lamps and forty-eight bracket outlets on the side walls and center posts. The entrance runway is indirectly lighted from a wooden inverted-reflector fixture projecting the light upward onto the red-stained stucco ceiling.

A novel and improved call board has been arranged for recording orders regarding the delivery of owners' vehicles. The blackboard surface is divided off into columns, the first giving the license number of the car, the next the owner's name and address, and the others being abbreviated for "Deliver," "Circuit" and "Call." The "Circuit" column is for recording the charging time of the cars. The "Deliver" and "Call" columns are provided with brass hooks on which can be hung a small blackboard just fitting the space and having marked on it blanks for the time, date and place to which the call or delivery is to be made. When an order is received to have a car delivered, the time and destination are chalked on the little blackboard, which is transferred to the "Deliver" column. When the car is delivered the attendant moves the small board to the "Call" column, rubbing off the figures and leaving it blank.

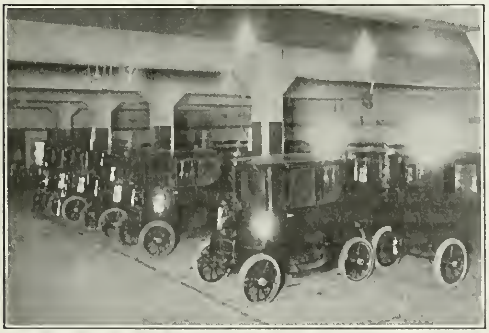

Fig. 2—Interior of New Electric Garage, Minneapolis.

A red target exposed on the "Deliver" column thus shows at a glance that the car is out of the garage. Call orders are similarly handled. The drivers who deliver cars are all attired in neat-fitting uniforms. To avoid over-running the time for which orders are given an alarm clock has been arranged to give a fifteen-minute-warning signal over an electric bell circuit in the garage. An automatic door opener is later to be installed, before the advent of cold weather, so that a car has only to approach the closed garage door to cause the latter to swing open automatically. Pleasure vehicles are boarded, with free delivery service, for $35 per month.

The garage complete is said to have cost $75,000. Messrs. Purcell & Feick were the architects. Mr. Milton L. Hughes is president of the Electric Carriage & Battery Company; Mr. A. H. C. Dalley is secretary, and Mr. R. L. Lunt is electrical engineer and designed the electrical features of the garage described.

Wiring and Illumination

GAS LAMPS VERSUS INDIRECT LIGHTING.

By Albert Scheible.

Whatever the limitations or shortcoming of the indirect method of lighting interiors may be, its advocates are at least deserving of thanks from all interested in illumination because of having led many to a more intelligent study of the various factors entering lighting problems. Particularly are they earning the gratefulness of the electric light industry because of the way in which they, consciously or otherwise, are calling attention to some of the decided shortcomings of gas as an indoor illuminant. The opposition of gas companies to any indirect-lighting methods will have been noticed by most readers of this journal, but may have been attributed to the general backwardness of the gas interests (at least in the West) in regard to modern lighting methods. However, the fact that at least one prominent manufacturer of reflectors and fixtures for indirect lighting has been tacitly declining to cater to the large field which a gas-mantle version of his equipment would open shows that there must be some good reason for this opposition of the gas companies to indirect-lighting systems. When interviewed recently in regard to the possibilities of indirect-lighting fixtures for use with gas lamps this manufacturer frankly stated that the use of his indirect-lighting equipments with gas-mantle lamps had not proved a success for three reasons:

(1) The impossibility of maintaining a bright ceiling for diffusing the light, the ceiling being blackened by the dust conveyed to it through the strong upward currents of the heated air and sometimes by soot from the flames when burning off new mantles.

(2) The difficulty of reaching jets in such fixtures for turning on and lighting the gas.

(3) The inability to make a highly efficient reflector which will withstand the heat of gas lamps when used under conditions similar to the tungsten clusters in indirect-lighting units.

All three of these reasons are interesting not only as showing why gas will always be handicapped in certain classes of lighting, but also as emphasizing some shortcomings of gas with which the electrical fraternity should be thoroughly familiar. Thus, the unsightly blackening of ceilings due to the use of gas is too often overlooked by store owners who do not stop to consider that the extra cost of recalcimining the ceilings so as to keep them as bright as they would be over electric lamps should be added to their gas bills in any comparisons that may be made.

As to the difficulty of getting at the gas burners, this has been minimized by the use of a pilot flame in close proximity to the cluster of gas mantles, but such a continually burning flame means a steady consumption of gas to an extent that has been generally underestimated. According to tests now being made by a prominent testing bureau, the gas thus burned in pilot flames in ordinary store practice with so-called gas arcs seems to be about one-quarter of the total yearly consumption of gas for the lamps, thus adding about 33⅓ per cent to the amount actually used for lighting purposes. This waste should always prove a handicap to the gas companies and should not be overlooked by electrical contract agents when they are figuring against gas on the basis of the cost of gas for the burning hours alone.

In regard to reflectors, the manufacturer's objection as above quoted was due to his experiments with silvered-glass reflectors of high efficiency, in which the silvering and the protective coating over it were melted off the glass by the heat of the mantles. This could be overcome by the substitution of procelain or opal glass of much lower reflecting power, with a reduction in the lighting efficiency of the lamp unit corresponding to about that of the older types of gas fixtures which suffered from similar limitations of reflector materials and their location with respect to the lamps. As long as the use of gas-mantle lamps means so large a radiation of heat there never will be the same adaptability to efficiently shaped and effectively placed reflector, which enables the modern tungsten lamp to be used so advantageously. Moreover, the strong air currents, due partly to the greater heating and partly to the supplying of the air needed by the gas burners, mean a much more rapid deposit of dust on the reflectors, thereby reducing their efficiency. This increased deposit on the reflectors, together with the blackening of the ceiling which must form part of the diffusing surface even if an enameled-steel disk is used immediately over the lamp, would largely reduce the effective illumination not only with an indirect-lighting system, but also with most other methods in which the ceilings form part of the diffusing means.

Thus the same shortcomings which even a manufacturer of lighting fixtures eager to cater to the large gas interests found in trying to adapt his methods to gas lamps really apply to such lamps under almost all conditions. If indirect-lighting fixtures help to call attention more strongly to these deficiencies and to bar gas entirely from use where certain effects are wanted, the advocating of an indirect fixture for this particular purpose may enable the central-station manager to impress the superiority of electrical methods so much the more strongly upon any prospective customer who leans toward the use of gas. At any rate, the fact that lighting methods which are strongly recommended by some, even though not favored by others, are at present out of the question with gas cannot be too strongly impressed on contract agents and others who come into direct contact with gas competition

LIGHTING OF CITY HALL AND COUNTY BUILDING, CHICAGO.

With the completion of the new city hall in Chicago adjoining the previously built county building, the whole forming one structure taking up a city block, the plan of decorative lighting around the four sides of the building has been revived. One plan suggested is the erection of eight ornamental iron posts on each of the four streets surrounding the building. Each post would be about 20 ft. high and support five 60-watt or 100-watt tungsten lamps in frosted-glass bulbs. The posts would be erected at the curb line, and there would be thirty-two of them, with 160 lamps, surrounding the building.

REVISION OF NATIONAL ELECTRICAL CODE.

At a meeting of the electrical committee of the Underwriters' National Electric Association held in New York March 22-23 a number of changes and additions were made in the code, the most important enactments being specifications covering rubber-covered wire, cabinets, switches, autostarters and fittings embodied in committee reports, which will be treated in detail in these columns in subsequent issues. The rubber-covered wire specifications are more drastic than those recently passed by the Department of Water Supply, Gas and Electricity of New York City and later adopted by the City of Chicago, in that chemical as well as physical tests of wire and insulation are specified. The new specifications will not become operative within possibly a year, or at a date agreed upon by the wire manufacturers, contractors and underwriters, in order to permit the manufacturers and contractors to dispose of their present stock and to carry out existing contracts where prices are based on the cheaper code wire. The new specifications will yield a much better insulated wire than the present code wire and result in a wire of higher price, the manufacturers estimating that the increase will range from 15 to 20 per cent on No. 14 wire, the increase increment becoming less with the larger sizes.

The committee on the wiring and fusing of induction motors has recommended that Rule 8 *c* (Motors) be amended so that small motors may be grouped under the protection of a single set of fuses, provided the rated capacity of the fuses does not exceed 6 amp. Rules 21 *d* and *e* have been amended so as to incorporate these suggestions.

Where rubber-covered wire is used for the leads or branches of alternating-current motors of the types requiring large starting currents the wire must be protected in accordance with the Table B of Rule No. 16, giving the allowable carrying capacities of wire with insulation other than rubber, except where circuit-breakers are installed which are equipped with time-element devices. Instead of permitting a fuse in each phase of alternating-current motor circuits, as at present allowed under Rule 21 *f*, the code has been changed so as to call for a fuse in each wire of the motor circuits, so that a two-phase motor instead of being protected with two fuses, one in each phase, must hereafter be protected by four fuses, one in each wire. Several of the amendments, while they refer specifically to alternating-current motors, are applicable to direct-current motors, and the committee has suggested that these rules apply to motors in general.

Rule 14 *b*, second paragraph, relating to the methods of fastening knobs and cleats, was amended as follows: "Knobs or cleats which are arranged to grip a wire must be fastened by either screws or nails. If nails are used they must be long enough to penetrate the woodwork not less than one-half the length of the knob and fully the thickness of the cleat, and must be provided with washers which will prevent under reasonable usage injury to the knob or cleats."

A number of suggestions which were referred to the Underwriters' Laboratories at the last meeting of the committee were reported on by that body. After careful consideration and tests, the laboratories did not find it advisable to recommend any limit to the weight of apparatus which may be attached to a flexible cord. With reference to the suggestion that all incandescent lamps consuming over 175 watts should be equipped with special bases, the laboratories reported that after experience and investigation no action is necessary other than is contained in the new ratings assigned to sockets and receptacles as given in recent editions of the "List of Electrical Fittings." Regarding the suggestion that all metal lining of sockets be of copper, the laboratories reported that copper is altogether too soft for screw shells, and that the present practice of using the metal known to the trade as "gilding metal" is very satisfactory, but that it does not seem necessary to specify in the rules that this metal shall be used, it being advisable to leave the matter to be governed by the general provisions of Rule 55, section *i*. On recommendation of the laboratories, Rule 50 *C*, containing specifications for flexible tubing, has another paragraph added to it, as follows: "Must have a distinctive marking the entire length of the tube, so that tubing may be readily identified in the field." The laboratories also reported the following opinion registered by the electrical committee through correspondence: "It is the opinion of this committee that all electric conduit should have an interior coating of a character and appearance which will readily distinguish it from ordinary commercial pipe, commonly used for other than electrical purposes and installed by persons not familiar with electrical hazards."

The committee on wireless-telegraph apparatus has provided the following additional specifications, intended to apply to the installation of wireless-telegraph apparatus on buildings, and not for apparatus on ships or isolated receiving stations along the coast and lake shores.

1. Aerial conductors to be permanently and effectually grounded at all times when the station is not in operation by a conductor not smaller than No. 4 copper wire, run in as direct a line as possible to water pipe at a point on the street side of all connections to said water pipe within the premises, or to some other satisfactory earth connection.

2. Aerial conductors when grounded as above specified must be effectually cut off from all apparatus within the building.

3. Or the aerial to be permanently connected at all times to earth in the manner specified above through a short-gap lightning arrester, said arrester to have a gap of not over 0.015 in. between brass or copper plates not less than 2½ in. in length parallel to the gap and 1½ in. the other way, with a thickness of not less than ⅛ in., mounted upon non-combustible, non-absorptive insulating material of such thickness as to give ample strength. Other approved arresters of equally low resistance and equally substantial construction may be used.

4. In cases where the aerial is grounded as specified in paragraph 1 the switch employed to join the aerial to the ground connection shall not be smaller than a standard 100-amp knife switch. The committee also recommended that an insulating transformer be interposed between the step-up transformer and the line, and that the grounding of the aerial supporting metal work be referred to the committee on grounding.

Rule 3, section *e* (Switchboards), was stricken from the code.

Rule 13 A, section *b*, paragraph 3 (Grounding Low-Potential Circuits), has been changed so that the neutral wire of overhead and underground systems shall be grounded at least every 500 ft., instead of every 250 ft. for overhead circuits and 500 ft. for underground circuits, as at present. The fine-print note under section *d* has been made a part of the rule, and the fine-print note under section *e* has been amended to include conduit as well as molding for protecting the ground wire.

It was the sense of the meeting that all suggestions on grounding which fall under Rule 13 A be referred to a committee with power to incorporate their findings in the next edition of the code, which will appear in the fall of this year.

Rule 14, section *g*, prohibiting the installation of electric conductors in wooden moldings or on insulators in elevator shafts, has been amended to permit armored cables in such locations, in addition to wires in approved metal conduits.

Rule 15, section *d*, relative to services supplying more than one building, was referred to a committee with power to incorporate its findings as a rule in the next edition of the code. The underwriters find that with the extended use of the tungsten lamp many isolated plants are only partially loaded, and that the owners of these plants, seeking an outlet for the surplus energy, feed circuits in adjacent buildings. The underwriters have also found that in not a few cases one individual on a block will purchase a large amount of energy in bulk from the local lighting company and resell it to various tenants in other buildings on the block. In order that these circuits, which are now run regardless of the wishes of the underwriters, may not introduce fire hazards, the committee will devise rules for their proper installation.

Rule 16, which has always been incorrectly labeled "Table of Carrying Capacity of Wires," has been changed to read "Table of Allowable Carrying Capacity of Wires," so as to come within the facts, and the last fine-print note has been stricken from the code.

Rule 21, section *b*, relative to the fuse in a neutral wire for a three-wire (not three-phase) system, has been amended by striking out the proviso that the neutral must be of equal carrying capacity to the larger of the outside wires and be grounded as provided for in Rule 13 A.

Rule 22, section *c*, third paragraph, has been amended to read "three-way switches are considered as single-pole switches," and the remainder of the paragraph has been stricken out

Rule 24 A, section *g* (Armored Cable), has been changed by making the provision applicable to the two or more conductors of the circuit, rather than of the cable.

Rule 25, section *d* (Interior Conduits), has been supplemented by the following addition to the first paragraph: "At exposed ends of conduits (but not at fixture outlets) where wires pass from the conduit system without splice, joint or tap an approved fitting having separately bushed holes for each conductor is considered the equivalent of a box."

The other amendments have to do with "Construction Rules." and will be covered in a later article.

At a meeting of the Underwriters' Association held in March, 1907, suggested specifications covering the construction and equipment of electric signs were accepted. These have been printed in the "List of Electrical Fittings" since that time as the present recommendations of the association covering the subject. It was voted that the Underwriters' Laboratories be empowered to draft specifications covering the construction of electrical signs, to be incorporated under the Construction Rules at a later date.

RECENT TELEPHONE PATENTS.

Probably the most vulnerable part of the telephone set in common use to-day is the hard-rubber mouthpiece. Breakage of this is so frequent that it is not surprising that there should be an effort to strengthen it. To this end Mr. L. Steinberger, of New York City, has arranged a threaded metal sleeve as the base of his mouthpiece. The perforated diaphragm now usual with mouthpieces is made integral with the sleeve and the mouthpiece proper of hard rubber is molded about the end of the sleeve. The pressure used in molding is sufficient to cause the compound to fill niches or holes in the sleeve to assist in firmly bonding it to the hard rubber.

The invention of Mr. W. Aitken, of Liverpool, England, is concerned with the arrangements for adjusting a transmitter for height of the user. He objects to the small limits of movement of the present customary mounting. He, therefore, provides an arm which carries at one end the transmitter and at the other a socket whose center line is parallel to the center line of the transmitter mouthpiece, both being perpendicular to the axis of the arm. The socket fits over a horizontal shaft. A rotation of the arm about the shaft affords a range of adjustment for the transmitter equal to twice the length of the arm.

Mr. C. M. Hartnett, of Malden, Mass., has patented a switch for short-circuiting the transmitter when this is desirable because of extraneous noises. A small clip carrying a flat spring is secured to the neck of a desk stand. A stranded cord serves to connect an insulated button in the end of the spring with the transmitter terminal. If the button be forced against the metal of the desk stand the transmitter is short-circuited

PHANTOM SYSTEM.

A second patent has been granted to Mr. O. M. Leich, of Genoa, Ill., for his system of introducing two non-interfering messages upon metallic circuits. According to his system the ringer windings of the metallic line bell are arranged as a phantom coil at the mid-point of which the superimposed grounded circuit is attached The drop at the central station for receiving signals upon the grounded circuit is similarly split so as to have a neutral mid-point which may be grounded. Further, the jacks are arranged so that the same calling plug will fit either circuit, according to which jack is used.

LETTER TO THE EDITOR.

The Eligibility of "Deceleration."

To the Editor of Electrical World:

SIR:—In a recent number of the *Proceedings* of the American Institute of Electrical Engineers appears an article by Mr. C. O. Mailloux vehemently protesting against the use of the words "decelerate" and "deceleration." At first sight the article might seem to "dispose effectually of any pretense that the words 'deceleration' and 'decelerate' have any justification whatever," but the writer, being another of the "college-bred doubters" referred to in the article, after reading the analysis which pretended, on etymological grounds, to confute absolutely the legitimacy of the words, determined to investigate the subject for himself. The fact that the result of this investigation proved so contradictory, and that the words "decelerate" and "deceleration" are doubtless already in use to some considerable extent in the profession, persuaded the writer not only to vindicate the use of the words, but to make a plea for their more extended use in textbooks on physics and mechanics. Before looking into the derivation of these words let us consider for a moment the physical meaning which the word "acceleration" is intended to represent.

The physical definition of "acceleration" is "rate of change of velocity." Or

$$a = \frac{dv}{dt} \text{ numerically.}$$

Velocity being a vector quantity, the "rate of change of velocity" must also be a vector quantity. Hence "acceleration" may be either positive or negative according to whether or not the "accelerating force" is acting in the same direction as the velocity. If it is in the same direction—that is, if $a = +\frac{dv}{dt}$—then the velocity will be *in*creased; if in the opposite direction—that is, if $a = -\frac{dv}{dt}$—then the velocity will be *de*creased.

Out of curiosity the writer has examined a number of modern textbooks on physics and has found that while all of them explained and applied the term in its positive sense, only a few emphasized *or in any way referred to the fact* that it might have a *negative* meaning. Some stated the general velocity and space equations for uniformly variable motion as

$$v = v_0 \pm at$$

and

$$s = v_0t \pm \tfrac{1}{2}at^2$$

the reason for the double sign being left to the mistrust of the student. In one of the books (Carhart's "University Physics") the following statement was found: "When acceleration is negative it is called retardation." This was the only case where the word "retardation" was used.

Here we have, then, one of the most important of the fundamental conceptions in all mechanics placed before the student either half-stated or else with its real meaning shrouded in the mist of a doubtfully significant equation. Let us turn back now to the derivation of "acceleration."

"Acceleration" comes from the supine form of the Latin verb *accelerare, acceleratum*, the *um* being changed to *ion*. The verb *accelerare* was originally formed by prefixing an intensive preposition *ad* to the verb *celerare*, giving *adcelerare*. The form *accelerare* was obtained by assimilation. But the verb *celerare* is a verb formed from the adjective *celer*, meaning "quick," which in turn may be traced back to the old Aryan root KAL, meaning "to drive." *Celerare*, therefore, means "to quicken," or, as it is more often stated, "to hasten." Evidently, then, from a physical standpoint, the idea to be conveyed by the verb *celerare* is *to change the velocity*, and furthermore the idea is unquestionably *to change the velocity in a positive sense*—that is, an *in*crease. The difference between *celerare* and *accelerare* is therefore one of degree only. As far as expressing the idea of a positive rate of change of velocity is concerned, it would have been precisely as "apposite" to "create" and apply the word "celeration."

Turning now to "deceleration," we find the following statement in Mr. Mailloux's article: "Assuming now that it were possible to manufacture such a word as 'deceleration' from *de* + *celerare*, that word could not possibly be the antonym or have the opposite meaning of 'acceleration.'" What, then, would be the meaning of the word? In order to answer this question consider for a moment the etymology of a few familiar words.

Take the two words "ascend" and "descend." No one can question the contrariety of these two words. The one represents motion in one direction, while the other *represents motion in exactly the opposite*. "Ascend" is derived from the Latin by prefixing the intensive preposition *ad* to the verb *scandere*. "Descend" is derived from *de* + *scandere*. But *scandere* of itself means "to mount up," or "to climb," and comes from the Aryan root SKAND, which meant "to spring upward." It is not difficult to see that there is a perfect analogy between the derivation of the word "ascend" from *ad* + *scandere* and the derivation of "accelerate" from *ad* + *celerare*.

Now is there any doubt as to the meaning of the word "descend"? Hardly. Derived from ***de*** + ***scandere***, meaning "to climb up," it signifies motion in the opposite direction to "ascending." The prefix *de* unmistakably gives a negative meaning to the root. Take the word "deplete," meaning "to empty"; derived from the verb *plere*, meaning "to fill," the prefix ***de*** completely inverts the meaning.

Nor are these the only cases in the English or the Latin language where *de* has a negative significance. To quote from Harper's Latin Dictionary: '*De-* signifies cessation, removal of the fundamental idea, and hence direct negation, as in dedecet, deformis, demens, etc." Again, quoting from Skeat's Etymological Dictionary: "*De-* is negative and opposite in destroy (from *de* + *struere* = to build), also desuetude and deform."

As for the formation of the verb "celerate" from *celerare*, referring again to Skeat we find the following: "Verbs in *ate* can be formed directly from Latin verbs in *are* by mere analogy with others. All that was necessary was to initiate the habit of formation."

Is not the above sufficient warranty for the word "decelerate"? Surely one could not question the fact that "de" imparts a negative meaning to the root without challenging the accuracy of "descend," and, as for the root itself, the above rule from Skeat is authority enough for the formation of the verb "celerate" without laying oneself open to the title of "fabricator."

The only possible objection to the word "deceleration" is based on two grounds. First, it may properly be claimed that the verb *decelerare* does not occur in Latin literature. But that is not positive proof that it was not used in colloquial Latin. If it were perfectly good Latin to form the verb *descendere*, having a meaning purely ***negative*** to *scandere*, is there any reason why it ceases to be good Latin for one now to form the verb *decelerare* as the ***antonym*** of *celerare?*

The second objection would be that in "retardation" we already have a word which expresses exactly the idea of "negative acceleration." If "retardation" is so apt a word, it is, to say the least, queer that it is not in more general use in the textbooks. In the teaching of physics the conceptions of velocity, change of velocity and rate of change of velocity are among the very first principles presented to the pupil. And a clear conception and a thorough mastery of this subject are essential before the student can hope successfully to cope with the laws of mechanics which follow. Any device or scheme which imparts to the student a clearer idea of the subject is *per se* justifiable. The surprisingly weak and incomplete presentation in most physical textbooks of the ideas concerning rate of change of velocity is most unfortunate, and it seems to me that the addition to our technical vocabulary of the words "decelerate" and "deceleration" would supply the means for a more illuminating presentation of the subject. It might even be justifiable to add the word "celeration" to designate the numerical value—

$$a = \frac{dv}{dt}$$

irrespective of algebraic sign.

One of my colleagues, who has taught physics for sixteen years, told me some time ago that he had been using the word "deceleration" for "negative acceleration" for a number of years with very gratifying results. There is a certain similarity in the form of the words "acceleration" and "deceleration" which presages an accurate understanding. "Deceleration" is a far more *graphic* and "apposite" word than "retardation." Its very sound brings out the meaning.

And, after all, what if "deceleration" were a "barbarism"? There are plenty of words in the English language, and especially technical English, that are in good use to-day, and always will be in good use, which if their "lineage" were to be traced would swap all their "good clothes" for the "birthright" of such "barbarisms" as "deceleration" and "decelerate."

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Digest of Current Electrical Literature

ABSTRACT OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Sliding Contact.—J. E. Noeggerath.—The conclusion of his article on the phenomena which occur in the collection of currents by means of brushes from slip-rings at high speeds. The author discusses the effect of the increase of temperature caused by the losses in the sliding contact. Brush temperatures of 100 deg. C. are perfectly permissible. With copper, bronze and iron contacts an increase of temperature causes an increase of voltage, while a decrease of voltage is obtained with carbon brushes. With increasing temperature the friction losses increase; they may easily be increased 25 per cent by heating. A high temperature is of greatest importance because it increases wear and tear. Lubrication has a small direct effect on the electric losses, but indirectly it decreases them on account of the lower temperature. The friction losses are also decreased. The chief advantage of lubrication is a reduction of wear and tear, on account of the lower temperature of the sliding surface. Good results are obtained with graphite, carbon, oil and water. For normal voltages graphite is especially suitable. The author finally points out in what respect the phenomena of the sliding contact are analogous to that of an electric arc. The chief conclusion is that the sliding brush contact is equivalent to a series of ohmic resistances (succeeding each other in time and parallel with each other in space) and electric arcs of limited cross-section in the nascent state. Energy consumption, temperature and wear and tear are less than with the electric arc. Finally, details are given of the construction of brushes and slip-rings for high speeds, with special reference to the design of unipolar machines. Figs. 1 and 2 show constructions which have proved satisfactory in practice with a peripheral speed of 100 m per second (20,000 ft. per minute) in continuous operation.—*Elek. Kraft. u. Bahnen,* Feb. 24.

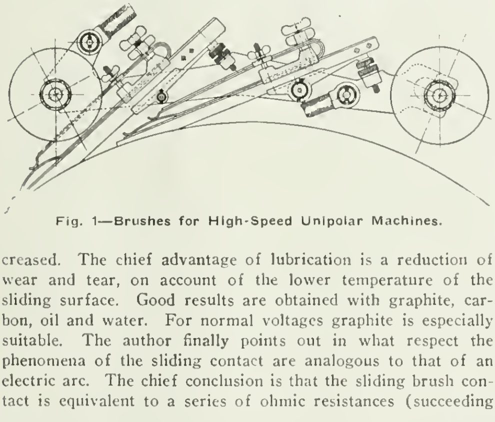


Fig. 1—Brushes for High-Speed Unipolar Machines.

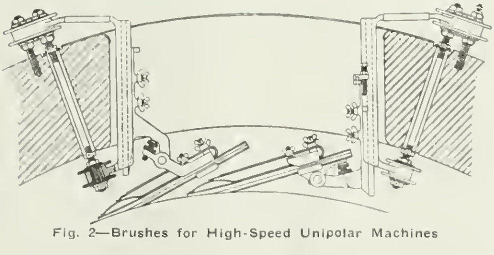


Fig. 2—Brushes for High-Speed Unipolar Machines

Variable-Speed Induction Motors.—An illustrated article on variable-speed induction motors built by a British company. Curves are given of the results of tests of a three-speed machine with two windings on the stator, one for four or eight poles and the other for twelve poles. On a 50-cycle circuit the synchronous speeds are 1500 r.p.m., 750 r.p.m. and 500 r.p.m., the corresponding full-load speeds being 1485 r.p.m., 735 r.p.m. and 490 r.p.m. The horse-power ratings corresponding to these speeds are 40, 20 and 14 respectively. In exceptional cases where a machine is required for operating at any speed from the maximum down to 15 per cent or 20 per cent above zero speed it is necessary to insert variable resistances in the rotor circuit, although this is wasteful. But even then it is useful to provide the motor with a changeable-pole stator winding and also a changeable-pole rotor winding. A straight two-to-one ratio requires only a single winding on the stator and a single winding on the rotor. A simple throw-over switch on the stator is all that is necessary to change the connections from full speed to half speed and at both these speeds a highly efficient machine is obtained. To obtain any speed between half speed and zero speed it is necessary to insert resistance in the rotor circuit, but the losses in reducing the speed of this type of machine down to, say, 25 per cent of maximum speed are much less than if resistance had been introduced to take care of the complete reduction in speed from full speed down to 25 per cent of same.—Lond. *Elec. Eng'ing,* March 2.

Three-Phase Series Motors.—R. Rüdenberg.—The author discussed in a recent paper the chief properties of the three-phase series commutator motor under simplifying assumptions. One of these assumptions was that the effective winding numbers in stator and rotor are equal. It was shown that only at a speed double that of synchronism phase compensation is exact, while below this speed the current lags behind and above this speed the current leads the voltage. Secondly, at low speeds and especially with considerable displacements of the brushes there exists a certain minimum speed below which a stable operation of the motor is no longer suitable. It was shown in his former paper that by changing the ratios of the windings the phase compensation and the stability limit could be influenced. Good phase compensation at low speed requires an increase of the rotor windings. Stability at low speeds requires a decrease of rotor windings. In the present paper the author discusses numerically these two effects of changing the numbers of windings. The action of the three-phase series motor when operating as a generator is also discussed. The paper is to be concluded.—*Elek. Zeit.,* March 9.

Motor for Demonstrating Purposes.—An illustrated description of a motor for experimental purposes built for a British electrical institution. The machine is a four-pole, 400-volt, compound-wound, variable-speed, direct-current motor provided with interpoles and designed for a continuous output of 100 hp at from 300 r.p.m. to 1000 r.p.m. It stands on a heavy cast-iron circular bed-plate and is arranged vertically with the pulley below to render the commutator brush-gear and all connections easily accessible. The base is a casting in the form of a truncated cone supporting the laminated yoke and poles on a ball race, which takes both weight and side stresses. The field system, therefore, is free to rotate, but is attached to a spring balance by a steel cord so that the torque can be measured. This torque lies in a groove so that its center is at a radius of 1.05 ft. from the center line of the machine; this measurement is equal to 33/10 ft., and hence allows of easy determination of the horse-power. The main poles and interpoles are easily removable from the yoke for the purpose of exchanging coils. The armature revolves on ball bearings round a steel spindle firmly secured to the bed-plate. A search coil spanning the winding pitch is provided in the armature and is connected to slip-rings. This coil is to enable investigations of the field form to be made, either with an oscillograph or by plotting a curve from instantaneous readings. The latter are obtainable by means of a contact-maker and a variable timing arrangement by which both the time of contact and the position of the coil at the time of contact are variable through the whole range. The commutator is provided with box-type brush-holders, with provision for using varying widths of brushes.—Lond. *Elec. Eng'ing,* March 9.

Circular Diagram of Induction Motor.—C. F. Guilbert.—The first part of a theoretical paper in which the author shows how it is possible to simplify the most general circular diagram of the induction motor, which is due to Ossana. The method of simplification is to suppress the many stray flux coefficients which complicate the theory of Ossana and to introduce instead of them the single coefficient of Blondel. The paper is to be concluded.—*La Lumière Elec.,* March 4.

Induction Motors.—J. Rezelman.—The article deals with the leakage reactance of three-phase slip-ring induction motors. The influence of the higher harmonics in the field wave upon the leakage is investigated. Experimental results and formulas are given.—Lond. *Electrician,* March 10.

Carbon Brushes and Electrodes.—A note on a recent British patent (3336, March 2, 1911) of the British Thomson-Houston Company, Ltd. (General Electric Company of this country). Brushes or electrodes of increased density and of mechanical strength and of high conductivity are produced by molding from a mixture of carbon and a carbonaceous binder and baked to a temperature of 480 deg. C. They are then impregnated with pitch or other suitable material and fired to a temperature of about 1400 deg. C. The following result is given as an example: Apparent density, 1.66; absolute density, 2.05; porosity, 19 per cent; resistance, 0.00108 ohm per inch-cube; tensile strength, 2130 lb. per square inch.—Lond *Elec. Eng'ing,* March 9.

Lamps and Lighting.

Flames of Low Temperature Supported by Ozone.—R. J. Strutt.—An abstract of a British Physical Society paper. The author had formerly shown that the yellow after-glow observed when an electric discharge had passed through a vacuum tube containing air is due to the mutual reaction of ozone and nitric oxide, each produced in the discharge. The present paper describes the effect of mixing a current of ozone from a vacuum discharge with other gases and vapors. Luminous flames of low temperature are produced in several cases. They often possess characteristic band spectra. These flames are, however, decidedly less conspicuous than that obtained with nitric oxide. —Lond. *Electrician,* March 10.

Supports for Metallic Filaments.—A note on a recent British patent (27,710, March 2, 1911) of the Lichtwerke Company (Berlin). Elastic supports for preventing the sagging of metallic filaments are made of an alloy of molybdenum with a small percentage of a highly refractory and brittle metal, such as tungsten, chromium, titanium or vanadium. A wire containing 2 per cent of tungsten is said to give excellent results. It is stated to be as elastic as watch-spring steel and not to lose its elasticity with continued heating and cooling.—Lond. *Elec. Eng'ing,* March 9.

Generation, Transmission and Distribution.

Turbo-Alternator.—Particulars of the official tests of a 6250-kw turbo-alternator in the new generating station of the Newcastle-upon-Tyne Electric Supply Company at Dunston-upon-Tyne:

	1	2	3
Duration of trial	9 a.m to 10 a.m	11:30 a.m. to 1 p.m	2:30 p.m. to 4·40 p m.
Output, kilowatts	4,256	5,600	6,257
Speed, revolutions per minute	1,210	1,210	1,210
Steam pressure at boiler side of turbine stop valve, pounds per square inch	192	189	189
Temperature of steam at boiler side of turbine stop valve degrees Fahrenheit	546	549	559
Supertemperature, degrees Fahrenheit	162	166	176
Exhaust pressure (absolute) in condenser, in Hg, inches	0.81	0.88	0.90
Temperature in condenser, degrees Fahrenheit	73	75	76
Temperature of circulating water, inlet, degrees Fahrenheit	44	44	44
Temperature of circulating water, outlet degrees Fahrenheit	50	52	53
Steam Consumption—			
Total water per hour, pounds	52.907	67.950	75.000
Water per kw-hour, pounds	12.4(4)	12.1(4)	11.9(7)
Water per kw-hour corrected for condenser leakage, pounds	12.4(2)	12.1(2)	11.9(5)
Steam consumption per kw-hour corrected for 190 deg. Fahr. supertemperature and 29.1 in. vacuum, pounds	12.1(5)	11.8(5)	11.8(0)

An interval of one and one-half hours was allowed between changes of load. The output was measured by a watt-hour meter specially calibrated for the purpose, while the steam condensed was weighed by the permanent weigh tanks installed in the power station. These steam consumptions are exceptionally low. The plant had, previous to the tests, been in regular commercial operation for about five months, and no adjustments whatever have been made to the turbine itself from the day when the plant was first started up.—Lond. *Electrician,* March 10.

Turbo-Alternator.—A description, with drawings, of a large turbo-alternator built by a British company which presents several interesting features in design, particularly in the construction of the rotor center and in the scheme of ventilation. The machine is designed to give 2000 kva at a power factor of 0.85, the pressure being 6600 volts and the frequency 50, when the machine is running at 1500 r.p.m.; but it must also give 3000 kva continuously without excessive heating.—Lond. *Electrician,* March 10.

Installations, Systems and Appliances.

Breaking High-Tension and Low-Potential Circuits.—A. G. Collis.—A paper giving a series of oscillographic records of the effects of opening a continuous-current circuit, at predetermined loads and on a "dead short," by means of various types of switches. High-tension and low-tension alternating-current circuits are also considered. The practical conclusions reached in the present instalment are that within the limits of the conditions under which the tests were made the system of opening direct-current circuits by breaking contact under oil is safe and efficient; that a breaker with a wide break and comparatively weak magnetic blow-out is a safer instrument to use on all circuits having an appreciable inductance than is the type with short break accompanied by the necessarily strong blow-out magnetic field, and that a carbon-break circuit-breaker tends to reduce the rise of pressure occurring at rupture of the current. The paper is to be concluded.—Lond. *Electrician,* March 10.

Testing Oil Switches.—A translation of the standard rules of the German Association of Electrical Engineers for the construction and testing of high-tension oil switches.—Lond. *Electrician,* March 10.

Wires, Wiring and Conduits.

Laying of Cables.—C. Vernier.—A paper read before the (British) Institution of Electrical Engineers on the laying and maintenance of transmission cables. The author first describes the three systems that are used at present for laying cables in England (the draw-in system, using pipes or ducts; the solid system, using wood, earthenware or iron troughing, and armored cables laid direct in the ground with protective coverings of planks or tiles). Methods of joining are described as follows with reference to a recent invention of the author. The method of joining which is illustrated in Fig. 3 consists in using strips of flexible copper braid (*a*) which are laid longitudinally along the conductors and which are bound down on to them lightly by a circular binding of copper wire (*b*), the joint being afterwards soldered. Joints of this type give a greatly increased electrical contact, as the flexible braid is compressed tightly into all the interstices of the conductor strand, and in proof of this it is mentioned that a joint of this type left unsoldered required one-third of a ton merely to pull one of the conductors out of the braids. A similar joint, again unsoldered, was run up gradually to 7000 amp per square inch, its temperature rise being at all times lower than that of the conductor. Fig. 4 shows an alternative type of this joint for heavier conductors which consist of more than three strands of wire. In this the continuity of each strand can be maintained independently by separate layers of copper braid. The copper braid when soldered and dissected can scarcely be distinguished from solid copper, so thoroughly does it become filled with the solder, which it holds like a sponge. A joint which the author considers more reliable than either of these two types and one which, moreover, does not call for such great skill on the part of the joiner is illustrated in Fig. 5. In this type of joint the insulation is provided by loosely fitting tubes, preferably micanite, which are sprung over the cores, the conductor joint being left bare inside them and the tubes overlapping some distance over the ordinary paper insulation at each end. The tubes, which are split on one side with a lap joint, are finally taped over their whole length with two layers of insulating tape to keep them together, and the three tubes are separated by star-shaped china pieces taped down to them, which keep them apart and center them in the lead sleeve. This lead sleeve is then filled with the insulating composition, either an oil or a viscous joint-box compound—preferably the latter—which can run into the tubes and all parts of the joint box. It is important to space the china separators as far as possible from the ends of the tubes, so as to increase the leakage path between cores and to earth. In a joint of this type the risk of puncture between cores is avoided, the workmanship is of the simplest description, and with a suitable joint-box compound breakdowns are not likely to be caused by air.—Lond. *Electrician*, March 10.

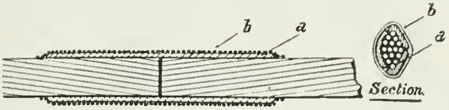


Fig. 3—Cable Joint.

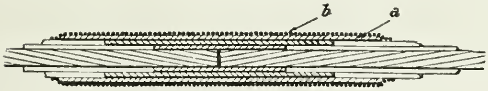


Fig. 4—Cable Joint.

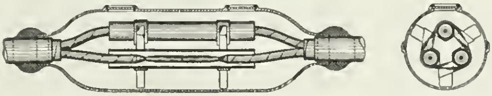


Fig. 5—Cable Joint.

High-Tension Cables.—L. Lichtenstein.—A paper in which the author first gives data on the perforation voltage and the flexibility of modern high-tension cables and on the capacity of modern cable works. The author then discusses the problems which have come up in cable manufacture by the increase of voltage. It is necessary to study further dielectric hysteresis and the heating of strongly insulated cables due to the heat developed in the copper. For long distances and high voltages, say above 30,000 volts, the problem of the cable capacity becomes important. Different methods of compensating the charging current are discussed.—*Elek. Zeit.*, March 2.

Reinforced-Concrete Poles.—M. Foerster.—An illustrated article on the manufacture of reinforced-concrete poles by the centrifugal process, with the results of tests from practice.—*Elek. Zeit.*, March 9.

Electrophysics and Magnetism.

Influence of Magnetic Fields on Spectral Rays.—G. A. Hemsalech.—The influence of the magnetic field on the duration of the spectral rays emitted by luminous vapors in the electric spark is that the duration of almost all of the rays of iron is diminished and the intensity of the action upon the different rays is selective. Almost all rays decrease in intensity, except in the immediate vicinity of the electrode, where they are all reinforced by secondary reactions. (1) The general effect, which is independent of the orientation of the discharge with respect to the lines of force of the magnetic field, results in the decrease of the duration as well as of the luminous intensity of the rays emitted by the metallic vapor. (2) The longitudinal effect produces a prolongation of the duration of the metallic rays and an increase of their brightness as well as of the brightness of the air. This action is apparent only when the spark flashes parallel to the lines of force. (3) The transverse effect is obtained only with very slow discharges (self-induction in the discharge circuit of the condenser) when the spark flashes perpendicularly to the lines of force. This effect is shown by a prolongation of the duration of certain rays, and is due to the displacement experienced by the oscillation which carries the current of the discharge under the influence of the field. Its action is selective.—From *Moniteur Scient.*, Vol. 74, page 57; abstracted in *Jour. Franklin Inst.*, March.

Cathode Drop of Potential.—L. A. Jones.—A fresh metal electrode when used as cathode in a glow current in helium and argon gives off hydrogen at the rate required by Faraday's law for electrolytes. This effect continues only for a few minutes after starting the current and then only when fresh metals are used. The present author has investigated the effect which the evolution of gas by the cathode produces on the drop of potential at the cathode. The investigation was divided into two parts, the first dealing with the effect on the cathode potential drop under a constant-current density; the second, with the effect on the normal cathode potential drop. The chief results are as follows: (a) It has been found that the use of a metal as cathode with a constant-current density greater than the normal does not change the metal in a way such as to change appreciably its cathode potential drop, but it does in general lower the cathode potential drop by producing some change in the gas. (b) On the other hand, use of a metal as cathode with normal current density increases its cathode potential drop, which in the light of (a) appears reasonably explicable only by assuming that in the first case the cathode potential drop and current density were large enough to keep the surface of the metal clean by "disintegration," but not in the second.—*Phys. Review*, March.

Sounds Produced by Sparks.—A. Campbell and D. W. Dye.—An account of an experimental investigation carried out in the (British) National Physical Laboratory on very high sound vibrations produced by electrical sparks. The authors have measured the wave-length of the inaudible high-frequency sound waves produced by spark discharges, Kundt's dust method being used. The electrical frequency varied from 100,000 up to 1,000,000 per second. It was found that the sound frequency was double that of the spark frequency, as was to be expected. Sound waves were measured from a source having a frequency of 140,000 up to 800,000 per second.—Lond. *Electrician*, March 10.

Units, Measurements and Instruments.

Calibrating Fine Capillary Tubes.—T. R. MERTON.—The methods commonly used in the determination of the bore of capillary tubes are direct optical measurement of the bore at the orifice, and weighing a drop of mercury which occupies a known length in the capillary. When very fine capillaries, with an internal diameter of the order of 0.1 mm, are to be measured, these methods present serious difficulties. The author describes experiments made with the object of investigating the accuracy with which a measurement of the electrical resistance of a fine glass capillary filled with mercury can be made. From this a mean value of r^2 (where r is the internal radius) can be calculated. In one case he found the square of the radius 0.004192 mm². Hence the radius itself was 0.06474 mm. The error in r^2 is probably not over 0.000002 mm². A measurement of r with a microscope and micrometer eyepiece gave the value of 0.064 mm. The only difficulty which arises consists in keeping the tubes clean and free from moisture.—*Phil. Mag.*, March.

Paralleling Voltmeter.—An illustrated article on a new central-zero voltmeter of English make for alternating currents for paralleling purposes. The windings are so arranged that equality of pressure is shown by the pointer standing at zero in the center of the scale. Should the voltage of the incoming machine be higher than that of the busbars the pointer deflects to one side of the scale, and if lower to the other. One side of the central zero is marked "too high" and the other "too low" to correspond with the voltage of the incoming machine.—Supplement to Lond. *Electrician*, March 10.

Telegraphy, Telephony and Signals.

Underground Wireless Telegraphy.—G. LEIMBACH.—On the basis of theoretical considerations concerning the conductivity and the dielectric constant of dry rock deposits the author shows numerically the possibility of wireless telegraphy below ground through rock. Experiments made between different potash mines at a depth of 500 m below the surface of the earth have been successful to a distance of about 2 km (1.2 miles). The author thinks that wireless telegraphy might have extended applications for signaling in mines as long as the rock is non-conducting. For metallic ore and coal mines the method must be modified if applicable.—*Elek. Zeit.*, March 9.

Miscellaneous.

Electrical Accidents.—S. JELLINEK.—A paper on recent progress in the pathology of electrical accidents. Electrical engineers often consider 500 volts as the danger limit for direct current and 300 volts for alternating current, but a voltage of more than 1000 may not cause a death, while deaths have occured with voltages as low as 100. It is therefore clear that the voltage alone is not the determining factor. Besides the voltage, importance is attached also to the current, the time during which the current passes through the body, the individual condition of the man, the resistance of his body and the path or paths which the current takes through his body. From a physiological viewpoint every electric installation should be considered with special precaution. It seems to make a great difference whether the man is conscious of the danger in which he is or gets a shock quite unexpectedly. In the latter case the result seems to be far more serious. The author discusses the burning of the skin, the effects of Joulean heat developed in the body and the specific effects on the different organs of the body. He refers briefly to first aid given in such accidents and recommends strongly that systematic statistics of all electrical accidents should be kept.—*Elek. u. Masch.* (Vienna), Feb. 26.

Scientific Research.—W. VON SIEMENS.—A paper on the foundation of new institutions for scientific research, with special reference to the Emperor William Society for the Promotion of Science. From the funds collected a chemical and a chemico-physical institution will soon be opened near Berlin.—*Elek. Zeit.*, March 9.

Porcelain.—W. BECK.—An article discussing the different properties of porcelain which make it useful in electrical engineering and describing various types of insulators.—*Elek. u. Masch.* (Vienna), Feb. 26.

BOOK REVIEWS.

ELECTRIC CABLES. Their Construction and Cost. By D. Coyle and F. J. O. Howe. London: E. & F. N. Spon. New York: Spon & Chamberlain. 466 pp., illus. Price, $5.

A thoroughly practical and very useful cable engineer's pocket book. It relates particularly to electric distributing cables, both for high-voltage and low-voltage service; also in lesser degree to telephone cables, and casually in a few particulars to submarine telegraph cables. Extensive tables for conversion from British to metric measures and data are given, so that the tables are applicable either to British or Continental practice, especially German practice. In many particulars it is the best cable handbook that has yet appeared. Much of its contents refers more particularly to European practice and can be taken only as comparative in reference to United States cable manufacture. The contents of the chapters are as follows:

1. Conductors. 2. Impregnated paper insulation. 3. Impregnated jute insulation. 4. India rubber and gutta percha. 5. Paper and air-space telephone cable. 6. Vulcanized bitumen. 7. Tapes and braids. 8. Lead sheath. 9. Steel-wire armor. 10. Steel-tape armor. 11. Labor, charges and examples. 12. Complete cables. 13. Miscellaneous, index, index to tables.

CONTINUOUS-CURRENT MACHINE DESIGN. By William Cramp, M.I.E.E. New York: D. Van Nostrand Company. 240 pages, 135 illus. Price, $2.50.

A short textbook on the design of direct-current generators and motors. It is divided into twelve chapters on the following subjects: The form of modern machines; general proportions of modern machines; relative proportions of the armature parts; relative proportions of the field magnet parts; relationship between armature and field strength; temperature rise; armature windings; commutation insulation; general mechanical construction: costs; examples of procedure in design. The treatment is direct and simple, well adapted to students in technical schools. The machine practice is essentially British and differs in a number of details from the American practice. All costs are in British money. The book will be useful to students of dynamo design, particularly as illustrating British methods. It will also be useful as a reference of costs and sizes for designers.

HANDBUCH DER TELEPHONIE. By Dr. Victor Wietlisbach. Edited by Dr. Robert Weber. Second edition, edited by Johannes Zacharias. Vienna: A. Hartleben. 468 pages, 447 illus. Price, 12 marks.

A well-illustrated and carefully prepared textbook on telephony from the German standpoint. The book is remarkable in its being a close combination of physics, mathematics and engineering practice. The original author was technical director of telephony in Switzerland. The first succeeding editor was a professor of physics and the second succeeding editor an engineer. The preparation bears, therefore, the marks of the physicist and the engineer side by side. Thus, immediately following a good mathematical theory of the telephone as a vibration reproducer is a very practical description of the transmitters in actual service, with details of their construction and installation. The book will be of much interest to advanced students of telephone engineering desirous of becoming acquainted with German practice and theory of the subject. The practice is well up to date, but some of the mathematical theory is behind the times.

The Engineering Index Annual for 1910. Compiled by the *Engineering Magazine*. New York: The *Engineering Magazine*. 496 pages. Price, $2.

The present is the ninth volume of the Index, which has been issued continuously since 1884, the last five being in "annual" form. The references are arranged in very convenient form under eight general heads, namely, civil engineering, electrical engineering, industrial economy, marine engineering, mechanical engineering, mining and metallurgy, railway engineering, and electric railways. Under each of these heads the items are placed alphabetically. The present edition contains a feature representing a marked improvement over former editions in a "classification of the index," which gives not only the main and sub-heads, but lists also every catchword. This classification is in reality a topical index of the contents of the volume.

In addition to noting the title of each article indexed, a hint is given as to the exact character of the article, the approximate number of words and the price at which the full text of the article can be supplied. The book is highly valuable in giving in condensed form an index covering practically all of the important articles that appeared during 1910 in the engineering journals published in English, and many in Spanish, Italian, French and German.

Physics. By Charles Riborg Mann and George Ransom Twiss. Revised edition. Chicago: Scott, Foresman & Company. 424 pages, 220 illus. Price, $1.25.

The volume is an elementary text-book on physics adapted for use in secondary schools. It is divided into two parts, the first being designed to represent the unit of physics as adopted by the North Central Association of Colleges and Secondary Schools. The second is more advanced and is intended to meet the requirements in physics of the College Entrance Examination Board. The descriptive matter is very clear and definite. The illustrations are simple and diagrammatic. No mathematics other than arithmetic appear in Part I, while only very elementary algebra appears in a few places in Part II. The book is well up to date, although elementary. The electron theory, Röntgen-rays, radioactivity and subatomic energy find a place under "Molecular Physics" at the end. The book will recommend itself to teachers of physics in the secondary schools.

New Apparatus and Appliances

SWITCHBOARD WATTMETERS.

There has just been placed on the market a complete line of single-phase and polyphase wattmeters, belonging to the Weston electrodynamometer type, which possess many novel features of construction and several unique operative characteristics.

All of the instruments have the same base dimensions. The single-phase meters are mounted in full-front and full-flush cases; while the polyphase meters are equipped with three different styles of cases—the full front, the full flush and the semi-flush, as shown in Fig. 1. The semi-flush case brings the front of the instrument in the same plane with other standard full-front Weston alternating-current switchboard instruments and thus harmonizes with them.

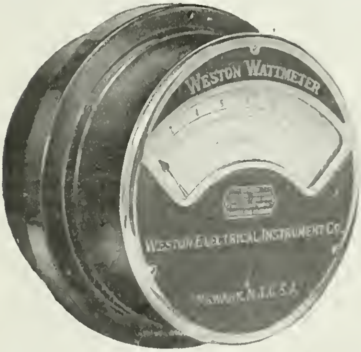


Fig. 1—Semi-Flush Polyphase Wattmeter.

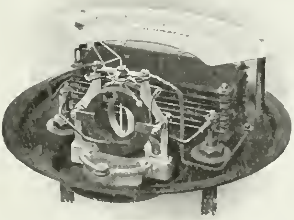


Fig. 2—Interior of Single-Phase Wattmeter.

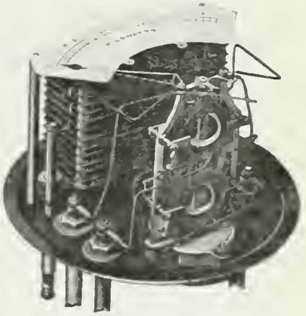


Fig. 3—Interior of Polyphase Wattmeter.

The general assembly and arrangement of the parts is shown in Figs. 2 and 3. The entire working system is mounted on one base, which in turn is secured to the back of the case by two stud bolts. By removing these two bolts the entire movement can be taken out without disturbing the resistors or the switchboard connections. It will also be noted that the construction throughout is extremely simple and accessible.

The movable system consists of a circular coil of silk-insulated special alloy wire, mounted rigidly on a staff which also carries the damper vanes, the spiral springs and the pointer, as shown in Figs. 4 and 5. The movable coil is spread at diametral points while winding; when completed, small curved plates are cemented to the inside periphery at these points. These plates are perforated with a hole which exactly fits the staff and are fitted with tiny ears which engage an equally tiny pin that passes entirely through the staff. By this construction the coil is given a definite and fixed position with reference to all other working parts of the system, each one of which is also definitely located by some equally positive means.

The fixed system includes the base, the field coil supports, the field coils, the bridge, the spring abutments and the jewels. The field coils are mounted coaxially on internal flanges fastened to the coil supports (Fig. 4) and are maintained in perfect alignment by the supports themselves, which are accurately rolled to gage for this purpose. The conductors in these coils are so liberally proportioned that they will carry double full load indefinitely and will even carry three times full-load current without overheating; the wattmeters may therefore be used to measure full load at power-factors below 0.50.

By properly choosing the proportions of the fixed and movable coils the scales of the wattmeters have been rendered uniform for all ranges. This is the first electrodynamometer switchboard wattmeter to have a uniform scale; in switchboard work such a scale is of special value, since it permits the approximate reading of the load from a distance based on the general position of the pointer with reference to the scale as a whole.

The coil supports shown in Figs. 4 and 5 are made of a special, high-strength, high-resistivity alloy. The favorable properties of this alloy in conjunction with a logical disposition of the metallic masses have reduced the eddy currents in these parts to a practically negligible quantity. Eddy currents have previously formed a serious obstacle to the attainment of high accuracy with alternating-current wattmeters, and especially is this true at very low power-factors. Tests were made on one of these wattmeters at frequencies as high as 900 cycles per second without introducing an error greater than 1 per cent; it is evident, therefore, that eddy currents must be quite negligible.

It is impossible in this limited space to give a detailed description of the construction of the instrument. However, there are a few points which deserve special mention both on account of their novelty and their value. These special features are the damper, the pointer, the zero adjustment and the terminals.

A switchboard wattmeter to perform its functions properly as a guide to the operator of a plant must be accurate, reliable, convenient and durable. Furthermore, it must indicate the value of a fluctuating load with substantially the same accuracy as it does that of a steady load. In order to fulfil this last requirement the instrument must respond quickly and accurately to the slightest as well as the greatest sudden change in load and must come to rest immediately upon cessation of that change.

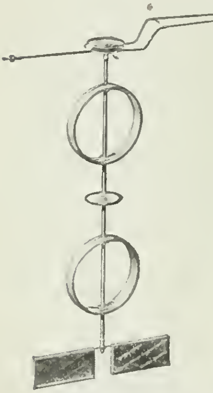


Fig. 4—Movable System, Polyphase Wattmeter.

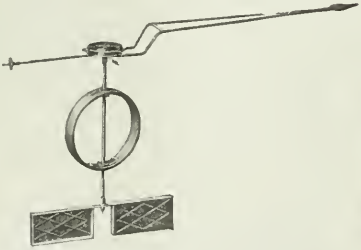


Fig. 5—Movable System, Single - Phase Wattmeter.

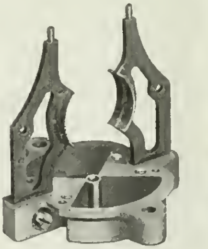


Fig. 6 — Coil Supports, Single - Phase Wattmeter.

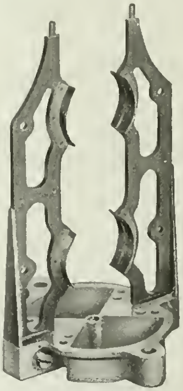


Fig. 7—Coil Supports, Polyphase Wattmeter.

A wattmeter to respond promptly to changes in load must have a high ratio of torque to weight of the moving system, and since the wear on the pivots is dependent almost entirely on the weight, this high ratio should be gained by reducing the weight rather than by increasing the torque. The moving system shown in Fig. 4 weighs only 1.83 grams and is so designed as to give a minimum moment of inertia.

The damper used in these meters is said to represent the first successful attempt to utilize the full damping power of air. Air dampers depend for their action upon the compression of air on the advancing side and the rarefaction of air on the receding side of a moving vane. In open air this effect is almost negligible, and even in a closed chamber it is but slight unless the resistance to leakage around the vane is relatively great.

There are three ways of increasing the damping effect of an air damper, namely, by increasing the area of the vane, by increasing the speed of the vane and by increasing the resistance to leakage around the vane.

The first two methods can easily be applied, but are inherently defective, since every increase in damping effect is offset by a disproportinate increase in weight and moment of inertia of the movable system, thus requiring increased damping and subjecting the bearings to unnecessary wear, which greatly shortens the useful life of the instrument . The third method is very difficult to carry out, but it is the only correct one. This is the method which is used in the Weston damper.

This air damper consists of two very light vanes mounted symmetrically upon the lower end of the instrument staff, as shown in Figs. 4 and 5; each vane is inclosed in a damper chamber, which is cast in one piece with the base of the instrument, as shown in Figs. 6 and 7. Each chamber is closed with a tight-fitting cover, the only opening to the outside being a very small arc-shaped space left to allow the free motion of the arm which carries the damper vane. Denoting the leakage through this space to and from the outside as useless and that directly around the edges of the vane as useful leaks, that damper which has the highest ratio of useful to useless leakage will be the most efficient. In this case the useless leakage has been reduced to a minimum by placing the vanes and chambers as close to the axis as possible. This arrangement also gives a minimum weight and moment of inertia which further add to the effectiveness of the damper and greatly increase the useful life of the instrument. By this construction the useless leakage has been so far reduced that the designer by suitably proportioning the clearness space between the vanes and the chamber can get any desired damping effect. Indeed, it is claimed that these wattmeters could be made absolutely deadbeat were it desirable. As a matter of fact, a slight overswing—about 2 per cent—is allowed so as to assure the user of the absence of friction in the movement.

The pointer is a vitally important part of an indicating instrument. It must be light and must have a low moment of inertia, and when used on alternating-current circuits it must have a natural period of vibration which is not a multiple of the frequency of the electric circuit, so that it will not be set into resonant vibration. All of the above characteristics are claimed for the trussed pointer used in these wattmeters. By this form of construction the pointer is given great stiffness with minimum material. Furthermore, it has no resonant point at any commercial frequency between 15 cycles and 900 cycles per second.

Another novel feature is the adjustment device which permits the adjustment of the pointer to the zero position by means of a screwdriver from the outside and without removing the instrument from the board and without disturbing the seals. Spring sag caused by shocks received during transportation is thus rendered perfectly harmless. This adjustment device is so designed that no damage can result to the instrument by its accidental or wanton misuse.

In order to facilitate the installation of the instrument on the switchboard the full-front type meters are fitted with a new form of terminal. Each terminal on all ranges below 20 amp is surrounded by a wrought-iron sleeve, three or four of which are externally threaded to receive nuts which serve to clamp the instrument to the board. On ranges above 20 amp no sleeves are used, but the nuts are screwed directly over the terminals. The sleeves also protect the terminals from contact with metallic parts of the board and serve as ground terminal for the case.

The polyphase meters consist essentially of two single-phase movements with their movable coils mounted on the same staff, so that the resultant torque is indicated by the pointer on a single scale. The construction is shown clearly in Figs. 3, 4 and 7.

The claims for accuracy under all the very variable conditions of practical work are quite unusual. For instance, all of these wattmeters have a guaranteed accuracy of 1 per cent independent of frequency changes from 15 cycles to 900 cycles per second; of temperature changes from 50 deg. Fahr. below to 50 deg. Fahr. above normal temperature; of fluctuations in power-factor from 0.50 lag to 0.50 lead, and of variations of wave form within the limits of general commercial work. They may be used interchangeably and with the same accuracy on direct-current and alternating-current circuits.

The above-described wattmeters have been placed on the market by the Weston Electrical Instrument Company, Newark, N. J.

INDIVIDUAL AND ADJUSTABLE-SPEED MOTOR DRIVE, WITH AUTOMATIC STARTING IN NEW CHICAGO CAR SHOPS.

What are perhaps the most modern and complete wood-working and machine-tool shops ever built for electric car construction and repair purposes, employing throughout the most improved features of individual-motor drive, automatic starting and adjustable-speed motors where varying-speed tools are to be operated, have just been completed by the Chicago Railways Company in its newly reconstructed and re-equipped West Side car shops at Lake and Harding Streets, Chicago. These shops, besides making all repairs on the 2400 cars in the service of the company on its North and West Side lines, are now engaged in reconstructing 325 old-style double-truck cars into double-vestibule pay-entrance type, and are also building 200 new large double-truck cars for the same service.

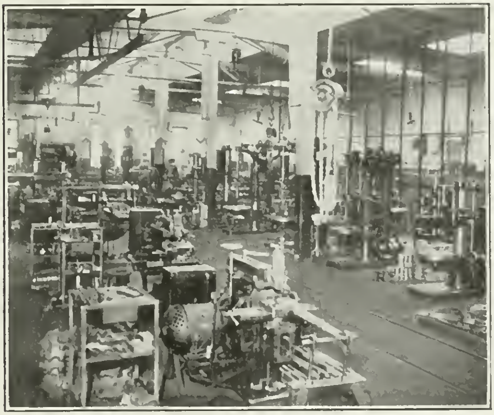


Fig. 1—Corner of Machine Shop.

In the reconstruction of these wood-working and machine shops, which has been going on during the last year, a number of new tools and machines have been installed, while a great many others, formerly designed for line-shaft drive, have been rebuilt for individual motor operation. In many instances adjustable-speed motors were used to advantage to replace cone-pulley and change-gear speed adjustments, some ingenious substitutions being made to adapt the machines for self-contained operation. In the new shops, too, all of the motors are arranged for automatic starting from push-buttons mounted at convenient points on the machines they drive, the starting apparatus itself being inclosed in cabinets and placed out of the way of interference or curiosity. The installation is also unusual in being operated from a grounded 550-volt direct-current circuit.

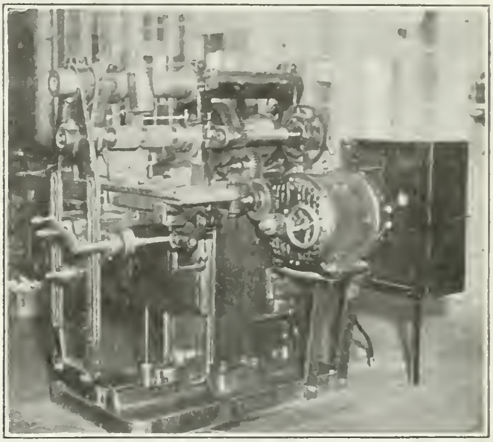


Fig. 2—Milling Cutter Adapted to Be Driven by Adjustable-Speed Motor.

In all there are about 140 motors in the shop departments, sixty of these being in the wood mill and eighty in the machine shop. A view of a portion of the machine shop is given in Fig. 1. With the exception of a 32-hp Westinghouse 3-to-1 adjustable-speed motor driving a Sellers car-wheel lathe and a 2-hp Roth motor driving a nut-tapper, all of the wood-working and machine tools are driven by Reliance motors, about 40 per cent of these being of the adjustable-speed type, in which the speed variation is accomplished by drawing the armature aside and so increasing the air-gap of the motor. The constant-speed motors range in rating from 1 hp to 40 hp, while the adjustable-speed motors range from 1½ hp to 12 hp, with speed change ratios from 3-to-1 to 8-to-1. The entire shop equipment aggregates about 600 hp in motors, and, although the energy consumption of the motors in the machine shop is intermittent, as is characteristic of this class of work, the long-hour operation of the machines in the wood mill brings the load-factor of the entire installation up to about 40 per cent on the ten-hour-working-day basis.

Twenty-three of the automatic motor starters, with push-button control, are of the Monitor limit-switch type, the other 105 starters being of the Cutler-Hammer-Schureman type with either solenoid-operated sliding contacts or cam-operated switches. The Monitor starters for 1-hp and 2-hp motors have two-point limit-switch starting; 3 hp to 5 hp, four points; 7 hp to 10 hp, five points, and 15 hp, six points. In the Monitor starter series-connected limit switches are operated successively as the starting current taken by the motor falls to predetermined values at which switches drop in, cutting out resistor steps. In this way the current taken by the motor during starting is limited to definite value, the motor being accelerated under proper starting-current conditions regardless of the time taken in getting under way. The Schureman automatic starters for motors under 10 hp are of the solenoid-operated pivoted contact-arm type; for 10 hp to 20 hp, the solenoid-operated sliding type, and for the 30-hp and 40-hp motors, the cam-operated multiple-switch type.

The 550-volt direct-current energy supply for operating the shops is brought over independent lines from the Western Avenue power house of the company, and from the Cicero substation, the alternating-current input of which is primarily generated in the Fisk and Quarry Street stations of the Commonwealth Edison Company. From the main distribution switchboard at which the supply feeders end lines are carried underground to panel boards mounted on the walls of the wood mill, each of which contains the circuit-breakers, fuses and switches for the motors of the machines in its immediate vicinity. The wood mill is thus divided into four sections, each fed through its respective panel box. The 550-volt ungrounded or trolley side of the circuit to each motor is equipped with a circuit-breaker and fuse, while in the grounded or rail side of the line there is inserted a single-pole knife switch. These circuit-breakers, fuses and knife switches are mounted in parallel rows in the panel boxes. By the aid of the circuit-breakers and switches any motor can be entirely disconnected from the line for inspection or repairs, and as all live parts of the motors are carefully insulated from possible grounds, the liability of trouble has been reduced to a minimum. The main feeders from the power stations to the shops are also protected by two circuit-breakers in each line. The plan of sectionalizing the various machine motors under panel boxes containing circuit-breakers, fuses and knife switches will also be carried out in the machine shop, as has already been done in the wood mill, the distribution lines being laid under the floor in conduit.

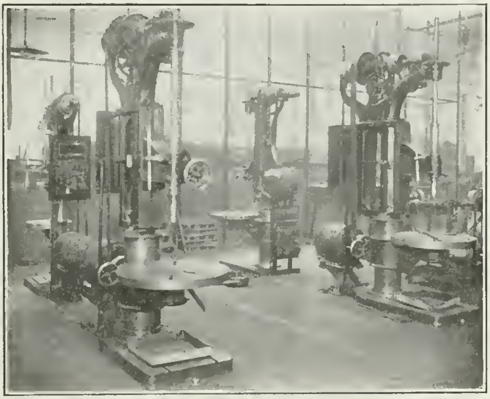


Fig. 3—Group of Drill Presses.

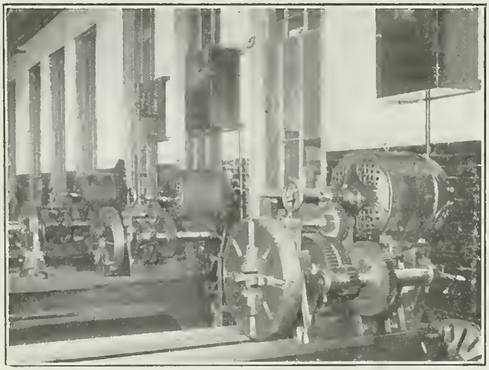


Fig. 4—Lathes Driven by Adjustable-Speed Motors.

Descriptions of some of the instances in which individual-motor drive and adjustable-speed operation were applied to the 125 machine tools in the wood mill and machine shop will be of interest.

Fig. 2 shows a No. 5 Kempsmith milling machine, now driven by a 5-hp Reliance adjustable-speed motor with a speed range of 3.4-to-1, through a gear train comprising a rawhide motor pinion, cast-iron idler, rawhide idler, and cast-iron gear on the headstock quill. In place of this main quill a three-step cone pulley was formerly mounted on the milling shaft, being arranged for belt drive from a countershaft. While the train of gears shown is unusual, it was adopted in this case to permit the motor to be placed on this side so that its speed-regulating hand-wheel could be brought under the operator's hand. The starting and stopping push-buttons and the conduit wiring to them are shown alongside the sliding head at the top of the machine. The automatic starter is inclosed in the steel cabinet just behind the motor. The illustration shows the simple bracket which it was necessary to construct to carry the motor.

Fig. 3 shows a group of 24-in. to 32-in. drill presses now driven by 3.5-hp adjustable-speed motors with a speed range of 6-to-1, but formerly obtaining their speed changes by means of cone pulleys, the largest steps of which are still in use by the belts from the adjustable-speed motor. These cone pulleys, now useless, of course, will be replaced by simple pulleys.

Fig. 4 illustrates one of the four Lodge & Davis 27-in. lathes driven by 5-hp motors. These applications show especially the results obtained in avoiding gaps in spindle speed ranges by replacing the former five-step cone pulleys with adjustable-speed motors. With the former 10-to-1 back-gears the possible spindle speed ranges of these machines were 7.5 to 30 and 75 to 300, leaving a 150 per cent speed-gap. With 6-to-1 adjustable-speed motors the range is now 8.3-to-50 with back-gears in and 50-to-300 with open belt. In converting these lathes the back tail gears were moved up, as shown in the picture, leaving space for mounting the motor, and a rawhide compound idler, carried in bearing-stands at each end to insure its alignment, was inserted between the spindle gear and the motor pinion.

The Warner & Swasey 1-in. screw machine was adapted from a three-step cone-pulley drive giving 2-to-1 speed reduction, without back gears,, but is now driven by a 2-hp 6-to-1 adjustable-speed motor.

In arranging a No. 1 Kempsmith milling machine for individual adjustable-speed drive a ⅞-in. steel band was shrunk onto the cone pulley and into this gear-teeth were cut, an intermediate rawhide idler being inserted between the gear and the pinion of the 3.5-hp 6-to-1 motor. A similar feat of shrinking and cutting gear teeth in an external band was accomplished on a 54-in. Hamilton engine lathe.

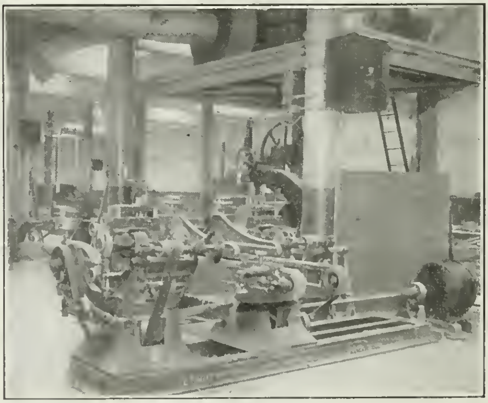


Fig. 5—Direct-Driven Double-End Tenoner.

The machine shop contains a number of other interesting examples of converting belted machines to direct-motor drive. Among those in which a gear has replaced tight and loose pulleys are a double-end punch and shear driven by a 5-hp motor and a 30-in. Whitcomb planer. Other tools now motor-driven are: Acme 2-in. bolt cutter, 3.5-hp, 6-to-1 motor; 20-in. Gould & Eberhard shaper, 5-hp, 6-to-1 motor; Niles axle lathe, 7.5-hp, 3-to-1 motor; Burr key-seater, 5-hp, 3.25-to-1 motor; 54-in. American metal planer, 15-hp, 2-to-1 motor; 2-ft. plain radial drill, 3.5-hp, 6-to-1 motor; six-spindle multiple drill, 2-hp 6-to-1 motor.

A 60-in., three-drum Columbia sander is driven by a 20-hp motor which has been inserted in the center of the regular countershaft, enough shaft being cut away to make the machine a self-contained unit. In fitting a 26-in. McDonough band resaw for a 30-hp constant-speed motor it was necessary to drop the concrete-motor foundation 16 in. below the floor level, but the unit is thoroughly successful. The 15-hp motor shown in Fig. 5 drives a Hayes double-end tenoner, and is controlled from push-buttons front and rear. The saws, cut-offs, chain carriage and other attachments of the tenoner are all driven by the motor through the shaft, which replaced a tight-and-loose-pulley connection. A 16-in. four-head car-sill machine driven by a 40-hp motor is provided with four push-button stations, from any of which the stopping and starting of the motor can be controlled. The only adjustable-speed motor in the wood shop is one of 5 hp with a speed range of 3-to-1, driving a rod-and-dowel machine. Different cutting speeds are required for turning out round rods of from 3/8 in. to 1½ in. diameter.

The shops are warmed by a hot-air heating system, motor-driven blowers being used to circulate the air through the pipes. Other blowers are used to remove shavings from the wood mill and to create forge drafts for the blacksmith shop. Compressed air, delivered by motor-driven compressor sets, is piped about the barns and shops for cleaning purposes. The machine shop, which measures 228 ft. x 72 ft., is lighted by Cooper Hewitt mercury-vapor lamps, while the wood mill is lighted by inclosed-arc lamps, five in series across the trolley circuit.

The car shops herein described and the other new car stations, all of which provide for car maintenance, were designed under the direction of Mr. J. Z. Murphy, chief engineer of the Chicago Railways Company, in consultation with the Board of Supervising Engineers, Chicago Traction.

BAKELITE AS AN INSULATOR IN INFLUENCE MACHINES.

Interesting information on the possibilities of bakelite and bakelized paper as electric insulators is found in a recent German patent of Dr. H. Wommelsdorf for improvements in influence machines. In the past the disks, posts and other insulating portions of influence machines have always been made of glass or hard rubber. Both these materials have distinct disadvantages, the glass being breakable and the hard rubber becoming inefficient in time through electrical and chemical action. Dr. Wommelsdorf has found that bakelite is suitable in a surprisingly effective manner for the manufacture of those parts of influence machines which are subject to the effect of the sparks and silent discharges and to the chemical action of the mixture of ozone and nitrogen oxide formed during the operation of the machine. Bakelite is very resistive against these influences. Moreover, by comparative tests the unexpected fact was established that influence machines, the inducing parts of which (for instance, disks) are made of this material, give an appreciably greater—almost double—the quantity of electricity (coulombs) than influence machines of the same size and the same design with hard-rubber disks. It was further found that paper or pasteboard impregnated with bakelite A and then treated in the well-known manner in a bakelizer may also be used, since by this treatment the paper or pasteboard is changed into an excellent insulator.

ELECTRIC MOTORS IN AN ARTIFICIAL ICE PLANT.

In the manufacture of artificial ice it is necessary to produce a sufficiently low temperature to freeze the water. To obtain this the Crystal Ice & Storage Company, Buffalo, N. Y., utilizes the principle of the rapid absorption of heat by the evaporation of liquid ammonia. A long tank is divided into compartments by plates 15½ ft. long and 9½ ft. wide. Between each two compartments there are two plates spaced a sufficient distance apart to admit of a system of coils for conveying the liquid ammonia being placed there in contact with both plates. Spring water is placed in the compartments, and the evaporation of the liquid ammonia extracts heat from the water in contact with the plates, causing ice to form on them. The ice is allowed to get 12 in. thick before harvesting. There are sixteen tanks in use, each containing plates for eight cakes of ice.

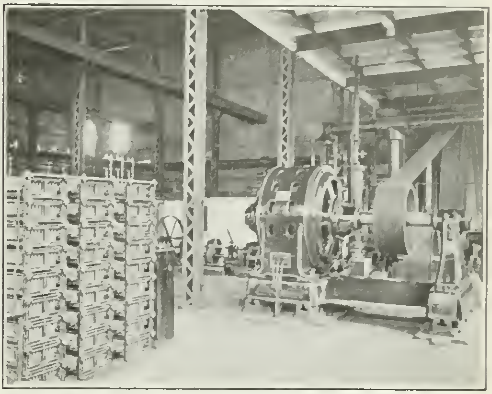


Fig. 1—Induction Motor Driving Ice Machines.

In order that the ammonia may be used again and again after evaporation it is liquefied by a double-cylinder compressor (Fig. 1) driven by a 200-hp, 2200-volt induction motor by means of a rope drive. To produce ice free from air bubbles the water in contact with the freezing plates is agitated by means of compressed air admitted from a perforated pipe placed near the bottom of the tank. The circulation produced by the air bubbles floating upward through the water assists in

Fig. 2—Cake of Ice Suspended from Crane, Showing Iron Supports.

removing the impurities and air bubbles from the surface of the ice. To facilitate handling the large cakes, which, when 12 in. thick, weigh about 9400 lb., two eyebolts are frozen into each cake of ice, as shown in Fig. 2. When the cake is built up to the desired thickness hot ammonia gas is sent through the pipe system, loosening the cake from the plate.

The tanks are arranged in two rows, each served by a 7-ton crane. Each crane is operated by two induction motors of 5-hp and 3-hp capacity respectively and of the slip-ring type, as they are required to start under load. These remove the cake of ice from the tank and carry it to the tipping table, shown in Fig. 3.

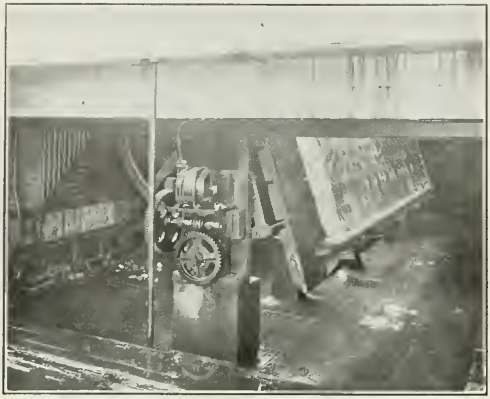


Fig. 3—Induction Motor Operating Tipping Table.

After the cake is placed on the tipping table, the bolts are removed by applying a heavy current of electricity to the rods. The projecting terminals at the lower end of the bolts are connected together by means of a flexible copper cable and voltage is applied to the upper ends. A specially wound transformer is used for this purpose, rated at 1 kw at 4 volts on the secondary. The 250 amp thus obtained will loosen the bolts in about one minute.

The tipping table is operated by a 2-hp motor wired for reverse operation as well as direct to allow a range of motion of the table through nearly 180 deg., permitting placing the cake with its flat side—that is, the side which was next to the freezing plate—down, regardless of its position when removed from the tank.

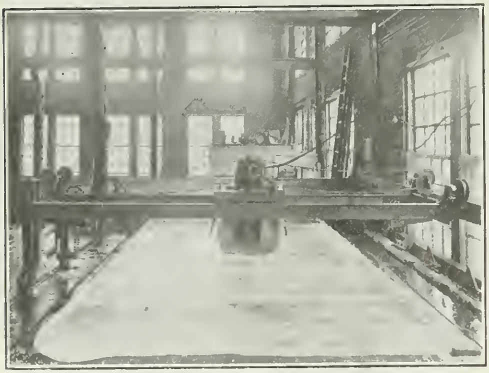


Fig. 4—Induction Motor Operating Ice-Cutting Saw.

For distribution to customers the cake is now cut into smaller cakes by the motor-operated saw shown in Fig. 4. This saw is mounted on a revolving stand and traveler so arranged that a cut may be made either sidewise or lengthwise of the cake. The motor speed is 1500 r.p.m. and it drives the saw at a speed of about 1200 r.p.m.

The panel for controlling the supply is equipped with a polyphase indicating wattmeter, a polyphase watt-hour meter and an automatic oil switch provided with both overload and low-voltage release coils. Air-break switches are installed in the incoming lines so that the panel may be isolated in case it is desired to inspect the panel equipment. Another panel controls a 200-hp induction motor driving the ammonia compressor and is equipped with an ammeter and a 100-amp oil switch with series overload coils.

The Crystal Ice & Storage Company purchases its energy from the Cataract Power & Conduit Company, local distrbuting agent for the Niagara Falls Power Company. Only two men are required to handle the entire output of this plant from the freezing tanks to the loading platform. The average daily production is about 78 tons, although during the hot weather the output sometimes runs as high as 100 tons per day. The building is lighted throughout by tungsten lamps of the 60-watt and 100-watt sizes.

The entire electrical equipment, including induction motors, transformers, switchboard panels and controlling apparatus, was furnished by the General Electric Company, Schenectady, N. Y.

A "BATTERY SMOKER" IN CHICAGO.

On the eve of the Maintenance of Way convention in Chicago the Electric Storage Battery Company gave a "battery smoker" at the rooms of the Western Society of Engineers on March 20. Employees of the signal and car-lighting departments of the railroads and others interested in storage batteries were invited to enjoy the hospitality of the company. Mr. Godfrey H. Atkin, the Chicago manager, presided, and there was an attendance of over 200. Mr. H. M. Beck, engineer of operation of the battery company, gave an interesting illustrated talk on storage batteries and their manufacture and care. He dwelt at length on the possibilities of the Tudor plate for car lighting and the new Ironclad Exide battery for vehicle work, and exhibited some interesting curves showing life and capacity. After the lecture the assembly was entertained at supper by the Electric Storage Battery Company, Mr. Atkin doing the honors.

ENAMEL WIRE.

The demands of the larger manufacturers of electrical apparatus, particularly apparatus of the types in which small magnetic coils are used, for an insulated wire which would enable them to increase the efficiency of their product while decreasing its cost have led to the development of a black enameled insulation for magnet wire. Prior to the development of black enameled magnet wire attempts had been made to produce a satisfactory substitute for silk insulation. These were not successful, as the product either did not possess many of the essential features of satisfactory insulation or it was not such that it could be manufactured commercially. Black enameled wire is now offered to the market by the Western Electric Company. It is claimed for this wire that, while the black enameled insulation is only 0.0002 in. to 0.0004 in. in thickness, it is so elastic that when the wire is stretched to the breaking point the enameled insulation does not break until the wire itself gives way. It will withstand the ordinary atmospheric corrosives and the severe atmospheric conditions of shops, factories, tropical climates and the seacoast. The manufacturer claims that it is not injured by exposure to a temperature of 250 deg. Fahr., a temperature which will destroy the tensile strength of cotton or silk in a few hours. The enamel cannot be removed from the wire by the ordinary solvents, and the wire can be handled as easily and successfully as a silk-insulated wire. One of the great advantages possessed by black enameled wire is its small diameter as compared with that of single silk or cotton-insulated wire. The winding space (for a specified number of turns) saved by black enameled wire over single silk No. 34 B. & S. wire is 25 per cent.

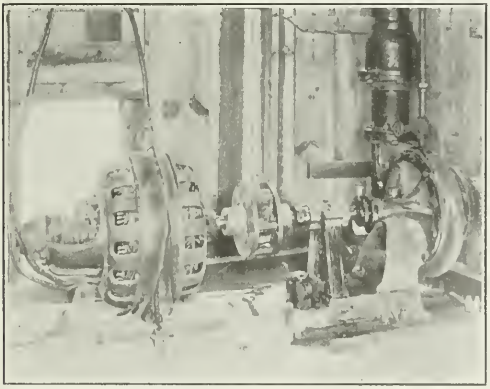
SUBSTITUTION OF ELECTRIC FOR STEAM PUMP IN A STONE QUARRY.

The accompanying view taken at a quarry where a steam engine partly dismantled has been left to rust out its days in the weather is of the interior of a shanty in which an electric pump is installed. The view shows the motor and the pump, installed across the end of the shanty close to the suction and delivery pipes. As the motor is about 2½ ft. high, an idea may be had of the relative sizes.

This outfit, consisting of a high-duty American centrifugal pump driven by a 30-hp Westinghouse alternating-current motor running at 690 r.p.m., was installed over a year ago by the Kankakee Electric Light Company in the stone quarry of McLaughlin & Mateer, Kankakee, Ill., to keep the quarry dry, and has been giving excellent service ever since.

The pump delivers 1100 gal. per minute against a discharge head of 55 ft. and a maximum suction lift of 25 ft. from the quarry sump. The water is started and stopped by a ball float and master switch in the pump house and a magnetic starter on the bank above the quarry. The pump works automatically, running eight hours out of the twenty-four—that is, the sump fills in one hour and the pump empties it in a half-hour.

The owners of the quarry were somewhat skeptical of the powers of the pump when it first appeared on the scene and called it a "toy," owing to its diminutive appearance beside the steam pump. When the pump was connected and ready to work they came around confidently expecting that this new device would be totally inadequate, but when the equipment dug right into the load and pumped water in a large stream and never once hesitated until the sump was emptied orders were given for the complete abandonment of the steam equipment.



Motor-Driven Pumping Outfit.

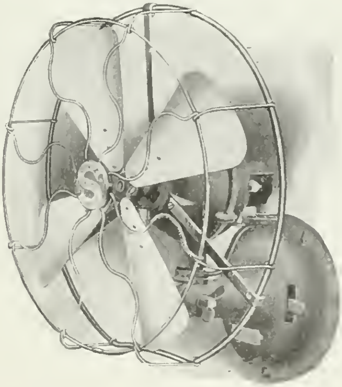
The motor application is a particularly good one. The first point of excellence is the use of a flexible coupling between the pump and the motor, which permits slight inaccuracies in the alignment of the two shafts. Some form of flexible coupling should preferably be used on all installations where the motor is direct-connected to any two-bearing machine. The second point is the excellent concrete foundation provided, even though the pump and motor are mounted on the same cast-iron bed plate.

GENERAL ELECTRIC COMPANY DINNER AT BOSTON.

The annual dinner of the General Electric Company at Boston to central-station representatives was held at the Hotel Somerset on March 24. Mr. Charles B. Davis, manager of the Boston office, presided, and the principal speakers were Mr H. W. Buck, Mr. J. R. McKee and Mr. E. W. Burdett. Mr Buck pointed out the opportunities lying at Boston's door in the line of transmitting hydroelectric energy from the rivers of Maine to Massachusetts. Mr. McKee opposed the granting of limited-power franchises by the government and declared that the best results can be secured by placing public utilities in private hands, under State supervision and regulation. Mr. Burdett discussed the subject of hydroelectric energy from the side of the possible damage that might result industrially from the introduction of such energy, maintaining that in the long run it should result in increased prosperity.

SPRAGUE ELECTRIC FANS.

The Lundell fans built by the Sprague Electric Company, New York City, have enjoyed an enviable reputation because of excellence in design and long service. The line includes desk, bracket, telephone, oscillating, ceiling, column and exhaust fans for standard direct-current circuits, and in addition the Sprague company is offering a line of alternating-current fans covering the entire range of usage. The universal-joint, oscillating fan serves as a typical illustration of the Lundell type, which, as is well known, possesses a single field coil. The fan is illustrated herewith. The worm-gear mechanism, which is entirely inclosed within a dustproof enameled-iron casing, is of generous proportions and possesses no fine gears. This is conducive to durability in the small details and is characteristic of the design of the entire line. The oscillating mechanism is controlled by an indicator knob mounted at the rear of the gear casing and is arranged so that the fan body may be adjusted to any desired fixed position or may be made oscillating at will. The degree of oscillation and the degree of downward pitch of the fan blade is approximately 100 deg. in the oscillating movement and 100 deg. fan-blade pitch downward when the fan is in the bracket form or 25 deg. when in the desk form. By the removal of the gear box at the upper side of the gear casing the commutator is open for inspection.



Universal Fan.

Industrial and Commercial News

THE WEEK IN TRADE.

TRADE reports show very little variation from those of a week ago, or, as a matter of fact, from those of the entire spring. Buying in the central markets is still unsatisfactory, and is strongly marked by that spirit of conservatism which has been the important development in all commercial circles since the business upheaval of 1907. Wholesalers and jobbers report that the demand for goods continues to be for small lots on quick shipment. No heavy lines are being placed by retailers. The late season is held partly responsible for this condition. The majority of the business being done comes from salesmen on the road. House buying is remarkably light and the majority of the buyers who visited the wholesale centers returned home without placing orders. The agricultural situation is satisfactory and, although it is too early in the season for any valuable information as to crops, the outlook is very promising. Reports from the leading industrial centers are negative. The iron and steel mills show no progressive gains and buying for the future is restricted. Railroads are buying little and are visibly retrenching in their repair-shop expenses. Operations are below the level of a year ago and there are at this time four times as many idle cars as at the same period one year ago. It is still estimated, however, that the steel mills are operating at 75 per cent of capacity. There is a slightly improved demand for structural material and wire products continue to be active. Collections continue to be quoted as only fair in spite of the fact that money rates are easy all over the country and the banks are burdened with surplus cash. Business failures for the week ended March 23 as reported by *Bradstreet's* were 235, as compared with 251 the previous week, 231 for like week in 1910, 226 in 1909, 286 in 1908 and 166 in 1907.

THE COPPER MARKET.

ALTHOUGH there is continued evidence of price-cutting in the copper market, the volume of sales has not been large during the past week and there is abundant evidence that the report for the month of March will show a considerable increase in surplus stocks. The exports of copper for the month have not been heavy and it is not likely that for the full month they will exceed 45,000,000 lb. Domestic deliveries have also been moderate and it is doubtful if the total takings for the month will be more than 100,000,000 lb. On the other hand, the rate of production is believed to have increased rather than diminished. The general expectation is that it will amount to between 115,000,000 lb. and 120,000,000 lb. for the month. Under such circumstances there would be a carry over of something like 15,000,000 lb. to be added to the surplus at the beginning of the month, which amounted to 156,637,770 lb. It is evident, however, that the greater part of this accumulation is being carried by the Amalgamated and other large interests affiliated with it. These concerns have held firmly, as is their habit, to the fixed schedule of prices while the independents by shading figures ⅛ cent have been able to secure the bulk of the contracts. Wire-drawers and electrical companies continue to be the principal buyers on domestic account and deliveries are mostly for April and May. Speculation in standard warrants in London has been irregular and every advance has been checked by the hurry of holders to liquidate. Imports of copper continue to be fair but are not up to the averages set last summer. Exports, as stated above, are only moderate and the demand abroad is uncertain. Exports for the month, including March 27, were 17,037 tons. The daily call on the Metal Exchange March 27 quoted standard copper as per accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.70	11.85	....
March	11.70	11.85	11.77½
April	11.70	11.85	11.77½
May	11.70	11.85	11.77½
June	11.70	11.85	11.77½

The London market March 27 was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	54	7	6	54	6	3
Standard copper, futures	55	0	0	54	18	9

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.30c			11.77½c		
London, spot	£56	15	0	£53	15	0
London, futures	57	12	6	54	10	0
Best selected	60	5	0	58	0	0

INDUSTRIAL AND COMMERCIAL NOTES.

Crude-Rubber Market Irregular.—There have been considerable uncertainty and many sharp fluctuations in the crude-rubber market during the past few weeks, which have done much to make uncomfortable the manufacturers of rubber-covered wire. In the closing days of February there was a sudden advance and considerable excitement among the dealers. This was followed toward the middle of the present month by a pronounced decline and this in the past week by another advance. Just at the present writing prices have moderated a bit, and trading is rather light. Speaking of the condition of the market, a representative of one of the largest wire producing concerns in the country said: "The violent fluctuations in the crude-rubber market have created a condition which is decidedly unsatisfactory. We never know how to figure on large contracts, for we have no stable basis for raw material. We cannot afford to lay in large stocks of rubber when it looks low, for prices are as apt to decline as to advance, in which case we should be at a disadvantage with our competitors. Such methods are not business, but speculation. The worst feature of the situation is that the price fluctuations are not the result of the laws of supply and demand, but are the work of manipulators who are gambling in rubber stocks. This makes it totally impossible to forecast the market's future."

New River Power Company.—The New River Power Company, which was incorporated last spring and which was referred to in our issue of June 16, 1910, has now practically completed all arrangements for beginning the construction work. The company proposes to develop five hydroelectric plants on the New River in West Virginia and will develop when completed about 60,000 hp. The first plant that will be undertaken will be the largest of the five and will develop 16,000 hp under a 50-ft. head. The lighting properties at Bluefield, W. Va., have been purchased by the New River company and contracts are about ready for signature taking over similar properties at four other towns. Viele, Blackwell & Buck, consulting engineers at 49 Wall Street, are the engineers of the new company. The Virginia Power Company, which was incorporated two weeks ago to develop hydroelectric properties on the New River, has no connection with the New River Power Company.

Lighting Rates in Toledo.—The question of rates for lighting dwelling houses has been taken up in Toledo, Ohio, by the City Council, which has made a demand for a reduction from 9 cents to 6 cents per kw-hour, with a discount of 1 cent if bills are paid by a certain date. President Albion E. Lang, of the Toledo Railways & Light Company, made the statement to the Council that if dwelling-house business is all that could be got in Toledo it would pay better to shut the lighting plant down. The report made by the Columbus municipal plant as to the cost of producing energy seems to have taken hold of the members of the Council and several conferences have resulted.

Long Acre Electric Light & Power Company.—Hearings were resumed last week by the Public Service Commission of the First District of New York upon the application of the Long Acre Electric Light & Power Company for permission to issue $10,000,000 in stock and $50,000,000 in bonds. Testimony was taken on the validity of the franchise of the American Electric Illuminating Company, under which the Long Acre company proposes to operate. Attorneys for the New York Edison Company contended that the franchise had never been exercised and had, on that account, lapsed many years ago.

Winnipeg Municipal Ownership.—The City Council of Winnipeg, Manitoba, is negotiating for the purchase of the Winnipeg Electric Company, which controls the street railway, electric light, power and gas franchises of that city. When this deal is effected the city will own all of its public utilities.

Colorado Telephone Merger.—Negotiations have been completed for the taking over by the Colorado Telephone Company of the plants and business of five independent telephone companies in Southeastern New Mexico, which now serve a population of 50,000 in the Pecos valley and adjoining territory. The transfer will be made April 1. With improvements to be made by the Colorado Telephone Company in the lines of the newly acquired concerns, the deal represents an investment of $350,000. The companies to be absorbed are the Roswell Telephone & Manufacturing Company, of Roswell; the Chavez County Telephone Company, the Artesia Telephone Company, the Roosevelt County Telephone Company and a long-distance line from Texico to Fort Sumner, N. M., a distance of seventy-five miles. Roswell is now the eastern terminus of the heavy copper circuit of the line from Denver to Albuquerque. The improvements include the building of a heavy copper circuit from Roswell to Texico, to connect at that point with a similar circuit of the Southwestern Telephone & Telegraph Company, the Bell company in Texas, which is building from Amarillo to Texico, and two new copper circuits from Roswell to Artesia, the latter situated in the rich fruit-growing district of the Pecos valley. When the improvements are completed telephone service will be provided for a territory embracing Curry, Roosevelt, Chavez and Eddy Counties, and a part of Guadalupe County. They will mean, also, a second line from Denver to the Panhandle country in Texas, one line now being in operation by way of Las Vegas and Tucumcari.

New Mexican Hydroelectric Plant.—The Cia. Minera de Natividad y Anexas, one of the most active mining properties in the State of Oaxaca, located in the Sierra Juarez district of Mexico, has recently purchased from the Cia. Ingeniera, Importadora y Contratista, S. A., successors of G. & O. Braniff & Co., a new hydroelectric plant of 1000-hp capacity. The mining company already has a power plant which was installed many years ago but which was insufficient to meet the present demand, and the company is now building a canal which will take the waters from the tailrace of the old plant, and by using an available head of about 170 m can develop the 1000 hp. The equipment will comprise two 500-hp Pelton water wheels, which will be direct-coupled to two 375-kw Westinghouse alternators. The power house will also be equipped with two 15-kw exciters, each of sufficient capacity to excite both generators; also a large switchboard for control of the machines and outgoing circuits. The transmission will be in the vicinity of two miles at 2400 volts, three-phase, and the power will be for motors in and about the mine and mill. This plant will be in full operation in a few months.

Extension of Augusta (Ga.) Electrical Properties.—A contract has been placed with J. G. White & Company, New York, for extensions and improvements to the power house and system of the Augusta Railway & Electric Company and the Augusta-Aiken Railway Company, of Augusta, Ga., the estimated cost being approximately $500,000. The power house will be extended for two 2500-kw steam turbines, one of which, with boilers and auxiliaries, will be installed this year. A seven-and-one-half-mile transmission line will be built from the power house in Augusta to the power house of the Augusta-Aiken Railway Company, near Clearwater, S. C., in which a 500-kw motor-generator set will be installed, and also a 300-kw set in the present substation near Aiken. The wires in the City of Augusta will be placed underground on three of the principal streets, involving the laying of about three miles of conduit. Ornamental poles will be installed on the principal street for carrying trolley wires and feeders, and also clusters of tungsten lamps for street lighting.

Hocking Valley Power Project.—J. J. Henry, of Denver, Col., has been in Columbus, Ohio, for the past several days, presenting a plan to business men for the establishment of one or more large central generating stations in the Hocking Valley, where the slack coal may be secured for the steam plant at a very low figure. He believes that such plants would be able to furnish energy to the numerous mines in that section much more economically than it is now being produced at the individual stations and that it can be transmitted for use in the towns near the coal field and furnished to interurban roads now in operation in eastern Ohio. These roads can be reached by transmission lines running direct at a much smaller distance than would at first appear. Mr. Henry even believes that the plants could supply cities as far away as Columbus and that the energy can be transmitted more cheaply than the coal can be hauled to the points of consumption by rail. Mr. Henry has built several plants in the coal fields in Colorado, all of which have been successful.

Otis Elevator Company.—The annual report of the Otis Elevator Company for the year 1910 shows net earnings of $1,157,371, an increase over the previous year of $108,683. After making the customary allowance for depreciation there was a balance left available for dividends amounting to $966,247. During the year the dividend rate on the common stock was increased from 3 per cent to 4 per cent. In his annual report W. D. Baldwin, president of the company, stated that the volume of business done in 1910 was considerably in excess of that done the previous year, and the profits were the largest in the history of the corporation. The outlook for business in 1911 he did not consider as favorable as it was at the same time last year, although quite a number of important contracts were already closed. As a result of the investment made several years ago in Canada, he said that the volume of business in that country was increasing very satisfactorily. The company's plants are now of sufficient capacity in most departments to take care of a much larger business than ever before.

Hydraulic Properties Company.—The Hydraulic Properties Company, of 60 Broadway, New York, of which Lamar Lyndon is chief engineer, has recently made a report for the City of Austin, Tex., upon the practicability of replacing the dam across the Colorado River at that point which was washed out several years ago. This report declares that the rebuilding of the dam and the installation of a hydraulic electrical plant is entirely feasible. The matter is now being considered by the city authorities of Austin. If the dam is constructed on the plans proposed it will establish a reservoir above it of twenty-eight miles in length and will insure a continuous flow of water during the dry seasotn.

Electrical Progress at Portland, Ore.—President Josselyn, of the Portland Railway, Light & Power Company, has announced that within the next two years the company will spent $4,000,000 in electrical development in Portland and vicinity. The expenditure will be largely for new hydroelectric plants and extensions to the present steam plant. President Talbot, of the Pacific Power & Light Company, Portland, has also announced the proposed expenditure of $1,000,000 on hydroelectric plants and transmitting and distributing systems.

Montgomery Light & Water Power Company.—Henry L. Doherty & Company, who operate the Montgomery (Ala.) Light & Water Power Company, have ordered from the General Electric Company one 1000-kw turbo-generator set to be added to the auxiliary steam plant of that company. This apparatus is to be delivered in July. In addition to the generator, a switchboard, exciter and other apparatus have also been ordered, and the company has purchased 600 hp of additional boilers.

Foreign Westinghouse Sales.—The American Smelting & Refining Company has awarded the Westinghouse Electric & Manufacturing Company a contract for nine oil-insulated, self-cooling, 25-cycle, single-phase, 32,000/480-volt transformers. These transformers range in size from 100 kw to 200 kw and will be installed at Santa Eulalia Station, Chihuahua, Mexico. The Hauami Mines of Japan have just ordered eight Westinghouse 550-volt, three-phase, 60-cycle motors, aggregating 510 hp.

Equipment for Municipal Electrical Plants.—The City of Troy, Ala., invites bids, on a cost basis, for machinery, including a 400-hp steam engine; 250-kw, three-phase, 60-cycle, 2300-volt generator; pump of capacity of 500 gal. per minute against 200-lb. working pressure, and three-phase motor for same. Also line material for three-phase line three and one-half miles long, including No. 4 wire. Bids will be submitted to the City Council on April 17.

Westinghouse Turbo-Generator for Chemical Works.—The Westinghouse Machine Company has recently received an order from the Solvay Process Company, of Syracuse, N. Y., for a 750-kw, three-phase, 60-cycle, 480-volt, 3600 r.p.m. turbo-generator, the generator to be furnished by the Westinghouse Electric & Manufacturing Company.

Renny Electric Company Sold.—The Renny Electric Company, of Anderson, Ind., one of the largest magneto ignition manufacturers in the world, was sold during the week to Indianapolis interests; the purchase price was about $2,000,000.

Financial.

THE WEEK IN WALL STREET.

WAITING was again the principal business done in Wall Street last week. The failure of the Supreme Court to return decisions in the trust cases before adjourning for the spring holiday placed the market again in a comatose condition. Professionals are unwilling to take a chance and the public is not in the slightest degree interested. The total sales of last week were only 1,217,499 shares, an amount that in former times was exceeded every day. Only two issues on the list—Union Pacific and Steel common—sold more than one hundred thousand shares. Price changes for the week were insignificant, although the general tone of the market was firm.

NEW YORK.

	Mar. 20.	Mar. 27.	Shares Sold.		Mar. 20.	Mar. 27.	Shares Sold.
All. Ch......	8*	8*	——	Int. Met., pf.	54⅞	53½	9,000
All. Ch., pf..	32½	32½	300	Mackay Cos..	93½*	93½*	——
Amal. Cop...	64⅝	63¾	26,420	Mackay C. pf.	75⅞	76¼	867
Am. D. T....	20½*	20½*	——	Man. Elev...	138⅜*	137*	100
Am. Loco....	39¼	38½	500	Met. St. Ry.	15*	15*	——
Am. Loco. pf.	109¼*	106½*	460	N.Y.&N.J.Tel.	139½*	139½*	——
Am. Tel. & C.	81*	81*	——	Steel, com...	79⅛	78⅞	231,600
Am. T. & T..	146½	147	6,785	Steel, pfd...	118⅞	119¼	4,925
B. R. T....	77¾	78⅝	19,720	W. U. T.....	72¾	73	2,550
Gen. Elec...	149½	148½*	425	West'h, com..	68½	66½	520
Int. Met....	19¾	18¾	2,900	West'h, pfd..	120⅛*	120½*	130

PHILADELPHIA.

	Mar. 20.	Mar. 27.		Mar. 20.	Mar. 27.
Am. Rys...........	44	44	Phila. Elec.........	16¼	16⅛
Elec. Co. of A......	12⅛*	12*	Phila. R. T.........	19¾	19¾
Elec. St. B'ty......	55½	54¼*	Phila. Trac.........	84	84⅛
Elec. S. B'ty., pfd..	30*	30*	Union Trac.........	47¼	47⅜

CHICAGO.

	Mar. 20.	Mar. 27.		Mar. 20.	Mar. 27.
Chi. City Ry.......	185*	185*	Chi. Tel. Co.......	121*	124
Chi. Rs., Ser. 1....	91½*	91½*	Met. El. Co........	23*	23¾
Chi. Rs., Ser. 2....	24*	24¼*	Met. El., pfd.......	69*	69*
Com. Edison........	128	127⅞	Nat'l Car..........	119⅞*	120
Chi. Subways.......	4⅝*	4½	Nat'l Car, pfd......	118½*	120*

BOSTON.

	Mar. 20.	Mar. 27.		Mar. 20.	Mar. 27.
Am. T. & T........	146½	147	Mex. Tel..........	3½	3½*
Cum. Tel..........	150*	150*	Mex. Tel., pfd......	6	6½
Edison E., Ill.......	290*	286	N. E. Tel..........	143¼	144
Gen. Elec..........	149	148¾*	W. T. & T.........	20½*	20*
Mass. E. Ry........	17½*	17½*	W. T. & T., pfd.....	93	93½*
Mass. E. Ry., pfd..	87¼	87½			

*Last price quoted.
Shares sold for week, March 20 to March 25.

Such a condition indicates plainly that Wall Street is still in the firm grip of the powerful money interests which have controlled it so successfully for the past eighteen months and that there is little likelihood of any demoralization or forced liquidation even if adverse decisions are rendered on the trust cases. There has been little news to affect the market in either direction. Early reports from the crops are encouraging, while the earning returns from the railroads are the reverse. The result of the latter has been added announcements of retrenchments in expenses and curtailments in purchases. The larger companies, almost without exception, report decreases in both gross and net for February. On the other hand, the money market is phenomenally easy. There is so little demand upon the banks for either commercial or speculative purposes that money is a drug on the market. Rates March 27 were: Call, 2⅛@2½ per cent; 90 days, 2¾ per cent. The quotations in the table are those of the close March 27.

FINANCIAL NOTES.

Western Electric Company Report.—The full report of the Western Electric Company for 1910 has been made public. The report is for thirteen months, from Nov. 30, 1909, to Dec. 31, 1910, the company having changed its fiscal year to conform to the calendar year. It shows for this period gross income of $68,861,455, as compared with $45,575,000 for the twelve months ended Nov. 30, 1909. Manufacturing costs, expenses, etc., were $63,442,286, interest charges $884,893, and the balance left for dividends, $4,534,276. After paying dividends to the amount of $1,700,000 and carrying to reserve $1,150,000 there was added to the surplus $1,684,276. The total earnings of the $15,000,000 capital stock were equal to 30.2 per cent. In his annual report President Thayer says: "There have been no increases in prices during the year, as might have been justified by increased cost of labor and material. For the thirteen months orders received in America were 896,000, compared with 695,000 in 1909, an increase of 19 per cent, and the value of an order for 1910 was $72 compared with $62 for 1909. Additional buildings authorized during 1909-10 and now in use aggregate 235,000 square feet for floor space. Manufacturing plants have been worked to full capacity during the year. For 1911 additions at Hawthorne have been authorized amounting to $1,000,000. During the year the company sold its Clinton Street and Polk Street properties in Chicago for $3,247,204. These properties were carried on the books at $2,759,971. The profit of $487,252 has been carried to reserves. On Jan. 1, 1911, the number of employees was 23,464 compared with 17,835 Dec. 1, 1909. Total current assets, including sundry investments, less all liabilities except first mortgage bonds, on Jan. 1, 1911, were $42,695,123."

Dividend Rate of Commonwealth Edison.—In explaining the increase of the dividend rate of the Commonwealth Edison Company, of Chicago, as was done by the directors on March 20, and noted in these columns last week, President Samuel Insull said: "The earnings of the company fully justify the increase, which was felt to be desirable in view of the fact that stock issues must provide for so large a proportion (approximately 50 per cent) of the necessary money for the increase of the company's permanent plant to meet the growth and development of its business. Large amounts of money have to be obtained for this purpose from time to time from sales of new stock, and the company believes that a higher rate of dividend than 6 per cent is needed to make its future issues sufficiently attractive. It is expected that the next issue of stock will be made in November next and will be about 10 per cent or 15 per cent of the present issued capital, which is $33,000,000."

Portland Railway, Light & Power Company.—The annual report for 1910 of the Portland (Ore.) Railway, Light & Power Company shows gross earnings of $5,638,895, an increase over the previous year of $820,873. The increase in net was $573,191. During the year the company added to its traction department equipment to the amount of $642,663. There was also spent for transformers, meters, street service, etc., in the light and power department $333,890. The report states that the generating capacity in steam and water-power stations Dec. 31, 1910, was 45,853 hp, an increase of 9045. A new steam station with an ultimate capacity of 8000 kw was erected, and one 2000-kw unit was put in operation. The connected light and power load at the end of the year was 47,517 kw, an increase of 19.9 per cent over the previous year, and the number of light and power customers was 26,413, an increase of 5910.

Denver Gas & Electric Company.—An issue of $2,500,000 in three-year notes, bearing 6 per cent interest, has been authorized by the directors of the Denver Gas & Electric Company. The proceeds will be used to make extensions and improvements of the company's property amounting to $500,000; to retire $1,000,000 of one-year notes due Sept. 6, 1911, and to pay off $936,600 in bonds of the Denver Consolidated Gas Company, issued twenty years ago. The most important improvements to be made will be the enlargement of the Denver steam-heating plant at Nineteenth and Hartford Streets, purchased by the company from Henry M. Porter last year. The improvements will include also extension of gas mains and electric light facilities to the new suburban districts opened up in the last year.

Opposition to Telephone Merger.—It is announced in Rochester that a large number of the stockholders of the Rochester Telephone Company, which is allied with the Independent lines, are opposed to the sale of the property to the Bell interests, and it is predicted that they will be able to prevent the merger which was referred to in our last issue. It will be remembered that the Friendship Telephone Company, representing the New York Telephone Company, had arranged to buy sufficient Independent lines to connect Rochester and Syracuse. The opposition is relying upon the Buffalo Consolidated Telephone Company, an Independent concern, which owns about 1700 shares in the Rochester company. These shares, it is expected, will be voted against the consolidation.

Illinois Traction System.—Mackay & Company, bankers, of New York, are offering a limited amount of the 6 per cent cumulative preferred stock of the Illinois Traction System at 93 and interest. This company, with headquarters at Champaign, owns and operates twelve interurban railroad properties in eleven cities of Illinois, and electric light and power properties in five cities.

Gerber Water & Light Company.—The Gerber Water & Light Company has been incorporated in California with a capital of $50,000. The company proposes to construct water and light plants for the proposed town of Gerber, nine miles south of Red Bluff, Cal. The principal place of business of the company is given as Sacramento. Edward H. Gerber is president.

Electric Storage Battery Company.—The annual report for 1910 of the Electric Storage Battery Company shows that, after paying all fixed charges and expenses, the company earned a surplus available for dividends of $1,120,012, which is equivalent to 6.9 per cent on the outstanding common and preferred stock. This compares with a surplus in 1909 of $933,492, or 5.8 per cent. After paying 4 per cent on both issues of stock there was a net surplus remaining of $470,048. The report shows that at the end of the year the company had a working capital of $2,576,630. It is considered that the prospects of the company with this large capital are much brighter, in view of the growing use of storage batteries. During the year 1910 the company acquired all the patent rights of the Westinghouse Storage Battery Company, including ownership of the rights of the General Storage Battery Company and the storage-battery interests and patents of the Westinghouse Machine Company. The company now has the sole right to manufacture Westinghouse batteries. It is also stated in the report that during the year 1910 the company perfected a new vehicle battery having greatly increased storage capacity, which has recently been put upon the market.

La Crosse Water Power Company.—W. J. Ferris, president of the La Crosse (Wis.) Water Power Company, has written a circular letter addressed to the bondholders of the company stating that the interest on the bonds due April 1 would be passed and that the company would be compelled to avail itself of the six months' grace allowed by the deed of trust. In explaining this inability to meet its interest Mr. Ferris says that the prime cause is the abnormal drought which prevailed throughout that section of Wisconsin during 1910, there being only about one-half the normal rainfall. This compelled the company greatly to reduce its output of power and to make continuous use of its steam auxiliary plants. The added cost to the operation of the company was $92,000.

American Automatic Telephone Company.—Certain creditors of the American Automatic Telephone Company, of Urbana, Ohio, have filed a petition asking for a receiver. It is said that the business has been at a standstill for several months. The company has outstanding $328,250 preferred stock and $1,750,000 common stock. The assets are said to be valued at $142,653, while the liabilities are placed at $192,006. James S. Brailey, president of the company, and some of the stockholders claim to hold $33,670 of the company's bonds as security for money advanced. Recently a Chicago company claimed infringement of patent and filed suit against the company.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Denver, Col.; Omaha, Neb.; Hamburg, Pa.; Ishpeming, Mich.; Petersburg, Tenn.; Newport, Tenn.; Charlestown, Ind.; Waurika, Okla.; Newton, Miss.; South Norwalk, Conn.; Magog, Que., Can.; Toronto, Ont., Can.; Waynoka, Okla.; Minneapolis, Minn.; Sedan, Kan.; Newberry, S. C.; Washington, D. C.; Troy, Ala.; Chappell, Neb.; El Reno, Okla.; Basin, Wyo.; Gunnison, Col., and Hamilton, Ont., Can.

Kings County Electric Light & Power Company.—Reports of the Kings County Electric Light & Power Company for January and February show that they are the best two months at the beginning of any year in the company's history. From Jan. 1 to March 1 the gross earnings increased $107,445, or 14.67 per cent over the same period the previous year. The improvements over 1910 were about equally divided between the two months, and are attributed by the officials largely to the active campaign which has been made for new business.

Electric Boat Company.—After a meeting of the board of directors of the Electric Boat Company last week it was announced that the matter of resuming dividends had not been considered. It was stated, however, that the current business of the company is showing great improvement, the volume of orders on the books being considerably in excess of that of the same period last year. The outlook for the current year was considered very promising.

Wisconsin Telephone Merger.—The Wisconsin Telephone Company has taken over the Citizens' Telephone Company, an independent organization, of Racine. The entire system of the smaller concern was purchased, and the two plants will be consolidated. Duplicate telephones will be removed, and all service will be handled at one exchange. The two companies had 3000 subscribers each, and there were about 800 duplicates. The new exchange will have over 5000 subscribers.

Washington, Baltimore & Annapolis Property Sold.—The Washington, Baltimore & Annapolis Electric Railway was sold last week under a decree of foreclosure issued by the United States Court to satisfy the first mortgage for $3,000,000, and the second mortgage for $1,000,000. George A. Craig, of Toledo, Ohio, representing the reorganization committee, was the only bidder. His bid was $2,501,000, and upon its acceptance he deposited a certified check for $100,000.

DIVIDENDS.

American Gas & Electric Company, quarterly, 1½ per cent, payable April 1.

American Locomotive Company, quarterly, preferred, 1¾ per cent, payable April 21.

American Power & Light Company, quarterly, preferred, 1½ per cent, payable April 3.

Bell Telephone Company of Canada, quarterly, 2 per cent, payable April 15.

Bell Telephone Company of Missouri, 1 per cent, payable April 1.

Edison Electric Illuminating Company of Boston, quarterly, 3 per cent, payable May 1.

Electric Storage Battery Company, quarterly, 1 per cent, both common and preferred, payable April 1.

Kansas Gas & Electric Company, Wichita, quarterly, preferred, 1¾ per cent, payable April 1.

Metropolitan Elevated Railroad Company, quarterly, 2 per cent, payable April 18.

Mexican Telegraph Company, quarterly, 2½ per cent, payable April 14.

Minneapolis General Electric Company, quarterly, 1¾ per cent, payable May 1.

National Carbon Company, quarterly, common, 1½ per cent, payable April 15.

New Orleans Railway & Light Company, quarterly, preferred, 1¼ per cent, payable April 10.

Ottawa Light & Power Company, quarterly, 1¾ per cent, payable April 1.

Philadelphia Company, quarterly, 1½ per cent, payable May 1.

Quebec Railway, Light, Heat & Power Company, initial common, 1 per cent, payable April 15.

Shawinigan Water & Power Company, quarterly, 1¼ per cent, payable April 1.

Toronto Electric Light Company, quarterly, 2 per cent, payable April 1.

Westinghouse Electric & Manufacturing Company, quarterly, preferred, 1¾ per cent, payable April 15.

REPORTS OF EARNINGS.

Period.		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
AMERICAN TELEPHONE & TELEGRAPH COMPANY.						
Year,	1910	$35,358,328	$3,425,114	$31,933,214	$5,077,321	$26,855,803
"	1909	32,761,341	2,570,575	30,190,765	7,095,377	23,095,388
CENTRAL & SOUTH AMERICAN TELEGRAPH COMPANY.						
Year,	1910	$1,755,166	$676,720	$1,078,446	......	$480,682
"	1909	1,665,029	667,983	997,046	......	404,447
CUMBERLAND TELEPHONE & TELEGRAPH COMPANY						
Feb.,	1911	$576,034	$339,425	$236,609	$51,901	$184,708
"	1910	542,358	315,102	227,256	47,199	180,057
INTERNATIONAL RAILWAY COMPANY (BUFFALO).						
Qr., Dec.	'10	$1,224,665	$699,126	$425,914	$208,867	$244,047
"	1909	1,158,196	678,535	421,307	206,[illegible]42	215,265
MEXICAN TELEGRAPH COMPANY.						
Year,	1910	$939,109	$165,621	$773,488	......	$720,882
"	1909	848,597	170,327	678,270	......	575,136
MISSOURI & KANSAS TELEPHONE COMPANY.						
Year,	1910	$3,182,397	$2,501,155	$681,242	$681,242	......
"	1909	2,859,161	2,357,208	501,953	817,201	*$315,248
NEW ORLEANS RAILWAY & LIGHT COMPANY.						
Feb.,	1911	$559,812	$334,607	$225,205	$133,723	$92,277
"	1910	521,184	315,805	205,379	135,585	73,290
PORTLAND (ORE.) RAILWAY, LIGHT & POWER COMPANY						
Year,	1910	$5,638,895	$2,444,178	$3,194,717	$1,678,228	$1,516,489
"	1909	4,818,022	2,196,496	2,621,526	1,493,[illegible]39	1,128,486
WESTERN ELECTRIC COMPANY.						
13m., Dec.	'10	$68,861,455	$63,442,286	$5,419,169	$884,893	$4,534,276
Yr., Nov.	30	45,575,000	43,206,000	2,369,000	280,[illegible]0	2,089,000
WEST PENN TRACTION COMPANY.						
Year,	1910	$2,107,002	$987,642	$1,119,360	......	......
"	1909	1,767,915	981,340	786,575	......	......

*Deficit.

General News

Construction News.

ALBERTVILLE, ALA.—The City Council has awarded the contract for the installation of an electric light plant to the J. B. McCrary Company, of Atlanta, Ga. An 80-hp engine has been ordered. The distributing system will require more than six miles of wire.

BESSEMER, ALA.—The Coosa River Electric Light Company has applied to the City Council for a franchise to supply electricity in Bessemer.

GADSDEN, ALA.—Surveys are now being made in connection with the Little River Falls power project. The falls are located about thirty miles from Gadsden. It is proposed to develop the water power of the falls to generate electricity which will be transmitted to Gadsden and used for industrial purposes, etc. Col. H. R. Mitchell is at the head of the enterprise.

TROY, ALA.—Bids will be received by A. B. Campbell, superintendent, for the following machinery and equipment: One stationary 400-hp steam engine, one 250-kva, three-phase, 60-cycle, 2300-volt generator, one pump having a capacity of 500 gal. per minute against a working pressure of 200 lb., one motor, 60-cycle, three-phase, to drive above pump; material for three-phase transmission line, three and one-half miles in length, No. 4 B. & S. wire.

PHOENIX, ARIZ.—The Phoenix Railway Company has awarded the contract for the construction of its new substation at Orangewood to the New State Electric Supply & Fixture Company. A 100-kw generating unit will be installed.

PHOENIX, ARIZ.—The contract for the electrical equipment for the electric plant to be built at the South and Consolidated Canals of the Salt River Valley Water Users' Association has been awarded to the General Electric Company, of Schenectady, N. Y., for $30,000. S. Morgan Smith Company, of York, Pa., was awarded the contract for hydraulic turbines for $16,590. Charles A. Van Der Veer is secretary of the association.

HELENA, ARK.—Plans are being made by the Helena Street & Interurban Railroad Company for the construction of an extension of its railway system to the southern end of Helena.

HELENA, ARK.—The plant and holdings of the Helena Gas Company have been purchased by Newberger, Henderson & Loeb and John Gribbel, all of Philadelphia, Pa. Work will begin immediately on the construction of a new power house for the electric plant. The gas plant will not be rebuilt for about two years. The Schofield Engineering Company, of Philadelphia, Pa., will have charge of the engineering work. W. J. O'Brien is manager of the Helena Gas & Electric Company.

SCRANTON, ARK.—It is reported that A. P. Kincaide, of Paris, Ark., is contemplating the installation of an electric light plant in Scranton. It is understood that Mr. Kincaide will soon apply to the Town Council for a franchise for same.

BENICIA, CAL.—Sealed proposals will be received at the Benicia Arsenal, Benicia, Cal., until May 1 for furnishing during the fiscal year ending June 30 electrical supplies, bar iron, hardware, etc. For further information apply to Lieutenant-Colonel J. W. Benet, commanding officer.

BERKELEY, CAL.—The Southern Pacific Company, it is understood, will soon award the contract for the construction of its new substation in Berkeley.

CONCORD, CAL.—The Great Western Power Company has applied to the Board of Trustees for a franchise to erect transmission lines for the distribution of electricity in the town of Concord. Bids for the above franchise will be received by the Board of Trustees until May 8.

ESCONDIDO, CAL.—The City Trustees have authorized W. H. Baldridge, president, and Henry Nulton, city clerk, to enter into a contract with the Escondido Utilities Company for lighting the streets of the city for a term of five years. The contract calls for the installation of fifty lamps. The business men are considering the question of installing cluster lamps on Grand Avenue.

FERNDALE, CAL.—Preliminary steps have been taken with a view of constructing an electric railway to connect Ferndale and vicinity with other parts of the county. D. A. Francis, of Ferndale, is interested in the project.

LONG BEACH, CAL.—The City Council has granted a franchise to H. C. Pike for the construction of a scenic electric railway on Pike Street, work on which will begin in the near future. The cost of the proposed railway is estimated at about $80,000.

LOS ANGELES, CAL.—A committee composed of T. B. Comstock, engineer, Board of Public Utilities; E. F. Scattergood, chief engineer of Electrical Bureau of Owens River Aqueduct, and W. E. Corey, electrical engineer, of San Francisco, Cal., has submitted a report to the Board of Police Commissioners, and has recommended the installation of police and fire-alarm systems, to cost $102,500, as follows: For central office equipment, $22,500; 150 additional fire-alarm boxes, $12,000; underground cables to replace leased ones, $13,275; 150 additional police boxes, $12,000; 240 red lights for police signals, $6,000, and 267 miles of overhead wire extensions.

MARYSVILLE, CAL.—The Natomas Consolidated Company of California is reported to have placed orders with the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for 1000 hp in motors, which will be used in operating a gold dredge.

PORTERSVILLE, CAL.—The Holley Electric Railway Company has purchased a site in Strathmore upon which it proposes to erect a power house to be the main distributing station for electricity transmitted from Portersville for the Holley system.

SACRAMENTO, CAL.—It is reported that another electric power company promoted by New York capitalists is being formed to operate in Northern California. It is understood that the proposed company is planning extensive developments on the middle fork of the Feather River, which will include the erection of a series of power plants, having a total output of 85,000 hp. Preliminary surveys will soon be made for the proposed work. The new company proposes to supply electricity to all towns in the Sacramento Valley and transmission lines will be erected through the rich farming districts to supply power to operate the pumps for irrigation purposes.

SAN BERNARDINO, CAL.—The Lytle Creek Power Company is reported to have submitted a proposition to the City Council offering to sell its system to the city for the establishment of a municipal electric light plant. The company has the contract for lighting the city.

SAN FRANCISCO, CAL.—Preliminary surveys are being made by the Owens River Valley Electric Railway Company between Bishop and Laws for its proposed electric railway through the Owens River Valley.

DENVER, COL.—The Colorado Telephone Company has acquired complete control of all independent telephone companies in the Pecos Valley, N. M. The deal involved an expenditure of $350,000, and includes the following companies: The Roswell Telephone & Manufacturing Company, the Chaves County Telephone Company, the Artesia Telephone Company and the Roosevelt County Telephone Company. The Colorado Telephone Company will begin work immediately on the erection of two copper circuits from Roswell to Artesia and from Roswell to Texico.

GREELEY, COL.—It is understood that the plant of the Home Electric Light & Power Company will be used to supply electricity to operate the pumps for irrigating about 10,000 acres in the Grover district. This plant has been idle since the Home company has secured energy from the high-tension transmission system of the Northern Colorado Power Company to operate its system.

GUNNISON, COL.—Plans and specifications have been prepared for improvements to the water-works system and electric-light plant, including a 215-hp water-power development on the Gunnison River, which will involve an expenditure of about $90,000. Bids for the above work will be asked for in May. Burns & McDonnell, Scarritt Building, Kansas City, Mo., are consulting engineers.

LONGMONT, COL.—The question of municipal ownership and operation of an electric light and power plant is reported to be under consideration.

BRIDGEPORT, CONN.—The Aetna Construction Company, of New Haven, Conn., has been awarded the contract for the construction of the proposed new electric railway between Bridgeport and Danbury, work on which will begin at once. Rails, ties and copper wire have already been purchased.

ESSEX, CONN.—The Essex Light & Power Company has contracted with the Shore Line Electric Railway Company for energy. The Essex Light & Power Company proposes to supply electricity for lamps and motors in Chester, Deep River, Essex, Saybrook, Westbrook and Clinton, and is now receiving applications for service in order to prepare plans for erecting its distributing system. The company now operates an acetylene gas plant.

SOUTHINGTON, CONN.—Negotiations have been completed whereby Clark Brothers have leased the electric power plant which supplied electricity to operate the Meriden, Southington & Compounce Electric Railway Company before energy was secured from the plant of the New Milford Power Company, located at Bulls Bridge. The plant has an output of 500 hp and will be able to supply sufficient power to operate both plants of Clark Brothers, which heretofore have been operated by steam power.

SOUTH NORWALK, CONN.—Plans are being considered by the Housatonic Power Company for building an addition to its power house in South Norwalk, 50 ft. x 50 ft. Alterations will also be made in the interior of the present power house. Engineers of the New York, New Haven & Hartford Railroad Company, of which Edward Gagel, of New Haven, is chief, will have charge of the work.

CLAYTON, DEL.—A bill has been passed by the State Legislature authorizing the City of Delaware to call an election to vote on the proposition to issue $40,000 in bonds for the construction of a municipal lighting plant.

WASHINGTON, D. C.—Bids will be received at the office of the

Chief Signal Officer, Washington, D. C., until April 16 for furnishing under proposal No. 514 170 miles of single-conductor intermediate cable No. 65, specification No. 520-A, to be made in two lengths of 57 miles each and one length of 56 miles. Captain A. S. Cowan is disbursing officer.

WASHINGTON, D. C.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 29 for furnishing turbo-alternators and electrical equipment for the United States Naval Station at Pearl Harbor, Hawaii. Plans and specifications can be obtained on application to the above bureau or to the commandant of the navy yard named. R. C. Hollyday is chief of bureau.

FORT MEADE, FLA.—D. O. Rogers, of Wauchula, Fla., is reported to be promoting the organization of a company to construct and operate an electric light, heat and power plant. The company will be capitalized at $50,000.

SOUTH JACKSONVILLE, FLA.—At an election to be held April 6 the proposition to issue $60,000 in bonds, the proceeds to be used for construction of an electric light plant and sewerage system, will be submitted to a vote.

AUGUSTA, GA.—Arrangements have been made by the Augusta Railway & Electric Company and the Augusta-Aiken Railway Company, of Augusta, Ga., for extensions and improvements to their power houses, to cost about $500,000, including the installation of two 2500-kw steam turbines, one of which with necessary boilers and auxiliaries will be installed this year, and the erection of a seven and one-half mile transmission line from the power house in Augusta to the power house of the Augusta-Aiken Railway Company, near Clearwater. A 500-kw motor-generator set will be installed at this point and a 300-kw motor-generator set will be added to the equipment of the present substation near Aiken. Arrangements have been made with the City of Augusta whereby wires will be placed underground in three principal streets, involving the installation of about three miles of underground conduits. In connection with this underground work the company will erect ornamental poles on Broad Street, Augusta, to carry its trolley wires and feeders and also clusters of tungsten lamps for street lighting. An extension of about one mile of single track will be made and plans have been made for the reconstruction of present tracks. J. G. White & Co., engineers and contractors, 43 Exchange Place, New York, N. Y, have the contract for the proposed work.

COLQUITT, GA.—The citizens on March 13 voted to issue bonds to the amount of $22,000, the proceeds to be used for the installation of an electric light plant, extension of water-works system and erection of school building.

GAINESVILLE, GA.—The North Georgia Power Company has awarded the contract for the construction of a dam across the Tullalah River at Tullalah Falls to B. H. Hardaway, of Columbus, Ga. The dam will be 110 ft. high and will develop 90,000 hp. The power house will be located about one mile from the dam, to which the water will be conveyed by means of a tunnel, securing a head of 600 ft. C. Elmer Smith, of York, Pa., is president.

GRIFFIN, GA.—The Light, Water and Sewerage Commissioners have closed a contract with the Central Georgia Power Company, under which the company will furnish electricity to operate the municipal electric system. It is estimated that the city can save from $3,000 to $5,000 annually by purchasing power. The municipal generating plant will be closed down.

OGLETHORPE, GA.—The proposition to issue $18,000 in bonds, the proceeds to be used for the construction of an electric light plant and water-works system will be submitted to the voters at an election to be held April 12.

PELHAM, GA.—At an election held March 18 the citizens voted to issue $25,000 in bonds, the proceeds to be used for improvements to the municipal electric light plant and water-works system and other improvements.

SWAINSBORO, GA.—The City Council has called an election to be held April 17 for the purpose of voting on the proposition of issuing bonds to the amount of $40,000, the proceeds to be used for installation of an electric-light plant and water-works system.

ALTON, ILL.—The Alton Gas & Electric Company has increased its capital stock from $500,000 to $600,000.

CHICAGO, ILL.—The West Chicago Park Commissioners have awarded the contract for furnishing and installing electric cables and connecting cables with electric substation in Garfield Park to the Safety Insulated Wire & Cable Company, to cost about $11,898.

DESPLAINES, ILL.—The capital stock of the Desplaines Telephone Company has been increased from $20,000 to $30,000.

WASHINGTON, ILL.—It is understood that the plant of the Washington Light & Power Company, which was recently destroyed by fire, will be rebuilt. The loss is estimated at about $15,000. R. M. Howard is president and manager of the company.

BRAZIL, IND.—The City Council is reported to have taken steps toward the construction of a municipal electric light plant in Brazil. The present plan calls for the installation of two generators and necessary equipment at the water-works plant. Frank Hattman is city engineer.

CHARLESTOWN, IND.—It is reported that the Louisville & Northern Railway & Lighting Company is planning to make improvements to its power plant in Charlestown, including the installation of a new engine and other apparatus.

FORT WAYNE, IND.—Various departments of the Bass Foundry & Machine Works are being equipped for electrical operation. Electricity for operating the plant will be generated at the company's own plant.

FORT WAYNE, IND.—The capital stock of the Home Telephone & Telegraph Company has been increased from $10,000 to $25,000.

HENRYVILLE, IND.—The Home Telephone Company, recently incorporated, is reported to be in the market for material and equipment for a telephone system.

HOBART, IND.—The Town Board has granted a fifty-year franchise to U. P. Hord and others, who are organizing a company to build an interurban railway between Hobart and Gary.

INDIANAPOLIS, IND.—A company is being organized under the name of the Indianapolis & Seymour Traction Company to build an electric railway between Indianapolis and Seymour. M. L. Clawson, of Indianapolis; J. B. Dill, A. G. Kelly and W. T. Todd, of Greenwood, Ind., are interested in the project.

MISHAWAKA, IND.—The Central Union Telephone Company is contemplating extensive improvements to its local system, which will involve an expenditure of about $32,000.

RICHMOND, IND.—Plans are being considered by the South Bend, Richmond & Southeastern Traction Company for the construction of an electric railway to connect Richmond, Liberty, Union City, Brownsville, Brookville and Harrison. F. C. Charles, Charles W. Jordan, A. Jenkins, A. H. Bartel, B. B. Johnson and Paul Comstock are interested in the project.

RICHMOND, IND.—The City Council is asking for bids for the installation of two new engines and other machinery and equipment for the municipal electric light plant.

SHOALS, IND.—The Southern Indiana Power Company, a consolidation of the Bedford Power Company and the Shoals Power Company, has filed a mortgage with the recorder for $800,000. The company is erecting a dam and power plant at Williams on White River and is preparing to build a similar plant at Shoals.

DES MOINES, IA.—It is reported that the plant and holdings of the Des Moines City Railway Company has been purchased by N. W. Harris & Company, which already owns 52 per cent of the stock. It is understood that improvements will be made at once to the system.

ROLAND, IA.—The City Council has called a special election to be held April 10 to vote on the proposition to issue $18,000 in bonds, the proceeds to be used for the construction of an electric-light plant and water-works system in Roland.

SIOUX CITY, IA.—The City Council is reported to be considering the question of erecting an electric power plant near the pumping station on Main Street at a cost of about $27,000.

WEBSTER CITY, IA.—The contract for constructing power house for electric plant has been awarded to C. E. Atkinson, of Webster City, Ia., for $9,897.

MEADE, KAN.—The Meade Light & Power Company has submitted a proposition to the Council offering to furnish sixty street lamps for $30 per month.

MULBERRY, KAN.—It is stated that the proposition to issue $8,000 in bonds, the proceeds to be used for the installation of an electric light plant, will soon be submited to a vote.

SEDAN, KAN.—Plans are being made for the construction of an electric light plant by the Sedan Ice, Light & Power Company, to cost about $20,000, bids for construction of which will probably be called for about May 1. N. B. Wall, of Caney, Kan., is engineer in charge. C. D. Inglefield is promoter of the project.

PAINTSVILLE, KY.—The Paintsville Water & Light Company, recently incorporated to operate an electric light plant in Paintsville, it is understood, will purchase electricity to operate its system. The company is capitalized at $20,000. John G. Smith is president.

BANGOR, MAINE.—The Northern Aroostook Electric Company, recently granted a charter, has been organized with a capital stock of $50,000, and the following officers: Earlon K. Gould, president; Walter B. Gould, treasurer, and Herbert T. Powers, clerk. The company proposes to develop and transmit electricity for lamps, heat and motors in and through Fort Fairfield, Limestone, Caswell Plantation, Cyr Plantation and Van Buren in Aroostook County.

DEXTER, MAINE.—The Dumbarton woolen mill is being equipped for electric motor drive. Electricity for operating the mill will be supplied by the Dexter Electric Company.

PORTLAND, MAINE.—A company has been organized to build an electric railway on Peaks Island. The officers are: Edgar E. Rounds, president; Arthur Moulton, treasurer, and W. C. Wheldon, clerk.

ROCKLAND, MAINE.—It is reported that the R. & T. Cement Railway Company is planning to build an electric railway near Rockland to be used by the New England Portland Cement Company to connect its quarries and works with the water front. The proposed railway will be from three to five miles in length. It is understood that surveys have been made for the proposed railway. Alfred S. Black and Edward B. McAllister, of Rockland, Maine, are interested in the project.

BALTIMORE, MD.—The Electrical Commission has submitted specifications to the Board of Contract calling for 1,000,000 ft. of duct vitrified tile conduit pipe, and 200,000 ft of special duct pipe.

COCKEYSVILLE, MD.—The Public Service Commission has approved the plans of the Towson & Cockeysville Electric Railway Company to build an electric railway from Towson to Cockeysville. J. Alexis Shriver is president of the company, and James S. Nussear secretary and treasurer.

BOSTON, MASS.—The Walworth Manufacturing Company has entered into a five-year contract with the Edison Electric Illuminating Company of Boston to supply electricity for lamps and motors for its plant located on East First Street and extending along the water front to the boulevard in South Boston. The contract calls for 1000 hp. The works are now operated by five steam plants, having a total capacity of 1100 hp. In the plant there are twelve elevators, which will be remodeled for electrical operation. The company also has an electric power plant generating electricity for lamps for its works, which will be closed down.

CHESTERFIELD, MASS.—It is reported that preparations are being made for the erection of an electric power plant on the Westfield River in Chesterfield. E. E. Davis, engineer, of Northampton, Mass., is understood to be interested in the project.

DANVERS, MASS.—Governor Foss has signed the bill authorizing the Electric Light Commissioners to supply electricity generated at the municipal electric plant to the Middletown Electric Company and to purchase a piece of land opposite the power station, which contains a pond, which it is proposed to use for steam condensation purposes.

NORTH ATTLEBORO, MASS.—A petition has been presented to the Selectmen asking that the electric lighting system be extended to Holmes' neighborhood. The extension asked for would require the erection of about four miles of wire.

PITTSFIELD, MASS.—The General Electric Company has awarded the contract for conduit work of the power plant at the Stanley Works to Rivers & Young, of Holyoke, Mass., to cost approximately $25,000.

ROCKLAND, MASS.—A committee has been appointed to make investigations in connection with the establishment of a municipal electric light plant in Rockland.

ELSIE, MICH.—It is reported that bonds to the amount of $5,000 have been voted for the purpose of installing a lighting system in this village.

HASTINGS, MICH.—At an election to be held in April the proposition to issue bonds to the amount of $120,000, the proceeds to be used to establish a water-power plant to supply power to operate municipal electric light plant and pumping station, will be submitted to a vote.

ISHPEMING, MICH.—The Cleveland Cliffs Iron Company, it is stated, is making preparations to construct a power plant near Eagle Mills, Mich., on the Carp River, to cost about $100,000. Electricity generated at the plant will be used for its mining properties and the Pioneer furnace.

KALAMAZOO, MICH.—At an election to be held April 3 the proposition to issue $55,000 in bonds, the proceeds to be used for a new municipal electric plant, will be submitted to a vote. C. L. Miller is city clerk.

INTERNATIONAL FALLS, MINN.—Arrangements are being made by the Minnesota & Ontario Power Company for the construction of a dam at Kettle Falls, in order to reserve the waters of Namakan Lake.

MINNEAPOLIS, MINN.—A bill appropriating $12,000 for a new heating and lighting plant for the women's building at the Soldiers' Home at Minnehaha Falls has been introduced into the State Legislature

MINNEAPOLIS, MINN.—Proposals will be received by the City Council, March 31, for substituting an alternating-current generator for the present direct-current generator in use at the city crematory, in accordance with specifications on file in the office of the Department of Health. Henry N. Knott is city clerk.

ST. CLOUD, MINN.—The Public Service Company is reported to be contemplating building an addition to its power plant 27 ft. x 38 ft. and the installation of a 600-kw generator and 750-hp water wheel.

ST. PAUL, MINN.—The Legislature has passed a bill giving the City of St. Paul authority to contract with private companies for street lighting for periods of two years.

STARBUCK, MINN.—The Starbuck Milling Company has placed a contract with the Minneapolis Steel & Machinery Company for a complete power plant equipment, including a 75-hp Corliss engine and a 100-hp heater.

NEWTON, MISS.—It is stated that bids will be received until April 4 by the City of Newton for materials and machinery for the construction of an electric light plant, for which bonds to the amount of $11,000 were recently voted.

FRISTOE, MO.—The construction of an electric railway from Warsaw to Springfield via Cross Timbers is under consideration. E. E. Trippe, of Fristoe, has been elected president of a club formed for the purpose of building the proposed railway. B. Orlando Taylor, of Bosworth, is also interested in the project.

ST. LOUIS, MO.—The Missouri Lamp & Manufacturing Company, which is adding another story to its factory building, it is said, will install an electric elevator.

BIG FORK, MONT.—The business men of Big Fork and Columbia Falls have subscribed $100,000 toward the construction of an electric railway on the Flathead reservation, fifty-five miles in length.

CHESTER, MONT.—The citizens at an election held recently voted to grant a franchise to L. D. Pugleys to construct and operate an electric light plant and water-works system in Chester. The cost of the proposed plants is estimated at $40,000 and under the terms of the franchise they are to be ready for operation by Nov. 1, 1912.

SHELBY, MONT.—At an election to be held in April the proposition to issue $35,000 in bonds, the proceeds to be used for the installation of an electric light plant, will be submitted to the voters.

ALLIANCE, NEB.—The Alliance Electric Company has sold its property to the City of Alliance. The electric plant will be owned and operated by the municipality. It is reported that $73,000 in bonds has been voted to establish a municipal plant.

CHAPPELL, NEB.—Preparations are being made for the construction of a municipal electric-light plant and water-works system in Chappell, bids for which will be received until April 8. The cost of the work is estimated at $12,950. W. E. Downer, of Grand Island, Neb., is engineer in charge.

OMAHA, NEB.—The County Commissioners have rejected the proposition submitted by the Omaha Electric Light & Power Company to supply electricity to light the county building, and has decided to install an electric plant at a cost of $14,000, unless the company makes a better offer. The county now pays 6 cents per kw-hour for the service. The company offers to continue the service for 6 cents per kw-hour for the first 2000 kw used each month, and 3 cents per kw-hour for all consumed above that amount.

WYMORE, NEB.—The City Council is reported to have awarded the contract for erecting the transmission line from the power house to the wells to Frank Wheelock, of Havelock, and for engines to the St. Mary's Machine Company.

CALDWELL, N. J.—The West Caldwell Borough Council has awarded a contract to the Public Service Corporation of New Jersey for street lighting for a period of three years, under which the company is to furnish eighty lamps.

HOBOKEN, N. J.—Bids will be received by the Board of Education at School No. 4, Park Avenue, near Sixth Street, Hoboken, N. J., until April 3, for furnishing all gas and electric fixtures and slate blackboards for the high school building. Plans and specifications may be seen at the office of the board. William A. Kerr is secretary.

KEANSBURG, N. J.—Plans are being prepared for the construction of an electric railway in Keansburg this summer to extend from the railroad station to the beach. It is expected that the proposed railway will be extended along the shore road to the Port Monmouth steamboat dock and the Bedford station. Judge W. W. Ramsey, William Gehihaus and Richard Carr are interested in the project.

MILLVILLE, N. J.—Surveys are being made by the Millville, Tuckahoe & Ocean City Electric Transportation Company for its proposed electric railway between Millville and Ocean City. E. W. Rush is interested in the project.

OCEAN CITY, N. J.—Plans have been prepared by the Ocean City Electric Railway Company for the construction of an electric railway from Thirty-fourth Street to Beesley's Point in Ocean City.

AUBURN, N. Y.—Bids will be received by Thomas H. O'Neill, Mayor, until April 4, for the construction of subways with necessary appurtenances and appliances in East Genesee Street, from Owasco Street to Hunter Avenue, and will include approximately 67,200 duct ft. of 16-duct tile, 25,800 duct ft. of 12-duct tile, 19,700 linear ft. of straight iron-pipe laterals, 190 iron-pipe bends and 23 double manholes, including sewer connections. Plans, specifications and additional information can be obtained from Elbert C. Aldrich, city engineer. A deposit of $10 will be required for plans and specifications. J. S. Hanlon is city clerk.

BUFFALO, N. Y.—A bill is before the State Legislature asking authority for the City of Buffalo to issue bonds to the amount of $250,000, the proceeds to be used to establish a municipal electric light plant at the water-works pumping station at the foot of Porter Avenue. Francis G. Ward is Commissioner of Public Works.

BUFFALO, N. Y.—Mayor L. P. Fuhrmann has vetoed the ordinance authorizing the Commissioner of Public Works to contract with the Westinghouse Electric & Manufacturing Company for three steam turbine electric generators for the pumping station at the foot of Porter Street, at its bid of $248,180. The present plant of the Department of Public Works is the installation of steam-driven pumps. The city now has three electrically driven pumps in use.

COHOES, N. Y.—Plans are being made to form a company affiliated with the Harmony Mills, recently incorporated with a capital stock of $3,000,000, for the purpose of developing the water privileges at the plant by combining the several streams that serve the mills to operate a large electric plant, to supply electricity to operate the mills and other industries. The mills will be equipped with 240,000 spindles and 5000 Northrop looms.

GLOVERSVILLE, N. Y.—The Fulton County Gas & Electric Company, of Gloversville, N. Y., on March 21 submitted a bid to the City Council for street lighting for a term of five years, as follows: (1) For furnishing 132 series inclosed alternating-current carbon arc lamps, consuming 400 watts, $59 each per year; (2) for 132 series magnetite lamps, consuming 275 watts, $63 each per year; (3) for 164 40-watt or other latest improved incandescent lamps, $16 each per year; (4) for 30 75-watt tungsten or other latest improved incandescent lamps, $21 each per annum. Under a ten-year contract the company offers to furnish the service as follows: (1) For 132 series inclosed alternating-current carbon arc lamps, consuming 400 watts, $57 each per year; (2) for 132 series magnetite arc lamps, consuming 275 watts, $61 each per year; (3) for 164 40-watt tungsten or other latest improved incandescent lamps, $15 each per year; (4) for 30 75-watt tungsten or other latest improved incandescent lamps, $20 each per year. Morrell Vrooman is city engineer.

NEW YORK, N. Y.—The contract for the installation of electrical equipment of the conduit tracks on the Queensboro Bridge over the East River has been awarded to the Snare & Triest Company, 143 Liberty Street, New York, N. Y., for $182,300.

CHARLOTTE, N. C.—The contract for the construction of the first section of the interurban road to be built by the Southern Power Company has been awarded to Stewart & Jones, of Baltimore, Md., for $400,000. The railway will extend from Charlotte to King's Mountain, a distance of thirty-five miles. Contracts will soon be awarded for the construction of the section extending from King's Mountain to Greenville and Greenwood, S. C., via Anderson, sixty-five miles in length.

RUTHERFORD, N. C.—The Isothmeral Traction Company has amended its charter, changing its name to the North Carolina Interurban Railway Company. The new charter also gives the company the right to make physical connection with the Seaboard, Southern & Carolina, Clinchfield & Ohio railroads. George L. McKay is acting financial agent for the promoters.

HANKINSON, N. D.—The Phillips-Carleton Electric Company has applied for a charter for the purpose of installing an electric light plant in Hankinson. The company will be capitalized at $25,000. The incorporators are: George F. Phillips, E. L. Carleton, John H. Canham, J. T. Eager and M. E. Phillips.

JAMESTOWN, N. D.—The City Council has authorized bids to be called for a pump having a capacity of 300 gal. per minute and an electric motor to operate the same.

BOWLING GREEN, OHIO.—The question of establishing a municipal electric light plant in Bowling Green is under consideration. The present contract for street lighting will expire next November. The service is now supplied by the Lake Erie, Bowling Green & Napoleon Railway Company.

CINCINNATI, OHIO.—Sealed proposals will be received at the office of the Director of Public Service, City Hall, Cincinnati, Ohio, until April 3 for lighting the streets and public places of the City of Cincinnati (excepting therefrom all property under the management of the Board of Park Commissioners) with electricity for a term of ten years, beginning June 1, 1912. Plans and specifications may be obtained at the above office. John J. Wenner is clerk.

CLEVELAND, OHIO.—The contract for installing electric light fixtures in the new court house has been awarded to Edward F. Caldwell & Co., of New York, N. Y., for $119,900.

ELMORE, OHIO.—The Council is contemplating lighting the streets of the village with electricity. The Toledo, Port Clinton & Lakeside Railway Company has submitted a proposition to the Council to supply electricity for street lighting and for domestic purposes. It is understood that the Lake Shore Electric Railway Company contemplates submitting a proposition also. The streets are now lighted by gas, the service being furnished by the Cleveland Vapor Light Company.

HICKSVILLE, OHIO.—The Hicksville Electric Light Company has been awarded a new contract for street lighting for a term of ten years under the terms of which the company is to supply thirty-four arc lamps at $65 each per year and 16-cp incandescent lamps at $12 per lamp per year.

PENDLETON, OHIO.—The Ohio Traction Company is reported to be contemplating the construction of a new power house in Pendleton.

DURANT, OKLA.—The City Council is reported to have awarded the contract for the construction of a municipal electric light plant in Durant, to cost $17,000. H. C. Lutz is superintendent.

EL RENO, OKLA.—Plans have been completed for improvements to the water-works system and construction of a new power plant to cost about $65,000. Bids for construction will be asked in April. Burns & McDonnell, Scarritt Building, Kansas City, Mo., are consulting engineers.

MANGUM, OKLA.—It is reported that the local electric light plant is being enlarged to meet the demands made upon it. It is understood that an installation of ornamental street lamps is under consideration.

MUSKOGEE, OKLA.—The Muskogee & Fort Gibson Interurban Railway Company has applied for a charter to build an electric railway from Muskogee to Fort Gibson, a distance of ten miles, which will ultimately be extended to Tahlequah, thirty-five miles southeast, and to Tulsa, fifty miles northwest. The company is capitalized at $200,000 and the directors are: C. N. Haskell, W. N. Patterson, Thomas H. Owen, Thomas P. Smith, all of Muskogee, and O. L. Hayes, of Webber Falls.

WAURIKA, OKLA.—The Waurika Ice & Electric Company is reported to be contemplating improvements to its plant. The capital stock of the company has been increased from $50,000 to $75,000.

WAYNOKA, OKLA.—It is reported that plans are being prepared for the installation of an electric light plant and water-works system, for which bonds to the amount of $27,000 have been voted.

MILTON, ORE.—The transmission lines of the municipal electric plant are being extended into the fruit districts to provide electricity to the farmers for pumping purposes.

PORTLAND, ORE.—The Portland Railway, Light & Power Company has placed a contract with the General Electric Company, of Schenectady, N. Y., for six 1000-kw motor generator sets, four of which will supply power for the street railway system; each set will consist of a 1060-hp, 10,000-volt, 3-phase, synchronous motor connected to a 1000-kw, 600-volt, direct-current generator. The other two sets will provide energy for lighting purposes.

EPHRATA, PA.—Preparations are being made for the construction of an electric railway between Ephrata and Lebanon, work on which will begin in the near future. The proposed railway will be twenty-three miles in length and will cost about $425,000.

HAMBURG, PA.—Arrangements are being made by the Hamburg Electric Company to rebuild its plant which was recently destroyed by fire. It is understood that orders have been placed for generating machinery, which will be installed temporarily in Bausher's Gotham Mill No. 1, to supply electricity for the street lighting system. The incandescent lighting service will be out of service until the new plant is put in operation.

MARCUS HOOK, PA.—The Council is reported to have awarded the contract for street lighting to the Beacon Light Company, of Chester, Pa.

PHILADELPHIA, PA.—The Philadelphia Suburban Gas & Electric Company has purchased a site in Oreland, on which, it is understood, it will erect a large electric plant and gas plant in the near future.

PHILADELPHIA, PA.—Preparations are being made by M. A. Metz & Brother for the construction of a new five-story factory, bids for which are now being received. The company has not yet decided whether to install an electric power plant or to purchase electricity to operate the plant.

SCRANTON, PA.—Applications will be made to Governor John K. Tener for charters for the following companies: The Archbald Light, Heat & Power Company, of Archbald, Pa.; the People's Light, Heat & Power Company, of Scranton, Pa.; the Pioneer Electric Light Company, of Carbondale, Pa.; the Dunmore Electric Light Company, of Dunmore, Pa., and the Lackawanna Light & Power Company, of Olyphant, Pa. It is proposed to erect a large hydroelectric plant near Hawley at the head of Paupack Falls. A dam will be built at this point, forming a lake about twelve miles long. Electricity generated at the plant will be transmitted over the mountains, a distance of thirty-five miles, and will be distributed in the cities mentioned above. C. D. Simpson, Col. L. A. Watres, of Scranton, Pa., and Alvin Markle, of Hazleton, Pa., are interested in the project.

STROUDSBURG, PA.—The Stroudsburg & Water Gap Railway Company is reported to have awarded a contract to E. P. Arbogast for the construction of an extension of its railway connecting Delaware Water Gap and Portland, a distance of five miles, which will form the last link of the electric railway service between Stroudsburg and Delaware Water Gap.

WILKES-BARRE, PA.—The capital stock of the Wilkes-Barre & Lucerne Street Railway Company has been increased from $6,000 to $300,000. The company proposes to build an electric railway in Wilkes-Barre and Kingston.

EDGEFIELD, S. C.—The Town Council is reported to be considering the question of calling an election to vote on the proposition to issue $15,000 in bonds for the construction of an electric light plant. A proposition has been submitted to the Council by Mr. Cox, proprietor of the electric light plant at Johnston, S. C., to supply electricity to the town.

NEWBERRY, S. C.—Permission has been granted to the Parr Shoals Power Company to increase its capital stock from $50,000 to $100,000. The company is planning to develop water powers in Newberry County.

FAIRVIEW, S. D.—The Fairview Milling Company has awarded the contract for the installation of a hydroelectric power plant on the Big Sioux River to the Missouri Valley Engineering Company, of Mitchell, S. D., at a cost of about $50,000. John J. Hammann is president and A. G. Pond is secretary of the milling company. R. G. Culbertson, of Mitchell, S. D., is secretary and treasurer of the Missouri Valley Engineering Company.

HILL CITY, S. D.—The Hill City Lumber Company, it is reported, is erecting a building for the installation of a power plant.

NEWPORT, TENN.—Plans are being made by England & Bryant, of Newport, Tenn., for the construction of a power plant on Pigeon River, near Newport. Electricity generated at the plant will be utilized to operate a tannery now controlled by them and another to be erected during the summer.

PETERSBURG, TENN.—Arrangements are being made for the installation of an electric lighting system in Petersburg. It is understood that a generator will be installed in the local flour mill to furnish the service.

SHELBYVILLE, TENN.—We are advised that the Sylvan Cotton Mills are in the market for several second-hand 110-volt and 220-volt, single and three-phase, 60-cycle alternating-current motors. J. B. Frierson, president.

TRENTON, TENN.—The City Council will submit to the voters the proposition petitioning the State Legislature to give the city authority to issue $22,000 in bonds, to establish a municipal electric plant, of which the proceeds of $9,300 would be applied for the purchase of the old plant, and the remainder for a new plant. During the interim the city is to operate the plant.

UNION CITY, TENN.—Plans are being considered by the citizens of Union City for the construction of an electric railway from Union City to Gibbs to connect with the Illinois Central Railroad.

BROWNSVILLE, TEX.—R. H. Kern is interested in a project to have the interurban railway extended from San Benito to Santa Maria and Mission.

DALLAS, TEX.—Arrangements are being made by the Stone & Webster Corporation, of Boston, Mass., for the construction of an electric interurban railway from Dallas to Waxahachie, thirty miles in length, at a cost of about $1,000,000. It is stated that the company is planning to build an interurban electric railway from Waxahachie to a connection with the lines of the Northern Texas Traction Company at Oak Cliff.

FORT WORTH, TEX.—The City Commissioners have entered into a five-year contract with the Nutt Light & Power Company to supply electricity to operate the artesian well water supply at the rate of 1 2/10 cents per kw-hour.

GALVESTON, TEX.—The City Council has granted the Brush Electric Light & Power Company a new franchise for a period of fifty years, under the terms of which the city will be able to extend the street lighting system without enlarging the municipal electric plant. By the terms of the new franchise the city may make certain changes at the city water and electric-light plant, now in the same building, at a cost of not exceeding $6,500, which will give the citizens a lower fire insurance rate. The company offers to furnish electricity for use of the city only, including lighting of the Seawall Boulevard, at the rate of 2½ cents per kw-hour; the city is also given the privilege of attaching one crossarm on all poles now in use or to be hereafter erected by the Brush company, and the company will also supply energy to be distributed by the city's plant over its own circuits and lines throughout the city. The company also agrees to install and control a circuit to be known as the "sign" circuit, which will burn from dusk until midnight every night, furnishing electricity to consumers for lighting signs and exterior lighting and private street decorative lighting adjacent to stores or buildings at the rate of 6 cents per kw-hour, the contract to be for not less than one year, with a minimum charge.

NEW BRAUNFELS, TEX.—The W. K. Palmer Company, Dwight Building, Kansas City, Mo., is reported to have been engaged to prepare plans and take charge of the engineering work of the installation of a municipal hydroelectric plant in New Braunfels.

TAYLOR, TEX.—The Citizens' Light & Power Company is reported to have entered into a contract with the International & Great Northern Railroad Company to supply electricity for operating the machinery in the new shops of the railroad company. The Citizens' company is installing a 350-hp engine in its shops on First and Oak Streets.

WACO, TEX.—The Citizens' Railway Company is installing a 2000-kw turbine, a 300-kw rotary, a surface condenser and is in the market for a storage battery and a 500 to 600-hp water-tube boiler.

WEST, TEX.—Plans are being made by the West Water, Power & Light Company for the construction of a brick power house in the rear future, to replace the frame structure now in use.

OGDEN, UTAH.—It is understood that the Merchants' Power & Light Company, which recently obtained a franchise from the City Council to maintain and operate an electric light plant in Ogden, will purchase energy from the Davis & Weber Counties Canal Company to operate its system. Herman Strauss, electrical engineer, is reported to be preparing plans for the plant, which is to be ready for operation by Jan. 1, 1912.

ROSSLYN, VA.—The Rosslyn Electric & Gas Company is contemplating extending its system to supply electricity throughout Alexandria County. It is understood that the company proposes to purchase energy from the Old Dominion & Great Falls Railroad Company, the power plant of which adjoins that of the Rosslyn Electric & Gas Company.

WILLIAMSBURG, VA.—Plans have been completed for extensions and improvements to the lighting and heating plant at William and Mary College, calling for an expenditure of about $30,000. It is understood that contracts have been placed for the equipment.

BELLINGHAM, WASH.—The residents of Mountain View are reported to have subscribed the sum of $10,000 toward the construction of the proposed Nooksack interurban railway.

EVERETT, WASH.—It is reported that the Everett Railway, Light & Water Company is planning to erect cluster lamps on Wetmore Avenue.

EVERETT, WASH.—The Boyes Monorail Edmonds Company is reported to have applied to the County Commissioners for a twenty-five-year franchise to construct a monorail system between Everett and Edmonds.

NORTH YAKIMA, WASH.—The installation of a sewage disposal plant in connection with the proposed municipal electric plant is under consideration. The cost of the proposed work is estimated at about $20,000.

MORGANTOWN, W. VA.—Preparations are being made by the Morgantown & Dunkard Valley Railroad Company for the construction of an extension through Asage, about three miles in length, during the coming year.

CORNELL, WIS.—The Cornell Land & Power Company is reported to be preparing to build a power dam, work on which will begin soon.

BASIN, WYO.—Plans are being prepared by Burns & McDonnell, Scarritt Building, Kansas City, Mo., for improvements to the waterworks, electric light and sewer systems, to cost about $75,000. Bids for the above work will be asked for in April.

CALGARY, ALTA., CAN.—The city has awarded the contract for ornamental street lamps to the Canadian Equipment Company, to cost $12,400.

LETHBRIDGE, ALTA., CAN.—Estimates prepared by Arthur Reid, superintendent of the municipal electric light plant, calls for an expenditure of $26,600 during 1911, as follows: Poles and wire extensions, $8,623; transformers, $3,000; meters, $5,000; sixty new street lamps and mast arms, $7,240; two watt meters, water meter and frequency meter, $1,025; boiler gage glasses, $110; new equipment for power house, $1,600. It is understood that bids will soon be asked for the above.

STRATHCONA, ALTA., CAN.—Contracts have been awarded by the City Council for machinery for the municipal electric plant, as follows: For one 600-kw generator to the Chapman & Walker Company, of Toronto, Ont., at $10,160; to German, Clancey & Gridley, of Edmonton, Ont., for Burham regulator, $750; for engine to Goldie & McCulloch Company, of Galt, Ont., at $12,900; for boilers to the Canada Foundry Company, of Toronto, Ont., $12,700; for smokestacks and fans, $7,304, and for two feed pumps, $1,167. The new equipment will double the present output of the plant.

VERNON, B. C., CAN.—Arrangements have been completed by the Coteau Power Company for the construction of an electric railway from Vernon to Lumby. For further information address A. E. Ashcroft, Vernon, B. C.

COBOURG, ONT., CAN.—The citizens of Campbellford and Warkworth are reported to be negotiating for the construction of an electric railway through Northumberland County.

GALT, ONT., CAN.—Arrangements have been made by the Galt, Preston & Hespeler Electric Railway Company and the Grand Valley Railway Company with the Hydro-Electric Power Commission for electricity. The Grand Valley Railway Company is installing a rotary converter and will be ready for the service in a few weeks. The power house of the Galt, Preston & Hespeler Railway Company is expected to be connected with the main power line of the commission very soon.

HAMILTON, ONT., CAN.—Plans are being made by the Dominion Power & Transmission Company for rebuilding part of its lines in Hamilton in the near future.

HAMILTON, ONT., CAN.—The Board of Control has engaged E. L. Sifton, of London, Ont., Can., to prepare plans and estimates for the installation of a municipal electric light plant and street lighting system in Hamilton.

KINGSTON, ONT., CAN.—The Seymour Electric & Power Company, of Campbellford, has submitted a proposition to the Light, Heat and Power Committee of the Council offering to supply the city a certain amount of power at $25 per horse-power per year and all above that amount consumed at the rate of 1½ cents per kw-hour.

TORONTO, ONT., CAN.—The Hydro-Electric Power Commission will soon call for bids for material for eight or ten miles of transmission lines from a point on the Severn River to the towns of Midland and Penetanguishene, including material for substations. The Hydro-Electric Power Commission has contracted with the Simcoe Power Company for 1500 hp from its plant at the Big Schute Falls on the Severn River, which will be transmitted to Midland and Penetanguishene on the new lines. The ratepayers in Midland have voted to enter into a contract with the commission for between 400 hp and 500 hp. The Penetanguishene Council is contemplating submitting a by-law to the ratepayers to appropriate $16,500 to purchase the local electric light plant and to enter into a contract with the commission for power to operate the same. The commission will also probably supply electricity to farmers along the transmission line, as well as to the two towns named.

MAGOG, QUE., CAN.—It is reported that plans have been prepared by Ross & Holgate, of Montreal, Que., for the construction of an electric light and power plant, near Magog.

MONTREAL, QUE., CAN.—The Montreal & Southern Counties Railway Company, which operates an electric railway from the foot of McGill Street, at the city limits of Montreal, across the Victoria Bridge to St. Lambert, has applied to the City Council for permission to operate within the city limits. F. B. Powell is general manager.

PRINCE ALBERT, SASK., CAN.—Owing to the successful operation of the municipal electric light and power plant the price of electricity will be reduced 1 cent per kw-hour. The plant showed a profit of $7,550 for the year 1910.

REGINA, SASK., CAN.—Bids will be received by the City Commissioners for the construction of approximately seven miles of track for street railway system. For further information address L. A. Thornton, city engineer.

YORKTON, SASK., CAN.—The farmers of the surrounding districts have decided to form a large rural telephone company to cover ten districts in this vicinity. For further information address Mayor Beck.

New Industrial Companies.

THE AMERICAN ELECTRIC MANUFACTURING COMPANY, of Salt Lake City, Utah, has filed articles of incorporation with a capital stock of $5,000 for the purpose of manufacturing electrical fixtures and to do a general electrical supply business. R. L. Shannon is president of the company; J. H. Cook, vice-president, and H. L. Boner, secretary and treasurer.

THE BURKE ELECTRICAL WORKS SUPPLIES COMPANY, of New Orleans, La., has been incorporated with a capital stock of $15,000 by T. J. Burke, Otto T. Maier and J. H. Brady.

THE COTIL SUPPLY COMPANY, of New York, N. Y., has been incorporated by E. Jacques, S. Alexander, F. Corilteau and Alphonse Cotil, of New York, N. Y. The company is capitalized at $50,000 and proposes to manufacture and deal in lamps and lighting devices.

THE DETROIT INSULATOR COMPANY, of Detroit, Mich., has been chartered with a capital stock of $10,000 for the purpose of manufacturing insulation materials. Harry A. Robertson is interested in the project.

THE DURABLE ELECTRIC COMPANY, of Boston, Mass., has been incorporated with a capital stock of $50,000 to manufacture and deal in electrical supplies. J. W. Burnett is president and W. K. Mason, treasurer, both of Somerville, Mass.

THE ECLIPSE LIGHT COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $50,000, for the purpose of manufacturing gas and electric light fixtures, etc. The incorporators are: L. B. London, F. Caplan, of Brooklyn, N. Y., and M. Bernstein of New York, N. Y.

THE ECONOMY ELECTRIC SUPPLY COMPANY, of Chicago, Ill., has been chartered with a capital stock of $10,000 by Wallace F. Kirk, Robert Moss and David Morgeson. The company proposes to manufacture and deal in electrical instruments and electrical apparatus.

THE FISHER ELECTRIC & MANUFACTURING COMPANY, of Toronto, Ont., Can., has been incorporated with a capital stock of $250,000 by F. C. L. Jones, L. W. Nurse, F. H. White, A. J. Pierce and E. M. Brown, all of Toronto, Ont.

THE C. A. GEORGIA ELECTRIC COMPANY, of Elmira, N. Y., has been incorporated by C. A. Georgia, F. S. Georgia and J. C. Gallagher, all of Elmira, N. Y. The company is capitalized at $25,000, and proposes to do a general electrical contracting business.

THE KENYON SEARCHLIGHT COMPANY, of Bedford, Ind., has been incorporated by P. D. Metzer, Robert H. McKay, P. C. Stoller, E. L. Keckler and Ralph B. S. Keels. The company is capitalized at $15,000 and proposes to deal in electrical appliances.

JAMES MILLARD & SON, of Kingston, N. Y., have filed articles of incorporation, with a capital stock of $50,000, for the purpose of manufacturing electrical devices, etc.; also manufacturing factory supplies, heavy hardware, etc. The incorporators are: J. Millard, J. R. Millard and M. M. Millard.

THE MOFFATT-IRVING ELECTRIC SMELTERS, LTD., of Toronto, Ont., Can., has been incorporated with a capital stock of $40,000 by J. W. Moffatt, M. E. Irving and I. C. Irving, Jr., of Toronto, Ont.

THE NATIONAL CONDUIT & CABLE COMPANY OF CALIFORNIA, of San Francisco, Cal., has been chartered with a capital stock of $5,000 by C. H. Pennoyer, P. A. Breen and H. G. W. Dinkelspiel.

THE NU-VO MANUFACTURING COMPANY, of Kittery, Maine, has been incorporated with a capital stock of $75,000 by B. O. Preston, Charles C. Smith, of Boston, Mass.; Lucius B. Swett, George E. Burnham and Elmer J. Burnham, of Kittery, Maine. The company proposes to manufacture electrical supplies.

THE UNION ELECTRIC MANUFACTURING COMPANY, of Milwaukee, Wis., has been chartered with a capital stock of $50,000 by Charles A. Rhine, Charles H. Keeney and John Rhine.

New Incorporations.

EDMUNDSON, ARK.—The Edmundson Electric Plant & Manufacturing Company has filed articles of incorporation with a capital stock of $50,000.

INDIANAPOLIS, IND.—The Indianapolis & Delphi Traction Company has been chartered with a capital stock of $100,000 to construct and operate an electric street and interurban railway in and between the cities of Indianapolis and Delphi and intervening towns.

MARION, IND.—Articles of incorporation have been filed for the Upland Electric Company by George N. Tidd, H. L. Finley and Frank B. Ball. The company proposes to supply towns, cities and villages with electricity for lamps, heat and motors, and also with gas and water service.

MASON CITY, IA.—The Ownes Grove Telephone Company has been incorporated with a capital stock of $9,990 by A. L. Runyan, Elmer Beach, J. H. Woodward, Evans Jenkins, Renaldo Richardson and S. L. Stevens.

SAC CITY, IA.—Articles of incorporation have been filed for the Farmers' Mutual Telephone Company with a capital stock of $5,000 by Fred Pellersels, W. W. Henning, John G. Brill, Clarence Purdy and others.

WOLCOTT, N. Y.—The Northern Wayne Electric Light & Power Company has been granted a charter with a capital stock of $70,000. The company proposes to operate in the eastern part of the towns of Sodus, Rose, Huron, Butler and Wolcott; the villages of Alton, Escort, Butler, Butler Centre, North Huron and North Wolcott in Wayne County; in the towns of Sterling and Victory, villages of Westbury and Fair Haven in Cayuga County. The directors are: Thomas D. Welch, of North Rose; Lewis S. Town, of Rose; Omar M. Curtiss and Raymond H. Kelly, of Wolcott and George L. Colgate, of Rochester, N. Y.

GALLIPOLIS, OHIO.—The Gallipolis & Meigs Electric Railroad Company has been chartered with a capital stock of $50,000 for the purpose of constructing and operating an electric interurban railway extending to Kanuaga and Middleport.

NINNEKAH, OKLA.—The Ninnekah Electric Company has been incorporated with a capital stock of $1,800 by George R. Beeler, R. A. Thompson, George E. Alkire and others.

PITTSBURGH, PA.—The Marianna Light, Heat & Power Company has been granted a charter with a capital stock of $10,000. The incorporators are: J. E. Lynch, treasurer; Charles R. McGregor and Stephen Stone, all of Pittsburgh, Pa.

PELZER, S. C.—Articles of incorporation have been filed for the West Pelzer Public Service Company with a capital stock of $10,000 by M. D. Sullivan, W. L. Wellborn, John Frank and C. C. Hindman.

LIBERTY, TENN.—The Liberty Home Telephone Company has been incorporated with a capital stock of $3,000 by H. M. Evans, N. H. Craddock, T. H. Chapman and W. Percy Whaley.

CANYON, TEX.—The Canyon Power Company has been chartered with a capital stock of $25,000 by C. R. McAfee, C. N. Harrison and D. A. Park.

Personal.

MR. HORATIO A. FOSTER spoke before the Electrical Engineering Society of the University of Southern California, Los Angeles, on March 15, his subject being "A Rambling Talk by a Wandering Engineer."

PROF. W. F. SCHAPHORST, of the mechanical engineering department of the New Mexico College of Mechanic Arts, has resigned his position there to become a technical writer on the staff of A. Eugene Michel, advertising engineer, New York City.

MR. WILLIAM H. TUCKER has been appointed superintendent of the electric light plant of the City of Jacksonville, Fla. Mr. Tucker was formerly manager of the Jacksonville Electric Company, and more recently superintendent of motive power of the Northern Ohio Traction & Light Company, Akron, Ohio.

MR. ALDIS E. HIBNER has resigned his position as assistant power engineer with the Toronto Electric Light Company, Ltd., Toronto, Ont. and has accepted a position with the Livingston Niagara Power Company, of Avon, N. Y., where he will have in charge the sale of electric energy for the entire system of the company, covering several towns in the vicinity of Rochester.

MR. W. J. O'BRIEN, formerly with the Denver Gas & Electric Company and the Pueblo Gas & Fuel Company, is now manager of the Helena (Ark.) Gas & Electric Company. This property has recently been purchased by a Philadelphia syndicate, which has engaged the Scofield Engineering Company, of that city, to prepare plans for a new power house of the most modern design.

MR. C. M. GODDARD.—At the final meeting of the Underwriters' National Electric Association on March 23 resolutions were enacted, ordered to be engrossed and to be presented to Mr. Goddard, the retiring secretary, as a token of the esteem in which the association held him and in recognition of his unstinted and untiring work in the interest of safe electrical installations. For nearly twenty years Mr. Goddard has been secretary of the Underwriters' National Electric Association, and by common consent is recognized as the highest authority on electric wiring installations in this country. To him more than to any other one person the industry is indebted for the present National Electrical Code.

MR. E. C. DEAL has been appointed manager of the North Carolina Public Service Company, with headquarters at Greensboro, N. C. Mr. Deal will have charge of the Augusta Railway & Electric Company and the Augusta & Aiken Railway Company, which properties have recently been acquired by Redman & Company, and J. G. White & Company, of New York. Mr. Deal, who is a native of Atlanta, Ga., obtained his first electrical experience with the Georgia Electric Light Company (now the Georgia Railway & Electric) with which he was connected from 1894 to 1898. Subsequently he was connected in various capacities with Stone & Webster properties in Baltimore, Seattle, Brockton and Terre Haute, and in 1904 became chief engineer of the Gas & Electric Company of Bergen County. When this property was absorbed by the Public Service Corporation of New Jersey, he served as superintendent of the electrical properties of the latter in central New Jersey until 1908, when he joined W. N. Coler & Company, bankers, of New York, acting as general manager of the North Carolina Public Service Company and other Coler properties throughout the country.

MR. TORSTEN F. HOLMGREN, general manager of the Royal Trollhättan Power System of Trollhättan, Sweden, who is inspecting hydroelectric and other electrical installations in the United States, was in Chicago last week and viewed the water-power development of the Chicago Drainage Canal and the stations and transmission system of the Commonwealth Edison Company. Mr. Holmgren was accompanied by Mr. Knut W. Bildt, mechanical and electrical engineer, of Kiruna, Sweden, and Lieutenant Frederik Jonson, of the Royal Swedish Engineers.

Obituary.

MR. EDWARD L. BREWSTER, prominent in the business and social life of Chicago for many years, died in St. Luke's Hospital in that city on March 21, aged sixty-eight. Mr. Brewster had retired from active business, but was a special partner in the brokerage firm of Russell, Brewster & Co. He was interested in electrical progress and for many years had been a director of the old Chicago Edison Company and its successor, the present Commonwealth Edison Company.

MR. WILLIAM C. WOODWARD, who had been with the Narragansett Electric Lighting Company, Providence, R. I., for the past eighteen years, serving as its electrical engineer, died on March 25 as a result of cerebral hemorrhage. Mr. Woodward was born in Roxbury, Mass., fifty years ago. He was for a time employed by the General Electric Company and the Standard Electrical Company, Boston. He was elected associate of the American Institute of Electrical Engineers in 1896 and transferred to full membership in 1902. He is survived by a widow and four sons.

MR. EDWARD DELOS SWEET, who had been a prominent figure in the early development of the telegraph in Illinois, died in his home in Oak Park, Ill., on March 18. He was born in New York State in 1825, but was brought to Morgan County, Ill., by his parents four years later. As a young man he was a telegraph operator in Rock Island and Galena, and in 1856 he was sent to Chicago as division superintendent for the Illinois and Mississippi Telegraph Company. In 1870 he went to New York as vice-president of the Atlantic & Pacific Telegraph Company and later returned to Chicago as a superintendent for the Western Union Telegraph Company. Later he engaged in other business, from which he retired in 1887.

MR. CHARLES W. HUNT, past-president of the American Society of Mechanical Engineers, died on March 27 at his home on Staten Island, N. Y. Mr. Hunt was born at Candor, Tioga County, N. Y., on Oct. 13, 1841. He pursued a scientific course at Courtland Academy, Homer, N. Y. In 1872 he established a business relating to the design and construction of machines for the unloading of cargoes of coal, ore and other heavy materials, which was enlarged to include the design and erection of wharves and buildings thereon for the handling of these materials. He obtained more than 150 patents on his inventions along the lines just indicated. The business was conducted under the firm name of C. W. Hunt Company, of which Mr. Hunt was president at the time of his death. He was also the president of the McCaslin Machine Company and vice-president of the Richmond County Savings Bank. For many years Mr. Hunt was chairman of the committee on publication of the American Society of Mechanical Engineers. He served as vice-president of the society from 1892 to 1894, during which time he formulated the rules of the society with respect to the qualifications for membership. He was elected president of the society in December, 1897, and served for one year. He was a member of the American Institute of Mining Engineers, the American Institute of Electrical Engineers, the American Association for the Advancement of Science, the Municipal Arts and Science Association, the New York Electrical Society, the United Engineering Society, the Franklin Institute, the New York Chamber of Commerce and the Staten Island Chamber of Commerce, of which he was president from 1896 to 1902. He was a member of the Masonic order and of the Engineers, Hardware, Machinery and Staten Island clubs. Mr. Hunt was twice married. He is survived by his wife, two sons and two daughters.

MR. FREDERICK LIVINGSTON HART, eldest son of Frederick and the late Nellie L. Hart, died on Thursday, March 23, 1911, at the residence of his brother-in-law, Dr. Ralph D. Macfarland, 53 Clinton Avenue, Jamaica, N. Y. Mr. Hart was born in the Cypress Hills section of Brooklyn, N. Y., on July 3, 1861, and after graduation from the Brooklyn Polytechnic Institute entered the steam engineering works of William Wright, Newburg, N. Y. After completing his course of instruction there he took a course in electric lighting at the United States Electric Lighting Company, Newark, N. J. He was then appointed engineer in charge of installing and operating the electric plant of the New York and Brooklyn Bridge, and for the following seven years was superintendent of operation of the One Hundred and Twenty-fifth Street & Tenth Avenue Railway Company. This position he resigned to become engineer in charge of the Metropolitan Railway Company, and two years later became manager of the Baltimore City Passenger Railway, which position he held for six years. He then became general manager of the Washington Railway & Electric Company, of Washington, D. C., with which he remained for two years, then returning to Baltimore to become associated with the firm of Thomas Basshor, contracting engineers. About two years later his health began to fail and he returned to New York, making his home with his father and brother at 116 Warwick Street, Brooklyn, N. Y. Mr. Hart was a member of the American Society of Mechanical Engineers. Besides his father he leaves a brother, Lewis T. Hart, of 116 Warwick Street, Brooklyn, N. Y.; two sisters, Mrs. R. D. Macfarland, of Jamaica, and Mrs. E. L. Rockefeller, of Arlington Avenue, Brooklyn, and one daughter, Jeanie Case Hart. The funeral services were held on Sunday, March 26, at 2:30 p. m., at his late residence, 116 Warwick Street, Brooklyn, N. Y., interment being in the family plot at Cypress Hills Cemetery.

Trade Publications.

SPEED INDICATORS.—In Catalogue No. 40, issued by the Industrial Instrument Company, Foxboro, Mass., are listed various types of speed-measuring instruments from the simple device to count revolutions to the elaborate speed-variation recorder. The complete line of tachometers and tachographs devised by Dr. Horn is covered.

FLAME ARC LAMPS.—One of the recently issued publications of the Westinghouse Electric & Manufacturing Company is Circular No. 1191, covering multiple and multiple-series metallic flame arc lamps, which are used for lighting places where direct current is available and where high-intensity illuminating units are required, such as business streets, parks, freight yards, mills, car barns, foundries, machine shops, train sheds, etc.

FORT WAYNE.—The Fort Wayne Electric Works, Fort Wayne, Ind., have issued a souvenir book of Fort Wayne, comprising photographs of its public buildings, parks and works, churches, schoolhouses, office buildings, manufacturing establishments, etc., with a story of Fort Wayne in retroscope and protoscope. The advantages of Fort Wayne as a manufacturing and residence center are pointed out. The souvenir is handsomely got up and is a credit to the city issuing it.

WATER SOFTENER.—The National Water Softener Sales Company, Indianapolis, Ind., has issued a catalog pointing out the deleterious effects of hard water, the principle of water softening and a description of the National water softener, its capabilities and methods of operation. The softener is of the continuous type, comprising a solution tank which holds the reagents, a dumping bucket in which the raw water is measured and from which it is automatically dumped into a mixing chamber, a measuring valve for apportioning the reagents into the mixing chamber, and a precipitating tank in which the hardening elements are finally removed from the water.

ELECTRICAL FITTINGS FOR POWER PLANTS.—The Electrical Engineers' Equipment Company, of Chicago, has issued its Catalog No. 2, which contains much valuable information for the designers and owners of electric power plants. Many types of cable and bells, busbar supports, terminals, connectors, insulator pins, switchboard pipe fittings, wall brackets, etc., are illustrated and described. Dimensions, characteristics and prices are given, together with instructions for making installations and many tables and diagrams. In addition there are various other tables and formulas of value to the engineer and inspector, such as those relating to currents in three-phase circuits for various power factors, amperes per phase, sparking distances, carrying capacity of copper tubing, carrying capacity of flat busbars, etc. The catalog is one which the engineer will be glad to preserve in his library.

BUSINESS NOTES.

H. M. BYLLESBY & COMPANY have moved their Chicago office to 206 La Salle Street.

THE ALBERT & J. M. ANDERSON MANUFACTURING COMPANY has moved its Chicago office to 105 Dearborn Street.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, has moved its Chicago office to 320 South Fifth Avenue.

THE REYNOLDS ELECTRIC FLASHER MANUFACTURING COMPANY will move on May 1 from 191-193 Fifth Avenue, Chicago, to 617-631 West Jackson Boulevard.

MEXICAN HOTEL ELECTRICAL PLANT.—A new hotel at Monterey, Mexico, to cost $1,000,000, will be supplied with two Westinghouse 100-kw steam turbine outfits for light and power purposes.

THE COMMERCIAL ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., has appointed Louis L. Hunt as sales manager. Mr. Hunt has for the past fifteen years been connected with the electrical trade tributary to St. Louis.

THE CONNECTICUT DYNAMO & MOTOR COMPANY has moved its works from New York City to Irvington, N. J., where it occupies a new plant with increased facilities for the production of plating generators and motors.

BOSTON OFFICE OF LINK-BELT COMPANY.—To care properly for "Link-Belt" elevating, conveying and power transmission machinery and chains, the Boston sales office of the Link-Belt Company, formerly located at 84 State Street, has been moved to more commodious quarters at 131 State Street. Mr. Lawrence Spillan is in charge.

MR. JAMES G. BIDDLE will in April move his place of business to the fireproof-construction Boyertown Building, 1211 Arch Street, Philadelphia. The new quarters include a special room, with floor space of about 1000 square feet, that will be devoted to a permanent exhibition of instruments from the manufacturers represented by Mr. Biddle.

WILLARD STORAGE BATTERY COMPANY BUILDS ADDITION TO PLANT.—The completion of the new building for which ground has just been broken will add 8000 square feet of floor space to the Willard Storage Battery Company's plant at Cleveland, Ohio. The building will front on Marquette Road and is built to take care of the company's rapidly increasing business.

THE PEERLESS ELECTRIC COMPANY, an Illinois corporation doing a manufacturing and repair business in dynamos and motors at 127 South Green Street, Chicago, sustained considerable damage by a fire in the building at that address on March 18. This concern is entirely distinct from the Peerless Electric Company of Warren, Ohio, which is in no way affected by the fire.

THE AGUTTER-GRISWOLD COMPANY, Seattle, electrical engineers and manufacturers of switches, switchboards, steel cabinets, etc., is erecting a large factory building for the manufacture of its product. The first floor will be used for offices and store purposes, the second floor will be devoted to the manufacture and assembling of switches, panel boards and switchboards, and the entire third floor will be occupied by the sheet metal department, including the machinery required for the manufacture of steel cabinets, panel boxes, meter cabinets, etc.

FOOS GAS ENGINES FOR GOVERNMENT WORK.—The Foos Gas Engine Company, Springfield, Ohio, has shipped to the United States government two Foos engines for use in operating one of the dams in the river improvement work near Wheeling. These engines are of the heavy-duty, vertical, multiple-cylinder type, consisting of three cylinders each of 100-hp capacity. These machines are part of an order received from the United States government and turned out by the Foos factory for the above purpose and will be installed at Dam No. 8.

ELECTRIC SERVICE SUPPLIES COMPANY.—On and after April 1 the Keokuk office, factory and warehouse of the Electric Service Supplies Company will be discontinued and moved to the company's new office and factory building, Seventeenth and Cambria Streets, North Philadelphia. The Philadelphia office and warehouse, at present at 1020-24 Filbert Street, will likewise be moved to the new building on or about May 1. With increased factory facilities in Philadelphia and with offices and extensive warehouses in both Philadelphia and Chicago the company will be better able to give customers the fullest benefits that accrue through more prompt and efficient service. The company's Keokuk (Ia.) branch is to be discontinued.

NEW PLANT FOR THE JAYNES COMPANY.—The factory which was being equipped in Irvington, N. J., for the manufacture of the Jaynes insulating joint was completely destroyed by fire on Feb. 21. This company has now decided to locate in Newark, N. J., and its new plant will be in operation the early part of May. The Jaynes insulating joint is built on the principle that compression is the principal factor in mica insulation for high-tension voltage, and by its employment the Jaynes joints are enabled to stand the severe requirements of the National Board and at the same time possess a mechanical strength which enables the user to handle them practically the same as if they were pipe fittings. The temporary office of the Jaynes Company is in Union Building, Newark, N. J.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 21, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

13,219. SOLDERING DEVICE; F. S. Chapman, Toledo, Ohio. App. filed Sept. 21, 1909. Soldering joints, including a metallic union or tube into which the wires are inserted with a body of soldering material within the tube and a coating of inflammable material on the outside thereof which when heated melts the solder.

987,107. TELEGRAPH KEY; C. Bolick, Rocky Mount, N. C. App. filed Dec. 30, 1910. Attachment for a Morse key which prevents the thumb lever from being accidentally opened, it being retained by a spring latch.

987,114. PROCESS FOR SEPARATING AND COLLECTING PARTICLES OF ONE LIQUID SUSPENDED IN ANOTHER LIQUID; F. G. Cottrell, Berkeley, Cal. App. filed Oct. 12, 1909. For separating oil and water by passing the mixture through a wall which forms part of a system of electrodes, the drops coalescing on passage of the current.

987,115. SEPARATING AND COLLECTING PARTICLES OF ONE LIQUID SUSPENDED IN ANOTHER LIQUID; F. G. Cottrell and J. B. Speed, Berkeley, Cal. App. filed May 20, 1909. For separating emulsions of water in oil by bringing the material between electrodes at a sufficient voltage to coalesce the suspended particles.

987,116. APPARATUS FOR SEPARATING AND COLLECTING PARTICLES OF ONE LIQUID SUSPENDED IN ANOTHER LIQUID; F. G. Cottrell and J. B. Speed, Berkeley, Cal. App. filed May 20, 1909. For separating water and oil by means of a cylindrical tank with a cylindrical, porous separator within the tank, the latter forming the electrode. The mixture passes through the electrode and upon being subjected to a sufficiently high voltage the drops coalesce.

987,117. SEPARATING AND COLLECTING PARTICLES OF ONE LIQUID SUSPENDED IN ANOTHER LIQUID; F. G. Cottrell and A. C. Wright, Berkeley, Cal. App. filed Dec. 1, 1910. For separating emulsions by passing the material through a field of electrodes whose voltage is sufficient to coalesce the suspended particles and agitating the mixture.

987,128. TELEPHONE EXCHANGE SYSTEM; W. A. Fricke, Chicago, Ill. App. filed April 11, 1908. Magneto generator for ringing, operated by hand. Provides a clearing out signaling device in a magneto switchboard with apparatus whereby such signaling device may also serve to indicate to the operator that her attention is desired by a subscriber while operating the magneto.

987,129. TELEPHONY; W. A. Fricke, Chicago, Ill. App. filed Nov. 24, 1909. Signal receiver with polarized relay having windings to co-operate with soft iron cores and permanently magnetized armatures to give signals, avoiding the demagnetizing effect upon the polarized armature by distributing the winding about the soft iron core. Associates signal receiver with the line so as to keep them in balance by means of a bridge conductor containing a signal receiver upon one side of the ground connection, the other side containing the winding which balances the winding of the signal receiver.

987,136. RAIL BOND; A. B. Herrick, Ridgewood, N. J. App. filed Apr. 19, 1905. A rail bond with a mold formed of carbon which incloses the portion of the bond adjacent to the face thereof so as to attach it directly to the rail.

987,146. ALTERNATING-CURRENT ELECTROMAGNET; D. L. Lindquist, Yonkers, N. Y. App. filed Aug. 18, 1906. Liquid dash pot for an alternating current electromagnet and armature used in starting electric motors.

987,152. LAMP SOCKET; N. Marshall, Newton, Mass. App. filed July 7, 1909. Pull chain lamp socket with two base blocks recessed and a pull switch within the recess.

987,161. ELECTRIC OVEN; G. J. Ogden, Toronto, Ontario, Canada. App. filed Sept. 21, 1909. An oven with an electric contact socket having two contacts therein in combination with a removable electric heating element having a contact plug with two contacts thereon and connected to the heating element and adapted to engage the socket and complete the electrical connections when the heating element is put into place.

987,192. ELECTRICAL SWITCH; W. A. Turbayne, Lancaster, N. Y. App. filed June 16, 1908. For maintaining connection between a plurality of circuits and reversely connecting them, including two sets of spring pressed contact arms pivotally mounted, each set insulated from the other and one contact arm of each set engaged by a movable armature to open or close the switch.

987,193. ELECTRICAL REGULATING APPARATUS; W. A. Turbayne, Lancaster, N. Y. App. filed Feb. 3, 1909. Makes use of a carbon pile of blocks for regulating, with means for locking the apparatus which operates the carbon pile when the system is undergoing regulation, and also provides an electromagnet responsive to variations in the work voltage by means of an auxiliary device operated when the voltage varies in the work circuit.

987,194. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Feb. 24, 1909. For train lighting system with a generator, a plurality of train units, a work circuit and storage battery on each unit and a booster for each battery responsive to variations in the load on the work circuit and a switch on each unit for disconnecting the battery from the generator and connecting it across the work circuit, which responds to certain particular variations in generator voltage.

987,200. ELECTRIC SWITCH; O. B. Whipple, Saginaw, Mich. App. filed Nov. 22, 1910. Hand-operated knife switch with heavy current on starting the motor and light current on running it, the movement of one handle throwing in a fuse of large size, then cutting it out and throwing in a fuse of smaller size, the fuses being arranged on the movable switch frame.

987,220. BURGLAR-ALARM PLATES; G. Dzerma, Bellefontaine, Ohio. App. filed Nov. 4, 1909. Sounds an alarm when stepping on the mat; the mat consists of an upper plate with an opening, an intermediate plate with openings and a spring plate with ends in contact with the base plate and also with the upper plate and bridging the opening in the upper plate.

987,228. ELECTROTHERMAL CONTROLLING APPARATUS; W. O. Haymond and J. O. Potter, Muncie, Ind. App. filed July 7, 1909. For heating systems supplying hot and cold air by means of an electric motor, a worm wheel connected thereto and a thermostat with electromagnets and switches, the motor cutting out the active magnet and opening the motor circuit when the device has reached the end of this movement.

987,239. SNAP SWITCH; C. J. Klein, New York, N. Y. App. filed Feb. 20, 1908. Socket for snap, switch of a push and cam type, the push button and cam and operating parts of the switch being freely and simultaneously removable from the socket sections.

987,240. SNAP SWITCH; C. J. Klein, New York, N. Y. App. filed Sept. 20, 1907. Electric snap switch in which the lever carrying the switch contact is given a snap action by push button and double cone, a spring surrounding the cone and connected to the lever.

987,241. SNAP SWITCH; C. J. Klein, New York, N. Y. App. filed Feb. 20, 1908. Push button snap switch, push button carrying a double cone between its ends upon which a tilting and rocking switch lever is mounted, which is given a snap action by a spring surrounding the cone and attached to the lever, the parts being mounted in a casing.

987,254. ACTUATING MEANS FOR ELECTRIC METER RECORDERS; C. M. Page, Dixon, Ill. App. filed Aug. 30, 1909. For registering and recording electric and similar meters, driven by an electric motor, the circuit of which is momentarily and intermittently closed when the meter is in operation. Improvements in the construction of a switch, which with very little power controls the register motor circuit.

987,270. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Feb. 21, 1908. Includes a storage battery and booster with a rotary converter to steady the load on the main alternating current generator, the improvements relating to the rectification of the currents for the regulating portion of the system, the rectifier having windings connected to the alternating and direct sides of the regulating portions of the system, the winding in inductive relation to magnetizable material, so that all the flux in the rectifier is produced by the current in the winding. This reduces sparking and decreases the motor action of the rectifier.

987,274. ILLUMINATED SIGN; H. E. Westerberg, Seattle, Wash. App. filed Feb. 8, 1909. Makes a hand grasping a stylus write the sign by means of an endless belt following the contour of the sign, with a pointer on the belt.

987,293. ELECTRICALLY HEATED MATRIX PRESS; H. B. Gale, Natick, Mass. App. filed Feb. 10, 1910. A plate with a heating resistance adjacent thereto, the resistance in sections with different coefficients for the outside and central parts of the plate and a switch for directing current through the sections in series or in multiple.

987,300. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed June 2, 1907. For keeping substantially constant the power factor which is controlled by a synchronously driven electric machine in accordance with wattless energy changes in the circuit so that the effect of the compensator upon the circuit is varied as the energy changes.

987,301. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed June 22, 1907. Storage battery compensates to steady the load on the alternating current generator, and the action of the battery is regulated by a booster controlled by changes of the main generator and by varying inductance connected to the alternating circuit which varies the power factor of the circuit, this being controlled by the power factor changes of the circuit.

987,304. TELEPHONE; W. J. C. Kenyon, Chicago, Ill. App. filed June 1, 1908. Telephone desk set with a transmitter at the end of the standard, a rigid shaft projecting laterally from the end of the standard and a flexible self-supported shaft at an angle to the rigid shaft permanently carrying the receiver, so as to avoid the necessity of holding it by hand.

987,306. SNAP SWITCH; C. J. Klein, New York, N. Y. App. filed Sept. 20, 1907. Push button snap switch in which a double cone between the push buttons is surrounded by a spring whose ends are attached to the lever riding upon the cone.

987,318. MANUFACTURE OF THIN ELECTROLYTIC IRON PLATES OF LARGE AREA; W. Pfanhauser, Leipzig, Germany. App. filed Sept. 24, 1910. For making ductile iron by electro deposition from hot solutions of iron salts with the use of high-current densities.

987,338. SWITCH; E. E. Yaxley. App. filed July 21, 1906. Electromagnet operating switches for telephone switchboards, the jack-switch being electrically connected with the magnet and at the end opposite to the armature so as to permit ready removal of the spool.

987,339. ELECTRIC GAS-IGNITING FIXTURE; H. Younker, Louisiana, Mo. App. filed May 27, 1910. Electric gas igniter or fixture with valve and pilot tube and electric contact member carried by the pilot tube. A longitudinally movable bar carries another contact and is moved when the valve is moved.

987,356. ELECTRIC LAMP SOCKET CAP; G. W. Goodridge, Bridgeport, Conn. App. filed Jan. 10, 1911. Has a shouldered skirt with latching elements, the shoulder being perforated and an inclosing ring with tongues entering the perforation and offset to lock the ring on the cap.

987,357. ELECTRIC SWITCH FOR TELEPHONE BOOTHS; S. M. O. Grant, Pittsburg, Pa. App. filed May 15, 1910. A switch with support, contact pieces and socket, the metal tube extending through the pieces carrying a contact plug, a pair of spring pressed rods in the support and connected with the battery.

987,404. ELECTRIC INDUCTION FURNACE; W. Rodenhauser, Volklingen-on-Saar, Germany. App. filed Nov. 3, 1908. Has a primary winding surrounding the core of the melting chamber, the core being made of laminæ and piercing the hearth and facing the open working portion of the hearth.

987,414. ELECTRIC LAMP SOCKET; G. B. Thomas, Bridgeport, Conn. App. filed Jan. 11, 1911. Has a recessed casing containing a coil forming a side contact for the lamp base.

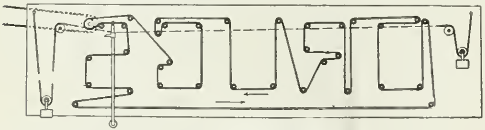
987,428. APPARATUS FOR THE TREATMENT OF ORES AND FOR THE ELECTROLYTIC DEPOSITION OF GOLD AND SILVER AND OTHER METALS FROM SOLUTIONS CONTAINING SAID METALS; F. C. Brown, Komata, New Zealand. App. filed Aug. 5, 1907. A vessel for ore pulp containing a circulating pipe, a fluid supply pipe extending through the first pipe, a second fluid supply pipe outside of the first pipe and electro deposition device in the path of the pulp.

987,441. CURRENT-CONTROLLING APPARATUS; W. N. Dickinson, Jr., Brooklyn, N. Y. App. filed Oct. 23, 1905. Electric motor with reversing switches, a pilot motor pivoted to a fixed support carrying switch arms and a base carrying one set of contacts for each reversing switch.

987,446. PUSH-BUTTON CONTROL FOR ELEVATOR AND DUMB-WAITER SYSTEMS; E. L. Dunn, Worcester, Mass. App. filed Feb. 14, 1908. For controlling a hoisting machine by means of a commutator having a contact maker which shifts its position in response to push buttons and acts as a selector.

987,483. TUNGSTEN INCANDESCENT LAMP; J. J. O'Brien, Shamokin, Pa. App. filed June 1, 1910. A tubular insulating support through which a wire leads and looped wires connected with the wire at a point within the support.

987,493. ELECTRIC WATER HEATER; H. N. Roche and W. R. Ray, San Francisco, Cal. App. filed Aug. 3, 1910. A rotary snap switch completing an electric circuit through the heater and operated by a water valve stem, with a pair of independent loose walking beams on the switch stem adapted to rotate the stem when oscillated and connections between the lever and the beams to actuate the latter when the valve stem is moved.

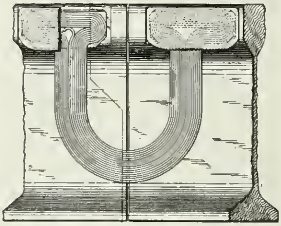


987,274.—Illuminated Sign.

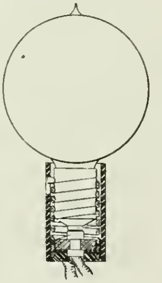
987,495. ALTERNATING-CURRENT PLANT COMBINED WITH STORAGE BATTERY; L. Schroder and A. Muller, Berlin, Germany. App. filed Oct. 7, 1904. Regulates the charge and discharge so that if the current varies the main motor actuating the main generator works under constant load. Includes a motor generator, storage battery, series transformer and rotary converter.

987,515. INSULATED HANGER FOR TROLLEY WIRES; J. L. Wagner, Syracuse, N. Y. App. filed April 30, 1910. An insulator with annular shoulder, jaws above the shoulder with depending lower ends that are threaded and are drawn together by a clamping nut.

987,536. METHODS OF AND APPARATUS FOR COOLING ELECTRICAL GENERATORS AND MOTORS; F. G. Baum, San Francisco, Cal. App. filed Sept. 7, 1910. Drives a current of air through the generator, which air is saturated with moisture, cools it and takes away the heat in the generator by permitting it to dry the air.



987,136.—Rail Bond.



987,414.—Electric Lamp Socket.

987,563. TELEPHONE ATTACHMENT; C. L. Fields, Rochester, Ind. App. filed July 9, 1910. Telephone attachment for the head of the operator, with a mouth section, an ear section, including mufflers and a pair of flexible tubes from the mouth section to the ear section.

987,581. SNAP SWITCH; S. Korf, Chicago, Ill. App. filed June 6, 1910. For lamp sockets, having a ratchet wheel turned by a ratchet and spring with a pull chain for operating the same.

987,582. TELEGRAPH AND TELEPHONE SYSTEM; O. T. Lademann, Milwaukee, Wis. App. filed July 24, 1908. Combined telegraph and telephone for carrying on a plurality of conversations and also telegraphing simultaneously with a telegraph relay at each station which prevents telephonic interference, a telephone at each station which can be plugged in to either one of the incoming ends of adjacent portions of the line wire, and a high frequency signal receiver in series with the ground.

987,622. ELECTROLYTIC CELL; V. E. Goodwin, Schenectady, N. Y. App. filed Sept. 1, 1909. A plurality of superimposed disk-shaped aluminum pans acting as a condenser in a tank of insulating liquid, with means to permit circulation of the insulating fluid.

987,630. QUADRUPLEX TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed Aug. 10, 1910. Two sets of batteries oppositely connected and normally in line, the transmitter short-circuiting one set and another transmitter short-circuiting part of the second set and both transmitters short-circuiting the remaining unshunted part of the second set.

987,631. QUADRUPLEX PRINTING TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed Sept. 3, 1910. Quadruplex system with four transmitters, two for each terminal, each including a localized differenterial polar relay, which is actuated in accordance with the characters to be transmitted and having two sources of current in opposition at each terminal, the relay shunting one or the other of the batteries at one or the other of the stations.

987,632. SNAP SWITCH; C. J. Klein, New York, N. Y. App. filed Feb. 20, 1908. Push button snap switch with double cone between the buttons, a coiled spring surrounding the cone and held from bodily movement by walls in the socket, the tension of the spring co-operating with the cones to give a snap action to the push button which makes and breaks the circuit.

987,637. LOCKING KEY; F. R. McBerty, New Rochelle, N. Y. App. filed Sept. 5, 1908. For telephone systems in which a group of keys, each controlled by one or more pairs of contacts, each having an armature adapted when the key is operated to be pressed into engagement with the poles of an electromagnet and thus held in its operative position until the electromagnet is de-energized.

987,647. PRIMARY BATTERY; C. B. Schoenmehl, Waterbury, Conn. App. filed Feb. 4, 1910. Primary battery with cylindrical electrode, one within the other, the one being of copper oxide, another of zinc surrounding it and a third zinc positive electrode within the copper negative electrode.

987,648. BATTERY ELEMENT SUPPORT; C. B. Schoenmehl, Waterbury, Conn. App. filed Dec. 9, 1910. Primary battery with oxide of copper scale and zinc as electrodes, the zinc being both inside and outside of the basket containing the copper scales.

987,650. METERING ELECTRICAL DISTRIBUTION SYSTEM, INCLUDING A METERING PANELBOARD; F. F. Skeel, Chicago, Ill. App. filed Aug. 7, 1905. Installed when the building is wired for the maximum number of meters. Wiring system.

987,658. ELECTRIC HEATER AND STERILIZER; J. G. Wallmann, Oakland, Cal. App. filed Nov. 8, 1909. A vessel with top and bottom openings and a handle through which the wires run with cup-shaped frame in the vessel and a plurality of electrodes of opposite polarity within the vessel.

987,653. RAILWAY SIGNAL; J. B. Struble, Wilkinsburg, Pa. App. filed July 19, 1909. A semaphore for two positions, an operating train of gears, an electric motor and electric means for holding the semaphore. Details.

987,669. FIRE PROTECTING AND SIGNALING APPARATUS; A. Busch, Riga, Russia. App. filed Oct. 27, 1909. Fire protecting and signaling system with sprinkler, started by electric magnets communicating with thermostats.

987,673. ELEVATOR OPERATING SYSTEM; E. L. Dunn, Worcester, Mass. App. filed July 2, 1906. A controlling mechanism with series of contacts for the different floors, an arm therefor, a conductor connecting the arm with the power main and means outside of the controller for making a motor-stopping circuit through each contact as the elevator car passes the floors. A signal lamp is operated to show whether the car is in motion or not. Particularly for dumbwaiters.

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A LESSON IN ECONOMY.

The article by Mr. Warren H. Miller in this issue on the so-called locomobile electric plants is one which ought to bring a blush to the cheeks of our countrymen who pride themselves on their progressiveness in engineering matters and in manufacture. We have been preaching superheated steam in season and out of season for some years past and even now its use is only sporadic. When one looks at the record of the German units his patriotic fervor for American enterprise receives something like a cold douche. When one considers that there are many thousands of these units in use varying from less than 100 hp to 600 hp and on the average producing the hp-hour on less than 10 lb. of steam he can only wonder in a dazed sort of way how our engineers and manufacturers have allowed themselves to be outdone without a single recorded effort in self-defense. The typical locomobile superheated steam unit is merely an intelligently designed self-contained combination of boiler, superheater and compound condensing engine, so arranged as to eliminate as far as possible all the incidental heat losses and consequently to operate at an enormously high efficiency.

In one of the typical plants described by Mr. Miller the units are of only 200 hp, but by means of double superheating the coal consumption is brought down to barely over 1 lb. per hp-hour. This remarkable result is obtained simply by intelligent design. The engines are compound condensing and the cylinders are jacketed in the steam dome. The steam at 170 lb. pressure is carried to a temperature of 570 deg. before it enters the high-pressure cylinder, is expanded down to about 260 deg., rises in the low-pressure superheater to about 370 deg., is expanded down to about 150 deg., and even then passes through a feed-water heater to give up the last available thermal unit. The total floor area occupied by the plant is only 45 ft. x 60 ft. and the saving both of fuel and labor over ordinary American practice is enormous. This same kind of performance is repeated over and over again in similar plants throughout Germany and the great industrial territory scattered all over the world which is gradually becoming tributary to German enterprise. The performance of these units even with poor coal is something extraordinary in the way of economy.

With the introduction of apparatus of this kind the reciprocating engine gets a new lease of life. Fine as are the results which have been obtained from American steam turbines, one can only too readily fancy the look of horror that would come over a turbine engineer if casually asked to guarantee a performance of 10 lb. of steam per brake hp-hour on a 200-hp unit. Indeed, he would be grievously worried to duplicate the best performances of these little superheated steam sets with an equipment of any rating whatever. It is putting it mildly to say that machines of this class are capable of cutting the coal consumption and labor in two, as indeed the properly planned superheating plant should. They are doing the work which in this country is mostly done by high-speed single-cylinder engines using at least 30 lb. of steam per indicated hp-hour and requiring the service of two men instead of one. We hear rumbling in the distance a deprecatory chorus about upkeep and repairs, but the fact is that the Continental engineers have already had a good deal of experience with superheated steam and are not in the least afraid of it, while high superheating is here looked upon with the distrust that is born of ignorance. If any one thinks that we are putting the case too strongly, let him the next time he wants a small generating unit try the experiment of asking bids on a superheated steam equipment with a guarantee of 10 lb. of steam per brake hp-hour. It would be interesting to see the correspondence which would follow the proposition.

The simple fact is that the American mania for so-called standardization has blinded us on this side of the water to what is really going on in the world. High superheating doubtless has its difficulties like every other improvement. Yet the Continental engineers who are working along that line lack neither in skill nor in experience and would not be willing to send equipment of this kind to the ends of the earth to be run by untrained men unless they were prepared to stand back of it. American manufacturers, we may be proud to say, can do as good work as any in the world, and American engineers are fully capable of holding up their end, but the latter cannot move until the former tell them to go ahead and the former consistently dodge the introduction of unfamiliar apparatus until they are clubbed by commercial pressure into the path of progress. They move along the path of least resistance and unfortunately this is not upon an up grade. We understand fully the commercial forces that tend toward standardization of output and we do not undervalue the convenience of this standardization, yet the time comes when a break has to be made, and when this time comes it is necessary to work quickly. In our judgment the psychological moment in superheated steam work is near at hand. Suppose, for example, the not impossible case of the abolition of the tariff on such machinery as is here under consideration and the subsequent irruption of active German agencies. How, indeed, could competition be met if the tariff were even materially lowered? If our American manufacturers do not brace up and meet the situation they will wake up some fine morning to find their business imperiled. Making all due allowances for possible German over-enthusiasm and for possible unforeseen difficulties, the fact remains that the apparatus here described has passed the experimental stage and has brought the generation of electrical energy from steam onto a new plane of economy.

ELECTRICAL PUMPING FOR WATER-WORKS.

Numerous installations have demonstrated long since the entire practicability of driving pumps in water-works stations by electric motors. In city water-works reliability of service is an essential, of course, and it has been shown that electric motors may be relied upon to do the work. However, steam-pumping engines, operating at steady load, represent reciprocating engines at their best, and there has been some question whether the electric pumps could equal them in economy of operation. The question is materially influenced, naturally, by the cost of electrical energy on the one hand and of steam production on the other.

A test is to be made at the West Side pumping station of the Chicago municipal water-works system that should throw some light on the subject. In this case electrical energy is to be obtained from the hydroelectric development on the Chicago Drainage Canal to operate two centrifugal pumps, each capable of delivering 25,000,000 gal. daily under a total head of 115 ft. Energy will be sold to the city by the Sanitary District at a rate which will be low, perhaps $15 a hp-year for twenty-four-hour operation. The pumps will be driven by synchronous motors. The pumps will be installed under conditions that will permit of exact measurement of the electrical energy consumed and the water pumped. It will be possible, therefore, to make an interesting determination of the cost of pumping water into the city mains under these especially favorable conditions. No doubt it will be low, including interest and depreciation, and probably less than the cost of steam pumping. If so, it is probable that the use of electric pumps will be extended gradually to other pumping stations of the city, for the Sanitary District, which governs the Drainage Canal, has sufficient energy available or in sight to drive all the pumps of the water department that it would be safe to operate by electricity alone. It will hardly be considered safe engineering to have all the pumps of the city driven by Drainage Canal power because the transmission line, although exceptionally well built, is thirty miles long, and in the event of a great conflagration it would be hazardous to be dependent exclusively upon it.

PROMOTING THE USE OF ELECTRICITY IN FARMING DISTRICTS.

It is gratifying to observe that the possibility of extending greatly the use of electrical energy in rural districts—a subject to which this journal has devoted considerable attention—is now engaging the earnest attention of many central-station operators. The National Electric Light Association's committee on "electricity in rural districts," appointed recently, is busily at work and has collected already data of much value to form the basis of a useful report, while it has nearly two months remaining in which to work and still present its findings to the secretary of the association a month before the convention, as all good committees should strive to do. The committee consists of eight members residing in the States of Massachusetts, New York, Illinois, Nebraska, Colorado and California. It is thus widely distributed geographically, and as to each man is assigned a certain territory to cover in making the investigation the report should be of value and of local application in all sections of the country.

The committee, through its chairman and its members, asks the co-operation of all central-station men who can give it information of actual installations of electric lamps, motors or other appliances on farms or country estates, or, generally, in the rural districts. Attention is directed more particularly, of course, to what has been accomplished, or what it is hoped to accomplish, in the United States and Canada; but some attention will also be given to foreign practice in relation to rural distribution and application, for it must be confessed that France, Germany and Italy have something to teach us in this respect. The work of supplying electricity along country highways is now in the pioneer stage, but there seems to be no question that this development is one which is bound to be greatly extended. The N. E. L. A. committee is trying to take note of what has been accomplished and to call particular attention to what seem to be the best methods of meeting the situation, which, with boundless possibilities, is not without its perplexities. Investigations of this kind are of self-evident value, and the National Electric Light Association is perhaps the organization best fitted to undertake them. We trust that all readers of this journal who are interested in rural electrical distribution will give the committee the benefit of their experience.

"GOING VALUE" OF PUBLIC UTILITIES.

In a recent decision of the Oklahoma Supreme Court, reported in these columns, it was held that the valuation of a telephone plant, for rate-making purposes, should include an allowance for "going value." This is but another instance of the fact, which the courts have usually recognized, that "going value" is an essential element in determining the value of a public utility. Few utilities, if any, can be made self-sustaining from the first day of their operation. Several years must elapse before the earnings are sufficient to cover operating expenses, including depreciation and a reasonable rate of interest on the investment. The amount by which the earnings fail to meet these requirements may be regarded as a deficit, and, as such, constitutes a part of the cost of building up a business. This loss is unavoidable in the early years of every public utility. The question has been whether this loss shall be borne by the owners of the plant, by the initial consumers, or be treated as a part of the investment, or value of the plant, constituting the basis upon which consumers shall pay interest. The public cannot expect, as a business proposition, that the loss shall be borne by the utility, for investors in public-service corporations expect and deserve a return upon their investments from the time when they were made, and if the law required that a portion of the investment should yield no return it would be a difficult matter to induce capital to favor this form of investment; nor would it be fair to the capital already invested. It is not evident that this loss should be borne by the initial consumers in the form of excessive rates, but there may be cases where it is desirable that the losses be carried along and written off out of the surplus earnings. When "going value" is capitalized it becomes a permanent charge upon the consumers and is included in the valuation upon which interest is earned. Under these conditions the burden is distributed among those who receive the benefits of the expenditures and the use of the public utility in its enhanced value. This method seems the most logical and satisfactory way of dealing with the problem.

"Going value" is not a mere unearned increment in every case; neither should it be the means of fictitiously increasing values or creating values which do not exist. It is too often made the excuse for unreasonable charges by those public utilities whose rates are based upon what the public will bear. When unrestricted it becomes an evil pretty closely associated with watered stock The cost of building up a business admits of approximate computation and should be determined when it is to be made an element of total valuation. It has been held, however, that the expenditures and deficits involved must be legitimate and reasonable, and should not include items that have been incurred under other than usual conditions, or items that could have been avoided by the exercise of ordinary care and business judgment. The element of "going value" is, in short, an item which requires careful analysis if justice is to be done both consumer and utility. Although authorities agree as to its reasonableness, it is not a value that can be assigned arbitrarily. It has a distinct value in each case, depending upon the particular circumstances involved; it may be positive, zero or even negative, and is closely associated with the entire financial history of the utility. While the courts are competent to pass on the equity of the question, the determination of what constitutes a fair and equitable amount to be charged against the capital account for building up a business requires a discretion and a technical knowledge of the matters involved which the courts are not presumed to possess. Questions of this nature can best be handled by those whose training and experience fit them to take an accurate and unbiased view of the factors involved. To determine the cost of building up a business is not always an easy matter. To ascertain it may require an extended knowledge of the economies of utility operation and a considerable number of data relating to the plant in question or to other plants similarly situated. The work is often rendered difficult by the fact that so few utilities ordinarily, unless compelled to by commission control, keep an accurate account of all the expenses incurred in building up their business.

Much excellent work upon the subject of "going value" has been done by the Wisconsin Railroad Commission. Its aim in the cases before it has been to ascertain, in so far as possible, the unrequited expenditures incurred in establishing the business of a public utility upon a basis where operating revenues become adequate to meet all the legitimate demands of the utility. One of the methods employed was outlined recently in the summary of a case in these columns. In this case the company and its experts testified that a sum of $300,000 should be allowed for going value, and that this amount should be added to the total valuation. The commission found that the company was entitled to no "going value" whatsoever, inasmuch as the cost of building up the business had been more than made up through excessive rates extending over a period of years. This decision was not offhand, but the result of great care in gathering statistics conclusively accurate. Besides the Oklahoma Supreme Court previously mentioned, several other courts and utility commissions have followed the methods of the Wisconsin Commission in forming an estimate of the amount to be allowed for building up a business, and with satisfactory results. It is obvious that "going value" is an element which must be taken into consideration, and it is equally apparent that some logical method must be employed in fixing this value. It cannot be said that any one method is the exclusive one except as results show it to be the most equitable. The question of "going value," which affects so materially the total valuation of any public utility, merits the most careful consideration on the part of trained and experienced men, for both utility and consumer are vitally concerned in its correct determination.

Meetings of A. I. E. E.

A meeting of the American Institute of Electrical Engineers will be held in the Engineering Societies Building, New York, on April 14. The following papers will be presented: *The Effect of Temperature Upon the Hysteresis Loss in Sheet Steel,* by Prof. Malcolm MacLaren, of the electrical engineering department of Princeton University, and *Commercial Testing of Sheet Steel for Hysteresis Loss,* by Mr. L. T. Robinson, engineer, General Electric Company, Schenectady, N. Y.

PACIFIC COAST MEETING.

At the Pacific Coast meeting of the Institute to be held in Los Angeles on April 25, 26, 27 and 28 the following papers will be presented and discussed: *Transmission Applied to Irrigation,* by Messrs. O. H. Ensign and J. M. Gaylord; *Cisoidal Oscillations,* by Mr. G. A. Campbell; *Continuity of Service in Transmission Systems,* by Mr. M. T. Crawford; *New Automatic Telephone Equipment,* by Mr. Charles S. Winston; *Auto-Manual Telephone Systems,* by Mr. Edward E. Clement; *Some Recent Developments in Railway Telephony,* by Mr. Gregory Brown; *Electricity in the Lumber Industry,* by Mr. E. J. Barry; *The Refining of Iron and Steel by Induction-Type Furnaces,* by Mr. C. F. Elwell; *Transmission Systems from the Operating Standpoint,* by Mr. R. J. C. Wood; *A Power Diagram Indicator for High-Tension Circuit,* by Prof. Harris J. Ryan.

Arrangements have been made for transportation on the Supply Jobbers' special train which will leave Chicago on April 18 over the Santa Fé route. The rate of fare from Chicago to Los Angeles and return on the special train or on other trains leaving April 18, 19 or 20 will be $72.50.

TORONTO MEETING.

A meeting of the Institute will be held in Toronto on April 7. A paper will be presented by Mr. W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad Company, entitled *Electrification Analyzed, and Its Practical Application to Trunk Line Roads, Inclusive of Freight and Passenger Operation.* The paper is an analysis of the electrical operation of the New York, New Haven & Hartford Railroad, which it compares with steam operation, and shows a decided advantage in favor of the former.

Central-Station Welfare Work.

The public policy committee of the National Electric Light Association held a meeting in New York on March 28, when the report on welfare work as related to the central-station industry was adopted and the recommendations were put in shape for presentation at the annual convention in New York in May. The plans proposed include accident insurance, sickness insurance and death benefits, service annuities, profit sharing, employees' savings and investment funds and life insurance, although with regard to the last item it is suggested that the companies limit themselves to providing their employees with all possible information in connection with safe low-cost life insurance and do not put in force any plan of their own.

The report will give in detail the methods by which provision can be made under each of the other heads. By unanimous vote the term "pension" has been dropped and the service annuity adopted as the recognition of an automatic recompense for continuous service, and the committee expressed the opinion that member companies should provide such annuities for every male employee reaching the age of sixty-five and every female employee of sixty years after continuous and satisfactory record of ten years of service. The details of profit sharing are based upon the idea that it is better to have those engaged in the industry as partners rather than as employees; that preferably profits of the employee based upon his wage scale should reach him in the securities of his company, and that dividends upon such securities should be paid in cash, in the manner customary with other security holders. Details are also given with regard to savings funds and investment funds, with the object of promoting thrift among employees and, where feasible, combining the plan with profit sharing, it having been found that the two work out very satisfactorily together.

The personnel of the committee is Mr. Charles L. Edgar, chairman, president of the Edison Electric Illuminating Company, Boston, Mass.; Messrs. Nicholas F. Brady, vice-president of the New York Edison Company; Charles A. Stone, of Stone & Webster Corporation; H. M. Byllesby, whose company is also operating and managing numerous central-station properties; Henry L. Doherty, president of the Denver Gas & Electric Company; W. W. Freeman, president of the National Electric Light Association and vice-president of the Brooklyn Edison Company; Samuel Insull, president of the Commonwealth Edison Company, Chicago; Joseph B. McCall, president of the Philadelphia Electric Company; Samuel Scovil, vice-president of the Cleveland Electric Illuminating Company, and General George H. Harries, vice-president of the Washington (D. C.) Railway & Electric Company; Mr. Everett W. Burdett, counsel of the N. E. L. A., and Mr. Arthur Williams, of the New York Edison Company, vice-chairman of the committee. The committee has also had the active co-operation of Mr. Thomas E. Murray, president of the Association of Edison Illuminating Companies, and Messrs. W. H. Blood, Jr., and R. S. Hale.

It is believed that it is the first time in the history of the country that an association representing so many corporations and representing over 90 per cent of the investment and earnings in the industry for which it stands has taken up such a subject in this comprehensive and thorough-going manner, and the report itself will be awaited with the utmost interest by all connected with public utilities and by economists in general.

Meeting of the Electric Vehicle Association of America.

At the regular monthly meeting of the Electric Vehicle Association of America held in the Engineering Societies Building, New York City, March 28, President Blood announced that the publicity committee had already raised a fund of over $23,000 among the central-station companies and that it was expected to raise $25,000 among the manufacturers. The money will be used in a national publicity campaign on the electric vehicle. The standardization committee, he also announced, expects to make definite recommendations shortly on charging plugs for pleasure vehicles. Mr. Frank W. Smith, speaking for the membership committee, stated that including the Electric Vehicle and Central Station Association of Boston the membership of the association now totals 240.

The topic of the evening was "Tires: Their Use and Abuse," by Mr. D. C. Swander, of the Firestone Tire & Rubber Company, New York. The author considered pleasure and commercial vehicles separately and said that opinion differed as to the superiority of solid or pneumatic tires for pleasure-vehicle work. Manufacturers design the springs of cars with a view to using one or the other kind of tire equipment. His company's experiments show that the pneumatic tire designed for service on electric pleasure vehicles cannot be made to secure both economy in energy consumption and satisfactory mileage, and for that reason has dismissed pneumatic tires as a serious possibility on pleasure cars. Solid tires are made in various shapes and standardization is most needed in the cushion type, where variations in the volume of rubber are as high as 40 per cent between different makes. For commercial electric vehicles solid tires are essential, pneumatics being quickly destroyed on account of the great loads. The side-wire tire in both channel and flange types is in wide use, and lately the dual motor tire has been adopted for rear wheels of heavy cars. The author described the various types of tires, pointing out the improvements made within recent years to overcome certain defects which long experience and use have revealed. Mr. Swander pointed out the importance to the electric vehicle trade of a tire which will not call for undue expenditure of electrical energy and which will give ample resiliency to prevent jarring the batteries and to protect the mechanism. A hard tire will show decreased energy consumption in the vehicle, but damage to battery and mechanism, while a resilient tire that will absorb stones and pebbles will result in excessive energy consumption and insufficient mileage. A tire which is a mean of these and combines economy of energy with proper resiliency is expensive if it also entails good wearing quality. The ease of repairing solid tires was emphasized. The author claimed that there is great room for improvement in solid-rubber tires. Reduced tire expense is possible, he said, if cars are equipped with a tire of adequate size. The following tire sizes were recommended:

Size of Tires, Inches.	Carnegie Channel, Inches.	Endless Channel, Rim No.	Extreme Load, Pounds
2	2½	2	500
2½	3	2½	750
3	3½	3	950
3½	4	3½	1375
4		4	1750
5		5	2000
6		6	3000
7		7	4000
2½ Dual	Two 3	Two 2½	1900
3 Dual	Two 3½	Two 3	2500
3½ Dual	Two 4	Two 3½	3500
4 Dual		Two 4	5000

If properly cared for and inspected tires can be made to give ample service. Nine suggestions on the care of tires which aim in reducing the most common abuses were appended to the paper. These are printed on a placard by the Firestone company for the guidance of drivers.

The paper was discussed by Messrs. Blood, Lloyd, Wagoner, Wilcox, Stoughton, Appleton, Marsh and Phillips, the discussion consisting chiefly of questions for the author to answer.

American Institute of Consulting Engineers.

The American Institute of Consulting Engineers, recently organized, has now a membership of forty-two. Membership in the body is limited by the constitution to engineers actively engaged in the practice of their profession as consulting engineers and who are not engaged in contracting. A candidate to be eligible for membership must be at least thirty-five years of age, must be a full member in good standing in one of the national civil, electrical, mechanical or mining engineering bodies, or have been an engineer officer in the United States army or navy. Election to membership requires seven favorable votes of the total nine votes of the council. The entrance fee is $10 and the annual dues $25.

An official annual ticket for election of officers is prepared by a nominating committee of three members of the Institute appointed by the council. Other nominations may be made in writing, which, if signed by at least fifteen members, are mailed to each member.

The present officers of the body are Mr. Alfred P. Boller, president; Mr. Gustav Lindenthal, vice-president, and Mr. Eugene W. Stern, 103 Park Avenue, New York, secretary. The following electrical engineers are members of the society: Messrs. Frank J. Sprague, L. B. Stillwell, George F. Sever, C. O. Mailloux and L. B. Marks. Among leaders in other branches of engineering who are members in addition to the officers above named are Gen. T. A. Bingham, Prof. George F. Swain, Messrs. E. L. Corthell, Rudolph Hering, H. W. Post, W. J. Wilgus, R. P. Bolton, J. F. Wallace, Charles Sooysmith, Henry R. Buck and F. A. Molitor.

Convention of Iowa Electrical Association.

At the eleventh annual convention of the Iowa Electrical Association, to be held in Davenport on April 19 and 20, the following papers will be presented: *Waterloo Transmission Records*, by Mr. Ira L. Craig; *Underground Distribution in Medium-Size Cities*, by Mr. H. B. Gear; *Refrigerating Advantages and Disadvantages*, by Mr. G. W. Du Mont; *Flat Rates for Small-Demand Consumers*, by Prof. A. H. Ford; *The Electric Automobile*, by Mr. F. H. Golding; *Methods of Securing Motor Loads and Properly Installing the Apparatus*, by Mr. Harry G. Glass; *Ornamental Curb Illumination*, by Mr. J. D. A. Cross; *Public Policy*, by Mr. George Carson.

The entertainment features include a smoker on Wednesday evening, when a vaudeville performance will be witnessed. On Thursday evening the members will be taken in a party to one of the theaters. Immediately after the theater performance the Sons of Jove will hold a rejuvenation at Kimball Hotel. The president of the association is Mr. Thomas Crawford, Clinton; the secretary is Mr. W. N. Keisen, Dubuque.

Convention of the Southwestern Electrical & Gas Association.

Several of the papers to be presented at the convention of the Southwestern Electrical & Gas Association at Houston, Tex., on April 27, 28 and 29 will be of special interest to electrical engineers. Among these are the following: *Investigation and Core of Return Currents*, by Mr. George H. Clifford; *Development of Electric Motor-Service Business*, by Mr. P. A. Rogers; *Practical Tests of Railway Equipment*.

A committee, of which Mr. M. B. Wheeler, 602 Preston Boulevard, Houston, is chairman, is making arrangements for an elaborate electrical show to be held in the Municipal Auditorium, where the meetings will also be held. The show will be conducted on a co-operative plan: any excess of income from exhibit spaces above expenditures will be returned pro rata to the exhibitors.

The Sons of Jove will hold a rejuvenation on April 28.

The president of the association is Mr. W. B. Tuttle and the secretary Mr. D. G. Fisher, 1316 Commerce Street, Dallas.

Congress of Technology at Boston.

The Congress of Technology to celebrate the fiftieth anniversary of the founding of the Massachusetts Institute of Technology will be held at Boston on April 10 and 11, 1911. The sessions will be open to the public, and a large number of papers are to be read by graduates of the institute on topics of an industrial, economic and engineering character. The practical applications of science to the affairs of modern life will be surveyed by authorities in different fields, and the conditions and problems in many industries will be reviewed. Members of the institute faculty will also contribute to the discussions.

The papers will cover such general subjects as architecture, business administration, economics, public health and factory sanitation, industrial organization and education, power production and distribution, materials and manufacturing processes, and the reclamation of arid lands. Among the speakers and topics of electrical and allied interests will be the following: "Reliability of Materials," by Mr. Walter C. Fish ('87), manager Lynn works, General Electric Company; "Scientific Industrial Operation," by Mr. Tracy Lyon ('85), assistant to vice-president, Westinghouse Electric & Manufacturing Company; "Scientific Management," by Mr. David Van Alstyne ('86), Allis-Chalmers Company, Milwaukee; "The Control of Thermal Operations and the Bureau of Standards," by Mr. George K. Burgess ('96), Bureau of Standards, Washington, D. C.; "Coal Combustion Recorders," by Prof. A. H. Gill ('84), Massachusetts Institute of Technology; "Thirty Years' Work in Boiler Testing," by Mr. George H. Barrus ('74), consulting engineer, Boston; "Analysis of Some Losses of Efficiency in a Large Producer-Gas Plant," by Mr. J. G. Callan ('06), electrical engineer, Arthur D. Little, Inc., Boston; "Power Plant Betterment," by Mr. H. H. Hunt ('80), Stone & Webster Management Association, Boston; "The Engineer and Architect Unite," by Mr. L. S. Cowles, Boston Elevated Railway Company, Boston: "An Electric Furnace for Zinc Smelting," by Francis A. Fitzgerald ('95), consulting engineer, Niagara Falls, N. Y.: "The Improvements in Efficiency of Electric Lighting Properties and What the Public Gains Through These Improvements," by Mr. William H. Blood, Jr. ('84), technical expert, Stone & Webster, Boston; "The General Solution for Alternating-Current Networks," by Mr. George A. Campbell ('91), research engineer, American Telegraph & Telephone Company, New York; and "Research as a Financial Asset," by Mr. Willis R. Whitney, director research laboratory, General Electric Company, Schenectady, N. Y. Among the other speakers whose topics are not yet announced will be Messrs. Henry G. Bradlee, of the firm of Stone & Webster, Boston, and Louis A. Ferguson, second vice-president Commonwealth Edison Company, Chicago.

The congress will be concluded by a subscription banquet in Symphony Hall, at which addresses will be made by speakers of national reputation. Mr. Walter Humphreys, 491 Boylston Street, Boston, is active in the preparations.

The Schaefer Resuscitation Method in England.

Our correspondent in Berlin, Germany, in a recent interview was informed by Prof. Gisbert Kapp, of the University of Birmingham and formerly secretary of the German Electrical Association, that, according to information received from Professor Cadman, of the University of Birmingham, the Schaefer method of artificial respiration has been employed with good success in England and is there almost universally in use. English experience is, therefore, not in agreement with the opinion of German specialists as indicated in the report of the National Board of Health of Germany against the use of the Schaefer method in Germany.

Mechanical Device for Resuscitation from Electric Shock.

The Bureau of Mines, Washington, D. C., has received for test an oxygen resuscitating apparatus made by the Drager-Werke, Lubeck, Germany, an illustration of which is shown herewith. The apparatus was designed for resuscitation of persons from apparent death by drowning or by electric shock, or who are overcome through the inhalation of irrespirable gases.

Resuscitation Apparatus.

The operation of the device consists in inflating and deflating the lungs by means of oxygen. The apparatus consists of a cylinder in which oxygen is stored under a pressure up to 125 atmospheres, a blowing and suction valve actuated by two accordion bellows, a face mask which incloses the mouth and nose, making an air-tight connection with the face, to which mask are attached two flexible tubes leading to the blowing and suction valves respectively.

When the mask is made air-tight on the face and the oxygen is turned on, the apparatus works automatically. Oxygen is forced into the lungs until a pressure of 4 in. of water gage is reached, which pressure is in connection with one of the accordion bellows, and owing to the elongation of the bellows under this pressure the valves are operated and the pressure in the lungs is released. The suction immediately begins operation and continues to exhaust the oxygen from the lungs until a vacuum of 4 in. of water gage is reached. The oxygen used for creating this partial vacuum deflates the bellows and changes the position of the valves, allowing the oxygen again to be forced into the lungs, etc. A lever enables the inflow and outflow of oxygen to be regulated by hand independent of the automatic device.

The application of the device necessitates placing the subject on his back, in which position the tongue may fall to the back part of the throat, allowing the soft palate to close the larynx. To overcome this condition a flexible rubber tube is attached to the upper part of the face mask which will admit of grasping the tongue with a pair of forceps and withdrawing it sufficiently to raise the soft palate.

Another type of mask is one which fits over the nose and nostrils only, allowing the mouth to be free. With the use of this nose mask the tongue may be withdrawn and held between the teeth and lips with sufficient pressure to hold it in place and make the mouth air-tight. For the successful use of the apparatus it is necessary that an air-tight fit be made with the type of mask used.

Attached to the lid of the pulmotor box is an inhalation device which may be substituted for the pulmotor as soon as the subject responds to treatment. This inhalation device is fitted with a rubber bag which holds 2 liters of oxygen when inflated and a metallic mask which fits over the mouth and nose and which may be held in place with a rubber band passing around the head.

A lever at the hinged end of the box has the enameled inscriptions "Pulmotor" and "Inhalation." Whichever name is exposed indicates the manner in which the apparatus will operate—"Inhalation" or "Pulmotor." To demonstrate the pulmotor action of the device there is provided a rubber bag and disk which may be attached to the face mask. The rubber bag when fitted represents the lungs of a subject being treated.

Boston Edison Company Opens Electric Garage.

An important step forward in the Boston electric vehicle campaign was taken on April 3 in the opening by the Boston Edison Company of a public garage for electric vehicles at 476 Atlantic Avenue, adjoining the company's downtown generating station. The garage at present occupies a space about 125 ft. long by 63 ft. wide on the company's property at the foot of Congress Street. It is centrally located on the Boston water front with easy access to the main teaming thoroughfares of the city, and has a capacity of about twenty-five vehicles. It is completely equipped with charging facilities, and within a few days twenty-four trucks or pleasure vehicles can be charged simultaneously at the station. Artificial lighting is to be furnished by an installation of fifteen 150-watt tungsten lamps placed inside prismatic glass reflectors about 15 ft. above the floor, and the lighting service will be metered separately from the energy used in battery charging. Energy is supplied from the Atlantic Avenue station by three No. 0000 copper cables carrying 110 volts and 220 volts standard three-wire direct-current service. The garage will charge a fixed rate per month for its service, depending upon the size of the vehicle. The price will include the usual care, including washing, charging and adjustments. The charging outlets are arranged in the form of bushings carried in water-proof and short-circuit-proof cases closed by a spring-actuated hinged cover, and all connections to vehicle batteries will be made by a flexible cable with a plug at each end, the plug being so arranged that if a vehicle starts while connected to the charging outlet the cable will simply pull out of the bushing and fall upon the floor without damage. Mr. A. G. Campion is in charge of the garage, which is to be operated under the general supervision of Mr. E. S. Mansfield, of the Boston Edison company, and under the auspices of the Electric Vehicle Association of America. On the evening of the opening day the company entertained at dinner at the Hotel Thorndike, Boston, the dealers in electric pleasure and commercial vehicles now established in Boston.

Cost of Energy in Toledo.

On March 29 Mr. F. B. Ford, of Ford, Bacon & Davis, New York, appeared before the Council committee of the whole at Toledo, Ohio, and made a report on the cost of producing and transmitting energy for residence lighting purposes, together with the cost of maintenance and other items. This was done at the instance of the Toledo Railways & Light Company, which is now asking for a new contract from the city.

Mr. Ford said that a fair rate for residence lighting would be 12 cents per kw-hour, with 10 per cent discount for the payment of bills within ten days, instead of 9 cents with a discount of 10 per cent, as at present charged. He said that the company had received a return of only 2.2 per cent on the investment in its lighting department and that the rate he proposed would allow it about 8 per cent after making provision for depreciation, taxes, operating expenses and other things that naturally come in.

The cost of delivering energy to residences, including 8 per cent return on the investment, operating and other expenses, is 10.8 cents per kw-hour, Mr. Ford said. Mr. Ford put the cost of energy at the switchboard at 1.2 cents, although President Lang had said that it is 0.75 cents.

Mr. Ford's report showed that the cost of serving residences in 1910 was $29.94 each. This is figured at a profit of 8 per cent on an investment of $130 for each consumer. The average revenue for the year, he said, was $22.36. The difference, deducted from a reasonable return of $10.40 on the investment of $130 per customer, leaves a profit of $2.82, or 2.2 per cent interest on the investment.

It was shown that there are 6405 residence and 1326 business consumers who pay more than 5 cents per kw-hour. Together they comprised 81 per cent of the total number of lighting customers for that year and contributed only $225,790.70, or 36 per cent of the total receipts. During the same year 64 per cent, or $396,560.79, of the total receipts was paid by 1883 consumers who get a rate of less than 5 cents. Reduction of the maximum residence and business rate to 5 cents would entail a decrease of $89,637.21, or 14 per cent, in the company's receipts, assuming that they remain the same as they were in 1910.

In making up the annual cost of service per customer the report took into consideration the various items that enter into production as follows: Operating expenses, $7.44; 8 per cent interest and 8 per cent depreciation and 1 per cent taxes on the investment, $5.10, or a total of $12.54. This is at the rate of 4.5 cents per kw-hour. The cost of energy at the switchboard is $3.40, or 1.2 cents per kw-hour. Residence customers were charged with one-fifth of the peak-load equipment, estimated at $100 each. Using the same rate of interest, depreciation and taxes, it is estimated that the expense of maintaining this is 5.1 cents per kw-hour, or $14 per year.

Electric Development at Portland, Ore.

Announcements of large extensions of their plants have been made by the Portland Railway, Light & Power Company and the Pacific Power & Light Company, of Portland, Ore. The latter company has purchased the Hood River Power & Light Company, Hood River, and the Husum Power Company, of White Salmon, and will expend $1,000,000 in the development of a system for distributing power along the Columbia River for 250 miles. The Hood River plant will be increased from 2500 hp to 3000 hp, and the White Salmon plant will also be enlarged. The two properties are to be connected by cable across the Columbia River. Construction has commenced on a high-tension line between Hood River and The Dalles, which will connect these two places, Mosier and White Salmon, on one circuit. A high-tension line will also be built from The Dalles to Umatilla, 121 miles, which will cross the Columbia to Luzen, extending up that river to Kennewick, where it will meet the new transmission line which is being built from Walla Walla; from Kennewick it will proceed to Priest Rapids, thus connecting all of the company's properties. A considerable amount of the power will be employed in pumping water for irrigation purposes.

The Portland Railway, Light & Power Company expects within the next two years to expend $4,000,000 on its various plants. With construction work now under way, together with that laid out for 1912, the company will by 1914 have a hydro-electric capacity of 100,000 hp. This includes a 15,000-hp plant at Oregon City, a 25,000-hp plant at Cazadero, a 25,000-hp plant at Estacaba, which will be completed this September, and 40,000 additional horse-power on the Upper Clackamas. On the latter river the company will utilize heads at three different points. With all the above-mentioned plants and high-tension connections completed the company will have expended $7,000,000. Eventually it is intended to supply power to a territory within a circle of 100 miles surrounding Portland. In order to insure continuity of service the capacity of the present steam station is being increased yearly and an entire new steam plant has been erected on the east side of the river at Portland.

Chicago Freight Tunnels.

No counterpart exists to the system of freight tunnels underlying the central business district of Chicago and constituting what is sometimes called "Underground Chicago." These tunnels contain narrow-gage railways on which trains of small-platform cars are electrically operated. The system is of unusual interest and has been frequently described, the latest illustrated article on the subject in the *Electrical World* being in the issue of Dec. 23, 1909, page 1519, entitled "Train Operation in Chicago Freight Tunnels." A brief reference to the amount of traffic in the tunnels was given in the issue of March 17, 1910, page 680.

Mr. W. E. Worth, general superintendent of the Illinois Tunnel Company, which operates this unique system, gave an instructive talk on "Transportation Facilities of the Illinois Tunnels" before the Electric Club of Chicago on March 22. Some of the facts brought out by Mr. Worth are summarized below.

The work done by means of these tunnels consists principally in the removal of earth from the excavations for new buildings, the delivery of coal and the removal of ashes from office buildings and the transportation of package freight. For several years excavated material, where suitable, was dumped to make land in the new Grant Park on the lake front, and about 1,500,000 cu. yd. of blue clay was deposited in this manner. At the present time earth from excavations and ashes are taken out eight miles into Lake Michigan for dumping. However, freight transportation constitutes the largest item of the tunnel company's business, and about 100 tons of groceries—to mention one item—are carried through the tunnels for wholesale houses daily. There are four public receiving stations outside of the Loop district, and freight in less than carload lots, if the individual pieces are not too large, is accepted at these stations and taken through the tunnels to the railroad freight warehouses.

Five different kinds of electric locomotives are used. A train consists of a locomotive and ten cars, each 12.5 ft. long and 4 ft. wide over all. The motorman constitutes the entire train crew. Ordinarily one man can handle eight train movements a day, or the equivalent of eighty carloads. One carload is about equal to the load on a one-horse dray. The largest locomotives are equipped with two 25-hp motors. An overhead trolley is used, and direct current at 250 volts is employed. It is asserted that the public freight-receiving stations receive freight packages which would otherwise require the daily employment of 1200 wagons in the Loop district.

The bottoms of the tunnels are 42 ft. to 45 ft. below the street level, and there are sixty-two miles of tunnels inside the Loop district. There are twelve river crossings and here the tunnels drop down to a depth of 65 ft. below the street level. Three per cent grades are used on the approaches. Water-tight doors are arranged at intervals to close the tunnels in case of fire in the buildings on the surface, so that they will not be flooded with the water used to extinguish the fire. Sixty electrically operated pumps are installed to pump seepage up to the sewers, which are on a higher level than the tunnels. The temperature in the tunnels is about 55 deg. the year around. There is some moisture from condensation in summer, so that to those who use the tunnels they seem comparatively warm in winter and comparatively cool in summer.

Traffic is carried on all in one direction, and there is an elaborate network of tracks; practically every street in the downtown business district is duplicated by a tunnel underneath it. It takes a man about three weeks to learn the various routes and a new man is on probation for about six months. The regular motormen get good wages, making from $80 to $100 a month. Electrically operated track switches will soon be installed to save the time necessary to operate the switches by hand. The movement of the trains ventilates the tunnels sufficiently through the shaft connections with the air. Indeed, the current of air from the tunnels is of very material assistance in maintaining a draft for the furnaces of boilers in some of the office buildings having basement connections with the tunnel network. The speed at which trains are operated is about eight miles an hour, and a carefully devised system of signals is operated at cross-overs, as described in the article referred to.

Several members of the club took part in the discussion, and in addition brief remarks were made by W. N. Matthews, of St. Louis; Victor L. Crawford, of New York, and Hugh M. Wilson, of New York.

Central-Station Development on Vineyard Sound.

Active developments are under way for central-station expansion during the coming summer in the Vineyard Sound district of Massachusetts. The electric service in the Falmouth-Woods Hole district is supplied by the Buzzard's Bay Electric Company, and that in the Oak Bluffs-Edgartown section of Martha's Vineyard by the Vineyard Lighting Company, both organizations being controlled and operated by the Carpenter interests of Newton, Mass. The earnings of these properties have increased about 200 per cent in the past two years, under the management of Mr. Eugene Carpenter, who is also prominent in the field of electric refrigeration and who placed the first three-phase induction motor in the country in operation in 1893 in connection with the Sewalls Falls-Concord (N. H.) transmission. The Vineyard Lighting Company is a consolidation of the Cottage City (now Oak Bluffs) Gas Company with the Martha's Vineyard Electric Light & Power Company, and it serves Oak Bluffs, Tisbury, Vineyard Haven, Edgartown and Eastville. The Buzzard's Bay company now serves Falmouth, Falmouth Heights, East Falmouth, Teaticket and Waquoit. The service is now being extended to Quisset and Woods Hole.

The advantages of developing off-peak motor-load business are thoroughly appreciated by the management of these companies and an active campaign is now under way to obtain long-hour patronage. The district served by the two companies has a winter population of about 7000 and a summer population of about 30,000. Residence lighting on the flat-rate basis is being introduced extensively, and the success of this is one of the main causes of the gain in income which the properties have experienced. During the coming open season special efforts are to be made to secure motor-load customers, particular attention being given to the installation of small motors for pumping service in connection with farm irrigation. A large truck garden business is done on the island of Martha's Vineyard and on the mainland in the Falmouth section. The company has already distributed a large number of circulars calling attention to the advantages of electric irrigation and the reliability and cheapness of such service, and has placed many of these circulars in prominent locations in the various towns on the system. Circuits are now being run to the outlying districts to supply the demand for general farm motor service. The company employs the novel plan in this connection of discontinuing its motor service during the hours of the lighting peak, or from half an hour before sunset to 11 p. m. After the lighting load is off, the service on the motor circuits is restored and maintained throughout the rest of the twenty-four hours in summer, when the system provides a twenty-four-hour service from its plants. Energy for motor service is sold from the off-peak circuits at from 5 cents to 3 cents per kw-hour, according to the amount used. On account of the large summer business the peak comes during the warm season and rarely before 6 p. m. Only fan motors are permitted on lighting circuits.

The use of the flat rate in residential lighting has done much to popularize the service of each company. While watt-hour meters are used, their applications are diminishing and practically all the new business is being gained on a first-rate charge. House-lighting rates are based upon the use of the tungsten lamp only, payments being dependent upon the maximum number of lamps in use at any one time. Usually the customer's word is taken as the basis of a contract and in case of any question a Wright demand meter readily settles any difference. A charge of 75 cents per month is made for the first 25-watt lamp connected in a residence, the second and third lamps are billed at 50 cents each per month, and when over three lamps are connected all in excess of that number are charged at the rate of 35 cents per lamp. Under this system each additional lamp beyond three costs the consumer about 1 cent a day, which is a strong talking point with the residents of the territory served by these companies. In the houses so-called "convenience lamps" are permitted in the ratio of 1 to 3—that is, the customer may, if he desires, install extra lamps up to a maximum of twelve. He is not expected to use over one-third of his connected lamps at any one time without special permission from the company. Lamps are purchased by the consumer. The company places them on sale in each case in the stores of prominent merchants practically at cost. The merchant sells with no guarantee and for cash only. At the end of every fortnight he settles with the lighting company and retains 5 per cent commission for handling the sales. This plan enables the consumer to buy lamps at a reasonable rate. The lighting companies maintain a wiring department, which is conducted at a profit, and there are also several local contractors who handle such work. Summer residents desiring lighting service receive the same rates as all-the-year residents, with the exception that the former are required to guarantee a minimum of $9 per season. The meter rates of the companies vary between 25 cents and 15 cents per kw-hour net.

The Vineyard Lighting Company is about to erect a new power plant on Vineyard Haven Harbor, about half-way between Cottage City and Vineyard Haven, the two communities being about two and one-half miles apart. The existing plant is located on the gas-works site near the center of Oak Bluffs and is equipped with simple, non-condensing engines and belted generators. The new station will be provided with greatly improved facilities for coal handling and with compound condensing engines. A wharf will be built for coal reception, the maximum dimensions being 150 ft. x 80 ft., and coal will be delivered at less expense to the company. The station building is to be a frame structure, 110 ft. long x 42 ft. wide, and it will contain two 200-hp horizontal return tubular boilers with forced-draft equipment, and a station design permitting the use of mechanical stokers and an economizer when conditions warrant their installation. The engine-room equipment will consist of an American-Ball angle-compound and a Harrisburg tandem-compound engine. Condensing water will be drawn from the harbor and the discharge delivered into Lagoon Pond, on the opposite side of the plant. The generating units will consist of a 300-kw, 2200-volt direct-connected alternator; a 100-kw, 2200-volt belted alternator, and a 75-kw and a 62-kw, 550-volt direct-current belted pair of alternators for railway service, all generators being of General Electric manufacture. The plant will operate the Oak Bluffs Street Railway and supply all electric lighting and motor service on the island of Martha's Vineyard. Three transformers are to be provided for future transmission of energy at 6600 volts to distant points which may become centers of electric service application. In connection with the development of electric service in the Vineyard Sound territory much good work has been done in the replacing of kerosene street lamps of about 8 cp by 25 cp series-tungsten lamps, thus revolutionizing the lighting of the quaint old whaling town of Edgartown and providing a much more satisfactory service than was formerly given by oil in many parts of the territory. The local manager of the two companies is Mr. Henry H. Taylor, formerly of the Gardner (Mass.) Electric Light Company. Mr. Charles A. Carpenter is superintendent of the Oak Bluffs Street Railway Company and Mr. Eugene Carpenter is treasurer and general manager of the combined properties.

Electrolytic Corrosion of Iron in Concrete.

Prof. Charles F. Burgess, of Madison, Wis., made a valuable contribution to the literature bearing on the subject of "Electrolytic Corrosion of Iron in Concrete" in a paper with that title read at a recent joint meeting of the electrical section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers in Chicago.

The author reported the results of a study of the protective effect of concrete in preventing electrolytic corrosion of embedded iron structures as made at the University of Wisconsin. The tests seem to show that the resistance of cement or concrete may vary from 30 ohms to several thousand ohms per foot cube. The experiments at Madison were made with a constantly applied e.m.f. of 8 volts. This is a greater difference of potential than the average encountered in commercial practice, but it is a value occasionally found, and 8 volts was chosen as a working pressure which, in a reasonable time, would give measurable results.

Two sets of experiments were made. In each case an iron pipe 2 in. in diameter was embedded in concrete blocks which were placed in jars, the space between the concrete block and the containing vessel being filled with a liquid to form the electrolyte. In the first set of tests this electrolyte was lake water—that is, the ordinary fresh water obtained in Madison—and the tests were continued for 180 days. In the case of the fresh-water tests the cylindrical concrete block was 10 in. in diameter, making the wall of concrete between the iron and the electrolyte 4 in. thick.

The cathode consisted of an iron plate hung from the side of the jar. The jars were connected in parallel, electricity being supplied by storage batteries through a rheostat by which a fairly constant pressure was maintained throughout the test. Frequent measurements were made of current, applied pressure and polarization pressures.

Assuming 1.05 grammes per ampere-hour as the electrochemical equivalent of iron, the theoretical corrosive action of the current was obtained, and by comparison of this value with actual loss of weight the figures on "corrosive efficiency of current" were obtained. Ten samples were prepared for the fresh-water tests, several brands of cement being used. At the end of 180 days the concrete was carefully removed from the pipes and the latter were weighed to show the loss by corrosion due to electrolytic action. A table was given showing that in this fresh-water test the current efficiency of corrosion ranged from 1.05 per cent to 6.88 per cent. The actual loss of iron by corrosion varied from 1.2 grammes to 11.7 grammes.

The second test lasted for sixty-four days and in this case instead of fresh water a 3 per cent salt solution was used to surround the concrete blocks (seven specimens) containing the iron pipes. In this case, however, the cylindrical concrete block was 6 in. in diameter, making the wall of concrete between the salt solution and the metal 2 in. thick. This test was made because it was thought that the pure water used in the other test might not be fairly comparable to the moisture experienced in ordinary commercial practice with reinforced-concrete structures. In this case it was found that large masses of ferric hydrate were formed on the outside of the concrete blocks. The concrete itself, however, was found to have little rust or iron within it. The pipes embedded in it were corroded far more extensively than in the case of the fresh-water test, although the latter lasted much longer, being 180 days, compared with sixty-four days for the salt-water tests. Indeed, the iron pipes were found in some cases to be eaten entirely through. A table given to show the results of the tests with different samples of cement subjected to the salt-solution test show that the current efficiency of corrosion ranged from 40 per cent to 80 per cent, and the loss by corrosion from 105 grammes to 247 grammes. Test results were cited by Professor Burgess to show the polarization pressures, and as those specimens showing the highest polarization pressure exhibit also the greatest current efficiency of corrosion it appears that the polarization pressure may have some relation to the corrosive action. The tests showed that salt in the electrolyte greatly increases electrolytic action. It is not shown that the concrete is affected by the electrolytic action. The speaker believed that the statement that the concrete itself undergoes decomposition has not been proved, at least as far as practical conditions are concerned.

The tests showed that where fresh water is used to moisten the concrete the corrosion per square foot of iron per year is 8 volts and the average amperage of the current applied in the tests ranges from 0.013 lb. to 0.122 lb. for fresh water and from 3.13 lb. to 7.42 lb. for salt water. The figures for corrosion per square foot of iron per year, taking the current applied at the end of the test—and these figures are perhaps the ones of most practical importance—are for fresh water from 0.0036 lb. per square foot per year to 0.41 lb. The corresponding figures for salt water are from 2.70 lb. to 5.85 lb. It must be remembered that all these results were obtained with an applied e.m.f. of 8 volts.

These figures show that under favorable conditions there is the possibility that the iron element in reinforced concrete may be attacked to a serious degree by electrolytic action. It is true that comparatively few failures of reinforced concrete have been traced directly to this cause, but one should not conclude that the day of reckoning has passed. The subject is one of great importance, and one to which increasing study should be devoted. The liability of a difference of potential exists anywhere along the line of an electric railway, not necessarily near the power house. There have been some mysterious failures of reinforced concrete, and one may wonder how far this phenomenon of electrolytic action was involved. In studying the subject field observations are needed as well as laboratory tests. A more general realization of the serious possibilities of electrolytic action may have something to do with the design of future reinforced concrete. For one thing, the continuity of the reinforcing members should be broken as often as possible. In conclusion, the speaker exhibited three specimens of iron pipe which had been subjected to his tests at Madison. In one case, that where the salt solution was used, the shell of the pipe was completely eaten through, making an opening several inches long.

In opening the discussion Mr. J. G. Wray said that it was some relief to find that the concrete itself may not be disintegrated by electrolytic action, as some investigators have contended. Possibly the age of the concrete or the composition of the aggregate or the porosity of the concrete may have something to do with electrolytic corrosion on embedded iron.

Professor Burgess remarked that apparently if the concrete is made waterproof a positive prevention ought thus to be obtained as a provision against electrolytic action. He believes that the porosity of the concrete has an influence in allowing room for the electrolyte. Mr. W. B. Jackson remarked on the great difference in the results of the tests where fresh water and salt water was used. He made the point that salt is frequently used in mixing concrete in cold weather, and perhaps, with the results of these tests in view, this should not be done. The speaker also commented on the differences in corrosion where different kinds of cement are used, and said these differences were undoubtedly due to the presence or absence of certain ingredients. Tests along this line to determine what these ingredients are might be of further interest.

Mr. R. F. Schuchardt spoke of the value of the work of scientific investigators like Professor Burgess in aiding the accomplishments of engineers engaged in commercial work.

Mr. William Siefert asked what kind of iron was used in the test. Mr. C. A. Keller brought up the subject of cinder concrete, and asked if a coating of pure cement around an iron beam would be sufficient protection where cinder concrete is used in juxtaposition.

Mr. Anderson asked what would have happened in the tests if no electricity had been applied. Mr. G. T. Seely pointed out that it was proposed to use reinforced concrete in the construction of the passenger subway in Chicago, and he advanced the opinion that the insulation of the track rails in the subway should be made very carefully in order to prevent the danger of escaping electricity setting up electrolytic action in the subway structure itself. Mr. O. E. Strehlow said that in building retaining walls, for instance, it might be safer to stick to the gravity wall rather than to use reinforced concrete in view of the possibility of electrolysis.

Mr. W. H. Finley said that it is necessary to use extreme care in making concrete, which should be thoroughly waterproofed. The results of the tests described in the paper show that great care should be exercised also in building reinforced concrete to see that a good mixture is secured, and that the concrete is made as nearly impervious as possible. Mr. Ralph H. Rice asked for further information about the polarization and also about the absorption of the concrete; that is, whether the conductivity was to be considered to be in the moisture in the concrete.

Mr. F. F. Fowle said it would be interesting to know what the current characteristics would be with an applied e.m.f. of, say, 2 volts—what effect it would have on the polarization. He asked if electrolysis affects the strength of the reinforced concrete.

In closing Professor Burgess said that in cinder concrete local electric couples are probably formed by particles of carbon and iron. However, this local electrolytic action is probably slight unless air is admitted. At any rate, the coating of pure cement over the iron should prevent electrolytic action through these local couples. As to the kind of iron used in the tests, he said that it was mild steel, but added that he did not think that the kind of iron used in reinforced concrete makes a great deal of difference so far as electrolytic action is concerned. In relation to what would happen if the tests had been made exactly as they were without the application of electricity, the speaker said that such tests were made, and it was found that fresh water or even salt water produced very little oxidation where no current was flowing. The greatest corrosion was found at a point on the iron pipe near its entrance into the concrete block. The question of polarization is an important one in the study of electrolytic corrosion. Too little attention has been given to it. Another series of tests is now being made at which the applied e.m.f. is 0.5 volt. It is true that if the average pressure is 8 volts, setting up a polarization pressure of 2 volts, then if the applied pressure drops to 2 volts, there ought not to be any electrolytic action until the polarization has decreased below this value. The speaker believes that the current is carried through the concrete by the moisture in it; in other words, by the electrolyte. It is purely a question of the electrolyte.

Electrical Resistance of Wood Treated with Preservative.

The American Railway Engineering Association's committee on wood preservation, of which Prof. W. K. Hatt, of Purdue University, is chairman, reported at the recent Chicago convention that there are now more than seventy wood-preserving plants in the United States. A number of the large steam roads possess expensive plants fitted to handle large quantities of timber in a very efficient manner. Nearly all treated crossties used by steam railroads are prepared in closed cylinders permitting the application of pressure and designed to secure a heavy absorption of the preservative. The principal preservatives used were creosote oil and, to an almost equal degree, a solution of zinc chloride. Many ties are treated with an emulsion of creosote oil and a solution of zinc chloride, and one road treated large quantities of its ties with a heavy injection of crude petroleum. Other preservatives are also used. The electric railroads own but a few cylinder treating plants and are generally obliged to purchase treated ties or to use some less expensive method of treatment, such as dipping the ties in a bath of the preservative. Many different preservatives are used in this manner.

An interesting appendix to the report related to the electrical resistance of timber as affected by treatment with preservatives. It is based on an investigation made by Mr. J. T. Butterfield, of the School of Electrical Engineering at Purdue University, in the spring of 1910. The results tended to establish the fact that, although timber is ordinarily classed with the nonconductors, and when dry and well seasoned it has a very high dielectric strength and practically infinite resistance, yet when green or moist it becomes a kind of electrolytic conductor of comparatively low resistance. The treatment with zinc preservatives has the simple effect of producing in the wood a stronger electrolyte and hence a better conductor of current. All of the data obtained confirmed the view that the conductivity of wood is due primarily to the presence in the pores of an electrolyte formed by an aqueous solution of the salts found in the natural timber, or of these salts and others artificially introduced.

The investigation related primarily to ties, but the conclusions reached may have some bearing on the preservation of poles.

Importance of Fundamentals in Engineering Education.

In an address given at a weekly luncheon of the Electric Club of Chicago Prof. E. H. Freeman, professor of electrical engineering in Armour Institute of Technology, Chicago, dwelt on the fact that engineering education should tend toward instruction in fundamentals rather than in specialization. His subject was "Electrical Education," and he showed how the demand for electrical education was met first in the colleges by physicists, although at the present time the courses in electrical engineering bear practically the same relation to the teaching in physics as do the other engineering courses.

In selecting material for the course in electrical engineering two requisites must be borne in mind. These are, first, the supplying of information to students, and, second, training their ability to solve problems in engineering by means of the information which has been obtained. The student is apt to think that the first requisite is of primary importance, while the instructor believes that the second is of greater significance. The attempt is therefore made to give the student what he thinks he wants and also what he really needs. The subjects in the course must be selected, therefore, with these two ends in view.

But to meet fully both requirements of the electrical course would require a greater amount of material and more time than are available ordinarily. So those subjects must be selected which the student would have the greatest difficulty in mastering by himself or without the assistance of the instructor and the aids in teaching which are presented in the school. This leads to the consideration that careful attention must be given to theory as applied in practice. Thus considerable time must be given to the mathematical theory of electrical calculations and investigations, because the college is particularly the place where the student is helped over the difficult steps in this study. Practical men often regret their lack of training in theory, and it is the province of the engineering school to deal largely with the study of the underlying theory. Steinmetz was quoted as saying that the electrical engineer gives only four years to theory against perhaps forty years to practice.

Three well-defined classifications of electrical engineering may be made. These relate to power and heavier currents, to the telephone and lighter currents and to the various aspects of illumination and electric lighting. The student might specialize in relation to one of these branches if he knew just where his work would lie in after life, but as a matter of fact it is not desirable to carry specialization very far in college. The work in the engineering school should dwell especially on the fundamental relations underlying engineering work of a given character, as civil engineering, mechanical engineering or electrical engineering. Indeed, it is perhaps advisable not to give too much attention to even these broad lines of demarcation, except such as are necessary in order not to offend too deeply the susceptibilities of the student who, for instance, insists that he wants to study electrical engineering and not mechanical engineering. At Armour the endeavor is to make the electrical engineering course rather general in its nature. Students can specialize after taking the general course if they wish.

Instruction is given by means of lecture and recitation work and by laboratory and shop work. Professor Freeman referred briefly to the plan which has been recently tried of giving the shop work in commercial establishments outside the school, thus interspersing practical shop work in outside factories with instruction in school. He said that it was too early to pass final judgment on this plan. However, he pointed out that this mixed form of instruction would not be so valuable for a man who afterward engaged in plant operation or consulting work as it would be for the one who later went into manufacturing.

As to efficiency of educational institutions, the speaker said that it was more important that they should be efficient educationally than from the business side—that is, in making students themselves more efficient rather than in seeking to use the buildings and equipment of the school to the highest degree of efficiency. An exact comparison cannot be drawn as to efficiency between an educational institution and a commercial organization. As education is a development coming from within, the student is not working for the professor, although he sometimes thinks he is; he is working for himself. On the contrary, the employee of a business house finds his highest efficiency in working for his employer. There should be co-operation between instructors and engineers. In closing Professor Freeman asked not only for the moral support but the conscientious criticisms of his hearers in the effort to make engineering education more efficient.

Prof. P. B. Woodworth, of Lewis Institute, was called on and said that he was pleased with what the speaker of the day had said about specialization in engineering education. There is every evidence that specialization is carried too far in college work. The demand is for good, positive groundwork in general physics. Professor Woodworth quoted facetiously a rough-hewn declaration made at a recent conference in classic Boston in relation to engineering education. This dictum is to the effect that "Them as knows does; them as don't know teaches."

Telephony and Telegraphy Under Interstate Commerce Commission Control.

As a result of arguments presented on Dec. 7, 1910, before the Interstate Commerce Commission relative to the control of the commission over telegraph and telephone companies, the commission has made public its view that when "two or more lines are connected so that a person within one state, territory or district of the United States talks with a person at a point without such state, territory or district of the United States, or so that a message is transmitted directly from a point within a state, territory or district of the United States, to a point without the same, the transmission of messages in this manner constitutes interstate commerce" and brings all of the participating lines within the control of the commission.

Telegraph and telephone companies coming under the above control are required to make reasonable and just rates and charges for the transmission of interstate messages, are forbidden to make discriminatory rates and are required to keep their accounts and memoranda in the manner specified by the commission, to which they must make reports at stated intervals.

St. Louis Valuation and Rates.

A statement regarding the report of the St. Louis Public Service Commission in relation to the valuation of the property of the Union Electric Light & Power Company has been made by Mr. Alten S. Miller, president of the company. Mr. Miller said that the findings of the commission were naturally very disappointing to those connected with the company, and that many large expenditures on the property had been disallowed in spite of the fact that vouchers were produced showing that the expenditures had been made properly. As large sums had been spent in building up the business it seemed only proper that the amount thus spent should be allowed as part of the cost of the property.

While the effect of the commission's action had been to reduce the value of the property $14,000,000 below the actual cost as shown by the books, Mr. Miller said, the most serious decisions were those in relation to the schedule of rates. The commission found that the company was justly entitled to what it is now earning, but at the same time it recommended that maximum rates be cut down. This seemed to Mr. Miller to be utterly inconsistent unless it was the policy of the commission to compel an increase in the rates on commercial and industrial consumption, a policy which would certainly be bad for the city generally.

Although Mr. Miller did not question the sincerity and good intentions of the commission, he did feel that simple justice had not been done to the Union Electric company. Detailed and complete records were submitted to prove that the business had up to this time not earned nearly what the commission now says the company was entitled to earn. An endeavor was made to make plain the policy of the company to improve and expand its facilities beyond immediate needs and regardless of present profits, looking to the future growth of St. Louis and the business to obtain ultimately the just return on actual investment, but the commission, Mr. Miller felt, had ignored this view and had arrived at conclusions which must necessarily hamper future development.

Mr. Miller stated that in determining the rates the commission assumed that it cost a certain definite amount to take care of each customer, large or small. This it called the "customer's charge." The next element was the cost for each kilowatt used at the time of the heaviest load on the company's station in December. This element the commission called the "investment charge." The last element of cost covered the actual generation and some portion of the delivery of the electric energy and varied with the amount generated. This the commission called the "manufacturing charge."

After stating that these three elements should be considered in determining an equitable rate, the commission, Mr. Miller added, entirely eliminated the investment charge in reaching the conclusion that 9½ cents was a fair maximum charge. It could quite as consistently have omitted the customer's charge and have claimed that a much lower rate than 9½ cents was proper and sufficient. The customer's charge used by the commission in reaching its rate was approximately $11 per annum. In its analysis of the investment charge it showed that the investment charge per kw-hour was $82 per year, and that the average residence customer used 157 watts and, therefore, cost the company $12.87 per annum in addition to the $11. This customer would not meet his portion of the actual cost of service unless he paid $24 per annum in addition to the manufacturing cost of the energy used, which, however, was comparatively small. If the provision in the ordinance making the maximum monthly charge 50 cents was allowed to stand this would involve an average loss of $1.50 per month on each customer paying the minimum rate.

Mr. Miller stated that the commission was wrong in saying that the residence rates are high and that it had reached this conclusion by ignoring the results of its own analyses. If the pending ordinance was passed much constructive work in establishing the uniform system of rates in St. Louis would be destroyed and for several years there would be the same dissatisfaction and confusion that resulted from the rates established in 1907, to the serious disadvantage of the city and everyone doing business therein.

Mr. Miller, in a communication to the Municipal Assembly on March 27, specified a number of objections and exceptions to the report of the commission. The reasons which he gives are, in part, as follows:

1. A member of the commission made the investigation as engineer to the commission and, therefore, was not in position to review the report in a judicial capacity.

2. Hearings of the commission were not open to the public as required by the ordinance, and were in part conducted in secret and were not open either to the public or to the company.

3. The commission examined witnesses in secret and failed to submit them to the public investigation for examination or cross-examination.

4. It was influenced in its findings and conclusions by ex parte statements made in secret by witnesses not submitted to examination or cross-examination.

5. The findings and conclusions of the commission are in conflict with the conclusive testimony of witnesses publicly examined before the commission and are not supported by the record of the proceedings.

6. The findings of the commission fail to support and are, as a matter of fact, in conflict with its recommendations.

7. The conduct of the entire investigation by the commission was in conflict with the fundamental principles of law, the long-established and recognized policy of the government and the recognized rights of individuals under it, in that it was in part a secret investigation in which it was attempted to affect the rights and property of citizens without affording to them an opportunity of being properly heard or of examining or cross-examining witnesses adduced against them or of inspecting the record of the investigation.

8. The findings of the commission regarding the cost and value of the property of this company are erroneous and are not in accord with the evidence or the facts.

On account of the irregularities thus averred the company asked that the report be referred back to the commission with instructions that the investigation be reopened and that the company be allowed the fullest opportunity to cross-examine all witnesses and to meet all other testimony which the commission used in forming its report.

The bill recommended by the Public Service Commission making the maximum rate 9½ cents per kw-hour was passed by the Council on March 28 and was sent to Mayor Kreismann for signature.

Ohio Public Utilities.

The Winters public utility bill will come up in the Ohio House of Representatives for action during the first week in April. Judge Winters has announced that amendments must be made that will replace important provisions that have been removed since its introduction. Representative L. K. Langdon will offer a number of amendments and many members of the House have announced their intention of not supporting it unless they are adopted. As it stands at present the bill applies only to telephones so far as actual supervision is concerned.

The Yount telephone bill has been before the Senate committee on railroads for some time and so far it has refused to report the bill out for action. Senator Yount demanded that the bill be reported in March, but the excuse that the Winters bill would come up first for consideration in the House was given. Many of the telephone companies favor the Yount bill to the exclusion of the public utilities bill.

Massachusetts Legislative News.

An unexpected turn occurred last week in the House in connection with the discussion of the Henebery bill providing that municipal authorities may grant limited franchises to street-railway companies for the carriage of freight and express matter. By a vote of 107 to 61 the House set aside the adverse report of the committee on street railways upon this measure and placed the bill in the calendar for further consideration. Chairman Washburn, of the committee on railroads, said that if the bill should pass it would completely overturn the policy of the State, which for many years has granted perpetual franchises to street railways, the companies having the right to appeal to the Railroad Commission in case the local authorities refuse their petitions for the right to handle this class of traffic. The Henebery bill takes the power of franchise grant away from the commission except in cases where obstruction occurs to the establishment of through lines of express service.

The committee on public lighting has sent in an adverse report on the bill requiring electric light companies to furnish energy to properly qualified consumers without a contract. A bill has been introduced into the Senate to provide for post-mortem examinations of the bodies of persons electrocuted in accordance with the sentence of a court. The committee on metropolitan affairs has reported no legislation necessary on that part of the report of the Joint Commission on Metropolitan Improvements which discussed the question of steam railroad electrification within the Boston district. The commission voted by a narrow majority against immediate legislation banishing the steam locomotive, but several bills are pending which deal directly with the electrification problem. At recent hearings it has become apparent that if the New York, New Haven & Hartford Railroad tunnel is authorized under Boston Harbor by the present Legislature a beginning in electrification will certainly be made in that connection. The disposition to require the railroads to electrify the lines in the entire metropolitan district bids fair to yield to a program in which some of the more important lines will first be equipped for electrical operation, with extension of the system as fast as practicable to branch lines. The committee on public lighting has reported that the resolve ought not to pass which provides for an investigation of the price of electricity and the rate of dividends to stockholders of electric light companies. There is a general belief that this legislation is unnecessary in view of the publicity of returns on file with the Gas & Electric Light Commission. The committee on public lighting has sent in an adverse report on the bill providing that the readings of gas and electric meters shall be furnished to customers by companies. The committee on street railways has reported leave to withdraw the bill providing for the revocation of street railway franchises in certain cases. The committee on taxation has reported favorably upon the bill extending the exemption of property subject to inheritance taxation to cover shares of stock in any railroad, street railway, telephone or telegraph company incorporated under the laws of the State and also of some other State or country.

California Conservation Measures.

On March 22 the Senate of the California Legislature passed the Assembly bill creating a California Conservation Commission and appropriating $100,000 for its work in the next two years, and the bill will be given to Governor Johnson, whose signature is considered certain. The commission is to consist of five members, to be appointed by the Governor, and to serve without compensation beyond having their actual expenses paid. The commission is to gather data and information concerning forestry, water and water-power, electricity, mines and mining, mineral and other lands, dredging, reclamation and irrigation, and is to advise the next Legislature what laws should be passed.

Following the bill the Senate passed four additional conservation measures. The most important of them is a bill which regulates and limits the appropriation of water for the generation of electricity, fixes the terms and conditions for such appropriations, provides for licenses to run for twenty-five years and reserves to the State the right to fix the rates of compensation for which electricity shall be furnished and to impose charges for the use of appropriated water, and provides for a board of control to consist of the Governor, State engineer and three other persons, whom the Governor shall appoint.

An Assembly bill introduced by Assemblyman Schmidt, of San Francisco, has been passed by the Senate amending a section of the civil code which now requires corporations to furnish gas and electricity on demand so as to include steam and heat, which must be supplied to householders residing not more than 100 ft. from the mains on application and payment. The Senate passed also an Assembly bill introduced by Assemblyman Coghlan, of San Francisco, empowering municipalities to grant franchises for laying pipes to carry steam heat under high pressure for distribution and sale to inhabitants.

Massachusetts Commission News.

The Massachusetts Gas & Electric Light Commission gave a continued hearing on March 20 at Worcester upon the petition of Mayor James Logan for a reduction in the price of street lighting as charged by the Worcester Electric Light Company. Mr. William D. Marks, of New York, consulting engineer for the petitioner, was re-examined. He stated that he figured the cost of street lighting in Worcester by estimating the cost of energy delivered at the lamp, assuming the present value of the street-lighting equipment, allowing 7 per cent depreciation and 5 per cent profit. The cost of energy was estimated on the basis of eleven hours' daily use of the connected load. Mr. Marks said that in 1910 the municipal arc system of Worcester, which is a magnetite installation, required a station equipment of about 348 kw. He felt that it would be necessary to make an appraisal of the property in order to make a proper determination of the cost of street lighting, but admitted that there was room for much difference of opinion as to depreciation values. Mr. Marks figured the cost of energy at the lamp terminals to be 1.38 cents per kw-hour, but admitted in response to inquiries that this cost was based upon the operation of the entire connected load of the station for a period of eleven hours per day—a condition not realized in practice. He was unable positively to cite any specific central station in the world which is delivering energy at the terminals of street lamps at a cost as low as 1.38 cents per kw-hour, taking all charges into account. It was shown that the average cost of energy was 3.4 cents per kw-hour as a result of questions by members of the board. Chairman Barker pointed out that the latter figure was based on actual facts of cost and output, and that the former figure was based only upon assumed facts of cost and output having no real existence. General Schaff, of the commission, said that in his opinion the companies would never satisfy the public until they bring their prices down to a leved, not an absolute level, but as nearly so as possible, following a somewhat extended discussion of early methods of charging for energy.

Mr. Fred H. Smith, assistant superintendent, testified that the company estimated the present value of its municipal lighting equipment to be $436,520, compared with Mr. Marks' estimate of $290,000. The items were as follows: (a) Lamps, machinery, poles and fittings, $42,716; (b) steam plant, $10,465; (c)) buildings and real estate, $7,349; (d) 1,279,971 ft of No. 6 B. & S. copper wire, $161,256; (e) 100 miles of single ducts, $214,804; total, $436,520. Mr. Smith stated that item "a" included about 10 per cent of the equipment of the station (station equipment used for no other purpose than street-lighting service) and arc lamps. There are now about 900 arc lamps in service in Worcester. The structural cost of the municipal arc-lamp equipment, less 40 per cent depreciation, came to $20,093. Mr. Smith stated that the depreciation on a 4-amp magnetite arc lamp is about $2 per lamp per year. An allowance of 7 per cent was made for the depreciation of the generator equipment and about 5 per cent on the building. The company estimated the present value of arc-circuit wire placed underground at about 12 cents per foot, the average price new installed being from 17 cents to 18 cents per foot for No. 6 wire. About 33,000 lb. of weatherproof wire of this size was also included at a present value of 12 cents and about the same length of No. 6 rubber-covered wire at 10 cents per foot. The hearing was continued to April 7, when the company will present further evidence bearing upon the cost of magnetite lighting.

The commission has granted the petition of the Greenfield Gas Light Company for authority to issue 700 shares of additional stock at the par value of $50 per share to meet the cost of additions to the plant.

The Railroad Commission gave a hearing at Boston on March 31 on the petition of citizens of Holliston for a reduction in fares on the Milford & Uxbridge Street Railway. The petitioners desired that the present fare of 10 cents between South Framingham and Holliston be cut to 7 cents. The company's response pointed out that the distance is six miles; that similar rates are charged by itself and other street railways in central Massachusetts; and that even if the present earnings are maintained until the end of the fiscal year in June the company will be able to pay a 6 per cent dividend only by refusing to set aside any money for depreciation. Wendell Williams, Esq., counsel for the company, stated that no conditions have arisen since the board's adjudication of last fall in favor of the increased fare that would warrant a finding that the rate is excessive. He pointed out that the company has about thirty-six miles of track in operation, and said that there should annually be put by at least $25,000 surplus in order that the road may be properly maintained with modern standards of equipment. Wages have increased on the road in the past year from 22.5 cents per hour to 25 cents per hour, and the transportation expense has consequently gone up by about $8,000. An average dividend of only 1.83 per cent has been paid on the stock in the past six years. A strong point was made for the company by the presentation of petitions signed by the selectmen of every town in the territory except the municipalities named above urging the commission not to order a reduction, on the ground that such an action would be an unfair discrimination against the towns in which the fares remained unchanged. The board took the case under advisement.

The Railroad Commission gave a final hearing on April 3 upon the petition of Mayor Fitzgerald, of Boston, for a transfer investigation on the Boston Elevated system. Mr. C. S. Sergeant, vice-president of the company, testified at length regarding the difficulties of establishing a consistent free-transfer system on a large urban electric railway. He pointed out that if the company issues transfers permitting passengers to ride in a direction opposite to their original course, danger exists of excessive rides being taken on a single fare. In Boston this policy would lead to the company's giving a forty-mile ride for 5 cents, which would obviously be an intolerable situation. It is probable that the company will make an attempt to install transfers of limited validity as to distance in the present case, provided the operating difficulties are not too great. A conference with this object in view will be held by the board in connection with the company and the petitioners.

New Jersey Commission News.

The Board of Public Utility Commissioners for the State of New Jersey has approved the agreement of merger and consolidation of the Shore Electric Company, Sea Bright Electric Light Company and the Citizens' Light & Fuel Company of South Amboy, forming the Shore Lighting Company, the agreement having been entered into March 21, 1911, and has also approved the proposed issuance, sale and delivery of $400,000 5 per cent mortgage gold bonds by the Shore Lighting Company at the par value thereof.

The board has approved ordinance of the township of Little Egg Harbor granting a franchise to the Ocean County Gas Company and a resolution of the Ocean County Board of Chosen Freeholders granting the company permission to construct gas mains along the Shore Road, in Ocean County, from Toms River south, through the townships of Berkeley, Lacey, Ocean, Union, Stafford, Eagleswood and Little Egg Harbor.

Maryland Commission News.

The Maryland Public Service Commission has received a petition asking that the Hyattsville Gas & Electric Light Company be required to reduce the price of gas from $1.50 to $1 per 1000 cu. ft. The petition will be referred to the company in question for a reply before any action is taken.

The commission last week signed an order granting authority to the Washington, Baltimore & Annapolis Electric Railway Company, in accordance with the company's reorganization plan, to transfer its franchises and physical properties to the new corporation and to issue stock for the discharge of obligations incurred by both. In addition to permission to take over the properties of the Anne Arundel Electric Railroad Company, the Washington, Baltimore & Annapolis Railroad asks that it be allowed to issue $3,000,000 of 5 per cent bonds at par, $1,369,512.75 par value of non-cumulative preferred stock at 6 per cent and $1,500,000 common stock of the Anne Arundel company in payment of obligations. A trust mortgage of $7,500,000 from the Washington, Baltimore & Annapolis to the Cleveland Trust Company was filed last week for record. It covers all of the property, rights and franchises of the company, and is to secure the issue of an equal amount of first-mortgage gold bonds dated March 1, 1911, payable March 1, 1941, and bearing 5 per cent interest. The mortgage states that $5,000,000 of the bonds will be issued immediately to acquire the Anne Arundel road. The remaining $2,500,000 will be used for enlargements, improvements and extensions.

New York Commission News.

In connection with the investigation which John N. Carlisle is making of the New York Public Service Commission, First District, at the request of Governor Dix, announcement was made that a public hearing would be held at the Engineering Societies Building, New York, on April 4. Mr. Carlisle announced that the hearing had been called to afford an opportunity to any who desired to make complaints regarding the work of the commission. He had received a letter on the subject from F. W. Whitridge, receiver of the Third Avenue Railroad, which he would make a part of the record. Mr. Whitridge's letter said in part: "As receiver of the Third Avenue Railroad I have been attacked, regulated and harassed by the Public Service Commission of the First District in a way which is explained in my replies to the communications of the commission. All of these have been printed and are public property. I have never taken the initiative in attacking the commission at any time, and practically the whole of my writings in respect to them are in the nature of replies. I do not care to take the initiative now, but if there is any assistance which I can give you I am entirely at your service." Mr. Carlisle then asked if any of the few who were present wished to appear. As there was no response he said he would wait a few minutes before adjourning the hearing. As no one appeared to testify Mr. Carlisle made a brief statement regarding the progress of his work. He said that he had been directed by Governor Dix to make the investigation into the affairs of the First District commission. He had talked with the employees in order to become familiar with their duties and had examined the work of the commission. An auditor from the Second District commission was now making an investigation of the books of the First District commission. The work of examination would be continued by Mr. Carlisle until its completion, when a report would be made to the Governor.

Wisconsin Commission News.

The Railway Commission has authorized the Milwaukee Northern Electric Railway Company to issue $1,500,000 par value of 5 per cent bonds to be secured under the terms of a mortgage executed by the company to the First Savings & Trust Company, of Milwaukee. The bonds are to be issued for money only and for not less than 75 per cent of the par value. The company has been empowered also to issue 4000 shares of first preferred cumulative stock, of the par value of $100 per share, and 6000 shares of second preferred non-cumulative stock, of the par value of $100. The stock is to be sold for money only and at not less than par. The stock and bonds are to be sold for the purpose of supplying the company with funds with which to purchase and retire an outstanding bonded indebtedness of $2,500,000. The total assets of the company are given as $3,500,000.

The Eastern Wisconsin Railway & Lighting Company, of Fond du Lac, has been authorized to issue $76,000 par value of its 5 per cent twenty-year first-mortgage gold bonds, of the par value of $1,000 each, to be secured by the refunding and extension mortgage executed by the company to the Milwaukee Trust Company, of Milwaukee. The funds to be derived, in so far as possible, are to be used to pay the obligations incurred in making additions and extensions to the system, and also to reimburse the reserve, working capital and surplus accounts for the funds taken from these accounts and used in paying for the extensions and additions.

The commission has received a petition signed by members of the Commercial Club, of Superior, Wis., in which it is alleged that the rates for electric, water and gas service now being charged by the Superior Water, Light & Power Company are excessive and discriminatory. The petitioners contend, among other things, that the city is receiving electrical energy at a lower rate than the private consumer for the same kind of service; that the revenues from lighting and motor service are more than sufficient to pay a reasonable return upon the property properly devoted to this branch of the service, provided ordinary care and business management are used in the conduct of the business. The petition prays for a general reduction in rates and the removal of all discrimination between city and private consumer.

The Manitowoc Electric Light Company has requested the commission to determine upon a reasonable rate for motor service in cases where a varying quantity of power is used for ten hours a day or more. The company objects to the present schedule for the reason that it offers the same rate regardless of the number of hours that the power is used daily. This contention is in accord with the commission's doctrine to the effect that special consideration should be given "off-peak" and "long-hour users" in formulating a rate schedule.

The Burkhardt Milling & Power Company has applied to the commission for authority to abolish its present meter rental of 25 cents per month and to substitute therefor a minimum bill, the amount of which is left to the commission to determine. The village of Sun Prairie, which recently acquired the plant of the Sun Prairie Electric Light Company, by the exercise of its option to purchase granted by the Public Utilities law, has requested the commission to investigate conditions in Sun Prairie and to recommend a schedule of rates for electric lighting and motor service.

The City of Baraboo has concluded to install a municipal lighting plant and has applied to the commission for authority to do so. Inasmuch as the Baraboo Lighting Company is now doing business under an indeterminate permit granted by the commission it will be necessary for the city to show cause why such a municipal plant should be installed. The municipality rests its claim chiefly upon the fact that the city water-works plant is operated by water-power and that there is a surplus of power available which might be utilized in generating electric power for the city's use at a comparatively small cost. The commission has taken the matter under advisement.

Canadian Hydroelectric Commission News.

At a meeting of the commission at Toronto on March 30 it was decided to extend the Niagara power transmission line from St. Thomas west to Windsor, a distance of 128 miles, at an approximate cost of $2,000,000. The extension will depend upon whether favorable contracts can be made with the City of Windsor and the distributing company. Twenty-three municipalities along the line of the proposed extension have been anxious to secure power for some time and the majority of them have authorized the civic authorities to enter into contracts with the commission for an aggregate amount of 12,000 hp. Windsor stands ready to take about 15,000 hp, provided arrangements can be made to export the excess over that used by the city. The principal portion of the power to be supplied to Windsor will be required for the Detroit River tunnel and terminals there, the amount necessary for that purpose being estimated at 7500 hp, while for the use of the municipalities of Windsor and Walkerville 3000 hp will be taken. If the necessary arrangements are made Windsor will be allowed to export any excess power under a contract that makes the power returnable when required in the Province of Ontario. This contract may be terminated and the power kept within the province at any time after five years, upon one year's notice. The City of Windsor will be required to secure a Dominion license to export power, but it is not expected there will be any difficulty in obtaining the consent of the federal authorities for this purpose.

In the meantime a proposition has been made by the Sandwich, Amherstburg & Windsor Electric Railway Company to supply electricity to the City of Windsor from its new power plant at a rate estimated by the company to be equivalent to $35 per horse-power per annum. The matter was brought to the attention of the City Council at a meeting on March 27 in the form of an offer to deliver to the city sufficient energy at 2200 volts for 350 street lamps at a rate of 1.56 cents per kw-hour, the energy being furnished from the street railway's three-phase, 60-cycle system. A condition attached to the proposition was that the city should enter into a ten-year contract, subject to cancellation on six months' notice, not to be given, however, until after three years from the time the contract begins. The proposition was referred to the power committee, which is to report during the following week.

The municipalities of Napanee, Kingston, Lansdowne, Brockville, Lyn, Prescott, Cardinal, Morrisburg and Athens have been informed by Hon. Adam Beck that the commission is not prepared now to give the prices at which power would be supplied to these municipalities, but that the towns in eastern Ontario would receive power on as favorable terms and at as favorable prices as the towns and cities in western Ontario which are being furnished Niagara power. The whole matter, including prices, will be laid before the municipalities at a meeting to be held at either Brockville or Kingston during the next week.

The commission has closed a contract with the Simcoe Power Company for the supply of 1600 hp to be transmitted by the commission to Penetanguishene, Midland and Waubaushene in northern Ontario.

The formal celebration of the arrival of Niagara power in Toronto over the hydroelectric transmission lines is arranged to take place on May 2. It was decided that the city hall should be made the central feature in the scheme, which will be elaborately decorated in honor of the event. A public reception will be tendered by the city to the members of the Hydroelectric Commission, members of the Ontario government and members of the Western Ontario Power Union. After the banquet Sir James Whitney, Premier of Ontario, will press the button to start the illumination of the hall. Mr. Philip W. Ellis, the wholesale jeweler, has been selected by the Board of Control as the city's nominee to the commission appointed to manage the hydroelectric system of Toronto. The Ontario government through the Hydroelectric Commission appoints one member, and the third will be the Mayor for the time being, who serves without salary. Each of the other commissioners will receive a salary of $4,000 per annum and hold office for two years. Mr. Ellis was a member of the original Ontario Power Commission appointed by the Union of Western Ontario Municipalities in 1905, which first inquired into the possibilities of utilizing Niagara power.

The Galt, Preston & Hespeler-Berlin Railway is the first railway in Canada to use Niagara Falls power, the connections having been made and the power turned on at the company's own transformer station at Berlin on March 27. The company's passenger and freight trains were run with noticeably improved smoothness and on schedule time, the freight trains, consisting of twelve heavily laden cars, being hauled by specially constructed electric locomotives, said to be the first of their kind used on a Canadian railway. Hon. Adam Beck, chairman of the commission, came from London for the occasion and was met by representatives of Galt, Berlin and Waterloo and Chief Engineer Sothman, of the commission. After the turning on of the power a trip was made over the line in a special car.

On March 31 Chairman Hon. Adam Beck announced at London that the Power Commission would send two or three engineers to Europe at the end of April to study the electrical situation there. They will be accompanied by an expert who will make a special investigation of electricity as applied to farms, and Mr. Beck will also join the party in May.

CURRENT NEWS AND NOTES.

Chicago Electrification Committee Organized.—Permanent organization of the Association of Commerce committee on electrification of steam railroads in Chicago has been effected. Former Judge Jesse Holdom is chairman, Mr. T. E Donnelley vice-chairman, and Mr. Frederick W. Rawson secretary of the association.

Columbia Electrical Engineering Society.—At a meeting of the Electrical Engineering Society of Columbia University, to be held on April 7 at 8:15 p. m in the Engineering Building, Mr. A. H. Armstrong, of the General Electric Company, will deliver a lecture on the subject of recent developments in electric traction. This meeting is open to the public.

Missouri Convention Next Week.—The annual convention of the Missouri Electric, Gas, Street Railway & Waterworks Association will be held in St. Louis April 13, 14 and 15.

Los Angeles Desire for N. E. L. A. Convention in 1912.—It is reported that Los Angeles will make a strong effort to secure the 1912 convention of the National Electric Light Association. The Chamber of Commerce of that city has taken the matter up, and it is said that it will make a decided effort to obtain next year's convention.

New Gas Company in Southern California.—Following the incorporation of the Southern Counties Gas Company of California comes the announcement that the Southern California Edison Company, Los Angeles, has transferred to the new company its gas properties at Santa Ana and Whittier, Cal. The general offices of the new company will be at Santa Ana. Mr. C. S. S. Forney is president.

Society of Wireless Telegraph Engineers.—The Society of Wireless Telegraph Engineers will hold a regular monthly meeting in the Walker Building of the Massachusetts Institute of Technology on April 3 at 8 p. m. At this meeting the future work and plans of the society will be discussed. The president of the society is Mr. Fritz Lowenstein, of New York City; vice-president, Dr. Louis Cohan, Washington, D. C., and secretary, Mr. E. M. Moore, 39 Trinity Place, Boston, Mass.

Hat Creek Farmers' Demand for Damages.—About sixty farmers using water from Hat Creek, near Redding, Cal., have brought suit against the Shasta Power Company (Sacramento Power Company successor) alleging damages amounting in the aggregate to $255,000. The defendant utilizes the water of Hat Creek to generate electricity, which is transmitted to Redding, Chico and other towns. The farmers allege that their riparian rights have been impaired by the abstraction of water without due authority of law.

International Railway Fuel Association.—The third annual convention of the International Railway Fuel Association will be held in the Hotel Patten, Chattanooga, Tenn., on May 15-18, 1911. The program includes six papers, mainly relating to coal and oil as locomotive fuel, although one relates to "Fuel Investigations Under the Bureau of Mines," by Dr. J. A. Holmes, director of the United States Bureau of Mines. Mr. W. C. Hayes, Erie Railroad, New York, is president of the association, and Mr. D. B. Sebastian, Rock Island Railway, Chicago, is secretary.

Arkansas Association of Public Utility Operators.—At a meeting of the executive committee of the Arkansas Association of Public Utility Operators held in Little Rock, Ark., March 15 it was decided to hold the annual convention of the association in Little Rock on May 3, 4 and 5. The papers presented will cover public-utility operation of railways, gas, electric light, natural gas and water. The chairman of the committee for the entertainment of delegates and guests is Mr. D. A. Hagarty, vice-president and general manager of the Little Rock Railway & Electric Company.

Turin International Congress.—The American Institute of Electrical Engineers has appointed a special committee to attend to the representation of the Institute at the International Congress of the Application of Electricity to be held at Turin, Italy, from Sept. 9 to 20, 1911. The members of the committee thus far appointed are Chairman, J. W. Lieb, Jr., past-president of the A. I. E. E.; Dr. A. E. Kennelly, president of the United States National Committee of the International Electrotechnical Commission; Dr. S. W. Stratton, director of the National Bureau of Standards, and Mr. T. C. Martin, executive secretary of the National Electric Light Association.

Electricity in California Oil Fields.—The San Joaquin Light & Power Company, Fresno, Cal., has reached Taft with its transmission line from Bakersfield through the West Side oil fields and will soon be in position to supply the operators with electrical energy to operate their oil drills. The new line will form a loop from Fresno to Bakersfield, passing through the Coalinga and Kern River oil fields. Substations at Famosa, Wasco and other points are contemplated. It is said that the company will spend $250,000 on its new plant in Bakersfield, largely increasing the steam-power plant equipment. This will insure the steady supply of energy necessary for the operation of the plants in the oil fields.

Fort Frances Power Situation.—The efforts of the town of Fort Frances (Ont.) to place restrictions regulating the power development at that point by the Ontario & Minnesota Power Company, as previously noted in these columns, culminated in the passing of a bill through the Canadian Parliament on March 27 which specifically provides that the Public Works Department shall have authority to determine the character of the power development at Fort Frances. After considerable discussion by various members, both for and against the measure, Sir Wilfrid Laurier suggested an amendment under which it is provided that 50 per cent of the power now or in future developed shall always be available on the Canadian side, and, with this change, the bill was finally approved.

An All-Electrical House.—One of the comparatively few residences in this country to be wired complete for electric lighting, cooking and heating is the house of Mr. A. Lamborn, the manager of the famous all-electrically equipped Hotel Stanley and Stanley Manor, at Estes Park, Col. The house, an eight-room building, with four bedrooms, contains sixty lamps, and each room is equipped with special baseboard outlets for heating appliances, these circuits being wired with especially large copper section. All cooking is done on an electric range in the kitchen, and hot water for the house is supplied from an electrically heated waterback. Energy for the house and hotel equipment is obtained from a nearby water-power plant owned by the hotel estate. Coal at this point costs from $12 to $16 a ton.

Meeting of Polytechnic Society of Colorado Springs.—At the regular meeting of the Polytechnic Society of Colorado Springs, Col., held March 14, Mr. George D. Luther read a paper on the "Ironclad-Exide" electric vehicle battery. Mr. Luther outlined the development of electric vehicle batteries and described various types of batteries that have been used for this service. Besides the members of the Polytechnic Society there were also a number of vehicle users present as well as the employees of the Colorado Springs Light, Heat & Power Company. This company intends to put several electric vehicles into service in Colorado Springs and to push actively the sale of electric vehicles. Professor Griswald, in charge of the Electrical Engineering Department of Colorado College, was the presiding officer.

Baltimore Section, N. E. L. A.—The winter work of the Baltimore Section of the National Electric Light Association has proved of great educational value to the section members. The course of ten lectures being delivered by Dr. John B. Whitehead, professor of applied electricity at the Johns Hopkins University, will be concluded on April 4, when at the last meeting of the educational course the subject will be "Principles of Illumination." At the meeting on Feb. 28 Mr. H. L. Parker, illuminating engineer of the Consolidated Gas, Electric Light & Power Company, lectured on "Interior Illumination." The lecture was illustrated with lantern slides. At the meeting on March 14 Mr. R. H. Tillman, who is in charge of the company's motor-service department, lectured on "Private Plants." On March 28 Mr. William Schmidt, Jr., secretary of the Consolidated Gas, Electric Light & Power Company, lectured on "Corporation Accounting."

Prussian State Railway Electrification.—The adoption of the railway budget containing an item of $10,000,000 for changing the railroad between Magdeburg and Leipzig from steam to electric operation is looked upon as the beginning of the complete electrification of the Prussian State railroads.

Denver Sign Ordinance.—A new sign ordinance before the City Council of Denver, Col, calls for elimination of wood from all classes of signs, and above a certain area all signs must be of mesh construction. The object of the ordinance is to exclude cheap, flat wood signs, both in order to decrease the fire hazard from inflammable structures or buildings and to minimize danger to the public during windstorms.

Pennsylvania-New Haven Connection.—It is said that the Pennsylvania Railroad is preparing to expend $25,000,000 for a link to connect its Long Island tracks with the tracks of the New York, New Haven & Hartford Railroad in order to enable passenger trains from the South and West to run through to New England without being ferried around New York City. Details of the plans for electrification have not as yet been announced.

Public Lands Withdrawn for Water-Power Reserves.—President Taft, acting upon the recommendation of Mr. Fisher, the new Secretary of the Interior, withdrew from settlement 6790 acres of public lands in Utah and Washington on April 1. These lands are reserved for water-power development. The areas in Utah comprise 640 acres along the Provo River and in Washington 3000 acres along the Similkameen River and 3150 acres along Bonaparte Creek.

Tungsten-Coated Silver Lamp Filament.—In a patent issued on March 14 to Mr. Karl Farkas, New York City, a description is given of a process for producing a compound filament for incandescent lamps consisting in heating electrically a fine silver wire in a rarefied atmosphere of about 20 in. composed of about 85 per cent of vapors of a tungsten compound, about 8 per cent of vapors of chloride of silver and 7 per cent of pyrogallol vapors, the result being a metal coating on the fine conductor after reduction in an atmosphere of hydrogen.

Meeting of Los Angeles Section A. I. E. E.—On March 28 the executive committee of the Los Angeles Section of the American Institute of Electrical Engineers held a meeting of the local chapter, preceded by a dinner given at the University Club, at which the following engineers were guests: Profs. Elihu Thomson, C. L. Cory and W. F. Durand, and Messrs. B. J. Arnold, H. A. Foster, G. A. Damon, A. H. Babcock, D. G. Vincent, G. L. Hoxie, K. B. Miller, S. G. McMean, O. H. Ensign, M. M. Corbin, G. H. Hill, R. J. Cash, F. F. Scattergood, T. B. Comstock, G. G. Watson and F. H. Anderson.

Conservation Conference of Engineers.—The National Electric Light Association has issued invitations to about 12,000 members of engineering societies to attend its conference on the conservation of water-powers, which will be held in the Engineering Societies Building, New York, on April 8, at 2:30 p. m. Among other papers and addresses one will be presented on "The Hydroelectric Business from the Investor's Standpoint," and the speakers will include Messrs. John Bogart, H. M. Byllesby, H. L. Doherty, R. D. Mershon, S. Z. Mitchell, J. R. McKee, D. B. Rushmore, L. B. Stillwell and J. G. White, who with others will consider the subject from different angles of approach. The meeting will be open to the public.

Entertainment on Electrical Jobbers' Train.—For the entertainment of the members of the Electrical Supply Jobbers on the special train leaving Chicago for Del Monte, Cal., on April 18, special song-books containing the choruses of 100 popular songs have been prepared. A piano will be provided in the observation car and abundant opportunity will be afforded for using the books. Card tournaments have been arranged and on one night an amateur vaudeville show will be given in the observation car. Other entertainment features have been planned, but they will be "sprung as surprises" upon those making the trip. Mr. H. H. Cudmore, president of the Brilliant Electric Company, is chairman of the entertainment committee.

Compulsory Delivery of Telegraph Message.—On April 3 the Supreme Court at Washington upheld as constitutional the statute of the State of Virginia imposing a penalty upon telegraph companies for failure to transmit promptly messages filed with them. The case came to the Supreme Court on a writ of error to the Supreme Court of Virginia, which found the Western Union Telegraph Company guilty and assessed a fine of $200 for failure to forward promptly a message filed with it at Richmond, Va., by a commission firm, Crovo & Crenshaw, for transmission to a firm in Brooklyn. The opinion, which was written by Justice Lurton, was brief and held that the fact that the transaction was interstate did not deprive the State of Virginia, in the absence of a federal statute, from legislating regarding it.

Chicago Railway Tunnel.—The sinking of the 278-ft. twin tubes for the new La Salle Street street-railway tunnel under the Chicago River was successfully accomplished on Sunday, April 2. The tubes were built at a dry dock on the North Branch of the river and floated to position. They are 24 ft. in diameter, except as the circle of each is modified by a central web constituting a chord of each circle. The width of the two tubes is 41 ft. over all. The outer shell is of steel lined with from 20 in. to 40 in. of reinforced concrete. The work of sinking was done on Sunday when the reverse flow of water in the river, due to the Drainage Canal hydroelectric plant, may be minimized. Steam tugs and electric hoisting engines were used to adjust the tubes in the final position, and water was introduced to sink them to temporary piling. As placed in position the tubes weighed about 8000 lb. Each will contain a street-railway track when completed.

Public Utility Commission for Pennsylvania.—A bill embodying the ideas of Governor Tener covering the establishment of a public utilities commission to supersede the present Railroad Commission has been presented to the State Legislature of Pennsylvania. The Governor, in his pre-election speeches, made some very definite promises as to what he hoped to do in regard to a bill of this kind, and it is said he will exert his utmost efforts to have passed the bill embodying these promises. It is the Governor's idea that a commission with such powers, and properly conducted, would create a better feeling between the people and the corporations and compel the latter to render the satisfactory service for which their franchises were granted. It would protect the companies from unfair attacks and at the same time preserve the rights of the public. It is understood also that a provision will be included in the bill looking to the prevention of over-capitalization of companies. Governor Tener is said to be taking a great deal of personal interest in this bill and has had extended conferences with Attorney-General John C. Bell in an endeavor to draw up the bill so that it may successfully meet any legal or constitutional objections offered to its passage. The bill will establish a commission with power to regulate twenty-nine classes of public service and also corporations or persons engaged in quasi-public business as well as holding companies. The present State Railroad Commission is abolished The bill is said to go far beyond the law providing for railroad or public-service commissions in other states. The commission is to be composed of five members, who shall serve five-year terms, at an annual salary of $8,000 each.

Fire in Bakersfield Electric Plant.—The breaking down of a transformer in the steam plant of the San Joaquin Light & Power Company north of Bakersfield, Cal., on March 22 is said to have caused the burning out of a 750-kw generator and started a fire that threatened the buildings. In some way, according to a newspaper account, the insulation in a transformer gave way, short-circuiting it and allowing current at 17,000 volts to pass to the generator, which was burned out, setting fire to the building. The loss is said to be $25,000.

Two Hundred and Fifty Thousand Electric Flatirons Sold Last Year.—It is estimated that no less than 250,000 electric flatirons were sold in the United States and Canada last year. There are more than 10,000,000 homes within central-station territory, of which fewer than 2,000,000 have electric service: consequently the estimated sales last year approximate one iron to every eight homes. Although the electric iron was on the market almost fifteen years ago, its general use dates back only a few years. Other electric appliances have a similar history of long neglect followed by rapid introduction.

Telephone Rates in Spain.—Rates for long-distance telephone service in Spain, for conversations of three minutes or fraction thereof, are 9 cents for thirty miles, 22 cents for 125 miles, 40 cents for 250 miles and 75 cents for 500 miles. In connection with the above service a new system has also been inaugurated for the transmission of telephone messages. A fifteen-word message destined to any point without the Province of Malaga may be sent for 19 cents; to any point within the province for 9 cents. These messages are received on blanks similar to those now in use for the telegraph service.

Litigation Relating to Fuel-Oil Supply.—The Los Angeles Gas & Electric Corporation has brought suit against the Amalgamated Oil Company seeking to recover $44,500 from the defendant for its alleged failure to deliver fuel oil. A breach of contract is asserted, and the amount asked represents the difference between oil at 45 cents a barrel, said to be the contract price, and the price which the company is now paying for its oil, which is much larger. It is asserted that the oil company entered into a contract to deliver fuel oil for five years at 45 cents a barrel, but that deliveries were made for two years only and then stopped. The contract expired on Jan. 1, 1911.

Wages of Arc-Lamp Maintainers in Chicago.—A threatened strike on the part of the maintainers of arc lamps used in the municipal street-lighting system of Chicago was averted recently by a compromise in relation to wages. The arc-lamp repairers, who were getting $100 a month, asked for $125 and accepted $110. Of the arc-lamp trimmers nineteen were getting $87 a month and eighty-six were paid $83.33 a month. They all asked for an increase to $100 a month, but agreed to accept $91.67, on which terms settlement was effected. By the old agreement with the arc-lamp trimmers, each man cared for 270 inclosed-arc 100-hour lamps. Under the terms of the new agreement each man will care for 300 lamps, so that the increase in operating expenses will not be so great as the higher rate of wages would indicate. The number of arc lamps in the city street-lighting service is over 12,000 and will be increased to over 22,000 within the next three years by an arrangement with the Sanitary District, which has a contract to take over the street lighting of the city.

Electrical Water Works Pumping in Chicago.—A contract for supplying and erecting the two electrically driven centrifugal pumps to be installed in the West Side pumping station of the Chicago water-works system has been awarded to the Platt Iron Works Company, of Dayton, Ohio, for $53,949. The plan of using electrical energy supplied from the hydro-electric plant of the Chicago Drainage Canal to operate pumping stations in Chicago has been alluded to previously in these columns. Each unit is a horizontal-shaft single-stage pump direct-connected to an alternating motor and capable of delivering 25,000,000 gal. daily under a total head of 115 ft. The contract includes starting apparatus, switchboard, instruments, oil switches, exciters and transformers to reduce the line voltage of 12,000 volts to 440 volts, which is the working potential. Synchronous three-phase, 60-cycle motors of 1000 hp or 8000 kva rating are specified. There will be seven 275-kva water-cooled, oil-insulated transformers, including two banks of three each and one spare transformer not connected. Each motor is provided with an exciter. It is expected that the installation will be ready for service about Sept. 1 of this year.

Emergency Use of the Telephone.—Mr. George K. Gann, of Lincoln, Neb., told an interesting story at the recent Chicago convention of the National Independent Telephone Association to show that in cases of emergency it may be necessary to disregard strict operating rules as a duty to humanity. A woman called up the Lincoln exchange one day in great excitement, and after some difficulty it was found that she was the wife of a traveling man who had left home a day or two before on one of his trips. The wife had just discovered that a bottle of laudanum was missing from the medicine closet, and as her husband was taking cough medicine from a bottle of similar shape, which had been left behind, she was greatly alarmed, realizing that her husband had taken the poison with him by mistake. She rushed to the telephone at once to call up her husband in some way and tell him of his mistake, but she was unable to tell the operator where her husband might be located; she did not even know what state he might be in. The telephone company called up the employer and obtained a list of about twenty towns in one of which it might be possible to locate the man wanted. These places were called up in succession, and after three or four attempts the traveling man was located. In a few minutes a happy though excited woman was talking to a surprised husband. After the latter had succeeded in convincing the anxious wife that he was really alive he told her that he had noticed his mistake shortly after he left home.

Electric Light from Salt and Water.—According to an Arkansas newspaper an inventor at Mansfield in that State has discovered a method of producing electricity for electric lighting from salt and water. The newspaper states that the inventor is a stranger who came to the town about a year ago and has shrouded himself in mystery, living in a house on a neighboring mountain and rarely being visible. The newspaper account proceeds as follows: "Then one day Brice came down to the village post office, where he mailed a number of letters. A week or so later mail began arriving at the post office for him in large quantities. This fact soon became known, and the entire village wagged with gossip as to Brice, the strange lights in his home and the mystery in which he kept himself clothed. Finally aristocratic-looking men began arriving in Mansfield quite frequently and they journed at once to Brice's home. At night the villagers were amazed to see a constant switching on and off of the lights in the Brice home on the mountains. The electricity made by Brice's system makes a better light than the present electricity. It can be made 75 per cent cheaper than the present kind. The most remarkable part of it all is that the electricity is perfectly harmless, except that a charged wire will burn. However, it produces no shock and can be handled with perfect ease and without danger, except that to come in contact with it will have the same result as placing one's hand on a red-hot iron. Brice refuses to reveal his secret, declaring that already a plan is on foot to rob him of his invention. However, it is known that an effort is now being made to place his invention on the market and that a gigantic company is in process of organization."

STEAM TURBINE GENERATING STATION AT STILLWATER, MINN.

The new steam turbine station of the Consumers' Power Company at Stillwater, Minn., will provide relay service for the water-power plants of the company at Riverdale and Somerset, furnishing energy for the adjoining towns of Stillwater, White Bear, Riverdale and Somerset.

The Stillwater steam plant has been designed for an ultimate capacity of 2250 kw in turbine-driven units, the first 750-kw unit of which has been installed. This station has also been planned as a switching point for the circuits from the two 500-kw hydroelectric plants on the Apple River at Somerset and Riverdale, twelve and ten miles distant, respectively, from Stillwater. An interesting operation feature of the station is the motor-driven pump intake for supplying circulating water to the condensers.

The plant building is a brick structure 73 ft. x 92 ft., the boiler-room occupying 50 ft. and the generator room 42 ft. of the major dimension. The present boiler equipment comprises two 320-hp Stirling boilers with twin flues entering a 6-ft. steel stack 135 ft. high. This steam-generating installation will be duplicated when the remainder of the turbine apparatus is installed.

From the 8-in. main header in the boiler-room a 5-in. steam line is brought overhead to the 750-kw horizontal Curtis turbine driving its 2300-volt, 60-cycle General Electric alternator at 1800 r.p.m. This turbine exhausts through a 28-in. line into a Wheeler surface-type condenser mounted on the basement level directly beneath the turbine setting. This exhaust line is also provided with a 12-in. relief pipe opening to the atmosphere. Turbine, generator, condenser and auxiliary apparatus have been grouped as a single unit, the same design being extended to the two future 750-kw turbine units to be installed in the station.

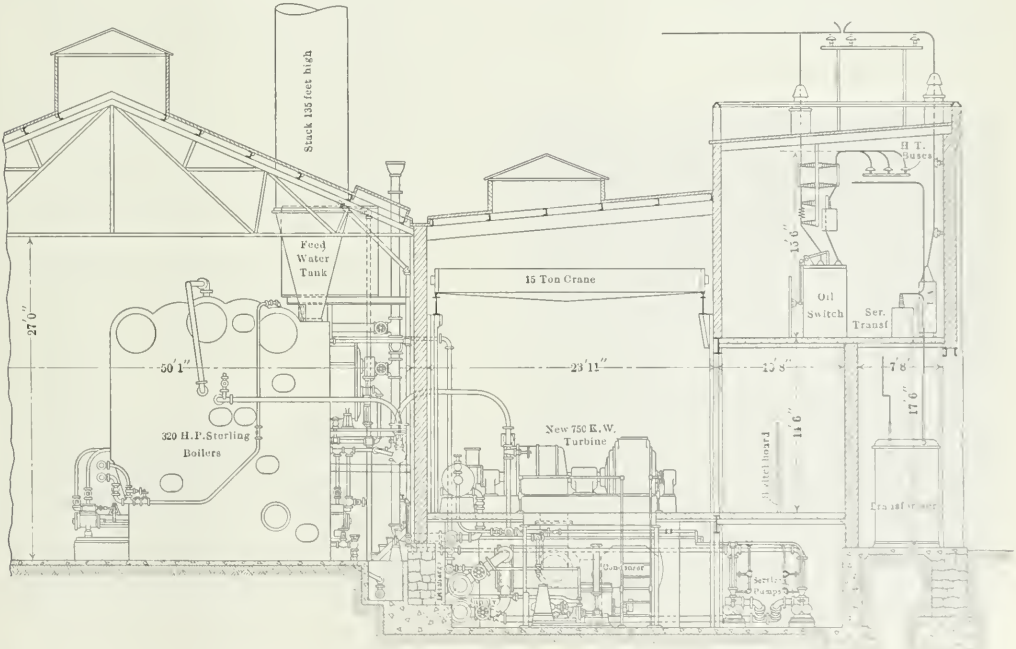


Fig. 1—Sectional Elevation of Stillwater (Minn.) Turbine-Generating Station.

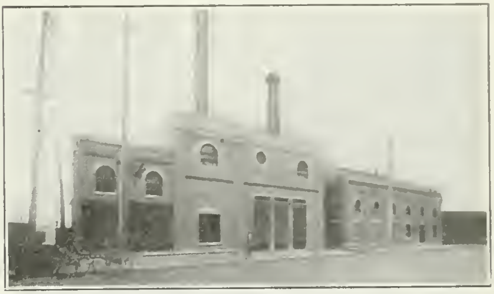


Fig. 2—Reconstructed Power Plant and Switching Station of Consumers' Power Company.

Cooling water for the condenser is taken from the St. Croix River, 150 ft. from the plant, through a special intake designed to accommodate the changes in level to which the river is subject. The arrangement of this pump-house is shown in the accompanying sectional elevation. The river intake crib, erected 50 ft. off shore from the pump-house on the bank, is built up of 10-in. piles tied together by 6 in. x 10-in. timbers, which form the frames for two tiers of 9-ft. x 3-ft. racks made up of 2-in. x 0.375-in. bars at 0.75-in. intervals. From the bottom of this 18-ft. crib a 24-in. pipe extends shoreward to the base of the 15-in. draft line of the 100-hp induction motor-driven center-discharge centrifugal pump at the shore level 19 ft. above. This pump discharges into an 18-in. pipe line to the condensers in the generator room 150 ft. distant. Provision has also been made for a second similar pumping unit in the pump-house, which is 12 ft. x 13 ft. in plan. At this point the St. Croix River undergoes changes of level from an extreme stage of 14.6 ft. down to 0.7 ft., the intake being designed to accommodate itself to this range. The present season has marked the lowest stage reached by the river since 1868, but no difficulty has been encountered in supplying adequate quantities of condenser water to the turbine. The pump space is provided with a hand-tackle for installing and changing machines. The house is electrically lighted and the pump motor is controlled from a starting compensator panel in the turbine-room. An 18-in. pipe similar to the intake line returns the condenser water to the river. The service-pump supply is taken from the incoming inlet water and the boiler-feed supply from the discharge water. An engine-driven Rotrex vacuum pump is employed to remove the air and water of condensation. The condensate is returned to the feed-water tank over the boilers by a small centrifugal pump chain-driven from the shaft of the Rotrex pump.

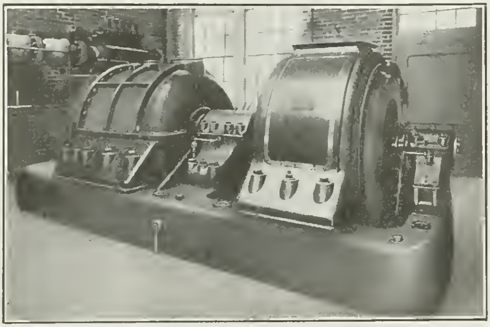


Fig. 3—750-kw Horizontal Turbine in Stillwater Plant of Consumers' Power Company.

Steam for the 35-kw General Electric turbine-driven exciter generators, of which two are installed, is supplied from the 4-in. auxiliary header under the generator-room floor.

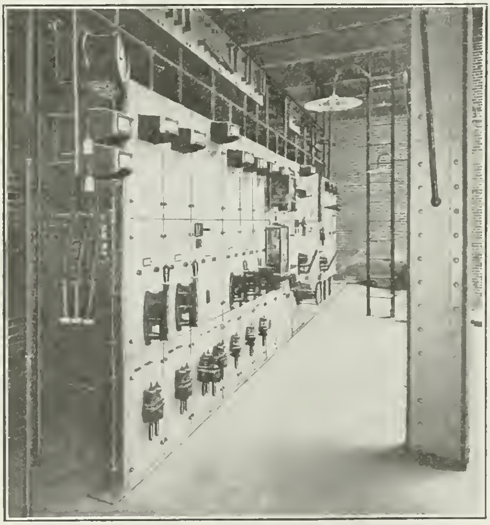


Fig. 4—Switchboard.

The switchboard containing the generator panels and transformer and line-switch control is mounted in the turbine-room in front of the transformer compartments. These six individual concrete cells for the 250-kw, 2300-15,000-volt, self-cooling, oil-insulated step-up transformers are of concrete, with 7-ft. x 8-ft. interiors. The cells communicate with the front of the station, being closed by Kinnear roller steel doors in the front outside wall. Above these doors special ventilating transoms are arranged to provide air circulation to aid in cooling the transformers, the shutters being held open by weights, cords and fusible links, so that in case of accident or excessive temperature rise the cell is quickly and automatically closed to the outside air.

From the high-tension terminals of the transformers the 15,000-volt lines are led up through the ceiling into the high-tension switching gallery, through the series transformers, across under the high-tension bus structure and down to the oil switches. Thence the outgoing energy traverses hook-type disconnect switches to the high-tension buses. The outgoing lines from the 15,000-volt buses are brought down through disconnect switches and series transformers to the line switches, from the line terminals of which they are taken, through the choke coils and disconnect blades, directly up to the vertical roof-entry insulators. Here they tap at a 90-deg. angle onto the line wires which are carried through to the lightning-arrester spark gaps and down through similar porcelain-roof insulators to the aluminum-cell lightning arresters on the high-tension gallery floor. The incoming line wires are similarly equipped, except that the oil switches between buses and line have been omitted. All of the transmission lines entering the

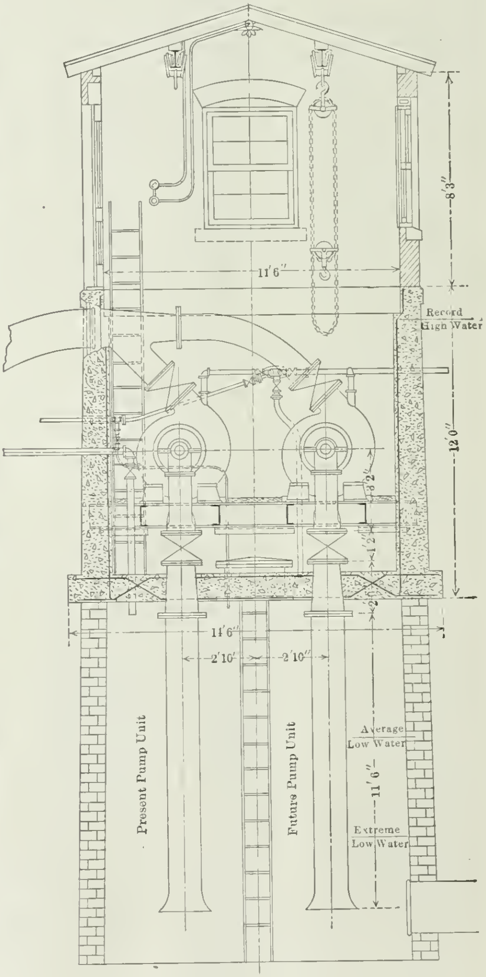


Fig. 5—Sectional Elevation of Condenser Water Pump-House.

station are of No. 2/0 copper cross-section. Through lever extensions from the spark gaps on the roof of the high-tension structure the aluminum-cell arresters can be discharged from the gallery floor. The concrete-floor area surrounding the aluminum cells themselves is waterproofed with special oil-resisting material and is inclosed by low coffers formed of the vertical webs of angle-irons anchored to the floor, preventing the spreading of any oil or electrolyte solution which may be thrown onto the floor from the arresters.

Among the interesting motor loads served by the Stillwater plant is the Minnesota State penitentiary near the town, where motor-drive is used in factory operations. Electricity for motors is also used by the contractors engaged in building the new State prison. Two shoe factories and a flour mill also have electric drive. The total connected load in motors in Stillwater is 764 hp. The population of the town is 10,000 and the company has 1000 electrical consumers on its lines. The rate for lighting service is 15 cents per kw-hour for the first six units and 10 cents per kw-hour for all additional energy used up to 100 kw-hours per month.

The Stillwater steam turbine station was designed and erected under the supervision of the engineering department of H. M. Byllesby & Company, which manages the Consumers' Power Company. Mr. Herbert Markle is local manager at Stillwater and Mr. J. W. G. Johnson is superintendent.

MODERN ALTERNATING-CURRENT COAL DOCKS AT DULUTH, MINN.

On their return trips to Duluth the great fleet of ore and grain carrying vessels which ply to the ports of Lakes Michigan, Huron and Erie carry hard and soft coal from Eastern fields, destined for the consumers of the Northwest. In a single year as much as 7,000,000 tons of coal is handled by the twenty-one Duluth coal docks, which have an aggregate storage capacity for nearly 6,000,000 tons. The work of transferring this tremendous quantity of fuel from the lake vessels to the storage bays and then again to railroad cars as it is needed for consumption has become one of the important services of the hydroelectric energy developed by the Great Northern Power Company's water-power plant on the St. Louis River at Thompson's Falls, eighteen miles west of the city.

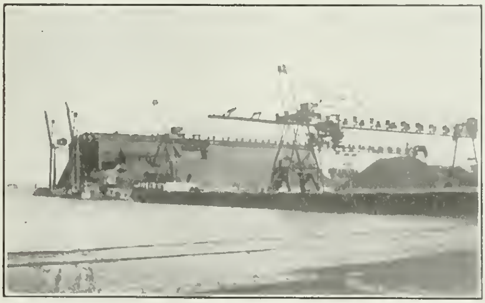


Fig. 1—Two-Bay Alternating-Current-Operated Coal Docks at Duluth.

Of the twenty-one coal-storage docks at Duluth eleven of the principal and newest ones are operated by electricity, all of these but two employing alternating-current motors for all operations. The 25-cycle energy for operating these great docks is transmitted eighteen miles at 30,000 volts from the 39,000-hp Thompson Falls plant, developing a 375-ft. head in the St. Louis River, to the terminal substation at Duluth, where it is stepped down to 13,200 volts for local distribution. A large part of this transmitted energy is utilized for the electric lighting and street-railway services in the adjoining cities of Duluth and Superior, Wis., where the Great Northern Power Company wholesales energy to the Duluth Edison Company, the Superior Water, Gas & Light Company and the local street-railway companies, reserving for itself in both cities the business of supplying blocks of power to customers whose demands exceed 50 hp. Other interesting uses of this hydroelectric energy are the 1000-hp motor-driven Duluth waterworks pumping station, twelve miles east of the city, and the 7500-kw electric furnace load of the Carbolite Company, manufacturer of calcium carbide, both of which services are supplied directly from the system of 13,200-volt lines radiating from the Great Northern company's Duluth substation.

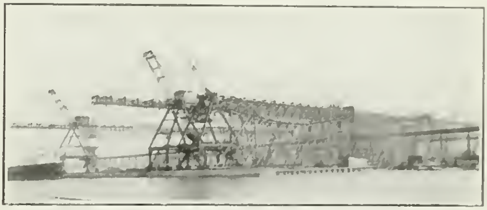


Fig. 2—New Three-Bridge Alternating-Current-Operated Coal Dock at Duluth.

The most modern of the coal docks at Duluth are of the so-called "man-trolley" type, in which the operator's cab is mounted on the hoist carriage, so that the operator always has a clear view of the movements of the bucket suspended beneath him. Four of these great man-trolley docks driven by alternating-current motors are now in operation, and two other large ones, with storage capacities for handling 600,000 tons and 1,200,000 tons of coal respectively, will be completed next year. The coal-storage areas of the docks are usually divided into two or three bays, each 250 ft. wide and sometimes 2000 ft. in length, parallel to the water's edge. Each bay is spanned by several steel bridges having folding cantilever arms extending over the water's edge and forming part of the trolley way which extends back 500 ft. to 750 ft., to the extreme rear of the dock. These bridges are arranged for side travel along their parallel rails at a maximum speed of 50 ft. per minute, being driven by four 75-hp motors through shafts and gearing. The side travel is employed for moving the bridge from one hatchway to the next as the process of unloading goes on. Traveling on the overhead bridges are the hoist carriages supporting the buckets, which are thus enabled to run out onto the cantilevers overhanging the vessel hatchways, returning to dump into the hoppers feeding to the cars along the docks or to discharge onto the storage piles extending 500 ft. or more back from the water line.

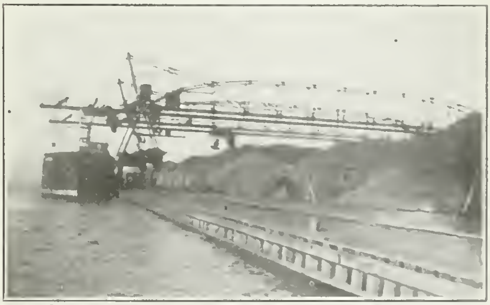


Fig. 3—Single-Bridge Coal Docks Unloading from Vessel at Duluth.

In the Heyl & Paterson type of "man-trolley" dock, of which three docks are now in operation at Duluth, the 25-cycle energy for the various motors is distributed directly by 13,000-volt catenary trolleys to the carriages, on which are mounted the transformers stepping-down to 440 volts for the motors. A 150-hp motor is employed to close the bucket, which weighs eight tons and which holds five tons of coal. For hoisting this bucket the 150-hp bucket-closing motor is arranged to aid a special 150-hp hoist motor, the combined 300 hp in motors raising the bucket at a vertical speed of 300 ft. per minute. For "racking" or trolleying the 50-ton carriage back along the bridge two 75-hp motors are employed, driving the carriage with its loaded bucket at a speed of 1000 ft. per minute. These bridges are manipulated by Westinghouse pneumatic-control apparatus with direct-current auxiliary circuits. In addition to the air brakes dynamic braking within the motors themselves is accomplished by throwing 125-volt direct current through the motor stators, causing the induced currents generated in the revolving rotors to bring them to rest.

The accompanying chart shows the power demand during a typical cycle of operation of one of the crane bridges just described. The first peak is due to closing the bucket through the coal in the vessel's hull; the second and highest one represents the starting power taken by the hoist motors. At the third peak "racking" or carriage travel begins and continues for twenty-two seconds until the bucket is emptied. The return trip then begins and the bucket is lowered again into the hold. The approximate duration of these peaks is indicated on the diagram, which shows a cycle unloading coal from the boat to the rear bay of the dock. These bridges were guaranteed to deliver 250 tons per hour from the hold to the car hoppers, but the actual delivery of ninety-eight trips has been 445 tons during an hour. A ten-hour record held by the two bridges is 5000 tons of coal handled.

When freight cars are available the coal is delivered directly into the car hoppers from the boats, but during most of the open season for navigation, when there is little demand for fuel, the coal has to be deposited in the storage bays for reshipment during the winter as needed. While the rate of unloading during "cutting down" into the full hatchways is very high, some time is lost after the bottom of the hold is reached and trimmers have to shovel the coal by hand into piles for the bucket to handle. Eleven-thousand-ton vessels have been unloaded in eighteen hours by three bridges at Duluth.

The newest coal dock erected at Duluth is one built by the Brown Hoist Company, arranged with three bridges moving over two 250-ft. bays, and a fourth bridge spanning the third bay, which is arranged to be coupled and operated with any of the other tandem bridges. In this bridge the hoist travel is 200 ft. per minute, the bucket being lifted by a 225-hp motor which also performs the closing operation. The trolley is driven by two 112-hp motors at a speed of 1200 ft. per minute along the bridge. The lower hoisting rate is designed to relieve the peak noted in the characteristic cycle diagram, the higher trolley speed throughout the longer period of "racking" more than compensating for any loss of time in hoisting. In this type the 13,200-volt, 25-cycle energy is reduced through transformers installed in a substation on the dock to 440 volts, at which it is distributed to the trolleys, relieving the carriage of the weight of transforming apparatus. This new equipment has been only recently installed and has not yet been fully tested in operation, but is guaranteed to deliver 450 tons per hour to the first hopper or 350 tons per hour to the first bay. Besides the friction foot brakes installed the motors are arranged for dynamic braking, operating as asynchronous generators.

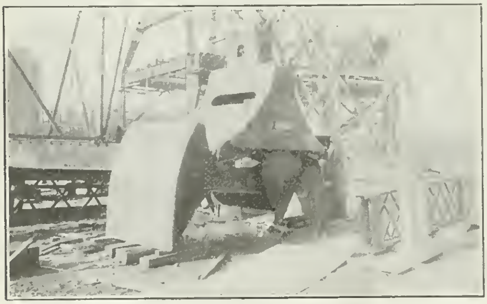


Fig. 4—Bucket of New Alternating-Current Coal Dock at Duluth.

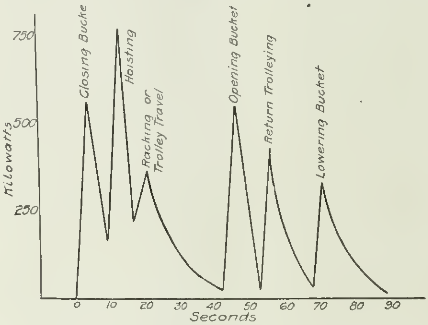


Fig. 5—Load Curve of Alternating-Current-Operated Coal Dock Bridge Bucket Delivering to Rear Bay.

Each coal-dock customer's lines are equipped with a totalizing watt-hour meter and a curve-drawing wattmeter, from the readings of which the bill is computed. The rate is based on a demand and an energy factor. The former charge is $1 per month for each kilowatt of demand of the "minimum rating" of customer's load. To this is added 1.1 cents per kw-hour up to a consumption of seventy times the minimum rating and 0.5 cent per kw-hour for all additional use. The "minimum rating" of the customer's load referred to is taken to be his assumed maximum demand during a five-minute peak, or 40 per cent of his maximum instantaneous peak, 50 per cent of his one-minute peak, or 33.3 per cent of his three-minute peak, as determined by the graphic-wattmeter record.

The results adduced from a careful study made by Mr. J. B. Crane, commercial engineer of the Great Northern Power Company, of the energy consumption of the three man-trolley docks before described show that 889 watt-hours are required for handling a ton of coal from the hold to the average storage bay. Carrying an average of 4.43 tons to the trip throughout the entire process of unloading and trimming the empty hold, this represents a consumption of 4.42 kw-hours per trip. The highest instantaneous peak of this four-bridge dock during a month has been 1967 kw, indicating a virtual load-factor of 8.5 per cent. Taking the computed "minimum demand" to be the virtual peak, the load-factor for the same month becomes 21 per cent.

An older type of coal-conveying apparatus, less modern than the "man-trolley" docks, is the cable-operated bucket dock, of which several are in use at Duluth. In these docks the trolley carrying the bucket is drawn along the bridge by a cable, the winch motors being controlled from one or two stationary operators' cabs, one at the front of the bridge, commanding a view of the bucket in the vessel's hold, and the other at the rear, in sight of the coal piles. One interesting dock of this type at Duluth has screening towers for grading the coal received. Its 250,000-ton storage area is served by three traversing-bridge tramways to which the 440-volt, 25-cycle, three-phase energy is conducted from special contact posts on the dock engaging with trolley conductors carried by the bridges themselves. The bridges are 506 ft. long, serving two bays, the principal span being 300 ft. with cantilever-boom extensions overhanging the front and rear of the dock. The bucket is hoisted by a 225-hp motor and the trolley racking motion and side travel are imparted by two 75-hp motors. The racking speed along the bridge is 300 ft. per minute and the hoist speed is 250 ft. per minute. In practical unloading tests this dock has handled 85,266 tons in 239 hours, making 34,933 trips. Round trips from the vessel to the storage bay, 270 ft. distant, were made in forty-five seconds. Three bridges made 822 trips in 693 minutes, unloading 10,500 tons of coal in twenty-six hours. During a month this three-bridge dock consumed 51,840 kw-hours, attaining an instantaneous peak of demand of 1400 kw.

Other large electric coal docks will be installed at Duluth coincident with the opening of the extensive new plant of the Minnesota Steel Company, a subsidiary of the United States Steel Corporation, which is now under construction on the shore of St. Louis Bay, west of the city. This plant is understood to be built especially for the purpose of reducing and converting the lower grades of ore which it is not profitable to haul to the Eastern blast furnaces. Instead, the coal from the Eastern fields will be brought to Duluth and there utilized for reducing the ore of low-percentage iron.

Besides furnishing energy for the motors of the coal docks at Duluth, the 25-cycle hydroelectric energy is used to light the bridges and bays for night work. For this purpose several hundred 25-cycle flaming-arc lamps are successfully used about the docks, giving no trouble or perceptible annoyance due to the frequency of flicker.

MODEL SMALL MUNICIPAL PLANT AT PRINCETON, ILL.

Although the electric light plant at Princeton, Ill., is run as a municipal venture, it has benefited from the practice of keeping a practical superintendent in charge, without respect to the varying political fortunes of the heads of the city government, so that the history of the electric light service has been a successful one. The plant itself is one of the model installations of its section of north-central Illinois, having been recently equipped with new direct-connected engine-driven generating units. The electrical station occupies part of the building with the city water works, with which it shares the steam-generating equipment and the operators' attention.

Three 150-hp Kewanee boilers are installed for supplying steam to the flywheel pumping engines in the water-works section and to the total of 320 hp of engines driving the electrical apparatus. This electrical generating equipment has been divided into two units of unequal ratings in order to carry the station electrical demand more efficiently. The larger unit comprises a 15-in. x 21-in. Erie City engine driving a 150-kw, 2300-volt, 60-cycle, three-phase Fort Wayne alternator at 200 r.p.m., while the smaller set is made up of a similar 13-in. x 18-in. engine driving an 85-kw alternator at 225 r.p.m Each alternator unit is provided with a belted exciter. The engines are of the horizontal, protected type and are controlled by inertia-type governors. Solid concrete foundations for the machines are carried through the cement floor to a good bearing base beneath the plant sub-basement, through which the conductor cables are carried in conduit to the switchboard at one side of the engine-room. This switchboard comprises eight marble panels; two from which the generators are controlled, one totalizing panel equipped with a watt-hour meter by which record is made of the entire output generated by the station, and five line panels through which pass the outgoing commercial and street-lighting lines. All of these panels are provided with phase ammeters for reading the currents in the various wires and an extra totalizing watt-hour meter is provided for summing up the energy used by the town street lighting. A three-phase ground detector is installed on the totalizing panel, and a synchroscope, mounted on a swinging bracket, is arranged at the left of the two generator panels. The 2300-volt switches are of the plug-and-socket type for the commercial-lighting and street-lamp circuits.

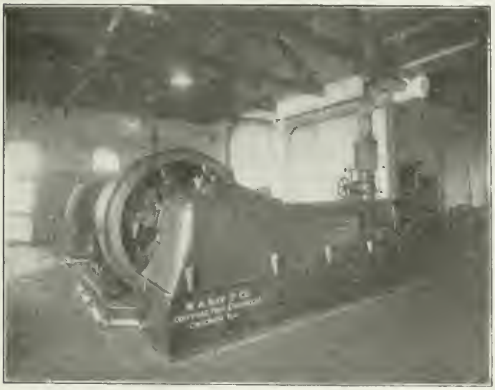


Fig. 1—Interior of Engine-Room of Princeton Municipal Plant.

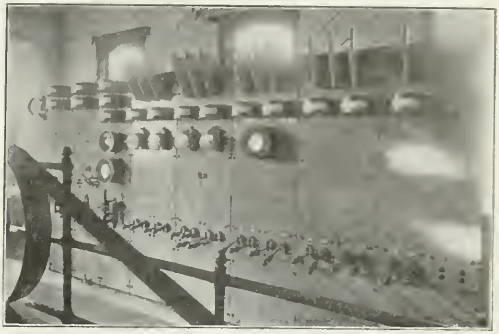


Fig. 2—Switchboard of Princeton Lighting Plant.

Princeton is a peculiarly shaped "dumbbell" town. Years ago, before the coming of the railroad, that end of the present community known as South Princeton was already settled. Then the railroad was built, its line running almost a mile north of the established town center. In the course of events a few houses grouped themselves about the newly built station, a storekeeper or two moved down to the new settlement by the "depot," and soon a second or rival business center was established at the railroad station. Meanwhile the road or street connecting the two centers had been built up with pleasant residences, and in later years the binary town board decided to pave the link of roadway that binds the halves together. Soon the splendid street became the virtual boulevard of the com-

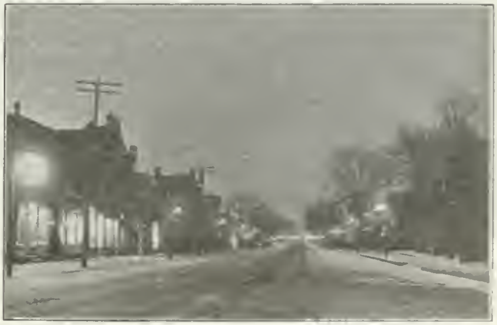


Fig. 3—Series-Tungsten Illumination of Main Street, Princeton, Ill.

munity, and it was decided that more adequate lighting was necessary. The construction of the new electric light plant about this time made this possible, and 140 40-watt series tungsten lamps were installed, one on each of the trolley poles supporting the conductor wire of the electric car line that connects the two civic centers. These 40-watt series lamps, protected by metal shades, are carried on bracket arms mounted on the trolley poles at intervals of 100 ft. along the curb, and after nightfall present a virtual "wide, white way" when viewed from either end of the street. The appearance of the illuminated street, taken on a snowy winter night, is shown in Fig. 3. The cost of this installation throughout the twenty-five blocks, approximately six lamps to the block, was $1,200, complete for lamps, reflectors, brackets and line. In addition to the 140 lamps on Main Street referred to there are also about 500 other series tungsten and carbon lamps used in the street-lighting circuits of Princeton.

The electric lighting department has 450 metered customers, although a few flat-rate services remain. The total income of the plant during the last year was about $8,000. Of this, $4,400 was expended in operating costs and $2,000 in new construction during the year, including the Main Street lighting and the erection of several transmission lines about the city, leaving the net income on the twelve months' operation $1,600. The rates for electrical energy in Princeton are as follows: 1 kw-hour to 10 kw-hours, 15 cents; 11 kw-hours to 20 kw-hours, 12 cents; 20 kw-hours to 50 kw-hours, 10 cents; 50 kw-hours to 100 kw-hours, 9 cents; over 100 kw-hours, 8 cents.

Mr. W. S. Moore is superintendent of the Princeton municipal plant.

TYPICAL LOCOMOBILE ELECTRIC PLANTS.

By Warren H. Miller.

In this country there is little idea as to the spread of the locomobile, or superheated steam unit, throughout Europe and her over-sea trade dependencies. This is particularly the case with isolated electric stations, large central generating plants and other places where easy attendance and small coal account are desirable. Of the many thousands of these steam units placed by the Wolf company alone, the largest repeat orders are from the great electric companies, the Siemens-Schuckert Company leading the list with 174 locomobiles and the A. E. G. (German General Electric) showing 140. Friedrich Krupp comes next with sixty-three and the Imperial State Railways with forty-eight repeat orders. Of 9584 locomobiles, with a total rating of 725,000 hp, 1615, aggregating 136,770 hp, are used in electric generation, being exceeded in number (but not in horse-power) only by the 1885 superheated steam units employed in the wood-working industries.

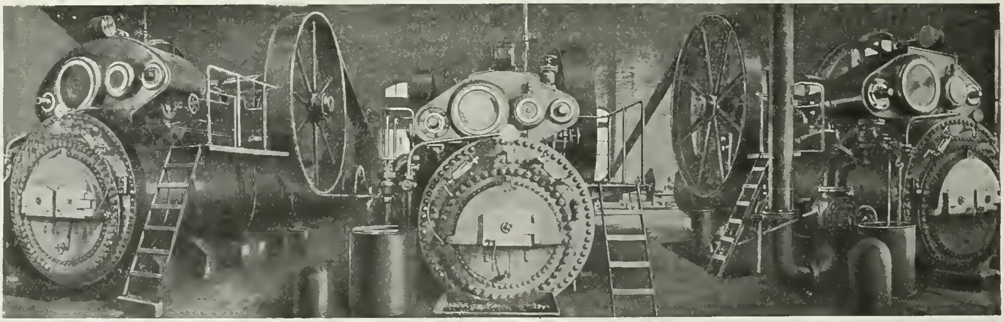


Fig. 1—Generating Plant of Central Electric Company, Concepcion, Chili.

The construction of the locomobile was described by a writer in the *Electrical World,* June 2, 1910. Briefly reviewed, the so-called locomobile is a compact arrangement of boiler and engine in which the heating surface available in the boiler is divided up somewhat more rationally than with the ordinary steam boiler, allowing only a certain part of the heating surface for evaporation and devoting the balance to superheating. While the record consumption is held by a small 138-hp locomobile at 7 lb. of steam per brake hp-hour (Magdeburg Boiler Association test, Jan. 21, 1910) the average consumption ranges from 8.5 lb. to 9.5 lb. of steam per brake hp-hour, or from 1.05 lb. to 1.12 lb. of coal per hp-hour. This average extends over a range from 70 hp up to 800 hp and even as high as 1200 hp in the large Lanz locomobiles, such as were exhibited at the recent Brussels Fair.

This consumption does not depend to any large extent upon the size of the unit; in fact, the record up to last year was held by a 70-hp Wolf locomobile with double superheat, the high-pressure cylinders being located in the smokestack, the steam consumption of this engine being 8 lb. per hp-hour. This is from one-half to one-third the best consumption of our own engines of equal horse-power. The low consumption is attributable to several causes combined, the principal of which are the elimination of cylinder condensation, boiler feed-pump waste and heat losses in the stack and in the piping.

It is difficult to refrain from commenting upon our alleged progressiveness when it is realized that there is not in central-station service in the United States to-day a single locomobile unit, though they have been known for the past ten years in Germany and have become the standard prime mover for central-station plants and all sorts of isolated drives. The Wolf and Lanz companies have built over 20,000 of these units, now in use all over Europe, throughout South America, India, East Africa and even China.

Without again going into the technique of the locomobile, or "superheated steam unit," this article will note at random a few typical installations of the locomobile in different parts of the world in order to remove the idea that seems to prevail among American engineers that this apparatus is experimental. The fact is that if ignorant Chinamen, Malays, bushmen of Africa and South American half-breeds can serve as combined engineer and fireman, as they do on units as large as 350 hp, our own "licensed" engineers should find no trouble in learning to do so.

Fig. 1 shows the generating station of the Central Electric Company, of Concepcion, Chili, a plant of three 205-hp locomobiles driving generators in parallel. The illustration shows the entire plant. The locomobiles are compound condensing, with high-pressure and low-pressure cylinders cast in one piece with the steam dome which jackets the two. There is double superheat—that is, first, the saturated steam at 170 lb. is led from the dome by a pipe running inside the boiler above the water line, comes out through a nipple and enters the first superheater. This is a spiral coil in the smoke box, three spirals deep, and the saturated steam enters it at the outer layer at the stack end, passing inward toward the flue pipes. The boiler gases leave the flue pipes at a temperature of about 700 deg. and traverse the superheater coils, giving up their heat to them and superheating the steam inside to about 570 deg. The gases leave this superheater at about 400 deg. and traverse a second set of coils, which are in multiple instead of spiral and contain the steam from the high-pressure cylinder on its way to the low. Going back a step—the steam in the first superheater at 570 deg. enters the high-pressure cylinder and expands down to receiver pressure, say 4 lb., and its temperature falls without condensation to about 260 deg. It then enters the low-pressure superheater, where its temperature is raised to about 370 deg.; it then passes to the low-pressure cylinder and expands down to condenser pressure, losing heat down to about 150 deg. It then passes through a feed-water heater which reduces the temperature to nearly 90 deg. as it is released to the condenser. Meanwhile the flue gases in traversing the high-pressure superheater give up heat to it so that they reach the chimney at the temperature of about 340 deg. It will be seen that the Chili engines get about every stray heat unit out of every pound of coal consumed. The coal consumption is only 625 lb. per hour for all three locomobiles, so that two men suffice to feed the furnaces and run the whole plant. The floor area occupied by the plant is 45 ft. x 60 ft. If American engineers were required to put in a similar plant of three 200-hp units for street railway service, bidding against the Germans, they would have to offer about as follows: Three compound high-speed engines consuming about 18 lb. of steam per indicated hp-hour, say, 20 lb. per brake hp-hour; three tubular boilers at 250 lb. ultimate pressure; two duplex steam pumps for boiler feed; one feed-water heater; one economizer. Floor area, for boilers, economizer, etc., 40 ft. x 40 ft.; for engines and generators, 40 ft. x 45 ft. Coal consumption, 1500 lb. per hour. The German plan would be better in first cost, in floor space, and above all in economy, the saving in coal being 900 lb. per hour, or about, roughly, $35 a day less in coal expense. In attendance there would be required at least one engineer and one oiler for the three engines and at least two firemen to the shift, the total cost being $15 a shift, against which the Germans would offer to run the plant on $7 a shift for attendance. It is pertinent to ask, Where should we stand in the eyes of the Chilian engineer buying the plant, and why do we not have some of these up-to-date equipments in our own country?

In Fig. 1 will be noticed the arrangement of the firebox, whereby the whole end of the box, which is a standard marine corrugated furnace, may easily be taken off by unscrewing the nuts of the stud-bolts in the rear head of the boiler. The forward head has a similar circle of studs, except that they are in the tube-sheet head and project through the boiler head, being secured by nuts outside in the smoke box. Both heads are packed with vulcabeston packing, and by removing the nuts the entire furnace and tubes can be withdrawn for cleaning, which also permits men to go inside the shell and clean out around all gussets, etc. All this is possible because the grate itself is very small compared to the amount of coal an ordinary boiler has to burn to provide steam for its engine. The standard grate for a 250-hp boiler, allowing 30 lb. of water evaporated to be reckoned as a horse-power, is 6 ft. wide by 7.5 ft. back to the bridge wall. In a locomobile of the same size, allowing 10 lb. of water evaporated to the horsepower, it is 3.5 ft. wide by 4.5 ft. to the back of the fire. For the same reason it is possible to install a crude oil-burning system that will not introduce such enormous temperatures on the crown sheet, for a large easy grate can be used and a moderate degree of heat obtained by projection of the burning oil and air upon suitable refractory briquettes. In other installations this same grate matter comes up, and locomobiles are found easily burning tan-bark refuse, straw, shavings and low grades of brown coals, because there is plenty of room to get a large grate surface inside the boiler for the low-grade fuels without having to make an external furnace for the grate, as must be done with an ordinary boiler where the shell itself is not large enough to give a sufficiently wide grate to handle low-grade fuels directly under the boiler.

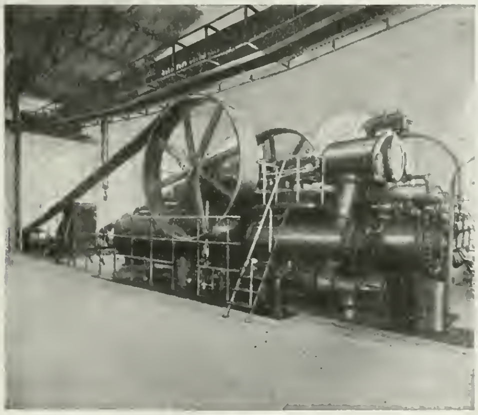


Fig. 2—Central Electric Plant, Weltevreden, Batavia.

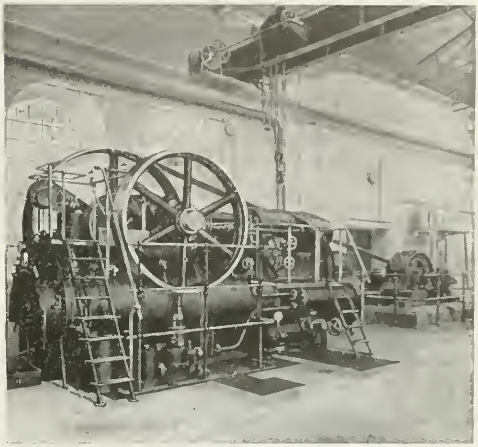


Fig. 3—Generating Plant at New Peterhof Palace, Russia.

Fig. 2 shows a large central electric installation at Weltevreden in Batavia. The plant contains a compound condensing 440-hp locomobile driving a generator from each of its two flywheels and is arranged to burn crude petroleum.

Fig. 3 shows another type of locomobile, which differs from both of the above in being tandem-compound instead of cross-compound and in having both the high-pressure and low-pressure cylinders located in the smokestack, being jacketed by the waste heat gases instead of by the saturated steam in the dome. By a suitable channeling in the cylinder jacket casting the heat jacketing for the high-pressure cylinder is taken directly from the flue pipes, while the low-pressure cylinder is heated by the gases after they have passed through the superheater coils of the high-pressure cylinder. The stack gases themselves are of too low a temperature to be of much use to jacket either cylinder. This type of locomobile has shown remarkable economies and has held, up to the present, all the records, such as 8 lb. of steam per brake hp-hour for the 80-hp and 7 lb. (the world's record) for the 135-hp. The specimen shown is one of the 135-hp type and runs the Czar's electric generating equipment for his famous new Peterhof palace Concerning the 80-hp size, Messrs. Caavedra, Benard & Company, importers, of Valparaiso, Chili, write: "We installed and operate this machine without the assistance of any erecting engineer from the Wolf representatives and find that it works very simply and with a low consumption of oil. A native Chilian runs the entire installation and gets 8.5 per cent better results out of the coal than the Wolf guarantee. The locomobile was ready for service before the condensing outfit could be erected, so we started it and found that we were getting 95 brake horse-power without condensation. This rose to 120 hp upon starting the condenser. The coal consumption, using Chilian brown coal of 6000 calories, runs 0.8 kg per brake hp-power. We consider these results rather remarkable for a native, untrained fireman, oiler and engineer combined to get from such a plant." This firm has since ordered twenty-seven locomobiles, aggregating 2215 hp.

Fig. 4 suggests a point in which the locomobiles ranging from 200 hp to 335 hp have shown themselves especially desirable—that is, as a standby or steam reserve for water and gas-engine plants. The two engines in the illustration happen to be located in the saltpeter mines in Chili and are of 200 hp each, driving in parallel two three-phase alternating-current generators for running induction motors in the mines. The locomobile, occupying as it does such little floor space and having a very low coal consumption when under banked fires, makes a most excellent standby for any hydroelectric plant, as it can be placed in the same room with the turbines and requires no extra boiler house or other complications attendant upon using an ordinary steam plant. In Wangen, in Switzerland, a 335-hp locomobile generating unit runs in parallel with two turbines, all being under the greatest fluctuation of load. The operators speak in the highest terms of the quick and positive regulation and the general excellence of the valve gear. It may be mentioned in passing that the valve gear of the Wolf engines differs but little from the ordinary piston valve of a saturated steam engine, except that the sleeve is of cast iron instead of brass and the valve itself is lightly proportioned with due attention to heat expansion. The Lanz gear is quite different, being of the well-known lift valve or ventil gear type, known throughout Europe as the "Lentz system" of valve gears. It is used on large slow-speed engines running on superheated steam by all the large engine builders, such as Bollinck in Belgium, Tosi in Italy, Krupp in Germany and Dujardin in France.

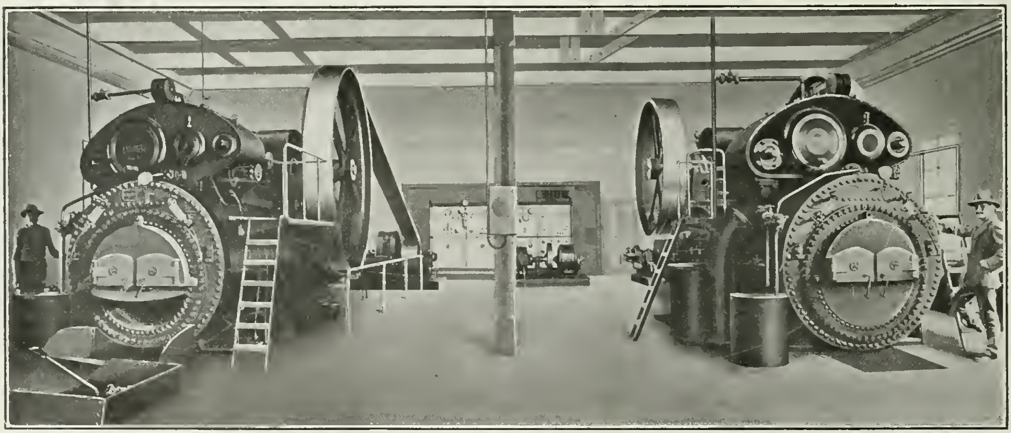


Fig. 4—Two 200-hp Compound Condensing Locomobiles at Antofagasta, Chili, Driving Two Three-Phase 150-kw Alternators in Parallel.

A typical Lanz installation is that in Lourenço Marques, on Delagoa Bay, Portuguese Southeast Africa. This is a 225-hp compound condensing unit, with no valve-rod packing and no piston-rod packing beyond a cast-iron automatic contrivance wherein the exhaust of each stroke takes away all the steam that tries to escape into the stuffing box around the piston rod. This locomobile runs as "isolated" an electric light station as the writer has yet heard of, as the engineer-fireman is the only white man on the plantation that does anything resembling work.

Fig. 5 shows the electric generating station of the Brussels Exposition. All of the energy was furnished by a Lanz 1000-hp directly connected locomobile and the Wolf 650-hp locomobile shown. Both took grand prizes. The Wolf unit was probably slightly the more economical, due to its double superheating in both the high-pressure and the low-pressure cylinders, and the Lanz superior in valve design for large horse-powers, as the lift valve is essentially the ideal valve for all distribution of superheated steam. Both of these firms have shown extraordinary energy in introducing the locomobile throughout Europe and in pushing it over-sea wherever their natural trade lines go. They have not done much in England, though a large and flourishing English branch, with headquarters in London, is now established by one of these companies. Neither company has made a move in the direction of the United States, possibly fearing our usual prejudice and opposition to anything foreign in the engineering line. When they do come they will be prepared to strike hard.

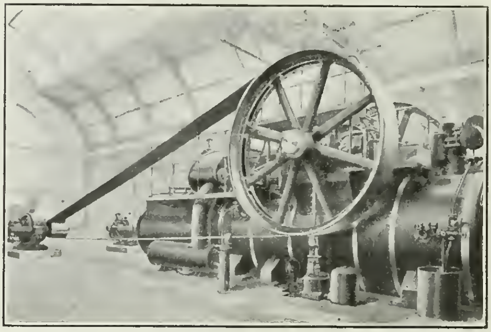


Fig. 5—650-hp Compound Condensing Locomobile at Brussels Exposition.

When the locomobile invades this country it will encounter, first, the boiler insurance and inspection crowd, who will have a lot to say about that removable furnace and tubes; and, second, the unions of engineers and firemen in the large cities, as it takes one man's job away from him. However, if our German friends begin with the isolated plant and the Western power station where coal is at a high premium, they will have plenty to do along these lines before going any deeper into the matter. If a Western mine owner can see that his coal bill is going to be cut down to less than a third he will either assume his own risks or else will take out insurance with German companies that have learned enough about the locomobile to know that it is thoroughly safe.

DISTRIBUTION-LINE CONSTRUCTION IN MINNEAPOLIS.

SPECIFICATIONS for the distribution-line construction used by the Minneapolis General Electric Company were described in a paper by Mr. H. G. Winsor before the Minnesota Electrical Association at St. Paul, March 13.

The poles used are of Idaho cedar, 35 ft. to 65 ft. in length, with 8-in. tops. Butts and tops are treated with coal-tar preservative. The cross-arms are of Washington fir, dipped in preservative. The special eight-pin arms measure 3.75 in. x 4.75 in. and are 9 ft. 8 in. long. The standard four-pin and two-pin arms, in section 4.25 in. x 4.25 in., are 5 ft. and 3 ft. long respectively. Galvanized cross-arm braces are 0.25 in. x 1.25 in. and 26 in. long. For heavy work the following guy equipment is employed: Rod, 0.625 in.; strain insulator, railway type, 1.25 in. x 20 in.; strand, 0.5 in.; average tested strength, 8000 lb. For ordinary work: ¼-in. rod; railway-type strain insulator, 1 in. x 5.25 in.; 5/16-in. strand tested to 4000 lb. For extra heavy guying duty a strain insulator of hard wood, 2.25 in. square and 18 in. long, is used, clevises at each end being held by 0.375-in. through bolts. The tested strength of these insulators averages 15,000 lb. The deep-groove, double-petticoat glass insulators used are carried on pins of first-quality locust. The triple-braid weatherproof wire used ranges in cross-section from No. 6 to 500,000 circ. mil, no wire smaller than No. 6 being used.

In the construction of distribution lines only capable and experienced linemen should be employed and they should have intelligent and careful supervision. Care in laying out the work and the expense of the best of material are of no avail if the construction men are careless or indifferent. A pole improperly set or guyed, or a pit or nick in a wire, due to carelessness, may cause much trouble and possibly injury or death to some innocent person.

Poles are usually set to the depth of about one-seventh of their length, but settings in concrete, rocky soil, etc., may often be safely made at less depth and with perfect security. Some companies use 18 in. to 2 ft. of concrete filling at the top of the hole, finished with a crown raised slightly above the surface to protect the pole from decay at the ground line. This is not necessary, however, where soil has reasonably good drainage and pole butts are properly treated with preservative. Sometimes where extra heavy stress is placed on poles, as in the case of bends in the line, it is well to provide 3 ft to 4 ft. of concrete for strengthening the setting.

In framing the pole and placing the arms the following requirements should be observed: The top arm should be placed not less than 10 in. from the top of the pole, the arms placed below being not less than 2 ft. apart on centers. Buck arms should be placed 12 in. below line arms, and all arms should be fastened to the pole by the use of through-bolts. It is the custom in some places to use spreader brackets in place of buck arms for taking off services and taps, the purpose being economy of space and a provision of safety to linemen. An objection to this method is that the strain is placed on the end of the line arm, instead of on the pole, where it naturally belongs. It is also doubtful if any considerable advantage is gained in additional safety to the lineman.

Double arms, said Mr. Winsor, should be placed at all junction points, at intersections, and at line terminal poles. In framing double arms care should be taken in placing the blocking, and substantial through-bolts should be used in all cases.

Pin spacing on the Minneapolis special eight-pin arm is arranged as follows: Between pole pins, 18 in.; between others, 15 in.; distance of end pins from ends of arm, 4 in. This spacing gives adequate separation for ordinary work

In the case of lines carrying several wires the location of each particular wire on the arm is of considerable importance. The arrangement advised by the Minneapolis engineers and which is adhered to in all new construction is as follows: A line of single eight-pin arms has city-arc wires on outer or end pins; 2300-volt primaries on next to end pins; three of the four remaining pins are used for three-wire secondaries, leaving one of the pole pins vacant for climbing space. If more than seven wires are to be carried the secondaries are placed on a lower arm. Three-phase power feeders are usually carried on a separate arm at the top of the pole.

In stringing, pulling up and tying in the several wires it is necessary to use much care. The sag should be evenly distributed with due regard for contraction and for the weight of conductors. Care must be especially exercised to avoid nicking when pulling up or making up the ties, particularly with regard to high-tension conductors. Many fatal accidents are due to fallen wires. It is therefore imperative that every precaution be exercised to eliminate defects of every kind.

One of the most important factors in safe line construction is the guying. At junction poles, terminals, and wherever there is a turn or bend in the line, the pole, in addition to its own weight of arms, insulators, etc., which is a vertical load, must also support a much more dangerous horizontal force occasioned by the original tension in the wires and by that due to coverings of ice and sleet.

In making up a guy the strain insulator should be carefully placed to prevent accidents. Clamps with double bolts should be used in all cases where the strand is to be fastened or joined. At the point where the guy is attached to the pole eye-bolts should never be used unless a straight pull can be obtained. As this is rather difficult, the method of wrapping the strand around the pole two turns and fastening with clamps seems very satisfactory.

In locating transformers it is unwise to place more than one transformer on a pole, unless special provision be made for support. In the smaller sizes, say up to and including 10 kw capacity, it is safe practice to support from the line arm. It is best, however, with the larger units to provide special supports in the form of double arms and braces. This also applies where banks of two or more transformers are necessary on the same pole, as in service for two or three-phase power. Single units should always be supported from the central point and not hung out on the arm away from the pole. As a rule the top of the transformer should be hung from the arm which carries the primary mains to which it is to be connected. Connection with primaries should always be made by installing a single-pole pole-type primary cut-out in each leg of the primary circuit. These cut-outs should be fused at about 1 amp per kilowatt of transformer rating, when primary voltage is approximately 2300 volts.

Lightning arresters should be installed on each leg of all primary circuits. They should be inclosed in a box made of non-conducting material, preferably wood, which should be painted or treated with an approved wood preservative. They should never be placed on poles carrying transformers, nor on poles at terminal of lines, but rather on poles next to the ones mentioned. In fastening the arrester to the cross-arm bolts should be used, not screws. To assure usefulness the ground connection must be permanent and effectual, and an active water-main system is the best, and, in many cases, the only dependable point to furnish a satisfactory connection. Where such a system is not available the usual methods of driving pipe or burying a plate or coil of copper can be used. Where the driven-pipe or buried-plate plan is adopted care must be taken to go to a sufficient depth to assure their resting in permanently moist earth.

Systematic and thorough inspection and reinspection of overhead lines is a necessity, and should be done by all companies, regardless of the territory covered. Poles will pull out of position or become weakened at the ground line, causing unequal sag in the wires or adding load where not intended; cross-arms will split, become rotten and allow pins to pull out; pins will decay and break; insulators are good targets for stones or a rifle in the hands of a mischievous boy, or they may break as a result of excessive strain; guys will break down from improper application, overstraining or corrosion; crosses may occur from careless tying in or slipping at insulators; ground wires may become broken and useless, and many other defects are likely to develop. It is quite essential that these faults when they develop should be discovered quickly and repaired as soon as found. A systematic inspection of overhead lines may cause some expense, but it will improve the service, impart a feeling of confidence to both the company official and the public he seeks to serve, and avert many a serious accident.

In closing Mr. Winsor suggested that, if properly instructed, arc-lamp trimmers going about a city or town renewing carbon electrodes might be made useful inspectors of line conditions, making daily reports of all troubles noticed along their routes.

USE OF LOW-GRADE FUEL IN BRITISH PRODUCER PLANT.

In Europe the situation regarding the use of low-grade coals is not unlike the condition here. The higher-grade fuels are consumed, says Mr. R. H. Fernald, of the United States Bureau of Mines, while trouble is not taken to transport the poorer classes of material away from the mines. The increasing seriousness of this condition is realized, and deep interest is being taken in the possible utilization of low-grade fuels in gas-producer plants. Already one or two such plants abroad are being operated successfully on high-ash fuels.

One 2500-hp plant in Wales uses coal containing 23 per cent ash, 27 per cent volatile matter and 2 per cent to 3 per cent sulphur. The two 1250-hp Crossley pressure-type producers besides supplying gas for four two-cylinder opposed, double-acting engines driving generators for lighting and power about the factory also furnish gas for heating purposes.

At full load the producers are charged and the fire-chambers poked at intervals of one hour to forty-five minutes. The plant force comprises four men on each shift; one chief engineer, two men on the producers and one in the engine-room. The producers are jacketed with asbestos coverings, securing an increase in efficiency of about 5 per cent, it is claimed. A baffle box in the line from the gas generator prevents dust and other impurities from entering and clogging the economizer tubes. Tar recovered by centrifugal extractors is one of the valuable by-products of the plant, selling for $4.25 a ton, and returning a rebate of 19 cents on each ton of coal fired. From the tar extractor the gas passes to two sawdust scrubbers, either of which can be by-passed to facilitate cleaning of the other.

No gas reservoir is used. A small holder, 30 in. in diameter, is tapped onto the gas line entering the engine. When the pressure in this tank is lowered a switch contact is automatically made accelerating the motor-driven blower which provides the blast for the gas generator. Steam for the producer is made in an auxiliary boiler heated by the gases from the producer. By means of this special arrangement for generating steam in a "hot-gas" boiler through the sensible heat of the gases, only a small percentage of the total steam required has to come from the independent auxiliary boiler. When the load is light no steam is furnished by the "hot-gas" boiler, but with full load this boiler supplies about seven-tenths of all the steam required.

The grate in the gas generator is conical and of the revolving type. The continuous removal of ashes is made possible by a water seal. In the operation of the producer the ash bed is kept about 3½ ft. or 4 ft. thick and the fuel bed about 14 ft. thick

One of the special advantages claimed by the manufacturers for this producer is that low-grade fuels containing high percentages of non-combustible matter can be handled successfully. Care must be taken, however, not to use a caking coal.

METER DEPARTMENT NOTES.

By T. B. Morgan.

There seem to be comparatively few central-station managers who take an active interest in the meter department and its maintenance, while fewer still are interested in the installation of meters. A good example of neglect of meters is shown by the manager who starts an investigation to determine the cause of an increase to the fraction of a cent per kilowatt generated, while he is losing from 25 kw to 100 kw out of every 1000 kw generated through improperly set or calibrated meters. This loss has come upon the lines so gradually with the spread of the system and the resultant installations of meters that it is attributed to line and transformer loss, which is considered unavoidable under the existing conditions. This type of loss is a double one, first, in cost of production, and, second, in the loss of net profit. To cover this loss high rates must be maintained, and one consumer is paying for the unmetered energy of another.

It is most fortunate for many lighting concerns that the present business conditions, and especially the public-utility boards which exist in many States, are putting a veto upon such a state of affairs, for in the past it has been the cause of loss of consumers and, what is much worse, of creating public opinion against the company. Central stations are themselves beginning to wake up to this fact, and the question of proper methods in dealing with the subject is being continually brought up. As a whole, the central-station management is finding that the public-utility board has done more to increase the revenue of the company than the reverse—first, by calling attention to the condition of meters, where five out of every six are, as a rule, found running slow; second, by insuring to the public a fair and just adjustment of their complaints, and, third, by indicating to the management that when meters are found running slow it is the company's loss and that it represents a loss that may be turned into a clear profit.

There is still a tale of woe circulating among many small central-station men to the effect that the cost of maintenance and periodic tests depletes rather than increases the net earnings, as the gain through accuracy is not held by the meters for a sufficient length of time to recompense the company for actual cost of testing. This may have been true in the old days when this branch of the business was undeveloped, but strides have been made along every line of this work, and should such difficulty be found to-day the trouble will be in the manner in which the work is handled rather than in the meters themselves. It is safe to say that at the present time there is no electric company doing a live business and carrying meters upon its lines which cannot show a proportionate gain in both gross and net earnings by maintaining or assisting in the maintenance of an efficient meter department.

While this may appear to be a broad statement and meet with disapproval at first glance, let those who disagree or are inclined to doubt the assertion look into the matter in an impartial way. For a number of years the large companies throughout the country have collected the major part of their income from the energy sold through the watt-hour meter. It has been proved to the satisfaction of these companies that the maintenance of a meter department is necessary to insure a just return from the consumer, and in turn to insure the consumer a just deal. The Association of Edison Illuminating Companies, one of the largest associations of electric lighting interests in the country, if not in the world, has appointed a committee from its most prominent engineers to investigate and report to the association the most efficient methods of installation and maintenance, and also to report upon the types and efficiency of meters. The National Electric Light Association and, I believe, the American Institute of Electrical Engineers are looking into the same matter with a view to standardizing meter practice. The first association represents all types of companies and electrical men, while the latter is the acknowledged leading electrical society in the Western Hemisphere. The papers already published by the committees of these societies are of great importance to lighting companies, and a careful perusal of them will show the opinions of the best meter men in the country.

Pass from the opinions of others to your own judgment and consider the watt-hour meter as an instrument. It has a motor which is the lightest and most delicate motor placed upon the commercial market to-day. It must work under all conditions, in any location, and run intermittently for months without oiling or any attention from inspectors. Is it possible to expect it to maintain a high efficiency unless it is treated with care and its location and setting considered with a view of giving it the most favorable conditions to work in?

TESTS OF WATT-HOUR METERS ON LIGHT LOAD.

	Under 94% Accuracy.	94 to 96%	96 to 98%	98 to 102%	102 to 105%	105% up	Total
Lot A..	(12 not recording) 50	34	50	94	4	7	239
Per cent of total	20.9	14.2	20.9	39.3	1.67	2.92	
Lot B	....	5	7	278	4	1	295
Per cent of total	.	1.69	2.37	94.4	1.34	.34	...

TESTS OF WATT-HOUR METERS ON FULL LOAD.

Lot A	(4 not recording) 12	14	61	139	6	7	239
Per cent of total	5.02	5.85	25.5	58.2	2.51	2.91	.
Lot B	..	..	2	292	1		295
Per cent of total	....	....	.68	98.8	.34		

Many managers of small companies who are anxious and endeavoring to maintain a high efficiency on their systems will find that they can add considerably to their dividends by seeing that the proper location and setting are given to their meters. It is also possible to reduce the cost of maintenance one-third where the meters have been badly set by having a reliable man go over the installations and see that the meters are leveled, trued and firmly set against their supporting walls. While it may be too late to improve the location of the old installations without considerable outlay of money, new installations may be located in a place which will suit the meter as well as the consumer.

To demonstrate the advantage the single-phase induction meter will gain from being properly set a periodic test was made in a district where the superintendent had been too busy to keep track of his installations. Many of these meters had been reported as improperly set by the testers who had run the periodic test eleven months previously, but the limited number of men employed or local conditions forbade the use of time necessary to reset the meters. It will appear at first glance that the tests show fairly satisfactory results until comparison is made with another district. This lot of meters may be designated "Lot A." It contains the test of 239 meters and their accuracy as found. Just prior to this periodic test 295 meters were tested in a district where special attention had been given to the setting of meters. Previous to the installation of induction meters the installations had been fitted with the old type of commutator meters, and when the change was made to induction meters it was found impracticable to change the locations, although there were many poorly located. To overcome bad locations as much as possible special attention was paid to the setting and leveling of the meters. All meters were set on boards which had previously been securely fastened to the wall or other uprights where the old meters had been installed. The meter was then set and leveled, and no meter was left with less than three screws supporting it. In the table below the results of the test upon these meters will be found under "Lot B." The meters tested were manufactured by one company and were one type. They were located in the residential section of the town and their capacity averaged the same. The time between periodic tests in both cases was eleven months, and tests were made by the same men, standards being checked under identical conditions. In fact, the tests and conditions were as nearly identical as could be had under commercial conditions, and the results should have been the same, or very near it. Light-load test was made with one-tenth of the rated amperes given on nameplate, and full load with the rated amperes.

As stated before, these meters were installed in a residential section and it is presumed carried a light load the greater part of the time. Therefore, it is to be expected that loss was really indicated by the light-load test.

The following table is given to show the actual loss on the meters:

LIGHT-LOAD TEST OF WATT-HOUR METERS.

	Meters Registering Under 98c on the Dollar	Meters Registering 98c to 102c. on the Dollar	Meters Registering Over 102c on the Dollar
Lot A	134	94	11
Lot B	12	278	5

FULL-LOAD TEST OF WATT-HOUR METERS.

Lot A	87	139	13
Lot B	2	292	1

The difference shown in the foregoing tables is the result of the setting of the meters. While other conditions might enter in a small degree, they are so small as to be insignificant in the result. It should be borne in mind that this table shows only the loss for one month, while the meters are read twelve times a year.

Anyone wishing to figure the loss to a company will see that unconscious neglect in setting meters is a costly one, and one which is lasting, unless an effort is made to correct it. The management which permits its meters to be carelessly set is neglecting the first principle in maintaining a high efficiency upon its meters and is losing considerable money for its company which should be clear profit.

SLIDE-RULE ERRORS.

By W. L. Durand.

A short time ago the writer was talking on the subject of slide rules with a man who in the course of the conversation said: "I have always wanted to investigate the possibilities of a rule in which the scale is laid off on a logarithmic curve. By this means the divisions would be uniform throughout the entire length of the scale. Then the error would be the same instead of variable, as in the present rule, where the divisions are so much greater at one end than the other."

This remark set me to thinking, and a short investigation served to show that, while the divisions would be uniform, the angle through which the part corresponding to the sliding scale of an ordinary slide rule would have to be moved would vary to the same extent as the divisions on the ordinary rule. Thus a rule of this type would be no more accurate than the present type.

Further investigation showed that the percentage error of a slide rule due to an error of any definite distance in reading is the same at any part of the rule. This can easily be proved as follows:

Let $a =$ first correct reading.
$b =$ first observed reading.
$e =$ first error in actual distance on the rule.

Then, since distances are logarithms of the scale numbers, we have,

$$e_1 = \log b_1 - \log a_1 = \log \frac{b_1}{a_1}$$

Let $a_2 =$ second correct reading.
$b_2 =$ second observed reading.
$e_2 =$ second error in actual distance on the rule.

Then, as before,

$$e_2 = \log b_2 - \log a_2 = \log \frac{b_2}{a_2}$$

Hence, if $e_1 = e_2$, we have,

$$\log \frac{b_1}{a_1} = \log \frac{b_2}{a_2}, \text{ or } \frac{b_1}{a_1} = \frac{b_2}{a_2}$$

Therefore the percentage error is the same in both cases.

For a non-mathematical proof, take a hypothetical case, assuming an error in a 10-in. slide rule of 0.01-in. type. This will mean adding 0.001 to the logarithm of the number.

The log of 2.00 = 0.30103.

Adding 0.001 gives 0.30203.

The antilog of 0.30203 is 2.0046, which gives an error of 0.23 of 1 per cent.

The log of 8.00 = 0.90309.

Adding 0.001 gives 0.90409.

The antilog of 0.90409 is 8.0184, which gives an error of 0.23 of 1 per cent.

In order to determine the accuracy of a 10-in. slide rule, or rather the error in using a rule of this size, the writer took sixty sets of three figure numbers and multipled them first on the slide rule and then on a multiplying machine. The numbers were chosen at random, but so as to take in all parts of the rule, and the answers were such that all parts of the rule were included. The two sets of answers were then subtracted and the ± error determined. The greatest error was 0.15 of 1 per cent and the least 0. The average of all the errors was 0.06 of 1 per cent. There were 29 plus and 30 minus errors and the difference between the sum of the plus and minus errors was 0.60 of 1 per cent. This divided by 60 (the total number of operations) gives 0.01 of 1 per cent as the error for each operation. Where the work consists of only a few operations they may not balance off as well as with a large number; and the probable error for a short series would presumably be greater than the number of figures in the series × 0.01 of 1 per cent.

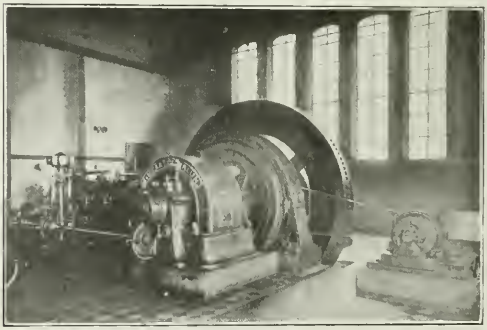
From these figures it is certain that the probable error for any one operation should not exceed 1/10 of 1 per cent and that the probable error for a series of operations should not exceed 2/100 of 1 per cent for each operation. This would mean that, due to the balancing of the plus and minus errors, the error for a series of five operations should not exceed that of a single operation, while for one of ten operations the total error should not be over 0.2 of 1 per cent.

Of course, the personality of the observer enters to a large extent into any determination of this character, and other observers would probably get results either greater or less than those given above; but the order of the figures would be the same and the difference should not exceed 25 per cent.

ELECTRICITY FROM A SWEDISH PEAT BOG.

Several Swedish towns and villages in the neighborhood of Skabersjö, a great modern dairy farm in the Province of Skana, obtain electrical energy for lighting and motor service from a 300-hp gas-engine plant located in the center of the peat bogs of this region. The bituminous material of the peat is converted into fuel gas by suction producers and the gas engines thus operated drive alternators transmitting energy at 3000 volts into the towns. This peat gas-producer transmission system, probably the first installation of its kind, was recently visited by Mr. R. H. Fernald, of the United States Bureau of Mines, and is described in the bureau's newly issued bulletin on the subject of producer plants in Europe, from which this account is abstracted.

The plant equipment comprises two 150-hp suction-type Koerting gas producers, specially designed to burn peat, and two 150-hp twin horizontal-cylinder, single-acting, four-cycle Koerting engines. These engines drive three-phase, 3000-volt alternating-current generators, the output of which, operating in parallel, is transmitted to Skabersjö and the neighboring towns for lighting and for operating motors in the shops and factories. The residence lighting rate is 9 cents per kw-hour.



Gas-Engine-Driven Alternator Using Producer Gas from Swedish Peat Bog.

The 300-hp plant requires about 4.4 lb. of dry peat for each hp-hour developed, the annual consumption of the producers being 750 tons of the fuel at an average cost of 80 cents per ton. Soft coal in this neighborhood costs $3.75 per ton. The total quantity of peat used during the year is got out of the bog between April 15 and Sept. 1 by fourteen workmen and neighboring farmers, who earn about 50 cents a day. From the bog the peat is shoveled onto a conveyor which is driven by a 35-hp motor obtaining its energy through transformers from the power station. The average depth of the bog is about 7 ft., and at the present rate of digging it will last about fifty years. A cubic yard of the bog deposit supplies about 180 lb. of peat, of which 25 per cent to 30 per cent is moisture.

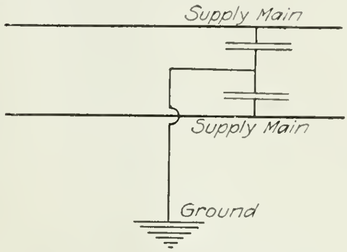
For operating the producer this degree of moisture in the fuel is found to give the best service. With less than 30 per cent present the peat is too dry and steam is required. Fuel is charged into the producers hourly, three men being required during the day shift and two at night. One man supervises the producer-room, one the fuel supply, and the third is stationed in the engine-room. One engine is operated from 5:30 a. m. to 6 p. m., and the other from 5:30 a. m. to 11 p. m.

WIRELESS AS A FIRE HAZARD.

By Elmer J. Lamb.

The use of high-voltage transformers for wireless purposes on the ordinary lighting circuits without the proper protective device constitutes a fire hazard which has been generally overlooked by wiring inspectors.

The supply mains oscillating in harmony with the antenna of the transmitter carry a static charge which, although harmless in itself, very often may result in serious consequences. As the supply mains and the oscillating antenna approach the same length they come nearer to a state of perfect harmony—that is, they are electrically in tune—and the trouble becomes proportionally more aggravated.



Condensers in Wireless Circuit.

The charge carried by the "live" side tends to ground itself by jumping to the grounded neutral wire, sometimes carrying the low-voltage current with it and establishing a destructive arc.

In case the fixture is a combination electrolier for the use of both electricity and gas the static current is liable to jump to the gas-pipe ground to relieve the difference in potential, carrying the line current with it and setting fire to the insulation. The fire in turn may be communicated to the insulating joint, which is made of an inflammable compound.

The above supposition became a reality in several cases brought under the observation of the writer, the insulating joint taking fire from the resultant arc. Had the fire remained unnoticed for a time sufficient to allow the joint to burn through and let the gas escape what would have eventually happened can be easily imagined.

The trouble is not confined merely to the building in which the transformer may be used, but is strongly in evidence in all places which may be supplied from the same lighting transformer. In many cases, as a result, the voltage coils of the consumers' meters are burned out in identically the same manner as when the lines are affected by lightning disturbances.

This trouble is most conveniently corrected by the use of a small high-tension condenser constructed of glass and tinfoil, arranged in two sections of proper capacity, which must be determined by experiment and is dependent upon local conditions. The condenser should be installed as shown herewith. This arrangement will alleviate any abnormal difference in voltage between the two lines, or between one side and the ground.

A SUGGESTION FOR STAGE SCENERY.

By Albert Scheible.

Under the rigid building inspection laws now enforced in Chicago theaters are divided into different classes according to the fireproofing qualities of the buildings and the supply of exits, only the better equipped houses being allowed to use the old style of scenery. Those barred from using the "drops" which permit of quick changes in scenery in the middle of any act are greatly limited in the range of plays which they can adequately stage, and some of them might do well to profit by an electrical scene-changing effect which removes a drop visually without moving it bodily. How this can be done was shown in a model of the Portland cement plant at Universal, Pa., as exhibited at the recent Chicago Cement Exposition.

The model comprised a panoramic view of the buildings with tracks on which trains with raw and finished materials moved at intervals, all operated by electric motors and nicely lighted by concealed lamps. Besides thus showing the exterior of the plant the interior of the main building was presented about once every two minutes without any shifting or moving of the wall facing the spectators.

To accomplish this the front wall of this building in the model was made of a wire gauze with a mesh of rather fine wire. On this the doors, windows, stone trimmings, etc., were painted so as to match the rest of the picture when lighted from the front. Every two minutes a motor-driven switch turned off part of the lamps so as to dim the light on the scene and then turned on a row of lamps concealed in the building. This made the light inside the structure so much brighter than the outside illumination as to render the interior of the building clearly visible through the wire gauze, just as the landscape is visible through a window screen in the summer. A minute later the inner lights would be extinguished and the outer ones increased in number, thereby exposing the painted and apparently solid outer wall of the building. The same principle could undoubtedly be used on the stage in connection with drops close to the proscenium arch and the adoption of such stationary, yet disappearing, scenery may enable theaters of a certain class to overcome their present handicaps.

NOTES ON COMBUSTION OF FUEL.

By John B. C. Kershaw.

Greater attention to the composition and temperature of the exit gases and also to the training of stokers and boiler engineers is the line upon which progress is occurring in fuel combustion.

The figure given in the heat efficiency diagram for the heat loss with the waste-gases from the boilers, namely, 24 per cent, is, it must be understood, quite an average one. It is based on these gases containing 8 per cent CO_2 and passing away with a temperature of 600 deg. Fahr. In many boiler plants, however, the average percentage of carbonic acid contained in the exit gases is considerably below 8 and on some shifts with bad stoking it falls to 6 per cent. The loss then rises to 32.8 per cent and with chimney gases testing only 5 per cent CO_2 it will be nearly 40 per cent of the total heat generated from the fuel. With a dirty boiler and bad stoking the temperature of the exit gases may also rise above 600 deg. Fahr. and the heat loss be still further increased. The fact that the plant is provided with economizers should not cause indifference to this heat loss with the exit gases.

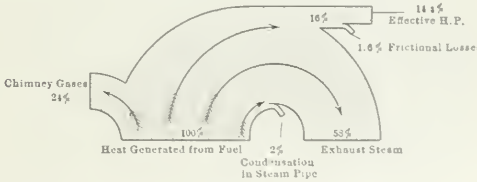


Fig. 1—Heat-Efficiency Diagram for Steam Boiler and Engine.

It is wiser and more economical to utilize all the heat one can within the boiler in the conversion of water into steam rather than to allow it to escape, in order to absorb it at a later stage in the economizers. If all the wasted heat were recovered in the latter apparatus the case would be different. The efficiency of economizers, however, rarely rises above 35 per cent and the remaining 65 per cent of the heat passing through them is lost, either by radiation or with the exit gases. As already stated, the writer advises the use of live steam to supply the heat required (after the water has passed through the economizers) to raise the temperature to that of the boiler. In order to obtain the best efficiency from steam-raising plant, therefore, close attention should be given to the composition and temperature of the exit gases, and in the best managed boiler houses this is now being done. An average of 10 per cent of carbonic acid with a temperature of 600 deg. Fahr. will reduce the heat loss in the chimney gases to 20.2 per cent, and an average of 12 per cent CO_2 to 17.1 per cent. Still further gains can be obtained by reducing, if possible, the temperatures of the escaping gases. A 10 per cent saving of heat is, therefore, in the majority of plants quite practicable, on the left hand side of the heat efficiency diagram.

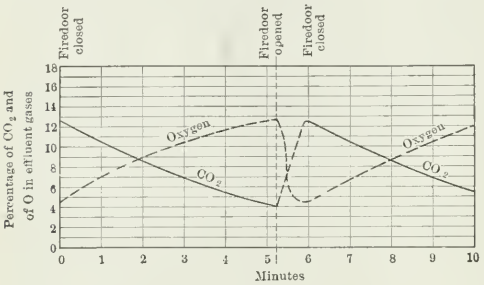


Fig. 2—Diagram Showing Flue-Gas Analysis Under Bad Firing Conditions.

It would not serve the writer's purpose to discuss in this article the relative advantages of the various systems of stoking or of the various methods of testing the exit gases for carbonic acid. With care and skilled attention good results can be obtained from any of the well-tried systems and apparatus now in general use. The need is not so much for improved methods and apparatus as for better trained men to handle them. The old idea that any man who can handle a shovel is good enough to fire boilers or to take charge of a mechanical stoker is dying slowly, but it is dying, and stokers are now receiving in many cases better treatment and better pay. Improved results will be obtained in most plants when equal recognition is given to the fact that special knowledge and training are required in the man who is to have charge of, and interpret the results of, the testing apparatus. To obtain better trained men as firemen is perhaps the greatest need of the moment. The writer is a great supporter of the scheme of training employed by the Hamburg Smoke Abatement Society. This society maintains several instructor stokers who give their whole time to training and supervising the work of the firemen employed by members of the society. The lectures to firemen, such as those given by Mr. W. H. Booth at the Borough Polytechnic, London, are do doubt effecting some good in relation to this matter; but the writer considers the Hamburg system the more practical of the two. The adoption of a bonus system of payment, in which the firemen's wages rise and fall according to the efficiency of their work, as recorded by the CO_2 and temperature tests during each fireman's shift, is also a move in the right direction. As regards the maximum carbonic acid percentage possible, it must be remembered that the danger of working with too high percentages of CO_2 is that incomplete combustion of the carbon and hydrocarbon gases may occur and that carbonic oxide gas, CO, may be formed in place of CO_2. The heat losses due to the formation of only 2 per cent of this gas more than balance the gains due to the difference between 10 per cent and 14 per cent of CO_2. The writer therefore advises engineers in charge of boilers to be satisfied with an average of 10 per cent or 11 per cent carbon dioxide in the exit gases and to frame their bonus scheme on this figure.

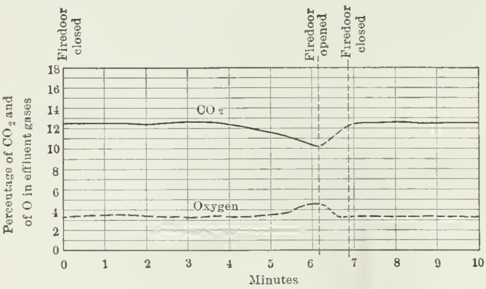


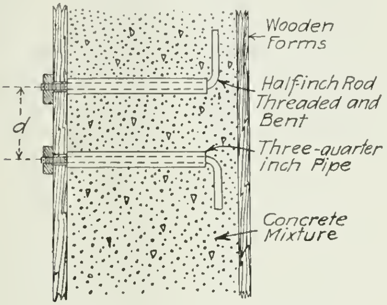
Fig. 3—Diagram Showing Fire-Gas Analysis Under Good Firing Conditions.

The engineer in charge of a small hand-fired steam-raising plant need not consider that large expenditure upon automatic recording apparatus is necessary or essential for the adoption of this system of control. An expenditure of $25 would cover all the apparatus required by the Hamburg system of sampling and testing, and a bonus system of payment can therefore be adopted for installations of only one or two boilers. The chief point to be attended to in obtaining good CO_2 averages is to prevent air leakage through, first, the fire-doors when clinkering and stoking; second, badly pointed boiler settings and brickwork; third, damper openings, and, fourth, defective brickwork in flues. The casing in of boiler brickwork with heat-insulating materials and sheet iron, leaving an air space between the two, is now often done with good results. A cheaper method is to re-point the brickwork and also to paint or tar it every six or twelve months. The snap flue gas tests plotted in diagrammatic form in Fig. 2 and Fig. 3 show the marked effects of good and bad firing on the composition of the flue gases. The results shown in the second series of tests were obtained after the boiler had been fitted with an automatic vane apparatus for regulating the air supply to the demands of the furnace, a most necessary addition to all hand-fired furnaces. The average in the first diagram is 8½ per cent as compared with 12½ per cent in the second; the difference with flue gases passing to the chimney at 600 deg. Fahr. represents a saving in fuel of about 8 per cent. The use of draft gages for recording the volume of air passing through boiler furnaces is now commencing to receive attention. The velocity and amount of the combustion gases are recorded by the apparatus, and from these data the amount of fuel burned and of air used for combustion can be calculated. As proof of the extraordinary results that can be attained by strict regulation of the air supply in combustion processes the new form of laboratory gas burner, known as the Méker burner, may be instanced. This burner yields a homogeneous flame of practically one temperature throughout, the coolest portion of the flame being at a higher temperature than the hottest portion of the ordinary Bunsen flame. The better regulation and distribution of the air supply in this case result in a saving of between 15 per cent and 20 per cent, as compared with the Bunsen form of burner, which for over fifty years has been considered perfect. If to the gains due to the better regulation and distribution of the air supply to boiler furnaces one adds those due to the use of a preheater, most extraordinary efficiencies can be attained with steam boilers. As an example of this one may cite the results obtained at a certain station with a system of force-draft and preheated air supply. In this case the water evaporated per hour per square foot of heating surface was 7.14 lb.; the water evaporated per pound of coal from and at 212 deg. Fehr. was 10.433 lb., and the efficiency of the whole boiler installation, including superheater, was 84.9 per cent. In view of these figures no engineer can say that finality has yet been obtained in the methods of burning fuel under steam boilers.

LETTERS ON PRACTICAL SUBJECTS

CASTING BOLTS IN CONCRETE WALLS.

In mounting high-tension switches, busbar frames, barrier slabs and other parts on concrete walls the job will be far more permanent and workmanlike if during the pouring of the concrete the bolt studs are cast directly into the wall material itself. This can best be done as shown in the accompanying sketch, in which template holes, at the distances and positions of those in the future fitting, are shown bored in the form used to mold the concrete. Then through these holes are clamped the bolts, inclosed in pieces of pipe a little larger than their own diameter, and having their far ends bent into a partial hook, against which to tighten the nut. When the concrete has hardened and the forms are removed the cleanly threaded bolts are left firmly embedded in the wall in position for the attachment of fittings. The purpose of using the pipe to inclose the bolt is to allow a little play of the bolt for slight variations in the distances between holes in the templates or fittings. If a ½-in. bolt is inclosed in a ¾-in. pipe an adjustment of ¼ in. is possible at each bolt, the shank being easily sprung into the position desired. The pipe also forms a shoulder against which to lock the form template when clamping on the nut before pouring the form.



Clamping Bolts in Concrete Walls.

Gary, Ind. Alex. McCarty.

EXTRA GENERATOR AS ROTARY CONDENSER TO IMPROVE POWER FACTOR.

To the power-station operator with a large motor load the summer season usually means a low load-factor and a low power-factor on his system. Fortunately, however, the same causes place at his disposal means for improving the power-factor of the station generating apparatus by employing one of the extra machines, unused during the summer load, as a rotary condenser to take leading current and thus neutralize the lagging characteristics of the outside load. In a turbine plant containing several units one of the machines which would otherwise be shut down during the season is started under its own steam, brought up to speed and synchronized with the other operating units. The steam valve is then closed and the machine allowed to run as a synchronous motor on the buses, its field excitation being meanwhile raised to a point where it takes a leading or condenser current. This current thus offsets the low power-factor current of the outside load, leaving the working generators to carry nearly unity power-factor load, avoiding overheating by extra-phase currents. Besides correcting the power-factor in the station itself efforts should also be made to improve conditions out on the lines. By making an inspection of the transformer ratings in use, it will frequently be found that some of these transformer sizes can be replaced to advantage by others more nearly suited to the load they have to carry. Load conditions change after the transformers have been installed according to the expected loads of motors and lamps, and in many cases transformers may be found to be underloaded or overloaded, impairing the power-factor. The motor sizes installed on the system should also be looked into, as it frequently happens that the use to which machines are put may be changed, and large motors at first provided are later run underloaded, giving low power-factors.

Chicago, Ill. Richard Owen.

BEHAVIOR OF SOME POP SAFETY VALVES.

Pop safety valves, particularly those of the smaller sizes, frequently give trouble by leaking in a most unwarranted manner. Two small pop valves in particular have given the writer much trouble recently, as they could not be kept from leaking under 150 lb. boiler pressure although the valves were of approved standard make and were stamped for 150 lb. The first valve worked very well for several days. It was attached to a small cylinder in which 150 lb. pressure was maintained for eight hours at a time, then the pressure was removed and the apparatus allowed to remain cold until required for use again. Sometimes this use was immediate, while at other times it would be several days before the safety valve would be used. After fifteen heatings of the cylinder the valve began to leak. It first failed to close sharply after relieving pressure by blowing. Then it refused to seat itself quite completely and slight leakage was observed which constantly increased, hour by hour, and became greater each time the valve operated. The valve was removed and ground with silica sand and water. To facilitate the grinding and testing operations the valve was screwed in a vertical position upon the end of a water pipe in which about 30 lb. pressure (water) was available. Thus it was very easy to test the grinding at any instant by simply allowing water to flow until the sand had been washed out and then applying weight to the valve disk and noting whether any leakage took place beneath it. Considerable trouble was experienced in grinding the valve tight. It was found necessary to finish the grinding with the finest available sand dust and even then to continue rubbing the valve surfaces for some time after all the grinding material had seemingly been removed. This burnished the surfaces and probably filled some of the minute channels or scratches formed by the abrading material. But it was soon found that no matter how well the surfaces were ground together when cold, or how tight they appeared under the slight cold-water pressure, the valve was sure to leak after it had blown once under 150 lb. steam. A new valve was procured, placed on the steam vessel, and was found to behave even worse than the first one. In fact, it was not possible to make this valve tight under pressure by any engineering resource known to the writer. The new valve was never tight and leaked at considerably less than 150 lb. pressure. The writer can find but two explanations for the failure of these safety valves; one that the valve was never ground tight, and the other that the seat or the disk changed shape under pressure. Regarding the first, it is certain that the valve was ground tight, for the reason that it would be tight under 150 lb. pressure until it had blown once, and this same circumstance leads to the belief that the metal changed shape under pressure and heat. This is very noticeable in the cheaper forms of stop valves placed upon the market—the "competition" valve is an example of this kind—and as these valves are made very light indeed, even below the limit, they are not able to withstand even ordinary low pressures; consequently such valves are never tight after having been used once. The writer has decided views in regard to the influence of heat upon the copper and zinc alloys from which valves are made. The action of low degrees of heat is very noticeable upon one of the metals—the zinc—and while this metal in ingot shape is very brittle at ordinary atmospheric temperatures it becomes quite ductile when heated to 150 deg. Fahr.

to 200 deg. Fahr., and becomes even more brittle when heated to higher temperatures. It then becomes more and more brittle until it melts. Even then the tension is greatly decreased by a little more heat, for if the heat becomes greater the zinc is soon ignited and is dissipated in the form of oxide. It is to be presumed that a certain somewhat similar change takes place in the alloy of zinc from which the valve disk is made, and as the heat or temperature due to steam pressure of 150 lb. is about 366 deg. it looks as if the designers of safety valves should increase the factor of safety used in dimensioning disks and seats.

South Bend, Ind. James F. Hobart.

TROUBLE WITH INTERPOLE MOTORS.

It is a well-known fact that the good performance of an interpole motor is dependent upon the exact brush position far more than is that of the common shunt or compound motor. Some trouble lately encountered with a number of small interpole motors brings this out remarkably well. All of the motors were of the same type, being 1-hp variable-speed, bi-polar, compound-wound interpole motors directly connected to the head-stocks of wood-turning lathes. The speed variations were from 800 r.p.m. to 2800 r.p.m., the first steps being controlled by armature resistance and the later steps by field-circuit resistance.

The motors were started up by means of a rheostat, which left the motors running at 800 r.p.m. Then, as they were speeded up, some of them would stop at the 1600-r.p.m. point and reverse at approximately the same speed, while others would do the same thing when passing from 2600 to 2800. It was then found that the motors that reversed at 1600 r.p.m. would not reverse until they reached the 2600-r.p.m. point if they were speeded up very slowly. These particular motors, it was discovered, had no oil in the bearings. Upon being oiled they could be rapidly speeded up to the 2600 point, where, like all the rest, they would reverse. After making a number of tests the conclusion was reached that the brush position was wrong. This proved to be the case, for after putting the brushes back (opposite to the rotation) about one bar the trouble was entirely remedied.

The internal magnetic actions that take place are very interesting and are as follows:

In any motor when the brushes are ahead of the neutral point, as they were in the first place, the armature reactions are less than normal and consequently the resultant field is stronger than usual. The result is that at each successive point the armature falls more and more below the designed speed.

As the counter e.m.f. in an armature is directly proportional to the speed there is a proportional decrease in the counter e.m.f. and a proportional increase in armature current which results in a very strong armature field, the strength of which is greater than the proportional increase of armature current.

The higher speeds being obtained by field control, it is found that at the last point the field m.m.f. due to the field winding is very weak and the armature m.m.f. very strong, due to the low counter e.m.f. The consequence is that the pole-pieces were demagnetized and then magnetized with opposite polarity, which caused the motor to reverse. This reversing, as would be expected, was accompanied by sparking at the brushes due to the interpole polarity being wrong for the reversed rotation

Philadelphia, Pa. R. W. Wilbraham.

CONSTRUCTION OF FOUNDATIONS FOR ELECTRICAL MACHINERY.

Foundation bolts are used to tie machines to the foundation. The types of bolts most commonly used are shown in Fig. 1. For medium and large-sized machines the bolts required are so long that commercial standard bolts of the necessary length are not ordinarily available. Therefore, a threaded rod having a nut on both ends is used, as shown at *A* and *B*, Fig. 1. Another reason for using a rod having a removable nut at both ends is that in certain applications the bolts must be removable from the foundation. In such cases, after the lower nut has been taken off, the bolt can be withdrawn. Foundation washer pockets are required where foundation bolts must be removable. The bolts of *A* and *B*, Fig. 1, are inclosed respectively in an iron pipe and in a wooden box casing. Casings are described in detail in following paragraphs.

If foundation bolts for a given application do not exceed, say, 5/8 in. or 3/4 in. in diameter, standard commercial bolts of sufficient length can, ordinarily, be readily obtained. Such bolts can be either set in casings similar to those shown at *A* and *B*, Fig. 1, or they can be set directly in the concrete or masonry as indicated at *C*, Fig. 1. When a bolt has a knee formed in it (*C*, Fig. 1) it is known as a bent bolt. The deformation prevents bolts from turning in the masonry if they happen to be loosely set and it also greatly increases their resistance to withdrawal. The angle in the knee is usually made about 90 deg. and the apex of the bend is offset about three diameters. The knee should be formed well toward the bottom of the bolt, so that if a great stress is imposed on the bolt there will be no possibility of the knee straightening and breaking out the concrete at the surface. Bent bolts are widely used in structural steel construction for tying columns to footings. Commercial, unbent, wrought-iron bolts are frequently set in concrete without being altered in any way. However, a cast-iron washer should be slipped on before the bolt is set. Bolts thus arranged give entire satisfaction if judiciously employed.

It is not at all necessary to deform or to have a nut or washer on the lower end of an iron rod set in concrete to develop the full strength of the rod. The rod must, however, be set to a certain depth, as will be shown. Mild bolt steel has an elastic limit of about 25,000 lb. per square inch and will yield excessively when stressed in excess of that value. The adhesive strength of concrete to round iron bars is from 250 lb. to 400 lb. per square inch of exposed bar surface for round steel bars, where $d =$ diameter of bar in inches and $l =$ length in inches of the bar embedded in the concrete. Taking the lower value for adhesive strength: The adhesion, in pounds, between the bar and concrete $= 250 \pi dl$; the supporting power of the rod, in pounds, when stressed to the elastic limit $= 25{,}000 \pi d^2 \div 4$. Then, if a rod be embedded to such a depth that its supporting power is just equal to the adhesion between it and the concrete: $250 \pi dl = 25{,}000 \pi d^2 \div 4$, or $l = 25 d$. That is, the rod must be embedded a length equal to twenty-five times its diameter. Such a rod would pull out just as it became loaded to 25,000 lb. per square inch. It should be noted that in the above demonstration it is assumed that the rod is not threaded. A threaded rod is obviously weaker than an unthreaded one. Foundation bolts are always threaded. Therefore, the quantity $25 d$ is somewhat liberal for foundation bolts. The letter "d" in the demonstration indicates the outside diameter of a rod—not the diameter at the root of the thread.

Inasmuch as the strength of bond between a rod and concrete is a somewhat uncertain factor, plain rods, to develop their full strength, should for safety be embedded a distance somewhat over twenty-five diameters; thirty diameters is believed to be a conservative figure. For reinforced concrete work it has been authoritatively recommended that the safe adhesive strength between round rods and concrete be taken as 75 lb. per square inch of exposed surface.

Where two or more small foundation bolts lie close together they are sometimes connected at their bottoms with a length of angle or strap iron (Fig. 1, *D*). Where such a connecting piece is used short bolts can be utilized, because an enormous force would be required to effect the failure, through shearing through the concrete, of such an arrangement. A connecting piece also retains the bottom ends of the bolts in correct relation with each other while the concrete is being poured. Either threaded rods or standard bolts (Fig. 1, *D*) can be used.

Sometimes foundation bolts must be inserted in a foundation or in a masonry structure where no provision was made for them during construction. In these cases holes must be drilled with a hand or a power drill, the bolt inserted and a cement of some sort poured in around it as indicated at *E*, Fig. 1. It is said to be the regular practice in some mining districts in the West to build foundations for machines without foundation bolts intentionally. When the machine is received it is mounted on the foundation and the holes for the bolts are drilled, using the machine bedplate as a templet. It is claimed that where air drills are available this is a very economical and satisfactory method of securing the machine.

Usually either sulphur, lead or cement is used, as indicated at *E*, Fig. 1, for holding the bolt in a drilled hole. To ascertain which of these three materials was best suited for securing bolts in holes experiments were conducted as follows: Fourteen holes were drilled in a ledge of solid limestone. Seven were 1⅜ in. in diameter and seven were 1⅝ in. in diameter. All holes were 3½ ft. deep. Fourteen bolts, plain at the lower end and having a nut at the upper end, were cemented in the holes as indicated in the following table. All of the bolts were ragged for 3½ ft. at their lower ends. All were permitted to stand until the cement was two weeks old. Then they were pulled with a lever. The results were as follows:

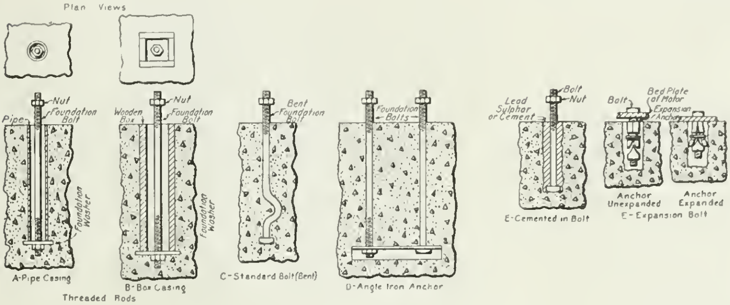


Fig. 1—Various Forms of Foundation Bolts.

Bolt Set in	¾ In. Bolts in 1⅜ In. Holes.	1 In. Bolts in 1⅝ In. Holes
Sulphur		
1	Developed full strength, 16,000 lb.	
2	Developed full strength, 16,000 lb	
3		Pulled out under 12,000 lb.
4		Developed full strength, 31,000 lb.
Lead		
1	Developed full strength, 16,000 lb.	
2	Developed full strength, 16,000 lb.	
3		Pulled out under 13,000 lb.
4		Developed full strength, 31,000 lb.
Neat Cement.		
1	Broke without pulling out.	
2	Broke without pulling out.	
3	Broke without pulling out.	
4		Broke without pulling out
5		Broke without pulling out.
6		Commenced to yield at 26,000 lb. but sustained load a few seconds and then broke

While these experiments do not indicate the adhesive strengths of the materials in pounds per square inch, they show conclusively that cement is the best of the three. It is the most reliable and the strongest and should therefore be used where possible. It is not necessary that a "cemented-in" foundation bolt have a head on it as has the one at *E* (Fig. 1). The head greatly increases its resistance to pulling out, but if the bolt be inserted thirty diameters into the cement the full safe strength of the bolt will be developed.

Expansion bolts, one type of which is illustrated at *F*, Fig. 1, are occasionally used for attaching small machines to existing masonry. If of sufficient length and properly installed they stand well under static loads, but cannot be recommended for the varying, vibrating loads imposed by machinery unless the machines be small and the bolts large.

Summarizing, the applications of different types of foundation bolts may be classified as follows: Rods threaded at both ends are used for foundation bolts (*A*, Fig. 1) when a commercial headed bolt of sufficient length cannot be obtained or where, when used in a foundation with pockets, the bolts must be removable from the foundation.

Standard commercial headed bolts can be used where it is not necessary that they be removable from the foundation, either bent (*C*, Fig. 1) or straight if they can be obtained of sufficient length.

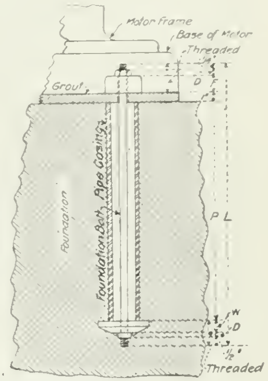


Fig. 2—Foundation-Bolt Dimension.

Connecting straps can be used with either threaded rods or standard bolts (*D*, Fig. 1) when the bolts lie close together in the foundation. The strap increases the resistance to withdrawal.

Cemented-in bolts can be used where it is necessary to attach a machine to an existing foundation. Either plain rods, sufficiently long to develop full strength, or standard headed bolts (*E*, Fig. 1) can be used.

Expansion bolts can be used for the attachment of machines of small capacity.

Foundation bolts that are to be set directly in concrete are sometimes slightly deformed by "bruising" or by threading them along the part that is to be set in the concrete. Tests indicate that little or nothing is to be gained by threading. Bruising or nicking probably increases the resistance to failure somewhat, but it is usually considered better and cheaper to use a bolt sufficiently long than to use a shorter one and hack it full of notches. Once it was a popular practice to slot the lower end of a foundation or anchor bolt made from a rod and insert a cotter through the slot. This cotter rested against a washer. In modern construction the rod is usually threaded at both ends and a special washer, which engages with a square nut, is arranged at the lower end. The modern method is preferable in that it is cheaper and in that the bolt is more readily prepared.

Although, from the standpoint of resistance to withdrawal, a bolt set directly in concrete need extend into the concrete only thirty times its diameter, it is ordinary practice to extend the bolts almost to the bottom of the foundation unless the foundation be exceptionally deep. This is also the practice with bolts arranged in casings, as shown in Fig. 4. The reason for this practice appears to be that there is a possibility in some cases of a whole top stratum of a green foundation being cracked off by vibration and tension unless the foundation bolts extend well down into it. Probably the practice originated with brick and stone masonry foundations laid in weak mortar, which were not as strong as modern concrete ones. It is necessary that bolts set in casings (*A* and *B*, Fig.

1) be reasonably long so that they will have sufficient flexibility to enable their top ends to be shifted to any part of the mouth of the casing. This is required to permit moving the tops of the bolts when the machine supported is being aligned.

It is difficult to suggest a rule for determining proper burial lengths of foundation bolts. They must be set deep enough so that there can be no possibility of their failure by withdrawing due to the cracking out of the concrete or to the lack of sufficient adhering surface exposed to the concrete. An empirical rule that has been largely used and appears to have given satisfaction is as follows: A foundation bolt should extend into the masonry a distance at least equal to fifty of its diameters, or P (Fig. 2) $= 50\,d$. This rule has been used for bolts set in casings and for those set directly in concrete. The outside diameter and not the diameter at the root of the thread is indicated by d.

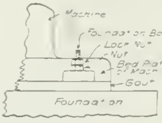


Fig. 3—Application of Lock Nut.

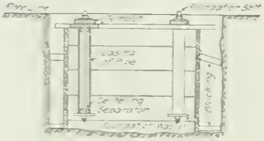


Fig. 4—Form Ready for Pouring.

To determine the over-all length L (Fig. 2) of a foundation bolt several increments must be added to the nominal buried length P. At the top end the increments are (1) a clearance of at least ¼ in. above the nut; (2) the thickness of one nut or of two nuts if lock nuts are used; (3) the thickness F of the machine bedplate or foot through which the bolt passes, and (4) at least 1 in. for grout. At the bottom the following must be provided for: (1) the thickness of the washer W; (2) the thickness of one nut, and (3) a clearance of at least ½ in. The shop drawing for a foundation bolt indicates only its length, diameter and the distance, or distances in the case of a threaded rod, to be threaded.

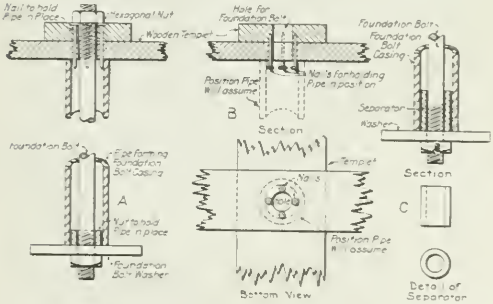


Fig. 5—Methods of Centering Casings.

Diameters of foundation bolts are usually determined by the size of the foundation-bolt holes in the machines which they are to secure. Hence the diameters are really determined by the machine builders. A working clearance must be allowed in every case and, taking this into consideration, the largest diameter bolt that will enter the hole is selected. A diametral clearance of ⅛ in. is used for bolts ⅞ in. in diameter and smaller; a ¼-in. clearance for 1-in. to 2½-in. bolts, and ⅜ in. for 2¾ in. bolts and larger. Sometimes smaller clearances than those indicated are used where there is every assurance that the bolt holes in the machine frame will be drilled accurately in accordance with the outline drawing submitted by the machine builder. Some of the electrical manufacturing companies recommended diametral clearances as small as 1/16 in. for bolts as large as 1¼ in. The safe load for foundation bolts may be taken as 10,000 lb. per square inch. When calculating the strength of a rod that is threaded the effective area, that is, the area at the root of the thread, must be taken. Lock nuts, as indicated in Fig. 3, are frequently used on foundation bolts, but are not always considered necessary. The additional nuts cost but a trifle and it is believed that in almost every case their use is justified. Casings are provided for foundation bolts so that the tops of the bolts can be shifted slightly to allow for the alignment of machines and so that the bolts can be made to enter bolt holes in bedplates that are inaccurately located. With pocketed foundations casings also provide a vertical hole through which the foundation bolt can be dropped. The internal diameter or width of the case of a square casing is usually made equal to the diameter of the bolt plus two times the diameter of the bolt ($d + 2\,d$). The length of a casing (P, Fig. 2) is equal to the distance from the top of the foundation to the top of the washer.

Where it can be so arranged it is convenient to have the bottom face of the foundation-bolt templet lie in the same plane as the top of the foundation, as illustrated in Fig. 4. Then the bolts and casings can be suspended from the templet. The washer is located in its correct position on the bolt and the casing clamped in tightly between the templet and the washer (Fig. 4). It may be necessary to insert blocking between the top face of the templet and the top nut to clamp in the casing effectively. If the casing is made and clamped as described the concrete can be poured without its being necessary to take elevations on the tops of the foundation bolts. The casings locate the bolts as to elevation. If the casings are accurate as to length the bolt tops will extend exactly the right distance above the face of the finished foundation. The form shown in Fig. 4 is ready to be poured and the bolts and casings are suspended in it in the manner described. Where foundation bolts are to be removable and the foundation is pocketed, a casing cut correctly to length determines the elevation of the top of the pocket and accurately locates the wooden piece that constitutes the top of the pocket form.

A casing around a bolt suspended from a templet should lie concentrically with the bolts while the concrete is being poured. Some methods of centering applicable to either square or round casings are outlined in Fig. 5. At A a nut dropped into the casing over the bolt serves to center the bolt's lower end. Nails driven through the templet secure the top of the casing. At B the nails are driven from below instead of from above. They can be accurately inserted with their heads tangent to and inside of (concentric with the bolt hole) a circle of the diameter of the hole through the pipe. At C a wooden hollow cylinder is used at the bottom of the casing instead of a nut. A round piece of board with a bolt hole bored through it satisfies every requirement.

Casings are sometimes merely wooden boxes without ends, as shown in Fig. 1, B. Lengths of drain tile and vitrified sewer pipe have been used. Small casings, those under, say, 1½ in. internal diameter, are usually of wrought-iron pipe. Larger ones are often formed from sheet iron. Ordinary leader pipe can be used, but if the stock from which it is made is too thin it may crush when the concrete is being tamped in. About old plants there is usually discarded wrought-iron pipe which has only a junk value. This makes admirable casings that cost little.

Pittsburgh, Pa. Bruce H. Page.

QUESTIONS AND ANSWERS

In electrical contracting work how is the cost of work usually estimated? P. O. J.

In ordinary work the cost is apportioned with a fair degree of accuracy as follows: Labor, 40 per cent; conduit, 22 per cent; wire, 18 per cent, and incidentals, switches, outlets, etc., 20 per cent.

What are the standard rate of wage and the working hours of electricians in this country? D. I. N.

There is no generally recognized standard. In New York City the contractors' agreement calls for an eight-hour day, the working hours being between 8 and 5. Work before 8 or after 5 and after 12 on Saturday and work on Sundays and legal holidays is subject to a double rate. The number of helpers must not exceed the number of journeymen on the job. A journeyman receives $4.50 a day; second-year helper, $2.20 a day, and first-year helper, $1.50.

Will there be any difference in the steam consumptions of two cross-compound engines directly connected to generators carrying 500 kw each, one operating at 100 per cent power-factor and the other at 80 per cent power-factor, their speed, voltage and all other conditions being the same? S. A.

The efficiency of a machine delivering 500 kw is somewhat greater when the power-factor is 100 per cent than when 80 per cent, and therefore the input in the former case would be slightly less than in the latter case. Thus the engine driving the former generator would consume less steam than the engine driving the latter. However, the difference would be relatively inappreciable.

The National Electric Code distinctly specifies the relative positions and accessibility of the cut-out, switch and meter. In many of the devices now on the market designed to protect the electric light company against theft of energy the rules are not always observed. Is it permissible to use these devices under such conditions? K. E.

At a meeting of the Underwriters' National Electric Association in 1909 a committee appointed on "theft of current" reported that in its judgment there was a need of recognition in the code of service and other special devices for preventing theft of energy and recommended that the switch and cut-out committee classify such apparatus. The majority, if not all of these devices, have been approved by the Underwriters.

When two 1000-kw, three-phase alternators are operated in parallel and the field circuit of one of them is opened, will they fall out of step or drop the load? If the field circuit is reversed on one of them will they still remain in parallel? H. T.

So long as the generators remain in parallel the division of load between them is not affected by the variation in the field strength. However, not many alternators are built with such synchronizing ability that they will remain in step at full load with no field current. That is to say, if the field circuit of one of the machines is opened it will probably drop out of step. In certain instances, however, the generators may remain in step, and under these conditions will divide the load just as though the field strength was properly adjusted. Even when a negative value is given the field current such a machine may continue to remain in step and carry its share of the load.

In case it is necessary to apply two motors for the driving of line shafting in an industrial establishment, is it proper to divide the line shafting in two parts, or to belt the two motors to the same shaft? B. E.

Assuming that shunt-wound motors are to be employed, it can be stated that when the motors are mechanically so connected that they must operate at relatively the same speed the division of load between them will depend largely on the resistance in the armature circuits of the two motors and except for this fact will be independent of the specific ratings of the two machines. In other words, the load-speed characteristic of the one motor should be identical with that of the other if the two are to divide the load equally between them. When this is not done the motor with the better speed regulation becomes more quickly overloaded than the other motor. Resistance should be placed in the armature circuit of this motor in order to cause the other motor to assume its proper share of load.

How much iron would be needed for a transformer to be used in reducing the e.m.f. from 110 volts, single-phase, 60 cycles, to from 33 volts to 45 volts, and from 30 amp. to 40 amp.? What size wire will be needed and what will be the weight and number of turns? How can the speed of series motors be increased? Is aluminum wire used for magnet windings? Does it have to be insulated when used as magnet wire? R. O.

The cross-sectional area of the core should be about 10 sq. in. The transformer should be wound with 110 turns of No. 8 wire and 45 turns of No. 4 wire. There will be required about 45 lb. of iron and 15 lb. of copper. At full load the copper loss will be about 60 watts and the iron loss about 45 watts, the efficiency being probably 93 per cent. The speed of a series motor already constructed can be increased most conveniently by placing a shunt around the field coils. If the motor is well designed it will withstand such an adjustment, but if poorly designed it may be inclined to spark. Magnets are sometimes wound with aluminum wire without insulation. The oxide which forms on the surface of the aluminum is sufficient to withstand the small e.m.f. impressed between adjacent turns.

Where a central station can install only one circuit for lamps and motors the system being three-phase, is it best to operate a three-phase, four-wire system with different voltages on the lamps and motors, or to operate a plain three-wire, three-phase system having the same voltage on the lamps and motors? Is a three-phase watt-hour meter accurate when measuring a single-phase load? L. L.

Where the motor load forms only a small part of the total output from a station it is preferable to arrange the circuits with reference primarily to the requirements of the lighting load, causing the motor to adjust itself to these requirements. Where the motor load is relatively large it is best to install separate circuits for the motors and for the lamps. In only a few cases is it desirable to install a four-wire, three-phase system having one voltage for lamps and another voltage for motors. Unless a three-phase meter registers accurately on unbalanced loads it is very probable that it will not register accurately with balanced loads. The maximum of unbalance occurs when the load is purely single-phase, but a properly adjusted three-phase watt-hour meter should register a single-phase load accurately.

What is the ratio between the loads that can be carried by two transformers connected in open delta and by the same transformers used separately in single-phase circuits? R. G.

The comparison can be best explained by a simple illustration. With three transformers connected in closed delta, each carrying 10 amp, the current in each lead wire is 17.3 amp, and the voltage between wires is that produced by each transformer, while the total power output is the sum of the power delivered by the three transformers. If one of the transformers is removed, leaving the other two in open delta, the currents in the other two transformers would be increased to 17.3 amp, but the power would remain the same as before. However, the two transformers would be greatly overloaded, the heating effect in the coils of each being three times as much as formerly. If the currents were reduced in each to 10 amp in order to reduce the heating to the normal value, then the actual power would be reduced to 57.7 per cent of its former value. If, for example, each transformer was designed for 10 kw, under normal conditions when used in a delta three-phase group, the total output would be 30 kw; with the two transformers in open delta with 300 per cent heating in the coils the output would still be 30 kw, while with the two transformers in open delta with normal heating the output would be 17.32 kw. With the two transformers used single-phase the output with normal heating would be 20 kw.

Central Station
Management, Policies and Commercial Methods

ELECTRIC ROCK DRILLS SUPPLANT AIR DRILL IN HARD-ROCK TUNNELING.

The contractors engaged in excavating the tunnel for the Canadian Northern Railroad entering Duluth, Minn., after going part way through the mountain struck an extremely hard granite-like formation of igneous rock, which, unlike granite, does not chip and so has to be drilled all the way. For this purpose the compressed-air drills in use soon proved unequal to the severe work required of them. Four electric-operated drills, in which revolving hammers deliver 1800 blows a minute on drill points rotated at 70 r.p.m., were then secured, and with these progress of 50 ft. per month has since been made continuously, which will enable the contractors to finish their work on schedule time, besides making up the time already lost. Four additional electric drills have also been ordered to assist in the work of tunnel construction. This demonstration of the electric drill's superiority and speed over its older compressed-air counterpart is especially interesting when it is recalled that these electric drills take only 2 hp each, while the compressed-air drills, without reheating of the air, required about 14 hp per drill to drive the air compressors. The electric drills are operated from the contractor's camp electric plant at the site of the tunnel about six miles from Duluth.

CUSTOMERS' EMERGENCY REPAIRS BY CONTRACTORS.

The Electric Illuminating Company, of Cleveland, Ohio, does no emergency repair work for its customers, but maintains a call service by which in response to a customer's request for assistance a repairman is at once dispatched from the contractor's shop nearest the location of the trouble. For this purpose the city is divided into a number of districts, one for each of the electrical repair shops co-operating in the emergency service. When a customer telephones to the central-station company's office that his washing machine, flatiron, fan or other electrical appliance is out of order, and expresses no preference regarding who shall make the repairs, his name and location are taken down and immediately referred to the contractor in the same district of the city. The latter can then send a man without delay to the scene of the trouble, which is usually in his near neighborhood.

The contractors co-operating in this emergency repair service run a combined advertisement in the Cleveland "People's Electrical Page" in the newspapers, giving the name, address and telephone number of each, together with a statement of the uniform schedule for repairs charged by all—70 cents per hour for the workman's time, plus the cost of material used.

ELECTRICAL ICE-MAKING IN LATITUDE 49 DEG. NORTH.

The utility of making artificial ice by means of electrical energy does not appear to be limited by geographical location or low mean annual temperature. The City Dairy & Produce Company, of Vancouver, B. C., has just installed a motor-driven Triumph compression system with a capacity for making ten tons of ice daily. The Canadian Fishing Company, at Vancouver, also operates a similar motor-driven 42-ton refrigerating plant. Vancouver is in north latitude 49 deg. and is several hundred miles more northerly than any city in the United States.

ELECTRIC-VEHICLE CAMPAIGN AT LOUISVILLE.

Mr. Roscoe Woltz, power engineer and electric-vehicle expert for the Louisville Lighting Company, of Louisville, Ky., is arranging in booklet form battery-charging instruction matter for users of electric vehicles, with the idea of making electric-vehicle performance in that city even more satisfactory than ever before. Where necessary the company offers free the advice and assistance of its expert to aid any electric-vehicle owner. Supplementing this campaign of instruction for present owners of cars, advertising matter calling attention to the advantages of the electric automobile is being spread in the Louisville papers and in the company's own publication, *Chained Lightning*. About seventy-five electric vehicles are now in use in Louisville. The Louisville Lighting Company accords these its power rate for charging purposes, which is equivalent to 5 cents per kw-hour unless the monthly bill exceeds $8, in which case the rate is 4 cents. The Kentucky Electric Company, which also has a number of vehicle-charging stations on its lines, makes use of an off-peak rate, with time switches which prevent the taking of energy during the peak period.

"SAVE MONEY BY USING ELECTRIC LIGHT."

During the recent Minneapolis Electric Show the Minneapolis General Electric Company distributed thousands of small savings banks on which was printed the appropriate legend "Save money" and below this "by using electric light." The little banks were made out of pasteboard cylinders with tin heads, one of which was slotted to receive coins up to the size of a quarter. The souvenirs were appreciated by the public, and in almost every case were carried home. Along with them went the following house-wiring arguments printed on the label:

"Electricity makes the home beautiful, cheerful and inviting; safe, lessening danger of fires and burglary; healthful—electric light cannot affect the air; convenient—use it anywhere, any time, as much as you want.

"Electricity will do your work in the sewing-room, laundry, kitchen and elsewhere.

"Wiring the house involves no tearing up of furnishings, and, with our new lamps, your lighting bills are cut in half."

RESIDENCE SERVICE IN DULUTH.

The number of houses in Duluth, Minn., with a population of 80,000, is estimated by Mr. C. E. Van Bergen, manager of the Duluth Edison Electric Company, to be about 14,000. Of this number 12,000, or more than 85 per cent, are customers of the central-station company. The latter has thus 2000 more customers than the 10,000 water connections listed and 5000 more than the number of gas consumers, although the water and gas plants are both municipal, gas selling for 75 cents per 1000 cu. ft., with a 25-cent monthly minimum bill. The electric company has also established the same minimum bill. From 0.2 kw to 0.3 kw of transformer rating per residence customer is now found to be ample. During the last two years the Duluth company has made a special effort to have all the better class of residences wired for both a lighting and a heating meter, with very satisfactory results. Nearly all medium-sized residences and many small houses are thus equipped. For all energy used through the heating meter (to which may be connected electric ranges, radiators, vacuum cleaners and irons) the company makes a rate of 3 cents per kw-hour, less

20 per cent for prompt payment, with a minimum bill of $1 per month. Notwithstanding the 75-cent gas rate, the electric company has installed during the last year a dozen electric ranges and a number of electric grates and radiators.

ADDITIONAL MOTOR-DRIVEN WATER-WORKS PUMPS FOR DULUTH.

To the present electrically operated main water-works pumping station of the City of Duluth, Minn., which has a daily delivering capacity of 20,000,000 gal., bonds have been voted to add new motor-driven equipment capable of delivering 30,000,000 gal., bringing the total rating of the station up to 50,000,000 gal. per day. Additional motor-driven booster pumps will also be installed at various points of the distribution system. The energy used by the Duluth water works is developed at the St. Louis River hydroelectric plant of the Great Northern Power Company, which now receives $6.50 per 1,000,000 gal. pumped, or the equivalent of about $0.0045 per kw-hour for this off-peak 18-hour service. The main pumping units operate against a hydrostatic head of 290 ft., to which is added 30 ft. friction head.

DAY CIRCUITS ESTABLISHED THROUGH ELECTRIC-IRON CAMPAIGNS.

In these columns instances have several times been cited showing how, in the case of small central-station companies operating only night lighting circuits, the inauguration of Tuesday-morning electric service for the use of electric irons has later been followed by the establishment of profitable full-day service and the securing of local shop and factory motor loads. Municipal water-pumping, ice-making, sale of steam to local industries, such as laundries, etc., are some of the other central-station auxiliaries which make such day-service operation possible and profitable.

Several instances where at first partial and later full-day service was established as the direct result of electric-iron campaigns were mentioned by Mr. J. D. Cross, heating-appliance expert for the General Electric Company, Chicago, in a discussion on the subject of day loads for central stations at the St. Paul convention of the Minnesota Electrical Association, March 15.

When Mr. James J. Roe, manager of the Hampton Electric Light & Power Company, Hampton, Ia., was considering running his plant Tuesday mornings for ironing-day service Mrs. Roe called up a number of her friends on the telephone, told them about the plans and of the conveniences and advantages of the new irons, and enlisted their interest in the new departure to the extent of getting the promise of each to try the irons for a number of Tuesday mornings. Seventy-five electric irons were soon connected to the lines, and the plant was operated half a day each week to serve them. The customers were at once pleased with the convenience of the new service, but soon demanded more than merely one day's operation, volunteering to use a certain amount of energy each day of the week if full-day service were furnished. Mr. Roe then yielded to these importunities, started twenty-four-hour operation and now has a profitable motor load, besides additional heating appliances, in his little city of 3000 inhabitants.

Crown Point, Ind., is one of the few places where a day motor circuit was established and later abandoned on account of the invariable discouragements of the first few months' operation. In this instance the company, after feeling that its day service was conducted at a loss for three months, disconnected its customers' motors, bought them back at the sale price and was endeavoring to return them to the manufacturers when Mr. Cross laid before the company a proposal to try the Tuesday-morning day-circuit plan that had proved successful elsewhere. One hundred irons were at once placed, and fifty more were ordered in the course of the next few months. The ironing-day service grew of itself profitable and the customers were well pleased. They, together with the original motor customers, who had been greatly disappointed at the withdrawal of service before, then insisted on the re-establishment of every-day operation. The heating-appliance results have now convinced the company that this can be done to advantage, and the same motors once taken out are now being put back into place and day service will be commenced at once. During its recent Tuesday-morning operation the same company has been transmitting energy twenty miles over a high-tension transmission line each ironing day to obtain the revenue to be derived from the twenty or thirty irons in the distant community to which it supplies lighting.

TUNGSTEN LAMPS IN DIRTY PLACES

It has frequently been urged in favor of tungsten lamps when they have displaced arc lamps that they require less attention in the shape of trimming. While it is of course true that they require less attention, and that their efficiency is considerably higher than the common inclosed carbon arcs in use at the time the tungsten lamp came into the field, it may nevertheless be equally true that the fact that the arc lamp requires frequent trimming and cleaning is a positive gain to the purchaser of light rather than a detriment. In many establishments lamps are likely to be absolutely neglected as far as cleaning is concerned, unless there is trimming required. The tungsten lamp makes a fine showing as compared to the old arc lamps when it is first installed and cleaned, but we have seen many installations where dirt has been allowed to collect on tungsten lamps, so that most of the supposed advantages in efficiency have been wiped out. However, it is a mistake to suppose that when an arc lamp is trimmed its globe is necessarily cleaned. Attention which is ordinarily given to trimming and cleaning of arc lamps is insufficient to obtain the best results. Not a few arc-lamp installations which are supposed to be in good shape show remarkably poor results when actually tested, simply because of lack of adjustment and cleaning.

DOMESTIC HEATING-APPLIANCE EFFICIENCIES.

At its March meeting in Chicago the North Shore Electric Company Section of the National Electric Light Association was addressed by Mr. Charles P. Madsen, engineer for the Pelouze Electric Heater Company, Chicago, on the subject of "Domestic Heating Appliances."

Electric irons, said Mr. Madsen, constitute by far the most important part of the domestic heating appliances manufactured, sold and used. While all electric heating appliances and electric irons have, of course, an efficiency of 100 per cent in heat production, their efficiency of utilization in delivering this heat to the working surface ranges from 30 per cent to 60 per cent in the case of various modern types. This efficiency may be tested with fair accuracy by inverting the iron and placing on its upturned surface a can of the same shape as the iron containing a known quantity of water. Measuring the temperature rise of this water due to the expenditure of a given amount of energy in the iron will enable the latter's utilization efficiency to be computed. Temperature measurements of the top, side and bottom surfaces, using well-known radiation constants for obtaining the heat output at each part, also enable a fair determination of efficiency to be made. Other tests are by immersing the working surface in a known quantity of water, clamping the iron to a mass of metal, etc., in each instance measuring the heat input into the material heated.

Of almost equal importance with the efficiency of an iron for domestic use is its starting speed, or the time taken to reach an ironing temperature of 500 deg. at its bottom surface. The ideal iron quickly reaches a high temperature on its bottom, without wastefully heating the top and side surfaces.

Starting speed can be tested by standing an iron upright and affixing pieces of wax to its top and bottom surfaces. The relative times required before the two pieces drop give an indication of the starting speed of the iron. The best record was obtained with an iron which melted loose its bottom-side wax ball in ninety seconds, while the wax on the top adhered for fifteen minutes. In a less efficiently designed type of iron, in which the heating element was farther from the bottom and was required to warm first a large mass of material besides penetrating several air-gaps, eight minutes was required after turning on the circuit before the bottom wax melted, while the top wax dropped off two minutes later.

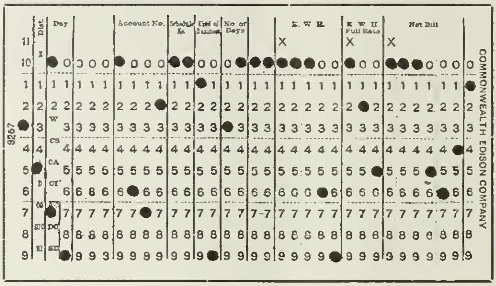
In discussing electric cooking and water-heating devices Mr. Madsen urged against solicitors making unfounded claims and guesses about the work which a given heater will do. The failure of the apparatus to "make good" the pretensions thus assumed for it always results in a dissatisfied customer. The service a given water heater will actually render can be computed as follows, if the efficiency of heat application of the device is known: To raise one pint of water from room temperature to boiling about 3000 watt-minutes would be required for a device having 100 per cent efficiency. Disk stoves range in efficiency from 30 per cent to 73 per cent, and the above energy expenditure must be increased inversely proportionately to the efficiency figure of the heater used. To raise a pint of water to be merely "hot," 175 deg., the temperature for tea-making and coffee-making, 2320 watt-minutes are required. A 250-watt disk heater of 100 per cent efficiency would accomplish this result in nine minutes, but as the best heater made has an efficiency of 73 per cent, at least twelve minutes will be required.

TABULATING MACHINES FOR CHECKING BILLS AT CHICAGO.

The Commonwealth Edison Company, Chicago, was one of the first central-station companies to make use of the Hollerith tabulating machines, and has had several sorters and tabulators in use for four years. Besides the preparation of the large amount of statistical work done by this company an important use is made of the machines in checking the extensions of each of the 130,000 customers' lighting and power bills before these are sent out each month.

As is well known, the Chicago company employs a double-rate schedule, charging 12 cents net (13 cents with 1-cent discount for prompt payment) for each kw-hour up to thirty hours' use of the maximum demand during the month, beyond which all additional consumption is charged at the rate of 7 cents gross or 6 cents net per kw-hour. The meter department furnishes the accounting department with the customer's consumption and demand during the month, which is entered in the customer's billing card and the amount of his bill figured, adding the high-rate and low-rate portions to find the total amount. The billing clerks then transfer these figures to the bill forms, making out the accounts in the usual way. When finished, the amounts of these customers' bills are listed and summed on an adding machine and held for checking with the Hollerith punched data cards.

These Hollerith data cards are then also prepared from the customers' billing cards from which the bill forms were filled out. The data card used by the Commonwealth Edison Company carries columns denoting the month of the year, district, day of meter reading, account number, rate schedule used, business of consumer, connected load in kilowatts, a blank extra column, total kw-hours consumed during month, kw-hours used at full rate and net amount of bill. After the cards have been punched they are run through the sorter and separated by rate schedules, all the cards coming under, say, the 12-6-cent schedule mentioned being taken to the tabulating machine, the counters arranged to add the columns "Kw-hours used," "Kw-hours at full rate," and the amount of the bill. As the full-rate portion is charged for at 12 cents per kw-hour and the low-rate portion at 6 cents, obviously an equivalent operation for computing the amount of the double-rate bills is to add the product of the total kw-hours multiplied by 6 to the full-rate kw-hours multiplied by 6. The sum thus obtained should check with the total of the customers' bills read on the other counter of the tabulating machine. After the different schedules are checked the cards are summarized by light and power kw-hours consumed and income, the grand total of which equals the total obtained by the listing machine. When a discrepancy is found to exist, smaller numbers of bills are taken and similarly compared until the error is located. As the result of this system of checking, the extension and billing clerks and the punch operators are all able to work much more rapidly, without the necessity for extreme care in going over and rechecking their work, which is later done mechanically and speedily. This also checks the Hollerith cards for statistical data, in addition to checking the extensions.



Tabulating Card Used by Chicago Company Perforated for Small Residence.

Some of the interesting results obtained by the Commonwealth Edison Company's statistical department with these tabulating machines were presented in a paper by Messrs. G. A. McKana and B. F. McGuire, entitled "Significance of Statistics," read before the 1910 convention of the National Electric Light Association at St. Louis. A reproduction of the former card form used by the Chicago company is given in that paper. This type of card has now been replaced by a smaller card with single spaces between vertical columns, making it more compact to handle. Several columns appearing on the old card have also been dispensed with. The new card is shown herewith.

The machines now in use by the Commonwealth Edison Company comprise two sorting machines and three tabulators, the latter each arranged to add one three-digit, one five-digit and one six-column field. The average operator can punch 200 cards an hour with an error of less than one-half of 1 per cent. The sorting machine separates 250 cards a minute into eleven classifications, while the tabulators add 150 cards per minute.

This method of analyzing central-station customers' accounts is also in use in New York, Brooklyn, Boston, Minneapolis, Denver and by the Washington Water-Power Company, but the Chicago company is the only one, perhaps, employing the card system for checking bill extensions. The system has also been used at Chicago to study employees' data, ages, salary, length of service, etc.

SIX THOUSAND LUMINOUS-ARC LAMPS FOR CINCINNATI.

Bids have been advertised and contracts will be let in April for 6000 or 7000 luminous-arc lamps with rectifying equipment for lighting the city streets of Cincinnati. When placed, this order will be the largest single purchase of luminous-arc equipment ever made, comprising more than 125 75-lamp rectifier transformers and sufficient lamps to illuminate the entire city.

replacing the present inclosed-arc lamps. The specifications provide for 4-amp magnetite or metallic-flame arc lamps to replace all existing city arc lamps at street intersections in the outlying overhead district and at 133-ft. intervals in the downtown section, except on certain streets where incandescent curb lighting may be required. The new lighting contract on which bids are invited will remain in force ten years from June 1, 1912. As evidence of good faith, all bids must be accompanied by certified check for $100,000. At the present time the Union Gas & Electric Company, of Cincinnati, holds the street-lighting contract. The specifications for the new street lighting describe in detail matters of metering, penalties, and other points relating to the supply of energy for the large number of luminous-arc lamps, 800 clusters and 3000 tungsten lamps which the city is expected to use. The specifications were prepared by Mr. J. H. Sundmaker, director of public service for the City of Cincinnati.

EXHAUST STEAM HEATING AS DEVELOPED BY A LARGE CENTRAL LIGHTING STATION.

By E. Darrow.

Most American citizens can look backward and can recall the time when fireplaces and stoves were considered very satisfactory as heating systems. Methods used a few years ago and considered satisfactory then are now obsolete. Concentration of population has developed new conditions for living and business and the watchword of our large corporations is "economy."

The Merchants' Heat & Lighting Company, of Indianapolis, has developed an extensive system of exhaust-steam heating, which covers the entire business district, and steam is supplied to points more than two miles from the power stations.

Apartment buildings, hotels, business blocks, office buildings, schools and residences are demanding that the responsibility and necessary expert attention for the operation of isolated plants be transferred to the specialist—that is, the central-station man.

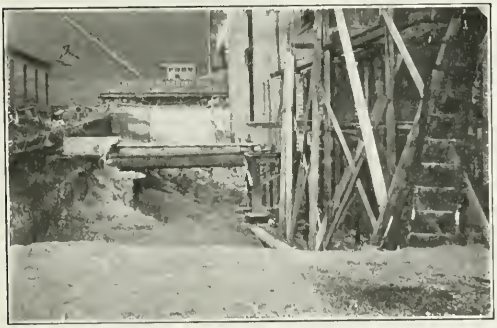


Fig. 1—Steam Line Leaving Station.

The chief advantage of a central-station supply of heat is in the economy of exhaust steam. The one principal objection has been that it necessitates heat transmission through a system of conduits, which in the past has been a wasteful process, but in the system as developed by the Merchants' Heat & Light Company steam is distributed through a system of pipes and conduits, more than fifteen miles in all, together with necessary service connections, and the losses are less than 10 per cent.

There are now nearly 400 central-station companies supplying heat, and the awakening to this important adjunct is just beginning. The central-station man should appreciate what it would mean to his soliciting department if he could send men to the large department stores, hotels, theaters, apartment buildings, schools, libraries and public buildings and offer to furnish light, motor service and steam for all heating purposes and hot water as needed.

Ninety per cent of the hotels, theaters, department stores and large buildings have availed themselves of this privilege in Indianapolis, and hundreds of smokestacks are now smokeless, the result being a cleaner and brighter city.

The solicitors have found the following form very advantageous in getting new business. The operator is asked to fill in the yearly costs of his isolated plant, which he can do if his heating costs have been properly kept.

MONTHLY LEDGER ACCOUNT—ITEMS CHARGEABLE TO ISOLATED PLANTS.

OPERATING EXPENSES.	
Superintendence	$
Wages, engineers and engine attendance	
Wages, firemen and coal passers	
Fuel	
Cost of removing ashes	
Water for boiler	
Repairs to engines	
Repairs to boilers	
Repairs to generators	
Repairs to belts	
Repairs to steam elevators	
Repairs to hydraulic elevators	
Repairs to pumps and miscellaneous machinery	
Incandescent lamp renewals	
Arc lamp electrodes	
Arc lamp globes	
Arc lamp repairs	
Miscellaneous expense, oil, waste, packing, etc	
Insurance—fire and boiler	
Total account, operating expenses	$
FIXED CHARGES.	
Interest on plant investment, 5 per cent	$
Depreciation on plant investment, 7 per cent	
Rental value of space occupied by plant	
Decreased rental value of space made less desirable by heat of plant in summer	
Taxes on plant	
Risk of damage to employees and public through accident	
Total account, fixed charges	$
Total cost for maintaining plant, per month	$

The Merchants' Heat & Light Company has been in the steam-heating business nine years and the past year has seen the greatest demand in its history for its steam service. Close to 1,000,000 sq. ft. of radiation is now supplied and the service is so uniformly excellent that not one customer has ever left the lines because of dissatisfaction.

The Merchants' Heat & Light Company supplies lighting, motor service and heat from two central plants; one to the east of the business center of Indianapolis and the second and larger on the White River one mile west of the business center. That the engineering conditions may be better understood a brief outline of the equipment of the plant is inserted here.

The east plant has four 300-kw. 250-volt generators driven by compound non-condensing engines and three 850-kw, 250-volt generators driven by non-condensing turbines; the steam is generated in seven 300-hp boilers and four 600-hp boilers. In the east plant there are two 1000-kw non-condensing turbine units, two 850-kw condensing turbine units and one 4000-kw generator driven by a cross-compound Corliss engine which can be run either condensing or non-condensing; the steaming equipment consists of twelve 510-hp and four 600-hp Stirling boilers.

These two plants are connected by a 20-in. steam line from the east plant and a 30-in. line out of the west plant. The 30-in line, which is inclosed in a reinforced concrete tunnel, is shown in Fig. 1 leaving the station and entering the tunnel. Fig. 2 shows the insulating covering being applied. It consists of 1.5 in. of asbestos, wool felt and tarred paper. Fig. 3 relates to details of pipe construction in tunnels, showing the location of manholes, anchors, expansion joints, etc. Fig 4 shows the construction as developed by the Merchants' Heat & Light Company for building pipe lines in sizes of 20 in., 15 in., 12 in., 10 in. and 8 in. It consists briefly in replacing the concrete tunnel with sewer tile, split longitudinally and cemented together after pipe and insulation are in place. This construction has proved very durable, of excellent insulating value and easily built and maintained.

TABLE I.—SPLIT-TILE CONSTRUCTION COST, INCLUDING TRENCHING AND PAVING.

Size in Inches	Cost per Foot.
20	$19.50
15	14.75
12	12.35
10	9.50
8	8.40
6	6.85
4	5.25

The heating and lighting company maintains its lines to the curb and requires that the consumer own and maintain all pipe, regulating devices and fittings within the curb line and building served.

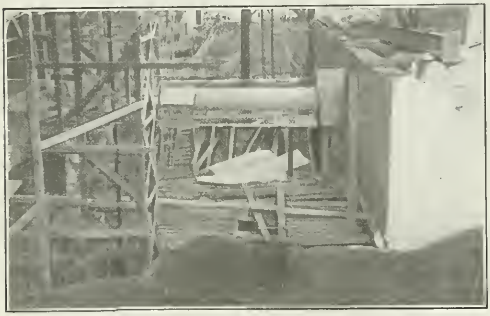


Fig. 2—Steam Line Being Covered.

The company's contract provides that the consumer shall attend to two very important details: First, at the point where service enters building there is installed either a Powers regulator or a "Sylphon Regitherm" control valve. The first of these is operated by compressed air and the second by a mechanical device, so that when the temperature at an agreed point reaches 70 deg. Fahr. the steam pressure is diminished automatically. Second, on each system served there must be placed a cooling coil or hot-water radiation sufficient to reduce the condensed steam from 212 deg. Fahr to 100 deg. Fahr.

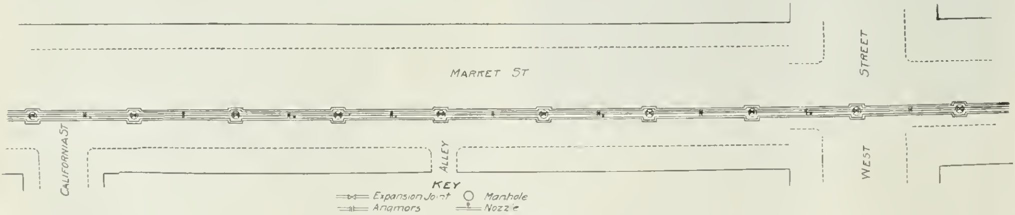


Fig. 3—Details of Pipe Construction in Tunnels.

The minimum charge per season is 20 cents per square foot of radiation required. The above meter rate approximates very closely to a flat-rate charge of 30 cents per square foot per heating season of eight months.

From the very first advocates of central-station heating have had the opposition of certain consulting engineers and manufacturers of engines and turbines, and it is only when they have been forced by their clients that they have recognized and accepted the facts and data obtained by workers in the field of central-station heating.

TABLE II.—RATES FOR STEAM SERVICE.

Consumption per Month. Pounds.		Rate per 1000 lb. of Condensed Steam.
First	10,000	$0.80
Next	40,000	0.75
"	50,000	0.70
"	100,000	0.65
"	100,000	0.60
All over	300,000	0.50

TABLE III.—ANALYSIS OF COSTS.

Coal cost, per ton	$1.20
Water, per 1000 gal.	0.04
Firing and boiler maintenance, per ton	0.20
Evaporation from Indiana coal, lb. per lb.	0.06
Manufacturing cost of steam, per 1000 lb.	0.122
Total extra station cost	134.20

Let us take another view of operating results.

TABLE IV.—COST IN CENTS PER 1000 LB. SOLD.

Production cost	0.122
Distribution cost	0.013
Collections	0.002
General expense	0.015
Insurance, taxes, damages	0.017
Depreciation	0.050
Interest	0.050
	0.269

The old argument was used continually that condensing units operate on 18 lb. to 20 lb. of steam per kw-hour, whereas a back pressure of 5 lb. requires a steam consumption by the engines of from 40 lb. to 50 lb. per kw-hour. A hasty consideration of the above by a skeptic would be convincing, but it is well to analyze the result obtained in the west plant of the Merchants' Heat & Light Company, bearing in mind that this plant is so arranged that every pound of steam generated can be used for exhaust steam heating or can be condensed as required. This plant has a daily electric load-factor in excess of 50 per cent and during the winter months has a daily output of 45,000 kw-hours. Indiana nut, pea and slack coal is burned, which does not average over 9500 heat units per pound. The cost of this fuel under the boiler is $1.30 per ton.

Concerning the revenue of one day's output, both condensing and non-condensing, in either case there is 45,000 kw-hours to sell, for which, based on switchboard meters, the price may be assumed as 4 cents per kw-hour, or $1,800 per day electric revenue. It may be assumed that under condensing conditions the steam consumption is 20 lb. per kw-hour, or 900,000 lb. in twenty-four hours.

Under non-condensing conditions for the same period, when exhausting into the heating mains against 5 lb. back pressure, the average steam consumption per kw-hour is 45 lb., or a total of 2,025,000 lb. Then the added revenue from sale of steam at an average price at plant of 50 cents per 1000 lb. is $1,012.50 per day, or a total plant revenue of $2,812.50.

It will be seen that with the heating system on it required

1,100,000 lb. more steam to produce 45,000 kw-hours than when condensing.

With steam netting an average of 50 cents per 1000 lb. at station, there is a net profit of 23 cents per 1000 lb. See Table IV.

A third consideration of this particular heating system is that the revenues from sales of steam pay for the entire fuel bill (electric and steam) for twelve months, all power-house maintenance and labor and 10 per cent on entire investment in street piping and services.

Fig. 5 shows the relationship between outside temperature and heating-main pressure (back pressure) as determined by experience on this system and is for the guidance of the chief engineer during changing weather conditions.

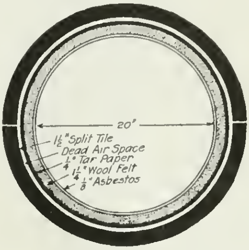


Fig. 4—Typical Cross-Section of Steam Main.

In conclusion it may be stated that there are many reasons why it is advantageous for central stations to undertake exhaust steam heating. When a central station is able to supply heat the strongest argument for an isolated plant is taken away. In order to get the light and motor-service business the central station must also take the heating business.

Most large central stations, having secured the bulk of small light and motor-service business, have now reached a point where further development depends upon their taking on business of a larger character and their ability to supplant isolated plants.

Equipped to supply heat the central station is in a position to forestall the installation of isolated plants. Again, the central station can balance the isolated plant electric and steam load and can offer a reliability of steam and electric service which the isolated plant cannot give.

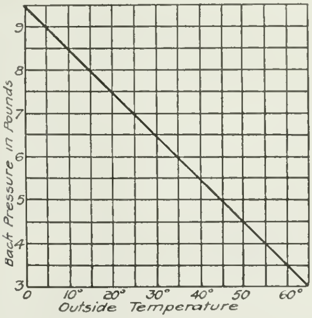


Fig. 5—Relation Between Outside Temperature and Heating-Main Pressure.

And, lastly, the central station, which originally was designed for lighting only, then later added motor load, and now seeks heating, is a powerful factor in smoke abatement and cleaner and brighter cities. Hundreds of smoking chimneys have been put out of business by the Indianapolis central stations, which with their modern stoker-fired boiler plants scarcely show a haze above the stacks, even when developing tens of thousands of horsepower.

Wiring and Illumination

SIGN LIGHTING IN LOUISVILLE, KY.

In the matter of electric signs the streets of Louisville, Ky., are probably as well equipped as any city of its size in the country. Several professional sign companies have aided the efforts of the local central-station companies in putting signs into service, and, besides the great number of small merchants' signs, many spectacular displays are in operation. Mr. A. T. Macdonald, general traffic manager of the Louisville Lighting Company, estimates that at least 100,000 sign lamps are in use in Louisville, in 1000 different signs, and that these signs have cost to install about $200,000. These figures afford some idea of the stable basis on which electrical advertising has been placed in the Kentucky city.

Fig. 1—Electric Signs in Louisville, Ky.

The Louisville Lighting Company has used several attractive spectacular displays on a Fourth Street roof sign, calling attention to central-station motor service. One of these, similar to that in use by the St. Louis company, showed a piece of iron thrust into a motor-driven grindstone, with an attendant display of sparks. The present central-station spectacle depicts a motor-driven power punch. Motor pulley, belt and wheel rotate, and as the punch descends sparks are seen to fly in all directions. The idea has been artistically and faithfully worked out, with the company's own legend prominently displayed.

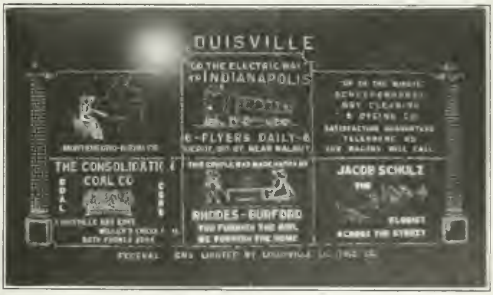


Fig. 2—Electric Display Sign at Louisville, Ky.

The chief electric sign feature in Louisville, of course, is the huge display, 60 ft. by 100 ft., fronting on Federal Square near the post office on Fourth Street. This huge sign, containing nearly 6000 lamps, is divided into six 20 ft by 30-ft. panels, each of which is rented to advertisers for $80 a month. The electric car shown in the center of the illustration by a flasher arrangement is apparently in motion, with wheels turning, track flowing behind it and trolley emitting faint green sparks. The little folks in the panel below are shown walking. The upper left-hand panel shows a young lady playing a piano and below is a realistic, flickering coal fire in a grate of electric lamps. The sign is thus a scene of animation, without the misguided application of flasher effects which—fearful to relate—set the huge columns at the sides spinning wildly on their axes while the gentle scrolls of their Corinthian capitals are made into fiery pinwheels.

Other attractive moving displays in Louisville are those representing a pool player with cue and ball movements shown in lamps, a bubbling glass of liquid refreshment, a man tipping his hat and the significant arrow of a soda fountain drink.

The city streets of Louisville are lighted by 2500 magnetite luminous-arc lamps, installed several years ago, this being the first large-scale use of these lamps made in an American city. There are 15,000 consumers of central-station energy in Louisville.

ORNAMENTAL STREET LIGHTING IN FORT WAYNE.

Tungsten lamps will be used for the ornamental street lighting of Calhoun, Berry, Main and Court Streets in Fort Wayne, Ind., according to a resolution adopted by the Board of Public Works of that city recently. The matter has been under consideration by a committee of business men which has advised with the city officials. The committee considered both tungsten lamps and magnetite arcs, but preferred the former. The new lamps will be installed on attractive posts and there will be five on each block. The adjacent property owners will pay for the installation, and the city will maintain it. Each post will support five 60-watt lamps.

FREIGHT-YARD LIGHTING.

By W. S. Austin.

At Dupo, Ill., about thirteen miles southeast of the St. Louis Union Station, on the St. Louis, Iron Mountain & Southern Railroad of the Missouri Pacific Railway System, is located one of the largest double-hump freight yards in the West, designed to handle both north-bound and south-bound traffic, each hump having a capacity of 120 cars per hour. The yard is about three miles long and about 800 ft. wide at the classifying yards, with connections to the railroad company's Illinois Division, East St. Louis, Ivory Ferry, the Terminal Railroad Association and other systems. The yard is divided into receiving, classification, forwarding, storage, caboose and repair yards. The two humps, the roundhouse, repair yards, coal and water stations and the power house, together with a hotel and other facilities, are located at practically the longitudinal center of the yard, making it very nearly symmetrical.

Under the direction of the construction department of the Missouri Pacific Railway Company, Westinghouse, Church, Kerr & Company, in 1906, acting as engineers and constructors for the Railway Company, designed, constructed and equipped its Dupo power house. The following year the engineers were instructed to investigate and recommend a system of artificial illumination for the yard. All of the commercial systems of outdoor arc lighting were investigated, but as the power house contained alternating-current equipment, the direct-current systems could not have serious consideration. Owing to business conditions, all work in the yard was suspended from 1907 to 1909, in the fall of which year the subject was again taken up; and as many improvements had been made in different lighting systems, another investigation and report were made, which included flaming arcs, in addition to the systems previously considered.

Several installations of flaming arcs were visited in and around New York, including those at the Bush Terminal yards, the New York Central yards and a foundry installation. In a portion of the foundry the carbon arcs, which the flaming arcs had superseded, had not been removed, making it possible to study the effect, intensity and quality of light produced by both systems by using first one system and then the other.

Tests made showed that in direct sunlight an 8-in. high white chalk figure made on a brown background with a ½-in. diameter crayon could be read up to 275 ft., and that on a dark night with the flaming arc the same figure could be read at a distance of from 100 ft. to 150 ft., depending upon the position of the board with relation to the lamp. Under the same conditions with carbon and other white-light arcs the figures could not be read more than one-half the distance possible with the flaming arc. This had an important bearing on the selection of lamp, as in operating the humps it is necessary that the men in the switch towers at the entrances to the classification yard shall be able to read the car numbers at a distance of from 100 ft. to 175 ft. in order to throw the proper switch in front of the approaching car.

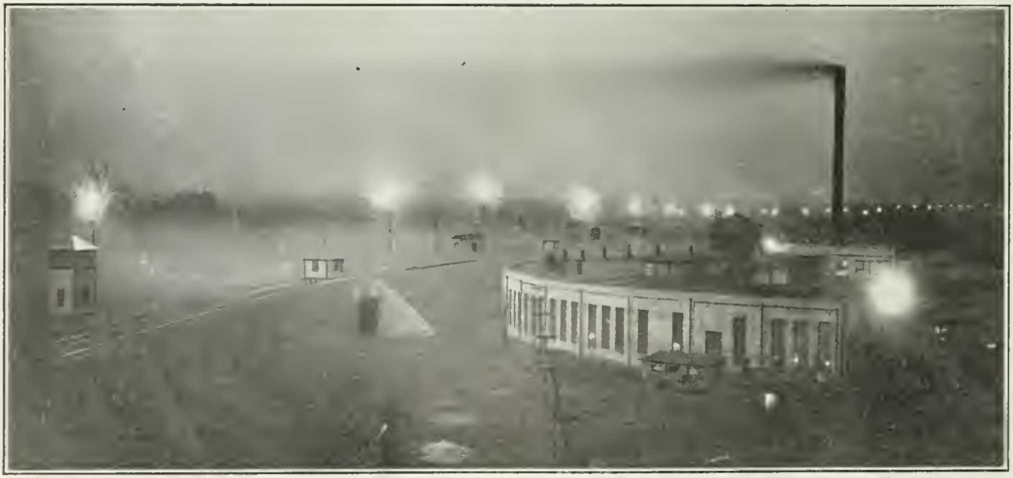


Fig. 1—Freight Yard at Dupo, Ill., by Night.

A detailed investigation and study showed the candle-power of the flaming arc to be greater than that of any other type, and that the quality of light generated by it was better suited for

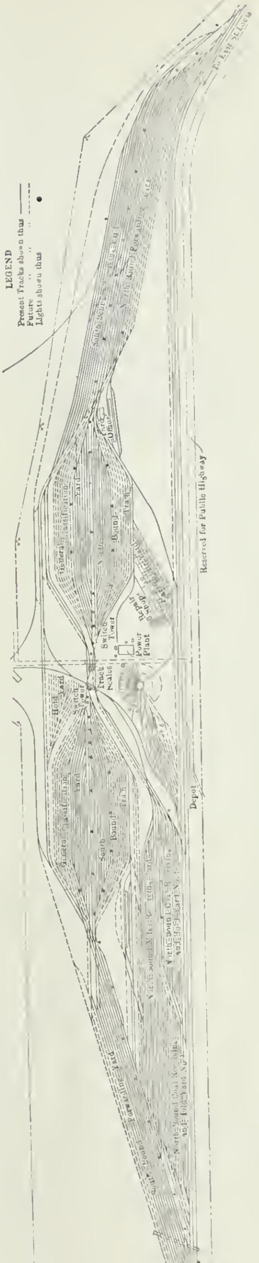


Fig. 2—Plan of Freight Yard.

this installation than that produced by any of the other lamps, as the penetration in clear weather, as well as in smoke and fog, was greater than with any of the other types, with the further advantage that the unshaded lamps would not blind or dazzle the eyes of the switching crews while working around the yard, even though they looked directly at the lamp or beyond it, thus making it unnecessary to provide expensive and complicated reflectors and shades.

A comparative study of the different kinds of flaming arcs was made to determine reliability, freedom from interruptio length of burning between trims, cost of operation, repairs, maintenance, etc., with the result that the regenerative flaming arc, manufactured by the Adams-Bagnall Electric Company, was recommended for this installation.

Fig. 2 shows the outline of the yard and spacing of tracks, as well as the approximate location and spacing of lamps. The lamps are spaced most closely around the humps, the distance between the lamps increasing through the classification yard and out into the forwarding and receiving yards, where some of the lamps are spaced 600 ft. A spacing of 400 ft. was found to give a very satisfactory illumination for general work with the lamps located 40 ft. above the rails, making it possible for men standing on the cars to see underneath the lamps.

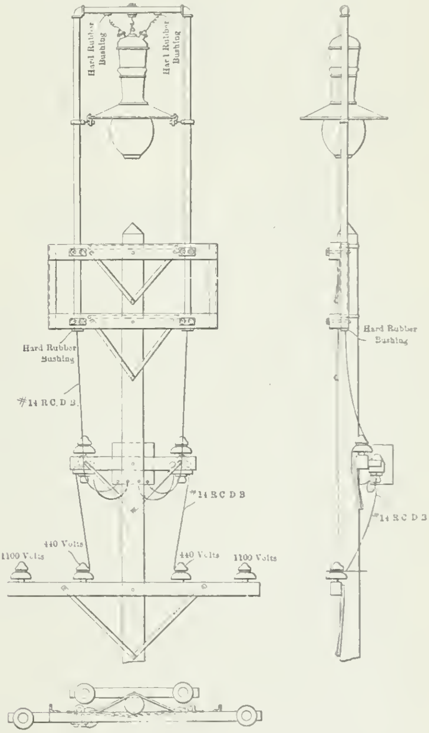


Fig. 3—Flaming-Arc Post Details.

The problem of locating the different lamps was worked out in conference with the railway engineers, and when the system was put in service it was found necessary to move but one of the lamps—this not to change the distribution of light, but owing to one of the poles obstructing the view of the tower men. This being the first large installation of flaming-arc lamps in a railroad yard in this country, no data were available that could be used as a guide in locating the different lamps. The entire installation, including distribution and erection of poles, feeders, etc., was made without interfering with the operation of the yard and without anyone being injured.

The different types of lamp suspension were considered, with the result that the lamps were installed in pole tops, designed for the installation as shown in Fig. 3.

The arrangement of circuits is such that two ways are provided for supplying energy to the lamps on the humps and in the classification yards. No duplication was attempted for the other yards, where cars could be moved without artificial illumination, if necessary.

The intensity of illumination secured equaled all expectations, and when the lamps were started up in the north half of the yard the effect produced was such that engineers on trains crossing the Eads and Merchants' bridges, twelve miles away, could plainly see the illumination, and residents as far distant as ten miles telephoned to ask what was burning at Dupo. Since the system has been put in operation it has been possible to secure results in operating and policing the yard at night such as have never been approached elsewhere. Fig. 1, from a photograph taken at night, gives an indication of the intensity of illumination secured.

At the present time this yard is without question the best artificially illuminated railway freight yard in the country and the only one in which the results obtained give anything approaching a uniform intensity of illumination over the entire area. We are indebted to Westinghouse, Church, Kerr & Company for blue prints and photograph from which the accompanying illustrations were engraved.

LETTERS TO THE EDITOR.

The Comparison of Illuminants.

To the Editor of Electrical World:

SIR:—The letter by Mr. Sydney W. Ashe in your first issue for March calls attention to certain facts to which entirely too little attention is paid. The term "candle-power" when applied to any source of light departing to any appreciable extent from a point is liable to lead to misrepresentation and is almost sure to result in confusion. Although when the source is considerably extended it may still be treated as a point source if it does in fact consist of a large number of widely separated points, yet, when it is a surface source, and especially when the real source is a lamp with a parabolic or concentrating reflector, the term "candle-power" as usually applied is meaningless, its use being permissible only when accompanied by the explanatory words "apparent at a distance of ——," either directly stated or strongly implied.

The only logical method of rating a lamp's output is in "lumens," 4π (approximately 12.5) of which equal 1 mean spherical candle-power. The only logical method of expressing the illumination is in lumens per unit area—1 lumen per square foot being 1 ft.-candle, 1 lumen per square meter being 1 meter-candle. When light output is expressed in flux (lumens) and illumination is expressed in flux density, all of the calculations are greatly simplified as compared with calculations required when dealing with candle-power, inverse square of distance from source, cosine of angle of incidence, etc., most of which can often be eliminated in "wholesale" estimations.

New York, N. Y. R. HILLBERG.

Canadian Electrical Association.

To the Editor of Electrical World:

SIR:—I note that in your report of the minutes of the National Electric Light Association it was stated that the Canadian Electrical Association had unanimously voted for affiliation with the National Electric Light Association. I wish you would be kind enough to state in reference to this matter that a special meeting of the members of the Canadian Association was called on Jan. 20, 1911, at Toronto, for the purpose of voting on the question of affiliation. Out of 474 members in the Canadian Electrical Association, and out of some 200 voting members, only eleven voting members were present at this special meeting, these eleven voting unanimously for affiliation. The secretary reported at this meeting that he had received a number of letters from members of the association, and a large number of the letters were written in opposition to the idea of affiliation. It will, therefore, readily be seen that affiliation was not voted upon by the members of the Canadian Association unanimously by any means, and it would only be right that this matter should be fairly understood by your readers.

P. S. COATE,

Late President Canadian Electrical Association.

Chatham, Ont.

Digest of Current Electrical Literature

ABSTRACT OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Angular Displacement in Synchronous Machines.—W. W. FIRTH.—An illustrated paper read before the Newcastle Section of the (British) Institution of Electrical Engineers. When the working conditions of a generator and synchronous-motor system are changed by alteration of the load or the excitation of either machine, a relative mechanical displacement of the rotors takes place, and if the change is sufficiently rapid there is an oscillation or phase swing about the new position of equilibrium which is quickly damped out by eddy currents and friction. The magnitude of the steady displacement is governed by the condition that the vector sum of the circuit voltages must be zero; or, in other words, that the resultant of the generated voltages of generator and motor is equal to the impedance drop in the circuit. These voltages depend upon the exciting currents of the machine together with their armature reactions, while the impedance drop is proportional to the current in the line. The author discusses in detail the influence of the armature m.m.f. in modifying the effective strength of the magnetic field. Some tests were made by the author with two similar 5-kw, four-pole separately excited converters with connections for both single-phase and three-phase working. The generator was driven by a directly coupled direct-current motor, and the second machine when running as a synchronous motor was loaded by a direct-current directly coupled generator and when running as a converter by rheostats. The four machines are in line with the synchronous machines in the center. Fig. 1 shows the apparatus used for observing or recording the space-phase displacement. Fixed on the half coupling on the motor shaft is a sheet-iron ring *R* carrying a pinhole *H*. On the end of the shaft of the generator is fixed a small mirror *M* with the reflecting surface in the axes of rotation; *S* is a fixed shield with another pinhole on it opposite to that in the ring. The light from an arc *A* passes through the two holes in line once per revolution of the motor and strikes the mirror *M* if the latter is suitably adjusted with reference to the synchronous position of running. Then it passes through the fixed lens *L* to the tracing-screen *T* or alternately to the drum *D*, which carries the recording sensitive paper. When relative motion of the armatures takes place its amount is measured by the change of position of the spot of light on the screen or drum. The spot of light is intermittent, and when a space-phase swing occurs gives rise to a series of dots on the sensitive paper. The apparatus was calibrated with the machines standing and the pinholes in line. It was found that equal angles of turning of the generator armature gave equal space-phase displacements on the screen of the spot of light, the errors of refraction of the lens almost exactly compensating for lack of curvature of the screen. Observations of the steady displacement with change of load and with change of excitation were plotted. The displacements at two constant speeds show that the displacement decreases with increase of speed for any given load; that it is much less in three-phase than single-phase machines and less again for converters than for synchronous motors. The latter might be predicted from the fact that in converters the armature reaction is much smaller than in synchronous motors.—Lond. *Electrician*, March 17.

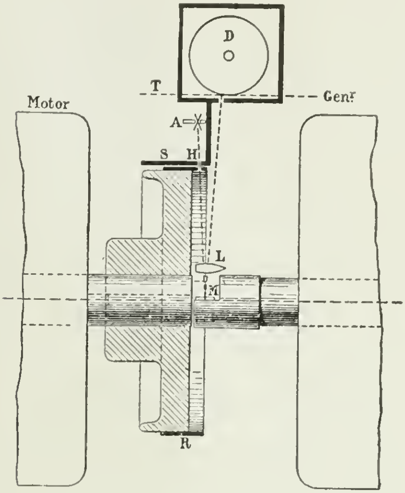


Fig. 1—Diagram of Testing Apparatus Used.

Commutator Truing Machines.—A description of an apparatus of O. Kirchenberger which enables anyone to true up a commutator on the spot accurately and promptly without dismounting the machine. The commutators or slip-rings are turned in the bearings of the machine so as to be perfectly true. After removing a brush-holder carrier with its insulation, the arm *A* (Fig. 2) is fixed in its place by means of a screw *S* as firmly as possible. The support *B*, which is free to slide in the top part of arm *A*, is then adjusted to reach over the width of the commutator that requires turning down, after which the steel cutter is set in position, while the screw *S* and the bolt *K* are tightened up, and the brush-holder ring *C* is secured by tightening its set screw (generally fitted with a handle) so that it will not turn round. In the meantime the position of the cutter is slightly altered, coming into place of its own accord, so that even unskilled persons can do the work. The cutting speed varies between 8 m and 10 m per minute. Where there is no motor for driving the armature a crank is attached to the end of the shaft, the armature being turned round by hand. The steel cutter is made of first-class high-speed steel.—Lond. *Elec. Review*, March 10.

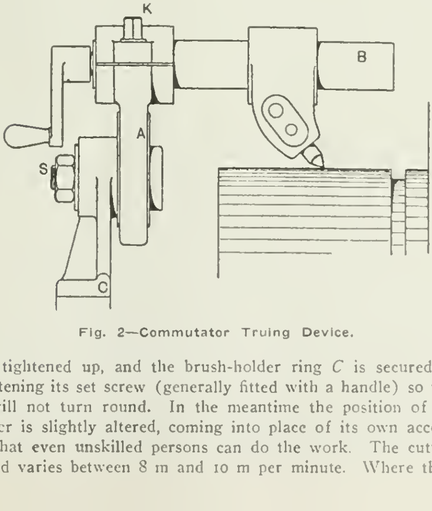


Fig. 2—Commutator Truing Device.

Lamps and Lighting.

Water Sterilization by Ultra-Violet Rays.—An account of experiments made in Paris by Henri, Helbronner and von Recklinghausen on the use of the ultra-violet rays from a mercury-vapor lamp for the sterilization of drinking water. Two different apparatus have been devised. The first apparatus is illustrated in Fig. 3. It was designed to give a large output of water, as much as 125 cu. m per hour, or sufficient for a town of about 20,000 inhabitants. The dimensions of the apparatus were fixed upon after the following experimental data had been obtained. The rays given off by the quartz mercury-vapor lamp (Westinghouse-Cooper Hewitt type) working at 220 volts with a current of 3 amp will completely destroy the microbes contained in water, including bacillus coli and other very dangerous microbes (cholera, dysentery, etc.), at the following distances and in the following times: At 60 cm, 40 cm, 20 cm and 10 cm from the lamp the times are respectively thirty seconds, fifteen seconds, four seconds and less than one second. The lamp should, therefore, be placed as near as possible to the surface of the water and a sufficiently slow flow used, so as to give the rays the proper time to act. It is best to use several lamps in this case, and to dispose of the apparatus so that the surface water coming under the first lamp is brought to the bottom, thus providing a fresh surface under the second lamp, and so on, thereby constantly changing the position of the water. An apparatus of this type, recently exhibited at Marseilles, is composed of a water tank of 3 cu. m capacity, a turbine pump, a water meter and the sterilizer proper formed of the triple-curved conduit 25 cm wide and 50 cm deep. Four mercury-vapor lamps, *LI*, etc., are placed in the positions indicated, and are suspended from the floats which keep them at a constant distance above the water, this distance being 2 cm. Above each lamp is placed a reflector of suitable type. With this apparatus the water is found to be completely sterilized when it has passed the second lamp. Such water was charged very heavily with bacteria when in the tank by appropriate means. Starting with 5250 microbes per cubic centimeter, 3650 were found after the first lamp had been passed and none after the second lamp. Each lamp takes 660 watts, and thus in the present test 36 cu. m of water is sterilized with 1320 watt-hours, use being made of only two of the lamps. For a higher rate of flow it would be necessary to use three or four lamps, according to circumstances. The above figures correspond to 36 watt-hours per cubic meter, but this figure has been reduced. In the second and more recent apparatus the lamp is immersed in the water, but direct contact of the globe with the water would be detrimental, as it would reduce the temperature of the lamp. The lamp is, therefore, inclosed in a protecting box with the three principal sides made of quartz plates. The arrangement is shown in Fig. 4. (See *Electrical World*, Dec. 1, 1910.) An electrically operated valve insures that no water can

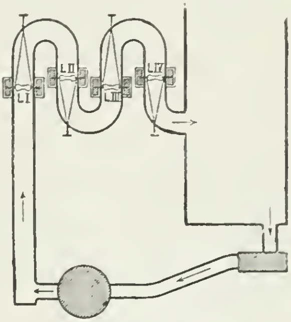


Fig. 3—Early Type of Water-Sterilization Apparatus.

be passed through the sterilizing chamber should the lamp break or the current supply be cut off. In series with the lamp is an electromagnet *M* which holds the valve up against its seat, so that in normal working no water passes through the valve. Should the circuit be broken, the valve is dropped and all the water then flows out at *V* without entering the sterilization chamber. In this way no unsterilized water can be delivered by the apparatus. Previously filtered water must be used. —Lond. *Electrician*, March 17.

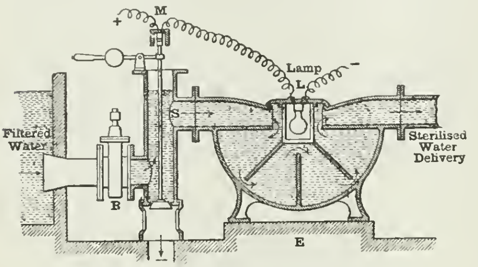


Fig. 4—Later Type of Water-Sterilization Apparatus.

Generation, Transmission and Distribution.

Condensing Plants.—G. L. Kothny.—An abstract of a paper read before the (British) Junior Institution of Engineers. The author spoke chiefly about modern air pumps, realizing that with the high vacua now demanded this part of the plant is of supreme importance. Dealing mainly with rotary pumps, he described in detail the Le Blanc dry-air pump. It was shown that a reversed turbine wheel, revolving before a jet of water, cuts off thin sheets, each of which, projected through stationary nozzles, entraps a layer of air. This air and water sandwich is compressed into a plug which passes through a diffuser to the atmosphere or at any required head. The author explained that the latest design can be self-starting, and will continue working with unexpectedly heavy air leaks. He next outlined various forms of condensers to which the rotary principle is applied, dealing first with the "simple jet," in which the steam is condensed and the air removed by a single jet composed of many sheets of water, exposing an enormous surface to the steam. He next described the "multiple jet," in which the cooling water is projected through nozzles into a steam space and is thence extracted by a turbine pump mounted on the air-pump shaft, the latter working on the above-mentioned system. After touching briefly on "barometric plants," the author passed on to the consideration of "surface condensers" and gave a description of turbo-driven auxiliaries, air-circulating and hotwell pumps, all being directly coupled to a small impulse turbine. In conclusion he discussed the relative advantages of the different types and the particular purposes to which they are adaptable, other than standard work, such as soap making, sugar refining, refrigerating, etc., and expressed his opinion that rotary auxiliaries will as rapidly supplant reciprocating sets as the turbine is doing in main units. Tables were shown which clearly indicated that the rotary air pump can compete favorably with the most modern reciprocating types and give better results in the higher range of vacua, combined with maximum simplicity, there being only one rotary wheel, while all valves are eliminated.—Lond. *Electrician*, March 17.

Boilers.—In the course of an informal discussion on boilers at Sheffield two new types were described. One of these, made by Hawksley, Wild & Company, is a water-tube boiler with nearly vertical tubes and embodying a new design of tube plate; the other, made by Frazer & Chalmers, under the Bettington patents, is fired with coal dust. Some details are given on the construction of both types.—Lond. *Elec. Eng'ing*, March 16.

Traction.

Electric Locomotives.—A note on tests now being carried out between Cannes and Grasse with an electric locomotive built by the Alioth Company according to the system devised by Auvert and Ferrand. This locomotive is supplied with single-phase current at 12,000 volts and a frequency of 25, and has been drawing trains weighing (without the locomotive) 220 tons on the Mediterranean coast line at a speed of thirty-five miles per hour on 2 per cent gradients. The 12,000-volt current is supplied from an overhead wire, is reduced in e.m.f. for the locomotive by transformers and converted to direct current by two special mechanical rectifiers. The power demand from the network at starting is insignificant. For instance, a very heavy train takes only 150 kw, a figure which rises to 1000 kw or even 1500 kw as the speed increases. This is due to the fact that Auvert and Ferrand regulate their locomotive by altering the position of the brushes on the rectifier. At starting the voltage is practically nothing, being just sufficient to maintain in the series motors a current corresponding to the torque to be overcome. At full speed the total voltage is utilized, the brushes having been moved progressively. The arrangement allows the torque to be regulated at will. Another advantage of the system is that the power-factor is never less than 0.5 even at starting, while at full load it varies between 0.95 and 0.98. The total efficiency is very high, as the ratio of the mechanical power at the road wheels to the high-tension power at the station is about 0.78. This locomotive, it is claimed, possesses all the advantages of both single-phase and direct-current locomotives, with none of their disadvantages. Tests which have just been made show that the power that can be exerted easily exceeds that of the best steam locomotives.—Lond. *Electrician*, March 17.

Mechanical Feature of Electric Locomotives.—B. P. Haigh.—An abstract of a paper read before the (British) Institution of Engineers and Shipbuilders in Scotland. The author pointed out that several mechanical problems have arisen in the design of large electric locomotives, one of these being the collection of the heavy current required from the overhead conductor or third rail. From the point of view of the mechanical engineer the "single-phase" system is much more promising for high speeds than either the direct-current or three-phase system, as only a single overhead conductor and collector are required. The main problems as compared with modern steam practice arise from the fact that electric locomotives are much lighter than the steam equipment of equal power. For this reason it is necessary to put a greater proportion of the total weight when possible on the driving wheels. Against this is the known fact that a leading bogie gives smoother running. In the largest locomotives driving bogies have been less successful than in moderate sizes, for the great height of the bogies necessitated by the large motors and driving wheels causes great strains in the upper framing. Articulated locomotives and others with semi-rigid wheel-bases have been more successful. Perhaps the most important point requiring attention is the support of the motors so as to avoid excessive vibration and shock on the rails. It is immaterial how the weight of the motors is transmitted to the driving wheels so long as the great mass of the motors is not forced to vibrate along with the axles. In the largest locomotives this problem has been solved by supporting the motors, weighing up to 15 tons each, on the main framing, the motion being transmitted to the driving wheels by means of connecting rods.—Lond. *Electrician*, March 17.

Thermit Welding.—Brewitt.—An illustrated account of a lecture on the different applications of thermit welding for the repairs of broken castings, etc., with special reference to the welding of rails.—*Elek. Zeit.*, March 16.

Installations, Systems and Appliances.

Breaking High-Potential and Low-Potential Circuits.—A. G. Collis.—The conclusion of his paper. In the present instalment the author deals with alternating-current tests. So far as his tests were carried they confirm the practice of the industry in the general use of oil switches for alternating-current work as being a wise practice. A large volume of oil adds considerably to the factor of safety, and the oil should, of course, have a high flash point. Some notes are also given of the resistances between carbon contacts in comparison with other contacts and it is shown that the carbon contact is relatively of very low conductivity. With moderate currents this is not of serious consequence, but with heavy currents, such as are experienced in cases of short-circuits, some burning of the main brush is difficult to avoid. On that account the practice of using metallic contacts for the auxiliary breaks is to be recommended as a general rule. An account of the extended discussion which followed is also given.—Lond. *Electrician*, March 17.

Meter Testing in Central Stations.—A. T. Bullen.—The author gives practical rules on arrangements of meter tests in central stations which he thinks are very important. The introduction of low candle-power metallic-filament lamps has become a source of great loss to many supply companies, but a large proportion of this loss occurs through the older types of meters being called upon to register small amounts which they are not sensitive enough to record. He prefers to use in the testroom a set of standard meters which would be checked by the instruments every morning; the actual calibration of the meters would then be carried out by running them with the standard meters.—Lond. *Elec. Review*, March 10.

Conveying Systems in Post Offices.—E. W. Pettit.—An abstract of a paper read before the (British) Institution of Post Office Electrical Engineers. The author emphasized the difficulty of commercially justifying the introduction of conveyors into existing post offices because, on account of the complex organization of these offices, it is only possible in the majority of cases to deal mechanically with sections of the work and not with the whole of it. Yet considerations of speed, increased facilities for supervision and general convenience may, and often do, make the installation of conveying machinery desirable. The principal conditions to be fulfilled by postal conveyors are freedom from breakdown and danger to staff and the elimination of the machinery from the office itself. In the opinion of the author the conveyor which more closely approximates to these conditions than any of its rivals is the form known as the "band," and he showed complete designs for two large conveyors, one 450 ft. in length and suitable for carrying bags weighing up to 125 lb. or 57 kg. Methods of distributing correspondence from band conveyors, either at stated positions or automatically over a given length by means of deflection plates, were discussed. It is stated that the authorities of the British Post Office have been making experiments on conveying systems for some time past and that conveyors will probably be installed in the near future.—Lond. *Electrician*, March 17.

Automatic Control of Motors.—Henry.—An illustrated article on arrangements of controllers for the automatic control of motors, especially rolling-mill motors.—*L'Industrie Elec.*, March 10.

Wires, Wiring and Conduits.

Improvements in Underground Conduit Construction.—E. N. Lake.—An illustrated paper read before the Western Society of Engineers. The author first discusses the use of vitrified clay and the arrangement of the ducts, and then passes on to consider the connections between underground mains and the overhead line of an electric tramway. He finally suggests improvements in manhole fittings.—Lond. *Electrician*, March 17.

Electrophysics and Magnetism.

Principles of Thermodynamics.—H. L. Callendar.—His presidential address to the British Physical Society in which the author shows that the caloric theory of heat as developed by Carnot in his "Reflections on the Motive Power of Heat" (Paris, 1824) leads immediately to the correct solution of the relations between heat and motive power (energy or work) in all reversible processes, and appears to be in some respects preferable to the mechanical theory as a method of expression because it emphasizes more clearly the distinction, first clearly stated by Carnot, between reversible and irreversible transformations, and because it directly provides the natural measure of a quantity of heat as distinct from a quantity of thermal energy. The caloric theory is perfectly consistent with Carnot's principle and with the mechanical theory for all reversible processes. Caloric is the natural measure of a quantity of heat in accordance with Carnot's equation, if the gas-scale of temperature be adopted. The only defect of the caloric theory lay in the tacit assumption, so easily rectified, that the ordinary calorimetric units are units of caloric. The quantity measured in an ordinary calorimetric experiment is the motive power or energy of the caloric, and not the caloric itself. If this had been realized in 1850 it would have been quite unnecessary to recast and revolutionize the entire theory of heat.—Lond. *Electrician*, March 10.

Röntgen Rays.—R. Whiddington.—A note on a paper read before the Royal Society of London on the production and properties of soft Röntgen radiation. Röntgen rays from ordinary bulbs are usually produced at generating potentials of between 10,000 volts and 100,000 volts. It is possible by using a special tube with a very thin aluminum window to experiment with rays generated at only a few hundred volts. The rays dealt with in this paper were generated at from 1000 volts to 3500 volts. It has been found that such soft Röntgen rays have much the same properties as the harder rays usually experimented with. They produce ionization in air, affect photographic plates and can excite secondary radiations when incident on solid bodies. Their range in air, however, is not many centimeters. For many purposes a Röntgen radiation is sufficiently defined by a knowledge of the total energy and the penetrating powers in absorbing screens. These two properties were, therefore, investigated in some detail, with reference particularly to the influence exerted by the material of the anti-cathode and the potential at which the rays are generated. The anti-cathodes used fall naturally into two groupings: Group A—Al, Pt. Group B—Ag, Cd, Cu, Fe, Ni, Pb, Sb, Sn, Zn. The anti-cathodes of Group A emit secondary radiations, those of Group B do not.—Lond. *Electrician*, March 10.

Units, Measurements and Instruments.

High-Voltage Storage Battery.—A. A. Campbell Swinton.—An illustrated paper read before the Rontgen Society on a storage battery of the Planté type for high-tension direct-current experiments. The battery consists of 4800 cells. The reason for this particular number is that it divides up into convenient sections of eighty cells for the purpose of charging in parallel off the 200-volt supply. When all the cells are in series the battery gives 10,400 volts on open circuit. The 4800 cells are contained in five cabinets, which hold 960 cells each. They are arranged in twenty-four blocks of forty cells each. Each cell consists of a glass test tube 4 in. long and of 0.75-in. bore, and each set of forty cells is cast solid with paraffin wax in a wooden tray. With the full 10,000 volts between polished brass balls, 12.5 mm in diameter, the current is found to jump some 2.5 mm, and the resultant arc can be drawn out into a considerable length, largely dependent on the amount of resistance in the circuit and consequent strength of the current. That the current is often not entirely continuous is evidenced by the fact that the arc makes a whistling sound of very high periodicity. Connecting a Leyden jar across the arc immediately converts it into a series of sparks, which give out a musical note.—Lond. *Electrician*, March 10.

Frequency Meter.—A note on a recent British patent (16,342. March 9, 1911) of the Siemens & Halske Company for an instrument for indicating and recording frequency, which consists of a voltmeter arrangement in parallel with an inductance with a condenser in series with both. The closed iron circuit of the inductance is saturated so that the resonance point of the measuring circuit is displaced with any alteration of current and the circuit is tuned so that the whole range of the instrument lies outside the resonance point. The use of a highly saturated transformer core with large leakage, and also of a second voltmeter in opposition, to eliminate the effect of variations in the pressure, is also covered by this patent.—Lond. *Elec. Eng'ing*, March 16.

Motor Meter.—An illustrated announcement by the Reichsanstalt admitting a direct-current motor meter of the Isaria Company for official calibration. The construction of the meter, which is built for currents of from 3 amp to 30 amp and voltages up to 600 for two-wire and three-wire direct-current installations, is described and illustrated.—*Elek Zeit.*, March 9.

Telegraphy, Telephony and Signals.

Protection of Telephone Lines.—An illustrated description of methods for the protection of telephone lines against atmospheric electricity and transmission circuits. The article is illustrated by numerous diagrams.—*Elek. Anz.*, March 5 and 9.

Electricity Transmission in Cables.—K. W. Wagner.—A paper on the mathematical theory of the propagation of electricity in cables if there is an energy loss in the dielectric. The author also discusses briefly the possibilities of transatlantic cable telephony, but finds that the prospects so far are poor.—*Elek. Zeit.*, March 16.

Spectrum of the Poulsen Arc.—E. O'Connor.—An account of an investigation of the spectrum of the Poulsen arc when there are strong oscillations in the oscillation circuit and when there are not, with a discussion of the mechanism of the production of the oscillations.—*Phys. Zeit.*, March 15.

Miscellaneous.

Definitions.—A set of seventy-seven definitions of important terms used in electrical engineering with comments on the different definitions. "Anker" (armature) is defined, for instance, as that part of the machines in which the lines of the magnetic flux are in motion relatively to the metal when the machine is in operation.—*Elek. Zeit.*, March 2.

Heating Apparatus.—A note on a recent British patent (26,120, March 9, 1911) of the British Thomson-Houston Company (General Electric Company of this country). A flat heating unit for hot plates and other electric heating apparatus is constructed by covering a length of the insulated resistor with a metal tape or a thin metal sheath deposited on the insulation. The conductor is then wound into a close helix and electroplated until the whole becomes as rigid as a solid disk of metal. This results in a heating unit in which the conductor is in close contact with the metal to be heated and is well protected.—Lond. *Elec. Eng'ing*, March 16.

Plastic Insulating Materials.—A. Hakannson.—A translation in abstract of his recent German paper. The author discusses the properties of plastic insulating materials now largely used in electrical manufacture. They may be classed as (1) rubber substitutes, (2) insulators with organic binding materials, (3) insulators with inorganic materials. Mechanical strength, hygroscopic and heat-resisting properties are considered, and emphasis is laid on the fact that insulation resistance often falls off enormously as the temperature is raised.—Lond. *Electrician*, March 10.

"Commercial Engineering."—M. J. Railing.—An address delivered before the Municipal School of Birmingham. The author urges that our technical education should proceed on broad lines and should not overlook the fact that subjects which are not strictly technical are nevertheless a part of the necessary equipment of the successful engineer. It is only by such a combination of strictly technical and commercial knowledge that a supply can be obtained of trained engineers able to regain for Great Britain the premier position among manufacturing countries of the world.—Lond. *Electrician*, March 10.

Architects and Electrical Engineers.—K. Simons.—The author discusses the possibilities of giving to architects the proper and desirable training in electrical engineering in German institutes of technology.—*Elek. Zeit.*, March 16.

BOOK REVIEWS.

Electric Motors. By Francis B. Crocker and Morton Arendt. New York: D. Van Nostrand Company. 291 pages, 158 illus. Price, $2.50.

Professors Crocker and Arendt have arranged in book form the substance of a course of lectures on electric motors and their applications given in Columbia University. The subject matter has been selected with great care and is presented in excellent style.

The types of motors dealt with include the various forms of direct-current motors, single-phase and polyphase induction motors, synchronous motors and commutating alternating-current motors. Each of these types is discussed with reference to its operating characteristics and applicability for certain services. No mention is made of methods of design or of design constants. However, design proportions are not entirely ignored in that they are indirectly considered in connection with the discussion of the characteristics of motors suitable for various applications.

Somewhat less than one-half of the book is devoted to direct-current motors, much attention being given to adjustable-speed machines of both the variable-reluctance and the variable field-current types. As introductory to the section relating to alternating-current motors a chapter is added on the history of the development of the various types now in use. It is interesting to note that most credit is given to Professor Ferraris for the invention of the induction motor and to Professors Anthony, Jackson and Ryan for the invention of the machine commonly known as the repulsion motor. Both of these machines seem to have been patented in 1888, the former having been invented in 1885 and the latter in 1887.

The authors have employed remarkably simple methods for representing the characteristics of synchronous and asynchronous motors and have succeeded in explaining all of the essential features without resort to complicated mathematical analysis. Simplicity in presentation also characterizes the chapter on commutating alternating-current motors, which, however, appears too brief in view of the increasing industrial importance of these motors and the desirability of greater knowledge of their main features on the part of students now graduating from electrical engineering courses.

The book as a whole is well balanced and is conveniently arranged for instructional purposes.

Application of Arc Lamps to Practical Purposes. By Justus Eck. London: S. Rentill & Company. 101 pages, 90 ills. Price, 2s. 6d.

The task to which this author has applied himself is the very practical one of selecting those units from the number of existing types of modern English arc lamps which are best adapted for lighting certain kinds of interiors. Beginning with the flux-distribution curves of various direct and indirect arc lamps, it is shown how these can be applied to illuminate such interiors as art galleries, show windows, halls, shops, factories, etc. Detailed descriptions are also given of the modern types of alternating-current and direct-current inclosed, flaming and metallic-flame arc lamps in use in Great Britain. Several pages are included on arc-lamp auxiliary and switchboard apparatus and on arc-lamp testing.

Scientific Management and Railroads. By Louis D. Brandeis. New York: The *Engineering Magazine*. 92 pages. Price, $1.

The statement by Mr. Louis D. Brandeis that "at least $1,000,000 a day" could be saved to the railroads of the country by scientific management created more than a passing sensation when made some months ago. The evidence upon which this statement was made was submitted to the Interstate Commerce Commission in the form of a brief by Mr. Brandeis on Jan. 3, 1911. The present book contains the essential parts of that brief arranged in logical order to bring out the main conclusion, which is that if the net income of the railroads is insufficient the proper remedy is not higher rates, resulting in higher costs and lessened business, but scientific management, resulting in lower costs, in higher wages and increased business. A record is given of the testimony offered as to the profitable results from the use of methods that have proved effective and economical in manufacturing establishments.

Electrical Pocket Book for 1911. Manchester: Emmott & Company. 208 pages. Price, 6d.

The 1911 number of this reference book is marked by condensation of the material in preceding issues, affording room for a number of new tables. These include data on current density, temperature rise, losses, illumination, life of lamps, depreciation, etc. Most of the material printed in this volume can be used to advantage by the practical installer, but aside from the reference tables the text matter is chiefly of an elementary character.

Several pages which are devoted to the subject of "cheap house wiring" describe systems of surface-molding work that have been brought out abroad and are taken advantage of to cheapen construction commensurate with the economy of service made possible by the tungsten lamp. Obviously these forms of construction hardly satisfy American standards of wiring construction.

New Apparatus and Appliances

ALTERNATING-CURRENT CONTROLLING APPARATUS.

Of the accompanying illustrations, Fig. 1 shows an alternating-current single-phase motor starter of the hand-release type and Fig. 2 an alternating-current single-phase speed regulator without the automatic release. The construction of these appliances, which are made by the Independent Electric Manufacturing Company, of Milwaukee, Wis., is marked by simplicity and rigidity throughout, and is the result of much experimental work. The resistor element of the starter is inclosed in a fireproof and moisture-proof cast-iron box, careful provision being made for ventilation. The corresponding element of the speed regulator is contained in a semi-inclosed cast-iron box. One good feature about these motor-controlling appliances is the large wearing surface, together with ample carrying capacity proportioned to all parts.

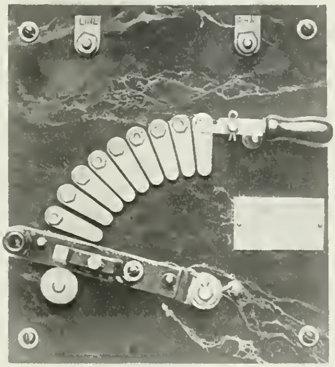


Fig. 1—Alternating-Current Single-Phase Starter with Hand Release.

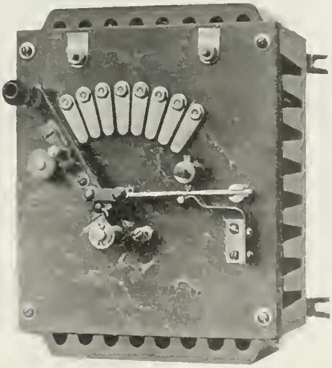
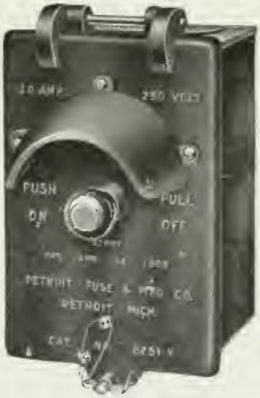


Fig. 2—Alternating-Current Single-Phase Speed Controller.

IRONCLAD FUSED SWITCH.

The Detroit Fuse & Manufacturing Company, Detroit, Mich., has placed on the market a new type of switch known as the "severe-service junction-box switch." In addition to being an ironclad fused switch, this device provides for the branching out of circuits in all directions and for the main lines passing entirely through the box and under the porcelain base. The switch is of the quick make-and-break type, positive in its action, and controlled instantly from the outside of a cast-iron box. All working parts are of phosphor bronze, making a rustproof design, and the switch is equipped with gaskets, giving a water-tight construction. It can be installed outdoors or where directly exposed to water, steam, fumes or any other extreme condition. This switch is especially desirable for engine-house service and is being rapidly adopted, it is claimed, by prominent railroads as part of their equipment.



Junction-Box Switch.

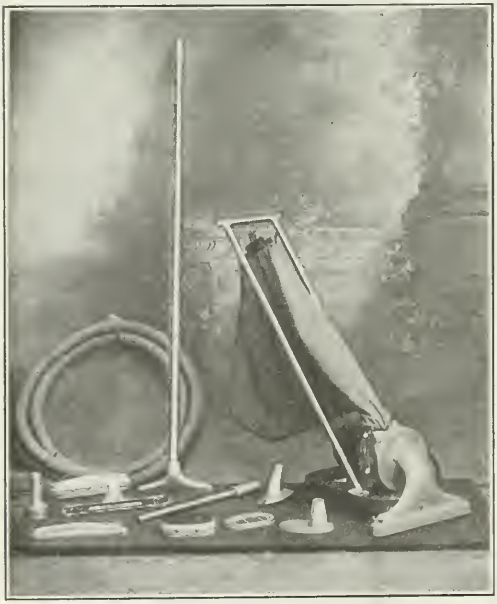
AN ELECTRICAL RECORDING COMPASS.

The principle of the curve-drawing meter has been applied advantageously to the mariner's compass, thereby providing a continuous record of the direction in which the ship was heading during any hour and minute of her voyage. The instrument shows variations of direction within 2.5 deg., or half a point, and also furnishes a log of sea conditions, presenting an irregular line under choppy weather and a smooth curve in smooth water. The curve-drawing apparatus is separate from the contact-making compass and binnacle, but is connected to it through a pair of wires. Standard ship's lighting e.m.f., 100 volts to 125 volts, can be used for operating the compass. In case of interruption to the generator voltage an automatic circuit-breaker throws the compass mechanism onto batteries, thereby restoring it to the generators again when service is resumed. The chart is fed under the recording pen at the rate of 2.5 in. per hour by an electrically wound clock movement.

One chart lasts thirty-one days, and is graduated to five-minute spaces so that one-minute intervals can be read easily. The binnacle for the recording compass is provided with compensating devices for making all corrections for magnetic deviations. These curve-drawing compasses, which are manufactured by the Schuette Recording Compass Company, of Manitowoc, Wis., have been in daily use on navigable waters for three years, under all kinds of weather, and are reported to have given excellent results.

PORTABLE VACUUM CLEANER.

The vacuum cleaner built by the Semco Vacuum Cleaner Company, Nashville, Tenn., is equipped with a ⅛-hp motor and weighs complete 33 lb. The machine is also adapted to be used for blowing purposes, exhausting foul air, hair drying, grinding and sharpening cutlery, polishing silverware, drilling, running a sewing machine, etc. The motor bearings are equipped with large oil cups and the motor has a ½-in. shaft. Alternating-current and direct-current motors of standard voltages are used in connection with a rotary suction fan placed directly on the motor shaft. The fan is of boxed construction and thrown off center, which is claimed to add to the efficacy of its work. The dust bag is of ample proportions for the service required. When it is desired to use the motor for running a sewing machine the former is pushed up beside the sewing machine and a belt placed on a deep-groove pulley on the motor shaft, the other end of which holds the suction fan. The speed regulation of the sewing machine is governed by an idler arrangement attached to the pedal of the machine and controlled by the foot of the operator. For polishing brass the shaft is extended ½ in. beyond the grooved pulley and on this shaft is a screw tapering chuck for holding the cloth-buffing wheel, also a bristle brush. For grinding and sharpening, a plain chuck is used with an emery wheel. For hair-drying purposes tools are used on the blowing end of the fan. The vacuum cleaner itself can be used by pushing it along the floor or by attaching a hose to the machine. The usual cleaning tools form part of the equipment. No revolving brush is employed, but a stationary brush is confined in the tool used on the cleaner when it is pushed along the floor. This tool covers 14 in. of floor space. The manufacturer points to the numerous applications which can be obtained without making any changes in the machine.



Portable Vacuum Cleaner and Cleaning Tools.

A NEW SUCTION CLEANER.

The suction cleaner illustrated herewith is built in both the portable and stationary types. In the former the pump is mounted above a small electric motor, to which it is belted. The bag of screening material is placed above the pump, and the whole is placed in a cylindrical case. The air drawn into the machine leaves its dust in the bag, and on its passage out is used to ventilate the motor. If desired the action may be reversed, the machine being used as a blower for hair drying, renovating pillows, blowing out pianos, etc. The motor in the portable machine is rated at 1/6 hp and the machine complete weighs 50 lb. A number of attachments for vacuum cleaning are provided. In the stationary type the motor and pump are fastened to a bench, the connections to the tank being as shown.

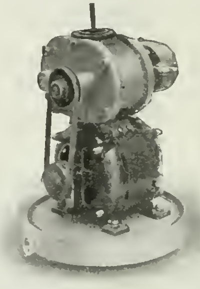


Fig. 1—Portable Cleaner with Cylindrical Case Removed.

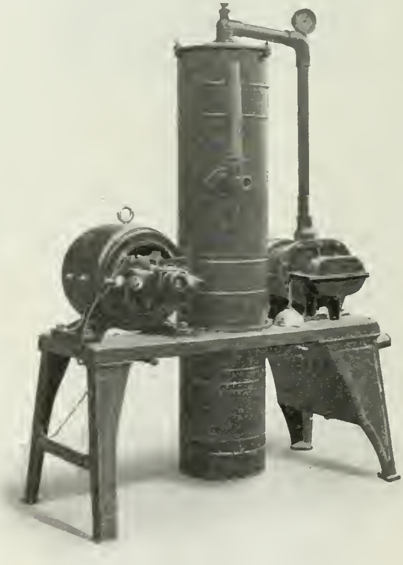


Fig. 2—Stationary Type of Cleaner, Showing Connection for Standpipe.

These cleaners are built by the Perfex Cleaner Company, Waukegan, Ill.

VARIABLE-SPEED POLYPHASE MOTOR.

The Richmond Electric Company, Richmond, Va., manufactures a full line of variable-speed polyphase motors ranging in ratings from ¼ hp to 75 hp. The standard form of construction employed is shown in Fig. 1. The motor corresponds very closely in operating characteristics to a shunt-wound direct-current motor with armature control and is suited to work requiring a motor of heavy starting torque with minimum starting current. The standard starting rheostats and variable-speed controllers are so designed as to limit the current at starting to one and one-half times normal full-load running current. The motors are well protected and at the same time sufficiently ventilated to permit them to carry heavy loads continuously without abnormal temperature rise. The construction is rugged throughout. The motors can be mounted on the wall or ceiling by turning the end plates 90 deg. to 180 deg. so as to keep the oil wells in a vertical position. A substantial iron sub-base is furnished with motors of from ¼-hp to 3-hp rating and rails with motors of from 5-hp to 75-hp rating.

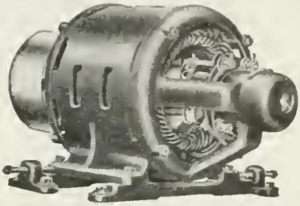


Fig. 1—Polyphase Motor.

The stator frames are of cast iron in one piece. The section is such that a rigid support is obtained for the laminations. The feet are broad and the entire frame construction is such that there can be no springing. The laminations are of the highest grade electrical sheet steel, and are annealed after the slots are punched in the inner periphery. In this manner the effects of hardening of the steel, due to punching, are eliminated. The steel is especially treated during the process of annealing to eliminate the effects of aging. Before assembling in the stator frame each disk is japanned and baked. By handling the steel in this manner the hysteresis and eddy losses are reduced to a minimum. The stampings are then clamped in the stator frame under hydraulic pressure between heavy malleable iron rings. At each end of the laminations is a fiber disk with slots of the same size as in the steel punching. These disks are an additional protection to the coils where they come out of the slots. The inside diameters of the stator punchings are ground on a special machine, thereby insuring an accurate air-gap. The partly closed slots are then lined with fiber and mica tubes. The stator windings, which are liberally designed as to carrying capacity, are then placed in position. A hardwood key is driven in, thus closing the top of each slot, and holding the coil securely in its place. The coils are carefully taped, and the stator is dipped in a high-grade moisture and oilproof compound and then baked. A 50-hp completed stator ready for assembling is shown in Fig. 2.

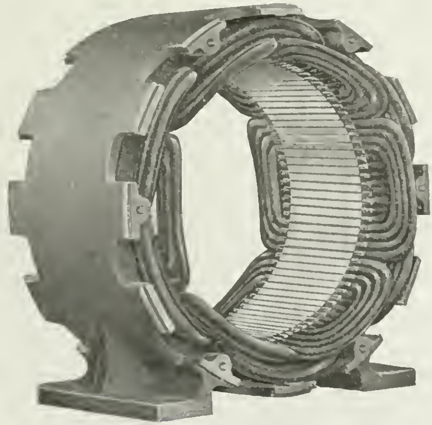


Fig. 2—Stator of Polyphase Motor.

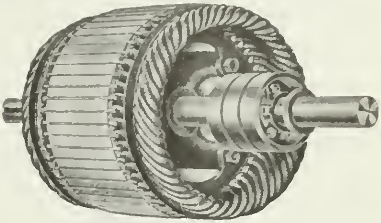


Fig. 3—Rotor of Polyphase Motor.

The rotors are built and ground in the same manner as the stators. In the smaller sizes the punchings are mounted directly upon the shaft and clamped under hydraulic pressure between malleable iron heads; in the larger sizes the punchings are mounted on spiders and clamped between malleable iron rings. A punching of fiber is placed at each end of the core. The coils are carefully wound on forms and placed in the partly closed slots of the rotor. The rotor is then dipped and baked as in the case of the stator. The rotors are invariably wound for three-phase currents. The collector rings are carefully built and have liberal sections to provide for brush wear.

The bearings are liberal in diameter and length, exceeding, the manufacturer claims, the majority of motors on the market. The linings are one solid casting of phosphor bronze, and rings dipping in large oil chambers provide constant lubrication. A cleaning hole is provided at the bottom of the oil chambers, and an overflow at the side and cover permits ready access for filling and inspection.

In many cases the slow speed of the driven machine requires the use of intermediate gears, and to provide for this condition motors may be equipped with countershaft, cast-iron cut gear and rawhide pinion, as shown in Fig. 4. The brackets are cast right or left-handed, according to the side of the motor on which the countershaft is to be used. The countershaft bearings on motors larger than 3 hp are supplied with oil rings and oil reservoirs with holes or for draining. Three horse-power motors and smaller have oil-cup lubrication. The standard ratio for back gearing is 5 to 1.

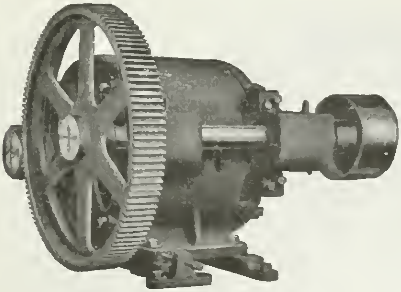
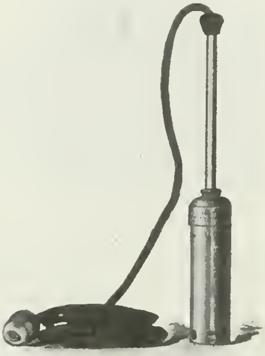


Fig. 4—Back-Geared Polyphase Motor.

IMMERSION-TYPE ELECTRIC WATER HEATER.

A plunge-type water heater making use of an annular-flue principle for increasing the circulation over its heated surface is shown in the accompanying view. The water-tight barrel containing the heating element is surrounded at a distance of about 3/16 in. by a metal shell, perforated with holes top and bottom, for the admission and egress of the water from the annular flue thus formed about the heating element. This construction is designed to induce a circulation of water past the heating surface, increasing the effectiveness of the device. The resistor element is of alloy wire wound on a lava spool and is inclosed in the water-tight inner barrel. The outer shell also serves as a protection in case the heater is left turned on, out of liquid. The heater is made for use on circuits from 95 volts to 125 volts, and consumes approximately 500 watts at 110 volts. This heater has been developed by the Insto Electric Heater Company, Blymer Building, Cincinnati, Ohio.

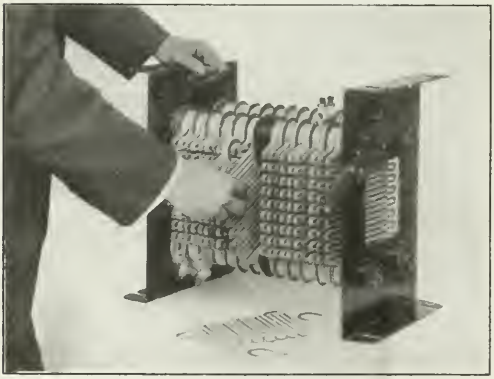


Plunge-Type Water Heater.

* * *

RHEOSTAT ARRANGED FOR RAPID REPAIRS.

In the rheostat shown herewith the feature of ready repairability has been worked out to the point of maximum convenience. The rheostats are of the cast-iron-grid resistor type. In the ordinary forms the grids are strung on the supporting tie rods like so many beads or buttons on a string, and the replacement of one or more injured grids necessitates the unmounting of the whole rheostat and the removal of practically all the other grids. In the rheostat here shown this trouble is avoided by slotting the supporting bosses at the top and bottom of the grids, thus permitting each grid to be slipped on or off the tie rods without disturbing any of the others. The rheostats are particularly well adapted for railway service. A few extra grids and a wrench carried on the car will eliminate the delays usually encountered during service. Loosening the nuts on the ends of the tie rods, removing the injured grid and slipping in a new one and then retightening the nuts entail a delay of only a few minutes, which is inappreciable on slow urban or interurban schedules and easily made up even under the closest rush-hour headway. This type of rheostat has been developed for the market by the General Electric Company.



Rheostat with Removable Grids.

* * *

TROLLEY-WIRE SPLICER.

A trolley-wire splicer than can be used without bending tools or wrenches is illustrated herewith.

The distinctive feature of the splicer is the method of securing the wire. A tapered and slotted chuck fits snugly around the wire. The chuck is threaded on the inside and when inserted in the tapered hole in the splicer firmly grips the wire. The greater tension there is on the wire the firmer the grip becomes, and it is impossible to pull the wire out of the splicer. The chuck is easily removed, however, when it is desired to take up slack. This splicer has been placed on the market by the Westinghouse Electric & Manufacturing Company.

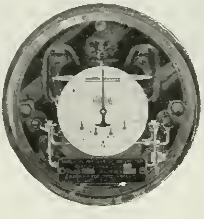
Trolley-Wire Splicer.

* * *

DIRECT-CURRENT WATT-HOUR METER.

The increasing importance of economy in switchboard space, especially in the larger stations, has created a demand for meters of large rating which can be installed in close proximity to each other. The shunted type of meter is especially suitable for this class of service in that the meter itself can be made of smaller dimensions than is possible with the series type of meter in which all the current to be measured must be passed through the meter itself. With the shunted principle the main series shunt can be located at any desired point, the only conductors from the meter being a pair of small leads.

The watt-hour meter here shown is of what is known as the "mercury-motor type," because in it mercury is employed to form the electrical contact in place of brushes as used on the commutator type of meter. At the same time the mercury floats the entire moving system and avoids the necessity of employing a lower step bearing. The result is a practically frictionless mercury-floated moving system which cannot be injured by severe shocks or jars, which would soon ruin the usual type pivot-and-jewel bearing. At the same time the absence of



Shunted Watt-Hour Meter.

commutators and brushes renders the meter free from errors due to sparking or tarnishing, inevitable with commutator and brush contacts.

The shunted principle of operation is especially valuable in meters intended for use in large direct-current switchboards where it is desirable to employ watt-hour meters, recording meters and indicating ammeters. These three meters can be operated from a single shunt, thus effecting a saving which in many cases, such as on a 10,000-amp circuit, will amount to several hundred dollars on a single installation. In addition to the economy secured by this method of metering, it is also very desirable in that the meters can be quickly and easily checked without interrupting the main circuit.

The watt-hour meter described above is built by the Sangamo Electric Company, Springfield, Ill.

NEW MOLDED INSULATOR.

The Hemming Manufacturing Company, New York, after a long series of experiments by Emile Hemming, its chemist and the inventor of the well-known "Gummon" and "Hemit" molded insulating materials, is producing a new material which is held to possess great dielectric and tensile strength and all of the elasticity and resiliency of the older forms of shellac compounds, which it is designed to replace, owing to its heat-resisting qualities. This new material is called "Tegit" and, its makers claim, is not affected by temperatures up to 600 deg. Fahr., and is absolutely waterproof, not warping or cracking when subjected to climatic changes. The material, it is stated, has been successfully produced for some time and is being placed on the market only after the manufacturing process has been perfected to a point insuring a standard product.

A STEAM TURBINE FOR DRIVING MODERATE-SPEED GENERATORS.

Although the large-size steam turbine has found application for the driving of alternators and the propulsion of ships, little progress comparatively has been made in its adaptation for driving direct-current generators and for direct connection to other machinery of moderate speed, such as centrifugal pumps and blowers, or for the driving of machinery by means of ropes or belts. While suitable for these purposes because of its simplicity, small weight and space requirements and good steam economy, it is only recently that the problem of driving such machines by steam turbines has been solved. One of the great difficulties the engineers have encountered is the speed-reduction problem. This seems, however, to be satisfactorily solved in the turbine described below.

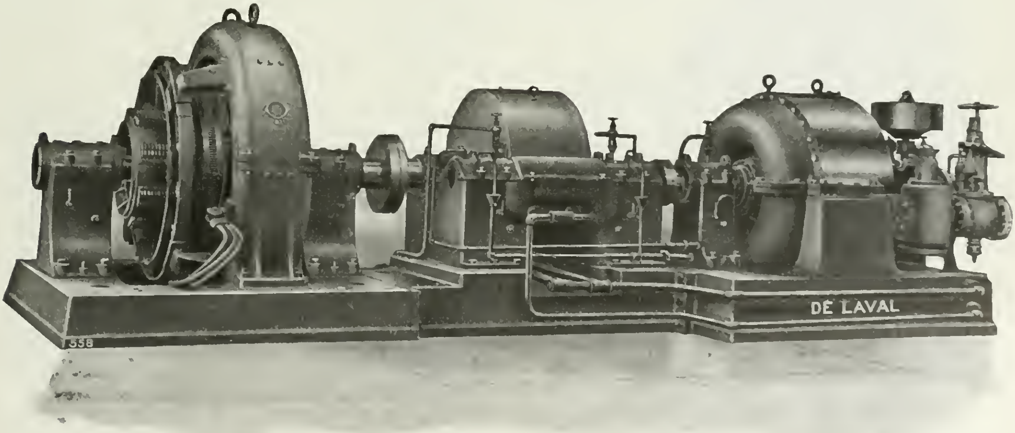


Fig. 1—Turbine Driving Direct-Current Generator.

Fig. 1 illustrates a multi-stage turbine driving a standard-speed, direct-current Crocker-Wheeler generator through a pinion and single gear, the speed at the turbine shaft being 3600 r.p.m. and the speed at the generator shaft 500 r.p.m.

The main casing of the turbine is of cast iron and is split horizontally so that the top half may be lifted off to give access to the revolving and stationary members of the turbine. The casing is supported on a level with the center of the shaft by two pedestals rising from the bedplate, one on each side, and is bolted down only at one end, being free to expand and contract in an axial direction between steel guides. As the endwise position of the shaft is also determined by a thrust bearing at the same end, the results of axial expansion are largely compensated for.

Steam is admitted to the turbine first through a strainer case and then through a combined trip and throttle valve, next through the adjacent governor valve, and then, after passing through steam nozzles of the standard De Laval type, impinges upon the blades of the first-stage wheel. The wheels are all of the standard De Laval type. Upon rebounding from the moving blades the steam again expands by passing between the guide vanes placed all around the periphery of the diaphragm between the first stage and the second stage. These blades are made of "extruded" metal and are fitted onto the cast-iron diaphragm. The diaphragm itself is slightly dished in order to increase its strength to withstand pressure, and to complete it a solid steel band is shrunk over the tips of the guide blades.

The wheels are mounted upon the shaft by split taper sleeves drawn tightly into place by internal nuts in the wheels, and after the wheels are assembled a lock nut on the shaft serves further to secure them, while rotation of the wheels about the shaft is prevented by a key.

The governing mechanism is in duplicate; that is, there is a speed-regulating governor and a speed-limiting or emergency governor. The former is mounted at the top of a vertical shaft driven by a worm gear from the turbine shaft. It is of an extra-heavy, substantial type and controls, through a system of two bell-crank levers and a connecting rod, the movement of a vertical double-seated poppet valve similar to that used on standard De Laval turbines. In order to prevent damage to the valve by overtravel of the governor, a spring is inserted in the connecting rod. The same worm which meshes with the worm wheel on the governor shaft meshes with another worm wheel driving the tachometer. The lower end of the governor shaft is connected to a pump supplying oil to the bearings of the machine and the pinion and gear.

The emergency governor is located in the end of the turbine shaft itself and is ordinarily not in contact with the trip mechanism. Upon touching the latter steam pressure is at once released from underneath a piston by means of which a toggle gear is released, allowing the combined trip and throttle valve to close under the pressure of the steam in the supply pipe. This trip may also be sprung by hand if desired, while the valve spindle is also furnished with a hand wheel and is threaded so that it may be used as a throttle valve independently of the trip.

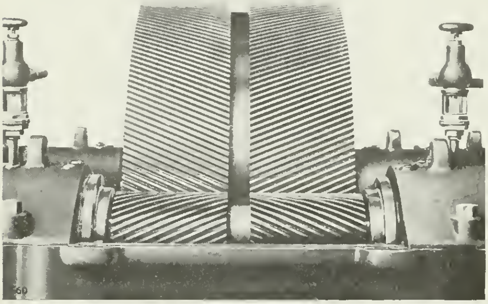


Fig. 2—Pinion and Gear.

The bearings of the turbine proper are of the split babbitt-lined type and are supplied with oil through sight-feed oilers from the pump above mentioned.

The pinion and gear, perhaps the most important and interesting part of the construction, are shown in Fig. 2. As will be noticed the gear is of the double helical or herringbone type, differing from the standard gears supplied with De Laval turbines only in size and the fact that only a single gear is used for the largest machines. The pinion is cut from a solid bar of steel and is carried in plain babbitted bearings supported in a rigid cast-iron frame, which also supports the gear bearings. The pinion bearings are lubricated by sight-feed oilers from the pump system, the excess oil overflowing to the wells of the gear bearings, which are ring-oiled. The gear consists of a solid cast-iron center upon which are shrunk two thick steel rings. The hub is mounted on a stiff shaft, which carries at one end a half of the flexible coupling for connection to the driven machine.

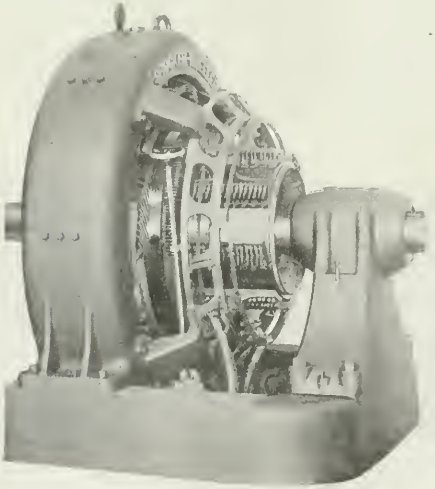


Fig. 3—Commutator End of Generator.

The lubrication of the gear and pinion teeth is accomplished by jets of oil directed at the line of contact on the entering side. This oil after use is passed through an oil strainer located in the base of the turbine, then through a cooling and settling chamber and then to the oil well, from which it is again pumped through the circuit.

The operation of the turbo-generator above described is remarkably free from vibration and noise. There is no vibration and no noise that may be overheard at a short distance. The quiet running is attributed to several causes, chief among which is a specially designed gear-cutting machine and the adequate method of lubrication employed.

As stated above, the turbine drives a standard Crocker-Wheeler 500-kw, 500-r.p.m., 250-volt generator. The generator is of the auxiliary-pole type, having eight main poles and eight commutating poles. The windings of the latter are connected in series with the armature circuit and proportioned so as to eliminate sparking through all ranges of load within the rating of the turbine. The shunt-field coils are of impregnated cotton-covered wire. The series-field coils and interpole-field coils are of solid copper bars, formed to shape and insulated from the pole, pole shoe and shunt-field coil by wooden and fiber spacing blocks. The armature coils are of heavily insulated strip copper. They are retained in the slots by wedges and are held down on the heads by band wires. The above-described turbo-generator set has recently been put on the market by the De Laval Steam Turbine Company.

SUBSTATION MACHINERY AND SWITCHBOARD EQUIPMENT OF THE ENGINEERING DEPARTMENT OF THE NATIONAL ELECTRIC LAMP ASSOCIATION.

The work of research, investigation and testing which is carried on by the engineering department of the National Electric Lamp Association makes it necessary that there shall be available a large amount of power, both direct current and alternating current. The machinery and switching apparatus required to handle this must of necessity be varied, and the manner in which some of the problems have been solved may be of interest.

The most important part of the equipment is a 300-hp, 2300-volt, 60-cycle synchronous motor running at a speed of 600 r.p.m., which is connected by a flexible coupling to a 120-volt, single-phase generator having a capacity of 1600 amp. Both the motor and the generator are self-contined units with the exciters built into the machines. The purpose of this motor-generator set is to convert the power supply from 2300 volts alternating current, as purchased from the Cleveland Electric Illuminating Company, to 120 volts alternating current for the main feeders to the lamp-test racks, and to permit the introduction of an automatic voltage regulator.

The switching and meter apparatus for this set consists of a compensator for starting the set, an oil switch for the motor, a switch for the field circuit, and meters for indicating field current, field voltage, the main-line voltage and power-factor. For the generator there are two circuit-breakers, one in each side of the line; one is connected with an over-voltage relay operated from a recording voltmeter and both open normally on currents in excess of 2000 amp. The instruments used with the generator indicate voltage, current, wattage and field current—the last being controlled by a separate field switch—and in addition to the indicating meters there is a kw-hour meter for determining the total energy consumed by the lamps on test.

For charging storage batteries and supplying direct current to lamps on the test racks there is used a 30-kw compound-wound, commutating-pole generator direct-connected to a 2300-

volt induction motor which runs at a speed of 1800 r.p.m. For light loads and to obtain 280 volts direct current (which is the highest voltage needed in commercial practice for an individual lamp) there is used a 7-kw motor-generator set consisting of a 440-volt induction motor and a 140-volt direct-current generator, which may be connected in series with the 30-kw machine when the double voltage is desired. When a high voltage is needed, as for battery charging or in case of emergency, a 2-kw booster set may be connected in series with either the 30-kw or 7-kw machine.

The switching apparatus and meters for these three motor-generator sets are as follows: for the 30-kw machine an oil-break switch and a main-line ammeter on the motor side, with ammeters for the line and the exciter, and also a voltmeter to show the voltage on the generator end. The generator field circuit is controlled by a separate switch. There are circuit-breakers for the 7-kw unit, the 2-kw booster and the 30-kw exciter, and instruments showing current and voltage for the 7-kw set and for the booster. The field-rheostat control wheels are all on the board placed directly below the circuit-breakers for the different machines—each machine having its own panel. As the lamp-test racks are fed through transformers direct from the alternator and as the life of the lamps is, of course, dependent on the voltage upon which they are burned, it is necessary that the voltage at which both alternating current and direct current are supplied shall be constant. For this purpose Tirrill regulators are used. The instrument used to control the alternator is fitted with contacts and connections for two machines, although at present only one is in use. The direct-current regulation is maintained by an instrument operating on the field of a small motor-driven exciter.

The storage batteries, which are charged from this plant and which discharge to various parts of the building through the distribution board located in this room, are made up of fourteen sets, as follows: On 140-volt circuits, two sets, 120 amp-hours; three sets, 80 amp-hours; one set, 45 amp-hours; one set, 36 amp-hours; two sets, 30 amp-hours; one set, 24 amp-hours; one set, 6 amp-hours. On 18-volt circuits, two sets, 80-amp-hours. On 14-volt circuits, one set, 24 amp-hours.

In order properly to handle the charging and discharging of these batteries there are used eleven ammeters in the charging circuit, twelve rheostats for regulating charging voltage and eleven amp-hour meters from which may be found the charge required and discharge possible from any set of batteries. The voltage of the batteries—which are located in a battery house 100 yd. away—may be ascertained by the use of a voltmeter plug. Twelve double-pole, double-throw switches are connected to the batteries through the ammeters and amp-hour meters and are used in charging and discharging. In order to obtain power at various voltages from the 120-amp-hour battery there are "end-cell" switches which allow sixteen cells to be cut out two at a time.

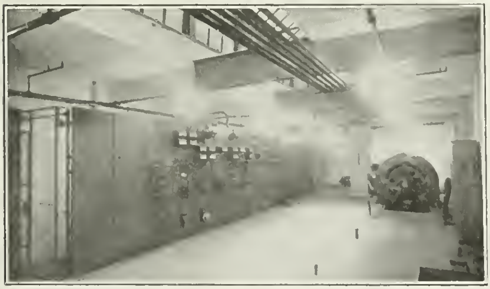


Fig. 1—View of Switchboard and Motor-Generator Sets.

In order to distribute power to the various departments of the building a very extensive plug-board system is employed. There are for this purpose 180 plug receptacles in the power-room, distributed as follows: Incoming alternating current, three pairs, 240 volts; three pairs, 120 volts; three pairs, 60 volts; three pairs, 30 volts; nine pairs, spare; three pairs, test rack room, 0-300 volts; ten pairs, 140 volts; five pairs, 120 volts, and five pairs, 80 volts. Incoming direct current, twelve pairs, 18-130 volts. Outgoing leads, eleven pairs to photometer-room, eight pairs to calibrating-room, eight pairs to research-room, two pairs to tool-room, one pair to projecting-lantern-room, one pair to blueprint-room and three pairs to physical research laboratory.

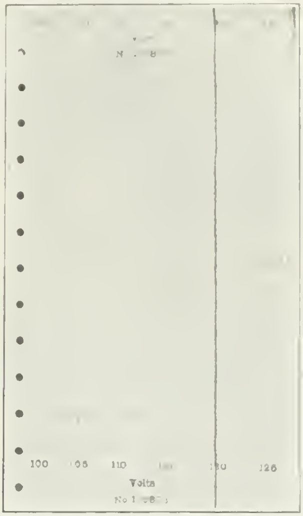


Fig. 2—Characteristic Section of Recording Volt-Meter.

As there are a number of intercommunicating lines between the plugboads in the various departments, it is possible, in case of necessity, to supply power to one room through more lines than there are leads to that room from the power-room. The great flexibility of this system and the possibility of using the same leads for a number of kinds of service renders it inexpensive and yet also very satisfactory.

TRANSFORMER-PRINCIPLE ELECTRIC HEATING APPARATUS.

In a new line of electric-heating apparatus devised by Mr. W. K. Freudenberger, of McGill, Nev., the resistance-wire heating element is replaced by a solid piece of plate brass in which large secondary eddy currents are set up by transformer action from a primary winding and core. The brass plate, stamped in the form required, usually annular or rectangular, is quite indestructible under conditions of ordinary use. In applying the transformer principle the body of the appliance is made of iron or steel and constitutes the magnetic circuit of the transformer. The primary coil is placed in a protected position, separated from the secondary ring, which is the heating element, and may be wound with enameled or asbestos-covered copper wire, designed for the ordinary service voltage. The iron or steel body may be a solid casting, stamping or punching, because the usual hysteresis and eddy-current losses are not losses in this case, but are entirely converted into useful heat.

The principle is clearly shown in the sectional sketch of a melting pot for melting solder, babbitt metal, glue, wax, lead and other materials, and for heating soldering irons placed in melted solder or other metal. (Fig. 1.)

The heating element is very thin, has a large surface in immediate contact with the bottom of the metal pot and requires no insulation, so that the heat is rapidly communicated to the part to be heated. A high efficiency is thus obtained because there is less chance for lateral radiation. On account of the extremely low potential developed in the secondary or heating element it is not short-circuited by being placed in contact with the metal pot.

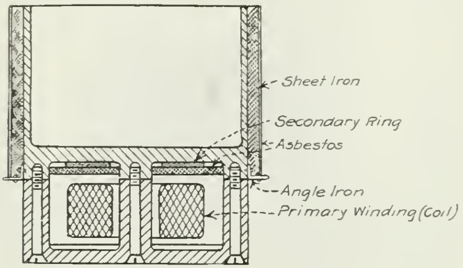


Fig. 1—Section of Melting Pot.

Ample thermal insulation is placed beneath the heating element, and around the pot, to retain the heat and thus increase the efficiency of the apparatus. In large sizes flanges are cast at the junction of the pot and base and these parts are bolted together through the flanges instead of by using long tap bolts through the base.

Fig. 2 shows how the principle is applied to an iron. From this it is clearly seen how very near the center of the heat element is the surface of application of the heat. The electric stove is made generally similar to the iron, except that it is virtually turned bottom up and set on legs. The same principle is utilized in immersion heaters, curling-iron heaters, coffee percolators and other apparatus. On account of the heat elements being practically indestructible very high temperatures may be used when desirable and quick work may be done. A patent has recently been applied for by Mr. Freudenberger on the principle involved in this innovation in electric-heating appliances.

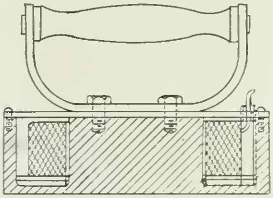


Fig. 2—Section of Flatiron.

DEVELOPMENT IN CURVE-DRAWING ELECTRIC METERS.

By H. S. Baker.

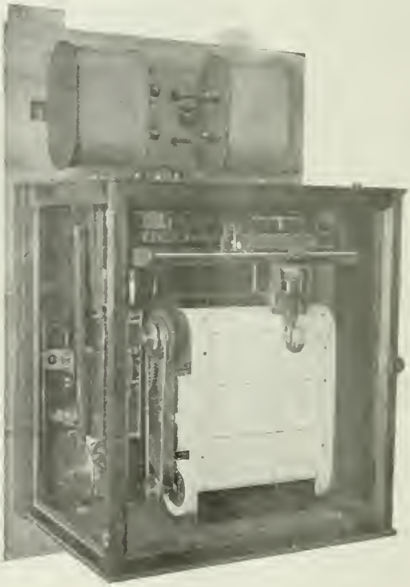
A form of relay type of curve-drawing meter has been developed by the writer, which forms a combination novel in this type of meters.

The principal feature is the combination of a Kelvin balance type of meter element with a moving weight instead of a restraining spring. Practically all previous types of switchboard instruments balance electromagnetic forces against the resilience of springs, and the permanency of those meters is dependent on the permanency of the springs, which are subject to aging, setting and to varying elasticity with temperature variations.

The adaptation of the moving-weight principle to the curve-drawing meter has been very satisfactorily worked out, and the result is a meter more permanent in calibration and zero registration than is the case in some forms of curve-drawing meters. A test under actual operating conditions of several months' duration has warranted the above statement.

As in other relay-type instruments, the measuring element operates electrical contacts which close circuits that energize solenoids, which in turn operate the pen. After the electrical force to be measured has been applied the balance of the "zero-reading" meter element is automatically re-established by the movement of a weight which travels on an arm attached to the meter element.

The movement of the traveling weight is accomplished by a specially designed drag link, which constrains the weight to follow the motions of the pen. The drag link does not in any way apply mechanical force to the meter element, which might cause error in the accuracy of its reactions.



Gravity Watt-Balance.

The moving-weight principle produces an inherently uniform scale on wattmeters of this type, and when any two points in the scale are correct then all points are correct. Three checks were made upon one of these wattmeters at considerable intervals of time, and the greatest error as read, either in proportionality of scale or in permanency of registration, was 1/7 of 1 per cent of full-scale reading.

The absence of restraining spring and the improved design of knife edges render this instrument sensitive to variations of power of 1/10 of 1 per cent of full-scale reading.

The design of the pen-operating solenoids has been developed so as to reduce to a minimum the amount of power broken at the relay contacts; and, being ironclad, the solenoids are very perfectly protected from affecting the meter element by stray fields. Up to the present time there has been absolutely no contact trouble experienced, and this result is attributed to the small quantity of energy at the breaking contacts.

The instrument embodies many minor features of design of which the need has been felt during the four years' experience of the Ontario Power Company, of Niagara Falls, with previous forms of relay-type graphic meters.

The new meter goes by the trade name of the Baker Gravity Watt Balance, and is placed on the market by Messrs. E. Staebler and F. G. Baker, of Kingston, Can.

Industrial and Commercial News

The Week in Trade.

Reports from commercial centers show that there is very little change in the situation which has existed in trade for the last six weeks. Buyers are still extremely conservative, and the orders are small in volume and merely for filling-in purposes. House trade has been to some extent stimulated by liberal cuts that have been made in textiles. Reports from salesmen on the road are only fair, and wholesalers and jobbers complain that what business they are doing at the present time is transacted upon such small margins that profits are far below those of average years. This disappointing situation is offset to a considerable extent by the good crop reports, which indicate that winter wheat is in fine shape and that other crops are progressing satisfactorily. The season has been somewhat late, owing to continued cold weather, but there is every prospect that the acreage, both for cereals and for cotton, will be considerably greater than that of last year. Retail trade has not improved with the progress of the season. In the iron and steel industry mill operations and specifications are reported as satisfactory, although the new business booked for March was not on a par with that done in February. Mills were more actively employed during the past month than they will be, propably, in April. Apparently a good lot of small business is being transacted in structural material, and considerable tonnage is anticipated in connection with the proposed railroad bridge over the East River between Brooklyn and the Bronx. Orders for steel rails are of moderate volume, and equipment orders are very light. Railroads are buying sparingly, and car purchases for the most part are simply to fill in missing numbers. The wire mills are still busy, and there is an active demand for tin plate. In fact, these two branches of the industry are the only ones which have shown any activity, and are the only ones in which no price shading has been reported. Taken as a whole, the reports show that the iron and steel mills of this country are not nearly so busy as those of Canada. Collections continue to be reported only fair. Business failures for the week which ended March 30, as reported by *Bradstreet's,* were 260 as against 235 the previous week, 232 in the same week of 1910, 204 in 1909, 247 in 1908 and 137 in 1907.

The Copper Market.

Wire-drawers were not quite so anxious to buy copper last week as they were earlier in the month and consequently fewer domestic sales were made. Since the first of the year the demand for bare copper wire has been active and prices have readjusted themselves to the bettered conditions. This has given more stability to the market for electrolytic copper and has discouraged price concessions on the part of the independents. One sale that was reported last week was that of 4,000,000 lb. of electrolytic wire bars, thirty days delivery, at 12¼ cents. The record of the copper market for March has turned out more satisfactory than was at first expected. Exports for the last week of the month were 6522 tons, bringing the exports for the month up to 23,300 tons, or about 52,000,000 lb. The domestic takings are figured to be in the neighborhood of 60,000,000 lb., so that the total deliveries for the month will probably amount to 115,000,000 lb. It is predicted that the production for the month will be about 120,000,000 lb., and if this is correct the increase in the surplus stocks for the month will amount to only about 800,000 lb., which is far less than was anticipated. The major portion of this accumulation will be carried by the Amalgamated interests, as the independents never hesitated to shade prices in order to consummate sales. In Europe there was also a fair volume of business, but as the market was open to very much sharper competition than in this country prices were not so well sustained. It is believed that when the Amalgamated company takes charge of its own selling through the agency of the United Metals Selling Company our market will also become more competitive than at present, and that the big companies will get their full share of business. Imports continue to be heavy. For March they were 12,000 tons. The daily call on the Metal Exchange April 3 quoted standard copper as per accompanying table:

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.70	11.85	.....
March	11.70	11.85	11.77½
April	11.70	11.85	11.77½
May	11.70	11.85	11.77½
June	11.70	11.85	11.77½

The London market, April 3, was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	54	13	9	54	8	9
Standard copper, futures	55	3	9	55	1	3
	Highest.			Lowest.		
Standard	12.30c			11.77½c		
London, spot	£56	15	0	£53	15	0
London, futures	57	12	6	54	10	0
Best selected	60	5	0	58	0	0

Industrial and Commercial Notes.

Heavy Order for Oil-Well Motors.—The Westinghouse Electric & Manufacturing Company has recently received an order from the Kern River Oilfields of California, Ltd., calling for the largest number of oil-well motors ever placed in that territory at one time. The order is for early delivery and calls for 100 motors, which will be used for pumping and cleaning the great number of oil wells on the properties of the above company. The motor adopted is of the back-geared type and a pulley on the countershaft drives the main belt. The motors are of the alternating-current variable-speed, continuous-service induction type and will operate on a three-phase, 60-cycle, 440-volt circuit. The motor windings are so arranged that by the simple operation of the switch handle two economical working capacities are obtained. The motors will operate continuously at 10-hp output with high efficiency on pumping service. For cleaning wells they will easily develop 30 hp on intermittent service. For oil-well service this double feature makes this type of motor especially suitable. The results obtained in the way of economy of operation, both as to consumption of power and to cost of maintenance and attendance, as compared with gas and steam operation, will prove of great interest to operators in the oil fields.

Eleventh Avenue Electrification.—Reginald P. Bolton, an engineer, has submitted to the Public Service Commission of the First District of New York an estimate of the cost of electrification of the New York Central Railroad's tracks from Spuyten Duyvil along the Hudson River to Fiftieth Street. Mr. Bolton says that this work can be done for $2,211,017. Mr. Bolton was a witness for George L. Wilson in his action before Commissioner Eustis upon a complaint that the noise and smoke of the steam locomotives so close to Riverside Park was a public nuisance. Mr. Bolton submitted detailed figures of the cost of the electrification. He estimated that the cost of the trackage would be $387,000; transmission and distribution, $250,000; substations and batteries, $679,000, and rolling stock, $573,000. To this he added 20 per cent for engineering and superintendence on the first three items, and 10 per cent on the rolling stock.

A 10,000-kw Waterwheel-Driven Generator.—The greater efficiency, reduction of losses and compactness of the power station gained by the use of large electric generating units have led to the installation of machines of unusual capacity in some of the great power stations. The General Electric Company recently shipped the Pennsylvania Water & Power Company, McCall Ferry, Pa., a three-phase, 10,000-kw, 11,000-volt waterwheel-driven alternator designed to operate at a speed of 94 r.p.m. The shipping weight of this unit was approximately 700,000 lb. and fifteen cars were required for its transportation. It is 27 ft. in diameter and 10½ ft. high. A duplicate is now being shipped. Three 7500-kw generators of the same type, also of General Electric manufacture, are now in service in this plant.

New Stone & Webster Property.—Stone & Webster, of Boston, have perfected plans for the construction of an interurban railway line between Dallas and Waxahachie, Tex., a distance of about thirty miles. Engineers are now in the field and construction work will begin in a few weeks. The line will enter Dallas over the tracks of the Northern Texas Traction Company.

Pacific Power & Light Company.—The Pacific Power & Light Company, of Portland, Ore., operating plants at Walla Walla, North Yakima and The Dalles, has purchased the Hood River Power & Light Company, Hood River, Ore., and the Husum Power Company, on the White Salmon River, Wash. These will form part of the supply for the 250-mile transmission system which the purchasers plan to extend along the Columbia River. The Hood River company was capitalized at $1,000,000, and its bond issue was $76,500. The Husum company was capitalized at $15,000. The equipment of the Hood River plant will be increased from 2500 hp to 3000 hp, and a concrete dam will be built with a view to enlarging the output of the White Salmon plant, which is now rated at 200 hp. The properties will be connected by a cable across the Columbia River. Material has already been ordered for a high-tension line between Hood River and The Dalles, which will bring Hood River, Mosier, White Salmon and The Dalles on one circuit. A high-tension line 121 miles long, to be built this summer from The Dalles to Umatilla, will cross the Columbia to Luzon, extend up the Columbia to Kennewick, meeting the new transmission line now completed from Walla Walla to Kennewick, and from Kennewick will advance to Priest Rapids, in this way connecting all the properties and furnishing sufficient energy for industrial, lighting and irrigation service.

Hudson River Power Companies.—The three receivers of the eight affiliated Hudson River Power Companies which have been in the throes of bankruptcy for the past two and a half years have just made a report of the present condition of the properties. It was the attempt to finance these companies that forced the assignment of E. H. Gay & Company, the Boston banking firm. The report says that the companies are being gradually reorganized, and the figures presented show that, in spite of an unusually dry season last year, the companies were operated at considerably less loss than in 1909. The total income of the companies for the year was $250,072, and the deficit after paying the bond interest was $79,731. The deficit in 1909 was $106,766. The report says that by reason of the low water in the reservoirs last summer it was necessary to spend $45,626 in the purchase of 4,976,501 kw-hours of energy mostly from the Delaware & Hudson. It is also stated that, subject to the approval of the court, an arrangement has been closed with the General Electric Company for the interchange of spare energy when needed, as well as for the settlement of the litigation between the parties. Efforts are now being made to secure legislation providing for the construction by New York State of an immense dam at Sacandaga which will give a constant flow of water to the Hudson River power properties.

Canadian General Electric Company.—The annual report for 1910 of the Canadian General Electric Company, Ltd., which was given out last week, shows net earnings of $911,208, an increase over the previous year of $285,218. After charging $188,088 to depreciation and paying interest amounting to $76,820, the company had a balance available for dividends of $646,300. The report says in relation to the present condition of the company: "Business contracted for during the year was satisfactory, both with regard to volume and price. The unfinished business, upon which no profit whatever has been taken into account, is carried forward to the current year to the value of $4,000,000, and orders are still being received in satisfactory volume. During the year there has been under construction an extensive addition to the machine shop at the Peterborough works. It is expected that this extension will be completed and fully equipped by May 1. This will very materially increase the company's output. In order that the structural steel department may increase its capacity, the company has leased the lands and plant of the Canadian Shipbuilding Company, near Bridgeburg, Ont. While the transaction is in the nature of a lease it has been acquired in the same way as the company acquired its hydroelectric power plant at Nassau some years ago, that is to say, the capital sum of $250,000 will be extinguished by twenty annual payments of principal and interest, so that at the end of twenty years the property will come into the absolute possession of the company without further charge."

Otto Gas Engine Works.—Mr. Frank Salomon has become president and taken entire charge of the management of the Otto Gas Engine Works. Under his administration the entire works and offices have been reorganized and put on a twentieth-century basis. The result has already been increased manufacturing facilities and greater output at less expense, enabling a reduction to be made in the selling cost of the engine, while retaining its high standard of excellence. Mr. Salomon is now turning his attention to the selling organization, and in addition to the branch offices in Chicago, Boston, New York, Pittsburgh, Omaha, Kansas City, Minneapolis and San Francisco he is planning agencies to cover every square mile of territory throughout the country. An extensive campaign of advertising is rapidly maturing, and it is safe to predict that the Otto products will enjoy a wider sale than ever before.

Electric Locomotive for Salt Lake & Ogden.—H. A. Strauss, of Chicago, consulting engineer for the Salt Lake & Ogden Railway Company, has placed an order with the McGuire-Cummings Manufacturing Company, of Chicago, for a 30-ton electric locomotive to handle heavy freight equipment. This is the first of a series of such locomotives which will be placed in operation on this line. The equipment will consist of four 100-hp, 700-volt direct-current General Electric interpole motors, with forced ventilation, with double-end multiple-unit control and Westinghouse combined straight and automatic air brakes. The machine is designed to handle 400 tons trailing load at seventeen and one-half miles per hour. The locomotive proper, including trucks, will be of all-steel construction.

Electric Service Supplies Company.—Contracts for Garton-Daniels lightning arresters have recently been closed by the Electric Service Supplies Company with the Rockford (Ill.) & Interurban Railway Company; St. Joseph (Mo.) Railway, Light, Heat & Power Company; Chicago Railways Company; Birmingham (Ala.) Railway, Light & Power Company; Stark Electric Railroad Company, Alliance, Ohio, and many others. There is a growing tendency of late for operators to purchase lightning protective apparatus early in the season, many even going so far as to purchase arresters in the late fall for use the coming spring.

Electric Pumps for Chicago Water-Works.—The Burke Electric Company, of Erie, Pa., will supply the motors for driving the electric pumps in the West Side pumping station, Chicago, the contract for which has been awarded to the Platt Iron Works Company, of Dayton, Ohio, as mentioned in the *Electrical World* of March 23, page 748. There are to be two centrifugal pumps, each capable of delivering 25,000,000 gal. in twenty-four hours under a total head of 115 ft. They will be direct-connected to two 440-volt, three-phase, 60-cycle synchronous motors rated at 800 kva (1000 hp) each.

Canadian Light & Power Company.—It is reported in Montreal that Canadian Light & Power interests are identified with D. L. McGibbon in his recent purchase of the hydroelectric properties at Cedar Rapids. It is also said that the company is negotiating for other valuable water-power properties in the neighborhood of Montreal. If the plans now formed are carried out the company will have one of the most extensive power propositions in Quebec Province and will become a competitor of the Montreal Light, Heat & Power Company and the Shawinigan Power Company.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Moberly, Mo.; Radford, Va.; Bakersfield, Cal.; Portland, Ore.; Bolton, Miss.; Walker, Ia.; Simpsonville, Ky.; Francesville, Ind.; Fraser, Ia.; Washington, D. C.; Vermilion, S. D.; Anita, Ia.; Winnipeg, Man., Can.; Puebla, Mex.; Port Orchard, Wash.; Ogden, Utah; New York, N. Y., and Carson, Nev.

H. M. Byllesby & Company.—H. M. Byllesby & Company, of Chicago, who operate central stations in various sections of the United States, have just placed an order with the General Electric Company for 5004 electric irons for distribution in the domestic appliance departments of their numerous companies.

Automatic Telephone Service.—President Harris, of the Subway Telephone Construction Company, says that the automatic telephone now has 37,000 subscribers. It was expected that the number of subscribers would reach only 30,000 by April 1.

General Electric Car Equipment Sales.—The Utica & Mohawk Valley Railway Company has purchased from the General Electric Company eight quadruple car equipments for its city service and four quadruple equipments for its interurban service.

Financial.

The Week in Wall Street.

SLUGGISHNESS which has characterized Wall Street trading for the past few months experienced no perceptible variation during the week. The constant repetition of the opinion that no activity can develop until the trust cases are disposed of has practically made this a general belief, as is evidenced by the secondary interest shown in the extra session of Congress, with prospective tariff legislation. To a certain degree this attitude is not unreasonable, since it is felt by many that any changes in the tariff schedules will not, in the main, be disadvantageous, and that reciprocity with Canada will be a benefit. During the week 1,338,224 shares were sold, representing only a fractional increase over the transactions of the previous week, with only slight variations in the majority of prices, indicating that the average day's trading is about as quiet as experienced in the history of the Exchange. As far as the general public is concerned, there seems to be but little interest in Wall Street at the present time for speculative purposes, the majority preferring to seek conservative returns upon investment, as is borne out by the strong tone of the bond market. Ending the first quarter of 1911, the past week has shown little, if any, encouragement for the immediate future. The steel industry in general is believed to be writing business at approximately 60 per cent of capacity. As an indication of the dullness in financial circles it is of interest that municipal bond sales are reported as close to $30,000,000 less for the month than for March, 1910, while there has been a decided falling off in the capitalization of new incorporations. Although it is held in some quarters that conditions do not warrant a hopeful attitude toward improvement, in many cases the opinion is offered that the entire country is slowly recovering from the panic of 1907, that confidence is gradually increasing, and that a period of readjustment to sound business principles will follow the Supreme Court decisions almost irrespective of the trend of the rulings, and that, with a slight impetus, a fair degree of foreign capital should favor the purchase of American securities. Crop indications are reported excellent from all sources, and the money market is in an easy condition. Rates April 3 were: Call, 2@2¾ per cent; 90 days, 2¾@3 per cent. The quotations in the table are those of the close, April 3.

NEW YORK.

	Mar. 27.	April 3.	Shares Sold.		Mar. 27.	April 3.	Shares Sold.
All. Ch......	8*	8*	———	Int. Met., pf	53½	53	2,900
All. Ch., pf..	32½	30¼	600	Mackay Cos.	93½*	93½	350
Amal. Cop...	63¾	62⅞	16,300	Mackay C. pf.	76¼	77*	1,000
Am. D. T...	20½*	20½*	———	Man. Elev...	137*	136½	860
Am. Loco...	38½	37¼	630	Met. St. Ry.	15*	15*	———
Am. Loco. pf.	106½*	108	210	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	81*	81*	———	Steel, com...	78⅞	78	210,200
Am. T. & T..	147	144⅞	9,584	Steel, pfd..	119¼	119	3,460
B. R. T....	78⅝	77¾	7,925	W. U. T....	73	73½*	5,275
Gen. Elec...	148½*	148	800	West'h, com.	66½	66½*	1,600
Int. Met....	18¾	18⅝	2,000	West'h, pfd..	120½*	120¼	340

PHILADELPHIA.

	Mar. 27.	April 3.		Mar. 27.	April 3.
Am. Rys	44	43⅞	Phila. Elec........	16⅛	16¼
Elec. Co. of A.....	12*	12	Phila. R. T.......	19¾	19½
Elec. St. B'ty......	54¼*	53½	Phila. Trac.........	84⅛	84
Elec. St. B'ty., pfd..	30*	30*	Union Trac.........	47⅜	46⅞

CHICAGO.

	Mar. 27.	April 3.		Mar. 27.	April 3.
Chi. City Ry.......	185*	185*	Chi. Tel. Co........	124	121*
Chi. Rs., Ser. 1....	91½*	90*	Met. El. Co........	23¾	22⅞*
Chi. Rs., Ser. 2....	24¼*	24	Met. El., pfd.......	69*	69½*
Com. Edison.......	127⅞	128¼	Nat'l Car...........	120	119*
Chi. Subways.......	4½	4⅜	Nat'l Car, pfd......	120*	119*

BOSTON.

	Mar. 27.	April 3.		Mar. 27.	April 3.
Am. T. & T.......	147	144¾	Mex. Tel...........	3½*	3⅝*
Cum. Tel..........	150*	147*	Mex. Tel., pfd......	6½	6½*
Edison E., Ill......	286	282	N. E. Tel...........	144	144½*
Gen. Elec..........	148¾*	148¾	W. T. & T.........	20*	20
Mass. E. Ry.......	17½*	17½*	W. T. & T., pfd...	93½*	93½
Mass. E. Ry., pfd..	87½	87¾*			

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*Last price quoted.

Shares sold for week, March 27 to April 1.

Financial Notes.

Western United Gas & Electric Company.—Six per cent gold debentures of the Western United Gas & Electric Company, of Aurora, Ill., to the amount of $600,000, are offered for sale by the company's bankers. These debentures represent a short-time loan, being dated Feb. 1, 1911, and redeemable serially up to Feb. 1, 1918. The company's principal business relates to the distribution of gas, but it also supplies electrical energy in Aurora, Wheaton, Glen Ellyn and Montgomery. The company has $1,500,000 of preferred stock authorized and outstanding and $5,000,000 authorized common stock, of which $3,000,000 is outstanding. It is authorized to issue $5,000,000 in bonds, and of these $3,885,000 are outstanding. For the year ended Jan. 31, 1911, its gross earnings were $1,230,273, and operating expenses and taxes $775,344, leaving a net income of $455,029. The interest on outstanding bonds was $178,950, leaving a net surplus of $276,079. I. C. Copley, of Aurora, is president of the company, and the majority of the capital stock is owned by the management and local capitalists in Aurora and Joliet. The American Gas Company, of Philadelphia, is also a large stockholder. A modern steam-turbine electric generating station of 2200-kw rating is located in Aurora. Gas-making plants are maintained at Joilet, Aurora, Elgin and La Grange. Connected with the company's distributing mains are 33,658 gas meters and 2182 electric meters. The present issue of debentures is offered par and accrued interest.

Great Western Power Company.—Negotiations have been concluded by the Great Western Power Company for the purchase of the plant of the City Electric Company, San Francisco. The rating of the plant is approximately 22,500 kw. A ninety-day option at $150,000 was taken by the Great Western Company and has now been closed. An investigation of the property will be made, and if found satisfactory a first payment of 20 per cent of the purchase price of $4,000,000 will be made, to be followed by further payments of 20 per cent at intervals of three, six and nine months. The outstanding capital stock of the City company is $5,000,000.

Northern New York Telephone Merger.—The merger of the Bell and Independent telephone interests in Rochester and the territory east to Syracuse is still being held up owing to the inability of the Friendship Telephone Company, representing the New York Telephone Company, to purchase the stock of the Rochester Telephone Company, which is an independent concern. As stated in our last issue, Independent interests in Buffalo own a considerable portion of the stock of the Rochester company and are trying to prevent a sale to the Bell interests, which would isolate the Independent company in that city.

Municipal Light & Power Company, San Francisco.—Articles have been filed in San Francisco for the incorporation of the Municipal Light & Power Company, with $1,000,000 capital stock. The directors of the new company were named as: P. S. Scales, San Mateo; J. H. Sandford and Rudolph Spreckels, San Francisco; Frank Harrold, Fruitvale, Cal., and Claus A. Spreckels, New York. It is believed that the new company is in the nature of a reorganization of the Municipal Light & Power Company, which existed for several years as a part of the Spreckels estate.

Long Island Lighting Company.—A petition has been presented to the Public Service Commission of the Second District, signed by the Amityville Electric Light Company, the Northport Electric Light Company and the Islip Electric Light Company, asking for authority to merge into the Long Island Lighting Company, with a capital stock of $300,000 and an authorized bond issue of $6,000,000 5 per cent bonds, of which $370,000 would be issued at the present time. The two companies first named are now operating concerns.

Washington & Rockville Railway Company.—The United States Circuit Court at Baltimore has appointed George W. Williams receiver for the Washington & Rockville Railway Company, a line eleven and a half miles long, from the capital to Rockville, Md. The receiver was appointed upon the application of the Washington Railway & Electric Company, which holds the bonds of the smaller company.

Bell Telephone Company of Canada Bonds.—Lee, Higginson & Company, who recently purchased an issue of $1,250,000 5 per cent bonds of the Bell Telephone Company of Canada, announce that the offerings of these securities in Montreal and London were more than two and a half times over-subscribed. The bonds were offered at 102 and interest. No offering was made in the United States.

Shore Lighting Company.—The Board of Public Utilities of New Jersey has approved the proposed merger of the Shore Electric Company, of Red Bank; the Seabright Electric Company and the Citizens' Light & Fuel Company, of South Amboy, into the Shore Lighting Company. The new company will be authorized to issue $400,000 5 per cent bonds.

Proposed Merger of Elevated Roads in Chicago.—The proposed merger of the four elevated railroad companies in Chicago is still hanging fire, although Henry A. Blair and other men interested in the project hope that it will go through. It is said that the financing of the project will involve the provision of more than $40,000,000.

Cumberland Telephone & Telegraph Company.—A circular has recently been issued by a brokerage firm in Nashville, Tenn., showing the wonderful growth of the Cumberland Telephone & Telegraph Company during the past fourteen years. The net earnings for the year 1910 were $2,407,268, an increase of $250,000 over the previous year, and the company's surplus at the end of the year amounted to $6,844,409. At the beginning of the present year the company operated 554 exchanges and served 218,557 subscribers. Speaking of the value of the Cumberland company's stock as an investment, the circular says: "Of all the subsidiary companies of the American Telephone & Telegraph Company there are none better than the Cumberland, for the reason that it covers one of the largest and most profitable territories, an area of over 175,000 square miles with practically no competition; and, as already stated, over 90 per cent of its franchises are perpetual and unrestricted. The net earnings average 12 per cent the year round. It is for these reasons that the stock of the Cumberland sells higher than its parent company."

Northern Ohio Traction & Light Company.—W. E. Hutton & Company, of New York, are offering $1,000,000 preferred stock of the Northern Ohio Traction & Light Company at 97½, yielding 6.15 per cent per annum. The proceeds will be used for the construction of a combined steam and hydraulic power station to supply energy to Akron, Ohio, and to take care of the increasing demand for motor service in the other sections served by the company. The Northern Ohio Traction & Light Company system comprises 215 miles of street railway operating in the cities of Akron, Canton and Massillon, connecting these cities, and extending to Cleveland, Barberton, Ravenna, Kent, New Philadelphia, Canal Dover and Dennison, and the electric lighting systems in Akron and Barberton, serving a population outside of Cleveland of 190,000.

Baltimore Public Utilities.—It is reported in Baltimore that shares of the United Railways & Electric Company are being accumulated in the interest of James E. Aldred, the president of the Pennsylvania Water & Power Company and the Consolidated Gas, Electric Light & Power Company. It is reported that Mr. Aldred and his associates are buying in United in order to further the merger of the power companies controlled by Mr. Aldred and the United company, thus bringing under one control the public-utility companies of Baltimore with the exception of the Washington, Baltimore & Annapolis Electric Railroad and the telephone company. The report has created a fresh outburst of activity in United Railway & Electric Company common stock.

Great Falls Power Company.—The Guaranty Trust Company, of New York, has purchased $4,000,000 thirty-year 5 per cent bonds of the Great Falls Power Company, of Montana. The company has a hydroelectric development at Great Falls, on the upper Missouri River, of about 47,000 hp capacity, and has transmission lines to Butte and Anaconda. The company also owns undeveloped water-power properties capable of generating 100,000 hp. The company expects eventually to have sufficient demand from the railroads crossing the Rocky Mountains for all the energy it can produce. It is claimed that the company can produce energy at a lower cost than any other plant in the country. John D. Ryan organized and controls the company.

American Telephone & Telegraph Meeting.—At the annual meeting of the American Telephone & Telegraph Company the old board of directors was re-elected, including Lewis C. Ledyard and Norman W. Harris, who were elected during the year, succeeding G. L. Green and G. W. Persen, retired. The retiring officers were also re-elected. At the meeting 1,448,028 shares were voted. President Vail stated that business for the present year was up to the level of a year ago, and that the outlook is very promising for about the same percentage of increase in 1911 over 1910 as was shown in 1910 over the previous year.

Fonda, Johnstown & Gloversville.—Ladenburg, Thalmann & Company and A. B. Leach & Company, of New York, have purchased the balance of the 4½ per cent bonds of the Fonda, Johnstown & Gloversville Railroad Company. These bonds were recently authorized by the Public Service Commission of the Second District of New York and are tax-exempt in the State of New York. The report of the company for 1910 shows an increase in net earnings of almost 50 per cent over the preceding year. The company is paying 6 per cent upon its preferred stock and 2 per cent on its common.

Canadian Westinghouse Company.—The net earnings of the Canadian Westinghouse Company for the year ended Dec. 31, 1910 were $697,393. A dividend of 7 per cent was paid on $4,376,600, the capital stock outstanding, and the total reserve at the end of the year was $1,176,000. This is a decided betterment over the previous year, over 40 per cent more business being done in 1910 than in 1909. The retiring directors and officers were all re-elected, including George Westinghouse as president and Paul J. Myler as vice-president and treasurer, while F. A. Merrick was elected general manager.

New York Electrical Companies.—The statistician of the Public Service Commission of the First District of New York has just issued the operating figures of the New York Edison Company and the Edison Electric Illuminating Company of Brooklyn for the year 1910. These show that the net corporate income available for dividends of the New York Edison Company was $5,821,346, an increase of $1,101,538 over 1909, and for the Brooklyn company was $38,245. The detailed figures are given in another column of this issue.

Public Service Corporation of New Jersey Dividend.—The Public Service Corporation of New Jersey has declared a dividend of 1½ per cent, which places the stock on a 6 per cent basis, an annual increase of 1 per cent over the former rate.

DIVIDENDS.

Associated Gas & Electric Company, quarterly, preferred, 1½ per cent, payable April 15.

Boston Suburban Electric Companies, quarterly, preferred, $1 per share, payable April 15.

Cincinnati, Newport & Irvington Light & Traction Company, quarterly, preferred and common, 1⅛ per cent, payable April 15.

Commonwealth Gas & Electric Companies, quarterly, preferred, 1¼ per cent, payable April 15.

Dallas Electric Corporation, semi-annual, first preferred, 3 per cent; second preferred, 2 per cent; payable April 10.

Electrical Utilities Corporation, quarterly, 1¼ per cent, payable April 15.

Fort Smith Light & Traction Company (Ark.), quarterly, preferred, 1¾ per cent, payable April 15.

Marlborough Electric Company (Mass.), quarterly, 2½ per cent, payable April 15.

Milwaukee Electric Railway & Light Company, quarterly, preferred, 1½ per cent, payable May 1.

Northern States Power Company, quarterly, preferred, 1¾ per cent, payable April 15.

Oklahoma Gas & Electric Company, Oklahoma City, quarterly, preferred, 1¾ per cent, payable April 15.

Ottumwa Railroad & Light Company (Ia.), quarterly, preferred, 1¾ per cent, payable April 15.

San Diego Consolidated Gas & Electric Company, quarterly, preferred, 1¾ per cent, payable April 15.

United Gas Improvement Company, quarterly, 2 per cent, payable April 15.

REPORTS OF EARNINGS.

Period.	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
AMERICAN CITIES RAILWAY & LIGHT COMPANY.					
Year, 1910......	$893,185	$40,967	$852,217	......	$7,407
Year, 1909......	714,244	28,082	686,162	......	2,769
BELL TELEPHONE COMPANY OF MISSOURI.					
Year, 1910......	$2,068,245	$1,491,719	$576,526	......	......
Year. 1909......	1,984,156	1,273,586	710,570	......	......
KEYSTONE TELEPHONE COMPANY OF PHILADELPHIA.					
Feb., 1911.......	$94,484	$46,658	$47,826	$24,267	$23,559
Feb., 1910.......	95,194	49.347	45,847	25,702	20,145
LAKE SHORE ELECTRIC RAILWAY COMPANY.					
Feb., 1911.......	$76,258	$48,131	$28,126	$34,782	*$6,655
Feb., 1910.......	70,876	47,275	23,600	34,847	*11,246
MONTREAL STREET RAILWAY COMPANY.					
Feb., 1911.......	$330,737	$227,604	$103,133	$41,974	$61,159
Feb., 1910.......	303,977	204,255	99,722	39,875	59,846
NEW YORK EDISON COMPANY.					
Year, 1910......	$18,051,106	$10,685,241	$8,516.374	$2,695,060	$5,821,346
Year, 1909......	16,553,257	9,810.555	7,746,732	3,026.925	4,719,807
NORTHERN OHIO TRACTION & LIGHT COMPANY.					
Feb., 1911.......	$172,413	$104,868	$67,544	$44,357	$23,187
Feb., 1910.......	146,206	92.513	53,693	43,291	10,401
SYRACUSE RAPID TRANSIT RAILWAY COMPANY.					
Qr., Dec., 1910..	$400,036	$266,749	$133,287	$90,152	$37,162
Qr., Dec., 1000..	368,013	268,410	99,604	95,489	4,115
TRI-CITY RAILWAY & LIGHT COMPANY.					
Year, 1910.......	$2,513,487	$1,481,967	$1,031,520	$481,408	$550,112
Year, 1909.......	2,039,488	1.140.907	898,581	472,388	426,193
UNITED RAILWAYS OF ST. LOUIS.					
Feb., 1911.......	$863,990	$607,242	$260,039	$230,689	$29,350
Feb., 1910......	804,314	587,168	220.271	233,113	12,842
UNITED RAILROADS OF SAN FRANCISCO.					
Feb., 1911.......	$577,582	$343,775	$233,807	......	......
Feb., 1910.......	570,983	343,879	227,104	......	......

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*Deficit.

General News

Construction News.

DECATUR, ALA.—The City Council is reported to be contemplating the construction of an electric light plant.

CUMMINS, ARK.—The installation of an electric light plant with sufficient output to supply electricity for 200 lamps at the State convict farm is reported to be under consideration by the Board of Penitentiary Commissioners. John H. Page, of Little Rock, Ark., is secretary.

DE WITT, ARK.—It is reported that L. E. Faynter, of Medora, Ill., is considering the installation of an electric light plant in De Witt.

GURDON, ARK.—J. B. and J. G. Gresham are reported to have been granted a franchise by the City Council to construct and operate an electric light and water-works plant in Gurdon for a term of thirty years.

MONTICELLO, ARK.—The contract for equipment for the municipal electric light plant was awarded to the Ball Engine Company, of Erie, Pa., for $11,725, and calls for the installation of a Westinghouse generator. Oglesby Brothers, of Monticello, have the contract for construction of the power house, to be built of concrete. The plant was destroyed by fire about six weeks ago.

SILOAM SPRINGS, ARK.—The City Council has decided to make improvements to the municipal electric light plant and establish a twenty-four-hour service, involving an expenditure of about $5,000. It is understood that contracts have been placed for machinery and equipment needed.

BAKERSFIELD, CAL.—The electric plant of the San Joaquin Light & Power Company was damaged by fire on March 22, causing a loss of about $25,000. It is said that the fire was caused by the breaking down of a transformer, causing the burning out of a 750-kw generator.

BAKERSFIELD, CAL.—The San Joaquin Light & Power Company has completed its transmission line from Bakersfield to Taft, through the West Side oil fields, and will soon be in a position to supply electricity to operate the oil drills in that section. The new line will form a loop from Fresno to Bakersfield passing through the Coalinga and Kern River oil fields. The erection of substations at Famosa, Wasco and other points is contemplated. The company is contemplating increasing its plant in Bakersfield by 6667 hp, at a cost of about $250,000. Orders have already been placed for boilers and generator. A. G. Wishon, of Fresno, Cal., is general manager.

BAKERSVILLE, CAL.—Announcement has been made by the San Joaquin Light & Power Company of a reduction in the price of electricity and gas in Bakersfield to take effect from April 1. The present rates for electricity are on a basis of 20 cents per kw-hour with a discount allowed on bill, while the new rates are to be based upon the hours which the installed capacity of electrical equipment is used, and are graduated in this classification from 12 cents per kw-hour down to 4 cents per kw-hour. The rate for electrical energy for motors, which at present is 8 cents down to 2 cents per kw-hour, will be reduced to 6 cents down to 1½ cents per kw-hour.

BERKELEY, CAL.—Initial steps toward the reduction of light and water rates in this city have been taken by the City Council. Councilman McClure has been authorized to secure estimates on the cost of establishing and maintaining a municipal electric light plant. The conference committee of the allied improvement clubs of Berkeley has asked for a reduction of 33⅓ per cent in the price of water; from 9 cents to 7 cents per kw-hour for electricity and for gas from $1 to 90 cents per 1000 cu. ft.

LOS ANGELES, CAL.—Koebig & Koebig, engineers, 902 Broadway Central Building, Los Angeles, Cal., have been engaged by the Ramona Power & Irrigation Company to take charge of the construction of its proposed system. The project will involve an expenditure of about $2,500,000.

LOS ANGELES, CAL.—The San Joaquin Light & Power Company has authorized a bond issue to the amount of $25,000,000, the proceeds to be used for the purpose of establishing an extensive irrigation and reclamation project in the San Joaquin Valley. The proposed work will include the construction of power dams in the Sierra Nevada Mountains and the erection of transmission lines, covering the country between Bakersfield and Merced, for the purpose of supplying electricity to operate pumps for irrigating purposes and for reclamation work. The main office of the company is located in Los Angeles. A. G. Wishon, of Fresno, Cal., is general manager.

MADERA, CAL.—The City Trustees are reported to be considering the question of installing an electric plant to supply electricity to operate the pumping stations of the new water works and for street lighting.

OAKLAND, CAL.—The City Council has granted the Oakland Traction Company a franchise to construct and operate an electric railway on Hopkins Street from Fruitvale Avenue to Redwood Road, for which the company paid $1,000. The company also agrees to maintain lamps along the line of the proposed railway.

OROVILLE, CAL.—Notice of appropriation of 150,000 in. of water in the north fork of the Feather River has been filed by William S. Cone and Lloyd P. Cornehl. Mr. Cornehl is an engineer in the employ of the Great Western Power Company.

PORTERVILLE, CAL.—The Tulare County Power Company is planning to erect a transmission line to connect Porterville with Visalia, Exeter, Lindsay, Strathmore and Tulare. C. H. Holley, manager, is making contracts with farmers in this vicinity. It is understood that the service is to begin by Jan. 1, 1912.

SACRAMENTO, CAL.—Plans are being made by the Natomas Consolidated Company for the construction of a large irrigation system to reclaim a large tract of land north of Sacramento. The project includes the construction of an electric railway from the heart of the district to this city.

SAN BERNARDINO, CAL.—Notice of appropriation of 5800 in. of water in San Bernardino County has been filed by H. W. Dennis, engineer, of Los Angeles, Cal., representing the Union Power Company. It is proposed to develop the water-power to generate electricity for transmission to Los Angeles and other cities and towns. The water will be conveyed to the power house by means of cement conduits and canals, 3 ft. wide and 5 ft. deep.

SAN FRANCISCO, CAL.—It is reported that negotiations have been closed whereby the Great Western Power Company has purchased the property of the City Electric Company. The consideration is said to be $4,000,000. Edwin Hawley, of New York, N. Y., is president.

STOCKTON, CAL.—The Board of Supervisors has granted the San Joaquin Valley Electric Railway Company a franchise along McKinley Avenue from Stockton to French Camp. L. Brackett is interested in the company.

STOCKTON, CAL.—The Tidewater & Southern Railroad Company has commenced work on construction of its proposed electric railway to connect Stockton, Atlanta, French Camp, Escalon, Modesto, Cens and Turlock, forty-four miles in length. The company also proposes to supply electricity for lamps. K. C. Brueck, of Stockton, Cal., is president.

MIDDLETOWN, CONN.—The State Legislature has passed a bill authorizing the Middletown Electric Light Company to increase its capital stock to $500,000.

NEW LONDON, CONN.—The New London Gas & Electric Company has been granted permission by the State Legislature to supply steam heat and to lay conduits and mains for distribution of either steam or hot water.

SIMSBURY, CONN.—A bill has been passed by the State Legislature permitting the Simsbury Electric Company to increase its capital stock from $10,000 to $20,000.

WILMINGTON, DEL.—The Wilmington & Philadelphia Traction Company has been granted a franchise by the Street and Sewer Department to erect transmission lines in Wilmington to supply electricity for lamps and motors in this city. Under the terms of the franchise the company is to pay the city 2 per cent of its gross earnings, and to furnish electrical service at a maximum rate of 10 cents per kw-hour.

WASHINGTON, D. C.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until May 1 for furnishing and installing lighting fixtures in the United States buildings at Columbus, Neb.; Fort Dodge, Ia.; Hattiesburg, Miss.; Kansas City, Kan.; Lander, Wyo.; Helena, Ark.; Meridian, Miss., and Sacramento, Cal., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is Supervising Architect.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 29, 1911, for furnishing and installing six 450-hp water-tube boilers, equipped with oil-burning apparatus, superheaters, a flue and a stack; also one 300 cu. ft. air-compressor with intercooler, aftercooler and air receiver for the central power plant at United States Naval Station, Pearl Harbor, Hawaii. Plans and specifications can be obtained on application to the above bureau or to the commandant of the naval station named. The cost of the boilers and appurtenances is estimated at $75,000 and of air compressor at $13,500. R. C. Hollyday is chief of bureau.

FORT LAUDERDALE, FLA.—The Fort Lauderdale Ice & Light Company, recently incorporated with a capital stock of $50,000, it is reported, will install an electric light plant. Henry R. Brown is president.

TAMPA, FLA.—C. W. Alton, of Anderson, Ind., is reported to be interested in a project to build an electric railway from St. Petersburg to Tampa, Fla.

BARNESVILLE, GA.—At an election to be held April 18 the proposition to issue bonds to the amount of $50,000, the proceeds to be used for extensions to the municipal electric light plant, water works, sewer systems and other improvements, will be submitted to a vote.

CANTON, ILL.—The Home Telephone Company, of Canton, Ill., is contemplating the erection of additional cable lines. M. J. Gorman is president.

CONCORD, ILL.—It is reported that steps have been taken toward the construction of an electric railway to connect with the Hawley system at Keokuk and the McKinley system at Carlinville. At a mass meeting held recently in Exeter it is said that subscriptions to $30,000 in capital stock were secured. The proposed railway would cross the river at Meredosia, requiring the construction of a bridge at that place. The Concord Oil & Gas Syndicate, of Concord, Ill., is reported to be interested in the project.

GALESBURG, ILL.—The Galesburg Union Telephone Company is contemplating the installation of a new automatic switchboard.

SPRINGFIELD, ILL.—The appropriation bill introduced in the State Legislature by Senator Dunlap includes an appropriation of $50,000 for the enlargement of the lighting plant and $1,500 per year for the extension of the telephone system at the University of Illinois, Urbana.

CONVERSE, IND.—The construction of an electric railway to connect Converse and Somerset, Ind., is reported to be under consideration by local business men. L. O. Arnold, of Converse, Ind., is reported to be one of the promoters.

CRAWFORDSVILLE, IND.—The Commercial Club and the Mutual Credit Exchange are interested in the movement to secure a new street lighting system for the city.

FORT WAYNE, IND.—The Board of Public Works is conducting a series of tests of tungsten lamps and the Wood Magnetite lamp for the purpose of installing an ornamental street lighting system. A committee has reported in favor of the tungsten lamp, which has aroused considerable opposition and the competing companies will be allowed to install test lamps.

FRANCESVILLE, IND.—The Town Trustees have granted F. L. Kleckner, representing the Aurora Electrical Company, of Aurora, Ill., a franchise to install an electric light plant in Francesville. It is understood that the plant will be driven by gas engines.

INDIANAPOLIS, IND.—The City Council is considering an ordinance providing for placing all wires underground in the central portion of the city, within a radius of a mile square or more.

INDIANAPOLIS, IND.—Contracts will soon be awarded by the Cincinnati, Madison & Western Traction Company for the construction of forty-one miles of track. A subsidy tax of $100,000 has been voted the railway. The proposed railway will connect Madison, Scottsburg and Lexington. J. E. Greeley, of Louisville, Ky., is president.

INDIANAPOLIS, IND.—The Indianapolis & Seymour Traction Company, recently organized, is reported to have applied for franchises through Greenwood and Southport. Grafton Peck, A. O. Kelly and W. H. Todd, of Greenwood, are interested in the project.

JASONVILLE, IND.—The Jason Leader is preparing to install additional power machinery, including an electric generator.

RICHMOND, IND.—It is reported that a company is being organized under the name of the Eastern Indiana Traction Company for the purpose of building an interurban railway from Richmond, Ind., to Cincinnati, Ohio, passing through Liberty, Brookville and Harrison, Ohio. The company will be capitalized at $1,000,000. The incorporators are: A. M. Gardner, Paul Comstock, of Richmond, Ind.; Dr. E. L. Beard, of Liberty; R. L. Head, of Brookville, and F. J. Brinkman, of Harrison, Ohio.

RUSHVILLE, IND.—Plans are being made to install an ornamental street lighting system in Rushville.

ANITA, IA.—The W. K. Palmer Company Engineers, Dwight Building, Kansas City, Mo., has been engaged by the town of Anita to take charge of the installation of a municipal electric light plant and remodeling the water-works system, to cost approximately $30,000.

CLARION, IA.—It is reported that the local electric light plant has been purchased by M. E. Mozengo and W. H. Carr. It is understood that the new owners will make improvements to the plant and establish a day service.

DES MOINES, IA.—Permission has been granted the receivers of the Fort Dodge, Des Moines & Southern Interurban Railway by Judge Smith McPherson in the Federal Court to expend $500,000 on its system.

ELDORA, IA.—The Park Dam Power Company has been granted a franchise to install an electric light and power plant in Eldora. The cost of the plant is estimated at about $10,000.

FRASER, IA.—It is reported that the Fort Dodge, Des Moines & Southern Railroad Company is planning to build a power plant in Fraser, to cost approximately $48,500. It is said that the entire system will be equipped with automatic safety signals.

WALKER, IA.—At a special election held March 20 the citizens voted to light the streets of the town by electricity. The electric plant will be installed by Mr. Cross, of Monticello.

HENDERSON, KY.—Surveys are being made by H. U. Wallace & Company, of Chicago, Ill., for the proposed electric railway of the Henderson Interurban Railway Company, which is to connect Henderson, Ownesboro, Uniontown, Morgan Field, Sebree, Dickson and Providence. Malcolm Yeaman, of Henderson, Ky., is president, and E. F. Wheaton, of Nashville, Tenn., vice-president and general manager.

SIMPSONVILLE, KY.—The Lincoln Institute has awarded a contract to the George Rommel Company, of Louisville, Ky., for the construction of eight buildings to be erected on a site secured by the institute near Simpsonville. The project includes a power house and equipment, as the institute will build and operate its electric light and water-works plants. W. H. Frost, president of Berea College, at Berea, Ky., is interested in the project.

ANNAPOLIS, MD.—The Commissioners of Anne Arundel County have awarded a contract to the Consolidated Gas & Electric Light Company, of Baltimore, to furnish electricity for lamps in Brooklyn, Curtis Bay and other sections of the Fifth district contiguous to Baltimore for a period of five years. Under the terms of the contract the company is to furnish arc lamps at the rate of $77 each per year; 40-cp incandescent lamps at $26.75 per lamp per year; 60-cp incandescent lamps at $30.75 each per annum; 80-cp incandescent lamps at $34.50 each per year and 200-cp incandescent lamps at $67.25 per lamp per year.

BALTIMORE, MD.—Bids will be received by Board of Awards, care J. Sewall Thomas, city register, City Hall, Baltimore, Md., until April 12, for furnishing 1,000,000 duct feet of vitrified tile conduit; 200,000 ft. of special duct pipe, including bends for use of the Electrical Commission. Raleigh C. Thomas is city engineer.

SALEM, MASS.—The City Council has awarded the contract for street lighting to the Salem Electric Lighting Company for a period of five years, under the terms of which the company is to supply 25 magnetite arc lamps, 225 6.6-amp arc lamps and 700 tungsten lamps of 60 cp, for $36,750 per year. Under the new contract the city will save about $6,000 per year.

SHELBURNE FALLS, MASS.—A movement is on foot in Ashfield and Buckland to light the streets of the towns by electricity. The town of Ashfield has voted to appropriate $600 for street lamps and Buckland $250. It is proposed to secure the service from the Shelburne Falls plant of the Greenfield Electric Light & Power Company. The proposed transmission line will go through Apple Valley, where it is expected that farmers along the line will utilize the service.

SHERBORN, MASS.—The town of Sherborn has entered into a ten-year contract with the Edison Electric Illuminating Company of Boston for street lighting, giving the company the right to extend its commercial service through the streets of the town.

SOUTH FRAMINGHAM, MASS.—At a special election held recently the proposition to install a municipal electric light plant was defeated.

WORCESTER, MASS.—The Spencer Wire Company, of Worcester, Mass., is reported to be considering erecting an addition to its plant at Worcester, 80 ft. x 400 ft., three stories high. It is understood that the company will purchase electrical energy for operating the machinery in the new building, instead of enlarging its power plant.

TOWER, MINN.—The question of issuing bonds to the amount of $16,000, the proceeds to be used for the construction of a hydro-electric power plant at Pike Falls, is reported to be under consideration.

BOLTON, MISS.—The electric light and water-works plant was destroyed by fire on March 19. Steps will be taken at once to rebuild the plant, as the town is at present without water and lighting service.

JEFFERSON CITY, MO.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until April 25 for conduit and wiring and gas piping systems at the United States post office and court house at Jefferson City, Mo., plans and specifications for which may be secured at the above office or at the office of the custodian, Jefferson City, Mo. James Knox Taylor is Supervising Architect.

KANSAS CITY, MO.—Plans are being considered by the Kansas City, Ozark & Southern Railway Company for the construction of an extension from Kansas City to Forsyth and Hollister, via Brown Branch, Bradleyville, Kisee's Mills, Kirbyville and Mansfield, about thirty-five miles in length.

MOBERLY, MO.—Sealed bids will be received at the office of the Board of Public Works, Moberly, Mo., until April 20 for furnishing and installing material and equipment for improvements and extensions to the water-works and electric light systems as follows: Two four-valve, high-speed, automatic engines; two 75-kw, 2300-volt, alternating-current generators for direct connection to engines, complete with exciters; one 2,000,000-gal. crank and flywheel pumping engine; three horizontal, high-pressure return tubular boilers, with a rating of 125 hp each; one 400-hp feed water heater and boiler feed pump heads for two wells already sunk; one switchboard; one brick smokestack, 85 ft. high; construction of power house and erection of street-lighting system, etc. Plans and specifications are on file at the above office and at the office of Rollins & Westover, consulting engineers, Beals Building, Kansas City, Mo. H. A. Hatfield is president of Board of Public Works.

GREAT FALLS, MONT.—The farmers of Smith River Valley have organized a telephone company to construct a 15-mile telephone line to make connection with this city and other sections of the State, work on construction of which will begin at once. I. K. Huntzberger is president of the company.

LAVINA, MONT.—The cost of installing an electric light plant and water-works system in Lavina is estimated at $35,000 to $41,000 by the Lewiston Engineering Company, of St. Paul, Minn.

CARSON, NEV.—Sealed proposals will be received at the office of the United States Reclamation Service, 605 Federal Building, Los Angeles, Cal., until April 17, for furnishing a 72-in. penstock for the Truckee-Carson project. For particulars address the above office, or the United States Reclamation Service, Department of the Interior, Washington, D. C. F. H. Newell is director.

CARSON, NEV.—Sealed bids will be received at the office of the United States Reclamation Service, 605 Federal Building, Los Angeles, Cal., until April 13 for furnishing electrical apparatus for the Truckee-Carson project, Nevada. For further particulars address the above office, or United States Reclamation Service, Department of the Interior, Washington, D. C. F. H. Newell is director.

CARSON, NEV.—Bids will be received at the office of the United States Reclamation Service, 605 Federal Building, Los Angeles, Cal., until April 12, for furnishing hydraulic turbines for the Truckee-Carson project, Nevada. For further information address the above office, or the United States Reclamation Service, Department of the Interior, Washington, D. C. F. H. Newell is director.

SOMERSWORTH, N. H.—A bill has been passed by the State Legislature giving the town of Somersworth the right to establish and maintain a municipal electric light plant. The present pumping station was designed with a view of installing an electric plant. The Twin State Gas & Electric Company, of Dover, N. H., now furnishes electrical service and has the contract for street lighting, which will not expire for two years.

KENILWORTH, N. J.—The Papyrus Artificial Paper Company, of Hoboken, N. J., is reported to be erecting a factory building, 50 ft. x 150 ft., two stories high, at Kenilworth, N. J. As soon as the building is completed the company will remove its manufacturing plant in Hoboken to Kenilworth. Other buildings will be erected as needed. Power for operating the plant will be purchased from the Public Service Corporation of New Jersey.

VINCENTOWN, N. J.—It is reported that the Water Company is considering a proposition to install a generator to supply electricity for lighting the town.

NEW YORK, N. Y.—All bids received by the Department of Public Charities March 23 for furnishing material and construction of subway for conduit and electrical cables for lighting buildings and streets of the upper division of the New York City Home for Aged and Infirm, Blackwell's Island, have been rejected. Michael J. Drummond is commissioner.

NEW YORK, N. Y.—Bids will be received by John W. Brannan, president of the board of trustees of Bellevue and Allied Hospitals, Department New York City, 415 East Twenty-sixth Street, New York, N. Y., until April 11 for furnishing material and labor for the reconstruction of the electric light system at the Gouverneur Hospital, located at Gouverneur Slip, 621 Water Street, New York, N. Y. Blank forms may be obtained at the office of the contract clerk, 415 East Twenty-sixth Street, New York, N. Y.

UTICA, N. Y.—Bids will be received by the Board of School Commissioners, Utica, N. Y., until April 11, 1911, for combination gas and electric fixtures for the John E. Brandegee School. Dennis J. Kelly is clerk.

ANDREWS, N. C.—The City Council is contemplating issuing bonds to the amount of $20,000, the proceeds to be used for water-works, electric lighting and street improvements. H. N. Wells is Mayor.

CLEVELAND, OHIO.—The Cleveland, Alliance & Mahoning Valley Railroad Company has applied to the Secretary of State of Ohio for permission to increase its capital stock from $10,000 to $2,500,000. The company is planning to build an electric railway from Alliance to Ravenna, work on which has already begun.

CLEVELAND, OHIO.—The Standard Oil Company, it is stated, will erect a large can factory in Cleveland, consisting of two concrete buildings, 70 ft. x 300 ft., two stories high, and a boiler house, contract for which has been awarded to the Crowell & Sherman Company, of Cleveland, Ohio. It is understood that some power plant equipment will be required.

COLUMBUS, OHIO.—Proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until April 17 for furnishing two electric elevators and two electric dumbwaiters in the extension to the United States post office and court house, Columbus, Ohio, plans and specifications for which may be obtained at the above office. James Knox Taylor is Supervising Architect.

EAST LIVERPOOL, OHIO.—The capital stock of the East Liverpool Traction & Light Company has been increased from $10,000 to $1,300,000. It is stated that the Beaver County Light Company, which operates lighting systems in Beaver Falls, Rochester, Beaver, New Brighton and Ambridge, will be taken over by the new holding company. It is understood that it is proposed to operate all lighting and traction systems in the upper Ohio and Beaver Valley under one head. The company is contemplating the construction of a large electric plant either close to the Ohio-Pennsylvania State line or at the mouth of the Yellow Creek and the Ohio River.

BOSWELL, OKLA.—At an election held recently the citizens voted to issue bonds to the amount of $35,000, the proceeds to be used for the installation of an electric light plant and water works system.

VIAN, OKLA.—At an election to be held soon the proposition to grant an electric light franchise and to issue bonds to the amount of $20,000, the proceeds to be used for the construction of a water-works system, will be submitted to a vote.

MILWAUKEE, ORE.—The Mount Hood Electric Company is reported to have purchased a site in South Milwaukee, on which it proposes to erect a power station for the distribution of electricity from the transmission line running through Milwaukee.

PORTLAND, ORE.—Plans are being prepared by the Portland Railway, Light & Power Company for extensive developments to its properties during the next two years, which will involve an expenditure of about $4,000,000 and will place the company by 1914 in a position to supply electricity in a large district in Oregon and Washington. With construction work now under way together with work laid out for the next two years the company will be able to generate 100,000 hp by its hydroelectric plans. This includes the 15,000-hp plant at Oregon City, 25,000 hp at the Cazadero plant, 25,000 hp at Estacada plant, which will be completed in September, and 40,000 hp additional to be developed at the plant on the Upper Clackmas River.

PORTLAND, ORE.—The Portland Power & Light Company, which has recently purchased the property of the Hood River Light, Power & Water Company, of Hood River, Ore., and the Husum Power Company, at White Salmon, Wash., is contemplating extensive improvements and extensions, which will involve an expenditure of about $1,000,000, and include the construction of a transmission system for the distribution of electricity along the Columbia River for 250 miles. The output of the Hood River plant will be increased from 2500 hp to 3000 hp and the White Salmon plant will be enlarged. A cable will be extended across the Columbia River connecting the two properties. Orders have been placed for material for a high-tension line between Hood River and The Dalles, thereby connecting Hood River, Mosier, White Salmon and The Dalles in one circuit. Surveys have been started and a high-tension line will be erected this summer from The Dalles to Umatilla, a distance of 121 miles. This line will cross the Columbia to Luzon and extend up the Columbia to Kennewick, where it will meet the new transmission line just completed from Walla Walla to Kennewick, and from there extended to Priest Rapids, thus connecting all the properties of the company. Electricity will be supplied for lamps, motors and irrigation purposes.

SALEM, ORE.—Plans are being made by the Oregon Electric Railway Company to begin construction of its extension south from Salem to Eugene, work on which will begin, it is said, as soon as the route is decided upon.

SPRINGFIELD, ORE.—It is reported that the City Council has appointed a committee to secure the cost of erecting a sub-station in Springfield with a view of establishing a municipal plant to furnish electricity for street lighting.

PANAMA.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until May 27 for furnishing miter gate-moving machines, miter forcing machines and electric motors for same, for the lock gates. Blanks and general information relating to this circular (No. 627) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, New Orleans, La.

PANAMA.—A new 500-kw, 2200-volt, three-phase, 25-cycle turbo-generator set is to be installed in the electric generating and air-compressor plant near East Balboa, replacing the present electrical generating equipment. The plant has been supplying alternating current for lamps in Ancon, Balboa and East Balboa, and direct current for operating cranes on the Panama Railroad wharf and for motors in the Pacific Division machine shop. These motors will be superseded by alternating-current machines when the new equipment is put into operation. Under the new arrangement the Balboa and Miraflores plants will be operated in parallel, the former carrying the day load and the latter the night load. The committee has recommended that the present circulating-water system be retained for the condenser at the Balboa plant, but that a centrifugal pump driven by an electric motor be substituted for the circulating pump now in use.

BUTLER, PA.—The capital stock of the Butler Light, Heat & Motor Company has been increased from $50,000 to $200,000.

JOHNSTOWN, PA.—The Johnstown Passenger Railway Company is reported to be contemplating extending its railway to Geistown, for which, it is said, rights of way have been secured.

LOCK HAVEN, PA.—The Lock Haven & Jersey Shore Railroad Company is now locating the route for its proposed electric railway to connect Lock Haven and Woolrich, a distance of twelve miles. The power station will be located in North Fork, Pa. L. M. Patterson, of Lock Haven, Pa., is president.

PITTSBURGH, PA.—The Independent Developing Company, recently incorporated, proposes to build urban and interurban electric railways between Duquesne and Glassport and also to take over the property of the Duquesne & Dravosburg Street Railway Company and the Duquesne Annex Land Company. The plans include the construction of three miles of track to connect Duquesne Annex and Dravosburg, work on which will begin at once. It is expected that the railway will be extended to Glassport.

CHARLESTON, S. C.—The stockholders of the Charleston Consolidated Railway & Lighting Company have voted to increase the capital stock of the company from $2,000,000 to $3,000,000, the proceeds to be used to pay for additions now being made to the system and to provide for future improvements and extensions. Philip H. Gadsden, of Charleston, S. C., is president of the company.

VERMILION, S. D.—The City of Vermilion has engaged the W. K. Palmer Company Engineers, Dwight Building, Kansas City, Mo., to take charge of the engineering work in connection with the construction of a municipal electric light plant and remodeling the water-works system, which is to be taken over by the city.

CHATTANOOGA, TENN.—The sawmill of the McLean Lumber Company, of Chattanooga, Tenn., was destroyed by fire on March 22, causing a loss of about $60,000. Practically all of the machinery, including power plant, will have to be replaced.

NASHVILLE, TENN.—Preparations are being made to extend the new street lighting system in the downtown section, taking in the viaducts and the Woodland Street bridge. A contract has been awarded to the Union Metal Company, of Canton, Ohio, for fifty lamp standards for same. J. W. Pentecost, superintendent of the city light department, will have charge of the work.

ALTO, TEX.—A site on which to erect an electric light and ice plant has been donated to L. S. Atkins, of Center, Tex. It is expected to have the plant in operation within sixty days.

BROWNSVILLE, TEX.—The Brownsville & Gulf Railway Company has applied to the City Council for a franchise to operate motor cars over its line. The company is planning to reconstruct its road and establish a regular passenger service through the city and across the international bridge over the Rio Grande to Matamoras, Mex. The franchise includes a request to operate the cars by electricity, and it is understood that the railway will be equipped for electrical operation later on. The railway is owned by the St. Louis, Brownsville & Mexico Railroad Company, with which it connects.

CHAPIN, TEX.—Investigations have been made by D. B. Chapin, of Chapin, along the Devil's River, in western Texas, with a view of building one or more dams across the canyon for the purpose of utilizing the water to reclaim the land in that section by irrigation. It is proposed to construct a large canal system and install pumping plants.

FORT WORTH, TEX.—The Northern Texas Traction Company has secured the right of way for its proposed interurban electric railway to extend from Fort Worth to Cleburne, a distance of twenty-eight miles. The Stone & Webster Management Association has charge of the system.

HILLSBORO, TEX.—The Board of Trade has taken up the question of promoting the construction of an interurban electric railway between Dallas and Hillsboro. The extension of the electric railway, which is to be built from Dallas to Waxahachie, to Hillsboro is reported to be under consideration.

HOUSTON, TEX.—The contract for the electrical installations in the administration building, the mechanical laboratory and power plant for the William E. Rice Institute has been awarded to the Newberry Electric Company, of St. Louis, Mo., for $18,960.

HOUSTON, TEX.—Plans are under way for the construction of an electric railway from Houston to the turning basin in Buffalo Bayou, for which rights of way are now being secured. For further information address Harvey T. D. Wilson, of Houston, Tex.

HOUSTON, TEX.—Plans are being made by the San Leon Terminal Railroad Company for the construction of an interurban railway to extend from the Bay front at the suburb of San Leon to Dickinson, where it will connect with the Houston-Galveston Interurban Railway. The proposed road will be eight miles long, and it is understood that the contract for construction of the first three and one-half miles will be awarded before April 15. Gasoline motor cars will be operated temporarily; it is proposed to equip the railway for electrical operation the early part of next year.

LULING, TEX.—The City Council has granted the Luling Electric Light & Power Company a franchise to erect and maintain an electric plant in Luling for a term of twenty years.

SAN ANTONIO, TEX.—It is reported that preliminary plans have been prepared by F. S. Pearson, of New York, N. Y., and associates for the development of a large hydraulic and irrigation project in the southwestern part of Texas. It is said that options have been secured on several hundred thousand acres of land in the valleys of the Medina and Nueces Rivers and surveys made for a series of dams and hydroelectric plants. The initial plans call for an expenditure of about $5,000,000. C. H. Carney, manager and chief engineer of the Mexico Light & Power Company, Mexico City, is said to be in charge of the Texas enterprise.

WEATHERFORD, TEX.—It is reported that J. R. Deddinger, of Dallas, Tex., has purchased the plant and holdings of the Home Telephone Company in Weatherford. It is understood that the consideration was $98,600.

OGDEN, UTAH.—Surveys have been made and estimates prepared by W. M. Bostaph, city engineer, for the construction of a large reservoir in the South Fork Canyon, to cost about $350,000. It is proposed to erect a dam either in Magpie Canyon or Cobble Creek Canyon, both locations being owned by the City of Ogden. The water will be utilized to operate an electric plant to supply electricity for the City of Ogden and to supply water for irrigation purposes and also for domestic purposes in Ogden. The cost of the entire project that the promoters have in view is approximately $842,418, but the initial development will involve an expenditure of only $350,000.

RADFORD, VA.—The Virginia Power Company, recently incorporated, has purchased the plant and holdings of the Radford Water Power Company, which operates the electric light, street car and water-works systems in Radford. The consideration is said to be $200,000. The Virginia company has acquired water rights on the New River and on North Carolina streams. The first development, it is understood, will be at Ingles Ferry. The local plant will retain the same management for the present. Dr. J. V. Mott is president of the Virginia Power Company, and A. Bird is general superintendent of the Radford Water Power Company.

KELSO, WASH.—The City Council has granted the Washington-Oregon Corporation franchises to supply both water and light in Kelso for a term of fifty years. Under the terms of the franchise the company is to supply one arc lamp free of charge for every 400 in population; a reduction is also made in the rates for electricity for lamps. The city is granted the privilege of readjusting rates every five years under the lighting franchise.

NORTH YAKIMA, WASH.—The Business Men's Association is reported to have asked the Pacific Power & Light Company to submit estimates of cost for installing cluster lamps on Yakima Avenue.

PLEASANT VALLEY, WASH.—A temporary organization has been formed by a number of ranchers with a view of organizing a co-operative company for the purpose of building a power plant on Quillisasent Creek to furnish electricity for lamps and motors to the residents of Pleasant Valley. It is proposed to erect a small generating plant at the head of the creek, and to use the water after passing through the power plant for irrigating purposes.

PORT ORCHARD, WASH.—Plans are being prepared by J. W. Bullard, of Tacoma, architect, for the construction of a new hospital building to cost $65,000, and a power house, at $35,000, for the Veterans' Home in Port Orchard, Wash.

SEATTLE, WASH.—The contract for installing cluster lamps on Third Avenue, subdivision No. 1, has been awarded to R. E. Downie, of Seattle, Wash.

SUMAS, WASH.—The Western Canada Power Company is reported to be contemplating establishing a power plant and sub-station in Sumas, to cost approximately $100,000.

WHITE SALMON, WASH.—The property of the Husum Power Company has been purchased by the Pacific Power & Light Company, of Portland, Ore., which operates plants at Hood River, Walla Walla, The Dalles and North Yakima. It is understood that plans for the construction of a concrete dam to increase the output of the plant will be carried out.

BARABOO, WIS.—The City of Baraboo has applied to the Wisconsin Railway Commission for authority to establish and operate a municipal electric light plant. The Baraboo Lighting Company furnishes electrical service in the city at present.

BAYFIELD, WIS.—Preparations are being made by the Water and Light Commissioners for improvements to the electric light plant, work on which will begin in the near future.

FOND DU LAC, WIS.—The Wisconsin Railway Commission has authorized the Eastern Wisconsin Railway & Lighting Company, of Fond du Lac, to issue $76,000 in bonds, the proceeds to be used to pay outstanding indebtedness incurred for additions and extensions and improvements to its system.

HUDSON, WIS.—The Burkhardt Milling & Electric Power Company, which supplies electrical service in Hudson, Burkhardt and North Hudson, has applied to the Wisconsin Railway Commission for authority to abolish its present meter rental of 25 cents per month and to substitute therefore a minimum rate, the amount of which is left to the commission to decide.

MILWAUKEE, WIS.—A number of business men on National Avenue have decided to take steps to secure a uniform system of street lamps in that section of the city.

MILWAUKEE, WIS.—The Wisconsin Railway Commission has authorized the Milwaukee Northern Electric Railway Company to issue $1,500,000 bonds to be secured under a mortgage executed by the company to the First Savings & Trust Company, of Milwaukee, Wis. The bonds are to be issued for money only and for not less than 75 per cent of par value. The company has also been granted permission to issue $1,000,000 in capital stock, to be sold for money only and at not less than par, the proceeds to be used to purchase and retire an outstanding indebtedness of $2,500,000.

SHARON, WIS.—The proposition to issue $7,000 in bonds, the proceeds to be used to install an electric light plant, will be submitted to the voters at the spring election.

SUN PRAIRIE, WIS.—The village of Sun Prairie, which recently acquired the property of the Sun Prairie Electric Light Company, by the exercise of its option to purchase, granted by the public utilities law, has requested the Wisconsin Railway Commission to investigate conditions in Sun Prairie and to recommend a schedule of rates for electricity for lamps and motors.

NEW WESTMINSTER, B. C., CAN.—At the annual meeting of the Okanagan Telephone Company to be held April 7 the proposition to increase the capital stock by $450,000 will be voted upon. The question of moving the headquarters of the company from Vernon, B. C., to New Westminster will also be voted upon. The company is contemplating large extensions to its system.

BRANDON, MAN., CAN.—After considering several propositions for the construction of an electric street railway the City Council has instructed the city engineer to prepare plans for a municipal system.

WINNIPEG, MAN., CAN.—Bids will be received by M. Peterson, secretary Board of Civic Control, until May 1 for furnishing a number of ornamental lamp standards. For further information address F. E. Cambridge, city electrician.

WINNIPEG, MAN., CAN.—Bids will be received by M. Peterson, secretary Civic Board of Control, until April 27 for furnishing and installing electrical switching equipment complete for substation No. 1 on King Street, Winnipeg, Man. Plans and specifications may be obtained at the office of Smith, Kerry & Chace, engineers, Carnegie Library, Winnipeg.

CHATHAM, ONT., CAN.—The Windsor, Wallaceburg & Lake Erie Railway Company is reported to be contemplating extending its interurban railway to London, work on which will begin in the near future.

SANDWICH, ONT., CAN.—Mayor Breault has been authorized by the municipality to communicate with the Hydroelectric Power Commission of Ontario to secure the estimates of the cost of Niagara power to be supplied by the transmission system of the commission.

SANDWICH, ONT., CAN.—The Town Council is considering the question of granting a franchise to Robert Stuart, of Detroit, Mich., electrical engineer, for the construction of a transmission line from the old Mineral Springs property, through Sandwich, to supply electricity in the towns of Essex, Leamington and Kingsville. The company represented by Mr. Stuart already supplies electrical service in three towns in Essex County. It is proposed to abandon the small plants and establish a large central generating station, with transmission lines radiating throughout the county, supplying electricity to the farmers along the route of its transmission line.

TORONTO, ONT., CAN.—Bids will be received until April 11 (extension of time) for wiring exhibition buildings. G. R. Geary is Mayor.

TORONTO, ONT., CAN.—The Toronto Electric Light Company has applied to the City Council for a franchise to lay underground wires on several streets in this city.

WHITBY, ONT., CAN.—The Seymour Power Company, of Campbellford, Ont., it is reported, is contemplating extending its transmission line from Oshawa to Whithy. A by-law granting the company a thirty-year franchise in Whitby, will soon be voted upon. If the franchise is granted it is expected to have the system in operation by next June.

MONTREAL, QUE., CAN.—The Montreal Light, Heat & Power Company has awarded a contract for installing underground conduits to G. M. Gest, of Montreal, Que., for $100,000.

MOOSEJAW, SASK., CAN.—Bids will be received until April 10 for the construction of car barns and power house for the Moosejaw Electric Street Railway Company. R. G. Bunyard is architect.

REGINA, SASK., CAN.—According to a report submitted in the Provincial Parliament the Saskatchewan government has expended $1,600,000 in the construction of 1753 miles of long-distance telephone lines, in addition to 3490 miles of rural lines erected by the government-controlled companies. About $500,000 will be expended by the government on the erection of long-distance lines this year.

PUEBLA, MEX.—Preparations are being made for the construction of a large hydroelectric plant at Tuxpango Falls, at Tuxpango, by the Puebla Light & Power Company, work on which will begin as soon as surveys have been completed and plans prepared. The proposed project calls for an expenditure of about $6,000,000 and includes the erection of transmissino lines to Puebla and other cities and towns in this section.

New Industrial Companies.

THE AMERICAN INSULATING COMPANY, of Alexandria, Ind., has been incorporated with a capital stock of $600,000. The company will take over the property of the American Insulating Material Manufacturing Company. The directors are: M. F. and J. L. Sawyer, G. B. Slaymeker, F. M. White, C. L. Bayne and J. H. Boogher.

THE BROWN ENGINEERING & EQUIPMENT COMPANY has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $25,000, and the incorporators are: J. W. Brown, of Bellevue, Pa.; W. J. Storey and A. E. Duckham, of Pittsburgh, Pa.

THE CANTON MANUFACTURING COMPANY, of New York, N. Y., has been chartered with a capital stock of $150,000 by C. Kriser, of Brooklyn, N. Y.; S. L. Baron and A. A. Canton, of New York, N. Y. The company proposes to manufacture motors, engines, machinery, etc.

THE CLARK ELECTRICAL PURIFIER COMPANY, of Los Angeles, Cal., has been incorporated with a capital stock of $25,000 by D. A. Warren, C. W. Clark and C. C. Davis.

THE CULVER-STEARNS MANUFACTURING COMPANY, of Worcester, Mass., has been incorporated with a capital stock of $10,000 by Fred A. Culver, Jason C. Stearns and Edgar A. Dalrymple. The company proposes to manufacture electrical devices.

THE DELEVAN MOTORS COMPANY, of Wilmington, Del., has been incorporated with a capital stock of $150,000. The incorporators are: G. G. Stiegle, R. G. Lupton and H. W. Nock, of Wilmington, Del.

THE LEE'S RAILWAY SWITCH DEVICE COMPANY, of San Diego, Cal., has been incorporated with a capital stock of $500,000 by T. E. Lee, J. W. Hastain, J. C. Hocker, C. F. Mobnike, W. A. Browne, D. S. Miller and W. V. O'Farrell.

THE C. J. OLSEN MANUFACTURING COMPANY, of Pittsboro, Ind., has been incorporated by C. J. Olsen, W. F. Hiatt and C. A. Weaver. The company proposes to manufacture combined insulators and lightning arresters and sanitary window sash.

THE SEMI-DRY BATTERY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 by J. G. Hamner, Jr., A. G. Hubbell and W. H. Wooley, of New York, N. Y. The company proposes to deal in electrical apparatus and supplies and to do all kinds of electrical work.

THE SOUTHERN EQUIPMENT & SUPPLY COMPANY has been organized for the purpose of assisting in the development of the Bedford (Ind.) stone industry. It will handle general construction work with particular attention to electrical construction and maintenance and the application of electrical drive to quarrying and mill machinery. A complete line of quarry and mill supplies, both electrical and mechanical, will also be carried.

THE SWANSTROM MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $50,000 by G. E. Q. Johnson, J. A. Johnson and L. D. Swanstrom, of Chicago, Ill. The company proposes to manufacture engines and motors.

THE UNIQUE FAN COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $50,000 by M. A. Carmody, W. A. Grece and J. M. McIlravey, of Jersey City, N. J. The company proposes to manufacture revolving and tilted fans, etc.

THE VACUUM ENGINE MANUFACTURING COMPANY, of Chicago, Ill., has been chartered by R. T. Roadhouse, G. W. Hiltabrand and F. Benjamin, of Chicago, Ill. The company is capitalized at $25,000 and proposes to manufacture machinery.

THE WILMINGTON MOTOR SERVICE COMPANY, of Wilmington, Del., has filed articles of incorporation with a capital stock of $30,000. The incorporators are: C. W. Bush, H. R. Isaacs and A. Finger, of Wilmington, Del.

New Incorporations.

LITTLE ROCK, ARK.—The Arkansas Kerasolar Light & Fuel Company has been granted a charter with a capital stock of $40,000. The incorporators are: A. Danville, J. L. Richardson and James W. Hall.

MARMADUKE, ARK.—The Marmaduke Telephone Company has been chartered with a capital stock of $10,000 and the following named officers: Wilder Carpenter, president; J. S. Simpson, vice-president, and W. E. Lynch, secretary and treasurer.

MARTINEZ, CAL.—The Bay Point Light & Water Company has been incorporated with a capital stock of $25,000 by Scott Hendricks, G. S. Arnold, Grant Smith, F. A. Warren and A. E. Fisher, of San Francisco, Cal.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Oro Electric Corporation with a capital stock of $10,000,000 by F. V. Berry, F. S. McAllister, W. B. Phelps, W. S. Wilsey, A. Harvey, E. Buckholz and W. G. Jack.

VISALIA, CAL.—Articles of incorporation have been filed for the Alpaugh Telephone & Telegraph Company with a capital stock of $25,000 by N. L. Wilson, T. G. Adams, C. E. Timmons, W. F. McFarland and M. G. McNeely.

TWINS FALLS, IDAHO.—The Garnett Irrigation & Power Company has filed articles of incorporation with a capital stock of $10,000,000. The company proposes to build a dam 90 ft. high across Snake River, at Garnet, below Mountain Home, at a cost of about $5,000,000. The incorporators are: B. G. Jaynes, of New York, N. Y.; F. Johnstone, of Iowa, and E. J. Dockey, of Boise.

FARMINGTON, ILL.—The Farmington Light & Power Company has been chartered with a capital stock of $30,000 to construct and operate an electric light plant in Farmington. The incorporators are: A. L. Thompson, Theodore Bass, M. M. Anderson and H. E. Worden.

PEORIA, ILL.—Articles of incorporation have been filed with the Secretary of State for the Milwaukee, Peoria & St. Louis Railway Company by Eugene C. Morton, Frank B. Reed, Frederick C. Vehmeyer, John O'Neill and Frank H. Gardiner, all of Chicago, Ill. The company proposes to build an electric railroad direct from Milwaukee, Wis., to St. Louis, Mo., via Rockford and Peoria, Ill. The first link is to be built between Peoria and Rockford, for which, it is understood, bids have been called and contracts will soon be awarded.

ROCKFORD, ILL.—The Rockford City Traction Company has been incorporated by A. A. Anderson, Warren Partridge and P. B. Warren of Springfield, Ill. The company is capitalized at $2,000,000.

GENEVA, IND.—The Star Telephone Company has been incorporated with a capitalization of $1,200 to erect and operate a telephone system in Geneva and throughout Jefferson Township. Bartley Burk is president and Jesse C. Buckmaster is secretary of the company.

INDIANAPOLIS, IND.—Articles of incorporation have been filed for the Northern Indiana Gas & Electric Company with a capital stock of $5,000,000. The new company is a consolidation of the South Bend & Mishawaka Gas Company, the Michigan City Gas & Electric Company, the South Shore & Electric Company, the Indiana Harbor & East Chicago Electric Company, the Plymouth Light Company and the Whiting Electric Company. G. M. Geist is president and G. W. Curran secretary of the company.

VINCENNES, IND.—The Vincennes-Interstate Traction Company has applied for a charter to build urban and interurban railways in Indiana. The company is capitalized at $10,000. The directors are: J. L. Keymeyer, C. A. Benhain, C. E. Seeds, H. M. Lukens, C. W. Battin, A. W. Funkhouser and A. F. Funkhouser.

VINCENNES, IND.—The Vincennes Southeastern Interurban Railway Company has been incorporated with a capital stock of $50,000 to construct and operate electric street and interurban railways and power plants in the State of Indiana. The incorporators are: George B. Hazleton, Ray Eubank Roger and Q. M. Lewis. It is understood that the company proposes to build an electric railway from Vincennes to Jasper.

HENDERSON, KY.—The Henderson Interurban Company has been incorporated with a capital stock of $100,000 by W. W. Cooper, of Smith Mills; E. F. Wheaton, of Nashville, Tenn.; C. E. Sugg, N. P. Taylor, J. W. Henson, Albert Leiber and others, of Henderson, Ky. The company proposes to build an electric railway from Henderson to Owensboro, about eighty-five miles in length.

NEWPORT, KY.—Articles of incorporation have been filed for the Northern Kentucky Street Railway Company with a capital stock of $10,000 by J. M. Dawson, Edward F. Kelly and Gwynne Dennis.

NEW ORLEANS, LA.—The Louisiana Company has applied for a charter to build and operate electric and steam railways in Louisiana. The first line to be built will extend from New Iberia to Berwick Bay, via Jeanerette, Franklin and Patterson. The capital stock is placed at $1,000,000. The officers are: George W. Dallas, president; John R. Taylor, vice-president, and V. J. Smith, secretary and treasurer.

DULUTH, MINN.—The Virginia, Eveleth & Gilbert Traction Company has filed articles of incorporation with a capital stock of $200,000. The incorporators are: W. M. Prindle, E. B. Merrill and G. T. Eagling.

WYLIE, MINN.—The Wylie Farmers' Telephone Company has been incorporated with a capital stock of $10,000 by Leon Huot, Frederick Gotham, of Red Lake Falls, and Regis Huot, of Wylie, Minn.

RED CLOUD, NEB.—The East Garfield Telephone Company has been incorporated with a capital stock of $10,000 by A. W. Shipman, T. H. Hawkins and Henry Emerton.

CHARLOTTE, N. C.—Negotiations have been practically completed whereby the City of Charlotte will purchase the water-works plant in the Dilworth section from the Charlotte Electric Street Railway Company, the plant having been bought by the interests allied with the Southern Power Company with the street railways systems about the first of the year. The consideration is said to be about $20,000.

GUILFORD COLLEGE, N. C.—The Guilford Telephone Company has been incorporated with a capital stock of $6,000 to construct and operate a telephone system in Guilford County. The incorporators are: D. W. Lindley, Lee S. Smith and others.

RALEIGH, N. C.—The Yadkin River Power Company, of Raleigh, N. C., has been chartered with a capital stock of $40,000,000 for the purpose of taking over the Blewitt Falls hydroelectric power plant in Richmond County. The company proposes to complete the plant and supply electricity for the operation of public utilities and for interurban railways. Charles E. Johnson, of Raleigh, N. C., is president, and E. Clifford Potter, of Boston, Mass., treasurer.

SALISBURY, N. C.—The Virginia Power Company has been organized with a capital stock of $1,000,000 for the purpose of developing a hydroelectric power project, the principal one to be located on the New River in Virginia. J. J. Mott, of Statesville, N. C., is interested.

WHITE EARTH, N. D.—Articles of incorporation have been filed for the White Earth Lighting Company with a capital stock of $10,000 by O. M. Muss, Cornelius Hansen, Peter Herseth and A. B. Feiring, all of White Earth, N. D.

BROWNSVILLE, OHIO.—Articles of incorporation have been filed for the Brownsville Telephone Company with a capital stock of $10,000 by John A. Mack and others.

CINCINNATI, OHIO.—The Logan Electric Company has filed articles of incorporation with a capital stock of $25,000 for the purpose of erecting and operating power plants. The incorporators are: W. F. Bevill, Charles Bennett, S. M. Bisan, Naman Jackson and Frank R. Hurst, all of Logan.

STEUBENVILLE, OHIO.—The Steubenville, Wellsburg & Weirton Railroad Company has been incorporated by Frank D. Sinclair, Michael Keane, J. E. Wheaton and Nelson D. Miller, all of Steubenville, Ohio. The company is capitalized at $10,000 and proposes to build a street car line from the east end of Market Street bridge to Weirton. The company is a subsidiary of the Tri-State Railway & Electric Company.

MOUNTAIN VIEW, OKLA.—The Fairview Telephone Company has been chartered with a capital stock of $5,315 by R. L. Hadley, T. A. Cook and A. E. Carsten.

MUSKOGEE, OKLA.—The People's Electric Railway Company has been chartered by W. M. Patterson, Samuel Spaulding, J. M. McDonald, W. R. Robison, T. H. Martin and J. H. Huckleberry, all of Muskogee, and G. W. Risser, of Oklahoma City.

PITTSBURGH, PA.—The Pittsburgh, Butler, Slippery Rock, Grove City & Northern Street Railway Company has been chartered with a capital stock of $156,000. The directors are: Charles Gibson, Jr., of Pittsburgh, Pa., president; William M. Galbraith, of Pittsburgh, Pa.; W. C. McCandless, John Trautman, of Butler, Pa.; F. L. Forrester and John C. Kerr, of Slippery Rock, Pa.

Personal.

MR. A. G. SANGSTER, Vancouver, B. C., has been appointed electrical superintendent for the City of Saskatoon, Sask., succeeding E. L. White.

MR. N. J. FOSTER has retired from the Fairbury Electric Light Company, Fairbury, Ill., and H. A. Foster and W. B. Decker are now in full control.

MR. CLYDE PADDEN, of New Hampton, Ia., has been made a manager for the Padden Gas & Electric Manufacturing Company, of New Hampton, Ia.

MR. WILLIAM P. SIDLEY, of Chicago, vice-president of the Western Electric Company, has been elected president of the Union League Club, of Chicago.

DR. C. P. STEINMETZ will be the chief guest and speaker at a meeting of the Washington Section of the American Institute of Electrical Engineers to be held at the Cosmos Club on April 11.

MR. W. D. WEAVER, editor of the *Electrical World*, sailed on the steamship *Mauretania* on April 5 for a short visit to Paris, where his address will be, until May 1, 65 rue des Saints-Pères.

MR. FRANK G. SPRAGUE, of New York City, will address the Electrical Engineering Society of Massachusetts Institute of Technology, Boston, Mass., on April 12. Mr. Sprague will discuss some pertinent engineering topic.

MR. J. A. TRAWICK, who has been with the Tampa (Fla.) Electric Company since 1907, will resign as its general manager in May to become general manager of the Mississippi River Power Company with headquarters at Keokuk, Ia.

DR. ROBERT BOSCH, of Stuttgart, Germany, designer and inventor of the magneto-generator system of ignition with which his name is associated, is in this country visiting some of the larger American industries in company with Mr. Otto Heins, president of the Bosch Magneto Company, of New York.

MR. JOHN H. BARKER has been appointed manager of the New York office of the Diehl Manufacturing Company, 90 Prince Street. Mr. Barker has been salesman of the special apparatus department and for several years previous was manager of the New York office of the Northern Electric Manufacturing Company.

MR. N. A. KEMMISH has resigned as electrical engineer of the Lincoln (Neb.) Traction Company to become general manager of the municipal electric lighting and pumping station at Alliance, Neb. Mr. Kemmish, who has been with the Lincoln Traction Company for the past seven years, is a graduate of the University of Nebraska.

MR. C. E. ROESCH, JR., for several years connected with the power department of the Fort Wayne Electric Works at the home office, has been transferred to become a member of the selling organization in the Chicago office of the company. His fellow-employees in Fort Wayne gave him a farewell banquet at the Commercial Club before his departure for Chicago.

MR. MARQUIS D. CRAIN, night chief operator for the Western Union Telegraph Company in St. Louis, died on March 26, aged seventy years. "Colonel" Crain, as he was widely known, was a field telegrapher with the Union troops during the Civil War, serving under Andrew Carnegie and Col. R. C. Clowry. He is survived by a wife and eight adult children.

MR. ALBERT CAVALLO JEWETT, of the foreign department of the General Electric Company, is on a short visit to this country after a residence of some years in India. While in India Mr. Jewett was for three years electrical adviser to the government of Kashmir, and he will shortly sail for Cabul, Afghanistan, where he will act as chief engineer of a British firm in the installation of a large electrical plant.

MR. THOMAS H. YAWGER, superintendent of the Rochester Railway & Light Company, Rochester, N. Y., has returned from Europe, where he went three months ago in search of rest and recreation. Mr. Yawger has been connected with the Rochester company for many years and his recent trip abroad was the first extended leave from his strenuous duties in looking after the many generating stations and substations which his company possesses.

MR. FRANK W. SMITH, secretary of the United Electric Light & Power Company, New York City, was presented with a handsome diamond scarfpin and silver cigarette case and matchbox by the Association of Employees of the United Electric Light & Power Company at its recent beefsteak party. In years of service there are few men in the industry who surpass Mr. Smith, for he has been connected with the United company for thirty-one years, and the presentation was made as a fitting commemoration of the event.

MR. L. F. PAYNE, who has been commercial manager of the People's Water & Light Company, of Harrisburg, Ill., since Jan. 1, in charge of distribution and sales, has been made general manager of that company. Mr. G. Clinton Smith, formerly superintendent of production at Harrisburg, has gone to Iron River, Mich., to become superintendent of the Menominee Range, Power & Development Company. Both companies are under the general management of Mr. James R. Cravath, of Chicago.

MR. CHARLES L. EDGAR, president and general manager of the Edison Electric Illuminating Company of Boston, sailed from New York on the *George Washington* of the North German Lloyd Line on March 30 for a period of rest and recreation which will be enjoyed in an automobile tour through Europe. About two weeks each will be spent in driving through England, France, Italy and Germany. With Mr. Edgar are Mrs. Edgar, their son, Mr. Leavitt L. Edgar, Miss Margaret Clough and Miss Laura F. Duclos, together with a maid and chauffeur. All will return in the early summer.

MR. CARL RAYMOND GRAY has resigned as vice-president of the St. Louis & San Francisco Railroad Company to become president of the companies owning and operating the electric lines of the United Railways and the Oregon Electric Railway, Portland, Ore., and the steam lines of the Astoria & Columbia River Railroad, the Oregon Trunk Railway, the Pacific & Eastern Railway and the Spokane & Seattle Railway, with offices at Portland. Mr. Gray, who succeeds Mr. John F. Stevens in the presidency of the above road, has been connected with the St. Louis & San Francisco Railroad since 1882, when he began service as a telegraph operator.

Obituary.

MR. LOUIS A. LURIENNE, for fifteen years representative of the French Cable Company in the United States and Canada, died in Paris on March 25 after a lingering illness due to nervous prostration. He had gone to Europe to consult specialists. He was in his fifty-second year, and was an officer of the French Legion of Honor, vice-president of the French Chamber of Commerce in New York City, and an official of the French government telegraphs in France.

MR. GEORGE BOWERS CALDWELL, for many years connected with the engineering department of Westinghouse, Church, Kerr & Company, as one of the chief mechanical engineers, died March 31, 1911, at Yonkers, N. Y. Mr. Caldwell was born at Lawrence, Mass., in 1863. Prior to his connection with Westinghouse, Church, Kerr & Company, he was employed for thirteen years in the machine shops of the Lawrence Manufacturing Company, of Lowell, Mass., and the Washington Mills Company, of Lawrence, Mass., in charge of new construction and repair work. During his connection with Westinghouse, Church, Kerr & Company, which began in 1893, he was connected with the design and construction of the following important pieces of work: The mechanical and electrical features of the South Terminal Station, Boston, Mass.; the terminal station of the Pittsburgh & Lake Erie Railroad; the railroad shops of the P. & L. E. R. R., at McKee's Rocks; the construction of the Kingsbridge Power Station, New York City, for the Third Avenue Railroad. He also supervised the design and installation of the Long Island Railroad Company's electrification, including the large power house at Long Island City. His last work was in charge of design and construction of the mechanical and electrical features of the Pennsylvania Terminal Station in New York City, which he was obliged to relinquish just before it was completed. Mr. Caldwell leaves a wife, four children and his father, Lewis H. Caldwell, the latter being a resident of Los Angeles, Cal. The deceased was a member of the American Society of Mechanical Engineers and the American Society of Civil Engineers.

Trade Publications.

WIRES AND CABLES.—Detailed information relating to all types of wires and cables for electric installations is given in Catalog E of M. D. Austin & Company, Chicago, Ill.

ALTERNATORS.—Alternating-current generators arranged for direct connection with water turbines are described in detail in Bulletin No. 4799 of the General Electric Company.

ELECTRIC OVENS.—Various types of electric ovens are illustrated, listed and briefly described in a bulletin issued by the Despatch Manufacturing Company, Minneapolis, Minn.

AIR COMPRESSORS.—Bulletin No. 4025 of the Allis-Chalmers Company, Milwaukee, Wis., covers portable and stationary motor-driven air compressors for use in industrial establishments.

STEAM-ELECTRIC GENERATOR SETS.—Bulletin No. 411 of the Triumph Electric Company, Cincinnati, Ohio, is devoted to small directly connected generating sets intended for isolated-plant service.

ROCK DRILLS.—A good engineering description of electric rock drills is given in Bulletin No. 1120 of the Fort Wayne Electric Works, Fort Wayne, Ind., which has now reached its fourth edition.

OUTLET BOXES.—In its Bulletin D. the Steel City Electric Company, 1207 Washington Avenue, Pittsburgh, illustrates, describes and lists outlet boxes, which are furnished with the well-known knockout plugs.

TESTING SETS.—The Leeds & Northrup Company, Philadelphia, Pa., has issued Catalog No. 50, in which are illustrated and described the various types of cable-testing apparatus manufactured by the company.

INDUSTRIAL THERMOMETERS.—Bulletin No. 39 of the Industrial Instrument Company, Foxboro, Mass., deals with thermometers for industrial purposes covering a range of from 50 to 500 deg. Fahr.

INDUCTION MOTORS.—Polyphase induction motors rated at from 0.5 to 250 hp and for a frequency of 60 cycles are illustrated and described in Bulletin No. 126 of the Crocker-Wheeler Company, Ampere, N. J.

VENTILATING FANS.—Disk and propeller fan outfits driven by directly connected direct-current and alternating-current motors are described in Bulletin No. 235 of the Sprague Electric Company, of New York.

RAILWAY MOTORS.—Bulletin No. 4817 of the General Electric Company is devoted to commutating-pole railway motors rated at 75 hp, 600 volts. The weight of the motors complete with gear and gear case is 3800 lb.

BELTING.—Leather belting of the laminated type is described and its advantageous features discussed in a convincing manner in a booklet issued by the American Laminated Belting Company, 113 Hudson Street, New York.

TELEPHONE SWITCHBOARDS.—In its Pamphlet No. 33 the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., describes briefly its compact-type private-branch exchange telephone switchboard.

SMALL MOTORS.—Many suggestions concerning the applications of small motors are contained in Bulletin No. 1122 of the Fort Wayne Electric Works, Fort Wayne, Ind. The motors described include both single-phase and direct-current types.

INDUCTION MOTORS.—The Ideal Electric & Manufacturing Company, Mansfield, Ohio, has issued Bulletin No. 1031, in which the design details and operating characteristics of polyphase induction motors of the squirrel-cage type are fully covered.

PREPAYMENT WATT-HOUR METERS.—Single-phase prepayment watt-hour meters of the induction type are fully described in a well written publication, designed as Bulletin No. 1123, issued by the Fort Wayne Electric Works, Fort Wayne, Ind.

CORLISS ENGINES.—Design details relating to horizontal Corliss engines are given in Catalog E of the Vilter Manufacturing Company, Milwaukee, Wis. This catalog contains also a list of customers operating Corliss engines built by the company, which occupies 24 pages of closely spaced matter.

SMALL TRANSFORMERS.—Transformers designed for use with electric bells are briefly described and illustrated in folder No. 4511 issued by the Fort Wayne Electric Works, Fort Wayne, Ind. Transformers for use in sign lighting with low voltage lamps are described in leaflet No. 4512 of the same firm.

ELECTRIC FANS.—Bulletin No. 1126 of the Fort Wayne Electric Works, Fort Wayne, Ind., is a well-prepared publication dealing with fans for the 1911 season. The types described include desk and wall fans, booth fans, oscillating fans, floor column and counter column fans, ceiling fans and window ventilating fans.

STEAM ENGINES.—Bulletin No. 22 of the Ridgway Dynamo & Engine Company, Ridgway, Pa., is an attractive publication relating to four-valve engines of the so-called non-releasing-gear Corliss type. These engines differ from the usual type of Corliss engine in that they are designed for operation at considerably higher speed.

DIRECT-CURRENT MOTORS.—Motors of the constant-speed, variable-speed and adjustable-speed direct-current types are briefly noted in a booklet issued by the Rochester Electric Motor Company, Rochester, N. Y. Many of the applications made of these motors are shown by the means of illustrations of industrial establishments.

SELECTIVE RINGING SYSTEMS.—The Western Electric Company has issued Bulletin No. 1016, showing by means of well-prepared diagrams the arrangements that may be employed with harmonic selective systems for party telephone lines. The various elements which make up the complete system are briefly described and listed.

INDUSTRIAL THERMOMETERS.—Bulletin No 145 of the Bristol Company, Waterbury, Conn., relates to indicating thermometers of the so-called long-distance type. These thermometers are so arranged that the indicating mechanism can be mounted upon the wall at any convenient location to show the temperature at any desired point.

ELECTRIC FOUNTAINS.—Catalog No. 50 of F. W. Darlington, 5 North Twenty-third Street, Philadelphia, contains numerous illustrations relating to portable and semi-portable electric fountains. These fountains are automatic, being so arranged that the turning on of a switch starts the apparatus, which then continues in operation indefinitely.

INSULATORS.—Much valuable information concerning dimensional details and operating characteristics of high-tension line insulators is contained in a publication issued by the Locke Insulator Manufacturing Company, Victor, N. Y., known as the "Insulator Book." The book also contains descriptions of the tests to which insulators are subjected.

INDUCTION MOTORS.—Induction motors of the single-phase type, rated at from 0.05 hp to 0.5 hp, are described in Bulletin No. 3140 of the Emerson Electric Manufacturing Company, St. Louis. Back-gear type, single-phase induction motors, with countershafts, rated at from

0.33 hp to 0.50 hp, are described in Bulletin No. 3139 of the same company.

MAGNETO GENERATORS.—The Bosch Magneto Company, 223 West Forty-sixth Street, New York City, has issued in bulletin form a reprint of a paper presented by Otto Heims before the Society of Automobile Engineers on Jan. 11, 1911. This paper was entitled "Influence of Multipoint Ignition on the Efficiency and Output of Internal Combustion Engines."

SEWING MACHINE MOTORS.—The Emerson Electric Manufacturing Company, St. Louis, Mo., has issued Bulletin No. 3910 relating to direct-current and alternating-current motors, designed with particular reference to use with family sewing machines. Motors intended for use with factory sewing machines are described in Bulletin No. 3911 of the same company.

TEXTILE MOTORS.—The Westinghouse Electric & Manufacturing Company of Pittsburgh, Pa., has issued, as "Textile Motor Talk No. 12," a booklet comparing the development of the textile type induction motor to that of the automobile. It points out the fact that motor drive is doing in cotton machines what the vehicle motor and vehicle engine have done to the "horseless carriage."

SMALL DIRECT-CURRENT MOTORS.—A direct-current motor for driving light machinery, such as a player piano, advertising device, small lathe, sewing machine, etc., is described in Bulletin No. 109 of the Engineering Electric Manufacturing Company, Stamford, Conn. This motor is designed for operation at speeds up to 5000 r.p.m. It is stated that at 2500 r.p.m. its output is 0.05 hp.

THERMOMETER THERMOSTATS.—The Bristol Company, Waterbury, Conn., has issued Bulletin No. 129, in which are illustrated, described and listed thermometer-thermostats for temperatures up to 800 deg. Fahr. The thermometers are shown in two forms, one for the measurement of the temperature at the point where the instrument is installed and the other for the measurement of temperature at any distant point.

GROUND CONES.—Under the title "Some New Facts About Grounding," the Paragon Sellers Company, 60 Fifth Avenue, Chicago, distributes its Bulletin No. 2, giving some interesting facts about the Paragon ground cone. The pamphlet is devoted to a discussion of the use of ground cones in grounding general electrical installations, railway systems, as well as telephone and signaling circuits. Many instructive diagrams are included.

SWITCHBOARD PANELS.—Bulletin No. 4749, issued by the General Electric Company, will prove of interest to any one considering the purchase of alternating-current switchboard panels. The panels illustrated are of the sectionalized type, and each section has a separate catalogue number. The panels are in three sections, and the pages of the bulletin are sectionalized so that the user may have before him a picture of the complete panel desired, together with a full description of the equipment.

STORAGE BATTERIES.—Much information concerning storage batteries of the stationary type is given in Bulletin No. 34 of the Willard Storage Battery Company. The batteries described are designed particularly for use with railway signals, isolated plants, fire alarm, telephone and telegraph installations. The bulletin contains descriptions of the plate elements and price lists of each of the parts of the cell. Storage battery plates intended particularly for signal service are described in Bulletin No. 29 of the same company.

ELECTRIC FANS.—The General Electric Company is distributing Bulletin No. 4806, which is a neatly executed publication dealing with electric fans and small motors for domestic service. Fans for all services are fully described and illustrated. Among the newer features may be mentioned 8-in., 12-in. and 16-in. fans driven by motors possessing an improved form of induction winding, which eliminates the necessity of a centrifugal switch for the control of the starting winding. These motors contain no moving contacts, and are therefore extremely simple in construction.

RECORDING INSTRUMENTS.—The Bristol Company, Waterbury, Conn., has issued a series of bulletins relating to its numerous types of recording instruments. Bulletin No. 128 covers circular-chart recording thermometers designed for temperatures between 90 deg. and 500 deg. Fahr. Bulletin No. 135 covers recording shunt ammeters for all ranges of direct current. Bulletin No. 141 relates to recording pressure gages with circular charts, having a diameter of either 6 or 8 in. In its Bulletin No. 147 the Bristol Company describes a radii-averaging instrument for use with circular chart records. This instrument is particularly suitable for obtaining the average radius of records traced on circular charts having uniform gradations.

ELECTRICITY ON THE FARM.—The General Electric Company has issued Bulletin B3038, entitled "Electricity on the Farm." The bulletin is divided into brief chapters, each covering a specific use for electricity on the farm, the various descriptions of motor applications being accompanied by illustrations of electrically operated farm machinery in actual service. The section covering barn and field machinery includes description and illustrations of motor-operated hay hoist, ensilage cutter, thresher, grist-mill machinery, etc., while the chapter on electric drive for dairy apparatus shows the use of motor-driven vacuum pumps for the operation of vacuum-milking and cattle-cleaning outfits, motor-driven separators and churns. Other chapters deal with electrically operated refrigerating plants to meet the requirements of the average farm, the application of motor drive and auxiliary electrical devices in the farm workshop and the possibilities of electric haulage for farm products. Electric lighting for farm buildings and yards, together with the large number of labor-saving devices which can be readily operated from lighting circuits, are also described.

BUSINESS NOTES.

THE HEMMING MANUFACTURING COMPANY has moved its offices from New York, N. Y., to Garfield, N. J.

THE ELLIOTT COMPANY, manufacturer of steam specialties, has moved to its new Boston offices in the Oliver Building, corner of Milk and Oliver Streets.

THE WESTINGHOUSE TRACTION BRAKE COMPANY has moved its St. Louis office to Room No. 318, Security Building. The Southwestern manager of the company is Mr. E. L. Adreon.

THE ALBERT & J. M. ANDERSON MANUFACTURING COMPANY has moved its Chicago office to 105 South Dearborn Street instead of 105 Dearborn Street, as previously stated in our columns.

THE TRIUMPH ELECTRIC COMPANY.—The transformer department of the Triumph Electric Company, Cincinnati, has been placed in charge of Mr. R. F. Pier, who formerly held a similar position as foreman of the transformer department of the Canadian General Electric Company at Peterboro, Ontario.

THE W. K. PALMER COMPANY ENGINEERS.—The cities of Vermilion, S. D., and Anita, Iowa, have secured the services of the W. K. Palmer Company Engineers, Kansas City, Mo., in connection with the installation of electric lighting stations and distributing systems and remodeling of the water-works systems at both places.

THE NATIONAL INDIA RUBBER COMPANY.—A complete line of rubber-covered lamp hoods, wires and cables will hereafter be carried by the National India Rubber Company, Bristol, R. I., at its branch office, at No. 155 New Montgomery Street, San Francisco, Cal., which is in charge of Otis & Squires.

THE FEDERAL MINIATURE LAMP COMPANY.—General offices of the Federal Miniature Lamp Company have been opened at 812 Hippodrome Building, Cleveland. The president and general manager of the company is Mr. Walter R. Armstrong, who will receive the assistance of Mr. B. F. Whelan, formerly of the Buckeye Electric Company.

ESCHER WYSS & COMPANY, engineers of Zurich, Switzerland, have opened a Canadian office in the Lumsden Building, Toronto, in charge of their chief engineer, Mr. Heyendahl. The opening of this office has been rendered necessary by the increased development of the company's water-turbine business in Canada. Among the turbines built or on order are two 13,000-hp units for the Western Canada Power Company; one 10,000-hp turbine for the Shawinigan Water & Power Company, Montreal; eleven 5500-hp turbines for the Niagara Falls Power Company, Niagara Falls, and three 10,250-hp turbines for the Canadian Niagara Power Company, Montreal.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Geo. S. Emery, 11 N. Royal St., Mobile, Ala. Annual convention in November.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next semi-annual meeting, New York City, April 6, 7 and 8, 1911.

American Electro-Therapeutic Association. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York. Next meeting at Philadelphia, Pa., Sept. 5, 6 and 7, 1911.

American Institute of Consulting Engineers. Secretary-Treasurer, Eugene W. Stern, 103 Park Ave., New York City. The Council meets the first Friday of every month.

American Institute of Electrical Engineers. Secretary, Ralph W Pope, Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Electric Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Electric Railway Engineering Association. Secretary. Norman Litchfield, Interborough Rapid Transit Company, New York.

American Electric Railway Association. Secretary, H. C. Donecker. Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E.

Cowles, Little Rock, Ark. Annual Convention, May 16, 17 and 18, 1911. at Little Rock, Ark.

Association of Iron and Steel Electrical Engineers. Secretary, James Farrington, Steubenville, Ohio.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Boston, Mass., June, 1911.

Association of Railway Electrical Engineers. Secretary, J. Andreucetti, Chicago & Northwestern Railway, Chicago. Next annual meeting Chicago, November 6 to 10, 1911. Semi-annual meeting, Washington, 1911.

Association of Edison Illuminating Companies. Secretary, N. T. Wilcox, Lowell, Mass.

Canadian Electrical Association. Secretary, T. S. Young, 220 King St., West, Toronto, Can.

Colorado Electric Light, Power & Railway Association. Acting Secretary F. D. Morris, 323 Hagerman Building, Colorado Springs, Col.

Electric Vehicle Association of America. Secretary, Harvey Robinson, 124 West 42d St., New York. Meetings, fourth Tuesday of each month.

Electric Club, Chicago. Secretary, F. S. Hickok, 824 Marquette Building, Chicago. Meets every Wednesday noon, 303 Wabash Ave.

Electrical Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Annual meeting at Buffalo, N. Y., June 20, 1911.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursday of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo. Next meeting in Kansas City, Saturday, June 10, 1911.

Electrical Salesmen's Association. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Credit Association of Chicago. Secretary, Frederic P. Vose, Marquette Building, Chicago.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of directors meets second Thursday of each month.

Empire State Gas and Electric Association. Secretary, Charles H. B. Chapin, Engineering Societies Building, 29 West 39th St., New York.

Engine Builders' Association of the United States. Secretary, C. H. Lembower, Reading, Pa.

Florida Electric Light & Power Association. Secretary, H. C. Adams, West Palm Beach, Fla. Next meeting, Jacksonville, Fla., April 4 and 5, 1911.

Illinois State Electrical Association. Secretary, H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago. Annual convention, Chicago, 1911.

Independent Electrical Contractors' Association of Greater New York. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

Indiana Electric Light Association. Secretary, J. V. Zartman, Indianapolis, Ind. Annual meeting, August 23 and 24, 1911.

Internal Combustion Engine Association. Secretary, Chas. Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

International Association of Municipal Electricians. Secretary, C. R. George, Houston, Tex. Next meeting, St. Paul, Minn., 1911.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

Iowa Electrical Association. Secretary, W. N. Keiser, Dubuque, Ia. Next meeting, Davenport, Ia., April 19, 20 and 21, 1911.

Iowa Street & Interurban Association. Secreary, L. D. Mathes, Dubuque, Ia. Next meeting, Davenport, Ia., April, 1911.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Independence, Kan., Sept. 21 and 22, 1911.

Maine Electrical Association. Secretary, Walter S. Hyman, Waterville, Maine.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electric Association. Secretary, Herbert Silvester, Detroit, Mich.

Minnesota Electrical Association. Secretary, T. C. Gordon, Little Falls, Minn.

Mississippi Electric Association. Secretary, A. H. Jones, McComb City Light and Power Co., McComb City, Miss. Annual convention, Gulfport, Miss., June 20-21, 1911.

Missouri Electric, Gas, Street Railway & Water Association. Secretary, N. J. Cunningham. Next meeting, St. Louis, April 13-15, 1911.

National Arm, Pit & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National District Heating Association. Secretary, D. L. Gaskill, Greenville, Ohio. Third convention, Pittsburg, June 6-8, 1911.

National Electric Contractors' Association of the United States. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Niagara Falls, July 19, 1911.

National Electric Light Association. Executive Secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York. Annual convention, New York City, May 29-June 2, 1911.

National Electric Light Association, New England Section. Secretary-Treasurer, L. D. Gibbs, 39 Boylston Street, Boston, Mass.

National Electric Light Association, Pennsylvania Section. Secretary-Treasurer, Van Dusen Rickert, Pottsville, Pa.

National Electric Light Association, Nebraska Section. Secretary-Treasurer, S. J. Bell, David City, Neb.

National Electric Light Association, Georgia Section. Secretary-Treasurer, H. M. Corse, Columbus Railroad Company, Columbus, Ga.

National Electrical Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn. Next meeting, New York, March, 1911.

National Electrical Credit Association. Secretary, Frederic P. Vose, 343 Marquette Bldg., Chicago.

National Independent Telephone Association. Secretary, Joseph B Ware, Grand Rapids, Mich.

Nebraska Electrical Association. Secretary, Frank McMaster, Beatrice, Neb.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New Orleans Electrical Contractors' Association. Secretary, L. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

New York Electrical Society. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York.

Northwest Electric Light & Power Association. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July 25-28, 1911.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting at Youngstown, May 18 and 19, 1911.

Order of Rejuvenated Sons of Jove. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Building, Chicago, Ill.

Pacific Coast Electric Vehicle Association. Secretary, A. H. Halloran, 604 Mission St., San Francisco, Cal.

Pittsburgh Electric Booster Club. Recording Wattmeter, O. R. Rombach, 919 Liberty Ave., Pittsburgh, Pa. Meetings, fourth Monday of each month.

Society for the Promotion of Engineering Education. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

Society of Wireless Telegraph Engineers. Secretary, E. B. Moore, 39 Trinity Place, Boston. Monthly meeting, first Monday of each month.

Southwestern Electrical & Gas Association. Secretary, D. G. Fisher, 1316 Commerce St., Dallas, Tex. Annual convention, Houston, Tex. April 27-29, 1911.

Street Railway Association of the State of New York. Secretary, C. G. Reel, Kingston, N. Y. Annual meeting at Cooperstown, June 27 and 28, 1911.

Underwriters' National Electrical Association. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1911.

Vermont Electrical Association. Secretary, A. B. Marsden, Manchester Center, Vt.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 145 Monroe St., Chicago, Ill.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Wireless Institute. Secretary, Alfred N. Goldsmith, College of the City of New York, New York.

Wisconsin Electrical Association. Secretary, John S. Allen, Lake Geneva, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 28, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City]

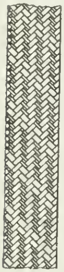
987,690. LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed April 11, 1907. Incandescent electric lamp socket carrying a plurality of lamps with axes in a common plane, including a shell carrying a socket with tubular stem secured to shell, one end forming a chamber, an insulating base in the chamber carrying binding screws and means extending through the stem for connecting the terminals with the socket contacts.

987,694. ELECTRIC HIGH WATER ALARM; E. E. Brackett, Central Falls, R. I. App. filed July 14, 1909. Ball float operates a lever switch which controls an electric circuit.

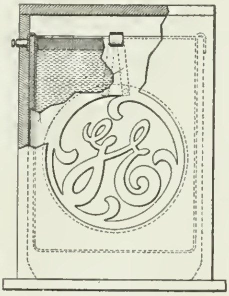
987,698. MULTIPLE VOLTAGE CONTROLLER; H. W. Cheney, Milwaukee, Wis. App. filed Oct. 5, 1908. Rheostat drum which is given a snap action and a non-snap action, the former when the motor armature connections are changed and the latter at other times with a blow-out magnet for blowing out the arc produced on interrupting the armature circuit, all said interruptions occurring at one fixed point.

987,717. ELECTROLYTIC CELL; T. Griswold, Jr., Midland, Mich. App. filed Dec. 7, 1907. Electrolysis of alkaline chlorids. Two solid non-porous carbon electrodes and an annular separating member between them whereby a chamber for the electrolyte is formed, the inner faces of the electrodes forming an anode and a cathode.

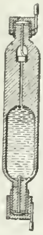
987,720. TELEGRAPHY; B. P. Hayes, Topeka, Kan. App. filed May 17, 1910. A line wire with jack contacts, a local circuit with a jack plug cutting into line, a direct connection from one side of the plug to the ground, a relay, a variable resistance, a key, a line from the other side of the plug to one relay contact and to the variable resistance, a connection between it and the relay winding and between the winding and the key and a connection between the key and the jack plug and the ground.



988,099.—Flexible Conducting Cord.



988,104.—Sign.



988,176.—Alarm for Bearings.

987,768. ELECTRIC CLOCK; L. F. Stadel, Freeport, Mich. App. filed Aug. 4, 1909. Electrically driven clock with an escape wheel driven by a spring, an electromagnet for tensioning the spring and electric circuit and hand arbor actuated by the magnet independently of the spring.

98- -75. ELECTRICALLY OPERATED CIRCUIT BREAKER; H. L. Van Valkenburg, Norwood, O. App. filed Oct. 27, 1905. Automatically breaks the circuit through the coil of the operating mechanism on overload by means of an auxiliary switch for automatically opening the circuit.

987,840. PROCESS FOR THE MANUFACTURE OF STEEL; S. S. Wales, Munhall, Pa. App. filed Dec. 11, 1908. Makes use of a single furnace with ordinary electrodes, the furnace having gas ports and regenerators. Introduces fluxing material and iron oxide, heats with gas, and finely treats with electric heat, for converting into steel.

987,864. OPERATOR'S SELECTIVE RINGING KEY OR SWITCH; W. W. Dean, Chicago, Ill. App. filed June 15, 1903. A key with long top plate, a post at each end, a parallel bottom plate, vertical key plungers passing through the plates, switch springs on the bottom plates and operated by the plungers and a pivoted catch-plate beneath the top plate.

987,874. SWITCHBOARD; T. A. Hammond, Passaic, N. J. App. filed March 8, 1905. Telegraph switchboard made up of units, each including a block carrying a line circuit including two jacks and a common grounding switch.

987,901. ELECTRIC FLATIRON; F. H. McManus, Boston, Mass. App. filed July 27, 1910. A chambered metal body, separate heating windings therein, a handle for the body and a switch within the body for connecting either winding in circuit and operated from the outside.

987,902. APPARATUS FOR PRODUCING OZONE; C. D. Meeker, East Orange, N. J. App. filed Aug. 4, 1910. Two concentric tubes, a conduit-box connected at its bottom to the outer tube, a cover for the box connected to the inner tube.

987,924. RECTIFYING SYSTEM FOR ALUMINUM CELL LIGHTNING ARRESTERS; C. P. Steinmetz, Schenectady, N. Y. App. filed Sept. 13, 1910. An electrolytic lightning arrester for an alternating system combined with a mercury-arc rectifier connected to derive a uni-directional potential from the system and impress it on the arrester.

987,947. ELECTROLYTICALLY REFINING ALLOYS; A. Gardner Betts, Troy, N. Y. App. filed April 19, 1909. A process of treating alloy by dissolving metals by electrolysis, depositing an alloy at the cathode and changing the condition of the solution and then depositing a different alloy.

987,953. ELECTRIC FURNACE; J. W. Brown, Lakewood, Ohio. App. filed March 5, 1910. Furnace of the ring type with air or gas circulation made in sections.

987,956. TELEGRAPHIC TRANSMITTER; G. A. Cardwell, New York, N. Y. App. filed Jan. 15, 1908. Key levers, selector bars moved thereby, normally opened circuits closed by the bars and grouped so as to transmit characteristic impulses when the bars are moved in one direction and different impulses when moved in the opposite direction.

987,979. ALTERNATING-CURRENT MOTOR AND CONTROLLING DEVICE THEREFOR; V. I. Gray, Toledo, O. App. filed April 13, 1908. Combines with the main windings, inductive auxiliary windings, comprising pairs of coils in multiple series with the main windings, bridge connections between members of each pair and means for cutting out the auxiliary windings and throwing resistance therein.

987,984. SWITCH; G. W. Hart, West Hartford, Conn. App. filed Feb. 21, 1910. Snap switch whose opening is controlled electromagnetically with a local shunt circuit for the electromagnetic means whereby the electromagnet is released from the work of putting the snap spring under tension.

987,985. SWITCH; G. W. Hart, West Hartford, Conn. App. filed June 30, 1910. Rotary snap switch for 500-volt circuits with large distance between contacts and a thin circular sheet of insulating material to prevent the arc following the switch arm.

988,004. ANNUNCIATOR; A. Lungen, New York, N. Y. App. filed Oct. 13, 1909. A pair of magnet bobbins, an armature with an arm, an angle to its body and a banner with a pair of curved flukes attached to the arm.

988,009. SIGNAL TRANSMITTER; J. McFell, Chicago, Ill. App. filed Aug. 19, 1909. For selective signaling, including a motor, a switch, a toothed actuator selectively positioned and axially moved to throw the switch in and out with means for latching the actuator upon the shaft.

988,018. FLUSH RECEPTACLES; W. J. Newton, Lynbrook, N. Y. App. filed June 26, 1909. Inserted in the wall in lieu of the usual switch mechanism. Includes a block with outside spring blades to establish electrical connection within the box, the block having tongues and protuberances to correspond to the usual operating buttons of the switch mechanism.

988,028. MOTOR CONTROL SYSTEM; W. H. Powell, Norwood, O. App. filed May 21, 1907. For rolling mills and hoisting machinery, including a motor, a generator supplying its armature, a rotary controller for the field of the generator and a manually-controlled rotary motor for operating the controller.

988,042. ELECTRIC METER; G. E. Stevens, Lynn, Mass. App. filed Aug. 31, 1905. A meter with an armature, a field coil in inductive relation thereto, a plate on each side of the coil and lacing of insulating material for binding the plates and coils together, particularly for integrating meters of the commutator type.

988,044. TELEPHONE RECEIVER; H. R. Stuart, Wheeling, W. Va. App. filed March 21, 1908. Multiple pole electromagnetic receiver for loud-speaking telephone,, including a tube, a disk, a ring and one or more magnets for magnetizing the ring and tube with opposite polarity.

988,067. ELECTRIC LOCOMOTIVE; A. F. Batchelder, Schenectady, N. Y. App. filed April 7, 1909. A plurality of driving wheels, a jack shaft in the plane of the axles of the wheels, a motor over the driving wheels, the plane of the motor shaft and of the jack shaft meeting at an angle and a crank and connecting-rod connections between the driving wheels and jack shaft and the jack shaft and rotor of the motor.

988,093. SYSTEM FOR CONTROLLING ELECTRIC CIRCUITS; G. W. Hart, West Hartford, Conn. App. filed June 30, 1910. A plurality of branch circuits with electromagnetically controlled switches so interconnected as to be controlled electromagnetically from a single point so as to open their respective branch circuits.

988,094. SWITCH; G. W. Hart, West Hartford, Conn. App. filed July 7, 1910. Double snap switch of the two push-button type with an oscillating actuating member. Details.

988,099. FLEXIBLE CONDUCTING CORD: O. Hoffstrom, Chicago, Ill. App. filed July 26, 1907. A flexible cord having graded layer with resilient insulated strands in one direction and conducting strands in the other, the latter grouped to form concentric conducting spirals, each spiral including a plurality of conducting strands.

988,104. SIGN; R. G. Jenckes, Manaos, Brazil. App. filed June 25, 1910. A luminous display device, including a vessel with a window containing an electrolyte, a film-coated electrode in the form of a letter mounted in the vessel to register with the window, a second electrode in the vessel, the current producing a luminous film.

988,148. MANUFACTURE OF FILAMENTS FOR INCANDESCENT LAMPS; C. P. Steinmetz, Schenectady, N. Y. App. filed April 30, 1904. Treats filaments with penta-fluorid of iodin.

988,162. ELECTRIC SIGNALING MEANS; A. J. Allard, Richmond, Va. App. filed Oct. 29, 1910. For indicating broken wheel flanges by means of electrical circuits co-operating with the wheel flange and a signal, operative upon a break in the flange.

988,171. FIRE ALARM SYSTEM; H. B. Bush, Littleton, Colo. App. filed May 25, 1909. A fire alarm system, including a drop, a circuit controlling it, a solenoid, a visible signal, a bridge plate operated by the solenoid to close the signal and an audible alarm.

988,176. ALARM FOR BEARINGS; A. H. De Lage, Alpena, Mich. App. filed June 14, 1910. A mercury tube with a neck containing contacts, wires connecting the contacts and ferrules so as to sound an alarm when in danger of hot box.

988,102. ELECTRICAL TESTING DEVICE; C. A. Hetherington, Des Moines, Ia. App. filed Dec. 20, 1909. A screwdriver with a testing device in its handle for testing circuits for voltage, etc.

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BRISK FEBRUARY EXPORT TRADE.

It is difficult to tell whether business is dull or not. Some people say it is—and then other people come along with reports of rush and activity. The probability is that all business just now is being conducted on a sane rather than a sanguine basis; and on the whole there can be no objection to that. In the meantime the export trade in electrical goods is certainly brisker than ever, and domestic dullness may in part account for it. The returns for February, 1911, are in excellent contrast with those of last year. The export of electrical instruments and small apparatus for the month has jumped from $607,359 to $939,714. Of heavy electrical machinery the export has risen from $331,136 to $551,885; so that the total amounts under both heads are $938,495 and $1,491,599. The increase is therefore no less than $553,104, which for a short month may well be characterized as extraordinary. Canada remains one of our best of customers, while Brazil is buying heavily and Japan seems inclined to become a large and steady customer as of old. European demand has become almost negligible, which is perhaps unfortunate, but we return the compliment.

CONSTRUCTIVE WORK IN CONSERVATION.

The conference held in New York last week on the governmental control of water-powers, under the auspices of the Power Transmission Section of the National Electric Light Association, was an altogether interesting and useful function. The attendance was very good as to size and remarkably diversified as to representation. The papers and speeches were of unusually high caliber, and an industry affected most seriously by the paralysis inflicted on hydroelectric development by the agitation of the last few years was at last able to voice its well-founded complaints. That these complaints were justified was shown at once by the frank admission of Mr. Fisher, the new Secretary of the Interior, that the national government has no plan or policy as to conservation and the use of water-powers. It is living from hand to mouth, so to speak, by continuing the present status, which is one of "negation." That makes at least a good starting point for some new and definite policy on which all can get together for the welfare of the nation, so that real conservation can be put into force in the utilization of the millions of horse-power now running idly to shameful waste. The Secretary made, it is evident, a most favorable impression on an audience not wholly disposed at first, perhaps, to be friendly, and his visit to New York must be accepted as an event of the best augury. He must have felt that he was met with a frankness and openness of mind equal to his own. It is, indeed, not a little curious to see, as evidenced by the discussion, that among the engineers and capitalists themselves, as amongst the larger public, differences of opinion exist as to how to go about it, what is best, and where real control of the powers lies and should vest. There must be some definite and general agreement before any forward work can be accomplished, and the conference seems to have helped most materially in that direction.

One of the features of water-power development upon which much emphasis was placed was the question of tenure. There are well-defined disadvantages in limited tenure without provision for extension of time, and there are possibilities of abuse in perpetual rights without regulation of service and rates. However, the disadvantages decrease when extension of time of occupation is made dependent upon service rendered, and the abuse involved in perpetual occupancy is eliminated when regulation is made effective. Whatever may be the form of tenure adopted it seems safe to predict regulation by commission, in which event the attractiveness of the development proposition to financiers is maintained and good service to the public is assured. In the development of water-powers upon public domain for utilization for public service the public-service companies are entitled to protection of their rights and adequate returns upon the money expended, and the public is entitled to proper service at reasonable charges therefor. It is to the interest of both the public and the companies that all unnecessary restrictions upon water-power developments be removed. With the unnecessary restrictions removed the division of benefits between the public as consumers and the companies as investors can well be determined by properly selected public-utility commissions. The temperately worded resolution unanimously passed by the conference should result in the accumulation of the information needed by such commissions in determining the regulation to which water-power companies should be subjected.

NEW RUBBER-COVERED-WIRE SPECIFICATIONS.

Rubber-covered wire labeled "National Electrical Code Standard" may be good, bad or indifferent. The label signifies merely that the wire has met certain tests and requirements, and, strange to say, wire with no rubber at all in the insulating compound has been known to pass muster. An insulation resistance of 100 megohms per mile during thirty days' immersion in water at 70 deg. Fahr. was the criterion and manufacturers had no difficulty in compounding a mixture that would show an initial resistance twenty times as high and yet be good for noting a year later. The cheapest wire that would pass the rules was what was wanted by electrical contractors who had to meet competition, and they would always find some manufacturer who was willing to accommodate them. Happily, some years ago the underwriters saw a light and set about to remedy a condition fast becoming intolerable. Meanwhile, however, private interests would no longer accept code wire and numerous municipalities passed ordinances virtually shutting it out from their borders. Now come the underwriters with more rigid specifications which it would seem impossible for manufacturers to get around if they would. Knowing from experience that an electrical test in itself did not suffice and appreciating that it was possible to beat even a physical and a chemical test separately, they have drawn up a combination of tests which baffles evasion. The specifications are printed elsewhere in this issue.

The underwriters have not sought the very best that can be obtained, but a wire that it is safe to use. The standard is not raised above what it was years ago, and the cost of the wire need not be increased greatly because of the new order. If the underwriters had specified 30 per cent of fine new Para rubber as a minimum, the industry might well stand aghast at the prospect with rubber at $1.40 a pound as it is at present. Assurance is given by the Rubber-Covered Wire Engineers' Association that under the new specifications the cost will be increased about 15 per cent for No. 14 wire and less for the larger sizes, and, inasmuch as the cost of the wire represents at most only about 20 per cent of the price of a wiring installation in first-class cities, no undue hardships will result. The manufacturers of rubber-covered wire welcome the change, as it will enable many of them whose integrity would not permit them to lower their standards to compete on an equitable basis for a share of this immense trade. Much better wire is made by most of them, but the cost ranges from 50 per cent to 100 per cent higher than that of the code wire, and from a fire-hazard viewpoint such wire is better than necessary. A glance at the new code specifications will show them to be a vast improvement not only over the present code requirements but over those recently adopted by some cities that have given this matter attention. Although the specifications will not become effective until probably a year from now, new code wire will probably be on the market in about six months.

OVERVOLTAGES ON OPENING SHORT-CIRCUITS.

When a direct-current generator supplies energy to a constant-potential system of mains and a short-circuit suddenly occurs on the system it is the duty of the nearest circuit-breaker to cut off the short-circuited branch from the system and relieve the healthy remainder of the tree from the overload. If, for instance, the short-circuit occurs in a particular motor, the circuit-breaker adjacent to the motor, and ordinarily mounted on the motor starting-panel, is supposed to open automatically. If it should fail, then the circuit-breaking device at the floor panel or at the service entrance to the building should open. The ordinary short-circuit is thus dealt with automatically without any difficulty or concern. The violence of a short-circuit depends upon its magnitude and suddenness. A short-circuit at a house service box is usually more violent than at a remote outlet on the fifth floor. A violent short-circuit may happen to do damage in particular cases, either by mechanically straining the generator unit, by overheating the conducting path, or by generating a sudden overvoltage on the system at the moment of opening the short-circuit. Such overvoltages may cause the insulation of the system to break down at some other point.

On page 919 is printed an abstract of a very practical paper dealing with an experimental inquiry into the behavior of circuit-breakers as used in Great Britain. The oscillographs appended show that when the short-circuit was made on mains receiving energy from a shunt generator the overvoltage produced tended to be greater than when a storage battery was used, owing to the greater inductance of the generator. While this appears to be a fair deduction for the particular circuit investigated, it would be unsafe to generalize from this case and to assume that overvoltages are always more pronounced with generator supply than with storage-battery supply, because when a powerful storage battery is used it may build up current through the short-circuit so much more rapidly than a generator that when the rupture comes the effect of the greater current in the one case may outweigh the effect of the greater self-induction in the other. Again, the oscillograms show how much the overvoltage depends on the suddenness of the rupture. The oil-break behaved distinctly better than the air-break equipment. The relatively lower overvoltages with storage-battery supply are partly attributable to the limited current of the battery, which did not exceed 1200 amp. Here again, however, the advantages of the oil-break are disclosed in the curves. On alternating-current circuits the oil-break has the additional advantage referred to in the article that the oil chills the arc out of existence at the first zero passage of the current. An air-break is not nearly so effective in this respect, and the arc is apt to carry over into the next reversal.

PORTABLE SEARCHLANTERNS.

A brief article elsewhere in our columns gives a vivid idea of the ingenious way in which technical engineering reinforces the army in its field operations. No sooner is an advance made in science than the military engineers seize upon it and adapt it to their uses. Of late there have been most ingenious modifications of motor trucks devised for army use in almost every possible sphere of its activity. The present paper gives a brief description of the portable and effective searchlantern apparatus which has been developed recently by the engineer corps. The searchlantern in offensive and defensive military operations has many times demonstrated its usefulness. More than a century since the importance of lighting the enemy's works was recognized and the necessity met by the production of fireballs thrown from mortars and loaded with a small shell to discourage efforts at their extinguishment. With the invention of the oxyhydrogen blowpipe a powerful source of artificial light readily adapted for use with projecting mirrors was at hand, and at least as early as the autumn of 1863 the oxyhydrogen searchlantern found its way into military practice. It was used at that time in the siege of Charleston, in the trenches before Fort Wagner, and subsequently in the batteries directed against Fort Sumter, in the latter case at a distance of some three-quarters of a mile. But the active use of the searchlantern had to wait for the development of the electric arc lamp, because readily portable electric plants were not conveniently available until the evolution of the gasoline engine which has resulted from the automobile industry.

The present equipment is interesting on account of the unusual character of the drive. The generating set of 15-kw rating is operated by a five-cylinder gasoline engine directly coupled to an 85-volt interpole generator. This serves to operate the searchlantern when in use. When in transit the energy is supplied by the generator to four motors, one within each steel-plate wheel, which it drives through an interior gear. The searchlantern itself is carried on a field artillery caisson towed in the usual manner behind the truck, and is of the 30-in. size with remote control. A further adjunct to the equipment is a telescoping tower for mounting the searchlantern in the field. This enables the lamp to be carried 30 ft. above the ground if necessary and to be operated at this height by distant control, so that the lantern itself can be used without exposing the operators to machine-gun fire, by which the lantern itself with its metallic mirror is not easily put out of action. The wireless telegraph, the portable searchlantern and the aeroplane are three developments of applied science likely to play no unimportant part in the next war, and it is a matter of some satisfaction to realize that the United States Army, small though it is numerically, is not backward in the development of these technical auxiliaries.

MECHANICAL ALTERNATING-CURRENT WAVE ANALYZER.

No great progress can be made in the study of alternating-current phenomena without means for analyzing a complex alternating current into its harmonic components. The elementary theory of alternating currents is ideal in the sense that it contemplates all such currents as simply sinusoidal in wave-form, just as the elementary theory of geodetics or of navigation contemplates a simply spherical world. But unless we are content with first approximations a simply spherical world does not conform with geodetic measurements and a simple sinusoidal current-wave theory often leads to marked inaccuracies in reasonings concerning alternating currents. The determination of the harmonic components in an alternating-current wave may be effected either by computation from a step-by-step ondographic measurement or by a process of computation based upon the co-ordinates of the photographed wave-form, or it may be arrived at electrically by an experimental weeding out process.

The article by Dr. C. A. Pierce which we publish this week offers another means of arriving at the analysis. It may be described as an experimental means of executing the "strip" method, which ordinarily has to be executed by graphical computation. It employs a set of commutators, one for each harmonic component, and all are rotated on the same shaft in synchronism with the e.m.f. to be analyzed. A direct-current voltmeter is connected to the brushes of each commutator in turn and the maximum reading is obtained by trial on adjusting the diameter of commutation. A brief computation from the observed rectified readings and the reading of an alternating-current voltmeter across the mains then gives the respective values of the harmonic components. The new method has the advantage of being nearly direct reading and of being swift in application. No oscillogram or curve of wave-form has to be obtained. Moreover, if the wave-form of the e.m.f. or current under consideration is subject to change, the amount of this change in any one component can be very speedily found as it occurs by merely seeking the maximum direct-current voltmeter reading and the diameter of rectification on the commutator at which it is obtained.

Until experience has been obtained with an apparatus of this character it is difficult to arrive at an estimate of its practical value. It would seem, however, that a difficulty with the apparatus might lie in maintaining its adjustment. Each commutator has to run smoothly at a high speed and a pair of brushes must be maintained in smooth contact therewith. The brushes must lie as closely as possible upon a diameter, must neither miss contacts nor bridge contacts. A harmonic analyzer is an instrument that is apt to lie idle for considerable periods between times of use, and the effort required to restore the instrument to working order after a long period of use should not be great if it is to remain in practical favor. It remains to be seen how far such criticisms may apply in practice. There is certainly a need for an experimental harmonic analyzer, and the design of this one is very interesting, whatever its practical capabilities may be. At present dependence must be placed upon the mathematical analysis of oscillographic records of alternating-current waves. In the first place, such records are not reliable if the oscillograph is not in proper damping adjustment. In the next place, as pointed out in the article, the outline of the oscillographic record is seldom sharp enough to admit of a high degree of precision in analysis.

Central-Station Statistics.

The April issue of *The McGraw Electrical Directory* contains reports of 169 companies not previously listed. The total number of companies is 6239, as against 6180 reported in the October, 1910, issue—the net increase being 59. The difference is due to the large number of small plants which have been taken over by large corporations, and does not mean fewer electric plants, but fewer electric companies. The total number of companies in the United States is 5718, as against 5669 in the October issue, with 153 new companies added. There are 3689 companies carrying supplies, an increase of 111. The total number of municipal plants is 1494, 1352 of this number being in the United States. The number of companies using only direct current is 903, being 13 less than previously reported, while the companies using only alternating current is 3935, an increase of 175. Two hundred and fifty-eight companies report the use of steam for heating and 1267 companies operate hydro-electric plants wholly or in part, the largest number being in New York, which gives 136, followed by Michigan with 82, Wisconsin, 71; Maine, 54, and California, 48. Fuller reports have been secured regarding the companies also manufacturing ice, which brings the number up to 218, as against 105 in the October issue. The list of electrical dealers and contractors contains 6084 names.

Technical Students at Foreign Schools.

The following compilation giving the number of students attending the engineering courses of seven of the large German technical high schools and of one Swedish technical school during the term 1910-1911 is reprinted from *Teknisk Tidskrift* (Sweden). It will be seen that the grand total of students enrolled at the seven German schools is over 10,000, of which 1492 are enrolled in courses of electrical engineering and 576 in courses combining electrical and mechanical engineering. In five schools reporting the number of foreigners enrolled these latter form no less than 26 per cent of the students.

	Electrical Engineering	Mechanical Engineering	Chemical and Metallurgical Engineering.	Architecture	Civil.	Special.	Total.	German	Foreigners.
Berlin	162	758	211	432	638	397	2598	...	
Braunschweig	95*	95*	167	64	119	61	506	451	55
Darmstadt	345	166	163	331	271	46	1322	957	365
Dresden	481*	481*	227	229*	229*	106	1043	812	231
Karlsruhe	278	178	230	202	208	39	1135	....	
Munich	576	206	304	534	534	602	2756	2106	650
Stuttgart	131	22	94	187	186	91	711	674	37
Total	2068	1906	1396	1979	2185	1342	10,071	5000	1338
Stockholm, Sweden	68	85	93	32	104	59	441	....	...

*Courses combined.

Sale of Toronto Electric Light Company to Sir William MacKenzie.

At a meeting of the board of directors of the Toronto Electric Light Company at Toronto on April 8 the offer of the corporation of the City of Toronto to pay $125 per share for the plant and equipment of the company, the shareholders to keep possession of the liquid assets or accounts receivable, was rejected. The board decided to recommend to the shareholders for acceptance an offer made on behalf of Sir William MacKenzie, president of the Toronto Railway Company, to purchase the stock of the Toronto Electric Light Company for the sum of $135 cash per share, on payment of $20 per share now and the balance within six months. Under this accepted offer the shareholders on depositing their scrip with National Trust Company will receive $20 per share cash and new scrip for the remaining $115 per share bearing interest at the rate of 6 per cent per annum. Within three months the new scrip will be redeemed by a cash payment, completing the deal, and the control of the company will be transferred to a syndicate headed by Sir William MacKenzie. To carry out the proposed transfer two-thirds of the shareholders must agree, but as the directors already control the company the deal will go through as a matter of certainty. In the meantime the business of the Toronto Electric Light Company will be carried on as usual, the old directors being re-elected and retaining their positions until the purchasing interests assume control.

The result of this purchase will give Sir William MacKenzie control of practically the entire electric service and railway business within the Toronto district, as he already has control of the Toronto Railway Company, which company, through the ownership of stock, controls the Toronto and Radial Railway and the Electrical Development Company of Ontario. The latter company owns the generating station at Niagara Falls, Ont., and owns the Toronto & Niagara Power Company, which constructed and operates the transmission line from the Falls to Toronto, while the Toronto Electric Light Company distributes the Niagara energy through its long-term contract with the Electrical Development Company.

It is expected now that all the public-utility companies are under one control that an active campaign of opposition will be waged in Toronto between these interests and the Hydro-electric Commission and the corporation of Toronto for the electricity supply business of the district.

New-Type Arc Lamps for Chicago Street Lighting.

As previously announced in these columns, electric street lighting is to be extended in the City of Chicago by the addition of about 10,000 arc lamps to the 12,000 already installed. The City of Chicago has made a contract with the trustees of the Sanitary District, who control the Drainage Canal output, which will make it possible for the city to obtain energy for these additional lamps.

Although the exact specifications for the additional new lamps which are to be installed have not been drawn up, it seems now practically certain that the lamps specified will be of a new type. The lamp under consideration is of the series alternating-current 60-cycle flame-arc type, taking not over 60 volts at the lamp terminals at 10 amp. The arc will be inclosed and the minimum hours of burning with one trim will probably be specified as 100. Eight thousand lamps will be taken on the first order, which will later be increased by 2000 lamps.

Sample lamps of this type are being tried out in a small way on some of the street corners in Chicago. They may be classed as occupying a position between the common flaming arc, which has a short life of electrode, and the old inclosed carbon-arc lamp. It is to be presumed that the efficiency of the lamp will likewise fall somewhere between the present flame arc and the old-fashioned inclosed-carbon arc. At any rate, the lamps when operated at the 10 amp specified will probably be the most powerful illuminant used for regular street lighting on a large scale in the United States.

Commonwealth Edison Branch, N. E. L. A.

At the meeting of the Commonwealth Edison Branch of the National Electric Light Association at Handel Hall, Chicago, on the evening of April 6, there was an attendance of 380. Chairman Ernest F. Smith announced that the total membership of the branch was 930, an increase of 90 per cent since Nov. 1, 1910. The new badges were distributed. The central portion of the badge is the bronze emblem of the parent association, while surrounding it are the words "Commonwealth Edison Branch, Chicago," on a circle having segments of red, white and blue enamel. It was voted to present gold badges to the chairman and past-chairmen.

Three papers were read at the meeting. The first was by Mr. H. A. Seymour, of the advertising department of the company and editor of the *Electric City Magazine,* who described the methods and aims of that monthly publication under the title "An Educative Force in the Electric Service Field." Mr. Harold Wright, of the contract department, read a paper on "Methods of Handling Business to Give Service," in which he told of the elaborate system of procedure of the contract department, with its numerous blanks and forms in the matter of handling reports, orders and contracts relating to new business. The third paper was by Mr. A. P. Good, of the engineering department, whose subject was "Interior Wiring Inspection." He told of the work of the inspection division of the engineering department in passing on the wiring on customers' premises. All of the papers were illustrated by lantern-slide pictures. Mr. G. L. Knight, of the Edison Electric Illuminating Company of Brooklyn, was a visitor and made a few remarks. He mentioned the fact that the Brooklyn Branch of the N. E. L. A. has now 520 members. The percentage of attendance at the meetings of this branch is very high, there being 490 members present at a recent meeting.

Following the serious part of the program there was an entertainment consisting of instrumental and vocal music, impersonations, amusing cartoons and a "chalk talk," all of the performers being employees of the company.

Peculiar Fire at St. Croix Water-Power Plant.

A peculiar accident due to a generator burn-out on April 3 in the Apple River Falls water-power plant of the St. Croix Power Company, near Somerset, Wis., set fire to the building, causing $5,000 damage, and resulted in several days' interruption to the operation of the station. The output of this plant is transmitted twenty-five miles into St. Paul, Minn., where it is utilized by the St. Paul Gas Light Company in conjunction with its local steam plant for supplying service to its St. Paul electric customers.

Breakdown of one of the 750-kw generators in the water-power plant caused the machine to burn out. Flying pieces of its armature coils set fire to the roof in a number of places, and a section about 30 ft. square was burned off. In the efforts to extinguish this fire water was thrown and some of the remaining equipment was soaked. Except for the water-soaked condition of this apparatus the plant might have continued in operation. It was, of course, immediately shut down and the machines carefully dried out so that several days later operation was resumed.

The total loss occasioned by the burn-out and fire will probably not exceed $5,000. Newspaper accounts the day of the accident greatly exaggerated the damage and its effect on the company's service at St. Paul. The local steam plant and storage battery were able to carry the load without interruption and with equipment to spare, so that no effects of the accident were felt at St. Paul.

N. E. L. A. Conservation Conference.

At the public conference on water-powers and their governmental control held under the auspices of the transmission section of the National Electric Light Association, in New York, on April 8, the feature of highest importance was the presence of Secretary of the Interior Fisher, who listened with sympathetic interest to the arguments of the various speakers and explained the attitude of the present administration concerning the development of water-power.

In his opening remarks Mr. H. L. Doherty, as chairman of the transmission section of the N. E. L. A., called attention to the fact that this organization represents over 80 per cent of the money invested in the electricity supply business in this country, the amount being in excess of $2,000,000,000, and showed that the discussion of the attitude of the national and state governments toward the development and utilization of water-powers is well within its province. He presented statistics indicating that approximately 33,500,000 hp in water, which can be economically developed, is not yet utilized, while the country is using annually more than $200,000,000 in fuel that might be saved by the development of the water-powers.

The development of water-power has been retarded by obstacles placed by the government which are of no benefit to the government or to the people. Although the N. E. L. A. is the only national body representing the financial and commercial, as well as the technical, side of the electricity supply business, it was not called upon when the government policy as to water-powers was framed. The association, therefore, inaugurated the conference as a public meeting, where all might be heard with proper regard to the opposing opinions of others, in order to determine what should be the attitude of the national and state governments toward water-power developments.

The chief paper of the session was one by Mr. Sidney Z. Mitchell, of the Electric Bond & Share Company, New York. Mr. Mitchell spoke of the fact that since water is not altered by its use for producing power, while the power thus produced results in the saving of fuel, the only real method of conservation represents the utilization of the water for power purposes. He stated that true conservation of this character is not now being practised as widely as should be the case. He attributed the lack of development to the obstacles placed by present governmental regulations upon water-power utilization. Attention was called to the fact that the use of water-power for public utility purposes is essentially different from its use for private purposes. In the one case the benefits derived are shared by the whole public, while in the other case all of the profits go to private owners. The proper attitude for the government to take is one which will encourage the fullest utilization of the water-powers, with proper regulation of the service for the public benefit. Among the great obstacles placed by the government upon water-power development mention was made of large taxes, limited franchises and restrictions relating to dams on so-called navigable streams. He claimed that limited franchises placed upon water-power result in the equivalent of limited tenure upon not only the hydraulic development but also upon the whole electrical equipment, including transmission line, substation and distributing circuits. He said that if the government insists on limited tenure and the expectation is that the tenure will be renewed on equitable terms, the government should give some assurance to the investors in order to facilitate the financing of the development. Any disadvantage of this nature under which the company is placed must result in excess charges to the public for service.

Secretary Fisher expressed his appreciation of the value of the conference as a means of obtaining information concerning the attitude of the public-service companies upon the development of water-powers. He expressed the belief that there is not at the present time any conflict between the state and the federal control over the water-powers. If, however, such conflict does exist, it should be pointed out and will then be remedied. He claimed that there is at the present time no set governmental policy concerning the development of water-powers. The government is postponing the forming of any policy until it has obtained the requisite information concerning the subject. Such information can best be obtained from societies such as the National Electric Light Association.

In a written communication Mr. Calvert Townley, vice-president of the Connecticut Company, New Haven, Conn., stated that the attitude of the government seems to be neither constructive nor obstructive, but rather meddling. This attitude is especially noticeable in the New England States, where, although there are at the present time no government reservations, yet much water-power remains undeveloped. All of the water-power developments already made have not proved satisfactory commercially. They are not the equal of gold mines, as the public has been led to believe. The imposition of high taxes upon water-powers is not desirable. It retards development and merely increases the cost to the consumer of the energy produced.

Mr. J. R. McKee, of New York, stated that the discussions should be confined to detailed information relating to water-power development, instead of generalities indulged in for mere eloquence. He called attention to the fact that the amount of land withdrawn for entry in the United States proper represents an area forty-four times as large as the State of Massachusetts. He stated that the salary of persons connected with the Forestry Service is approximately $144,000,000 per year, and yet the reforestation amounts to only 15,000 acres of land. It would seem, therefore, that the Forestry Service is a rather expensive luxury when one considers the results obtained. As a source of income from the forest reservations it is best to look to water-powers. At the present time the development of water-powers on government reservations is much hampered by the necessity for obtaining permission from proper government officials. For example, in certain cases it is essential to obtain permission not only from the Secretary of the Interior, but also from the Secretary of Agriculture and from the Secretary of War. He expressed the opinion that water-powers should be rendered readily available for development, and should be placed under regulation by local authorities, such as public-service commissions.

Mr. Richard Lamb, of New York, called attention to the fact that in many cases the government considers navigation of paramount importance on streams where the water-power, if developed, would be immeasurably more important than the navigation. At the present time the government often expends immense sums to maintain navigation along streams when the commodities transported by water along the routes would pay almost no interest on the money thus expended.

Mr. J. G. White, of New York, stated that the time had definitely arrived when it is essential for a conference to be held between engineers, financiers and government officials, in order to facilitate the development of water-powers. Such development is true conservation. Only by utilizing all the water-powers can the fuel supply of the country be conserved. Although in theory a revocable water-power permit may be disadvantageous, the facts are that the government has not used its power to revoke a permit when money was invested in a development in good faith.

Mr. H. E. Cutler, of Boston, stated that the problems of formulating laws relating to water-power development are greatly involved, and suggested that a commission be created to advise with government officials as to the laws that should be made.

Mr. F. E. Frothingham, of Boston, said that the hostility between the public-service corporations and the people is due largely to the ignorance of the general public. What is wanted at the present time is widespread knowledge concerning the problems encountered by such corporations. The National Electric Light Association should make of itself a source of information, both for the government and for the public. He stated that terminable tenure is of no benefit to anyone. It renders difficult the obtaining of money by the developing company, and causes such a company to increase its charges for service to the consumer. The company is placed at a disadvantage, the consumer is also placed at a disadvantage, while the government obtains no advantage whatsoever.

Mr. John Bogart, consulting engineer, New York, called the attention of the conference to the peculiar conditions existing on the so-called navigable stream, the Tennessee River, near Chattanooga, Tenn. During the dry season the river cannot be navigated on account of low water, while during the wet season the vessels cannot proceed on account of floods. The government issued a permit for the construction by a private company of a dam, work upon which was begun in 1905. This dam was intended primarily for water-power development, but it has proved highly advantageous in maintaining navigation throughout the whole year. The permit is for ninety-nine years, at the expiration of which time the property is to be given over to the government without cost. The dam, which is located thirteen miles below Chattanooga in a direct line and thirty-three miles by the river, will permit of about 50,000 hp being developed.

Mr. J. H. Finney, of Washington, remarked that the conservation idea is not a fad. It has come to stay and should be embraced rather than opposed. As applied to water-powers it means use rather than non-use. However, it must be appreciated that in the final analysis all public utilities are public property, and should be thus considered by all parties concerned. The operating companies should be permitted to obtain a proper income and the public should have proper service, which can be accomplished only when the government maintains the correct attitude concerning the companies.

Mr. C. F. Scott, of Pittsburgh, explained that the present recognition of the possibilities of water-power development is due to the work of the engineer during relatively recent years. The laws which now hamper the development of water-powers were formulated before such work had been accomplished. The old lawmakers could not possibly have predicted present conditions, and it will be seen, therefore, that laws have not kept pace with developments. He stated that the laws already made for railways are largely applicable to water-power. He suggested that the government adopt some constructive policy in order to make water-powers available to the public at equitable rates.

Mr. R. D. Mershon, of New York, outlined the problems relating to water-power development which remain to be solved. Among these are the placing of restrictions by either the state or the federal government and the holding of the title by the company or by the people. If the title is held by the people it is yet to be determined in what way the people can transfer the title to a company. He expressed the opinion that the control can better be placed with the state than with the federal government and the title should remain with the people. In order for development to take place it is necessary for the proposition to be made attractive to capital. He stated that a limited tenure is quite as permissible with the water-power proposition as it is with a public-utility franchise. In fact, water-power rights should be considered on a par with a public-utility franchise.

Mr. H. L. Doherty, of New York, expressed his disagreement with Mr. Mershon concerning the permissibility of limited tenure. It creates an artificial amortization rate. It is far better to have an unlimited franchise with public-utility commission regulation. Mr. S. Z. Mitchell reiterated his claim that a franchise for water-power development should be perpetual. When such a plan is put in operation all parties concerned gain thereby, while no one loses.

Mr. F. J. Sprague, of New York, stated that when franchises are given for a limited term the consumers must necessarily be charged at an extra rate during the life of the franchise, after which there will either be a drop in the rate or an increase in the income, neither of which is desirable. He claimed also that the problem is much complicated by reason of the necessity for increasing the equipment during the life of the franchise. The operating company is compelled to increase its equipment in order to keep pace with the demand for service, and it would be unwilling to expend money for such increased equipment as the time approached at which the franchise would terminate.

Mr. P. H. Thomas, of New York, remarked that many different methods are available by which the public can obtain the results desired. However, in selecting a method consideration should be given not only to the public, but also to the company. Doubtless in the end a compromise method will be found best.

Mr. D. B. Rushmore, of Schenectady, said that the co-operative spirit shown by the conference is highly encouraging with reference to the prospects for increased water-power development. What is needed at the present time is detailed information, in order that the conclusions derived may be in conformity with the existing facts.

Secretary of the Interior Fisher remarked that when all the facts become known the conflict between state and federal and that between public and private interests will disappear, since the interests are, in fact, identical. He said that the conference has proved excellent in affording opportunity for the interchange of information.

A committee consisting of Messrs. S. Z. Mitchell, R. D. Mershon, C. F. Scott, P. G. Gossler, M. A. Viele and C. F. Wallace was appointed to formulate resolutions expressing the general opinion of the conference. This committee reported as follows:

"*Resolved,* That it is the sense of this meeting, convened at the instance of the power transmission section of the national body, that the National Electric Light Association should offer its co-operation with the legislative and executive branches of the national and state governments for the formulation of a definite, constructive policy which will encourage the prompt and fullest development of our water-powers in the public interests; and be it further

"*Resolved,* That to this end it is recommended that the officers of the National Electric Light Association appoint a committee or committeees with power to act in the premises, and to invite the co-operation of such engineering, commercial or other bodies as they may deem expedient."

Congress of Technology at Boston.

The fiftieth anniversary of the founding of the Massachusetts Institute of Technology was celebrated at Boston on April 10 and 11 by a Congress of Technology, which was attended by a large number of engineers and scientists prominent in American industrial applications and research. The congress marked in an interesting manner the advanced status which engineering education has attained within the past half century and disclosed in a long list of professional papers read at the sessions the responsibility and standing of the technical graduate in modern affairs. President Maclaurin roused the congress to a high pitch of enthusiasm at the opening session by showing the absolute dependence of the civilized world upon applied science, a condition which postulates thorough undergraduate and graduate professional education and training in order that the demands of modern life shall be efficiently met. The program included many features of interest to specialists, men of large business affairs and the general public in connection with water supply, sewerage, sanitation, industrial and chemical engineering, gas-engine, steam and electrical practice, economics and finance. Abstracts of several papers of interest to electrical workers are given below.

IMPROVEMENTS OF EFFICIENCY OF ELECTRIC LIGHTING PROPERTIES AND WHAT THE PUBLIC GAINS THEREBY.

The author of this paper, Mr. W. H. Blood, Jr., technical expert, Stone & Webster, Boston, Mass., contrasted early central-station equipment and methods with present practice, expressing numerically typical savings effected by the development of apparatus and scientific management, and emphasizing the reductions in rates and gains to the public which have resulted from improvements in systems of charging and in the design of energy-consuming devices. Twenty-five per cent of the fuel is being saved to-day owing to improvement in the efficiency of the electric generators. This means the conservation of $12,000,000 worth of coal a year. This improvement has been accomplished partly through the increase in the size of generating units from 100 hp to 25,000 hp. Besides being more efficient, the new 25,000-hp generators are much more reliable and little if any more complicated than the older and smaller machines. Individual generator efficiency has risen from 70 per cent to 97 per cent. A 15,000-kw unit occupies less than half the space occupied by a former 3500-kw engine-driven set, which means that the operating company is getting eight times the capacity on the same floor space. An early plant containing twenty 100-hp dynamos required, including boilers and auxiliaries, 4.5 sq. ft. per horse-power. The same company is to-day building a new station which will have an ultimate capacity of 140,000 hp and which will require but slightly in excess of ½ sq. ft. per horse-power. The first plant represented an investment of $225 per horse-power and the second will cost about $45 per horse-power. Had there been no improvement in machinery design an additional investment of $12,500,000 would have been required. Mr. Blood reviewed the benefits of direct connection, the growing economy of steam-turbine units, increasing size of boilers, flexibility of modern switchboards, and labor-saving results of the use of units of great size. Only 30 per cent as much coal is needed to-day per kw-hour as was demanded twenty years ago, which means that if the fuel economy had not been effected a 5000-kw plant now earning 8¾ per cent on the investment would face a deficit of 6 per cent. Accompanying this go reductions from 16 cents to 10 cents per kw-hour in price charged the public. During the past twenty years the rate of return on the money actually invested in central stations has not materially changed, unless to decrease slightly because electrical properties are fast getting out of the speculative class and are, therefore, satisfying their owners with a somewhat reduced return. Continuing, the author discussed the benefits of high-tension alternating-current transmission, the adoption of direct-connected motor drives, utilization of water-powers, improvements in incandescent-lamp design, increase of household conveniences and the benefits of centralized management of public-service properties. He pointed out that the utilization of Niagara power saves about 6,500,000 tons of coal yearly; that scientific administration on the centralized plan has resulted in the introduction of equitable rates for electricity established in proportion to the cost of supplying the consumer, and that from being high-priced luxuries twenty years ago electric lights are to-day inexpensive necessities. Formerly hazardous undertakings have become safe and sure investments as a result of the work of the technical graduates.

MECHANICAL HANDLING OF MATERIALS.

This topic was discussed by Mr. Richard Devens, New York, and, although mainly of mechanical interest, the paper included the statement that the steamer *Morgan* of the Pittsburgh Steamship Company, with a cargo of 11,319 tons of ore, was recently unloaded at Fairport in five hours and fifty-eight minutes. Six Brown electric unloaders handled the work, and the result of these improved dock methods was that the vessel made a larger number of trips in the season, thereby increasing her earning capacity. The author made an able plea for the reduction of labor by the use of machinery in transferring freight.

POWER PLANT BETTERMENT.

This topic was discussed in a broad manner by Mr. H. H. Hunt, of the Stone & Webster Management Association, Boston, Mass. Mr. Hunt emphasized the importance of expert examination of power plants of small and medium size with a view toward their operating improvement without elaborate cost. The author pointed out that without the co-operation of the station staff little of permanent value can be accomplished, and laid much stress upon the need of executive ability and a sympathetic attitude in the power-plant organization. Unexpected ability is not infrequently brought out in men in station service through the progressive application of betterment work. The paper outlined many sources of inefficiency in active plants, including dirty boilers, leaky tubes, blow-off cocks and valves, poorly maintained dampers and gage glasses, leaks in boiler settings, worn furnace linings, bridge walls, grates, and incorrect instrumental indications. Fluctuations in boiler pressure and feed-water temperature exert a large effect on station economy. The recording instrument was recommended, and the importance of maintaining a daily station log of complete character emphasized. The writer made a strong plea for the purchase of coal on the basis of calorific power and chemical analysis. Fuel is not seldom lost by the absence of scales upon which the company can check its consignments. Bins in which the coal can be accurately measured at any time are most valuable. The paper urged the weighing and checking of the fuel with the greatest care in its use inside the plant property, and recommended carrying forward maintenance on a date-schedule basis. In conclusion, Mr. Hunt urged managers not to fail to spend a few moments regularly on the station log. If this is not done, economy is almost certain to suffer in the long run.

INCREASING EFFICIENCY OF A LARGE GAS-ENGINE PLANT.

The author of this paper, Mr. John G. Callan, of the Arthur D. Little Laboratory, Boston Mass., reviewed the improvements effected in a producer-gas-electric plant in mill service as a result of a test in connection with the acceptance of the installation. The equipment consisted of four single-tandem, double-acting engines driving 810-kw, three-phase alternators. The fuel used in the producer was lignite of 7600 heat units, and the gas averaged 105 heat units. The demand for the product of the mill was greater than its output, which was limited by the inability of the gas-engine plant to generate all the power required. After tests extending over several weeks the cause of the principal difficulty was found to be an inflow of explosive mixture into the exhaust passages, leading to serious backfiring, reduction in capacity and inefficient use of fuel gas. The conditions were much improved by changing the mixture and the ignition point of the engines, maintaining as complete and non-luminous combustion as possible, minimizing the carbon deposits, keeping the valve chamber cooler and enabling the engines through a changed valve setting to run on a so-called flat-topped indicator card. The latter reduced the temperature of the gas at the moment of release when the explosive mixture mingled with it. The economy of the plant was increased and the output enlarged by about 20 per cent as the direct result of the tests. The investigation showed the importance of avoiding engine designs which embody the use of inlet and exhaust valves in close relation to one another.

THE SPIRIT OF ALCHEMY IN MODERN INDUSTRY.

Under this somewhat unusual title Prof. William H. Walker, of the Massachusetts Institute of Technology, advanced a vigorous plea for publicity in industrial research work. He stated that there is in every laboratory much work which could be published and yet conserve the interests of the corporation. Germany is justly held up before us as a shining example of marvellous industrial progress and prosperity, no small factor in which is the helpful attitude her industrial organizations take toward the publicity of scientific data. There is little good in permitting industrial laboratories to remain the secret chamber of the alchemist. A fuller, freer, more generous publicity would bring large rewards.

RESEARCH AS A FINANCIAL ASSET.

Dr. Willis R. Whitney, director of the research laboratory of the General Electric Company, presented a significant paper upon the financial aspects of research work. He pointed out that our intricate and delicately balanced system of work is becoming continually more complex, but is still covered by the elemental laws of demand and survival. New discoveries in our day are largely mental instead of geographical, and the old battles of conquest have become wars with ignorance, struggles to overcome inefficiencies. The research laboratory is merely an extension of the principle of maximum efficiency and specialization. Where a group of men are co-operating, as distinct from merely operating, their work rises with a higher number than the first power. Dr. Whitney reviewed the results of a typical line of investigations beginning in 1901 with high-resistance electrically conducting rods for the meter department, and showed that until electric furnaces were employed in place of the former porcelain kilns the results were most unsatisfactory. With the electric furnace, temperature measurement and control with accurate records of time elements eliminated the uncertainties which had formerly been almost insurmountable. Proceeding along the above line, electrically heated muffles and, later, carbon-tube furnaces were developed for the production of lightning-arrester rods. Out of the carbon-tube furnace came the graphitized-filament carbon lamp, leading later to research upon the tungsten and other filaments of a refractory character. The company's experience with a metallized graphite led to the production of a special carbon for contact surfaces in railway-signal devices, circuit-breakers and motor brushes. A reasonable estimate of the value of a research laboratory is based on the amount of money earned through its work which otherwise would not have been earned by the company, allowing the laboratory a proper time to get under way. The experience and knowledge accumulated in a general research laboratory is a positive quantity. The annual expenditure of the General Electric laboratory passed the $100,000 mark several years ago. Dr. Whitney pointed out that the value of graphitized-carbon filament lamps sold last year was over $1,000,000. On the assumption that the present rate of lamp consumption is equivalent to about 80,000,000 25-watt tungstens per year, and on the basis of 1¼ watts per candle as against 3.1 of the earlier lamps, with energy at 10 cents per kw-hour, there is a total saving of $240,000,000 a year distributed among producers, consumers and others. About 65,000 magnetite-arc lamps, originally a product of the laboratory, are now in use, at an average total sales price of nearly $2,000,000, and bearing a business of $60,000 per year in electrode renewals. The laboratory's study of the properties of the mercury arc produced the rectifier, about 6000 of which have been sold at a total revenue of over $1,000,000. In the field of insulations and molded material the result of research has caused a saving of $24,000 a year for one piece alone. As far back as 1906 the company was using 30,000 specially drilled and machined soapstone plates annually, which cost $1.10 each. As the result of experiments for substitutes it was found that these pieces could be molded in the proper shape, with holes in place and with increased toughness, at a greatly reduced cost. As a result the price of the purchased material, which came from abroad, was reduced to 60 cents, and later the developments enabled the company to make it for 30 cents—a price which the foreign material could not equal. In closing, Dr. Whitney paid a high tribute to German methods of investigation. He pointed out that America is making a good start in the research field, however, and touched upon several lines of profitable inquiry, notably in connection with improved efficiency of illumination. Transformer iron can also be greatly improved, although the advances of the past decade mean a saving of probably $500 a day in the losses in transformers in use at Boston alone. So long as apparatus fails in service there will probably be the equivalent of research laboratories connected with the electrical industries.

ELECTRIC FURNACE FOR ZINC SMELTING.

The author of this paper, Mr. Francis A. Fitzgerald, consulting engineer, Niagara Falls, N. Y., described a new electric furnace equipped with a resistor built up of corrugated plates of special construction for high-resistance service, including an arrangement of the plates as an interlocking device to secure stability. A representative furnace 16 in. long at the top, 10 in. long at the bottom and 6½ in. wide had two resistor sections of seventy-one plates each. When cold this had a resistance of 0.200 ohm and when running at full output, or 150 kw, and with a furnace temperature of 1400 deg. C., the resistance was 0.0375 ohm. The resistance was due almost entirely to the contact between the plates. Working in an atmosphere of metallic zinc there was no danger of the destruction of the carbon resistor. Regulation is effected by transformer taps in the supply circuit. When the furnace is working at full load of 150 kw the thermal efficiency at 1250 deg. is 78 per cent and at 1425 deg. 72 per cent. The efficiency is still higher in later models. Furnaces of this general type have been successfully used in the melting of aluminum, copper and brass. The furnace walls are double, with air spaces between. The author criticises the use of the arc in furnace work on account of the difficulties of temperature regulation.

Electric Vehicle Conference at Boston.

Continuing the campaign of electric vehicle progress which was inaugurated at Boston on March 4 by a dinner and meeting at the Hotel Thorndike, a conference was held on April 3 at the same hostelry under the auspices of the Boston Edison company for the purpose of securing closer working relations and co-operation between the central station and the electric vehicle manufacturer, with particular reference to the Greater Boston territory. About forty representatives of the electric vehicle industry, including members of the Boston Edison staff, were present at the meeting, which was preceded by a dinner.

Mr. W. H. Atkins announced that the Boston Edison company will supply free electricity to dealers advertising electric vehicles by electric signs, and also for a large electric sign to be erected for the purpose of advertising in one spot all the local electric vehicle sales agencies.

Prof. Dugald C. Jackson, of the Massachusetts Institute of Technology, outlined the possibilities of electric vehicle research at the institute for the benefit of the industry as a whole. He pointed out that a large prospective development is in sight, and in order to make the most of it information of an impartial and scientific nature is needed along many lines, notably in connection with the best duties of electric trucks, the best methods of replacing horses, the actual expense of horse and electric operation in specific cases, cost of garage operation, best methods of routing vehicles to secure the maximum production upon a given cost. Careful statistics of the cost of garaging will be kept at the recently opened public garage of the Edison company. The relation of tire cost to the quality of roadways is another very important matter. If the public realized how the cost of haulage would go down it would insist on proper pavements. The speaker believed that the electric vehicle can defeat the horse even if the latter is routed according to the best possible methods.

Mr. E. S. Mansfield, in charge of the electric vehicle work of the Boston Edison company, delivered a suggestive address showing the vigor and enterprise with which the company is pushing the electric vehicle campaign in its territory of 550 sq. miles. The public interest has been greatly awakened by the coming forward of the Edison company as a believer in and purchaser of electric vehicles. The company's plans for further publicity include the preparation and distribution of four booklets relating to the electric vehicle. The first is to be sent to all the manufacturers and representatives of electric vehicle production in the country, outlining the campaign of the Edison company on behalf of increased development at Boston. The second booklet will be sent to local agents of vehicle manufacturers in the Boston territory for distribution to the general public. The third booklet, entitled "Social Distinction," will be particularly devoted to the electric pleasure vehicle. The booklet will comprise a symposium of the latest pleasure vehicle equipment, and will be sent to the highest class of prospective patrons. The fourth booklet will be devoted to representative commercial vehicles, and it will be sent to high-class establishments which may be interested in efficient transportation.

Mr. Mansfield touched briefly upon the company's plans for further newspaper publicity. On April 21 and May 10 two extra advertisements will be run in all of the nine Boston dailies, one issue being devoted to pleasure and one to commercial vehicles. Each manufacturer will have the opportunity of displaying one of his most typical machines in the advertisement of the Edison company. In the face of the company's offer of free electricity for electric vehicle advertising Mr Mansfield said that no dealer's place need be in darkness. The new public garage of the company has not been established to cut into the business of any existing place of the kind. The company is simply trying to prove to the public that such a garage is a success, and that the electric vehicle meets the most severe demands within its field.

Mr W. H. Francis, purchasing agent of the Edison company, said that there is a great need for an electric automobile which can be run at a schedule speed of twenty miles per hour, at a maximum speed of certainly thirty miles, and without reducing the mileage per charge below from 75 to 100. Such an equipment would do much to displace the gasoline machine in serving the outer suburban territory, where time is at a premium in passing between distributing and commercial centers.

Mr. L. D. Gibbs, superintendent of advertising, Boston Edison company, emphasized the opportunities for co-operative publicity now before the manufacturers. He also brought out the point that a very low maximum rate per kw-hour does not necessarily mean the largest business expansion in connection with the electric vehicle. Mr. Atkins stated that the company has the whole question of electric vehicle rates under consideration, and that it is planning to supply charging sets in the near future which will cost only $60 compared with the present price of about $250.

Mr. Day Baker, General Vehicle Company, cited the formation of a Boston Section of the Electric Vehicle Association of America as an instance of conditions now prevailing. He reviewed the importance of securing a suitable teaming thoroughfare in the City of Boston, pointing out the co-operative work done before legislative committees in connection with the Boston Chamber of Commerce. He felt that the Electric Vehicle Association will in time take care of the differences in charging prices now found in commercial garages. Among the other speakers were Messrs. Redding, of the Studebaker Automobile Company; Converse D. Marsh, New York; C. L. Morgan, Lansden Company; Col. E. W. M. Bailey, Bailey Company; Messrs. Neal, of the Baker Motor Vehicle Company, Daly, of the Babcock Electric Carriage Company; Eldredge, of the Couple-Gear Wheel Company; Emery, of the Walker Vehicle Company; Mr. Rommelfanger, Boston Electric Garage Company, and Mr. L. R. Wallis, superintendent of the sales department Boston Edison company.

Single-Phase Railway Electrification.

At a meeting of the American Institute of Electrical Engineers held in Toronto on April 8 Mr. W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad, presented a profusely illustrated paper entitled 'Electrification Analyzed and Its Practical Application to Trunk-Line Roads, Inclusive of Freight and Passenger Operation." The author recommended the universal adoption of the single-phase system using 11,000-volt, 25-cycle current for any and every trunk line electrification project, including suburban and terminal sections. He ventured the opinion that there is no trunk-line electrification problem to which there cannot be applied some construction drawing now in the engineering files of the New York, New Haven & Hartford Railroad.

He said that the only possible way that electrification can be made to pay is by electing a system the yearly operating cost of which, inclusive of its maintenance charges, subtracted from the yearly cost of the steam system it replaces leaves a figure which represents a little more than the interest on the capital investment required for the installation of the electric system. When the board of directors of a railroad company passes favorably upon an appropriation of several millions of dollars to purchase power houses at, say, $1,000,000 apiece, locomotives at $30,000 apiece and line construction at $25,000 or $30,000 a mile for a four-track system, it is not an unfair question for those directors (although they may be interested in eliminating the smoke and dirt incident to the original system replaced, and be glad to have the assurance of the electrical engineer that the time of switching movement of the railroad's equipment in yards, terminal property and main line has been reduced) to ask for a closer analysis than this, and also to ask for some specific explanation as to the return each year of a fair percentage of some of the dollars spent.

LOCOMOTIVES.

Referring to locomotives, Mr. Murray presented figures showing that, in switching, yard speeds could be greatly increased by the use of an electric locomotive of very much less engine capacity than that used in the steam locomotive. On account of the low average rate of energy required for its operation, a central power station will deliver at far higher efficiency the power necessary to the electric switching engine than that obtained from the individual power plant on the steam switching engine itself.

The electric switching locomotive which will be used in the Harlem River and Oak Point yards is of the quill spring-supported type, and on account of the buffing stress incident to yard switching the framing and attachments for all of the electrical apparatus are very strong and substantial. The four motors have an hourly rating of 150 hp each, giving the locomotive a total rating of 600 hp. This locomotive will be tried out in the electrified Stamford yard.

About a year ago a multiple-unit train consisting of four motor cars and six trailers was put in service. There are now under construction four additional motor cars and twelve trailers. These multiple-unit cars will gradually replace electric locomotives for suburban service, and the locomotives so released will be used in express service between New York and New Haven.

The complication of control apparatus to permit of operation on both alternating-current and direct-current sections is very marked. All freight and switching locomotives will have single-phase control only, as will the multiple-unit cars to be purchased for the Harlem River Branch and the New York, Westchester & Boston. The saving in weight of straight alternating-current control over alternating-current-direct-current control is more than 8000 lb. per car or locomotive.

LOG OF THE NEW HAVEN ELECTRIC OPERATION.

As showing the great improvement in the reliability of electric operation as time had developed troubles and remedies for them, Mr. Murray supplemented his "Log of the New Haven Electrification," presented before the Institute in December, 1908, with figures of train delays for the corresponding six months of 1909. These figures are summarized in the following table:

Month	Power-House Delays, Minutes.		Line Trouble, Delays, Minutes.		Locomotive Delays, Minutes		Total Delays, Minutes.	
	1908.	1909.	1908.	1909.	1908.	1909.	1908.	1909.
July	0	0	2100	170	1183	153	3283	323
August	132	0	1642	548	407	97	2181	645
September	0	0	942	0	224	219	1166	219
October	0	54	2140	204	343	124	2483	382
November	139	0	103	42	405	95	647	137
December	179	0	194	55	240	315	613	370

The average delay per train in 1909 was 5.25 seconds, as against 27 seconds in 1908. In this connection Mr. Murray said:

"A comparison of the 1909 and 1908 train minute delays is immediately indicative of the fact that even in this short time the disturbing factors of the system had disclosed themselves and had been eliminated. Eighteen months after commercial service was inaugurated our electrical failure report showed a record of over 15,700 miles per engine failure. Between Nov. 2 and 23, 1909, 66,000 electric locomotive miles were run, and this mileage, which is approximately eleven round trips from New York to San Francisco, was accomplished with a total of three minutes' delay. This kind of record is the ground upon which the board of directors of the New Haven road stood in ratifying the system and voting an extension to apply to all service—freight and passenger, inclusive of yards, terminals and main line west of Stamford." He presented diagrams showing that the electric locomotive failures are nine per 100,000 electric locomotive miles, while the steam locomotive failures, which are an average for all of the divisions of the New Haven, are twenty-one.

ENERGY SUPPLY SYSTEM.

The power house of the New York, New Haven & Hartford Railroad at Cos Cob, Conn., which now supplies energy to the main line between Woodlawn and Stamford, will also supply energy for the electrified six-track Harlem River branch and freight yards and the New York, Westchester & Boston, as well as for the operation of direct-current trolley lines connecting White Plains, Mamaroneck, Stamford and Bridgeport. The alternating-current distribution system is a unit without substations and no voltage higher than 11,000 will be used. The wires carrying energy are sectionalized and breakers controlled from the power house are installed to localize any line trouble without affecting the remainder of the network. Briefly described, the control consists of a single wire, upon which is impressed the normal voltage of the system when a short-circuit occurs anywhere, but not until the automatic resistance at the power station has been cut in series with the line, at which moment the control wire, through transformers, passes current through the tripping coils of the sectionalizing breakers, and the two breakers that are directly feeding the short-circuit are immediately opened. The resistance thus inserted, however, has reduced the short-circuiting current to a minimum and relieved greatly the duty of the opening breakers. The resistance scheme above mentioned has proved itself to be a most valuable acquisition to the system, serving at once to lessen the duty on both generating and distributing apparatus.

INSULATION.

Mr. Murray laid special stress on the importance of adequate insulation of lines carrying high-tension current. In this connection he said:

"Practice has shown the wisdom of sectionalizing the lines at cross-overs. At these points it is necessary to bring the electrical catenary cables to a dead end and anchor bridges are supplied for that purpose. Oil switches must be provided for cutting in or out as necessity may require voltage on the lines thus dead-ended. In the order of their higher degree of insulation requirements should be mentioned: One, sectionalizing switches; two, sectionalizing busbars; three, dead-end catenary insulators; four, intermediate catenary insulators." As the whole track system leads into the anchor bridge buses a ground on them means an immediate effect on any wire connected to them. This reasoning is applicable to the switch should the ground be on the busbar side, and as the switch is a piece of moving apparatus it is the more difficult to insulate and to keep insulated, and is, therefore, cited as the one deserving of the highest consideration of insulation. The dead-end insulator has been mentioned third, but it is in a class essentially its own and is worthy of respectful attention. No insulator throughout the past four years has had more constant study. The difference between insulators not under and under mechanical strain while performing at the same time their electrical duty is marked. When the New Haven electrification was completed in 1908 the best dead-end insulator then on the market was one rated at 7000 lb. mechanically and 40,000 volts electrically, and cost $27. In a very short time it was found that two of these had to be used in series, which, with the yoke harness, made the cost $61. To-day orders have been placed for dead-end (or strain) insulators, every one of which is tested before shipment for 110,000 volts under a mechanical strain of 35,000 lb., and they have an ultimate mechanical tensile strength of 50,000 lb These insulators cost only $7 apiece, as against $61, and are capable of withstanding seven times the mechanical strain and three times the electrical strain of the original insulators.

WEAR OF CONTACT WIRE.

Micrometer measurements of the steel trolley wire showed that the actual vertical wear of the wire since its first installation thirty months ago is 0.028 in., which is practically 4.5 per cent per year of the half diameter of the wire (one-half taken to permit the wire to be held in clips). Even on this vertical-diameter basis this indicates a life of over twenty years. As a matter of fact, it will be much more than this, for the reason that as the vertical diameter lessens the breadth of contact increases throughout, thus diminishing the rate of vertical wear. Of further interest, too, is the fact that there is practically no corrosion on the wire, for, like the traffic rails in service (only much more so), the wire is constantly covered by a film of grease—due to a generous amount of this material being placed on the pantograph shoe.

NEW CONSTRUCTION.

A part of Mr. Murray's paper was devoted to a brief description of the catenary construction in the Hoosac Tunnel. The electrification of the tunnel is now rapidly nearing completion and electric locomotive operation has been begun in the approach yards for the instruction of engineers. The introduction of 11,000 volts into this tunnel, with the close overhead clearance that the double-track arrangement requires, afforded an interesting problem in location and placing of insulators which would insure against any breakdowns between the electrified wires and ground. From the crown of the tunnel is suspended a bracket, on which are installed four insulators, each capable of resisting 150,000 volts to ground. Two of these insulators apply to each track. The arrangement of support is such as to place them in series, thus giving them a combined dielectric strength of 300,000 volts. The outside insulator holds the track messenger wire, from which are hung the contact wires below. Some criticism might be offered against using a 150,000-volt insulator where a 40,000-volt insulator might have sufficed. By the expenditure of $1 more per insulator there was secured practically eight times the insurance from breakdown. The tunnel is five miles long. There are 1000 insulators, hence $1,000 has been spent to secure eight times the protection.

Mr. Murray stated that all of the insulators purchased for the Hoosac Tunnel electrification, inclusive of the tunnel itself and its outside approaches, did not total one-half of 1 per cent of the total expenditure. Insulation is of all things the one most important thing to be right in order to secure continuity of service. It pays a handsome dividend every year.

The two large yards at the terminus of the Harlem River branch contain 62.3 miles of track, all of which will be electrified. On account of the extremely small amount of current required per horse-power developed, and on account of the excellent conductor section offered in the gridiron arrangement of the track yards, not a pound of copper will be required throughout this extensive trackage, with the exception of rail bonds. These are to be reduced to the smallest size and only one rail will be bonded, with the attendant result of an extremely low cost compared to main-line construction. Cross-catenary spans for the support of the track contact wires will be used. By a simple system of bridles, which require only one rigid post to hold many tracks, the overhead contact wires are held in proper alignment over the tracks they serve. The cost of yard electrification, as before stated, varies from $1,500 to $3,000 per mile of track, depending upon the average number of tracks spanned.

Basis of Graded Charges For Energy.

A correspondent of the Chicago *Daily Tribune* recently wrote to that paper for an explanation of the distinction between the "full" or primary rate of 13 cents a kw-hour and the "low" or secondary rate of 7 cents a kw-hour, as made by the Central Station Company. He appeared to have the idea that the difference might explain the cost of wiring the building in which he was a tenant. The newspaper referred the letter to Mr. John F. Gilchrist, assistant to the president of the Commonwealth Edison Company, and his explanation of this distinction, which is so perplexing to the mind of the ordinary customer, may be of general interest.

Mr. Gilchrist wrote: "The distinction between the 'full' rate and the 'low' rate shown on this company's bills for electricity is substantially like a cabman's charge of a certain rate for the first hour or first mile and a lower rate for subsequent miles or hours. The full or maximum rate applies to a use of electricity for not exceeding thirty hours in any month, and the low rate to all additional use of electricity for the month. This is in accordance with the existing city ordinance passed March 23, 1908, regulating the company's maximum rates, and has nothing to do with wiring, but is purely for the consumption of electricity."

New York Meeting of the American Electrochemical Society.

The nineteenth general meeting of the American Electrochemical Society, held in New York City on April 6, 7 and 8, was notably successful in its professional as well as social features and will be remembered with special pleasure as the first convention of a national body held in the new Chemists' Building in New York City. The number of members and guests registered was over 350.

On the three forenoons there were three professional sessions devoted to the reading and discussion of some thirty papers. The first of these sessions was opened by the annual business meeting of the society at which the reports of the secretary and treasurer were presented, showing the society to be in a splendid condition with respect to membership and finances.

The result of the election of officers was as follows: Dr. W. R. Whitney, chief of the Research Laboratory of the General Electric Company, was elected president; Mr. F. A. J. FitzGerald, Dr. E. F. Smith and Mr. Alois von Isakovics, vice-presidents; Dr. E. G. Acheson, Dr. Wilder D. Bancroft and Mr. Carl Hering, managers. Dr. Joseph W. Richards was re-elected secretary and Mr. Pedro G. Salom treasurer.

The program of excursions was very full and included two of the best-equipped copper refineries. The Nichols Copper Company, on Long Island, the largest electrolytic copper refinery in the world, was visited on Thursday afternoon, and the splendid Perth Amboy plant of the American Smelting & Refining Company on Saturday afternoon. For Friday afternoon four optional excursions had been arranged, including a visit to the fine electroplating demonstration plant of the Hanson & Van Winkle Company, in Newark; the electric furnace laboratory of Dr. F. J. Maywald, the New York Testing Laboratories, the photo-engraving and electroplating plant of the Moss Photo-Engraving Company and the laboratories of Columbia University and the College of the City of New York.

A subscription dinner on Thursday night and an informal smoker on Saturday night were very enjoyable, each in its own way. On Friday night there was a joint meeting with the New York Section of the American Electrochemical Society, at which the retiring president, Dr. W. H. Walker, of the Massachusetts Institute of Technology, presented his address on chemical research and industrial progress. The following are abstracts of the papers presented:

ALUNDUM REFRACTORIES.

The first paper was presented by Mr. L. E. Saunders on alundum refractories. Alundum is the trade name of electrically fused bauxite. The process has been carried out for a series of years commercially at Niagara Falls.

The chief application of alundum in the past has been as an abrasive. On account of its heat-resisting properties, however, its applications as a refractory have now been developed. Alundum has a melting point between 2000 deg. C. and 2100 deg. C. The coefficient of linear expansion is very low, about

0.000008. The thermal conductivity is comparatively high, which is an advantage for various applications. It is about twice that of Marquardt porcelain and three or four times that of most fireclays. Alundum articles can be made in various forms, for instance in the form of tubes (pyrometer-protection tubes), muffles, etc. Alundum muffles have four to five times the life of the ordinary clay muffle in gas-furnace work, and are especially adapted to the electrically heated, wire-wound type of laboratory furnace. On account of its porosity filtering dishes can be made from alundum. A useful modification is alundum cement, which may be used to coat the inside of crucibles and furnaces for high-temperature work. Alundum brick has been tested for the roof construction of electrical steel furnaces, where it has shown a very long life.

There was an interesting exhibition of various articles of alundum, and Mr. Saunders' paper was discussed at considerable length by Messrs. Hansen, Beckman, Amberg, Richards and Queneau.

NEW ELECTRIC RESISTANCE FURNACE.

Mr. F. A. J. FitzGerald, of Niagara Falls, then presented a paper on a new resistance furnace originally designed by Mr. John Thomson and himself for carrying out the Imbert electric zinc-smelting process. The furnace is of the radiation type, the heat being radiated from electrically heated resistors placed near the top of the furnace. In order to concentrate the heat radiation as much as possible down onto the charge provision is made to have a greater current density at the lower part of the resistor than at the top. Various arrangements of the resistors were described and the results were given of experiments made with a furnace of this type at the Hohenlohe zinc works in Upper Silesia, Germany.

For certain experiments in which there is an oxidizing atmosphere in the furnace the resistors must be protected and are inclosed in an air-tight resistor compartment with recrystallized silicon-carbide tiles, which have the two required qualities of refractoriness and high heat conductivity. A simple method of producing a reducing atmosphere in the furnace chamber is also described. For the operation of the furnace means must be provided for varying the applied voltage. For this purpose an adjustable transformer with a number of taps or an induction regulator may be employed. The furnace is especially suitable for the melting of copper, brass, aluminum, etc., and possibly of glass.

The paper was discussed by Dr. Whitney and Mr. Carrier.

LABORATORY ELECTRIC FURNACE.

An electric furnace for commercial laboratory work was described in a paper of Mr. M. M. Kohn. Its chief feature is the replaceability of the electric heating units so that when one of these burns out it can be quickly replaced by a new one held in reserve. This was demonstrated during the course of the paper.

The housing of the furnace is built of a number of sections of a special clay. After the sections have been assembled they are placed in a metal case, together with the necessary heat-resisting material and sealed in permanently. In this housing certain peculiarly shaped openings are molded into which the replaceable heating units fit. The latter carry the resistance wire or ribbon made from a special alloy. The furnace is operated directly from 110-volt or 220-volt mains. The safe maximum working temperature is from 1750 deg. Fahr. to 1850 deg. Fahr.

The paper was discussed by Dr. Richards and Dr. Patten.

ELECTRIC FURNACE FOR HEATING BARS AND BILLETS.

A new electric furnace for heating bars and billets was described in a paper by Mr. T. F. Baily, who referred to the very low thermal efficiency of modern oil-fired furnaces for heating forging stock. He has designed for such work an electric furnace of high thermal efficiency. It is a resistance furnace. Two carbon electrodes are provided spaced from each other, with an intermediate resistance body of crushed foundry coke in which the heat is generated. In the space directly under the roof of the furnace is placed the metal to be heated, a ledge at the rear of the furnace and one at the front supporting the bars or billets. The electrodes enter the furnace through the rear wall and are placed slightly convergent, so that the path of the electric current will be shorter from electrode to electrode at the front of the furnace than at the back. This arrangement compensates for the cooling effect from the charging door. Details of the construction of such furnaces were given. The paper was discussed by Messrs. Richards, Hering, Sperry, Lidbury and Hitchcock.

ELECTRIC ZINC SMELTING.

The electric zinc furnace invented by Mr. W. McA. Johnson was the subject of a paper by Dr. Joseph W. Richards, who pointed out the potential advantages of the electric furnace in general for zinc smelting. Mr. Johnson's first large-scale experimental work was directed along lines of treating a charge that produced a dry, fusible residue, but for the last two years he has been engaged in developing an electric furnace to smelt zinc ores with the production of a base lead bullion, a copper matte and a fusible slag. The smelting zone of his zinc furnace is practically a lead furnace, but operated by electrical heat and with slightly more intense reduction conditions, sufficient to reduce the zinc but not to reduce appreciably the amount of the iron oxide in the slag.

The Johnson furnace is in general of the Siemens arc type. In the operation a certain amount of carbon dioxide is evolved which would be fatal to efficient condensation. The gases are, therefore, passed through a filter of hot carbonaceous material, where the percentage of carbon dioxide is reduced to extremely low limits. The slag losses in the furnace are quite low.

The problem of the condensation of zinc vapor from electric furnaces was discussed in a paper by Mr. F. T. Snyder. The author bases his discussion on the design and dimensions of the standard retort zinc condenser and shows how it is possible to derive from these a set of data for use in the design of condensers for zinc vapors from electric furnaces.

RELIABILITY OF ELECTRIC FURNACES.

The last paper of the Thursday session dealt with the reliability of electric furnaces for commercial work, the author being Mr. F. T. Snyder. His conclusions were: (1) That the electric furnace itself has passed from the field of experiment to that of engineering, but that the fields of manufacture using the electric furnace products are still experimental; (2) that the electric furnace is technically reliable and will operate continuously with the men and supplies that are available in this country; that the details are simple and rugged, and that the inherent regulating powers can be made such as to bring it well within the ability of usual plant labor; (3) that the electric furnace is commercially reliable; that when installed with the same business care and adaptation to conditions that should be used with other furnaces it will earn a profit on the investment, and a profit that is larger than the normal manufacturing profit in proportion as the field is newer and more open.

ELECTROMETALLURGY OF GOLD.

The first two papers of the Friday session dealt with the electrometallurgy of gold. Mr. J. F. Clancy discussed the electric cyanamide process for treating gold ore. The object of the process is to find a cheap solvent for gold as a substitute for the expensive cyanide solution now universally employed. The author employs a solution prepared from calcium cyanamide and combines the use of this solution with electrolytic action. The object of the process is simply to dissolve the gold in the solution, but not to deposit it.

A paper by Mr. E. E. Carey dealt with an improvement in the well-known method of recovering gold by amalgamation. In this process the mercury is made the cathode of an electrolytic cell so that the electric current aids the alloying of the gold with the mercury. A suitable "sodium-mercury cell" developed for this purpose is described.

IRON REFINING.

A paper by Prof. C. F. Burgess dealt with electrolytic refining as a step in the production of steel. Since it is possible by the author's process to refine iron electrolytically as easily as copper, the question is raised as to the usefulness of electrically refined iron, and it is shown that the electrolytic iron may well compete in price with high-grade Swedish iron. Further advantages are its content of hydrogen, which may help in deoxidation, and its brittleness, which makes it easy to break it up into pieces for introduction into steel crucibles.

ELECTROPLATING.

A paper by Prof. W. S. Landis dealt with the corrosion of electroplated objects. The author found that gold-plated steel pens corroded far more rapidly than plain steel pens. This is due to the fact that the friction of the pen point on the paper rapidly wears off the plating on the point, thus exposing the steel; an electrolytic couple consisting of steel, ink and gold is thus set up. The rule is suggested that a material should not be plated with a nobler metal if it is likely to be subjected to wear on one spot and if this spot is liable to be moistened with liquid.

A paper by Mr. George B. Hogaboom emphasized the necessity for more intimate co-operation between the practical electroplater and the electrochemist, and gave a list of unsolved problems in the electroplating art the solution of which would be timely.

POLARIZATION.

A paper by Dr. O. P. Watts on polarization in its relation to the decomposition pressure of electrolytes gave the results of an experimental study of polarization in electrolytic cells set up under different conditions. Polarization is responsible for the phenomenon of decomposition pressure in electrolytes. The total polarization may be resolved into two components, the one at the anode, the other at the cathode. Since it is polarization which prevents the flow of current in accordance with Ohm's law, the residual current is the equivalent in current of the rate of depolarization of the electrodes by the electrolyte.

A paper by Dr. J. H. Mathews described detailed results of a laboratory study on the use of electric heating for preventing superheating of liquids. He described in great detail the most satisfactory arrangements.

STORAGE BATTERY.

A paper was presented by Mr. A. V. Tate on his "bifunctional accumulator." The chemistry is the same as that of the lead cell, the novel features of the new battery being chiefly mechanical. The chief feature is the use of short, narrow conducting strips. The positive and the negative are on both sides of one plate, hence the name "bifunctional." The plates are separated by perforated celluloid strips. Some of the advantages which were discussed in some detail are the avoidance of sulphating and the provision of permanent good contact between active material and support. The specific output of the battery was given as 11 watt-hours to 12 watt-hours per pound of complete battery in service.

ALUMINUM.

A paper by Prof. H. K. Richardson dealt with some observations on the laboratory production of aluminum. For the use of students in the laboratory a mixture of 85 per cent natural cryolite and 15 per cent aluminum is recommended with a current density of 3 amp per square centimeter anode surface. The anode effect appears to be due to two causes, either a gaseous envelope which opens the circuit or a non-wetting of the electrode which causes numerous small arcs. An amp-hour efficiency of 60 per cent to 70 per cent may be obtained.

The paper was discussed at some length by Messrs. Richards, Cowles, Tucker, Walker and Lidbury.

ELECTROLYTIC METER.

A paper by Mr. F. C. Mathers was present on a mercurous perchlorate coulometer. The advantages of mercurous perchlorate solution as an electrolyte for meters and coulometers are summed up as follows:

The ClO radical is exceptionally stable and is absolutely unchanged by electrolysis. Mercurous perchlorate is very soluble in water, and the solutions thus formed are entirely free from any decomposition.

Mercurous perchlorate solutions containing free perchloric acid have very high conductivity, such that a very high current density may be used in electrolysis.

The amount of mercury deposited may be very rapidly determined by measurement rather than by the much slower method of weighing.

The deposited metal is in such form that it may be transferred to the anode for further use without any treatment whatever. Equivalent quantities of electricity deposit from two to six times as great weight of mercury(ous) as of the other metals. This gives greater accuracy.

The paper was discussed by Messrs. Schleuderberg, Hering, and Sharp, especially with reference to the question why electrolytic meters are practically not used in this country.

ELECTRICAL THEORY.

A paper by Prof. L. A. Parsons sketched the phenomena of electrical discharges through gases at reduced pressure and discussed the experimentally established facts with reference to the properties of negative corpuscles and of positive ions in their relation to atoms and molecules.

A paper by Prof. Joseph W. Richards suggested a mechanism of electrolytic transfer based especially on the phenomena of electrolytic conduction through fused salts. One of the chief points is that the electrochemical action at the electrodes is the primary thing and that the electrolytic transfer throughout the electrolyte then follows as a result of the disturbed equilibrium.

PRESIDENTIAL ADDRESS.

The presidential address of the retiring president, Prof. W. H. Walker, was delivered at the evening session of Friday, which was a joint session with the New York Section of the American Chemical Society. It dealt with "chemical research and industrial progress." Dr. Walker condemned strongly the secretiveness of many manufacturers and emphasized forcibly that a free interchange of ideas is most important for further progress of science and industry.

Dr. Harrison E. Patten then lectured on the relation between surface union and electrochemical action.

ELECTROMETALLURGY OF IRON AND STEEL.

The first three papers of the Saturday session were concerned with the electrometallurgy of iron and steel.

A paper by Mr. James Lyman dealt with the application of electric furnaces to the manufacture of iron and steel, and gave descriptions of the following types of furnaces: the Frick electric arc furnace for the reduction of iron ore, the Frick induction furnace for refining steel, the Héroult furnace, and various induction furnaces.

A paper by Mr. C. G. Osborne gave many interesting personal experiences with a 15-ton Héroult electric furnace at the South Chicago works of the United States Steel Corporation, and more details were brought out in the extended discussion which followed. The chief summing up of Mr. Osborne was that while "we are as yet but on the threshold of this method of manufacture, we feel that electric steel is a success and its future assured."

A paper by Mr. A. E. Green discussed the possibilities of the electric steel furnace as a competitor of the Bessemer and open-hearth for making ordinary grades of steel. The author emphasized the great material losses in the Bessemer and open-hearth and showed that if these can be avoided in an electric furnace due to the chemical reactions possible in its adjustable chemical atmosphere there is a prospect for such a process. The author described an electric converter process which has been devised for this object.

ELECTROLYTIC FURNACE FOR METAL PRODUCTION.

A paper by Mr. John Woods Beckman dealt with an electrolytic-furnace method for producing metals, of which were mentioned iron, aluminum, chromium, vanadium, either as metals or alloys. The process is applicable to any metal whose oxide will form a salt with calcium. As applied to iron the process is as follows: Equivalent amounts of Fe_2O_3 and CaO are mixed together and heated in any suitable manner. The salt

$CaOFe_2O_3$ is formed and fused in a receptacle fitted for electrolytic purposes. Oxide of iron is introduced into this fused bath, and this molten solution is electrolyzed, iron being deposited on the cathode and an oxygen development taking place on the anode.

The paper was discussed by Messrs. Hansen, Bleecker, Tucker and Saunders.

A NEW TYPE OF ELECTRIC FURNACE.

In a paper by Mr. Carl Hering a description was given of a new type of electric furnace in which practical use is made of the pinch phenomenon. If a tube (for instance, of alundum) is attached to the bottom of an electric furnace, and this tube is filled with an electric conductor (which is solid at the bottom and liquid near the top, where it is in connection with the furnace charge) and if an electric current is passed through the resistor in the tube, then as a result of the pinch phenomenon forces will act on the liquid portion of the resistor in a radial direction so as to drive the liquid material inside. With vertical tubes these forces are horizontal and perpendicular to the axis along the whole length. The mechanical result is that the liquid metal is driven radially from the outside of the tube to the middle of the tube and then rises upward to the top of the charge and produces there a fountain.

The liquid flows up in the center and down to the periphery and down along the walls of the furnace back to the top hole of the resistor and down along the walls of the resistor. It is then driven again to the center of the resistor, whereby a very distinct circulation of the fluid bath is provided.

This is called the squirt phenomenon and is made the basis of a liquid-resistor furnace. If such a column is made the resistor in which the heat is generated by passing the current through it by means of an electrode at the bottom the heated liquid will be rapidly expelled and forced to the top against the blanket of slag, while the cooler liquid at the bottom will be sucked down into the hole near the circumference, to be in turn heated and immediately expelled with considerable force.

With a single-phase current or with direct current two such resistors are used at the bottom of the furnace; with three-phase current use is made of three such resistors.

The advantages of the furnace are its simplicity and cheapness, as it consists merely of a crucible or hearth with two suitable holes in the bottom plugged with the electrodes. The heat is generated in the material itself, and it is generated at the bottom and the bath is automatically circulated. The power-factor can be made very high and the frequency need not be abnormally low.

The author states that the larger the furnace the better, and the less will be the difficulties. The furnace currents must be at low voltage and of high amperage, and the transformer to give them is best attached directly to the bottom or side of the furnace.

The paper was discussed at some length by Messrs. Richards, Hibbert, Clamer, Saunders, Kemery and Queneau.

Two further papers on the program were one by Mr. C. Vey Holman on the advantages of Maine for electrochemical industries and one by Mr. F. P. Knight on the advantages of Keokuk, Iowa, for electrochemical industries.

A paper by Mr. W. B. Pritz on dry-cell testing dealt with results of the non-uniformity of dry-cell tests, the requirements for a satisfactory test, the effect of temperature upon dry-cell testing, and the rating of dry cells. The author finally proposed two different tests according to the purpose for which the cells are to be used, namely, for telephone service or for gas-engine ignition service. Since it is often the case that quite an interval of time may elapse between the manufacture and the installation of a cell in service, a knowledge of what may be expected during this period becomes of importance, and hence an open-circuit or "shelf-life" test is quite essential.

The next meeting of the society will be held at the end of September at Toronto, Ontario, Canada.

The president-elect, Dr. William Rodney Whitney, was born in Jamestown, N. Y., on Aug. 22, 1868. He graduated from the Massachusetts Institute of Technology with the degree of B. S. in 1890 and obtained the degree of Ph.D. at the University of Leipzig in 1896. He served for some time as instructor and associate professor of theoretical chemistry at the Massachusetts Institute of Technology before accepting his present position as director of the research laboratory of the General Electric Company. In this position he has been in immediate charge of the research work conducted by this company and has been responsible for the developments made in carbon-filament and tungsten-filament electric lamps. In addition to the A. E. S. he is a member of the American Chemical Society, the American Society for Testing Materials, the American Institute of Mining Engineers, the American Institute of Electrical Engineers, the American Association for the Advancement of Science and the Société Chémique de Paris. He translated into English Le Blanc's "Electrochemistry."

Specifications for New National Electrical Code Rubber-Covered Wire.

As pointed out in our issue of March 30, the electrical committee of the National Fire Protection Association, successor to the Underwriters' National Electric Association, drafted at its biennial meeting in New York, on March 23, new specifications for rubber-covered wire. These specifications are quite drastic as compared with those covering the old code wire and as compared with recent specifications passed by the cities of New York and Chicago, combining chemical as well as physical tests. The result will be a wire of somewhat higher cost than the old code wire; and in order to give manufacturers, contractors and dealers alike an opportunity to dispose of present stock, or to fulfill contract obligations, the specifications will not be enforced until such time as all the parties interested in the change agree is proper. Manufacturers will probably cease to turn out wire under the old specifications at once, except such as is needed to carry out present contracts.

The specifications for rubber-covered wire are contained in Rule 41, as printed in the "Construction Rules" edition of the code. The various sections of this rule have been changed as follows. Section *b* now reads:

"The insulation must consist of a rubber compound, homogeneous in character, adhering to the conductor or to the separator, if one is used, and of a thickness not less than that given in the following tables Nos. 41 *e* and *f*."

Section *c* of the rule has been greatly amplified and much of old Section *d* incorporated in it. This section now reads as follows:

"Any 1-ft. sample of completed covering must show a dielectric strength sufficient to resist throughout five minutes the application of an e.m.f. proportionate to the thickness of insulation in accordance with the following table:

Thickness in 64ths Inches.	Breakdown Test on 1 Ft.
1	3,000 volts A. C.
2	6,000 " "
3	9,000 " "
4	11,000 " "
5	13,000 " "
6	15,000 " "
7	16,500 " "
8	18,000 " "
10	21,000 " "
12	23,500 " "
14	26,000 " "
16	28,000 " "

"The source of alternating e.m.f. shall be a transformer of at least 1 kw capacity. The application of the e.m.f. shall first be made at 3000 volts for five minutes, then the voltage increased by steps of not over 3000 volts, each held for five minutes, until the rupture of the insulation occurs. The tests for dielectric strength shall be made on a sample wire which has been immersed in water for seventy-two hours. One foot of the wire under test is to be submerged in a conducting liquid held in a metal trough, one of the transformer terminals being connected to the copper of the wire and the other to the metal of the trough."

Section *d* as finally revised is as appended:

"Every length of completed wire or cable must be tested after not less than twelve hours' immersion in water and while still immersed by the application for one minute of an alternating-current voltage derived from apparatus of ample capacity, the test voltages to be those given in the tables of 41 *e* and *f*.

"After this voltage test every length of completed wire or cable while still immersed must show an insulation resistance after one minute electrification not less than the values given in 41 *e* and *f*.

"Any length of completed wire or cable may be tested during thirty days' immersion in water and must show not less than 50 per cent of the insulation resistance required after the twelve hours' immersion.

"The results of insulation test at different temperatures to be reduced to a basis of 60 deg. Fahr. (15.5 deg. C.) by using the multipliers in the following table:

Temperature, Degrees Fahrenheit.	Multiplier.
50–52	.69
53–55	.78
56–58	.88
59–61	1.00
62–64	1.12
65–67	1.27
68–70	1.43
71–73	1.60
74–76	1.81
77–79	2.04
80–82	2.29
83–85	2.58

Section *e*, specifying insulation for voltages ranging between 601 volts and 3500 volts, has been corrected as given below:

"Thickness of insulation, voltage tests and minimum insulation resistance to be in accordance with the following tables. The test voltages are to be for one minute. The insulation resistances are after one minute electrification and at 60 deg. Fahr. (15.5 deg. C.).

TESTS ON COMPLETED LENGTHS 0-600-VOLT CLASS.

Type Letters R. S.

Size.	Thickness of Insulation.	Megohms per Mile After Twelve Hours' Immersion.	Voltage Test One Minute.
14	3–64	300	1500
12	3–64	250	1500
10	3–64	225	1500
8	3–64	200	1500
6	1–16	200	2000
4	1–16	150	2000
2	1–16	125	2000
1	5–64	150	2500
1–0	5–64	125	2500
2–0	5–64	125	2500
3–0	5–64	100	2500
4–0	5–64	100	2500
225,000 circ. mil.	3–32	100	3000
300,000 " "	3–32	100	3000
400,000 " "	3–32	100	3000
500,000 " "	3–32	100	3000
600,000 " "	7–64	100	3500
700,000 " "	7–64	100	3500
800,000 " "	7–64	100	3500
900,000 " "	7–64	100	3500
1,000,000 " "	7–64	100	3500
1,250,000 " "	1–8	100	3500
1,500,000 " "	1–8	75	3500
1,750,000 " "	1–8	60	3500
2,200,000 " "	1–8	50	3500

"*Rule 41, Section f.*—Tests on completed lengths, 601 to 7000 volt classes.

MAXIMUM OPERATING VOLTAGE.

1500 *V. Type Letter R. S.*—15

Size	Thickness of Insulation.	Insulation Resistance, Megohms	Volts Test.
B. & S. Gage			
14–8	1–16	600	4000
7–2	5–64	300	4000
1–4–0	3–32	200	4000
Circular Mils.			
225,000– 500,000	7–64	175	4000
525,000–1,000,000	1–8	150	4000
Over 1,000,000	9–64	100	4000

MAXIMUM OPERATING VOLTAGE.

2500 *V. Type Letter R. S.*—25.

Size.	Thickness of Insulation.	Insulation Resistance, Megohms.	Volts Test.
B. & S. Gage			
14–8	3–32	700	6250
7–2	3–32	350	6250
1–4–0	7–64	250	6250
Circular Mils.			
225,000– 500,000	1–8	200	6250
525,000–1,000,000	9–64	175	6250
Over 1,000,000	10–64	125	6250

MAXIMUM OPERATING VOLTAGE.

3500 *V. Type Letter R. S.*—35.

Size.	Thickness of Insulation.	Insulation Resistance, Megohms.	Volts Test.
B. & S. Gage			
14–8	4–32	850	8750
7–2	4–32	450	8750
1–4–0	4–32	300	8750
Circular Mils.			
225,000– 500,000	9–64	225	8750
525,000–1,000,000	10–64	200	8750
Over 1,000,000	11–64	150	8750

MAXIMUM OPERATING VOLTAGE.

5000 *V. Type Letter R. S.*—50.

Size.	Thickness of Insulation.	Insulation Resistance, Megohms.	Volts Test.
B. & S. Gage			
14–8	6–32	1000	12,500
7–2	6–32	650	12,500
1–4–0	6–32	450	12,500
Circular Mils.			
225,000– 500,000	6–32	300	12,500
525,000–1,000,000	6–32	225	12,500
Over 1,000,000	7–32	175	12,500

MAXIMUM OPERATING VOLTAGE.

7000 *V. Type Letter R. S.*—70.

Size.	Thickness of Insulation.	Insulation Resistance, Megohms	Volts Test
B. & S. Gage			
14–8	8–32	1200	17,500
7–2	8–32	800	17,500
1–4–0	8–32	550	17,500
Circular Mils.			
225,000– 500,000	8–32	400	17,500
525,000–1,000,000	8–32	275	17,500
Over 1,000,000	9–32	200	17,500

Section *g* reads as follows:

"Lead-covered wires and cables for interior work only. (Type letters R S L.)

"Construction of lead sheath rubber-insulated conductors 0-600 volts. Thickness of insulating wall same as for braided cables, all cables to be covered with a compound-filled tape or braid over the insulating wall. If braid is used it shall be of such thickness as to increase the required diameter over the insulating wall by at least 1/32 in., and must comply with the requirements for braid on braided conductors.

"If tape is used it must not be less than 1/64 in. thick and must lap at least one-quarter of its width. The width of the tape used should not exceed twice the square root of the diameter of the conductor over the insulating wall; i. e., 500,000 circ. mil 3/32 rubber, tape not to exceed 2 in. in width; No. 14, 3/64 rubber, tape should not exceed 0.8 in. in width.

"The lead on single-conductor cables, 0-600 volt class, sizes 2 B. & S. and smaller, both solid and stranded, to be not less than the thickness of rubber called for by Rule 41-*c*. On larger sizes the thickness of lead to be not less than the thickness of insulating wall called for, less 1/64 in.; i. e., thickness of lead on No. 2, 1/16 in.; on 1,000,000 circ. mil, 3/32 in. On multiple conductor cables, thickness of lead to be that called for by single conductor, having same diameter over the insulation as the multiplier conductor cable has over the bunched insulated conductors.

"Rubber-insulated and lead-sheathed cables, 601 to 7000 volt classes inclusive (type letters R S L-15, R S L-25, etc.) shall comply with Rule 41-*f*, and the lead sheath shall be the same as called for in 0-600-volt class, having same diameter under the lead as 601-7000-volt conductor.

"(Electrical test on finished leaded cables the same as on braided.)"

The physical tests to which all rubber-covered wire will hereafter be subjected are contained in Section *h*, as follows:

"All physical tests to be made at a temperature between 60 deg. Fahr. and 90 deg. Fahr. All test samples to be kept at a temperature within this range for at least two hours before the tests are made.

"1. The rubber compound or other approved insulation must be sufficiently elastic to comply with a test made as follows:

"A sample of wire about 20 in. long shall have the braid and insulation removed for about 2 in. at each end, leaving the braid and insulation on balance of sample. One end of the bare copper should be fastened to a clamp on a shaft of the diameter given below and a weight as given below attached to the other end of the bare copper wire. The shaft shall then be revolved ten times in ten seconds, wrapping the sample in a close wind around the shaft. With the tension left on the sample it should then be immersed in water for twenty-four hours, immediately after which it should, while still immersed, be subjected to 1500 volts alternating current for one minute The braid shall not crack under the above test.

	B. & S.	Mils.	Pounds
Diameter of shaft	No. 14 wire	170	Weight 10
" " "	12 "	190	" 10
" " "	10 "	275	" 12
" " "	8 "	375	" 15

"2. The insulating covering shall be tested for softness as follows:

"A sample of wire to have the braid removed without injury to the insulation for a distance of about 2 in., and the exposed surface held against a flat surface and subjected to the pressure of a hard phosphor bronze-edged tool, the sharpness of whose edge shall be that obtained by two surfaces forming an angle of 90 deg. with each other.

"With the tool edge at right angles to the length of the wire a vertical pressure of 8 lb., applied perpendicular to the flat surface for fifteen minutes, shall not cut through the insulation and complete an electric circuit as indicated by a 16 cp, 110-volt carbon lamp in series with the tool and wire conductor.

"3. Any rubber compound used as insulation shall be tested for permanent set, elongation and tensile strength as follows:

"*New Wire.*—A test piece taken from the wire, having insulation less than 5/64 in. thick, shall have marks placed 2 in. apart, and shall be stretched longitudinally at the rate of 12 in. per minute till the marks are 5 in. apart, and then be immediately released and a measurement taken thirty seconds thereafter, when the distance between the marks must not exceed 2.5 in. The test piece shall then be stretched until the marks are 6 in. apart before rupture. The tensile strength shall not be less than 400 lb. per square inch, calculated upon the original cross-section of the test piece before stretching.

"Test pieces from wire having insulation 5/64 in. thick or over shall be tested in a similar manner, but shall be stretched to 4 in. instead of 5 in., and must not break until stretched 5 in., and shall have a tensile strength of 400 lb. per square inch.

"*Wire Tested at Any Time Up to One Year from Date of Manufacture.*—A test piece taken from wire having insulation less than 5/64 in. thick shall have marks placed 2 in. apart, and shall be stretched longitudinally at the rate of 12 in. per minute till the marks are 4 in. apart, and then be immediately released and a measurement taken thirty seconds thereafter, when the distance between the marks must not exceed 2.5 in.

"Test pieces from wire having insulation 5/64 in. or over shall be stretched at 3½ in. instead of 4 in."

The chemical tests are incorporated in a new Section *j* as follows:

"Five chemical tests shall be made of the rubber compound as follows: Acetone extract, alcoholic potash extract, chloroform extract, ash and total sulphur.

"The sum total of the results of these five tests shall not exceed 80 per cent by weight of the total compounds—tests to be made according to Underwriters' Laboratories' specifications."

The ash test shall be supplemented by tests to determine the quality of substances other than vulcanized rubber which are combustible but not soluble in acetone, alcoholic potash or chloroform and any such substance shall be counted as ash.

Decisions on Price Agreements by the United States Supreme Court.

The legality of price agreements is involved in a case decided by the United States Supreme Court on April 3. The case relates to an agreement affecting trade in proprietary medicines. The decision was written by Justice Hughes. A dissenting opinion was rendered by Justice Holmes. The Dr. Miles Medical Company, of Elkhart, Ind., sought to restrain the John D. Park & Sons Company, of Cincinnati, Ohio, from selling at cut prices the medicines manufactured by the former corporation. The manufacturer had contracts with jobbers and wholesale and retail dealers in the United States, prescribing prices at which its goods should be sold at retail. It was urged by the manufacturer that the company against which it brought suit conducted a wholesale drug business and by inducing other dealers to violate their contracts acquired medicines and sold them at such prices that they were resold to the public at cut rates. The lower court dismissed the bill for want of equity, and its judgment was affirmed by the higher court.

Justice Hughes holds that it is obvious that the agreements restrain trade. The manufacturer, although employing a secret process, urged an analogy to rights secured by letters patent. The purpose of the patent law is to stimulate invention by protecting inventors for a fixed time in the advantages that may be derived from exclusive manufacture, use and sale. A decision is quoted in which Chief Justice Marshall said: "It is the reward stipulated for the advantages derived by the public from the exertions of the individual, and is intended as a stimulus to these exertions. The public yields nothing which it has not agreed to yield. It receives all which it has contracted to receive. The great object and intention of the act is to secure to the public the advantages to be derived from the discoveries of individuals, and the means it employs are the compensation made to these individuals for the time and labor devoted to these discoveries, of the exclusive right to make, use and sell the things discovered for a limited time."

The court holds that whatever right a manufacturer may have to project his control beyond his own sales must depend not upon the inherent power incident to production and original ownership, but upon agreement. The earlier doctrine of the common law with respect to contracts in restraint of trade has been substantially modified in adaptation to modern conditions, but the public interest is still the first consideration. To sustain the restraint it must be found to be reasonable both with respect to the public and to the parties, and it must be limited to what is fairly necessary in the circumstances of the particular case for the protection of the covenantee. Otherwise restraints of trade are void as against public policy.

If there be an advantage to a manufacturer in the maintenance of fixed retail prices, the question remains whether it is one which he is entitled to secure by agreements restricting the freedom of trade on the part of dealers who own what they sell. The complainant could fare no better without his plan of contracts than could the dealers themselves if they formed a combination and endeavored to establish the same restrictions. Agreements or combinations between dealers having for their sole purpose the destruction of competition and the fixing of prices are injurious to the public interest and void.

Where commodities have passed into the channels of trade and are owned by dealers, the validity of agreements to prevent competition and to maintain prices is not to be determined by the circumstance whether they were produced by several manufacturers or by one, or whether they were previously owned by one or by many. The complainant having sold its product at prices satisfactory to itself, the public is entitled to whatever advantages may be derived from competition in the subsequent traffic.

Justice Holmes in his dissenting opinion said that by a slight change in the form of the contract the plaintiff could accomplish the result desired in a way that would be beyond successful attack. If it should make the retail dealers also agents in law as well as in name, and retain the title until the goods left their hands, he could not conceive that even the present enthusiasm for regulating the prices to be charged by other people would deny that the owner was acting within his rights. The most enlightened judicial policy was to allow people to manage their own business in their own way unless the ground for interference was very clear. He confessed that in inquiring on what ground there was interference in the present case he was in a minority as to larger issues than were concerned in this case. He could not believe that in the long run the public would profit if this court permitted knaves to get unreasonable prices for some ulterior purposes of their own and thus to impair and even to destroy the production and sale of articles which it was assumed to be desirable that the public should be able to get. Justice Holmes thought that the importance of the question, and the popularity of what he deemed mistaken notions, made it his duty to express his view in dissent.

Ohio Commission News.

Amended in such a manner as to make it stronger than the original measure, the Winters public utilities bill was passed by the Ohio House of Representatives on April 5. For some mysterious reason the fierce opposition to the amendments proposed by Representative Lawrence K. Langdon on the previous day had disappeared and their adoption came about with ease. There is a suspicion on the part of some that the opponents will attack the bill in the Senate and defeat it, if possible in the same manner they did the Woods bill a year ago. The vote on the bill stood 90 to 14.

As the bill stands amended the commission will have power to prevent public service companies from keeping any books or records except those that may be approved by the commission or required by the Interstate Commerce Commission or State laws. This is done for the purpose of securing a system of uniform accounting.

An important change in the bill was made by the provision for establishment of standard commercial units of service by the commission and each company must furnish data in units, depreciation, wages, legal service, taxes, rentals, materials, receipts from by-products, net cost, gross and net profits, dividends and interest, surplus and reserve, and prices per unit to consumers. The idea is to get the cost of production in units in order that the commission may be in better position to consider the various questions that will come before it.

Public-service companies must provide for the interchange of service by connecting tracks, wires, etc., and telephone companies must give a complete service through joint use of switchboards and equipment if the commission so orders. However, this provision safeguards companies in doing this, so that they may not take advantage or impose upon each other in any way. Telephone companies may consolidate only by the purchase of the franchises and business of competitors on consent of the commission.

Jurisdiction is given to the commission over all utilities except those which receive their franchises directly from a municipality and in the case of such it may sit as a board of arbitration between the municipality and the utility. It has nothing to say as to rates in the original franchise and may act only in the adjustment at the beginning of ten-year periods.

Through an amendment proposed by Representative Edwards the House of Representatives went on record for the second time this session as being opposed to municipal ownership. By a vote of 42 to 50 his amendment, giving cities the right to purchase by voluntary offer or condemnation railways, light plants and water-works, was defeated.

New York Commission News.

The New York Public Service Commission, Second District, has received a petition from the Syracuse Lighting Company asking for authority to issue $470,000 par value of its extension and improvement 6 per cent ten-year gold bonds. The proceeds of the bonds are to provide for the laying of trunk mains, for extensions to its distributing system and for improvements at works and stations, and for the reimbursement of moneys actually expended from income within five years for capital purposes.

The commission has received a complaint from Mr. William S. Massoneau, president of the village of Red Hook, Dutchess County, directed against the Red Hook Light & Power Company. Because of a dispute as to the amount to be paid for street lamps during the last six months of 1910 the company served a notice upon the village that if the amount was not paid by March 31 the street lamps would be shut off, and the streets of the village are now left in darkness. The commission is asked to require the company at once to renew its street-lighting service and to continue without interruption pending the adjustment of the disputed bill. The commission made an order requiring the company to show cause why it should not be required forthwith to furnish the village with street-lighting service.

The North Avenue Presbyterian Church, of New Rochelle, has filed with the commission a complaint against the minimum-service charge imposed by the Westchester Lighting Company upon a 5-hp motor in use by the church. This motor is used solely to run a fan for ventilating purposes during services. The company makes a minimum-service charge of $1 per horse-power per month, or a total of $5 per month, which the church is obligated to pay whether that value of energy is used or not. The church alleges that the actual monthly consumption of energy at the stated price of 10 cents per kw-hour does not exceed $1 per month. The church complains that this minimum-service charge is grossly excessive, unjust and unreasonable and in violation of the provisions of the Public Service Commissions law.

Mr. Neile F. Towner, as attorney for the Municipal Gas Company, of Albany, appeared before the commission in answer to an order to show cause why it should not at once restore its gas and electric service to Mr. James H. Farley, who had complained to the commission that the company had arbitrarily shut off both the gas and electrical service because of his refusal to pay a bill for gas mantles and other fittings furnished him by the company some months ago. The bill is in dispute and the company sought to enforce its collection by resorting to the means of depriving the complainant of the lighting service supplied by it.

The company asked for more time in which to put in its answer and was given until April 17, upon the condition that the service would meantime be restored in Mr. Farley's store. The issue raised involves a question of law. Under Section 65 of the Transportation Corporations law a corporation furnishing gas or electricity may prevent the service from entering the premises of any consumer who may neglect or refuse "to pay the rent or remuneration due for the same or for the wires, pipes or fittings let by the corporation." There seems to be some doubt as to the legal right of the company to shut off the supply of gas or electricity by reason of complainant's refusal to pay a bill for gas fittings sold to him by the company.

The commission has authorized the Katonah Lighting Company to exercise privileges contained in a franchise granted by the town of Lewisboro, County of Westchester, for the extension of electric lighting service to that town. The company is also authorized to issue its common capital stock to the amount of $45,000 for the purpose of extending and improving its plant.

On April 13 at New York a further hearing will be given on the application of the New York, Westchester & Boston Railway Company for permission to exercise franchises and for changing the route of its main line from North Street in New Rochelle to a point in Port Chester on the boundary line between this State and Connecticut. Also the application of the Westchester Street Railroad Company for permission to exercise franchises for the extension of a street railway in the town of Harrison, Westchester County, will be heard.

On April 13 and 14 at New York the commission will give a hearing on the complaints of residents of various towns in Westchester County against the Westchester Lighting Company as to the price of gas and electricity. On April 14 at Olean the commission will take up the complaints of various towns along the lines of the Western New York & Pennsylvania Traction Company as to the increase recently made in passenger fares on that line.

The commission has received a complaint from Dr. Thomas R. Sheldon, of Red Hook, directed against the Red Hook Telephone Company. The complaint alleges that the toll charge of 15 cents between the exchanges at Red Hook and Rhinebeck is unjust, unreasonable and excessive. Complainant alleges that he pays the regular rentals both at his residence in Rock City and at his residence in Rhinebeck for local telephone service and that the charge of 15 cents is made in addition to the local service charge. The commission is asked to fix a reasonable charge between these exchanges.

Maryland Commission News.

The Maryland Public Utilities Commission has concluded its first investigation of the utilities corporations in the State. Mr. Charles E. Phelps submitted last week to the Public Service Commission, of which he is chief engineer, a report of gas and electric tests made by him during the three months ended April 1. Eleven companies furnishing these commodities located in every part of Maryland were included in the examination. Candle-power and heating-power and pressure were considered by Mr. Phelps in making the examinations. The report is favorable to the gas and electric companies of Maryland. Twenty is established as the standard for candle-power for gas. Mr. Phelps found that the candle-power exceeded this, the average for January being 20.48. In only one instance was the heating power less than 600, which is the standard amount. Referring to the gas supply of Baltimore City, Mr. Phelps says it is above the standard both for quality and purity. During the three months when the tests were made 6298 gas meters and 1867 electric meters were subjected to an examination. Fifteen complaints were made of gas meters. Four of them measured correctly and eight were too slow, giving the consumer the advantage. Two were slightly fast and one was very fast. Complaints were also made of six electric meters. Four of the number were slow and the other two were fast.

The Western Union Telegraph Company filed a reply to the charges of the Belvedere Hotel Company with the commission last week, in which it denied the existence of any connection with the Postal Telegraph Company. The Belvedere Hotel Company filed a complaint a few weeks ago that the two corporations had acted in "illegal combination" in removing their offices and instruments from the hotel. The reply of the Postal Telegraph & Cable Company to the charges was also filed with the commission last week. The Postal denies that there existed any illegal combination with the Western Union Telegraph Company, as charged by the hotel, and denies further that an office in the hotel was necessary for the convenience of the hotel patrons and residents of that section of the city. The company adds that it is willing to restore an office in the hotel provided a suitable location be offered. The commission will await a statement from the hotel company as to whether the answers are satisfactory before deciding whether the case shall have a hearing.

A special meeting of the Morrell Park Improvement Association was held last week in the interest of getting a car line for the Washington Road. About 500 people attended the meeting and it is said that more than 5000 would be benefited by such a car line. At present these people are forced to walk from a quarter of a mile to three miles for a car. The association will ask the United Railways & Electric Company to extend the Columbia Avenue line one mile and a half along the Washington Road or to Canton Avenue. An attorney has been retained by the association to present the matter to the Public Service Commission.

Massachusetts Legislative News.

Chairman George G. Crocker, of the Boston Transit Commission, appeared before the joint committees upon metropolitan affairs and railroads on April 6 on behalf of steam-railroad electrification in the Boston district. Mr. Crocker said that as spokesman for the minority of the Joint Commission on Metropolitan Improvements, which favored early beginning of electrification through legislative enactment, he believed that electricity has been shown to be a thoroughly practicable motive agent. He emphasized the point that nothing in the utterances of Vice-president McHenry, of the New York, New Haven & Hartford Railroad, shows that a properly planned electrification system will not prove profitable. Mr. Crocker said that the fact that at present more than three times the number of passengers are handled in Boston that are passed through the Grand Central Station in New York is a strong argument in favor of electricity. A higher traffic density is one of the best reasons for electrifying. Because it has been found that to operate in one place 1000 cars per day in 100 trains of ten cars each costs more by electricity than by steam it by no means follows that electricity will be more costly than steam in another place where the volume of traffic is three times as great and where the conditions require that it be carried in 600 trains of five cars each. Mr. Crocker said further: "I submit that as compared with steam electric traction works to better advantage when the traffic requires a large number of separate train units than when it can be concentrated into a smaller number of large train units, and the fact that there are twenty or more branch lines which must be operated in and around Boston either by steam or electricity is a condition which is not adverse but, on the contrary, is favorable to the substitution of electricity for steam. * * * The possibility of using the multiple-unit system on the branch lines around Boston is a further condition advantageous to the use of electricity."

Mr. Crocker further pointed out that no account had been taken of so-called real-estate salvage through improvement of property by electrification in the studies of the railroads, and contended that only the merest hypothetical consideration had been given this point by the majority of the Joint Commission. Electrification eliminates the necessity of costly roofed structures used now because of smoke and gases in terminal stations. The speaker made a strong argument against the smoke nuisance, suggesting that it is not unlikely that it actually shortens life in a manner which is more serious in the aggregate than railroad accidents. He firmly believed that if electrification of the unified Boston & Maine and New Haven systems is carrried forward on the lines suggested by Vice-president McHenry, including both passenger and freight service, the result, taking all elements into consideration, will be notably profitable to the company.

A striking argument in this connection was submitted by Mr. Crocker. He stated that the present passenger traffic to and from the North and South Stations at Boston is about 60,000,000 per annum. The cost of electrification of the entire metropolitan district is estimated at $40,000,000. Five per cent on this is $2,000,000 per year. An increase of 20 per cent in the present passenger traffic, each passenger riding an average of ten miles within the electrified district and paying an average fare per mile of 1.6 cents—the average of the State per mile—would add the $2,000,000 to the gross earnings. He emphasized the fact that electrified service always tends to increase the volume of travel. At the Grand Central, in New York an increase of 12 per cent occurred between 1908 and 1910 in spite of the confusion incidental to the changes made at the terminal.

In closing, Mr. Croker said that he believed that the New Haven company fully intends to electrify its lines as promised before the Boston & Maine lease, but that compulsory legislation is essential in order to express the dissent of the State from the unsatisfactory report of the majority of the Joint Commission. Unless the State announces its intentions to hold the company up to its professions, the report itself will furnish good ground for claiming that it should not be expected to do anything which is of so little importance to the public, which will cost so much and be so unprofitable. Chairman Crocker was followed by Prof. George F. Swain, of the Joint Commission, who reiterated his well-known views that legislation compelling the adoption of electric motive power at present is undesirable, and that if the New Haven tunnel for electric service is built by legislative sanction under Boston Harbor electrification will proceed from that step as an economic extension to other lines.

Wisconsin Commission News.

The case involving an application for an increase in rates by the Troy & Honey Creek Telephone Company has been dismissed by the Wisconsin Railroad Commission. The company alleged that the revenues derived under the present rate of $1 per month for residence or business telephones did not return a reasonable rate of interest upon the investment. The rates asked for were $1.25 and $1.50 per month for residence and business telephones respectively. There was opposition on the part of the subscribers to this increase on the grounds that the service was not satisfactory and that, under proper management, the present rates should yield an ample return upon the investment.

The commission has handed down its decision in the matter of the application for an increase in rates by the Milton & Milton Junction Telephone Company. The company's present rates are as follows: $1.50 for business and residence individual lines; $1 for business and residence four-party selective; $1.25 for rural telephones. The increase in the cost of labor, material and supplies is the reason assigned for the increase in rates. The rates asked for are as follows: Business telephones, individual, $2; four-party, $1.50; residence telephones, individual, $1.50; four-party, $1; rural telephones, $1.50.

It developed at the inquiry that the company had maintained no depreciation account prior to the last fiscal year. As a result of this negligence the renewal requirements will undoubtedly exceed the amount allowed for depreciation. Yet, as the commission points out, this does not justify the company in loading the cost of past depreciation on the telephone users of the future. The operating revenues under the present rates are sufficient to give a fair return upon the investment, with depreciation computed at 7 per cent. The proposed rates would yield too great a rate return. Furthermore, the commission did not consider that the difference in the cost of serving the rural subscribers was as high as the proposed rate would indicate, It was thought advisable to reduce the proposed rate for rural telephones from $1.50, as requested, to $1.25, and to authorize the company to adopt its proposed schedule with this modification.

The commission has authorized the Wisconsin Electric Railway Company to issue $83,000 par value of 5 per cent, twenty-year first-mortgage gold bonds, in denominations of $1,000 each. The issue is to be secured under a mortgage executed to the Wisconsin Trust Company of Milwaukee. The bonds are to be sold for cash and for not less than 85 per cent of their par value for the purchase of electric railway property and equipment, the cost of extensions and additions to the property of the company.

The Great Northern Pail Company has received a franchise to do a general lighting business in the village of Gillet, Wis., and to light the streets of the village.

The Jefferson Electric Light Company has been empowered to put into effect the following schedule of rates: 16 cents per kw-hour for the first sixty hours' use per month of the active connected load; 10 cents for all excess. A discount of 10 per cent may be allowed. The active connected load is to be as follows: Class A, consisting of residences, public buildings, etc., 45 per cent active; Class B, consisting of schools, churches and industrial establishments closing not later than 6 p. m., 50 per cent active; Class C, consisting of stores, banks, saloons and all others, 60 per cent active. Street lighting, with 32-cp incandescent lamps operating on a moonlight, all-night basis, is to be furnished for $18 per lamp per year.

Canadian Hydroelectric Commission News.

It is reported on the authority of the local distributing company at Windsor that an agreement has been practically closed between that company and the Michigan Railway for a large block of hydroelectric power for use in the Detroit River tunnel. The Detroit Edison Company is now furnishing power to the tunnel company under a ten-year contract, which, however, is is understood, is not exclusive, and the power now being used represents but a small portion of what will be required by the Michigan Central Railway.

The City Council of Toronto at its meeting on April 3 refused to approve the recommendation of the board of control that Mr. P. W. Ellis be appointed as the city's representative on the proposed commission to manage the city's hydroelectric distribution plant and business.

On April 6 the steam-generating equipment at the Stratford (Ont.) municipal plant was shut down and the entire service for the city is being furnished by Niagara Falls power from the commission's transmission line to western Ontario. The steam plant will, however, be kept in reserve.

Representatives from nineteen municipalities in eastern Ontario met at Brockville on April 7 for the purpose of considering terms and conditions of hydroelectric power to be furnished them through the agency of the Hydroelectric Commission. Hon. Adam Beck, chairman, accompanied by Chief Engineer P. W. Sothman, stated that a contract had been entered into with the New York & Ontario Power Company, of Waddington, N. Y., with the option of securing 15,000 horse-power at a total cost of $657,000. In addition, Mr. M. F. Beach, owner of a power course at High Falls, had made an offer which would also cover the eastern portion of the province, with a distributing station at Kingston.

Mr. Beck read the contract made with the New York & Ontario Power Company, of which Mr. J. Wesley Allison, of Morrisburg, is the promoter. Mr. Beck claimed that the contract was more advantageous than any made in western Ontario. The rates throughout this contract would be higher than from the Niagara Falls source, but transmission would be cheaper on account of the shorter distance from the generating plant. After the expiration of ten months from the execution of the contract the company is to deposit $100,000 that it will supply and deliver at Morrisburg from 2000 to 5000 horsepower, and, later, upon one month's notice from the commission, to deliver in blocks until the maximum is reached. Within eighteen months the commission must give notice to the company that it will go on with the work.

AMERICAN ELECTRICAL ENGINEERS—No. XXIX.

E. N. Lake.

Edward Nelson Lake was born June 13, 1869, at Austin, Minn., and from 1876 to 1886 lived in Alabama, where he attended public and private schools. After teaching in country and city schools in the State of Florida for several years he took a course in civil engineering at the National Normal University of Lebanon, Ohio, receiving the degree of C. E. in 1889. During his last year at the school he carried on the work of one of the instructors who was forced to be absent through illness.

After graduation Mr. Lake served as instructor in the Florida Agricultural College at Lake City, where he devoted four or five hours daily to special electrical work, including such laboratory work as the facilities at the institution permitted. In 1893 he concluded to take up electrical engineering as a profession, and decided that under the circumstances the best method of training would be through direct contact with practical work, supplemented by reading and study upon subjects connected with the work in hand from time to time. This method was followed with more or less system and constancy of purpose.

The first twelve months were spent by Mr. Lake in armature winding and machine-shop work with the Independent Electric Company, Chicago, including some experimental work under Mr. Elmer A. Sperry; the following year he was engaged as wireman with the Chicago Edison Company, and the next year as electrician in the industrial power plant of Norton Brothers at Maywood, Ill. Another year was passed as construction foreman with the Topeka Edison Company, followed by a year as electrical contractor at Wheaton, Ill., and a similar period as superintendent for Mr. Charles A. Pratt, Chicago, a consulting engineer, in applying motors to industrial plants. After serving for a year and a half as head draftsman in the switchboard department of the Western Electric Company, Mr. Lake joined the engineering staff of the Chicago Edison Company, with which he remained for three years, his work principally being in connection with the three-phase distribution system of this company, which was at this time changed over from 4500 volts to 9000 volts. During this period he designed and supervised the construction of various rotary converter and battery substations. In 1903 he became manager of the switchboard department of the J. Lang Electric Company, of Chicago, having charge of the design, construction and sale of the product, which included both standardized and special switchboards. In 1905 he became connected with the Arnold Company of Chicago. Part of his work during this engagement was connected with the design and supervision of the construction of transmission lines, substations and low-tension distribution system of the Elgin and Belvidere Electric Railway.

Mr. Lake also assisted in the preparation of the plans and had charge of certain schedules in the valuation by the Traction Valuation Commission of the properties of the Chicago City Railway Company and the Chicago Union Traction Company. In 1907 he became division engineer of the division of electric transmission and distribution of the Board of Supervising Engineers, Chicago Traction. The work of this body was the preparation of plans and specifications for, and supervision of, the rehabilitation of the street railway systems of the City of Chicago. Recently Mr. Lake has joined the staff of the Stone & Webster Engineering Corporation, and he is at present engaged upon plans for the new alternating-current distribution system of the Boston Elevated Railway system.

E. N. Lake.

A number of patents have been granted to Mr. Lake, among which are the following: An electro-mechanical operating device for high-voltage switches; a form of conduit used largely in the high-tension systems of Chicago, and a panel-board for office buildings designed to simplify the changing of the circuits on meters, in order to make quickly and easily changes in meter connections in case of changes in the occupancy of floor space. He is a member of the American Institute of Electrical Engineers, American Society of Civil Engineers, American Electric Railway Association, Western Society of Engineers and American Society for Testing Materials.

CURRENT NEWS AND NOTES.

Iowa Convention.—The annual convention of the Iowa Electrical Association will be held in Davenport, Ia., on April 19, 20 and 21. Mr. W. N. Keiser, Union Electric Company, Dubuque, Ia., is secretary of the association.

Electricity in Gas Works.—At the new coal gas works at Providence, R. I., all the machinery of the works is operated by electricity, except that of the condenser and purifier houses, which is operated by steam. The generating equipment comprises two 300-kw, 220-volt direct-current generators. Electricity is also the only source of lighting used in the condenser, purifier and tar pump houses.

Cost of City Lighting in Denver.—During 1910 the City of Denver paid $161,694 for its electrical street lighting, no other form of street lighting being in use. Of this amount $20,870 was for ornamental lighting on the three principal business streets and $3,147 for other special street and boulevard illumination. The Denver Gas & Electric Company returns $50,000 yearly for its franchise.

New German Patent Law.—As the result of a petition of the German Machine Manufacturers' Association to the imperial government, asking the abrogation of the German-American patent agreement of Feb. 23, 1909, a new bill has been taken up by a committee of the Reichstag. The petitioners claim that Americans have an advantage in competition, as they are not compelled to manufacture in Germany, as are the German holders of patents.

High Towers for Wireless.— The experiments that have been in progress at Brant Rock, Mass., for two years, under the direction first of the Navy Bureau of Equipment and later of the Bureau of Supplies, for the ultimate establishment of a very powerful wireless system have so far succeeded that a decision has been made to construct three or four steel towers 450 ft. high at Fort Myer, Washington, D. C., as the land base of the system. This will give the system a radius of at least 1500 miles.

Cleveland Electrical League.—The Electrical League of Cleveland held a highly successful smoker and entertainment on April 7 at the Moose Club Hall, Cleveland, over 500 members and guests being present. More than fifty new members were admitted during the evening. The principal objects of the league are to encourage the interchange of ideas, foster co-operation and eliminate misunderstandings among the members of the various competing electrical concerns through mutual acquaintance.

Boston Electric Vehicle Meeting.—A meeting in the interests of electric vehicle development will be held at the Edison Building, 39 Boylston Street, Boston, Mass., on Monday evening, April 17. At that time formal steps will be taken to organize a New England Section of the Electric Vehicle Association of America, and a talk will be given by Mr. D. B. Strickland, of the Shepard, Norwell Company, Boston, on "The Economy of Delivery Service by the Use of Motor Vehicles." It is expected that the speaker will discuss plans for a co-operative electric vehicle delivery organization, which has lately been considered by some of the larger department stores in Boston.

Ships Must Have Wireless.—The Secretary of the Department of Commerce and Labor has notified the collector of the port of New York that all ships leaving United States ports after July 1 next which carry fifty passengers and which ply between ports more than 200 miles apart must be equipped with wireless-telegraph apparatus capable of maintaining communication over distances of at least 100 miles. The department is now engaged in preparing regulations for the enforcement of this act, which was passed June 24, 1910. It has been determined to accept as evidence of the competence of operators the certificate covered by the service regulations annexed to the Berlin International Radio-Telegraphic Convention.

Proposed Buffalo-Pittsburgh Electric Railway.—It is said that recent negotiations make it probable that Buffalo and Pittsburgh may be connected by electric railway by way of Erie, Pa. According to the report the electric road running from Meadville, Pa., to Cambridge Springs, Conneaut Lake and Linesville has come under the control of the same interests that own the line running from Pittsburgh to New Castle, Sharon and Sharpsville. All that is needed to give Pittsburgh electric railway connection with Erie, and, therefore, with Buffalo, is the filling in the gap between Sharpsville and Linesville, giving service to the entire Shenango Valley. It is reported that Mr. F. F. Curtze, of Erie, has said that this missing link will be built within a short time.

Electric Club of Chicago.—At the meeting of the Electric Club of Chicago on April 5 Mr. W. J. Hagenah, chief statistician of the Wisconsin Railroad Commission, who was to have addressed the club on the workings of that commission, was unable to be present owing to the sudden illness of a member of his family. There was, however, an interesting discussion of the public-service commission idea as applied to the State of Illinois. The death of Mr. George T. Westcott, a Chicago electrical man of many years' experience, was announced, and Mr. Albert Scheible was appointed chairman of a committee to draft suitable resolutions of condolence. The treasurer of the club reported that the cash balance on hand was $3,871.30. It was also announced that the club will hold a smoker and evening entertainment on April 27 at the Illinois Athletic Club.

Model Downtown Streets for Chicago.—The Chicago Association of Commerce has appointed a committee to be known as the committee on model downtown streets. This committee is authorized to employ an engineer to study the situation and prepare a plan for improving the central business district. The undertaking is the result of a report to the executive committee of the association made by a special committee of which Mr. Bion J. Arnold was a member. The task undertaken by the committee on model downtown streets includes a study of several methods of bettering present conditions, including a passenger subway under the streets, public-utility galleries under the streets, permanent street surfaces, broad sidewalks and brilliant illumination at night. The chairman of the new committee is Mr. August Gatzert, 308 Franklin Street.

Denver Electrical Show.—On the evening of April 3 a meeting of directors and committee members of the Colorado Electric Club was held in the club rooms of the Colorado Telephone Company, Denver. Reports of the various committees were presented with particular reference to the coming Electric Show in the Denver Auditorium. As compared with last year a complete change in decorations will be made, and bunting will be dispensed with in favor of autumn floral decorations. Christmas-tree lamps will be scattered throughout these decorations, and an electric sign will be placed at each display booth. The street illumination will be largely red and white, with the emblem of the Sons of Jove very much in evidence, since their national "rejuvenation" will be held simultaneously in Denver. The "devil" will travel nightly between two towers in the lower part of the city. The basement of the Auditorium will be arranged partly as a mine and partly as a farm to show in the best possible manner the mining and irrigation progress which has resulted from uses of electricity. Sixty-six per cent of the floor space has already been taken and considerable additional room will be needed over that available at last year's show.

Electrical Contractors' Association of State of Missouri.—The next meeting of the Electrical Contractors' Association of Missouri will be held at Kansas City Saturday, June 10, 1911.

Treasury Department Adopts Electrical Weighing Machines.—As a result of the weighing frauds in the customs house of New York last year the government has just placed electrical weighing machines in the customs houses of New York and Boston.

Toledo A. I. E. E. Meeting.—At a meeting of the Toledo Section of the American Institute of Electrical Engineers held on April 7 there was a general discussion of the factors entering into the cost, production and distribution of electricity, which was led by Mr. M. W. Hansen.

Electric Light for the City of Faith.—A franchise has been granted by the City of Faith, S. D., to the Faith Light, Heat & Power Company, of which Mr. F. C. Mills is the principal proprietor. The new company will begin service within six months. Mr. M. E. Brookman, of Eagle Butte, S. D., is the engineer in charge of construction.

Northwestern University School of Engineering.—The recently established school of engineering of Northwestern University, Evanston, Ill., has now fifty students taking the full five-year course. Most of the advanced students are in their fourth year. Mr. John Fillmore Hayford, C. E., is dean of the engineering school, and Mr. William C. Bauer is professor of electrical engineering.

Attitude of Chicago's New Mayor Toward Public Utilities.—Mr. Carter H. Harrison, the newly elected Mayor of Chicago, is quoted as saying that he regards the construction of the proposed passenger subway and a uniform policy in relation to public utilities as subjects of prime importance for the new administration. He also announced his opposition to all the bills pending in the Illinois Legislature providing for public-service commissions.

American Society of Swedish Engineers.—The Capt. John Ericsson Memorial Society of Swedish Engineers, which was organized by prominent Swedish engineers in America on March 31, 1907, has established quarters in the Engineering Societies Building, 29 West Thirty-ninth Street, New York. The officers of the society are as follows: President, Mr. Carl George P. De Laval; vice-president, Mr. Carl Vesterdahl; secretary, Mr. Algot Sylven.

Meeting of the New York Company Section of the N. E. L. A.—The committees on papers and addresses and entertainment have combined to give the New York Company Section members an unusual entertainment at the April meeting, to be held in the auditorium of the Engineering Societies Building, New York, on April 17. Col. Charles J. (Buffalo) Jones is to furnish the entertainment in the form of a lecture fully illustrated with moving pictures.

Municipal Public Utilities in Los Angeles.—By recently adopted amendments to its charter the City of Los Angeles may supply its citizens with any means of heating, lighting or motor service, selling the surplus, if any, to other municipalities. It may also operate quarries, railroads, elevators, tunnels or viaducts. The Board of Public Utilities of the city has power to investigate public utilities and to establish rates, subject to the approval of the City Council.

Opening of Winnipeg Power Plant by King George.—The Board of Control of Winnipeg, Can., has had under consideration the suggestion that King George V of England should be requested to open the Winnipeg municipal power plant at Point du Bois on its completion in July. At a meeting on April 4 the board decided that Mayor Evans, when in England attending the coronation ceremonies, should endeavor to obtain the consent of the King to perform the function of opening the power plant by pressing an electric button in England connected to the machinery at the power house at Point du Bois.

Hook-Switch Instruments Demanded.—Taking advantage of a section of the ordinance under which the Chicago Telephone Company operates requiring the company to use the latest improved apparatus, aldermen of the Thirty-third Ward of Chicago have secured the passage of an ordinance requiring the company to install automatic signaling devices upon the instruments connected with the Burnside exchange. Curiously enough, it appears that the subscribers connected to this exchange are provided with the older type of instruments, requiring the subscriber to ring a bell to signal the exchange.

Colorado Springs Electrical Ordinance.—The recently passed conduit electrical ordinance of Colorado Springs has been attacked owing to a defective installation made by an electrical contractor who was formerly city electrician. As a result of some weaknesses developed in the present ordinance, an entirely new ordinance has been submitted by a committee composed of two electrical contractors and an engineer of the Colorado Springs Electric Company. This proposed ordinance is in some respects an advance and in other instances less rigid than the present ordinance and will be submitted for immediate passage. The conduit feature has become so popular as to have no opposition before the ordinance committee or City Council.

Convention of the Missouri Electric, Gas, Street Railway & Water Works Association.—The fifth annual convention of the Missouri Electric, Gas, Street Railway & Water Works Association will be held at the Jefferson Hotel, St. Louis, Mo., on April 13, 14 and 15. The following papers will be presented: "Centrifugal Pumps," by Mr. W. H. Reeves; "Lubrication," by Prof. H. B. Shaw; "The Illuminating Engineer"; "Electric Vehicle," by Mr. Herman Shoehrer; "Ornamental Street Lighting," by Mr. N. J. Cunningham; "Coal and Water Gas," by Mr. P. A. Bertrand; "District Steam Heating," by Mr. Hal. C. Kimbrough. There will be a banquet and theater party for the ladies on April 13, an automobile ride for the ladies and a "rejuvenation" of the Sons of Jove, April 14; an inspection of the Ashley Street station and other properties is scheduled for April 15, and a theater party for the same night.

Meeting of Brooklyn Company Section.—The April meeting of the Brooklyn Company Section of the National Electric Light Association was held on Monday, April 3. The program included a paper by Mr. W. C. Pike on "Practical Accounting," which was of great interest and thoroughly discussed by members of all departments. Following the paper an interesting talk on "The Development of the Motor Car" from its beginnings in 1600 to 1896, when it commenced to assume its present-day form, was given by Mr. Parker H. Kemble, editor of the section *Bulletin*. The talk was illustrated by lantern slides made from old prints and engravings and presented to the section a side of the motor car concerning which comparatively little is known. Mr. E. E. Higgins, of the Anderson Company, then gave a thorough exposition of "The Modern Electric Vehicle," using the stereopticon to illustrate the various points of construction and operation. Besides these papers and addresses, the program for the evening included motion-picture films, illustrated songs, a vaudeville entertainment and refreshments and music. The attendance was between 400 and 500. This was the last of the section meetings of the season and the members will not meet again until the convention on June 31, which will be held at the Oriental Hotel, Coney Island.

WATER-POWER DEVELOPMENT IN SOUTHERN MINNESOTA.

The Blue Earth Hydroelectric Plant of the Consumers' Power Company, Serving Mankato and Vicinity.

THE new Blue Earth water-power development of the Consumers' Power Company on the Blue Earth River nine miles southwest of the City of Mankato, Minn., to which it transmits energy, is planned for a future 3500-hp development, of which 2320 hp in waterwheel-driven generating machinery is already installed and in operation. The dam, which creates a normal operating head of 62.5 ft., is of the hollow, reinforced-concrete type and carries on vertical extensions of its buttresses a 16-ft. county roadway 70 ft. above the tail-water surface, as shown in Fig. 1. The hydroelectric energy developed at the Rapidan plant is transmitted at 33,000 volts to the Mankato substation, where it is reduced and converted into suitable forms for supplying the city lighting and power service and for operating the street railway. Later this transmission line will be extended to Faribault, joining there the similar transmission through Northfield from the Cannon Falls water-power plant of the same company. The line will thus link together these two hydroelectric developments eighty miles apart, supplying through transformer substations the whole adjacent region with electrical service.

DAM AND HYDRAULIC WORKS.

The Blue Earth plant develops a former rapids and falls in the Blue Earth River near the center of Blue Earth County, Minnesota, and two miles west of the village of Rapidan. With its crests 53.5 ft. above tailwater and surmounted by 8-ft. tainter gates, the Ambursen hollow, reinforced-concrete dam impounds backwater for nearly six miles along the old river valley, creating a pond surface of about 550 acres. By drawing down the pond area thus formed to a depth of 15 ft., enough water can be obtained to operate the plant about twenty days if necessary. The turbines are designed to operate efficiently throughout this range of 47 ft. to 62.5 ft. of head.

The task of providing for the flowage of the impounded water also included the removal of a county bridge near the dam site, the deck of which would have been submerged about 28 ft. by the pond created. This crossing is replaced by the concrete roadway carried on the dam buttresses seen in Fig. 1, the steel bridge itself being moved to a point four miles up stream, where it provides another crossing for neighboring residents.

The dam, including the power-house section, is 500 ft. long, of which 272 ft. is spillway. There are fifteen bays or cells, separated by concrete buttresses 24 in. thick, and having up-and-down-stream bases 159 ft. long. On these buttresses is supported the 45-deg. sloping upstream wall or deck, the weight of the water itself pressing downward on this surface and rendering the structure stable against overturning or sliding caused by horizontal thrust. The cut-off wall at the level of the dam is carried down 15 ft. into the sandstone.

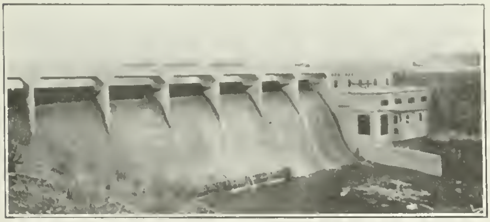
Fig. 1—Blue Earth Dam and Power House, Near Mankato, Minn.

The crest of the spillway is at an elevation of 151 ft. above datum, tailwater being at 96 ft. The seven 32-ft. hand-operated tainter gates stand 7 ft. above the spillway crest. To the tops of these gates are fixed 12-in. flashboards, the pins of which are designed to break, dropping the boards when more than 8 in. of water flows over their tops. The tainter gates are operated from hand-wheel shafts and chain drums. From the spillways the concrete aprons are carried downward with a gentle reverse curve designed to discharge the water without vertical impact into the splash pool below. Beneath the east end of the spillway apron are four 7-ft. x 5-ft sluice gates closed by hand-operated worm gear from platforms within the hollow cells of the dam, which is penetrated by two gallery passages extending throughout its length. Together with the spillway the four sluice gates have a capacity for discharging 30,000 cu. ft. of water per second in case of flood, or about one-seventh of the water that goes over Niagara Falls. On top of the piers, which also serve to support the pivots of the tainter gates, is carried the 16-ft. county-road crossing at a level with the adjacent plain and approach. The road structure is of reinforced concrete, its 36-ft. spans resting on 18-in. x 24-in. concrete beams.

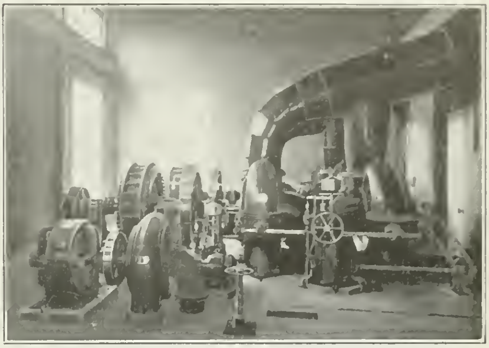
Fig. 2—Interior of Power House.

Ground was broken for the Rapidan dam on March 15, 1910, and the wheels were started up Feb. 25, 1911. During this interval 21,800 cu. yd. of rock excavation and 7100 cu. yd. of earth excavation were removed, and 20,000 cu. yd. of reinforced concrete was poured in the forms of the dam.

POWER HOUSE.

The power-house structure, which forms part of the dam bulkhead, is a poured-concrete building, 73 ft. long and 38 ft. wide, with a height of 30 ft. to the steel trusses supporting the tile roof. Two 1160-hp waterwheel-driven generator sets and one waterwheel-driven exciter set are already installed in the station, which is designed to contain additionally one main alternator set and one exciter set. An interior view of the power house is shown in Fig. 2.

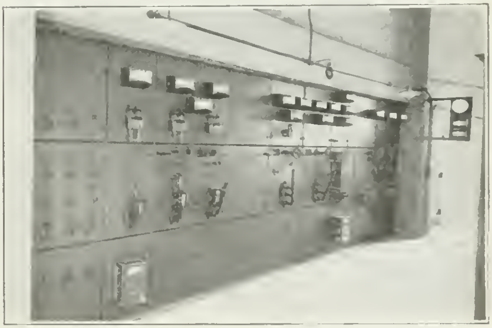
Fig. 3—Switchboard at Power House.

The water entering the headgates to the hydraulic units is cleared of any rubbish by a floating boom extending across the power-house corner of the floor bay. There are also inclined steel trash racks, arranged in two panels to slide in the channels of parallel I-beams like window sash so that either section can be pulled up for cleaning. The converging walls of square-sectioned concrete boxes convey the water from the hand-operated headgates to 5-ft. cast-iron thimbles in the concrete bulkhead wall of the power house, from which are led the riveted-steel penstock tubes to the waterwheels.

Each of the present main alternator units consists of a twin pair of horizontal 32-in. spiral-case Pelton-Francis water turbines direct-connected to drive a 750-kw, 2300-volt, 60-cycle, three-phase General Electric generator at 300 r.p.m. Individual 16-kw direct-current exciter units are mounted on extensions of the main shafts of these machines. Between the waterwheels and the main generator of each unit is mounted a 12,000-lb. flywheel to assist regulation of the machines. The units are controlled by Pelton oil-pressure governors, operating rocker arms which manipulate the gates of the twin waterwheels simultaneously. In addition to the direct-connected individual exciter units there is also a separate 50-kw exciter driven by an 80-hp waterwheel fed through an inverted siphon 22-in. supply pipe hung under the floor by U-hooks. All of the waterwheels discharge into steel draft tubes, 16 ft. in length.

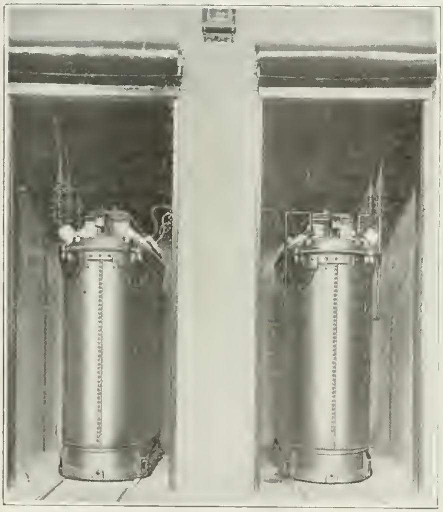

Fig. 4—Transformer Compartments with Self-Closing Doors.

SWITCHBOARD.

The main remote-control switchboard, Fig. 3, is installed in an opening under the north curtain wall of the waterwheel-room. Directly behind the board is a two-story switch bay, on the second floor of which all of the 2300-volt oil switches are mounted, being manipulated by pull rods from the handles on the switchboard below. With the exception of the instrument transformers on the 2300-volt cables, which ascend on the wall behind the first-story switchboard passage, no potential higher than the exciter voltage is exposed on the lower floor level. The 2300-volt oil switches above are mounted between 2-in. concrete barriers, with Hyrib centers. The main 2300-volt buses are carried on insulators across the tops of these panels, being sectionalized by the insertion of current transformers between the machine and transformer switches so that the output of the plant can be measured by the totalizing watt-hour meter in front. The black-slate switchboard comprises the two present and one future alternator panel, the exciter panels, regulator panel, transformer panels and station lighting and power panels. A Tirrill regulator is installed and is effective in reducing the effects of the trolley peaks of demand of the Mankato street-car system to a minimum voltage variation at the generator buses.

For raising the 2300-volt generated potential to the transmission pressure, 33,000 volts, two 1250-kw, three-phase, oil-insulated, water-cooled transformers are installed in separate concrete compartments closed by roller steel doors. These doors, as shown in Fig. 4, are arranged with fusible links and drop automatically in case of abnormal rise of temperature or fire in the compartments. From the high-tension terminals of the transformers the 33,000-volt buses rise through ceiling-type insulators to the disconnecting switches, separated by 3-in. concrete barriers, on the floor above. These switches enable either or both transformers to be connected to the horizontal overhead buses which pass through the east wall of the chamber to the solenoid-operated General Electric high-tension line oil switch in the adjoining concrete switchroom. All of the high-tension buses are of ¾-in. copper tubing, 1/16 in. thick, all joints being sweated connections. The high-tension line switch, Fig. 5, is equipped with trip coils in each lead and is arranged to open with an inverse time element. From the line switch the buses pass through the high-tension exits in the north wall of the building, where they are connected to the No. 3 copper line conductors. From this point the lightning-arrester discharge paths are tapped off, passing through the horn-gaps mounted on the power-house roof, shown in Fig. 6, and into the end chamber of the high-tension gallery, where the aluminum-cell arresters are installed. Each phase wire is thus tapped through an arrester cell to a common point which is grounded through a fourth cell to ground. A single aluminum-cell gap inserted in the ground wire of the arresters is bridged by an alarm bell which indicates when the arresters are discharging.

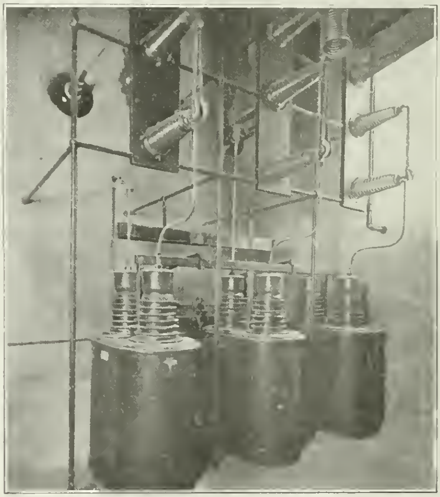

Fig. 5—High-Tension Oil Switch to Transmission Line.

TRANSMISSION LINE.

The transmission line from the Rapidan dam into Mankato employs the unique improved type of "wishbone" cross-arm construction developed by the engineering department of H. M. Byllesby & Company and described in the *Electrical World* Dec. 1, 1910. Two pieces of steel angle section are bent as shown in Fig. 7, and bolted together in the V-shape illustrated. This is then pinned to the pole at points two-thirds of the distance from the crotch end, at which the single insulator pin is attached, an arm of the V passing on each side of the pole. The two wires on one side, at a distance from the pole half that of the third one on the single-wire side, thus balance the arms for both horizontal and vertical forces. The arms are mutually braced between themselves, and tendency to rotate about the pole is prevented by the manner in which the arms are through-bolted on each side of the pole. The inclined position of the top cross-arm permits the top line wire to be carried above the pole top, allowing the use of shorter poles. When running along highways tree trimming can be reduced by placing the long side of the arms over the roadway. As the wires are at different heights, they are prevented from swinging together in high winds. No gains are needed in mounting the arms.

The Rapidan-Mankato line, 11.25 miles in length, consists of three No. 3 hard-drawn copper wires carried on Thomas insulators at the apexes of a 6-ft. triangle. A ground wire of ¼-in. Siemens-Marting steel strand is carried on angle-iron bayonets pinned under the cross-arm through-bolts and grounded at every pole. The 35-ft. wooden poles are placed at 150-ft. intervals.

Six feet below the transmission wires, on the same poles, is carried a telephone circuit on standard cross-arm construction. At both the power-house and substation ends the instruments are protected by highly insulated repeating coils and the line is cleared of induction troubles by attaching retard coils.

MANKATO SUBSTATION.

The Mankato transforming substation has been constructed as an addition to the existing gas-engine and steam-driven generating plant which formerly supplied the city lighting and railway service. Part of this prime-mover equipment will be retained for auxiliary purposes in connection with the hydro-electric transmission.

At the city end the incoming transmission circuit is equipped with aluminum-cell lightning arresters, oil switch and disconnecting switches leading to four 400-kva oil-insulated transformers, one of which is arranged as a spare unit. These transformers are inclosed in separate concrete cells and tubular buses are used as in the water-power station. All 2300-volt switches and circuits are installed on a second-floor gallery, Fig. 8, above the switchboard level, no potential higher than that of the 550-volt trolley circuits appearing on the board. A 200-kw synchronous motor-generator set has been installed for converting the incoming alternating-current energy into direct current for the street railway, replacing the 200-kw Corliss engine-driven set before used. Another Corliss engine is also held in reserve for belting to a rewound 350-kw, three-phase alternator. The plant also contains two 125-hp and one 85-hp Westinghouse vertical three-cylinder gas engine, driving a jackshaft to which a 100-kw alternator is belted. These gas engines were formerly operated on retort coal gas from the illuminating-gas plant which is owned by the same company.

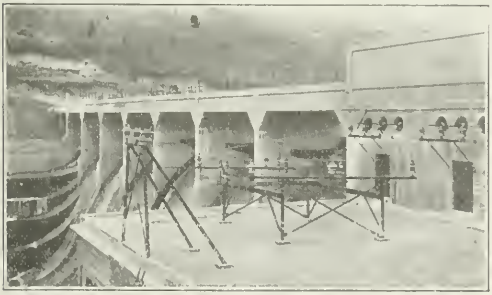

Fig. 6—Horn Gaps and Line and Arrester High-Tension Entries.

Electrical energy for lighting, power and street-railway operation is now supplied through the Mankato substation from the Rapidan water-power. The far end of the Mankato substation has been arranged for the future transmission line to come from Faribault and Cannon Falls.

Mankato, together with North Mankato, which is just across the Minnesota River, is a hustling manufacturing and distributing city of 15,000 inhabitants, and has a number of factories, besides limestone quarries producing the finest building stone in Minnesota. About 500 hp in motors is now connected to the local electric distribution lines and 1130 central-station customers use electricity for lighting their stores, shops, offices and homes.

A 2300-volt line taken directly from the generator buses of the water-power station also furnishes energy to the village of Rapidan, two miles distant from the dam. The construction of the dams and power houses at Rapidan and Cannon Falls and the substations at Northfield, Faribault and Mankato, together with the reconstruction of the steam reserve stations at the latter points, was done by the engineering department of H. M. Byllesby & Company, Chicago, of which Mr. Otto E. Osthoff is vice-president and chief engineer, Mr. W. R Thompson, assistant chief engineer, and Mr. J. W. Link, hydraulic engineer. Mr. F. C. Bacot was the designing engineer of the electrical equipment.

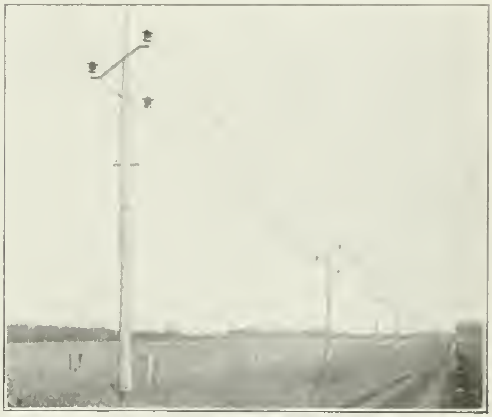

Fig. 7—"Wishbone" Cross-Arm Construction of Transmission Line.

The contracts for the dams were carried out by the Ambursen Hydraulic Construction Company, Boston. The Pelton Water Wheel Company furnished the wheels and governors, and the General Electric Company the electrical apparatus.

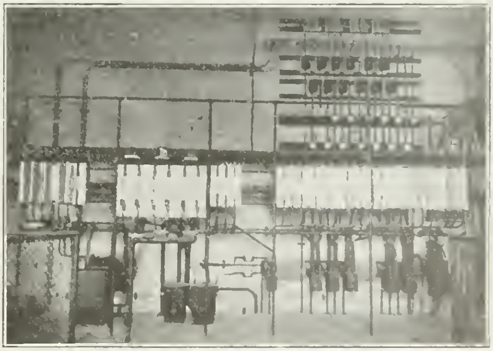

Fig. 8—2300-Volt Construction in Substation at Mankato

Acting for H. M. Byllesby & Company in the field were Mr D. M. Bunn, construction superintendent in charge of power house, substations and transmission lines, and Mr W. B. Sanders, resident engineer at the Blue Earth Dam. The operating department of the Byllesby company is represented by Messrs. R. E. Brown, B. W. Cowperthwaite and J E. Hanson, managers respectively of the Mankato, Faribault and Northfield divisions of the Consumers' Power Company

A MECHANICAL ALTERNATING-CURRENT WAVE-ANALYZER.

By C. A. Pierce.

THERE are various methods for determining the harmonic components of periodic alternating e.m.fs. and currents, most of which consist of the analysis of the wave by means of graphical or analytical methods. To obtain the wave various "point-by-point" contact makers are used, or else the wave is photographed by means of an oscillograph. Attempts have been made to measure the component harmonics directly, but the methods advanced for doing this have been deficient in some important particular.

The most accurate method for determining the harmonic components is one in which the wave is obtained by a "point-by-point" contact maker and analyzed by means of tables, the best of which are based upon the complete harmonic analysis of a periodic curve published by Rungi in 1903. The wave can be recorded with an oscillograph, but the accuracy is far less than that of the "point-by-point" contact maker due to the uncertainty in the measurement of the co-ordinates on the photographic record.

One serious defect in nearly all methods for obtaining the harmonic components of periodic alternating waves is that the results are not available until the data are worked up, so that the experiment is carried on in many cases blindly. A method which enables one to see immediately the effect of a change in conditions on any harmonic will facilitate many alternating-current experiments. This result is partially obtained by the oscillograph with a synchronously revolving mirror, which enables an experienced investigator to infer the changes in the harmonic components by the change in the form of the complex wave.

The following method of measuring the component harmonics in a periodic alternating-current wave was developed with the idea of making the measurements of amplitude and phase directly upon the harmonics themselves.

DEVELOPMENT OF THE METHOD.

If a two-part commutator has impressed upon it an alternating e.m.f. and is revolved at synchronous speed, the average value of the e.m.f. may be obtained by a direct-current voltmeter connected to the commutator through two brushes which bear upon it and are separated from each other by 180 deg. The brushes should be shifted about the commutator until the maximum reading of the voltmeter is obtained. This value is a measure of the average value of the impressed wave. The commutator acts as the familiar rectifying device which is employed for many purposes. In the case of a sine wave its action is represented by the equation,

$$D = \frac{E_1'}{\pi} \int_{a}^{a+180} \sin \Theta \, d\Theta = \frac{2E_1'}{\pi} \cos a = E_{1AV.} \cos a,$$

where D is the reading of the voltmeter in volts, E_1' is the maximum ordinate of the sine wave and a relates to the angular position of the brushes. If the brushes are so set that $a = 0$, i.e., if the brushes pass from one segment of the commutator to the other just as the alternating current passes through zero,

$$D = E_{1AV.}.$$

In the case of a complex alternating-current wave,

$$D = \frac{1}{\pi} \left[E_1' \int_{a}^{a+180} \sin \Theta \, d\Theta + E_3' \int_{a}^{a+180} \sin (3\Theta + \Phi_3) \, d\Theta + E_5' \int_{a}^{a+180} \sin (5\Theta + \Phi_5) \, d\Theta + \; . \; . \; . \; . \right]$$

If $a = 0$,

$$D = [E_{1AV.} + \tfrac{1}{3} E_{3AV.} \cos \Phi_3 + \tfrac{1}{5} E_{5AV.} \cos \Phi_5 + \; . \; . \; .]$$

The expression in the brackets of the last equation is the expression for the average value of a complex alternating e.m.f. Hence, the two-part commutator will measure the average value of a complex alternating-current wave if the brushes are set so that they pass from one segment to the other at the instant that the alternating current passes through zero. At this position of the brushes the direct-current voltmeter will give the maximum reading.

If a complex alternating current is impressed upon a six-segment synchronously revolving commutator in which the alternate segments are connected electrically together to form a six-part rectifier, a direct-current voltmeter connected to the rectifier through two brushes 60 deg. apart will measure the average value of the third harmonic of the alternating-current wave. It will also measure any harmonic, such as the ninth, fifteenth, etc., which is divisible by three. It will not measure the first harmonic nor any harmonic which is not divisible by three.

The equations for any harmonic impressed upon a six-part commutator are:

$$D = \frac{E_n'}{\pi} \left[\int_{a}^{a+60} \sin (n\Theta + \Phi_n) \, d\Theta - \int_{a+60}^{a+120} \sin (n\Theta + \Phi_n) \, d\Theta + \int_{a+120}^{a+180} \sin (n\Theta + \Phi_n) \, d\Theta \right]$$

$$= \frac{2}{\pi} \times \frac{E_n'}{n} [\cos (na + \Phi_n)(1 - \cos n \times 60 + \cos n \times 120) + \sin (na + \Phi_n)(\sin n \times 60 - \sin n \times 120)$$

The second term in the brackets is equal to zero for $n = 1$, 3, 5, 7, etc., i.e., for any odd harmonic; hence,

$$D = \frac{2}{\pi} \times \frac{E_n'}{n} [\cos (na + \Phi_n)(1 - \cos n \times 60 + \cos n \times 120)]$$

If $n = 1, 5, 7, 11, 17, 19$, etc.,

$$D = 0.$$

If $n = 3$,

$$D = \frac{2}{\pi} \times \frac{E_3'}{3} \times 3 \cos (3a + \Phi_3)$$

When a and Φ_3 equal zero, i.e., when the brushes are set for the maximum reading of the voltmeter,

$$D = E_{3AV.}.$$

If $n = 9$,

$$D = \frac{2}{\pi} \times \frac{E_9'}{9} \times 3 \cos (9a + \Phi_9) = \tfrac{1}{3} E_{9AV.} \cos (9a + \Theta_9),$$

i.e., the reading of the voltmeter will depend upon the setting of the brushes and upon the phase relation of the ninth harmonic. Likewise, any harmonic, such as the fifteenth, twenty-first, etc., will give a reading upon the six-part commutator, but the reading will not equal the average value of the harmonic, being reduced by the factor $\frac{3}{n}$ and also by the factor $\cos (na + \Phi_n)$.

In a like manner it can be shown that the ten-part commutator will measure the average of the fifth harmonic. Any harmonic which is divisible by five will give a reading upon the ten-part commutator, but the reading will be less than the average value of the harmonic, being reduced by the factor $\frac{5}{n}$ and also by a cosine term which depends upon the position of the brushes and upon the phase position of the harmonic. Furthermore, the fourteen-part commutator will measure the average of the seventh harmonic, etc.

THE WAVE-ANALYZER.

A set of commutators having two, six, ten, fourteen and eighteen segments was mounted on a shaft carried in lignum-vitæ bearings so that it could be rotated rapidly. On each commutator alternate segments were connected electrically so that it formed a rectifier. The commutators were connected in parallel to a pair of slip-rings to which the current to be analyzed was introduced through brushes. A brush holder in the form of a squirrel-cage was arranged to revolve upon bearings which were coaxial with the shaft of the commutators. Upon this squirrel-cage were mounted brushes, each commutator having two brushes placed 180 (or some odd multiple of 180) electrical degrees apart. A direct-current voltmeter was connected to the brushes by means of flexible leads with clamp-ends which could be changed easily to the different pairs of brushes. Upon one end of the squirrel-cage was described a circle graduated in degrees so as to measure the angular position of the brushes.

To test the wave-analyzer its shaft was lined up with the shaft of a two-pole alternator and the two shafts were connected together mechanically. Various wave-forms were developed in the alternator by varying the field excitation and by loading. An auto-transformer with which the e.m.f. could be changed by volt steps was used to vary the e.m.f. impressed upon the wave-analyzer. Readings were obtained by connecting the voltmeter to the brushes on the various commutators, on each commutator reading the maximum voltage and the corresponding angular position of the brushes. The commutators were set on the shaft so that all angular readings could be made on one scale having but one zero point.

CALCULATION OF THE HARMONICS FROM THE READINGS.

The two readings on each commutator consist of an average e.m.f. and a phase angle. On the two-part commutator the average value of the complex e.m.f. is obtained together with the angular position of the zero points of the wave. The readings on the six-part commutator give the average value of the third harmonic and the zero point together with corrections depending upon the value and phase of higher harmonics, such as the ninth, fifteenth, etc. Corresponding values for the fifth, seventh and ninth harmonics can be obtained on the other commutators.

Neglecting harmonics higher than the ninth, and neglecting the effect of the ninth harmonic on the six-part commutator,

$$E_1 = \sqrt{(1.111 \times E_{AV.})^2 - (1.111 \times E_{3AV.})^2 - (1.111 \times E_{6AV.})^2 - \ldots}$$

where $E_{AV.}$ is the reading on the two-part commutator,* $E_{3AV.}$ that on the six-part commutator, etc. From E_1, $E_{3AV.}$, etc., E_1', E_3', etc., can be obtained by the relations $E_1' = \frac{E_1}{0.707}$ and $E_3' = \frac{E_{3\,AV.}}{0.637}$, etc.

Referring to Fig. 1 it will be seen that the crossings *A*, *B* and *C* of the complex wave and the third and fifth harmonics (together with *D* and *E*, which refer to the seventh and ninth harmonics and are not shown in the figure) were determined by the measurements of the angular position of the brushes on the several commutators. *A* is the from negative to positive zero of the complex wave, *B* is the first from negative to positive zero of the third harmonic occurring after *A*. If some other zero of the third harmonic was measured, *B* can be obtained by adding to, or subtracting from, the angle measured the proper part of 360 deg. *C*, *D* and *E* are the corresponding zeros for the other harmonics.

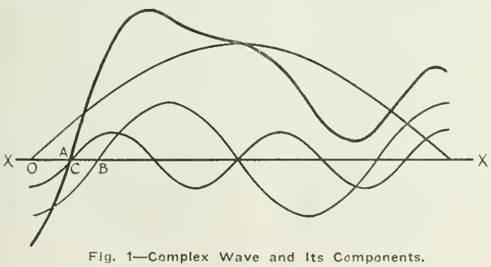

Fig. 1—Complex Wave and Its Components.

Let $\delta_3 = AB$ in Fig. 1, $\delta_5 = AC$, $\delta_7 = AD$ and $\delta_9 = AE$. Also let $\frac{\Phi_3}{3} = OB$, $\frac{\Phi_5}{5} = OC$, etc., i.e., these are the phase relations of the various harmonics with respect to the first harmonic when the equation of the complex curve is written in the form,

$$E = E_1' \sin \Theta + E_3' \sin (3\,\Theta - \Phi_3) + E_5' \sin (5\,\Theta - \Phi_5) + \ldots$$

Some value of Θ, *OA* in the figure, will make $E = 0$. Now,

$$\begin{aligned} OA = OB - AB &= \frac{\Phi_3}{3} - \delta_3, \\ = OC - AC &= \frac{\Phi_5}{5} - \delta_5, \\ = \ldots\ldots\ldots &= \frac{\Phi_7}{7} - \delta_7, \\ = \ldots\ldots\ldots&\ldots\ldots\ldots\ldots \end{aligned}$$

Hence,

$$E = 0 = E_1' \sin\left(\frac{\Phi_3}{3} - \delta_3\right) + E_3' \sin\left[3\left(\frac{\Phi_3}{3} - \delta_3\right) - \Phi_3\right]$$
$$+ E_6' \sin\left[5\left(\frac{\Phi_5}{5} - \delta_6\right) - \Phi_5\right] + \ldots$$

Or,

$$E_1' \sin\left(\frac{\Phi_3}{3} - \delta_3\right) = E_3' \sin 3\,\delta_3 + E_5' \sin 5\,\delta_5 + \ldots\ldots$$

From this equation $\frac{\Phi_3}{3}$ can be determined in terms of the maximum values of the harmonic e.m.fs. and the measured values, δ_3, δ_5, etc. Since $OA = \frac{\Phi_3}{3} - \delta_3$

$$\frac{\Phi_5}{5} = OA + \delta_5,$$
$$\frac{\Phi_7}{7} = OA + \delta_7$$
$$\ldots\ldots\ldots\ldots\ldots\ldots$$

The equation of the complex curve can now be written.

$$E = E_1' \sin \Theta + E_3' \sin 3\left(\Theta - \frac{\Phi_3}{3}\right) + E_5' \sin 5\left(\Theta - \frac{\Phi_5}{5}\right) + \ldots$$

in which all the values are known.

EXAMPLE OF A WAVE-FORM DETERMINATION.

	Values Measured.		Values Used in Computations.	
	I.	II.	III.	IV.
2......	71.7 volts	152.0 deg.	152.0 deg.	
6....	10.0 "	112.5 deg	232.5 deg.	80.5 deg. = δ_3
10...	1.7 "	185.7 deg.	185.7 deg.	33.7 deg = δ_5
14....	0 "	0	0	0 = δ_7
18.....	0 "	0	0	0 = δ_9

Column I is the voltage readings on the various commutators and column II is the angular positions at which the voltage readings occurred; 2, 6, 10, etc., refer to the two-part commutator, six-part commutator, etc.

$$E_1' = \frac{1}{0.707} \sqrt{(1.111 \times 71.7)^2 - (1.111 \times 10.0)^2 - (1.111 \times 1.7)^2} = 111.5$$

$$E_3' = \frac{10.0}{0.637} = 15.7;\ E_5' = \frac{1.7}{0.637} = 2.7$$

$$\frac{\Phi_3}{3} = \sin^{-1} \frac{15.7 \sin 241.5 + 2.7 \sin 168.5}{111.5} + 80.5 = 73.7 \text{ deg.}$$

$$\frac{\Phi_5}{5} = 73.7 - 80.5 + 33.7 = -6.8 + 33.7 = 26.9 \text{ deg.}$$

$$E = 111.5 \sin \Theta + 15.7 \sin 3\,(\Theta - 73.7 \text{ deg.})$$
$$+ 2.7 \sin 5\,(\Theta - 26.9 \text{ deg.})$$

DETERMINATION OF THE WAVE-FORM OF ALTERNATING CURRENTS.

To determine the wave-form of an alternating current it is necessary to introduce a non-inductive resistance of suitable value into the circuit, in which case the wave-form of the e.m.f. across the resistance is identical with the wave-form of the current. In many cases a resistance can be placed permanently in circuit and considered a part of the circuit. In some cases, however, it is not permissible to introduce very much resistance into a circuit because it will cause a change in the wave-form. In such cases the potential across the resistance must be kept low in comparison with the e.m.f. of the whole circuit. In order to analyze this low e.m.f. on the wave-analyzer some of the resistance in the voltmeter must be cut out in order to make it more sensitive. If so great a reduction of the voltmeter resistance is necessary that the brush contacts produce variations in the readings, a modern-type D'Arsonval galvanometer of low sensibility can be used in place of the voltmeter.

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*Form factor is, by definition, equal to effective value divided by average value, hence $1.111 \times E_{AV}$ is not strictly correct. For many waves, the approximation is sufficiently close, but where it is not, the true form factor can be measured as described in a later paragraph.

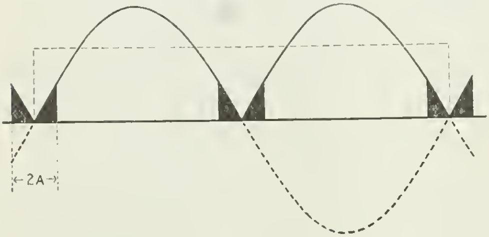


Fig. 2—Effect of Finite Width of Insulation.

The equation

$$I = 1.94 \sin \theta + 0.90 \sin 3 (\theta - 67 \text{ deg.}) + 0.07 \sin 5 (\theta - 11 \text{ deg.})$$

was obtained with the wave-analyzer. It represents the exciting current of a 60-cycle, 110-volt transformer when 77 volts from a particular alternator run at 25 cycles was applied to the terminals. To measure the wave-form of the current a 0.1-ohm non-inductive resistance was connected in series with the transformer coil, giving an e.m.f. of 0.2 volt to be analyzed. A D'Arsonval galvanometer of very low sensibility was used as the indicating instrument on the wave-analyzer for the current determination. A lower non-inductive resistance could have been used with a galvanometer of somewhat greater sensibility.

ERRORS AND APPROXIMATION IN THE METHOD.

The equations occurring earlier in the article were based upon the assumptions that the insulation between commutator segments was of zero thickness and that the brushes made contact in a line without area. Fig. 2 shows the error made by neglecting the width $2A$ of the insulation. The area of the rectified wave is reduced, as shown by the shaded portions in the figure, by an amount depending on the width of the insulation.

Fig. 3 shows the error made by the combined effects of width of insulation and width of brush. Since a brush continues to make contact after part of it has left a segment, and since the brush-contact resistance is negligible in comparison with the resistance of the direct-current voltmeter, the effect of the length of brush contact is to correct for the error due to width of insulation. Hence, the area lost is that determined by the distance $2A - 2B = 2C$, where $2B$ is the length of contact of brush with commutator. If the brush contacts were just as wide as the insulation no area would be lost, but the segments would be short-circuited every time a brush passed from one segment to the next. In the wave-analyzer described above the brush contact equaled 0.72 deg. and the insulation equaled 1.36 deg. The area lost in the case of a sine wave on the two-part commutator is negligible. The area lost increases as the number of segments on a commutator increases, because the combined width of brush and insulation is larger in comparison with a segment. The area lost in a half wave in the case of the eighteen-part commutator is

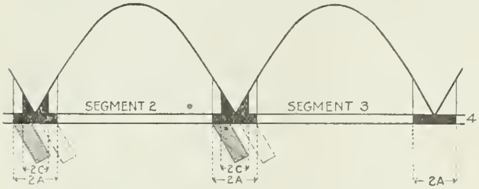


Fig. 3—Effect of Finite Brush and Insulation Width.

$$2 \int_0^{n \times 0.32 \text{ deg.}} \sin \theta \, d\theta = 2 \int_0^{2.9 \text{ deg.}} \sin \theta \, d\theta = 0.003 \text{ approximately,}$$

which is negligible in comparison with the area of a half wave. In the case of a complex wave on the two-part commutator, the error may be, in certain cases, larger than with a sine wave. No serious error will be introduced, however, with the wave-forms usually found in practice.

As was shown, no reading is produced on the six-part commutator by the first harmonic if the width of brush and insulation is zero. The effect of combined width of brush and insulation is shown in Fig. 4, where the first harmonic is broken into positive and negative parts due to the rectifier effect. The figure is drawn to represent commutation occuring at 0 deg., 60 deg. and 120 deg. The equation for commutation occurring at any time is

$$E = \frac{E_1'}{\pi} \left[\int_{a+c}^{60+a-c} \sin \theta \, d\theta - \int_{60+a+c}^{120+a-c} \sin \theta \, d\theta + \int_{120+a+c}^{180+a-c} \sin \theta \, d\theta \right] = 0.$$

Hence, the first harmonic can produce no reading on the six-part commutator. Similar equations for the other commutators would give similar results; and, furthermore, it can be shown that no error is produced in the measurement of any harmonic by lower harmonics.

As was proved, the ninth harmonic can produce a reading on the six-part commutator. The effect of width of brush and insulation on this error is negligible. Hence, as was proved, the error will be equal to one-third of the average value of the ninth harmonic multiplied by a cosine term. Since the ninth harmonic is usually only a small percentage of the third, no serious error will be produced.

The error in determining the maximum value of the first harmonic due to neglect of harmonics of higher order than the ninth is negligible for all ordinary cases because any harmonic of small amplitude produces but little error in the equation given.

To determine whether any harmonic greater than the ninth is present in a wave an alternating-current voltmeter may be connected in parallel with the direct-current voltmeter and the two placed on the brushes of the two-part commutator. If the brushes are revolved until the voltmeters give the maximum readings,

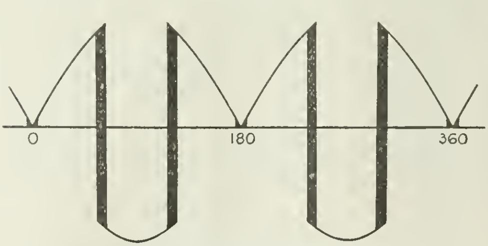


Fig. 4—Effect of Finite Brush and Insulation Width.

$$\text{form factor} = \frac{\text{alternating-current voltmeter reading}}{\text{direct-current voltmeter reading}}$$

This value can be compared with the value determined by the amplitudes and phases of the harmonics:

$$\text{form factor} = \frac{\sqrt{(E_1)^2 + (E_3)^2 + (E_5)^2 + \ldots}}{E_{1AV} + \frac{1}{3} E_{3AV.} \cos \Phi_3 + \frac{1}{5} E_{5AV.} \cos \Phi_5 + \ldots}$$

It must be remembered that the alternating-current voltmeter measures a rectified alternating current, so that errors may be introduced due to stray fields. Taking the average value of two readings with the current reversed and not reversed will eliminate this error.

If the brushes do not revolve around the same axis as the commutators an error may be introduced into any harmonic due to the lower harmonics. For instance, on the six-part commutator the sum of the rectified parts of the first harmonic may not equal zero under these conditions. Such an error can be recognized by the difference in the readings obtained at angular settings of the brushes differing by 180 electrical degrees or 360 electrical degrees. In the first rough machine made a slight error was noticeable in the third harmonic. In the machine as reconstructed no errors were found except in the seventh and ninth harmonics. Considering that the writer made both machines it is to be assumed that no trouble would be found in a machine made by a good mechanic. This error can be eliminated, when not too large, by taking the average of two neighboring determinations.

In accuracy the wave-analyzer stands between the "point-by-point" methods at their best and the oscillograph. In any case, except under ideal laboratory conditions, the accuracy of the wave-analyzer should equal or exceed that of the "point-by-point" methods due in part to the necessity of holding conditions constant for only five voltage readings; the angle determinations do not need such constant conditions.

Another advantage of the wave-analyzer over some "point-by-point" contact makers is that it is not a delicate piece of apparatus, no delays are caused by insulation troubles and the direct-current voltmeter is a reliable and rugged instrument.

A further advantage of the wave-analyzer over other methods is that amplitude and phase measurements are made directly upon the harmonics themselves. Suppose that the error in the determination of a third harmonic is 10 per cent and that the third harmonic is 20 per cent of the first. The error of the third harmonic in terms of the first is, then, 2 per cent. Any method which gives the harmonics by analysis of a complex wave must be such as to give the points on the complex wave with great exactness in order to secure moderate accuracy in the value of the harmonics. This is well brought out by the equations:

$$E = 111.5 \sin \theta + 15.7 \sin 3 (\theta - 74 \text{ deg.}) + 2.7 \sin 5 (\theta - 27 \text{ deg.})$$

$$E = 111.5 \sin \theta + 13.7 \sin 3 (\theta - 73 \text{ deg.}) + 3.4 \sin 5 (\theta - 26 \text{ deg.})$$

The first is that as determined by the wave-analyzer and the second that by a "point-by-point" method which was somewhat inaccurate. The runs from which the two equations were made were as nearly identical as could be obtained with the apparatus and assistance available. Fig. 5 shows the plots of the two equations. No such impression of inaccuracy is obtained from inspection of the curves as is obtained by comparing the amplitudes of the harmonics in the equations.

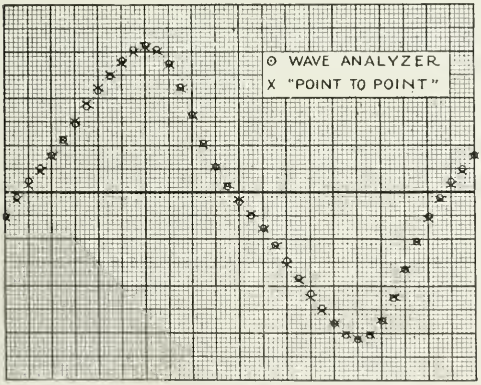


Fig. 5—Waves Obtained by Analyzer and by Point-by-Point Method.

In order to compare the wave-analyzer with the oscillograph an oscillograph record of a wave was made by means of a falling plate. No correction was made to eliminate the distortion due to acceleration of gravity. Fig. 6 shows the oscillograph record, which was obtained under the conditions of Fig. 5.

OPERATION AT 60 CYCLES.

A two-part commutator has to be driven at a speed of 3600 r.p.m. in order to rectify 60-cycle alternating current. To use the wave-analyzer on 60-cycle current it would be necessary to drive it by means of a two-pole synchronous motor or else by means of gearing. The wave-analyzer has not been run at a speed as high as this because no driving motor nor accurate gearing was available. However, in order to test whether the commutator and brushes would stand this speed a two-part commutator was made and geared up four to one and attached to a machine run at 900 r.p.m. This commutator and the brushes were made of the same materials as the commutators and brushes of the wave-analyzer. The commutator was made with phosphor-bronze segments mounted on fiber and fiber was used as insulation between the segments. The brushes were made by cutting down ordinary carbon brushes. This commutator was run for some time and was found to work satisfactorily. The best lubricant for the commutator was found to be kerosene. This softened the brushes so that all wear came on them, preserving the commutator surface. Of course, the brushes wore out rapidly, but these were easily renewed. The use of kerosene avoided any gumming of the commutators and brushes, which is very desirable in this work.

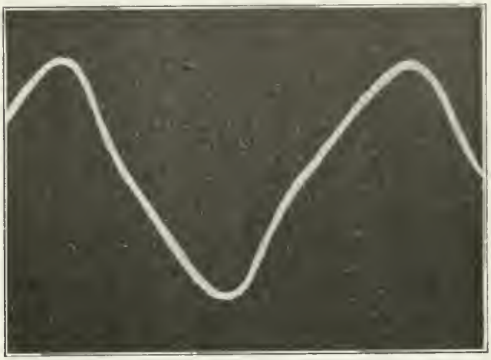


Fig. 6—Oscillogram of Wave Shown by Fig. 5.

PRESSURE RISES ON OPENING SHORT-CIRCUITS.

A PAPER of much interest to manufacturers and users of high-tension and low-tension switchgear was read by Mr. A. G. Collis before the South Wales Institute of Engineers at Cardiff, Wales, on Feb. 23, 1911. The author selected representative samples of various types of circuit-breakers in general use, and made comparative tests under conditions approximating to those likely to be encountered in practice. An oscillograph was used in connection with a rapidly moving photographic film and a large number of records showing the current and pressure variations over the short period of time required by the automatic switches to open the circuit were reproduced in the paper.

Some of the most interesting records are those illustrating the behavior of various types of circuit-breaker on short-circuit. These tests were made on both a direct-current generator and a storage battery. The arrangement of the plant and connections is shown in Figs. 1 and 4. The generator *G* used for the first series of tests was steam-driven and rated for a normal output of 100 kw at 230 volts. The battery, shown in Fig. 4, consisted of 110 cells in series and was rated for a maximum discharge of 353 amp under normal working conditions. The tests were made by closing first one and then the other of the two single-pole switches shown in the diagrams. The short-circuit thus produced was then interrupted by the automatic circuit-breaker under test. It will be seen from the diagrams that the potential coil of the oscillograph was connected directly across the terminals of the apparatus under test, while the current coil, being connected across a resistance in series with the circuit-breaker, measured the total current passing through the main circuit from the moment the second of the single-pole switches was closed to the moment when the current was again finally interrupted by the automatic breaker under test.

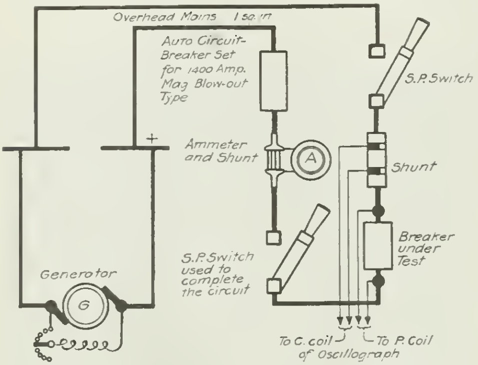


Fig. 1—Short-Circuit Test on Direct-Current Generator.

SHORT-CIRCUIT TESTS ON GENERATOR.

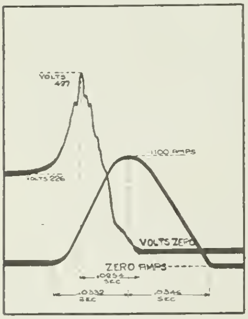


Fig. 2—Short-Circuit Opening on a Carbon-Break Circuit-Breaker.

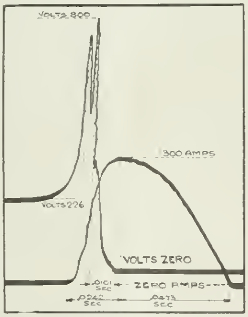


Fig. 3—Short-Circuit Opening on a Medium-Field Magnetic Blow-Out Breaker.

The oscillogram of Fig. 2 shows the effect of closing the generator on a circuit-breaker fitted with a long, quick break and auxiliary carbon contacts, but without magnetic blow-out. The photographic film in this and subsequent diagrams must be considered as moving from left to right; that is to say, any vertical measurement of current or potential values made on the *left-hand* side of the diagram refers to an instantaneous condition which has occurred *later in time* than the condition indicated by similar measurements taken on the *right-hand* side of the diagram. If, therefore, the curves be read from right to left it will be seen that when the full pressure of the generator is thrown on to the circuit-breaker the current rises from zero to a maximum of 1100 amp in 0.0346 second, after which, owing to the operation of the automatic circuit-breaker, the current again falls to zero in about the same interval of time (0.0332 second). The instant at which the circuit-breaker begins to open the circuit is indicated by the point at which the pressure curve begins to rise. It will be seen that the e.m.f. across the circuit-breaker terminals reaches a total of 497 volts in 0.0254 second, and, since the normal voltage of the generator was 226, the pressure rise, due to the rapid opening of a circuit having appreciable self-induction, is 497 — 226 = 271 volts. The inductance of the circuit is, of course, mainly in the generator itself; its presence is indicated in the oscillogram of Fig. 2 not only by the pressure rise at break, but also by the slope of the curve showing the gradual rise of the current in the circuit. If there were absolutely no inductance in the circuit the rise of current would be instantaneous and this point is of interest in connection with the tests made by short-circuiting a battery.

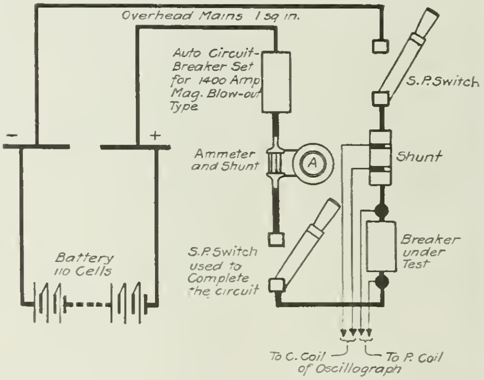


Fig. 4—Short-Circuit Test on Battery.

In Fig. 3 the pressure rise is considerably greater, although the constants of the circuit remain practically unaltered. In this case a circuit-breaker with final break in a magnetic field was under test and the greater pressure rise (574 volts) was no doubt mainly due to the fact that the current was interrupted more quickly than in the case of the previous test. On the other hand, the mechanical operation of the tripping mechanism was somewhat slower than in the case of the carbon-break circuit-breaker, and this would account for the current having reached 1300 amp as against the 1100 amp of Fig. 2. Fig. 5 is generally similar to Fig. 3, and both refer to the same circuit-breaker, but in Fig. 5 the arc would appear to have been disrupted and then started again, probably due to mechanical vibrations of the moving arm of the circuit-breaker, which have tended to re-establish the current.

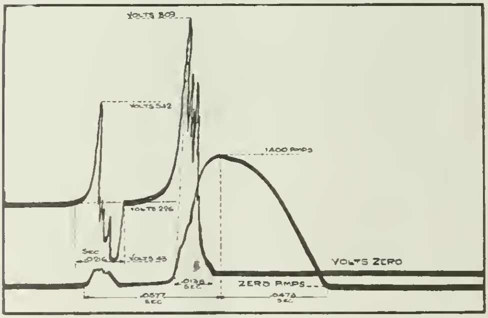


Fig. 5—Short-Circuit Opening on a Medium-Field Magnetic Blow-Out Breaker.

An important feature of Mr. Collis' paper is the information it contains in regard to the use of the oil type of circuit-breaker in direct-current circuits. Fig. 6 is an oscillogram which shows the behavior of an oil circuit-breaker of the type generally used in alternating-current circuits tested while opening a direct-current short-circuit. This apparatus was tested on the generator exactly in the same manner as the circuit-breakers previously described. The total length of time covering the closing of the circuit and its final interruption occupied a little over one-tenth of a second with a rise in pressure of only 204 volts notwithstanding that the current rose to 1200 amp. The variations in the current due to changes in the resistance of the arc under the oil are reflected by corresponding changes in the pressure curve. It is clear that, so far as any abnormal pressure rise is concerned, the oil type of circuit-breaker compares favorably with the other types tested. The author of the paper states that a fact of some importance, which cannot be shown on the oscillograms, is the silent operation of the oil breakers, which is very noticeable in comparison with the explosive violence with which the magnetic blow-out and other breakers interrupt the circuit.

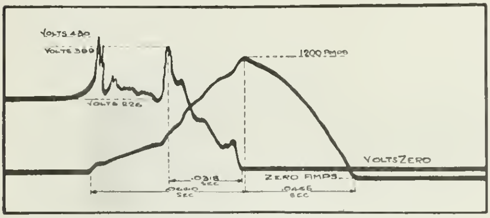


Fig. 6—Short-Circuit Opening on an Oil-Break Switch.

SHORT-CIRCUIT TESTS ON A BATTERY.

The diagrams of Figs. 7 and 8 show the behavior of the same oil circuit-breaker when a battery instead of a direct-current generator was short-circuited through it. These diagrams are interesting as showing the comparative absence of inductance in the circuit. This absence of inductance is shown by the steep rise of the current curve when the circuit is closed and also by the very small rise of pressure at the final break (only 59 volts in Fig. 7, as against 204 volts in Fig. 6). Another fact which is clearly indicated by these and the following diagrams is that the total current output of the battery, as limited by the resistance of the circuit (including the internal resistance of the battery), was 1200 amp, and this steady and ultimate value of the current was always reached before the circuit was finally interrupted.

Fig. 9 shows the effect of short-circuiting the battery on a circuit-breaker with magnetic blow-out. This oscillogram may be compared with Figs. 3 and 5, which are the records of the same circuit-breaker on a generator short-circuit. The inductive pressure rise, even on the battery test, is considerably greater than in the case of the oil type of circuit-breaker, but this is no doubt mainly due to the very much more rapid action of the magnetic blow-out breaker. Thus, in Fig. 9 it will be seen that the current falls from the maximum value of 1200 amp to zero in 0.0184 second, whereas in Fig. 8 (oil circuit-breaker) the corresponding time is 0.0473 second.

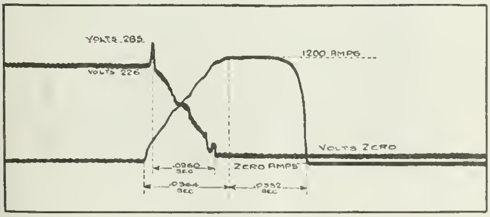


Fig. 7—Short-Circuit Opening on an Oil-Break Switch.

The diagram of Fig. 10 is one of the most interesting. It shows the effect of opening the battery short-circuit with the carbon-break circuit-breaker without magnetic blow-out field. There would appear to be an entire absence of pressure rise on the final rupture of the circuit.

Apart from the short-circuit tests on direct-current generator and battery, the author of the paper included oscillograms referring to a long series of tests of the various types of circuit-breakers at predetermined overloads, not only in direct-current circuits, but also on alternating-current circuits, both low-tension and high-tension. The conclusions which he arrives at, after making a careful study of the results obtained, are as follows:

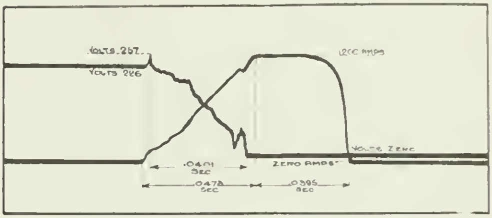


Fig. 8—Short-Circuit Opening on an Oil-Break Switch.

First—That within the limits of the conditions under which the tests were made the method of opening direct-current circuits by breaking contact under oil is safe and efficient.

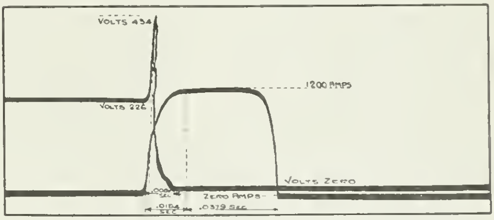


Fig. 9—Short-Circuit Opening on a Medium-Field Magnetic Blow-Out Circuit-Breaker.

Second—That a breaker with a wide break and comparatively weak magnetic blow-out is a safer device to use on all circuits having appreciable inductance than the type with short break accompanied by the necessarily strong blow-out magnetic field.

Third—That a carbon-break circuit-breaker without magnetic blow-out tends to reduce the rise of pressure occurring at rupture of the current.

In the case of the alternating-current tests the oil type of circuit-breaker was used, and the records show that, although the circuit may open at any point on the current curve, after the current has died down to zero value it never again rises on the other side of the zero line. It would appear, in fact, that in all cases the oil rushes in between the contacts and prevents an arc being drawn out which otherwise might permit the current to rise once more after it has passed through zero value.

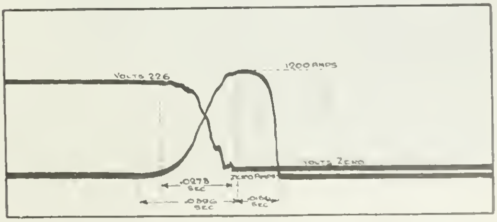


Fig. 10—Short-Circuit Opening on a Carbon-Break Circuit Breaker

ELECTRIC FIELD SEARCHLANTERNS OF THE UNITED STATES ARMY.

As pointed out by Mr. Earl Wheeler and Lieut. W. H. Rose in the January, 1911, number of the *Professional Memoirs of the Engineers Corps, United States Army,* field electric searchlanterns have important uses in night military operations of both offensive and defensive character. For the aid of the defensive army these lanterns can be used to illuminate points which attacking parties must pass; to light the attacking forces at close range; to illuminate distant areas, embarrassing troop movements and disclosing the transportation of supplies; to impede the use of hostile searchlights by producing glare; to aid working parties of all kinds; to assist in collecting wounded, and for purposes of signaling. The attacking force can use its searchlanterns to advantage for preventing the defense from strengthening works under cover of darkness; to light up artillery targets, redoubts, etc.; to assist the attacking column by illuminating rough ground and obstacles; to guide attacks by lighting defenders' lines under assault; to assist in repelling counter attacks, and for the general uses already mentioned above.

The most recent portable searchlantern outfits in the service of the United States army are the automobile searchlantern truck and the field-artillery set designed by the engineering department. The automobile truck, shown in Fig. 1, is equipped with a 15-kw gasoline-engine-driven generator producing electrical energy to operate the motors at each wheel-axle during transit and to supply the projection apparatus during use. The gasoline-engine generating set comprises a semi-automobile-type, five-cylinder, four-cycle, 5-in. x 6-in. Dock inclosed-type water-cooled engine of special design, direct-connected to drive a 15-kw Sprague six-pole, 85-volt, interpole, compound-wound direct-current generator. The engine is equipped with a fly-ball throttling governor, McCord force-feed lubricator and Stromberg float-feed carburetor. Gasoline is supplied through a sight reservoir from an 87-gal. tank on the car. The interpole construction of the generator enables overloads of 75 per cent to be negotiated without sparking, and the engine rating has been provided to deliver such outputs when the car must pull itself or other objects up steep grades. Inside the steel-plate structure of each of the four wheels is an electric motor, the pinioned shaft of which drives the wheel through annular racks. An eight-point street-car-type controller effects changes in the motor connections from series to parallel, giving any desired speed from three to ten miles an hour, for following bodies in marching order. The motors can be used for electric braking in emergency or long descents, although mechanical brakes are also provided. Four-wheel steering enables the car to make short turns, the hind wheels tracking with those in front and reducing tractive effort through heavy roads.

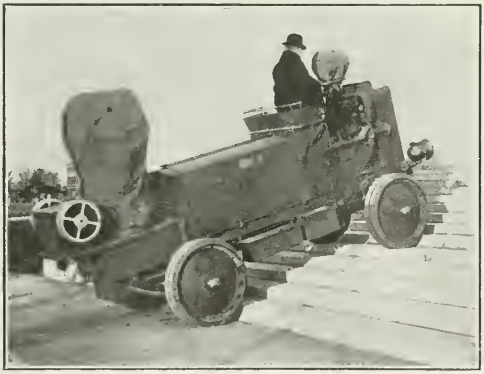


Fig. 1—Searchlantern Auto Truck Ascending Severe 35 Per Cent Grade.

A complete direct-current switchboard for the entire plant is mounted on the dash of the car, including voltmeter, field rheostat, circuit-breaker and feeder switches. The circuits are arranged so that the two searchlanterns with which the outfit is equipped can be operated independently or simultaneously. The large 24-in. projector, with Le Blanc relay control, shown in Fig. 1 mounted on the rear platform of the truck, has since been transferred to a trailer drawn behind the truck, in order to enable the latter to carry 32 gal. more gasoline in an additional tank. The weight of the truck proper has thus been decreased from 10,400 lb. to 9800 lb. and the gasoline-tank capacity increased from 55 gal. to 87 gal. The searchlantern trailer consists of a standard field-artillery caisson on which, on a spring-supported three-point suspended platform, is carried a 30-in. white-metal mirror General Electric electrically controlled searchlantern, together with 500 ft. of supply and control cables. The weight of the trailer complete is 4400 lb. A motor-driven hoist and portable field pile-driver are also built for use with the automobile searchlantern truck.

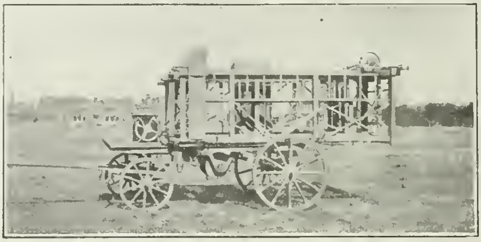


Fig. 2—Searchlantern Tower In Traveling Position.

This truck has been tested over extremely bad roads, soft plowed fields and in the ascent of hills up to 25 per cent grade, the truck pulling over all obstacles without apparent difficulty. The car can develop a 5-ton pull at standstill. On rough country roads the outfit has averaged 1.45 miles to 1.55 miles per gallon of gasoline. At loads from 60 per cent to 130 per cent of the engine rating the gasoline consumption has averaged about two pints per hp-hour. Over this range the generator shows a sustained efficiency of 85 per cent to 87 per cent.

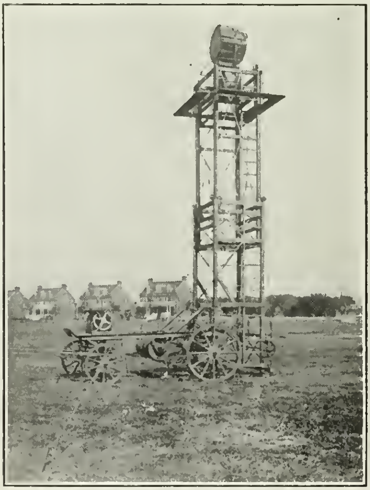


Fig. 3—Searchlantern Tower Raised Into Position for Operating.

The advantages recognized in searchlantern operation, when the projector itself is mounted on an elevated platform, have led to the development of the portable telescoping tower outfit shown in Figs. 2 and 3. The mounting is of German invention and is equipped with a 24-in. glass-reflector General Electric searchlantern arranged for remote control by either a Le Blanc relay or the older six-wire control. Fig. 2 shows the outfit in traveling position, with tower telescoped. To raise, the tower is first upset over the rear of the wagon and the projector run up through its internal shaft to the top, at the same time the whole upper half of the tower being untelescoped with the aid of the windlass shown. The rear posts of the base section of the tower are provided with blocks and leveling screws for adjusting the structure vertically on uneven ground. The tower is well braced and remarkably rigid, but may be guyed at its corner posts if desired. The reel under the body of the wagon carries 500 ft. of supply cable and 1000 ft. of control cable. The tower supports the lantern at an extreme elevation of 30 ft. The surrounding platform can also be occupied by six men, several of whom may be sharpshooters, as was done during the 1910 Gettysburg maneuvers, at which the auto-truck and the field artillery set were also used.

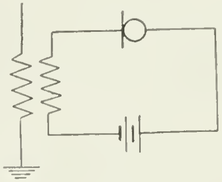
SIMPLIFIED WIRELESS TELEPHONY.

By M. Freimark.

So little has been heard of late from wireless telephony that it almost seems as if the art were entirely forgotten, or at least that it does not make any progress. It therefore gives the writer pleasure to bring out a few facts which he has observed and which he hopes will be followed up.

In the spring of 1910, while making experiments to devise a method for locating open circuits in insulated and concealed wiring, it was found that the human body acts as an excellent antenna and detector and responds remarkably to the slightest excitation from electromagnetic waves or static induction. Having perfected this method for localizing breaks in telephone wiring, a close resemblance was observed between the apparatus and a miniature wireless-telegraph sending station. The details of the apparatus, fortunately, were of a simpler and, necessarily, of a different design from those of a wireless station owing to the fact that neither a deafening spark nor high-tension currents can be tolerated on telephone lines or cables, as they would seriously interfere with transmission and insulation, and would carry beyond the break and possibly cause injury and damage to subscribers and property.

The sending outfit being identical—from a purely theoretical point of view—in the two cases, one could not help thinking why the receiving station should not be the same, and why, in particular, it should not be used for wireless telephony. To this end it was necessary merely to change the sending station to a talking circuit. An operator's telephone set answered the purpose. A few dry cells were put in series with the transmitter and the primary side of the induction coil. One terminal of the secondary was grounded, the other one serving as the sending antenna, as indicated in the accompanying illustration. The receiving station consisted of nothing more or less than a telephone receiver with one terminal connected to the body (ear or finger) and the other one to a wire which trailed on the ground or was directly connected to ground for the purpose of better receiving. The results were as anticipated. The sounds were audible a few feet from the antenna.



Antenna Connections.

Further experiments with a phonograph, in connection with a small step-up coil, such as is used in wire-telephone practice, brought out the fact that the phonograph could be heard through the receiver anywhere in a good-sized living-room when the wire was concealed under the rugs. Metal, such as a brass bedstead or a tin roof, readily takes up the waves, acts like a sounding board and gives them off with seemingly increased strength.

The writer could not make any further investigation on the subject. It seems, however, that good results could be obtained by taking into account the standard methods and apparatus which wire-telephony has established and which have reached such a high degree of development.

It is doubtful whether a transmitter of the present type will ever be developed to withstand currents strong enough to serve directly for wireless transmission. However, there is no doubt that combinations of this transmitter with generators, transformers, arc lamps or coils can be made which will be able to transmit sound within the limits of any city, and for overland or oversea transmission very high frequency waves can be used as the carrier.

Like present-day telegraphy the method described has the disadvantage of publicity, and even more so since anybody equipped with a receiver can pick up the message; for the same reason it also has the good side—though it is only one-way transmission—that it is accessible to everybody, rich or poor.

A city equipped with such a station could, for example, send out orders to the whole police force in an instant, publish election or ball-game returns, give free concerts to the whole population and accomplish a good many other things which would tend to better the social life of its citizens.

Central Station
Management, Policies and Commercial Methods

GASOLINE VERSUS ELECTRIC LIGHTING.

The disadvantages of lighting by gasoline systems as compared with electric were well pointed out in a paper on "Gasoline Competition," by Messrs Ward Harrison and H. H. Magdsick, of the engineering department of the National Electric Lamp Association, presented before the Minnesota Electrical Association convention at St. Paul, March 16. After describing the principles on which the five classes of gasoline apparatus in general use are operated the following serious charges were made against gasoline lighting:

In even the safest system of gasoline vapor, or "greased-air," operation the pipes corrode rapidly on account of the large amount of moisture carried with the vapor, causing dangerous leaks. In systems where gasoline is carried into the building under pressure leaks frequently occur at the brazed joints of the tubing and generator, allowing gasoline to drip and so inviting fire or explosion. Practically all gasoline systems emit an offensive odor at times; in some plants this smell is always present. Roaring sounds are frequently produced at the burners and at the generator. Gasoline-lighting systems give off from ten to twelve times as much heat per cp-hour as their equivalent in tungsten lamps, and in warm weather this heat may become very objectionable, rendering it impossible to light interiors properly without discomfort to the occupants. Gasoline fixtures are ugly, and the large pipes required with some systems detract from the appearance of interiors. Concealed piping is unsatisfactory, because when exposed to uneven temperatures the gasoline vapor becomes chilled and condenses, thereby extinguishing the lamps.

Although the Fire Underwriters issue permits for approved gasoline systems without an increase in the insurance rates, the conditions imposed provide substantially that the insurance company shall pay no claims for fires originating from the gasoline equipment. Losses have been paid in some cases where the gasoline equipment was indirectly the cause of a fire, but such action is in reality a matter of policy on the part of the individual companies. The owner of a store or building is, however, practically at the mercy of the insurance company.

Systems in which the liquid gasoline under pressure is introduced into buildings are particularly hazardous because any leaks which may occur will allow a large quantity of the liquid to escape. A small quantity of gasoline will render a large volume of air explosive; in fact, the range of explosiveness for gasoline vapor mixed with air is four or five times the range for ordinary coal gas. Perhaps the greatest danger in all gasoline systems is that due to the mere presence of the liquid. After a lighting system has been installed for a considerable period and the operator becomes accustomed to the handling of gasoline, he is likely to grow less cautious, and in the rush of business or from mere carelessness he may endanger not only his own life and property, but that of others as well. Frequently it is found that the gasoline supply has run out during the evening, and under these circumstances the temptation to replenish the tank while using artificial light can scarcely be overcome.

Insurance regulations specify that the reservoirs of gasoline-lighting systems shall be filled by daylight only, without the presence of artificial light, and with the gasoline burners not in use. No gasoline, except the reservoir contents, is allowed to be stored in the same building or those adjoining. Court decisions have shown that violation of any of the numerous restrictions in the gasoline permits voids not only the tenants' insurance policy but the policy of the building owner as well. Testimony has also shown that under strict interpretation it is impossible to handle this deadly explosive without violating some restriction embodied in the insurance permit.

Candle-power ratings on gasoline lamps show the widest divergence. The usual rating refers to bare mantles, but the candle-power is seriously diminished by the presence of globes which interfere with the supply of air and reduce the light flux by from 50 per cent to 60 per cent. Tests on rated 60-cp gasoline street lamps in Chicago showed an average of only 25.5 cp.

In considering gasoline lighting costs manufacturers reckon only the expense for gasoline, the usual claim being that from forty to fifty single-unit lamp-hours can be obtained per gallon. A recent investigation of 200 average installations showed performances ranging between actual extremes of fourteen and twenty-five lamp-hours per gallon of gasoline. The average output of 422 units in seventy-four other plants was twenty-three lamp-hours per gallon. With gasoline at 18 cents the cost of fuel will thus amount to from ½ cent to 1 cent per lamp-hour.

To the fuel expense must be added, of course, maintenance and capital charges on the installation. Mantles must be renewed often on account of the high pressures used and the small explosions occurring at ignition of the burners. Glassware becomes cracked and generator parts and tubes must be renewed. To keep lamps in good condition maintenance costs, excluding labor, of from 75 cents to $2 must be added for each lamp-year of 1000 hours. The attention and labor required by a gasoline system are by no means as insignificant as manufacturers may represent. The filling and pumping of the tank and the adjustment of the burners and generator will require usually many minutes each day, and with a common generator all the other lamps must be adjusted when another lamp is lighted. The bother of making these adjustments often leads to burning all the lamps continuously, thereby contributing to the cost of operation. The burners and gauzes become clogged and must be cleaned frequently. In many systems there is a delay in getting light while the burners are starting. Pilot flames have been provided, but, by becoming extinguished, these have caused dangerous drippings of gasoline.

Central-station rates, said Mr. Harrison, have an important bearing upon gasoline competition. A large proportion of the gasoline installations are made by long-hour users who have not received proper consideration under the straight-meter rate which is still so generally encountered. These consumers could be retained at a considerable profit to the central station if their bills were based on an attractive and more equitable system of charges. With short-hour users the danger from gasoline competition is relatively slight; their bills are low and the high first cost and fixed charges against a system of gasoline lighting will effectually prevent its installation.

The existence of a well-designed installation of tungsten-filament lamps is one indication that its owner is a progressive business man. Such an installation cannot fail to have a decidedly favorable influence upon the mind of a prospective customer. A gasoline equipment may be capable of economically lighting a building, but the electric illumination of stores and show windows is an advertising proposition that pays.

Among the anti-gasoline campaign literature cited by Mr. Harrison for enlightening the public on the dangers of gasoline lighting are the following, one of the best of which, said the speaker, is that issued by the Missouri association: *National Fire Protection Association Quarterly*, January, 1910; "A Red Light Signal," Missouri Electric, Gas, Street Railway & Water Works Association; "Gasoline as a Destroyer of Life and Property," San Francisco Gas & Electric Company; "Digest of Insurance Regulations as Applied to Gasoline Lighting," Victor S. Scott, San Antonio, Tex.; "Dangers of Gasoline," James A. Stewart, Madison, Wis.; "Inside Facts About Gasoline," E. A. Scantland, Memphis, Tenn.; *Bulletins*, National Electric Light Association, February and March, 1911; "Is Gasoline Dangerous?" Illuminating Publishing Company, Cincinnati, Ohio.

ADVERTISING CENTRAL-STATION SERVICE BY ELECTRIC SIGNS.

An interesting feature of the Boston Edison Company's own advertising practice is the use of large illuminated signs in conspicuous locations in the company's territory. Fig. 1 shows one of the most prominent, which is located in the City of Newton immediately opposite the Boston & Albany Railroad Company's station and within 1000 ft. of Nonantum Square, which is the terminus of the Boston Elevated Railway Com-

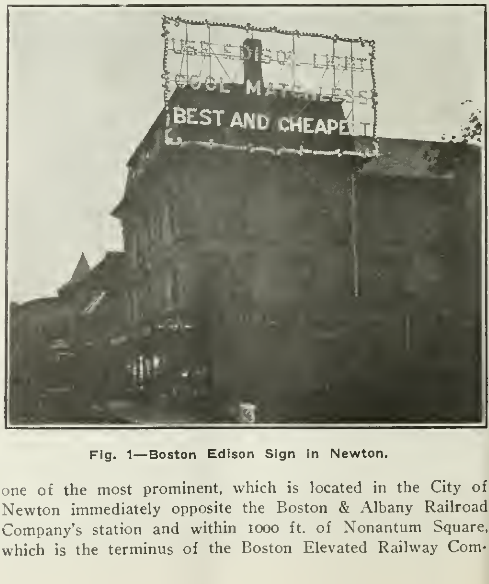


Fig. 1—Boston Edison Sign in Newton.

pany and the Boston Suburban Electric Companies' lines. The sign is mounted at the top of a three-story mercantile building, and is of the flashing type, the sentences upon it being varied every few weeks. Nearly ninety passenger trains per day stop at the Newton station, and a total of about 200 passenger trains either stop or pass daily. The sign is in full view from the railroad and can also be read with ease from Nonantum Square. It is equipped with 2-cp lamps, there being about 330 lamps in the border and 450 lamps in the inscription as at present arranged. Every passenger leaving a train at Newton in the evening is inevitably bound to notice this sign, which has a strategic location excelled by no other sign in the suburban area of Boston. Another prominent sign of the company is illustrated in Fig. 2, which shows a chimney of the Somerville substation, night view. Three rows of 8-cp carbon incandescents are installed at the top of the chimney, there being 120 on the four sides. A similar installation has been used at the Natick substation, and at the Waltham station of the company a large roof sign, visible from the Boston & Maine Railroad, is used. This calls attention to the light and power service of the company, and is made up of 345 4-cp carbon lamps. Figs. 3 and 4 illustrate a talking sign of the company which is installed opposite the North Station, Boston. This contains about 900 incandescent lamps of 4 cp each and nightly tells the story of electrical service and its advantages to throngs of passengers traveling through the northern railroad gateway of the city.

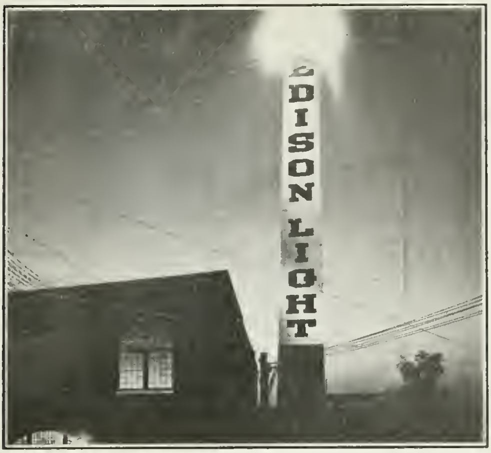


Fig. 2—Chimney Sign on Somerville Substation of Boston Edison Company.

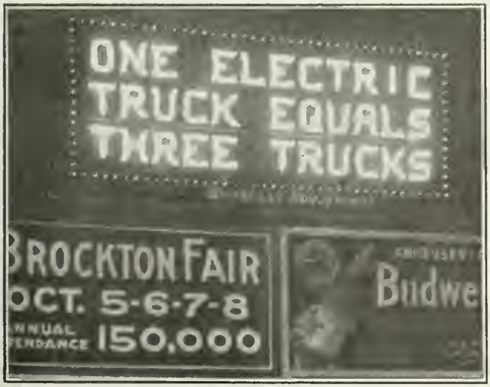


Fig. 3—Boston Edison Talking Sign Opposite North Station, Boston.

STEAM-CONSUMPTION TEST OF A SMALL CENTRAL STATION.

Analyses of the operating steam consumption of small steam-driven central stations furnish significant data to engineers interested in comparing the service performance of plants of moderate size. A representative test on an 865-kw plant serving a community of about 15,000 inhabitants was recently made by Messrs E. S. Howe and H. R. Wilbur, of the Massachusetts Institute of Technology, with the object of determining the relations of fuel consumption and output in the commercial operation of the plant and possible suggestions toward improved conditions in the station. The plant was located near the waterfront of the principal town served by the company, which supplies energy to municipal and private lamp and motor users, including a considerable street-lighting service throughout a wide countryside. The test was conducted under the auspices of the electrical engineering department of the institute.

The lighting load of the company was all single-phase in character, and the motor load was partly three-phase and partly 550-volt direct current. The latter service was supplied by a generator belted to a 150-kw synchronous motor, and the use of this equipment was found very beneficial in connection with the control of the power-factor. The boiler equipment of the plant consisted of two 250-hp B. & W. units and a 200-hp horizontal return-tubular boiler, which was not used in the test. The furnaces were hand-fired, and two Worthington feed pumps, an injector and a secondary heater were in service. All the feed water was purchased from the town supply, but ample supplies of condensing water were obtained from a large brook near the station, the brook discharging into the ocean. The feed water in the plant was run from the feed pump through a primary heater located between the engine cylinders and the condensing equipment, and thence through the secondary heater installation, from which it was passed to the boilers. The exhausts from the condenser pumps and feed pumps and the drips from the main steam line and from the heating system all run in together and pass through the secondary heater system.

The main generating units consisted of two General Electric 350-kw, 2200-volt alternators of the revolving-field type, each being a three-phase, 60-cycle machine directly connected to a Harris-Corliss horizontal cross-compound condensing engine, the engine dimensions being 15 in. x 28 in. x 30 in., and the speed 150 r.p.m. The low-pressure cylinder of one engine was connected to the main steam line through a reducing valve, and the necessary valves were placed in the exhaust connections so that if desired the engine could be run as a simple condensing machine on either the high-pressure or low-pressure cylinder. In addition to the 150-kw, 550-volt direct-current set, a 15-kw direct-current generator was provided in the plant for handling the motor load at times when the greater portion of the demand on the station for motor service is absent. The steam pressure in the plant was varied in daily operation from 65 lb. to 120 lb. gage. From midnight to morning, when the load was light, the pressure was reduced to about 65 lb. During the day it was run at about 85 lb., and in the early part of the evening at 120 lb. The object of this was to improve the economy of the engines, as they operated at about one-fourth load for six hours, at one-half load for twelve hours and at three-fourths load the rest of the time. By the reduction in pressure the company secured the benefits of a practically uniform cut-off. The condensing equipment of the plant was located beneath the engine-room floor at the sides of the engines served, both condensers being of the jet type, with an individual feed-water heater between each engine and its condenser. The condensers were of Warren and Worthington make, and the feed-water heaters were of National make. The exciters were belt-driven from the engine shafts and were interpole machines rated at 180 amp at 115 volts. The exciters could be operated in parallel or singly as desired, and two sets of main three-phase busbars were provided for the generators. The output of the alternators was controlled and measured at a switchboard of eight panels. Each feeder circuit was provided with an oil switch to each bus, so that the maximum flexibility of operation was secured, and the oil switches for each feeder panel were interlocked so that one switch could not be closed until the other was open to obviate the danger of throwing a circuit on each bus at the same time, which would cause trouble if the generators were running independently one on each bus, and out of phase.

TABLE I.—RESULTS OF A SEVENTY-TWO-HOUR PLANT TEST, EXPRESSED IN PER CENT.

Flue gas loss	22.8
Radiation from boilers	9.6
Primary heater	4.8
Secondary heater	4.4
Engine thermal loss	40.6
Engine mechanical and generator loss	1.7
Condensed steam loss	4.4
Auxiliary steam consumption loss	5.7
Leakage to idle boiler	0.2
Drip from steam mains loss	0.2
Radiation from steam mains, loss	0.6
Output at busbars	5.0
Total	100.0

TABLE II.—ANALYSIS OF TEST DATA.

Total coal burned in 72 hours (New River), pounds	36 840
Thermal value of coal per pound as fired, heat units	14,180
Corrected boiler-feed water in 72 hours, pounds	305,915
Total busbar output in 72 hours, kw-hours	7,700
Mean indicated horse-power of engine	193
Boiler efficiency, per cent	67.6
Engine thermal efficiency, per cent	16.7
Engine mechanical and generator efficiency, per cent	74.3
Pounds water per kw-hour output, per cent	39.7
Pounds coal per kw-hour output, per cent	4.78

The test further showed that 45.7 lb. of air per pound of coal were required; the total heat units carried off by gases per pound of coal was 3230, and the proportion of heat units carried off per pound of coal was 22.8 per cent. The steam contained 3 per cent of moisture. The boiler pressure averaged 98.3 lb. absolute, and the mean boiler output was 147 hp. The consumption was 67,900 heat units per kw-hour.

CONSTANT-LOAD ENGINE TESTS.

Three methods were considered with the object of securing a load which could be maintained with safety to the commercial service on the ground of non-interruption and with minimum danger to the persons making the test.

The first method was to run the test load on one generator connected with a water rheostat, with steam supply from two of the three boilers. The method would permit the load to be balanced exactly, but would introduce errors in the steam consumption for the reason that the boiler working on the commercial load is fed from the same water supply as the other two boilers. A Venturi water meter would be necessary on the boiler-feed pipe in this case.

The second method was to run the test load in parallel with the commercial load when the latter was not fluctuating and when it was heavier than the desired constant output. The constant output would have to be maintained by 2200-volt alternating-current rheostats, which are objectionable, although they permit the load to be nicely balanced and the boiler feed could be accurately measured.

TABLE III.—RESULTS OF CONSTANT-LOAD TESTS.

Mean kilowatt output	90.0	177.0	218.7	297.4
Pounds steam per kw-hour	36.1	28.6	29.7	31.8
Per cent efficiency of engine and generator	8.85	11.21	10.81	10.13

The third method, which was adopted, was a modification of the second method, the plan being to run the water rheostat in parallel with the 500-volt direct-current load. The 500-volt machine was driven by a 2200-volt synchronous motor, as stated above, and this method permitted accurate boiler-feed measurements to be made, although the load was not exactly balanced. The unbalancing of the load was insufficiently large to make an appreciable difference in the steam consumption, and there was a slight gain in the safety of operating the commercial load besides a decided gain in the safety of handling the artificial load at the water rheostat. The power-factor was kept at unity by the adjustment of the synchronous motor-field currrent.

DISCUSSION OF TEST POINTS.

Five per cent of the input reaches the busbars, which is about what would be expected for a small plant running under the conditions of the test. It was found that at certain times during the twenty-four hours the load on the three phases is considerably unbalanced. A better distribution was advised on account of its ability to reduce heating in the generators and lines to slight extent, and primarily because it will increase the accuracy of the station meters, some of which were running under unnecessarily light load conditions. The saving in the primary heater was indicated at about half what it should be and the conclusion was that the heater was provided with too small a heating surface or that it was operating inefficiently on account of scale or oil accumulating in the pipes. Thorough washing with caustic soda and water was advised. Similar treatment appeared desirable in the case of the secondary heater. It was also deduced from the tests that the engines operated most satisfactorily at 160 kw output. This point of maximum efficiency should correspond closely with the average station load. During the seventy-two-hour test the average load on the station was 107 kw, but this was less than the average load because one or two mills were not taking their full amount of power. When the average load changes considerably, the engine valves should be reset to give maximum efficiency at the new average load. A more rapid rise in boiler pressure with increase in load would prevent the efficiency curve from dropping so rapidly at the heavier loads. It was not feasible to determine the correct boiler pressure for any given load from the tests made, but it was pointed out in the test report that the best pressure could be obtained for any given load by comparison of boiler pressure with cut-off as shown by indicator cards taken at that load. The best engineering practice dictates that the best economy will be secured when cut-off occurs at about one-third stroke, or at as little above one-third stroke as is consistent with well-formed cards. This rule holds except at very light or very heavy loads. All instruments were carefully calibrated before and after the test.

Wiring and Illumination

TUNGSTEN POST LIGHTING WITH PRISMATIC REFLECTORS AT CINCINNATI.

About thirty-six ornamental street-lighting posts have been erected in Cincinnati employing a newly developed adaptation of the prismatic reflector to deliver a larger percentage of the light flux from the lamps down onto the pavement below.

Where an incandescent lamp is inclosed in a plain frosted-ball globe the distribution from the globe is, of course, practically that, diminished, of the lamp itself. On account of the large flux near the equatorial plane of such lamps it has been urged that this distribution is not best adapted for ornamental street lighting where the posts are spaced at short intervals along the curb. With the idea of projecting a larger part of this horizontal and upward flux onto the pavement beneath, a combination reflector and globe has recently been marketed in which the frosted globe is open at the bottom and contains a prism reflector surrounding the lamp. This reflector receives and redirects most of this light downward, while whatever gets through the interstices between the reflector prisms serves to illuminate the upper frosted globe as in other ornamental systems. One of the first installations of these reflectors for curb-lighting service was made about two months ago along several city blocks in Cincinnati, and careful records are being kept for checking the performance of the new system.

The five-lamp posts in Cincinnati carry 100-watt tungsten lamps on each side-arm and a 60-watt lamp in the top positions. Only the side-arm lamps are equipped with the reflectors. The outer whitened or frosted globes are open at the bottom and are held in position by flanges of the inner prismatic reflectors which inclose the lamps. A special 100-watt tungsten lamp, with concentrated suspension of the filament, is used in the reflector outlets. The top globe is of plain milk glass, but shaped so as to conform to the other globes.

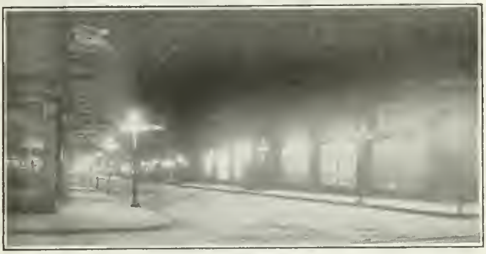


Fig. 1—Race Street, Cincinnati, Lighted by Tungsten Posts with Reflectors.

The first posts erected, on Fourth Street between Vine and Race Streets, carried the lamps 10 ft. 6 in. above the sidewalks, but this height was found to be too low, as "spotting" was produced in the lighting of the pavement below. In the second installation, on Race Street, between Sixth and Eighth Streets, the posts were lengthened so as to carry the lamps 12.7 ft. above the street surface.

This higher position has partially avoided the "spotting" first noticed, but to even a casual observer the illumination along the sidewalk varies widely between points under the posts and at midway distances. Viewed along the street, merely as decorations, the lighted globes also clearly lack the brilliancy found with unshaded 100-watt lamps.

At first fears were felt that the increased complexity of this glassware would make it cost more for cleaning. These objections have not been realized, however, as only the outer surface of the milk globe and the inside of the reflector appear to become dirty, even in Cincinnati's smoky atmosphere. Once a week an attendant rubs over these accessible surfaces with a cloth, cleaning them effectually. Once a month he takes down the two pieces of glassware and washes their unexposed surfaces. The cleaning cost thus seems to be only slightly different from that for simple glass globes.

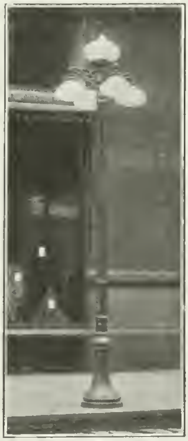


Fig. 2—Ornamental Lighting Pillar with Prism Reflector at Cincinnati.

The chief difficulty that has thus far made itself apparent at Cincinnati is the cracking of the outer milk glass, due, probably, to constraint against expansion, caused by the way the globes are clamped. A walk up Race or Fourth Street shows a number of cracked outer globes, besides those which have probably been replaced. As the price for equipping a five-lamp post with this reflecting glassware is about $15, or six or seven times that of simple glass globes, the cost of maintenance due to breakage may become important in the upkeep of such a system of curb lighting.

The present blocks of ornamental curb lighting in Cincinnati are trial installations, the erection of which was financed by the merchants. Energy for the lamps is paid for by the city out of the general lighting fund. In the new street-lighting contract, bids for which have just been advertised, it has been proposed to install this form of lighting only in the downtown section of Cincinnati. The present lamps burn from dusk to midnight only.

Careful records of the performance of this curb lighting are being kept by the Union Gas & Electric Company, of Cincinnati, which furnishes the energy to operate it. The installations have now been in service only a few weeks, but after a month or two the distribution department of the company, of which Mr. F. J. Healy is superintendent, will probably be able to offer a complete report on the cost of maintenance of the reflectors.

ILLUMINATION OF THE CATHEDRAL OF ST. JOHN THE DIVINE, NEW YORK.

Of all the handsome edifices for religious services in New York City the Protestant Episcopal Cathedral of St. John the Divine is the most splendid and monumental in plan, and even in its unfinished state it is imposing and impressive. The cathedral is situated on the rocky eminence overlooking Morningside Park, and when completed will be the fourth largest cathedral in the world, being surpassed in size by St. Peter's, Rome; the Cathedral of Seville, Spain, and the Duomo, at Milan.

The architectural style is Romanesque influenced by the Byzantine. The plans show a cruciform structure 520 ft. long, 165 ft. wide across the nave and aisle, 288 ft. wide across the transepts, covering an area of 99,500 sq. ft. The crowning detail will be an imposing central tower planted on a base 100 ft. square directly above the crossing and rising to a height of 425 ft. Two smaller towers are to be located at the front of the edifice and four in the angles formed by the intersection of the nave and transepts. The dome of St. Paul's Cathedral, in London, is of slightly greater span, but is lower by 36 ft. than that of the Cathedral of St. John the Divine. Surrounding the choir will be seven chapels, the Chapels of the Tongues, two of

Fig. 1—Unfinished Cathedral of St. John the Divine.

which have been completed, and the work on two others of which will shortly be commenced. Of the cathedral the choir and a part of the crossing are complete and will be dedicated with impressive ceremony on April 19. The cornerstone of the cathedral was laid in 1891 and work has been advanced as fast as funds, which come from voluntary contributions, have allowed. The cost of the completed structure is estimated at over $10,000,000, of which $4,000,000 has already been expended.

The massiveness and enduring nature of the construction may be understood from the photographs reproduced herewith. The four great arches which will hold the tower are 12 ft. wide, 14 ft. 3 in. thick at the springing line (74 ft. above ground level) and 12.5 ft. at the crown, and contain 1180 cu. yd. of granite masonry. Each of the main piers on which they rest is 21 ft. square and has bearing against it two flying buttresses with an average thickness of 12.5 ft. The great arches, piers and flying buttresses, all of which are constructed of granite, will be concealed when the cathedral is finished by the exterior architectural features and by an interior finish of buff-colored limestone. The roof, floors, etc., are supported from stone arches, no steel framework being used at all. A feature of the interior is the eight giant granite columns surrounding the reredos. Each of these is 18 ft. in circumference, 54 ft. high and weighs more than 130 tons. The beauty of the interior is best brought out at night under the light of the electric lamps. Owing to the absence of the rich stained-glass windows which will adorn the cathedral when completed the view by day lacks the softness of color necessary to impart the requisite ecclesiastical dignity to the edifice and its furnishings. Much of the electric work at present in use is temporary, but the greater part of the work in the sanctuary and choir is permanent. The lighting equipment of this part of the cathedral is worked out as an entity, although all of it is not to be used at present. The lighting fixtures at present used are temporary and will give place to architectural fixtures, lanterns, etc., in keeping with the edifice when specific appropriations for that purpose are made.

Electricity for all purposes is supplied from the mains of the New York Edison Company, the installation being made by Messrs. Peet & Powers, of New York, under the direction of Mr. J. R. Moore, electrical engineer. The choir and sanctuary are lighted chiefly from strips hidden behind the piers. Numerous floor pockets are also arranged in the mosaic tiling in the choir and sanctuary floor wherever candelabra are likely to be required. The sanctuary strips, shown in Figs 4 and 8, also encircle the arch above and are arranged in 24-ft. sections which can be lowered on a sliding rail for relamping by means of a windlass. There are sixty-eight lamps rated at 16 cp in vertical-mirror reflectors of the Frink type on each of the sanctuary piers. In the arch above these are 104 lamps and the strips are arranged to be readily relamped from an opening at the side of the arch. The arch being about 120 ft. high, some provision had to be made for renewing lamps and the plan adopted has worked very well. The chancel arch has no lamps in it, but strips are arranged back of the piers as in the case of the sanctuary and a similar arrangement prevails for relamping the strips. There are forty-eight 40-watt tungsten lamps on each side of the choir space and these give ample light for the choristers. In the rich canopies surmounting the stalls for the

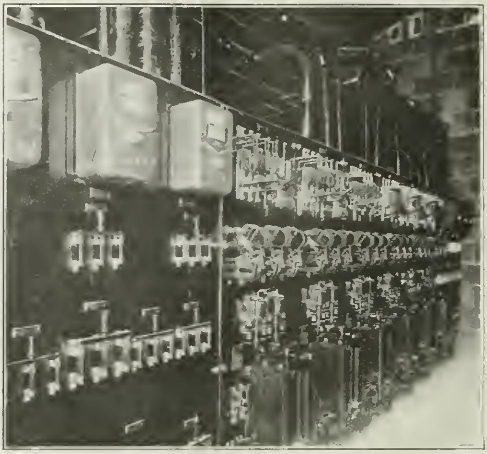


Fig. 3—Automatic Switches and Dimmers.

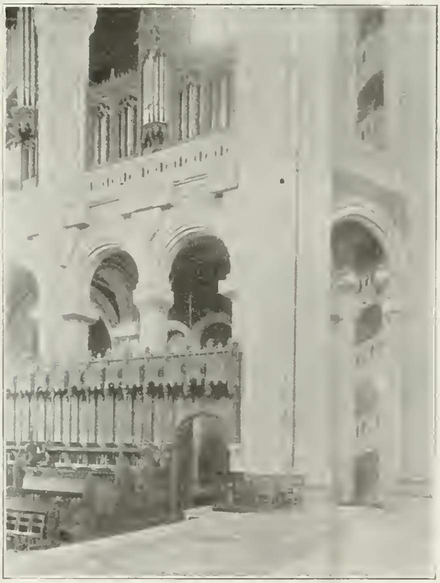


Fig. 2—Portion of Strip on Sanctuary Pier.

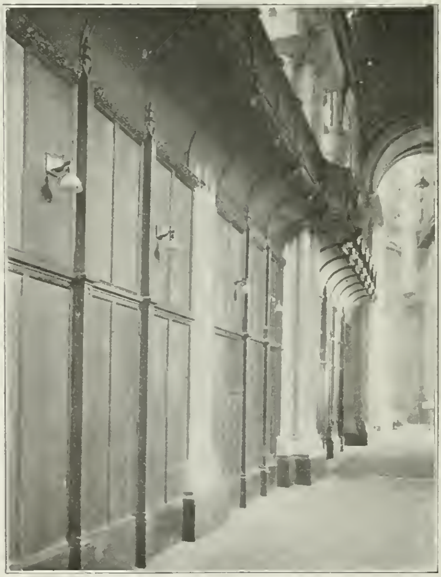
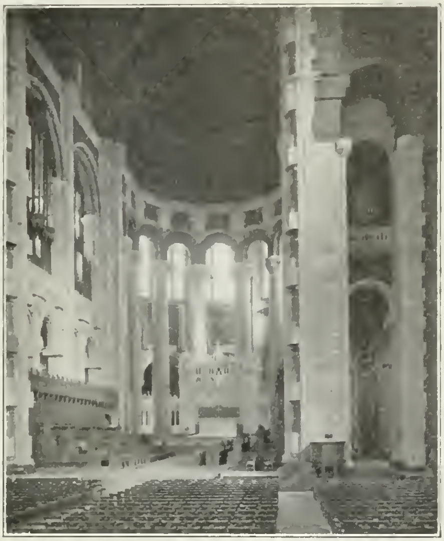
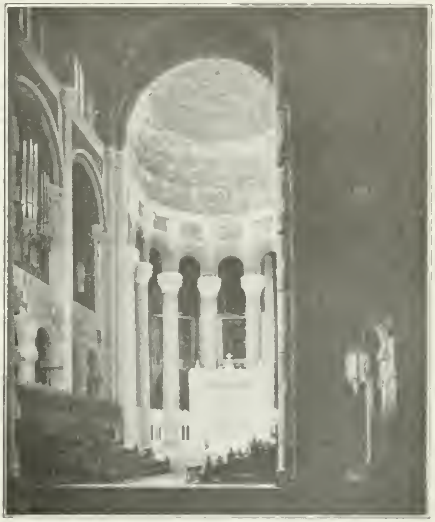


Fig. 4—Temporary Fixtures in Aisle Back of Organ.

clergy in the choir there is an opening covered with a disk of amber glass about the same color as the oak wood of which the screens are made. These disks are not noticeable by day and at night the light from 16-cp lamps shines through with a beautiful effect. There are twenty-one lamps hidden in these canopies on each side of the choir.

The lighting of the choir and sanctuary is subject to remote control by means of special switches. Every other lamp on the piers and arch is connected to a dimmer circuit and the alternate lamps are sub-controlled by automatic switches. The push-button control is arranged in a closet back of the choir screens, and similar switches are arranged at the side of the organ, giving the organist control of the choir lighting. By means of a pilot lamp over the push button one can ascertain before starting the dimmers if all or half of the lamps are in circuit, the lamp indicating whether the automatic switch is closed or open before starting (it will be understood that the attendant is in a closet and out of sight of the choir and sanctuary). By means of other push-button switches all or half of the lamps can be thrown in circuit. A supplemental contact on the automatic switch built by Messrs. Flucker & Keedwell, New York, enables this control to be effected.





Figs. 5 and 6—Choir and Sanctuary of the Cathedral of St. John the Divine as They Appear by Day and by Night.

Fig. 3 shows a view of the switchboard in the basement with the dimmers at the bottom and the automatic switches at the top. Each of the six individual operating dimmer panels shown controls groups of lamps independent of each other. Some of the dimmers are constructed to allow separating the lamps into groups controlled by switches at remote points.

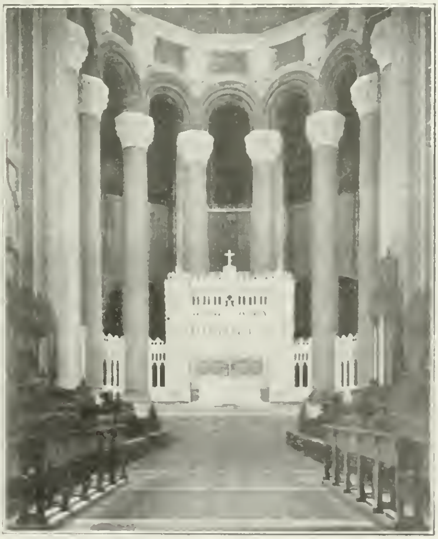


Fig. 7—Reredos Lighted from Strips on Sanctuary Piers and Arch.

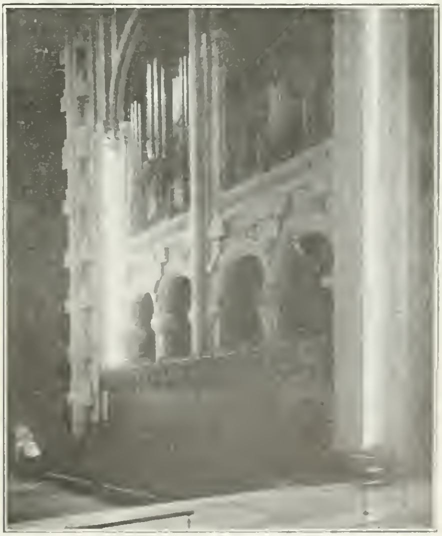


Fig. 8—Strip Lighting on Piers in Choir and Sanctuary.

Either one of the groups can be dimmed or brightened independently or both can be controlled alike. The principal parts of the dimmer arrangement consist of three solenoid-operated clapper-type switches for the three-wire circuits and a cross-head type commutator over which the brushes pass, driven through a screw shaft and spur gear by a ⅛-hp, 220-volt motor. The resistors are mounted in an angle-iron frame on the rear of the panel and comprise cast-iron grids and inclosed-type units. The 30-amp, 250-volt switches mounted on the panels control the motor circuits. Two solenoid switches operated by means of push-button switches reverse the motor armature circuit. One push button is located on each panel and similar ones are mounted as before mentioned, so that the solenoid switches can be operated to control the motor and, therefore, the dimming of the lamps remotely. The arrangement of the resistance permits of very fine and gradual variations in light brilliancy, causing glowing and fading by imperceptible degrees. The dimmers, which are of Cutler-Hammer Manufacturing Company design, are arranged so that the motors will automatically shut down whenever the lamps are either totally dimmed or totally brightened, and further when the lamps are totally dimmed the three clapper-type switches will open the main line, cutting off the energy and preventing waste.

In addition to the lamps on the sanctuary and chancel piers, the four great windows over the organ are arranged to add to the general effect. About 20 ft. back of each of these windows three rows of lamps in individual Frink reflectors are arranged to be brought up to full brilliancy on dimmers. There are sixty 80-watt carbon-filament lamps in each chamber, which have their light directed against the amber leaded-glass windows under the dome of the choir. These windows are not visible in any of the illustrations, being too high to come within the focus of the camera.

The temporary lighting in the unfinished crossing is obtained from three-lamp brackets on the walls and from rows of lamps located high up near the spring of the arches. The crossing as it now stands is 100 ft. square and is without obstruction of any sort clear to the temporary dome, about 150 ft. above the floor. The problem was to illuminate this vast expanse without thrusting the source of illumination, which must of necessity be temporary, conspicuously into view. It was found that sufficient light could be obtained by arranging a row of forty 125-watt lamps in individual reflectors on each side of the crossing. There are in addition three rows of thirty-five 16-cp lamps without reflectors fastened to the tie rods at present used across the arches in the crossing until the nave and transepts are added.

The immense organ arranged on both sides of the choir is equipped with a 26-hp motor on one side and a 7-hp motor on the other, driving blowers of the Spencer Turbine Cleaner Company, of Hartford, Conn. The aisles back of both sides of the organ through which the Chapels of the Tongues are reached are lighted temporarily by three-lamp fixtures attached to the organ frame and by Benjamin clusters dropped from the ceiling. The two magnificent chapels already built and those shortly to be commenced will be lighted from candelabra fed from floor pockets.

RECENT TELEPHONE PATENTS.

CIRCUIT SYSTEMS.

In most standard common-battery systems there are associated with each subscriber's line two relays, the line relay for energizing the line lamp and the cut-off relay for extinguishing the line lamp. To combine these functions in a single relay is the object of Mr. A. H. Weiss, of Chicago, in the system described in a patent recently granted to him and assigned to the Kellogg Switchboard & Supply Company.

The control relay is made two-stage. It responds to the removal of the subscriber's telephone operating through its first stage and closing the line-lamp circuit. With the response of the operator the currents are increased and the relay completes its action, thus performing the cut-off relay functions.

An intercommunicating system has been patented by Mr. A. K. Andriane, of San Francisco. The system is adapted for use where each station must select and ring any other one desired. The object is to simplify the present methods and circuits. This patent is assigned to the Direct Line General Telephone Company.

Mr. F. W. Adsit, of St. Paul, Minn., has obtained a patent for a step-by-step lock and selective system. A feature is an automatic clearing of the line with the return of the receiver to the hook at a calling station. This is caused by the release of a spring which is automatically wound incidental to signaling and which upon releasing drives the generator to send out a reverse current.

NEW APPARATUS.

While most telephone sets are provided with gongs there have been a few instances where the ringer has had to tap upon some part of the apparatus to give a signal. In these cases the containing case or some similar part has been used and the idea of utilizing the transmitter mouthpiece in this way is novel. According to the patent of Mr. C. L. Chisholm, of Marysville, New Brunswick, Canada, a seat for the ringer is formed in the transmitter mounting and a U-shaped double-end clapper taps alternately opposite sides of the transmitter to give the signal.

The patent granted to Mr. W. A. Soles, of New York City, describes a locking attachment for telephones. A sheet-metal bar, shaped for its particular use, blocks the hook switch and is held in place by a padlock which prevents its withdrawal.

Mr. V. Tardieu, of Arles, France, has designed and patented a breastplate transmitter in which the transmitter proper with its casing may be readily removed from the breastplate and a new one substituted.

PORTABLE CONTACT POLE.

A portable pole for tapping a telephone circuit at any point has been patented by Mr. G. J. Bayless, of Oakland, Cal. The pole carries two metallic arms at its extreme end. These swing about the end of the pole, being held by a spring joint in the position set. They are insulated from each other. The pole is a jointed one, very light.

LETTERS TO THE EDITOR.

Strength of Poles.

To the Editor of Electrical World:

Sir:—In his report of "An Experimental Determination of the Strength of Full-Sized Telephone Poles" in your March 16 issue Mr. L. S. Winchester states that his values for the modulus of elasticity are too low on account of "the give of the butt in the ground." Actually, however, his calculations involve a second error tending in part to offset the first. This purely mathematical error may be worth pointing out in detail, since it is one which must always be guarded against when applying the ordinary formulas to large deflections.

The fundamental equation of the common theory of flexure is

$$\frac{\dfrac{d^2y}{dx^2}}{\left[1+\left(\dfrac{dy}{dx}\right)^2\right]^{\frac{3}{2}}}=\frac{M}{EI} \qquad (1)$$

y being the deflection of the neutral axis at x. The formula

$$y=\int\int\frac{M}{EI}dx\,dx \qquad (2)$$

used by Mr. Winchester is good for small deflections only, since it is derived from (1) by neglecting $\left(\dfrac{dy}{dx}\right)^2$. Mr. Winchester is careful to enumerate the "three assumptions" underlying the equation for fiber stress, but in common with many other writers, he fails to note this fourth assumption peculiar to the flexure equation.

An exact integration of (1) will be found to yield, in place o1 (2), the relation

$$y - y_{x=0} = \int_0^x \frac{\phi \, dx}{\sqrt{1 - \phi^2}} \qquad (3)$$

in which x is measured from the location of zero slope, and ϕ denotes $\int_0^x \frac{M}{EI} \, dx$. For a beam of uniform section fixed at one end ($x = 0$) and loaded at the point $x = l$,

$$\phi = ax\,(2\,l - x) \qquad (4)$$

where a denotes $\frac{F}{2\,EI}$, the other symbols having their conventional significance.

To get an estimate of the errors incurred in the case of Mr. Winchester's timber poles by using the common formula (2), instead of the exact formula (3), which I here propose, consider for example pole No. 1, in which the deflection was 60 in. (In other cases the deflections ran as high as 103 in.) A tapering pole may be represented by one of uniform section by adopting the equivalent movement of inertia. $I = \frac{\pi}{4} (r_1^3 r_2)$ where $r_1 > r_2$. With this understanding the data for pole No. 1 combine to give to a the value 4.4×10^{-6}, leading to a deflection of 60 in. upon substitution in the common formula

$$y_{max} = \frac{Fl^3}{3\,EI} = \tfrac{2}{3}\,al^3 \qquad (5)$$

The question therefore becomes, what value of a (and hence of E) will give the actual deflection of 60 in. upon substituting into the exact formula (3) instead of into the common formula (5)? The graphical integration of equation (3) gives y_{max} X 49 in. when $a = 4 \times 10^{-6}$ and 63 in. when $a = 5 \times 10^{-6}$, from which the true value is seen to be $a = 4.8 \times 10^{-6}$ when $y_{max} = 60$ in.

The error, then, is $\frac{4.8 - 4.4}{4.4}$, and the conventional method of calculation has led to a figure 9 per cent too large for the modulus of elasticity.

Washington, D. C. Mayo Dyer Hersey.

Regenerative Control.

To the Editor of Electrical World:

Sir:—The article upon regenerative control by Mr. J. G. V. Lang in the issue of March 30 fails to take into account a very important item, namely, the additional cost of motors of sufficient size to withstand being run without any cooling period; this is the real determinative feature of all forms of electric braking. If the motors must be 50 per cent larger and the car wiring must be designed on a more liberal scale, and the controllers provided with extra contacts, with safety devices made necessary by the increased current in the local circuits, the interest on the added cost may very well wipe out all the saving by regenerative control, without regard to the added repair charges on the more complicated equipment. Unfortunately, predetermination of these items has not proved entirely accurate.

New York, N. Y. T. J. Johnston.

Digest of Current Electrical Literature

ABSTRACT OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Turbo-Alternators with Cylindrical Rotors.—A paper read before the Birmingham Section of the (British) Institution of Electrical Engineers. The author dealt with the characteristics of turbo-alternators with non-salient poles, giving special attention to the shape of the e.m.f. wave-form. The author points out that the general opinion is that a sine-wave is the best, and states that the non-salient pole machine closely approaches the ideal in this respect. Taking a rotor slotted uniformly over the whole periphery with equal-sized slots containing the same number of conductors and a few slots in the middle of each pole left unwound, the ratio of the number of wound to the number of unwound slots may be called β. Formulas are developed giving the harmonics which will be present in the e.m.f. curve for any value of β, and the results show that the more the winding is concentrated—that is, the lower the value of β—the greater is the amplitude of the fundamental curve, and consequently the higher the e.m.f. By concentrating the winding, therefore, the output is increased, or, conversely, fewer ampere-turns are required for a given output. Thus, taking the amount of copper required for a given output at 100 per cent with $\beta = 1$, the amount of copper is 84.5 per cent for $\beta = 0.8$, 78.7 per cent for $\beta = 0.7$, and 74 per cent only for $\beta = 0.6$, which is the lowest value of β found in practice, owing to the difficulty of accommodating the winding in the slots. Turning to the question of harmonics, the author points out that all harmonics above the fifth are negligible because of their small magnitude and low winding factors. The third and fifth, however, may reach 10 per cent and 5 per cent respectively of the fundamental in the flux wave in passing from β from 0.9 to 0.6, but on account of the influence of the winding factors with distributed windings the amplitude of the fifth harmonic in the e.m.f. wave is generally less than 1 per cent, and in a non-saturated machine can also be neglected. At $\beta = 0.66$ the third harmonic is zero, but for other values this harmonic becomes appreciable and may reach nearly 7 per cent in the e.m.f. wave of a three-phase machine. In order, therefore, to obtain a sine-wave flux and e.m.f. curve the value of β should be chosen between 0.7 and 0.6. The best distribution from all points of view is obtained with β from 0.85 to 0.65, as then there is plenty of space for the copper and the heating is more distributed. Considering the influence of saturation, the author shows that this causes the flux curve to be rounded off and tends to improve the shape of the wave. In a salient-pole machine the flux and pressure curves are more or less skewed and distorted, but this does not occur in a non-salient pole machine, because both stator and rotor m.m.f. curves are practically sine curves; and as the reluctance of the magnetic path is constant for any position the flux under load is simply the sum of these two curves at the proper displacement, and is therefore also a sine curve. The e.m.f. curve will also be a sine curve. The non-salient pole machine adapts itself readily to standardization. For 50 cycles, machines up to 2000 kw are made two-pole for 3000 r.p.m.; up to 5000 kw, four-pole for 1500 r.p.m., and up to 5000 kw, six-pole for 1000 r.p.m. A very few diameters are chosen for each speed, and the outputs are varied by alternating the core length. The air-gap, teeth and cores are identical. The open-circuit characteristic will thus be the same for all machines of one diameter. —Lond. *Elec. Eng'ing*, March 23.

Reactance of Electric Machines.—J. Rezelman.—A continuation of his long serial on synchronous and non-synchronous reactance. In the present instalment the author gives the results of tests of a 75-kva alternator with salient solid poles. As in former articles the author considers the reactance when the rotor is first removed and when it is put in place, and in the latter case he investigates the variation of the reactance with the position of the rotor. Finally the operation of the alternator as a non-synchronous motor is investigated.—*La Lumière Elec.*, March 18.

Lamps and Lighting.

Metallic-Filament Lamps.—G. S. Merrill.—A paper in which the author first discusses the physical properties required in materials from which lamp filaments are to be made. It is desirable that the filaments possess a high positive temperature-resistance coefficient, since the greater the value of the coefficient the less the changes in current, wattage and candle-power with fluctuations in applied voltage. One per cent increase in voltage will give approximately the following percentage increase in current, watts and candle-power:

	Per Cent Increase in Current.	Per Cent Increase in Wattage.	Per Cent Increase in Candle-Power.
Tungsten	0.59	1.59	3.73
Tantalum	0.72	1.72	4.27
Graphitized carbon	0.77	1.77	4.90
Treated carbon	1.07	2.07	5.69
Untreated carbon	1.31	2.32	7.10

These figures apply only to relatively slow changes in voltage. The author then discusses the effect of selectivity and emissivity and gives a comparison of the lengths and the diameters of filaments of various kinds which would be required to produce lamps of the same candle-power and voltage at the same luminous efficiency. In the conclusion of the paper some interesting microphotographs of the cross-sectional fracture of metallic filaments are given and tests are described for determining the mechanical strength of the filaments.—*Jour. Franklin Inst.*, April.

Electric Lighting of Docks.—A. Boje.—A detailed illustrated description of the electric lighting equipment of docks in Stettin Harbor in Germany. A comparison is made from practical experience between lighting the docks on the one hand with both arc and incandescent lamps and on the other hand with metallic-filament lamps alone. It is shown in great detail that the latter method, using metallic-filament lamps alone, gives not only a stronger and more uniform illumination, but is also considerably cheaper. Comparative details of cost of operation are given for both systems.—*Elek. Zeit.*, March 23.

Leading-in Wires.—A note on a recent British patent (13,295, March 16, 1911) of the British Thomson-Houston Company (General Electric Company of this country). A short length of drawn ductile tungsten or molybdenum wire is used as a leading-in conductor for incandescent lamps. The wire is dipped into fused potassium nitrate before sealing it into the glass, as it is necessary that it should be free from dirt and oxide.—Lond. *Elec. Eng'ing*, March 23.

Traction.

High-Pressure Direct-Current Traction.—H. K. Whitehorn.—An illustrated article in which the author draws attention to the advantage of continuous current at pressures up to 3000 volts for railway working, and describes the various methods available for using such pressures. Statistics are given of a number of lines employing continuous current at pressures above the usual 500 volts, the aggregate length of route so equipped being about 800 miles.—Lond. *Electrician*, March 24

Installations, Systems and Appliances.

Safety Automatic Switch and Plug.—An illustrated description of an automatic switch and plug for use in dangerous situations, such as coal mines, magazines, bunkers, etc. The switch contains an electromagnet so arranged that it holds in the "on" position the double-pole switch when current is passing through it, but should no current be flowing the magnet ceases to be energized and the circuit is broken. The socket also contains an electromagnet so arranged that when current is passing through it a small bolt is lifted, which locks the movable plug so that it cannot be withdrawn while the current is on. The magnets in both switch and plug are in series with the rest of the circuit. By the use of this apparatus it is impossible to insert or withdraw the plug from the socket while the latter is alive, and any accidental breakage in the continuity of the circuit, due to a broken lamp, etc., instantly causes the double-pole switch to open, the whole of the wiring in the dangerous area thereby being made dead. It will be seen from Fig. 1 that only one lamp is controlled by each plug, and the circuit can be used only when everything is in thorough working order.—Lond. *Elec. Review*, March 24.

Feeder Regulator.—A. R. Garnier.—An illustrated description of a method of voltage regulation of feeders in use in France. The regulator is essentially a voltmeter with contacts electrically connected with series and shunt instrument transformers so that when the voltage in the line varies a relay circuit is closed which operates a motor to bring the armature of the regulator to its position so as to produce again the normal voltage. The article is illustrated by several diagrams.—*L'Industrie Elec.*, March 10.

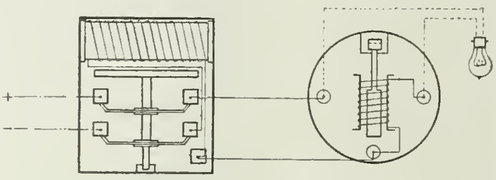


Fig. 1—Safety Automatic Switch.

Electrophysics and Magnetism.

Brownian Movements.—H. Fletcher.—A paper giving mathematical notes on the theory of the Brownian movements with an application to the determination of the elementary quantity of electricity by Ehrenhaft. The author gives an explanation of the irregularities observed by Ehrenhaft and proves the possibility that all the small particles observed by Ehrenhaft may have been of the same size and may have carried the same electric charge.—*Phys. Zeit.*, March 15.

Electrochemistry and Batteries.

Regenerating Old Battery Plates.—An article on a new chemical process for regenerating old storage-battery plates. "The old negative plates, riddled with cracks between the active material and the grid, are dipped in a bath of certain chemicals, baked for a short time and then reduced electrolytically to eliminate all impurities. This treatment has the effect of expanding the material so that it fills up all interstices and cracks. The treated plate is more uniform, of higher conductivity, and, as the material has expanded, is more porous than before the treatment. Furthermore, the material is much harder than that of new plates, and, it is claimed, retains this hardness after formation. A complete battery is made up from the negative plates of two old ones, one of the outer of each set of plates which is to be positive being cut off, so that both outside plates are negative. It is stated that apart from the saving effected by the regeneration of exhaust plates the regenerated batteries have a longer life and an efficiency from 10 per cent to 15 per cent higher than the original batteries, and at least equal capacity." Of a number of 46-cell regenerated traction batteries of a London electric automobile company, one has completed its life with 4500 miles, which is 1000 miles above the average figure for a new battery. The cost of such a battery is less than one-half that of a new one.—Lond. *Elec. Eng'ing*, March 23.

Purification of Water by Ozone.—G. Erlwein.—An illustrated description of the new ozone purification plant of the water works of the City of St. Petersburg in Russia. It supplies sterilized water to a district consuming daily 50,000 cu. m (13,200,000 gal.) of water. The water of the river Neva is first filtered and treated with aluminum sulphate to precipitate the suspended matter. The filtered water is then subjected to treatment by ozone. The Siemens & Halske ozonizer is employed. There is a special electric power plant containing two 150-hp generators. The cost of operation in practice, including the cost of aluminum sulphate and rapid filtration, is from 0.40 cent to 0.45 cent per cubic meter of water.—*Met. and Chem. Eng'ing*, April.

Fixation of Atmospheric Nitrogen.—J. Vanderpol.—A detailed description with illustrations of the new works of the La Nitrogène company in La Roche de Rame, Hautes-Alpes, France, using the Pauling process for making nitric acid and nitrates from air. The chemical reactions which take place are summed up and the construction of the Pauling furnace is described and illustrated. An account is also given of the treatment of the gases containing nitrogen oxide for change into nitric acid.—*Met. and Chem. Eng'ing*, April.

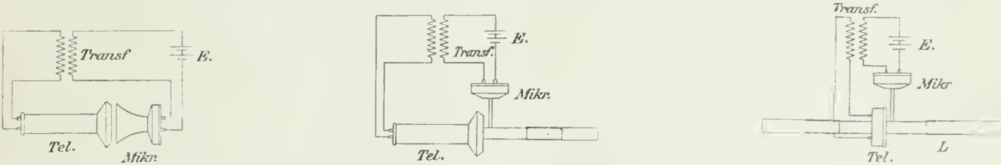
Heat Insulation of Furnace Walls.—Carl Hering.—An article giving the general principles of the heat insulation of furnace walls with the aid of the analogy of the flow of heat to that of the flow of electricity.—*Met. and Chem. Eng'ing*, April.

Laboratory Furnaces.—G. H. Goodwin.—An article illustrated by detailed drawings on an electric furnace in which granular carbon is employed as resistor. Within the granular carbon a graphite container is embedded for a working or removable crucible.—*Met. and Chem. Eng'ing*, April.

Vanadium.—W. F. Bleecker.—A second article of the serial on the chemistry and metallurgy of vanadium. In the present instalment the author deals with methods of analysis, including an account of electrolytic methods.—*Met. and Chem. Eng'ing*, April.

Units, Measurements and Instruments.

Telephone Generator of Weak Alternating Currents.—A. Larsen.—A telephone can be made to give out a sound if it is placed before a microphone with which it is connected by means of a transformer, as shown in Fig. 2. The condition of oscillations is rather unstable, and if the relative position of the telephone and microphone is only slightly changed the sound given out by the telephone may change considerably. The reason is that the mass of air which oscillates is of decisive importance. The author has therefore changed the arrangement as shown in Fig. 3, where a brass pipe is screwed on to the mouthpiece, the length of which can be adjusted by drawing extension tubes out more or less. Through a thinner side tube the air in this extension tube is connected with the microphone as shown in the illustration. The frequency of the sound can then be regulated within considerable limits by changing the length of the extension tube. A certain irregularity is experienced with this arrangement which is due to the oscillations of the air in the hollow space behind the telephone diaphragm. When the hollow space is filled with paraffine the irregularity disappears. This arrangement is especially suitable for frequencies above 1000 cycles per second. For lower frequencies the arrangement was changed as shown in Fig. 4, in which a telephone of the box or disk type is used and identical extension tubes are attached to it on both sides, which may be drawn out so as to change the length. With this arrangement it is easy to vary the frequency from about 600 cycles to 1100 cycles per second. Fig. 5 shows the change of the frequency with changes of the length of the extension tube. The abscissas give the length of the tube in centimeters The ordinates give for curve *a* one-fourth the wave-length in centimeters and *b* the frequency in cycles per second. For the higher frequencies the length of the extension tube is only a little greater than one-fourth of the wave-length. This arrangement is an easy, cheap and satisfactory generator of weak alternating currents of a frequency of 600 cycles to 1100 cycles per second. It is advantageous to use a second transformer to reduce the voltage to a value suitable for measurement. Since the oscillations chiefly depend on the mass of air, the wave of the sound is almost sinusoidal. When the apparatus is started the frequency may change in the beginning by about 1 per cent, but afterwards the frequency will remain constant for hours to about one-fifth of 1 per cent.—*Elek. Zeit.*, March 23.



Figs. 2, 3 and 4—Telephone Generator of Weak Alternating Currents of High Frequency.

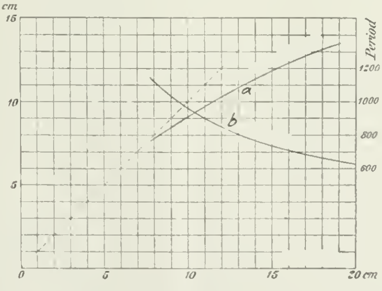


Fig. 5—Change of Frequency with Change of Tube Length.

Measuring Low Resistances.—An illustrated description of an instrument of British make called the "ducter," for measuring low resistances; for instance, for comparison of contact resistances of switches, testing all sorts of joints, bonds, etc. The moving system is composed of two coils, in planes at an angle to each other, carrying currents proportional to that passing through the resistance to be tested and to the drop of potential across it respectively. This system is free to swing in a permanent magnetic field, and the position which these coils and the pointer take up depends on the direction of the resultant of the forces due to the currents in the two coils, and is thus determined by their ratio, which is proportional to the resistance to be tested. The fundamental principle is, therefore, the same as that of the "megger," which is an instrument for measuring high resistances. The main differences are due to the fact that whereas in the megger the drop of potential amounts to some hundreds of volts and the current through the resistance is infinitesimal, in the ductor a series current measurable in amperes is employed, but only a diminutive drop is produced. Thus the working current is supplied from a few

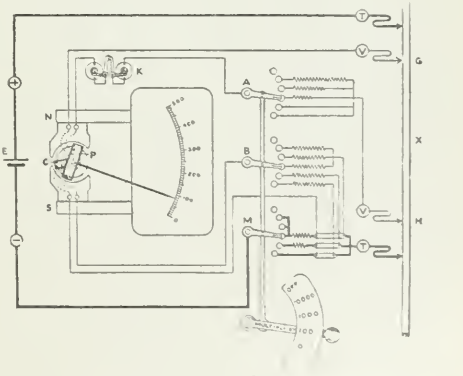


Fig. 6—Diagram of Connections.

storage cells instead of from a high-voltage generator, and suitable shunts are employed in connection with the current coil. The connections are shown in Fig. 6, in which E is the battery, C current coil, P potential coil, $N S$ poles of magnet, K cut-out, $A B M$ triple-pole grade switch, X resistance under test, $H G$ potential contacts,—Lond. *Electrician,* March 24; Lond. *Elec. Eng'ing,* March 23.

Calorimetry.—W. P. White.—The first of a series of articles on recent progress in calorimetry. In the present article the author discusses the real versus the supposed errors and shows that the cooling connection instead of being the largest is easily made the least of the sources of calorimetric error, that evaporation, while much more serious, can also be controlled without difficulty, as can the heat produced by the stirrer. The way to control evaporation is practically to prevent it. With the stirrer the essential thing is to find the proper speed. Lag effects, though numerous and complicated, may easily be made to produce negligible errors. The total inaccuracy of the calorimeter, therefore, is much less than the usual error of the temperature measurement. This error can be greatly reduced, though at the cost of considerable complications, by using electrical thermometers. It can be very easily, though less effectively, reduced by increasing the temperature interval through which the calorimeter is heated. The general opinion that small intervals are generally advantageous or conducive to accuracy is a fallacy.—*Met. and Chem. Eng'ing,* April.

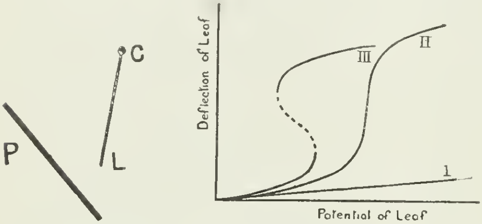


Fig. 7—Gold-Leaf Electrometer.

Gold-Leaf Electrometer.—G. W. C. Kaye.—A paper read before the British Physical Society describing a new form of the tilted gold-leaf electrometer. (Fig. 7, left-hand diagram.) An insulated gold leaf L hanging from C is attracted out of the vertical by an inclined charged plate P in its proximity. An alteration in the potential of either causes L to move. Depending on the tilt of the plate P, the relative potential of P and L and the proximity of P and L, the equilibrium of the leaf may either be stable over the whole of its path or unstable over part of it. The right-hand diagram illustrates the possibilities that may occur with the electrometer, the potential of the plate being constant. In curve I the deflection of the leaf increases steadily with the potential on it, and throughout there is a complete stability and only moderate sensitiveness. In curve III there are, for a certain range of potentials, two positions of equilibrium for the leaf. The central dotted portion of the S is experimentally unrealizable and indicative of instability. By adjusting the conditions curve II can be obtained. Here the deflection is single-valued throughout, and although the sensitiveness is high over part of the path there is complete stability. The critical curve between stability and instability will have a vertical portion indicating infinite sensitiveness, and the tilted electroscope derives its sensitiveness by working as near as may be expedient or desirable to this critical state. For any particular tilt of the electrometer there is a plate potential which will yield a maximum sensitiveness. The less the tilt (or the angle of the plate to the vertical) the greater is the plate potential required and the greater the maximum sensitiveness, until the critical tilt is reached beyond which comes instability over some region. The extent of this unstable region increases as the tilt diminishes. The author discusses the various points to be observed in the practical construction of the electrometer so as to obtain the best results. The cutting and mounting of gold leaves and the features of the various insulators available for electrometer work are discussed in two appendixes.—Lond. *Electrician,* March 24.

Direct-Current and Alternating-Current Electromagnets.—P. R. Friedlaender.—Considerable discrepancies have often been noticed between the pull exerted by an electromagnet when excited with direct current and that exerted by the same magnet (or one of the same dimensions, only modified to avoid eddy-current losses) when used on a single-phase alternating-current circuit at the same current. In many cases this is partly due to the effect of iron saturation, but, quite apart from this factor, considerable differences still occur. These are essentially due to the fact that the length of the working air-gap varies periodically when the alternating current is in use, and thus interferes with the shape of the time curve of the flux. This periodic variation of air-gap is generally made very obvious by the variation and noise set up by such magnets, especially just before the armature is attracted or released. The author describes experiments that were made for the object of studying the difference between direct-current and alternating-current electromagnets. In the case of plain solenoids pulling on straight, laminated iron cores no measurable difference between the pull with direct current and the pull with alternating current of the same mean effective value could be detected with either short or long coils. In such cases a small change in the position of the iron core has very little effect on the pull—the effective air-gap, and consequently the flux, being hardly altered at all. When, however, magnets of the more usual type having a practically all-iron magnetic circuit and a comparatively small air-gap were tested a marked difference between the pulls on direct current and alternating current was obtained. Some typical results, as obtained on a small laminated horseshoe electromagnet, are given. For this particular magnet with an air-gap of 0.01 in. and a magnetizing current of 1 amp the ratio of direct-current pull to alternating-current pull is about 0.69 when lifting and 4.3 when dropping. With a 0.04-in. air-gap and 3 amp the ratio is 071, when lifting and 2.1 when dropping. With an air-gap of 0.187 in. and 8 amp the ratio is 0.88 when lifting and 1.35 when dropping. It will be seen that the difference between the alternating-current and direct-current pulls gets steadily less as the air-gap length increases owing to the diminishing percentage effect of a given fluctuation in air-gap length.—Lond. *Elec. Review,* March 17.

Wave-Meter.—R. Hirsch.—Wave-meters now in use are based upon the principle of resonance. In these the amount of capacity or self-induction of an oscillating circuit is varied until an indicator connected in the circuit shows a maximum current or voltage. As the wave-length for each reading of the measuring circuit is known, the wave-length of the primary circuit can be found by a determination of the resonance. The determination of the wave-length follows in every case from an adjustment of the position of the resonance. The direct-reading wave-meter described by the author, and shown in Fig. 8, depends on the same principle. C is an adjustable condenser, L a self-induction which can also be adjustable and A a gas tube as the voltage indicator, which is in parallel with the self-induction or capacity. One of these, the self-induction or the capacity, or a combination of both, is rotated quickly by means of clockwork or by a small electric motor so that it periodically passes through its range from the

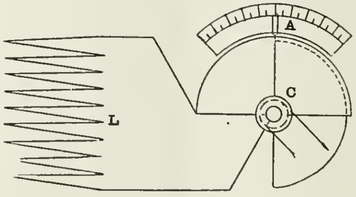


Fig. 8—Diagram of Wave-Meter.

smallest to the highest values, consequently the resonance position is passed during each revolution and the voltage indicator indicates this each time. As this always happens in the same position (that of resonance), it is continuously shown by a thin streak of light. If the gas tube be made to turn over a scale already calibrated in wave-lengths, the wave-length or frequency can be read off immediately. By a simple switching off of the condenser the wave-meter can be transformed into a so-called oscillation indicator, when it no longer indicates the constancy of the wave-lengths, but the strength of the oscillations and their clearness.—Lond. *Electrician*, March 17.

Errors in Measuring Instruments Due to High Voltages.—J. Zenneck.—If a commercial instrument for precision measurements is inserted directly in a high-voltage line, there are two errors due to the high voltage. The first is due to electrostatic influence, the second due to discharges in the damping device. While the errors due to the first source are comparatively small up to 6000 volts, the errors in the second case may become serious even at 4000 volts. The simple remedy for the second source of error is to provide a conducting connection between the stationary and the movable part of the damping device.—*Phys. Zeit.*, March 15.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—T. T. Baker.—An illustrated description of various arrangements for wireless telegraphy from aeroplanes. An earth connection being impossible, the use of balanced aerials is recommended. Several methods of connections are shown.—Lond. *Electrician*, March 17.

Book Review.

Principles of Electrical Engineering. By Harold Pender, Ph.D. New York: McGraw-Hill Book Company. 340 pages, 126 illus. Price, $4.

In the nine chapters of this book the fundamental principles of electrical phenomena that have a bearing upon engineering designs and undertakings are treated in a masterly manner. Beginning with fundamental ideas and units and passing through electricity, at rest and in motion, magnetic phenomena treated alone and then in connection with electricity, the author deals with continuous, variable and alternating currents, with the symbolic method of treating alternating-current phenomena and with three-phase circuit problems.

The language employed is essentially mathematical, in that practically all of the arguments and conclusions are based upon mathematical representations of the fundamental electromagnetic relations and the equations derived therefrom.

The book is one which can be used for reference only by those who are familiar with mathematics, and especially calculus. However, as a book intended for instructional purposes in engineering colleges where calculus is taught it should prove highly advantageous for two reasons, namely, the practical application of calculus to engineering problems and the convenient expression of electromagnetic relations in the language of calculus. Both those who have studied the average uninteresting textbook on calculus and those who have attempted to teach the average illogical textbook on electrical engineering in which calculus is used spasmodically will appreciate the value of a book written throughout in the language of calculus and arranged in such a logical order as to serve as text simultaneously on simplified calculus application to engineering problems and the expression of engineering principles in calculus in an understandable manner.

Not much of the book is devoted to alternating-current problems, so that in only a few cases are harmonic time functions employed. In view of the widespread use of convenient graphical methods for representing alternating-current relations it is to be regretted that the author has not discussed vector diagrams and their applications more fully. The treatment given is such that the student, even when thoroughly familiar with both calculus and electromagnetic phenomena, is apt to forget that the equations represent physical relations rather than mere mathematical quantities. That is to say, the student would be greatly inclined to confuse cause and effect when, as is here the case, the two are expressed in the form of equations with much too little explanation as to their physical significance. This criticism is not applicable to other portions of the book, which as a whole is exceptionally well arranged for instructional purposes in engineering colleges or for continuous reading by any one familiar with calculus who wishes to become better acquainted with electrical engineering problems and their solutions, or one familiar with electromagnetic relations who wishes to increase his knowledge of the application of calculus.

New Apparatus and Appliances

CLOCK NUMERALS ON MERCHANT'S ELECTRIC SIGN.

D. Sommers & Company, household furnishers, Indianapolis, Ind., have erected a large tungsten-lamp sign on the roof of their eight-story building, a feature of which is a series of electrically illuminated figures giving in hours and minutes the time of night. As this sign commands the principal street-car waiting place, it is useful to the public as well as a good publicity investment for the advertiser. The main sign is 80 ft. long and 22 ft. high, and contains 1250 5-watt, 10-volt tungsten lamps supplied through a sign-lighting transformer with energy from the lines of the Merchants' Heat & Light Company, of Indianapolis. The clock numeral-boxes at the right top corner of the panel are 7 ft. high and contain about 200, 110-volt carbon-filament lamps. The switching of the proper combination of lamps to form the numerals giving the hours and minutes is performed by an eight-day clock movement, which at one-minute intervals starts a small motor, each time advancing the switch mechanism one notch. The second-hand shaft of the clock at each revolution momentarily opens the circuit of a solenoid, the armature of which drops and closes the motor circuit. Through gearing and ratchets the motor drives three switch-arms, one over each of three face-plates with radial rows of contacts, corresponding to the three right-hand numerals. One starting of the motor advances the minute switch-arm one notch over its face-plate. When it has moved ten notches, the next or ten-minute arm is moved once ahead; when this has moved six steps, the hour-switch is advanced.

The clock mechanism to control this sign is the first of this kind to be built for the purpose. It is housed in a roof-cabin containing the electric-elevator machinery, and can be advanced or adjusted by hand control if necessary. The Sanborn Electric Company, Indianapolis, erected the sign, the clock feature of which was furnished by Betts & Betts, New York.

ELECTRICITY AT BOSTON IDEAL HOME EXHIBITION.

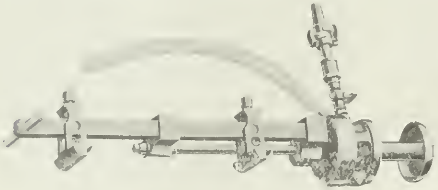
Various applications of electricity were effective in enhancing the attractiveness of the Boston Ideal Home Exhibition, held in Horticultural Hall during the early part of the present month. In the preparation of domestic exhibits portable tungsten lamps of 100-cp rating were employed, with the result that expert carpentry work was greatly facilitated and delays reduced to the minimum. The lighting of the main hall was effectively accomplished by about 150 tungsten lamps of 80-watt rating, spaced about 3 ft. apart on the under sides of the Gothic arches surmounting the room, with the addition of about eighty carbon incandescent lamps of the 16-cp rating installed beneath the roof monitor. Extensive uses were made of reflector lamps in connection with the lighting of signs at exhibits, and miniature lamps were employed in the interior lighting of model concrete houses poured on the Morrill system. Portable houses and hot-water heating equipment were also equipped with electric lighting, and in the case of the latter apparatus the operation of the inner mechanism was exhibited more clearly than would have been practicable with any other method. Other applications included the lighting of confectionery signs of colored glass and the concentrated illumination of an elaborate exhibit of photographs and drawings showing recent architectural progress in the City of Boston. The Boston Elevated Railway Company maintained a motor-driven exhibit of revolving photographs of historic points of interest in the company's territory. Other exhibitors included the Brackett, Shaw & Lunt Company, Boston, which displayed a directly connected pump for shallow wells driven by a 0.5-hp, 115-volt motor, the gears being run in oil and the pump operating through double connecting rods; the Electric Renovator Manufacturing Company, Pittsburgh, Pa., "Invincible" vacuum cleaners; the Pneuvac Company, Boston, electrically driven cleaners; 1900 Washer driven by motor; Minneapolis Heat Regulator, and the Santos vacuum cleaner.

COMMUTATOR-SLOTTING TOOL.

In any motor where there is a tendency toward sparking, due to defective design, hard usage or the presence of dirt, the destructive action of the spark causes the burning of the commutator segments at the trailing side. This reduces the level of the copper below that of the mica, which, on account of its refractory nature, remains almost unaffected and holds the brushes off the copper, thus aggravating the trouble. The destructive action once started proceeds rapidly, precluding good motor operation. Slotting out the mica to a depth of 1/32 in. or 1/16 in. below the surface of the copper makes possible proper contact of the brushes on the bars and, in addition, permits the use of soft brushes, leading to longer life of commutator. The slotting of commutators is now followed as a general practice by some of the large operating companies, particularly in railway work.

The Westinghouse Electric & Manufacturing Company, Pittsburgh, builds two types of slotting tools for this purpose. One type is pneumatically operated and the other electrically operated.

The slotting tool comprises a circular saw, with adjustable rests for centering the tool. Guides bearing on the commutator face are adjustable on the guide bar of the tool, making it applicable to a large range of commutator sizes. The guides also permit the depth of slotting to be accurately adjusted and maintained.



Commutator-Slotting Tool.

The pneumatically operated slotting tool is operated by an air turbine at a pressure of 40 lb. to 80 lb. per square inch. The air turbine forms part of the tool. The electrically operated slotting tool is satisfactorily operated by a 0.25-hp motor running at approximately 1700 r.p.m. A 5-ft. flexible shaft is provided for connecting the tool to the motor.

STEEL REFLECTORS FOR LARGE INCANDESCENT LAMPS.

When the tungsten lamp was first placed on the market it represented a small unit of high efficiency that by frequent spacing nearer the plane gave a more uniform illumination than was possible with larger units, such as arc lamps, placed at greater heights and further apart. The extended use of these incandescent units has developed their practicability under almost any condition of operation until now the larger units through their convenience and economy are replacing arc lamps hung at any height.

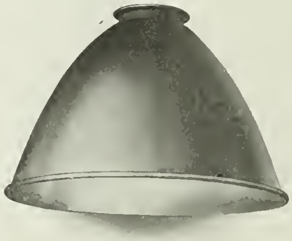


Fig. 1—Steel Reflector.

In many industrial plants it is advisable to use lighting units hung high above the plane to clear moving cranes or large machines, and in such places a 250-watt or 400-watt lamp under a reflector confining the lighting flux within a narrow angle is very suitable.

The accompanying illustration shows a steel reflector designed particularly for this service, together with photometric candle-power distribution curves relating to its use with 250-watt and 400-watt lamps.

The reflectors are at present built only with porcelain-enameled surfaces. While a matte-aluminum surface has a higher coefficient of reflection, the average industrial plants where such large units can be installed to advantage are too dirty to admit of the use of any reflecting surface that cannot be readily cleaned. The porcelain-enameled surface is impervious to moist and acid atmospheres, and as these reflectors are used with skeleton holders which insure thorough ventilation, the circulation of air around the lamps prevents an undue accumulation of dust on the surface of the lamp or reflector and prevents a shortening of the life of the lamp through overheating. This reflector has been placed on the market by the Wheeler Reflector Company, 156 Pearl Street, Boston, Mass.

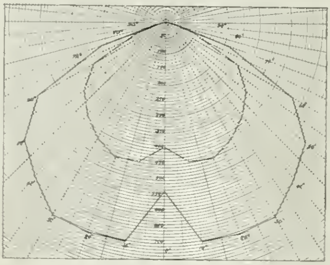


Fig. 2—Candle-Power Distribution.

ARC-WELDER GENERATOR.

The use of the electric arc welder for burning off risers on steel castings, patching large and small holes in castings and for other work of this kind is a branch of the electrical science which has not been extensively developed.

The great advantage of the arc process in work of this kind has made it practically the only method of accomplishing the results named in actual operation. However, since the arc itself takes from 30 volts to 35 volts and the e.m.f. usually employed in the steel foundries is at least 220 volts, there must be some kind of transforming apparatus to bring the e.m.f. down to a voltage which can actually be used. Heretofore a resistor was employed in series with the arc for this purpose and more recently motor-generator sets. Both methods of necessity entailed losses and in the first method about half of the energy was dissipated in heat.

The Lincoln Electric Company, Cleveland, has developed a machine which eliminates entirely the use of resistance to give the variable voltage at the arc which is absolutely essential to the best results. Its efficiency is very high, since only one machine is used, and its cost is low compared with that of a motor-generator set. This machine is fundamentally a variable-voltage machine, the voltage of which is controlled entirely by the inherent regulation of the machine itself, so that by varying the length of the arc the amount of current produced is automatically regulated by the machine itself. Thus, on open circuit with a 220-volt supply the e.m.f. at the arc is about 130 volts, while with a short-circuit and the same supply the e.m.f. at the arc is from 1 volt to 2 volts. The voltage under actual operation will vary with the length of the arc.

Generator for Arc Welding.

The entire weight of this outfit, including control board, is about 1500 lb., so that it may be carried around to different parts of the foundry on a truck with very little inconvenience.

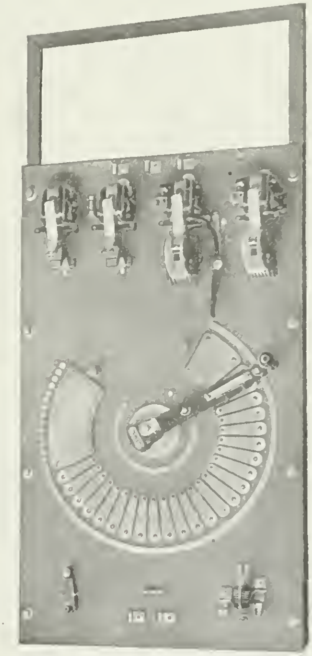
The efficiency that this machine will give under actual operating conditions is high on account of, first, the entire lack of resistance in series with the arc and the small amount of no-load losses in comparison with a two-machine equipment. This saving will amount to about 85 per cent in comparison with the use of large ohmic resistance and about 50 per cent in comparison with the motor-generator set.

ROTARY PRINTING-PRESS CONTROLLERS.

The type of controller shown herewith has been developed for use with rotary newspaper printing presses driven by single motors. These controllers give a low speed of 10 per cent of the normal speed by a combination or resistance in series with the armature and a resistance shunted across the armature.

The series armature resistance reduces the motor speed 50 per cent below normal and accelerates the press under load conditions. The armature-shunt resistance is controlled by a solenoid switch, which is energized from the motor armature voltage when the main controller lever is on one of the first four speed points. The low speed is adjusted by setting the main lever on one of these points and shifting a small link on the panel to adjust the amount of resistance shunted across the armature.

The line circuit to the motor is controlled by a solenoid switch provided with heavy copper and carbon arcing contacts and a powerful magnetic blowout. This switch is operated from any of the control switches and is so interlocked with the main controller lever that the motor circuit cannot be closed unless the proper amount of armature resistance is in circuit. This protects the motor and press from a failure of voltage and subsequent restoration thereof. A dynamic brake stops the motor quickly and smoothly whether actuated from the control switches, from the overload relay or when the main controller lever is moved to the "off" position. From any of the control switches the motor may be started, run at the low speed or stopped.



Controller for Rotary Newspaper Press.

When the rotary press is ready to print the motor can be accelerated to the printing speeds by the main lever of the controller. The press can be stopped by moving the controller lever to the "off" position, by the stopping switch on the controller panel or from any of the control switches. This controller has been placed on the market by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., and supplements the company's regular line of printing-press controllers.

Industrial and Commercial News

THE WEEK IN TRADE.

CONTINUED depression in commercial circles brought further disappointment to the business world last week. Reports from all lines of trade and industry were disappointing and the long-expected change for the better which the optimists have been predicting has been further deferred. Even the near approach of Easter has done little to stimulate retail trade and reports from the Western merchants are unsatisfactory. For this condition the unseasonable weather is held partly responsible. There has been little encouragement for the purchase of light clothing, and the season has now progressed so far that the carry-over of stocks of this kind promises to be unusually large. The one bright feature of the situation is the excellent outlook for magnificent crop returns. The rain and snow which have restricted retail business have at the same time vastly improved winter wheat and the crop condition generally. In the iron and steel industry there is very little new to be noted. Some growth in orders is reported, but is not of sufficient magnitude to call for any especial celebration. The railroads are very slow to place orders for either rails or equipment and there is little prospect that this policy will be changed until the revival of business brings about more encouraging financial reports. While there are fewer idle cars just at present than were reported two weeks ago, the number is more than double that of the same period a year ago. Structural material is in somewhat better demand, and wire products are still being purchased in large volume. Collections are distinctly slow and are not expected to improve to any material extent until retail business is better. Business failures for the week ended April 6, as reported by *Bradstreet's*, were 236, as compared with 260 the previous week, 240 for the same week in 1910, 227 in 1909, 258 in 1908 and 194 in 1907.

THE COPPER MARKET.

PRODUCTION of copper in March, as shown by the report of the Copper Producers' Association, broke all previous records since this association has been preparing statistics. This was particularly disappointing to those who are still optimists in the market, and was surprising to the entire trade. The large output is particularly striking when it is remembered that efforts have been made during the last six months to keep down production to a point somewhat nearer the actual consumption and to prevent the piling up of surplus stocks. The menace of this continued accumulation of metal that cannot be consumed by the melters is well understood. As long as the money market remains as easy and rates as low as at present it is not difficult for either the refiners or the speculators, who are well loaded up, to carry the burden. If these conditions change and interest rates advance to normal figures, demoralization is not unlikely. According to the figures of the March report, the surplus stock of copper held by the producers at the end of the month was 162,007,934 lb., an increase of 5,370,164 lb. during the month, and of about 40,000,000 lb. since the beginning of the year. The production for the month was 130,532,080 lb., an increase over February of 20,703,783 lb., and the addition to the surplus would have been much larger except for the unusually heavy takings during the month both for domestic and foreign delivery. These amounted to 125,161,916 lb., an increase over February of 29,531,899 lb. The large domestic deliveries were due to the eager buying of copper-wire manufacturers who, on account of keen competition and price shading, disposed of a tremendous amount of their product. The low price at which electrolytic was offered during the month also stimulated the purchases for export. In Europe there was only a fair buying, and this was mainly by small interests. The large manufacturers of both England and the Continent are reported to be heavily stocked. During the past week sales of copper were light and prices still showed a disposition to sag. The exports for the month, including April 10, have been 7 667 tons. The daily call on the Metal Exchange, April 10, quoted standard copper as per accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.70	11.85	.....
April	11.70	11.85	11.77½
May	11.70	11.85	11.77½
June	11.70	11.85	11.77½
July	11.70	11.85	11.77½

The London market, April 10, was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	54	1	3	54	0	0
Standard copper, futures	54	12	6	54	11	3

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.30c	11.77½c
London, spot	£56 15 0	£53 15 0
London, futures	57 12 6	54 10 0
Best selected	60 5 0	57 15 0

INDUSTRIAL AND COMMERCIAL NOTES.

Westinghouse Sales of Traction Equipment.—The Westinghouse Electric & Manufacturing Company has recently made quite a number of important sales of traction equipment, among which are the following: To the Toledo, Bowling Green & Southern Railway, of Findlay, Ohio, four quadruple equipments of interpole railway motors with latest type hand-operated unit-switch control; to the Georgia Railway & Electric Company, Atlanta, Ga., six additional double equipments of motors with control equipments; to the Johnstown (Pa.) Passenger Railway Company, five double equipments of motors with control; to the Fairmount (W. Va.) & Clarksburg Railway Company, four additional quadruple equipments of interpole motors with hand-operated unit-switch control; to the City Railways Company, of Dayton, Ohio, ten double equipments of interpole motors with control; to the Nashville Railway & Light Company, four double equipments of interpole motors and control; to the Cincinnati Traction Company, nine quadruple equipments of interpole railway motors and hand-operated unit-switch control, and to the British Columbia Electric Railroad, two forty-five-ton locomotives with quadruple equipments of interpole railway motors and automatic unit-switch control.

China's New Telephone System.—The two telephone exchanges which the Western Electric Company has been installing in the city of Peking, China, were cut into service on April 2. These exchanges are of the common battery type and are equipped for 6400 lines apiece. At present 3000 subscribers' lines are connected to this telephone system, which is owned and operated by the imperial government. The need for a telephone system in China became so apparent a couple of years ago that an imperial commission was sent abroad to study the telephone systems of other countries. The commissioners were impressed with the service in New York City and recommended an equipment along similar lines for the Chinese capital. The contract was awarded to the Western Electric Company, and the cost of the original equipment is in the neighborhood of $150,000. Underground cable, 3.5 in. in diameter and containing 400 paper-insulated wires, has been used. The telephone system will employ about thirty operators, all of whom will be Chinese girls. English-speaking operators will be employed on the switchboard section installed for use of foreign residents.

Electric Storage Battery Company.—The Minneapolis General Electric Company has recently contracted for a large emergency storage battery to be installed on its system by the Electric Storage Battery Company. It will consist of 150 "exide" cells and will have an output of 10,500 amp at the twenty-minute rate of discharge. This will be the third battery installed by the Electric Storage Battery Company for the Minneapolis General Electric Company. The same company has also contracted with the Consolidated Gas, Electric Light & Power Company, of Baltimore, for an emergency battery which, it is said, will be the largest storage battery in the world. With plates and electrolyte, it will weigh 1,079,200 lb. and is to be capable of lighting 240,000 20-cp tungstens for twenty minutes.

Philadelphia Electric Company Residence Lighting.—The March bulletin of the Philadelphia Electric Company states that the number of Philadelphia dwellings in which electricity is used increased 2000 in 1910, and that electricity will be supplied in 2000 which are now being erected.

Twenty-fifth Anniversary of Carbon Business.—Hugo Reisinger celebrated on April 1 the twenty-fifth anniversary of the establishment of his business as importer of carbons and other electrical supplies. The employees of the firm presented Mr. Reisinger with an artistic address bound in leather and silver, with the signatures of the entire staff attached. Mr. Reisinger was the pioneer in the importation of carbon arc-lamp electrodes to this country, and was the first to cause to be manufactured at the works of C. Conradty, Nürnberg, inclosed-arc and flaming-arc electrodes. Mr. Reisinger took a prominent part two years ago in the fight for a lower tariff on arc-lamp electrodes, and it was largely through his personal effort that the rate of $1 per hundred feet at first proposed in the new tariff bill was reduced to 65 cents. Mr. Reisinger suggested that 20 cents per hundred feet would be about fair, but it was impossible to push this reduction through. Outside of business Mr. Reisinger has devoted a great deal of time to art matters, and has promoted the exchange of works of art between America and Germany. He was honorary commissioner general for Europe to the World's Fair at St. Louis in 1904, has twice been decorated by the German Emperor and once by the Prince Regent of Bavaria. He is an active member of the New York Chamber of Commerce and a director in many important companies.

Crude Rubber Still Unsettled.—The crude rubber market still remains in an unsettled and excitable condition, although trading is very dull and prices seem to be on the decline. Manufacturers, especially the insulated-wire makers, are buying for only pressing and immediate needs. No stocks are being carried and contracts are based on the price of rubber at the time of signing. It is the general opinion among American rubber consumers that the market is in the hands of the speculators and is being manipulated without any regard to the laws of supply and demand. As one insulated-wire manufacturer put it: "The reason for the sudden decline in rubber during the latter half of March and the present comparatively low price is that the London speculators who represent the Brazilian rubber syndicate depressed prices in order to take in the surplus stocks cheaply and also to be able to buy the Ceylons offered at auction in March at bargain rates. This syndicate practically controls the Para output and as soon as it can gather in the loose rubber in Europe I expect prices to be advanced." Just at present business in insulated wire is very dull, and little rubber is being bought, but the manufacturers are hopeful that the new Underwriters' specifications will increase orders.

Telephone Apparatus for Seaboard Air Line.—The Seaboard Air Line Railway is placing orders with the Western Electric Company for telephone train-dispatching equipment covering more than 600 miles, with two complete circuits. This installation is being made as a direct result of the increased economy of the telephone over the telegraph as experienced by over a year and a half of service on divisions extending from Richmond to Raleigh, with a branch to Portsmouth, Va., and from Raleigh to Monroe, N. C. The first new division being equipped centers at Hamlet, N. C., and extends in one direction to Wilmington, a distance of 111 miles; south to Columbia, 106 miles, and west to Rutherfordton, 157 miles, making a total of 374 miles, equipped with thirty-six stations. The second division extends from Jacksonville, Fla., to Tampa, with branches to Orlando and Venice, 265 miles in all, on which will be installed thirty-eight way station equipments. This equipment is of the latest type manufactured by the Western Electric Company, which installed the present equipment on the Seaboard Air Line, and which has supplied over 90 per cent of the telephone equipment for the 37,000 miles of road which are so covered in the United States.

Lehigh Coal Company's Electrical Project.—Formal application has been made to the Governor of Pennsylvania for charters for about sixty electrical companies in that State by interests identified with the Lehigh Coal & Navigation Company. This is the first step toward carrying out the vast electrical project planned by that company, which was described in detail in the *Electrical World* of March 16. The company proposes to build large steam generating stations adjacent to its coal mines and manufacture energy by the use of dust and screenings that are now wasted. This energy will be distributed through many counties and towns in that section of the State, but under the law it is necessary that a separate local distributing company be organized for each township. When the present plans are fully carried out there will be more than 130 miles of high-tension transmission lines.

Sheridan (Wyo.) Power Plant.—Sanderson & Porter have completed a plant on the Tongue River, about ten miles from Sheridan, Wyo., for the Sheridan Electric Company. A 2000-kw Westinghouse turbo-alternator has been installed together with Le Blanc condensers and Heine boilers. Bituminous lignite is used. The plant will supply lamp and motor service for Sheridan and for various coal mines in the locality. Energy is generated at 2300 volts, transmitted at 22,000 volts and delivered at 2300 volts in substations in Sheridan. The old plant of the Sheridan Electric Light & Power Company, which is succeeded by the Sheridan Electric Company, will be used as a substation. The company is controlled by the Federal Light & Traction Company.

Western Electric Sales.—Sales of Western Electric in March were 10 per cent larger than for the same month a year ago. For the first quarter of its fiscal year to April 1 the company has done 11 per cent more business than in the same period a year ago. For the full twelve months this would mean total sales of $70,000,000 contrasted with $68,375,000 for the thirteen months to Dec. 31 last, or at the rate of $61,000,000 for a twelve months' year. This would mean an increase of about 15 per cent for the year. There has been some letting up in orders in the East, but sales in the Middle and far Western States continue excellent. Western Electric is now employing 25,000 persons, compared with 23,464 on Jan. 1 and 17,835 on Dec. 1, 1909. The present number is within 4000 of the largest payroll the company ever had.

Service on New York Streets Improving.—The monthly reports of defects in the car equipment of the Greater New York surface railways, made to the Public Service Commission, show that conditions are gradually improving and that the number of cars incapacitated is becoming smaller. The report for February shows that the percentage of cars withdrawn on the Brooklyn Rapid Transit was much smaller—in fact, only about half as large—as the smallest percentage shown for Manhattan. This is explained by the engineers of the commission as being due to operation by trolley as compared with underground conduit operation. Fully half of the causes for withdrawal in Manhattan were attributable to the underground connections.

Western Electric Company Transfers Insurance.—The Western Electric Company has transferred $30,000,000 insurance from the mutual companies to stock companies. The greater portion of this covers the company's Clinton Street and Hawthorn works in Chicago. All the insurance for the allied Bell interests, for which the Western Electric makes the telephones, is placed with stock companies. An official of the Western Electric Company made the following statement in connection with the above: "We decided to place our insurance with the Old Line Stock Companies for purely business reasons, the Manufacturers' Mutual Fire Insurance Company having always given us uniform satisfaction."

Detroit United Railways.—Although no settlement has been made in the franchise dispute, officials of the Detroit United Railways have made an agreement with the city officials which will enable the company to add about eight miles of track to the system for the purpose of relieving congestion in parts of the city. Construction cannot be started, however, until this has been ratified by the Municipal Council. The work will be done at the expense of the company, and should the franchise litigation result in municipal ownership the city can take over the extensions at cost, less depreciation.

Moloney Electric Company.—The new factory at Windsor, Ont., of the Moloney Electric Company, of St. Louis, is almost completed and will be in operation within a short time. The company purchased a two-acre plot in Windsor and has constructed a modern plant, which will have 30,000 sq. ft. of floor area. The St. Louis factory has a floor area of 35,000 sq. ft. and has been operated lately at almost full output. The Canadian business of the company has increased so rapidly that the Canadian plant was deemed a necessity.

Citizens' Electric Company (Ark.) Sold.—A company represented by F. F. Ackerman, of Chicago, has purchased the interests of the Citizens' Electric Company, of Eureka Springs, Ark. The company is consolidated with the Eureka Springs Electric Light & Railway Company, and operates a light and power station, street railway, refrigerating plant, the Auditorium Park and Opera House, all of which are included in the sale.

Financial.

The Week in Wall Street.

No marked change in the dullness of Wall Street trading can be reported for the past week. Such transactions as have been made have barely sufficed to keep the market in motion. At best, these have been manipulation, pure and simple, and cannot be regarded in any light as other than professional movements. For the week only 966,921 shares were sold. The significance of this is seen when it is realized that the week's total sales show only 50 shares more than the sales for the day Feb. 24, the date of the rate decision. Public utilities continue to show a firm tone in spite of depressing conditions. There seems to be a fair demand for investment securities of high grade and for bonds of responsible interests. The postponement of the Standard Oil and American Tobacco decisions is apparently causing less agitation than evidenced a week ago, for Wall Street is inclined to believe that additional influences are affecting the market. The decisions in the price agreement and commodities clause cases are regarded in many quarters as indicative of the rulings to follow in the Sherman law cases. The present stagnation recalls the conditions surrounding the Northern Securities case, but an encouraging note is felt in the comparison of dividends paid in the respective periods. While the average return on a number of stocks showed but 5 per cent during the dullness of 1904, the same securities are now yielding some 5⅛ per cent, and the present earnings are reported as 8¼ per cent, against 6½ per cent in 1904. Considerable interest is taken in the decrease in idle car surplus, which is the first decrease reported since October. Money continues abundant and cheap, which is felt by many to indicate confidence in the future, since an easy money market usually stimulates speculation and general trade. Stocks are held in the majority of cases by large interests and will probably be retained by them until the market becomes more active. Export and crop conditions are fully as encouraging as reported a week ago. Rates for money April 10 were: Call, 2 @ 2⅜ per cent; ninety days, 2¾ @ 3 per cent. The quotations in the table are those for the close, April 10.

NEW YORK.

	April 3.	April 10.	Shares Sold.		April 3.	April 10.	Shares Sold.
All. Ch......	8*	8*	100	Int. Met., pf.	53	54*	6,400
All. Ch., pf..	30¼	30¼*	200	Mackay Cos..	93½	93½*	150
Amal. Cop..	62⅞	62⅜	9,300	Mackay C. pf.	77*	77*	300
Am. D. T...	20½*	20½*	—	Man. Elev...	136½	137	235
Am. Loco....	37¼	37½	400	Met. St. Ry.	15*	15*	—
Am. Loco. pf.	108	104½	123	N.Y.&N.J.Tel.	139½*	139½*	—
Am. Tel. & C.	81*	83*	133	Steel, com...	78	77¼	150,300
Am. T. & T..	144⅞	145¾	7,340	Steel, pfd....	119	119	2,770
B. R. T....	77¾	77⅞	5,550	W. U. T.....	73½*	73	4,200
Gen. Elec...	148	151½	2,900	West'h, com..	66½*	67	600
Int. Met.....	18⅝	19	2,100	West'h, pfd..	120¼	121	310

PHILADELPHIA.

	April 3.	April 10.		April 3.	April 10.
Am. Rys...........	43⅞	44*	Phila. Elec.........	16¼	16¼
Elec. Co. of A......	12	11⅞	Phila. R. T.........	19½	18⅞
Elec. St. B'ty......	53½	53	Phila. Trac.........	84	84*
Elec. St. B'ty., pfd..	30*	30*	Union Trac.........	46⅞	46

CHICAGO.

	April 3.	April 10.		April 3.	April 10.
Chi. City Ry.......	185*	186*	Chi. Tel. Co.........	121*	120
Chi. Rs., Ser. 1.....	90*	85*	Met. El. Co........	22⅞*	22⅛*
Chi. Rs., Ser. 2....	24	23½*	Met. El., pfd.......	69½*	68
Com. Edison........	128¼	128	Nat'l Car..........	119*	115½
Chi. Suhways.......	4⅜	4¾	Nat'l Car, pfd......	119*	120*

BOSTON.

	April 3.	April 10.		April 3.	April 10.
Am. T. & T.........	144¾	146	Mex. Tel..........	3⅝*	3½
Cum. Tel...........	147*	150*	Mex. Tel., pfd......	6½*	6½*
Edison E., Ill.......	282	284	N. E. Tel..........	144½*	141*
Gen. Elec..........	148¾	152	W. T. & T.........	20	19½
Mass. E. Ry........	17½*	17⅛	W. T. & T., pfd....	93½	94
Mass. E. Ry., pfd..	87¾*	88			

*Last price quoted.
Shares sold for week, April 3 to April 8.

Financial Notes.

American Cities Railway & Light Company.—The annual report of the American Cities Railway & Light Company, which operates a number of important properties in Southern cities, shows an increase of $341,352 in the net earnings of the local companies for the year ended Dec. 31, 1910, over the net earnings of the previous year. An increase of $277,560 is noted in the balance for dividends, and there is an increase of $79,516 in the net surplus. The net earnings of the American Cities Railway & Light Company, together with the company's share of the undivided surplus earnings of the local companies, make a total of $1,255,098, as compared with $1,014,178 for 1909. The preferred dividend was 6 per cent. The surplus over preferred dividends is $841,632, which represents 7.82 per cent on the outstanding common stock, against 5.58 per cent in 1909 and 3.38 per cent in 1908. The local companies spent about $1,400,000 during the year on equipment and improvements, about $900,000 of which was provided by the sale of bonds and about $500,000 from surplus earnings. President J. K. Newman said: "The company has had no occasion to borrow either to finance its own requirements or to assist the local companies. The latter have been able to sell bonds for a considerable part of their construction requirements and to care for the balance thereof out of their undivided surplus earnings, except in the case of the Houston Company, where $500,000 new common stock has been sold for cash during the last two years, all of such new stock being purchased by the American Cities Railway & Light Company."

Kings County Electric Light & Power Company Bonds.—The Public Service Commission has authorized the Kings County Electric Light & Power Company to issue $1,500,000 6 per cent debenture bonds. These are the second allowance made on the original request for permission to issue $5,000,000 bonds, the first issue being $2,500,000, as mentioned in these columns March 10, 1910. The new bonds are convertible at par into stock of the company at the option of the holders after three years, and are payable twelve years from date. A condition is made that the bonds must be sold for not less than par and accrued interest. Ths bonds must be offered first to the stockholders, and then to the Brooklyn Edison Investment Fund, which is a pension and profit-sharing plan of the Edison Electric Illuminating Company of Brooklyn. In case the stockholders and the trustees of the fund do not take the entire issue, the balance is to be sold to the highest bidder, in presence of the Public Service Commission. The bonds are to be used to purchase $1,500,000 of non-interest-bearing notes of the Edison Electric Illuminating Company, and the proceeds will be used to pay for improvements and extensions and such advances as the Kings County company has financed for the Brooklyn company.

East Liverpool Traction & Light Company Merger.—In connection with the increase in capital stock of the East Liverpool (Ohio) Traction & Light Company from $10,000 to $1,300,000 and the expected increase in that of the Tri-State Traction Company, of Steubenville, Ohio, it is reported that the former contemplates the erection of a large power station near the Ohio-Pennsylvania State line or at the mouth of Yellow Creek and the Ohio River, and that plans are being formed to bring all traction and lighting interests in the upper Ohio and Beaver valleys under one control. This would include franchises in Beaver Falls, New Brighton, Rochester, Beaver and Ambridge. The East Liverpool Company is a consolidation of the United Power Company, East Liverpool & Rock Springs Railway Company and the Wellsville Electric Light Company, while the Tri-State Traction owns and operates the traction line connecting Steubenville, Ohio, with Follansbee and Wellsburg, W. Va.

Tacoma Municipal Plant.—Brown Brothers & Company, of New York, are offering $650,000 of the 5 per cent gold bonds of the City of Tacoma (Wash.) electric supply fund at 100 and interest. The bonds are issued under the ordinances of the City Council, providing that 40 per cent of the gross earnings of the electric supply system belonging to the city shall be turned into the fund to pay the interest and maturing instalments of the principal. The city charter prohibits the city forever from granting to any person or corporation a franchise to supply energy for light in Tacoma as long as the city owns a plant and is engaged in supplying energy for light. At present the city owns a distribution system 1425 miles in length and is constructing a 32,000-hp hydroelectric plant thirty miles away upon the Nisqually River.

Fort Smith Light & Traction Company.—Announcement is made that the Fort Smith Light & Traction Company, of Fort Smith, Ark., of which Arthur S. Huey is president, has called for payment on May 1 on all of its outstanding consolidated-mortgage 5 per cent gold bonds dated Dec. 15, 1904. The company will redeem these bonds in gold coin, with an addition of 2 per cent premium, at the Chicago office of the Central Trust Company of Illinois on the date mentioned. Thereafter interest on these bonds will cease.

Cuyahoga Telephone Company Notes.—On May 1 the Cuyahoga Telephone Company will buy in $118,800 of its 6 per cent collateral trust notes. These will be paid for in cash by the Cleveland Trust Company.

Public Service Corporation of New Jersey Report.—The annual report of the Public Service Corporation of New Jersey for the year ended Dec. 31, 1910, shows a gross income of $29,205,194 and $14,611,300 in operating expenses and taxes, leaving net earnings of $14,593,894. After deducting fixed charges and bond interest and rentals of leased and controlled companies the net income was $2,200,295. From this $130,000 was set aside as reserve, showing for the year a surplus of $2,070,295. Out of this surplus dividends at the rate of 5 per cent per annum, aggregating $1,250,000, were paid during the year upon the capital stock of the corporation, amounting to $25,000,000 at par. Various improvements and acquisitions have been made during the year, notice of which has appeared in these columns from time to time.

Long Acre Hearing Closed.—The taking of testimony by the Public Service Commission on the application of the Long Acre Electric Light & Power Company for permission to issue $10,000,000 stock and $50,000,000 bonds was concluded April 10. The last witness heard was John W. Lieb, Jr., third vice-president and associate general manager of the New York Edison Company, which has opposed the application. Mr. Lieb put in a written statement in which he declared that his company had "ample capacity, ample reserve and ample margin" for all emergencies and that it would be a bad thing for the public if competition were established.

Kentucky Securities Company.—The stocks and bonds pledged by the Lexington (Ky.) & Interurban Railways Company as collateral for $1,509,000 5 per cent bonds, which were defaulted Feb. 1, were sold in Philadelphia last week to the Kentucky Securities Company for $600,000. The purchaser is a holding concern incorporated last January under the laws of Virginia with an authorized capital stock of $5,000,000. The securities sold represent control of the gas, electric light and ice business of Lexington and surrounding towns. The Lexington & Interurban Railways Company has voted to dissolve.

Berkshire Street Railway Merger.—Plans are being made for the purchase of the Springfield (Mass.) Street Railway Company's system by the Berkshire Street Railway Company, and a bill will shortly go before the Massachusetts Legislature to effect this, stating that the merger shall become operative upon completion of the trolley connection between the Springfield and Berkshire systems. The new company would be known as the Springfield & Berkshire Street Railway Company. The Berkshire company is owned by the New York, New Haven & Hartford Railroad.

Interborough Rapid Transit Notes.—Announcement is made by the Interborough Rapid Transit Company that the $4,584,000 6 per cent notes of the company maturing on May 1, 1911, will be taken up at that time. Information is not given as to the means of raising the money to refund the notes. It may be obtained by the sale of about $5,000,000 of the authorized $55,000,000 5 per cent first mortgage bonds, $20,000,000 of which are now held in the company's treasury. The sale of these bonds would leave $15,000,000 issuable under the $55,000,000 mortgage of 1907.

Telephone Merger Enjoined.—The Federal Telephone Company, of Buffalo, last week secured a temporary injunction restraining the Rochester Telephone Company from selling its stock and property to the Bell interests, represented by the Friendship Telephone Company. The Federal company owns about 35 per cent of the stock of the Rochester company. This injunction will prevent, temporarily at least, the merging of the independent telephone interests with the Bell companies according to the plans heretofore outlined in the *Electrical World*.

Syracuse Lighting Company.—An application has been made to the Public Service Commission of the Second District of New York by the Syracuse Lighting Company asking for authority to issue $470,000 6 per cent bonds, the proceeds to be used for extensions and improvements. If the application is granted almost the entire proceeds will be used for laying new trunk mains and for extensions to the distributing system.

Value of Metropolitan System.—Hearings were reopened last week by the Public Service Commission upon the reorganization plan proposed by the bondholders' committee of the Metropolitan Street Railway Company. These hearings were adjourned several months ago in order that definite figures covering the valuation of the property might be prepared. At last week's hearing the attorney for the reorganization committee presented the report of Charles F. Uebelocker, acting chief engineer of the system, which placed the total reproduction value of the property at $120,562,885. This represented the sum of four items: Reproduction of construction and equipment, $84,108,586; development cost, $18,097,654; net investment in superseded assets, $13,355,645; reorganization assets, approximately $5,000,000. These figures, it was stated, were based on the best evidence obtainable as to what it would cost to-day to purchase the materials and do the work. Frank R. Ford, of Ford, Bacon & Davis, testified that the figures, $18,000,000, for development cost represented 25 per cent of the cost of construction and equipment, which basis, he said, was fully justified by his experience in the examination and appraisal of large street railway properties.

Salisbury & Spencer Railway Company.—Controlling interest in the street railway, electric supply and gas companies of Salisbury, Spencer and Concord, N. C., has been purchased by William J. Oliver, of Knoxville, Tenn. The price was about $1,000,000. This includes the Salisbury & Spencer Railway Company at Salisbury, N. C., which operates an interurban line between Salisbury and Concord, and a line connecting Salisbury and Spencer, where the Southern Railway has several large shops. Energy is purchased from the Southern Power Company. In addition to its traction interests the Salisbury company furnishes gas and electric lighting and controls the Piedmont-Carolina Railway. Extensive improvements will be made by the purchasers.

DIVIDENDS.

American Light & Traction Company, quarterly, preferred, 1½ per cent; common, 2½ per cent in cash and 2½ per cent in common stock; all payable May 1.

Butte Electric & Power Company, quarterly, preferred, 1¼ per cent, payable May 1.

Mexican Lighting & Power Company, quarterly, 1 per cent, payable April 15.

Public Service Investment Company, of Boston, quarterly, preferred, $1.50 per share, payable May 1.

Rio de Janeiro Tramways, Light, Heat & Power Company, quarterly, 1¼ per cent, payable May 1.

United States Rubber Company, quarterly, first preferred, 2 per cent; second preferred, 1½ per cent, payable April 29.

J. G. White & Company, quarterly, preferred, 1½ per cent, payable May 1.

REPORTS OF EARNINGS.

Period.		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
AMERICAN DISTRICT TELEGRAPH COMPANY.						
Year,	1910	$3,894,578	$3,090,832	$803,746	......	......
"	1909	3,638,928	2,756,779	882,149	......	......
BLACKSTONE VALLEY GAS & ELECTRIC COMPANY.						
Feb.,	1911	$98,904	$47,646	$51,258	$30,293	$20,965
"	1910	90,658	41,002	49,656	29,559	20,097
CENTRAL UNION TELEPHONE COMPANY.						
Year,	1910	$5,597,240	$4,112,416	$1,484,824	$1,482,947	$1,877
"	1909	4,999,424	3,636,062	1,363,362	1,363,272	90
COLUMBUS ELECTRIC COMPANY.						
Feb.,	1911	$37,029	$ 7,247	$19,782	$9,349	$10,433
"	1910	30,840	16,423	14,417	13,114	1,303
DALLAS ELECTRIC CORPORATION.						
Feb.,	1911	$119,965	$76,793	$43,172	$27,064	$16,108
"	1910	105,200	71,960	33,240	26,422	6,818
EL PASO ELECTRIC COMPANY.						
Feb.,	1911	$54,850	$31,050	$23,800	$8,341	$15,459
"	1910	53,839	27,753	26,086	8,486	17,600
GALVESTON-HOUSTON ELECTRIC COMPANY.						
Feb.,	1911	$99,928	$65,931	$33,997	$24,621	$9,376
"	1910	89,899	61,977	27,022	23,170	4,743
HOUSTON COUNTY ELECTRIC LIGHT COMPANY.						
Feb.,	1911	$26,752	$10,858	$15,894	$5,499	$10,395
"	1910	24,054	10,826	13,128	[illegible]	9,028
JACKSONVILLE ELECTRIC COMPANY.						
Feb.,	1911	$46,073	$27,025	$19,048	$10,161	[illegible]
"	1910	43,690	22,802	20,888	9,132	11,756
LOWELL ELECTRIC LIGHT CORPORATION						
Feb.,	1911	$42,207	$23,601	$18,606	$4,898	$13,708
"	1910	36,145	18,817	17,328	[illegible]	[illegible]
MEXICAN TELEPHONE & TELEGRAPH COMPANY						
Feb.,	1911	$50,520	$25,008	$25,521	......	....
"	1910	44,248	19,050	$25,180	..	
NORTHERN TEXAS ELECTRIC COMPANY						
Feb.,	1911	$100,088	$59,820	$40,268	[illegible]	[illegible]
"	1910	93,082	52,315	40,767	[illegible]	[illegible]
PUGET SOUND ELECTRIC RAILWAY						
Feb.,	1911	$132,135	$102,749	$29,386	[illegible]	*[illegible]
"	1910	131,219	96,882	34,337	[illegible]	*[illegible]
SAVANNAH ELECTRIC COMPANY						
Feb.,	1911	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
"	1910	45,130	27,365	17,765	[illegible]	[illegible]
SEATTLE ELECTRIC COMPANY						
Feb.,	1911	$428,557	$246,176	$182,381	[illegible]	[illegible]
"	1910	431,074	[illegible]	[illegible]	[illegible]	[illegible]
TAMPA ELECTRIC COMPANY.						
Feb.,	1911	$57,335	$28,331	$29,004	[illegible]	[illegible]
"	1910	56,284	27,256	29,028	4,566	24,462

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*Deficit.

General News

Construction News.

BIRMINGHAM, ALA.—Arrangements are being made by the Birmingham & Shades Mountain Electric Railway Company for the construction of an electric railway from Birmingham to Shades Mountain, a distance of four miles. The railway will be built by the High Point Land Company, of which Eugene Fies, of Birmingham, Ala., is president.

GLOBE, ARIZ.—Plans are being considered by the Old Dominion Copper Company for the installation of an extensive electric underground railway system for the purpose of hauling ore from different points in its mine to the surface.

WILCOX, ARIZ.—The construction of a central power plant and transmission system for operating irrigating pumps in the Sulphur Spring Valley is reported to be under consideration. A. I. McAllister, H. A. Morgan, L. V. McCourt, S. N. Kemp and J. W. Angle are interested in the project.

BAKERSFIELD, CAL.—Arrangements are being made by the Lerdo Land Company for the colonization of a large tract of land in Kern County. It is proposed to sink wells and install pumping plants before the land is sold. The transmission lines of the San Joaquin Light & Power Company will be extended through the tract to supply electricity for operating the pumps for irrigation purposes.

BISHOP, CAL.—Preparations are being made by the Owens River Electric Railway Company for the construction of its proposed electric railway to connect Bishop and Laws, four and one-half miles in length, which will be extended to Round Valley, a distance of twelve miles, in the near future. Electricity for operating the railway will be purchased. Harry Shaw, of Bishop, Cal., is president.

EUREKA, CAL.—The Western States Gas & Electric Company, which recently took over the property of the Humboldt Gas & Electric Company, has purchased the plant and holdings of the Arcata Light & Power Company, consisting of a distributing system, pole lines and transformer station. The former company already supplies the Arcata company with energy to operate its system. It is understood that the Western States Gas & Electric Company proposes to secure control of all small electric systems in Humboldt County and is now negotiating for the plants of the Fortuna Lighting Company, of Fortuna, and the Ferndale Light & Power Company, of Ferndale.

FRESNO, CAL.—Notices have been posted by the San Joaquin Light & Power Company that work will begin on the development of its water appropriations within sixty days. Four separate appropriations have been filed aggregating 160,000 in., part of which are below the site of the present power house. The transmission line extending from Crane Valley through Copper Mine and Cornolia to Bakersfield will be completed this summer. The proposed line will carry 60,000 volts. The branch line extending from Linnard to Le Grand into Merced County will be completed in about thirty days.

GRASS VALLEY, CAL.—It is reported that a movement is on foot for the installation of another large water system for Nevada and Placer Counties. According to documents recently filed, James D. Stewart, of Gold Run, Cal., has leased from the United Water & Power Company certain water and mining claims for a period of twenty years, and has also secured an option on 240,000 shares of the company's stock at $75,000. Mr. Stewart has also filed notice of appropriation on five water rights aggregating a total of 355,000 in. of water. It is understood that the property will be developed with a view of building another large water system to provide water for irrigating and other purposes. Besides this, mining claims will be developed and electricity generated at many of the power sites controlled by Mr. Stewart.

LODI, CAL.—Arrangements are being made by the Western States Gas & Electric Company for extending its electric light service to all suburbs of Lodi. The company is also extending a transmission line to the Barnhart tract and will furnish electricity to the Western Normal Institute, which has a generating plant of its own.

LOS ANGELES, CAL.—The Board of Supervisors of Los Angeles County has awarded a franchise to the Eagle Rock Water Company, at its bid of $100, to erect transmission lines for the installation of an ornamental street-lighting system and for commercial lighting.

MACDOEL, CAL.—The California Butte Land Valley Company has entered into a contract with the Siskiyou Electric Power & Light Company to supply electricity for lighting the town of Macdoel, including 8000 hp to be used for operating pumps for irrigation purposes. The service to be ready by July 1.

OAKLAND, CAL.—The Antioch & Oakland Railway Company, which is building an electric railway from Antioch to Oakland, thirty miles in length, has been taken over by the Oakland, Antioch & Eastern Railway Company, recently incorporated with a capital stock of $10,000,000. The railway from Antioch to Oakland is nearly completed and will now be extended to Stockton, which will add another fifty miles to the proposed railway. The directors of the new company are: A. W. Maltby, of Concord; S. L. Naphthaly, Laurence Arnstein, John R. Selby and A. J. Krutmeyer, of San Francisco, Cal.

OROVILLE, CAL.—Harold R. Ebright, of San Francisco, Cal., has deeded to the Oro Water, Light & Power Company water rights aggregating 60,000 in. of water in four creeks flowing into the north fork of the Feather River. The water will be carried in ditches to the site of the proposed power plant near the mouth of Yellow Creek, where it is estimated that about 60,000 hp can be developed. The power house will be located on the opposite bank of the Feather River, about fifty-five miles from Oroville. The company already operates three plants within fifteen miles of Oroville.

QUINCY, CAL.—Notice of appropriation has been filed by W. S. Cone, of San Francisco, Cal., with the County Recorder for 150,000 in. of water of the north fork of the Feather River, to be diverted at a point near Belden Bar, in Plumas County, to be carried to the power house, a distance of about ten miles, by canals and flumes. The water will be used for irrigation, power and domestic purposes in Butte, Yuba, Sutter and other counties. Mr. Cone also recently filed a notice of location of 150,000 in. of water in the north fork to be diverted at or near Big Bar, Butte County.

SACRAMENTO, CAL.—Plans are being prepared by the Pacific Gas & Electric Company for the construction of a steam power auxiliary plant for its Sacramento system. It is understood that the plant will be located on the north side of the city not far from the Southern Pacific Company's railroad shops.

SAN FRANCISCO, CAL.—Options have been obtained on property which it is proposed to use for the site of the power plant for the Geary Street municipal railway.

SEBASTOPOL, CAL.—The plant and holdings of the Sebastopol Light & Power Company have been purchased by the Pacific Gas & Electric Company, of San Francisco, Cal. The Sebastopol company has been purchasing electricity for operating its system from the Pacific Gas & Electric Company. The system was taken over April 1 and will become part of the Santa Rosa division.

SUSANVILLE, CAL.—The Lassen Electric Company has applied to the Board of Trustees for a fifty-year franchise to erect transmission lines for the distribution of electricity for lamps and motors. Bids will be received by the board for the above franchise until April 28. R. E. Baugham is clerk.

WATSONVILLE, CAL.—It is reported that the property of the Watsonville Transportation Company, consisting of power plant, rolling stock, a four-mile track from Watsonville to Monterey Bay, franchise and real estate, has been sold by Edward White, receiver, to J. W. Forgeus, of San Francisco, Cal. The consideration is understood to be $22,000. The new owner, it is said, proposes to rehabilitate the railway in time to handle the apple crop this year.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 3 for two electrically operated floating cranes, complete, one for the United States Navy Yard, Boston, Mass., and the other for the United States Naval Station, Pearl Harbor, Hawaii. Plans and specifications can be obtained on application to the bureau or to the commandant of the navy yard at Boston, Mass., or the naval station at Pearl Harbor, Hawaii. R. C. Hollyday is chief of bureau.

WASHINGTON, D. C.—It is reported that plans are being considered to equip the Chesapeake Beach Railway for electrical operation and extend the railway to Drum Point, a distance of six miles, for which the right-of-way has been graded for several years. The cost of equipping the railway for electrical operation is estimated at from $300,000 to $400,000 and does not include the cost of erecting a power house; the cost of the extension is estimated at about $200,000. Paul W. Waters, 1416 New York Avenue, Washington, D. C., is general manager.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of the District of Columbia, Washington, D. C., until April 25, for furnishing two steam engines and two generators for the McKinley Manual Training School. Forms of proposal, specifications and other information may be obtained upon application to the property clerk of the District of Columbia, Room 820, District Building, Washington, D. C.

JACKSONVILLE, FLA.—Bids will be received by W. M. Bostwick, Jr., chairman of the Board of Trustees Water Works and Improvement Bonds, until April 18 for furnishing six transformers and chimney complete. The Scofield Engineering Company, of Philadelphia, Pa., has charge of the engineering work.

JACKSONVILLE, FLA.—The Board of Bond Trustees have awarded contracts for the new electric plant as follows: For 30-ton electric crane to the Niles-Bement Company, of Philadelphia, Pa., for $4,960; four new boilers, rebuilding four boilers and removal of old ones to the Babcock & Wilcox Company, of New York, N. Y., for $39,384; three condensers for service equipment, complete, and replacing the auxiliaries of two other equipments to the C. H. Wheeler Manufacturing Company, of Philadelphia, Pa., for $32,950; one feed-water heater to the Warren Webster & Company, of Camden, N. J., for $1,850; two boiler feed pumps and two duplex piston pumps and necessary brass plungers to the Warren Steam Pump Company, of Warren, Mass., for $4,228; and two 1500-kw turbo-generators and two 100-kw turbo exciters to the General Electric Company, of Schenectady, N. Y., for $54,650.

PALATKA, FLA.—A company is being organized for the purpose of constructing an electric railway between Palatka and Summer Haven, twenty miles in length.

ST. PETERSBURG, FLA.—The Pelham Public Utilities Company is contemplating the installation of a 250-kw generator and 350-hp boiler and engine in its plant during the coming summer. The company supplies electrical service and ice in Pelham. William Cook, of Pelham, is manager. The main office of the company is located in St. Petersburg, Fla.

SANFORD, FLA.—It is reported that contracts will be awarded by the Citrus Southern Electric Railway Company for the construction of an electric railway connecting Sanford, Orlando and Kissimmee, forty-five miles in length. T. K. Miller, of Orlando, is president and J. J. Brophy, of Winter Park, is vice-president and engineer.

FAIRBURN, GA.—It is reported that bonds to the amount of $10,000 have been issued, the proceeds to be used for the construction of an electric light plant.

FORT SCREVEN, GA.—Contracts have been awarded for electrical work at Fort Screven as follows: For electric light fixtures and wiring in various buildings to the Sperry Engineering Company, of New York, N. Y., at $7,430, and switchboard, at $2,699; to the F. E. Newberry Electric Company, of St. Louis, Mo., for construction of primary-secondary and street lines, at $7,340, transformers, $1,262, two engines $2,370, steam piping and pump heater, $4,110; to the Ridgway Dynamo & Engine Company of Ridgway, Pa., for two 35-kw, 60-cycle, engine-type alternators, complete with exciters, at $1,980; for boiler and smokestack to E. Keeler Company, of Williamsport, Pa., at $3,131.

CAIRO, ILL.—The Cairo Railway & Light Company is reported to be contemplating improvements to its power plant. H. E. Chubbuck, of Peoria, Ill., is vice-president and general manager.

CHICAGO, ILL.—The contracts for electrical equipment to be installed in the controlling works at Lockport of the Sanitary District of Chicago are reported to have been awarded as follows: To the Crocker-Wheeler Company, of Ampere, N. J., for generator, at $24,900, and to the W. A. Jackson Company for a high-tension transformer, at $16,000.

ROCKFORD, ILL.—Plans are being considered by the Rockford & Interurban Railway Company for the construction of a power plant in Rockford.

SADORUS, ILL.—The directors of the Sadorus Telephone Company are reported to have authorized the construction of a new building, the purchase of a new switchboard and new cable lines.

YORKVILLE, ILL.—It is reported that plans are being prepared by the Fox River Electric Development Company for the construction of a hydroelectric power plant this summer. Bids, it is said, will be received about May 1 for same, which will include four turbines and generators, 22½ miles of transmission line, a masonry dam, 227 ft. long, and the erection of a power station, 90 ft. x 25 ft., which will involve an expenditure of about $75,000. R. S. Simpson is president; Hugh Palmer is engineer in charge, both of Yorkville, and H. B. Hallett, of Aurora, Ill., is consulting engineer.

BEDFORD, IND.—The substation of the Bedford Power Company was put in operation April 5. This station will distribute electricity generated at the Williams plant. Preparations are being made by the company to supply electrical energy to a number of stone quarries in this district as well as to the Bedford Water Works Company.

ELWOOD, IND.—The Elwood Trust Company, receivers for the Citizens' Heat & Light Company, has asked for an order of court to sell the plant. The plant has been idle for some time.

EVANSVILLE, IND.—William McLean, of Henderson, Ky., representing the independent telephone interests in Kentucky, Indiana and Illinois, has filed a petition with the Board of Public Works for a franchise to operate an independent telephone system in Evansville. The applicants agree to give the city 3 per cent of its gross earnings and to expend a large sum in the installation of a new telephone plant.

FARMLAND, IND.—The City Council is reported to have accepted the proposition submitted by E. Goodrich and J. Moorman, of Winchester, Ind., to light the town by electricity for $1,400 per year. It is expected to have the system in operation by Aug. 1.

LAGRANGE, IND.—G. F. Avis, of Hudson, Ind., owner of the local electric-light plant, has purchased water rights in Ontario owned by C. F. Cain. It is understood that Mr. Avis will install additional machinery at the plant in Ontario and transmit electricity to Lagrange for lamps and motors.

LAGRANGE, IND.—It is reported that C. C. Gilhams and Charles Smith, both of Lagrange, have secured options on a dam site located on Pigeon River between Mingo and Ontario which, it is said, they propose to develop, to be utilzed to generate electricity for transmission to Lagrange for lamps and motors.

VINCENNES, IND.—The Southeastern Interurban Railway Company, it is reported, will award contracts for the construction of its proposed electric railway from Vincennes to Jasper as soon as surveys are completed.

JEWELL, IA.—W. H. Grover, of Ames, Ia., is reported to be interested in a project to build an electric light plant in Jewell, wo k on which will begin in the near future.

KEOKUK, IA.—Steps have been taken to organize a company to build an interurban electric railway from Quincy, Carthage, Nauvoo, Hamilton, Niota, Powellson and Warsaw, Ill. Power for operating the railway will be supplied by the dam now being built across the Mississippi River at Keokuk. Henry E. Dayton, of Quincy, Ill., and Fred Swann, of Nauvoo, Ill., are among the promoters.

MASON CITY, IA.—Preliminary arrangements have been completed by the Forest City & Mason City Railway Company for the construction of its proposed electric railway between Mason City and Forest, thirty miles in length. Contracts for construction of the railway will be awarded May 1.

MORAN, IA.—It is reported that a special election will be held April 18 to vote on the proposition to issue $18,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant and water works system.

PENDLETON, IA.—It is reported that plans are being prepared for the installation of an electric light plant in Pendleton, for which bonds have been voted.

WEBSTER CITY, IA.—It is reported that all bids submitted for furnishing machinery and equipment for the new municipal electric-light plant have been withdrawn under agreement in order to allow the city time to secure more funds. Contract for construction of the power house has already been awarded. The new Council, it is said, may submit a proposition to the voters to authorize an issue of $25,000 in bonds to equip the plant

GARDEN CITY, KAN.—A petition has been presented to the City Council asking that a special election be called to submit the proposition to issue $20,000 in bonds, the proceeds to be used to purchase or build a municipal electric light plant.

GLASCO, KAN.—At an election held recently the citizens voted to issue bonds, the proceeds to be used for water works and an electric light plant. It is proposed to accept the proposition submitted by the Concordia Electric Light & Power Company to supply electricity from its plant in Concordia to operate the lighting system.

LEAVENWORTH, KAN.—The F. E. Newberry Electric Company, of St. Louis, Mo., has been awarded the contract for installing an electric light and power plant at United States penitentiary hospital, Leavenworth, Kan., at $4,470.

WICHITA, KAN.—Plans are being made by the Wichita Railroad & Light Company for building an extension of its railway system from Wichita to Hutchinson, through Burrton and Halstead.

HOMER, LA.—The Town Council is considering the question of purchasing the local electric-light plant, owned by E. Sawyers, to be owned and operated by the municipality.

BALTIMORE, MD.—Plans have been completed by the Consolidated Gas, Electric Light & Power Company for its new storage-battery plant to be established on McClellan Alley, the cost of which is estimated at from $250,000 to $300,000. Orders have been placed with the Electric Storage Battery Company, of Philadelphia, Pa., for the storage battery. It is expected to have the plant ready for operation by Aug. 15.

FALL RIVER, MASS.—The Fall River Electric Light Company has been granted permission to construct and maintain underground conduits for electric wires on several streets in the city.

READING, MASS.—The question of supplying the town of Wilmington with electricity from the municipal electric light plant is under consideration. Legislation has been enacted permitting the town of Reading to supply such service.

SPRINGFIELD, MASS.—It is announced that the Tariffville branch of the Hartford & Connecticut Western Railroad, eighteen miles in length, connecting Tariffville and Springfield, will be equipped for electric operation.

WESTFIELD, MASS.—The contract for furnishing cables for the underground conduit system of the municipal electric light and power plant in connection with the Elm Street and Park Square improvements has been awarded to the Safety Insulating Wire & Cable Company, of New York, N. Y., for $11,655.

MARQUETTE, MICH.—The citizens on April 5 voted to issue $1[illegible] in bonds, the proceeds to be used for the construction of a dam on the Dead River. George W. Rule is secretary of the Light and Power Commission.

BUFFALO, MINN.—J. A. Bonner is reported to have been granted a twenty-year franchise to construct and operate an electric light plant in Buffalo, Minn.

EXCELSIOR, MINN.—Application has been made to the Council by Arndt & Rauchworter, of Belle Plain, Minn., for a franchise to supply electricity in Excelsior.

PROCTOR, MINN.—The village of Proctorknott has granted the Proctor Water, Light & Power Company a franchise to construct and operate an electric-light plant and water-works system in that village for a term of twenty-five years.

TOWER, MINN.—It is reported that bonds to the amount of $16,000 have been voted, the proceeds to be used for the construction of a hydroelectric power plant at Pike River Falls.

TYLERTOWN, MISS.—O. L. Sands, of Tylertown, has applied to the City Council for a twenty-five-year franchise to construct and operate an electric-light plant and water-works system in Tylertown.

BETHANY, MO.—The question of making extensions and improvements to the municipal electric light plant and water-works system is reported to be under consideration.

HOLLISTER, MO.—Preparations are being made by the Ozark Water & Power Company for the construction of a large dam across White River, near Hollister, work on which will begin in the near future. The company proposes to build a large power plant and supply electricity to towns within a radius of 100 miles. R. E. Morrison, of St. Louis, Mo., is interested in the project, and W. J. Szwart is chief engineer.

SCOTTSBLUFF, NEB.—The local electric light plant is reported to have been purchased by F. H. Roberts, of Sterling, Col., who has been granted a franchise to operate an electric system in Scottsbluff. Under the terms of the franchise he agrees to install a plant to cost $20,000.

BURLINGTON, N. J.—The City Council has adopted a resolution calling an election to be held April 18 to vote on the proposition to install a municipal electric-light plant in Burlington.

JAMESBURG, N. J.—The Town Council has granted the Jamesburg Electric Company a franchise to supply electricity in Jamesburg.

RED BANK, N. J.—The Board of Public Utilities is reported to have approved of the consolidation of the Shore Electric Company, of Red Bank, N. J.; the Seabright Electric Light Company, of Seabright, N. J., and the Citizens' Light & Fuel Company, of South Amboy, N. J., under the name of the Shore Lighting Company. The new company will be capitalized at $112,000 and will issue bonds to the amount of $400,000, the proceeds to be used to take up outstanding bonds of the old companies and for the completion of the new plant at Red Bank and for other improvements to the three properties.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company is reported to be considering the erection of new elevated lines to tap the Hunter's Point, Greenpoint and Bushwick sections, and to connect these districts with Borough Hall, Brooklyn, and with Manhattan.

BROOKLYN, N.Y.—It is understood that the Drum Elevator Company, 103 Walker Street, New York, N. Y., which is contemplating the construction of a new plant on Sands Street, Brooklyn, N. Y., will require new equipment for its factory. The company has not yet decided whether it will use steam or electricity for motive power.

BROOKLYN, N. Y.—The Public Service Commission, First District, has granted the Kings County Electric Light & Power Company authority to issue $1,500,000 in bonds, the proceeds to be used to reimburse the Edison Electric Illuminating Company for expenditures for improvements and betterments made to its system.

ELMIRA, N. Y.—The plant of the Hatfield Manufacturing Company, has been moved from Cornwall, N. Y., to Elmira. It is understood that the company will install some new machinery, including power equipment, and it may use electric motors. W. N. Taylor is general manager.

JOHNSTOWN, N. Y.—Plans are being made to organize a company to construct and operate an electric railway from Little Falls to Johnstown. The proposed railway will connect with the Fonda, Johnstown & Gloversville system at Johnstown. J. J. Gilbert, L. O. Bucklin, F. G. Tealle and H. P. Snyder, of Little Falls, and F. G. Engelhardt, of St. Johnsville, and others are interested in the enterprise.

KATONAH, N. Y.—The Katonah Light Company has been authorized by the Public Service Commission, Second District, to exercise its franchise privileges granted by the town of Lewisboro for the extension of its electric-lighting service to that town. The company was also granted permission to issue capital stock to the amount of $45,000, the proceeds to be used for extensions and improvements to its plant.

NEWBURGH, N. Y.—The Newburgh Light, Heat & Power Company is contemplating the construction of a power plant in Balmville, near Newburgh, plans for which have been prepared by Frank E. Estabrook, engineer.

NEW YORK, N. Y.—The Treasury Department has awarded the contract for an electric elevator equipment for the new post office building in New York, N. Y., to the Otis Elevator Company, of New York, for $139,450.

SYRACUSE, N. Y.—The Syracuse Lighting Company, of Syracuse, N. Y., has applied to the Public Service Commission, Second District, for permission to issue $470,000 in bonds, of which the proceeds of $147,800 will be used in the electrical department to extend its transmission lines into districts not now reached by exitsing lines; a new frequency changer will be installed at a cost of $27,000 and other improvements made.

WADDINGTON, N. Y.—Announcement has been made by J. Wesley Allison, vice-president and general manager of the New York & Ontario Power Company, that the contract between the company and the Hydro-electric Power Commission of the Province of Ontario has been signed, under the terms of which the company is to supply electrical energy to the eastern municipalities in Ontario to the amount of 15,000 hp. The towns included are Prescott, Brockville, Lyn, Lansdowne, Napanee, Kingston, Cardinal, Morrisburg and Athens. Under the terms of the contract the power must be available within a year. The main transmission line will be extended to Ogdensburg, at which point it will cross the St. Lawrence River. Work on completion of the plant will be pushed rapidly. W. S. Connelly, of Hamilton, Ont., is president.

WAVERLY, N. Y.—Preparations are being made by the Elmira, Corning & Waverly Railway Company for the construction of a substation to be erected at Big Flats, work on which will begin in the near future. Electricity for the new substation will be supplied by the local power plant.

YONKERS, N. Y.—Bids will be received by John H. Claxton, secretary Board of Education, until April 14 for power transmission apparatus for the Saunders Trades School, now under construction. Bids will also be received until May 1 for other specified machinery for the school. The cost of the whole outfit is estimated at $20,000.

DURHAM, N. C.—The Southern Power Company is reported to have purchased a site in Durham, on which it will erect an auxiliary steam plant to supply electricity in Durham and vicinity. The proposed plant will have an output of about 10,000 hp.

SALISBURY, N. C.—It is reported that negotiations have been closed whereby 51 per cent of the capital stock of the street railway, electric light and gas companies of Salisbury, Concord and Spencer, N. C., has been purchased by William J. Oliver, of Knoxville, Tenn., involving $1,000,000. The deal also includes an electric interurban railway, connecting Salisbury and Concord, twenty-one miles in length, and the railway connecting Salisbury and Spencer. It is understood that Mr. Oliver will make extensive improvements to the properties.

GLEN ULLIN, N. D.—The installation of an electric-light plant in Glen Ullin is reported to be under consideration.

CLEVELAND, OHIO.—The Williams Edwards Company, it is reported, will soon place orders for equipment for power plant for its new building now under construction. The present plans call for two 200-hp water-tube boilers, two generating units and complete electric and elevator equipment.

COLUMBUS, OHIO.—The City Council is considering a resolution to submit a proposition to issue $250,000 in bonds, the proceeds to be used to equip the municipal electric light plant to supply electricity, to a vote of the people at an election to be held May 31.

NELSONVILLE, OHIO.—The citizens on April 1 voted to issue $16,000 in bonds, the proceeds to be used for improvements to the municipal electric-light plant.

WILLOUGHBY, OHIO.—The Cleveland, Painesville & Eastern Railroad Company is reported to be contemplating increasing the output of its power house at Willoughby. The equipment to be installed will include two boilers and electrical apparatus.

SENTINEL, OKLA.—At an election held recently the citizens voted to issue $12,000 in bonds for the construction of a municipal electric-light plant. F. Murch, of Clinton, Okla., is engineer in charge.

CANBY, ORE.—Work has commenced on the construction of an electric railway from Canby to Mollalla, a distance of twenty miles, with branch lines leading to Beaver Creek, Meadow Brook, Colton, Needey and McBurgh. A site has been secured on the Willamette River, two miles from Canby, on which a power station will be erected.

MEDFORD, ORE.—Contracts have been awarded by the Rogue River Electric Company for the equipment for its proposed new power plant at Prospect. The equipment includes a large waterwheel and three turbines. When the new plant is completed the present plant at Gold Bay will be used for auxiliary purposes only.

NEWPORT, ORE.—The plant and holdings of the Newport Power Company are reported to have been sold to Henry Hewitt, J. J. Hewitt and Seymour H. Bell. The system will hereafter be operated under the name of the Yaquima Electric Company. The plant will be reconstructed. The work will include the installation of new equipment, new power house and new wiring system in the city and extension of lines to surrounding towns and cities. The company contemplates an expenditure of about $30,000.

PORTLAND, ORE.—The City Council has granted the Mount Hood Railway & Power Company a franchise to supply electricity in Portland for a period of twenty-five years. Under the terms of the franchise the company is to pay the city 2½ per cent of the gross revenue derived from the sale of electricity within the city limits and 1½ per cent to outside points when electricity for such is transmitted through the city. In order to prevent a merger between the Mount Hood company and competing companies, a provision in the franchise stipulates that the company must pay to the city 25 per cent of the gross revenue derived from electricity sold to companies generating electricity. The installation of the first unit of the company will involve an expenditure of about $3,000,000. About five miles of transmission lines have been erected and the company expects to be ready to deliver power contracted for by May 1, when the auxiliary steam plant near St. Johns will be ready to supply about 4000 hp.

SALEM, ORE.—It is understood that the Kingwood Park Light & Water Company will obtain electricity for operating its system from the Portland Railway, Light & Power Company. The Kingwood Park company, it is said, will erect a transmission line across the river at Kingwood Park to connect with the power lines of the Portland Railway, Light & Power Company.

HARRISBURG, PA.—A bill has been introduced in the Senate by Senator McNichols, of Lackawanna, which would compel all water companies which furnish power for manufacturing purposes to furnish such power for public purposes.

LOST CREEK, PA.—The capital stock of the Lost Creek Valley Rural Telephone Company has been increased from $5,000 to $25,000.

STEELTON, PA.—The Steelton Light, Heat & Power Company has increased its capital stock from $60,000 to $100,000.

PHILADELPHIA, PA.—Arrangements are being made by Alexander Brothers for enlarging their plant. A contract has been awarded to G. F. Pawling & Company for the erection of a steel, brick and concrete building, 71 ft. x 178 ft., extending from 414-416 North Fourth Street through to Orinna Street. Plans are also being considered for enlarging the power plant, which will probably double the present output.

PHILADELPHIA, PA.—Work has begun on the construction of the large manufacturing plant to be erected by the Hohlfield Manufacturing Company at Tenth Street and Sedgley Avenue. The group will include three buildings. The present plant, located at Eighth and Dauphin Streets will be removed to the new factory when completed. The company has not yet decided whether to install a steam or electric plant. It is understood that both are under consideration.

PLYMOUTH, PA.—Proposals will be received at the office of John Love, secretary of Plymouth Township, Plymouth, Pa., until April 24 for lighting the streets of the town with twenty or more arc lamps for terms of five, seven and ten years.

SUMNEYTOWN, PA.—James S. Miller is reported to be contemplating the construction of an electric light plant in Sumneytown. The plant will supply electricity for lamps in Sumneytown and surrounding villages.

CEBU, P. I.—The Visayan Electric Company is planning to install a 240-hp engine and a 225-kw, two-phase, alternating-current generator. The 100-kw unit now in the plant will be used for the day service. Albert Bryan is president and manager.

LEXINGTON, S. C.—At an election held recently the citizens voted to grant the Lexington Electric Light & Power Company an exclusive franchise to supply electricity in Lexington. The company will begin work on the plant at once. W. W. Barr is president.

FAITH, R. F. D., LEMMONVILLE, S. D.—The Faith Light & Power Company is reported to have been granted a franchise to install an electric light plant in Faith.

LANGFORD, S. D.—The C. B. Hersey Company is reported to have been granted a franchise to install an electric light plant in Langford, S. D.

BRISTOL, TENN.—The Bristol Belt Line Railway Company is contemplating equipping the railway from Bristol to Big Creek Park, ten miles in length, for electrical operation.

HENDERSON, TENN.—Plans are being considered for the construction of an electric railway to extend from Henderson or Jackson and run east to some point on the Tennessee River, thence up the river to Savannah.

MEMPHIS, TENN.—The City Commission has adopted a resolution to ask the Legislature to authorize the City of Memphis to issue bonds, the amount to be specified later, for the construction of a municipal electric light plant. The city is paying at present from $130,000 to $140,000 per annum for lighting the municipality.

BELTON, TEX.—The Commercial Club, of Belton, is reported to be interested in a project to build an interurban electric railway from Belton to Holland, a distance of sixteen miles.

EL PASO, TEX.—The board of governors of the Elephant Water Users' Association and the El Paso Valley Water Users' Association has decided that the hydroelectric feature of the Elephant Butte Dam and the reclamation project in New Mexico shall be developed by the federal government instead of a private power company. Steps have been taken by the government to install a temporary electric power plant on the site of the dam at Elephant Butte, N. M., at a cost of about $500,000. O. H. Ensign, chief electrical engineer of the reclamation service, has charge of the hydroelectric part of the project.

HOUSTON, TEX.—The First National Bank has awarded a contract to the Barden Electric & Machinery Company for the installation of a power plant for its new building.

PALESTINE, TEX.—Plans are being prepared by the Trinity Valley Traction Company for the construction of an electric interurban railway between Dallas and Palestine, via Waxahachie and Corsicana, a distance of 110 miles. The cost of the road and equipment is estimated at about $3,000,000. The company expects to be in the market during the summer and fall for material for same. The general offices of the company are located at Dallas, Tex. J. V. Watkins is president.

SHERMAN, TEX.—Bids will be received by the Superintendent of Water Works, Sherman, Tex., until May 1 for the following equipment: Two deep wells, internal-combustion engine, gas producer, air compressor, electric generator, motors, switchboards and power-driven pump. Specifications are on file in the office of Barney C. Kreager, city secretary.

TYLER, TEX.—The Gulf States Telephone Company, of Doven, Del., has been granted a permit to do business in Texas with headquarters at Tyler. The company is capitalized at $250,000 and proposes to erect a telephone line through the eastern part of Texas running into McLennan County.

WICHITA FALLS, TEX.—The City Council has granted a franchise to another electric-light company in Wichita Falls. The franchise provides for a maximum rate of 11 cents per kw-hour for consumers using less than 50 kw per month, with a discount of 10 per cent if paid within ten days, with a minimum annual charge of $12. To consumers using more than 50 kw per month the rate will be 7 cents per kw-hour. The company will begin work immediately on construction of a plant.

LOGAN, UTAH.—The Cache County Amusement Company is making arrangements for the construction of an electric railway to connect Preston, Idaho, Franklin, Richmond, Lewiston, Smithfield, Hyde Park, Greenville, Logan, Providence, Millville, Hyrum, Wellsville and Paradise, fifty miles in length, work on which will begin about July 1. No contracts have been awarded as yet. The power station and repair shops will be located in Logan. Job White, of Salt Lake City, Utah, is president.

NEWPORT NEWS, VA.—The State Corporation Commission has issued an order to the Newport News & Old Point Railway & Electric Company to put its plant in repair within thirty days and that the entire plant must be completely renovated within four months. Both the traction and lighting service of the company is inadequate to meet the demands made upon it.

PETERSBURG, VA.—The special committee appointed by the City Council to look into the matter of establishing a municipal electric light plant has decided that it is not prepared to make a final report and has recommended that a sub-committee be appointed to make a full investigation as to the cost and maintenance of such a plant. It is estimated that a plant of sufficient output to provide the service required would cost from $300,000 to $400,000. The city now pays the Virginia Railway & Power Company $16,000 per year for lighting the city.

RICHMOND, VA.—The citizens of Highland Park have voted to issue additional bonds to the amount of $50,000, the proceeds to be used for the completion of water works and sewer systems, additional street lamps and other improvements.

RICHMOND, VA.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until May 8, for the installation of conduit, wiring and lighting system in connection with the reconstruction of the United States post office, court house and custom house building at Richmond, Va., in accordance with plans and specifications, copies of which may be obtained at the above office or from the office of the superintendent of construction at Richmond. James Knox Taylor is Supervising Architect.

WINONA, WASH.—M. W. Fockler, of Winona, is reported to have purchased a site about one mile west of Winona, on which he proposes to erect a power house. Electricity generated at this plant will be transmitted to Endicotte, Lacrosse and Winona.

RONDA, W. VA.—The power plant on Cabin Creek of the Coalburg Colliery Company is reported to have been destroyed by fire recently, causing a loss of about $10,000.

WELLSBURG, W. VA.—The plant and holdings of the Wellsburg Light & Power Company have been purchased by the Ohio Valley Scenic Company. The consideration is said to be from $20,000 to $25,000.

ALTOONA, WIS.—The Chippewa Valley Railway, Light & Power Company, of Eau Claire, Wis., is reported to have applied to the City Council for a franchise to construct and operate an electric railway in Altoona.

BARABOO, WIS.—At an election held April 4 it is reported that the citizens voted to issue $45,000 in bonds, the proceeds to be used for the installation of a municipal electric-light plant.

BROOKLYN, WIS.—It is reported that the proposition to issue bonds for the construction of a municipal electric plant in Brooklyn will be submitted to a vote of the people.

JIM FALLS, WIS.—It is reported that H. M. Byllesby & Company, of Chicago, Ill., have secured an option on the new dam at Jim Falls. It is understood that the company proposes to transmit electricity generated at the dam to Minneapolis and St. Paul, Minn.

KENOSHA, WIS.—Governor McGovern has signed the bill providing for the validation of the franchise of the Kenosha Electric Railway Company to supply electricity for lighting in Kenosha. Owing to the company having failed to comply with the demands of the Wisconsin Railway Commission the courts had pronounced the franchise void.

LA CROSSE, WIS.—M. W. Fockler, of Winona, Wis., is reported to be interested in a project to install an electric plant to supply electricity for lamps and motors in Endicott, Winona and La Crosse.

SOMERSET, WIS.—The hydroelectric power plant of the St. Croix Power Company at Apple River Falls is reported to have been damaged by fire recently, causing a loss of about $5,000.

PORTAGE LA PRAIRIE, MAN., CAN.—The City Council has appointed a committee, consisting of Mayor Garland, Aldermen [illegible] Sharpe and Sweet, to look into the proposition submitted by the City of Winnipeg to supply electricity in Portage La Prairie generated at the Winnipeg municipal hydroelectric power plant at Point du Bois.

MONCTON, N. B., CAN.—The Moncton Tramways, Electric & Gas Company is reported to have purchased the municipal electric-light plant. It is understood that work will begin on the construction of the street railway and the installation of a natural gas supply as soon as the frost is out of the ground.

DARTMOUTH, N. S., CAN.—A. C. Pyke and Robert Stanford are reported to be interested in a project to build an electric railway in Dartmouth out to Cow Bay, for which application for a charter will be made.

LUNENBURG, N. S., CAN.—Owing to a disagreement between the Council and Lunenberg Gas Company, the street-lighting service has been discontinued. The Council refused to pay the rate demanded by the company for electric street lamps. It is expected that the matter will be referred to the Public Utilities Commission.

BOWMANVILLE, ONT., CAN.—At an election held April 4 the ratepayers voted in favor of the by-law authorizing the sale of the municipal electric-light plant and franchise to the Seymour Light & Power Company for the sum of $16,000. A by-law was also passed granting the company a fixed assessment of $5,000 for ten years.

BROCKVILLE, ONT., CAN.—At a meeting of representatives of nineteen municipalities held April 7 at Brockville for the purpose of considering the question of securing electricity through the Hydro-Electric Power Commission, announcement was made by Adam Beck, chairman of the commission, that a contract has been entered into with the New York & Ontario Power Company, of Waddington, N. Y., with the option of securing 15,000 hp at a total cost of $657,000. In addition, a proposition has been submitted by M. F. Beach, owner of water rights at High Falls, which would cover the eastern portion of the province, with a distributing station at Kingston. The schedule of rates for municipalities forming the union in eastern Ontario is as follows: Kingston, 1200 hp at $29.45 per hp; rate per hp provided 50 per cent additional is taken, $23.76, and $15.20 per hp provided 100 per cent additional is taken. Napanee, 200 hp, $36.23 per hp; for 50 per cent additional, $28.44 per hp, and $22.09 per hp for 100 per cent additional. Lansdowne, 100 hp, $55.38 per hp; for 50 per cent additional, $34.13 per hp, and $26.81 per hp for 100 per cent additional. Brockville, 100 hp, $20.40 per hp; for 50 per cent additional, $17.49 per hp, and $15.37 per hp for 100 per cent additional. Lyn, 100 hp, $22.43 per hp; for 50 per cent additional, $18.83 per hp, and $16.31 per hp for 100 per cent additional. Prescott, 500 hp for $18.17 per hp; for 50 per cent additional, $15.86 per hp, and $13.50 per hp for 100 per cent additional. Cardinal, 100 hp, $18.18 per hp; for 50 per cent additional, $14.50 per hp, and $12.90 per hp for 100 per cent additional. Morrisburg, 2000 hp, $16.18 per hp; for 50 per cent additional, $12.03 per hp, and $11.67 per hp for 100 per cent additional. Athens, for 75 hp, $30.07 per hp; for 50 per cent additional, $30.05 per hp, and $24.60 per hp for 100 per cent additional. The contract is to run for ten years, with option of continuing for one, two or three similar periods, provided three months' notice is given before the expiration of the first ten years.

FORT WILLIAM, ONT., CAN.—The Grand Trunk Railroad Company is reported to be making investigations on State River with a view of locating a power dam on the river. E. J. Chamberlain, of Winnipeg, Man., Can., is general manager.

PETROLIA, ONT., CAN.—Owing to the Town Council refusing to accept the terms offered by the Petrolia Light, Heat & Power Company for lighting the streets of the town, the company discontinued the service on April 5. The town has applied to the Public Utilities Commission to look into the matter, as the officials claim that the company is charging excessive rates.

RENFREW, ONT., CAN.—Preparations are being made for the construction of a municipal electric light plant and water-works system, for which bonds to the amount of $117,000 have been issued. J. R. Stewart, of Renfrew, Ont., is engineer in charge.

STRATFORD, ONT., CAN.—Electricity for operating the municipal electric-light system is now supplied by the Hydro-Electric Power Commission's transmission line to western Ontario. The steam plant was closed down April 6, but will be held in reserve for use in emergencies.

STURGEON, ONT., CAN.—The report submitted to the Council for the installation of an electric-light plant and water-works system estimates the cost at $50,000. As funds are not available at the present time for this purpose, the Council is considering the question of arranging with a private company to erect a pumping station, the city to have the option of purchasing the plant when practicable.

TORONTO, ONT., CAN.—The board of directors of the Toronto Electric Light Company has rejected the offer of the City of Toronto to purchase the property of the company at $125 per share. The board voted to recommend to the stockholders to accept an offer made on behalf of Sir William McKenzie, president of the Toronto Railway Company, to purchase the stock of the Toronto Electric Company at $135 per share.

TORONTO, ONT., CAN.—The Ontario government has approved the plans of the Hydroelectric Power Commission for the extension of the St. Thomas transmission line to Windsor, to cost approximately $2,000,000. The proposed line will be 128 miles long and will supply electrical energy to twenty-three municipalities along the line. The extension will depend on whether favorable contracts can be made with Windsor for distributing electricity elsewhere. In order to secure the extension the City of Windsor must contract for 15,000 hp, and as only 2000 hp will be used within the city a market must be found outside of Windsor for the remainder.

TORONTO, ONT., CAN.—The special committee appointed by the City Council on subway railroads has decided to ask the City Engineer to prepare plans and specifications for the construction of a subway to admit traffic on Yonge Street from Union Station to St. Clair Avenue, a distance of about three miles. Tenders will be asked on these specifications and the most acceptable proposition will be submitted to a vote at the municipal election next January in a by-law asking for an appropriation to build the same. H. C. Hocken, chairman of the committee, states that three radial railways would use the subway if built. The committee will ask for an appropriation of $5,000 to pay for the cost of preparing preliminary plans and specifications for the subway.

WINDSOR, ONT., CAN.—It is reported that the local distributing company at Windsor has practically closed negotiations with the Michigan Central Railway Company for a large block of electrical energy for use in the Detroit River Tunnel. The Edison Company, of Detroit, Mich., is now furnishing electricity to the tunnel company under a ten-year contract, which, it is said, is not exclusive. The power now being used represents but a small portion of what will be required by the Michigan Railway Company.

REGINA, SASK., CAN.—Tenders will be received by S. P. Porter, Department Minister Railways, Telegraphs and Telephones, Regina, Sask., Can., for construction of the following telephone lines: Moose Jaw-Swift Current, Saskatoon-Battleford, Saskatoon-Biggar, Abernathy-Strassburg and Wolseley-Windthorst.

New Industrial Companies.

THE ALLIED SAFETY DEVICES COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $10,000 by George B. Hinkley, George B. Nye and George E. Houck, all of Buffalo, N. Y. The company proposes to manufacture apparatus to protect machinery operators and workmen.

THE AMERICAN STEEL MANUFACTURING COMPANY, of Jersey City, N. J., has been incorporated by H. W. Andrews, E. Madden and G. Cohen, of New York, N. Y. The company is capitalized at $125,000 and proposes to do a general electrical, mechanical and civil engineering business, etc.

THE BENTLEY-SNYDER COMPANY, of Chicago, Ill., has been chartered by Wilton Bentley, Frederick T. Snyder and James V. Cunningham. The company is capitalized at $8,000 and proposes to manufacture and deal in metals, electricity and electric furnace products.

THE BROZELLE, MOTOR COMPANY, of St. Louis, Mo., has been chartered, with a capital stock of $10,000, and proposes to manufacture engines and motors. The incorporators are: Benjamin Brozelle, D. M. Houser, Charles McKee and others.

THE ECONOMY ELECTRIC SUPPLY COMPANY, 335 Monadnock Building, Chicago, Ill., has been incorporated to deal in electrical supplies and specialties. The new company will make a feature of importing tungsten lamps and other electrical goods from Germany and elsewhere. Wallace Kirk, formerly connected with the Sanitary District of Chicago, is president; Robert W. Means is treasurer, and T. B. Hemmick sales manager. Mr. Hemmick was formerly connected with the Pittsburgh Electrical Supply Company. Robert R. McCormick, Potter Palmer, Jr., and A. A. Sprague, 2d, are among the stockholders.

THE ELECTRIC CONTROLLER COMPANY, of Oklahoma City, Okla,. has been incorporated with a capital stock of $100,000 by C. O. Alle, W. M. Bowles, of Shawnee, Okla.; Milton Bryan, J. M. Postelle and Abner Davis, of Oklahoma City, Okla.

THE ELECTRIC FURNACE COMPANY, of Alliance, Ohio, has filed articles of incorporation with a capital stock of $20,000. The incorporators are: T. F. Bailey and others.

THE ELECTRIC VEHICLE COMPANY, of St. Louis, Mo., has been incorporated by Lee Miles, Edward Drummond, of the Drummond Manufacturing Company; Philip Allison and H. B. Hewett, of the Cooper Hewitt Company, of Louisville, Ky. The company is capitalized at $10,000, and proposes to manufacture electric passenger and commercial automobiles.

THE FOXWORTHY ELECTRIC COMPANY, of Indianapolis, Ind., has been incorporated by M. K. and E. H. Foxworthy and L. R. Miller. The company proposes to manufacture and deal in electric devices and supplies of all kinds.

THE D. GORDON ELECTRIC COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $25,000 for the purpose of manufacturing electrical appliances. The incorporators are: Isaac B. Lipson, Morris K. Levinson and Sylvanus G. Levy.

THE HUDSON METALLIC MANUFACTURING COMPANY, of Ossining, N. Y., has been granted a charter with a capital stock of $10,000 for the purpose of manufacturing metal goods, electrical supplies, etc. The incorporators are: Robert M. Akin, Joseph Royle and William O. Higgins, all of Ossining, N. Y.

THE ILLINOIS CONTRACTING ELECTRICAL COMPANY, of Rock Island, Ill., has filed articles of incorporation with a capital stock of $7,000 for the purpose of doing a general manufacturing business. The incorporators are: W. W. Wilmerton, Martin McNealy and Frank H. Kelly.

THE L. H. L. IGNITION COMPANY, of New York, N. Y., has been incorporated with a capital stock of $250,000 by J. H. Lehman, A. T. Otto and C. M. Lowther, of New York, N. Y. The company proposes to manufacture electrical apparatus, etc.

THE NEW YORK ELECTRO-PNEUMATIC TOOL COMPANY, of

Ridgewood, N. J., has been incorporated by J. J. Roberts, W. W. Wilsey and L. D. Forman, of Ridgewood, N. J. The company is capitalized at $300,000, and proposes to manufacture foundry, factory and mill supplies.

THE SERVICE MOTOR CAR COMPANY, of Wabash, Ind., has been incorporated by C. S. Reiman, B. F. Reiman and E. A. Bullock. The company is capitalized at $500,000 and proposes to manufacture gasoline and electric vehicles and supplies.

New Incorporations.

JONESBORO, ARK.—Articles of incorporation have been filed for the Spring River Power Company with a capital stock of $100,000. The officers are: F. R. Lang, president; J. D. Browne, vice-president; William Henry Vaughn, secretary, and James E. Parr, treasurer. The company owns large holdings in and around Mammoth Springs, Imboden and other points, and proposes to supply electricity for various plants in this vicinity.

MODESTO, CAL.—The Turlock Traction Company has been incorporated with a capital stock of $500,000 by S. N. Griffiths, of Fresno, Cal.; A. M. Morton, Lloyd Griffiths, A. C. Chatom and D. R. Shafer, of Turlock, Cal. The company proposes to construct an electric railway between Turlock and Denair, four miles in length.

SAN FRANCISCO, CAL.—The Municipal Light & Power Company has been incorporated with a capital stock of $1,000,000 and the following directors: P. S. Scales, of San Mateo, Cal.; J. H. Sanford, Rudolph Spreckels, of San Francisco, Cal.; Frank Harrold, of Fruitvale, Cal., and Claus A. Spreckels, of New York, N. Y. It is understood that the company is a reorganization of the Municipal Light & Power Company, which was operated for several years as part of the Spreckels estate. The present plant is to be enlarged and the system extended as rapidly as possible. The company is to supply both gas and electric service.

DOVER, DEL.—The Western States Gas & Electric Company has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $15,000,000. The incorporators are: G. Graweig, H. H. Darling and W. C. McKenna, of Chicago, Ill.

ATLANTA, GA.—The Austell Power Company has been granted a charter with a capital stock of $300,000 with the privilege of increasing the amount to $1,000,000. The company proposes to develop and operate power plants, and it is understood that it has several locations in view convenient to Atlanta. The incorporators are: C. C. Bruckner, George W. Mason, of Atlanta, and George E. Zimmerman, of New York, N. Y.

LITTLE YORK, ILL.—Articles of incorporation have been filed for the Little York Telephone Company with a capital stock of $5,000 by Willis Wiley, C. W. Cooper and J. R. Porter.

NOBLESVILLE, IND.—The Prairie Telephone Company has been incorporated with a capital stock of $10,000 by Jacob M. McDonald, Williams Wales, Charles S. Snyder and O. V. Snyder. The company proposes to operate a telephone system in Hamilton County.

MAYSVILLE, KY.—The Maysville Public Service Company has applied for a charter to build an electric railway in Maysville. The company is to be capitalized at $150,000. The incorporators are: A. M. J Cochran, R. A. Cochran, W. H. Cox, H. Fichlin and Samuel Hall, of Maysville.

KANSAS CITY, MO.—The Kansas City, Clay County & St. Joseph Railway Company has been incorporated with a capital stock of $720,000 for the purpose of building a railway from Kansas City to St. Joseph, with a branch to Excelsior Springs. The motive power will be either steam or electricity. The incorporators are: George Townsend, George D. Beardsley, William A. Medill and Grant Peabody, of Kansas City, Mo., and Ward S. Arnold, of Chicago, Ill.

PEGGS, OKLA.—Articles of incorporation have been filed for the Spring Creek Telephone Company by C. W. Bradshaw, C. A. Downing, C. A Wilson, D. A. Robinson and Tilman England. The company is capitalized at $2,000.

LOCK HAVEN, PA.—The Lock Haven & Jersey Shore Railway Company has filed articles of incorporation for the purpose of constructing an electric railway to connect Lock Haven and Jersey Shore, via Dunstable, Pine Creek, Charlton, Woolrich and Avis.

PORTLAND, PA.—Articles of incorporation have been filed for the Water Gap & Portland Street Railway Company with a capital stock of $24,000. The directors are: B. F. Dillard, of East Bangor, Pa., president; William Bray, Joshua Bray, of East Bangor, Pa.; J. I. Johnson, of Portland, Pa., and George Raesly, of Mt. Bethel, Pa.

POTTSGROVE, PA.—Charters have been granted by the Secretary of State to the Suburban Electric Company of Upper Pottsgrove, the Suburban Electric Company of Lower Pottsgrove and the Suburban Electric Company of West Pottsgrove. Each company is capitalized at $5,000 and the incorporators are: Dr. William J. Ashenfelter, of Pottstown, Pa., treasurer; William R. Shuler and Livingston Saylor, all of Pottstown, Pa.

TITUSVILLE, PA.—The Titusville Light & Power Company has been incorporated with a capital stock of $5,000. The directors are: William J. Seltzer, of Philadelphia, Pa., treasurer; Charles C. Aeugle, J. Ross Burhouse, both of Philadelphia, Pa.

SUMTER, S. C.—The Sumter Lighting Company has been incorporated with a capital stock of $200,000 by I. C. Strauss and E. H. Moses.

ALPINE, TEX.—The Alpine Telephone Company has been incorporated with a capital stock of $15,000 by J. E. Mills, W. F. McCaughey and R. T. Burks.

BARRY, TEX.—The Vest Telephone Company has been chartered with a capital stock of $20,000 by D. W. Vest, H. W. Denton, A. H. Elnore and others.

BELTON, TEX.—Articles of incorporation have been filed for the Belton Ice & Electric Company with a capital stock of $75,000 by W. W. Thornton, N. K. Smith and M. V. Smith.

DALLAS, TEX.—Articles of incorporation have been filed for the Dallas Street Railway Company with a capital stock of $20,000 to construct and operate an electric railway in Dallas to connect at Garrett Avenue and Ross Avenue with the Dallas Consolidated Electric Street Railway, thence eastward on Ross Avenue to Henderson Avenue and north to the city limits. The incorporators are: George W. Works and W. Leslie Williams.

WESTFIELD, VT.—Articles of incorporation have been filed for the Missiquo Telephone Company with a capital stock of $10,000 for the purpose of acquiring, erecting and maintaining telephone lines in the town of Westfield, to and through the town of Orleans and other places in the county. The incorporators are: W. A. Young, H. W. Burnham, H. D. Miller, of Westfield, Vt.; W. E. Brock and W. D. Miller, of Troy.

Personal.

DR. F. S. PEARSON, the well-known engineer and capitalist of New York, sailed for London on the steamer *Mauretania* on April 5.

MR. EUGENE CREED has resigned his position as sales manager of the Toronto Electric Light Company to accept a similar position with the Morris Iron Company, New York City.

MR. ANGUS S. HIBBARD, vice-president and general manager of the Chicago Telephone Company, has been elected a director of the Chicago Savings Bank & Trust Company.

MR. GEORGE B. ROBERTS was selected last week by the Electrical Commission of Baltimore to be assistant electrical engineer to Raleigh C. Thomas, the chief engineer of the subway department.

MR. K. A. ALBRECHT, electrical engineer, formerly with Kiewert & Company, has resigned and will sail on the steamer *Pretoria* on April 15 for Berlin, Germany, where he will hereafter reside.

MR. WILLIAM J. NORTON, first assistant secretary of the Public Service Commission, First District, New York, has resigned to enter the service of the Commonwealth Edison Company of Chicago.

MESSRS TORSTEN HOLMGREN, KNUT BILDT AND FREDRIK JONSON, of Sweden, who have been on a visit to this country, sailed on the steamer *Kronprinz Wilhelm* on April 11 for Sweden.

MR. J. S. VIEHE, formerly electrical engineer for the Rockingham Power Company at Pee Dee, N. C., has become associated with the Electric Bond & Share Company, New York, and is now in its engineering department.

MR. FRANK F. FOWLE, consulting engineer, Chicago, addressed the student engineering society of Northwestern University at Evanston, Ill., on April 4, his subject being "The Problems of the Engineering Graduate Upon Entering Practical Life."

PROF. ELIHU THOMPSON, of the General Electric Company, who has been touring southern California, on March 31 delivered to the students of Throop Polytechnic Institute an address in which he related a number of incidents regarding his early work in the electrical field.

MR. MAURITZ SAHLBERG, of Sweden, is on an extended visit to this country to study hydroelectric developments for the Department of Commerce of the Swedish government. Mr. Sahlberg has for ten years been a representative in Sweden for the Allgemeine Elektricitäts Gesellschaft of Germany.

MR. A. H. WHITESIDE, who recently resigned his position with the Allis-Chalmers Company to become associated with the Triumph Electric Company, Cincinnati, was previously Southern manager of the Sterling Boiler Company, with headquarters at Atlanta, Ga. He is a member of the Engineers' Club of New York and an associate member of the American Institute of Electrical Engineers. He assumed his new duties on April 1.

MR. JOHN G. GLASSCO has been appointed electrical superintendent of the Winnipeg (Man.) municipal generating station at Point du Bois, to be opened in July. Mr. Glassco was born in Hamilton, Ont., and after graduating as electrical engineer from McGill University, Montreal, became associated with the Kern River plant in California, leaving there in 1905 to become electrical engineer of the Dominion Power & Transmission Company at Hamilton, Ont., where he remained until [illegible], when he accepted an appointment on the construction staff of Smith, Kerry & Chace, engineers for the Point du Bois power plant.

MR. H. A. BURSON, who recently resigned as [illegible] of the Packard Electric Company, of St. Catharines, Ont., to become associated with the Canadian Crocker-Wheeler Company, Limited, at [illegible], graduated from McGill University in [illegible] with the degree of B. S. and the following year received the degree of M. S. for special research work. After spending two years on the staff of the department of electrical engineering of McGill University he entered the engineering department of the Bullock Electric Company, of Cincinnati, specializing in the design of alternating-current generators under Mr. B. A. Behrend.

When the Allis-Chalmers-Bullock, Limited, of Montreal, was formed he was placed in charge of its electrical engineering department. In 1906 he severed his connection with Allis-Chalmers-Bullock to join the Packard Electric Company as chief engineer and general superintendent.

Obituary.

MR. WILLIAM C. WOODWARD, for twenty years connected with the Narragansett Electric Lighting Company, Providence, R. I., died at his home on March 25. Mr. Woodward was born in Roxbury, Mass., fifty years ago.

HON. L. J. FORGET, Senator, of Montreal, Que., a director of the Montreal Light, Heat & Power Company and president for many years of the Montreal Street Railway Company until control was acquired last November by the Robert-McConnell interests, died at Nice, France, on April 7. Senator Forget was born at Terrebonne, Que., on March 11, 1853, and was a prominent stockbroker at Montreal for twenty-five years, having founded the firm of L. J. Forget & Co. there in 1876. He was also prominent on the directorate of many institutions at Montreal. He is survived by a widow and four daughters.

HENRY GRADLE, M.D., one of the foremost oculists of Chicago, died at his winter residence in Santa Barbara, Cal., on April 4. Dr. Gradle took an intelligent interest in illumination and its effect on the eye, and for that reason was known to many electrical men in Chicago, by whom he was held in high esteem. He was a member of the Illuminating Engineering Society and had delivered addresses before the Chicago Section of that society and the Electric Club of Chicago. His scientific attainments were recognized and admired by his auditors. He was one of the comparatively few members of his profession who have shown a deep interest not only in the curing of eye troubles but also in their prevention.

MR. TOM LOFTIN JOHNSON, known as the "three-cent fare" Mayor of Cleveland, died at his home in that city on April 10, after an illness of more than one year. Mr. Johnson was born in Georgetown, Ky., on July 18, 1854. He began his business career as a clerk in a street railway office in Louisville, Ky., in 1869. He retained an interest in street railways throughout his life, having invented several street railway appliances. At different times he owned street railway property in Indianapolis, Cleveland, Detroit and Brooklyn. In 1891 he was elected to Congress, to which he was re-elected until 1895. From 1901 until 1910 he served as Mayor of Cleveland, when he became best known for his advocacy of a three-cent fare on the street railways

MR. GEORGE T. WESTCOTT, of Chicago, well known to electrical men throughout the Central West as a manufacturers' agent, died at Maywood, Ill., on April 2 from complications following an operation for stomach trouble. The son of one of the best known of Chicago's high-school principals, Mr. Westcott went direct from high school to the offices of the Western Electric Company in Chicago, where he earned repeated promotions, being for years first assistant to the purchasing agent. Leaving this post some five years ago, he entered the Chicago field as a manufacturers' agent for a number of Eastern firms catering to the electrical trade. Two years ago he was joined by Mr. G. D. Wilson, the business growing steadily under the firm name of Geo. T. Westcott & Company. He leaves a wife and daughter, and will be missed by many friends, who appreciated his sturdy sincerity and unfailing cheerfulness.

Trade Publications.

ELECTRIC SIGNS.—Signs of the reflector and flasher type are briefly described in leaflets issued by Veritys, Ltd., 28 King Street, Covent Garden, London, W. C., England.

ARC LAMPS.—Publication X124 of Veritys, Ltd., 28 King Street, Covent Garden, London, W. C., England, is devoted to flaming-arc lamps arranged for either interior or outdoor use.

INSULATION.—Insulating devices intended particularly for use with overhead trolley wires and contact rails for electric railroads are described in a booklet issued by the Randolph Insulator Company, 221 Murray Street, Newark, N. J.

ELECTRIC HEATERS.—In an illustrated catalogue and price list issued by Veritys, Ltd., 28 King Street, Covent Garden, London, W. C., England, various types of electric radiators, food warmers, kettles, glue pots, etc., are briefly described.

ELECTRIC FANS.—The Sprague Electric Company, 527 West Thirty-fourth Street, New York, has issued an attractive bulletin designated as Catalog No. 323, in which are illustrated, listed and briefly described numerous types of fans for the summer season.

DIRECT-CURRENT GENERATORS.—The Triumph Electric Company, Cincinnati, Ohio, has issued Bulletin No. 461, containing complete information concerning the constructive details of its engine-type direct-current generators, rated at from 30 to 1000 kw.

ELECTRIC SPECIALTIES.—The Central Electric Company, 320 Fifth Avenue, Chicago, Ill., has issued as its March price list an 84-page publication relating to switches, fuse boxes, sockets, attachment plugs, portable lamps and fixtures and numerous other electric lighting specialties.

ELECTRICITY IN IRRIGATION.—The Oregon Hydroelectric Engineering Company, Baker, Ore., has issued a booklet giving much information relating to the use of electric motors for driving irrigation pumps by the Harney Valley and Central Oregon Power & Irrigation Company.

STEAM BOILER OPERATION.—Bulletin No. 187 of the B. F. Sturtevant Company, Hyde Park, Mass., contains an article by F. R. Low entitled "Economical Fireroom Methods," which gives information relating to the theoretical and practical thermodynamic efficiencies of steam boilers.

AUTO TRANSFORMERS.—Auto transformers especially designed for use with low-voltage, high-efficiency metallic-filament lamps, arc lamps and for testing purposes are illustrated, listed and described in publication X125 of Veritys, Ltd., 28 King Street, Covent Garden, London, W. C., England.

MANUAL FOR BEGINNERS.—The Sangamo Electric Company, Springfield, Ill., has issued a pocket data book which contains a great deal of engineering information. The reference tables are conveniently arranged and the manual should prove of much value to mechanical and electrical engineers.

WESTINGHOUSE CATALOGS.—The Westinghouse Electric & Manufacturing Company has recently issued several new catalog sections, including the following: No. 228, Enclosed Fuse Blocks. No. 229, Subway Fuse Boxes. No. 553, Automatic Voltage Regulators. No. 731, Instrument Transformers. No. 735, Type S and SA Distributing Transformers

STEAM SPECIALTIES.—The Schutte & Koerting Company, Philadelphia, Pa., has issued a series of leaflets relating to various steam specialties. Section G of Catalog 7 deals with blast governors for Corliss engines, and Section L of the same catalog covers automatic engine lubricators. Section 5 of Catalog 8 is devoted to vacuum breaker valves, while grease extractors and feed-water filters are illustrated and described in Section E of this catalog.

MINE-VENTILATING FANS.—In a neatly illustrated catalog, designated as Publication No. 303, recently issued by the American Blower Company, Detroit, Mich., much information is given concerning the constructive details and operating characteristics of mine-ventilating fans. Much of the information in this catalog is of a technical nature, and it should prove of special value to operating and consulting engineers having to solve problems relating to the ventilation of mines.

ENGINE VALVE GEAR.—An ingenious model to illustrate the valve-timing gear in the Cochrane steam stack and cut-out valve water heater and receiver is being distributed by the Harrison Safety Boiler Works, of Philadelphia, Pa. The model is constructed of stiff celluloid. It serves to illustrate the fact that when the heater is cut off from the exhaust steam supply the separator is attached to and forms a part of the heater and continues to furnish exhaust steam to the heating system, while the stack is cut off from connection with the heater but still continues to drain the separator.

ELECTRIC SUPPLIES.—The Trumbull Electric Manufacturing Company, Plainville, Conn., has issued its No. 8, 1911, catalog describing its complete line of knife switches, covering all the regular sizes, styles and types of from 45 amp to 5000 amp, and for 250-volt and 600-volt direct-current and 440-volt alternating-current circuits. The line of porcelain material has been increased, and there has been an entire readjustment of panel-board material, a new feature being the listing of panel-board tables and steel and wood cabinets, complete with panels and slate frame. The catalog is bound in both paper and cloth.

ENGINE-DRIVEN ALTERNATORS.—Circular No. 1190, just issued by the Westinghouse Electric & Manufacturing Company, describes type "E" engine-driven, alternating-current generators from 50 to 1100 kva for operating on 60-cycle, 240-2400-volt circuits, which are arranged for direct mounting of the rotor on the shaft supplied with the prime mover. The makers claim that for moderate first cost, consistently satisfactory performance and low maintenance charges these machines are unsurpassed by any alternating-current generators on the market, and are peculiarly suited to conditions prevailing in isolated industrial plants and central stations of moderate capacity.

BUSINESS NOTES.

MR. J. S. JOSEPH has severed his connection as erecting engineer for W. A. Day & Company, First National Bank Building, Chicago, and has opened an office at 207 Union Bank Building, Chicago, as manufacturer's agent, handling contractors' equipment and supplies, locomotive cranes and grab buckets.

THE MORRIS IRON COMPANY, New York City, has been awarded the contract for furnishing poles for the ornamental lighting installation at Dallas, Tex. Magnetite arc lamps are to be used and the posts are to be of cast iron with steel shaft and ornamental crook, one lamp being used on each pole.

CANADIAN CROCKER-WHEELER COMPANY.—Mr. H. A. Burson, chief engineer of the Packard Electric Company, of St. Catharines, Ont., has resigned his position to accept that of commercial engineer with the Canadian Crocker-Wheeler Company, Limited, whose head office and works are located at St. Catharines, Ont.

YALE & TOWNE MANUFACTURING COMPANY.—Mr. C. H. Pearson, formerly with the Noera Manufacturing Company, of Waterbury, Conn., has become associated with the Yale & Towne Manufacturing Company to represent its hoist department throughout the Western States.

THE DONGAN ELECTRIC MANUFACTURING COMPANY will move on May 1 its main office and factory from Albany, N. Y., to 15 East Woodbridge Street, Detroit, Mich. The above company is placing upon the market a complete line of electrical measuring instruments, and its new location will greatly facilitate handling its rapidly increasing business. It will maintain branch offices at New York City, Birmingham, Ala., and Seattle, Wash.

TUNGSTOLIER COMPANY.—Mr. E. J. Kulas has severed his connection with the Central Station Development Company in order that he may give greater personal attention to other interests with which he is identified. Important developments in connection with the Tungstolier Company, of Conneaut, Ohio, of which he is president, are claiming much of his time and necessitate his retiring from active association with several other corporations in which he holds office.

THE GREGORY ELECTRIC COMPANY has let contracts for an addition to its works, Sixteenth and Lincoln Streets, Chicago, whereby the present storage space will be doubled. The addition will be of brick and steel construction of the same type as the present buildings. The floors will be heavy concrete. A brass foundry, etc., will be added and another 20-ton Whiting electric traveling crane installed, this making three electric cranes of the same make which will be in constant use at the works. The buildings will be completed about July 1.

THE NEW DEPARTURE MANUFACTURING COMPANY, Bristol, Conn., manufacturer of specialties, including a complete line of ball bearings, will open a western branch in the Ford Building, Detroit, Mich., on April 15. The company will maintain at this branch an engineering and sales force, which will be immediately available to the many customers in Detroit and the West. A full stock of all bearings of the company's manufacture will be carried at the branch. All of the important engineering data that have been accumulated by the company at the home office will also be on file.

CENTRAL ELECTRIC COMPANY.—The old quarters having proven unequal to the growing demands of its business, the Central Electric Company, of Chicago, has just completed changes which will nearly double its facilities. The offices are now on the top floor of its six-story building, where the arrangement of skylights will make artificial light unnecessary most of the time. The increase in floor space available for stock purposes, amounting to about 25,000 sq. ft., will enable the company to increase both the quantity and variety of its stock and work out in finer detail the system of stock-keeping and shipping.

GATES & BROWN.—Messrs. R. M. Gates and H. A. Brown have opened an engineering office at 1022 Citizens Building, Cleveland, Ohio, where they will specialize in consulting and designing work in mechanical and structural engineering. Mr. Brown has served in the engineering departments of the Browning Engineering Company, the Wellman-Seaver-Morgan Company, the Nevada Consolidated Copper Company and the Brown Hoisting Machinery Company. Mr. Gates has been associated with the Browning company and was until recently treasurer and general manager of the Victor Browning Engineering Company, of Cleveland.

TRIUMPH ELECTRIC COMPANY.—Mr. A. H. Whiteside, who was for over four years manager of the power and electrical department of the Allis-Chalmers Company, in charge of sales and engineering, has accepted a position as assistant sales manager with the Triumph Electric Company, of Cincinnati, Ohio. Mr. J. F. Nisbet, publicity manager of the Triumph Electric Company, has been selected to take charge of the publicity and advertising department of the Triumph Ice Machine Company also. These two departments were formerly operated independently of each other, but have recently been combined.

COLONIAL ELECTRIC COMPANY.—Mr. Alton Earle Williams has been elected secretary-treasurer of the Colonial Electric Company of Warren, Ohio, where he will be in charge of all the incandescent-lamp sales activities of that company. Mr. Williams has been connected with the general offices of the National Electric Lamp Association in Cleveland since the latter part of 1909, prior to which he was sales manager of the Brilliant Electric Company. Mr. Williams' work during the past few years has brought him into personal contact with many Western central station men and also with prominent electrical jobbers all over the United States. His training and acquaintance will thus enable him to handle the commercial problems of the incandescent-lamp business from a broad and comprehensive standpoint. Mr. Williams is a member of the committee on improved wiring and equipment standards of the commercial section of the National Electric Light Association.

MOLONEY ELECTRIC COMPANY.—The new Canadian transformer factory of the Moloney Electric Company, of St. Louis, at Windsor, Ont., is now nearing completion. The company owns two acres of ground in Windsor and on it is building a modern factory which will have about 30,000 sq. ft. of floor area. The St. Louis factory has about 35,000 sq. ft. of floor space and has been working lately nearly up to its maximum output. The company has secured very large orders in Canada, and the new factory at Windsor will meet this demand. The Moloney Electric Company, which manufactures transformers, was established about fourteen years ago by Mr. Thomas O. Moloney, the president of the company. Mr. Moloney thought that the loss in the transformers of the period was excessive, and, as the possibilities of alternating-current distribution were largely dependent on better transformer efficiency, he determined to bend his energies to designing and making high-efficiency transformers. The present extensive establishment has grown from this modest beginning. Mr. Moloney continues to give his personal supervision to the business, although he has now a staff of competent assistants, prominent among whom is Mr. J. J. Mullen, the secretary of the company, of which Mr. J. P. Casey is sales manager.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 28, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

987,845. APPARATUS FOR THE ELECTRICAL TREATMENT OF LIQUIDS AND SEMI-LIQUIDS; V. M. Wright, Cleveland, O. App. filed Jan. 13, 1910. For treating cider, etc., to destroy germs by means of a cylindrical, horizontal vessel with a carbon bar within it and a series of electrodes in contact with the bar and a series of bars within the vessel for baffling the liquid while moving through the vessel.

988,198. ALARM FOR INCUBATORS; L. H. Litscher, Dayton, Ohio. App. filed July 28, 1909. Thermostatic damper giving an alarm when the temperature varies.

988,210. ART OF ELECTROLYTICALLY EXTRACTING METALS FROM THEIR ORES; W. D. Rennie, Hackensack, N. J. App. filed June 8, 1910. Agitates the electrolyte in which a powder of an ore is held in suspension when acted upon by the current.

988,245. OIL SWITCH; H. W. Cheney, Milwaukee, Wis. App. filed April 19, 1909. A frame to which a removable oil receptacle is secured containing contacts, a terminal extending through the frame and a separate connection which is made or broken when the receptacle is moved to or from its normal position.

UNITED STATES PATENTS ISSUED, APRIL 4, 1911.

988,298. ATTACHMENT PLUG; R. B. Benjamin, Chicago, Ill. App. filed March 13, 1908. For sockets receiving incandescent electric lamps, the base having an enlargement, an end contact, a side contact, the latter movable around the base and along the base, and being expanded when moved forward on the base.

988,308. INCANDESCENT LAMP; C. E. Campbell, Lynn, Mass. App. filed April 18, 1910. A filament lamp with filament support of heat-conducting material having a loop whose thin end penetrates the glass bulb and acts to dissipate the heat.

988,312. CONSTANT CURRENT REGULATOR; E. R. Cliff, New York, N. Y. App. filed Aug. 21, 1908. A core for a magnetic circuit having a central portion with outward arms and upwardly extending portions at their extremities composed of oppositely disposed and alternately arranged groups of U-shaped plates firmly bound together.

988,321. MINERS' AND THE LIKE ELECTRIC SAFETY LAMP; C. V. E. Eley and T. P. Brady, Birmingham, Eng. App. filed Nov 18, 1909. Electric safety lamp having a battery, a circuit breaker controlled by a rod, the rod being moved by a spring with a ring within the glass shield so that when the shield breaks the circuit breaker is operated.

988,329. METHOD OF CONNECTING INCANDESCENT LAMP FILAMENTS WITH METALLIC CURRENT; L. Glaser, Pankow, Germany. App. filed April 10, 1907. Joins a lamp filament to a metallic conductor by softening the supply conductor by the passage of an electric current therethrough and applying pressure to bring the filament and conductor into contact.

988,337. BATTERY BOX; W. Henrichs, Moro, Oregon. App. filed Nov. 8, 1910. A holder for battery cells consisting of a box whose lid connects the cells of the battery by means of pole-engaging springs in the openings of the lower part of the lid.

988,340. UNIPOLAR EXCITER FOR TURBO-GENERATORS; H. Hertz, Chicago, Ill. App. filed June 3, 1907. A unipolar exciter having an armature located at the end of the rotor and mounted upon the end plate.

988,377. DYNAMO-ELECTRIC MACHINE; J. E. Noeggerath, Schenectady, N. Y. App. filed Sept. 23, 1909. Unipolar dynamo with an armature comprising a central disk or spider and an overhanging peripheral portion with axially extending flanges on opposite sides of the disk, cylindrical field frame members surrounding the shaft, circumferential field coils, collector rings on the periphery of the armature and collector rings on the shaft.

988,390. AUTOMATIC SELECTING SYSTEM; F. Schoenwolf, Chicago, Ill. App. filed May 6, 1907. A selective switch, a stationary switch, a stepping magnet for the switch, the switch having a ratchet and controlling pawl with means for reoperating the pawl when a partial step is made.

988,395. ALARM DEVICE; W. P. Stamps, Milvid, and William R. Philips, Munday, Texas. App. filed July 18, 1910. Wind gage which announces the approach of a storm by closing an electrical circuit at a given wind velocity.

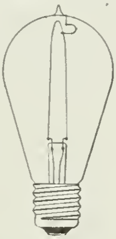
988,416. INCANDESCENT ELECTRIC LAMP; M. H. Welsh, Newark, N. J. App. filed March 16, 1910. A bulb, a straight filament therein supported on non-incandescent conducting supports, one of which has a thermostat portion transverse to the filament which when heated bends away from the other support so as to keep the filament taut.

988,440. ELECTRIC CIRCUIT CONTROLLER; E. J. Burke, New York, N. Y. App. filed Nov. 9, 1909. Selective system for telephone and telegraph calls, including a traveler actuated by gravity and moving over a plurality of contacts, the traveler being arranged on an inclined way so as to cause the gravity-actuated device to complete one or more circuits.

988,441. AUTOMATIC VOLTAGE REGULATOR; G. A. Burnham, Essex, Mass. App. filed Sept. 7, 1909. A voltage regulator with a common vibrating contact member, two contacts, mechanism for raising the voltage or for lowering the voltage and a vibrating contact member for coöperating with the two contacts.

988,442. AUTOMATIC VOLTAGE REGULATOR; G. A. Burnham, Cliftondale, Mass. App. filed Sept. 30, 1910. Two contacts which are given a make and break movement and one moved at high speed so as to give a shearing movement when separated.

988,465. ELECTRIC SIGNALING SYSTEM; J. S. Harley, Minneapolis, Minn. App. filed May 16, 1910. Electric signaling system for fire alarms having a main circuit, branches of grouped annunciators and a shunt circuit, including signaling means for indicating a deficiency of current in the main circuit.



988,308.—Incandescent Lamp.

988,456. POTENTIOMETER; H. Grensbach, New York, N. Y. App. filed Dec. 7, 1910. For wireless telegraphy, the potentiometer having a dished face carrying a scale with thumb-piece and indicator bars of high-resistance in the bottom face which contact with the screw.

988,461. CONNECTION BOX FOR ELECTRIC CONDUITS; J. E. Graybill, York, Pa. App. filed July 29, 1908. Box for electric wire conduits comprising a plurality of sections forming a tubular conduit at one end and having interlocking means at the other with locking means releasably securing the tubular ends together.

988,507. LAMP SOCKET SWITCH; H. E. Reeve, New York, N. Y. App. filed May 14, 1910. An electric switch with light spring contact arms, a porcelain cam between the arms, a power spring for supplying the power to effect a quick break of the circuit.

988,518. ELECTRICAL CONNECTOR; C. M. Steiner, Pittsburg, Pa. App. filed July 9, 1910. A body with threaded sleeve and yielding finger carried by the sleeve for effecting a locking engagement between the sleeve and the body. Designed particularly for plugging into lamp sockets.

988,534. MECHANICAL MOVEMENT FOR END CELL SWITCHES; J. W. Achard, Philadelphia, Pa. App. filed June 21, 1910. A pair of interconnected cams rotatable in either direction with a pivotal follower having a pair of pawls coöperative with the cam, a buffer, stops and a spring for the buffer.

988,571. ROTARY CIRCUIT BREAKER; S. T. Hutton, Chicago, Ill. App. filed Aug. 19, 1910. For rapidly interrupting the circuit by means of a rotary vessel containing mercury forming one terminal, the vessel having downwardly converging walls with an annular channel midway and a rotating insulating disk excentrically mounted within the vessel and carrying a contact.

988,695. ELECTRICALLY HEATED OVEN; F. J. Cook, Collinwood, O. App. filed Aug. 31, 1909. Heating oven made up of stones with a channeled edge and holes and a heating wire threaded through them.

988,706. TELEPHONE RECEIVER SHELL; J. Halldow, Elyria, O. App. filed Oct. 8, 1908. A body with a cap, the cap having a perforated member shaped to communicate sound waves from the receiver to the ear with a threaded ring engaging the receiver cap. The receiver is made of sheet metal.

988,711. CENTRAL TELEPHONE SYSTEM; J. D. Holmes, Pasadena, Cal. App. filed July 14, 1909. Telephone central exchange with cord circuit having a busy testing system in connection with the operator's instrument, there being means in the busy circuit controlled by an electric magnet for controlling a local circuit through the operator's instrument.

988,732. ALARM DEVICE; V. J. Niele, Pittsburg, Pa. App. filed Feb. 12, 1910. A suction disk carries the contacts for a local bell circuit and can be attached to the face of the clock dial so that its contacts are closed by the hand of the clock.

988,754. TROLLEY; C. H. Bierbaum, Buffalo, N. Y. App. filed May 13, 1907. Trolley wheel with a hub carrying two disks engaging a bearing ring and a wire independent of the other mechanical connections between the ring and the hub connected with the hub and with the ring.

988,767. ELECTROLYTIC INTERRUPTER; H. Gernsback, New York, N. Y. App. filed Feb. 12, 1910. A receptacle with cover carrying a tube of insulating material having an aperture in the bottom and anode passing through the cover resting within the aperture and closing it normally and a cathode secured to the cover having an angularly disposed lower end below the anode.

988,768. SPRINKLER ALARM SYSTEM; A. Goldstein, New York, N. Y. App. filed Dec. 3, 1910. For giving an alarm after the sprinkler has extinguished the fire to prevent further damage by water. The signal is controlled by stopping the flow of water, a water-wheel actuated by the flow controlling the signal.

988,792. METHOD AND MEANS OF PRODUCING SYNCHRONISM BETWEEN THE ROTATION OF A CONTROLLING MACHINE AND THE ROTATION OF ONE OR MORE ELECTRICALLY DRIVEN MACHINES; E. L. A. Lertourne, Rouen, France. App. filed Aug. 24, 1909. A controlling machine with a rotary distributor, a dependent machine driven by an electrical motor and driving a rotary receiver and electrical circuits which include the successive contacts of the distributor and receiver, together with resistances carried by the rotary distributor which permit the passage of current to control signals.

988,811. TELEGRAPHY; L. M. Potts, Baltimore, Md. App. filed July 1, 1908. A duplex telegraph line with an instrument giving a correct adjustment of the artificial line at a given station, responsive to current from a distant station only. The line is operated duplex at a fraction of its full capacity without the use of the artificial line and the artificial line is adjusted during this time.

988,819. TELEPHONE TRANSMITTER; C. R. Rogers, Waverly, N. Y. App. filed Jan. 28, 1910. Mouthpiece with a flange forming a chamber between diaphragm and mouthpiece, the chamber containing an antiseptic.

988,821. ELECTRIC SWITCH; J. R. Rossignol, Savannah, Ga. App. filed March 12, 1910. An electric switch with spaced contacts, a sliding contact, an operating lever carrying a curved projection and an annular spring fixed at one end and free at the other bearing against the projection.

988,859. ELECTRIC LOW-LEVEL SIGNAL FOR GASOLINE TANKS; O. C. Carr, Lansing, Mich. App. filed March 19, 1910. An electric signal including a circuit closer operated by a float in the gasoline tank.

988,862. HUMAN CREMATORY; J. Conley, Anadarko, Oklahoma. App. filed July 1, 1910. For cremating human bodies by means of arcs produced by groups of three or more electrodes radially projected into the cremating chamber.

988,873. ELECTRIC FUSE CARTRIDGE; J. Grohowsky, Plymouth, Pa. App. filed Aug. 8, 1910. An insulating tube with a disk at each end, terminals on the disk and a fusible conductor secured to the terminals.

988,876. TELEPHONY; I. Kitsee, Philadelphia, Pa. App. filed June 4, 1907. A vibrating diaphragm, an inductorium having a primary and secondary, the number of inducing convolutions of the primary being controlled by a diaphragm.

988,877. MEANS FOR CONNECTING SENSITIVE RELAYS; I. Kitsee, Philadelphia, Pa. App. filed Dec. 29, 1908. Prevents chattering of the relay contacts by means of auxiliary circuits and relays, the second relay actuating a signal-transmitting instrument and being controlled by the contacts of the first relay.

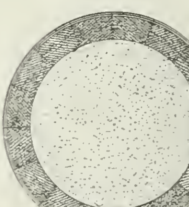
988,878. CABLE TELEGRAPH SYSTEM; I. Kitsee, Philadelphia, Pa. App. filed April 23, 1909. A line or cable of great capacity on which continuous current impulses are impressed. Means are provided for impressing signaling impulses thereon and for neutralizing the effects upon the receiver of the continuous impulses and the signal impulses.

988,879. TELEGRAPHY; I Kitsee, Philadelphia, Pa. App. filed July 8, 1909. The method of differentiating between a dot and dash in cable telegraphy by impressing upon the line for each character an impulse of substantially equal duration and intensity irrespective of the polarity and prolonging one character impulse by an impulse of the same polarity but lower electromotive force.

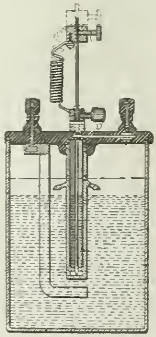
988,891. ELECTRIC FUSE TESTING DEVICE; C. W. Mitchell, Brooklyn, N. Y. App. filed June 28, 1910. For determining which of the fuses on opposite sides of the line circuit has been blown by an overload, where inclosed non-arcing fuses are employed. Provides a lamp within a protected casing with contact posts to test the fuse.

988,906. RECEIVER CASING; L. Steinberger, New York, N. Y. App. filed May 25, 1910. Magnet receiver casing for telephones having two protecting rings, one at each end to sustain the receiver out of contact with the surface upon which it is placed.

988,907. MOUTHPIECE; L. Steinberger, New York, N. Y. App. filed Aug. 6, 1910. A body portion with a thick massive floor having air passages of conical shape opening in front of the diaphragm.



988,695.—Electrically Heated Oven.



988,767.—Electrolytic Interrupter.

988,916. MOTOR FOR DYNAMO-ELECTRIC MACHINES; H. H. Wait, Chicago, Ill. App. filed Jan. 28, 1907. For supporting the winding against centrifugal strain by means of longitudinal and circumferential grooves which contain the winding with longitudinal and circumferential keys.

988,934. OXID PLATE FOR PRIMARY BATTERIES; J. W. Gladstone, West Orange, N. J. App. filed Nov. 8, 1904. Has a wedge-shaped protecting edge of greater density than the interior so as to prevent the edge from chipping.

988,936. ELECTRIC FURNACE PROCESS AND ELECTRIC FURNACE; C. Hering, Philadelphia, Pa. App. filed July 6, 1909. The resisting element includes molten material in column form of a special cross-section, so that the molten material is automatically agitated, the ratio of the square of the furnace current transmitted through the column to the cross-section of the column being great.

988,955. RELAY; J. B. Struble, Wilkinsburg, Pa. App. filed Feb. 2, 1910. Slow release relay for railway signaling system, particularly for use in polarized or wireless track circuit. The armature has a movement to two positions and mechanism is interposed between the armature and the contact for closing the contact when the armature is moved, and a retarding device holds the contact closed while the armature moves from one to the other position.

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THE SMALL CENTRAL STATION.

The little Iowa plant described elsewhere in our columns is, we think, unique in showing how small a community can in these days be efficiently and economically served by an independent central station. If there is a regularly constituted central station for general service actually furnishing a town with energy for public and private lighting smaller than this one, we have yet to hear of it. A station rating of 25 kw certainly does not sound big, and yet the little plant under consideration means a great deal in the way of convenience and comfort to its community, is capable of serving it effectively and with a fair degree of economy, and altogether represents a type of enterprise that deserves to be encouraged. The introduction of economical and convenient gasoline-engine sets, which has been rendered possible by the lessons of the automobile industry, makes it practicable to establish electric service in many places which ordinarily would be considered beyond the possibility of economical service. In this instance, with a fuel expense of less than $2.50 a day, the plant, small as it is, stands an excellent chance of being a profitable investment for the community even if it merely covers expenses and depreciation, and with fairly good luck it should do even better than this. With no bonded indebtedness and common stock issued for cash only and subscribed for largely by those directly benefited, the plant would be a good civic investment even if it never paid a dividend. The balance sheet of this central station at the end of a year's operation will make very interesting reading and with good luck ought to show results that would encourage similar enterprises elsewhere. At all events there are few reasonably prosperous communities, like this one, so small as not to justify an effort at modern improvements even if they should have to be strictly of a co-operative character.

CHARACTERISTICS OF ILLUMINANTS.

Mr. Ladoff's discussion of the operating characteristics of various illuminants is welcome as bringing together a large amount of pertinent data from scattered sources, all bearing upon the efficiency and economy of sources of light. It is particularly instructive as giving in convenient tabular form an unusually complete mass of data on the cost of light from various illuminants, ranging from the stearine candle to the most efficient of the flame-arc lamps. This table deals with the cost of fuel or energy, omitting only the items which have to be taken care of in maintenance. The comparison on the whole loses none of its weight by this omission, for the reason that the incidental costs can readily be determined in any specific case and put on an actual competitive basis, while it is very difficult to tabulate them with average values which would hold good. The cost of fuel or energy, however, is a thing which can readily be reduced to a fair comparison once it is definitely stated on given terms. The costs as tabulated are in cents per 1000 international cp-hours.

An examination of the results shows that so far as cost of fuel or energy is concerned commercial illuminants fall into four groups, putting candles aside as incomparably the most expensive, although sometimes the most convenient, source of light. Into the first group fall gas flames in general and the carbon-filament electric lamp, with costs running roughly from 4 cents to 8 cents per 1000 cp-hours. The second group contains the metallic-filament incandescent lamps in their various forms, the Nernst lamp and the better class of modern carbon arc lamps. These show figures from 1.25 cents to 2.50 cents per luminous unit. Then comes a group consisting of incandescent mantle burners fed with gas and with petroleum. These range, roughly, from 0.7 cent to 0.9 cent per unit. Finally, another electric group appears, consisting of the quartz-tube mercury-vapor lamp and numerous varieties of flame-arc lamp ranging from about 0.2 cent to about 0.4 cent per 1000 cp-hours as the cost of energy. Obviously the inclusion of operative costs exclusive of fuel or energy would make very considerable differences in the total costs for these various groups. In particular the second and third groups would tend to come nearer to each other in total cost and there would be a considerable rearrangement of the fourth group owing to very material differences in the maintenance costs. The relative positions of the four classes, however, would remain substantially unchanged.

The author takes a useful step in again calling attention to the possibilities of light from so-called luminescent phenomena, such light as is emitted by gases and vapors under special conditions and by cultures of light-giving bacteria. The firefly, of course, is the best known instance of that luminescent light which seems to violate all precedents of light-giving bodies. Practically nothing has been done regarding the commercial utilization of any of these phenomena. Indeed, it is somewhat doubtful whether they will prove capable of utilization on account of the very low degree of luminosity found in most instances. Even the firefly is very dim judged by ordinary criteria of brightness, and if his secret could be effectively stolen the light produced would still be of a curious bluish or greenish cast, effective from the standpoint of luminous efficiency, but of perhaps limited applicability in a general way. Of course, there would always be the chance of correcting this color by some such device as Dr. Hewitt's interesting light transformer, but even with its aid the resulting light from any substance yet tried would still lack intensity in an inconvenient degree.

The chemical and biochemical methods of producing light certainly deserve more investigation than has yet fallen to their lot. In fact, the future of illuminants perhaps lies in the direction indicated by these somewhat occult phenomena. The light-giving powers of incandescent solids which obey Wien's law, at least approximately, have at the present time been pretty thoroughly worked out. It is perhaps a hard saying to insinuate that we have already played the limit so far as incandescent bodies are concerned, but as regards luminous efficiency alone it seems not altogether improbable that such is the case. There seems very little probability of any new element being found in commercial quantities of which the melting point shall be materially higher than that of the elements already utilized. Nor is there any reason to expect any combination of elements which will possess this greatly-to-be-desired quality. Certainly the possession of any higher melting points than are now known seems improbable, and this condition sets a limit to what can be reasonably expected in the way of improvements along this line. With respect, however, to those illuminants which, like gases, do not obey Wien's law there is much hope and there is a very wide field for investigation which has as yet been scarcely touched. The results already reached with the quartz lamp and with the flaming-arc lamps show how great a gap has already been established between selective and non-selective radiators as sources of light, and the possibilities of gaseous and luminescent sources are worth all the pains that can be bestowed upon them. The next decade should see notable advances in this direction, advances perhaps as great as those made within this first decade of the twentieth century.

DECISION OF SUPREME COURT ON PRICE AGREEMENTS.

A price agreement made by a manufacturing company for the purpose of maintaining retail prices paid by ultimate consumers was the important pivotal issue in a decision rendered by the United States Supreme Court on April 3, an abstract of which was published in last week's issue. Between this case and general price agreements there are some points of perfectly clear similarity. The contracts made by the company, a manufacturer of proprietary medicines, were with wholesale and retail dealers. Through violation of contracts, one dealer was able to purchase from other dealers at such prices that the goods were placed on the market at cut rates. Seeking an injunction against this practice, the manufacturer was defeated in the lower court, which dismissed the bill for want of equity. This judgment has now been affirmed by the higher court. Although the court declares that agreements between dealers which have for their sole purpose the destruction of competition and the fixing of prices are injurious and void, the decision does not appear to be a sweeping one applicable to all contracts. It classifies with the agreements which it condemns the form of contract in restraint of trade which was employed by this manufacturer, but it tempers the language in which it sets forth its attitude regarding contracts in restraint of trade generally. It recognizes that a modified application of the common law is required in the light of modern conditions and, by a broad conception of this truth, holds that restraints in trade that are reasonable for the public and the parties, and limited to what is fairly necessary for the protection of the covenantee, may be upheld. The opinion of Justice Holmes, who alone dissented, indicates that if the contract had made the retail dealers agents in law, as well as in name, it would have been beyond attack.

It will be observed that only a single manufacturer was concerned in this case. There was no union of manufacturers engaged in similar or partly competitive business, no attempt to restrict output was involved, and the articles affected are not the subject of patent. The main question, then, was as to the legality of the method of control by which the retail prices were to be upheld. Unfortunately, the court, although recognizing shades of intent in the law, does not lay down an inflexible rule as to what is reasonable and what is unreasonable restraint of trade. Since the court, after all, decides that the determination of such questions can be made only in view of the circumstances of each particular case, the decision is less enlightening than it might have been. Where obedience to the statute must accord with that interpretation which the court makes in each particular case, the problem of conformity is surrounded with difficulty and peril. Slight differences in form rather than in purpose make the differences between reasonable and unreasonable restraint. Objections could be swept away and prices maintained by direct relations between the manufacturer and the ultimate consumer if it were possible to do without the convenient machinery afforded by the intermediate relationships with the jobber and retail dealer. In most industries, however, the convenience of the public is served best by the recognized and successfully intrenched channels for wholesale distribution in large lots and retail distribution in small lots. A reasonable degree of price rigidity is believed to be an economic necessity in these times. Barring definite restrictive acts, it is probable, therefore, that the operations of business will continue to tend toward price maintenance, with such reasonable agreements and reconstruction of the machinery of trade from time to time as may be required.

INTERNATIONAL SYMBOLS IN ELECTRICAL ENGINEERING.

The mathematical literature of any single branch of applied science, such as electrical engineering, can conveniently be classified in two divisions. In the first division would be placed certain stereotyped mathematical formulas which run through all the standard textbooks, formulas with which all engineers are more or less familiar and to which reference is frequently made in practice. Examples of such formulas are presented by the mathematical statements of Joule's law, Ohm's law, Kirchhoff's laws, the elementary laws of the magnetic circuit, the law of the dependence of the resistance of a wire upon its temperature, and so on. Reference is made so frequently to such formulas and to the quantities represented therein that it becomes very desirable to have the same symbols used for them by all writers. Uniformity in such symbols greatly simplifies mutual understandings and avoids unnecessary labor and confusion. Such uniformity is merely the standardization of intellectural implements. In the second division of the mathematical literature of the subject may be collected the great mass of theoretical analysis, which, however important it may be potentially, is of less general application. There is no sharp distinction between the second division of electrical engineering literature and the literature of pure electromagnetics. It is manifestly undesirable to standarize the symbols in the second division, mainly because there is no need for making the effort. Moreover, if the effort were made, it would probably be futile. The only justification for all such standardization is that the effort required to effect it is economically expended, since the saving in intellectual labor brought about by the memorization of a particular set of symbols should be very considerable.

It is to be observed that the symbols in the first division are very much fewer than in the second. The precise number of symbols in each is naturally a subject for debate, but it will generally be admitted that if thirty symbols be allotted to the quantities most generally used in electrical engineering textbooks the great mass of the mathematics in the literature of the first division would be covered and included; whereas it would certainly take hundreds, and possibly thousands, of symbols to cover and include all the mathematics of the second division. A comparative examination of the technology of electrical engineering would show that there is already a very fair degree of international agreement on a number of symbolized quantities. A particular research of this kind was published in the *Electrical World* for Aug. 12, 1909, in an article by Dr. A. E. Kennelly. Although there are numerous differences between the symbols used in different countries, yet it is remarkable how many are already alike. It evidently needs only a little giving and taking among electrical engineers in different countries to arrive at a satisfactory international list of symbols for all the mathematics of the first division.

The Brussels conference of the International Electrotechnical Commission last summer voted unanimously to recommend a certain list of eight symbols to the national electrical engineering societies and administrations for adoption at the next official convention, which is scheduled for next September at Turin. The quantities referred to are length, mass and time, in the fundamental units; e.m.f, inductance and electric quantity, in the electric units; flux density and magnetic force, in the magnetic units. On all of these quantities there already exists practically a complete international uniformity of symbology in a broad sense. That is to say, the same letter of the alphabet is used, almost without exception, for these quantities in all countries; but, in a narrower sense, the same symbols are not universally used if reference is made to the font of type employed. The French, who have always been most active in such classifications, have adhered to and recommended a Gothic script font for representing magnetic quantities, whereas in Germany and in Great Britain this script font, although not unknown, is less frequently used. However, the Brussels conference resolutions were restricted to the use of Gothic script capitals for magnetic force, flux density and inductance

Some discussion has recently appeared on this question in *The Electrician*, of London. Objection is raised to the use of the Gothic script characters and preference is expressed for Clarendon font, or heavy square block capitals. As a matter of history, such block capitals were introduced into electrical literature largely in connection with three-dimensional vector quantities; whereas such quantities are ordinarily used in engineering with mere scalar meaning, or at most as two-dimensional or plane vectors. Nevertheless, if there exists in Great Britain a marked preference for Clarendon letters, rather than for Gothic script letters, that preference can be recognized with very little difficulty in the international scheme. In America, France and Italy the script letters are standard, in Germany they are partly standard, and in Great Britain they are seldom used. If, therefore, the International Electrotechnical Commission should finally adopt these capital letters, upon which there is no dispute, marking them in script to satisfy the majority, but noting that when desired Clarendon capitals may be substituted for script capitals, it would seem that all engineers would be content. In short, the question at issue is a mere font question, and not a question of what alphabetical letter should be used.

As for three-dimensional or true vector quantities, they have as yet no position in first-division literature, and are hardly considered by engineers. Two-dimensional or plane vectors, which belong to a quite different mathematical category, are, of course, much used in alternating-current literature. However, it is not necessary to distinguish specifically between a scalar and a plane vector quantity, although writers sometimes do so by means of a subscript or other device.

Association of Licensed Incandescent Lamp Manufacturers Dissolves.

The Association of Licensed Manufacturers of Incandescent Lamps, against which the Attorney General of the United States brought suit in the United States Circuit Court for the Northern District of Ohio, as mentioned in these columns March 9, has dissolved. This association manufactured lamps under patents of the General Electric Company, which as licensor now fixes the prices, terms and conditions under which lamps covered by patents owned by it are manufactured and sold. The companies involved in the dissolution are as follows: General Electric Company, Westinghouse Electric & Manufacturing Company, Westinghouse Lamp Company, National Electric Lamp Company, Ætna Electric Company, American Incandescent Lamp Company, Banner Electric Company, Brilliant Electric Company, Bryan-Marsh Company, Buckeye Electric Company, Capital Electric Company, Colonial Electric Company, Columbia Incandescent Lamp Company, Economy Electric Company, Fostoria Incandescent Lamp Company, Franklin Electric Manufacturing Company, General Incandescent Lamp Company, Independent Incandescent Lamp Company, Kentucky Electrical Company, Liberty Electric Manufacturing Company, Munder Electric Company, New York & Ohio Company, Shelby Electric Company, Standard Electric Manufacturing Company, Sterling Electric Manufacturing Company, Sunbeam Incandescent Lamp Company, Warren Electric & Specialty Company and Gilmore Electric Company.

Reduction in Incandescent Lamp Prices.

Some details of the price reduction made by the manufacturers of incandescent lamps in general on April 1 have just now become available. The prices of standard carbon lamps remain unchanged, but the higher efficiency lamps have been subjected to a price reduction approximating 10 per cent from the list prices. List prices are, however, subject to a discount ranging from 15 per cent and 10 per cent up to 20 per cent, 15 per cent, 10 per cent, 5 per cent and 2.5 per cent, depending on the number of lamps purchased during the year. For instance, the 50-watt Gem lamp, which was previously listed at 23 cents, is now listed at 21 cents. The 25-watt tungsten has been reduced from 70 cents for the plain bulb and 75 cents for the frosted bulb to 65 cents and 70 cents respectively. A reduction of 10 cents a lamp is made on the 40-watt, 60-watt, 100-watt and 150-watt tungstens, both plain and frosted bulbs, and the 250-watt tungsten lamps, previously listed at $3 for the plain and $3.20 for the frosted, are now listed at $2.75 for the plain and $2.95 for the frosted.

It is interesting to note in this connection, also, what the increased efficiency in incandescent lamps to-day actually means when compared with the lamps of other years. For example, a 50-watt incandescent lamp during its life in 1894 gave 3500 cp-hours, as compared with 45,000 cp-hours for a lamp of the same consumption, the improvement in light output being over 1000 per cent.

Reduction in Lighting Rates in Chicago.

A voluntary reduction in the rates for energy for lighting has been announced by the Commonwealth Edison Company of Chicago to go into effect on May 1. On all bills computed from meter readings taken on or after that date the net charge for the primary or maximum portion will be reduced from 12 cents to 11 cents a kw-hour. The low-rate portion will remain at 6 cents a kw-hour net, as heretofore. This reduction will mean a saving of about $350,000 to the public during the next year, according to the company's estimate. It is considered that the reduction in the price of energy for residence lighting will amount to an average of about 5 per cent in the monthly bills.

Convention of the National District Heating Association.

The third annual convention of the National District Heating Association will be held at the Fort Pitt Hotel, Pittsburgh, Pa., June 6-7-8. The program arranged for the convention is as follows: Address, Mr. George W. Wright, Baltimore, Md.; *Investigation on the Transmission of Heat Through Radiating Surfaces,* by Mr. John R. Allen, Ann Arbor, Mich.; *Heating Franchises,* by Mr. A. C. Gillham, Chicago, Ill.; *Result of Measuring Station Load by Venturi and General Electric Meters,* by Mr. F. D. Chambers, Springfield, Ill.; *The Heating and Ventilating Equipment of the City Investing Building, New York City,* by Mr. J. Byers Holbrook; *Superheated Steam,* by Mr. W. E. Dowd, Philadelphia; *Handling Customers,* by Mr. George W. Wright, Baltimore, Md.; *The Preparation of a Rational Rate System,* by Mr. R. D. De Wolf, Rochester, N. Y.; *Best System of Radiation for Economy and Steam Consumption When Fed from a District Heating Station,* by Mr. W. J. Kline, Lockport, N. Y.; *Best System of Radiation for Economy and Steam Consumption When Fed from a Hot-Water System,* by Mr. A. C. Rogers, Toledo, Ohio. In addition to the above papers, reports were presented by the committee on data, the committee on meters and the committee on radiation. On June 7 a visit will be made to the works of the Westinghouse Electric & Manufacturing Company. Excellent entertainment features will also be provided. The secretary of the association is Mr. D. L. Gaskill, Greenville, Ohio.

Entertainment Features of the N. E. L. A. Convention.

The committee on which will devolve the work of entertaining the delegates and guests attending the convention of the National Electric Light Association has already begun its labors. Every one of the lighting companies in Greater New York and the Public Service Electric Company of New Jersey will act as hosts, joining forces to give the convention a taste of the hospitality of the metropolis. On May 29, the opening day of the convention, it is planned to give a promenade concert and reception at the Hotel Astor for which the best musical talent available in New York City will be engaged. The session at which the report of the public policy committee will be presented will be presided over by the President of the United States. Delegates and guests will be enabled to see Coney Island in all its glory, for the season at the seashore begins May 30 and arrangements have been made for a trip to the famous resort. One evening during the week there will be a theater party at the Hippodrome or some other playhouse of equal seating capacity. Those who desire to play golf will find that the sub-committee having this matter in charge has provided splendid links; and devotees of the American game will be treated to a contest between the Brooklyn Edison and the Philadelphia Electric Companies' teams at the American League Park. It is expected that a large delegation will come over by special train from Philadelphia to witness the game and root for the visiting team. A tea will be given for the ladies at either the Hotel Plaza or the Ritz-Carlton and a Bagby concert at the Waldorf-Astoria. In addition there will be automobile trips to interesting points about the city and shopping tours under the guidance of competent chaperons who will also be available for those who desire to attend the theater or attend other social functions. The committee has arranged for the publication of an artistic pamphlet or booklet featuring and illustrating the points of electrical interest in the city. In addition there will be an exhibition of the high-pressure fire service of New York City, the pumps for which are driven by electric motors supplied with energy from the local lighting companies. As a grand finale to the convention a steamboat excursion will be provided on the last day. All of the entertainment features will be looked after by sub-committees under the direction of the general committee, which is made up as follows: Mr. Arthur Williams, New York Edison Company, chairman; and Messrs. Dudley Farrand, Public Service Electric Company, Newark, N. J.; Frank W. Smith, United Electric Light & Power Company, New York; T. Beran, General Electric Company, New York; C. G. M. Thomas, New York & Queens Electric Light & Power Company, Long Island City; W. S. Rugg, Westinghouse Electric & Manufacturing Company, New York City; J. W. Lieb, Jr., New York Edison Company; Carleton Macy, Queens Borough Gas & Electric Company, New York; J. E. Phillips, Richmond Light & Railway Company, New Brighton, Staten Island; H. E. McGowan, Flatbush Gas Company, Brooklyn; E. H. Rosenquest, Bronx Gas & Electric Company, Bronx; W. F. Wells, Edison Electric Illuminating Company of Brooklyn; F. A. Stratton, Westchester Lighting Company, Mount Vernon, N. Y.; G. F. Parker, New York Edison Company; F. C. Bates, General Electric Company, New York; H. M. Edwards, New York Edison Company; A. A. Brown, Westinghouse Electric & Manufacturing Company, New York City; Gano S. Dunn, Crocker-Wheeler Company, Ampere, N. J.; L. A. Coleman, United Electric Light & Power Company, New York City; C. W. Price, Electrical Review Publishing Company, New York, and Hugh M. Wilson, McGraw Publishing Company, New York City.

Loss in Electrical Sheet Steel.

The general subject of the meeting of the American Institute of Electrical Engineers held in the Engineering Societies Building, New York, April 14 was the cyclic energy losses in electrical sheet steel. A paper entitled "The Effect of Temperature Upon the Hysteresis Loss in Sheet Steel" was presented by Prof. Malcolm MacLaren, of Princeton University, and one entitled "Commercial Testing of Sheet Iron for Hysteresis Loss" was presented by Mr. L. T. Robinson, of Schenectady.

Professor MacLaren described tests made at temperatures ranging from the mean normal room value to about 750 deg. C., at which later temperature the samples were found to become non-magnetic. The samples tested were placed in an electric furnace, the heating chamber of which was built up of layers of asbestos, and the heating element of which consisted of "nicrome" wire. Observations of the loss at various temperatures were made at frequencies of 25 cycles and 60 cycles per second, and the results were then plotted in form of curves between the loss per kilogram and flux density in lines per square centimeter. By means of these curves the eddy-current loss was separated from the hysteresis loss, and curves were derived for showing the change in the hysteresis loss with the change in temperature at constant induction. The results indicated a remarkably small variation in loss throughout the lower temperature ranges. The rate of change in loss with increase in temperature was practically constant up to about 500 deg. C., above which temperature the loss fell rapidly and reached zero value at approximately 750 deg. C. For example, with a certain sample the loss at a density of 1200 lines per square centimeter was about 0.78 watt per kilogram at 50 deg. C., it reached 0.62 watt at 300 deg. C., fell to 0.38 watt at 500 deg. C., and decreased to zero at 750 deg. C. It was found that the variation in hysteresis loss with change in magnetic density at each temperature followed an exponential law, with the exponent being very closely 1.6.

In the paper by Mr. Robinson the general requirements in the commercial testing of sheet iron for hysteresis loss were summarized as follows:

First, the accuracy of the test results should be such that the error obtained will be small in comparison with the unavoidable error in assuming the test sample to represent the actual average quality of the material.

Second, the dimensions, weight and treatment of the sample should be such that the results may represent the average material from which they are taken to as great an extent as is possible.

Third, if without sacrificing unduly other desirable features samples can be used that will be uniform in dimensions, weight and method of preparation with those used by others, such standard samples should be employed.

Fourth, the entire operation of preparing and testing samples and recording results should be quickly accomplished and at minimum expense for material and labor.

Fifth, the testing should not require the services of specially trained experts or the use of delicate special instruments.

Mr. Robinson described two methods for accomplishing the result desired, namely, one involving the use of a ballistic galvanometer and the other the use of a wattmeter. In one of the testing sets described the samples tested were cut in strips 0.5 in. wide by 10 in. long and assembled to a weight of 1 lb., the height of the sample being about 0.75 in. The exciting mmf was furnished by a small motor-generator set driven from a storage battery, so as to produce a frequency of 10 cycles per second. A low value of frequency was chosen in order to reduce the eddy-current loss as much as possible. The current was passed around the sample as in a solenoid with open ends, the magnetic flux returning through the air. The solenoid contained three windings, one to magnetize the sample, one to supply the potential circuit of the testing wattmeter and the third for determining the flux density at the middle of the sample by means of a voltmeter. The author stated that the loss per pound was based on the assumption that the flux surrounded by the coil placed at the center of the sample should bear a ratio of 1.3 to 1, as compared with the value which would be needed for the same loss in a uniformly magnetized sample.

In the second type of apparatus four solenoids were mounted in order to form a rectangular magnetic circuit with open spaces at the corners. In this case the circuit is much more nearly closed than in the former, so that the inequality of distribution of flux along the samples amounts to not more than 8 per cent, and the error due to the inequality in the flux is much less than 1 per cent. The total weight of the iron used in the test according to this arrangement is 10 kg (22 lb.).

The author remarked that the accuracy that can be obtained in testing 1-lb. samples should be considered as subject to a possible variation of 5 per cent from the actual hysteresis loss in any given sample. In the arrangement where the 22-lb. samples are employed the total loss is subject to a variation of not over 2 per cent of the true value. The accuracy obtainable with either arrangement was considered to be well within the limits of the ability of the producers of sheet steel to secure uniformity of product and of designers to produce definite results with material of uniform and known quality. Concerning the cost of testing, the author stated that, including the cost of the material, the expense per sample tested would be from ten to twenty times as great with the 22-lb. arrangement as it would with the 1-lb arrangement. He expressed the belief that the small-sample arrangement is eminently suited to such situations as require a very large number of tests and where the cost of labor and material in testing is important.

Discussion.

Dr. Clayton H. Sharp outlined some of the improvements in methods and apparatus for magnetic testing and also some of the difficulties encountered in this class of work. He claimed that there is a pressing need for a universally agreed upon method of testing magnetic material in sheets. Such a method might be prescribed by the standardizing committee of the A. I. E. E. to be used by all who wish to make hysteresis tests.

Dr. Edwin F. Northrup called attention to the decreased iron losses with increase of temperature, and suggested that a prolonged series of tests should be made upon properly insulated transformers operated at, say, 200 deg. C. He expressed the opinion that asbestos-covered wire and some of the new insulating compounds would prove suitable for use at such a temperature.

Mr. J. A. Capp remarked that an experience of about ten years with the apparatus employing a bundle of 10-in. x 5-in. strips proved that when a line of machines has been designed using material which has been tested in this apparatus the test data obtained from such machines may be used to determine the core loss of machines of new designs. By reason of the speed with which results may be obtained and the comparatively small weight of material required, considerable commercial use is being made of this testing outfit.

Mr. Lewis Chubb claimed that better results can be obtained with samples which are heavier than the 1-lb. samples and lighter than the 10-kg samples, namely, samples weighing about 15 lb. and having dimensions of 15.5 in. x 1 3/16 in.

Mr. B. R. Treat said that the 1-lb. apparatus is economical only for those who require many tests per week. Where few tests are required per week the 10-kg apparatus is the more economical, because of the use of commercial testing instruments.

Mr. W. J. Woodbridge said that the eddy-current loss in silicon steel sheets cannot be calculated from the known value of the specific resistance and the thickness of the sheet.

Dr. W. R. Whitney in a written communication claimed that it is desirable to employ as small samples as possible for test, because heat treatments, compression, bending experiments, etc., can be performed on them more easily than on large samples. One-pound samples are small enough so that care and storage of them are not serious matters, while even the cost of samples is a factor with the 10-kg apparatus.

Mr. Carl J. Fechheimer said that although the constants derived from the tests of samples can be used directly in transformer design, they cannot be used in the design of armature teeth and cores, by reason of the non-uniform flux density.

Photometry and Sign Lighting.

At a meeting of the New York Section of the Illuminating Engineering Society held on April 13 the plan inaugurated several months ago of having papers on both theoretical and practical subjects was carried out. Two of the papers were of a technical nature, dealing with photometric relations, and the third paper was one covering the practical subject of sign lighting, being the first paper on this subject thus far presented before the Illuminating Engineering Society.

In a paper entitled "The Photometry of Mercury Vapor Lamps" Dr. Joseph C. Pole described at considerable length the photometric relations concerning straight light-lines. In formulating his equations he assumed that the law of inverse squares and the cosine law were applicable. He deduced equations for showing the illumination produced on a plane parallel to the light-line and on a cylinder concentric with the light-line and a sphere concentric with the light-line. He made the surprising statement that "the proposition of determining the total luminous flux of a light-line, in distinction to point sources of light, is an indeterminate problem if the surface inclosing the light-line for which the luminous flux is to be calculated be not simultaneously defined." However, he showed that in the case of a concentric sphere of infinite radius the total flux produced by a light-line of the character assumed was equal to the quantity $\pi^2 JL$, where J is the apparent "radial candle-power" per centimeter of length and L is the length of the light-line. Dr. Pole used this value of candle-power as his unit in photometric dimensions. The mean spherical reduction factor of a candle-power thus defined is 78.54 per cent. Dr. Pole described tests for luminous output made upon mercury-vapor lamps operated at various current values. In photometering the lamp a section of the tube was isolated by screens, so as to become the equivalent of a point source of light when photometered in a radial direction.

Mr. Bassett Jones, Jr., presented a paper entitled "Polar Curves of Finite Line and Surface Light Sources." The author deduced certain photometric relations and showed by means of these and also by test data that, in so far as the surface source can be considered as perfectly diffusing, the apparent polar candle-power curve becomes the arc of a circle when photometered at a distance from the source large in comparison to the maximum dimensions of the source.

In a paper on "Sign Lighting" Mr. O. P. Anderson described a large number of signs of various types and explained the operation of the flashers used with talking and signs of similar character. He described the methods now in use for utilizing low-voltage sign lamps on high-voltage circuits, which are particularly advantageous when tungsten lamps are employed. He expressed the opinion that when tungsten lamps are used it is not economical to "flash" less than ten lamps at one time, on account of the necessity for connecting at least that many lamps in series at commercial operating voltages. On this account where spectacular effects are to be produced it is often necessary to employ carbon lamps. In comparison with carbon lamps the tungsten lamp possesses an advantageous characteristic in reaching its full brilliancy in approximately 0.04 second, as compared with at least 0.26 second with the carbon lamp.

Discussion.

Dr. K. Norden, in discussing Dr. Pole's paper, claimed that a mercury-vapor lamp can be treated as a point source of light, and photometered on this basis, when the distance between the photometric screen and the lamp is not less than 2.5 times the maximum dimension of the lamp.

Mr. S. W. Ashe stated that when a commercial form of mercury-vapor lamp is photometered at a distance of not less than 20 ft. the average of measurements made in three directions can be considered as a proper basis upon which to calculate the mean spherical candle-power of the lamp. Tests of this nature have shown that the total number of lumens given by a lamp is constant, independent of the distance, although the apparent value of the lumens would vary considerably when photometering a lamp at a shorter distance.

Dr. A. S. McAllister called attention to the fact that a mathematical line may be considered as having a cylindrical surface of infinitesimal diameter, or as composed of an infinite number of point sources. The calculations relating to these different types of sources are not identical, although when applied to any practical lamp the results obtained do not differ greatly. He expressed the opinion that the mercury-vapor lamp corresponds more nearly to a line source made up of an infinite number of points than it does to a source of the cylindrical surface type.

Mr. A. A. Wohlauer derived some formulas for showing the photometric relations involved in plain circular surface sources, and claimed that similar conclusions can be derived for line sources.

Mr. Bassett Jones, Jr., called attention to the fact that the statement by Dr. Pole relating to the variation in the total luminous flux according to the shape and size of the inclosing surface is either incorrect in itself, in being contrary to the law of conservation, or does not properly express the thought which the author had in mind. He contended that although the equations might show a variation in the total flux there is no actual variation in the flux and the apparent variation is due either to inaccuracies in the calculations or to lack of accurate physical significance to the quantity designated as the total flux.

In discussing Mr. Anderson's paper Mr. A. J. Marshall remarked that the slowness of the carbon lamp in reaching its full brilliancy can be overcome by selecting for a flasher installation lamps rated at somewhat less than the voltage at which they will be operated.

Mr. A. A. Wohlauer described various types of reflectors which can be employed in billboard illumination, and remarked that much of the work connected with the design of signs involves strictly illuminating engineering, rather than purely electrical engineering.

Mr. A. L. Powell explained that when colored lamps are used with signs it is found that the life of the lamp depends to a slight extent upon the color of the bulb. This variation he attributed to absorption, and stated in this connection that the life of the blue lamp is less than that of a red lamp, on account of the extra absorption of the former.

In closing the discussion Mr. Anderson remarked that in connection with the use of specially designed reflectors for billboard illumination one of the most difficult features resides in the accumulation of dust upon the reflector surface. Even with the simplest form of reflector used in the most advantageous position a cleaning once a week is highly desirable.

The secretary announced that at the meeting of the section to be held on May 12 a paper relating to the psychology of light will be read by Professor Woodworth, of Columbia University. On June 8 Mr. S. W. Ashe will read two papers, one of which will deal with the comparison of illuminants and the other with the training of students in illuminating engineering.

Convention of the Missouri Electric Association.

The fifth annual convention of the Missouri Electric, Gas, Street-Railway and Water-Works Association was opened at the Hotel Jefferson, St. Louis, Thursday morning, April 13, by President R. J. Irvine, of Marshall, with an attendance of about fifty members. The convention was welcomed to St. Louis in a speech by Mayor F. H. Kreismann. Following the reports of the association's secretary, Mr. N. J. Cunningham, of Springfield, a number of new company members were voted into the association, and on motion of Mr. Alten S. Miller, of St. Louis, after discussion by Messrs. C. C. Barnard, George Rosenthal, C. L. Clary, P. A. Bertrand and F. E. Murray, it was voted to construe the existing constitutional membership clause so as to admit representatives of municipal plants previously excluded from the organization.

CENTRIFUGAL PUMPS.

On Thursday afternoon Mr. W. H. Reeves read a paper on "Centrifugal Pumps." Although simple in construction, the engineering design of these pumps, said Mr. Reeves, involves complex considerations. The impeller peripheral speed is governed by the head to be developed, while the conditions of quantity to be delivered and speed of operation must also be satisfied. Centrifugal pumps may be arranged in series or in parallel, increasing the pressure or quantity delivered as desired. They are usually operated at 70-ft. head or less per stage, while turbine pumps, which differ from centrifugal pumps by the addition of diffusion veins, are run at about 100 ft. head per stage. The presence of diffusion veins aids in converting velocity into pressure and avoids the losses due to shock. Acceptance tests for pump units should be made at the contract conditions, the fact that a pump delivers more than its rated output, for example, being no criterion of its efficiency under specified conditions. Pumps can be designed both to deliver nearly constant head over a wide range of volume or a nearly constant volume in spite of pressure variations. Pumps for dry-docks exemplify the latter condition. Bronze is the best material for pumps, since in use it develops least friction and corrosion. For plants above 1000 hp capacity centrifugal boiler-feed pumps can be used to advantage. Such pumps cannot develop excessive pressures much above their rated head, and so require no relief valves. In non-condensing plants such pumps may be motor-driven. In condensing plants, where the feed water is heated by the exhausts from the auxiliaries, the pumps, too, are best driven by a non-condensing steam unit. Mr. Reeves also describes a new centrifugal jet-type condenser. Where office-building elevators are operated hydraulically motor-driven turbine pumps can be used to advantage to develop the required pressure. In the case of the Century Building, St. Louis, cited by Mr. Reeves, steam pumps occupying 230 sq. ft. of space were replaced by a 100-hp motor-driven, high-speed, four-stage turbine pump requiring 32 sq. ft. of space. The six elevators use water at 225 lb. pressure and keep the motor running about 40 per cent of the time, during which it is 75 per cent loaded. For water-works pumping, centrifugal units avoid excessive pressures and water rams. Prof. H. B. Shaw, of the University of Missouri, brought out the point that centrifugal pumps should be rated at their output of maximum efficiency. Mr. H. H. Humphrey, St. Louis, explained objections against submerged pumping from deep wells, declaring that with the proper alignment and support of the long shaft and pumping unit under such conditions good efficiencies were difficult to obtain. Messrs. John Hunter and A. S. Miller, of St. Louis, also discussed the mechanical efficiencies of centrifugal pumps, which range in the vicinity of 70 per cent.

LUBRICATION.

Prof. E. A. Flowers, of the University of Missouri, Columbia, reported to the association progress and results already obtained in a series of experiments he is conducting to study cylinder and bearing lubrication and friction under actual service conditions with various temperatures, pressures and speeds. The interesting results pointed out thus far will be given in a future issue of the *Electrical World*, together with an illustrated account of the apparatus used. The paper was discussed by Messrs. P. A. Bertrand, A. S. Miller, W. W. Humphrey and C. L. Clary.

EMPLOYERS' LIABILITY.

Following this discussion ex-Judge Daniel G. Taylor, of St. Louis, appeared before the association to explain a plan of employees' and public liability insurance conducted on a reciprocal arrangement between the public-service corporations subscribing to it. This plan is designed to avoid the heavy business-getting and administration expenses of the old-line companies, instituting better inspection and better selecting risks and reducing the cost of insurance to member companies.

ILLUMINATION AND STREET LIGHTING.

Following the elaborate banquet at the Hotel Jefferson Thursday evening, tendered to the Missouri Association by the League of Electrical Interests of St. Louis, Mr. W. D'A. Ryan, illuminating engineer for the General Electric Company, delivered an address on "Illumination and Street Lighting," illustrated by several hundred lantern slides. After tracing the development of the earliest crude forms of arc and incandescent lamps, generators and motors, Mr. Ryan discussed the distribution characteristics of the modern illuminants for indoor and street lighting, exhibiting a number of handsome slides. Hand-colored and Lumière-process plates were also shown of the electric aurora and scintillator effects produced by batteries of projector searchlamps at Niagara Falls in 1907 and at New York during the Hudson-Fulton celebration. A number of novel, ingenious and freak lighting schemes proposed at various times were also shown and explained. By an arrangement of lenses images of open-arc, inclosed-arc, magnetite and luminous-arc flames were projected on a screen for comparison, and by the aid of a powerful lantern the gorgeous colors of the diffraction bands in soap-bubbles were magnified on the canvas.

Mr. John F. McGlensey, illuminating engineer for the Union Electric Light & Power Company, St. Louis, gave a practical talk on illumination and the work of his office Friday morning, demonstrating the use and application of various types of reflectors. The St. Louis central-station company offers the services of its expert to householders, contractors, architects, merchants, or any others planning schemes of illumination. This advice is free and involves no obligations of any kind to any customer or electric-fixture maker or dealer. The local problems are individually studied and the best solution offered, the illuminating department having "nothing to sell but satisfaction." Mr. McGlensey preached against glare from unshaded lamps, declaring that the intrinsic brilliancy of the tungsten filament is about 1000 cp per square inch, or half that of the sun itself when on the horizon. By the use of various kinds of extensive, intensive, concentrating, focusing and compound prismatic reflectors, glass and steel shades, etc., he showed how the light flux from any source can be quite accurately controlled for any desired purpose. Mr P. A Bertrand suggested that in arranging a double row of lamps on a ceiling the lamps should be placed rather nearer the walls, the total width being divided into five parts, three of which should be between the rows of lamps. This arrangement secures a more uniform intensity of illumination in the room.

ELECTRIC VEHICLE.

Mr. Hermann Spoehrer, secretary and treasurer of the Union Electric Light & Power Company, of St. Louis, read a paper on "The Electric Vehicle," showing how important a factor in the central-station output battery-charging may become with its heavy off-peak demand. There are now 500 electric vehicles in St. Louis as a result of the stimulation afforded by the central-station company, which operates two exclusively electric garages, one for pleasure vehicles and one for commercial trucks. Mr. Spoehrer exhibited a table showing the demand and consumption of typical electric vehicles compared with other energy-consuming devices. Following his paper Mr. C. E. Michel, electric-vehicle expert for the Union Electric Company, exhibited a number of stereopticon slides showing recent electric-automobile types.

ORNAMENTAL STREET LIGHTING.

Mr. N. J. Cunningham, of Springfield, read a paper on "Ornamental Street Lighting" in which he discussed arch, bracket and curb-post tungsten lighting and flaming-arc lighting, all of which systems are exemplified in Springfield. Often the installation of a single block of ornamental lighting will prove contagious to other business sections, said Mr. Cunningham, but he advised central-station managers to allow merchants or others to initiate the ideas of such special illumination. Where possible the handling of the later operation of the system through a civic association or other third party will avoid arguments and annoyance for the central station. Mr. Cunningham described his own installations, and the subject of ornamental street lighting was further discussed by Prof. H. B. Shaw and Messrs. O. H. Caldwell, P. A. Bertrand and C. L. Clary.

Mr. Samuel Hobson extended to members of the association a cordial invitation to join the Sons of Jove, whose rejuvenation was held that evening.

DISTRICT STEAM HEATING.

Mr. H. C. Kimbrough, of Chicago, read a paper on "District Steam Heating" at the afternoon session, in which he recounted the advantages of steam heat from the customer's viewpoint and cited examples of the profitable income derived by central stations which have installed such systems. The figures quoted in this paper, together with the discussion by Professor Shaw and Mr. Bertrand, will be given later.

GAS MANUFACTURE.

Mr. P. A. Bertrand, of Jefferson City, read a paper comparing the advantages of coal-gas and water-gas manufacture. In concluding he pointed out that for combination plants engaged in generating electricity by steam power the water-gas plant will prove most advantageous on account of the presence of boiler equipment for generating the steam used in water-gas making, and also because of the short-hour operations of the latter process, rendering the plant labor available.

As the guests of the Laclede Gas Company, of St. Louis, members of the association were taken in automobiles to the company's South Side plant, where coal-gas and water-gas equipment is installed for producing 14,000,000 cu. ft. of illuminating gas per day. Modern electrically operated Debroew coal-projecting machines are used to charge the retorts. The crushed coal dropped from overhead bunkers is weighed in overhead hoppers on the motor-driven moving platforms of the projectors. From these hoppers it falls onto rapidly moving belts, the direction of which is suddenly changed by pulleys, so that the coal is projected at high velocity into the open doors of the retorts. In this way 1400 lb. of coal is charged into a retort in one minute. After completing the charging of one retort the projector car moves to the next. The projecting-belt apparatus can be elevated to charge into any of three levels of retort openings. An electrically driven ram is also used for "drawing" the retorts, pushing the incandescent coke through an opening on the opposite side of the oven. The exhaust lines from the various blower and auxiliary engines about the gas plant are led to a 300-kw Westinghouse exhaust-steam turbine-generator set, which furnishes energy for the plant motors and for part of the electrical commercial load of the Laclede Gas Company. This turbine receives steam at about atmospheric pressure, and exhausts into a Le Blanc condenser with a cooling tower, which maintains a 27-in. vacuum.

ELECTION OF OFFICERS.

On Saturday morning, following the report of Mr. H. Spoehrer, chairman of the committee on construction and by-law revision, the Missouri association unanimously elected officers as follows: President, Mr. F. E. Murray, Louisiana; vice-presidents, Messrs. P. A. Bertrand, Jefferson City; J. E. Harsh, Joplin, and C. L. Clary, Sikeston; secretary and treasurer, Mr. N. J. Cunningham. Executive committee: Messrs. R. J. Irvine, Marshall; H. Spoehrer, St. Louis; P. W. Markham; R. Scott, Kansas City, and C. C. Barnard. Advisory committee: Messrs. P. A. Bertrand, W. A. Bixby, Springfield, and Alten S. Miller, St. Louis. Finance committee: Messrs. S. M. Locke, Mexico; H. D. Hibbler, Washington, and R. B. Boyce. Upon the invitation of Mr. J. E. Harsh, of the Empire District Electric Company, at Joplin, Mo., the association voted to hold its next convention in that city.

Mr. F. E. Murray, the newly elected president of the Missouri association, is secretary and superintendent of the Louisiana Light, Power & Traction Company at Louisiana, Mo.

ENTERTAINMENT FEATURES.

The entertainment features of the convention opened Thursday evening with the elaborate banquet at the Hotel Jefferson, which was followed by Mr. W. D'A. Ryan's illustrated address. This affair was tendered the association by the St. Louis League of Electrical Interests, the officers and committees of which took an active personal interest in the entertainment of the delegates throughout the convention. Thursday evening the visiting ladies were entertained at a theater party and on Friday afternoon were taken on an automobile ride through the city. Saturday evening the convention members attended in a body a specially revised bill at a vaudeville house. Friday afternoon they visited the Laclede Gas Company's plant, as already mentioned, and Saturday noon they were the guests of the Union Electric Light & Power Company at its great Ashley Street generating station, where an electrically cooked luncheon was served. Saturday afternoon the delegates inspected the St. Louis water-works and sedimentation beds at Chain-of-Rocks on the Mississippi River.

Corporation Commission of Oklahoma.

Mr. George P. Player, telephone engineer of the Corporation Commission of Oklahoma, was a guest at a recent meeting of the Electric Club of Chicago and by invitation spoke briefly of the work of the commission. This commission, which supervises the public-service corporations of Oklahoma, was established about three years ago. It tried at first to investigate the conditions demanding its attention without technical assistance, but it was found necessary to secure trained men to advise it in the large proportion of questions requiring its attention which involved technical considerations. The commission is ascertaining the cost and the replacement cost of the properties of all public-service corporations. It has issued an order requiring these companies to make sworn reports giving the cost of all parts of their plants. To ascertain the replacement cost it is necessary to take an actual inventory of the plant and this the telephone department of the commission has done in several cases.

Referring to the famous Enid telephone case (see *Electrical World* of Jan. 26, 1911, page 214), in which the Supreme Court of the State reversed the commission when the latter ordered the Pioneer Telephone & Telegraph Company not to make a proposed increase in rates, Mr. Player said that the Attorney General has asked for a rehearing and hopes that if this is granted the Corporation Commission will fare better. The growth of the telephone business in Oklahoma is very marked, it having been about 30 per cent in the last year and a half. The Bell company has lines over nearly the entire State and operates 117 exchanges. The use of the telephone is very general and the telephone traffic in the principal cities is particularly heavy in comparison with the number of stations. In conclusion the speaker said that the Corporation Commission of Oklahoma is trying to help the companies as well as the consumers and is becoming somewhat more conservative as it measures the magnitude of its task. It is no doubt the hope of the commission that it will serve eventually as a board of arbitration between the public-utility corporations and the people.

Discussion of Commission Regulation in Chicago.

Alderman W. J. Pringle, chairman of the Chicago City Council committee on gas, oil and electric light, was the first speaker at the meeting of the Electric Club of Chicago on April 5, which was devoted to a discussion of the proposed commission regulation of public-service utilities in the State of Illinois. The alderman gave an account of the public-service commissions of Wisconsin, New York and Massachusetts, and remarked that in the last-named State it is proposed to consolidate a number of existing commissions into two, one to have jurisdiction over Boston and the other over the remainder of the State. Personally, the speaker does not think it material whether there are one, two or more commissions in Illinois. The public-service corporations in Chicago, at present dealt with by the City Council, are of great magnitude and might better be under the supervision of a commission of trained men. In the relation of the public-utility corporations and the public many important questions came up, such as valuation of plants, depreciation, proper return to stockholders, methods of operation, amount of capitalization, going value, rates and complaints. There are two sides to each of these questions, and their equitable adjustment requires the best efforts of highly trained specialists.

In relation to the half dozen or more bills pending at Springfield proposing the creation of public-service commissions, Alderman Pringle made the interesting statement that he did not look for any legislation at this time. However, one or more public-service commissions are sure to come in Illinois, and the question should be widely discussed so that the people may be educated. The municipal authorities who have control of these questions now are naturally loth to relinquish that control for political reasons. None the less, the question of regulation of public utilities should not be a question of politics, but one of political economy. In relation to rates, the alderman said that it was obvious that efficient service was not apt to be continued for any length of time unless a fair price is paid for that service. He thinks the companies themselves should favor the commission idea. The public-utility field is to be considered as a natural monopoly to be regulated by government. The corporations must be assured of a long tenure of operation if held down to a low rate.

Mr. George Weston, representing the City of Chicago on the Board of Supervising Engineers, Chicago Traction, gave a summary of the work of this board in supervising the rehabilitation and operation of the surface street-railway systems in Chicago. He expressed the opinion that public-service commissions will generally reach a more satisfactory conclusion if there is one commission to deal with each class of utilities rather than a general commission having supervision of gas, electric light, street-railway, telephone, water-works and other utilities. The Board of Supervising Engineers is composed of men who have made electric traction a life study, and its work has been beneficial. It is composed of one member representing the city, another representing the company affected and a third who is the chairman and umpire. This arrangement has been very satisfactory and it leads Mr. Weston to think that the companies interested might very well be represented on the proposed State commissions. The speaker made a plea for practical, qualified, experienced men on the public-utility commission rather than a board composed of lawyers exclusively. In making appraisals, for instance, it is of great importance that the work should be done by men who have practical knowledge of the plant under valuation and how it is used in actual service.

Mr. Frank F. Fowle, consulting engineer, who drew up the Brown bill pending in the Illinois Senate, was next called upon. He said that about one-third of the states of the Union have public regulation in some form, and claimed that both the public and the utilities must be protected. The right of petition should be given to both, and rates should not be either unreasonably high or unreasonably low. Mr. Fowle praised the Wisconsin law and the manner in which it is administered. In that State rates are fixed absolutely, whereas in New York only the maximum rates are determined. In the Brown bill one single state-wide commission is proposed for Illinois. The experience of New York, where there are two commissions and where an inquiry is now in progress in relation to the great expense of conducting the New York City commission, seems to show that one state-wide commission is preferable on the score of economy at least. There are other arguments in favor of the single commission, and the speaker enumerated several. For instance, a single commission will not have its jurisdiction divided in any case by geographical boundaries. It will be subject in the least degree to local political influence, and there will be no divided jurisdiction in case of companies giving various classes of service, as, for instance, is the case with a combined electric light and street-railway company.

Public Service Commission Law in State of Washington.

An act creating a Public Service Commission was approved by the Governor of the State of Washington on March 18. It makes the valuation of the property of every service company mandatory upon the commission. The members of the Railroad Commission constitute the first Public Service Commission. The most important provisions affecting electrical, telephone and telegraph companies are summarized below.

All charges made by gas, electric and water companies shall be just, fair, reasonable and sufficient. Every company shall supply such service, instrumentalities and facilities as shall be safe, adequate and efficient. Every company shall file with the commission, and shall print and keep open to public inspection, schedules in such form as the commission may prescribe showing all rates and charges and all general privileges and facilities. No change shall be made in any rate or charge, or any form of contract, or in any general privilege or facility, except after thirty days' notice and publication. For good cause, however, the commission may allow changes without this notice. No company shall charge any different compensation for any service than that indicated in the schedule, except that its product may be furnished at free or reduced rates to employees and their families, and officers, attorneys and agents, as well as to charitable institutions. No company shall grant any undue or unreasonable preferences or unjust discrimination, but there is no prohibition against a sliding scale of charges permitting a greater charge per unit for a less than for a greater quantity. Nothing in the act shall be construed to prevent the company from continuing to furnish its product or service at the rates fixed in any contract that may be in force when the act takes effect or on the effective date of any schedule filed subsequently. However, the commission shall have power in its discretion to direct by order that electrical contracts shall be terminated.

All rates of telephone and telegraph lines are to be fair, just, reasonable and sufficient, and all facilities, instrumentalities and equipment are to be safe, modern, adequate and to be kept in good condition and repair. Schedules shall be filed with the commission and printed and kept open to public inspection. No change shall be made in rates except after thirty days' notice, but for good cause the commission may allow changes without this notice. Regular and uniform charges to all persons and corporations under like circumstances for like or substantially similar service shall be extended. No free or reduced service shall be given, except to officers, employees, agents and others connected with the companies and their families, and charitable and religious institutions, etc. There shall be no unreasonable preferences. Existing contracts shall be carried out, except that the commission shall have power in its discretion to direct by order that they shall be terminated. No company shall charge any greater compensation in the aggregate for the transmission of a long-distance message of like kind for a shorter than for a longer distance over the same line in the same direction within the State, the shorter being included within the longer distance, or charge any greater compensation for a through service than the aggregate of the intermediate rates. This shall not be construed as authorizing any company to charge as great a compensation for a shorter as for a longer distance. The commission may authorize a less charge for a longer than for a shorter distance service in special cases after investigation. Every company shall receive, transmit and deliver without discrimination or delay the message of any other telephone or telegraph company.

Whenever after a hearing upon its own motion or upon complaint the commission shall find that rates or practices are unjust, unreasonable and unjustly discriminatory or unduly preferential, or in any wise in violation of the law, or that they are insufficient to yield a reasonable compensation for the service rendered, it shall order just, reasonable or sufficient rates. Whenever it shall find after a hearing that the efficiency of electric-lamp supply or the voltage of the energy supplied for lamps or motors is inadequate, it shall order such improvement as will be just and reasonable. Whenever the rules, regulations, measurements or standard thereof are unjust, unreasonable or inadequate, or any service which may be reasonably demanded is not furnished, it shall fix reasonable rules by order. Whenever it shall find after a hearing that repairs or improvements ought to be made, or that any additions or extensions should reasonably be made, either for the convenience or security of the public and employees or to secure adequate service, it may order that they be made. It may order physical connections and joint rates between two or more telephone or telegraph companies and may appoint inspectors of electric meters. No company shall put in use any meters the type of which shall not have been approved by the commission. Every such company shall prepare such forms, apparatus and facilities as may be required by the commission for testing meters. The commission shall have meters tested on complaint of consumers. If an electric meter is more than 4 per cent defective to the prejudice of the consumer the expense shall be borne by the company, otherwise the expense shall be borne by the consumer. The commission shall fix rates for the testing of meters.

The commission shall have the right at any time to inspect accounts, books, papers and documents of any public-service company. Every company shall furnish annually to the commission a report in such form as the commission may require. The commission may in its discretion prescribe the forms of all accounts, records and memoranda to be kept. No complaint as to the unreasonableness of rates shall be entertained except upon the motion of the commission, unless the same be signed by the mayor, council or commission of the community affected, or not less than twenty-five consumers. Any complainant or company affected by an order of the commission, deeming it contrary to law, may apply to the Superior Court of the county in which the proceeding was instituted for a writ of review within thirty days after the service of the order for the purpose of having its reasonableness and lawfulness determined. After the entry of judgment in the Superior Court, the commission or any public-service company or complainant may appeal to the Supreme Court of the State.

The section relating to the valuation of property provides that the commission shall ascertain the cost of construction and equipment, the amount expended in permanent improvements and the proportionate amount of such permanent improvements charged in construction and operating expenses respectively, the present as compared with the original cost of construction and the cost of reproduction of the property of every public-service company. It shall ascertain the total market value of the securities and of the property of every public-service company, the time intervening between the expenditure of money in the cost of construction and the time when dividend returns were first received, the probable earning capacity of each company under the rates now charged and the sum required to meet fixed charges and operating expenses, the density of traffic and population, whether the expenditures already made by any company in procuring the property were such as were justified by the existing conditions and such as might reasonably be expected in the future, and whether the money expended had been reasonable for the present needs of the company and for such needs as may reasonably be expected in the immediate future. Hearings are to be held for the purpose of ascertaining the value of such properties. The commission shall render findings of fact in writing concerning all matters respecting value. Any company affected may institute proceedings in the Superior Court of the county, if it believes such findings to be contrary to law or the evidence introduced, and decisions of that court may be appealed to the Supreme Court of the State. Nothing less than the market value determined by the commission shall be taken as the value for taxation. Further hearings shall be held from time to time for the purpose of ascertaining the betterments and additions made by any company subsequent to the date of prior hearings.

If the commission is of the opinion that any company is failing or omitting, or is about to fail or omit to do anything required of it by law or order of the commission, it shall direct the Attorney General to commence an action for the purpose of having such violations or threatened violations prevented. Every public-service company which shall violate any provision of the act or any order of the commission shall be subject to a penalty of not to exceed $1,000 for each offense. Every officer, agent or employee who shall violate any provision of the act or any order of the commission or aid in such violation shall be guilty of a gross misdemeanor. Similar penalties are provided for corporations and persons other than those engaged in public-utility service. Nothing in the act shall authorize the commission to make any order affecting rates or facilities of any street railroad, telephone line, gas plant, electrical plant or water system owned and operated by any city or town. The sum of $118,146 is provided for carrying out the provisions of the act.

Annual Report of New Jersey Public Service Corporation.

The annual report of the Public Service Corporation of New Jersey for the year ended Dec. 31, 1910, shows that of the $27,672,846 gross earnings of leased and controlled companies $5,872,238, or 21.2 per cent, was received from the electric properties. The railway properties contributed $13,308,726 and the gas properties $8,491,882. In addition to these totals the corporation received as income from securities pledged and from miscellaneous sources $1,532,347. The revenue of the controlled electric properties showed an increase of $754,510, or 14.7 per cent, over the preceding year. During the seven months of the existence of the corporation in 1903 the revenues of the electric properties were $1,776,558. In the full year 1904 they were $3,502,812. Increases over the preceding year have been shown in each year with the exception of 1908.

Under the plan of organization of the company the subsidiary properties of different classes of utilities are operated by the Public Service Railway, the Public Service Gas Company and the Public Service Electric Company. The latter was the last one of the three companies to be formed. It was organized on June 13, 1910, and, except directors' qualifying shares, all the stock is owned by the corporation. The leases of electric properties held by the corporation were assigned to the new company, which also leased the power plants and substations of the railway company. During the year the entire capital stock of the Burlington Electric Light & Power Company and 90.2

per cent of the capital stock of the Princeton Light, Heat & Power Company were acquired.

The general mortgage 5 per cent bonds of the company were listed upon the New York Stock Exchange, and since the close of the calendar year the capital stock has also been listed. On Oct. 1 the corporation sold $4,000,000 of 5 per cent three-year collateral notes for the purpose of raising funds to pay the cost in part of betterments and extensions. The improvements completed during the year include a substantial addition to the Marion electric generating station. The corporation has moved into its new office building in Newark, where a lunchroom has been provided and lunches are furnished daily to 600 employees of the corporation without cost to them. An insurance, sick-benefit and pension fund was established on Jan. 1, 1911. Mr. Thomas N. McCarter, president of the corporation, says that it is estimated that the application of this system will cost the corporation approximately $50,000 annually for the first few years and more thereafter. Regarding the Board of Public Utility Commissioners of New Jersey he says that it is a pleasure to say that the commissioners have entered upon their duties seriously and with a due regard to the importance of the interests to be supervised by them, and that the relations of the companies owned by the corporations with the commission have been and are both cordial and agreeable.

Capital charges on account of the electric system aggregated $2,111,737 during the year. The balance sheet of the Public Service Electric Company as of Dec. 31, 1910, shows the cost of plant, real estate and property as $6,877,443, and investments of $207,843. The capital stock of this company outstanding at the end of the year aggregated $6,750,000, and there were mortgages payable of $261,750. The sum of $900,000 advanced by the corporation has been paid since by the issue of stock. The development of the electric business is shown by the accompanying statement. The increases are affected somewhat, but not materially, by properties acquired between June 1, 1903, and Jan. 1, 1911. The total of kw-hours sold has increased from 48,894,308 in 1905 to 89,742,689 in 1910. The number of customers increased from 18,262 at the close of 1903 to 62,539 in 1910. The number of street arc lamps supplied in 1903 was 7745, and this increased by 1910 to 11,441. The number of street incandescent lamps supplied increased from 5733 in 1903 to 16,640 in 1910. The total connected load in kilowatts increased from 45,380 in 1903 to 137,058 in 1910. The company furnishes electric service to 152 municipalities, with a total population of 1,898,059.

TABLE I—ELECTRIC STATIONS

	June 1, 1903	Dec 31, 1910.
Number of generating stations	14	28
Number of boilers	113	219
Number of generators	156	189
Capacity of generators in kilowatts	40,075	124,158
Number of substations	9	42
Number of rotaries	12	73
Capacity of rotaries in kilowatts	5,400	50,200
Kw-hours produced (years 1903 and 1910)	129,614,180	288,740,147

TABLE II—ELECTRIC CONDUITS AND TRANSMISSION LINES. (RAILWAY AND LIGHTING COMBINED.)

	June 1, 1903.	Dec. 31, 1910.
Length of transmission lines (in miles)	47	374
Length of conduits (in street miles)	25	79

TABLE III—ELECTRIC DISTRIBUTION SYSTEM STATISTICS.

	June 1, 1903.	Dec. 31, 1910.
Number of poles	45,059	97,825
Miles of wire	4,244	9,686
Number of transformers	5,336	12,500
Number of meters	16,000	63,186
Number of customers	16,190	62,539
Number of street arc lamps	7,415	11,441
Number of street incandescent lamps	5,517	16,640
Total commercial load connected (in 50-watt equivalent)	710,000	2,613,236

* * *

New York Commission News.

The New York Public Service Commission, Second District, has authorized the Poughkeepsie Light, Heat & Power Company, the Newburgh Light, Heat & Power Company and the Hudson Counties Gas & Electric Company to consolidate in a new corporation under the name of the Central Hudson Gas & Electric Company.

The decision is an important one, indicating as it does various tests applied by the commission in consolidation cases, including the valuation of the properties involved. The opinion in the case was written by Commissioner Martin S. Decker, and among the findings and rulings are the following:

1. That two of the companies operate in practically common territory and the other company in territory adjoining and connected with the others by a transmission system.

2. That the stocks of the three companies are in great bulk held by a common interest, and that the management of all is practically the same.

3. That the corporate relations of these companies have become interconnected and interdependent with common control requisite under contract relations and reciprocal supply of electric energy, and larger economies in management, administration, production and financing would result from consolidation.

4. That each of the companies is in good condition financially and none of the properties is in such condition physically or financially that it would diminish the ability of the consolidated company to give full and adequate service at reasonable rates.

5. That the common capital stock of each company may be properly exchanged share for share for stock of the consolidated company.

6. That the value of each of the two larger properties is in its excess of its capitalization and balance of bills and accounts payable over those receivable.

7. That the fixed capital accounts of all three companies have not been sufficiently credited in the past for retirement of property, and have been charged with replacements under the accounting system employed prior to the prescription of the uniform accounting system by this commission.

8. That examinations by the commission's engineer and special accounting examiner indicate that considerable amounts should be written off from the fixed capital account of each company and that other accounting changes should be made, which are indicated in balance sheets given in detail and consolidated herein for purposes of the case.

9. That necessity for revision of the accounts is demonstrated by the fact that it would be practically impossible to require such revision after a consolidation.

The commission holds that the consolidation should be approved subject to agreement that the balance sheet stated by the commission shall constitute the basis of opening entries on the books of the new or consolidated company and that the new company shall have made under direction of the commission an inventory and appraisal of the permanent assets to be included in the "fixed capital account" according to rules stated, such inventory and appraisal after approval by the commission to be the basis for correcting the books of the corporation as to the accounts for fixed capital. It holds that the new company should be required to maintain separate accounts of its business as to each locality served, showing property employed, income received and expenses incurred, and that certain unissued bonds now held by two of the applicant corporations should be canceled.

The commission has authorized the Niagara Falls Power Company to issue 262 shares of its capital stock, par value

$26,200, and to apply the proceeds of 229 shares heretofore authorized toward the purchase of 491 shares of the stock of the Tonawanda Power Company. The Niagara Falls Company now owns 2009 of the 2500 shares of the capital stock of the Tonawanda Power Company and purposes to acquire the entire capital stock. The company proposes to pay from income the remaining $22,000 principal amount necessary to accomplish the transaction.

The commission has denied the petition of certain residents of Dunkirk and Fredonia asking for a reduction of fare on the Buffalo & Lake Erie Traction Company's lines between Dunkirk and Fredonia. The present rate is 10 cents, with full transfer privileges in both Dunkirk and Fredonia. By reason of the transfer facilities a passenger is now enabled to ride from the furthest transfer point in Dunkirk to the furthest transfer point in Fredonia, a distance of at least 3.5 miles. Further, the company now issues a book of tickets allowing all the privileges of single fare, twenty-four rides, for the sum of $1.25, making a ticket charge of approximately 5¼ cents a trip. The commission believes that the company is, under all the circumstances, charging a reasonable and just fare.

Massachusetts Legislative News.

At an executive committee session last week at Boston Mr. John H. McArthur, of the firm of McArthur Brothers, New York, stated that interests identified with his firm compose the principal financial backing of the Boston & Eastern Electric Railroad Company, which has for several years been endeavoring to secure permission from the Massachusetts Railroad Commission to build a high-speed electric interurban railroad between Boston and the North Shore district. It is expected that the committee on railroads and metropolitan affairs, which has the matter in charge, will shortly submit its conclusions to the Legislature upon the Boston & Eastern bill, which requires the Railroad Commission to issue a certificate of exigency to the company. The question of financial backing has been at the storm center ever since the promoters of the Boston & Eastern Company began their campaign. One of the main contentions of the existing steam and electric railways in the territory has been that the Boston & Eastern plans have not represented a bona fide transportation project. At the above hearing it developed that the company has already assembled about $250,000, and it is known that approximately $125,000 has thus far been expended in engineering and legal services. The feeling is strong in eastern Massachusetts that the time has come for the Boston & Eastern question to be settled. The plans of the organization have been prepared under the electric railroad law of 1906, and no road whose petition has been brought before the Railroad Commission in recent years has received such thorough investigation from the technical point of view. Thus far not a single road has been built under the law of 1906, although the Boston & Providence and Boston & Western companies have received certificates from the commission, and it is expected that construction will be inaugurated in the near future. The chief obstacle to the plans of the Boston & Eastern company is the bill of the New York, New Haven & Hartford Railroad providing for the construction of a tunnel under Boston Harbor, with the establishment of electrified service as a result between Readville and Beverly. No decision has thus far been reached in committee regarding this bill, but matters are rapidly coming to a head.

Opposition to legislation requiring electrification was presented at a hearing last week before the committee on railroads and metropolitan affairs. Mr. J. H. Heustis, general manager of the Boston & Albany Railroad, argued at length that the smoke nuisance has been so much reduced in the Boston suburban district that electricity is not needed on the grounds of cleanliness. He also contended that fares charged suburban traffic would have to be increased 40 per cent if electricity should be adopted between Boston and South Framingham, and stated that the Boston & Albany cannot at present afford to make the change. Mr. Woodward Hudson, counsel for the Boston & Albany Railroad, urged the Legislature to avoid any sweeping action relative to electrification, and said that nothing should be required on the Albany line until electrified service can be worked out on the New Haven company's Readville-Boston service. Mr. William H. Coolidge, counsel for the New Haven interests, also argued that the harbor tunnel electrification should first be effected, and that the cost of electrifying all the lines in the Boston district should not be laid upon the companies in a single act.

Massachusetts Commission News.

A ruling was made by the Massachusetts Gas & Electric Light Commission at a hearing in Haverhill on April 6 in connection with the petition of the Haverhill Gas Company for approval of an issue of new capital stock to the amount of $900,000, the proceeds to be used in the purchase of the Haverhill Gas Light Company's property and franchise. It was contended on behalf of the Municipal Council that the petitioner cannot lawfully apply the proceeds of new capital stock to the purchase of the property of the Haverhill Gas Light Company, for the reason that both the statute and the common law forbid the latter company to dispose of all its property without special legislative authority. The ruling of the board upon this point was as follows: "If the contention of counsel for the city is correct, such conveyance will be void because it is contrary to the statute prohibiting a gas company from transferring its franchise and because of the established common-law principle that a public-service corporation cannot so dispose of its property as to take away its power to perform its public duties. The determination of this board can make such conveyance neither valid nor invalid. That question is for the courts; it is not necessary that the board should attempt to determine it. It is the opinion of the board, however, that the question raised and the transaction to which it relates are of such importance, and that the legality of such a conveyance by the old company to the new is open to such serious doubt, that the board ought not to approve an issue of stock for such a purpose until either the conveyance has actually been made or its legality has been determined by some judicial tribunal."

Maryland Commission News.

The Maryland Public Service Commission has issued an order authorizing the issue of $111,000 of bonds by the Baltimore County Water & Electric Company to defray the expense of extensions, construction and improvements. It also authorized the sale of $100,000 worth of the bonds for immediate use, the other $11,000 to be held as a sinking fund.

Governor Crothers last week approved the Public Service Commission's appointments of extra inspectors to assist Chief Engineer Phelps in his general investigation of the physical conditions of all public utilities throughout the State in compliance with a recent order of the commission. They are as follows: Steam railroads, Mr. John D. Riley; electric roads, Mr. C. G. Edwards; gas works, Mr. L. A. Langham; wharves and piers, Mr. W. A. McDonough; in charge of tabulations, Mr. I. F. Howard. The list is composed entirely of Marylanders, who will work under Mr. Phelps' general supervision. They will be assisted in their investigation by the regular force of inspectors in the chief engineer's department.

City Solicitor Poe has stated that it will be some time before he completes gathering data so that he can submit to the commission the petition of the city of Baltimore urging that the price of electric energy be reduced. Mr. Poe has encountered the same difficulty which Superintendent of Lamps and Lighting McCuen encountered when the electric company refused to supply him with some figures which he desired. It is not expected that the company will supply the data desired until the case comes before the commission, which can require it to show its books.

AMERICAN ELECTRICAL ENGINEERS. XXX.

J. W. Esterline.

Mr. John Walter Esterline was born at Fort Wayne, Ind., Nov. 13, 1874. Entering Fort Wayne College at the age of sixteen to prepare to take up the study of law, he became interested in scientific subjects and changed his earlier intentions in favor of engineering. After completing a preparatory course of four years, he entered on the electrical course of Purdue University, Lafayette, Ind., in 1893, and was graduated in 1897.

For six years following graduation Mr. Esterline was in charge of the students' work in the experimental laboratory at Purdue University, meanwhile supervising the construction of extensive additions to the building and apparatus, and assisting in assembling and conducting the National Electric Light Association photometric laboratory, in which complete investigations of the inclosed-carbon arc lamp and other illuminants were made. In 1903 Professor Esterline took charge of instruction in design of electrical machinery at Purdue, and for several years served as acting head of the department during the illness and following the death of Professor Matthews.

J. W. Esterline.

During his connection with the university Professor Esterline employed his vacation periods and spare time in consulting engineering work, and laid the foundation of a business which in 1908 had grown to such an extent that he resigned from the university staff to devote all of his time to his commercial interests, having in the meantime organized a company to manufacture several types of electrical instruments and other electrical apparatus. Since the organization of the Esterline Company Mr. Esterline has devoted a good portion of his time to consulting engineering and to the design of steam and water-power stations, industrial plants and outdoor illumination.

Mr. Esterline is at present consulting engineer for the Wabash River Power Company, developing a water-power plant on a site on the Wabash River; the Crawfordsville Electric Light & Power Company and the Bedford Power Company. The last-named is carrying on extensive work, including the design and construction of a 10,000-kw combined water-power and steam plant and the electrification of the great oölitic-limestone quarrying and milling district of Bedford, Ind.

The Esterline Company is at present manufacturing a complete line of graphic recording meters, an automatic electric lighting equipment for automobiles and motor-boats; an incandescent locomotive head-lamp; a self-setting, reverse-power circuit-breaker for storage-battery charging; permanent magnets for electrical instruments and ignition apparatus, and several types of magnetic-testing equipment. It recently completed steam power plants for the Frankfort Electric Light & Power Company, Logansport Electric Light Company, Indiana State Soldiers' Home, Indiana Institute for the Deaf and Dumb, C. H. Campbell Furniture Company, the McDougall Kitchen Cabinet Company, American Box Ball Company, Indiana Springs Company and the Indiana Hospital for the Insane.

Mr. Esterline is the inventor of several commercial types of magnetic testing machines, and has given much attention to the subject of magnetic materials. His work on "The Design of Electrical Machinery" has now gone through three editions and is used as a textbook in a number of engineering schools.

Mr. Esterline is a member of the American Institute of Electrical Engineers, the American Society for Testing Materials, the American Society for the Promotion of Engineering Education and the Indiana Electric Light Association, and was a member of the Jury of Awards in the department of electricity of the Louisiana Purchase Exposition. From 1899 until he resigned in 1910 he served as chairman of the committee on magnetic materials of the American Society for Testing Materials. Before this society, in 1903, he presented a paper entitled "Direct-Reading Apparatus for Measuring Core Loss," in which were described original methods for measuring core losses in alternating and rotating magnetic fields. In 1905 he read a paper giving specifications for "A Complete Magnetic Testing Laboratory." Before the American Institute of Electrical Engineers in 1903 he presented a paper with Mr. C. E. Reid on "Some Factors Which Affect Energy Losses in Armature Cores."

CURRENT NEWS AND NOTES.

Terminal Electrification in Chicago.—The commission of seventeen city officials, business men and railroad executives appointed by the Chicago Association of Commerce to make a complete investigation of the electrical problem in Chicago has selected a chief engineer to have charge of the work of the commission. The commission has taken permanent headquarters in the building of the People's Gas Light & Coke Company, South Michigan Avenue and East Adams Street.

Nebraska Convention.—The fourth annual convention of the Nebraska Electrical Association (now affiliated with the National Electric Light Association) will be held in the Lindell Hotel, Lincoln, Neb., on April 24, 25 and 26. This convention will follow the Iowa convention at Davenport so closely that it is believed that many visitors, including representatives of manufacturers and supply dealers, will be able to attend both conventions. Mr. B. C. Adams, of Lincoln, is president of the Nebraska association and Mr. S. J. Bell, of David City, is secretary-treasurer.

Technology Congress Closes.—The Congress of Technology at Boston was brought to a close on the evening of April 12 by a dinner at the Technology Union under the auspices of the Electrical Engineering Society of the Massachusetts Institute of Technology. The chief speaker was Mr. Frank J. Sprague, consulting engineer, New York, who gave a talk on "The Romance and Realities of Engineering." The congress celebrated the fiftieth anniversary of the founding of the institute; it was attended by about 1200 alumni, and demonstrated the fact that the places of scientific education and engineering are well assured for the future. Abstracts of the more important papers of electrical interest were printed in last week's issue.

Electricity in Ice Plants.—At a joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers to be held at the rooms of the former on April 26 Mr. A. C. Smith, of Buffalo, N. Y., will deliver an address on "Electricity in Ice Plants," with lantern-slide pictures.

Meeting of the Electric Vehicle Association of America.—The regular monthly meeting of the Electric Vehicle Association of America will be held in the Engineering Societies Building, New York City, April 25. The topic for the evening will be "The Ampere-Hour Meter for Electric Vehicles," presented by Mr. R. C. Lanphier, of the Sangamo Electric Company.

Chicago Branch of Institute of Operating Engineers.—A meeting of the Waters Council of the recently organized Institute of Operating Engineers, composed mainly of engineers in charge of isolated plants, was held at the rooms of the Western Society of Engineers in Chicago on April 11. Mr. A. Bement, consulting engineer, gave an illustrated address on "Coal and Its Production in Illinois." Mr. Fleming, of the engineering corps of the Board of Education, was elected chairman of Waters Council.

The Institute of Operating Engineers.—On April 13 Mr. J. C. Jurgensen read a paper entitled "Economic Aspects of the Institute of Operating Engineers" at a meeting of the New York branch of the society in the Engineering Societies Building. On May 11 this branch will hold its second monthly meeting, at which Mr. F. L. Johnson will present a paper entitled "The Necessity of Industrial Education." The Isherwood branch of the Institute was organized on March 25, when Mr. F. L. Johnson was elected chairman and Mr. Frank Martin secretary.

Postponement of Exposition of Inventions.—The International Exposition of Inventions, which was to have been held in the Coliseum at St. Louis April 10 to 15, has been postponed until a date some time later in the summer, probably in August. The purpose of the exposition is explained to be that of providing meritorious but unknown inventors with facilities for exhibiting their productions before the interested public and investors. Patented machines, appliances and processes of all kinds will be shown, a special department being devoted to electrical inventions. The manager in charge of the enterprise is Mr. W. K. Small, 511 New Bank of Commerce Building, St. Louis, Mo.

Pittsburgh A. I. E. E. Banquet.—The annual banquet of the Pittsburgh Section of the American Institute of Electrical Engineers will be held at the Rittenhouse Hotel, Saturday evening, April 22, and a large attendance is anticipated. It will be attended by the members and their wives and friends. Mr. Charles F. Scott, consulting engineer of the Westinghouse Electric & Manufacturing Company, will act as the toastmaster, and his well-known ability as a happy speaker augurs well for the success of the occasion. President D. C. Jackson will be present and respond to a toast. Among the other speakers on the program are Rabbi J. Leonard Levy, Dr. R. K. Duncan, of Pittsburgh, and Col. H. G. Prout, general manager of the Union Switch & Signal Company, Swissvale, Pa.

New Home of Chicago Engineers' Club.—Work is under way on the new seven-story building of the Chicago Engineers' Club at 314 South Federal Street, adjoining the Union League Club. The building occupies a lot 25 ft. wide and 100 ft. deep. The first three floors have been leased to a well-known restaurant, but the banquet-room on the third floor is reserved for the exclusive use of the club from 11 a. m. to 3 p. m. The club headquarters will be on the fourth floor, including reception room, office, checkroom, lounging-room and cardroom. The fifth, sixth and seventh stories are to be divided into bedrooms. The Chicago Engineers' Club was organized eight years ago. It is a social club composed mainly of engineers. The total membership at present is about 340, of whom ninety are nonresident members. Mr. James O. Heyworth is president and Mr. Robert I. Randolph is secretary and treasurer of the club.

N. E. L. A. Convention Arrangements.—The hotel committee of the National Electric Light Association, of which Mr. Frank W. Smith is chairman, is taking the active initiative as to convention work by issuing its circular with regard to hotel provision for the convention, from May 29 to June 2, when the meetings will be held at the Engineering Societies Building, New York. The circular of the committee is quite an elaborate piece of work and includes a list of fifty-four hotels, with their location, telephone number and the fullest details as to accommodations and prices. In addition, this circular, which bears on the outside an admirable vignette of the Engineering Societies Building, embodies also a colored outline map of Manhattan Island, showing the location of this building and of every one of the hotels listed, so that the members can see at a glance the relative distance, convenience, etc., of all the accommodations. The map includes also lines of elevated railroad and subway with the stations indicated. An attendance of 3500 is now expected and virtually assured.

Rate Reduction in St. Louis.—On April 12 Mayor Kreismann, of St. Louis, signed the city ordinance reducing the maximum rate charged by the Union Electric Light & Power Company from 12 cents to 9.5 cents per kw-hour. The bill had already passed the two houses of the City Council and had the approval of the Municipal Public Service Commission. After a thorough investigation of the Union Electric company's business this local commission agreed to the correctness of the representations made by the company regarding its rates and revenues, but nevertheless recommended the passage of the rate-reducing measure. The new law will go into effect six months from the date of signing, and will also operate to reduce the minimum service charge to 50 cents a month. President Alten S. Miller, of the Union Electric company, has expressed no decision as to whether the terms of the ordinance will be contested or complied with. The matter of testing the constitutionality of the new ordinance in the courts was to come up at the regular board of directors' meeting of the company April 19.

Special Train for N. E. L. A. Convention.—Mr. G. A. Freeman, of 120 West Adams Street, Chicago, assistant master of transportation for the National Electric Light Association, announces that arrangements have been made with the New York Central Lines for a special train leaving Chicago on the Lake Shore railroad from the La Salle Street Station on Sunday, May 28, at 2:30 p. m. This train will be known as the "Electric Light Special," and it is intended for the use of visitors to the New York convention of the N. E. L. A. The style of the train will compare favorably with that of the finest train operated by the New York Central Lines, the equipment including drawing-room and compartment car, buffet and library car, compartment and observation car, dining cars and standard Pullman sleepers. The fare from Chicago to New York on this train will be $18.15 (party rate). Visitors from points west of Chicago desiring to travel on this train should consult first their local agent. If they can arrange to purchase through tickets at any lower fare than has been arranged for the Chicago party, they are, of course, at liberty to do so; otherwise tickets should be purchased to Chicago and the Chicago-New York tickets purchased in that city at the party rate. A good attendance is expected on this special train, and Mr. Freeman requests that those desiring to travel on it make their reservations with him as soon as possible.

DIMINUTIVE CENTRAL STATION AT LEWIS, IA.

Gasoline-Electric Equipment Supplying Energy to a Town of 650 Inhabitants.

By J. H. Kuhns.

The problem of electric lighting and power service for villages and small towns seems to be finding satisfactory solution in the gasoline-electric generating sets designed originally for the United States government for the long-continued and rigorous duty in seacoast fortifications. The successful use of these sets in a number of the forts has suggested their broader commercial utility. On Jan. 6 the Lewis Electric Light & Power Company started to operate at Lewis, Ia., what is believed to be the first central-station plant exemplifying the applicability of these gasoline-electric sets for street and general commercial lighting and motor service. Already there are connected to the circuits eighty customers, twenty-five of whom are new users of electric energy. Over 800 lamps, or an average of over ten lamps per customer and nearly one and one-quarter per individual member of the town's population, are connected, with still a large reserve of undeveloped business to draw upon to build up a profitable station load.

Lewis is a small town of 650 population in a rich and fertile section of the best farming country in Iowa. Farm lands are valued here at about an average of $150 an acre. Much seed corn is raised and shipped from this center. One of the most prominent horse and cattle ranches, handling high-grade stock, is located close by. As a town it has had a varied history, dating back over sixty years.

Lewis was at one time the county seat of Cass County, but was outrivaled for that honor by the more populous thriving little city of Atlantic, which has the good fortune to be situated on the main line of the Rock Island Railroad. With the building of the Atlantic & Griswold branch of the Chicago, Rock Island & Pacific Railroad a few years ago, now a connecting link between Atlantic and Red Oak, an important town on the main line of the Burlington route, Lewis spread out to the west, doubling its area and extending to meet the railway which crosses from north to south the extreme west end of the town. The railway station is at the foot of Main Street, a block west of the electric light plant. This newer portion comprises the principal business and newer residence part of the Lewis of to-day.

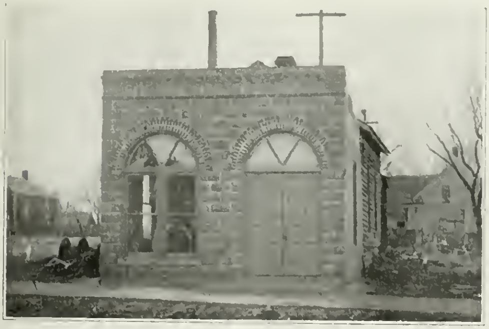

Fig. 1—Exterior of the Central Station at Lewis, Ia.

Five or six years ago there was installed an electric light plant in connection with a mill operated by water-power and later by steam. It met with but indifferent success in the hands of various parties. An unsuccessful effort was made to dispose of the old plant and system to the town at a considerable loss. It was then entirely dismantled and removed, a portion of the machinery being transferred to another town.

For the erection of a new plant upon more modern and progressive lines a group of business men organized the Lewis Electric Light & Power Company with the following officers and board of directors: Prof. S. W. Rowley, president; Mr David Hickman, vice-president; Mr. William B. Davis, secretary; Mr. Ivan H. Beardsley, manager and engineer, and Messrs. Daniel Stevens, Bert Hardenberg, W. W. Albright, V. M. Elstin and M. H. Elliot, directors. The company is capitalized for $5,000, all stock being common and issued at a par value of $10 per share. No bonds have been issued. The primary purpose has been to install a thoroughly good plant and equipment, and to this end the actual cost has exceeded the capitalization, which is permissible by Iowa State law, the whole costing in round numbers $6,000. In addition, $500 to $1,000 worth of supplies is carried for the convenience of consumers. The company is operating by agreement under a franchise granted other parties some years ago, as did its predecessors, no transfer of franchise rights ever having been made. After three years the town may acquire the plant, if desired, upon payment of a valuation determined by a committee of three appraisers, one appointed by the town, one by the company and these two to select the third.

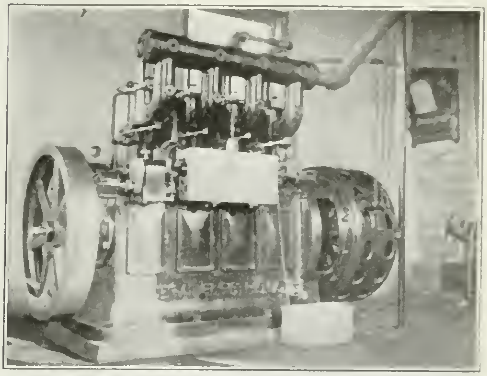

Fig. 2—Gasoline-Electric Generating Set.

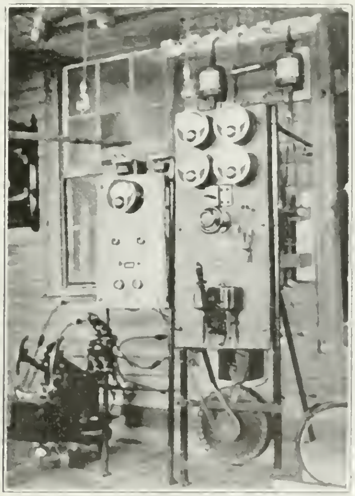

Fig. 3—Switchboard Panels.

The central station is located on Main Street, which is the principal thoroughfare, and is installed in a low one-story building for which a mere nominal rental charge is paid, the company having the option to buy the property later at the value of the land plus the cost of the improvements and simple interest on the same. To the front of an old frame building about 16 ft. x 28 ft. has been built a neat, well-lighted concrete blockroom, about 16 ft. x 16 ft., carrying the building to the lot line and affording ample space for the generating set and switchboards, and such desk room as is needed for the ordinary office business of the company. In this room, which is finished in natural pine with plastered walls, has been installed a standard General Electric 25-kw gasoline-electric generating set composed of a four-cylinder, four-stroke cycle, vertical water-cooled, 43/54 hp gasoline engine direct-connected to a three-phase, 2300-volt, 600-r.p.m. alternator with a 125-volt exciter mounted on the same shaft and in the same frame. The whole is so constructed as to insure permanent alignment and prevent objectionable vibration.

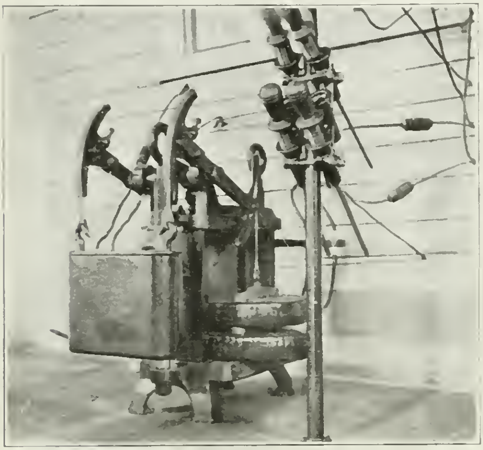

Fig. 4—Constant-Current Transformer.

The carburetor is of the constant-level type, and the gasoline is delivered by a pump connected to the engine through pipes direct from a 120-gal. tank set in the ground back of the station at a safe distance from surrounding buildings. Ignition is furnished by high-tension magneto with starting battery. Lubrication is effected by means of forced circulation through a pump connected with the engine.

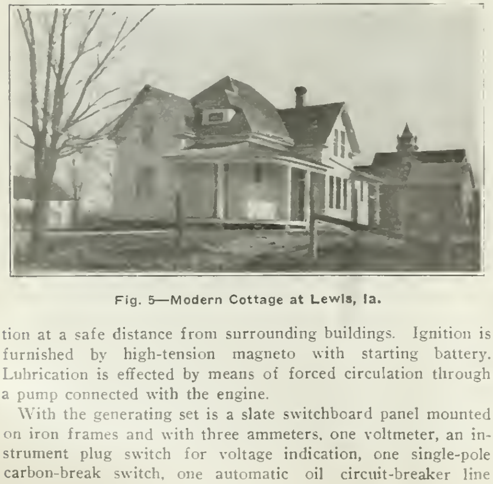

Fig. 5—Modern Cottage at Lewis, Ia.

With the generating set is a slate switchboard panel mounted on iron frames and with three ammeters, one voltmeter, an instrument plug switch for voltage indication, one single-pole carbon-break switch, one automatic oil circuit-breaker line switch and rheostats. Instrument transformers are mounted above and back of the board.

For street-lighting service a 4-kw constant-current transformer has been installed, and with it a gray marble switchboard panel mounted on iron frames and carrying an ammeter and a four-point plug switch. On a board near the generator set are mounted in convenient reach suitable wrenches, spanners and repair parts and tools.

To cool the engine cylinders a battery of five galvanized cylindrical steel tanks 6 ft. in diameter and 8 ft. high have been installed in the old part of the building adjoining the generating room and slightly above the level of the latter. By means of a pump connected with the engine the water with which these tanks are filled is kept in constant circulation during operation, thus dissipating the heat from the engine jackets. It was at first attempted to effect this water cooling by using a single small tank and pumping cold water direct from a well at the rear of the building. This proved inadequate because of difficulty with the pump and frequent need of pump repairs. Hence the well and pump method was abandoned and the tank system substituted. The rest of the space in the old part of the building is utilized as a stockroom for wire and supplies.

Insufficient data have as yet been taken to ascertain the amount and cost of fuel per unit of energy. However, for a period of fifty-three days, from Jan. 21 to March 15, there has been an average daily consumption of 21 gal. of gasoline at 11.7 cents per gallon.

Evening lighting service is furnished from dark until 11 o'clock daily except Saturday, when service is extended until 12 midnight; and morning service from 5:45 until daylight. Thirty-two 6.6-amp, 32-cp series-tungsten lamps at street crossings are lighted during the regular operating hours, modified by a moonlight schedule. For this service the town pays $1 per light per month. A few additional street lamps in the residence portion will be added soon. For commercial lighting a combination schedule of flat rate and meter rate has been arranged. For a small number of lamps the charge for energy per month is 75 cents for a 16-cp lamp, $1 for two, $1.50 for three. When there are more than three lamps the circuit is metered. Consumers may own their meters or the company will furnish them on a rental charge of 25 cents per month. The company now has $260 in rented meters in service and about as many more are owned by consumers. The meter rate is 15 cents per kw-hour up to 20 kw-hours and 10 cents per kw-hour for all energy in excess of that amount.

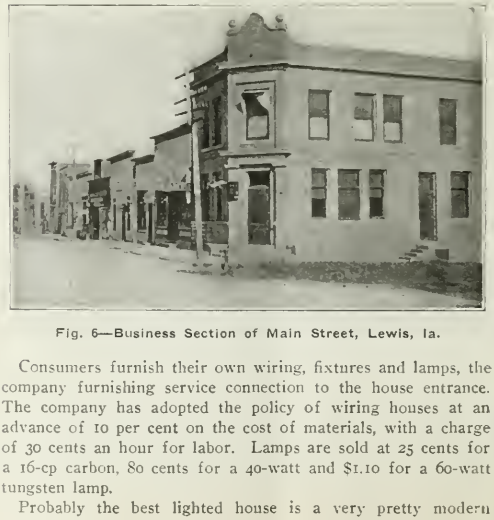

Fig. 6—Business Section of Main Street, Lewis, Ia.

Consumers furnish their own wiring, fixtures and lamps, the company furnishing service connection to the house entrance. The company has adopted the policy of wiring houses at an advance of 10 per cent on the cost of materials, with a charge of 30 cents an hour for labor. Lamps are sold at 25 cents for a 16-cp carbon, 80 cents for a 40-watt and $1.10 for a 60-watt tungsten lamp.

Probably the best lighted house is a very pretty modern cottage at the corner of Main and Washington Streets where twenty-three 40-watt tungsten lamps are used. The attractiveness of this well-lighted house sets a commendable example for others there and elsewhere. Liberal use of light goes a long way toward solving the problem of lighting villages and small towns, and promotes a spirit of progress that soon puts the town out of the rural village class, increases business and enhances property values.

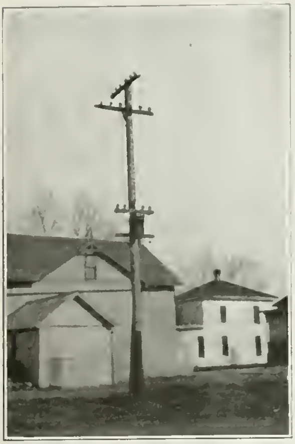

Fig. 7—Pole and Transformer in Pole-Line Distribution System.

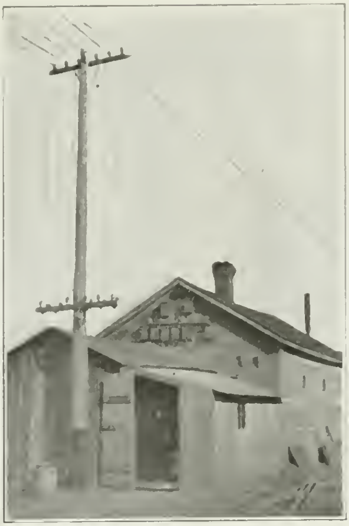

Fig. 8—Rear of the Central Station.

Fig. 9—Water Tower.

Negotiations are under way for operating the town pumping plant by means of a three-phase motor. The town has already bought and installed a 5-hp Fairbanks three-phase, 60-cycle, 220-volt motor belted to a countershaft and the company has run a special set of primary feed wires from the station to the pumping plant on Market Square to provide for this service. The water is lifted by a Deming pump from a 65-ft. well to a water tower on the Public Square six blocks distant on higher ground in the old part of the town. A 6-hp gasoline engine is now used for pumping, but it is estimated that not over 3 hp is required.

It is thought that by slight additional running time, or by operating a few hours in the day once or twice a week, the pumping can be done at a saving to the town and a profit to the company. The gasoline engine at the pumping station will be retained for auxiliary or emergency pumping service and probably operated by the company for the town at about actual cost of fuel and labor. A two months' trial will be given before closing negotiations.

There seems little demand in a place of this size for a day load. A possibility spoken of by the management is that in case of doing the water-works pumping it may be arranged to run the electric service on Tuesdays to care for washing machines and laundry irons, that being a convenient time for most housewives.

An electrical exhibit, perhaps with some of the practical domestic apparatus for heating and cooking, is contemplated in connection with the annual school exhibit about commencement time. It would be strange indeed if the intelligent demonstration by these bright young people of the utility, simplicity and convenience of such appliances did not influence their parents and friends to put some of these appliances into their homes.

Leaving the generating room all primary mains and feeders are carried from the back of the station to the pole line in the alley at the rear. The station equipment and circuits are protected by lightning arresters inserted where the lines leave the building. Additional lightning arresters will be placed upon the lines.

All primary and street-lighting circuits are of No. 10 weatherproof copper wire and the secondaries are of No. 6. The pole line exemplifies good regular engineering practice, though heavier poles would be an advantage. Much credit is due to the company's electrician, Mr Ivan H. Beardsley, for his skilful construction. White cedar poles of 25-ft., 30-ft. and 35-ft. lengths, supplied by local dealers, are set from 110 ft. to 125 ft. apart.

The entire equipment was supplied by the General Electric Company and installed under the supervision of an engineer from its Chicago offices. The service is said to be unsurpassed by that of any other town of similar size.

THE SCHERBIUS SYSTEM OF SPEED REGULATION FOR INDUCTION MOTORS.

By J. J. Elink Schuurman.

The magnetic field set up by the current in the primary windings of a polyphase induction motor revolves at a speed depending directly upon the frequency of the line and inversely upon the number of poles. The revolving field tends to turn the rotor in the same direction. The speed of the latter, however, can never equal the speed of the former, commonly known as synchronous speed, because the rotor conductors must cut the lines of force of the field in order to produce current in the secondary winding and provide a propelling torque. The difference between these two speeds is known as the slip. The strength of the secondary current depends upon the torque required by the load under which the motor is running. The e.m.f. which produces the secondary current is proportional to the slip.

The simplest means of varying the speed of an induction motor is based upon this proportion between the voltage and the slip. An external resistance, known as slip resistance, is inserted in the secondary circuit. As the secondary current is determined by the required torque, the secondary e.m.f. must increase in order that the constant current may flow through the increased resistance. The secondary e.m.f. and the slip are proportional to each other and hence the increased secondary circuit resistance will cause the speed to drop.

This method for speed regulation of induction motors has often been used, especially in connection with rolling mills, but notwithstanding its great simplicity it is most uneconomical, as an amount of energy proportional to the percentage of regulation is lost in the slip resistance. When, for instance, the speed is decreased to 30 per cent below normal, 30 per cent of the energy taken from the line is lost. The efficiency is consequently very low. Another distinct disadvantage of this method of regulation is that for a certain slip resistance the speed changes to a great extent with variations of the load and rises to practically its normal value at no load. The reason for this is that at no-load the secondary current is very low so that the drop of voltage in the slip-resistance, which originally caused the speed reduction, becomes negligible. This running back to the synchronous speed may be inconvenient in the operation of rolling mills when a low running-light speed is required in order that the rolls may be sure of getting a hold on the steel.

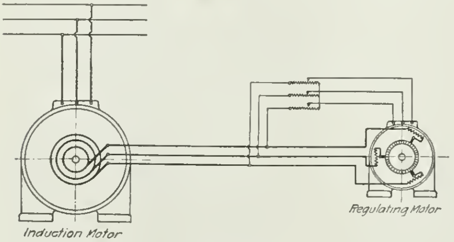

Fig. 1—Circuits of Regulating Motors.

In what follows will be given a description of a new system for the speed regulation of induction motors which maintains the efficiency practically constant over the entire range of regulation, which permits of all the speed characteristics that direct-current motors are able to give, and which raises the power-factor of the installation to unity.

The principle of the system is shown in Fig. 1. Instead of a variable resistance, an auxiliary motor is connected to the slip rings of the main motor. The purpose of this so-called regulating motor is to make use of the slip energy which was formerly lost in resistance and to convert it into mechanical energy.

The regulating motor was originated by Dr. A. Scherbius. It is of the three-phase commutator type. In series with its armature winding is an absolutely identical compensating winding on the stator by which the inductive effect is entirely eliminated. It thus becomes independent of the frequency. In its operation it can be compared to a direct-current motor, its e.m.f. merely depending on the speed and the field flux.

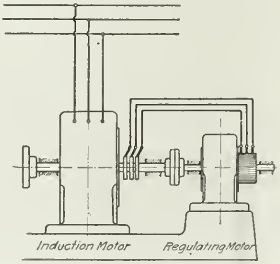

Fig. 2—Arrangement Employed with Directly Coupled Regulating Motor.

The speed regulation of the main motor is obtained in a simple manner by adjusting the excitation of the regulating motor. As the slip of the induction motor is proportional to its rotor e.m.f., its speed will decrease when the rotor e.m.f. is forced to increase, due to the counter e.m.f. of the regulating motor. The stronger the excitation of the regulating motor the lower will be the speed.

When the regulating motor is shunt-excited the speed of the main motor remains constant from no-load to full-load because the counter e.m.f. of the regulating motor, which differs from the rotor e.m.f. of the induction motor only to the extent of the ohmic drop in voltage, depends merely upon the excitation. When a drop of speed is required between no-load and full-load in order to make use of the flywheel effect of the rotating masses, the regulating motor can be provided with a compound exciting winding. As in the case of a direct-current compound motor, the speed will drop from no-load to full-load over a certain adjustable range. Finally, a series excitation can be provided which entails a form of regulation similar to that by resistance.

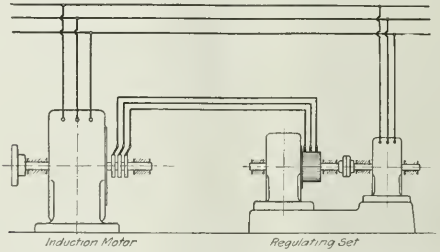

Fig. 3—Arrangement with Regulating Set.

The slip energy which the regulating motor converts into mechanical energy can be further employed in two different manners. First, the regulating motor can be coupled mechanically to the main motor so that the slip energy is given back to the main driving shaft (see Fig. 2).[1] Secondly, the regulating motor can be coupled with a small induction generator. This regulating set converts the slip energy into electrical energy and returns it to the line (see Fig. 3).[2] The first arrangement, in which the regulating motor is coupled directly or by means of a belt to the main motor, is in general the better one, as the available energy on the main shaft remains constant—that is, with decreasing speed the torque can be increased. In case of the arrangement with the regulating set only a constant torque is available, as in the case with regulation by resistance, so that the output must decrease with decreasing speed. Further, the total efficiency is more favorable for mechanical coupling between the regulating motor and the main shaft. However, this arrangement is not always possible as the regulating motor must follow the speed fluctuations of the main motors and becomes too expensive for very wide ranges

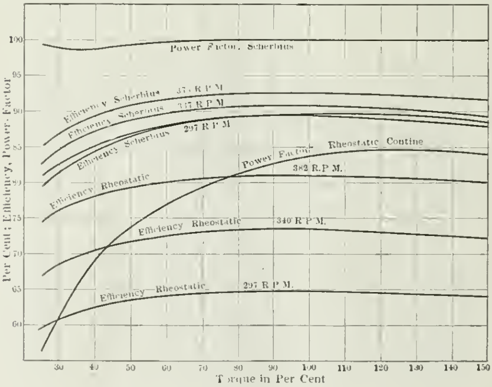

Fig. 4—Comparison Between Regulation by Resistance and Regulation with a Scherbius Motor.

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[1] Due to Mr. Krämer, German Patent No. 169,453.

[2] Due to Dr. Scherbius, German Patent No. 179,525.

of regulation. In such cases the regulating set which runs at constant speed is preferable.

A great advantage of the regulating system described lies in the possibility of extending the regulation above synchronous speed. The result is that the regulating motor can be kept smaller than is possible with exclusive regulation below synchronism. In order to obtain over-synchronous speeds the direction of the excitation of the regulating motor should be reversed. The latter then runs no longer as a motor, but as a generator. It does not take up slip energy, but, on the contrary, delivers slip energy to the main motor. The possibility of running above synchronism can also be of value for reaching very high speeds, as such are necessary for rotary blowers, rotary compressors, etc. It should be realized that in case of the normal frequency of 60 cycles per second 3600 r.p.m. was the highest speed which hitherto could be obtained. This is the synchronous speed of a two-pole motor. The next lowest speed is 1800 r.p.m. for a four-pole motor. The advantage of being able to obtain intermediate speeds, and above all, speeds over 3600 r.p.m., is obvious. Such values have until now been obtainable only with steam turbines.

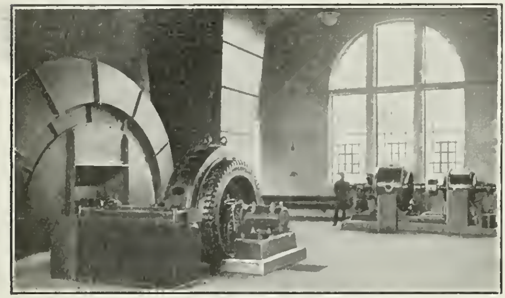


Fig. 5—Fan with Electric Drive with Regulating Set in Background at Gelsenkirchen.

The above-described system of regulation permits of compensating the phase difference between the current and the voltage of the main motor and of increasing its power-factor, independently of the load, to unity. By a small change in design the regulating motor can be made to supply the magnetizing current necessary for the excitation of the main motor. The generators at the power station and the transmission line are then relieved from delivering this wattless current. If necessary, the regulating motor can also be designed to supply the excitation for other motors on the line, and thus will contribute further to raise the power-factor of the entire system.

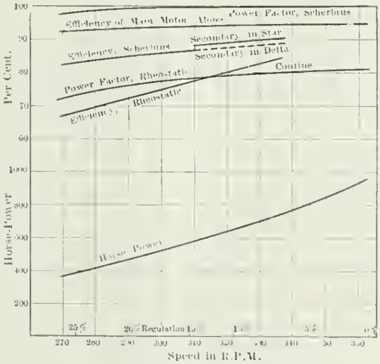


Fig. 6—Curves from Tests on the Regulating Set at Gelsenkirchen.

It has been mentioned that the regulating motor is of the three-phase commutator type. The simplest way to regulate speed by means of a three-phase motor would be to connect a three-phase commutator motor directly to the line. However, certain difficulties with respect to good commutation stand in the way of building such motors. The higher the frequency and the larger the output the greater are these difficulties. Commutator motors for several thousand horse-power, for instance, as often required in steel mills, have not yet been built, although it is to be expected that in the next few years considerable development will be made in this direction. The regulating motor described is connected to the rotor of an induction motor in which the frequency is low. Moreover, its output is small when compared with the output of the main motor. Consequently the system permits of very large outputs. The rotor voltage of an induction motor can be chosen at will within wide limits, even when the motor is directly connected to the high-voltage line. Thus the voltage of the regulating motor can be kept low, which still further facilitates its design.

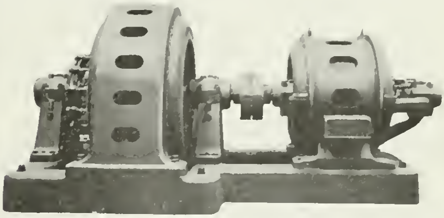


Fig. 7—Regulating Set for Varying the Speed of a 1800-hp Bar Rolling Mill.

The Scherbius system may be used with induction motors which already exist, as well as for new installations.

On curve sheet, Fig. 4, a comparison is made between regulation by resistance and regulation with the Scherbius regulating motor. The values of efficiency and power-factor for both systems have been plotted for different torque values at different percentages of regulation.

The above-described system of regulation has already found a wide field of applications, as can be seen from Figs. 5 to 9.

Fig. 5 shows the plant for ventilating the Rheinelbe pit of the Gelsenkirchen collieries. It consists of a mining fan capable of dealing with about 200,000 cu. ft. of free air per minute at a depression of 18.5 in. water gage when running at a speed of 363 r.p.m., directly driven by an induction motor of 1000 hp maximum continuous output. As the maximum output of this plant will not be required for a number of years, it is at present operated at a speed of 268 r.p.m., corresponding

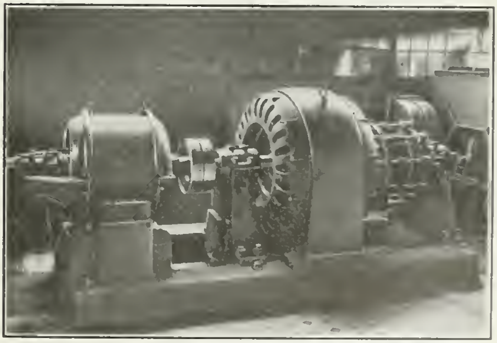


Fig. 8—Regulating Set for Varying the Speed of a 2500-hp Wire Mill at the Steel Plant, Differdingen.

to an output of about 194,500 cu. ft. of free air at a depression equivalent to 10 in. of water. As the pit is gradually opened up a certain increase in the air quantity will be required, which will necessitate a periodical increase in the speed of the plant. The required speed regulation is obtained by means of a Scherbius regulating set designed for 200 kva and 750 r.p.m., which is shown in the background. The results of tests carried out on this plant are shown in Fig. 6. Calculations which were made from these curves have proved that the annual saving in the amount of energy consumed in the case of Scherbius control in comparison with control by resistance, namely, $4,000, for a price per kw-hour of 0.6 cents, is sufficient to pay for the entire regulating equipment in about one year's time

Fig. 7 illustrates a 400-kva, 750-r.p.m. regulating set for varying the speed of a bar-rolling mill of the steel plant "Deutscher Kaiser," which is driven by an 1800-hp induction motor designed for 375 r.p.m. The regulating set is built for 50 per cent speed regulation of the main motor and 5 per cent drop of speed between no-load and full-load.

At the Differdingen steel plant a wire mill is in operation driven by an induction motor of 2500 hp and 150 r.p.m. which is regulated by a Scherbius set designed for 240 kva and 750 r.p.m., as shown in Fig. 8. The latter produces a 10 per cent drop of speed between no-load and full-load.

When a new rolling mill is installed it often cannot be determined beforehand what will be the most favorable speed for the process. In such cases it is advisable to design the driving motor with a sufficiently wide margin of speed. Should its speed prove to be too high the Scherbius system of regulation permits of reducing it without affecting the efficiency of the installation or its power-factor.

When the regulating motor is coupled mechanically to the main driving shaft the output of the mill can be kept constant over the entire range of regulation; that is to say, the torque can be increased at reduced speed. This may lead to an increased production at lowered speeds, as an excess load can be placed on the train.

The installations described above were built by Brown, Boveri & Company, of Baden, Switzerland.

SIMPLE METHOD OF MAKING THERMO-ELECTRIC MEASUREMENTS OF HIGH TEMPERATURE.

By J. P. Raymond.

The following is a description of an apparatus for use in measuring high temperatures, together with a brief discussion of the theory which is involved in the use of thermo-couples.

THERMO-COUPLE.

In a circuit formed of different metals with all the points where two metals join at the same temperature the differences of potential compensate each other all around the circuit and there is no current. If, however, the joints are not at the same temperature this compensation no longer exists and the circuit is traversed by a current. There is a particular range for each couple depending upon the material from which it is made and the e.m.f. generated is proportional to the rise in temperature throughout the range of the particular couple under consideration. The usual e.m.f. of the couple mentioned in this article is from 22 millivolts to 23.5 millivolts per 1000 deg. Fahr. rise in temperature.

In practice a thermo-couple is usually composed of two metals joined together at one end and arranged so that a generation of e.m.f. will result upon the application of heat to the joined ends. Various combinations of metals may be used in such a couple, a few of which are given below. The metals named in the following list are arranged in such an order that if any two or more of them are formed into a circuit as above described there is a current across the heated junction from the metal whose name occurs first in the list to that whose name occurs later:

↓	Bismuth,	Manganese,	Gold,	↑
	Nickel,	Silver,	Zinc,	
Hot	Platinum,	Tin,	Iron,	Cold
	Palladium,	Lead,	Arsenic,	
↓	Cobalt,	Copper,	Antimony.	

In a thermo-couple it is immaterial whether the two metals are joined directly, are brazed or soldered together, inasmuch as the e.m.f. is not altered if one or more metals are interposed between the metals composing the junction provided the temperatures of the two junctions are not altered.

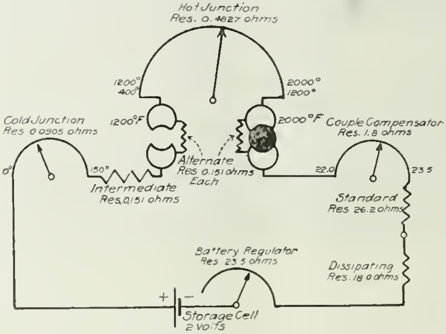


Fig. 1—Local Circuit.

To determine the temperature of the hot junction of the couple it is necessary to know the cold-junction temperature and by measuring the e.m.f. generated by the couple determine the difference in temperature between the two. The apparatus which will be described in this article is so designed as to provide automatically the proper correction for the cold-junction temperature as well as the various constants involved in the use of thermo-couples, eliminating the necessity for all calculations. The apparatus, therefore, provides for a direct reading of the temperature affecting the couple by a means so simple and accurate as to overcome the difficulties encountered in other types of apparatus.

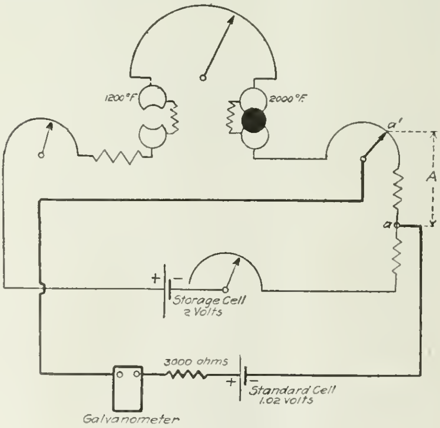


Fig. 2—Adjusting Circuit.

CIRCUITS.

The method by which the temperature of the hot junction is determined employs the use of a local circuit and two intermediate circuits. The e.m.f. of the couple is measured by balancing it against the e.m.f. between two points separated by a variable resistance in a local circuit through which a constant current is flowing.

The local circuit (Fig. 1) is composed of a series of resistances, a 2-volt storage cell and a battery regulator by means of which the resistance of the circuit can be varied to govern the amount of current flowing through the circuit. This current is calibrated by the use of a standard cell, as described below.

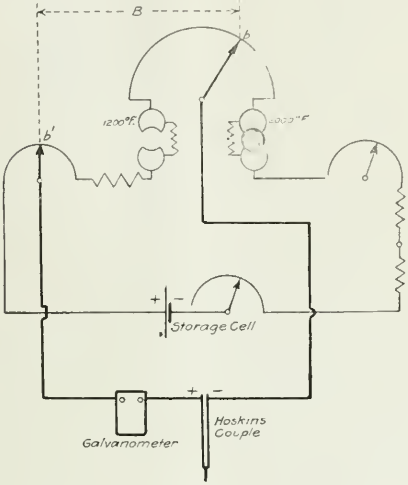


Fig. 3—Operating Circuit.

The adjusting circuit (Fig. 2) consists of a standard cell of 1.02 volts, a protective resistance and a galvanometer. The couple compensator is set to correspond with the constant of the particular couple under consideration and a voltage of 1.02 volts from the standard cell is impressed upon a certain part of the local circuit, as shown in the figure. The current in the local circuit is then adjusted by means of the battery-regulator rheostat until the e.m.f. drop between the two points (*a a′*) exactly balances the voltage from the standard cell. This will be indicated by a zero deflection of the galvanometer. The resistances in the circuit are so proportioned that when this condition exists the proper current for the tests to be made is flowing in the local circuit. This current must be maintained constant throughout the test.

The operating circuit, as shown in Fig. 3, is composed of a thermo-couple and a galvanometer and is shunted across a certain part of the local circuit between the variable points (*b b′*). The point *b′* is obtained by setting the cold-junction dial at the proper point to compensate for the temperature of the cold junction at the couple, as described below.

A balance may be obtained in a manner similar to that described above by moving the dial of the hot-junction resistance, thus varying the resistance comprehended between the points *b* and *b′* by known steps. By this means with a known current and a known resistance the voltage generated by the thermo-couple may be determined. As the generation of the thermo-couple per 1000 deg. Fahr. is known, to facilitate operation, a scale on the face of the hot-junction resistance is calibrated to read directly the temperature of the hot end.

DESCRIPTION OF RESISTANCES.

To eliminate any possibilities of error the resistances should be made of some resistance wire whose temperature coefficient is very low, and should be calibrated very carefully.

(a) The couple compensator, Fig. 1, is a resistance that can be adjusted to compensate for variations in the constants of different thermo-couples that may be used with the apparatus and is calibrated in millivolts per 1000 deg. Fahr. The calibration covers a range of from 22 millivolts to 23.5 millivolts.

(b) The hot junction is a resistance used to vary the resistance comprehended between the points (*b b′*), as shown in Fig. 3, and hence to vary the e.m.f. drop across the operating circuit, and is calibrated to read directly the temperature of the hot end of the couple.

(c) The cold junction is a resistance that may be used to compensate for variations in room temperature and is calibrated in units of temperature from 0 deg. to 150 deg.

(d) The alternate resistance is used to give a larger range to the reading of the hot-junction resistance, thus giving a double scale to the instrument.

A galvanometer of not less than 200 ohms resistance and 500,000 ohms sensibility should be used and if the temperature difference must be read closer than 5 deg. to 10 deg. a more sensitive galvanometer should be used. A double-throw key is used in this circuit. Fig. 4 shows the completed circuit, different sections of which were shown in the previous figures.

OPERATION.

From the above the five steps necessary to operate the pyrometer are as follows:

1. Connect the storage cell (2 volts), standard cell (1.02 volts) and thermo-couple, making certain of their respective polarities and then connect the galvanometer.
2. Set the couple compensator to the values designated on the calibration tag accompanying the thermo-couple.
3. Operating both keys, adjust the battery regulator until the galvanometer shows no deflection.
4. Set the cold-junction dial to the temperature of the free end of the thermo-couple as determined by a mercurial thermometer.
5. With the plug firmly seated in either socket, depress the galvanometer key and adjust the hot-junction dial until a balance results, changing the plug to the other socket if necessary. The actual temperature of the furnace is then read from the scale of the hot-junction dial.

EXAMPLE.

Taking an example to illustrate the operation, suppose a temperature of 1500 deg. Fahr. is to be measured. The temperature of the air near the furnace is 75 deg. and the constant of

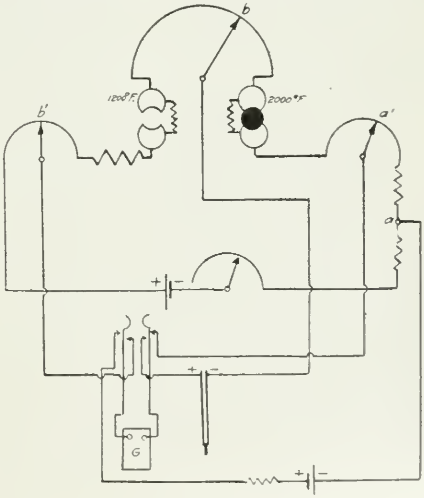


Fig. 4—Completed Circuit.

the thermo-couple is 22.5 millivolts per 1000 deg. Fahr. Set the couple-compensator dial to 22.5. In determining the current flowing in the local circuit use is made of a standard cell, its emf of 1.02 volts being impressed across the terminal of the 26.2-ohm resistance and the compensating point of the couple-compensator resistance. The total resistance is, then, assuming the variable portion of the resistance by proportion, 26.2 +

$1.2 = 27.4$ ohms. Therefore, the current flowing when a balance is established will according to Ohm's law be $1.02 \div 27.4 = 0.372$ amp. This current also traverses the entire local circuit.

The cold-junction dial is set at 75 deg. to conpensate for the cold-junction temperature—that is, room temperature—and the potential of the thermo-couple is impressed between this point and a variable point on the hot-junction resistance. As the temperature to be measured is 1500 deg. Fahr. when the movable arm of the hot junction is placed at this reading the resistance between this point and the 75-deg. point on the cold-junction resistance is $0.04525 + 0.151 + 0.4827 + 0.181 = 0.8599$ ohm, again assuming the variable resistances by proportion. Thus, the current and the resistance being known, the e.m.f. which will cause a flow of 0.0372 amp through a resistance of 0.8599 ohm equals 0.03199 volt. This value is also the value due to the difference of temperature of 1425 deg. Fahr. between the junctions, assuming that the thermo-couple develops 22.5 millivolts per 1000 deg. Fahr.

Therefore, should the temperature of the hot end of the couple be 1500 deg. and of the cold end 5 deg. the thermo-e.m.f. will just balance the drop across the included resistances *B* (Fig. 3) and there will be no deflection of the galvanometer in the couple circuit. Should there be a deflection of the galvanometer the hot-junction dial can be readjusted until the deflection is eliminated and the actual temperature can then be read from the scale.

In this particular apparatus a Hoskins thermo-couple was used and very satisfactory results were obtained. Where it is essential that high temperatures must be measured under conditions of high pressure the results obtained by the above method are accurate and may be obtained in a practical way. The results may be considered as accurate as those obtained by any other known method, the benefit being that all corrections are made before the reading is taken and the temperature then read directly from the scale.

This apparatus may be made up in portable form, or in cases where it is desired to read the temperature of a number of furnaces at frequent intervals a complete system may be installed by bringing the leads from the various couples to a central point. Suitable switching arrangements may be installed at this point and the apparatus and galvanometer set up in such a way that the temperature of any one of the furnaces may be obtained at once by making the proper switching connections.

LOSSES IN SINGLE-PHASE ROTORS.—I.

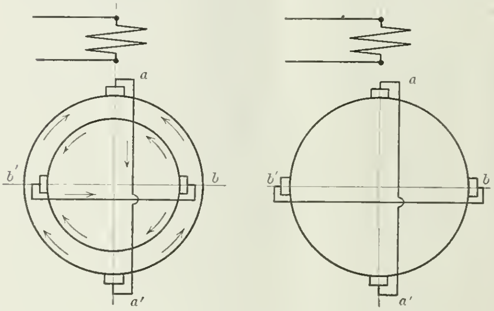
Rotors of the Squirrel-Cage Type.

By H. Weichsel.

The theory of single-phase motor phenomena has for a long time been considered so complicated that exact solutions of some of the problems involved are not attempted. The main reason for this is that most investigators make use of the rotating-field theory, considering that the single-phase field may be considered decomposed into two fields rotating in opposite directions. This theory is correct and should lead to the solution of all problems involving the single-phase motor, but frequently it will be found that it is rather difficult by this method to gain a clear physical conception of the phenomena involved.

Another theory reduces all phenomena occurring in single-phase motors to conditions similar to those in direct-current motors. It is this theory which will be used in this paper in determining the losses in single-phase rotors. According to this theory the rotor secondary of a single-phase motor carries two different currents. One of these is the working current and travels through the secondary in such a direction as to produce a field in the axis of the stator pole. The other may be called the rotor magnetizing current and produces a field at right angles to the axis of the stator pole. The conditions as stated may be illustrated in Fig. 1, where two separate windings are shown for the different currents. Conditions will be unchanged, however, if the two currents exist in the same winding, as shown in Fig. 2. The problem before us is now to determine the rotor secondary copper losses in this kind of a motor.

As before stated, each conductor of the rotor winding carries two currents, the working current *I* and the magnetizing current *i*. For an ideal motor these two currents are in time-phase with each other, but in the practical motor there will be a certain time-phase displacement between them which may be designated as α. Referring to Fig. 5, let *I* be the effective value of the rotor-working current and *i* the effective value of the rotor-magnetizing current. It is evident that the effective value of the resultant current flowing in any conductor located in the quadrant *a-b* (Fig. 2) will be



Figs. 1 and 2—Equivalent Circuits of Single-Phase Rotor.

$$I_{r_1} = \sqrt{I^2 + i^2 + 2\,Ii \cos \alpha}$$

Also the current in any conductor in the quadrant *b-a'* will be

$$I_{r_2} = \sqrt{I^2 + i^2 - 2\,Ii \cos \alpha}.$$

If *r* is the resistance of one conductor, then the power dissipated in the copper of any conductor in quadrant *a-b* is equal to

$$P_{c_1} = (I^2 + i^2 + 2Ii \cos \alpha)\, r$$

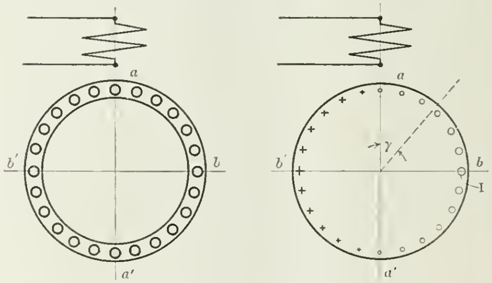
and in the same way the losses in any conductor in quadrant *b-a'* are equal to

$$P_{c_2} = (I^2 + i^2 - 2Ii \cos \alpha)\, r$$

If *z* conductors per pole the total secondary copper losses per pole are

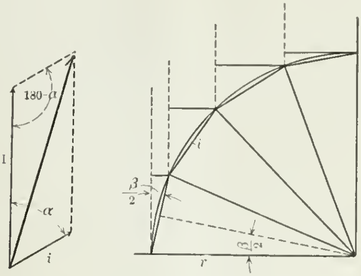
$$P_c = (P_{c_1} + P_{c^2}) = (I_2 + i^2)\, rz$$

This equation reveals the very important fact that the rotor copper losses in a motor, as shown diagrammatically in Fig. 2, are independent of the time-phase relation between the working current in the axis *a-a'* and the magnetizing current in the axis *b-b'*. The total rotor copper losses are, according to the above equation, equal to the sum of the copper losses that would be produced if each current were considered by itself.



Figs. 3 and 4—Squirrel-Cage Rotor Circuits and Currents.

The single-phase induction motor as ordinarily built is, however, not like the one shown in Fig. 2, but is of the squirrel-cage type, as shown in Fig. 3. Here the secondary rotor currents may also be considered as composed of two currents, one of which flows through the armature in such a direction as to produce a field in the axis *a-a'*, and the other current at the same time produces a field in the axis *b-b'*. The only difference between the motor of Fig. 2 and that of Fig. 3 lies in the fact that all of the conductors of the first are connected in series, and so the currents are the same in all conductors. In the latter, however, the conductors may be considered as connected in parallel, and the currents in the different conductors have different maximum values at any one instant, depending upon their position with respect to the stator pole. If it be assumed that the stator field has sine-shaped space distribution it will be evident that the currents in the axis *a-a'*, as well as the currents in axis *b-b'*, will also have sine-shaped distribution in space. The fact that the current in any rotor conductor varies with the position of that conductor makes it a little more difficult to calculate the total rotor copper losses. The current distribution in space may be graphically represented, as shown in Fig. 4, where the sizes of the crosses and points indicate the relative values of the working currents producing a field in axis *a-a'*. Here it is seen that the maximum current exists in that conductor which is in the axis *b-b'*. The maximum value of this current may be designated as I_b.



Figs. 5 and 6—Secondary Currents and Magnetomotive Forces.

In the same way it follows that the conductor in axis *a-a'* carries the maximum magnetizing current. Both currents have sine-shaped distribution in space, so that in a conductor located γ degrees from the center line of the stator pole, the maximum value of the working current will be

$$I_\gamma = I_b \sin\gamma$$

and the maximum value of the magnetizing current in the same conductor is

$$i_\gamma = i_a \cos\gamma$$

If it be assumed that the current also varies in time according to the sine law, then the instantaneous value of the working current in a conductor located γ degrees from the center line of the stator pole will be given by the expression

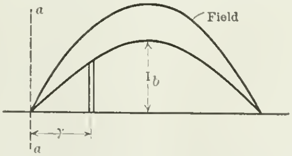


Fig. 7—Space, Distribution of Current and Field.

$$I_{\gamma t} = I_b \sin\gamma \sin(\omega t)$$

where $\omega = 2\pi f = \frac{2\pi}{T}$

$T =$ the time of one period.

The instantaneous value of the magnetizing current can also be expressed by a similar equation. That is,

$$i_{\gamma t} = i_a \cos\gamma \sin(\omega t + a)$$

where a is the time-phase displacement between the working current and the magnetizing current. The total current in the conductor is the sum of $I_{\gamma t}$ and $i_{\gamma t}$ and has, therefore, the value

$$I_{\gamma t} + i_{\gamma t} = I_b \sin\gamma \sin(\omega t) + i_a \cos\gamma \sin(\omega t + a)$$

The copper losses in this one conductor during one period T will be

$$P_{cr} = \frac{r}{T}\int_0^T [I_b \sin\gamma \sin(\omega t) + i_a \cos\gamma \sin(\omega t + a)]^2 dt$$

$$= \frac{r}{T}\left\{\int_0^T I_b^2 \sin^2\gamma \sin^2(\omega t) dt + \int_0^T i_a^2 \cos^2\gamma \sin^2(\omega t + a) dt + 2\int_0^T I_b i_a \frac{\sin 2\gamma}{2} \sin(\omega t)\sin(\omega t + a) dt\right\}$$

This is the resistance of one conductor multiplied by the square of the average value of the current in that conductor. These three integrals can well be evaluated separately.

$$\int_0^T I_b^2 \sin^2\gamma \sin^2(\omega t) dt = I_b^2 \sin^2\gamma \left[\frac{\omega t - \sin(\omega t)\cos(\omega t)}{2\omega}\right]_0^{t=T}$$

when $t = T$, $\omega = \frac{2\pi}{T}$. Substituting the limiting values, there is obtained as the value of this first integral

$$\frac{T}{2} I_b^2 \sin^2\gamma \tag{1}$$

The second integral is

$$\int_0^T i_a^2 \cos^2\gamma \sin^2(\omega t + a) dt = i_a^2 \cos^2\gamma \left[\frac{(\omega t + a) - \sin(\omega t + a)\cos(\omega t + a)}{2\omega}\right]_0^{t=T}$$

Substituting the limiting values as above, we get

$$\frac{T}{2} i_a^2 \cos^2\gamma \tag{2}$$

The last integral is

$$2\int_0^T I_b i_a \frac{\sin 2\gamma}{2} \sin(\omega t)\sin(\omega t + a) dt = I_b i_a \sin 2\gamma \int_0^T \sin(\omega t)\sin(\omega t + a) dt$$

$$= I_b i_a \sin 2\gamma \left\{\int_0^T \sin^2(\omega t)\cos a \, dt - \int_0^T \sin(\omega t)\cos(\omega t)\sin a \, dt\right\}$$

$$= I_b i_a \sin 2\gamma \left\{\frac{\cos a}{2\omega}\left[\omega t - \sin(\omega t)\cos(\omega t)\right]_0^T - \frac{\sin a}{4\omega}\left[\cos(2\omega)\right]_0^T\right\}$$

Substituting the limits as in the previous cases, there is obtained as the value of the third integral the expression

$$\frac{T}{2} I_b i_a \sin 2\gamma \cos a \qquad (3)$$

Collecting these terms, it is found that the copper losses in one conductor during one period T will be

$$P_{c\gamma} = \frac{r}{T}\left\{\frac{T}{2} I_b^2 \sin^2\gamma + \frac{T}{2} i_a^2 \cos^2\gamma + \frac{T}{2} I_b i_a \sin 2\gamma \cos a\right\}$$

$$= \frac{r}{2}\left\{I_b^2 \sin^2\gamma + i_a^2 \cos^2\gamma + I_b i_a \sin 2\gamma \cos a\right\}$$

There are z conductors per pole, and the above equation gives the losses in only one conductor. In order to determine the total losses assume that the conductors are entirely distributed over the surface of the armature; then the part of the polar arc covered by one conductor will be $\frac{\pi}{z}$. In any one element $d\gamma$ of the armature surface the losses will be

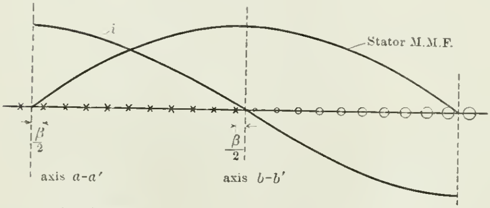


Fig. 8—Space Distribution of Magnetomotive Force.

$$dP_c = \frac{rz}{2\pi}\left[I_b^2 \sin^2\gamma + i_a^2 \cos^2\gamma + I_b i_a \sin 2\gamma \cos a\right] d\gamma$$

and the total losses per pole are

$$P_c = \frac{rz}{2\pi}\left\{\int_0^\pi I_b^2 \sin^2\gamma \, d\gamma + \int_0^\pi i_a^2 \cos^2\gamma \, d\gamma + \int_0^\pi I_b i_a \sin 2\gamma \cos a \, d\gamma\right\}$$

$$\int_0^\pi I_b^2 \sin^2\gamma \, d\gamma = \frac{\pi}{2} I_b^2$$

$$\int_0^\pi i_a^2 \cos^2\gamma \, d\gamma = \frac{\pi}{2} i_a^2$$

$$\int_0^\pi I_b i_a \sin 2\gamma \cos a = 0$$

Substituting these values, there is obtained

$$P_c = \frac{rz}{2\pi}\left\{\frac{\pi}{2} I_b^2 + \frac{\pi}{2} i_a^2\right\}$$

$$= \frac{rz}{4}\left\{I_b^2 + i_a^2\right\}$$

This represents the total armature copper losses per one pole where

r = ohmic resistance of one armature conductor.
z = armature conductors per pole.
I_b = the time maximum of the working current through the conductor located in axis b-b'
i_a = the time maximum of the magnetizing current through the conductor located in axis a-a'.

The equation shows that the losses are independent of the time-phase relation between the working current and the magnetizing current.

The equations just derived give a means of calculating the armature copper losses when the currents are known. The rotor currents, however, are a function of the load. In order to simplify their calculation assume an ideal motor without leakage and with rotor resistance negligible as compared with the rotor inductance. Under the above assumptions it follows that at synchronism the rotor field in axis b-b' will be equal in strength to the main stator field in axis a-a'. If this latter has sine-shape distribution in space it is evident that the rotor field in axis b-b' has sine-shaped distribution also. The rotor magnetizing current, producing the rotor field, must have cosine distribution in space. This is shown in Figs. 6 and 8.

Referring to Fig. 8, let $\beta = \frac{\pi}{z}$ be the angle between the centers of two adjacent conductors. The mmf in the center of the pole is the sum of all the mmfs produced by conductors located symmetrically with respect to the axis b-b'. The m.m.f. in the center of the pole is, therefore,

$$M = i_a \sin\left(\frac{\beta}{2}\right) + i_a \sin\left(\frac{3\beta}{2}\right) + i_a \sin\left(\frac{5\beta}{2}\right) + \text{etc.}$$

This equation can easily be expressed graphically, as shown in Fig. 8. The quadrant represents the angular displacement between axis a-a' and axis b-b'. This is divided into sections representing the angular displacement between two adjacent conductors. If the chord be considered as proportional to the maximum value of the magnetizing current, then the summation of the terms in the equation given above will be equal to the radius of the circle. From this it follows that

$$r = M = \frac{i_a}{2 \sin \frac{\beta}{2}}$$

$$\sin\left(\frac{\beta}{2}\right) = \sin \frac{\pi}{2z}$$

Since $\frac{\beta}{2}$ is a very small angle, it may be said that

$$\text{sine}\,\frac{\beta}{2} = \frac{\beta}{2} = \frac{\pi}{2z} \text{ and } M = \frac{i_a z}{\pi}$$

The magnetic induction in the center of the pole is, therefore,

$$B_c = \frac{4\pi}{10} \cdot \frac{i_a z}{\pi\delta} = 0.4 \frac{i_a z}{\delta}$$

and the total number of lines in the direction of the axis b-b' is, therefore,

$$N_b = B_c \tau l \frac{2}{\pi} = 0.4 \frac{I_a z}{\delta} \cdot \frac{\tau l}{\pi} \times 2,$$

where τ is the pole-pitch and l is the axial length of the rotor core.

The above treatment has been based on an ideal motor without leakage; in which case at synchronism the field "N_b" equals the stator main field "N_a." At any other speed

$$N_b = \frac{V_0}{V_1} N_0 = N_0 (1 - s) \quad \text{where } s = \text{slip.}$$

Substituting and solving for i_a, there is obtained

$$i_a = \frac{(1 - s) N_0 \delta \pi}{0.4 z \tau l \times 2} = 3.927 (1 - s) N_0 \frac{\delta}{z \tau l}$$

i_a = time maximum of magnetizing current through a conductor located in axis a-a'

N_o = time maximum of total lines in main field (sine-shaped space distribution assumed).

δ = length of single air-gap, centimeters.

z = number of conductors per pole.

τ = effective pole-pitch in centimeters.

l = length of armature in centimeters.

s = slip of rotor as a fraction of the synchronous speed.

The value of the working current in the rotor axis *b-b′* may be determined from the torque required. Under the previous assumption of an ideal motor without leakage we find that the working current I_b is in time phase with the magnetizing current i_a. The space distribution of the current I_b is the same as the space distribution of the rotor field N_b in axis *b-b′*. Fig. 7 represents this relation.

The torque acting on a conductor γ degrees from axis *a-a′* is given by the expression

$$T_q = k\,l \sin\gamma \sin(\omega t)\, B_c \sin\gamma \sin(\omega t)$$
$$= k\,l\,I_b\,B_c \sin^2\gamma \sin^2(\omega t)$$

The average torque on this conductor during one period is, therefore,

$$T_q = k\,l\,I_b B_c\, sin^2\gamma \frac{1}{\pi}\int_0^{\pi} \sin^2(\omega t)\,dt = \tfrac{1}{2}\,k\,l\,I_b B_c \sin^2\gamma$$

This is the average torque acting on one conductor located γ degrees from the axis *a-a′*. One conductor covers $\pi \div z$ degrees of the pole face. The torque acting on one pole of the rotor winding is, therefore,

$$T_q = \tfrac{1}{2}\,k\,l\,I_b\,B_c \int_0^{\gamma=\pi} \frac{\sin 2\gamma}{\pi \div z}\,d\gamma$$

$$T_q = \tfrac{1}{2}\,k\,I_b\,B_c\,l\frac{z}{\pi} \cdot \frac{\pi}{2} = \tfrac{1}{4}\,k\,z\,I_b\,B_c\,l$$

It has been seen that

$$N_b = B_c\,\tau\,l\frac{2}{\pi}$$

and

$$B_c = \frac{N_b\pi}{2\tau\,l}$$

Substituting this in the equation for torque, we get

$$T_q = \tfrac{1}{4}\,k\,z\,I_b\frac{N_b\,\pi}{2\,\tau}$$

and

$$I_b = \frac{2.55\,T_q\,\tau}{k\,z\,N_b}$$

The coefficient k depends on the units of measurement used for T_q, τ and N_b.

The losses in the squirrel-cage rotor can, therefore, be expressed as:

Copper losses due to the rotor magnetizing current

$$P_{cm} = \frac{i_a^2\,r\,z}{4} = \frac{(3.927)^2}{4} \cdot \frac{N_o^2\,\delta^2\,(1-s)^2\,r}{z\,\tau^2\,l^2}$$
$$= 3.855\,\frac{N_o^2\,\delta^2\,(1-s)^2\,r}{z\,\tau^2\,l^2}$$

Copper losses due to the working current

$$P_{cw} = \frac{I_b^2\,r\,z}{4} = \frac{(2.55)^2}{4} \cdot \frac{T_q^2\,\tau^2\,r}{k^2\,z\,N_b^2} = 1.625\,\frac{T_q^2\,\tau^2\,r}{k^2\,z\,N_b^2}$$

$N_b = N_o$ at synchronism.

In a later article the losses in rotors of the coil-wound type will be treated in detail.

UNDERGROUND TELEPHONE AND TELEGRAPH CABLE BETWEEN PHILADELPHIA AND WASHINGTON.

The American Telephone & Telegraph Company is at present engaged in installing about 135 miles of conduit and cable between Philadelphia and Washington in order to preclude a recurrence of the conditions that existed at the inauguration of President Taft in 1909, when Washington was completely isolated from the rest of the world.

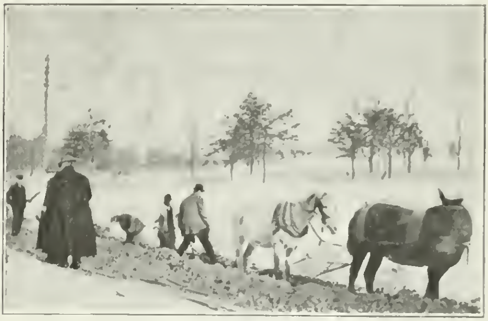


Fig. 1—Plowing Trench.

The stretch of cable from Philadelphia to Washington will pass through Wilmington and Baltimore, and is the first of a series of similar stretches that will ultimately form a continuous underground telephone and telegraph route from Boston to Washington. At the present time the longest commercial telephone circuits wholly in underground cable are those between New York and Philadelphia, a distance of less than 100 miles. While the outward dimensions and appearance of the cable between Philadelphia and Washington will be the same as that of the present cable between New York and Philadelphia, the wires are larger and are so arranged that from each two pairs of the larger wires in the cable it is possible to obtain simultaneously three complete telephone and eight complete telegraph circuits. There are also within the sheath a number of pairs of smaller wires for use between intermediate cities along the route, which may also be used for telegraphic purposes. All told, 148 wires arranged in seventy-four pairs and capable of giving ninety-nine telephone and 296 telegraph communications simultaneously are contained within the 2 9/16-in. lead pipe which forms the protective coating of the cable. The section between Philadelphia and Washington which is now being laid requires somewhat less than two-thirds of the cable needed to connect New York with

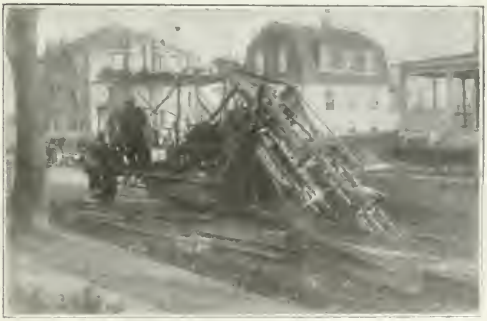


Fig. 2—Trench Excavator.

Washington, but yet involves the making and handling of nearly 1500 reels of lead-sheath cable, having a total weight of nearly 3000 tons. Each of the cables averages about 500 ft., and 1500 splices, involving more than 250,000 wiped joints, must be made. Of the 3000 tons weight of cable, approximately 900 tons are copper conductors, being in the form of more than 20,000 miles of wire. Seventeen hundred tons are accredited to the weight of the pipe sheath, of which about 50 tons are in the form of pure tin, the remainder being lead. The paper used for insulating individual wires contributes about 140 tons and is in the form of ribbon, more than 24,000 miles long. At intervals along the cable the wires are connected to Pupin loading coils. Altogether, nearly 10,000 of these loading coils in nearly 400 cast-iron cases are to be used between Philadelphia and Washington. To form the iron cores for the loading coils more than 17 tons of the best Norwegian iron has been drawn into 155,000 miles of wire about the size of a horsehair. The data on the line are given in the tabulation that is printed herewith.

NEW YORK-WASHINGTON DUPLEX CABLE AND LOADING COIL EQUIPMENT.

Item.	Philadelphia-Washington Section.	New York-Philadelphia Section.	Total.
Cable:			
Length	135.3 miles	86.7 miles	222.0 miles
Number reels (500 ft.)	1,429	916	2,345
Carloads	119	77	196
Total weight	2,720 tons	1,735 tons	4,455 tons
Number separate copper wires	148	148	148
Weight of copper wire	893 tons	572 tons	1,465 tons
Length of copper wire	20,000 miles	13,000 miles	33,000 miles
Weight of sheath:			
Lead	1,637 tons	1,046 tons	2,683 tons
Tin	50 tons	32 tons	82 tons
Total	1,687 tons	1,078 tons	2,765 tons
Weight of paper	137 tons	88 tons	225 tons
Length of paper ribbon	24,100 miles	15,400 miles	39,500 miles
Number of wire joints	226,000	145,000	371,000
Number of loading points	97	62	159
Loading coils:			
Number of	9,603	6,138	15,741
Number of pots	388	248	636
Weight of pots (equipped)	204 tons	130 tons	334 tons
Length of cable stubs	3,104 ft.	1,984 ft.	5,088 ft.
Length of wire in stubs	174 miles	111 miles	285 miles
Weight of copper in windings	52,820 lbs. 29.1 tons	37,200 lbs. 18.6 tons	95,400 lbs. 47.7 tons
Length of copper winding	1,370 miles	870 miles	2,240 miles
Length of copper conductor	6,720 miles	4,290 miles	11,010 miles
Loading coils:			
Weight of iron core wire	34,200 lbs. 17.1 tons	21,900 lbs. 10.95 tons	56,100 lbs. 28.05 tons
Length of iron wire	155,000 miles	99,000 miles	254,000 miles
Time required to draw iron—for whole job, 11 weeks; entire fine-wire output of Roeblings'.			
Area film insulation on iron and copper wires	24.7 acres	15.8 acres	40.5 acres
Operation:			
Number telephone conversations at any point in cables.	99	99	99
Number telegraph messages at any point in cables (assuming each circuit composited, with duplex telegraphic operation)	296	296	296

WILMINGTON-WASHINGTON CONDUIT.

The Wilmington-Washington conduit follows the route over which Professor Morse planned to lay an underground telegraph conduit in the early days of the telegraph business. This stretch involved the digging of a trench approximately 100 miles long along the highways, over hill and dale, the laying of ducts and placing of cables. Seventy-five bridges had to be crossed, each involving its own peculiar problem in telephone engineering, and in the construction of this underground conduit line some new and interesting features of telephone engineering were used.

The work of trenching was divided into three sections and let to contractors as follows: Section 1. From the southwesterly line of the city of Wilmington, Del., to the west bank of the Susquehanna River at Havre de Grace, Md. Section 2. From the west bank of the Susquehanna River at Havre de Grace, Md., to the northeasterly line of the city of Baltimore, Md. Section 3. From the southwesterly line of Baltimore, Md., to the northeasterly line of the District of Columbia.

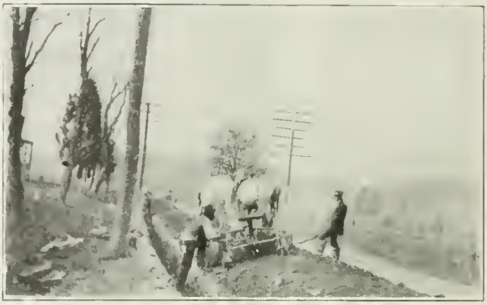


Fig. 3—Scraper Used for Back-Filling Trench.

The concrete manholes used on this conduit line are an innovation in telephone construction. This manhole, which is constructed entirely of concrete, has been substituted for the bricked-up manhole with iron cover in general use in underground work. The manhole is barrel shape—3 ft. wide by 4 ft. 6 in. long with 3 ft. of head room. The walls consist of four concrete slabs, 3 in. thick, reinforced by expanded metal. The roof is formed by two reinforced-concrete slabs, 4 in. thick. The flanged cover is also of reinforced concrete, 24 in. in diameter. When in place the manhole cover is 12 in. below the street grade. A concrete post, 4 in. x 6 in., is set 2 ft. out of the ground at the side of the road, so that the exact position of the manhole may be readily ascertained. Upon each post are stenciled the number of the manhole and its exact distance from the marker. The manholes were placed at an average distance apart of approximately 500 ft.

On Section 1 a trenching machine was successfully used by the contractor. The records of the engineers show that this machine excavated daily 1000 ft. of trench, 18 in. wide and 3 ft. deep, removing the dirt. The machine showed a capacity of 3 ft. of clean trench for each minute of actual working time. To operate it an engineer and two assistants are required.

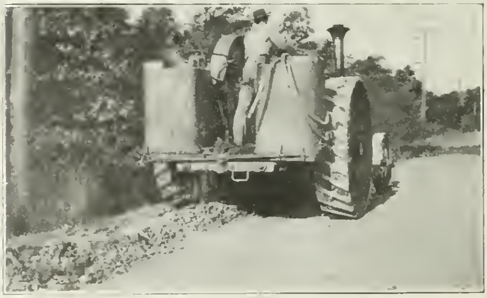


Fig. 4—Traction Engine Used for Rolling Trench.

On other sections of the work the trenching plow was used. This plow was drawn by two mules, or horses, driven abreast or tandem. The first plowing was at a depth of a few inches for a distance of about 300 ft.; then the shovelers were put on to throw out the dirt while the plow was breaking up another section, and this operation was repeated until the required depth was reached. The mules were frequently driven tandem in the trenches.

The line consists of four ducts, except where it passes through towns, where the number is increased to five and six. The ducts used are what are commonly known as pump logs. The ducts are 7 ft. in length, 3 in. inside measure, and are treated with creosote by special process. They are of Southern yellow pine, thoroughly saturated with dead oil of coal tar, which is forced into the pores of the wood under pressure, the standard of requirement being 15 lb. of oil to each cubic foot of wood.

The ends of the pump log ducts fit together, making a tight point requiring no cement. Over 300,000 pieces of duct were required for the Wilmington-Washington line.

In the preliminary surveys all bridges and crossings had been carefully studied and the best methods of crossing them determined. The usual method employed in the past has been to protect the cables by means of iron pipe, but this method possesses many disadvantages, chief among them being the fact that within a few years after being laid the iron is liable to rust and disintegrate. For this reason iron pipe in connection with bridge crossings has been avoided wherever possible. In the case of only six out of the seventy-five bridges on the present work was it found necessary to make use of it.

Running a telephone duct across a bridge involves many problems. The conduit must not interfere with traffic. In case of a bridge over a railroad the duct cannot be suspended where it would reduce the head room; if avoidable it must not be suspended where the spring freshets will force débris against it. Wherever placed, the telephone duct must be protected from damage in every possible way. In many cases this was accomplished by incasing the ducts in a wooden box made of heavy creosoted plank, supported by angle iron and suspended by iron hangers from the bridge structure. In some cases the angle iron has been laid across the bridge girders beneath the flooring, the ducts running across on wooden blocks placed at intervals, the whole being protected from mechanical injury by a wrought-iron plate or shield on the top and sides, a new thing in telephone construction. This metal shield is for the purpose of protecting the wooden ducts from the danger of being pierced by spikes when repairs are being made on the bridge.

Where the conditions made it necessary to suspend the ducts from the side of the bridge the engineers have swung the conduit on a curve, using iron ducts protected by concrete construction. On the bridge the ducts are run in a heavy plank box resting on angle iron and secured by iron hangers to the bridge structure.

After the ducts had been laid and 6 in. of dirt carefully filled in around them and tamped, a road roller was used and another layer of about 6 in. was filled in and tamped. This process was continued until the trenches were filled. A road roller weighing about 1000 lb. was used to pack the filling as solidly as possible. On Section 2 the earth was filled in loosely and crowned about 6 in. and a heavy steam road roller weighing about 10 tons was run over it many times.

Many of the roads between Baltimore and Washington are improved highways, a 14-ft. strip of macadam running down the center of the road. Some of the roads had been oiled, and it was feared that the work on the trenches would seriously impair the surface. Consequently, strips of burlap, between 3000 and 4000 running feet in length, and 8 ft. wide, were used to cover the improved roads while the work of trenching was going on.

Central Station
Management, Policies and Commercial Methods

ELECTRICAL DRAINAGE IN ILLINOIS.

During the past five years a motor-driven centrifugal pump has been used to advantage by Mr. C. B. Shedd to reclaim about 500 acres of swamp land near Hyde Lake, in the southern environs of Chicago. After being freed of its standing water by the pump, this land has now become valuable soil for raising timothy hay, some of the crops averaging 6 ft. in height and about 2 tons to the acre. When weather conditions were favorable it has also been possible during several seasons to raise a second crop, although, as is characteristic of timothy, after a year or two the soil becomes partially exhausted and must be turned over before new crops can be sown to advantage. While the acreage referred to is at present used for hay crops, it is being held for manufacturing-site purposes on account of its close proximity to the City of Chicago, which makes it valuable property.

The motor-driven pumping equipment installed comprises a 15-hp, single-phase motor driving through bevel gearing and a vertical shaft a 12-in. centrifugal pump capable of delivering 5000 gal. of water per minute, or about 1 acre-ft. of water per hour. Electrical energy is supplied by the Northern Indiana Gas & Electric Company, of Hammond, Ind. The motor and pump are mounted on a movable platform, and by means of screws the pump can be raised to any desired level. During the wintertime, if necessary, it can be lifted entirely out of the water to avoid freezing. The vertical adjustment of the pump also makes it possible to take water from any level desired.

The pump has now been in use about five years and is operated a number of hours a day during the spring season and following any heavy rainfall that occurs during the summer.

In the low-lying Calumet region, partly in Illinois and partly in Indiana, in which Lake Calumet, Hyde Lake and Wolf Lake are found, the total precipitation amounts to about 33 in. per year. Evaporation removes about 17 in. of this from the surface of the ground, leaving somewhat over a foot of water to be lifted from each acre of the submerged swamp land. At the rate charged for electricity, 8 cents to 4 cents per kw-hour, the annual total cost of freeing the land of this amount of water lifted to a level of 4 ft. is about $1 per acre. In return for this expenditure, however, as pointed out above, the land has been converted from a tract of almost no possible utility, except habitation by frogs, to a good agricultural ground which will later become very valuable industrial property.

The cost of installing the pump complete with motor and with the frame house which shelters it was $1,000. A pole line was also built a distance of one mile to meet the line from the Hammond plant, five miles distant, which supplies energy to operate the motor. After being lifted about 4 ft. from the submerged 500-acre tract, parts of which are several feet below the high-water level of Lake Michigan, the water is discharged into Hyde Lake and thence finds its way through the Calumet River into Lake Michigan.

Mr. Shedd, who made this installation five years ago, declares that the motor-driven pump has given thorough satisfaction in every way and during the entire period of its operation has been free from burn-outs or interruptions of any kind. As the result of his own experience, Mr. Shedd has become very enthusiastic on the subject of motor-driven irrigation as well as electrical drainage. A 3-in. centrifugal pump costing $100, he says, will properly irrigate ten acres. A 6-in. $200-pump will irrigate forty acres, and a 12-in. pump costing $400, like that installed on his tract, will care for 160 acres; in each case the total installation cost is about twice the cost of the pump alone. Such motor-driven irrigation can be used to advantage not only in arid climates, but also on comparatively fertile and humid ground, as it is realized that the crop output from such territory can be greatly increased by the application of a little water during the dry seasons of the year.

TRIMMING AND INSPECTION OF ARC LAMPS IN PHILADELPHIA.

The trimming of the lamps on the newly erected twin lamp poles in the central section of the City of Philadelphia proved to be quite a problem. As a temporary makeshift a 24-ft. two-section ladder was set on a quadrant, placed in the body of an ordinary express-type wagon and so arranged that the ladder could be swung to either side or made to assume an upright position. This arrangement answered the purpose, but the expense of operation was too great, as it necessitated the services of a horse and driver in addition to the trimmer.

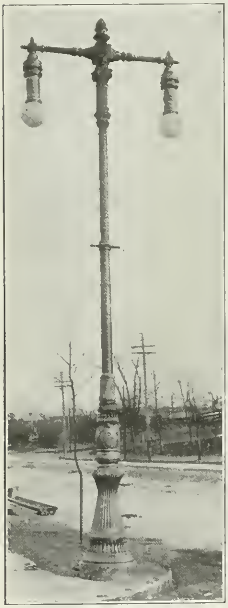


Fig. 1—Twin Arc Post.

The design and construction of an electric tower wagon was then considered, but the main difficulty was to devise a plant to obviate the necessity of having an extra man to do the trimming, as otherwise the driver would be compelled to climb to the top of the tower to trim each pair of lamps. At the suggestion of Mr. A. H. Manwaring, engineer of arc lighting of the Philadelphia Electric Company, a tower wagon was designed that could be operated from either the upper platform or the driver's ordinary position at the floor level and equipped with a turntable at the top to enable the operator to trim the lamps on both the street and house sides of the poles. The Commercial Truck Company, of Philadelphia, collaborated with Mr. Manwaring, and Figs. 2 and 4 show the result of their work.

The tower wagon is constructed on the ordinary 500-lb. chassis, the weight of which without the tower and including the battery is 2600 lb. The weight of the tower is 650 lb., making a total weight of 3250 lb. The vehicle is equipped with a 42-cell, seven-plate Philadelphia storage battery, which will furnish energy to drive the vehicle at an average speed of fifteen miles per hour on the level and has a mileage capacity of thirty miles per charge. The wheels are equipped with 2½-in. x 36-in. Firestone tires, both front and rear. The controller is mounted on the upper platform and can be operated from either the upper or lower seat by a tube outside the steering shaft. The reversing mechanism is a Z-slot bushing keyed on the controller tube, which is worked from the upper seat by the foot and from the lower seat by the hand. The steering gear is mounted in the usual manner and is worked from the upper or lower seat by a shaft which runs through the controller. The brakes can be worked from the lower seat by a foot lever in the usual manner and from the upper seat by a foot-lever rod and crank. The upper foot lever has an extension, so that the operator can set the brakes from the top seat, climb down and release the brakes from the lower seat, or vice versa. The electric bell is operated from either the upper or lower seat by a floor push in the toe-board. The platform is 13 ft. 6 in. from the ground and an additional height can be secured by hanging a portable stand from the side rails, which will increase the height to either 14 ft. or 15 ft. 6 in., depending on which rail is used.

A test of the stability of the machine was made by suspending a weight of 700 lb. from the end of the platform when turned in the position occupied by the trimmer in trimming the lamps (Fig. 4). This test was made before the battery was installed and proved the stability of the tower wagon under the most severe working conditions.

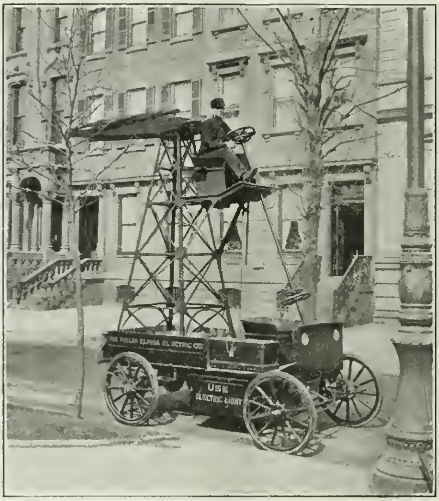


Fig. 2—Automobile Used in Trimming Lamps.

The tower wagon has been giving very satisfactory service, and enables the trimmer to cover each of his routes in approximately six hours, while by the old method nine hours were required to accomplish the same results.

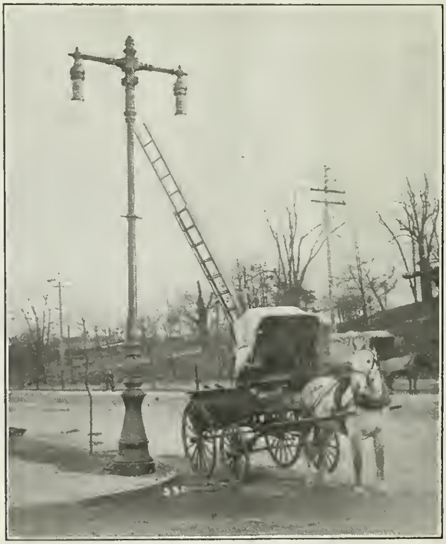


Fig. 3—Ladder Arrangement First Used.

Formerly the inspection of these lamps necessitated the stationing of a horse-drawn wagon and driver at a centrally located point, and also the use of a motor-cycle, the operator of which covered the district lighted by the ornamental lamps in about four hours. He reported all faulty lamps to the driver, who would proceed to the various locations with the team and start or change the defective lamps.

The tower wagon eliminated the necessity for the horse-drawn wagon and motor-cycle, as by its use all the lamps on ornamental poles are inspected in approximately two and one-half hours and faulty lamps started or changed by the operator, who carries a number of lamps for this purpose on the wagon.

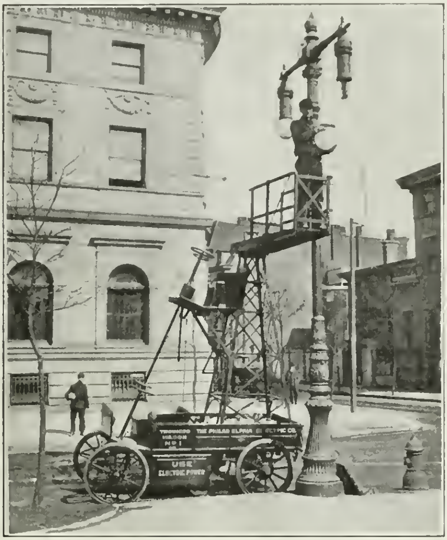


Fig. 4—Method of Trimming Lamps.

This method of trimming and inspecting the ornamental lamps shows a daily saving in the cost of transportation and labor of approximately 33⅓ per cent over the former method of using the horse-drawn wagon and motor-cycle, and in addition to this the tower wagon has a decided advertising value, as it attracts a great deal of attention on the streets. On one side of the body has been painted "Use Electric Light" and on the other side "Use Electric Power."

WOOD MILLS AS SUMMER MOTOR LOADS.

A distinctly summer load is found in some classes of wood-working establishments. The season of cutting the lumber is closely followed by its preparation in the wood mills, with the result that these places are usually busiest in the summer time, when motor load is most acceptable to the central-station company. In St. Paul, Minn., according to Mr. E. T. Street, new-business manager of the Northern Heating & Electric Company there, there is a planing mill using 250 hp in motors operated by central-station energy. This mill operates sixteen to twenty hours a day in the summer time, almost shutting down in December and January.

On account of the large amount of refuse, useful as fuel, produced in such wood mills they are usually difficult motor customers for the central station to obtain. Mr. J. B. Crane, commercial engineer for the Great Northern Power Company, Duluth, reports, however, that his company is supplying motor service to several sawmills and wood-working plants, and that these actually find that by selling the kindling and shavings formerly burned to make steam they obtain more than enough to cover their electric bills.

Another objection raised by wood-mill proprietors when approached by central-station solicitors on the subject of motor drive is the point that steam is required anyhow the year around for the kilns. In St. Paul, however, Mr. Street reports, there is a mill using 45 hp in electric motors which operates dry kilns all the year. Another planing mill, soon to start operation, has installed 75 hp in motors, using central-station energy in preference to using a steam engine.

In laying out motor drive for a wood-working plant the work to be done must be considered, as well as the rated size of the machines to be operated. For instance, on light work a 5-hp motor will handle very easily a 24-in. planer, while on heavy work a 35-hp motor will sometimes be overloaded when driving a 24-in. planer. Tests show also that dull knives will sometimes increase the power requirements of wood-working machinery as much as 300 per cent. In general, group drive is often desirable in wood-working plants, and this fact does a great deal to simplify the problem of laying out motor drive.

Do not guess at the power required to drive a blower, advises Mr. Street. A fan requiring ¼ hp when operating at 600 r.p.m. will under the same conditions of inlet and outlet apertures require 2.2 hp at 1200 r.p.m. and 11.4 hp at 2000 r.p.m. This illustrates the fact that the power requirements of a blower vary as the cube of the speed; that is, if the speed of a fan or blower is doubled, it will require eight times the original power. For this reason the slowly revolving fan on a ventilating system may be easily driven by a 5-hp motor, while the little high-speed shavings blower may require a 20-hp motor.

Mr. Crane also points out that in replacing steam engines with motor drive in wood shops larger ratings of motors will be required than the engines which they replace. When an engine-driven tool is overloaded by pushing too large material through it the tool simply slows down and the work is withdrawn until the engine has regained its speed. But when a motor-driven tool is worked beyond its rating by too large or too coarse stock the motor strives to hold its speed, simply taking more current to supply the overload. The motor-driven tool thus gives no warning to the unskilled operator that it is being overloaded and is accordingly often pushed far beyond its intended capacity, with the result that the motor may be overheated and destroyed.

COMMERCIAL ELECTRIC HEATING IN NEW YORK CITY.

The extent to which electricity is being employed for commercial electric heating in New York City is quite remarkable, and it is also noteworthy what numerous and varied usages have been the outgrowth of experimenting and developing along these lines. The installations cited below are typical of many others connected to the New York Edison circuits. The most popular and best known of the heating devices is, of course, the electric iron. This device is now taking the place of every other kind of iron in large cloak and suit, necktie, shirtwaist and other garment-manufacturing concerns in the city. Already the New York Edison Company has nearly 100 large

Fig. 1—Electric Irons in Garment Manufactory.

establishments on Fifth Avenue using flatirons in manufacturing and for pressing samples. In the great garment-manufacturing district, which centers about Twentieth Street, there are hundreds of firms now employing electric flatirons. The reason for their coming into such wide use is that they accomplish 25 per cent more work than any other kind of iron, do it in a more cleanly way, and improve the sanitary conditions of factories where they are used. The weight of the irons for ladies' tailoring averages from 16 lb. to 18 lb., while what is perhaps the largest electric iron is one which weighs 35 lb. and was made for a firm of men's tailors. One of the leading cloak and suit houses has twenty-one irons, an electrically heated plaiting machine and an electric coffee urn, so that employees may have hot coffee with their lunches.

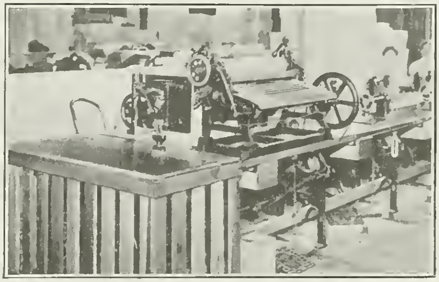


Fig. 2—Electrically Heated Plaiting Machine.

Among necktie manufacturers the electric iron has also taken the place of other devices, a maker of fashionable cravats at Fourth Avenue and Twenty-eighth Street having forty electric irons. Those used for pressing ties average 6½ lb. in weight, but as linen and wash ties require more heat than silk ones, every iron is equipped with a regulating device. As shown in the engravings, a red pilot lamp is connected in multiple with the irons so as to indicate whether the iron is in circuit or not. This signal is provided in conformity with the rulings of the Underwriters.

One of the handicaps which the manufacturers of silk and chiffon waists have had is that of ironing the tucks. By experimenting a novel scheme has been found which does away with the difficulty. A long, narrow goose-iron is riveted upside down to stilts which are set in the table. The tucked material is then passed gently over the face of the iron. This smooths the goods without flattening it. This device was suggested by the heating department of the New York Edison Company.

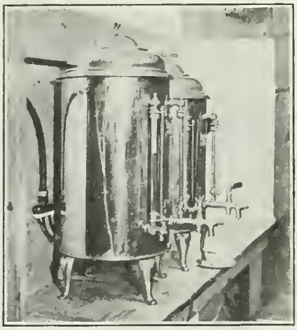


Fig. 3—Electrically Heated Coffee Urns.

Another interesting branch of electric heating for commercial purposes that has developed is the use of electric baking ovens by the large typewriter exchanges. These concerns do a large business in second-hand typewriters, many of which they re-enamel. In the enameling there is a baking process and it was discovered that the electrically heated oven was just the thing for the purpose. The heat supplied is even and easily regulated to a single degree. The enamel used contains ingredients which give off fumes that are to a certain degree explosive. For this reason electricity is much safer than any heating agent which gives off a flame.

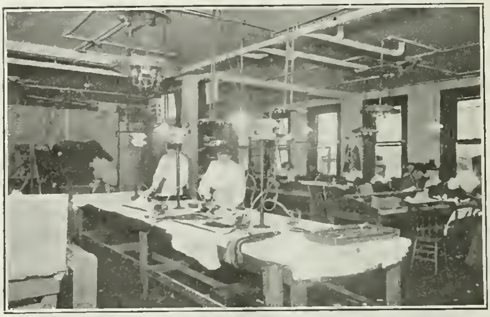


Fig. 4—Electric Irons in a Fifth Avenue Shop.

A novel use to which the electric iron has recently been put is in the finishing of furniture. A downtown firm found an electric iron the best device for melting composition substance into cracks and nicks in furniture that had become harmed in transportation. The iron smooths off the mended place so well that after the stain and varnish have been applied it is impossible to tell where the repair was made.

Electric glue-pots are used with pronounced success in envelope factories, for very little energy is required to keep the glue at an even melting temperature. Electric soldering irons are now used extensively in the manufacture of leaded glass and metal cornices. They have also been found very handy for the work which has to be done on an electric sign after it is placed on a building. An ordinary soldering iron would cool before it could be passed to the man using it.

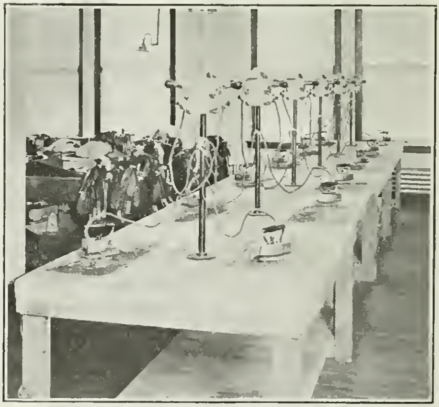


Fig. 5—Electric Irons in Cravat Factory.

In large brush factories where setting mixtures, wax and resin, requiring a temperature of 400 deg. Fahr. to melt, are used, electric pitch-kettles have been installed. In many of the banks and large express companies the sealing wax used is melted in an electric device.

Several of the large moving-picture film manufacturing concerns have found that electric foot-warmers are exceptionally valuable for keeping the developer and other solutions at the right temperature. This peculiar use of the foot-warmers came about as follows: The Kadem Company, one of the large makers of motion-picture films, sent to the New York Edison Company's heating department for suggestions on some sort of device to keep the chemical solution used in developing films at a uniform temperature of 70 deg. Fahr. To produce the best results the developing bath must be kept as near 70 deg. as possible. Hence there is difficulty both in summer and in winter. However, the extra heat in summer has been successfully dealt with by using electric fans. Until recently film manufacturers used kerosene oil in heaters in cold weather, but when the fire-insurance authorities learned of this the manufacturers were informed that any heater with a flame would not be tolerated near the long rolls of celluloid. It was found impossible to use an electric coil, since the acid in the developing solution attacked the copper. Accordingly, the experiment was tried of mounting the trays which hold the solution on electric foot-warmers. The trays are some 15 in. long by not more than 18 in. wide, the developing fluid rising only a few inches in the tank. By placing the foot-warmers underneath the trays at intervals of several feet it has been found possible to keep the solution at the desired temperature.

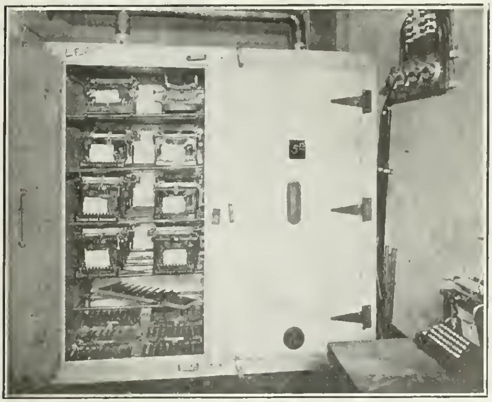


Fig. 6—Electrically Heated Enameling Ovens.

Wiring and Illumination

NEW TYPES OF ILLUMINANTS.

"New Types of Illuminants" was the subject of a talk by Prof. W. E. Barrows, of the electrical department of Armour Institute, before the Armour Institute Branch, A. I. E. E., April 5. After sketching the history of artificial illumination down through the pine-knot, candle and, finally, to the later forms of gas-mantle units, the speaker took up the subjects of electrical illuminants, describing the construction and principles of operation of the principal arc and incandescent types of electric lamps. Attention was called to the distinction between mere incandescence and the phenomenon of luminescence of which advantage is taken in the newer types of illuminants. An ordinary incandescent substance giving black-body radiations changes in color through red to white with increase of temperature, while, on the other hand, a luminescent material changes in color from the shorter blue wave-lengths to the longer white vibrations with rise in temperature.

Professor Barrows described the operation and construction of the principal kinds of flaming-arc and metallic-flaming-arc lamps. The neon vacuum-tube lamp was also referred to as a possible supplementary unit to compensate for the greenish wave-lengths of the mercury-vapor lamp. The speaker also described the new type of reflector invented by Dr. Peter Cooper Hewitt, the fluorescent material of which converts the short greenish wave-lengths falling upon it into longer reddish vibrations, the complementary relations of the two light sources producing nearly white light. The most highly efficient lamp yet produced, said Professor Barrows, is the quartz-tube mercury-vapor lamp, which has shown a light-producing output of 46 lumens per watt.

ELECTRIC WIRING AND LIGHTING EQUIPMENT FOR NEW BOSTON STOCK EXCHANGE.

A new board-room is rapidly approaching completion for the Boston Stock Exchange, and electricity will play a prominent part in its service. Fifty-two telephone booths equipped with private wires have been installed, and an elaborate telautograph, telegraph, electric fan and lighting service is to be maintained. Although the wiring is concealed, there is to be easy access to every cable through invisible closets in the pillars which carry the principal circuits. The quotation boards are to be equipped for magnetic operation. In place of the present card racks the boards will be provided with magnetized surfaces against which the board boys will place tin cards with iron backs. It is expected that much time will be saved by the arrangement. Elaborate provision is to be made for artificial electric ventilation and lighting, although the building is designed with a large glass dome which will render the use of natural light much more common than in the present quarters of the Exchange.

COMPARISON OF THE OPERATING CHARACTERISTICS OF VARIOUS ILLUMINANTS.

By Isador Ladoff.

The hearth of the hut inhabited by the primitive man was the source simultaneously of heat and light. Light was a by-product of heat. The semi-barbarian used to snatch a chip of burning wood from his hearth to illuminate some particularly dark corner for a short while or to light part of the road of a departing honored guest.

The writer of these lines remembers the "louchina" burning in the windowless, smoky hut of Russian peasants, where the long and thin piece of dry wood was simply stuck into the cracks of the naked timber of the wall. At a somewhat later period wood, pitch and tar were elaborately conglomerated into torches. The candle of a more enlightened age is but an improvement on the torch.

The ancient Assyrians and Egyptians were known to have used liquid vegetable oils in flat dishes in combination with fibrous material, as lamps with a wick. The classical Roman olive-oil lamp was in general use as late as the eighteenth century.

The first step in the direction of a rational utilization of illuminants was made by the druggist Quintet in the year 1765. He was the first to suggest the use of a lamp chimney. The next important step was made by Count Argand, who invented the hollow wick and round burner bearing his name. This happened in 1786.

The light produced by burning wood, pitch, tar, fats, oils or gas is due to the incandescence of the minute particles of carbon. If too little air (consequently oxygen) is finding access to the burning material the combustion is incomplete, the flame is smoky and only feebly luminous. On the other hand, complete combustion, as it is exemplified by the Bunsen burner, produces a comparatively hot, but weak, flame due to the poverty of the latter in incandescent carbon particles. Quintet and Argand struck the happy medium.

In the year 1859 American petroleum was first sent to Europe. This event sealed the doom of the vegetable-oil lamp, and in spite of the progress made since that time in illuminating engineering the petroleum lamp tenaciously keeps its place as a popular illuminant.

The attempt to use the comparatively hot, but non-luminous, alcohol lamp led to the discovery of the Welsbach mantle. Welsbach originated the idea of using incandescent luminous bodies foreign to the flame itself. He was the first to combine "black body" with "selective" radiation in one illuminant.

The first man who manufactured illuminating gas enthusiastically called it "philosophical light." Strange to say, the illuminating gas only slowly gained its popularity as an illuminant. Not until the year 1812 was it introduced in London and not before 1826 in Berlin. In order to maintain the proper degree of incandescence the illuminating gas is subjected to a pressure of from 20 mm to 30 mm of mercury and the flame is spread so as to present sufficient surface. This condition was attained by the Schnitt burner and the Argand burner. This statement applies also to the acetylene gas as an illuminant.

Edison made the carbon-filament incandescent lamp a practical success in the year 1880. The filament gives light as a consequence of electric friction or resistance. There can be no combustion because oxygen is excluded from the interior of the bulb and there is no open flame on account of the absence of incandescent gases. Not until the invention of the differential arc lamp in the year 1879 could the carbon arc be generally adopted as an illuminant.

Beginning with the hearth of the semi-barbarian and ending with the carbon-arc lamp, the actual source of light remained the same, namely, carbon in the state of incandescence. Carbon represents the nearest approach to the theoretical "black body," that is, a body radiating energy in accordance with the temperature to which it is raised. It is but natural that the general tendency of those engaged in the task of increasing the luminous intensities of the sources of illumination was to raise the temperature of the incandescent carbon in one way or another.

In the carbon arc the highest terrestrial temperature so far technically attainable is being utilized. The carbon-arc lamp represents the maximum of luminous intensity attainable with incandescent carbon. In the carbon arc the crater, a small area of the upper positive carbon electrode, is the place where the electro-vaporization or ionization of the carbon is going on. This crater is the principal seat of the illuminating incandescent carbon particles, the arc itself being only feebly luminous because of its considerably lower temperature.

It is an established fact that with the rise of temperature of a body the energy-flow at any wave-length of the spectrum increases and that the increase in energy is the stronger the shorter the wave-length. The maximum of energy-flow consequently moves with the increase of the temperature of a body always in the direction from the invisible infra-red through the visible range into the invisible ultra-violet end of the spectrum.

The following table shows in brief form the wastefulness of the modern artificial sources of light based on the energy value of the fuel used:

TABLE I.—RELATIVE EFFICIENCIES OF MODERN ILLUMINANTS.

Sources of Light.	Watt per Candle.	Relative Efficiency.
Petroleum flame	0.113	0.029
Alcohol flame	0.00092	0.0068
Incandescent gas mantle	0.00183	0.0180
Carbon incandescent lamp	0.083	0.2 to 0.48
Osmium lamp	0.077	0.85
Nernst lamp	0.127	0.3 to 0.34
Carbon arc lamp	0.0215 to 0.0047	

The figures in Table II are not strictly comparable since in some cases the candle-power means the horizontal, in others the spherical, in others the hemispherical, as indicated. The comparative costs of electricity and gas on which the figures are based are, according to the third column, 50 pfennigs=12.5 cents per kw-hour and 16 pfennigs per cubic meter or $1.13 per 1000 cu. ft. of gas. (See Neuerungen in *Der Beleuchtungs-Technik. Zeit. Ingen.*, 1904, 676.)

TABLE II.—COMPARATIVE COSTS OF LIGHT FROM VARIOUS SOURCES.

Source of Light.	Consumption for 100 International Cp-Hours.	Candle-Power Measured.	Price of Fuel or Energy, Cents.	Cost of 1000 Cp-Hours, Cents.
Stearine candle	2.25 lb.	Horizontal	16 per lb.	36.0
Paraffine candle	1.87 lb.	Horizontal	18 per lb.	32.0
Petroleum	0.73 lb.	Spherical	3.2 per lb.	2.33
Petroleum incandescent lamp	0.22 lb.	Spherical	3.2 per lb.	.70
Alcohol incandescent lamp	0.1 gal.	Spherical	19 per gallon	1.90
Gas (ordinary burner)	67.0 cu. ft.	Spherical	113 per 1000 cu. ft.	7.55
Gas (Argand burner)	39.0 cu. ft.	Spherical	113 per 1000 cu. ft.	4.40
Gas, incandescent lamp	7.8 cu. ft.	Spherical	113 per 1000 cu. ft.	.88
Inverted gas incandescent lamp	6.4 cu. ft.	Spherical	113 per 1000 cu. ft.	.72
Acetylene	4.6 cu. ft.	Spherical	700 per 1000 cu. ft.	3.2
Acetylene incandescent lamp	1.2 cu. ft.	Spherical	700 per 1000 cu. ft.	8.4
Electric carbon-filament lamp	350 watt-hours	Horizontal	12.5 per kw-hour	4.4
Nernst lamp	165 watt-hours	Horizontal	12.5 per kw-hour	1.9
Tantalum lamp	165 watt-hours	Horizontal	12.5 per kw-hour	1.9
Osram, tungsten, zirconium, sirius colloid lamps (100 volts)	110 watt-hours	Horizontal	12.5 per kw-hour	1.4
Bergmann, A.E.G., Sonnenlamp, Econo. lamps (220 volts)	130 watt-hours	Horizontal	12.5 per kw-houz	1.6
Electric arc lamp without globe	130 watt-hours	Hemispherical	12.5 per kw-hour	1.6
Electric arc lamp with globe	190 watt-hours	Hemispherical	12.5 per kw-hour	2.4
Inclosed-arc lamp	169 watt-hours	Hemispherical	12.5 per kw-hour	2.1
Liliput lamp	100 watt-hours	Hemispherical	12.5 per kw-hour	1.25
Regina and Reginula arc lamps	88 watt-hours	Hemispherical	12.5 per kw-hour	1.10
Helia arc lamp	55 watt-hours	Hemispherical	12.5 per kw-hour	0.70
Quartz lamp	30 watt-hours	Hemispherical	12.5 per kw-hour	0.37
Bremer, Rebofa flame mercury-vapor lamp	22 watt-hours	Hemispherical	12.5 per kw-hour	0.27
Westinghouse	22 watt-hours	Hemispherical	12.5 per kw-hour	0.27
Beck lamp	21 watt-hours	Hemispherical	12.5 per kw-hour	0.26
Prima flame lamp	17 watt-hours	Hemispherical	12.5 per kw-hour	0.21

Table III, on the next page, shows the ratio between the useful visible and injurious dark radiation in some of the sources of artificial illumination.

The examination of the table reveals the rather startling fact that even the most efficient source of light, the Geissler tube, utilizes only one-third of the total energy in the shape of luminous radiation, while the others fall far behind in their luminous efficiency. Next to the Geissler tube the electrolytic light of zirconium and magnesium oxides, which are selective radiators, shows the highest efficiency.

The color of a source of light to a considerable extent determines its value as a technically important illuminator. Only the following sequence of color, produced by the transversal waves of the ether of certain lengths, affects the animal eye as light: Red, orange, yellow, green, blue, violet. A combination of these waves produces on the eyes the sensation of white, as, for instance, sunlight. Candles, oil, petroleum and gas appear to furnish yellowish light, while the carbon arc seems bluish. Various incandescent lamps show different shades of color. The reason of this phenomenon is the difference in the intensity of various parts of the spectra of various substances. The following table contains comparative data as to the spectrophotometric values of various illuminants ascertained by Mr. H. C. Vogel (1880). A petroleum lamp was taken as the basis for comparison and the relative brilliancy of the radiation for a wave-length of 555 $\mu\mu$ (yellow) was assumed 100 for both light sources to be compared. The figures of the table consequently show the relative values of the brilliancy of other wave-lengths.

TABLE III.—VISIBLE AND INVISIBLE RAYS.

Sources of Light.	Light Rays in Percentage of Total Radiation.	Loss in Percentage.	Authority.
Candle........	1.35	98.47	F. J. Rogers
Gas argand burner ..	1.6	98.42	F. J. Rogers
Welsbach...........	2 to 4	96 to 98	Strache
Acetylene...........	5.5	94.5	Angstroom
Zirconium..........	8.4	91.6	Strache
Magnesium.........	13.7	86.3	F. J. Rogers
Geissler's tube......	34.0	66.0	Merritt
Electric incandescent	6.0	94.0	Merritt
Carbon arc..........	8 to 12.7	87.3 to 92	Marx
Arc................	10 to 16	83.4 to 90	Nakano

A body whose spectrum is stronger in red, for instance, will appear of reddish tint, while a body whose spectrum is especially strong in the blue part, of course, will show a bluish hue. The best source of light is that which approaches nearest to the sunlight.

In comparing various lamps the cost of trimming must be mentioned. An electrode of long life, for instance, minimizes the cost of trimming. The distribution of the light from the source may be favorable and otherwise according to conditions of radiation. It is important to have the illumination so arranged as to throw the major portion of the light where it is most needed. The ordinary carbon-arc lamp, for instance, has a very unfavorable light distribution. This is due to the fact that its most important light-producing part, the crater, is limited to a comparatively small area located on the lower surface of the upper positive carbon electrode, thus allowing the lower negative eletrode to eclipse a great deal of the luminous surface of the crater.

TABLE IV.—SPECTROSCOPIC COMPARISON OF LIGHT SOURCES.

Color.	Wave Length, $\mu\mu$	Relation Between Petroleum and the Sun.	Relation Between Petroleum and the Carbon Arc.	Relation Between Petroleum and the Clear Sky.	Relation Between Petroleum and the Moon.	Relation Between the Sun and the Carbon Arc.
Red........	633	232	190	398	220	80
Orange.....	600	175	149	252	164	83
Yellow.....	555	100	100	100	100	100
Green......	517	52	64	40	62	125
Light blue..	486	24	43	19	40	159
Blue.......	444	18	32	9	29	189
Blue.......	484	11	25	4	22	224
Violet......	424	10	20	2	18	

The luminous wave-lengths are contained between 0.008 mm and 0.004 mm (800 $\mu\mu$ to 400 $\mu\mu$). As the velocity of light in the air is 3,000,000 km per second, the number of vibrations of the visible rays is between 750,000,000,000 and 375,000,000,000 per second and embraces one octave.

An ideal source of light is furnished only by luminescent bodies; that is, bodies giving, under the influence of chemical or molecular processes, cold light. Such light is emitted by certain infusoriæ, by rarefied gases and by phosphorescing substances as, for instance, phosphorus and sulphur. Unfortunately the color of such light is bluish or greenish and the luminous intensity exceedingly low. However, there are bodies producing under certain conditions light at a comparatively low temperature; these are called selective radiators. For instance, E. Pringsheim demonstrated (1892) that certain salts introduced into non-luminous flames cause the latter to turn luminous not from any rise in temperature, but from certain purely chemical reactions. No volatilization or dissociation of the substances involved in the process was observed. A mixture of air with CS_2 vapor was proved by Fringsheim to produce a luminous flame with a continuous spectrum, the blue and violet portions of which were rather strong and the temperature of which did not exceed 150 deg. C. This experiment seemed to indicate that luminous vapors may possibly be a promising field of investigation. The question then arose whether gases follow Kirchhoff's law; that is, whether the luminescence starts at a fixed comparatively high temperature or not. It is known that some substances give colored radiation at comparatively low temperatures (thermoluminescence) and consequently do not follow the laws of radiation. Light phenomena are observable during crystallization or when slightly shaken (triboluminescence). Gases may be made to radiate light by fluorescence and electric discharges. Electrification or ionization of a gas is by no means a purely thermal process, but affects the nature of the minutest particles of the gas acted upon.

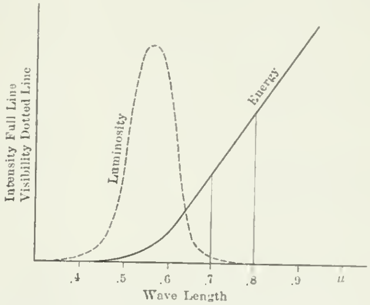


Fig. 1—Energy and Luminosity Curves of Carbon-Filament Lamp.

Our methods of perceiving light and color at high and low intensities are of rather complex nature. At very low illumination the eye acts in a profoundly different way from that characteristic at high illumination, and makes use of an entirely different set of minute organs of the retina. At high illumination we utilize organs known as "cones" and at low illumination a quite distinct variety known as "rods." Consequently the quality of light best adapted to certain purposes is very different in the two cases.

The determination of the amount of energy which the eye must receive in order to experience a certain sensation of brightness is a problem going to the very root of the theory of light production. Indirectly, suitable curves of energy radiation and luminosity of a certain illuminant enable one to calculate the mechanical equivalent of light. For instance, Fig. 1 represents the energy and luminosity curves of a carbon-filament glow lamp as determined by Dr. W. W. Coblentz. The difficulty in calculating the mechanical equivalent of light is that of deciding exactly what range of wave-length can be designated as luminous. One can conclude from the study of Fig. 1 that a great difference in the result would be occasioned by taking the upper limit as 0.8 instead of 0.7. The total light is hardly affected, but the energy is enormously increased.

The problems are very materially affected by the degree of illumination employed, on whether one is working with weak light and must depend on "rod vision," or with strong light, in which case "cone vision" is used. Intermediate sensations are perceived by the aid of both the rod and the cone vision. Fig. 2 shows the distribution of luminosity in the spectrum corresponding to rod vision, to cone vision and to both combined.

Koenig and Brodhuhn have studied exhaustively photometric sensibility, the reciprocal of which is the minimum charge of illumination that the eye is capable of detecting at different intensities. The results of these investigations are shown in Fig. 3. At high illumination the photometric sensibility practically includes all wave-lengths and all intensities.

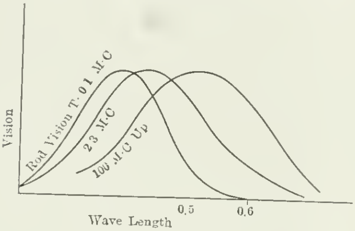


Fig. 2—Distribution of Luminosity in Spectrum.

TABLE V.—ROD AND CONE VISION. VISIBILITY AT VARIOUS INTENSITIES IN METER CANDLES.

Intensities.	0.00024	0.00225	0.036	0.575	2.30	9.22	36.9	147.6	590.4
Ratio to Proceeding		9.38	16	16	4	4	4	4	4
λ =									
0.430	0.047	0.057	0.076	0.060	0.063	0.057	..	..	..
0.450	0.23	0.21	0 21	0.20	0.14	0.10	0.085	..	..
0.470	0.50	0.46	0.42	0.42	0.36	0.19	0.16	0.13	..
0.490	0.85	0.78	0.75	0.70	0.63	0.40	0.28	0.25	0.24
0.505	0.99	0.99	0.98	0.94	0.88	0.63	0.50	0.45	0.40
0.520	0.97	0.96	0.94	0.99	0.97	0.85	0.72	0.69	0.67
0.535	0.75	0.76	0.76	0.83	0.98	0.98	0.91	0.88	0.87
0.555	0.36	0.42	0.47	0.54	0.83	0.97	0.99	0.99	0.99
0.575	0.12	0.17	0.20	0.26	0.58	0.85	0.97	0.98	0.98
0.590	0.045	0.059	0.095	0.15	0.42	0.71	0.88	0.92	0.92
0.605	0.015	0.022	0.044	0.10	0.28	0.54	0.71	0.079	0.79
0.625	...	...	0.022	0.05	0.17	0.05	0.42	0.52	0.54
0.650	...	...	..	..	0.057	0.11	0.15	0.18	0.23
0.670	...	...	..	..	..	0.038	0.050	0 055	0.058
λMax.	0.511	0.511	0.511	0.515	0.529	0.545	0.560	0.565	0.565
Const't	461.	466.	445.	395.	254.	221.	214.	198.	197.
Vo-13 =	1.08	1.16	0.94	0.74	0.31	0.48	1.07	1.00	1.00

In Table VII, in the next column, are given some values of the mechanical equivalent in candles per watt for different wave-lengths.

The study of the metal-lamp filaments, that is, electrical conductors with a high reflecting power in the visible range and probably reflecting uniformly high in the infra-red, resulted in the discovery of the fact that their distribution of energy in the spectrum is subject to a law similar to that of platinum, but with different constants. One of the principal causes of the higher efficiency of the metal filaments is that they may be run at a very high temperature. The intensity of light increases at the fourteenth power (or thereabout), while the energy per second which must be supplied varies only as the fourth or fifth power of the temperature. Table VIII shows the difference between the true temperatures and the black-body temperatures of platinum, tungsten and tantalum for different wave-lengths, thereby showing their selective radiation as compared with carbon.

TABLE VI.—VISIBILITY AT LOW INTENSITY (ROD VISION).

Wave-Length.	A.B.	E H.	F.D.	R.R.	E.B.	A.K.	A.H.	E.K.	F H.	X.P
0.430	0.015	0.10	0.038	0.062	0.064	0.059	0.047	0.069	0.31	0.089
0.450	0.074	0.30	0.14	0.25	0.21	0.21	0.23	0.23	0.47	0.01
0.470	0.27	0.64	0.31	0.50	0.47	0.49	0.50	0.49	0.74	0.58
0.490	0.57	0.90	0.58	0.74	0.80	0.60	0.86	0.69	0.96	0.84
0.505	...	1.00	0.85	1.00	1.00	1.00	1.00	1.00	1.00	0.99
0.520	1.00	0.96	1.00	0.85	0.98	1.99	0.98	0.87	0.90	1.00
0.535	0.78	0.77	0.85	0.64	0.74	0.77	0.75	0.66	0.71	0.81
0.555	0.45	0.47	0.49	0.33	0.41	0.42	0.36	0.38	0.44	0.47
0.575	0.20	0.20	0.25	0.12	0.17	0.17	0.12	0.14	0.21	0.13
0.590	0.085	0.076	0.15	0.051	0.067	0.061	0.045	0.071	0.10	...
0.605	0.035	...	0.09	0.022	0.026	0.022	0.015	0.024	0.048	...
λMax....	0.518	0.507	0.521	0.504	0.512	0.511	0.511	0.506	0.502	0.514

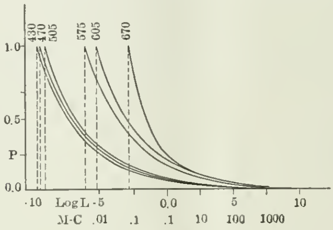


Fig. 3—Curves of Photometric Sensibility.

For three wave-lengths used the carbon did not vary at all, while the platinum varied most. Fig. 4 shows the distribution of the energy in the visible spectrum from various illuminants using a gas flame as a standard.

TABLE VII.—MECHANICAL EQUIVALENT OF LIGHT OF DIFFERENT WAVE-LENGTHS.

Wave-Length.	Watt per Square Centimeter.	Meter-Candles.	METER-CANDLES.	Candles per Watt
			Meter-Candles per Watt per Square Centimeter.	
0.620	0.000162	64	390,000	3.1
0.566	0.000042	64	1,520,000	12.1
0.566	0.000036	61	1,700,000	13.5
0.595	0.000123	182	1,480,000	11.8

The ability of the metallic filaments to withstand higher temperatures than carbon, in spite of the fact that carbon is the most infusible body known, appears to be due to their higher vaporization points. The higher vaporization point, in its turn, is a function of their high atomic weight (191 for osmium, 183 for tantalum, 84 for tungsten, instead of only 12 for carbon).

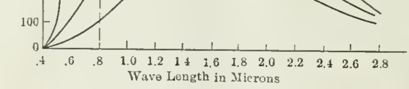


Fig. 4—Distribution of Energy Throughout Spectrum.

In general, the results arrived at in the investigation of Dr. W. W. Coblentz, of the Bureau of Standards, on the selective radiation of various solids show that oxides obey the same laws of the shifting of the maximum of intensity of emission toward the short wave-length. It is remarkable that many oxides have an emission band in common in the region of 2.8, from which it would appear that this band is due to the oxygen atom which is common with all of them. Especially significant in this connection are the low radiation properties of titanium oxide at a temperature of about 1000 deg. C., while the radiation of the same substance in the arc is highly selective. It is also curious to note that the color of metallic titanium is bluish-white, while the color of the rutil arc is rather of yellowish tint, a tint enhanced by increasing amperage. This difference may be due to the difference between the resistivity of these two bodies. Rutil is a better conductor of electricity than is metallic titanium. In the broad sense, the intensity and sharpness of the emission bands are a function of the electric conductivity; the best insulators furnish the sharpest emission bands. The molecular weight of the base seems to affect the sharpness of the bands to as great an extent as does the electric conductivity. With rise in temperature there is a rise in the reflective power and an accompanying increase in electric conductivity of oxides and the spectral emission turns more continuous, as it is found in the Nernst glower. However, the positions of the well-defined maxima of emission are not affected by the change in temperature.

TABLE VIII.—TEMPERATURE COMPARISONS.

	True Temperature, Degrees.	BLACK BODY TEMPERATURE:		
		Red. $\lambda=0.66$	Green. $\lambda=0.55$	Blue, $\lambda=0.47$
Platinum	1700	1505	1545	1575
Carbon	1800	1710	1710	1710
Tantalum	1800	1700	1727	1752
Tungsten	1800	1700	1724	1734

The high emissive power of Welsbach mantles is due to the fact that thoria, coming from its physical characteristics to a high temperature and under the influence of the ceria, which it probably holds in solid solution, acts as a "colored" body having a high selective radiation in the shorter wave-length of the visible spectrum.

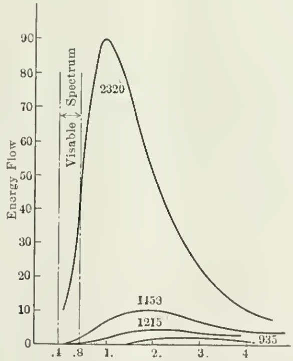


Fig. 5—Energy Distribution.

André Blondel tried in 1900 to employ for his mineralized carbon electrodes rare earths, especially the bodies used in the Welsbach mantles. The results were negative. The flame of the arc was only feebly luminous. Calcium salts the same investigator found to be most useful. These salts appeared yet of reddish color at the temperature of the Bunsen burner. while in the arc their maximum radiation was replaced toward yellow; that is, toward the region most favorable from the physiological viewpoint.

The white chemical combinations of calcium and the bodies nearest related to it, as, for instance, barium, strontium, zinc and berilium, give the best results as mineralizing substances for carbon electrodes. The colored oxides or salts of iron or similar metals give only very weak luminosity. This is not surprising in view of the fact that they approach black bodies in their properties, the electro-vaporization or ionization of which takes place at unfavorable temperatures.

The metallic vapors may be utilized either in vacuo, as in the case of the mercury arc, or in open air, as in the case of the titanium arc. Stark, Kuch and others obtained interesting results with the vapors of lead, bismuth, tin, antimony, sodium, etc. But no technically important application followed. The spectra of the enumerated metallic vapors show no marked superiority in luminous efficiency over the old illuminants. Besides this, the metals require preliminary exterior heating of the tubes containing the metals and a careful control of temperature after the vaporization is started in the tubes.

Iron, copper and other common metals give more or less colored and feebly luminous arcs. Other metals, as, for instance, aluminum, produce oxides of high resistance, extinguishing the arc and keeping it from relighting. The only metallic vapor vacuum arc that has attained some technical importance, namely, the mercury arc, is objectionable on account of the absence of red rays. The degree to which the mercury arc distorts colors may be judged by the data of the following table:

TABLE IX.—COLOR DISTORTION.

Substance.	Natural Color.	Color in the Light of the Mercury Arc.
$FeSo_4$	Bluish green	Colorless.
$CuSo_4$	Blue	Blue (brilliant hue
$K_2Cr_4O_4$	Yellow	Yellow (brilliant hue).
$K_2Cr_2O_7$	Red	Yellow (dull).
$CoCl_2$	Pale red	Dirty brown.
$Cr (No_3) 3$	Red	Dark green (turbid)
P	Red	Metallic (dark).

It is obvious that the choice of utilizable substances for increasing luminous efficiencies is rather more limited than it was generally supposed *a priori*. Moreover, as can be seen from Fig. 5, the useful visible part of the spectrum is so small that it cannot even be presented with precision. It cannot surpass 0.1 per cent of the total energy in the red heat and 0.01 per cent at the highest temperature attainable. The relation between the visible and invisible radiation and the total energy varies from 0.02 per cent for petroleum lamps through 0.19 per cent for carbon filaments to 0.32 per cent for the ordinary arc.

RECENT TELEPHONE PATENTS.

IMPROVEMENTS IN CIRCUITS.

One of the better known four-party systems employs what is termed the "braised" bell, which discriminates between impulses of opposite sign. It has been customary to employ a bell of the standard magneto bell design with a spring giving a bias of the armature in one direction. As usually arranged the impulse ringing current is applied to one side of the line at a time, one pole of the generator being grounded. The bells are correspondingly connected between one or the other side of the line and ground. Mr. W. A. Fricke, of Chicago, has devised an improvement in constructing the bells so that they will respond to currents passing through one coil of the winding, but will not respond to currents in the second coil. The bells are bridged and the midpoint between the coils is grounded. It will be seen that if the windings are properly proportioned there will be no unbalancing effect upon a line whether or not some of the stations are omitted.

Another patent granted to this same inventor and, like the preceding, assigned to the Monarch Telephone Manufacturing Company relates to improvements in magneto switchboard. The special features lie in the drops. These have auxiliary contacts which close a lamp circuit when the drop is energized. The clearing-out drop has a split winding so that a ring-off will not pass the drop when a low-wound bell is connected in parallel with it.

Mr. O. T. Ladermann, of Milwaukee, has invented a circuit for combined telegraph and telephone work. The telephone conversations are limited to the loop between adjacent telegraph stations and are superimposed without interference with or by the telegraph signals. High-frequency telephone ringers are used. The telephones are connected to plugs and each station has a jack connected with the line each way from it. The telegraph relay coils serve to isolate the sections telephonically, while a condenser in the jack circuit keeps the telegraph impulses from the telephone instrument. An adjustable impedance is shunted about the telephone receiver so that any "thump" may be made practically non-interfering.

TELEPHONE ATTACHMENTS.

A telephone receiver holder is the subject of a patent granted to Mr. W. J. C. Kenyon, of Chicago. A flexible tube, such as used in some adjustable lamp stands, forms the arm at the end of which the receiver is mounted. This flexible arm is carried at right angles to an arm which in turn is seated in a base secured to one of the transmitter lug clamping cheeks.

The patent granted to Mr. C. L. Fields, of Rochester, Ind., provides two ear mufflers. These are of felt or other suitable material and one has a closed pocket presented to the orifice of the ear while the other has a tubular passage open at both ends. Both these apertures are tapped by metal tubes which lead to the space within the transmitter mouthpiece and thus while serving to support the muffler also serve as sound conductors. The receiver is held against the open ear muffler. As a further protection from extraneous sounds a special transmitter mouthpiece is used which surrounds the user's lips and contacts all around with his face.

LETTERS TO THE EDITOR.

The Eligibility of "Deceleration."

To the Editor of Electrical World:

Sir:—It seems unnecessary for me to reply at length to Professor Daggett's apology for "deceleration" which appeared in your issue for March 30 in view of my communication on the subject on page 124 of the April *Proceedings* of the American Institute of Electrical Engineers which anticipates and meets completely the points mentioned. Professor Daggett's philological display, though very elaborate, adds nothing to Dr. Steinmetz's. Both confuse partial with complete reversal of meaning. Both fail completely to produce one parallel comparable case. Hence their reasoning is entirely out of phase. It needs better evidence than this to make the word "deceleration" respectable and improve upon the diction of the Roman classics.

If some want to use this word anyhow, right or wrong, it is another matter entirely. All pretence of legitimacy should then be dropped. This word may be forced upon us by might. It can never come into use by right.

My arguments may not be unanswerable, but they are certainly unanswered.

Los Angeles, Cal. C. O. Mailloux.

[The concluding paragraph of the communication to the A. I. E. E. to which our correspondent refers is as follows: "If anybody had tried to make an educated Roman believe, 2000 years ago, that 'deceleration' is synonymous with 'retardation he would have been ridiculed. The proposition is even more ridiculous to-day. In the first place the problem which the proposed new words were designed and intended to solve does not exist at all, having been solved completely, definitely and satisfactorily over 2000 years ago. In the second place the proposed modern solution is entirely wrong. It is a condition where 'the court has no jurisdiction and the applicant has no case.' The application cannot be entertained. I trust that I have this time justified fully my negative answer to the question whether the words 'decelerate' and 'deceleration' are needed. I may add, however, that before condemning the new words as hybrids I made a very conscientious effort myself to find justification for them. I made a thorough search through the entire series (158 volumes) of the 'Delphini' Latin classics, a work containing all of the best Latin literature, edited and published in the seventeenth century by the best Latin scholars of that day. I have not been able to find anything, either there or in any other Latin work, or in any French work, which would entitle the new words to establish a legitimate pedigree. If any Latin scholar who objects to the verdict rendered against these words wishes to make a more complete search I will gladly place these and other books at his disposal. If he finds any evidence I will be the first to acknowledge it. Until such evidence is forthcoming, however, the proposed words are not, in my opinion, entitled to serious consideration. The appearance of these bogus words in the Century Dictionary is like the appearance of bogus noblemen in fashionable circles. The discovery of their bogus character ought to be sufficient reason, in both cases, to 'put them out.' Men of science are wont to resent and denounce the violation of natural laws; yet they are prone to violate the laws of language, some of which are very natural and entirely scientific. They ought to be the first to appreciate and uphold order and system and to cultivate and encourage good diction; yet they are notoriously most lax in this respect. Let us have reform."—Ed.]

Gas Lamps Versus Indirect Lighting.

To the Editor of Electrical World:

Sir:—The writer was somewhat interested in the deductions appearing in the article by Mr. Albert Scheible on "Gas Lamp Versus Indirect Lighting" in the *Electrical World* of March 30. The conclusion that because the manufacturer of a mirror cone reflector has been unable to adapt his product to gas lamps therefore gas cannot be used for indirect lighting is rather far-fetched. One could as well make the statement that because this manufacturer's reflectors are opaque and consequently would not be satisfactory for many direct-lighting systems using tungsten lamps, therefore electric lighting is as a consequence badly handicapped, having to depend upon translucent opal or prismatic reflectors of lesser efficiency. It has been somewhat generally admitted—perhaps not openly—that the chief incentive to push indirect lighting by central stations is largely due to its claim to inefficiency, a tungsten indirect-lighting installation appeasing both the consumer and the company—the former with the knowledge that he is using the most efficient lamp and the latter with a consumption equal to that of the previous carbon-filament direct-lighting system.

The number of indirect-lighting systems using gas, in the opinion of the writer, is quite as large a proportion of the total gas-lighting installations handled by gas companies as is the proportion in the electrical field and with about the same efficiency when compared with direct-lighting systems, varying from one to two to three to five.

The exponents of indirect lighting are doing good work and have made wonderful strides. There is, however, more of the regular gas-lighting business undeveloped than the lamp manufacturers can take care of before they will have either the time or inclination to devote to indirect-lighting systems, which, to say the least, are more difficult to sell and in a more restricted market. Indirect lighting with tungsten lamps may be more largely a necessity with a filament having a specific brilliancy of 1000 cp per square inch than with a mantle having less than one-tenth that intensity.

"The difficulty of reaching jets in such fixtures for turning and lighting the gas" is readily overcome. Wall and pendent switches for electric lighting are more expensive, more difficult to install and will generally result in more trouble than any similar means for the control of gas lamps.

The consumption of the pilot flames can be much more clearly stated than by "adding one-third to the yearly charges for lighting." Lamps used six hours daily, 2190 hours per year, should surely not be charged with the same percentage of yearly consumption for pilot flames as lamps used only one hour a week, fifty-two hours per year. Then, again, the 0.1 cu. ft. per hour pilot may be attached to a lamp having a maximum consumption of 2 cu. ft. or a lamp consuming 5 cu. ft. per hour. The 0.5 cu. ft. per hour pilot may be on a lamp consuming 10 cu. ft., 20 cu. ft. or 30 cu. ft. per hour and consequently bear no fixed relation to the yearly costs for gas.

In the writer's home ten pilot flames are used with a meter registration equivalent to 50 cents per month, as shown by actual test. This is a remarkably low cost for night lights in all the rooms and halls and is alone well worth the cost, without considering the convenience of having to use only from two to five matches per month to ignite pilot flames on lamps not used regularly.

For an engineer to refer to heat and vitiation of air in interiors lighted by gas lamps may some day be as popular as it is to-day to refer to a 5-amp inclosed arc as a "2000-cp lamp."

Gloucester City, N. J. NORMAN MACBETH.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Electrolytic Valves for the Compounding of Alternators.—M. C. LIMB.—A French Academy paper. The author formerly showed that an alternator can be made self-exciting by the use of electrolytic valves. From this he concluded later that it is possible to build, at least in theory, not only alternating current generators without exciters, but also direct current dynamos without commutators. In the case of alternators the possibility of avoiding a special exciter is of small importance on account of the small size of this machine. But by means of electrolytic valves a new method of compounding alternators can be effected. The primary of the alternator is provided with two sets of exciting windings, the one producing the principal field and the other being the compounding winding. This compounding winding is supplied with rectified current by means of electrolytic valves from the secondary of a transformer the primary of which is fed from the alternator to be compounded. The author tried this method with a 10-kva, 150-volt alternator and stated that the method worked satisfactorily.—*L'Industrie Elec.*, March 10.

Speed Control of Polyphase Motors.—A note on a recent British patent (25,964, March 23, 1911) of the Siemens Brothers Dynamo Works, Limited. The speed of the polyphase commutator motors is usually varied by altering the voltage applied to the rotor winding through the commutator. According to this invention the control is effected either by maintaining the total of the stator and rotor voltages constant and varying the exciting field or by altering both voltages and field. The former is suitable when the torque decreases as the speed rises, and the latter when the torque decreases with the speed. Various arrangements of the transformer connection between the stator and rotor circuits are described.—Lond. *Elec. Eng'ing*, March 30.

Non-Salient Pole Turbo-Alternator and Its Characteristics.—S. P. SMITH.—This paper in full, an abstract of which was recently noticed in the Digest. The author shows that the non-salient pole alternator possesses the inherent characteristics of a sinusoidal flux and pressure wave under all conditions of load. The best distribution of the winding is ascertained, and it is shown how the flux and pressure waves can be constructed.—Lond. *Electrician*, March 31.

Reactance.—J. REZELMAN.—A continuation of his long serial on synchronous and non-synchronous reactance. The author gives the results of tests of a 75-kva alternator with solid salient poles, and discusses especially the influence of the excitation and the variations of the reactance when the alternator operates as a non-synchronous motor.—*La Lumière Elec*, March 25.

Lamps and Lighting.

Photometry.—In the annual report of the (British) National Laboratory an account is given of further researches in photometry. The last report described the "cascade method," which is being adopted for stepping up from low to high-efficiency lamps in order to minimize the effect of color difference in the comparisons. There has been a difficulty, however, in obtaining high-efficiency metallic-filament lamps which are satisfactory as sub-standards. Several makes of lamps which it was intended to run at 1.5 watts per candle have had to be discarded on account of small but erratic candle-power fluctuations. For the same reason it has been found necessary to supersede the set of 2 watts per candle sub-standards by a new set which have been specially made for the laboratory. This new set of lamps has been independently standardized during the year by six observers against the carbon sub-standards, which run at about 3.5 watts per candle. A similar set of lamps to run at 1.5 watts per candle is now under observation, and if found satisfactory, the chain will be complete for the present as far as high-efficiency lamps are concerned. Experiments are being made, however, with a view to using low-efficiency tungsten lamps as sub-standards, and two sets have been made, burning respectively at approximately 5 watts and 3.5 watts per candle. The former have six filaments and the latter five, giving about 14 candles at 100 volts. One set matches the pentane lamp in color and will be compared directly against it, thus affording another opportunity of reproducing the British unit in terms of the primary standard. The second set will represent the unit in a light of whiter hue.—Lond. *Electrician*, March 31.

Metallic-Filament Lamps.—MONASCH.—A review of the development of the metallic-filament industry in Germany since the first 40-cp, 110-volt tungsten lamp was exhibited in May, 1906. Now there are on the market for 100-volt to 130-volt tungsten lamps of 16 hefner cp, 25 hefner cp, 32 hefner cp, 40 hefner cp, 50 hefner cp, 75 hefner cp, 100 hefner cp, 200 hefner cp, 300 hefner cp, 400 hefner cp, 600 hefner cp, and 1000 hefner cp; for higher voltages up to 250 volts tungsten lamps of 20 hefner cp, 25 hefner cp, 32 hefner cp, 40 hefner cp, 50 hefner cp, 75 hefner cp, 100 hefner cp, 200 hefner cp, 300 hefner cp, 400 hefner cp, 600 hefner cp and 1000 hefner cp. All these lamps can now be used in any position. In 1906 it was regretted that 110-volt tungsten lamps for 10 cp could not be made. They are not being made, however, because there is no real demand for them. In competition with arc lamps the metallic-filament lamp has succeeded in capturing the whole field up to 1000 cp, both for interior and street lighting, while the arc lamp is still supreme above 1000 cp. When tungsten lamps were first introduced it often happened that when a larger number of lamps were switched on the fuses burned out. The reason is that on account of the higher conductivity of the metals when cold the starting current of tungsten lamps is seven or eight times the normal current and the starting current of tantalum lamps is four or six times the normal current, while the starting current of the carbon lamp is 0.7 times the normal current. For the tantalum lamp with its drawn filament the life is not so long with alternating current as with direct current, due to intermolecular changes. The same is stated to be true for the new drawn-tungsten-filament lamp, developed in this country. But tungsten lamps with sintered tungsten filaments have practically the same life with alternating current as with direct current. The effects of wave-form and frequency are finally briefly considered.—*Elek. Zeit.*, March 30.

Street Lighting.—A table prepared by H. Tomlinson-Lee and D. Stuart comparing the cost of gas and electric street lighting in twenty-eight English towns and boroughs. The comparison is very much in favor of electric lighting, which is in all cases cheaper than gas. The average figure of the cost of the cp-year is 9.92 cents for electric light and 24.5 cents for gas light. The most extreme case is in Islington, where the cost of the cp-year is 6.26 cents for electricity and 33.12 cents for gas. In this case the majority of electric lamps are arc lamps. At Fulham, however, where 914 incandescent electric lamps and 226 arcs are used, the ratio of the cost of gas and electricity is about the same. The best figure for gas is at Chelsea, where the cost of the cp-year is 11.04 cents, inverted gas burners being used. But even that is higher than the average for electric lighting.—Lond. *Elec. Eng'ing,* March 30.

Generation, Transmission and Distribution.

Speed Regulation of Direct-Current Shunt Motors.—E. W. Short.—An account of observations which the author has made in the use of direct-current shunt motors for driving textile machinery. The tendency of a shunt motor to maintain even speed under all conditions, which might be called its inherent speed regulation, is sometimes not so good as might be supposed. Even if the motor is differentially compounded for perfect speed regulation for all steady loads within the usual limits of output of the machine, or if interpoles are added to allow greater latitude in the brush position or in the working range of the flux, the particular correction which is adopted disappears when the motor is worked on a rapidly varying or intermittent load, and the speed variation may be of considerable importance. Although any given motor may be arranged by rocking the brushes or by differential compounding to regulate perfectly on slowly varying loads quite other effects show themselves when the load is quickly intermittent or rapidly varying. This is due to the mutual induction between the shunt and series-field windings or between the armature and shunt-field windings. Details are given of the behavior of a 35-hp motor on a rapidly varying load. The author does not condemn the use of direct-current motors for textile driving as a whole or for driving machine tools and industrial machinery in general. He says, however, that such a machine should not be employed if it is desired to obtain absolutely constant speed when driving a rapidly varying load.—Lond. *Electrician,* March 31.

Dauphiné-Centre Transmission Line.—J. Reyval.—An illustrated description of the equipment of this 60,000-volt line, which extends from Grenoble to Saint Etienne and which is the first French line in which aluminum conductors are used. This transmission line is an interesting example of the interconnection of two hydroelectric power plants with very different conditions of water supply, inasmuch as the times of highest water in the two plants were different.—*La Lumière Elec.*, March 25.

Electric Driving of Rolling Mills.—A note on a recent British patent (12,265, March 23, 1911) of the British Thomson-Houston Company (General Electric Company of this country). When an induction motor is used for the main drive and a direct-current motor for driving the finishing strand trouble may arise with varying load due to relative speed variations between the two motors. This patent describes apparatus responsive to speed variations of the induction motor for controlling the speed of the direct-current motor so as to maintain a proportionality of speed between the two, and thus prevent the steel from buckling as it passes to the finishing strand. —Lond. *Elec. Eng'ing,* March 23.

Steam Plant.—F. L. Richter.—The first part of an illustrated article on steam-plant exhibits at the Brussels World's Fair. The present instalment deals with boilers, pipes and fittings, and reciprocating engines. The article is to be concluded. —*Elek. Zeit.*, March 30.

Traction.

Rail Bonds.—A note on a recent British patent (30,138, March 23, 1911) of the British Thomson-Houston Company (General Electric Company of this country). In order that a rail bond may be both flexible enough to withstand the constant vibration without crystallizing and breaking and strong enough to withstand impact and abrasion it is constructed of small-gage wires with an armoring of heavy-gage wires. In another form described the body consists of concentric layers of strands increasing in thickness toward the exterior.—Lond. *Elec. Eng'ing,* March 30.

Installations, Systems and Appliances.

Rate System.—E. Chonlet.—A continuation of his illustrated paper on rational methods of charging for electrical energy. The author discusses the system in which the energy for lighting is not measured by meter but a charge is made per kilowatt installed and the power which can be employed at any moment in kilowatts is controlled by a limiting device. The system is found to be excellent for all power plants where the cost of producing a kw-hour is low, such as hydroelectric stations. This rate system is less suitable for steam and gas plants, where the cost of producing a kw-hour is higher. Having thus concluded the discussion of rates for electric lighting, the author takes up the discussion of rates for energy used by motors. The article is to be continued.—*L'Industrie Elec.*, March 10.

Small Central Stations.—A. R. Garnier.—In a continuation of his serial on economical conditions for the operation of small central stations the author deals especially with the utilization of exhaust steam and with the use of town refuse as fuel.—*L'Industrie Elec.*, March 10.

Electric Drill.—P. Schiemann.—An article on electric drills, with special reference to details of construction of a new centrifugal electric drill.—*Elek. Zeit.*, March 30.

Wires, Wiring and Conduits.

Dial Fuses.—An illustrated description of a system of non-interchangeable cartridge fuses and fittings of English make. In one type the non-interchangeability depends both on the diameter and the length, in another type on the diameter only. —Lond. *Elec. Eng'ing,* March 30.

Electrophysics and Magnetism.

Ebonite.—The annual report of the (British) National Physical Laboratory gives an account of an extended investigation of the properties of ebonite. The troublesome deterioration of the surface of ebonite when subjected to light, the surface tending to decompose, with the production of free sulphuric acid, is well known. Samples of many qualities of ebonite were placed under a sheet of glass to protect them from dust and exposed for many months to a north light. The test was made on polished and unpolished surfaces and on surfaces as they are left straight from the tool. A portion of each was covered with a brass disk which protected some of the surface of the material from the action of the light, and the production of acid could be roughly gaged by the gradual discoloration of the brass. The acid, especially in damp weather, is quite visible in the form of drops, and a rough estimate of the relative amount on the surface of the different samples could thus be made by inspection and microscopic examination. It was found that a yellow glass acted as a great protection and that a blue glass had but little effect in retarding the production of free acid. The results of the tests showed differences in the rate of production of acid, but the conclusion was only a negative one, viz., that no quality was found to be free from the production of acid, so that where insulation is of great importance ebonite cannot be relied upon if exposed to strong light. The only entirely satisfactory method of protection is to cover all ebonite where high insulation is required by wood, or opaque glass or other material, leaving holes for the handles required for manipulating the necessary switches and for making the electrical connections. A third arrangement which has been successfully adopted is to depend on amberite (an artificial amber made from amber waste) for insulation. The disadvantages of amberite are that it is brittle and expensive, but if necessary it could probably be molded to any required shape. The effect of covering the surface of ebonite with shellac varnish has also been tried, but this has not prevented the production of acid and consequent low insulation resistance. The insulation may be restored by thorough washing, and it has generally been found that the rate of production of acid diminishes and that the trouble lessens with time. In certain qualities of ebonite this is accompanied by a change in the color of the surface, which gradually becomes greenish-gray and which, as far as observation has gone, is electrically as good and more permanent than the polished black new surface. It is quite possible that a satisfactory material might be produced by "aging" the surfaces through exposure to a strong light and by frequent washings.—Lond. *Electrician*, March 31.

Radiant Energy and Matter.—J. J. Thomson.—An account of the first three of six lectures delivered before the Royal Institution in London. The author discusses in considerable detail Stefan's law of the total radiation, the theory of light pressure and the law of the spectrum of radiation.—Lond. *Electrician*, March 24.

Stretching of a Conductor by Its Own Current.—Two critical letters by F. M. Denton and F. Wenner on C. Hering's recent paper on the stretching of a conductor by its own current.—Lond. *Electrician*, March 17 and 24.

Electrochemistry and Batteries.

Regenerating Old Battery Plates.—A note giving some further details on the method used by a British electric automobile company for regenerating old battery plates. When a battery becomes unfit for further use the negative plates are taken and treated with chloride of sulphur, baked for a short time and reduced electrolytically to eliminate all impurities. They are then in a neutral condition, neither positive nor negative. The plate is, however, it is claimed, more uniform and porous, while the treatment it has received has caused the material to expand and fill up the cracks. These plates are then formed into positives and negatives in the usual way and combined to form a regenerated battery. It is stated that, apart from the saving effected by the regeneration of exhausted plates, the regenerated batteries have a longer life and an efficiency of 10 per cent to 15 per cent higher than the original batteries. The process can be repeated when the regenerated battery is in turn worn out, provided the foundations of the plates remain sound.—Lond. *Electrician*, March 31.

Units, Measurements and Instruments.

(British) National Physical Laboratory.—An account of the annual inspection of the National Physical Laboratory. The new experimental tank for carrying out naval experiments was shown. The electric equipment for towing the paraffine models is described. As to the work proposed for the year 1911 the following information is given: The absolute determination of the ohm by means of the new Lorenz apparatus will be the main feature of the year's work. In continuation of the work on the international ohm, new mercury standards of resistance will be made, and these will include five for the new electrical standards laboratory in Japan, the construction of which has been intrusted by the Japanese government to the National Physical Laboratory. Experiments dealing with the silver voltameter and standard cells will be continued in co-operation with other standardizing laboratories, particularly those of America, France and Germany, with a view to settling certain points left undetermined by the London conference of 1908. In connection with the calibration of wave-meters, which has been in progress for some time, it is proposed to improve the steadiness of the source by the employment of a short-spark method. In the work of iron testing it is hoped that the comparison of methods with the Reichsanstalt and the Bureau of Standards will be completed early in the year. It is proposed to continue the investigation of the power-factors of standard condensers, and to increase the accuracy of the methods by minimizing the residual inductances. A new method for making the measurements will also be tried. Further investigation of the effect of frequency on the capacity determination of the condenser is also desirable. The construction of a subdivided self-inductance coil from 1 millihenry up to 10 millihenries will be completed. It is hoped, in addition, to improve the sources of alternating current at 1000 periods per second and to set up vibration galvanometers of increased sensitivity. The chief work in photometry will be the standardization of new sets of sub-standards which will help still more rigidly to maintain the value of the unit of light. It is intended to continue the investigation on the degree of accuracy which may be expected from ordinary supply meters which are subjected from time to time to railway journeys. An account is given of the chief investigations made during the last year, accounts of which are given in separate abstracts in the Digest.—Lond. *Electrician*, March 24 and 31.

Silver Voltameter.—In the annual report of the (British) National Physical Laboratory it is stated that according to the Bureau of Standards in Washington organic matter in the form of filter paper affects the deposit of the silver in the voltameter. The observations at the National Physical Laboratory confirmed this, and it was found that when pure silver nitrate solutions were filtered through filter paper the contamination was such as to increase the mass of the deposit per amp-second by one part in 10,000. The suspension of more filter paper in the electrolyte, as in the Rayleigh form of voltameter, produced little further effect, and in consequence when the filtered electrolyte was used in different forms of voltameters substantially equal deposits were obtained. Afterward experiments were made with a voltameter having no septum between anode and cathode. The voltameter devised has an anode in the form of a silver disk *D* (Fig. 1) coated with electrolytic silver. This disk is contained in a shallow glass basin *B* (with ground edge), supported by a glass rod passing through the center of the disk. A glass cylinder *G*, with ground ends, fits over the basin and is used to separate the electrolyte into two parts, before and after electrolysis. Before electrolysis commences *G* is raised until the glass cylinder occupies the position indicated by the dotted lines. At the conclusion of electrolysis the cylinder is lowered into the first position and then disconnected from *C*. By raising the arm *A* the anode, disk, cylinder and contained liquid are removed from the bowl without unduly disturbing the liquid in contact with the cathode. A silver rod supports the disk *D* and is surrounded by a glass tube to prevent considerable electrolytic action at its surface. The experiments made with this voltameter were so satisfactory that a number of the glass vessels were constructed and taken to Washington for the experimental work there.—Lond. *Electrician*, March 31.

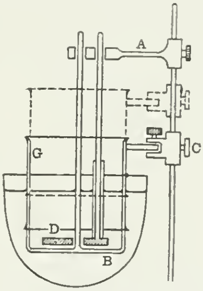


Fig. 1—Voltameter.

Standard Cells.—In the annual report of the (British) National Physical Laboratory it is stated that a large number of Weston normal cells were made during the past year. In connection with the work at Washington sixty new cells were set up in the spring, nine samples of mercurous sulphate and 10 per cent amalgam being used. The maximum difference of e.m.f. between any two of the cells was 0.00003 volt and the mean e.m.f. agreed very closely indeed with the mean of several hundreds of cells made during the past five years. Thirty-four of the sixty cells were taken to Washington, and a number were left there for comparison purposes. A review of all the observations at the laboratory on standard cells during the past five years leads them to believe that the presence in the cell of a small quantity of free acid is beneficial, as the e.m.f. is more constant, although slightly lower than when the ingredients are acid-free. The results suggest that if part of some freshly precipitated mercurous sulphate is washed in the usual way with concentrated cadmium sulphate solution until apparently free from acid, and a second part is well washed with water, cells containing the two samples will differ in e.m.f. by about four to five parts in 100,000, the cells with the water-washed salt having the higher voltage. If the washing with water is not prolonged the cells containing the water-washed salt appear to remain stable, at least for several years. On the other hand, prolonged washing appears to result in the cells remaining stable for about twelve months, but afterward irregularities become very marked. It appears to be probable that in the majority of the old cells the mercurous sulphate has retained a small quantity of free acid which has been slowly liberated after the cell has been set up, and as a result there has been a gradual fall in the e.m.f. to a steady value. In a few cases the washing has been very thorough, and cells set up with this well-washed mercurous sulphate have e.m.fs. slightly higher than the average e.m.f., and in some instances the cells have become unstable after a few years. A number of experimental cells were therefore made up which contain paste washed in different ways, but a considerable time must elapse before conclusive evidence is obtained. During the visit to Washington a comparison was made of a large number of freshly made standard cells set up at the Bureau of Standards, the Laboratoire Central, the Reichsanstalt and at the National Physical Laboratory. In all eight complete comparisons of these cells were made, the mean differences being as follows:

Laboratory at Which Cells Were Made.	Mean Difference from Mean E.m.f. of All.
B. S.	— 0.000009 volt
L. C.	+ 0.000009 "
R.	+ 0.000000 "
N. P. L.	+ 0.000002 "

The agreement is most satisfactory. The e.m.f. of the Weston normal cell was found to be 1.0183 international volts at 20 deg. C. The provisional value recommended by the London conference was 1.0184 international volts. It has now (Jan. 1, 1911) been agreed by the International Committee to recommend that electrical standardization in the standardizing laboratories of all countries should be based on the value of 1.0183 international volts for the e.m.f. of the Weston normal cell at 20 deg. C.—Lond. *Electrician*, March 31.

Electric Trevelyan Rocker.—W. H. Eccles.—An illustrated description of an electric rocker, the arrangement being shown in Fig. 2. *E* is an ebonite block carrying a stout brass bar *B* and a thin iron wire *F*. These carry the pieces of conductor C_1, C_2 that form the contact. By means of the terminals *A* and *D* a current can be sent through the contact. The circuit usually includes also a potential divider, a telephone and a shunted fiber galvanometer. The apparatus is employed in the following manner: The permanent magnet *M* is pushed toward the iron wire *F* till the contact is just broken, the magnet *M′* being meanwhile at a considerable distance. Now *M′* in its turn is brought toward the other side of the iron wire till the contact is remade—an event that produces a sound in the telephone. By arranging that *M′* is always a fair distance from the iron wire exceedingly delicate adjustments of the contact can be made. In short, *M* is a coarse adjustment and *M′* is a fine adjustment. At some stage of these adjustments the Trevelyan rocker action starts. The best of the common metals for getting the vibrations is lead, and it is well to arrange that C_1 is a plate and C_2 a point. With a suitable current and with occasional adjustment of the magnet *M′* the vibrations can be maintained for an hour at a time. The interruptions produced by the Trevelyan rocker action could in all cases be used for generating high-frequency electrical oscillations in the manner indicated, but they showed no practical advantage over directly driven interruptions. That is to say, the "make" and "break" of the current is not more sudden than occurs in vibrating contacts of the ordinary type of make-and-break apparatus. —Lond. *Electrician*, March 31.

Meters.—An official communication of the Reichsanstalt admitting for calibration an induction meter of the Siemens-Schuckert Company for a balanced three-phase system. This type is a modification of the company's single-phase meter.—*Elek. Zeit.*, March 30.

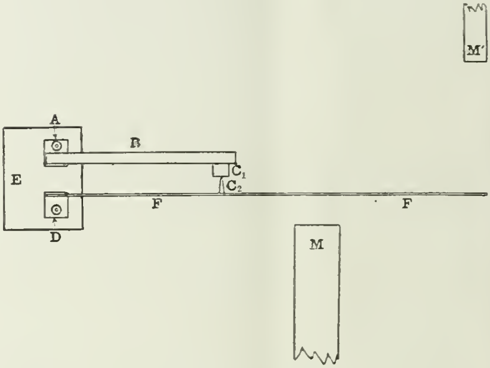


Fig. 2—Electric Rocker.

Proposed International Symbols.—A. P. Trotter.—A letter referring to the recent recommendation to use German script letters for the representation of magnetic quantities. The present author recommends the use as heretofore of the English roman-block type, for instance, B for flux density. In an editorial note on the same subject the hope is expressed that the script letter may be avoided in an international agreement.—Lond. *Electrician*, March 24.

Instruments.—A. Cheneveau.—In a continuation of his illustrated serial on electric instruments at the Brussels Exposition the following instruments of British make are described and illustrated: Oscillograph of Duddell, hot-wire oscillograph of Irwin, single-pivot dynamometer of Paul, reflection electrodynamometer of Sumpner, precision wattmeter of Duddell and Mather, and wattmeter-dynamometer of Nalder Brothers and Thompson.—*La Revue Elec.*, March 10.

Book Reviews.

The Construction of Graphical Charts. By John B. Peddle. New York: McGraw-Hill Book Company. 109 pages, 58 illus. Price, $1.50.

This is a very useful elementary text-book on the different types of charts used in engineering and their methods of construction. There are so many important methods of presenting natural phenomena graphically on a plane surface that a book of this kind is needed in order to classify and explain them. The book is divided into seven chapters. Chapter I discusses rectangular-co-ordinate charts, including logarithmic scales. Chapter II discusses the alignment chart. Chapter III deals with the alignment chart for more than three variables. Chapter IV deals with the hexagonal index chart. Chapter V treats of proportional charts. Chapter VI relates to graphical determinations of empirical equations. Chapter VII relates to stereographic charts and solid models. The book will be of value to students of applied science in many different fields. It might be improved in a later edition (1) by including more examples from branches of physics other than mechanics and (2) by adding an index.

Annuaire pour l'An 1911. Bureau des Longitudes. Paris: Gauthiers-Villars. 639 pages. Price, 1.50 francs.

This excellent and most comprehensive little volume is devoted this year to astronomical, geographical and meteorological statistics. It is virtually a pocket nautical almanac on this occasion, the chemical and physical sections appearing on alternate years only. A mass of information is offered concerning astronomical phenomena such as a layman would have great difficulty in procuring elsewhere. For example, a tabular list is presented of the principal elements of the orbit of Halley's comet since the year 240 B. C. down to its twenty-eighth repassage last year.

At the end of the volume are certain interesting special appendices. One of these is by M. H. Poincaré on the sixteenth conference of the International Geodetic Association last year in London. Another is by M. G. Bigourdan on the eclipse of the sun to occur on April 12, 1912. It appears that the central line of totality in this eclipse will pass through Paris, or at least through the suburbs of Paris. The volume is a most useful compendium of precise information of an official character as presented by the French government. It offers to the public nearly a million facts for the sum of 30 cents.

Metal Statistics. New York: *The American Metal Market and Daily Iron and Steel Report.* 208 pages.

The 1911 edition of this work contains a larger selection than previous issues of statistical information relating to the metal trades. The statistics cover the production, consumption and price movements of all metal and iron and steel products for a series of years. Among the various copper statistics a table is given showing the total production of this metal for more than 100 years, or from 1800 to 1910 inclusive, which indicates the great strides made by this industry within the last ten years.

New Apparatus and Appliances

SYNCHRONIZING REACTANCE.

One of the most unique features of the municipal plant at Portland, Ill., is the novel synchronizing device furnished by the Fort Wayne Electric Works. Energy is generated and distributed over the city at 2200 volts, transformers being installed at various points to reduce the voltage for lamp and motor service. The series incandescent street-lighting circuit is operated at 4000 volts, this pressure being obtained by means of a step-up transformer installed in the station. One hundred-watt, 4-amp tungsten lamps are used on the street-lighting circuit, there being 134 lamps in series.

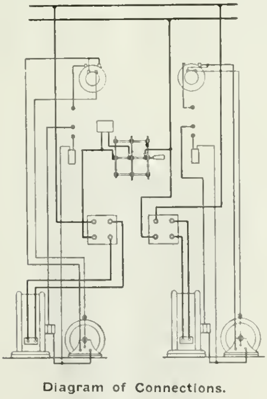


Diagram of Connections.

The station installation consists of two International Harvester gasoline engines belt-connected to two three-phase, 60-cycle revolving-field Fort Wayne alternators. Each alternator is connected to operate single-phase and is rated at 25 kva, this rating being 70 per cent of the full-load output when operating three-phase. The excitation for each generator is furnished by a 1.5-kw belt-connected exciter. The two-panel switchboard is provided with the necessary apparatus for the control of the two alternators and feeder circuits. The current regulator which maintains constant current on the incandescent lighting circuit is a standard Fort Wayne product, as is all the electrical equipment in the plant.

The most important feature of this installation is the synchronizing reactance used in throwing the two alternators in parallel. It consists simply of an air-core reactance coil, mounted on suitable brackets on the back of the switchboard. Its operation is as follows: When one alternator is running and it is desired to parallel the other the second machine is brought up to approximately the required speed and connected directly to the busbars in series with the reactance coil. This coil prevents objectionable surging, and by ordinary motor action the second machine is quickly drawn into synchronism, after which the reactance coil is short-circuited by means of a plug switch on the generator panel.

Neither synchronizing lamps nor synchroscopes are necessary with this device and no skill whatever is required in paralleling two machines. With the reactance coil in series with a generator the line switch may be thrown in regardless of the speed of the machine. Even though the alternators be standing still the coil will prevent surges of sufficient amplitude to cause trouble. The device has been in use for some time and it has conclusively demonstrated its ability to parallel two alternators quickly and certainly.

UNLOADING PIG IRON FROM CARGO BOAT BY LIFTING MAGNETS.

One of the interesting applications of the powerful lifting magnets that are now available for service where masses of iron are to be handled is in the unloading of vessels. An example of unusual expedition in work of this character occurred a short time ago at the plant of the Inland Steel Company at Indiana Harbor, Ind. One of the large lake freighters, laden in this case with machine-cast pig iron, was unloaded by means of the lifting magnets between the hours of 7:35 a. m. and 6:35 p. m. of the same day. The manner of handling this pig iron is clearly indicated by the accompanying illustration. The work was done at the ore dock at Indiana Harbor, and as shown in the pictures two magnets were employed. These are of the type made by the Cutler-Hammer Manufacturing Company and each is 62 in. in diameter.

The steamer docked at 7:15 a. m. and work was begun on unloading the pigs of iron at 7:35 a. m. As stated previously the work of unloading was finished at 6:35 p. m. and the steamer cleared at 7:20 p. m., making a very creditable record of a day's performance. The number of lifts of each magnet per hour was normally sixty to seventy, and the total number of lifts of both magnets was 1281. The actual time of unloading was only ten and one-half hours and the total weight of pig iron unloaded was 1960 tons, making the weight of the average lift 3060 lb. The magnets were in practically continuous operation, there being a half-hour intermission between

12 and 1 p. m. which was utilized for oiling and inspection. It may be of interest to add that the length of the boat unloaded is 240 ft., its draft being 15 ft. 3 in. forward and 16 ft. 6 in. aft.

The lifting magnets used for discharging the cargo of iron from this vessel are of the same kind as those successfully used last year for salvaging a boatload of nails, barbed wire, etc., from the bed of the Mississippi River near New Orleans. The advantages of quick unloading and the fewer men required for this arduous work while unloading are entirely obvious.

Magnets Unloading Cargo of Broken Pig-Iron.

HIGH-EFFICIENCY DISK VENTILATING FAN.

The fan illustrated herewith has ten broad blades of the proper dip or curve to produce large volumes freely or against pressures at remarkably high efficiency.

The fan runs at speeds as high as any other fan of the disk type, if not higher, and throws an air current straight ahead. In fact, the air as it leaves the fan has a tendency to bend inward for a considerable distance before it begins to expand. This is said to be contrary to the action of any other disk fan on the market. For example, one of these fans can be set 16 in. away from a hole in a box and discharge more air on the other side of the opening than the fan itself handles, due to the siphon action of the air as it passes through the opening drawing in air along the face of the box.

Ventilating Fan.

It is claimed that the mechanical efficiency of the fan runs as high as 64 per cent, whereas the best of the other types shows a maximum of 25 per cent. This fan has been placed on the market by the American Blower Company, Detroit, Mich.

WASHING AND WRINGING MACHINE.

In the washing and wringing machine built by the American Washer Company, St. Louis, Mo., the clothes are placed inside of a cylinder, which revolves in hot, soapy water automatically and alternately in opposite directions, forcing the water through the clothes, thereby cleansing them without possibility of injury. The cylinders are built of selected wood, reinforced with strips of galvanized iron or brass. The tub ends and sides are made of cypress, and the bottom of the tub of specially galvanized iron or copper, according to the type. The legs are made of oak and the mechanism is held in place by heavy castings, etc. In the "Jewel" washer the transmission is from a motor operated at from 1700 r.p.m. to 1800 r.p.m., connected with a short round belt to the grooved pulley, as shown. This pulley operates the shaft drive. A wide belt on the outside connected with this shaft in turn drives a 1¼-in. flat belt on a triple pulley at the top of the machine. From the same drive shaft at the bottom is extended a direct-shaft drive connected with beveled gears for operating the wringer. From the wringer drive shaft

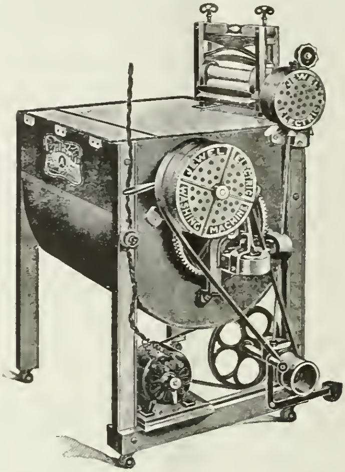


Fig. 1—General View of Washing and Wringing Machine.

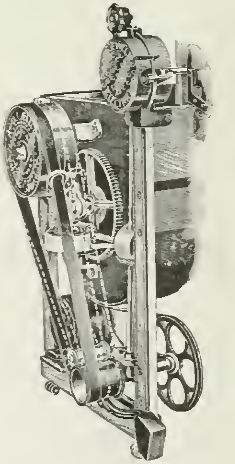


Fig. 2—Driving Mechanism of Washing Machine.

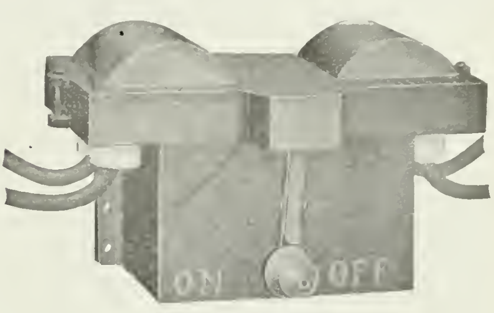
by means of bevel gears a worm gear in the center of the machine is operated, and moves the arm through which the belt runs. This arm moves backward and forward by means of a cam, and shifts the belt from one pulley to another over the center, or idler, pulley, and as the two outside pulleys operate in opposite directions, the proper reverse is made without jar. An automatic belt tightener presses against the lower belt, so as to take up slack and to hold the belt more securely around the pulley. A lever at the top of the machine puts the cylinder gear in and out of mesh. At the top of the wringer will be observed a small hand wheel, a slight turning of which in either direction causes the wringer to operate one way or the other. The wringer and the washing machine can be used simultaneously. The machines are equipped with either alternating-current or direct-current motors suitable for operation on standard circuits.

COMMUTATOR CEMENT.

The pitting of the mica insulation between commutator segments usually leads to more or less commutator trouble, the hole filling up with copper or carbon dust, which bridges the segments and, being conducting, causes flashover. Troubles of this sort may be avoided if the crevice is filled immediately with an insulating substance. A cement which is said to be very useful for this purpose is manufactured by the Edward E. Early Company, Canton, Ohio. This cement is said to possses high insulating properties and to stay where it is put. In applying it the burned or charred insulation is scraped out thoroughly until clear mica is uncovered, and the compound is then firmly pressed into the hole or crevice and allowed to stand five or ten minutes. The surface is then filed or scraped with sandpaper so as to give it a fine, smooth finish with the rest of the commutator. For quick repairs in large crevices the manufacturer recommends the use of a blow torch to heat the cement until dry. If the motor is not in use, and is not wanted immediately, air drying of the cement is sufficient. The dryer the cement, however, the better its insulating qualities, and it is said not to crumble out due to expansion or contraction, nor to burn, lose its insulating effect or its adhesiveness with red heat.

ARC CIRCUIT CUT-OUT.

The increasing areas covered by systems of electrical distribution introduce many new conditions of operation into the daily work of the central-station administrator. In arc lighting in particular it is important to localize so far as possible the effect of tests on the circuit, since interruptions are measured in actual money deducted from the payments of the city to the company. It is important to be able to cut off sections of the circuit located at situations more or less remote from the generating or distributing plant, and the equipment for this purpose is necessarily designed to permit installation out of doors with operation under load conditions. To meet this demand the High-Tension Electrical Specialty Company, of Newton, Mass., has designed a series arc cut-out which is simple, introduces no complications in the wiring, and on account of the convenient construction of the frame and method of supporting is installed with ease. It can be mounted on a flat surface or, by the use of strap-iron lugs or hooks, placed in service on pole-line cross-arms in the manner of mounting pole-type transformers. This cut-out is entirely weatherproof, being inclosed in a watertight iron casing with detachable cover. The make-and-break contacts are carried in oil, and an external hand switch is carried down the outside of the casing for convenient operation at "on" and "off" positions. When the cut-out switch is set at the "on" position it allows a series circuit to burn. When the cut-out is at the "off" position it short-circuits the line toward the source of supply and leaves the loop or section protected by it absolutely dead, so that the defective loop may be tested by means of a magneto generator with perfect safety and without removing any wires from the box. Any number of these cut-outs may be placed on a long series circuit (double wire) of arc and incandescent lamps, or both, and an open circuit located very quickly by throwing the cut-outs off and testing ahead with a magneto generator. This may be done with the circuit alive, so that when the cut-out is "off" the lamps behind it will at once be placed in service.



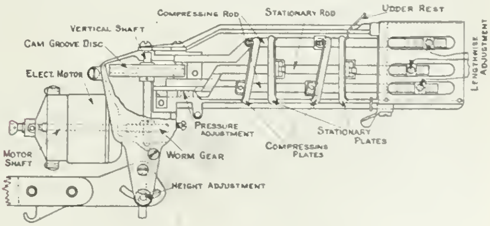
Arc Circuit Cut-Out.

Another valuable feature of these cut-outs is that the break in oil permits "flashing in a loop," which may be open, as shown, by a magneto generator, due to broken incandescent lamps, which frequently happens, as the paper film cut-out does not operate when the circuit is dead at the time the lamp is broken. As is well known, it is often impossible to "flash in a loop" under such conditions with the ordinary air-break cut-out, due to the arcing across the contacts. The fact that such loops may readily be flashed into circuit often saves a great deal of time in restoring service. The cut-out is designed for use on circuits running in e.m.f. as high as 8000 volts

ELECTRICALLY DRIVEN MILKING MACHINE.

The milking of cows by machine is by no means a new art. It reaches back as far as the early nineties, and a great number of patents have been granted in the United States for mechanical devices designed for this purpose. There are few in actual use, although every intelligent farmer would gladly welcome and pay any reasonable price for a machine that could be depended upon to do the work required without injury to the cows and with adequate saving of hired help and time.

There are two entirely different types of milking machines, one built on the principle of suction and the other on that of pressure produced as in hand milking. The [illegible] with the suction type is that it is liable to cause injury to the cow, and with the pressure type that it is either not suitable for different sizes of the udder or, if adjustable, is too complicated and easily put out of order.



Details of Milking Machine.

A new make of milking machine, built upon the pressure principle, has for some time been in use in Europe, the principal features of which machine seem to be the simplicity of construction together with the minute adjustment rendered possible.

Side views of this milking machine are given in the illustrations, which show that it consists of two sets of stationary members and two sets of compressing members. The plates are covered with pliable rubber and attached to the machine in a way that makes them very easily removable for cleaning. One set of stationary plates is rigidly connected to the middle rod, and the other set adjustable along the same rod for different adjustments for size. The compressing plates are connected to the upper and lower rods, one set rigidly and the other set adjustable, corresponding to the stationary members. The adjustment lengthwise is made so that the relative position of the stationary and the compressing member of each set remains unchanged. The two compressing rods end with rollers sliding in a cam-grooved disk. These grooves are made so that the upper edges of the compressing plates first are pressed against the teats near the udder, then swing around the upper supporting points against the stationary plates, ultimately reaching positions parallel to these, and move back with kept parallelism. In order to regulate the pressure the middle rod supporting the stationary plates can be moved lengthwise within certain limits, thus simultaneously altering the relative position of the compressing and stationary plate in each set and consequently the pressure also, the stroke in each case remaining the same.

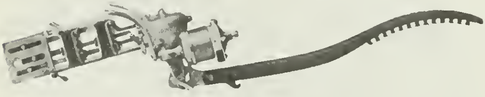


Fig. 2—Side View of Milking Machine.

An electric motor is mounted on the frame of the machine and the power is transmitted from the motor to the cam-grooved disk by means of a worm gear and a vertical shaft. The energy required to drive the machine is somewhat less than that required by an ordinary 16-cp lamp.

It is stated that machines of this construction have been in successful operation for over a year at many dairy farms in Sweden and other European countries, and for the last few months have been tested at the Swedish government agricultural research station at Alnarp, Sweden.

The manufacturer's representative in this country is Mr. A. E. Sylven, 29 Broadway, New York.

SHELL-TYPE BRIM COOLER FOR ICE PLANT.

In the ordinary can type of ice plant racks of ammonia pipes are inserted in the brine between the rows of cans, and in these pipes the liquid ammonia evaporates and expands, chilling the brine, which in turn extracts the heat from the water in the cans.

In an improved "shell-type" brine cooler recently developed a steel container, generally similar to a fire-tube boiler in construction, is used as the ammonia-expansion vessel to replace the ammonia pipes, while through the tubes or flues of this shell the brine is circulated, being chilled as it traverses the tubes. The arrangements for circulating and cooling the brine are well illustrated in the accompanying sectional view of a tank of this kind.

The shell-type cooler was first introduced about two years ago, and has now apparently passed the experimental stage, twenty-four large plants being in successful operation.

Many of the usual ice-tank troubles are due to the expansion coils, and the elimination of these coils secures many advantages of construction and operation.

The cans can be spaced more closely and tank space saved. This also results in a less quantity of brine, less radiating area and fewer heat losses. The absence of coils makes the equipment about 33 per cent lighter, so that it is considerably less expensive to ship and erect. The useful life of cans is also increased, since they are saved the battering against the freezing coils which ordinarily occurs and which is responsible for about 50 per cent of their repairs and renewals. As the shell cooler has fewer parts to keep in repair the maintenance of the entire equipment is considerably reduced.

The rapid circulation of brine possible with the shell-type cooler results in quicker freezing, 300-lb. cans of ice being produced in forty hours. Together with the closer tank spacing, the rapid-freezing action above mentioned accounts for the large output of ice from a given tank capacity obtained with the shell-type cooler.

The conditions under which this system operates also permit a higher back pressure and lower brine temperature than would otherwise be possible, thereby increasing the ice-making capacity without the use of a larger ammonia compressor becoming necessary.

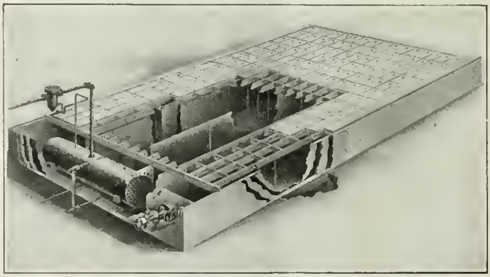
The shell cooler itself is of flanged steel, with heads of somewhat heavier material. Into the heads are inserted special tubes of charcoal iron, the main gas outlet flange, as well as the various connections, being welded into the shell. All joints are welded, and upon completion all coolers are tested to 150 lb. per square inch air pressure under water.

On the outside of the brine tank is placed an ammonia column and a separating device which automatically traps any unevaporated liquor, returning it through a syphon connection to the cooler. This prevents any wet or saturated ammonia from going to the compressor.

Liquid ammonia is permitted to cover just the top row of tubes, the ammonia being loose in the shell, while the brine circulates through the tubes and around the shell, causing the ammonia to evaporate or boil. The accumulated gases pass off at the surface in much the same manner as steam is generated in a horizontal-return tubular boiler. Practically all fittings are eliminated, with the exception of one expansion valve placed above the tank, the liquid being allowed to flow into the cooler at one end at the bottom.

Owing to the large liberating surface there is no difficulty from boiling over or carrying the liquid into the gas as is sometimes experienced with flooded systems.

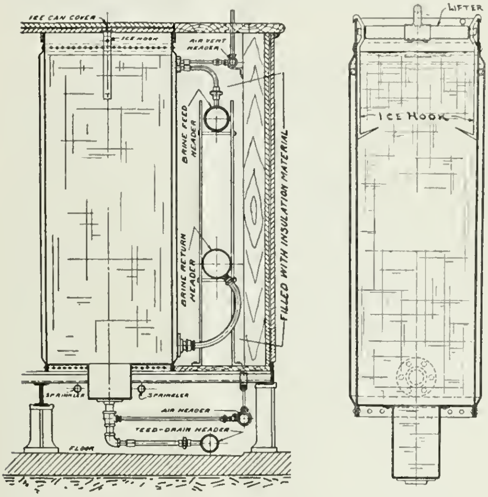
The ice tank is constructed with specially designed agitator and bulkheads, arranged so that a positive and extremely rapid circulation of brine is maintained throughout the entire tank. Owing to the rapidity of the brine circulation a difference of level exists in the various parts of the tank. This is overcome by the use of a special tank top so arranged that the cans are free to rise and fall, and so adjust themselves readily to the variation of the brine level. The cans, however, are always held in a perfectly upright position, insuring square tops to all blocks of ice.


Shell-Type Brine Cooler for Can Ice Plants.

The shell-type cooler described in this article is manufactured by the Triumph Ice Machine Company, Cincinnati, Ohio.

SIMPLIFIED HARVESTING OPERATIONS IN IMPROVED SHORT-CYCLE ICE-MAKING PROCESS.

Cakes of pure, clear ice are made from raw or undistilled water in eighteen to twenty hours by a newly improved can system recently devised by Mr. O. H. Jewell. A number of these plants are already installed and working with good satisfaction, among them being the eight-ton equipment in the Blackstone Hotel, Chicago, a description of which was given in the *Electrical World,* Aug. 4, 1910. The short freezing cycle which it is possible to attain with the Jewell process is of special interest to central-station operators, since with such a system the actual energy-consuming operation of freezing the ice can be completed in about eighteen hours, avoiding the peak period of lighting demand on the electric plant. The ice apparatus can thus be operated on a twenty-four-hour cycle, turning out its full rated tonnage of ice every twenty-four hours, and thus saving the 100 per cent to 150 per cent additional cans, space, tank area, etc., required with forty-eight-hour or sixty-hour ice-making processes.



Figs. 1 and 2—Sectional Elevations Through Jewell Can.

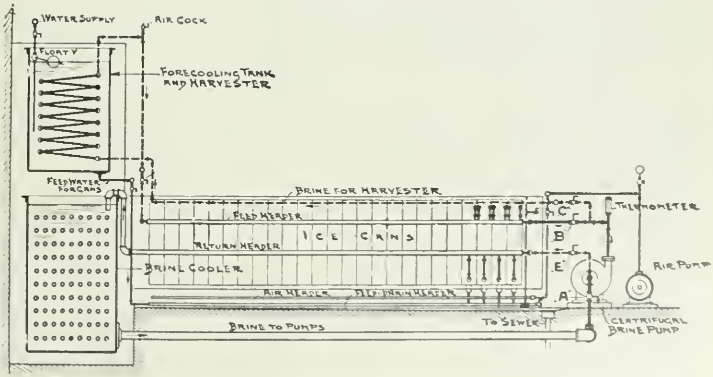


Fig. 3—Fore-Cooler, Brine Cooler and Freezing Cans of Jewell Process.

The freezing cans used in the Jewell process differ radically from those of the standard can-type plant. The cans, made of heavy metal, are double-walled, as shown in Figs. 1 and 2, the brine, chilled to a temperature about zero deg. Fahr., being circulated through the hollow jacket spaces thus formed. The cans are mounted stationary in position, and all the operations of filling, freezing, harvesting, etc., are performed without handling the cans themselves, thus conducing considerably to their useful life. After the cake of ice has been frozen the chilled-brine circulation is cut off and warm brine is passed through the can jackets, thawing the ice loose from their sides. Then by means of hooks which, as shown in the illustration, Fig. 2, are previously inserted and frozen into the sides of the cake the ice is hoisted out of the can and carried to the shipping floor or the storage-room. When released the hooks drop freely off the cake. The brine used for harvesting is warmed to about 38 deg. by passing it through the fore-cooling tank, used to cool the raw water preparatory to ice-making, so that in this exchange of heat between brine and water no actual losses of "cold" take place.

The production of clear and pure ice from raw water is the result of a physical action simply described as "the tendency of impure water to freeze itself pure," the foreign matter present being pushed ahead and out of the way of the formation of the ice-crystals. In the Jewell process this action is assisted by agitating the can contents during freezing by a jet of air released from the bottom of the can. The stationary construction of the cans makes it possible to protect this air supply pipe against interruption from freezing by contact with the cold brine or from any other cause. As freezing progresses from each of the four sides of the can, concentrating in the central, vertical unfrozen core of the ice cake all the impurities present, this impure water can be drawn off by opening sewer connections at the bottom of the cans, at once draining off all the collected impurities. By manipulating a second valve, pure, fresh chilled water from the fore-cooler is then admitted to the cans, filling the core holes and freezing them solid. Any number of freezing cans up to fifty are assembled in a single group, and all of the sewer drains and fresh-water inputs for the entire group are controlled from single sewer and inlet valves respectively. In this way the manipulation of the cold and warm brine through the jackets, and the filling and draining of cans, is conveniently controlled from a compact group of several valves, as shown in Fig. 3.

The unique principle in making of the cans simply stationary freezing receptacles thus saves double handling of the cans from the freezing tank to the dump and return, doubtless increasing their useful life.

In case it is not desired to withdraw the impure water in the core of the cake, the foreign matter in this will settle to the bottom after the air supply is cut off, collecting in the non-freezing pocket at the bottom of the can and leaving the ice cake comparatively pure.

The ice cakes produced are of standard weight, from 50 lb. to 400 lb. as desired, but are preferably of thickness not greater than 10 in., to effect rapid freezing in the eighteen hours' time mentioned. An entire plant is divided up into units, each unit producing a fraction of the total plant output. A 5-ton plant is thus divided up into two or three units; a 30-ton plant into six units, etc. The ammonia-expansion apparatus and other equipment used in conjunction with this process are in general similar to those employed in standard ice-making plants, in some instances existing apparatus being readapted for this purpose. The Jewell process freezing-tank equipment is made by the Polar Ice Machine Company, 77 East Jackson Boulevard, Chicago, and is marketed by the Creamery Package Manufacturing Company, ice-machine manufacturers, 61 Kinzie Street, Chicago.

Industrial and Commercial News

THE WEEK IN TRADE.

ASIDE from a slight increase in retail trade due to the Easter season, the dullness in general business has been practically unchanged for the past week. Reports from trade centres throughout the country are not, in the main, indicative of early activity. In the majority of lines demand continues light, and current necessities are the dominant features of interest. General merchandise is reported slightly improved in a few cities of the Middle West. Iron and steel trades are barely holding their own, very few sales of pig iron are being effected, and while the volume of steel trade is undiminished, buying in this line is largely for early delivery. The textile markets are quiet and buyers are holding off for the present, but manufacturers in this field are looking for early improvement. Records of salesmen on the road are only fair, a few increased sales in agricultural implements constituting the principal interest in this quarter. The building trade shows a gain over February business, but is nearly 20 per cent smaller than in March, 1910. Stock markets are listless, and speculation is light. Exports of cotton were less than usual, and while agricultural exports are higher than in March, 1910, they show a falling off from the figures of the four previous years. Weather conditions have been favorable for crops as regards moisture, but continued rain in some sections has delayed planting. Record crop production is expected, and the production of winter wheat is reported as unusually large. Money is abundant. Collections remain slow, and in some quarters requests for extensions are not infrequent. Movements in several lines of trade are affected by prospective changes in tariff schedules. Underlying conditions indicate that activity in general business is not unlikely as soon as present uncertainties can be removed. Business failures for the week ended April 13, as reported by *Bradstreet's*, were 233, as compared with 236 for the previous week, 207 for the same week in 1910, 201 in 1909, 261 in 1908 and 167 in 1907.

THE COPPER MARKET.

DEMAND for copper continues light in all branches of the trade. Wire-drawing and supply interests are not increasing their purchases to a noticeable extent, and the status of the market is reflected in the smaller demand from domestic smelters. Consumption of copper abroad continues to be fairly active, but recent orders for American copper have not been large enough to have any pronounced effect. Conditions at present indicate that the April output will be from 5,000,000 lb. to 10,000,000 lb. less than the March production. These figures are not particularly encouraging when it is remembered that consumption will also be somewhat curtailed, with a net result of increased stock. Owing to small activity on the part of the larger interests in meeting competition prices in this country have declined somewhat, and in Europe there has also been a slight falling off throughout the week. The situation is not attractive and there is little hope that the copper market will reach a rational basis for some time to come. A temporary activity within a few weeks in finished materials is looked for in some quarters, in spite of the fact that domestic consumers in general continue to buy sparingly The electrolytic market is now regarded as being on a 12-cent basis for the next few months, since attempts to sell for April delivery were met by price shading for May and June shipments. Standard copper continues weak and shows an inclination to decline. Imports up to the Easter holidays were 1165 tons of copper, making a total for the month of 3420 tons. Exports for the month, including April 17, were 11,278 tons. The daily call on the Metal Exchange, April 17, quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.60	11.75	.....
April	11.60	11.75	11.67½
May	11.60	11.75	11.67½
June	11.60	11.75	11.67½
July	11.60	11.75	11.67½

The London market, April 17, was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	53	15	0	53	13	9
Standard copper, futures	54	7	6	54	6	3

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.30c			11.62½c		
London, spot	£56	15	0	£53	12	6
London, futures	57	12	6	54	5	0
Best selected	60	5	0	57	10	0

INDUSTRIAL AND COMMERCIAL NOTES.

Housatonic Power Company Enlarging Plants.—Erection of the additional equipment for the plants of the Housatonic Power Company, New Haven, Conn., is nearing completion. The company operates plants at Beacon Falls, some six or eight miles above Waterbury, a plant at Waterbury and a hydroelectric plant at Bulls Bridge, about thirty miles below Waterbury. A 4000-kw, 2300-volt turbo-alternator, two 1000-kw, 600-volt, six-phase rotary converters, together with transformer and switchboard apparatus, are being furnished by the General Electric Company for the Waterbury plant, and the same company is placing a 300-kw, 6600-volt motor-generator set for railway service at 600 volts direct current in the Beacon Falls plant. This unit is to be a duplicate of two other 300-kw sets already installed. The new turbine is to run in parallel with two 1500-kw, 2300-volt Westinghouse turbine units now in operation at the Waterbury plant. Energy will be generated at 2300 volts, transformed at the plant and transmitted at 6600 volts to the motor-generator sets at the Beacon Falls plant and will be transmitted at 33,000 volts to the 6000-kw hydroelectric plant at Bulls Bridge, with which the Waterbury plant will run in parallel and for which it will act as reserve in the dry season. The new 4000-kw turbine will be condensing on Alberger jet condensers. Additional boiler capacity is also to be provided.

Power Contract for Fall River Electric Light Company.—The Pilgrim Mills of Fall River, Mass., which was recently formed for manufacturing cotton goods, has entered into a contract with the Fall River Electric Light Company for the lighting and motor service in its mill. The plans call for the erection of a 60,000-spindle mill, to cost about $1,000,000, for which contract has been let. The motor installation will be approximately 1700 hp, and about 100 kw will be taken for lighting. The energy to be furnished will be at 40,000 volts primary and 550 volts secondary, three-phase, 60-cycle. Two sources of supply will be provided by the lighting company, both of which will be underground. One is to be a private circuit from the station, and the other a connection to the commercial circuit. Efforts are being made by the central-station officials and the consumer to make the installation modern in every respect. The equipment will be in operation in about one year.

Wiring of New York State Capitol Begun.—Repairs have been started on the New York State Capitol, which was badly damaged in the recent fire. The Tucker Electrical Construction Company, of New York City, has been awarded a contract to put the present wiring system in a safe condition. A large force is now at work in Albany, and will probably be engaged with the rewiring for several months. In addition to the State contract, which is on a basis of cost plus percentage, the Tucker company is doing electrical work for the Tidewater Portland Cement Company at Unionbridge, Md., where about 800 hp in motors will be installed, and has contracts for wiring the new stations for the Fourth Avenue subway, Brooklyn, N. Y., and the St. Luke's Hospital addition.

Westinghouse Equipment for Lumber Company.—The Western Lumber Company, owned by W. A. Clark, of Montana, has closed a contract with the Westinghouse Electric & Manufacturing Company for a 600-kw turbo-generator, together with motors, transformers ,and switchboards. Other recent sales include equipment for remodeling the switchboards of the main plant and substations of the Augusta-Aiken Railway & Electric Company; additional apparatus for the remote-control switching station of the Eastern Tennessee Power Company, and thirty-two interpole motors to the Public Service Railway Company of New Jersey.

Telephone Train-Dispatching Adopted.—The use of the telegraph has been done away with in the way-station towers of the Middle Division of the Pennsylvania Lines East, which extends from Harrisburg to Altoona. The only telegraph business here consists of through messages between division points. Telephone equipment is now in operation also over the Philadelphia Division, from Philadelphia to Harrisburg. A system of sending out time on the telephone wires has recently been put into effect between Philadelphia and Harrisburg. The system in use is one developed by the Western Electric Company, which has supplied the telephone equipment of these two divisions. At Harrisburg the telephone business of the Pennsylvania Railroad is handled through a central-battery, multiple switchboard with four positions and connected with the lines of the Bell Telephone Company of Pennsylvania. Trunk lines from this board go to Altoona and Philadelphia and to small switchboards located at important points both east and west on the railway's telephone system. Altoona also uses a multiple-exchange equipment of the type used in large operating offices. Two telephone sets are placed in each way-station tower, one mounted on a special transmitter arm, the other an emergency desk-stand telephone with head receiver. Telephone train dispatching has also been adopted by the Duluth & Iron Range Railroad, and equipment is now being installed between Two Harbors and Ely, with a branch from Allen Junction to Virginia and Eveleth, in Minnesota. The new telephone system will cover 123 miles, and there will be fifteen way stations. The officials of this road decided upon this equipment after an investigation of the operation of the telephone circuits on the Great Northern Railway, which for some time has been making extensive use of the selective system of train dispatching.

Philadelphia-Washington Underground Cable.—In order to preclude a recurrence of the conditions that existed on March 4, 1909, when Washington, D. C., was isolated by telephone and telegraph communication by reason of severe weather conditions, the American Telephone & Telegraph Company is building an underground telephone cable between Philadelphia and Washington. When completed the underground conduit will be approximately 135 miles long and will pass through Wilmington and Baltimore. These cities will thus be given the same protection against unbroken communication as will be afforded to Washington. The line from Washington to Philadelphia will be completed in the early fall. The longest commercial telephone circuit wholly underground is between Philadelphia and New York, about ninety miles in length. The plans as projected involve a line wholly underground between Boston and Washington. The construction of the Philadelphia-Washington line has presented many complex problems and required a large amount of equipment of both general and special nature, most of which has been furnished by the Western Electric Company.

Amalgamation of Operation by Telephone Companies.—The directors of the Michigan State Telephone Company elected officers on April 11 at Detroit as follows: President, B. E. Sunny; vice-president and treasurer, Alonzo Burt; vice-president, B. W. Trafford; auditor, B. S. Garvey; engineer, J. G. Wray; general counsel, L. G. Richardson. These changes represent a further step in the standardization of administration among the Bell telephone companies of the Middle West. Three of the officers named, Mr. Sunny, Mr. Garvey and Mr. Wray, are respectively president, auditor and chief engineer of the Chicago Telephone Company. Mr. Sunny is also a vice-president of the American Telephone & Telegraph Company and a director of the Western Electric Company. Mr. Burt is president of the Wisconsin Telephone Company and Mr. Richardson is president of the Central Union Telephone Company. No consolidation of companies is expected, it is said, but there will no doubt be a close working agreement between some of the Bell telephone companies to effect economy in management.

New Factory for Electric Storage Battery Company.—It has just been announced that the Electric Storage Battery Company at Nineteenth Street and Allegheny Avenue, Philadelphia, has closed a contract for the design and construction of a new reinforced-concrete building which will be the largest manufacturing building of this type in the city. This addition to its present plant will be a building approximately 300 ft. long by 115 ft. wide, six stories high, with a one-story triangular extension about 80 ft. x 120 ft. These buildings will be constructed by the patented system of mushroom reinforced-concrete construction, and will be designed to meet the particular demands of this company. These new buildings will be strictly fireproof, and will be provided with the best facilities for the convenience of the employees. The construction of these buildings is to start at once, to be completed during the fall, and will give employment to a large additional force of workmen.

Electrification on the New Haven Railroad.—Thompson, Towle & Company, of Boston, have issued a circular in which they quote an official of the New York, New Haven & Hartford Railroad Company to the effect that within a year the line would be electrically equipped as far as New Haven, and that possibly, also, by that time work would have been commenced on the Boston end of the road. He said that the railroad's engineers are now at work upon the problem of the transportation of freight by electric locomotives with very satisfactory results. As far as the question of economy is concerned, this official said that while the New Haven may not be showing any substantial reduction in operating costs between New York and Stamford by the use of electricity, as compared with steam, the general results to date have more than justified the expenditure.

Electrical Equipment for Danville, Va.—The Riverside & Dan River Cotton Mills, Danville, Va., has placed an order with the General Electric Company for one 200-kw, 600-volt, three-phase generator, one 351-kw, 600-volt, three-phase generator, two 20-kw, 125-volt exciters, three 40-kva transformers, sixteen induction motors of from 10-hp to 100-hp rating, and a 600-volt alternating-current switchboard. The latter consists of one double-circuit exciter panel, one single-circuit lighting feeder panel and one double-circuit feeder panel for furnishing energy to induction motors throughout the factory. The switching equipment consists of hand-operated, remote-control oil switches. A voltage regulator equipment was also ordered.

Wheeler Condensers for Turbine Work.—The New York Edison Company has awarded a contract to the Wheeler Condenser & Engineering Company, of Carteret, N. J., for three surface condensers. These will be furnished with circulating, hot-well and vacuum pumps, and will be used in connection with three 20,000-kw turbines. The condensers are to handle 300,000 lb. of steam per hour, and are said to be the largest of their kind in the world. The Minneapolis General Electric Company has also ordered two surface condensers and auxiliaries from the Wheeler company for the 10,000-kw turbines in its new plant.

Municipal Receipts from Street Railway Operation in Chicago.—The city's 55 per cent of the net earnings of the Chicago Railways Company for last year was less than in the preceding year, the amount being $744,110, compared with $811,776. Notwithstanding this decrease, however, the city's revenue for 1910 from both car companies, through the 55 per cent clause of the ordinance, was much larger than the preceding year, amounting altogether to $1,705,025. The returns from the Chicago City Railway Company were greatly increased because nearly all of the rehabilitation of that company has been accomplished.

Hydroelectric Development in Texas.—It is reported that plans are being formed by David R. Francis, of St. Louis; D. B. Chapin, of Edinburg, Tex., and others for constructing a large irrigation system and hydroelectric plants on the Devil's and Pecos Rivers in the western part of Texas, and that a purchase has been made of most of the land for the irrigation system. The report states that a large dam will be built on each of the rivers, that the hydroelectric plants will have a capacity of about 30,000 hp and that the work will cost in the neighborhood of $5,000,000.

New Warehouse for General Electric Company.—An eight-story building has been erected at Greenwich and Morton Streets, New York City, for the General Electric Company, and will be occupied within a short time as a storage warehouse for reserve equipment of various kinds. Part of the building will be used for the storage of some 500,000 incandescent lamps.

Fire-Alarm Office Equipment.—Kohler Brothers, of Chicago, have been awarded the contract for supplying equipment to the fire-alarm office in the new city hall, Chicago. This order includes generator supporting frame, jumper distributing frame, generator distributing frame and cable terminal units. The amount of the contract is $2,078.

Financial.

THE WEEK IN WALL STREET.

WITH only 579,106 shares sold, trading on the New York Stock Exchange for the short Easter week showed an appreciable falling off from the low figures of the previous weeks. Final prices show few variations of importance, speculation remains exceedingly quiet, and the few transactions recorded continue to be largely professional. In view of the fact that no Supreme Court decisions were handed down on Monday last, Wall Street is inclined to believe that the rulings will be deferred until autumn, and that activity will be delayed until that time, at least. The larger interests are making no efforts to dispose of their holdings, which serves as an indication that responsible interests are guided by their belief in sound fundamental conditions. The opening of the markets after the holiday recess showed no marked improvement over the dullness of the preceding week. Wall Street depression is spreading to Western centres, and the influence is reactionary in the volume of Eastern trade. Bank clearings are decreasing, building operations are reported as falling off in volume, and railroad purchases are below the usual figures for this period of the year. The effect of prospective revision of tariff schedules is now considered of more importance than evidenced at the opening of the extra session of Congress, and is being felt in many lines of industry, while unsettled conditions on the Mexican border are believed to be exerting an influence toward curtailment of activity, although this is more toward restriction of general trade than stock market transactions. An indication of the amount of funds now idle is the fact that State canal bonds were oversubscribed some ten times the amount of the original issue. Crops are in excellent condition, the foreign trade of the country is improving, and no uneasiness for the future is felt by many Wall Street interests. Several commission houses are quoted as having many large orders for fulfilment in case a break in the market follows the Supreme Court decisions, and plans are said to have been made by large interests for action in case decisions are favorable. Mid-April statements indicate that money will become even cheaper than at present. Rates for April 17 were: Call, 2@2¼ per cent; ninety days, 2¾@3 per cent. The quotations in the table are those of the close, April 17.

NEW YORK.

	April 10.	April 17.	Shares Sold.		April 10.	April 17.	Shares Sold.
All. Ch.	8*	7½	200	Int. Met., pf.	54*	52⅝	920
All. Ch., pf.	30¼*	29	100	Mackay Cos.	93½*	93½*	———
Amal. Cop.	62⅜	62⅛	11,850	Mackay C., pf.	77*	76¼	———
Am. D. T.	20½*	20½*	———	Man. Elev.	137	139	210
Am. Loco.	37½	37¼*	960	Met. St. Ry.	15*	15*	———
Am. Loco, pf.	104½	104½*	100	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	83*	83*	———	Steel, com.	77¼	76⅝	95,600
Am. T. & T.	145¾	145⅞	3,360	Steel, pfd.	119	120	3,824
B. R. T.	77⅞	77⅞	2,500	W. U. T.	73	72¾*	600
Gen. Elec.	151½	150½	3,425	West'h, com.	67	65½	300
Int. Met.	19	18½*	1,070	West'h, pfd.	121	117	100

PHILADELPHIA.

	April 10.	April 17.		April 10.	April 17.
Am. Rys.	44*	44½	Phila. Elec.	16¼	16¼
Elec. Co. of A.	11⅞	11¾*	Phila. R. T.	18⅛	17¾
Elec. St. B'ty.	53	53¼	Phila. Trac.	84*	83¾*
Elec. St. B'ty., pfd.	30*	30*	Union Trac.	46	45¾

CHICAGO.

	April 10.	April 17.		April 10.	April 17.
Chi. City Ry.	186*	186*	Chi. Tel. Co.	120	120
Chi. Rs., Ser. 1.	85*	85*	Met. El. Co.	22⅛*	22⅛*
Chi. Rs., Ser. 2.	23½*	23½*	Met. El., pfd.	68	68
Com. Edison	128	126	Nat'l Car	115½	114½
Chi. Subways	4¾	4¾	Nat'l Car, pfd.	120*	120

BOSTON.

	April 10.	April 17.		April 10.	April 17.
Am. T. & T.	146	145¾	Mex. Tel.	3½	3½*
Cum. Tel.	150*	150*	Mex. Tel., pfd.	6½*	6½*
Edison E., Ill.	284	284¼	N. E. Tel.	141*	142
Gen. Elec.	152	151*	W. T. & T.	19½	19*
Mass. E. Ry.	17⅛	16¾	W. T. & T., pfd.	94	94*
Mass. E. Ry., pfd.	88	87			

*Last price quoted.
Shares sold for week, April 10 to April 15.

FINANCIAL NOTES

United Light & Railways Company.—The new United Light & Railways Company, which has its headquarters in Grand Rapids, Mich., operates public utilities in several cities in the Middle West along lines similar to those of the American Light & Traction Company. It is a Maine corporation and operates and controls by stock ownership all of the properties which have been under the direction of Child, Hulswit & Company for several years, with the addition of two new ones. The properties include the entire gas business of Cedar Rapids, Fort Dodge and Muscatine, Ia.; Cadillac, Mich.; La Porte, Ind.; Mattoon, Ill., and Chattanooga, Tenn. In addition there are three electric plants in Fort Dodge and Muscatine, Ia., and La Porte, Ind. In each of these cities the company has a street-lighting contract. The company also controls the local electric street railway in Muscatine, Ia., and the hot-water district heating system in La Porte, Ind. The company is authorized to issue $12,500,000 of first preferred 6 per cent cumulative stock. Of this amount $2,133,000 is outstanding. It is also authorized to issue $5,000,000 of second preferred 3 per cent cumulative stock, and of this $866,500 is outstanding. The second preferred is used only in exchange for old securities in taking over properties. There is also $12,500,000 of common stock, of which $800,000 is outstanding. The company has no bonded indebtedness of its own, but bonds and preferred stock of constituent companies to the extent respectively of $2,231,500 and $500,000 are outstanding. The operations of the company date from Oct. 1, 1910, and for the five months ended Feb. 28, 1911, the net earnings of constituent companies were $158,114. Deducting from this the fixed charges of the underlying companies and the dividends on the underlying preferred stock of constituent companies, there is left $82,018 as the net profit on the stock of underlying companies. Of this amount there is due the United Light & Railways Company $67,768, while other income brings the total income of that company up to $87,615. When expenses and accrued interest are deducted the net earnings for the period are $67,518. The directors of the United Light & Railways Company are made up largely of men who have invested in the properties taken over. Mr. Frank T. Hulswit is president of the company and Mr. T. J. Weber is consulting engineer. First preferred 6 per cent cumulative stock to the amount of $800,000 is now offered at par and accrued dividends, with a bonus of 40 per cent in common stock, by Russell, Brewster & Company, Chicago brokers

Philadelphia Electric Company Report.—The net results of the fiscal year ended Dec. 31, 1910, show an increase of $67,457 paid in cash dividends and $339,141 added to surplus account, despite the fact that the charge for depreciation was increased $175,000 more than that for the previous year. Gross earnings were $5,946,026; operating and fixed charges, $4,729,647, leaving a net income of $1,216,378. The report shows an increase of 252,296 50-watt equivalents connected at the end of the year. President Joseph B. McCall states that the increasing motor business is especially gratifying, and that the gross income from this source has more than trebled in the past six years, representing at the present time more than 20 per cent of the total sales for all purposes. Contracts have been made to install a 14,000-kw turbine unit and auxiliaries at the Christian Street station and a 5000-kw turbine unit at Tacony, on the Delaware River. Mention is made of the success of the Philadelphia Electric Beneficial Association. Recommendations by the board of directors for the adoption of a "service annuity," or pension plan, based on age and period of service, are embodied in the report.

Texas Utilities Show Improvement.—February reports of the majority of utilities in the principal cities of Texas show substantial increases in earnings over the corresponding period for the previous year. The earnings of the Northern Texas Electric Company, which controls the Northern Texas Traction Company, show a gain of over $16,000, while the increase in net surplus is about $2,000. The company operates an interurban line between Ft. Worth and Dallas, and also furnishes electric light in Ft. Worth. Gross earnings in February for the Dallas Electric Corporation, which owns practically all the electric lighting and street railway properties in Dallas, represent an increase of $15,000, and of $9,000 in net earnings. The Galveston-Houston Electric Company report shows a gain of $10,000 in gross returns, while the net earnings increased about $4,600. A small decrease is shown in the report of the El Paso Electric Company, operating the El Paso Electric Railway, and the El Paso & Juarez (Mex.) Traction Company. The falling off is attributed to the unsettled conditions in Mexico.

North State Hydroelectric Company.—A. C. Wyckoff, H. L. Walker and F. H. Briggs, of Raleigh, N. C., have filed papers of incorporation at that city for the North State Hydroelectric Company, with an authorized capital stock of $300,000. It is said that the new company is a subsidiary of the Carolina Power & Light Company.

Peerless V Belt Company.—Preparations are being made by the Peerless V Belt Company, of Chicago, to broaden its activities. The company is incorporated under the laws of Illinois with a capital of $300,000. A number of capitalists of Cedar Rapids, Ia., have become interested in the company and the main office will be removed to that city, where a modern factory is now under construction. The Chicago office will be removed to the corner of Jackson Boulevard and Canal Street, and there will also be branch offices in New York, St. Louis and several other cities. The company has issued $100,000 in bonds, of which $50,000 has been sold in Cedar Rapids. Treasury stock to the amount of $50,000 is offered to the public at par. The proceeds of this sale will be used in financing the sales department, while the money realized from the sale of bonds in Cedar Rapids will be put into the factory. The company makes a wedge-shaped chain drive, hence the name V belt. Mr. Alphons Gits, formerly of the Western Electric Company, is president of the company.

Detroit Edison Report for February.—Gross earnings of the Detroit Edison Company for February were $287,092, against $231,946 for February, 1909, an increase of $55,146, or 23¾ per cent. Operating expenses were $162,091, an increase of $30,824, the net income gaining $24,322, equivalent to 24 per cent. Interest charges increased $4,953, amounting to $47,580, leaving a surplus after deducting these of $77,421, which represents an increase of $19,369, or 33¼ per cent. During the fiscal year the Detroit Edison Company earned a surplus for dividends equal to 12.33 per cent on the $5,747,000 stock outstanding, comparing favorably with the 8¼ per cent earned the previous year on $5,000,000 stock. The earnings of the company have grown rapidly in the past few years. In 1910 the $3,000,000 mark was reached, while in 1904 gross earnings did not exceed $700,000. It is also of interest that the net earnings for 1910 were in the neighborhood of $1,300,000, contrasted with net earnings of $230,000 in 1904.

United Railways & Electric Company.—At the annual meeting of the stockholders of the United Railways and Electric Company of Baltimore, held last week, the following directors were elected for the ensuing year: H. Crawford Black, Alexander Brown, Frank A. Furst, B. Howell Griswold, Jr., William A. House, George C. Jenkins, Seymour Mandelbaum, H. A. Orrick, John B. Ramsay, Douglas H. Thomas and Francis E. Waters. There were 268,913 shares of the common stock of the company voted at last week's meeting out of a total of 301,000, as against a little over 259,000 at last year's meeting, which was the largest number participating in any previous annual meeting up to that time. Comparing the report of 1910 with 1909, the following is noted: Increase in gross earnings, $477,910.97, or 6.63 per cent.; increase in operating expenses, $240,024.28, or 7.14 per cent.; increase in fixed charges, $82,447.42, or 3.03 per cent; increase in amount carried to credit of profit and loss for the year, $259,803.84.

Report of Rubber Goods Manufacturing Company.—Figures given in the annual report of the Rubber Goods Manufacturing Company for the year ended Dec. 31, 1910, show gross sales of $35,188,295, which is an increase for the year of $9,558,702, a gain of 37.2 per cent over the figures for 1909, and the largest increase in the history of the company. In spite of this large showing, the net profits were $2,122,247, which is a decrease in this item of $247,725. The report attributes the falling off to the fluctuations in crude rubber prices, stating that prices increased from $1.75 per lb. in January, 1910, to $3 per lb. during the year, and dropped at the end of the year to $1.35 per lb., making business operation difficult. Depreciation on rubber stock December 31, 1910, was charged to the amount of $1,000,000. Surplus cash is being used in developing the plants, improving factory operation, and in financing the large tire interests controlled by the company.

Central Hudson Gas & Electric Company.—The Public Service Commission for the Second District, New York, has authorized a consolidation of gas and electric companies which have been merged under the name of the Central Hudson Gas & Electric Company. The merger includes the Poughkeepsie Light, Heat & Power Company, the Newburgh Light, Heat & Power Company and the Hudson Counties Gas & Electric Company. The various companies furnish gas and electricity in Cornwall, Wallkill, New Windsor, Montgomery, Gardiner, Newburgh, Poughkeepsie and other neighboring points in upper New York State. The stocks of the three companies have been held largely under one control heretofore, and the management, interests and territories have been closely connected for some time.

Chicago Engineering Firm in Financial Difficulties.—A creditors' committee headed by Ira M. Cobe is endeavoring to straighten out the affairs of the George W. Jackson Company, Inc., of Chicago, the business being carried on as usual. The corporation was founded and directed by George W. Jackson and is doing an extensive business in engineering contracting. It is asserted that the assets of the company exceed its liabilities and that the trouble has been caused by trying to do too much business on the capital invested. Mr. Jackson is now attending to his contract for building a tunnel at Yonkers, N. Y., in connection with the New York water supply. Mr. Cobe is reported as saying: "The final balance sheet will show a comfortable margin of assets and all proper claims will be met in full."

Yadkin River Power Company Bonds.—A first mortgage to secure $15,000,000 first-mortgage, thirty-year 5 per cent gold bonds has been filed by the Yadkin River Power Company, of Raleigh, N. C., with the Old Colony Trust Company of Massachusetts as trustee. The bonds are payable April 14, 1941, and are in denominations of $1,000 each. The Yadkin River company will take over the unfinished development of the former Rockingham Power Company at Blewith Falls on the Yadkin River, as mentioned in the *Electrical World* March 23, 1911.

Kentucky Electric Company.—First mortgage 5 per cent sinking-fund gold bonds of the Kentucky Electric Company, of Louisville, Ky., to the amount of $600,000 are offered for sale at 97, yielding 5.30 per cent. The bonds are due Feb. 1, 1926, and the company does an electric light and power business in Louisville under a franchise that will outlive the bonds. The net earnings are reported to be more than three times the interest charges.

Northern Ohio Traction & Light Company.—A report of the Northern Ohio Traction & Light Company for the first two months for this year shows an increase of 54 per cent in surplus earnings over those of January and February, 1910. The surplus earnings will produce from 9 per cent to 10 per cent on the common stock if this showing is maintained for the balance of the year.

Earnings of the Edison Electric Illuminating Company of Boston.—The statement of March earnings of the Edison Electric Illuminating Company of Boston shows an increase of $51,771 over those for March, 1909. The increase in operating expenses was $6,648, showing a gain in net earnings for the month of $45,122, or 19.44 per cent.

DIVIDENDS.

American District Telegraph Company of New Jersey, quarterly, 1 per cent, payable April 28.

Binghamton (N. Y.) Light, Heat & Power Company, quarterly, preferred, 1½ per cent; common, ¾ per cent, both payable April 15.

Detroit United Railway Company, quarterly, 1¼ per cent, payable June 1.

Electric Bond & Share Company, quarterly, preferred, 1½ per cent, payable May 1; common, 2 per cent, payable April 15.

Havana Electric Railway Company, quarterly, preferred, 1½ per cent; common, 1½ per cent, both payable May 13

Michigan State Telephone Company, quarterly, preferred, 1½ per cent, payable Aug. 1; common, 1¾ per cent, payable June 1.

Sayre (Pa.) Electric Company, quarterly, preferred, 1½ per cent, payable April 15.

United Electric Securities Company, semi-annual, 3 per cent, payable May 1.

REPORTS OF EARNINGS.

Period.		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON.						
March,	1911	$471,630	$194,343	$277,287	......	......
"	1910	419,859	187,694	232,165	......	......
FORT WAYNE AND WABASH VALLEY TRACTION COMPANY						
February,	1911	$253,876	$143,444	$110,432	[illegible]	[illegible]
"	1910	234,438	129,784	104,654	[illegible]	[illegible]
KEYSTONE TELEPHONE COMPANY OF PENNSYLVANIA						
March,	1911	$95,862	$47,822	$48,040	$24,351	[illegible]
"	1910	95,101	47,490	[illegible]	[illegible]	[illegible]
PHILADELPHIA ELECTRIC COMPANY.						
Year,	1910	$5,946,026	$4,729,647	$1,216,378	[illegible]	[illegible]
"	1909	5,489,903	[illegible]	1,202,261	[illegible]	393,480
UNITED RAILWAYS OF BALTIMORE						
Year,	1910	$7,687,894	$3,601,796	$4,086,098	$2,801,635	[illegible]
"	1909	7,209,983	3,361,871	3,848,112	2,734,287	1,116,415

General News

Construction News.

MONTGOMERY, ALA.—Contracts will be placed by the Montgomery Traction Company for the construction of a power house in Montgomery in the near future. W. J. Ginnavan, Montgomery, Ala., is manager.

TROY, ALA.—Plans have been prepared by the Standard Chemical & Oil Company for the construction of an electric power plant to develop 1400 hp, at a cost of about $50,000. The plant will be located about 2 miles from Troy and will supply electricity to operate two oil mills and fertilizer plants. Contracts for machinery and equipment have been awarded. It is estimated that the company will save from $12,000 to $15,000 per year by using electric power.

EUREKA SPRINGS, ARK.—The plant and holdings of the Citizens' Electric Company, consisting of electric light and power plant, street railway system, cold storage plant, opera house and large auditorium, have been sold to E. F. Ackerman, of Chicago, Ill.; Hugo Seidel, of Eureka Springs, and others.

ALAMEDA, CAL.—The City Council is considering the question of appropriating $5,000 for the erection of a transmission line to supply electricity to operate the motors on the three drawbridges across the tidal canal.

AUBURN, CAL.—The Board of Supervisors has granted the Great Western Power Company a franchise to erect transmission lines along the Rocklin-Folsom Road.

COACHELLA, CAL.—Plans are being considered by the Coachella Valley Ice & Electric Company for the construction of an ice plant and electric light and power plant to supply electricity in Coachella and surrounding towns. It is understood that bids will soon be asked for the work. W. F. Holt, of Holtville, is president.

JACKSON, CAL.—Preparations are being made for the construction of an electric railway across Amador County to connect Jackson and other towns in the county with Sacramento or Stockton, for which application for a franchise will soon be made. C. P. Vicini, of Jackson; Julius Chihizola, of Amador City; V. Brignola and C. E. Jarvis, of Sutter Creek, are interested in the project.

MARTINEZ, CAL.—The Board of Trustees has granted the Great Western Power Company a franchise to supply electricity for lamps and motors in Martinez for which the company paid $155.

NATIONAL CITY, CAL.—The Board of Trustees is contemplating changing the street-lighting system, using tungsten lamps in place of the present arc lamps.

RIVERSIDE, CAL.—The Pacific Light & Power Company has applied to the Board of Supervisors of Riverside County for a franchise to erect transmission lines on the highways throughout the county. The company proposes to supply electricity for lamps and motors to the smaller towns in the county and to farmers along the route of its line to operate pumping plants.

SACRAMENTO, CAL.—The Citizens' Light & Power Company, recently organized with a capital stock of $2,500,000 and an authorized bond issue of the same amount, proposes to erect a large generating plant and will supply electricity for lamps and motors and also gas in Sacramento. The plant will be located in the Sierras and a substation near Brighton. The company at first will secure electrical energy from the Great Western Power Company. It is understood that George Peltier will be president of the company.

SAN JOSE, CAL.—The Southern Pacific Company is reported to have purchased the entire traction holdings in the Santa Clara Valley controlled by L. E. Hanchett for about $4,000,000. The property includes three extensive electric railway systems.

LONGMONT, COL.—At an election held recently the proposition to issue $46,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant, was carried.

GROTON, CONN.—The Board of Water & Electric Light Commissioners is contemplating increasing the output of the municipal electric light plant. The installation of a 500-hp engine is under consideration.

NEW LONDON, CONN.—Sealed proposals will be received at the office of the Constructing Quartermaster, New London, Conn., until April 25 for construction of addition to the water sytem at Fort H. G. Wright, N. Y., including two reinforced concrete pump houses, two electrically driven centrifugal pumps, water mains and reinforced concrete storage reservoir. Plans may be secured from Captain F. T. Arnold, Constructing Quartermaster, New London, Conn. A deposit of $10 will be required for plans.

WASHINGTON, D. C.—Sealed bids will be received at the office of the Commissioners of the District of Columbia, Washington, D. C., until May 1 for furnishing 830, more or less, lamp standards and accessories of special design. Specifications, drawings and form of proposal may be obtained on application to the property clerk, Room 320, District Building, Washington, D. C. A deposit of $10 will be required for plans, which will be refunded on return of same.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of District of Columbia, Washington, D. C., until April 25, for furnishing 2800 ft. of armored submarine cable and 3200 ft. lead-covered cable. Form of proposal, specifications and other information may be obtained on application to the property clerk, Room 320, District Building, Washington, D. C.

FAIRBURN, GA.—Plans are being considered for the construction of a municipal electric light plant in Fairburn, to cost about $10,000. Bids for construction of plant will be called for about May 1. W. B. Green is city clerk.

JACKSON, GA.—The Georgia Power Company is reported to be contemplating the construction of an electric railway from Montezuma, via Oglethorpe to Miona and Reynolds, Ga.

BOISE, IDAHO.—Bids will be received at the office of the United States Reclamation Service, 605 Federal Building, Los Angeles, Cal., until April 27 for furnishing electrical apparatus for the Boise project, Idaho. For further information address the above office or United State Reclamation Service, Department of the Interior, Washington, D. C. F. H. Newell is director.

BOISE, IDAHO.—Proposals will be received at the office of the United States Reclamation Service, 605 Federal Building, Los Angeles, Cal., until April 26 for furnishing hydraulic turbines for the Boise project, Idaho. For further information address the above office or United States Reclamation Service, Department of the Interior, Washington, D. C. F. H. Newell is director.

ALBION, ILL.—H. H. Knipe, of Robinson, Ill., is reported to have been granted a franchise to construct and operate an electric-light plant in Albion for a term of thirty years. The city has entered into a contract with Mr. Knipe for lighting the streets and public places of the city, under the terms of which it is to pay $1,207 per year for the service.

BARRY, ILL.—The electric and milling plant of the Barry Milling & Grain Company, of Barry, Ill., was destroyed by fire recently, entailing a loss of about $30,000.

DECATUR, ILL.—The Decatur Railway & Light Company is contemplating improvements to its system in Decatur this year, which will involve an expenditure of about $50,000. It is understood that new lines will be erected.

EAST ST. LOUIS, ILL.—The East St. Louis Light & Power Company is reported to have filed a mortgage of $145,000 in favor of the Mercantile Trust Company of St. Louis, Mo., to secure funds for enlarging its plant. Among the improvements contemplated by the company is the installation of new lamps to be placed on Broadway, Collinsville and Missouri Avenues, at a cost of about $40,000.

GIBSON CITY, ILL.—Two propositions have been submitted to the City Council asking for franchises to supply electricity for lamps and motors in Gibson City. The Gibson Electric Light & Power Company, which has been making improvements to its service, has asked for a renewal of its present franchise. Messrs. Clark and Gleason, said to be salesmen of the Western Electric Company, of Chicago, Ill., have asked for a franchise to supply electricity in this city, agreeing to install a new plant to cost about $50,000 and to supply electrical service at a more favorable rate than is now being given.

LEXINGTON, ILL.—It is reported that the property of the Lexington Electric Light Company is to be sold at a sheriff's sale, the court dismissing the suit of A. J. Scrogin, of Lexington, to replevin the property.

QUINCY, ILL.—The Quincy Gas, Electric & Heating Company has been granted a new franchise for a term of thirty years. The company is contemplating placing its wires underground in the business district of the city.

SEARS, ILL.—The Village Council has granted the Peoples Power Company, of Moline, Ill., a franchise to supply electricity in Sears for a term of thirty-two years.

SHELBYVILLE, ILL.—Plans are being considered for the installation of the park lighting system in the business district of the city. The plans call for the erection of seventy-two ornamental lamp standards, each carrying five lamps.

STERLING, ILL.—The proposition submitted by John T. Mooney to install an ornamental lighting system in the business section of the city has been accepted. The contract calls for the installation of ninety ornamental lamp posts, with wiring and lamps, for $4,250.

WASHINGTON, ILL.—The Peoria Gas & Electric Company, of Peoria, Ill., is reported to have applied to the Council for a franchise to supply electricity in Washington, Ill. The company proposes to erect a transmission line from its plant in Peoria to Washington to supply the service.

KOKOMO, IND.—The Kokomo, Marion & Western Traction Company will place contracts for the construction of a new power plant during the next few weeks. The company expects to purchase equipment, including 1000 hp in boilers, stokers, a 200-ft. smokestack, coal-handling apparatus and other apparatus for its power plant in Kokomo.

SHOALS, IND.—It is reported that plans are being considered for the construction of a municipal electric light plant, bids for which will be asked about July 1. F. W. Bateman is city engineer.

CENTRAL CITY, IA.—It is reported that Fred J. Cross, of Monticello, Ia., is planning to erect a power plant to supply electricity for lamps in Coggon, Central City, Center Point, Walker and Springville.

DECORAH, IA.—It is reported that plans are being prepared by Chicago capitalists for the construction of a dam to develop 600 hp. Electricity generated at the plant will be transmitted to Waukon, Potsville, Lansing and other towns.

DUBUQUE, IA.—It is reported that the Dubuque Packing Company is building a new packing plant. It is understood that about $20,000 will be expended for new machinery, which will be equipped for electrical operation.

DUBUQUE, IA.—The Flick-Ziepprecht Box Company, of Dubuque, is reported to be erecting a new building to cost about $15,000, which will double the output of the plant. An electric lighting system and new machinery will be installed.

EDGEWOOD, IA.—It is reported that W. Ageton, representing the Ames Iron Engineering Company, is making investigations in Edgewood with a view of establishing an electric-light plant in this town.

FT. DODGE, IA.—Negotiations have been closed for the purchase of a site on the Des Moines River, 10 miles north of Ft. Dodge, for the erection of a large hydroelectric power plant. The proposed plant will cost approximately $612,000 and will supply electricity for lamps and motors in Ft. Dodge, Des Moines, Webster City and Boone, Ia. E. T. Meredith, president of the Des Moines Commercial Club, J. R. Martin and Geis Botsford and others are interested in the project.

KEOSAUQUA, IA.—J. A. Johnson is reported to have been granted a franchise to install and operate an electric light plant in Keosauqua, Ia.

MANILLA, IA.—It is reported that the proposition to grant a franchise for the installation of an electric light plant in Manilla will be submitted to a vote of the people.

MOUNT PLEASANT, IA.—It is reported that plans are being prepared by the Iowa Power Company for the construction of a hydroelectric power plant on Skunk River, bids for which will be called for about May 1. The cost of the work is estimated at about $350,000. The W. H. Rosecrans Engineering Company, Stock Exchange Building Chicago, Ill., has charge of the engineering work.

MOUNT VERNON, IA.—The Iowa City Light & Power Company is reported to have purchased the plant and holdings of the Mount Vernon Electric Light Company. It is expected a day service will be established and it is probable that the company will ultimately supply electricity to operate an interurban electric railway extending from Mount Vernon to Cedar Rapids.

OSCEOLA, IA.—The Osceola & Southwestern Railway Company, recently incorporated, is reported to be contemplating the construction of an electric railway to Lacelle and Hopeville.

SPIRIT LAKE, IA.—The installation of an ornamental street lighting system in the business district of Spirit Lake is reported to be under consideration.

GREENSBURG, KAN.—It is reported that bonds to the amount of $15,000 have been voted, the proceeds to be used for the construction of a municipal electric light plant.

HORTON, KAN.—At an election held April 4 the proposition to issue $25,000 in bonds, the proceeds to be used to establish a municipal electric light plant and water works system in Horton, was carried. B. B. Morris is city clerk.

KANSAS CITY, KAN.—Preparations are being made to begin work on the construction of the proposed municipal electric light plant in Kansas City, Kan., for which bonds to the amount of $350,000 have been voted.

JEFFERSONTOWN, KY.—Announcement has been made by W. J. Semonin, president of the Commercial Club, of Jeffersontown, that plans have practically been completed by Louisville capitalists for the installation of an electric light and power plant in Jeffersontown. The plant is to be exempt from taxation for ten years.

LOUISVILLE, KY.—Plans are being made for the construction of the new Henry Watterson Hotel in Louisville to cost about $650,000. The plans include electric light, power and refrigerating plants.

LOUISVILLE, KY.—It is reported that plans are being drawn by Fred Erhart, of Louisville, Ky., for an addition to the Capitol Hotel, Louisville, to cost about $20,000. The improvements will include electric light and ice plants.

LOUISVILLE, KY.—A permit has been granted for the construction of the new power house to be erected by the Kentucky Electric Company on Water Street, between Second and Nelson Streets. The building will be 134 ft. x 110 ft., and will cost about $100,000.

LOUISVILLE, KY.—It is reported that plans have been prepared by the Schoppenhorst Dry Cleaning & Dyeing Company, Tenth and Grayson Streets, Louisville, Ky., for installation of an electric power plant to cost about $10,000. Individual motors were recently installed by the company to operate its machines.

NORTONVILLE, KY.—The Norton Traction Company, recently incorporated, is planning to build an electric railway in Nortonville. The company is capitalized at $100,000. Frank E. Hoge, of Nortonville, Ky.; Frank E. Mohr, of Columbus, Ohio, and T. F. Callard, of Hopkinsville, Pa., are interested in the company.

VASSALBORO, MAINE.—The capital stock of the Vassalboro, China, & Windsor Light & Power Company has been increased from $10,000 to $150,000.

BALTIMORE, MD.—The Maryland Public Service Commission has authorized the Baltimore County Water & Electric Company, of Baltimore, Md., to issue $111,000 in bonds, the proceeds to be used to pay for extensions and improvements to its system. Of this amount $100,000 are to be sold at once and the remaining $11,000 to be held as a sinking fund.

AMHERST, MASS.—Announcement has been made by the Amherst Gas Company of a reduction in the price of electricity for lamps to private consumers from 16 cents to 15 cents per kw-hour and also for street lighting. The rate for incandescent lamps has been reduced from $16 per lamp per year to $15 and for arc lamps from $70 to $66 each per annum.

BEVERLY, MASS.—Contracts have been awarded by the Beverly Gas & Electric Company, of Beverly, for building additions to its plant on River Street, Beverly, to Mack Brothers, of Salem, Mass. The cost of the proposed improvements is estimated at about $200,000.

FALL RIVER, MASS.—Plans are being considered by the Pilgrim Mills, of Fall River, Mass., for the erection of a large spinning mill and weave shop, consisting of 50,000 spindles and 1200 looms. The plant will be equipped for electric motor drive. It is understood that electricity for operating the plant will be secured from the Fall River Electric Light Company.

HUBBARDSTOWN, MASS.—W. A. Belcher, of the Gardner Electric Light Company, of Gardner, Mass., has submitted a proposition to the Selectmen of Hubbardstown, Mass., offering to supply fifty 60-cp incandescent lamps for street lighting at the rate of $20 each per year with midnight service for a period of five years. The town has appropriated $1,000 for street lighting and $100 additional for Williamsville.

MILTON, MASS.—The Selectmen have signed a new contract with the Edison Electric Illuminating Company, of Boston, for a term of ten years beginning with May 1, 1911. The company agrees to supply incandescent lamps at $21.20 each per year with all-night service. Under the new rate the town will save about $900 per year.

NORTH ADAMS, MASS.—The decision handed down by the Board of Gas and Electric Light Commissioners recommends a further reduction in the price of gas and electricity as follows: Beginning with May 1 the net price for electricity furnished by the North Adams Gas Light Company shall not exceed 12½ cents per kw-hour and the minimum charge shall be abolished for both electric and gas service. The price of gas is to be reduced to $1 per 1000 cu. ft. beginning with May 1.

WEBSTER, MASS.—The question of establishing a municipal electric light plant in Webster is under consideration.

WORCESTER, MASS.—The Connecticut River Transmission Company has entered into a contract with the Worcester Pressed Steel Company to supply electrical energy to the amount of 600 hp to operate its plant near Barbers Crossing. The Morgan Spring Company has also placed a contract with the Connecticut company for power to operate its works.

HASTINGS, MICH.—At an election held recently the citizens voted to issue $120,000 in bonds, the proceeds to be used for the construction of a hydroelectric power plant. J. M. Patten is city clerk.

HILLSDALE, MICH.—At an election held recently the citizens voted to appropriate $10,000 for improvements to the municipal electric light plant.

JACKSON, MICH.—The Michigan United Railways Company is reported to be considering the erection of a power plant and substation in Jackson. The power plant, it is said, will have an output of about 6000 kw. M. S. Ralls, of Jackson, is chief engineer.

LUVERNE, MINN.—It is reported that the question of reconstructing the present municipal electric plant or the erection of a new plant is under consideration.

SOUTH HAVEN, MINN.—The South Haven Telephone Company, recently incorporated with a capital stock of $8,000, is preparing to erect about forty-five miles of telephone lines as soon as the weather will permit.

WAYZATA, MINN.—The Village Council has granted the Electric Short Line Railroad Company a franchise to construct and operate its proposed railway through the main streets of the village. Announcement has been made by the company that it proposes to extend the railway to Clara City next year, 120 miles from Minneapolis, Minn. A steam plant to cost $100,000 and shops will be erected by the company in Wayzata. The power plant will supply electricity to operate cars over the thirty miles of tracks, which are to be equipped for electrical operation. The company has applied to the Council for a franchise to supply electricity for lamps and motors and also steam for heating purposes in Wayzata.

CARROLLTON, MO.—The capital stock of the Carrollton Telephone Exchange Company has been increased from $5,000 to $25,000.

MONTGOMERY, MO.—At an election held recently the proposition to grant a twenty-five-year franchise to the Stover Electric Light Company was carried. The company has agreed to improve its service and establish a day service.

MUSSELSHELL, MONT.—Fairbanks, Morse & Company are reported to have been awarded the contract for the installation of an electric light plant in Musselshell.

FULLERTON, NEB.—It is reported that the Fullerton Electric Company is planning to erect a new power house, 32 ft. x 70 ft. New equipment, including two large gas engines and switchboard manufactured by the Western Electric Company, will be installed. The company has also awarded a contract for a 10,000-gal. oil storage tank.

WYMORE, NEB.—The City Council is reported to have adopted plans submitted by C. H. Meeker for an electric power house and city hall combined, bids for construction of which are now being advertised.

MANCHESTER, N. H.—The State Legislature has passed the bill authorizing the city of Manchester to establish and maintain a light and power plant.

NASHUA, N. H.—Announcement has been made by the Nashua Light, Heat & Power Company of a reduction in the price of electricity for lamps from 14 cents to 12 cents per kw-hour and for gas from $1.30 to $1.20 per 1000 cu. ft. The new rate is to take effect from April 1. A reduction is also made in the price of Mazda lamps supplied by the company.

ALBANY, N. Y.—Plans and specifications are being prepared for a standpipe and a complete system of fire protection and rewiring of the entire Capitol Building, involving an expenditure of from $75,000 to $80,000. It is understood that proposals will be called for same. A temporary wiring system is being installed at a cost of about $5,000.

NEW YORK, N. Y.—Bids will be received by the Department of Public Charities, foot of East Twenty-sixth Street, New York, N. Y., until April 24 for the installation of electric wiring and appurtenances for lamps and motors for the Metropolitan Hospital and surrounding buildings, Blackwell's Island, N. Y., plans for which may be seen at the office of Frank Sutton, consulting engineer, 80 Broadway, New York, N. Y. Michael J. Drummond is Commissioner of Charities.

RIVERHEAD, N. Y.—The Riverhead Electric Light Company has awarded a contract to Overton & Tuthill, of Riverhead, N. Y., to install a new street lighting system in the city. Tungsten lamps will be erected throughout the entire village.

SAVANNAH, N. Y.—The citizens have voted to appropriate $6,300 for the installation of an electric-light plant in Savannah.

WEST POINT, N. Y.—Sealed proposals will be received at the office of the Quartermaster, West Point, N. Y., until May 15 for supplying the United States Military Academy, West Point, with electrical goods, gas and steam fittings and other miscellaneous goods specified in schedules, copies of which can be secured on application to this office, for the fiscal year ending June 30.

DURHAM, N. C.—Plans are being made by the Durham Hosiery Mill No. 1 to erect a building, 115 ft. x 126 ft., to be used for finishing machinery and offices. The mill is operated by electricity.

THOMASVILLE, N. C.—The plant and holdings of the Thomasville Light & Power Company are reported to have been purchased by the Southern Power Company. The Thomasville company supplied electricity for lighting the city and to operate the local street car system. Z. V. Taylor has been elected president of the reorganized company.

DICKINSON, N. D.—Messers. Hughes and Deiters, owners of the local electric light plant, are reported to be contemplating extensive improvements to the electric light system in Dickinson.

FARGO, N. D.—It is reported that the City Council will receive bids for the construction of an electric light plant in connection with the proposed filtration plant.

HANKINSON, N. D.—The Hankinson-Carleton Electric Company, recently incorporated with a capital stock of $25,000, proposes to supply electricity in Hankinson. M. E. Phillips, E. L. Carleton and George F. Phillips, all of Jamestown, are interested in the company.

AKRON, OHIO.—Plans are being considered by the Biggs Boiler Works Company, of Akron, Ohio, to enlarge its plant. The new building is to be 120 ft. x 225 ft. and will be used as a machine shop, an erecting shop and flanging shop and will be equipped for electric motor drive. A power plant will be installed.

AVONDALE, OHIO.—Proposals will be received until May 6 for furnishing material and construction of an electric power plant and lighting fixtures for the Muskingum County Children's Home at Avondale, the equipment to include a motor-generator set and switchboard, including voltage regulator, storage battery and lighting fixtures, erected complete. Plans and specifications may be seen at the office of H. A. Buerhaus, auditor of Muskingum County.

CANTON, OHIO.—The City Council is reported to have authorized an expenditure of $17,000 for electrical equipment for the new auxiliary pumping station in Canton.

CANTON, OHIO.—The American Mine Door Company, of Canton, Ohio, is reported to have decided to enlarge its plant and install a new power plant. N. K. Bowman is general manager.

CINCINNATI, OHIO.—The Union Gas & Electric Company has been awarded the contract to supply electricity for lighting the streets of the city as follows: For arc lamps supplied by overhead circuits at $50 each per year and $55 each per year in the underground district; under the present contract the city pays $60 and $72 each, respectively. The company agrees to install and maintain a boulevard system in the district served by underground wires, bounded by Fourth, Eighth, Central and Main Streets and such other districts as the City Council may designate from time to time at $56 per lamp standard per year. For 80-watt tungsten, mazda or other incandescent lamps in the overhead district, $13 per lamp per year. It is stated that it is proposed to change the gas lamps now in use for electric lamps.

COLUMBUS, OHIO.—The City Council has passed an ordinance authorizing a bond issue of $15,000 to provide funds to extend the municipal electric light system to the annexed territory and for additional lamps in the old sections of the city. Preliminary plans have been completed and work will begin as soon as the bonds are sold.

EAST LIVERPOOL, OHIO.—The Tri-State Railway & Electric Company, recently incorporated, has assumed control, through lease, of all electric railway and light franchises in the East Liverpool district, including the East Liverpool Traction & Light Company, which operates between the Ohio-Pennsylvania State line and the Columbus-Jefferson County line; the Steubenville & East Liverpool Railway & Light Company; the Ohio River Passenger Railway Company, which operates between Pittsburgh, Pa., and Chester, W. Va.; East Liverpool & Chester Bridge Company; electric light franchises and system in East Liverpool and Wellsville, Ohio, together with the power plant and holdings of the Island Coal Company, the mines of which are located over the Pennsylvania State line, and the Ohio River Railroad Company, which operates between Smith's Ferry, Pa., and Beaver, Pa. The company also proposes to take over the Steubenville & Wellsburg Traction Company, of Wellsburg, W. Va., and the Steubenville, Wellsburg & Wierton Railway Company. The properties taken over by the company are valued at more than $3,000,000 and have a bonded debt amounting to $3,000,000, secured by a mortgage.

MIDDLETOWN, OHIO.—The Middletown Gas & Electric Company, controlled by the Sorg estate, has purchased the plant and holdings of the Middletown Electric Lighting Company in this city, and will take possession May 1. It is understood that the consideration was $150,000.

XENIA, OHIO.—Arrangements have been made by the Springfield & Xenia Telephone Company to take over the plant of the Springfield & New Carlisle Telephone Company in case the Legislature enacts a law, under which consolidations can be made. The plan proposed is for the local companies to handle the local business, while the Bell companies, which control the New Carlisle Company, will take over the long-distance business.

HELENA, OKLA.—At an election held recently the citizens are reported to have voted in favor of the proposition to issue bonds to the amount of $10,000, the proceeds to be used for the installation of an electric light plant in Helena, Okla.

KINGFISHER, OKLA.—Bonds to the amount of $28,000 have been voted, the proceeds to be used for extensions to the water-works system and enlarging the electric light plant. The system will be changed from single-phase to three-phase. V. H. Francis is superintendent of water and light plant.

OKEMAH, OKLA.—W. H. Dill is reported to be contemplating the construction of a hollow concrete dam, to cost from $40,000 to $50,000. The proposed dam will be located about 7 miles from Okemah; the power will be utilized to generate electricity for transmission.

BROWNSVILLE, ORE.—Negotiations have been closed whereby the Oregon Power Company has secured the property of the Brownsville Electric Light Company. Electricity for operating the local system will be supplied from the plant at Springfield and later from the large hydroelectric plant on the McKenzie River, now under construction. The high-tension transmission line will be extended from Halsey to Brownsville. It is proposed to rebuild the local system and establish a day service for both lamps and motors. The system was taken over by the new owner April 1.

PORTLAND, ORE.—The Mount Hood Railway & Light Company has purchased the power plant of the Monarch Lumber Company. The Monarch plant will be used in connection with the new power plant of the Mount Hood company, now under construction on the peninsula to supply electricity for lamps and motors in Portland and vicinity until the large hydroelectric plant at the junction of the Bull Run and Sandy Rivers is completed.

CHESTER, PA.—The Beacon Light Company is reported to be preparing plans for extensive improvements to its system. The installation of a large coal-conveying plant, it is understood, is among the improvements contemplated.

ERIE, PA.—The Erie & Suburban Railway Company has applied for a charter to build an electric railway between Millcreek and Harborcreek. The incorporators are: J. M. Sherwin, W. F. Burgess, Dorman Weaver, H. Schuwerk and Frank Brown.

ERIE, PA.—The Erie Light Company has applied for a charter for the purpose of supplying electricity for lamps and motors in Erie. The new company, it is said, will secure electricity from the transmission line of the Niagara Falls Power Company, which has been extended as far as Westfield, N. Y.

HARRISBURG, PA.—The Central Pennsylvania Traction Company is contemplating the purchase of new engines and generators with a rating of from 1000 kw to 1500 kw for its power plant in Harrisburg during the next six weeks. Frank B. Musser, of Harrisburg, is president and general manager.

HUMBERT, PA.—The United Railways Company, recently granted a charter, is planning to build an electric railway to connect Humbert and Barronsvale, 7 miles long. The company is capitalized at $70,000. The incorporators are: I. W. Seamans, of Uniontown, Pa., president; T. B. Palmer, B. A. Smith, L. W. Fogg, J. H. Palmer, D. D. Johnson and Harold W. Seaman, of Uniontown.

WOONSOCKET, R. I.—Plans are being prepared by the Stone & Webster Engineering Corporation, of Boston, Mass., for the construction of a concrete dam in Woonsocket to replace a wooden dam.

ORANGEBURG, S. C.—Plans are being considered to enlarge the municipal electric-light plant in order to meet the increased demands made upon it. New equipment, including engines and generators, will be installed.

WAGNER, S. D.—The Interstate Power Company, of Oshkosh, Wis., is reported to have purchased the plants and property owned by the Dakota Gas, Electric Light & Power Company at Platte, Geddes, Lake Andes, Wagner, Armour and Scotland. It is said that the consideration for the Charles Mix County plants, not including the systems at Armour and Scotland, was $145,672.

GALLATIN, TENN.—Sealed bids will be received by the city of Gallatin until May 5 for furnishing one Corliss engine, two 100-kw, alternating-current, three-phase engine-type generators, two marble switchboards and two electrically operated pumps, either plunger or multistage centrifugal type, having a capacity of 500 gal. per minute. Plans and specifications are on file at the office of the clerk of the Water and Light Commission. E. L. Anderson is chairman of the Water and Light Commission.

KINGSLAND, TEX.—Arrangements are being made by C. H. Alexander, of Dallas, Tex., who is at the head of the Colorado River Power Company, which is constructing a large hydroelectric plant at Marble Falls, Tex., for the construction of a large dam and hydroelectric plant near Kingsland. The proposed plant will develop about 10,000 hp and will be operated in connection with the Marble Falls plant. The two plants will supply electricity to towns and cities within a radius of 150 miles.

LLANO, TEX.—Plans are being considered for extensions and improvements to the municipal electric light plant in Llano.

MARSHALL, TEX.—The Marshall Traction Company is contemplating building an extension to its street railway system, one and one-half miles in length, and other improvements.

SAN ANGELO, TEX.—J. D. Sugg, of San Angelo, who recently purchased the local electric street railway system, is planning to make extensive improvements to the property, including the construction of new lines.

TULIA, TEX.—It is reported that bonds to the amount of $25,000 have been voted, the proceeds to be used for the construction of an electric light plant and water-works system in Tulia.

KAMAS, UTAH.—Plans are being made by the Kamas Valley Development Company to begin work on development of its water rights, for which surveys have been completed. R. W. Barnes is interested in the company.

FAIR HAVEN, VT.—Arrangements have been made by the Rutland Railway, Light & Power Company to equip the slate mill of Durick & Keenan, of Fairhaven, for electrical operation. The Rutland company has secured a contract to supply electricity to the Bomoseen Slate Company for its quarry at Cedar Mountain. Preparations are being made to erect a transmission line to the quarry, to be completed in about thirty days.

CLARENDON, VA.—The Clarendon Electric Company, recently incorporated with a capital stock of $200,000, it is reported, is planning to erect transmission lines and substations for the distribution of electricity for lamps, heat and motors in Alexandria and Fairfax Counties, Virginia. It is understood that the company proposes to purchase electrical energy to operate its system. M. E. Church, of Falls Church, Va., is president; L. L. Northrup, secretary, and E. Wiley Stearns, treasurer, both of Clarendon, Va.

FT. MONROE, VA.—Sealed bids will be received at the office of the post quartermaster, Ft. Monroe, Va., until April 25 for furnishing 134 holophane shades, 61 pendent switches, 22 rosettes, 67 fixture blocks, 158 shade holders, 144 pendent sockets, 2400 ft. rubber-covered wire, 1200 ft. molding, 600 ft. lamp cord, 67 snap switches and 6 fixtures 6 ft. long. Captain R. B. McBridge is post quartermaster.

IVANHOE, VA.—The Carter Iron Company, Park Building, Pittsburgh, Pa., is reported to be making preparations for the construction of a hydroelectric power plant to develop 3300 hp. Electricity generated at the plant will be used to operate iron furnaces, for mining, railway and lighting purposes.

NEWPORT NEWS, VA.—It is understood that the City Council will submit the proposition to issue $150,000 in bonds for the construction of a municipal electric light plant to a vote of the people.

PORTSMOUTH, VA.—The Seaboard Air Line Railway Company has recently placed orders for additional telephone train dispatching equipment covering more than 600 miles, with two complete circuits.

CHEHALIS, WASH.—The new factory now under construction by the Palmer Lumber & Manufacturing Company in Chehalis, it is said, will be equipped for electric motor drive.

OLYMPIA, WASH.—Preparations are being made by the Olympia Light & Water Company for the construction of the Lawrence Lake Reservoir to supply supplementary water to the Deschutes River during the low-water periods for operating its system. Hazard Stevens, of Boston, Mass., is president.

LOGAN, W. VA.—The Aracoma Coal Company, of Logan, W. Va., has awarded a contract to the W. E. Wolfenden Electrical Company, of Roanoke, Va., for the construction of its light and power plant.

OAK HILL, W. VA.—The Beckley & Fayetteville Telephone Company is reported to have increased its capital stock from $5,000 to $25,000.

GRAFTON, WIS.—The Jungers Stove & Range Company, of Grafton, Wis., is reported to be preparing to erect a plant for the manufacture of stoves and ranges. The plant will be equipped for electric motor drive.

MARINETTE, WIS.—The City Councils of Marinette, Wis., and Menominee, Mich., have adopted resolutions providing for the introduction of bills in the Legislatures of Wisconsin and Michigan and Congress to prohibit power generated at the hydroelectic power plant to be erected on the Menominee River to be carried out of the two counties. The proposed plant will have an output of 50,000 hp, a large part of which will be utilized in the cities of Marinette and Menominee.

NEW LISBON, WIS.—The City Council has engaged Langstead & Myers, of Appleton, Wis., engineers, to take charge of the construction of the municipal electric-light plant and water-works system. The cost of the work is estimated at $20,000.

LETHBRIDGE, ALTA, CAN.—Owing to the large profit in the operation of the municipal electric-light plant last year the City Council has reduced the rates for electricity for lamps and motors 25 per cent. During the past year a net profit of $30,000 is shown by the plant.

REVELSTOKE, B. C., CAN.—Plans are being considered for the construction of a power plant on the Columbia River near Revelstoke and also the erection of a paper and pulp mill. F. C. Adams, of Portland, Ore.; C. D. Danahar, of Tacoma, Wash., and Charles A. Barnum are reported to be interested in the project.

VANCOUVER, B. C., CAN.—The British-Canadian Lumber Company is planning to erect a large lumber mill on Lulu Island, near New Westminster, this summer, which will have a cutting capacity of 250,000 ft. per ten hours. The plant will be equipped for electric motor drive.

WINNIPEG, MAN., CAN.—Preparations are being made for large extensions to the Manitoba government telephone system which will involve an expenditure of about $750,000. F. C. Patterson is chairman.

COBALT, ONT., CAN.—Preparations are being made by the Cobalt Power Company to install a water-works system and electric plant to supply electricity for street and commercial lighting in South Porcupine. The plant will be located on Bloor Avenue. The plant will be operated by steam power until the transmission line is extended from Sandy Falls plant, now under construction by the company. It is expected to have the system ready for operation by June 1.

LINDSAY, ONT., CAN.—The Hydroelectic Power Commission is reported to have secured an option on the plant of the Lindsay Light, Heat & Power Company for the town of Lindsay, and in addition has been furnished reports of the company's hydroelectric plant at Fenelon Falls, with an output of 2000 hp, which is transmitted to Lindsay. The ratepayers have authorized the town to open negotiations with the company and it is expected that an offer will be male to the company on the basis of the price named in the option.

LONDON, ONT., CAN.—It is reported that negotiations are under way by a syndicate headed by Murray A. Verner, of Pittsburgh, Pa., for the consolidation of the London Electric Light Company, the London Street Railway Company and the Southwestern Traction Company (now the London & Lake Erie Transportation Company).

PETERBORO, ONT., CAN.—The Hydroelectric Power Commission has secured an option of the Otonabee Power Company's hydroelectric plant and transmission system, now supplying 3000 hp from locks No. 4 and 5 on the Trent Canal. In presenting the option to the citizens' committee at Peterboro, Adam Beck, chairman of the commission, stated that by carrying out the proposition the city would be able to secure a twenty-four-hour service at from $16 to $17 per horsepower per year, and by taking up the option would have an immediate service free of competition.

RIPLEY, ONT., CAN.—Tenders will be received by Angus Martyn, secretary and treasurer, Ripley, Ont., Can., until May 11, for construction of a telephone system in the township of Kinloss, Ont., plans and specifications for which may be seen at the office of Angus Martyn, secretary and treasurer.

SANDWICH, ONT., CAN.—The town of Sandwich has granted Robert Stuart a franchise to erect transmission lines through Sandwich. Mr. Stuart is planning to install a large electric plant in Sandwich on the old Mineral Springs property to supply electricity in the towns of Essex, Leamington and Kingsville, and also proposes to furnish electrical service to farmers along the route of the transmission line.

TORONTO, ONT., CAN.—Sealed bids will be received by G. R. Geary, Mayor, chairman of Board of Control, City Hall, Toronto, Ont., Can., until June 6 for vertical electrically driven pumps, motors and other electrical equipment, screens and cleaning apparatus and venturi meters for the main drainage works. Specifications and form of tender may be obtained at the office of the city engineer, Toronto.

TORONTO, ONT., CAN.—Arrangements have been completed by the Temiskaming & Northern Ontario Railway Commission for the purchase of the Nipissing Central Railway, an electric railway extending from Cobalt to Haileyburg, in the Cobalt region. The purchase includes the control of the water power at High Falls. It is expected that the government will now carry out plans for the ultimate equipment of the entire system of the Temiskaming & Northern Ontario Railway system for electrical operation.

HULL, QUE., CAN.—The Hull Electric Railway Company is reported to be contemplating extending its railway to Chelsea, work on which will begin in the near future.

REGINA, SASK., CAN.—Bids will be received until April 25 by S. S. Porter, Deputy Minister of Railways, Telephones and Telegraphs, for the construction of four long-distance telephone lines for the provincial system. Tenders will soon be called for erection of other lines.

BALSAS, GUERRERO, MEX.—Surveys are being made for the proposed hydroelectric plant to be erected on the Balsas River, near Balsas, by the Balsas Power & Irrigation Company. The proposed plant will develop about 40,000 hp, and will supply electricity for mining districts, towns and industrial plants within a radius of 65 miles. The company will also install a large irrigation system in connection with its power project. The proposed dam will be approximately 165 ft. high and 570 ft. long and will cost about $1,000,000. A B. Adams, inc., of Mexico City, is interested in the enterprise.

MATAMOROS, MEX.—A concession has been granted by the State government of Tamaulpas and the municipal government of Matamoros to A. B. Cole, R. B. Renfro and R. C. Cowen, all of Brownsville, Tex., and Procofio Guerra, of Matamoros, for the construction of an electric railway from the Mexico terminus of the new international bridge across the Rio Grande River to the city of Matamoros, about three miles in length, and over the principal streets in this city. It is reported that the same parties are contemplating the construction of an electric railway system in Brownsville, Tex., and extending the railway across the bridge to connect with the Mexico system.

New Industrial Companies.

THE ACCUMULATOR LIGHTING COMPANY, of Winnipeg, Man. Can., has been incorporated with a capital stock of $50,000 by A. R. Sutherland, agent; T. Froggatt, manager, and J. D. Suffield, all of Winnipeg.

THE ACME ELECTRIC APPLIANCE COMPANY, of Brantford, Ont., Can., has been incorporated with a capital stock of $300,000 by G. Brereton, O. M. Mackie, of Hamilton; A. Sheard, of Brantford, and N. G. Patterson, of Cambridge, Ohio.

THE CONSOLIDATED ELECTRIC SIGN COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $10,000 for the purpose of manufacturing and dealing in electric signs and equipment therefor. The incorporators are: P. L. Becker, F. E. Parks and William E. Mooney.

THE EDWARD SPRANGLEY ELECTRIC COMPANY, of New Orleans, La., has been incorporated with a capital stock of $25,000 to manufacture electrical appliances. Edward Sprangley is president of the company; S. B. Swift, secretary and manager, and A. W. Lewin, treasurer.

THE GRISSINGER TELEPHONE REPEATER COMPANY, of Buffalo, N. Y., has filed articles of incorporation with a capital stock of $100,000 for the purpose of manufacturing and dealing in telephone apparatus. The incorporators are: E. Grissinger, L. A. Grissinger and C. F. Wheeler, of Buffalo, N. Y.

THE HARBROOK ELECTRIC & MANUFACTURING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 by A. T. Holbrook, of Summit, N. J. I. Josephson and J. T. Sullivan, of New York, N. Y. The company proposes to manufacture electrical and mechanical appliances.

THE JEFFRIES ELECTRIC & MANUFACTURING COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $10,000 by S. S. Jeffries, O. L. Jeffries, H. H. Culbertson and others.

THE NATIONAL ELECTRIC COMPANY, of Boston, Mass., has been incorporated with a capital stock of $50,000, to manufacture electrical supplies. C. H. Sprague, of Newton, Mass., is president and treasurer.

THE SUPERIOR FIXTURE COMPANY, of Des Moines, Ia., has been organized to manufacture gas and electric lighting fixtures. John C. Hansen and F. M. Deemer are interested in the company.

New Incorporations.

OAKLAND, CAL.—The American Heat & Power Company has been chartered with a capital stock of $100,000 by J. H. King, A. Craig, of Oakland, Cal., and J. H. Becker, of San Francisco, Cal.

OKLAHOMA CITY, OKLA.—The Monticello Company has been incorporated by Thomas P. Smith, L. E. Haskell and Thomas P. Smith, all of Muskogee. The company is capitalized at $100,000 and proposes to supply electricity for lamps and motors and water power.

JOHNSTOWN, PA.—The Bens Creek Light, Heat & Power Company has filed articles of incorporation with a capital stock of $5,000. The directors are: C. G. Campbell, 445 Somerset Street, Johnstown, Pa., treasurer; John H. Waters, of Johnstown, Pa., and H. H. Weaver, of Westmount, Pa.

JOHNSTOWN, PA.—Articles of incorporation have been filed with the Secretary of State for the Cambria Light, Heat & Power Company, the Stonycreek Light, Heat & Power Company and the Upper Yoder Light, Heat & Power Company. Each company is capitalized at $5,000 and the directors are: C. G. Campbell, 445 Somerset Street, Johnstown, Pa., treasurer; H. H. Weaver, of Westmount, Pa., and John H. Waters, of Johnstown, Pa.

ALBERNI, B. C., CAN.—Articles of incorporation have been filed for the Alberni District Electric Light & Power Company for the purpose of supplying electricity in Alberni. Dr. A. D. Morgan is president and W. W. G. McAllister is secretary and treasurer.

COBALT, ONT., CAN.—The Northern Ontario Light & Power Company has been incorporated with a capital stock of $7,500,000. It is understood that the company proposes to take over the light and power systems in Cobalt and Haileybury and the hydraulic system which supplies power to the mines in this district. David Fasken is reported to be interested in the company.

OTTAWA, ONT., CAN.—The Development Company of Canada has been incorporated with a capital stock of $1,000,000 for the purpose of developing a large power project on Rapids du Quinze. It is estimated that 150,000 hp can be developed, which will be distributed in the Cobalt region. For further information address M. J. O'Brien, of Renfrew, Ont., Can.

Personal.

MR. ARTHUR S. PARTRIDGE, a well-known electrical man of St. Louis, Mo., has been appointed a member of the board of education of that city.

MR. SAMUEL G. McMEEN, who has spent the last four years in San Francisco designing, constructing and developing a number of telephone properties, will return to his home in Chicago about May 1.

MR. HORACE G. BURT, formerly president of the Union Pacific Railroad, has been chosen chief engineer by the commission appointed to investigate the problems involved in the Chicago terminal electrification.

PROF. ARTHUR F. NESBIT, of the Department of Physics of the New Hampshire State College, addressed the Worcester Polytechnic Institute Branch of the A. I. E. E., on the subject of the induction motor on April 14.

MR. LEONARD KEBLER, president of the Ward Leonard Electric Company, delivered an illustrated address entitled "Electric Devices on Gasoline-Driven Vehicles" before the Brooklyn Institute of Arts and Sciences on March 14.

MR. RODMAN GILDER has resigned as secretary of the Crocker-Wheeler Company to become associated with the brokerage house of Dick Brothers & Company, New York, which handles bonds of many industrial and similar corporations.

DR. A. E. KENNELLY has accepted an invitation from the University of London to deliver a short series of lectures in London, at the end of May next, on "The Application of Hyperbolic Functions to Electrical Engineering Problems."

DR. C. P. STEINMETZ addressed the members of the Baltimore Section of the American Institute of Electrical Engineers in the physical laboratory of Johns Hopkins University last week on "New Developments in Electrical Engineering Theory."

DR. JOSEPH W. RICHARDS, professor on metallurgy at Lehigh University, addressed the Engineers' Society of Western Pennsylvania, in Pittsburgh, on April 18, his subject being "The Electrometallurgical Revolution in the Iron and Steel Industry of Norway and Sweden."

MR. J. H. PALLISTER, chief engineer of the power station of the Lincoln (Neb.) Traction Company, has been promoted to the position of electrical engineer of the company, filling the post relinquished by Mr. N. A. Kemmish, who resigned to become general manager of the municipal electric lighting and pumping station at Alliance, Neb., as noted in these columns April 6.

MR. CONVERSE D. MARSH, president of the Bates Advertising Company, well known among electrical engineers for the active part taken by him in the development of the high-efficiency carbon lamp during his identification with the Bryan-Marsh Company, received a fracture of the right leg on April 16 as a result of being knocked down by an automobile in Fifth Avenue, New York.

MR. W. H. OLIN, industrial commissioner of the Denver, Laramie & Northwestern Railway, was the speaker at the mid-week lunch of the Colorado Electric Club in Denver, on April 13, the subject being "Our Bill-of-Fare." He emphasized the necessity for better farming methods and for better transportation facilities in order to minimize the cost of food supply and he spoke of the economic values of electric applications on farms.

MR. MORRISON R. LASH has been appointed electrical engineer of the Union Electric Company, Dubuque, Ia., succeeding Mr. W. N. Keiser, who has resigned to join the staff of the G. M. Parsons Company, Newton, Ia. Mr. Lash is a graduate of the Rose Polytechnic Institute, and was engaged for several years in the electrical contracting business in Indianapolis, Ind. For the past ten years he was in the employ of the Western Electric Company.

MR. WILLIAM S. KENYON, who, as assistant to the Attorney General of the United States, was largely instrumental in preparing the government case against the incandescent-lamp manufacturers, was elected United States Senator from Iowa on April 12. Mr. Kenyon's home is in Ft. Dodge, Ia., and he has been assistant to the Attorney General for about a year. In that capacity he has been particularly active in preparing for the government suits brought under the Sherman anti-trust law.

DR. SVANTE ARRHENIUS, president of the Nobel Physical Institute in Stockholm, Sweden, is at present on a lecturing tour in this country under the auspices of the Lowell Institution in Boston. During the past week Dr. Arrhenius has been in New York as the guest of Dr. Jaques Loeb of the Rockefeller Institute. On Wednesday, the 12th instant, Dr. Arrhenius was the guest of honor at a dinner given by the Captain John Ericsson Memorial Society of Swedish Engineers at the Engineers' Club. Before returning to Sweden Dr. Arrhenius will deliver some public lectures at Columbia University and possibly one before an engineering society. In 1884 Dr. Arrhenius attained the degree of doctor of physics and has since been among the foremost of scientists. In 1887 he published his theory of electrolytic dissociation, which probably is the most important of his many achievements, and during the following ten years he wrote a great many papers on this subject. In connection with his early studies of the conductivity of solutions he had investigated electric conduction in silver chloride in light and darkness, in phosphorescent and illuminated air, and in Bunsen flames in which various salts were vaporized. In 1888 he studied the influence of the sun's rays on the electrical state of the atmosphere. From 1895 to 1898 he published researches on the moon's influence on auroras, thunderstorms and terrestrial electricity, the twenty-six-day period of thunderstorms and auroras, and the effect produced on the earth's temperature by the carbon dioxide of the atmosphere. In 1898 he published a paper on the effect of cosmical influences upon physiological conditions. In 1905 he produced a two-volume textbook on cosmical physics, containing many original ideas relating to the origin of the heavenly bodies. Later he published "Worlds in the Making." Recently Dr. Arrhenius has taken up the study of serum-therapy.

Obituary.

MR. ROBERT WEBB MORGAN, president and director of the Ætna Electric Company and of the Anchor Lamp Company, died of pneumonia on April 17 at his home in Bronxville, N. Y.

MR. EUGENE W. SULLIVAN, secretary of the Cosmopolitan Electric Company, of Chicago, and brother of Mr. Roger C. Sullivan, president of the company, died on April 14. Mr. Sullivan did not take an active part in the affairs of the company. He was, however, active in politics, in which his brother is even more conspicuous. He was born in Belvidere, Ill., in 1865, and leaves a wife, but no children.

Trade Publications.

CIRCUIT BREAKERS.—The Cutter Company, Philadelphia, is distributing advertising blotters calling attention to its circuit breakers in a striking manner by the use of brief quotations from well-known sources which are neatly turned to point to the I-T-E breakers.

TACHOMETERS.—Tachometers for testing and recording the revolution and speed of shaftings, machines, engines, etc., are described in Bulletin No. 146 of the Bristol Company, Waterbury, Conn. These tachometers are especially valuable in connection with electric generators, etc.

REFLECTOR SOCKETS.—The Benjamin Electric Manufacturing Company, of Chicago, has issued Bulletin No. 7, in which are listed and described reflector sockets which can be properly adjusted in order to obtain the most satisfactory illumination results from incandescent lamp installations.

SYSTEM OF LIGHTING.—Catalog No. 407, issued by the H. W. Johns-Manville Company, New York, is devoted to its J-M linolite system of lighting. The linolite lamp comprises a tube nearly 1 ft. long, having a uniform diameter of 1 in. In place of the cap or base at one end, it has caps at both ends, and instead of the circuit passing through and out at the same end it is made at one end and passes out through the other. The filament is not looped as in the ordinary incandescent lamp, but stretched the entire length of the tube. The lamp is one of the elements of the system, which in its entirety includes the lamp, sockets, reflectors, conduit and means of support. These are combined according to requirements of the various uses to which the system is adapted. The lamp is made with tungsten or other filaments, and is used for store window lighting, showcase lighting, shelf lighting, picture lighting, etc., and can also be obtained in desk and portable forms.

BUSINESS NOTES.

WILLIAM RYLE & CO., manufacturers of silk for insulating purposes, have moved from 54 Howard Street to 225 Fourth Avenue, New York.

THE VICTOR ELECTRIC COMPANY has moved its main office and factory from 55 Market Street to the corner of Jackson Boulevard and Robey Street, Chicago.

THE ALLIS-CHALMERS COMPANY has moved its Chicago sales offices from the First National Bank Building to the People's Gas Building, Michigan Boulevard and Adams Street.

ADAMS-BAGNALL COMPANY.—Owing to the new system of street nomenclature in Chicago, the Chicago office of the Adams-Bagnall Electric Company, of which J. G. Pomeroy is Western sales manager, is now at 217 South Dearborn Street.

THE CENTRAL STATION DEVELOPMENT COMPANY.—Mr. Leonard J. Bolting has resigned as secretary and general manager of the Central Station Development Company to carry on the work as an individual rather than a company.

FERRIS ELECTRIC COMPANY.—The firm of Ferris & Salisbury having been dissolved, Mr. Charles R. Ferris has formed the C. R. Ferris Electric Company, with headquarters in the Case-Meade Building, Providence, R. I., for conducting the business of electrical contracting, construction and repair work.

AMERICAN CARBON & BATTERY COMPANY.—The American Carbon & Battery Company has removed its executive offices to the La Salle Building, St. Louis, Mo. All correspondence should now be addressed to the company at 509 Olive Street, St. Louis, Mo., rather than to the factory in East St. Louis, Ill.

THE ELECTRIC SERVICE SUPPLIES COMPANY, Philadelphia, has recently adopted the catch phrase "The Complete Arrester," as applying to the Garton-Daniels lightning arrester. The construction of the Garton-Daniels lightning arrester is such that it has the three essential features—a small air gap, low series resistance and a circuit-breaker—in combination in one unit, thereby making it complete in itself.

SPRANLEY ELECTRIC COMPANY.—After having been connected with the New Orleans office of the Sprague Electric Company since its opening about five years ago, Mr. A. W. Lewin has resigned his position as manager to become associated with the Ed. Spranley Electric Company as treasurer and manager of the sales department. This company will conduct a strictly jobbing business in the electrical supply line.

INTERNATIONAL ACHESON GRAPHITE COMPANY.—Through an agreement entered into between the International Acheson Graphite Company and the Acheson Oildag Company, the first-named company on April 1 became general agent in the United States for the sale of the new lubricants, oildag and aquadag, products of the second-named company. All Acheson graphite is made in the electric furnace, while all other graphite is mined from the earth. The production of Acheson graphite last year was over 13,000,000 lb., which is said to be far more than all the graphite mined in the United States during the same period.

THE HOOPER-FALKENAU ENGINEERING COMPANY has recently been formed to take over the business of Mr. George K. Hooper, whose experience covers a period of twenty-five years of work ranging in importance from that of an unskilled laborer to executive and consulting engineer. Mr. Hooper's recent work has included the designing and planning of a wide variety of industrial projects. Mr. Falkenau, in joining forces with Mr. Hooper, withdraws from the Falkenau-Sinclair Machine Company, of Philadelphia, of which he has been president for a number of years. His best known work is in the field of designing and manufacturing special machinery. In the course of thirty years' experience as a consulting engineer and owner of machine works Mr. Falkenau has designed many successful devices, among which probably the best known is the pneumatic system for handling mail. The new firm will carry on the same class of work that each member has done previously.

BROOKFIELD GLASS COMPANY DINNER.—A testimonial dinner was tendered to Mr. B. M. Downs, president of the Electrical Manufacturers' Club, at the Union League Club, New York, Friday evening, April 14, by the Brookfield Glass Company, of which company Mr. Downs is vice-president. The dinner was to celebrate the twenty-fifth anniversary of Mr. Downs' connection with the Brookfield Company, and was attended by about twenty of his business friends in the electrical field, among whom were the following: Messrs. T. M. Debevoise, lawyer; Frank Brookfield, secretary and treasurer Brookfield Glass Company; R. G. Hemingray, president Hemingray Glass Company; R. E. Gallagher, secretary New York Insulated Wire Company; W. L. Fort, Western Electric Company; *Electrical World;* R. B. Corey, president R. B. Corey Company; E. W. Rockefellow, supply sales manager Western Electric Company; J. B. Olson, secretary Habirshaw Wire Company; F. B. Downs, treasurer and manager United States Can Company, Cincinnati; W. Joerger, General Chemical Company; W. S. Benedict, Benedict & Benedict, Brooklyn; Herbert Sinclair, Star Porcelain Company, Trenton; T. L. Cuyler, assistant treasurer Postal Telegraph Cable; Clarence Winter, lawyer; C. C. Hay, Ingersoll-Rand Company; A. H. Pease, president Hart & Hegeman Company; A. T. Clark, secretary American Circular Loom Company; Walter Cary, manager Westinghouse Lamp Company; C. W. Price, *Electrical Review*; P. M. Downs, vice-president Brookfield Glass Company.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 11, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

989,008. CIRCUIT TROUBLE INDICATOR; C. L. Healy, Chatham, N. J. App. filed Oct. 12, 1910. For printing telegraph circuits with two normally balanced co-operating partial circuits, printing instruments having parts in each circuit and an electric indicator coacting with the partial circuits for indicating a lack of balance between them.

989,018. ALTERNATING-CURRENT MAGNET; N. O. Lindstrom, Nutley, N. J. App. filed Oct. 27, 1910. Prevents chattering by so arranging the armature and so laminating the poles that the magnetic field continues by reason of eddy currents while the current fluctuates, thus preventing a dropping away of the armature.

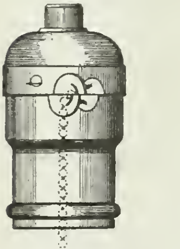
989,030. GOVERNOR FOR GAS ENGINES; P. Okey, Columbus, Ohio. App. filed Feb. 16, 1910. Electromagnetic valve mechanism for controlling the feed of the gas to the generator, one valve controlled by variations in current strength of the dynamo driven by the engine and the other by variations in voltage.

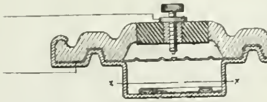
989,063. SYSTEM OF MOTOR CONTROL; G. B. Schley, Milwaukee, Wis App. filed July 3, 1909. For rolling mills and hoisting machinery with separately excited motor, a control for varying the voltage upon the armature, the current in the motor armature actuating means for preventing the controller from raising the armature current above a predetermined value, but allowing the controller to diminish the impressed voltage when such diminution would decrease the current in the motor armature circuit.

989,076. MOUTHPIECE; L. Steinberger, New York, N. Y. App. filed June 13, 1910. The mouthpiece has an annular groove with a plurality of passages extending through the body and cone-shaped, the cones being oppositely arranged, and opening toward the diaphragm.

989,107. FIRE ALARM; J. E. Barrett, Pollock, La. App. filed April 30, 1910. Fire-alarm bell signal with fusible conducting wires between a magnet and the source of electric supply, the magnet holding the bell armature from ringing, but allowing it to be operated by the bell magnet when the wires fuse.

989,127. HOVER FOR POULTRY; G. M. Curtis, Buffalo, N. Y. App. filed Aug. 28, 1908. For growing chicks. A flat resistance coil is suspended horizontally from the top of the hover and carries a thermostat in series with the coil to control the temperature.


989,220.—Chain Guide for Electrical Pull Sockets.


989,347.—Electrical Thermostat.

989,133. SELECTOR MECHANISM; A. F. Dixon, New York, N. Y. App. filed Jan. 20, 1908. For automatic or semi-automatic telephone exchange system for operating the brush carrier, which is moved step by step and returns to initial position by a single movement. The brush, instead of being actuated directly by magnets, is actuated by power from another source, the selecting magnets throwing in stops to limit the movement of the brush.

989,148. CARBON HOLDER FOR ELECTRIC FURNACES; P. L. T. Heroult, La Praz, France. App. filed Sept. 7, 1910. A metal clamp embracing the carbon with means for cooling it and slitted to dissipate the heat.

989,169. ELECTROMETALLURGICAL FURNACE; F. Louvrier, Mexico, Mexico. App. filed Dec. 18, 1909. A furnace divided into reduction and condensing chambers, the volatile member being delivered from the reducing to the condensing chamber, with means for feeding the ore to the reducing chamber for heating the ore to volatilize it and for cooling it, the heating means being electrical.

989,191. MULTIPLE TELEPHONE RECEIVER; W. B. Relth, Chicago, Ill. App. filed Aug. 14, 1905. For connecting in a plurality of telephone receivers to enable a number to hear a conversation. Makes use of spring contacts connected to the receiver wires which can be slipped over the terminals of a receiver.

989,194. SIGNAL SYSTEM FOR RAILWAYS; A. L. Ruthven, Topeka, Kan. App. filed Feb. 20, 1909. Third-rail and locomotive, the latter carrying a partial circuit which is completed thorugh the third-rail to give a signal.

989,205. TELEPHONE SYSTEM; D. L. Temple, Chicago, Ill., and C. L. Goodrum, Atlantic City, N. J. App. filed March 1, 1902. A telephone line with relay for supervising which controls a lamp.

989,212. AERIAL CONDUIT AND CABLE GUARD; E. M. Van Nostran, Wabash, Ind. App. filed Jan. 10, 1910. A messenger wire, an electric cable supported on the wire by hangers and a continuous inclosing tubular guard offsetting from contact with the cable with an air space between.

989,220. CHAIN GUIDE FOR ELECTRICAL PULL SOCKETS; D. P Wolhaupter, Washington, D. C. App. filed Jan. 5, 1911. The guide body opens laterally to admit the laying in and removal of the pull chain, the sections being carried by the separate members of the socket shell.

989,231. INSULATOR SUPPORT; W. L. Chamberlain, East Hartford, Conn. App. filed June 5, 1908. A base for supporting insulators at various angles with rotatable supports for the insulators.

989,259. VAPOR ELECTRIC APPARATUS; P. C. Hewitt, New York, N. Y. App. filed Feb. 20, 1902. An exhausted container containing a plurality of anodes, a vaporizable reconstructing cathode, all supplied by polyphase alternating current with an inductance in the lead from the cathode and starting means for temporarily passing starting current through the inductance and around the rectifier.

989,273. THERMOSTATIC CONTROL FOR ELECTRIC HEATING DEVICES; E. C. McBride, Santa Ana, Cal. App. filed July 26 1909. An electric laundry iron with a cut-out controlled by a thermostat for cutting off the current when the iron becomes unduly heated and for re-establishing the current when at normal temperature.

989,292. ELECTRIC ARC LAMP; W. R. Ridings, Stratford, England. App. filed Dec. 28, 1905. Brings the arcing points of the electrode together for starting the arc, the electrodes being inclined downwardly and toward each other. Provides a horizontal strip of insulation on which the electrodes rest when the lamp is not in operation, a slotted plate through which they project, a movable strip with hole through which an electrode passes and a bell crank lever connected to the clutch and attached to the movable strip.

989,305. ELECTRIC SYSTEM OF DISTRIBUTION; W. H. Sherbondy, Fort Wayne, Ind. App. filed Nov. 3, 1910. For lighting railway cars, using a storage battery, a plurality of work circuits, a voltage regulator, which latter is disconnected when the work circuits are disconnected and thrown in when the work circuits are thrown in.

989,335. SIGNAL FOR FIRE SPRINKLER SYSTEMS AND THE LIKE; L. D. Chandler, North Abington, Mass. App. filed March 4, 1910. A signal is sounded after a given quantity of water has passed through the apparatus, but which is not operated on leakage of water.

989,347. ELECTRIC THERMOSTAT; Albert Goldstein, New York, N. Y. App. filed May 2, 1910. A spiral tube is arranged within the thermostat chamber which retards the escape of air so that a gradual change of temperature will not start the current flowing, but a quick change will do so.

989,362. KNIFE SWITCH; O. H. Hoeft, Brownlee, Neb. App. filed May 24, 1910. Single or double pole switch of the handle and knife type for rounding or testing lines in case of trouble. Details of construction.

989,364. SWITCH; C. Huffman, Versailles, Mo. App. filed July 23, 1910. Knife switch forming a lightning arrester when thrown to inoperative position.

989,401. CONTROLLER FOR ELECTRIC MOTORS; W. A. Paris, Edgewood Park, Pa. App. filed Dec. 28, 1905. Motor for driving pumps, started and stopped in accordance with the predetermined fluid head by means of a reservoir, a motor controller with ratchet wheel, pawls and cam, controlled by the height of fluid in the reservoir.

989,414. ELECTRIC TANK SWITCH; H. A. Prindle, East Orange, N. J. App. filed Oct. 14, 1908. Electric tank switch controlled by the rise and fall of water in tanks which makes and breaks a circuit and starts and stops an electric motor and pump driven thereby. The switch is adjustable for different water levels.

989,420. FIRE ALARM; L. T. Reichel, Wellington, New Zealand. App. filed Dec. 22, 1908. A thermopile with galvometer in circuit, a terminal near the galvometer pointer, a magnet near the terminal acting on the pointer and a bell and battery completing the circuit with the pointer and terminal.

989,458. ELECTRIC CIRCUIT BREAKER; W. Walz, Toronto, Ont., Canada. App. filed March 6, 1909. Avoids fusing of contacts by means of a spring-actuated contact held closed by a spring-held latch which is released when desired.

989,462. REGULATING MECHANISM FOR INCUBATORS; L. L. White, Eugene, Ore. App. filed April 19, 1910. The damper closing the heating chamber is automatically opened and closed by variation of heat through a rotary driving shaft, a pair of alternating operating electric motors and a thermostat.

989,465. AUTOMATIC DISTRIBUTER FOR ELECTRICITY; H. A Wolff, Chaville, France. App. filed Dec. 31, 1910. For operating automatic machines by means of concentric arc-shaped contacts controlled by a radial arm, one of the concentric rings connected with the motor being divided into as many segments as the ring which supplies the working current so that the motor circuit may be automatically and independently modified for each working circuit.

989,487. LIGHTNING ARRESTER; F. E. F. Creighton, Schenectady, N. Y. App. filed Aug. 26, 1909. Electrolytic cells used as lightning arresters, two of their corresponding terminals being electrically connected and the grounding switch mounted to coöperate with the other terminals of the condensers and so ground either one of the other terminals at will.

989,516. FIRE-ALARM TELEGRAPH APPARATUS; N. H. Suren, Needham, Mass. App. filed April 12, 1909. A plurality of mains, controlling main relays, a repeating circuit with switches operated by the main relays, with an actuating mechanism controlled by any one of the main relays and time-controlled so as to hold the switch of the active relay closed and open the remaining switches while the signal is being received by the active relay.

989,518. ARC LAMP; S. P. Wilbur, Wilkinsburg, Pa. App. filed June 2, 1905. Series arc lamp with cut-out after the lamp has burnt out, the movable electrode having a sheath with a projection which operates a portion of the clutch mechanism for cutting out the lamp.

989,529. CONVERSATION METER FOR TELEPHONE SYSTEMS; G. W. Lorimer, Piqua, Ohio. App. filed April 13, 1906. Manual actuating means for the meter, a call sending device, a talking circuit with means for locking the call-sending device and the meter actuator when the talking circuit is in use.

989,549. FILAMENT-MOUNTING MACHINE; W. R. Burrows, Newark, N. J. App. filed Dec. 29, 1906. For securing filaments to leading-in wires, the stems and filaments being on a moving carrier and the paste being applied automatically with means for cutting off the anchor wire and shaping the leading-in wires to the proper width for mounting.

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ELECTRIC ACTIVITY IN THE SOUTH.

The industrial development of the Southern States, which has proceeded with great rapidity in the last decade, is in nowise better exemplified than in the enterprise being shown in the construction of electrical transmission plants, especially for the distribution of energy to textile mills. An excellent example of this, described in the current issue, is the plant at Lloyds Shoals, near Jackson, Ga. This place is within easy reach electrically of a considerable group of enterprising and rapidly growing cities, so that the chance for a market is excellent The plant is a good type of recent construction for the utilization of moderate heads, the fall in this case being 100 ft. The dam is of monolithic concrete about 1000 ft. long, and, owing to favorable topographical conditions, the station is placed at the dam, which forms part of the rear station wall. The river itself is the forebay of the plant, and the hydraulic design is therefore very simple, each wheel unit receiving water through a very short penstock and discharging it directly into the tailrace through short draft tubes. This hydraulic construction is singularly cheap and efficient and extremely favorable to the close regulation which is so important in hydroelectric plants. In this respect the Lloyd Shoals plant is one of the neatest which has yet been constructed.

The plant is not remarkable in rating or voltage, consisting merely of six 3000-kva. three-phase generators of ordinary design and construction. The transmission system is arranged for 66,000 volts, a value which must now be considered sufficiently conservative for long-distance plants. The electrical equipment is absolutely standard in its general character and while thoroughly worked out does not differ in any notable way from the ordinary constructions. It is simply a thoroughly workmanlike plant, containing the customary rather elaborate switching apparatus and safety appliances ordinarily recommended by the manufacturers. The transmission line is of the conventional steel-tower construction with large pin-type insulators. duplicate circuits being provided as usual in plants of this size. In the substations there are some features of interest. The most striking of these is the steel trussed framework provided entirely outside the substation for dead-ending the high-tension lines and supporting them entirely clear of the building and its connections. From this framework the high-tension lines pass to a steel tower on the roof of the station where the lightning arresters are installed, and thence the lines drop straight down through the roof to the high-tension oil switches. Although it looks intricate, this arrangement for supporting the lines on entering the station would appear to be very safe and substantial. The plant as a whole is an excellent example of the businesslike, well-organized transmission station which has done so much toward the improvement of industrial conditions in the South. The hydraulic resources of the Appalachians, however, have as yet been drawn upon only in very moderate measure and much more of the same sort is available for the future.

GOING VALUE IN THE CHICAGO GAS CASE.

Some interesting conclusions in the matter of "going value" of a public utility are reached in a recent report made by Mr. W. J. Hagenah to the Chicago City Council in reference to the rates charged for gas by the company in Chicago. The general methods of analysis employed were similar to those used by the Wisconsin Railroad Commission, of which Mr. Hagenah is chief statistician. These were commented upon in our issue of April 6. The difference between the going value and the tangible physical-property value of a public-utility company is made up of the necessary expenses of getting the business started and the losses necessarily and justly incurred in putting the business on a successful and profitable basis. In going over the accounts of the gas company in Chicago, Mr. Hagenah makes a substantial addition to the physical value of the property in making up this total going value. However, he deducts from the going value the returns which have been made to the investors in the shape of profits, which are considered greater than those which may be assumed as fair. This is also in line with the decisions of the Wisconsin Railroad Commission. However, one of the most interesting points in the Chicago gas case is that Mr. Hagenah put in as going value money spent by the gas company in buying up competing companies and the losses connected with such competition. In his analysis he consistently follows out the theory that the granting of competing franchises of this kind is an economic mistake and that the public, through its officers, having granted such franchises, must allow the gas company to be reimbursed for the losses which the granting of such franchises has brought about. This is simply carrying to its logical conclusion the economic principle that competition in public utilities must necessarily in the end mean more expense to the user than regulated monopoly.

DETERMINING THE LOSSES IN ROTOR SECONDARY CIRCUITS.

An interesting analysis of the losses in the secondary circuits of single-phase induction motors is given in an article by Mr. H. Weichsel, the second and concluding part of which appears in this issue. The author's treatment is characterized by completeness in detail and hence should be of value not only to the designer of electrical machinery but to all those interested in investigating interrelated electromagnetic phenomena. In determining the losses in the secondary circuits of a coil-wound rotor it is desirable to analyze the emfs, mmfs and currents connected with the secondary coils, all of which are affected by the space-phase displacement of the coil sides—that is, by the coil-throw. By reason of the confinement of the secondary currents to definite paths the secondary mmf is not disturbed sinusoidally in space and its combination with the primary mmf produces a resultant mmf that is not sinusoidally disturbed, although it must have a time-phase value and space-phase position such as to produce a sinusoidal counter emf in the primary circuit when the impressed emf has a sine wave of time value.

The conditions are somewhat different in the case of a squirrel-cage rotor in which the secondary currents are relatively unconfined to definite paths, or rather are free to follow many different paths. In this case the combination of the primary and secondary mmfs is such as to produce a resultant flux which is distributed sinusoidally in both time and space. Superposed upon the load component of the secondary current is a current in space-quadrature therewith which serves to wipe out any irregularities in the resultant flux that would be produced by the direct combination of the primary current in its confined paths and the component of the secondary current which is opposed by the load component of the primary current. The space-quadrature secondary current has a value not departing widely from the "reduced" value of the primary exciting current when the secondary is open, and it produces a loss that is independent of the presence of the load component of the secondary current. When the space-quadrature secondary current is neglected it is safe to assume that the load component of the secondary current per rotor slot bears to the load component of the primary current per stator slot the inverse ratio of the slot numbers. When the load component of the primary current is known one can easily determine the load component of the secondary current by means of the slot ratio, and can then calculate the loss in the secondary conductor bars with the maximum of simplicity. To this loss must be added both the loss in the bars due to the space-quadrature secondary current and the loss in the end-rings in order to obtain the total secondary circuit losses. Since the currents over one half pole arc flow in a common direction through the end-rings at the point of maximum current, the determination of the end-ring loss is not difficult. It would seem, therefore, that the problem of calculating the losses in the secondary conductors of a squirrel-cage rotor is even simpler than determining the corresponding losses in a coil-wound rotor.

THE IOWA CONVENTION.

The two-day convention session of the Iowa Electrical Association at Davenport last week had crowded into it more useful information for the small central-station man than one often finds in a two-day state convention program. In fact, the first half-day session was enough to repay the average manager for attending. One of the notable features of this session was the presentation of the "facts and factors" committee report with some fundamental information from thirty-one stations operating in Iowa, ranging in size from those in towns of 700 population to that in the largest city in the State. From the good showing made on some of the items one must conclude either that Iowa central stations are more generally prosperous than some others or that those having the enterprise to report to the committee are naturally of the better managed and more prosperous class; we suspect the latter. One interesting fact noted in the report is an increase in the number of consumers per 100 population, which now averages in the neighborhood of ten. Taking the table as a whole, it indicates steadily bettering conditions in the shape of greater revenues for a given population; a natural result of increasing wealth in a very prosperous state. The increase in station equipment during the past two years has somewhat exceeded the increase in business. This, however, may be due to local conditions in some of the large centers where an increase of equipment has a considerable effect on the results.

The stations in communities of from 3000 to 10,000 population are, on the whole, making the best financial showing with the money invested. It is not safe to generalize from such limited information as this table contains, but the indication stated has been further verified by other observations in the central-station field. Stations operating in towns of from 3000 to 10,000 population frequently avoid some of the heavy investments connected with distributing systems in large cities and do not suffer so much from the extreme smallness of the undertaking as those in towns under 3000 inhabitants. They are so large that they are out of the "one man" class, but nevertheless must operate with very simple plants and organizations. It is in stations of this size that combination with ice manufacturer, water supply and a limited amount of exhaust steam heating is most advantageous, and such combinations frequently are able to obtain a return on the investments which make the returns on some of the larger and supposedly more stable central-station investments look small. However, it is recognized that the smaller the company the greater the profits should be because of the risks in small companies.

The report of the committee which has been carrying on tests for two years on the resistance of different types of ground connections in Iowa soil reaches some very interesting and gratifying conclusions. Its tests showed that the most inexpensive types of connections are the best in the long run. Such luxuries as copper plates buried in coke or charcoal are inferior to plain iron surrounded with earth. This applies to Iowa black soil and moist clay, but might not be true under other conditions. The situation was well summed up by one member of the committee who pointed out that the resistance of a ground connection is dependent more on the conductivity of the moisture surrounding the plate than anything else. Finely divided earth retains more moisture near the ground plate than does coke or charcoal, hence the superiority of the earth.

RECENT PROGRESS IN THE FIXATION OF ATMOSPHERIC NITROGEN.

We live at the bottom of a nitrogen ocean, because the atmosphere consists essentially of nitrogen with adulterations, chief among which is, fortunately, oxygen. On every square meter of the earth's surface there rests a load of 8 tons of nitrogen. Notwithstanding this seeming superabundance of nitrogen there is some danger to the human race of a prospective nitrogen famine. The case somewhat resembles that of castaways on a raft adrift on the great ocean of sea water in danger of dying for lack of water in their tissues. A salient and remarkable property of gaseous nitrogen is its chemical aloofness, or disinclination to unite with other substances. Yet plants need nitrogen for their growth, and nitrogen enters into the composition of all living plants. No nitrogen no plant-growth seems to be an axiom of nature. It also appears that plants, although surrounded by gaseous nitrogen, are unable to help themselves to any nitrogen in this form. They require to take it in from the soil in the so-called *fixed* form—that is, in chemical combinations, principally nitrates. Animals also need nitrogen and fail to get it from the air. They derive all of their food ultimately from plants, and assimilate nitrogenous substances—proteids—which are necessary for the maintenance of animal life. In the processes of life these proteids are decomposed, and some of the decomposition products contain nitrogenous salts. Every crop of food-plants, such as wheat, gathered off the soil carries away a definite amount of nitrogen and impoverishes the soil to this extent. Manure containing animal excreta is capable of replenishing the nitrogen stock of the surface soil for the next crop. Unless, however, nitrogenous manure is fed to the soil it is only a question of time as to the exhaustion of the plant-supporting power of the soil under continual depletion by crops.

In the natural state—and without assistance from animals—there are two, and as yet only two, recognized means of restoring nitrogen to a soil that has given up its nitrogenous stock to marketed crops. One is by means of micro-organisms or microscopic plants in the soil. The other is by electric storms in the atmosphere. The nitrogen producing bacteria, or microscopic plants, appear to have the power, denied to regular-sized plants, of absorbing nitrogen from the air and bringing it into combination with other substances—that is, of fixing nitrogen. These especially useful bacteria are fostered by the roots of certain plants; and the rotation of crops which was to some extent practised in ancient Egypt consists, when properly directed, not merely in giving intervals of rest to the nitrogen robbing of the soil by crops, but also in restoring the lost nitrogen by an intervening crop capable of fostering nitrogenous bacteria on its roots. The second natural restorative source of fixed nitrogen is the lightning flash. At the very high and momentarily applied temperature of the lightning discharge some nitrogen is forced into combination with the oxygen of the air. The amount of oxides of nitrogen formed in this way by a single flash can be only small, but the process is cumulative. The nitrogen fixed in this way sooner or later becomes absorbed by the soil and offered up to plants.

It may well be imagined that the natural rate of feeding nitrogen to the soil is slow, and that in the long run the crop production of the world's wheat tends to be limited by this slow rate of restoration. Artificial restoration by suitable nitrogenous plant food is, on the other hand, immediate; that is, it restores within the incubation period of a single crop. Moreover, 1 ton of a good artificial nitrogenous fertilizer, such as ammonium sulphate, applied to a proper surface area of soil is found to be as effective as 50 tons of farmyard manure. Hence the demand for cheap nitrogenous plant foods. Up to within the last few years the only commercial available sources of nitrogenous fertilizers have been the Chili saltpeter deposits, the island guano deposits, and the by-product of gas works. The first two supplies are necessarily limited in amount and are bound to become exhausted. The present yield of gas-works-fixed nitrogen is quite inadequate for the world's farms. In view of these facts some agricultural chemists have felt compelled to descend to pessimistic predictions of a future perpetual nitrogen famine and shrinkage of crops. But electrical engineering seems destined to dispel these fears for the present

As Mr. John B. C Kershaw describes in his interesting article in this issue, the electrical engineer is commencing to use a perpetual thunderstorm in an oven for the artificial production of fixed nitrogen, the natural rate of thunderstorm production being entirely too small for this purpose even in Colorado, where lightning plays in a clear sky. He shows that several plants are already at work in Norway, Austria and France taking hydroelectric energy in the mountains and producing flame arcs to which air is fed. The azoted air escaping from the flame is quickly chilled to prevent the dissociation of the nitric oxide formed and the nitric oxide is finally allowed to enter into the formation of nitric acid or some other nitrogenous compound. It is often feared that since water powers are in the habit of presenting themselves in out-of-the-way parts of the world, remote from markets for energy, it may never pay to develop hydroelectric energy from the more remote falls. But if these recently introduced nitrogen-fixing factories develop to the point of producing fertilizer on a large scale it may be profitable to develop every large fall for fertilizer because there will always be air in abundance

N. E. L. A. Membership.

On April 18 the total membership in the National Electric Light Association exceeded 7500. In July, 1909, the membership was 3135, and at the annual convention in St. Louis last May it was 5520. The increase thus far during the current association year has therefore been in excess of 2000, and the indications justify the belief that by the time of the annual convention next month even the very large growth of 1910 will have been exceeded and that a total of 8000 members will be reached. The growth is due to a variety of causes, and the new list given in the latest N. E. L. A. Bulletin not only includes several central-station companies but large lists from newer company sections, such as those in New York, Joplin, Mo., and Pittsburgh, Pa. At the present time company sections are being organized at Scranton, Pa., and Birmingham, Ala., and are expected to be in operation before the end of the month. It would appear that the association has now become the largest electrical society in the world. The officers expect confidently that in another year the membership will be at least 10,000.

Annual Report of General Electric Company.

According to the annual report of the General Electric Company the year 1910 was the most prosperous one in its existence, the total orders received aggregating $71,182,391, as against $60,483,659 in 1907, which was heretofore the banner year. The total number of orders and contracts received during the year was 338,272, exceeding all previous records. The sales department is careful to state that the increased business came largely from established customers in small contracts and current orders, rather than from new enterprises requiring large amounts of electrical apparatus. The high-voltage, direct-current railway system for interurban and steam railroad companies is increasing in popularity, much additional equipment having been ordered. Over 85,000 hp of 1200-volt direct-current motor equipments is now in service and on order.

During the past year the company's facilities for manufacturing Curtis steam turbines have been taxed to the maximum, and provision is being made for meeting the increasing demand. Curtis turbines having an aggregate rating in excess of 2,600,000 hp are now installed or on order. Several turbo-generators having a rating of 27,000 hp each are now in process of manufacture for the Commonwealth Edison Company and the New York Edison Company. The company has standardized a complete line of vertical and horizontal-shaft Curtis turbines for operation with high, mixed and low-pressure steam. The business of the foreign department was larger last year than in any previous year.

In his report to the president upon manufacturing and engineering, Mr. E. W. Rice, Jr., says that the expenditures for buildings and extensions and for additional equipment have amounted to $5,846,531.64 during the year, one-third of which has been applied to the enlargement of productive capacity. The total manufacturing area in square feet of floor space in 1910 was 8,530,000, the number of employees 32,000. Extensions were made to the Schenectady, Lynn and Pittsfield shops and to the lamp works at Harrison and Toledo. The total land area at all the works is about 608 acres. The policy of decentralization has been continued with most satisfactory results.

The company's engineers have confined their energies largely to the extension and improvement of existing lines of apparatus and supplies and to the design of special appliances to meet novel conditions. The size of the units employed in the generation and transmission of electricity has continued to increase, the company now manufacturing generators of 20,000-kw rating and transformers of 14,000-kw rating. Much attention has been given to the design of apparatus especially adapted to industrial works, such as paper mills, cement mills, cotton mills, steel mills and publishing houses. Advances have been made in devices for protection against lightning, and improvements have been made in steam turbine generators. Substantial progress is reported in the development and improvement of wiring devices, rheostats, circuit-breakers, switches, instruments, meters and arc lamps. A most noteworthy advance has been made in the metallic-filament incandescent lamp by the use of a new filament of drawn wire, developed by the engineers in the company's research laboratory.

The company expended $564,097.38 during the past year in acquiring sundry patents, for the cost of applications and licenses under patents and in patent litigation and miscellaneous expenses. The book value of the stocks and bonds of affiliated manufacturing and selling companies owned by the General Electric Company is given as $8,225,879.05. In addition, the book value of the stocks of the security-holding companies, consisting of the United Electric Securities Company of Boston, the Electrical Securities Corporation and the Electric Bond & Share Company of New York, is $6,262,397.67. The value of stocks and bonds of local lighting and railway companies in its possession is placed at $8,322,206.01. The book value of the factory plants is given as follows: Schenectady works, $8,567,953; Lynn works, $3,896,858.27; Pittsfield works, $1,898,831.53; lamp works, $1,152,671.67. The company has invested in copper mines $1,129,961.63, represented by capital stock, and $1,675,115.22, represented by advances. This investment includes the Bully Hill Copper Mine, Winthrop, Cal., a railway company and other equipment, and the properties of the Hermosa Copper Company, in Grand County, New Mexico. The total value of the outstanding debenture bonds on Dec. 31, 1910, was $14,962,000. The total capital stock of the company authorized Dec. 31, 1910, was $80,000,000, of which $65,179,600 has been issued, the balance, with the exception of $1,912,066.67, which has not been issued, being reserved against debentures. The profit for the year ended Dec. 31, 1910, was $10,855,692.13, and the surplus carried forward to the next year $23,022,705.82.

Meeting of Philadelphia Electric Company Section of the N. E. L. A.

The regular monthly meeting of the Philadelphia Electric Company Section of the National Electric Light Association was held on April 17. Three papers were presented. The first, by Mr. George F. Peifer, was entitled "A Historical Sketch of the Philadelphia Brush Station," which was the first electric light station operated in Philadelphia and with which Mr. Peifer has been connected as chief engineer for the past thirty years. Much of the apparatus installed thirty years ago was in active use, or capable of being used, until six months ago, when the station was reconstructed and changed to a motor-generator station.

The second paper was on "The Phenomena of Cyclones, Tornadoes, Etc.," by Mr. George S. Bliss, section director of the United States Weather Bureau. The talk was a popular one, and as a section of Philadelphia had been recently visited by a tornado the remarks on this variety of wind disturbance were particularly interesting. Mr. C. J. Russell, of the Philadelphia Electric Company, described the course of the recent tornado in the vicinity of Tacony. All the trees, telegraph and electric light poles and buildings in its path were seriously damaged. The storm destroyed all the electric wires radiating from generating station "J" of the Philadelphia Electric Company, so that the station was completely shut down. A remarkable piece of aerial line construction was accomplished within the next six days, as some seventy 65-ft. poles were erected and 60 miles of wire strung, a large portion of which was No. 0 in size. Service was reintroduced to the principal consumers within twenty-four hours by the installation of about 1 mile of three-conductor cable buried about 15 in. below the surface of the ground. The entire service was restored within five days and within six days the station was operating normally. The work was accomplished under most trying conditions, the weather being particularly cold and high winds prevailing.

The membership committee announced a total membership of 449, and the prize award committee announced the award of a first prize to Mr. J. W. Sylvester, who suggested the placing of ducts in the foundation walls of building operations for underground service instead of waiting for service orders, which usually arrive so late that the duct has to be introduced at considerable damage to the property, and the award of a second prize to Mr. Frank T. Adams, who suggested a change in the numbering of the working order system. There were in attendance 300 members and guests.

Low Gas Rate for Chicago.

A report presented to the City Council of Chicago on April 17 by its committee on gas, oil and electric light contains an exhaustive report on the subject of gas rates from Mr. W. J. Hagenah, the expert retained by the committee. As a result of his investigation Mr. Hagenah asserts that the People's Gas Light & Coke Company could sell its product at 77 cents per 1000 cu. ft. instead of 85 cents, the present price, and still pay 7 per cent interest to its stockholders, with an annual surplus of at least $141,753. The total value of the company's investment is fixed at $61,849,879 in 1910. The value of the physical property is placed at $49,023,947, the office building owned by the company being excluded. There is an elaborate discussion in the report on the subject of intangible values. No value is given to the franchise, but a large allowance is made for "going value," due to the losses which the company has sustained in the development of its business. Much of the difference between value of total investment and of physical property is made up of "going value." No action was taken on the report. It is reported that the officers of the gas company will appeal to the courts to prevent the establishment of a 77-cent rate. On the other hand, there are many who demand that the rate be made as low as 70 cents, the new Mayor, Mr. Harrison, being elected largely on the 70-cent gas issue.

The California-Bound "Electric Special."

A jolly party of ladies and gentlemen, with a sprinkling of youngsters, numbering 159 persons in all, left the Dearborn station in Chicago at 8:20 p. m. on April 18 bound on a leisurely trip to California. The travelers consisted of members of the Electrical Supply Jobbers' Association and their friends and guests, who were for the most part on their way to the convention of the association to be held in Del Monte, Cal., on April 25 to 27. Most of the members of the party are taking advantage of the occasion to enjoy a vacation, and many of them will remain away from their Eastern homes for a month or more.

The train, which left over the Santa Fé Railroad, consisted of twelve cars, including nine Pullman sleepers, two dining cars and one club car. For sight-seeing purposes it was scheduled to stop at Laguna Pueblo, in New Mexico, and the Grand Canyon of the Colorado. At Upland, Cal., automobiles were provided, and the last 40 miles of the journey to Los Angeles was taken by this means through the orange country of southern California. At Los Angeles the party was taken in hand by the Pacific Coast jobbers, although the train was chartered to go through solid to Del Monte, arriving there on the evening of April 24.

The arrangements for the special train were in charge of Mr. F. Overbagh, general secretary of the association, and various forms of amusement were provided to while away the long trip, including various musical and vaudeville "stunts," as well as the publication of a daily paper. A large number of Chicago electrical men assembled at the railroad station to see their friends depart, and when the train pulled out a burst of cheers followed it.

Many well-known electrical men are in the party. A hasty look around on the eve of departure revealed among them the following: Messrs. F. N. Boyer, John F. Gilchrist, T. G. Grier, N. G. Harvey, W. W. Low, W. W. Merrill, F. Overbagh, E. K. Patton, Louis Schwab, T. C. Ringgold, E. O. Sessions, Chicago; H. W. Bliven, B. M. Downs, P. M. Fletcher, C. I. Hills, George L. Patterson, E. W. Rockafellow, New York; J. Robert Crouse, H. H. Cudmore, F. S. Terry, Cleveland; John McNaughton, W. H. Seldon, Jr., Detroit; John W. Brooks, Solvay, N. Y.; Daniel Hemingray, Covington, Ky.; A. P. Munning, Milwaukee.

Relation of Technical Men to City Planning.

Mr. William B. Jackson, consulting engineer, was the principal speaker at the luncheon of the Electric Club of Chicago on April 12. His subject was "The Relation of Technical Men to City Planning." Mr. Jackson referred to the work of the Chicago Plan Commission, indorsed by the Chicago Association of Commerce, and said that technical men should take a broad view of the subject. Methods of transportation, water supply, sewerage, gas supply, electric service and telephone distribution are involved. Then there are the various aspects of sanitation, the provision of playgrounds and the important consideration that the city as a whole should be made attractive or even beautiful for the purpose of making its inhabitants better satisfied with their surroundings.

The great value of suitable workrooms is recognized. Working places should be made attractive as well as provided with utilitarian accessories in doing work. The same is true of electric power houses, for instance, and the returns on the extra investment to secure attractiveness may be considered to be ample in the greater satisfaction and loyalty of employees. As power plants are planned for future extensions, so should cities be built to some rational, comprehensive plan. Plenty of light, power, air and attractiveness should be provided for all the people and the whole city, and not alone in work places and during working periods. The great work is to make more efficient men and women. The speaker concluded by asking for the hearty support of electrical men in furthering the work of the Chicago Plan Commission.

Mr. Albert Scheible spoke of the progress in Europe in city planning. It is unfortunate, he thinks, that the existing Chicago Plan was prepared largely by architects and artists, without the advice of technical men.

Mr. Frederic P. Vose said the problem consisted in reforming the people themselves. Mr. H. E. Niesz spoke of the work of the Board of Health of Chicago in improving the cleanliness and sanitation of school children and their homes in the poorer districts. Mr. Frank L. Perry referred to the "human engineering" of the National Electric Lamp Association as a significant tendency in the right direction. Mr. James H. Delany added a few words, and Mr. George P. Player, of Oklahoma City, also spoke briefly. A vote of thanks was extended to Mr. Jackson.

Important Telephone Unification in Central States.

Arrangements have been perfected by which the management of five large Bell telephone companies in the Central States will be centralized in Chicago. At the annual election of the Central Union Telephone Company, held in Chicago on April 19, these officers were elected: President, Mr. B. E. Sunny; vice-president and treasurer, Mr. Alonzo Burt; vice-president in charge of commercial department, Mr. B. W. Trafford; general manager, Mr. H. F. Hill; secretary Mr. Charles E. Mosley; general counsel, Mr. L. G. Richardson; auditor, Mr. Benjamin S. Garvey; chief engineer, Mr. J. G. Wray. These are substantially the same officers that were elected at the meeting of the directors of the Michigan State Telephone Company in Detroit, on April 11 They will also be elected substantially by the directors of the Wisconsin Telephone Company at Milwaukee, and later by the Cleveland Telephone Company at Cleveland.

The fifth company is the Chicago Telephone Company, and the executive headquarters of the five affiliated companies will be in Chicago. Mr. Sunny, who is president of the Chicago

Telephone Company and a vice-president of the American Telephone & Telegraph Company, will be at the head of the new affiliation. Mr. Mosley is the secretary of the Chicago company, Mr. Garvey is auditor and Mr. Wray is chief engineer.

The five companies in the present unification have been working along smoothly with their diverse organizations, but it has been felt that by making a larger operating unit and by the centralization of management increased efficiency can be secured.

The companies of which Mr. Sunny will be the head will serve a combined territory having an area of 247,450 sq. miles and a population of 18,250,621, or about 20 per cent of the population of the United States. The total number of Bell telephones in use in this area is 1,491,577; the number of employees of the five companies is 23,141, and the value of the plants is $110,000,000.

The Wisconsin Telephone Company has for its territory all of that State. The Chicago Telephone Company covers the northeastern portion of the State of Illinois. The Central Union Telephone Company has the remainder of Illinois, all of Indiana and all of Ohio except Cleveland and Cincinnati. The Michigan State Telephone Company has all of that State, while the Cleveland Telephone Company covers the city of Cleveland, Ohio.

The policy of grouping Bell operating companies into much larger operating units is in execution of a definite plan adopted by the American Telephone & Telegraph Company, which is the parent organization. There are now twenty-six licensee companies in the United States, and it is proposed to combine the operation of these into seven or eight larger groups. This operating system has already been put into effect in New York State and New Jersey, and is now being carried out in the Central West, as indicated above.

Atomic Theory of Electricity.

In former numbers of the *Electrical World* (most recently in the issue of Dec. 1, 1910, page 1276) have appeared several references to the important and interesting work carried on at the Ryerson Physical Laboratory, University of Chicago, by Dr. R. A. Millikan, professor of physics in the university, with the assistance of Mr. Fletcher. These experiments relate to the isolation of atmospheric ions on minute droplets of oil floating in the air. It has been shown that all electrical charges are built up of elementary atoms of electricity, and the value of this ultimate electrical atom has been accurately determined. Readers of this journal will be interested in the following account of the extensions of the investigation now under way as reprinted from *The Daily Maroon* of April 13:

"(1) The act of ionization itself is now being studied, each of the two electrical fragments into which a neutral molecule breaks up being caught upon oil drops at the instant of formation. This study has shown that the act of ionization of a neutral air molecule always consists in the detachment from it of one single elementary charge rather than of two or three such charges. In other words, the phenomenon of valency does not exist in gaseous ionization.

"(2) By suspending these minute oil drops in rarefied gases instead of in air at atmospheric pressure the experimenters have been able to make these oil drops partake of the motions of agitation of the molecules to such an extent that they can be seen by any observer to dance violently under the bombardment which they receive from the flying air molecules. By measuring accurately the amount of the motion of agitation of the oil drops and comparing it with the motions which they assume under the influence of an electrical field because of the charge which they carry, the investigators have been able to make an exact and certain identification, with the aid of computations made by Mr. Fletcher, of the electrical charge carried by an atmospheric ion (and measured in their preceding work) with the electrical charge carried by univalent ions in solution.

"This work not only furnishes complete proof of the correctness of the atomic theory of electricity, but gives a much more satisfactory demonstration than had before been found of the perpetual dance of the molecules of matter."

A number of noted physicists have viewed these interesting experiments. A recent visitor was Professor Pflueger, of the University of Bonn, Germany.

Meeting of New England Section, Electric Vehicle Association.

A New England Section of the Electric Vehicle Association of America was organized at the Edison Building, Boston, at a meeting on April 17. The meeting was called to order by Mr. Day Baker, New England manager of the General Vehicle Company, who stated that the results of the work of the Electric Vehicle and Central Station Association had borne fruit in the organization of the present national association, and that it was desirable to carry forward the New England development in co-operation with the more inclusive body. Mr. E. S. Mansfield, of the Boston Edison company, moved that a New England Section be organized, and upon the unanimously favorable vote resulting, the following officers were elected: President, Mr. E. S. Mansfield, Boston Edison company; treasurer, Mr. John A. White, National Battery Company; secretary, Mr. W. F. Kimball, of Charles H. Tenney & Company; executive committee, Messrs N. T. Wilcox, of Stone & Webster; O. F. Brastow, General Electric Company; H. L. Converse, Studebaker Brothers Company; A. F. Neale, Baker Motor Vehicle Company; E. C. Baugher, Westinghouse Electric & Manufacturing Company; C. A. White, Boston Edison company; Frank J. Stone, Electric Storage Battery Company; Day Baker, General Vehicle Company, and P. E. Whiting, S. R. Bailey & Company.

At the conclusion of the business meeting Prof. Dugald C. Jackson, of the Massachusetts Institute of Technology and president of the American Institute of Electrical Engineers, outlined the plans of the Massachusetts Institute of Technology for electric-vehicle research work at Boston. Professor Jackson said that as a result of an appropriation by the Edison Electric Illuminating Company of Boston through the initiative of President C. L. Edgar a fund is available for a year's research into the higher economics of the electric vehicle. The authorities of the institute and the Edison company as well feel that the assembly of data, the discussion of tests, preparation of cost figures and general conduct of research with full publicity by an absolutely impartial organization will be of immense value in molding public opinion and in disclosing any sources of weakness in design or operation, pointing the way toward improvements in practice and showing in a genuinely scientific manner exactly what can be expected of the electric commercial and pleasure vehicle in service of a specific character.

Among the points which will be investigated are the cost of operation and maintenance under enlightened treatment, reliability of service, comparative cost of horse, gasoline and electric-vehicle operation, merits of tires and roadways, results of the operation of the public garage of the Boston Edison company under the auspices of the Electric Vehicle Association of America; types of daily logs which may be desirable; reports of owners and drivers as to service performance; economics of routes in delivery and other service, and the assembly of information now possessed by different manufacturers into a comprehensive grouping. Professor Jackson said that the institute would probably send a representative to various cities where the electric vehicle has attained a high stage of commercial utilization for the purpose of securing data, with further visits to vehicle factories. It is hoped that many suggestions of general interest to the industry may thus be advanced. Regarding the fear that the interests of different manufacturers might be injured by the pursuance of such an open policy, Professor

Jackson said that in any new and growing industry publicity is a supremely powerful factor for progress, and he emphasized the point that the enormous progress of electricity within the past generation is very largely due to the willingness of workers in every field to share the benefits of their discoveries and experience.

Various representatives of manufacturing houses present indicated their willingness to co-operate in the work. Mr. Day Baker said that desultory research work has already been carried on for some time by some makers of vehicles, and he cited several users of commercial vehicles in New York that have established record systems of high value, notably the Motor Vehicle Delivery Company, which handles the mails north of Forty-second Street. Mr. Frank J. Stone emphasized the fact that the electric vehicle has already attained a very large and successful development. Mr. N. T. Wilcox said that the Lowell Electric Light Corporation has decided to discard all its horse-drawn service and that it has confidence in the business capabilities of the electric vehicle. Two other Stone & Webster companies are likely to follow the example of Lowell in the near future. Mr. Baker said that he is frequently asked to lecture on electric-vehicle development, and he has strongly advised every vehicle manufacturer to have lantern slides made of his most representative equipment, so that the full range of development and the possibilities of the work can more effectively be brought home to the audiences. Special efforts are made to give non-partisan lectures, and the educational work is bound to result in good to all concerned in the progress of electric-vehicle service.

Discussion of the Electric-Vehicle Situation at Boston.

The first of a series of luncheons to be given to facilitate the exploitation of the electric vehicle in New England was given by the Edison Electric Illuminating Company of Boston on April 20. About twenty representatives of electric-vehicle manufacturing companies, members of the Boston Edison staff and guests convened at the office of General Superintendent W. H. Atkins at noon, and after an informal interchange of greetings and experiences were escorted into the company's conference room, where a dainty buffet luncheon of electrically prepared edibles was served. At the conclusion of the luncheon Mr. Atkins called the meeting to order and a committee was appointed later to nominate officers for an organization of electric-vehicle dealers at Boston, the meeting having previously voted to form an association to further the progress of the work.

A letter was then read from the Anderson Electric Carriage Company, offering to sell 100 Detroit electric runabouts to central stations in the New England field at the manufacturing cost, in order to enable the electric companies to encourage the development of this service throughout their territory. The letter pointed out that in the city of Detroit alone the sale of energy for vehicle charging amounts to over $7,500 per month, and 90 per cent of this service comes off the peak. The manufacturers are convinced that there is an equal opportunity for development in New England if the companies will only take the initial steps. A copy of the letter has been sent to every central station in New England.

Mr. Atkins announced that the Boston Edison company is ready to install large and striking electric signs advertising pleasure and commercial electric vehicles at strategic points in the territory, notably near the L Street generating station in South Boston, where the advantages of electric automobiles and trucks will be set forth for the benefit of the great excursion traffic which passes up and down Boston Harbor, and at conspicuous points in Boston proper, the outer Back Bay and Somerville. Five large signs are to be erected at first, and these will be supplied with energy by the company without charge. Mr. Atkins also offered to send out in the name of the Edison company a letter to selected customers calling attention to the advantages of electric vehicles, the mailing list to be prepared in line with suggestions of the representatives of the vehicle dealers having offices in the Boston district. Mr. L. D Gibbs, superintendent of advertising of the Edison company, stated that plans are afoot to assemble the various automobile editors and advertising men connected with the Boston press at a dinner to be given by the company for the purpose of bringing out more clearly the growth and possibilities thus far attained and indicated in the electric-vehicle field. Mr. Day Baker, of the General Vehicle Company, reviewed recent progress in the field, including the following impressive comparison between the efficacies of the commercial gasoline and electric machines. In a large commercial garage containing both gasoline and electric trucks the electric machines are in service 98 per cent of the time during the working hours of the day, compared with a maximum of 79.5 per cent for the gasoline outfits, and this in spite of the fact that the gasoline cars have the advantage of having been more recently purchased by the business house in question.

Iowa Electrical Association Convention.

The Iowa Electrical Association held its eleventh annual convention at the Coliseum, Davenport, Ia., April 19 and 20, 1911. The first session was called to order on Wednesday morning, when President Thomas Crawford, of Clinton, introduced Mayor Alfred Mueller, of Davenport, who welcomed the convention. He complimented the association on its selection of Davenport for its meeting place and on the fine collection of exhibits on display. He said further that the convention city was well chosen because of the cordial relations existing between the public and city officers and the public-service corporation. He complimented the local central-station and railway interests on their service and fair dealing. He did not believe in the Des Moines plan (Des Moines is one of the cities having the commission form of government). He said that in a hearing as to a certain bill before the Legislature a Des Moines official had boasted that since the commission form of government went into effect in Des Moines all of the public-service corporations had been brought into court. Davenport's boast is that it has never had to bring its public-service company into court.

Mr. L. D. Mathes, of Dubuque, responded to the address of welcome on behalf of the association. Commenting on the electric service in Davenport, he said that the service and rates are fair—in fact, neighbor companies sometimes think almost too fair—to the public. The low rates made in Davenport because of the water-power and large quantities generated are not always possible in other communities and other companies are sometimes embarrassed in explaining the difference. He complimented Davenport on its progressiveness, as shown by the special curb illumination on its down town streets. This plan has also been adopted at St. Paul, Minneapolis, Des Moines, Kansas City, Duluth and many smaller towns.

President Crawford then gave his address, calling attention briefly to notable points in the industry during the past year. He said that most of the Iowa central stations operated under certain disadvantages, among which he named the high price of coal, the small size of the communities and the long distances from electrical manufacturing centers. He said that during the past year there had been notable advances in lamp manufacture and in meters. There had also been a reduction of price in both lamps and meters. Certain electrical conveniences have now practically become necessities in well-regulated homes. Among these necessities are the electric iron and vacuum cleaner. There has been much increase in the amount of ornamental curb lighting. A number of bills for the regulation of public utilities have been introduced in the Legislature and the work of some members in Des Moines appearing at the various hearings on these bills was commended. He urged members to take more interest in proposed legislation. In general, he thought there is more cordial feeling between the public and public-service companies throughout the State than formerly.

Mr. Austin Burt, of Waterloo, who is the "facts and factors" committee of the association, presented a very complete report on Iowa central stations. He tabulated the results from thirty-one stations, giving various facts, including the items used by the *Electrical World* in similar tables it has presented from time to time, and also several additional items. This table appears elsewhere in this issue. The results as compared to similar results obtained by Mr. Burt two years ago show an increase in business which indicates that the tungsten lamp has not had the effect of reducing the demand. This report was discussed by Prof. A. H. Ford, of Iowa City; Messrs. A. J. Young, of Cedar Rapids; H. G. Glass, of Pittsburgh; J. R. Cravath, of Chicago, and others. In executive session at the close of the convention this committee was continued.

The committee on "grounding of secondaries," which has been a standing committee of the association for several years, presented a report giving results of tests on different forms of ground connections, part of which were installed at Iowa State College, at Ames, and others at Iowa State University, at Iowa City. Some of these grounds have now been in service for two years. Prof. A. Shane, of Ames, presented the results obtained and the comments of the committee, which were further commented on by Prof. A. H. Ford, of Iowa City. The tests in general showed conclusively that plates buried in coke and charcoal are less reliable as grounds than plates in plain Iowa soil. They also indicated that plain iron is better than copper. On the whole, the results showed that some of the elaborate and expensive methods of grounding commonly recommended in the past are not as good as some of the cheaper methods using plain iron pipes or plates. The failure of coke and charcoal is presumed to be due to the fact that it is not as finely pulverized as earth and, therefore, does not hold the moisture so well.

Professor Shane also called attention to the existence of an appropriation for carrying on the State Engineering Experiment Station and said that it is the desire of those responsible for this station to get in closer touch with the electrical industries of the State, and that the station is prepared to perform any experiments within reason which would be of general benefit if the association would indicate what experiments are considered desirable.

Mr. A. L. Dodd, of Charles City, reporting on behalf of the membership committee, presented applications for membership from central stations at Jewell, Maquoketa and Fairfield.

A nominating committee was elected consisting of Messrs. A. L. Dodd, of Charles City; L. D. Mathes, of Dubuque; Austin Burt, of Waterloo; F. J. Hanlon, of Mason City, and George S. Carson, of Iowa City.

The Wednesday afternoon session was opened with a paper on "Transmission and Distribution System Record," by Mr. Ira L. Craig, of Waterloo. He described the system followed at Waterloo for keeping track of the company's distributing lines and the connected transformer load. This was followed by a discussion which was mainly on the sizes of wires used for the smallest feeders and services. The practices in Waterloo, Charles City and Chicago, Ill., were discussed.

"Refrigerating Advantages and Disadvantages" was the subject of a paper by Mr. G. W. Dumont, of Omaha. He took up first the operation of ice plants in connection with central stations and, second, the supply of electric energy for driving refrigerating machines on consumers' premises. He gave some figures on the power necessary for motor-driven ice machines. He criticised the inability of some central-station companies to quote rates promptly on motor-driven refrigeration plants, and said that the companies should get their rates into shape so that prices could be quoted without delay when the ice-machine salesman is about to close a contract with a prospective buyer. He thought 48 kw-hours ample energy per ton of ice. He thought any rate not exceeding 4 cents per kw-hour would be satisfactory for motor-driven refrigerating plants. This paper drew considerable discussion. Mr. Mathes, of Dubuque, especially urged co-operation of the central-station man with the ice-machine salesman. Mr. Rufus E. Lee, of Clarinda, spoke unfavorably of electric-motor drive for a combination light and electric plant.

Mr. H. B. Gear, of Chicago, read a paper on "Underground Distribution in Medium Cities," which gave valuable information on costs and methods to be pursued in underground work and in combination of underground and overhead lines. He also gave pointers on making overhead lines as inoffensive as possible. Unit costs were given for various underground work. One point brought out in the discussion was the extensive use of steel-armored cable buried directly in the ground for cheap underground work in parkways, lawns, etc.

Prof. A. H. Ford read a paper on "Flat Rates for Small-Demand Consumers," which analyzed the question which has recently been brought up so prominently of supplying certain small consumers at a flat rate with some flicker device to limit the maximum demand. His analysis was favorable to such business. The discussion following showed considerable difference of opinion as to the merits of the scheme. Mr. Young, of Cedar Rapids, reported having tried it at that place, and Mr. J. R. Cravath reported a limited experience with the plan at Harrisburg, Ill. The general sentiment of others, including Messrs. A. W. Zahn, of Mason City; Austin Burt, of Waterloo, and Gear, of Chicago, was adverse to the plan.

On Wednesday evening the supply men gave a complimentary smoker to the central-station men at the Hotel Davenport.

On Thursday morning the convention listened to a brief paper by Mr. F. H. Golding, general manager of the Rockford (Ill.) Electric Company, on the "Electric Automobile," telling of the remarkable development of the electric-vehicle business in Rockford, where 165 electric vehicles are in use. This paper included figures on the cost of maintenance of electric vehicles and the revenue which they brought to the company. President Crawford pointed out how remarkably far behind Rockford most other cities are in electric-automobile development. A number of questions were asked Mr. Golding, and the discussion finally drifted into the introduction of the electric truck. Some figures were given on the performance of these, although there appears to have been but little progress made with their introduction.

"Ornamental Curb Illumination" was taken up in a paper by Mr. R. M. Parker, of Ft. Dodge. He outlined different methods of getting this kind of lighting introduced in cities. He thought the cost should be paid for out of the city treasury after installation by the property owners. He advocated posts with five lamps for large cities and with three lamps for small. This paper was discussed by Messrs. A. L. Dodd, Prof. A. H. Ford and others.

Mr. Harry G. Glass, of Pittsburgh, presented a set of lantern slides intended to arouse the enthusiasm of the central-station man as to the possibilities of the general introduction of electric-motor service for all purposes in a community. He also proposed a rate system which was criticised in the discussion as being adverse to certain rulings already made by the Wisconsin commission and therefore unlikely to be held equitable in the future.

On Thursday afternoon Mr. J. D. A. Cross in a paper on "Industrial Heating Loads" told briefly of the numerous possible applications of electricity to industrial heating processes and gave some figures on cost of operation in specific cases. This paper led to a discussion of electric-heating appliances in general.

"Public Policy" was the subject of a brief address by Mr. George S. Carson, of Iowa City. He said that companies are realizing the importance of this subject more every day. Good service is of first importance in a wise public policy. The rates must not discriminate unjustly between consumers, and concessions must not be secretly made to certain consumers which are not made to others of a similar class. The voluntary lowering of rates as rapidly as can be done under existing operating conditions is good policy. A liberal use of newspaper advertising enables the company to tell its side of the case or to advertise its service as necessity may require. Another important matter is prompt attention to complaints. Every employee of the company is looked upon as a representative of the company, therefore every employee should be cautious and courteous in his statements. For example, the tact of an employee has much to do with the ease of procuring the permission to trim trees. The company should aid in all public improvements and help them along in a public-spirited way.

In the discussion Mr. A. L. Dodd said that he liked to contribute to public affairs and did not mind being considered an easy mark. But even supposing he did not enjoy it he thought it would be good policy to make such contributions. Mr. R. M. Parker, of Ft. Dodge, read an advertisement appearing over the name of a central-station company doing a wiring business which called attention to the danger of fire with improper wiring and the number of fires caused by the wiring of one of its competitors in the wiring business. This was read as a good example of what not to do in the way of advertising. Mr. J. L. Craig, of Waterloo, told of a fire in the new First Methodist Church of that city just as it was completed. This was charged to electric wires, but the city electrician responsible for the inspection promptly took up the matter and had the electricity turned on the building circuits in the presence of several witnesses after the fire without touching the wiring to repair it. The wiring was thus shown to be intact. Mr. A. D. Ayres, of Keokuk, said that his company used to do wiring, but had turned the work over to good contractors, who built up a good business. Later when irresponsible boys had undertaken contracting his company had found it necessary to refuse to connect to wiring not thoroughly and properly done. Mr. P. B. Sawyer, of Des Moines, pointed out that not only is good electric service necessary, but good office service likewise. That is, customers must be treated courteously and have complaints attended to promptly at the office if the public is to be satisfied. Mr. Carson said that companies should be ready to test meters carefully whenever consumers make complaint, even though there may appear to be little probability that the complaint is just. President Crawford said that his company now installs nothing but glass-case meters so as to overcome any suspicion by the customer that the meter is running with no load. He also tried to teach consumers to test their own meters and so dispel some of the mystery. He thought it a good thing to make public the earnings of the company just as the local company in Davenport had done the day before. Even though the earnings were high, the comments of the local press had been favorable. The problem of tree trimming is largely a question of tact. He had once accomplished with the owner's consent the trimming of an exceedingly troublesome tree by offering to do other trimming of nearby trees for the owner at the same time.

In settling complaints Mr. H. G. Blackwell, of Davenport, advocated employment of a recording instrument to show when and how much energy was used. A record on paper makes the consumer much more contented. He described one case of a gas consumer who could not understand large bills in a certain month when the consumption was theoretically very low. The use of the recording instrument indicated considerable gas consumption at hours when all gas was supposed to be turned off. Investigation revealed a number of gas jets in out-of-the-way places where they would often be used unnoticed. The same principle applies to electric consumers.

At the executive session at the close of the Thursday afternoon session the following officers were elected: President, Mr. H. C. Blackwell, of Davenport; vice-president, Mr. P. B. Sawyer, of Des Moines; secretary, Mr. A. W. Zahm, of Macon City; treasurer, Mr. W. A. Mall, of Belle Prairie; executive committee, Messrs. L. D. Mathes, of Dubuque; A. L. Dodd, of Charles City, and J. P. Jones, of Cedar Falls. Des Moines was selected as the place for the 1912 convention.

The president-elect is general superintendent of the People's Light Company, of Davenport, which carries on the gas and electric business of that city, and the Davenport Gas & Electric Company, which carries on the exhaust-steam heating business. Mr. Blackwell is thirty-three years of age. He was born in Montreal, Canada. His early education was received in the public schools and in the Cincinnati Technical School. He graduated from the Purdue University, engineering course, in 1902. Upon graduation he went with William B. Scaife & Company and was engaged in the design and erection of water-purification plants. In 1905 he entered the employ of J. G. White & Company, and was assistant superintendent during the construction of the interurban lines from Alton to Granite City, Ill. In 1906 he left Alton to go to Davenport, where he was first engaged in engineering and construction work. For the past three years he has been general superintendent. Important improvements have been going on under his supervision, and his company is just completing the placing underground of all wires in the fire-limit district of Davenport. The Davenport company is under the control of the firm of J. G. White & Company.

President-Elect H. C. Blackwell.

Electrical Manufacturing Plants in Europe.

By Capt. Godfrey L. Carden, U.S.R.C.S.

The Charleroi electrical works are one of the important electrical manufacturing plants of Belgium. The shops are located at Charleroi on the line of railway between Paris and Liège. This firm has shown net earnings of $193,000 in a single year on a total capitalization of $965,000. The machine-tool installation comprises 510 machines, representing an outlay of $386,000.

The outputs of the Charleroi works include electrical equipment of great variety. This firm is exporting to all parts of Europe, and in particular to Russia, Spain, Italy, Turkey, Egypt and South America. The rates of pay of various operators are, in United States money: Lathe men, 7.7 cents to 12.5 cents per hour; milling-machine men, 7.7 cents to 11.6 cents; planer hands, 7.7 cents to 9.6 cents; stamp-press men, 5.8 cents to 8.7 cents, radial-drill operators, 6.7 cents to 8.7 cents, and foremen, 15.2 cents to 19.3 cents.

A large proportion of the machine tools in service at Charleroi are of American origin, and the equipment from the United States is in high favor. The engineer-in-chief of the shops declares that, after a careful calculation based on the prices asked for American boring mills and for foreign tools of the same sizes, having regard to the weights involved in both machines, the prices charged per kilogram of weight he found were practically the same. On the face of it, he remarked, the American machines would appear to be more expensive, but the difference in price was made up by the greater weight in the American tools.

The Ganz works of Hungary have long been regarded as one of the first electrical manufacturing plants of the world. The shops are located on the outskirts of Budapest and employ about 1200 people. At present the main outputs are in connection with power plants and electric traction work

A noteworthy Ganz installation is the 30,000-volt Manojlovoc power station, located in Dalmatia, containing four 30,000-volt, 42-cycle, three-phase, 4500-kw generators driven by Francis turbines. The line potential, 30,000 volts, generated directly by the machines without step-up transformers, is transmitted a distance of twenty miles and then transformed down to 50 volts at one step, so that the 1500-kva transformers have a ratio of transformation of 600 to 1. No trouble has been experienced, it is reported, at the Manojlovoc station in more than two years of service.

The name of Ganz is identified with much of the best in electric locomotive work abroad. Electric locomotives built by this company have a total rated output of 2000 to 2800 effective horse-power, yielding a maximum bar pull of 42 tons. This rating is regarded as theoretical only, since no real drawbar, it is pointed out, could stand the strain, and the adhesive weight at 42 tons is not sufficient for executing more than from 9 to 10 tons under favorable conditions. Ganz first introduced the three-phase system in connection with railway-traction work on the Valtellina line in Italy. Three of the Valtellina locomotives were loaned at the outset for use on the Simplon tunnel route.

The visitor to the Ganz shops is impressed with the fact that the establishment is more than a mere manufacturing one; in other words, Ganz stands for the origination of some of the best laboratory ideas in Europe. The names of such men as Blathy, Dery and Zipernowsky are associated with many of the distinguishing features bearing the Ganz name. It was Ganz who first brought out transformers with closed magnetic circuits, and also first connected these in parallel. Ganz also claims to have been the first to do away with belt and chain drives, coupling directly between generators and steam engines. It is asserted that this was done as early as 1889. Among other claims by the Ganz works is the distinction of first bringing out the wattmeter for accurately measuring alternating-current power. This was in 1885. They also designed alternating-current watt-hour meters based on the induction principle. Important equipment produced at the Ganz shops comprises large transformers, turbo-dynamos, electric traction outfits, controlling apparatus and arc lamps. No attempt is made to manufacture telephone and telegraph material.

The Ganz shops contain many fine examples of American machine tools. Some of the very latest designed tools from the United States are in evidence, and the Ganz firm is in the market at all times to secure new and meritorious machines. A day's work comprises ten hours. The better grade of workmen receive about 1 crown (20.3 cents) per hour. Apprentices receive 50 hellers (10.2 cents) per day. These apprentices serve three years, putting four to five hours each working day at night school.

In Hungary many of the power-station engines in service are the make of Messrs. Lang, of Budapest. The Lang engines are well constructed and invariably well finished. At the Budapest central station there are three of these Lang engines of the vertical triple-expansion type, direct-connected to generators, the high, intermediate and low-pressure cylinders measuring 60 cm, 82.5 cm and 140 cm. respectively, by 80 cm stroke. These engines run at 112 r.p.m.

Alongside the Lang engines are Zoelly turbines, also the make of Lang. It is the practice now to build Zoelly turbines complete in one casing. The exciters for each of these machines are mounted on the same shaft with the motor. The effectiveness of the Lang shops may be gathered from the fact that their per-man capacity, figured on a year's basis, is 5,468 crowns ($1,110). The average rate of wages paid good machinists is 62 hellers (12.6 cents) per hour. Foremen receive 1 crown (20.3 cents) per hour. Apprentices receive 12 hellers (2.4 cents) per hour.

In the big steel works of Austria-Hungary gas engines are much used for driving generators. The writer has no hesitancy in saying that the best gas-engine work coming under his notice was at the Witkowitz steel works of Moravia. These Witkowitz works employ approximately 28,000 people. This is one of the great iron and steel plants of Europe. Witkowitz is to Austria what Krupp is to Germany. Both the Witkowitz and Krupp plants are privately owned works. The blast-furnace works at Witkowitz are divided into two groups, that at Witkowitz proper and a second group at Sofienhutte. In the Sofienhutte group there are three blast furnaces with outputs, respectively, of 260 tons, 200 tons and 120 tons, or a total of 580 tons per day. The gas derived from these furnaces is used for fuel in a central station near by. In the central station there are two steam engines of 1400 hp and 800 hp respectively, and two of 4600 hp.

The writer has observed many gas engines in service in Europe, but nowhere, except possibly at the Resicza works in southeastern Hungary, did he witness such fine showings as at Witkowitz. The gas engines at Sofienhutte and at Witkowitz proper ran with all the smoothness and quietude of a beautifully adjusted steam engine—no shock and no jar. One 1200-kw gas engine seen at work made no more noise than a turbine which it paralleled. This gas engine was a double-acting tandem unit. All Witkowitz gas engines are of the Otto type, built under Witkowitz modifications. As an illustration of the effectiveness of the Witkowitz gas engines the statement was made that they are in use 99 per cent of the working time, running almost continuously night and day. Such slowing down as is required by the gas engines does not exceed 1 per cent of the entire period.

Witkowitz builds gas engines only for its own use, and its gas engines are to-day being run by men familiar with every element in their construction. This must necessarily have much to do with the success of operation. In answer to the question why Witkowitz does not build gas engines for others, the reply was made that Witkowitz had no time at present for outside gas-engine orders.

There are four blast furnaces at Witkowitz proper, that is to say, other than at Sofienhutte, comprising two of a rating of 250 tons each and two which range from 150 tons to 200 tons each.

At the Sofienhutte station the power derived from the combined steam-engine and gas-engine installation is utilized for operating blowing engines at this point. At Sofienhutte the gas for the blast furnace is passed into a washer of Witkowitz design, containing fans, where it is first roughly cleaned. The gas next passes into a second washer, also of the same Witkowitz design, where it is further washed, and thence through a large system of fans. These fans are all of Witkowitz type. The gas is then dried in two driers, from which it passes directly to the engine. When too much gas is available the surplus gas goes into the air.

The Resicza works in Hungary, another great iron and steel plant, is working 6000 people, but the total force employed in all the shops and works of the company in the Hungarian territory alone is 18,000.

Resicza has been utilizing blast-furnace gas for the past thirty-five years, and to-day a large proportion of the power produced comes from the gas engines. Both blast furnace and producer gas are used. The gas-producer system employed is of the Kerpely design. In the steel-making department there are fourteen gas producers in series. In one central station there are four gas engines, each of 1650 nominal horse-power, running at 97 r.p.m. The engines were built by Lang, of Budapest, after the Eberhardt system. The 1100-kw generators came from the Allgemeine Elektricitäts Gesellschaft, Vienna, and produce 5500-volt, 208-cycle, three-phase alternating current. All four engines run in parallel with a second hydro-electric central station of 6000 kva rating. Resicza employs a gas washer, the design of General Director Veitte, supplemented by an additional washer built on the Theisen system. From the Theisen washer the gas goes direct to the gas engine, without recourse to any gas reservoirs. Arrangements exist whereby producer gas can be used at any time in the event of blast-furnace gas giving out.

Excessive Rates Due to Holding Company.

The Massachusetts Gas and Electric Light Commission has issued an order reducing the prices of gas and electricity as charged by the North Adams Gas Light Company, upon complaint of over twenty customers, as required by Sec. 34, Chap. 121 of the Revised Laws. The decision includes an extremely important discussion by the board of the holding-company principle, and in general the commission finds that the exercise of control in this case through the holding device tended to maintain too high prices for the company's products. The board also orders a restriction of the minimum-charge feature of the company's rates. The decision is one of the most significant that have been issued by the board in recent years.

The North Adams company has been supplying both gas and electricity since 1890. Its products are distributed in North Adams, Adams and Williamstown, and it supplies electricity alone to a local company in Stamford, Vt. About 70 per cent of the gas output is sold in North Adams and 89 per cent of the electrical income is derived from that source. In North Adams the maximum net price of gas is $1.05 per 1000 cu. ft. with special discounts to certain large consumers. The maximum net price for electricity for lighting is 13½ cents per kw-hour, with lower rates to customers using more than 15 kw-hours a month. The maximum net price for motor service is 4 cents per kw-hour, with a minimum charge of $1 per month for each horse-power of motors installed. These prices were made on Jan. 1, 1910, and represent reductions from previous maximum net prices of 30 cents per 1000 cu. ft. for gas and 1 cent per kw-hour for motor service. When these reductions were made a minimum charge of 50 cents a month was imposed for gas customers whose net bills average less than that during the year and of $1 a month for electric light customers whose net bills average less than that amount. Particular complaint was made at the hearing against these minimum charges, none of which had been previously included in the company's tariff.

The board's investigation of the company's operations for the fiscal year 1910 showed that, although the dividends for the year were somewhat increased, even with no allowance for depreciation, the gross profits were not sufficient to pay the interest and dividend charges, these being paid in part from the surplus previously earned. The operating costs for the gas and electric departments amounted respectively to 85 per cent and 88 per cent of the income. Considering that these figures indicated that either the selling prices are already too low or the operating costs too high, the board made a careful examination of the company's accounts, its business methods, and many of its contracts, invoices and vouchers, which were all found to be kept with care and precision. During the year 1909 practically all the capital stock was acquired by the Massachusetts Lighting Companies, an unincorporated voluntary association, which controls sixteen other gas and electric companies in the State, and the Light, Heat & Power Corporation, chartered under the laws of West Virginia. The last-named company is organized for the purpose of manufacturing, selling and purchasing machinery and appliances, building, equipping, leasing and selling water, light, power and heat plants and pipe lines, and furnishing machinery and appliances to be used in such connection, and in maintaining and operating such plants. The responsible officers are identical with those of the North Adams Gas Light Company. Nearly all the latter's operations, and especially its plant construction and purchase of supplies, are virtually carried on by the Light, Heat & Power Corporation. This relation is not evidenced by a written contract, but is secured through the identity of their ownership and of their principal executive officers. The board examined the books of the Light, Heat & Power Corporation and found that there existed a substantial profit to the latter upon nearly all the supplies purchased from it by the North Adams company. These commissions amounted to about $27,000 in 1910, with the addition of sums paid for engineering services. The board points out that the accounts of the North Adams company show under the present management a very large increase in that part of the operating cost represented by the salaries of the executive officers, who occupy similar positions in the Light, Heat & Power Corporation and receive from it compensation for their services to that concern. The board says: "To determine definitely the reasonable compensation of the incumbents of these respective positions is a matter of great difficulty, but, in view of the peculiar relations of the Light, Heat & Power Corporation to the others, it may be safely assumed that the salaries actually realized by the executive officers of the Light, Heat & Power Corporation as such ought to be, and are in fact, quite the full compensation of these officers for their entire services in behalf of the allied corporations; that the combined salaries apparently paid to these officers by the several companies are larger than the volume of the business or its character would justify or the interests of the owners, the Massachusetts Lighting Companies, would permit. * * *

"The method of carrying on the business thus described has not only contributed to advance the operating costs to the high percentage named, but the rendering of monthly bills by the Light, Heat & Power Corporation for its numerous claims against the company has kept the North Adams company almost constantly in debt to it, making necessary the immediate transfer of most of its income directly to that corporation, and has enabled the Light, Heat & Power Corporation to add to its other profits interest upon the average balance of the debt thus created. All the facts combined lead to the conviction that the method of carrying on the business has substantially increased the current charges of the company beyond what they might be were the business conducted in the manner usual with an independent company. The whole arrangement tends to mislead the public as to the actual reasonable cost of carrying on the North Adams company, and so is directly contrary to the spirit and purpose of the law providing for the regulation and supervision of such concerns. The company ought not to pay twice for carrying on its affairs. * * * It is the duty of this board in fixing a price to determine whether the operating costs are reasonable and fair. * * * The public is concerned with the character of the management and the reasonableness of its cost. The company is entitled to a reasonable profit above only reasonable costs. Reasonable profits presuppose or are based only on reasonable costs.

"In justification of the course of dealing between the two companies it may be urged that because of the large purchases of supplies by the Light, Heat & Power Corporation for the several companies to which it is related it can supply them at a profit to itself for less than the individual concerns cay buy in the open market. To some extent this claim may be successfully made, but, in the opinion of the board, the actual charges for this service to the North Adams company are too great to be justified under that proposition. In so far as a unified management of a group of companies actually promotes economy in operation and increases the ability to serve the public it is entitled to commendation and a liberal reward, but even under these conditions it is neither necessary nor wise that the entire profit from that endeavor should be taken from the owners. It is not a question whether any additional profit is to be accorded to superior management, but rather how much is reasonable and fair. The outstanding capitalization of the association controlling these companies, which amounts to more than $3,500,000 and is greatly in excess of the capital stock and bonds which its subsidiary lighting companies might under the most liberal administration of the law be authorized to issue, and the peculiar relation assumed by the Light, Heat & Power Corporation create a situation whose necessities invite the taking of a heavy toll from the public. In view of these facts and principles the board is of the opinion that a further reduction in the maximum price for both gas and electricity may reasonably be required of the company, and that the prices hereinafter named are sufficient to cover reasonable operating expenses, including a proper allowance for depreciation and a fair return upon the value of the property which the company is reasonably and actively employing for the public convenience.

"With respect to the minimum monthly charges for gas and electric lighting the money value of these charges is not important to the company. No such charge had been made by the former management. The company had been and would probably continue to be prosperous without it. It is supported by the claim that the readiness of the company to supply is a convenience to the customer and a service which has value even though he may not actually use the light, and that such service is of some cost to the company, which ought not to be required to render any service at a loss. The statutes appear indirectly to recognize the legality and justice of some charge in the case of the gas supply, but make no attempt to determine its fair and reasonable amount. It is under any conditions extremely difficult to determine the cost of such service. * * * If any such charge is to be made, its amount must, therefore, be determined somewhat arbitrarily with reference to other considerations rather than its cost. While it is doubtless true that any public-service company may sometimes be legally and reasonably required to render certain services without a demonstrable profit or even at less than the apparent cost, to require a company to give any service continuously or repeatedly at an obvious loss would be manifestly unjust and inexpedient. When any amount of gas or electricity is used for which the customer pays the company receives some return, and while it may be impossible to show that such return is an adequate one, it may be equally difficult to prove that it has been rendered at a perceptible loss."

The board, therefore, recommends that from May 1, 1911, the net price of gas shall not exceed $1 per 1000 cu. ft.; that the net price for electricity for any use shall not be over 12½ cents per kw-hour; that no minimum charge for gas shall be made against any customer for any month unless in that month the customer uses less than 100 cu. ft. of gas, nor during a portion of twelve consecutive months if during such time the customer uses gas to the value of $7, and that if the minimum charge be made it shall not exceed 50 cents for any one month, and that no minimum charge for electricity for lighting shall be made by the North Adams Gas Light Company for any month unless in that month the customer uses less than 1 kw-hour, nor during any portion of twelve consecutive months if during that time the customer uses electricity for lighting to the value of $12, and that if any minimum charge be made it shall not exceed $1 for any one month.

New Rate Ordinance in St. Louis.

The new ordinance regulating electric rates in St. Louis, mention of which was made in last week's issue, is to go into effect six months from April 12, the date of its approval by Mayor Kreismann. The ordinance fixes a maximum rate of 9.5 cents per kw-hour and a minimum service charge of 50 cents per month. Printed schedules of rates are to be filed in the office of the Public Service Commission of St. Louis within six months after the approval of the ordinance, and thereafter schedules are to be filed whenever changes are made in rates. The rates indicated on the schedules shall not be effective until thirty days after they have been filed, unless in the opinion of the commission, declared in writing, an emergency exists, in which event a schedule may become effective immediately.

A charge for the installation of meters of not to exceed $2 may be made, and meters shall be furnished for the use of consumers free of cost. In all cases where the maximum rate is paid no charge shall be made for renewals of 8-cp, 16-cp, 24-cp or 32-cp carbon-filament lamps of the regular clear-glass type upon the return of burned-out lamps with glass unbroken. No person desiring to obtain energy shall be required to contract not to use other means than electricity for light or motor service. No person who desires electricity at the maximum rate shall be required to contract for a longer period than one month. No rentals shall be exacted for service connection or meters. No customer who pays the maximum rate shall be required to guarantee the use of any fixed amount of energy or the payment of any fixed sum except the service rate of 50 cents per month. In all cases where the company contracts to furnish energy at a rate lower than the maximum it may require a guarantee of not more than the equivalent of the maximum rate of 9.5 cents per kw-hour for the energy actually furnished. No customers' deposits in excess of two average months' bills shall be required, and upon these deposits interest shall be allowed at the rate of 5 per cent per annum.

Where a special investment in addition to the ordinary cost is required to provide a service connection from mains adjacent to the customer's premises the company may require a reasonable guarantee sufficient to cover the cost of such special investment. Overhead service connections in the overhead district and underground service connections in the underground district shall be furnished free of charge, provided that the connection from the street-service lines adjacent to the premises to the inside walls of the customer's premises shall not be longer than 100 ft. If the connection exceeds that length the customer may be required to pay a reasonable cost for the excess.

No meter shall be used which has an error of registration in excess of 3 per cent on light load or full load. Each service meter shall be tested and adjusted for accuracy at the time of installation, and shall be tested thereafter at least once a year by comparison with suitable standards of light-load, half-load and full-load rate of operation. A complete record of all meter tests shall be kept by the company. Upon the request of a consumer a company shall test a meter, provided the request is not made more frequently than once in six months. A report thereof shall be made to the consumer. If the test shows an inaccuracy beyond 3 per cent, the amount of the bill last rendered shall be adjusted in accordance with the inaccuracy and settlement made. Upon written application of a consumer to the supervisor of city lighting a test of the meter shall be made by the supervisor, who shall charge a fee of $1, to be paid by the consumer if the meter is found to be slow or accurate within the allowable limit and by the company if it is found to be fast beyond the allowable limit. In the latter case the fee shall be returned to the consumer. If the meter is found to be inaccurate beyond the allowable limit, the amount of the bill last rendered shall be adjusted and settlement made between the consumer and the company.

The ordinance applies to every corporation, association, copartnership or person engaged in furnishing or selling electrical energy in the city under any permit, privilege or franchise granted by the city or the State. Violations shall constitute a misdemeanor, punishable upon conviction by a fine of not less than $50 and not more than $500 for each offense. Every case of violation shall constitute a separate offense. The city reserves the right to alter, amend or repeal the ordinance at any time.

Public-Utility Commission Law in Kansas.

The new public-utility commission law in Kansas, which has been signed by the Governor, makes the Board of Railroad Commissioners a public-utility commission with greatly enlarged powers. The law applies to telephone, telegraph, dining-car, heat, light, water and transmission companies, as well as common carriers, although mutual telephone companies are excluded. Public utilities owned and operated by municipalities are excepted from the provisions of the act.

The present members of the Railroad Commission retain their offices for the terms for which they were elected, but thereafter the commissioners shall be appointed by the Governor, one to be a practical, experienced business man, and another experienced in the management or operation of a common carrier or public utility. Of the three persons to be appointed, one is to serve for one year, one for two years and one for three years, and upon the expiration of these terms commissioners are to be appointed for three years. The salary of each commissioner is to be $4,000 per year, and not more than two members of the commission are to be of the same political party. No person owning securities in any common carrier or public utility, or in any way pecuniarily interested in any company subject to the law, shall be eligible unless he divests himself of such interest or employment to the office of commissioner, attorney or secretary of the commission. Neither commissioner, attorney nor secretary shall hold any office of profit or any position under any committee of any political party, or hold any position of honor, profit or trust by virtue of the laws of the United States or of the State of Kansas.

Every company shall be required to furnish reasonably efficient and sufficient service, joint service and facilities, and to establish just and reasonable rates and rules. Every company shall publish and file with the commission copies of all schedules of rates. The commission shall have power to prescribe reasonable rules regarding the filing of schedules of rates. No company shall knowingly or wilfully charge a greater or less compensation for the same class of service than is specified in the printed schedules, or receive any rate not specified, except that different rates may be charged by agreement with the customer in cases of charity, emergency, festivities or public entertainment, and officers, employees and agents of the utilities companies may have free or reduced rates.

It shall be the duty of the commission, either upon complaint or upon its own initiative, to investigate all rates, and if the commission, after full hearing and investigation, shall find that such rates are unjustly discriminatory it shall have power to fix just and reasonable rates. If the regulations are unreasonable and inefficient the commission shall have power to substitute other practices and to make such order respecting changes as shall be just and reasonable. Upon complaint regarding rates or practices by any organization or society, or by any taxpayer, firm or corporation the commissioners shall proceed, with or without notice, to make such investigation as they may deem necessary. No order affecting rates or practices against which such complaint is made shall be entered by the commission, however, without a formal public hearing. The commission shall have power to require such improvements as may be required by law.

Whenever any company desires to make changes in rates and practices it shall file a schedule with the commission indicating the changes, which shall not be put into effect without the consent of the commission. Any company or other party in interest who is dissatisfied with any order of the commission may commence an action within thirty days in a court of competent jurisdiction to vacate such order on the ground that its provisions are unlawful or unreasonable. All actions brought under this section shall have precedence in any court. Appeal from the decision of the District Court may be taken to the Supreme Court of the State, but during the pendency of any action all orders of the commission shall remain in force until final judgment is rendered.

The commission may prescribe for each kind of public utility suitable and convenient standard commercial units of products and service. It shall provide reasonable regulations for examinations of such service and the measurement thereof. It shall establish reasonable rules and standards to secure the accuracy of the meters.

Each public utility shall furnish, in such form and at such times as the commission shall require, accounts showing unit figures for depreciation, the various classes of expenses and revenues, dividends and interest, etc. Each company shall transmit to the commission on or before Sept. 15, 1912, and on or before the same date each year thereafter a full statement for the period ended on the June 30 preceding. Failure to make such reports within the time specified causes forfeiture to the State of $100 for each day of default.

It is stated that the power to create liens on corporate property in Kansas by common carriers and public utilities is a special privilege, the right of the supervision of which shall be vested in the State. A company may issue securities payable at periods of more than twelve months after the date thereof when necessary for the acquisition of property, carrying out corporate powers, construction, completion, extension of improvement of facilities, or for the improvement or maintenance of service, or the discharge or lawful refunding of obligations, or such other purposes as may be authorized by law, provided that there shall have been secured from the commission a certificate stating the amount, character, purposes and terms of issue, and that the statements in the application have been ascertained to be true.

Any company, or any agent, director or officer thereof who shall issue or cause to be issued any securities contrary to the provisions of the act or who shall apply the proceeds from the sale thereof to any purpose other than that specified in the certificate shall be guilty of a misdemeanor and upon conviction shall be subject to a fine of not less than $500 and not more than $5,000, or by imprisonment in the county jail for not more than one year, or by both fine and imprisonment. No company after the passage of the act shall acquire or hold any part of the securities of any competing company unless authorized by the commission.

The commission shall have the power, and it shall be its duty, to ascertain the reasonable value of all property of any company whenever it deems the ascertainment of such value necessary in order to enable it to fix fair and reasonable rates. Authority is given to the commission to examine all accounts.

Unless otherwise ordered by the commission it shall be unlawful for any company to receive a greater compensation for any service than the charge fixed on the lowest schedule of rates for the same service on Jan. 1, 1911. Accidents involving loss of life or serious personal injury are to be reported immediately by telegraph to the commission, which may investigate such accidents.

Every municipal council or commission shall have power to contract with any company as to quality of service and maximum rates, conditions and maintenance and penalties. Complaint regarding such ordinance may be made to the commission by the company affected or by ten or more taxpayers, and a date shall be set for a hearing. If the commission shall find that any provision of such ordinance is unreasonable, or against the public welfare or interest, or if it has reason to believe that the ordinance may be contrary to law, it shall recommend such changes as may be necessary. If the municipal council or commission shall not amend the ordinance to conform to the recommendations of the Public Utilities Commission the latter may commence proceedings in any court of competent jurisdiction to set aside any ordinance because of its unreasonableness or illegality, or because the measure is not for the promotion of the welfare of the municipality.

No company shall issue any securities, either directly or indirectly, or receive any money, property or service in payment thereof until there shall have been recorded upon the books of the corporation the certificate of the commission relating to the issue of securities. No company governed by the act shall declare any stock, bond or scrip dividend or divide the proceeds thereof among its stockholders unless authorized by the commission. No franchises shall be assigned, transferred or leased, nor shall any contract or agreement with reference to such franchises or rights be valid unless approved by the commission. Any person who shall wilfully make any false entry in the accounts of a company subject to the act, wilfully destroy any accounts, wilfully neglect to make full and correct entries in such accounts, or falsely make any statement required of him to the commission, shall be guilty of a felony, and upon conviction shall be punishable by a fine of not less than $1,000 or more than $5,000, or by imprisonment of not less than one year or more than three years, or by both fine and imprisonment

The commission may at its discretion issue orders specifying records which may be destroyed after a reasonable time. If any company governed by the act shall violate any of the provisions thereof, or shall fail to obey any requirement made by the commission, or any final judgment of court upon appeal, it shall forfeit for every offense not less than $100 and not more than $1,000. Any act of any officer, agent or other person acting for the company within the scope of his employment shall be in every such case the act of the company, and every day during which there shall be such violation shall constitute a separate offense.

Ohio Legislative News.

The sub-committee of the committee on railroads and telegraphs of the Ohio Senate is hard at work revamping the Winters public utilities bill to accord with ideas the members may have received during the numerous hearings that took place last week. If the bill is made up to suit some of the telephone interests represented at these hearings it will be minus almost everything but a provision allowing the consolidation of telephone companies in their own way. These representatives objected to all the Langdon amendments made to the bill which would make it a real utilities commission law. Objection was made to the provisions that all companies should be required to interchange business through switchboard connections and it was urged that a certificate of public necessity be secured from the commission before a competitive company should be allowed to enter the field at any point. Other telephone men present did not insist upon such wholesale elimination of regulation, however. Attorney Cyrus Huling said he believed that corporations are unduly exercised over the prospect of regulations and that it would be better to submit now to the terms of the bill than to get something worse later on, and that it would come to this. Mr. Starbuck Smith, of Cincinnati, who appeared for the people, said that if a law is to be enacted it should be a real utilities measure or nothing. If the original idea is not carried out the statute books would be better off without anything at all in this line. Representatives of express companies, interurban railway companies and some other classes of utilities asked that they be eliminated entirely from the bill. This would leave only the telephone companies.

The Russell bill, which was intended to clear up all objections to interurban railway companies furnishing energy for lighting and industrial purposes in villages that are too small to support independent lighting companies, has been defeated in the Ohio House of Representatives. The fight against the bill was made on the ground that the big companies would drive the little plants out of business by making low rates and then, when they had a clear road, would increase the rates until they became exorbitant. These objections were raised principally because energy is being furnished in larger towns in some instances by railway companies, but the small places may suffer through the defeat of the bill.

New Hampshire Public Service Commission.

The act establishing a public service commission which has been passed by the New Hampshire Legislature is drawn along very broad lines, giving the commission authority over all public utilities, including gas, electric, telephone, telegraph and railroads, both steam and electric, but excepting municipal plants.

The commission is to be composed of three persons, to be appointed by the Governor, a chairman (to be appointed and commissioned as such) at a salary of $3,500, a clerk at $3,200 and a third member at $3,000. The term of one member shall terminate in 1913, the second in 1915 and the third in 1917; the appointments thereafter will be for a term of six years. The Governor and Council may at any time remove a commissioner for inefficiency, neglect of duty or malfeasance in office, but not without a hearing.

The commission is authorized to expend $4,000 annually, and with the approval of the Governor and Council such further sums as may be necessary. It will have power to subpœna witnesses and to compel the production of any books, papers, etc. If any public-utility company refuses or neglects to make such reports as ordered by the commission, or to answer specifically any questions asked, it will be fined $100 for each day until they make such report or answer. For refusal or neglect to comply with an order of the commission the act provides for a fine of not more than $5,000, and for any officer or agent who wilfully violates any of its provisions a fine of not more than $1,000 or six months' imprisonment, or both.

Any public-utility company generating electricity by water-power is prohibited from exporting energy beyond the confines of the State without the approval of the commission, and such approval may be withheld if it can be shown that a market for such energy exists within the State and within a reasonable distance of the development. The commission may impose the condition that consumers within the State shall be furnished with energy on terms as reasonable as granted to those outside the State, having due regard for all facts and conditions which would affect the subject. These provisions, however, are not to affect companies now transmitting energy without the State, except to apply to additions to existing plants, and not to apply to plants on the Connecticut River, nor to railroads within the State transmitting energy for the operation of their own cars without the State.

The law provides that the commission must investigate complaints if made by city councils, mayors or selectmen, or upon the complaint in writing of 100 or more customers or subscribers in cities of 30,000 or more, not less than fifty in cities of 20,000, or not less than twenty-five in all other cities or towns.

When petitioned by a public-utility company the commission may have a hearing, take evidence, and should it decide that the necessity exists may condemn land for extension of plants, pole lines or conduits.

Massachusetts Legislative News.

A resolve has been sent to the Railroad Commission by the Legislature requiring the Board to investigate the traffic conditions at the stations of the Boston Elevated Railway Company and to submit a report upon its findings by the middle of May. The committee on public lighting has sent in an adverse report on the bill accompanying the petition of Mr. W. W. Roberts for legislation authorizing cities or towns to construct municipal gas or electric lighting plants. The bill provides that nothing in it should be construed as compelling the municipality to purchase the plants of existing private companies, and was regarded by the committee as hostile to the best interests of both the public and the electric and gas lighting industries The committee has also reported leave to withdraw the Morrill bill for municipal plant establishment, which resembled the preceding bill in not requiring compulsory purchase by the city or town, and which also relaxed the present law requiring votes in two successive years in order to establish a plant. At the hearings it was clearly shown that any such legislation would be a reversal of the policy of the State, which protects existing investments from exploitation and unfair competition with the public treasury in return for the supervision exercised by the public utility boards.

Wisconsin Commission News.

Six electric-light companies have been ordered to appear before the Wisconsin Railroad Commission and explain their failure to comply with the rules of electric service. The hearings have been set for April 27, 28 and 29. The commission will shortly carry on an investigation, on its own motion, of the rates and practices of the Southern Wisconsin Power Company and the Green Bay Gas & Electric Company.

The commission issued an order some weeks ago which will result in a reduction of operating revenues by the Racine Gas Light Company to the extent of approximately $13,000 annually. The decision is of interest on account of the many elements of valuation which figure in the case. The petition, which was brought before the commission by the city of Racine, alleges that the rate charged by the Racine Gas company was excessive; that consumers were obliged to use two meters, one for fuel gas and one for illuminating gas, although only one quality of gas was furnished. As the meter rate subsequently ordered was made the same for both fuel and illuminating gas the necessity of a double-meter system no longer existed and it was therefore ordered abolished.

The plant of the company had a cost of reproduction new of $986,290 on June 30, 1910, and this value was assumed by the commission as the basis upon which the company was entitled to earn interest. The bonded indebtedness was considerably greater than this. The valuation claimed by the company exceeded this figure by about $218,663, which included the cost of pavement, the value of property owned but not used by the company, and an allowance for "going value."

The tentative valuation included an item of $27,794 representing the cost of reproduction for paving. However, in line with this opinion an investigation authorized by the commission showed that only $3,444 had actually been expended by the company on account of paving and that no matter how much the reproductive value of the property had been enhanced by reason of pavement laid subsequent to the laying of the mains, the company was entitled to only $3,444 increase in its valuation.

Property valued at $15,370 which was owned by the company but not used by it or necessary in the conduct of its business was not allowed by the commission in fixing the earning value of the property.

The company contended that approximately $179,000 had been expended in building up the business; that, inasmuch as no return had been received on this expenditure, it should be allowed as part of the value of the property upon which the company was entitled to earn interest. It is the view of the commission that going value, if it exists, is a proper element of valuation. But in the present case it developed that a large portion of the $179,000 had been paid out of the earnings as the expense was incurred and the remainder had been charged to the construction account. Upon calculation it was found that if the amounts thus charged to construction had been charged to operating expenses and paid out of the earnings each year, the company's net earnings, after allowing 2 per cent on the total property for depreciation, would have never been less than 7 per cent of the cost of reproduction, taken year by year, and would have reached 9 per cent during the highest year. Consequently to-day the Racine Gas Company has no going value, for the rates in the past have yielded a sufficient revenue to reimburse the company for all business-promotion expenditures and to yield, in addition, a reasonable return upon the investment.

It was contended also by the petitioner in this case that the consumers in Racine were paying interest upon an over-investment. The special investigation carried out by the engineering staff proved the truth of this allegation. The over-investment apparently was not confined to any single portion of the plant. The plant equipment with but few exceptions is far in excess of the present needs of the city and great enough for many years to come.

The net rates previously in force were as follows: Illuminating: Any amount, $1.20 per 1000 cu. ft. Fuel: First 10,000 cu. ft., $1 per 1000 cu. ft.; next 20,000 cu. ft., 80 cents per 1000 cu. ft.; all over 30,000 cu. ft., 60 cents per 1000 cu. ft.

The rates ordered by the commission are as follows: For all gas service, a charge of $1 net or $1.10 gross per 1000 cu. ft. for the first 4000 cu. ft. used during any one month; 80 cents net or 90 cents gross per 1000 cu. ft. for the next 11,000 cu. ft. used per month; 60 cents net or 70 cents gross per 1000 cu. ft. for all gas in excess of 15,000 cu. ft. per month. The minimum bill was graduated according to the size of the meter from 25 cents per month for the three-lamp meter to $4 per month for the 200-lamp meter.

New Jersey Commission News.

A bill which enlarges greatly the powers of the Board of Public Utility Commissioners of New Jersey was passed by the Legislature of New Jersey at its closing session on April 21. Gov. Woodrow Wilson in a statement regarding the legislation enacted at the session said:

"The public-utilities act goes the full length of reform in respect of the control of public-service corporations. It is a thoroughly businesslike act, well conceived and well constructed, and ought to afford a means of settling some of the most perplexing questions connected with the control of corporations."

Prof. Winthrop Moore Daniels has been appointed a member of the commission to succeed Mr. Frank H. Sommer.

Canadian Hydroelectric Commission News.

The City Council of Toronto at a meeting on April 18 unanimously appointed Mr. P. W. Ellis as its nominee on the commission to manage the city's hydroelectric distribution system. The aldermen who formerly opposed the appointment of Mr. Ellis stated that their action had been taken in view of the position of the city in the negotiations for the purchase of the Toronto Electric Light Company; but now that the latter had been sold to Sir William MacKenzie it is expedient that the city should immediately appoint the commission to manage the city's plant. Mr. W. K. McNaught, M. P. P., who it was expected would be the commissioner appointed by the Hydroelectric Commission, has announced that he will not be able to accept the appointment. The third member will be the Mayor of the city for the time being.

AMERICAN ELECTRICAL ENGINEERS.—XXXI.

J. W. Fraser.

James William Fraser was born in Bridgeville, N. C., March 6, 1874, and after passing through the common and high schools of his native town spent a year at the Pictou Academy, Pictou, N. S. In 1895 he entered McGill University, Montreal, from which he was graduated with the degree of Bachelor of Applied Science in 1899, and two years later received the degree of Master of Science, his thesis being "An Original Investigation on the Distribution of Alternating Current in a Conductor." While pursuing the post-graduate course Mr. Fraser was assistant in physics at McGill for one year and assistant in electrical engineering for another year.

J. W. Fraser.

After spending somewhat over a year in the shops of the

Westinghouse Electric & Manufacturing Company at East Pittsburgh, Mr. Fraser went with the Shawinigan Water & Power Company, of Canada, with which he remained for a year as constructing engineer. During this time the first 50,000-volt transmission line in Canada was put in service, this being the second line of this voltage in America, that of the Missouri River Power Company antedating it by a few months. In the autumn of 1905 he returned to the Westinghouse Electric & Manufacturing Company as constructing engineer, and in May of the following year he accepted the position of assistant chief engineer with the Southern Power Company, which was then in the course of organization for the larger work which it subsequently undertook. During his connection with that company a plant has been installed having a total capacity of 150,000 kw. including two 24,000-kw, one 18,000-kw, and nineteen 11,000-volt, thirty-two 50,000-volt and twelve 100,000-volt substations and four tie-in stations. One thousand miles of high-tension lines have been constructed, and several hundred additional miles are now under way. Moreover, the hydroelectric system is now being reinforced with three 10,000-hp steam turbine generating stations, one of which is now nearing completion.

The work of Mr. Fraser with the Southern Power Company has been as varied as it has been extensive, including the design and construction of transmission lines of 2200 volts, 11,000 volts, 50,000 volts and 100,000 volts; the design and installation of transformer stations of all capacities from 100 kw to 28,000 kw, and both hydroelectric and steam generating stations. His experience has also extended to other lines not generally included under engineering, involving familiarity with details of standard apparatus and market prices. The ability with which the plant of the Southern Power Company has been designed and constructed is indicated by the continuous favorable experience in operation. With the 100,000-volt lines, for example, there have never been any insulator troubles, which is remarkable when it is considered that there are over 300 miles at that voltage in operation and in a district where lightning is very severe.

Mr. Fraser has contributed to the technical press and to discussions of the American Institute of Electrical Engineers, of which he is a member, and last year (March 24, 1910) contributed an article to these columns entitled "The Distribution System of the Southern Power Company."

CURRENT NEWS AND NOTES.

Legislation in Colorado.—At the mid-week lunch of the Colorado Electric Club in Denver on April 20 Hon. Robert S. Ellison, State representative from El Paso County, Col., spoke on legislative methods and emphasized the growing tendency toward direct legislation in Colorado and other states, and the anti-corporation spirit that prevails throughout the country.

Electrical Show at Ohio State University.—An electrical show will be given by the junior and senior electrical engineers of the Ohio State University on the nights of May 12 and 13 in the electrical engineering laboratory. The enterprise is being undertaken for educational purposes and to bring the work of the engineering department to the attention of the people of central Ohio.

Electric Pumps in Horticulture.—Small cultivators in the neighborhood of Seville, Spain, are rapidly substituting electric motors for the old nória, or endless chain of buckets worked by a mule or bullock, hitherto used for raising water from wells for irrigation purposes. The electric light company at Seville supplies energy over the agricultural zone which extends for some 2 or 3 miles around Seville. Within the first year fifty-six installations were made, aggregating 362 hp.

Electric Equipment of New York Library.—At a meeting of the New York Electrical Society to be held in the Engineering Societies Building on April 28 Mr. Frank A. Pattison will describe the electrical equipment of the New York Public Library. After the meeting the members will visit the library building to inspect the generating equipment, wiring installation, illumination features and motor-driven apparatus, including elevators, book conveyors, ventilating fans, machine tools, printing and binding machinery, etc.

Oil Fuel for Steam Boilers.—At a meeting of the Boston Mechanical Engineers held on April 21 a paper was presented by Mr. B. R. T. Collins on "Oil Fuel for Steam Boilers." A valuable feature of the paper was the presentation of a series of tests made last fall at the Redondon (Cal.) plant of the Pacific Light & Power Company on a 604-hp Babcock & Wilcox boiler equipped with a Hammel furnace and burners. The boiler was in regular service under the usual operating conditions. The oil was obtained from the Los Angeles fields, with a heating value of about 18,300 units. A maximum efficiency of 83.3 per cent was obtained on the tests while running at 109.2 per cent of the builder's rating, and the water evaporated per pound of oil from and at 212 deg. Fahr. corrected for moisture was 15.81 lb. The average efficiency for seven tests was 80.47 per cent, and the average evaporation 15.23 lb.

Pittsburgh A. I. E. E.—The annual banquet of the Pittsburgh Section of the American Institute of Electrical Engineers was held at the Hotel Rittenhouse on April 22 About 185 people were present, of whom about sixty were ladies. Past-president Charles F. Scott acted as the toastmaster. The first speaker was Col. H. G. Proutt, vice-president and general manager of the Union Switch & Signal Company, Swissvale, Pa., who spoke on the engineer of the future. Colonel Proutt was followed by President Dugald C. Jackson, who spoke of the aims, development and work of the Institute. The next speaker, Rabbi J. Leonard Levy, of Pittsburgh, took as his subject "A Word in Due Season." The last speaker was Dr. Robert Kennedy Duncan, of the chairs of industrial chemistry at the University of Kansas and the University of Pittsburgh, whose theme was "Industrial Opportunities."

Milan Municipal Water-Power Plants.—The Commune of Milan, Italy, is building the larger part of the new municipal electric plant, to cost $6,485,000, and embracing five water-power stations in the Alps and one steam-power station in Milan, the commune having adopted a new street illumination system to replace the gas-lighting system now in use. The energy derived from the streams in the Upper Valtelline Alps is conveyed across the country ninety-three miles to Milan. Twenty-seven thousand kilowatts at a tension of 65,000 volts will be developed at first, to be subsequently increased to 50,000 kw at 72,000 volts. The transmission line will be three-phase, and the city figures on furnishing users about 24,400 kw. The project embraces the five following power plants: Grossotto, 20,320 hp; Le Prese, 6510 hp; Tirano, 5210 hp; Mazzo, 4050 hp, and Roasco, 3930 hp. Up to the present work has been confined to the construction of the steam station in Milan and the Grossotto hydroelectric station.

Boston Electric Show.—Active preparations continue to be made for the Boston 1912 Electric Show, which will be held in the Mechanics' Building from Sept. 28 to Oct. 26 inclusive, under the auspices of the Edison Electric Illuminating Company of Boston. The manager of the show is Mr. Herbert W. Moses, of the Edison company, with headquarters at 39 Boylston Street, Boston. The entire building, containing over 100,000 sq. ft. of exhibit floor space, has been leased for the occasion. It has accommodations for over 100,000 visitors at one time. The object of the exhibition is to bring together electrical devices, showing by actual demonstration their adaptability to every kind of business, and to give manufacturers every opportunity to present the merits of their apparatus and to impress upon the public the magnitude of the electrical industry and the readiness with which electric service adapts itself to every condition. The Edison company is undertaking the task to promote the electrical industry and to familiarize the public with the possibilities and economy of electric service.

Manufacturers' Convention.—The sixteenth annual convention of the National Association of Manufacturers will be held at the Waldorf-Astoria Hotel, New York, on May 15, 16 and 17. The president of the association is Mr. John Kirby, Jr., and the secretary Mr. George S. Boudinot. The general offices are at 30 Church Street, New York.

Michigan Electric Convention.—The eighth annual convention of the Michigan Electric Association will be held on board the steamship *Minnesota* from June 19 to 22. The steamer will leave Grand Haven at about 9 p. m. on Monday, June 19, and will visit Sault Ste. Marie before returning to Grand Haven, at about 10:30 a. m. on Thursday. The fare will be $25 for the trip, including berth and meals. The president of the association is Mr. John A. Cavanaugh and the secretary Mr. Herbert Silvester, 18 Washington Boulevard, Detroit.

Divided Cost of Curb Lighting.—In Los Angeles the city pays one-eighth of the cost of the ornamental curb lighting on Hill, Broadway, Spring, Main, Fourth and Fifth Streets. The remaining seven-eighths is paid by the abutting property owners. Some of the city officials assert, however, that the city in reality has paid 35 per cent of the cost of lighting the streets during the present fiscal year, and it is proposed that in consequence the city be relieved from paying any part of the lighting cost during the next fiscal year, beginning July 1.

Improvements in Corona, Cal.—The Corona Electric Light Company, of Corona, Cal., is making some improvements in its transmission and distribution system. The 24-ft. poles on Main Street will be replaced by 35-ft. poles and the transmission line on West Sixth Street will be extended to Vincentia Street and south to Tenth Street to serve the new additions to the city. The high-tension wires will be removed from Railroad Street, leaving only the distribution circuits. Another improvement will be the placing of electric lamps at the intersection of alleys in the business section of the city.

Philadelphia Boulevard Lighting.—Arrangements are being made for installing 190 lamps of the so-called 2000-cp rating, arranged in pairs on either side of the center drive along Southern Boulevard in Philadelphia, and 420 70-cp tungsten lamps on the sides of the service driveways flanking the boulevard. The arc lamps will be placed on ornamental standards similar to those now used along Market and Chestnut Streets, while the incandescent lamps will be installed in single units on 10-ft. poles, each lamp being inclosed in a 16-in. glass globe. It is expected that about $75,000 will be appropriated for the equipments.

Keokuk Dam Construction in Full Swing.—Mississippi River hydroelectric energy for St. Louis from the great dam being constructed across the river at Keokuk, Ia., is now positively promised for delivery in 1913. Financial arrangements for the first 120,000-hp portion of the undertaking are reported to be completed and a large force of engineers, draftsmen and laborers is now at work on the site. The plan involves ultimate developments of 200,000 hp and 300,000 hp, with a 110,000-volt transmission line into St. Louis, 140 miles distant, and a power network furnishing hydroelectric energy to towns surrounding the development.

System Changes at St. Louis.—The Lewis Street Station of the Union Electric Light & Power Company, St. Louis, which was formerly the generating station of the Laclede Power Company, absorbed by the Union company, is now being operated by steam transmitted through a pipe line from the Ashley Street Station, a block distant, all boilers at Lewis Street having been shut down. The installation of a 4000-kw rotary-converter unit, soon to be placed in the Tenth and St. Charles Streets substation of the company, and the addition of further 12,000-kw turbine units to the Ashley Street plant, which now has a total rating of nearly 60,000 kw, will make it possible to close down the Lewis Street plant during ten months in the year, operating it only in the heavy peak season.

Chicago Section, I. E. S.—The monthly meeting of the Chicago Section of the Illuminating Engineering Society was held at noon on April 20 at a restaurant at 422 South Wabash Avenue. Mr. C. R. Gilman, of Milwaukee, read a short paper on "Recent Developments in Train and Car Lighting." There was some discussion. A committee was appointed to draft resolutions of regret at the death of Dr. Henry Gradle, an oculist and a member of the society. The May meeting will probably be held in the new building of the People's Gas Light & Coke Company, South Michigan Avenue and East Adams Street, when Mr. C. A. Luther, illuminating engineer for the company, will describe the lighting of this building. At the June meeting the subject for discussion will be "Daylight Illumination."

Entertainment by Long-Distance Telephone.—Mr. U. N. Bethell, president of the New York Telephone Company, entertained the Cliff Dwellers' Club at his home in Montclair, N. J., on April 10, by means of speeches, music, recitations, etc., which came over the long-distance telephone from points in some cases thousands of miles distant. Performers were stationed at New York, Boston, Asbury Park, Washington, D. C., Detroit, Chicago and Denver. From Chicago Mr. W. D. Nesbit made a regular after-dinner speech and from Detroit Mr. A. S. Hibbard, of the Chicago Telephone Company, sang a song. The feature of the Denver participant was a reading which came over the wires for about 2000 miles with perfect clearness. The talking from Denver was done over a phantom circuit made up of two pairs of loaded No. 8 wires. The event was one of great interest to Mr. Bethell's guests and was an exceptional demonstration of the comparative perfection now achieved by long-distance telephony.

Electrolytic Treatment of Water.—At the recent annual meeting of the Illinois Water Supply Association in Urbana, Ill., Mr. W. B. Bull, of Chicago, read a paper on "A New Method of Chemical Treatment of Water." The author described experiments whereby an electrolytic cell was utilized for the production of caustic soda by an iron dissolving agent, presumably HCl. This agent was introduced into a vessel containing iron shavings and produced an iron coagulant which was fed directly into the water to be treated, the water having previously received the caustic soda so as to insure complete neutralization of any CO_2 which might be present. The electrolytic cell was fed with a continuous stream of brine and fresh water. As the chlorine given off reacts with the water much more quickly in the presence of light, an electric incandescent lamp with a reflector was placed over the cell. Mr Bull declares that the coagulant can be formed by this means at about one-third of the ordinary cost.

Pittsburgh Convention of A. S. M. E.—The local Pittsburgh committee of the American Society of Mechanical Engineers, of which Mr. E. M. Herr is chairman and Mr. Elmer K. Hiles is secretary, having in charge the preparations for the convention of the society, which will be held in Pittsburgh from May 30 to June 2, as noted in our issue for March 16, has nearly completed the work of arranging the program for each day during the meeting. The headquarters will be at the Hotel Schenley. On the evening of Tuesday, May 30, there will be an informal reception in the hotel. Professional sessions will be held in the Carnegie Institute on Wednesday morning and evening, Thursday and Friday morning. In the meantime there will be a number of inspection trips to various industrial plants in the vicinity; a boat excursion for the members and ladies up the Monongahela River, a reception and ball at the Schenley on Thursday evening and, finally, on Friday evening, a smoker and entertainment, given by the Engineers' Society of Western Pennsylvania, in its rooms in the Oliver Building.

Electric Sign for Church.—Trinity Chapel, in West Twenty-fifth Street, New York, just off Broadway, it is announced, will have an electric sign to advertise to all who pass that a chance for prayer and meditation is offered.

Philadelphia Meeting of I. E. S.—At a meeting of the Philadelphia Section of the Illuminating Engineering Society held on April 21 Mr. E. C. Crittenden, of the Bureau of Standards, Washington, D. C., presented a paper entitled "An Experimental Study of Flame Standards."

Institute of Operating Engineers.—At the last meeting of the executive committee of the Institute of Operating Engineers Mr. Herbert E. Collins was elected secretary in place of Mr. M. W. Rice, resigned. Mr. W. P. F. Hill was elected treasurer in place of Mr. Adams Harkness, whose term had expired.

Veto of Nebraska Telephone Merger Bill.—Governor C. H. Aldrich of Nebraska has vetoed House Bill No. 537, generally known as the telephone-merger bill, recently passed by the Legislature of the State. The Governor enumerates eight objections, the first being that the bill aims at the control and monopoly of existing telephone business under one management.

No Redress When State Owns Telephones.—The Association of Telephone Subscribers of Paris, France, was nonsuited in its action for damages against the state for interruption of the telephone service after a fire at one of the big central telephone stations. The court threw the case out on the ground that the state could not be held responsible for any damages caused by the interruption of service.

Co-operation Between City of Chicago and Sanitary District.—A commission of engineers has been appointed to lay out a comprehensive plan for future work in which the city of Chicago and the Sanitary District are interested. It is pointed out that the construction work done by the city and the Sanitary District has oftentimes resulted in unnecessary duplication. The commission of engineers will report its findings to the Council.

Municipal Regulation of Public Utilities Upheld in Missouri.—The Supreme Court of Missouri has sustained the public utilities law in that State which allows municipal corporations to regulate the rates of public-service corporations. The question came up in the case of the Home Telephone Company against the city of Carthage, and on April 11 the Supreme Court overruled a motion for a rehearing in that case, and by doing so upheld the existing law.

Public Control of Street Railways Recommended in Pittsburgh.—In his report to Mayor Magee, after investigating the street-railway conditions in Pittsburgh, Mr. Bion J. Arnold, of Chicago, recommends strongly that there be public control of this utility so as to secure adequate service and at the same time a protected investment for the owners of the street-railway properties. Mr. Arnold recommends that a definite policy be adopted tending to secure comprehensive transportation for the entire Pittsburgh district. The city and the company should co-operate and make mutual concessions in working out the problem, with the end in view of complete public control of the entire transportation situation.

Kansas City Special to N. E. L. A. Convention.—Special-train service is being arranged for from Kansas City to New York by way of Chicago to connect with the Electric Light Special on the Lake Shore for conveying members to the convention of the National Electric Light Association to be held from May 24 to June 2. Persons who are contemplating attending the convention and who will travel by way of Kansas City should correspond with Mr. E. J. Bowers, assistant master of transportation of the N. E. L. A., 1500 Grand Avenue, Kansas City, Mo., who will look after their welfare, make all necessary reservations, arrange for party tickets from Kansas City, etc.

Corrosion of Iron in Concrete.—In the second paragraph on page 827 of our issue for April 6 appears a typographical error where it is stated that "The tests showed that where fresh water is used to moisten the concrete the corrosion per square foot of iron per year is 8 volts and the average amperage of the current applied in the tests ranges from 0.013 lb. to 0.122 lb. for fresh water and from 3.13 lb. to 7.42 lb. for salt water." This sentence should read: "The tests showed that where fresh water is used to moisten the concrete the corrosion per square foot of iron per year, at 8 volts and the average amperage of the current applied in the tests, ranges from 0.014 lb. to 0.122 lb. for fresh water and from 3.13 lb. to 7.42 lb. for salt water."

Lighting of Halls in Apartment Buildings.—There is a city ordinance in Chicago requiring that lights be kept burning in the public hallways of "tenement houses" more than two stories in height. Curiously enough, the law does not specify whose duty it is to keep these hall lights burning. It has been commonly understood, however, that it is the duty of the owner of the building to provide these safeguards. Any person who refuses to comply with the ordinance is subject to a penalty of not less than $10 nor more than $200. The subject has received some attention of late, some tenants complaining that landlords are neglecting to comply with this ordinance. It is suggested that where such violation exists the complainant shall notify the prosecuting attorney of the city.

Philadelphia's Electric Street Lighting.—Chief McLaughlin, of the Electrical Bureau of Philadelphia, in his report shows the overwhelming preponderance of arc lamps maintained by Philadelphia for street lighting as compared with the principal European cities. The report states that Philadelphia has over twice as many arc lamps on its public circuits as New York. The number of arc lamps in use in Philadelphia is 13,258; in New York (including the boroughs of Manhattan and the Bronx), 5500; in Berlin, 1055; in Paris, 1851; in Vienna, 1155; London, 400, and Brussels, 210. During 1910 Chief McLaughlin points out that there were 986 new arc lamps connected. The cost of maintenance in Philadelphia is $94.63 per lamp, and notwithstanding the number of new lamps added the contract for maintaining the city's electric street lamps for 1911 will be practically lower by 5½ per cent than the cost for 1910.

Four Years of Municipal Administration in Chicago.—In his final annual message, delivered April 17, Mr. Busse, the retiring Mayor of Chicago, reviewed the work of his four-year administration. During this period the reconstruction of the surface street-railway lines was begun and is now nearly completed. About 420 miles of street-railway track, costing approximately $50,000 a mile, has been laid, and over 2000 large double-truck cars have been put into service. The city's share of the "net receipts" of the street-railway companies, with accrued interest, received during this four-year period now amounts to $6,109,845. This traction fund may be drawn on for the construction of the proposed passenger subway. Several investigations of the subway problem have been made, and Mr. Bion J. Arnold, chief subway engineer for the city, has prepared general plans for a subway system. Mr. Arnold and his staff are now engaged in developing the engineering details necessary for the carrying out of his recommendations. Mr Busse also gave a brief history of the agitation for the electrification of steam-railroad terminals in Chicago, and said that this is one of the great questions which must be solved before Chicago is many years older.

HYDROELECTRIC DEVELOPMENT IN GEORGIA.

Plant of the Central Georgia Power Company at Lloyd Shoals, Ga.

ONE of the largest hydroelectric installations recently placed in service in the South is the plant of the Central Georgia Power Company at Lloyd Shoals, on the Ocmulgee River, about 8 miles southeast of Jackson, Ga. The market for the energy developed exists largely within the cities of Atlanta and Macon, lying within a radius of from 50 miles to 100 miles of the plant, including also various cotton mills which are being established at isolated points in the neighborhood. The ultimate development possible at Lloyd Shoals consists of a maximum of 25,000 hp and the present installation consists of six 3000-kva generating units direct-driven by waterwheels under a head of 100 ft. Electricity is transmitted to Atlanta and Macon at a potential of 66,000 volts over a double three-phase line carried on steel towers.

The slope of the river bed at the power-house location is abrupt, and at the site of the dam built by the company the valley is extremely narrow. The west bank of the river rises to a height of 120 ft. at a distance of only 150 ft from the edge of the channel. The opposite bank is less steep, although the abutment extends only 600 ft. from the water's edge. A total length of 1700 ft. was sufficient for the closing of the valley and the development of 100-ft. head at the plant site. The dam is a monolithic concrete structure, having a total length of 1050 ft. between abutments, with a 750-ft. spillway extending from the east abutment to a point near the center of the original river channel. The power plant was built between the end of the spillway and the west shore of the stream, the downstream face of the dam forming in part the rear wall of the station. The location of the plant beneath and at one face of the dam resulted in a simple hydraulic design. The river serves as its own forebay, and no canal, flume or elaborate penstock construction was necessary. Each unit is supplied with water by a short penstock, 12 ft. square, with flattened corners, leading through the dam to the wheelpit of the station, the wheels being of the central-discharge type with short draft-tube connections leading into the tailrace. The draft tubes are elliptical in section and are 11½ ft. x 15 ft. in dimensions at the discharge end. The discharge is carried directly downward from the wheels and deflects into the tailrace by an easy curve at the bottom of the tubes, so that the minimum amount of retardation is experienced through friction. The plant illustrates in this particular the tendency of designers to avoid reducing the wheel efficiency by leaving water passages in service where sharp corners or unsatisfactory curves may cause a partial impedance to the flow.

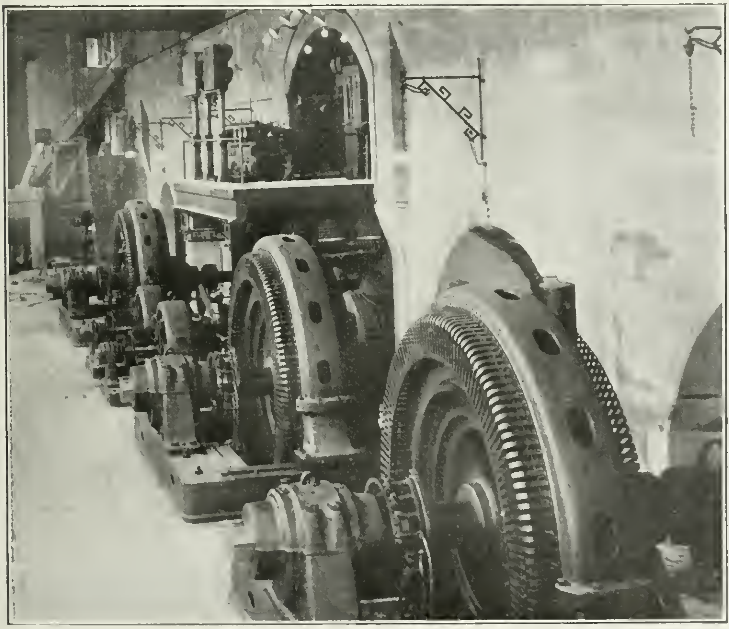

Fig. 1—Generating Room.

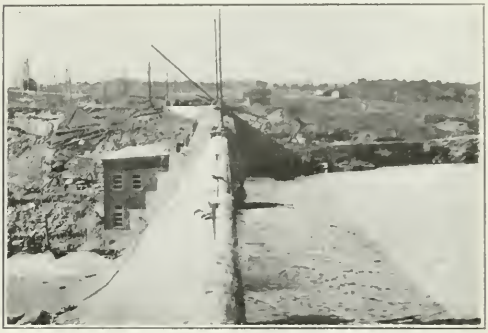

Fig. 2—Dam from East Abutment.

The west end of the power house is completed to the abutment of the dam, as shown in the accompanying photograph, and behind the abutment are located a 125-ft. section of retaining wall and earth embankment 150 ft. long with a concrete core wall. On the east bank is an earth fill 500 ft. long, which is built on a curve carrying it 400 ft. upstream. The foundation was excellent for supporting heavy masonry as both sides of the valley and a large part of the river bottom are of solid gray granite. The site is 6 miles distant from the nearest point on the Southern Railway, and is connected with it by a standard-gage railway built by the contractors for the plant.

The normal width of the river before the building of the dam was about 300 ft., and the ordinary depth 3 ft. to 4 ft., with a velocity of 3 ft. to 5 ft. per second. The average low-water flow approximates 1500 cu. ft. per second. The reservoir created by the dam extends back up the river for a distance of about 14 miles, and immediately above the dam the pondage widens to an extreme width of 1 mile. All the preliminary surveys and gagings of the stream flow, etc., were carried out by Messrs. Lockwood, Greene & Company, of Boston, Mass., who also prepared the plans for the dam and the power house.

The power plant is a brick and steel building 200 ft. x 45 ft. and two stories in height. The outer and division walls are of brick and are 20 in. thick at the first story and 16 in. thick at the upper story. Brick pilasters are provided for traveling-crane service. The floors and roof are of steel-beam and concrete-slab construction, the roofing being five-ply tar and gravel. The station cornices are of concrete and the windows are of wooden frame, sash and clear-glass construction. The downstream side of the station is on a line with the bed of the dam and its profile conforms to the slope of the dam. As a result the upper floor is stepped back one bay beyond the lower floor. The basement of the plant is devoted to draft tubes and tailrace discharge outlets, and is of concrete construction throughout. Separate discharge outlets are provided for each hydraulic unit.

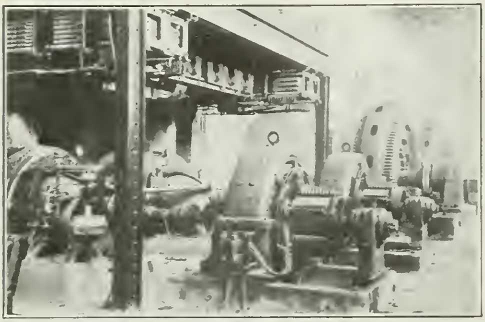
Fig. 3—Exciter and Generators.

The generating equipment of the plant consists of six 3000-kva, 2300-volt, three-phase, 60-cycle alternators, each direct-connected by a horizontal shaft to an S. Morgan Smith waterwheel operated at 300 r.p.m. There are two exciter sets in service, one being driven by a small waterwheel and the other by a motor. The exciters run at 550 r.p.m. and deliver direct current at 250 volts for station lighting as well as for field excitation. The main generating units are of the revolving-field type and all the electrical equipment was supplied by the Westinghouse Electric & Manufacturing Company. Couplings are installed in the generator shafts to facilitate disconnecting the machines from the waterwheels. The waterwheel governors are mounted in a recessed portion of the generator-room wall on the same floor level as the alternators. On the dam side of the building is located a switchboard gallery of concrete construction, the platform being carried on steel posts set into the generator-room floor. The entire operating-room is served by an electrically driven crane with cab for controller equipment. Behind the switchboard is a circular iron staircase leading from the main floor to the gallery and second floor. All the transforming and high-tension equipment of the station is located on the upper floor of the building, where ample space has been provided for safe operation. Power from the generators is carried through cables run in floor ducts to a set of 2300-volt busbars mounted in barriers in a bus compartment located above the switchboard gallery but below the high-tension division of the station. The path of the current is from a generator through the leads to a generator switch, to a bus switch, from thence to the busbars and to a transformer switch, through

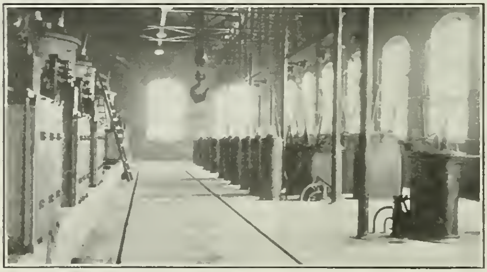
Fig. 5—Switches on High-Tension Floor in Power House.

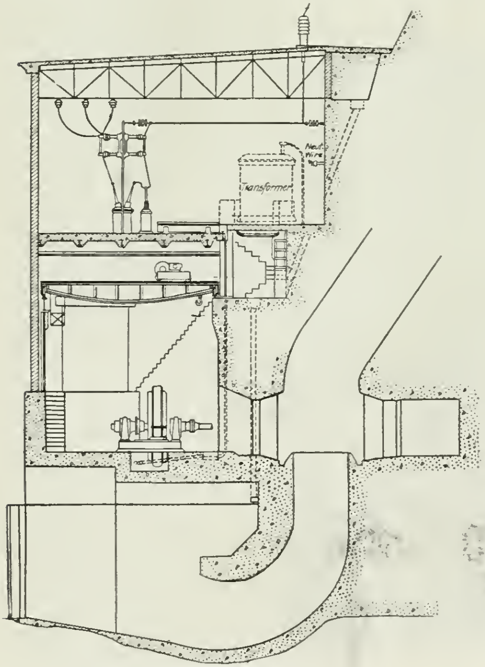

Fig. 4—Transverse Section of Power House, Showing Generator and Turbine Equipment.

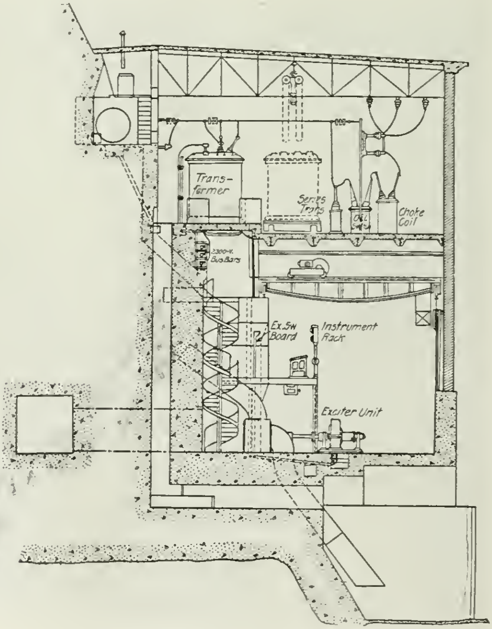

Fig. 6—Transverse Section of Power House, Showing Exciters and Controlling Apparatus.

the primaries of the step-up equipment. From the secondaries the power passes through an outgoing feeder oil switch with series-transformer connections and thence to the high-tension lines. Series transformers are installed in the generator leads for use in connection with switchboard instruments and overload relays. Each generator is controlled between its terminals and the 2300-volt busbars by a 1200-amp, three-phase Westinghouse oil circuit-breaker. The transformer equipment consists of six 3000-kva units of the three-phase type mounted on the floor of the second story. A chain hoist is provided for lifting out the core windings of any transformer and a transfer track is installed throughout the entire length of the second floor.

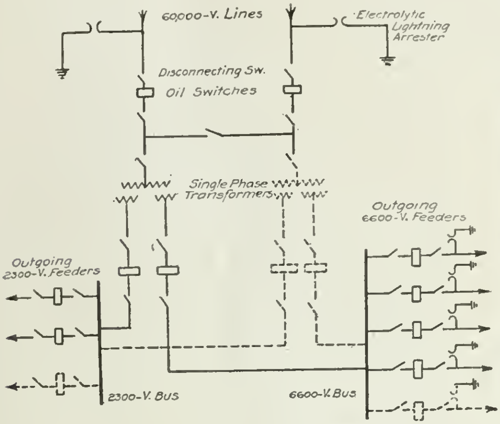

Fig. 7—Wiring Diagram of Macon Substation.

Each generator unit is connected to the 2300-volt busbars through a second 1200-amp oil switch, and also to the secondaries of the transformers through a third switch of the same type and size. Disconnecting knife switches are provided in the leads between the generator, the low-tension busbars and the transformer primaries. The connections permit the operation of any generator on any transformer, and the multiple operation of all transformers on the high-tension busbars. Normally each generator is operated on its corresponding transformer. On the secondary sides of the transformers the power is controlled by six 200-amp, three-phase, 66,000-volt oil circuit-breakers, equipped with trip coils operated by series transformers in circuit with the high-tension line. Choke coils are installed in each lead between the high-tension oil switch and the busbar. The low-tension and high-tension busbars are each divided into two sections by bus-junction switches. From each 66,000-volt bus section taps are taken off for the outgoing lines. There are two three-phase circuits carried on four-leg steel towers, the insulators being of the upright umbrella type. Each outgoing circuit is equipped with a 200-amp automatic oil switch. Disconnecting switches of the knife-blade type are installed between the choke coils and 66,000-volt busbars in each tap from the transformer secondary coils, and also between the high-tension busbars, the line oil switch, and between the latter and the external circuits. Taps leading to horn-gap and electrolytic lightning arresters are provided at the point of exit of the transmission circuits just outside the station building. The switching arrangements enable either line to be operated on the secondary of any transformer unit. The high-tension transformer primaries are connected in delta and the secondaries in Y, with a grounded neutral point. A steel ground wire is installed at the top of the transmission-line towers for additional protection against lightning. All busbars in the plant are sectionalized and fed by remote-control switches mounted on a deskboard set on the switchboard gallery. At the front of the deskboard and backed against the operating-room are installed the principal indicating and recording instruments. The alternator-field rheostats are located on the under side of the switchboard gallery and are thus provided with excellent ventilating facilities. The exciters are not controlled on the remote principle, but are connected with switching and indicating apparatus mounted on a special switchboard behind the deskboard.

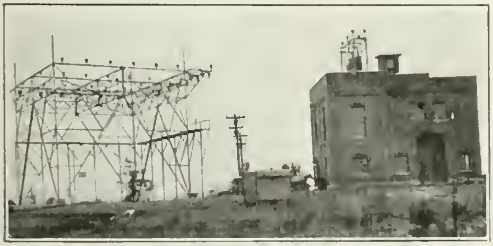

Fig. 8—Substation at Forsyth.

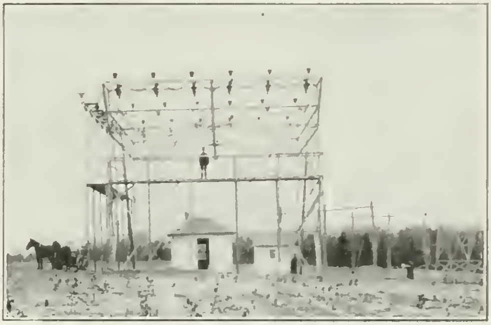

Fig 9—Sectionalizing and Branch-off Tower at Bibb.

Among the substations of the system that at Macon is most representative in construction. The same general features of design characterize all these installations. The high-tension lines are dead-ended on insulators carried on elaborate angle-iron framework outside the buildings. At Macon a single floor and basement are in service, the latter extending only half way across the building. The substation is of brick and steel construction, with concrete floors and foundations for the transformers and oil switches. The roof is carried on a light steel truss, the incoming line being carried on a steel tower on the top of the former. Westinghouse electrolytic and horn-gap arresters are installed on the roof. The electrical connections of this substation are shown in the accompanying drawing. The high-tension lines, two in number, are connected with the

Fig. 10—Substation at Griffin.

arrester equipment outside the building, and thence the power passes through disconnecting switches to high-tension oil switches located on the floor at the side of the station opposite the transformers. Beyond the oil switches in each case are two disconnecting knife switches, between which a bus tie line connects the two incoming circuits, a further disconnecting switch being provided in the tie. Each line then passes to its corresponding transformer primary. At Macon seven transformers are provided for, but only four are installed at present, three being used on one of the lines and a fourth held as a reserve. The transformers are rated at 1500 kw each, and the secondary connections provide for the delivery of 6600-volt and 2300-volt current for local distribution. Each low-tension feeder is provided with a set of disconnecting switches on each side of a central oil switch, which enables the circuit to be isolated in the most convenient manner at any time. Two sets of low-tension busbars are provided, but the busbars are not duplicated for any low-tension voltage, as in the generating station. The 6600-volt lines are protected with electrolytic lightning arresters in the same manner as the 66,000-volt circuits. The low-tension switches and busbars are located in the basement of the substation building. As in the main generating plant, the transformers are provided with a track running the entire length of the building to facilitate their removal in case of emergency. The substation apparatus are located at about the center of the building. Two oil pumps are installed in the substation and an air-compressor and storage-battery equipment are in service, the latter providing energy for the operation of the oil-switch tripping relays.

The work for the Central Georgia Power Company was handled in part by Messrs. J. G. White & Company, Inc., New York, and in part by Messrs. Lockwood, Greene & Company, Boston, Mass. The former firm received the general contract and prepared final detailed plans, while the latter firm acted in a consulting capacity.

ELECTRIC WELDING AND THE FUSING OF METALS.

By A. S. Hatch.

As it is the design of this article to consider incandescent or resistance welding only, since it is the only process which has similar characteristics to the fusing of metals in electrical protecting apparatus, we will first note the method of operation practised in the Thomson process.

The parts to be welded are clamped to the terminals of an alternating-current circuit having a potential on open circuit of from 3 volts to 6 volts. There is only sufficient metal between the clamps to form the weld, usually less than 1 in. except when welding large stock. When the circuit is completed current flows through the abutting metals, heating them to the point of fusion usually in a very few seconds, since in practice it is desirable to make as many welds as possible in a given time rather than to consume the least current. As soon as the proper temperature is secured the operator, applying a pressure of about 5000 lb. per square inch, forces the two pieces together into a perfect weld, the excess metal with the oxides and other impurities being forced outwardly into a fin which is rolled, hammered down or ground off as desired. Such a weld requires no flux, and when it is made at the right temperature without excess heat the joint is nearly as strong as the solid bar. Of a number of tests made at the University of Ohio on welded bars from ⅜ in. to 1 in. in diameter the poorest welds showed a tensile strength of 65 per cent of a solid bar, a majority of the tests showing about 75 per cent and some as high as 85 per cent.

From the above it is clear that the weld is purely the result of the heating effect of the current similar to that produced in an incandescent lamp. Therefore, since incandescent or resistance welding is based on the principle that in an electric circuit resistance generates heat, the weld must be at unity power-factor. In fact, of a number of welds made by the writer, the readings taken at the jaws of the welder showed in no case less than 98 per cent power-factor. However, in order to weld different sizes of stock in the same machine variation of output is obtained by switches or by a reactance coil in the primary circuit. This coil, with the construction of the welder, the shape of the material being welded, the method of compression, the time consumed in completing the weld and other minor conditions, determines the power-factor of the primary circuit. Even such a slight thing as putting the work between the jaws will vary the amperes of the primary circuit.

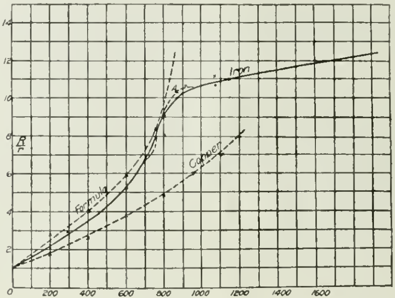

Fig. 1—Variation of Resistance-Ratio with Temperature.

Since the performance of the welder is judged by the input of the primary current, it is the power-factor which the central-station manager considers when he is applied to for service, and as under the usual mode of operating welders the power-factor is between 50 per cent and 70 per cent rather than between 75 per cent and 95 per cent they are not generally considered a very desirable load for the small station. The factors which enter into the operation to produce such a difference in the power-factors of the primary and secondary circuits are easily divided into two classes, first, those due to the construction of the welder and regulator or choke coil, which includes not only the design for the class of work to be done but also the time in which it is to be done; second, the external factors, which are legion. As an illustration of how simple a thing will affect the power-factor the clamps in a machine were so altered that the work could be reversed, which increased the factor about 10 per cent. A glance at the primary currents given in Table II shows the variation under seemingly the same conditions, possibly not all a magnetic effect either.

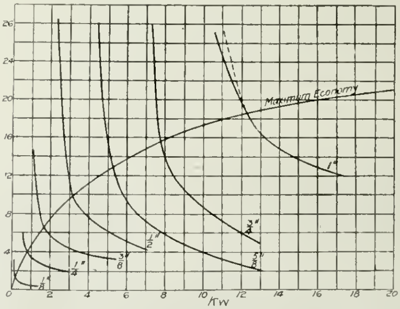

Fig. 2—Relation Between Time and Power in Kilowatts.

As welding machines are used more for welding iron than probably all other metals combined, it is usually thought the magnetic property of this metal has some effect on the power-factor. The readings of the table contradict such assumption, and further, demagnetization of iron occurs at the temperature of recalescence, 750 deg. C., while the welding temperature is usually about 1200, so that there can be no reluctance in the weld or produced by the iron during the process of welding.

TABLE I.

Degrees C.	10 Mils		13 Mils.		16 Mils.		18 Mils.		19 Mils.		1/8 In	[illegible] In
	Obs.	Est.	Obs.	Est.	Obs.	Est	Obs.	Est.	Obs.	Est		
15	.7	.6	.5	.4	.3	.25	.23	.2	.13	.125	.00045	[illegible]
200	1.5	1.72	1.2	1.15	.76	.72	.54	.57	....		....	
290	....	....	....	....	....	....	....	....	.38	.37	....	
400	2.42	2.44	1.72	1.63	1.0	1.02	.83	.82			....	
460	....	....	....	....	....	....	....	....	.59	.565	....	....
600	3.7	3.6	2.4	2.40	1.6	1.5	1.15	1.2	....	....	....	....
700	4.8	4.43	3.3	2.95	2.0	1.84	1.55	1.47	....	....	....	....
750	....	....	....	....	....	....	....	....	1.1	1.05	....	....
800	5.1	4.86	4.2	3.24	2.4	2.02	1.7	1.62	1.21	1.15	....	....
860	....	....	....	....	....	....	....	....	1.3	1.301	....	....
910	6.5	6.27	4.3	4.19	2.8	2.61	2.0	2.08	1.34	1.34	....	....
1,068	....	....	....	....	....	....	....	....	1.4	1.4	....	....
1,150	(Welding heat)		....	....	3.0	2.75	2.1	2.21	....	....	.0054	.000432

The lowest temperature a good weld can be made at is 1150, and if permitted to heat over 1350 the weld will be burned. Since the weld is at unity power-factor, the ratio of the current to the voltage gives the resistance at the welding temperature. The temperature at the weld is not always the same, since the operator judges the heat by the color of the metal, and in a good weld is considerably below the melting point, but above that of fusion as determined by the formula of Sir William Preece, which is also the same as that of Dr. A. E. Kennelly. In this the element of time is considered as infinite and consequently it gives a minimum value of *I*, or that required to fuse and not melt the metal. However, in welding the current is higher than that

TABLE II.

Method of Control.	I_2 by Preece's Formula.	Size of Stock Welded.	Average No. of Welds.	Time in Seconds.	E_1.	I_1.	W_1.	W_1 Sec. Integrated.	E_2.	I_2.	W_2.	W_1 per Square Inch.	Power-Factor Primary	Efficiency
Non-inductive	139	1/8" round iron	6	1.	220	2.	.372	.370	.8	210	168	13.8	.84	.46
Reactance coil		1/8" round iron	5	.98	220	2.2	.412	.410	1.	205	.205	16.7	.85	.50
Switches		1/8" round iron	5	.9	220	2.	.408	.370	1.2	210	.252	20.35	.93	.62
Switches[1]	393	1/4" round iron	8	2.7	220	12.	2.15	5.7	.99	1,960	1.94	39.5	.82	.90
			5	2.8	..	12.8	2.22	6.12	.99	2,040	2.02	41.2	.85	.90
			2	4.	...	10.	1.72	6.75	.98	1,170	1.15	23.4	.79	.67
			5	5.	224	13.	2.84	14.	1.	1,645	1.645	33.5	.92	.58
	723	3/8" round iron	9	5.27	220	21.9	4.13	21.3	.99	2,190	2.17	19.7	.88	.53
			3	8.93	220	17.3	3.44	30.	1.05	2,490	2.61	23.7	.91	.76
			3	4.	220	40.	6.	24.	1.05	4,330	4.55	41.3	.88	.76
Choke coil			20	15.8	85	27.	1.95	30.8	.78	1,800	1.4	13	.852	.719
			2	3.	220	50.	7.2	21.4	1.1	5,000	5.5	111.5	.655	.76
	1,110	1/2" round iron	2	6.2	220	46.	8.13	49.8	1.1	4,970	5.47	27.8	.805	.67
			9	9.6	220	33.3	6.1	58.2	.88	3,860	3.4	17.3	.831	.56
			2	4.	220	76.	14.	56.	1.05	6,680	7.0	35.6	.84	.50
Choke coil			20	21.5	100	42.	3.4	73.5	.7	3,400	2.47	12.25	.81	.73
Choke coil		9/16" round iron	5	18	190	71.6	7.66	134.	....	4,580	....	....	.565	....
Choke coil			4	5.1	185.2	106.3	15.15	58.4	....	6,800	....	....	.774	....
Choke coil			3	3.6	180.6	131.5	20.3	61.	....	8,400	....	....	.853	....
	1,550	5/8" round iron	8	10.85	220	62.6	11.12	120.	1.05	5,510	5.79	18.85	.805	.52
			4	12.5	220	53.5	9.15	112.2	1.	5,140	5.14	16.71	.779	.56
			1	17	220	53.	9.	149.8	1.	5,730	5.73	18.65	.775	.64
			2	3.5	220	147.	24.5	85.1	1.1	9,400	10.35	33.7	.76	.42
			2	5.	220	115.	16.4	82.1	1.1	8,270	9.1	29.6	.65	.55
			1	9.	220	77.	12.	108.	1.	5,850	5.85	19.	.71	.49
			3	11.	220	73.6	10.3	112.8	.98	5,880	5.77	18.8	.618	.55
Choke coil			12	15.	140	75.	8.5	127.	1.05	5,900	5.8	18.3	.808	.69
	2,024	3/4" round iron	7	11.6	220	98.5	18.8	214.	1.19	7,100	8.49	19.2	.814	.45
			12	16.4	220	85.3	15.6	251.4	.91	6,480	7.71	17.5	.811	.495
			2	7.	220	160.	28.	190.	1.17	9,600	11.23	25.45	.735	.40
			1	4.	220	170.	27.4	108.	1.20	10,900	13.1	29.7	.73	.47
			1	17.	220	100.	16.	267.	1.00	7,600	7.6	17.2	.73	.47
			10	22.2	160	90.	11.3	250.	1.13	6,450	7.16	16.26	.785	.633
	2,570	7/8" round iron	1	7.	220	270.	43.	298.	1.4	11,900	16.67	27.7	.76	.39
			..	9.	220	250.	40.	353.	1.20	12,000	14.4	24.	.78	.36
			..	12.	220	175.	27.5	324.	1.16	9,800	11.38	18.9	.75	.40
			..	17.	220	165.	23.	384.	1.12	10,550	11.8	19.6	.635	.515
	3,148	1" round iron	2	23.75	220	155.	25.1	583.	1.25	8,670	10.82	13.8	.726	.43
			1	33.	220	121.	19.4	627.	1.05	7,740	8.14	10.35	.73	.42
			6	17.4	220	172.4	28.2	481.3	1.34	9,450	12.66	16.1	.75	.45
		1 1/4" r'd iron	5	18.3	220	234.6	44.7	799.2	1.45	12,900	18.7	15.8	.87	.42
		1 1/2" r'd iron	5	17.	220	463.	67.2	1115.4	1.5	25,400	38.1	21.6	.66	.57
Choke coil		8 1/2"x3/4" flat	3	25.	138	800.	80.	1934.3	1.5	40,000	60	20	.73	.75
Choke coil		11"x1/2" flat	4	30.	196	800.	140.	4082.5	1.4	82,000	115	20.9	.89	.82
See Footnote 2		1/8" round iron	10	1.	220	.96	.200	.195	.76	210	160	13.	.95	.80
		1/4" round iron	10	3.	220	4.2	.825	2.55	.8	875	700	14	.945	.85
		3/8" round iron	10	7.	220	9.6	1.9	12.5	.83	1,900	1.6	14.5	.945	.85
		1/2" round iron	10	10.	220	17.	3.5	34.	.88	3,500	3.0	15.25	.945	.85
		5/8" round iron	10	12.	220	30.7	6.35	75.	.9	6,200	5.5	17.8	.94	.86
		3/4" round iron	10	15.	220	41.	8.3	121.	1.	7,300	7.2	16.3	.925	.87
		1" round iron	5	20.	220	87.	17.2	340.	1.1	13,800	15.0	19.1	.90	.86
		1 1/2" r'd iron	5	40	220	240.	47.5	1150.	1.3	31,400	40.5	23	.90	.85

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[1] Welder designed for these sizes of stock.

[2] These three machines were designed for these tests, and the proportions were based on the data of Table I

necessary, as it is desired to bring the metal to a welding heat quickly. Many fuses blow because they are too soft to support their own weight and not because they melt. It is this factor which gave open fuses the name of being unreliable, while the reason was more often that the composition or the dimensions, or both, had given the margin observed.

In 1890 the writer while designing some street-car heaters made a series of tests for resistance and temperature, particularly between the points of recalescence and fusing. These, together with one published in the *Electrical World* of April 19, 1890, are tabulated in Table I as the observed readings, while the estimated resistances are based on the published resistances of those sizes of wire and determined by the formula $R = r(1 + 7\,t \times 10^{-3} - 2\,t^2 \times 10^{-6} + 7\,t^3 \times 10^{-9})$. The averages observed and the estimated resistances are quite close up to the critical point of iron, 855 deg. C., with the exception of a slight excess at recalescence. From 855 deg. to the fusing point we have an entirely different curve, it being even less than that produced by the formula for platinum-silver alloy, $R = r\,(1 + 0.00031\,t)$. Fig. 1 shows curves plotted from the ratios of resistance at the given temperature to its resistance at the temperature of the surrounding air.

The temperature in Table I corresponding to welding heat is so called from the color, it being between a bright yellow and a dark white, and not because it was a welding heat at the time of the test.

In Fig. 1 that part of the curve above recalescence or the critical point, marked *a*, has not been studied very much for a comparison of resistance with temperature. A properly constructed welding machine affords an ideal method for such study. In fact, there is no other means by which accurate readings can be secured with very slight changes in temperature, and a small change in this section of the curve can produce a material error in the resistance due to the critical points of iron and steel. As the two retardations producing these points of flexure are about 30 deg. apart, the one which occurs in heating being the higher, a reversal, either lowering during a heating test or raising during a cooling one, will not give correct readings unless the critical points are passed and the readings repeated. Table I also indicates that the commonly accepted formula for iron, $R = r\,(1 + 0.006\,t)$, is too low, and even the formula suggested above is low in the upper part of the curve—that is, for the temperatures just preceding the point of recalescence. The resistance cold of the ⅛-in. and ⅜-in. round iron is estimated, but the resistance at welding heat is taken from the averages of the readings at the jaws of the machine.

As all the above heating tests were made with wire of small diameter it is interesting to note how closely the welding readings of the small rods agree with the small wires in the total rise in resistance. These comparisons confirm the conclusions arrived at in the second paragraph; furthermore, we should expect the watt-seconds per square inch to be quite constant, being varied only by the difference in radiation and conduction, and also that there is a time element where the watt-seconds are a minimum. This point should be with the highest power-factor—that is, with the lowest current. Again, since welding is at unity power-factor the shape of the cross-section, whether round, square or rectangular, should make no difference in the power consumed except for the difference in radiation and conduction. Table II is compiled from a number of welds made on different machines, with different methods of control, in different lengths of time, for the same cross-section, with different degrees of temperature at the point of welding and with different operators. For comparison there are inserted data taken from the published records on welding. As assumed above, the kilowatts at the clamps with the smaller sizes of stock increase quite closely with those of the cross-section, confirming the assumption made, and with the larger sizes the increase is less marked in the tests made on the experimental welder than with one having heavy inductance in the primary circuit. For this reason the most interesting curve in Fig. 2 is probably that of the kilowatts at the jaws as plotted to the time in seconds. The true or ideal curve is a conic section, consequently there is a point in the time of welding when the power consumed is a minimum and has the least effect on the potential of the supplying circuit. We thus see how easily wide variations are secured in tests made with only slight changes in the operation or in the construction of the machine, thereby illustrating the importance of the factors giving the highest power-factor as shown above. Again, a welder to give the most efficient results must be so designed that it can be adjusted for the work to be done when different classes of work are to be performed on the same machine. The common nomenclature is used in Table II, E for volts, I for amperes, W for kilowatts, the subscripts 1 and 2 referring to primary and secondary respectively.

So far iron is the only metal that has been considered, but all the commercial metals have been welded. The characteristics of the other metals—better electrical conductivity, less tensile strength, and generally with a melting point lower than that of iron—give quite different readings. The method of operation is entirely different from that of iron, so much so that the welding of some shapes of the softer metals has been thought by some to be impossible. The formulas for the increase in resistance with the increase in temperature of nearly all the other metals agree closely with the results determined in the higher temperatures, and consequently the curves are much sharper, thus necessarily requiring a different method of welding. Copper on account of its higher melting point is easier to weld than some of the other metals.

LOSSES IN SINGLE-PHASE ROTORS.—II.

Rotors of the Coil-Wound Type.

BY H. WEICHSEL.

IN connection with the derivation of the losses in rotors of the squirrel-cage type, as given in the issue of the *Electrical World* for April 20, it should prove of considerable interest to determine in a similar manner the losses in a wound rotor, such as is represented in Fig 2. In order to make a comparison of the two cases on the same basis it must be assumed in this instance that the stator main field has a triangular space distribution, but the same number of lines as in the first instance. In other words, the stator main field must exactly equal the field set up by the rotor, which in the case of an entirely distributed winding is triangular in shape.

The e.m.f. across the brushes *b-b′* due to rotation at synchronism will be equal to

$$E_b = z\,P\,N_o \frac{n}{60\sqrt{2}} \quad \text{(for parallel rotor winding)},$$

where

$$n = r.p.m. = \frac{120\,V}{P}$$

Substituting in the above equation, there is obtained

$$E_b = z\,N_o\,V\sqrt{2}$$

This e.m.f. across the brushes *b-b′* must be counterbalanced by a field N_b which by induction produces an e.m.f. equal in magnitude, but opposite in direction. Therefore,

$$E_b = 2.22\,g\,z\,N_b\,V_1$$

In this equation g is a coefficient depending on the rotor winding distribution. For the special case we are considering

$$g = 0.666$$

and

$$E_b = 1.48\,z\,N_b\,V_1$$

From these two equations for E_b the number of lines in the cross-field is found to be

$$N_b = \frac{E_b}{1.48\,z\,V_1} = \frac{z\,N_o\,V\sqrt{2}}{1.48\,V_1\,z} = 0.955\,N_o\,\frac{V}{V_1}$$

The magnetizing current necessary to produce this field is found by the following equations:

$$N_b = \frac{k i z}{Q}$$

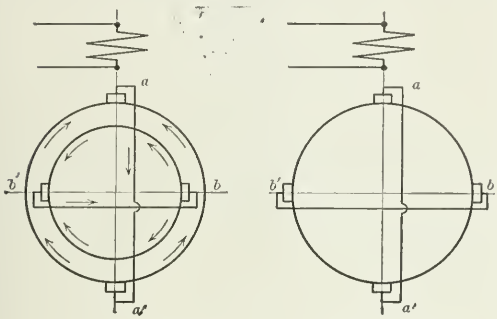
$k = 0.445$ for distributed winding.

$$Q = \frac{\delta}{\tau l} = \text{reluctance of air-gap.}$$

$$i = \frac{\delta N_b}{\tau l z 0.445} = \frac{i}{\sqrt{2}}$$

$$i = 3.18 \frac{\delta N_b}{\tau l z} = 3.04 \frac{\delta N_o}{\tau l z}$$

The value of the rotor-working current in this type of motor may be derived in a way very similar to that used for the squirrel-cage rotor. The relation between the rotor field and the space distribution of the rotor-working current is shown graphically in Fig. 3. It is evident that the torque of one conductor located γ degrees from axis a-a' can be expressed as



Figs. 1 and 2—Equivalent Circuits of Single-Phase Rotor.

$$T_q = k l B_\gamma \sin(\omega t) I \sin(\omega t)$$

From the relation of similar triangles it is known that

$$\frac{B_\gamma}{\gamma} = \frac{B_o}{\frac{\pi}{2}}$$

and

$$B_\gamma = \frac{2 B_o \gamma}{\pi}$$

Substituting this value in the equation for torque,

$$T_q = \frac{2}{\pi} k l B_o \gamma I \sin^2(\omega t)$$

The average torque acting on one conductor is

$$T_q = \frac{2}{\pi} k l B_o \gamma I \frac{1}{\pi} \int_0^\pi \sin^2(\omega t)\, dt$$

$$= \frac{k l B_o \gamma I}{\pi}$$

The arc occupied by one conductor is $\frac{\pi}{z}$ and, therefore, the torque produced by all the conductors per pole is

$$T_q = \frac{2 k l B_o I}{\pi} \int_0^{\frac{\pi}{2}} \frac{\gamma\, d\gamma}{\frac{\pi}{z}} = \frac{2}{\pi^2} k z l B_o I \left[\frac{\gamma^2}{2}\right]_0^{\frac{\pi}{2}}$$

$$= \frac{k z l B_o I}{4}$$

Referring to Fig. 3, it will be seen that

$$N_b = \frac{B_o l \tau}{2} = 0.955 N_o$$

and

$$B_o = 1.91 \frac{N_o}{l \tau}$$

Substituting in the equation for torque, there is obtained

$$T_q = \frac{1.91 k z N_o I}{4 \tau}$$

$$I = \frac{2.09 T_q \tau}{k z N_o}$$

The copper losses due to the magnetizing current may be expressed as

$$P_{cm} = \frac{i^2}{2} r z = 4.62 \frac{\delta^2 N_o^2 r}{\tau^2 l^2 z}$$

and the copper losses due to the working current are

$$P_{cw} = \frac{I^2}{2} r z = 2.18 \frac{T_q^2 \tau^2 r}{k^2 N_o^2 z}$$

There can now be obtained a comparison between the secondary copper losses in the wound-rotor and squirrel-cage types based on equal torques. The losses due to the magnetizing current are

$$P_{cw} \text{ (squirrel-cage)} = 3.855 \frac{\delta^2 N_o^2 r}{\tau^2 l^2 z}$$

$$P_{cm} \text{ (wound rotor)} = 4.62 \frac{\delta^2 N_o^2 r}{\tau^2 l^2 z}$$

Due to the magnetizing current, therefore, the wound rotor has $\frac{4.62}{3.855} = 1.2$ times the losses that the squirrel-cage motor has. The losses due to the working current are

$$P_{cw} \text{ (squirrel-cage)} = 1.625 \frac{T_q^2 \tau^2 r}{k^2 N_o^2 z}$$

$$P_{cw} \text{ (wound rotor)} = 2.18 \frac{T_q^2 \tau^2 r}{k^2 N_o^2 z}$$

Due to the working current, the wound rotor has $\frac{2.18}{1.625} =$ 1.34 times the losses that the squirrel-cage motor has. These results show the very important fact that for equal torques the wound rotor with commutator and two brushes per pole has from 20 per cent to 34 per cent more losses than the squirrel-cage motor, assuming the same number of conductors and the same resistance per conductor, or (which means the same thing) the same weight of copper, not considering the free ends of the wound rotor or the resistance rings of the squirrel-cage rotor.

The formulas just derived enable one to determine the rotor copper losses for any given torque. However, in the design and testing of single-phase induction motors it is often necessary to determine the rotor copper losses as a function of the slip. In the case of the polyphase induction motor the function is a simple one and may be expressed as follows:

$$\frac{P_c}{O} = \frac{s}{1 - s}$$

P_c = watts copper loss in rotor,
O = watts output of rotor,
s = slip.

For small values of slip it is sufficiently accurate to say that the copper losses are proportional to the slip in the polyphase motor. In the single-phase motor, however, the relation is somewhat more complicated, because one must consider separately the losses due to the rotor-magnetizing current and those due to the working current. It is evident that the first-mentioned losses decrease with the slip, while the latter increase with the slip.

Assuming sine-shape space distribution of stator and rotor currents, it can be said that the e.m.f. induced across a-a' by transformation, minus the e.m.f. generated across these points by rotation, must be equal to the impedance drop, as shown diagrammatically in Fig. 4. Here it is seen that

$$(E_{Ta} - E_{Ra})^2 = I^2R^2 + I^2\omega^2L^2$$

$$E_{Ta} - E_{Ra} = I\sqrt{R^2 + \omega^2L^2}$$

Where E_{Ta} represents the e.m.f. due to transformation in the axis a-a' and E_{Ra} is the e.m.f. due to the rotation in the same axis. R is the ohmic resistance in the axis a-a' and ωL is the apparent leakage reactance in axis a-a'. The output of any motor may be expressed as

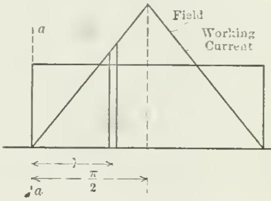


Fig. 3—Relation Between Rotor Field and Space Distribution of the Rotor-Working Current.

$$O = E_{Ra}I\cos a$$

$$\cos a = \frac{IR}{E_{Ta} - E_{Ra}} \quad \text{(see Fig. 4)}$$

$$O = \frac{I^2RE_{Ra}}{E_{Ta} - E_{Ra}}$$

Since I^2R is the total rotor copper loss, the above equation may be written

$$\frac{P_c}{O} = \frac{E_{Ta} - E_{Ra}}{E_{Ra}}$$

This equation is strictly correct even for a motor with leakage reactance. The only assumption made is that E_{Ta} and E_{Ra} are in time-phase opposition to each other. It is known further that the e.m.f. due to transformation can be expressed as

$$E_{Ta} = 2.22\,g_a z V N_o$$

$$= 2.22\,g_a z N_o \frac{n_o P}{120}$$

where

$$n_o = \frac{120\,V}{P}$$

And the e.m.f. due to rotation equals

$$E_{Ra} = N_b z \frac{nP}{60\sqrt{2}}$$

In the axis b-b' the e.m.f. of rotation is

$$E_{\ b} = N_o z \frac{nP}{60\sqrt{2}}$$

This e.m.f. must be counterbalanced by the e.m.f. produced by the lines N_b in axis b-b'. Therefore,

$$E_{Rb} = 2.22\,g_b z V N_b = 2.22\,g_b z N_b \frac{n_o P}{120}$$

$$2.22\,g_b z N_b \frac{n_o P}{120} = \frac{N_o z n P}{60\sqrt{2}}$$

$$N_b = \frac{\sqrt{2}N_o n}{2.22\,g_b n_o}$$

This substituted in equation for E_{Ra} gives:

$$E_{Ra} = \frac{N_o z n^2 P}{60 \times 2.22 n_o g_b}$$

The values of E_{Ta} and E_{Ra} may now be substituted in the expression for rotor copper losses:

$$\frac{P_c}{O} = \frac{2.22\,g_a z N_o \dfrac{n_o P}{120} - \dfrac{N_o z n^2 P}{60 \times 2.22\,n_o g_b}}{\dfrac{N_o z n^2 P}{60 \times 2.22\,n_o g_b}}$$

$$= \frac{2.46\,g_a g_b n_o^2 - n^2}{n^2}$$

Let $n = n_o(1 - s)$

Then

$$\frac{P_c}{O} = \frac{2.46\,g_a g_b n_o^2 - n_o^2(1-s)^2}{n_o^2(1-s)^2}$$

$$= \frac{2.46\,g_a g_b - (1-s)^2}{(1-s)^2}.$$

This equation is true regardless of the winding distribution of stator and rotor, but assuming that the e.m.f. of total self-induction in axis b-b' fully counterbalances the e.m.f. of rotation appearing in this axis. This means that the ohmic resistance drop is small compared to the reactance drop.

If the assumption be made of a sine-shape space distribution of stator field and a squirrel-cage rotor, it will be found that $2.46\,g_a g_b = 1$. For any other distribution of winding this coefficient will differ slightly from unity. In the case assumed, however, the final result obtained is

$$\frac{P_c}{O} = \frac{2s - s^2}{(1-s)^2}$$

For small values of slip s^2 is negligible and

$$\frac{P_c}{O} = \frac{2s}{1 - 2s}$$

This equation gives the secondary copper loss for the working current, I, when the slip is known. In some cases, however, it may be more convenient to determine the slip loss as a function of the loss at zero speed.

At standstill the current in axis a-a' is determined by the equation

$$I_k = \frac{E_{Ta}}{\sqrt{\omega^2L^2 + R^2}}$$

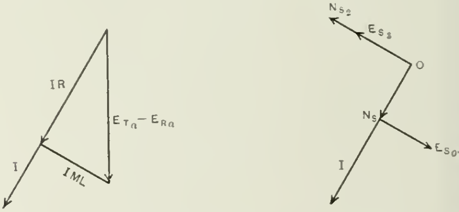
and the corresponding copper loss is

$$P_{ck} = I_k^2R = \frac{E_{Ta}I_kR}{\sqrt{\omega^2L^2 + R}}$$

At any other speed the copper loss is

$$P_c = \frac{(E_{Ta} - E_{Ra})IR}{\sqrt{\omega^2L^2C^2 + R^2}}$$

At any given slip the e.m.f. of rotation producing current in the axis a-a' has the following relation to the e.m.f. of transformation if a sine-shape of space distribution of the field be assumed.



Figs. 4 and 5—Relative Time-Phase Position of Currents and Voltages.

$$E_{Ra} = E_{Ta}(1-s)^2$$

Therefore,

$$P_c = \frac{E_{Ta}[1 - (1-s)^2]IR}{\sqrt{\omega^2L^2C^2 + R^2}}$$

$$= \frac{E_{Ta}(2s - s^2)IR}{\sqrt{\omega^2L^2C^2 + R^2}}$$

Dividing this equation by the equation for copper loss at standstill,

$$\frac{P_c}{P_{ck}} = \frac{I(2s - s^2)\sqrt{\omega^2L + R^2}}{I_k\sqrt{\omega^2L^2C^2 + R^2}}$$

This equation is strictly correct only on the assumption that the stator is without leakage or ohmic resistance, and that the e.m.fs. $E\ _a$ and $E\ _a$ are directly in time-phase opposition. This latter condition will be very nearly true for a rotor with small ohmic resistance and small magnetic reluctance in axis *b-b'*, as, under these assumptions, the e.m.f. E_{Rb} which appears in axis *b-b'* will produce a field which is practically 90 time-degrees displaced from it. The e.m.f. $E\ _a$ produced by rotation in this field must, therefore, be very nearly in time-phase with the e.m.f. of transformation E_{Ta}.

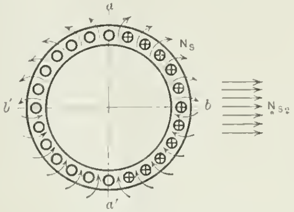


Fig. 6—Leakage Fields.

In the equation for P_c is introduced the factor C, which should indicate that the e.m.f. of leakage self-induction changes with the speed, as has been shown by Mr. Val. A. Fynn in the *Proceedings* of the (British) Institution of Electrical Engineers, December, 1907. In the following the value of the factor C will be determined. Referring to Fig. 5, let OI represent the secondary current. This will produce a magnetic leakage field N_S around the armature rotor conductor, as indicated in Fig. 6. These lines produce the leakage reactance voltage.

$$E_{S0} = I\,\omega\,L = 2.22\,k\,z\,N_S\,V \times 10^{-8}$$

and at the same time produce an e.m.f. of rotation across the brushes *b-b'*. If these brushes are short-circuited the resulting current will set up a magnetic field N_{S2} in the direction of the brushes *b-b'*. This field must be 90 time-degrees displaced from the rotor current, as shown in Fig. 5. Due to rotation in this field, an e.m.f. E_{S3} will appear in axis *a-a'*, and it is readily seen that this e.m.f. opposes the e.m.f. of self-induction E_{S0}. At synchronism these two e.m.fs. E_{S0} and E_{S3} will be equal and annul each other. At standstill the e.m.f. of rotation, E_{S3}, will be zero, and at any other speed it will be proportional to the square of the speed.

$$E_{S3} = (1-s)^2\,E_{S0} = (1-s)^2\,I\,\omega\,L$$

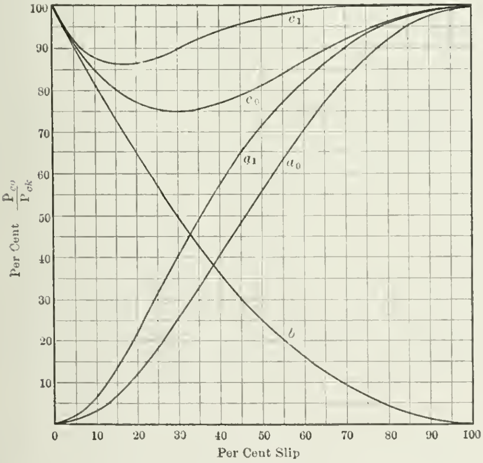


Fig. 7—Computed Losses at Various Slip Values.

The leakage reactance voltage which remains is given by the expression

$$E_S = (E_{S0} - E_{S3}) = [1 - (1-s)^2]\,E_{S0}$$
$$= (2s - s^2)\,E_{S0} = I\,\omega\,L\,C$$

and

$$C = (2s - s^2)$$

Substituting in the equation for $\frac{P_c}{P_{ck}}$ the values of C, I and I_k, where

$$I = \frac{E_{Ta} - E_{Ra}}{\sqrt{\omega^2 L^2 C^2 + R^2}} = \frac{E_{Ta}\,(2s - s^2)}{\sqrt{\omega^2 L^2 (2s - s^2)^2 + R^2}}$$

and

$$I_k = \frac{E\ _a}{\sqrt{\omega^2 L^2 + R^2}}$$

there is obtained.

$$\frac{P_c}{P_{ck}} = \frac{(2s - s^2)\sqrt{\omega^2 L^2 + R^2}\,(2s - s^2)\sqrt{\omega^2 L^2 + R^2}}{\sqrt{\omega^2 L^2 (2s - s^2)^2 + R^2}\,\sqrt{\omega^2 L^2 (2s - s^2)^2 + R^2}}$$

$$= \frac{(2s - s^2)^2\,(\omega^2 L^2 + R^2)}{\omega^2 L^2\,(2s - s^2)^2 + R^2}$$

and if, further, $\frac{\omega L}{R} = a$ the above equation can be expressed as

$$\frac{P_c}{P_{ck}} = \frac{(2s - s^2)^2\,(a^2 + 1)}{a^2\,(2s - s^2)^2 + 1}$$

When the leakage self-induction is small in comparison with the ohmic drop, that is, when a approaches zero in value.

$$\frac{P_c}{P_{ck}} = (2s - s^2)^2$$

This equation is graphically represented by curve a_0 in Fig. 7. This curve shows that the slip losses (copper losses) due to working current increase nearly proportionally to the square of the slip for small values of slip. For slip values above 40 per cent (approximately) the losses increase less rapidly.

Curve a_1, Fig. 7, represents the same equation, but under the assumption that $a = 1$; that is, that the rotor current at standstill has a time-phase displacement of 45 deg. against the e.m.f. $E\ _a$.

In a similar way the rotor copper losses due to currents in axis *b-b'* can be expressed. In this case, however, it is more convenient to express the slip losses as a function of the losses occurring at synchronism. Assuming, as in the first case, that the field has sine-shaped space distribution, the current in axis *b-b'* at synchronism is given by the expression

$$i_0 = \frac{E_{Rb}}{\sqrt{\omega^2 L_b^2 + R^2}} = \frac{E_{Ta}}{\sqrt{\omega^2 L_b^2 + R^2}}$$

where L_b is the total self-induction (including leakage self-induction) in axis *b-b'*.

At any other speed.

$$i = \frac{E_{Ta}\,(1-s)}{\sqrt{\omega^2 L^2 b + R^2}}$$

and the ratio of losses due to currents in axis *b-b'* occurring at any given speed to the losses occurring at synchronism is given by the expression

$$\frac{P_c}{P_{co}} = \left(\frac{i}{i_0}\right)^2 = (1-s)^2$$

This equation has been graphically represented by curve *b*, Fig. 7. The total losses due to working current and magnetizing current are represented by curves c_0 and c_1, for the cases of zero leakage reactance, and for leakage reactance equal to resistance, respectively. Both of these curves show that there is a certain slip where the armature copper losses reach a minimum.

The total rotor copper losses may be represented by the equation

$$P_c = P_{co}(1-s)^2 + P_{ck}\frac{(2s-s^2)^2(a^2+1)}{a^2(2s-s^2)^2+1}$$

This value reaches a minimum for the speed determined by

$$\frac{dP_c}{ds} = 0$$

The first part of the equation is easily differentiated.

$$\frac{dP_{co}(1-s)^2}{ds} = P_{co}(2s-2)$$

For differentiating the second part there may be written,

$$2s - s^2 = x \text{ and } P_{ck}(a^2+1) = A$$

Then

$$\frac{P_{ck}(2s-s^2)^2(a^2+1)}{a^2(2s-s^2)^2+1} = \frac{x^2 A}{a^2x^2+1} = \frac{U}{V}$$

$$\frac{d\frac{U}{V}}{dx} = \frac{V\frac{dU}{dx} - U\frac{dV}{dx}}{V^2}$$

$$U = Ax^2, \qquad \frac{dU}{dx} = 2Ax$$

$$V = a^2x^2 + 1, \quad \frac{dV}{dx} = 2a^2x$$

Substituting the above values,

$$\frac{d\frac{U}{V}}{dx} = \frac{2Ax(a^2x^2+1) - 2a^2Ax^3}{(a^2x^2+1)^2}$$

$$= \frac{2Aa^2x^3 + 2Ax - 2a^2Ax^3}{(a^2x^2+1)^2}$$

$$= \frac{2Ax}{(a^2x^2+1)^2}$$

This equation may now be reduced to a function of s.

$$x = 2s - s^2$$

$$\frac{dx}{ds} = 2 - 2s$$

$$\frac{d\frac{U}{V}}{ds} = \frac{2Ax(2-2s)}{(a^2x^2+1)^2}$$

To fulfil the condition $\frac{dP_c}{ds} = 0$,

$$-P_{co}(2s-2) = \frac{2Ax(2-2s)}{(a^2x^2+1)^2}$$

Substituting $A = P_{ck}(a^2+1)$ and simplifying the equation,

$$\frac{P_{co}}{P_{ck}} = \frac{2(a^2+1)x}{(a^2x^2+1)^2} = \frac{2(2s-s^2)(a^2+1)}{[(2s-s^2)a^2+1]^2}$$

A graphical method for solving this equation may be used by plotting the relation of P_{co} to P_{ck} as a function of s. There would, however, be a separate curve for each value of a; two of these are given in Fig. 8, where curve a_0 shows the relation for the case of zero leakage reactance, and curve a_1 for the case where leakage reactance equals resistance.

For $a = 0$ the equation becomes

$$\frac{P_{co}}{P_{ck}} = 2s(2-s)$$

For the very small fractional values of s the value of s^2 can be neglected as compared with s, and the equation is,

$$\frac{P_{co}}{P_{ck}} = 4s(a^2+1)$$

$$= 4s \text{ (when } a = 0)$$

$$= 8s \text{ (when } a = 1)$$

These curves, or the equations just given, enable one to find, for any known relation of $\frac{P_{co}}{P_{ck}}$, the slip at which the rot losses are at a minimum. It is evident that for any we designed motor the value of P_{co} is always very much smal than P_{ck}, and that the minimum rotor copper losses occur at speed very close to synchronism.

Assuming, for instance, that the value of P_{co} is 10 per ce of P_{ck}, it is found from the curves that the minimum copp losses occur at a slip of 2.5 per cent when $a = 0$, or at a s of 1.5 per cent when $a = 1$.

From the above treatment it is to be noted that a single-pha induction motor having a wound rotor with commutator a four brushes for each pair of poles has from 20 per cent to per cent more losses, not including brush losses, than has corresponding squirrel-cage motor developing the same torqu assuming the resistance per bar to be the same in the two case

The total copper losses in the rotor can always be e pressed as

$$P_c = P_{cb} + P_{ca},$$

where P_{cb} are the copper losses due to the rotor magnetizi current in axis b-b' and P_{ca} are the copper losses due to t working current in axis a-a'. This equation is true regar less of the winding distribution and time-phase displacemer of the currents.

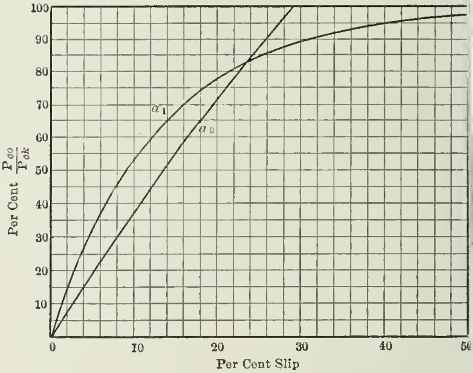


Fig. 8—Copper-Loss Ratios at Various Slips With and Withou Leakage.

Neglecting the copper losses due to the rotor-magnetizin current, the rotor losses can be expressed as

$$P_{ca} = O\frac{2s}{1-s}$$

O = output of motor.

s = slip.

This equation holds true for squirrel-cage rotors even wher the leakage reactance voltage is considered; however, it assumed that the speed is close to synchronism.

The space-phase displacement between rotor current an e.m.f. of rotation can be measured by the relation

$$\tan a = a = \frac{\omega LC}{R}$$

Since C is a function of slip, there may be written

$$\tan a = \frac{\omega L}{R}(2s - s^2)$$

$$= \tan a_0 (2s - s^2)$$

The rotor losses are not a minimum at synchronism, but at certain value of slip which is a function of $\frac{P_{co}}{P_{ck}}$, as given Fig. 8, where P_{co} = rotor loss in axis b-b' at synchronisr P_{ck} = rotor loss in axis a-a' at standstill.

RECENT PROGRESS IN THE FIXATION OF ATMOSPHERIC NITROGEN.

By John B. C. Kershaw.

CONSIDERABLE progress was reported during the year 1910 in the industrial development of furnaces and processes for the fixation of atmospheric nitrogen. It is estimated that 100,000 hp is already applied to these processes of manufacture, and that by the end of 1911 this total will be more than doubled.

The methods in use may be divided into two broad classes. To the first belong the processes in which a direct union of the oxygen and nitrogen of the air is effected, the air being brought to a very high temperature by means of a large and extenuated form of electric arc. To the second class belong those processes in which the nitrogen of the air is caused to combine with calcium carbide to form calcium cyanamide. The present article is confined to the processes of the first-mentioned class in operation upon a commercial scale at the present date.

So far, the chief success with these processes has been secured in Norway, whose high-head water-power enables an electrical hp-year to be developed in many cases at the extremely low charge of about $5. There seems no proof as yet, however, that the fixation processes can be worked successfully in countries where the lowest charges for energy are double or treble this amount. Improvements in the design and yield of the furnaces for the arc processes are, however, widening the area within which they can be successfully operated, and it is by no means beyond the bounds of probability that in the course of the next few years we may witness successful installations of this character in the United Kingdom and in America. Several plants for the production of calcium cyanamide have already been started in North America.

The Birkeland and Eyde process is one of the oldest successful direct-combination processes, having been operated at Notodden, in Norway, since 1905. The latest developments in connection with the enlarged works erected by the Aktieselskabet Notodden Saltpeterfabrik, at Notodden, in 1907, have been described by the two inventors, Mr. Eyde and Professor Birkeland, in papers read before the Society of Arts and the International Chemical Congress in London, May, 1909. The works at Notodden now contain thirty-six 1500-hp furnaces, replacing the three original 800-hp units. Eight of these large new furnaces are run in series. The air is blown into the electric arc or flame disk, which is 10 ft. in diameter and about 4.5 in. in thickness, through ducts and openings arranged radially in the walls of the furnace.

The Svaelgfos power station, from which the Notodden works derive their energy, is about three miles distant on the Tinn River. A dam has been constructed which raises the level of Lakes Tinnsjoen and Mosvand by 56 ft., and by means of a tunnel and four almost vertical channels cut through the solid rock an effective head of 140 ft. is obtained at the power house. The turbines are four in number and are each of 10,000 hp to 11,000 hp capacity. They run at 250 r.p.m. and produce normally 40,000 hp to 45,000 hp. They were constructed by the firm of Voith in Heidenheim, Germany. The generators were built by the Allmänna Svenska Elektriska Aktiebolag at Vesteras, Sweden, and are three-phase machines, delivering in each phase 600 amp at 10,000 volts.

As regards the financial results the output of nitrates at these works in 1908 was valued at $555,000, and the total expenses amounted to $415,000, leaving a net profit of $140,000. The average power used during 1908 was only 13,000 kw. For 1909 the British consul at Christiania reports that the new industry has been working under fairly favorable conditions, but that lack of water-power has prevented the factory attaining the output of 20,000 tons expected when the plant was completed. The actual production figures in 1909 have been: Nitrate of potassium, 12,600 tons; nitrates of soda, 2,700 tons; nitrate and nitrite of soda, 370 tons; total, 15,670 tons. Owing to the low prices which ruled during the year the profits were less than in 1908. A plant for the manufacture of nitrate of ammonia was erected at Notodden in 1909.

Professor Birkeland in December, 1908, patented a new form of furnace in which an elongated form of revolving arc takes the place of the disk arc of the earlier type of furnace. The electrodes are placed at a considerable distance apart, and a magnetic field is set up within the furnace by an external coil. The arc is started by moving one electrode near to the other. When separated the flame rotates within the chamber of the furnace, and the air, which is blown in through openings at one end, is carried round with the arc flame and brought into intimate contact with it before escaping from the other end of the furnace. In this way ample opportunity is obtained for heating the air and for thorough mixing of the products of combustion with the excess air.

Experimental trials with this new type of furnace are at present being carried out in Norway, and it is possible that it may ultimately replace the earlier type now installed at Notodden. So far the factory at Notodden is the only one operating the Birkeland and Eyde furnace.

The Badischen Anilin und Soda Fabrik type of furnace was patented in 1905 and consists of a double-walled iron tube along the axis of which a column of arc flame is made to burn steadily and quietly by ingenious yet comparatively simple means. The air is blown into the tube with a tangential direction and comes into intimate contact with the arc, causing it to elongate in an upward direction. By use of circulating water the gases are quickly cooled and decomposition of the already formed nitrous gases is prevented. The exit gases leaving the tube contain, it is stated, 2 per cent of nitric oxide, or about one and a half times as much as that obtained in the earlier Birkeland and Eyde type of furnace.

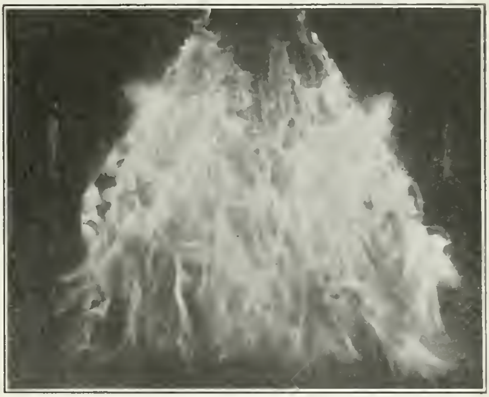


Fig. 1—Pauling Form of Arc Discharge for Nitrogen Fixation.

An experimental factory for trial of this furnace was erected by the Badischen company at Fiskaa, near Christiansand, in Norway in 1907, and the trials have led to valuable results. Three-phase, 4200-volt energy is employed, the 600-hp furnaces being connected in star and each containing a flame arc of 16.5 ft. in length.

The temperature of the flame is believed to be about 3000 deg. C. along its entire length, and the incoming air attains this temperature gradually during its passage up the tube. At Christiansand the air is preheated to 500 deg. C. before entering the furnace and leaves it through a water-cooled header at 1200 deg. and containing 2½ per cent of NO. These exit gases give up another 350 deg. of their temperature in heating the incoming air, and then pass through a steam boiler which utilizes 30 per cent of the total heat available, generating steam for the engine-driven apparatus used to concentrate the gases later. The gases from the furnace, now at 200 deg. C. to 300 deg. C., are then absorbed in caustic alkali liquor and worked up for calcium nitrite according to the method described in German patent No. 188,133, granted to the Badischen Anilin und Soda Fabrik.

In the 1000-hp furnace using a higher voltage the arc length is increased to about 23 ft., and about 40,000 cu. ft. of air is required per hour. Still larger furnaces, up to 2000 hp, are now being tried at Notodden to determine the size best suited for the large works to be equipped in the interior of Telemarken, on the Rjukan. The energy actually used in the formation of the nitric oxide, according to Schönherr, amounts to only 3 per cent of the total required by these processes, but a large amount of the heat energy of the arc is recovered in other ways. An investigation of the Badischen furnace at work has shown that 40 per cent of the heat of the arc is obtained in hot water, 30 per cent is recovered in the steam boiler, and that another 10 per cent can be recovered from the gases by water-cooling after they have passed through the boiler. The actual loss of heat is, therefore, 17 per cent, and is put down to radiation.

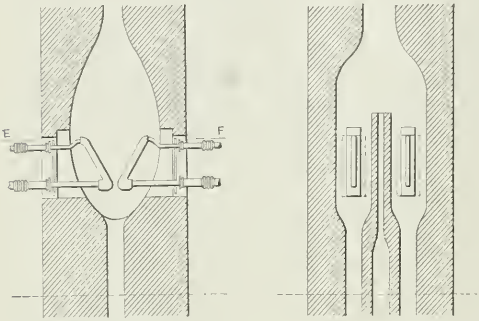


Fig. 2—Sections Through 400-kw, 4000-Volt Pauling Furnace.

The Badischen Anilin und Soda Fabrik type of furnace is to be employed at the nitrate factory now being erected for utilizing the immense water-power development on the Rjukan, in Norway, and will also be used at a factory at Burghausen, in south Bavaria, and at some yet undetermined locality in northern Italy. Of these schemes the first named is most advanced, and two new Norwegian companies with a combined capital of 34,000,000 kroner ($9,460,000) have been floated to finance the developments, the Badischen company having combined with the Notodden company in promoting these new undertakings. There are two developments of the Rjukan water-power, the upper fall, which is expected to produce 140,000 hp, being the first dealt with. Ten 14,000-hp water-turbines driving 11,000-volt, 50-cycle, three-phase alternators at 250 r.p.m. are to be installed. According to Director Bernthsen the power station and factory will be ready for operation in 1911. The nitrate produced will be carried by twenty-nine miles of new narrow-gage railroad to Lake Tinn, and from there steam ferries will transport it twenty-five miles to Notodden. The lower fall of the Rjukan, capable of producing 110,000 hp, and other water-powers on the Matre and the Tyn, in west Norway, have also been acquired by the Norsk Kraft-Aktieselskabet and will be held in reserve for future use. In a comparatively few years, therefore, the Badischen furnace and process may be producing 100,000 tons of nitrate per year from the nitrogen of the air. Although no figures for the cost of operating the Badischen process have yet been made public, one may assume that it will yield rather more favorable results than other processes, since the furnaces are of simpler construction and the yield of nitric oxide is higher.

A third system of nitric-acid and nitrate production which has attained trial upon an industrial scale is that invented by the brothers H. and G. Pauling and now being employed by the Saltpetersaüre Industrie Gesellschaft, at Patsch, near Innsbruck, in Austria, and by a French company at La Roche de Rame in the High Alps, Savoy. An Italian plant is also in course of erection.

The process employs flaming arcs formed between two hollow iron conductors similar in shape and design to the well-known horn lightning arresters, giving the discharge form shown in Fig. 1. The arc is started at the narrowest point of the open V by secondary conductors, is carried upward by the current of air blown in from below and breaks at every half period of the alternating-current cycle only to be renewed again at the lowest point. The main electrodes are of iron, are water-cooled and produce an arc 1 m in length at the widest point. They last about 200 working hours. An opening about 1.5 in. in width is left at the narrowest gap, the arc-starting electrodes projecting into this space within a fraction of an inch of each other. These secondary conductors are designed to offer minimum resistance to the air current, but require frequent readjustment as their ends are quickly burned away. The gases are cooled after passing through the flame chamber by air blown into the upper part of the furnace chamber. A concentration of 1.5 per cent of nitric oxide is said to be obtained with this type of furnace. The furnaces, shown in Fig. 2, are built of brick, each inclosing two flame-arcs, which consume 400 kw at 4000 volts. Each furnace requires 600 cu. m of air per hour, not including the cooling-air supply. At the present time twenty-four furnaces are installed at the Patsch works (Fig. 3), the control of these being so simple that one man can superintend the work of six furnaces. The yield of nitric acid is 60 grams per kw-hour.

The present capacity of the Patsch works with all the furnaces in operation is, therefore, 576 kg per hour, or 4608 tons of nitric acid per year. The hot gases leave the furnaces at a temperature of 700 deg. C. to 800 deg. C., their heat being utilized for heating the incoming air and for concentrating the acid or solutions of nitrate. The Innsbruck factory, shown in Figs. 4 and 5, now utilizes 15,000 hp. Its success has been sufficient to warrant the erection of works for operating the same process and furnace in the south of France and in the north of Italy. These new works are each of 8000 hp capacity. The former has been built and is operated by La Nitrogène Société Anonyme, at La Roche de Rame in the High Alps. Power is obtained from a fall on the Biaysse, a tributary of the River Durance, four sets of turbo-generators, each of 2000 hp, being installed. The nitrous gases, at a temperature of 700 deg. C., pass through apparatus in which a portion of their heat is given to the incoming air, and then through two brick cooling towers. These gases are then forced by fan action through the oxidizing chamber, or tower, 70 ft. high and 33 ft. in diameter, and finally through five absorbing towers, in which the nitric acid is produced. A sixth tower is employed for concentrating the acid furnished by the other five and all strengths of nitric acid testing from specific gravities of 1.332 to 1.515 are produced. The acid is exceptionally pure, being

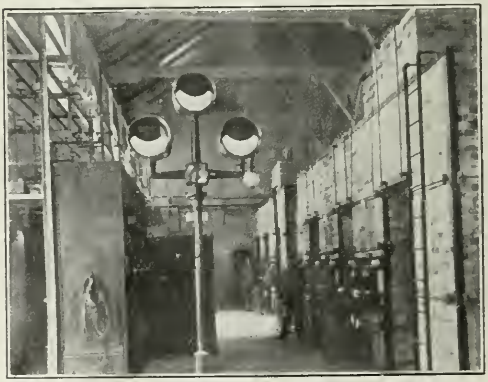


Fig. 3—Interior of Patsch Plant, Showing Arc Furnaces.

quite free from sulphates or chlorides, and meets with a ready sale. The nitrous gases which have escaped oxidation are used for the production of sodium nitrite.

The yield of the Pauling furnaces is from 60 grams to 70 grams of nitric acid per kw-hour.

The Moscicki furnace and process are the invention of Messrs. Kowalski and Moscicki and are being operated by the Société de l'Acide Nitrique at Fribourg in Saxony. Few details of this installation have yet appeared in print, but as two separate companies have been formed to exploit the process it must be assumed that the experimental plant at Fribourg has achieved some success. The early type of furnace used by these inventors was planned on the Bradley and Lovejoy model. It involved a large number of arcs and the use of alternating currents of relatively high potential—25,000 volts to 50,000 volts. In their earlier experiments at Vevey, Switzerland, the inventors obtained a maximum output of 440 kg nitric acid per kw-year when using a current of 0.05 amp, and a frequency of discharge of 6000 cycles to 10,000 cycles per second, at a pressure of 50,000 volts. This method failed on account of the high cost of installation. Increase of the electric energy in each flame was followed by a decrease in the efficiency of the process, and the resulting large number of flames necessitated complicated and expensive apparatus for control purposes. In the new form of apparatus devised by Moscicki the principle of magnetic deflection of an arc flame is employed. Two concentric ring-electrodes of copper are used and the arc passes from the inner to the outer ring in a radial direction. A magnetic flux draws the hottest portion of each arc flame down into the annular space between the two rings and the revolving arc takes on the appearance of a luminous ring of flame which fills the space between the two electrodes. The air or gases are forced through the revolving arc flame under pressure and are quickly cooled by contact with the outer metallic electrode through openings into which they escape. Assuming that all the conditions and dimensions of the early experimental trials have been found suitable for the 500-kw furnaces now being operated, only 17.5 cu. ft. of air or gas will be required for each kw-hour of flame-energy, as compared with 87.5 cu. ft. in the ordinary types of flame-arc furnace. A minimum yield of 60 grams of nitric acid per kw-hour can be obtained with the furnace and the most recent results have proved that this yield can be increased.

Haber and Koenig, in a recently published article, give the figures printed in the next column for the yields and concentrations obtained with the three leading processes of nitric-acid production from the air.

Fig. 4—Nitrate Factory at Patsch, Austria.

It has been calculated by Haber from thermo-chemical data that theoretically one kw-year should produce 1000 kg of nitric acid. Without making any allowance for the heat recovered it may be estimated from this figure that the thermal efficiency of the Schonherr furnace is about 63 per cent.

As regards modifications of the existing furnaces and methods of working a very large number of patents have been granted during the past three years. Many chemists are directing their investigations toward the improvement of the yield obtained from the Birkeland and Eyde and Badischen type of furnace; and it is probable that in the near future gas mixtures containing not 2 per cent of nitric oxide, but treble and quadruple this amount, will be obtained with little or no alteration in the furnace design. Thus Haber and Koenig have proved that by using a gas mixture containing 50 per cent of oxygen the concentration of nitric oxide can be increased to 14.4 per cent. The use of Nernst filaments as electrodes also increases the yield of nitric oxide. In the opinion of these investigators the reaction between the oxygen and nitrogen of the air is not purely thermal in character, and by use of an "ionizing" arc flame like that produced with Nernst electrodes the oxidation of the nitrogen occurs at a much lower temperature than has hitherto been supposed.

Fig. 5—Water-Power Plant and Nitrate Factory at Patsch, Austria.

	Grams Nitric Acid per Kw Hour	Concentration Per Cent of NO
Pauling Process.	60	1 to 1.5
Birkeland and Eyde	70	2
Schönherr....	75	2.5

Sir William Ramsay has also turned his attention to the subject and has suggested separating the atmosphere into its two constituents, oxygen and nitrogen, by the fractional distillation of liquid air. The oxygen would then be employed in the electric arc method of nitric acid manufacture, and the nitrogen for the production of calcium cyanamide by the Frank and Caro process. This plan for its successful operation would therefore involve the erection and working of the two rival nitrogen-fixing processes side by side. Du Pont, of the Nemours Powder Company, has patented a process which has points of resemblance to both the Birkeland and Eyde and Badischen processes. A long tube of quartz glass is used, with electrodes at each end. The arc which forms between these electrodes is deflected and kept in rotation by means of a series of rotating magnetic fields, each successive field along the length of the tube being of reversed polarity to those on either side of it. In this way the arc is caused to rotate and to move from side to side of the tube, and the air in its passage through the tube has to pass through the arc as many times as the arc is deflected.

Haber and Koenig have patented the use of reduced pressure and intentional cooling of the arc flame. Reduced pressure alone produces no change in the yield, but when allied with a reduction in the temperature of the arc it is easy to produce gases containing 9.5 per cent to 10 per cent nitric oxide when using air, and 13½ per cent to 14 per cent when using a 50 per cent mixture of oxygen and nitrogen gas.

The pressure is maintained at not more than one-half atmosphere, and electrodes of metal or of calcium and magnesum oxide are employed. The cooling is effected automatically, since the arc, which at ordinary pressure assumes the form of a thin rod, under reduced pressure expands and touches the walls of the tube which, being cooled artificially, remove the heat from its flame. In this way discharge flames are produced which do not inclose the zone in which nitric oxide gas is decomposed again into nitrogen and oxygen. The patent, No. 938,316, for this modified process has been assigned to the Badischen company.

Whether it will prove economical to adopt any or all of these patented modifications of the methods of working the furnaces and processes now in practical operation will doubtless be decided by practical trials in the course of the next two years.

Central Station
Management, Policies and Commercial Methods

MUNICIPAL-OWNERSHIP DEFEAT AT LINCOLN, ILL.

Lincoln, Ill., a city of 10,000 inhabitants, has had during the past five years a contract for street lighting with the Lincoln Water & Light Company at a very low rate. In January bids were advertised for street lighting for five years after March 1, 1911. The Water & Light Company presented the only bid, which was a considerable advance over the existing price. The bid was rejected and the lighting committee of the Council secured figures on a municipal lighting plant.

On Feb. 25 the company started a publicity campaign, giving facts on municipal ownership, showing what the general experience had been with municipal ownership in the past and estimating the lowest possible cost of operating a municipal plant such as was proposed by the lighting committee. The reasons for increasing the price of street lamps were also given.

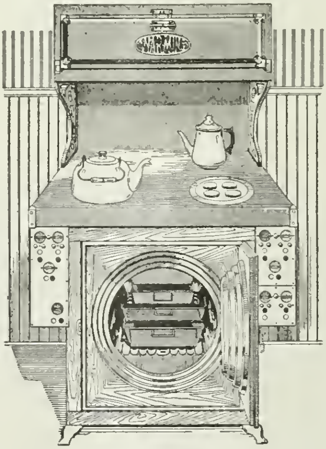
On March 1 the contract expired, but the company continued the street lighting without a contract for two weeks, when a temporary contract was made, extending to May 1, the last date on which the company could use the present lamps, owing to the replacement of the 133-cycle equipment with 60-cycle equipment.

It was brought to the attention of the business men, through the company's advertisements, that the city must necessarily be dark after May 1 unless a contract was immediately made, and on March 27 the Council met for the purpose of passing an ordinance submitting municipal ownership to a popular vote. On the same evening the directors of the newly organized Commercial Club met and appointed a committee to visit the Council chamber immediately and ask that Council postpone action until the lighting committee could confer with the directors of the Commercial Club. The Council meeting was adjourned until the following evening, and the lighting committee was asked to name an hour at which it would meet the Commercial Club directors.

The next afternoon the lighting committee and the Commercial Club directors held an executive session lasting several hours, during which the information published in the company's advertisement was gone over and fully discussed. When the Council reconvened in the evening the municipal-ownership ordinance was unanimously laid on the table and the Council unanimously approved a proposal from the lighting company for a new contract. The contract gives the company a net return of about $600 per year more than the former contract and precludes any further consideration of municipal ownership for at least five years.

The publicity campaign was undertaken by the Public Service Publishing Company of Chicago, under the personal direction of Mr. Glenn Marston.

CONTINUOUSLY CONNECTED ELECTRICAL COOK STOVES IN CLEVELAND.



Continuously Connected Electric Cook Stove.

Among the residence consumers of the Cleveland Electric Illuminating Company there are now in use about fifteen of the continuously connected electric ranges, the idea of which is due to Mr. M. E. Turner, contract agent of the company. This stove, employing the fireless-cooker principle and having its interior held at a cooking temperature of 400 deg. Fahr. by the continuous night and day operation of a 150-watt heating element, was designed to avoid the short-hour heavy demands of equivalent electric cooking aparatus. Its thermal insulation and heat-storage capacity enable the energy delivered to it continuously throughout the twenty-four hours to be held and conserved for cooking purposes at any time. The 400-deg temperature continuously maintained serves for baking, roasting, boiling or any kind of cooking except frying. For broiling, in addition to the 150-watt continuous heater in the oven, there is an 1800-watt incandescent-type broiler element mounted directly over the shelves. In the intense radiation of this broiler and at the oven temperature meat is quickly done to a turn. The broiler cannot be left on, however, with the oven closed, which might endanger overheating, since the oven door is fitted with an arm which presses the "off" push-button of the broiler switch when the door is closed. The oven is cylindrically shaped to present the least heat-conducting surface, and is thoroughly insulated against radiation and conduction. It is spacious enough to hold the largest turkey.

On the shelf or top of the oven are four electric hot plates, two taking 100 watts at low heat and 400 watts at high heat and two others each taking four times as much power. These hot plates are useful for all cooking operations, including frying. Food that has been cooked is kept warm in a special warming box above the oven, also electrically heated. All of these special heaters, including the hot plates, broilers, warmer and the continuous heater, are controlled by push-button switches mounted at the side of the range. Each circuit is also equipped with different-colored indicating lamps behind a glass lens of the switchboard type, showing at a glance what heaters are in use and whether they are operating at high or low heat.

While the present type of range has its continuous heater fitted with a switch, the newer forms will have the oven element connected directly to the lines so that it cannot be turned off except by opening the main house switch. With the oven thus maintained always at cooking temperature the customer will be encouraged to cook with the heat available rather than to turn on for a short time one of the hot plates having a large demand. All cooking appliances on the Cleveland company's lines come under its secondary charge of 5 cents per kw-hour, their demand not being figured into the bill. After practical experience customers have expressed themselves as well pleased with these electric stoves. The heat is of a peculiarly uniform quality, and is supplied to the cooking food from all sides as well as the bottom once the oven is heated. The monthly bills of consumers where these stoves are in use have ranged from $6 and $8 to $15. Of this $5.40 is probably due to the 108 kw-hours consumed by 720 hours' or 30 days' continuous operation of the 150-watt heater at the 5-cent rate.

SHOWCASE, WINDOW, OUTLINE AND SIGN LIGHTING.

At the convention of the Minnesota Electrical Association held in St. Paul, March 14, a paper on the subjects of "Showcase Lighting, Display-Window Lighting, Outline Lighting and Sign Lighting" was presented by Mr. T. R. Wilwerschied, of St. Paul. The speaker deplored the lack of assistance thus far given merchants in lighting their showcases and declared that this field represents a large income for the central-station company. Department stores and those larger merchants who could afford to experiment until they found satisfactory showcase lighting attest the advertising value of these displays, but the electric company's expert should be equipped to see that the little customer can profit in the same manner, while in the meantime the company secures connected service of good load-factor. Outline lighting, said Mr. Wilwerschied, is another department in which the new-business solicitor fails to realize his opportunities. Outline lighting is a powerful advertising force now monopolized by big businesses. Meanwhile the smaller merchant, convinced of the high cost of such an installation, takes no trouble to investigate. The lighting solicitor should demonstrate to these possible users that the expense is not excessive, but entirely within their reach. Mr. Wilwerschied, after long experience in the manufacture of electric signs, declares that for practical reasons central-station companies should supervise the signs erected on their line. This arrangement, he thinks, enables the customer to obtain through the company and at the lowest price the best grade of sign construction, insuring lasting satisfaction. Safe and proper mechanical and electrical construction is also assured. The interest of the local electrical solicitor also serves to close many negotiations that would otherwise drag along and might eventually be given up. In the case of some progressive companies, declared the speaker, the gross income for "advertising lighting," exclusive of all other street lighting, reaches $1 and more per capita.

Mr. H. J. Gille, of Minneapolis, in discussing Mr. Wilwerschied's paper, pointed out that until recently showcase lighting has been impossible on account of the construction used by the cabinet builders. The tungsten lamp has greatly changed conditions in outline lighting as in electric signs, effecting the rapid development of the latter more than any other agency. A display once costing $100 a month to operate with carbon-filament lamps now costs $25 per month with tungsten lamps. Mr. Gille also spoke of the changes in sign construction and the favor with which municipal authorities now regard electric signs, as sources of both beauty and illumination. Mr. Wilwerschied recounted his own successful experience with 2.5-watt tungsten sign lamps, no renewals being needed in three months' operation after the first weaklings were eliminated, although the loss during these first weeks reached almost 40 per cent. Mr. F. J. Benson said the cost of the 2.5-watt sign lamps is the same as the 5-watt lamps, but the introduction of the smaller units is yet under consideration from a policy viewpoint on account of their reduced energy consumption. Mr. Findlay suggested that, without reducing the wattage of a given display, the smaller lamps might be placed closer together, improving the effect of continuity of designs. Mr. R. W. Clark advocated a change of sign-lamp size in the direction of 10 watts, if at all, rather than 2.5 watts, since he considers that the smaller lamps may give too dim a display and so would not be conducive to the perpetuation of the business. Mr. J. B. Crane spoke of the way in which ornamental post lighting may detract from signs and vice versa. Mr. H. Schroeder, of Harrison, N. J., told of the large range of sizes, from 2.5 watts to 25 watts, in which low-volt lamps are now manufactured, and spoke of the use of candelabra-base sign lamps in indoor show-window displays. Mr. H. E. Griffin suggested a little missionary work on the part of electrical men in mentioning the use of electric signs and devices to merchants and others, wherever these could be used to advantage. Such propaganda benefits the industry, and Mr. Griffin told of some direct results gained from one instance of this kind.

CENTRAL STATION FACTS AND FACTORS FROM IOWA.

Mr. Austin Burt, of Waterloo, Iowa, who is the facts and factors committee of the Iowa Electrical Association, made to the convention of that body at Davenport on April 11, 1911, the most complete report on Iowa central stations yet compiled. His first report, made in 1909, tabulated facts and factors from twenty-six companies. This table appeared in the first issue of the *Electrical World* for May, 1909. The form of the report is, in the main, the same as that used by the *Electrical World* in tables appearing in the issues for April 29, 1909, June 24, 1909, and Jan. 13, 1910.

Mr. Burt's 1911 report contains results from thirty-one companies. The table is given in full herewith. Inquiries were sent to 148 companies and thirty-one available replies were received. The returns were unsigned.

In estimating net earnings on investment 2 per cent depreciation was allowed on the investment. Some of the factors Mr. Burt considers erratic, but he thinks the averages good.

For comparison with the 1909 report the averages for each group are given for both 1909 and 1911.

STATION NUMBER	Population of District	Number Consumers per 100 Population.	Station Rating.	Station Rating per Capita.	Station Rating per Employee.	Ratio Station Rating to Connected Load.	Average Load During Operation.	Ratio of Average Load to Station Rating.	Annual Load Factor.	Investment per Kilowatt of Rating.	Investment per Capita.	Gross Income per Kilowatt of Rating.	Gross Income per Consumer.	Gross Income per Capita	Gross Income per $100 Invested.	Gross Income per Kw-hour Made.	Ratio Expense to Gross Income.*	Net Earnings per $100 Invested.†	Total Hours of Operation per Year.
	Number	Number	Kilowatts	Watts	Kilowatts	Per Cent	Kilowatts	Per Cent.	Per Cent.	Dollars.	Dollars.	Dollars.	Dollars.	Dollars.	Dollars.	Cents	Per Cent.	Dollars.	Hours
1	700	13.4	70	100	70	200.0	10.0	14.3	30.0	100	10.00	50 00	37 20	5.00	50.00	15.9	40.0	....	2,196
2	750	13.3	75	100	37	115.0	45.0	60.0	80.0	66	6.66	40.00	30.00	4.00	60.00	21.1	50.0	....	3,110
3	800	11.3	40	50	40	....	...	....	....	187	9.40	45.10	20.10	2.26	24.10	....	62.8	6.60	2,160
4	1,200	11.1	100	83	33	. .	11.9	11.9	7.5	259	21.60	74.00	55.70	6.16	28.60	10.2	70.0	5.72	6,050
5	1,300	14 9	65	50	22	....	8.8	13.5	11.6	338	16.90	176.00	93.30	5.38	31 80	10.0	77.6	3.64	8,000
6	1,300	20.2	50	38	25	33.0	9.8	19.6	24.3	270	14.20	133.00	25.30	5.13	36.10	17.2	83.9	2.34	3,987
7	1,500	10.0	100	67	50	100.0	....	. .	30.0	136	9.60	68.00	45 30	4 53	49.90	.. .	99.0	-5.10	6,500
8	1,500	10.0	60	40	12	31.0	11.4	19.0	19.0	367	14.60	125.00	50.00	5.00	34.10	7.5	66.7	7.96	8,760
9	1,600	4 1	100	62	33	83.0	....	...	....	90	5.60	72.00	107.50	4.50	81.00	....	77.5	10.00	2,600
10	1,750	16.1	150	86	75	100.0	15.8	10.5	19.8	100	8.60	51.50	27.60	4.42	51.60	8.2	85.7	2.23	6,000
11	2,000	7 2	120	60	30	. . .	27.9	28.2	56.0	200	12.00	60.80	50.70	3.65	30.40	3.3	91.2	-.38	7,800
12	2,000	6.0	75	37	25	112.0	23.9	31.9	....	180	6.75	72.00	45.00	2.70	40.00	8.8	86.2	1.48	2,555
13	2,000	9 1	55	27	18	67 0	29.9	54.0	60.0	273	7.50	129.00	39.00	3.57	47.50	7.4	64.7	12.10	3,240
Average, 13	1,415	11 9	82	62	36	93.4	19 4	26.3	33.8	205	11.03	84.30	48.20	4.33	43.50	10.9	73.4	4.23	4,840
Average, 10–1909.	1,600	10.0	67	42	27	93.5			36.0	236	10.00	94.00	37.00	4.06	38.00	..	70.0		....
14	2,500	13.0	100	40	20	50 0	30.0	30.0	43.7	250	10.00	131.50	40.40	5.26	52.60	7.1	80.7	91	6,120
15	2,500	18.0	155	62	26	32.0	37.9	24.4	31.6	229	14.20	98.20	30.50	5.48	38.60	4.16	66.2	8.82	8,700
16	2,600	8.8	250	96	50	83.0	27.4	10.9	23.7	120	11.55	55.60	60.40	5.35	46.40	5.82	77.3	5.87	8,730
17	3,000	10.8	125	42	21	.	....	....	. . .	160	6.67	48.00	18.40	2.00	30.00	....	80.0	10 00.	6,500
Average, 4.	2,650	12.7	157	60	29	55.0	28.4	25.1	33 0	190	10.61	83.20	37.40	4.52	41.90	5.70	76.1	6.39	7,620
Average, 8–1909.	2,470	10.0	122	44	38	47 6				221	9.40	95.00	43.00	4.04	41.00	. ..	63.0	..	....
18	3,200	11.7	125	39	25	103.0	20.1	16.1	22.0	256	10.00	88.60	29.60	3.46	34.60	6.66	77.9	4.16	8,270
19	4,000	11.9	250	63	15	43.4	58.0	23.2	22.0	294	18.40	125.30	65.90	7.83	42.50	6.16	61.4	12.18	8,760
20	4,000	15.3	370	93	53	86.0	35.4	9.6	36.2	157	14.52	54.00	32.60	5.00	35.00	11.00	57.5	11.18	5,143
21	4,500	11.5	180	40	26	90.0	25.0	13.9	35.0	352	14.43	90.40	31.30	3.62	25.10	7.43	85.5	1.12	8,760
22	5,000	7.2	210	42	26	62.0	51.0	24.3	19.0	241	10.13	61.80	36.40	2.59	25.60	3.50	58.3	8.14	7,250
23	7,800	11.5	300	39	50	59.0	63.0	21.0	26.0	187	6.40	111 00	37.00	4.27	66.50	6.03	55.5	23.00	8,760
Average, 6	4,580	11.5	239	53	33	73 8	42 1	18.0	26.7	248	12.30	88.50	38.75	4.46	38.25	6.78	67.1	9.95	7,720
Average, 3–1909.	5,670	10 0	285	51	37	50.0	.			202	10.00	85.00	42.00	4.40	49.00	....	56.0	...	....
24	10,000	10 8	833	83	114	87.0	120 0	14 3	21.6	264	22.00	73.20	50.70	6.10	27.80	5.81	51.2	10.72	8,760
25	10,500		2,000	190	200	...	....	. .	....	....	....	....	....	....	....	....	. .	....	....
26	14,000	10.1	850	61	77	43.0	77.0	9 1	23.5	300	18.20	60.00	36.30	3.65	20.00	7.57	59.6	6.04	8,760
27	18,000	4.3	1,350	75	193	111.0	146.0	10 8	19.3	296	22.20	39.70	73.20	2.97	13.40	4.22	59.0	4.13	8,760
28	20,000	8.4	1,000	50	56	39.0	222.0	22.3	26.0	250	12.50	87.40	51.70	4 37	34 90	4.48	50.0	13.96	8,760
Average, 4	14,500	8 4	1,206	92	128	70.0	141 0	14.1	22.6	277	18.70	65.70	52.95	4.27	24.10	5.52	54.7	8.71	8,760
Average, 2–1909.	15,500	5.0	775	50	71	67.0	. ..	..	22.0	139	8.00	60.00	60 00	3.20	54 00	....	71.0	...	....
29	33,000	9.53	2,200	66	91	31.0	519.0	23.6	28.1	432	28.80	82 90	57.80	5.52	19.20	4.02	50.2	7.67	8,742
30	48,000	3.19	1,275	27	106	50.0	283.	22 2	37.0	580	15.40	77.40	64.30	2.06	13.30	3.98	43.8	6.17	8,760
31	86,000	5.80	5,200	61	45	46.0	1158.0	22.3	29.4	612	37.10	81.40	84.70	4.92	13.35	4.17	52.9	4.95	8,760
Average, 3.	55,600	6 17	2,890	51	81	43.0	653.0	22 7	31 5	541	27.20	80.50	68.90	4.17	15.27	4.06	48.9	6.26	8,750
Average, 3–1909.	53,000	5 00	2,110	46	262	42.0		. . .	24.0	195	9 00	88.00	79.00	3.50	42.00	...	51.0	....	....
Gr'd Av'ge, 31.	14,920	10 62	576	64	51	72.0	117.0	22.0	30.1	252	13.85	82.10	47.60	4.36	36.80	7.75	67.5	6.63	6,710
Gr'd Av'ge, 26–1909.	9,411	9 00	401	44	63	56 0	. .		32.0	220	9.60	89.50	46 00	3 93	41 60	. . .	64.0	...	.. .
Gr'd Av'ge, 1911 and 1909.	11,760	9.90	494	55	56	65.0	....	.	30.6	237	11.95	85.50	47.20	4.17	38 85	....	65.9	....	....

* Excepting depreciation. † With depreciation 2 per cent.

Stations are divided into five groups according to population, as indicated by the table, and the average for each group is given as are the grand averages for all.

The number of consumers per 100 population increased in each group over 1909. The station rating per capita also increased in a still greater proportion. The author expressed the belief that this fact is good evidence that the tungsten lamp has not cut the demand.

The connected load is much nearer the station rating in small plants than in the large ones. The smaller stations are enjoying higher gross revenues per kw-hour than the larger ones.

In the discussion of Mr. Burt's report some question was raised as to the method used for determining the average loads and load factors, using as a basis only the hours operated instead of the total hours per year. It seemed to be agreed that from a financial point of view the total hours per year should be the basis, while from the operating engineer's standpoint the average load during the time of operation is of more interest. Both might well be given.

LIGHTING AND ELECTRICAL EQUIPMENT OF A CENTRAL-STATION OFFICE BUILDING.

By Ross B. Mateer.

To use electricity for lavish display lighting, charging the cost to advertising, is the prevailing idea among central stations. In many instances the customer is persuaded to advertise for his own benefit, the central station calmly watching the consumer use the energy and forgetting that what is good for the consumer may prove advantageous to the company itself.

In planning the exterior of the new office building now occupied by the Denver Gas & Electric Company, Denver, Col., ample provisions were made for display lighting. The result is said to be the best lighted building in the world. The exterior presents a pleasing appearance during the day, while at night it is the brightest spot in the city, as the great number of people using Fifteenth Street, the main artery for traffic, will testify.

The exterior is of glazed white terra cotta and 9000 lamps of varying candle-power are used for night illumination. While the brilliancy characterizing the exterior is noteworthy, yet the interior is no less interesting. The main floor is scientifically lighted with tungsten lamps, the electric fixtures having satin-finished prismatic glass shades. The counters are of tile with vitrolite tops. All the woodwork used in office fixtures is African mahogany. The eye is attracted both by the brilliancy of the exterior and the beauty that characterizes the plain, yet striking, interior.

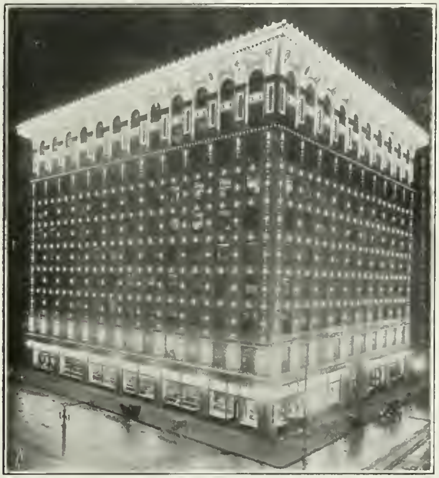


Fig. 1—Denver Gas and Electric Company's Office Building by Night.

Some, not satisfied with mere display, exhibit the sagacity of the business man, whose forte is the mechanical end and the approximate cost. The questions asked lead to the disclosure of the most interesting and instructive part of the entire building. Elaborate exteriors are dwarfed before motor-operated pumps, the substation and the transformer rooms that occupy the basement.

What would the lamp-studded front of the building be without energy at night? Would one recommend steam-operated house pumps or deep well pumps in a building that represents the highest development in buildings of its class?

In the basement is installed an Ingersoll-Rand air compressor. It was designed for this building. The cylinders are 12-in. x 12-in. and 6½-in. x 10-in. The compressor is belted to a 60-hp Westinghouse motor and is used in connection with the artesian well 749 ft. in depth. The compressor, operating at a pressure of 135 lb., forces the water to the 10,000-gal. storage tank in the basement.

Two 3-in. single-stage centrifugal pumps, manufactured by the Buffalo Steam Pump Company, elevate the water 165 ft. to the huge storage tank located upon the roof. From this tank all the water used in the building is distributed by gravity pressure. Each pump is direct-connected to a 10-hp 500-volt "Northern" motor. The motor on the compressor and those on the house pumps are equipped with floats and an automatic starting device. Two sump pumps of 1½ hp each are installed in the boiler-room and one of the Union Steam Pump Company's vacuum pumps, operated by a 15-hp Crocker-Wheeler motor, is installed in the basement. The elevators, manufactured by the Otis Elevator Company, are of the semi-traction type and are four in number. Each motor is designed for 470 volts and 51 amp, or 30 hp. A 5-hp General Electric motor is belted to a Connersville blower, which supplies the air for the pneumatic-tube system installed in the accounting department of the gas and electric company.

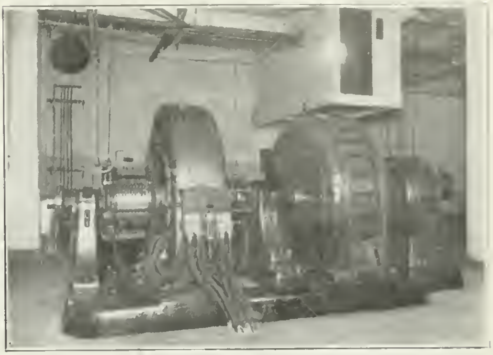


Fig. 2—Motor-Generator Set in Basement.

To provide for future needs and to be prepared at all times to supply energy to the direct-current motor network in the business section, as well as to provide for direct-current motor "peaks," a 750-kw motor-generator set has been installed in the basement. This consists of a 1150-hp, 2300-volt, three-phase, 60-cycle motor, direct-connected to a 500-550-volt direct-current generator. The speed of the motor-generator is 514 r.p.m.

The exterior lamp circuits are connected to a separate board of four panels installed in connection with the switchboard, controlling the interior lighting.

The remaining portions of the basement are used for trouble men, supply bureaus and a model demonstration room for gas and electric appliances.

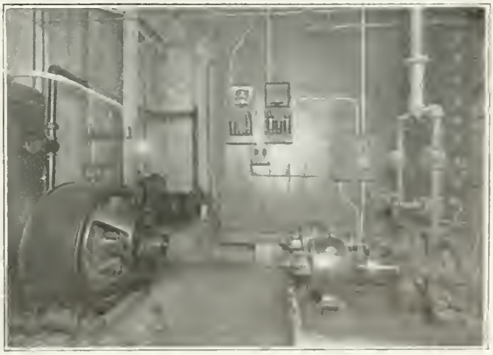


Fig. 3—Motor-Operated Pumps.

The motor-operated pumps used in the building are an excellent example of industrial power drive that, if installed in other large buildings, will result in considerable revenue to the central station.

Wiring and Illumination

ORNAMENTAL CURB LIGHTING AT HAMILTON, ONTARIO.

Less than a year ago the Hamilton Electric Light & Power Company, Ltd., of Hamilton, Ontario, which is considered to be the most progressive of the Canadian central-station companies, not willing that the title of Electric City of Canada should be usurped by any other city in the Dominion through any lack of enterprise on its part, started among the merchants a campaign for ornamental downtown street lighting. The business center of the city, including about twelve blocks on either side of King Street and six blocks on either side of James Street, was chosen as the portion of the city to be thus illuminated. It was proposed by the company that it erect standards at its expense at each street corner, with other standards spaced about 45 ft. apart between corners, the equipment to be maintained in first-class condition and the lamps kept burning from dusk until 11 p. m. The merchants were asked to sign contracts agreeing to pay for the energy consumed in the lamps at the rate of 12½ cents per month for each front foot of property on the block. The rate was not contingent upon the location of the standards, each merchant paying the same regardless of whether a standard was in front of his store or not.

When the plans were formulated they were made known to the daily press, which published accounts of what was done elsewhere and what it was proposed to do in Hamilton. The merchants were then canvassed block by block and in less than a month four blocks were secured. To quicken matters two standards of the type chosen were erected on one block and a representative meeting of merchants was held to witness their lighting. A vigorous store-to-store campaign on a competing block was then inaugurated, the more progressive merchants on the first block being relied on to whip their neighbors into line on the proposition. So soon as the news was published that the "white way" had actually started and standards been ordered the merchants on the first block made contracts with the company for energy for the complete installation on that block. Soon afterward two other blocks were contracted for, followed by four additional blocks. Eight other blocks were subsequently added, so that the plan proposed at first was brought to fruition.

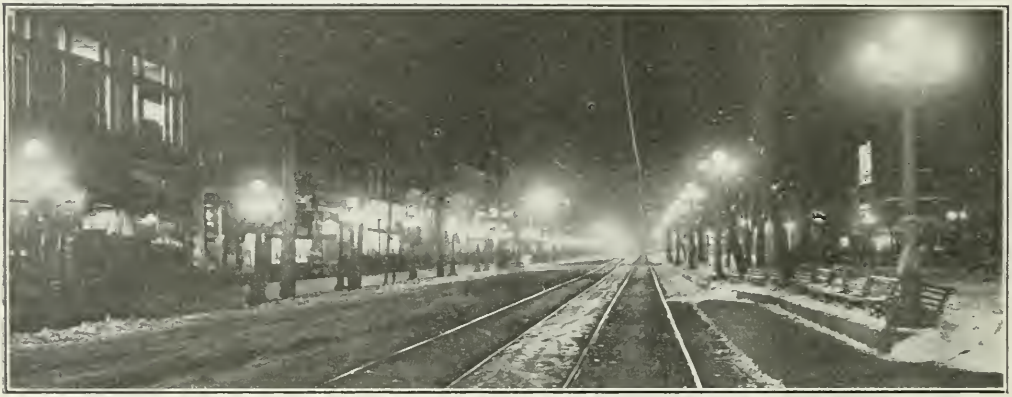


Fig. 1—Ornamental Street-Lighting Standards on King Street, Hamilton, Ontario.

The lamp-posts selected by the company are made of pressed steel and represent a tapered fluted column of classic lines. Each holds five tungsten lamps in diffusing globes. On the arms the lamps are of 100-watt size and in the central globe the tungsten lamp is rated at 125 watts. As the lighting circuits are overhead, the posts are fed from a transformer located on a pole in the middle of the block. Three wires in conduit are run down the pole from the transformer to the nearest standard, and from there energy is distributed to the other standards, the wires being in conduit run 3 in. below the pavement near the curb. The lamps on each block are controlled by a switch in the base of the standard nearest the transformer. Owing to the use of a three-wire system it is possible to burn the central lamp all night on a separate circuit should this be desirable or required later by the City Council.

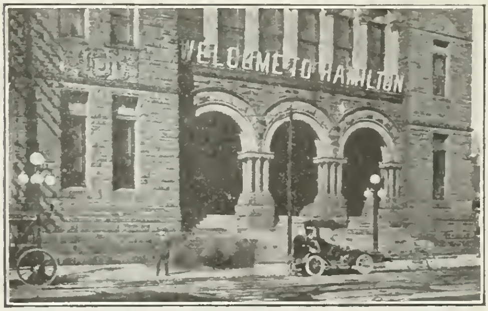


Fig. 2—Standards and Sign at City Hall.

Fig. 3—James Street, Hamilton, by Night.

SCHOOL AND LIBRARY LIGHTING.

In a recent number of the *Electrical World* some account was given of progress in connection with illuminating engineering in Great Britain, especially as regards the discussions of the (British) Illuminating Engineering Society in London.

Since that date the society has held several successful meetings, which served admirably to show the kind of co-operation the society should help to bring about. In Great Britain it is recognized that there is still a great deal of spade work to be done in educating the general public to appreciate good lighting, and it is found there, as elsewhere, that long after the experts have come to an agreement regarding some point in illumination the general public continues to follow blindly the older and probably inferior methods.

It is, therefore, necessary to be bringing constantly home to the non-technical public the progress that has been made in expert ideas about lighting. There are, of course, many points on which it is impossible to dogmatize at present. But, on the other hand, there are some matters, some simple rules in illumination, on which agreement seems possible, and it is essential to spread a knowledge of these as far as possible. At the same time it is desirable to induce each section of the public to rate the question of good lighting as more important than it is now held to be; to persuade school authorities that the lighting of schools is one of the most important factors in their equipment, and to demonstrate to librarians and library committees what an important part the choice of correct lamps and fixtures and their correct location play in rendering a library successful and attractive.

The recent meetings of the (British) Illuminating Engineering Society, at which the two subjects of school and library lighting have been discussed, afforded an excellent example of the work such a society can do in this direction.

The first subject dealt with at meetings on Jan. 16 and Jan. 31 of this year was library lighting. On this occcasion the co-operation of the Library Association was sought, and a joint meeting of these two bodies was held. On the first night it was agreed that the librarian's standpoint should receive chief attention, and papers were presented by Mr. S. L. Jast, honorary secretary of the Library Association and librarian of the Croydon Public Libraries, and Mr. J. Duff Brown, public librarian at Islington. These papers led to a very interesting discussion, in which representatives of the British Museum Library, the Patent Office library, the Board of Education library and other well-known libraries in London took part. The discussion on this evening was not only a means of bringing home to engineers the chief matter on which librarians desire further information, but also suggested quite a number of points which are of considerable consequence to the librarian, but which the engineer, if left to himself, might easily overlook. It became evident that different classes of libraries have quite distinct demands as regards illumination, and that there are frequently points in local routine which have to be taken into account by the engineer when the lighting is being planned. Among the libraries represented some, like the British Museum, are purely for student and research work; others, like the Royal Colonial Institute, are more in the nature of reading-rooms, while public libraries again have their special departments devoted to the reference, reading and lending libraries, not to mention the storing department basement-storing facilities, each of which presents a problem in itself.

Among the points much discussed by librarians were the relative claims of local and general illumination, the best methods of making use of reflection from light-colored walls and ceilings, and the best varieties of shades for local table lighting. One special difficulty which almost all librarians had experienced was that of effectually lighting bookshelves and gangways.

At the next meeting the discussion was resumed and the various points raised in the former discussion were dealt with from the engineer's standpoint. A special feature was the presentation of data regarding the conditions of illumination, consumption of energy, etc., in various London libraries by Messrs. Leon Gaster and J. S. Dow. It was shown that, excluding certain libraries in which the lighting was considered abnormal and clearly unsatisfactory, the general value of the illumination on the reading tables was in the neighborhood of 2 ft.-candles, so that in attempting to frame a standard of what was necessary there was already a good practical record on which to base suggestions.

Some curious anomalies in the specific consumption in watts per square foot in different libraries were presented, and it was pointed out that in some cases in which this figure was highest the resulting illumination was least satisfactory. One of the best-lighted libraries, that in the British Museum, has, however, a very high consumption, but this is due mainly to the use of about 300 table lamps, each equipped with a carbon-filament 16-cp lamp, over the immense floor of the library. The diameter of the great dome in this library, it may be mentioned, exceeds that of St. Peter's at Rome.

One point which certainly had not received enough attention in many of the libraries visited was the importance of avoiding glare. Many typical arrangements of lamps and shades were exhibited, and it was shown that many of these are not only very ineffectual as a means of distributing light, but that they screened the filaments of the lamps in a most imperfect manner so that the eye was continually being dazzled once it was raised from the book. Stress was laid by many speakers on the desirability of employing half-frosted lamps or else concealing the filaments completely by suitable globes and reflectors or by indirect systems of lighting.

A series of measurements of the distribution of illumination over the bookshelves was also presented, and it was pointed out that the light was most unevenly distributed and that a mere fraction of the total flux of light properly applied would have sufficed. There were a number of suggestions as to how greater uniformity might be obtained. Mr. T. E. Ritchie described some excellent results secured by inverted-arc lighting, and Mr. V. H. Mackinney exhibited a new type of metallic reflector designed to produce a perfectly even illumination on a vertical or horizontal surface and to screen the eyes while doing so.

The relative merits of general and local illumination were fully discussed. From the lighting standpoint many of those present preferred a certain number of local lamps. The chief objection to this method of lighting from the librarian's standpoint is that it entails practically fixing the positions of the furniture. It was also contended that in many cases, as, for example, a public reading-room, the "subdued" impression caused by local lighting is not what is wanted. A room of this kind must be cheerful and stimulating so as to attract passers-by, many of whom are of the poorer class, and provide them with something that is a pleasant contrast to their usual comparatively dull surroundings. In passing, another important suggestion from the librarians may be noted, namely, that lighting contractors should make provision for bright light outside the building. The main function of a public library being to attract the casual passer-by, it is most essential that the building should stand out from neighboring ones so that people in the street may have no difficulty in knowing that it really is a library.

From this discussion the following conclusions seem to represent the general view:

First, that a reading illumination of at least 3 ft.-candles is needed for modern print; for special work, such as the examination of finely printed patent specifications, engineering drawings, manuscripts in Oriental languages, parchments, etc., a higher value of at least 5 ft.-candles or more, according to the fineness of the detail and reflecting power of the material on which it is written, is needed.

Second, that no unduly bright source of light should be visible in the normal field of view in libraries: either some form of indirect lighting should be employed or the lamp should be effectually concealed in a suitable globe or reflector.

Third, that in general the ideal system of illumination for a library will be found to consist in a combination of diffused and soft general illumination with local, well-shaded table lamps. The nature of the interior must, however, be borne in mind. It is suggested that local lamps are desirable in student or reference libraries, in which the attention is concentrated on serious work. This method is employed in the British Museum, Fulham Library and other successfully illuminated libraries. However, the contrast between the brightness of the printed page and the surroundings should not exceed 100 to 1. In reading-rooms where most of the seats are occupied simultaneously and light reading is indulged in a cheerful general illumination is usually satisfactory. The data accumulated suggest that local lighting is no more expensive as regards running costs than general lighting, though it may be more expensive to install.

Fourth, that the methods of shelf lighting usually adopted in London libraries call for improvement. The chief desiderata are the production of more uniform illumination and better means of screening the eye from the direct rays of light. It is suggested that experiments should be made with a view to developing more satisfactory forms of fixtures for shelf lighting. Meantime it seems to be generally accepted that the average illumination on shelves should be about 1 ft.-candle to 1½ ft.-candles.

Fifth, further data are also needed regarding the best height of standards for table lamps, types of shades to be used, etc., and the desirability of producing uniform illumination. Some have held that the table ought to be quite uniformly illuminated, but other librarians urge that it is not needful to do this as spaces must necessarily be left in many cases for readers to place their books beside them for reference.

The second important discussion embarked upon by the Illuminating Engineering Society, namely, school lighting, was again productive of an excellent discussion, and again it was found necessary to adjourn the discussion to a second evening.

On this occasion the same plan as previously was adopted, namely, devoting one evening to the treatment of the standpoint of the medical authorities, while the second was given up to more purely engineering aspects of the matter. The discussion was opened by papers from Dr. James Kerr, medical officer to the London County Council, on "Daylight Illumination," and Dr. N. Bishop Harman on "Artificial Illumination." Representatives from the following bodies were invited and took part in the discussion: The Medical Officers of Schools Association, the London Teachers' Association, the Association of Technical Institutions and the Association of Teachers in Technical Institutions. Representatives of the engineering department of the London County Council also took part in the discussion, and it was generally agreed that the discussion would be very beneficial in bringing home the need for good lighting in influential quarters.

As on the previous occcasion, Messrs. Gaster and Dow presented a collection of data regarding the conditions of illumination met with in elementary schools, higher public schools, and technical and other colleges. Similar data regarding the results of gas lighting and arc lighting were put before the meeting by Mr. F. W. Goodenough and Mr. T. E. Ritchie respectively.

As regards artificial illumination the discussion followed a very similar course to that which prevailed in the case of library lighting. The method of lighting adopted in the most recent London County Council schools was spoken of with approval, but some of the older schools visited were found to be poorly lighted in many respects. In some cases old carbon-filament lamps, imperfectly shaded, were used, and, although the watts per square foot were as high as 1.2, the illumination was not more than 1.5 ft.-candles and the general arrangement of the lamps with regard to the desks was unsatisfactory. In some of the older public schools visited (which included in their number the famous school at Harrow) the lighting was good, but in others antiquated forms of burners and feeble illuminations down to 0.5 ft.-candle prevailed. A collection of sketches of fixtures encountered in different schools was shown at the meeting. Some of these were crude in the extreme.

There was also much discussion regarding the arrangement of the lamps and benches. In many schools and colleges the lamps are so arranged as to be extremely trying to the eyes of those at the back. In this respect technical colleges are specially criticised, for it was pointed out that they have a special interest in lighting and ought to lead the way in the direction of showing how the illumination of lecture theaters, drawing offices, etc., ought to be carried out.

One point emphasized by many speakers in the discussion was the extraordinary variation in daylight at different parts of a room. This might easily prevent a student in some remote corner receiving enough illumination to read by. It was suggested that the old formula to the effect that the available window area should be one-fifth of the floor area could not be applied to deep rooms, and Dr. Nash suggested that the facts brought to light in this discussion might lead to a movement in favor of narrower rooms, with a minimum depth from the window, in the future. The London County Council has already adopted the plan of insisting on smaller classes and aiming at a standard size of room, about 20 ft. square.

The electrical contractor is often at a loss to predetermine what the artificial illumination in a building is going to be, and it is probable that the architect is often quite as much at sea in estimating beforehand the daylight illumination. Yet there are available data regarding the sky-brightness at different times in the year which should enable it to be calculated for a given interior for which the exact outlook and window area are known, with very fair accuracy. The need for calculations of this kind before a school is built was emphasized by several speakers, who alluded to the value of the Continental plan of arranging for a joint discussion between the architect, the engineer and the school medical officer at an early stage in the design. A method of checking out what the distribution of daylight in a given schoolroom is likely to be was recently adopted by Professor Ruzicka, of Prague, based on the construction of a small model of the interior above which was placed a sheet of translucent paper, illuminated from behind, which served as an artificial sky. The relative illuminations at different points in the model interior could then be studied photometrically, and should give an approximate idea of those likely to be met with in the final building. However, the difficulty in most of these determinations is to allow for the obstruction of neighboring buildings. For instance, in the Harrow school old, heavily latticed windows are used, and in many cases the ratio of window area to floor area would appear unduly low, yet, owing to the fact that the school stands in its own grounds at the top of a hill, with free space all round, the daylight illumination is said to be exceptionally good.

One other special point on which there was some discussion was the need for special illumination of the blackboards and diagrams. For this purpose some form of reflector which completely screens the source but yet distributes the light quite evenly over a wide vertical area is needed. It was pointed out that most blackboards can be quite efficiently illuminated by the flux of light from a single 16-cp lamp if the light is properly distributed; yet, so inefficient are many of the methods of blackboard lighting in use, the amount of light spent on the blackboard is not infrequently as great as that expended on the lighting of the whole room and even under these circumstances the distribution of light is very uneven.

The average intensity of light in schoolrooms devoted to reading purposes is from 2 ft.-candles to 3 ft.-candles. This is put forward as evidence of the reasonableness of the expectation that educational authorities should provide at least 3 ft.-candles for reading purposes and not confine themselves to the old 1 ft.-candle as the absolute minimum. However, it was pointed out that in many of the trade schools even 3 ft.-candles is not enough in view of the specially fine work performed. For example, when sewing with dark material and dark thread is undertaken even 10 ft.-candles is none too much.

Among the different types of schools described there was an interesting variety. Classrooms devoted to laundry work, cooking, art, coppersmith's work, etc., were referred to, and it appeared that the order of illumination in such cases was almost invariably higher than for ordinary classwork. For example, in the Arts and Crafts School of the London County Council values of from 4 ft.-candles to 6 ft.-candles are usually provided, and indirect arc lighting is the general rule. But for jeweler's and other fine work local lighting up to 30 ft.-candles is provided.

Some of the chief conclusions to be drawn from this discussion might perhaps be expressed as follows:

First, no unscreened unduly bright sources should be visible in the direct line of sight from the desks or from the blackboard, otherwise either the students will have difficulty in seeing the blackboard with comfort or the teacher will be unable to watch them.

Second, for general reading purposes an illumination of at least 3 ft.-candles is desirable; for work that is specially trying to the eyes at least 4 ft.-candles should be provided.

Third, special local lighting is desirable for blackboard and demonstration table. It is recommended that special study should be given to the production of efficient forms of fixtures for this purpose and in selecting the best form of blackboard to give a dead-black mat surface.

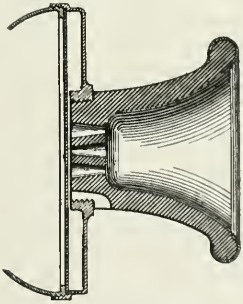
These two discussions may be taken as typical of meetings of the Illuminating Engineering Society in London and of the methods employed of inviting co-operation from those outside interested in the special problem under discussion. It is hoped that in these two cases the result will be to stimulate an interest in lighting on the part of librarians and school authorities so that experiments will be made along the lines suggested and new facts will be available when these matters again come up for consideration.

RECENT TELEPHONE PATENTS.

IMPROVED INSTRUMENTS.

One of the sources of expense of operation of a telephone plant is the breakage of receiver shells and transmitter mouthpieces. These have usually been made of rather brittle insulating material. It is not surprising, therefore, that some attention is being given to this subject. One of the results is the receiver casing and transmitter mouthpiece patented by Mr. L. Steinberger, of New York City.

The receiver casing of usual construction is provided with a metal ring at the base of the ear-cap and at the small end of the shell. These are somewhat larger in over-all diameter than the adjacent parts of the shell. If the receiver falls the metal rings receive the blow.


Mouthpiece.

The transmitter mouthpiece is shown above. The outer edge or lip is thickened and is inclosed in a metal ring. The base is made solid and thus there is little tendency to break. The central aperture of the base is made conical with the small end toward the diaphragm, while in the surrounding ring of holes the flare is reversed.

The patent of Mr. J. Halldow, of Elyria, Ohio, describes an all-metal receiver shell. This is pressed out of thin sheet metal. Both shell and ear-cap are reinforced by threaded metal rings where they must be screwed together. The ear-cap ring is counterbored with an internal annular recess. The edge of the sheet-metal ear-cap is made the same as the counterbored groove and the edge of the cap piece is notched so that when the ring is pressed home the groove holds the ear piece in locking engagement. This patent is assigned to the Dean Electric Company.

Mr. C. R. Rogers, of Waverly, N. Y., has also patented a transmitter mouthpiece. He extends his transmitter casing forward of the diaphragm a distance equal to the depth of the mouthpiece. The lip of the mouthpiece is of the same diameter as this casing and the mouthpiece is seated within the casing. An antiseptic holder is formed upon the back of the mouthpiece, filling the space between the casing and the mouthpiece.

An especially sensitive receiver has been invented by Mr. H. R. Stuart, of Wheeling, W. Va. A flat circular box, with top and bottom of brass and sides of magnetic material, carries the diaphragm. Rising from top and bottom of the box at their centers are tubular cores which carry the receiver coils and which serve as sound passages. Four bobbins are arranged about the box, the cores being screwed into the side walls of the box. The outer ends of the cores carry U-shaped return pole pieces and these in turn are secured to plates carried upon the tubular central cores. The diaphragm is thus supported in a strong field of force.

CIRCUIT SYSTEM.

Mr. J. D. Holmes, of Pasadena, Cal., has obtained a patent for a common battery switchboard circuit system which he has assigned to the Dean Electric Company. The invention lies in the busy test features of the cord circuit. The operator's receiver picks up the test clicks from a tertiary winding upon the induction coil. Thus the receiver may be short-circuited at the test period and made insensitive to any currents existing upon the calling line to which the answering plug is connected.

AUTOMATIC SELECTOR.

In an automatic selector the contact arms may tend to stop in a mid-position. Thus the talking wipers must not make contact except when the steps are complete. Again the stepping circuits must be so maintained as to insure each step being carried to conclusion. In the selector of Mr. F. Schoenwolf, of Chicago, this is accomplished by having two sets of stepping wipers. One is associated with the back contact of the stepping relay and the off-contact wiper and the other with the front contact of the relay and the normal step wiper. If a step is incomplete when the stepping relay is released, as soon as the relay falls back the auxiliary circuit is closed to complete the action.

LETTERS TO THE EDITOR.

Regenerative Control.

To the Editor of Electrical World:

Sir:—In view of the title of my article in your issue of March 30 the point raised by Mr. T. J. Johnston in his letter published in your issue of April 13 seems most pertinent. It was my intention, however, that this article should be merely a part of a series of articles outlining the development of regenerative traction, with which I have been closely connected, and the results obtained in a number of tests, which results give an idea of the magnitude of saving which it is practicable to obtain.

I believe that I shall be able to satisfy Mr Johnston that even after ample allowance has been made for added repair charges there will be a very substantial balance in favor of the regenerative equipment on top of interest and sinking fund charges on the additional investment, even on the basis of a double series-parallel system with its relative complications, The return to the single series-parallel system will have a very slight influence on the saving and will reduce the complications. This will tend to make the figures I am preparing to submit still more conservative. When in addition (as shown in your issue of Feb. 2) Mr. Robert Lundell has developed a motor which weighs only 1400 lb., has an outside diameter of only 23 in. and has an efficiency of nearly 90 per cent at full-load rating of 50 hp (which rating is so conservative that experts admit that the motor should be rated at 60 hp) there is no doubt that regeneration has reached a stage where it is bound to revolutionize commercial saving.

Davenport, Ia. J. Gustaf V. Lang.

Rubber-Covered Wire Specifications.

To the Editor of Electrical World:

Sir:—I should like to make some comments regarding the chemical tests called for in the rubber-covered wire specifications of the National Fire Protection Association, as published in the April 13 number.

It is stated that five chemical tests should be made of the rubber compound, as follows: acetone extract, alcoholic potash extract, chloroform extract, ash and total sulphur. The sum total of these five tests should not exceed 80 per cent by weight of the total compounds—tests to be made according to the specifications of the Underwriters' Laboratories. The ash test should be supplemented by tests to determine the quality of substances other than vulcanized rubber which are combustible but not soluble in acetone, alcoholic potash or chloroform, and any such substances should be counted as ash.

It would seem that this would be more simply stated by saying that the compound should contain not less than 20 per cent of pure rubber, that is, rubber containing no resinous matter and that would yield no extract with acetone. Such a determination can be very easily made with the methods at present in use, and by determining the amount of rubber in the compound direct the errors in all the other determinations mentioned are eliminated. It would appear that it makes no difference whether the insulating compound has a high grade of rubber, such as Para, or contains the poorest grade. Of course, in using a low grade of rubber a little more will have to be added to make up for the excess of acetone extract. In fact, any kind of rubber could be used. The compound could have an acetone extract of 40 per cent or 50 per cent, and by reducing the amount of mineral fill such a compound would pass the test, while it is well known that for a compound to have lasting qualities and to give satisfaction it must contain a good quality of rubber having a low extract. The writer has made tests of insulation for years, and finds all this to be only too true. He has also found that where it is possible manufacturers will use a cheap rubber, putting in a little more than is required so as to obtain the correct percentage, and unless the relation of acetone extract to the rubber present is considered the purchaser will usually get a poor article at the price of a good article. The cheap rubber may be made to accomplish good results when it is new, but for some reason which is not well understood it has no lasting qualities. With the specifications as published one may never expect to get good rubber, while, on the other hand, insulation must be watched closely in order for one to be certain that he is getting the rubber for which he is paying.

New York. W. Jones.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Determination of Friction Losses in Induction Motors.—B. Zavada.—The friction losses of an induction motor are part of the mechanical load of the motor, and when the motor runs unloaded the friction losses together with the "additional losses" form the complete load. With decreasing voltage the power decreases in proportion to the square of the voltage and the motor is then heavily loaded by the friction losses and may even become overloaded by them, as is apparent from the increasing slip. Evidently all values obtained in this test when reduced to normal voltage must give points in the circular diagram of the motor. The power taken from the circular diagram and reduced to the original voltage represents the sum of the friction losses and the additional losses. The latter are negligible at low voltages. A numerical example illustrating the method is added.—*Elek. u. Masch.* (Vienna), March 5.

Three-Phase Series Commutator Motor.—R. Rüdenberg.—An illustrated translation of his recent German paper. The properties of the three-phase commutator motor with a series characteristic are here considered in an elementary way, the deductions being based on the ideal motor without leakage or losses. By this means a clear insight into the characteristics of the motor is obtained, and test results are added to show how nearly the practical motor agrees with the ideal.—Lond. *Electrician*, April 7.

Lamps and Lighting.

Alternators.—P. Bunet.—The first part of a paper giving "some remarks on synchronous and non-synchronous alternators." In the present instalment the author gives some theoretical points on the design and operation of high-speed synchronous machines and points out their difficulties.—*L'Industrie Elec.*, March 25.

Radiation from Electric-Incandescent Lamps.—G. Leimbach.—The author first gives the following definitions: Specific watt-consumption is the number of watts required to produce 1 mean spherical candle-power. Mean spherical total radiation is to be distinguished from mean spherical light radiation since the latter includes only the wave-lengths of the visible spectrum. "Relative radiation capacity" (relative Strahlungsvermögen) is the ratio of the energy of the total radiation to the total energy consumed and is, therefore, the greater the less heat is lost by conduction, etc. "Light effect" (Licht-effect) is the ratio of the energy of light radiation to the energy of total radiation and in all artificial lamps has a small numerical value. Selective radiation in the infra-red portion of the spectrum improves the light effect and also the "useful effect" (Nutz-effect)—that is, the ratio of the energy of light radiation to the energy consumed. Light effect and useful effect would be identical if no heat was lost by conduction, etc. Finally, "absolute specific light radiation" is the ratio of mean spherical light radiation in watts to the mean spherical candle-power; that is, what was formerly called the mechanical equiva-

	Carbon Lamp.	Nernst Lamp.	Tantalum Lamp.	Osram Lamp.
Ratio of energy of total radiation to total energy consumed, per cent..........	61.9	49.2	64.8	75.6
Ratio of energy of light to energy of total radiation, per cent..............	2.85	4.43	4.26	4.63
Ratio of energy of light to total energy consumed, per cent..................	1.75	2.17	2.75	3.50
Ratio of mean spherical light radiation in watts to mean spherical candle-power....	531	340	449	418
Specific watt consumption in watts per cp.............	3.8	2.0	2.02	1.51

lent of light. This is not a constant, but depends on color and temperature. The author has carefully determined these quantities for various lamps, and compared them with the results of other experimenters, some of which, especially those of Wedding, are somewhat criticised. In the table on the preceding page the author's own results are given.

With respect to the "mean spherical light radiation in watts per mean spherical candle-power" it is not exactly clear what units are used in the author's figures. These figures—the fourth row of the table—are, therefore, only of relative value. The sequence of these figures shows, however, according to the author, that the temperatures of the tantalum and osram filaments are between the lower temperature of the carbon lamp and the higher temperature of the Nernst lamp. The figures in the first row show that there is considerable loss of heat by conduction, especially in the Nernst lamp, where 50 per cent is thus lost, against only 25 per cent in the osram lamp.—*Elek. Zeit.*, March 16.

Ultra-Violet Light from the Mercury Arc.—A. L. Hughes.—An account of an experimental investigation, the chief results of which are as follows: The ultra-violet spectrum of mercury, investigated electrically, extends to about λ 1230. There is no appreciable radiation from the mercury arc between λ 1450 and λ 1780. The hydrogen discharge has relatively more energy in the short wave-lengths than the mercury arc. The velocity of the electrons due to one wave-length is independent of the presence of other wave-lengths in the beam of light.—*Phil. Mag.*, April.

Generation, Transmission and Distribution.

Insulation Resistance of Networks.—F. Leprince-Ringuet.—The first part of a theoretical paper on the earthing of the neutral point and the permanent control of the insulation resistance of an alternating-current network. In the present instalment the author first discusses the analytical study of the distribution of the potentials in an alternating-current network by means of voltmeters inserted between each pole and earth. He shows how the constants of the network can be found from the readings of the voltmeters, especially insulation resistance and capacity. The article refers both to single-phase and three-phase systems. The paper is to be concluded.—*La Lumière Elec.*, April 1.

Metallic-Filament Lamp.—A note on a recent British patent (5388, March 23, 1911) of the Westinghouse Metal Filament Lamp Company and A. Lederer. Metallic filaments purchased from manufacturers are further decarbonized by heating in an atmosphere of pure hydrogen only. This permits of the amount of carbon present being reduced to 0.04 per cent.—Lond. *Elec. Eng'ing*, March 30.

Traction.

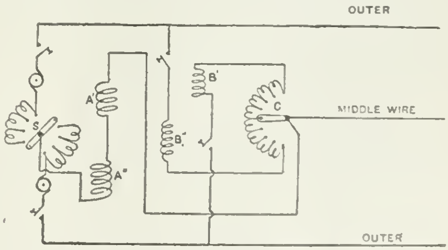
Frequency for Heavy Traction.—K. Pichelmayer.—An article on the choice of the most suitable frequency for heavy traction. The author believes that a frequency of from 15 to 17 should be used, preferably a frequency of 16⅔.—*Elek. u. Masch.* (Vienna), March 5.

Installations, Systems and Appliances.

Gas and Electricity Supply in Germany.—Meyer Coschütz.—The change of Germany from an agricultural into an industrial country has been accompanied by a rapid extension of the uses of electricity. Practically all cities with 20,000 inhabitants or more are provided with electric-supply stations, and much attention is now being paid to building electric-distribution and transmission systems in rural districts. On the other hand, the gas industry is also very active and recently gas plants have made progress in districts which had been supplied with electricity for a considerable time. This has been the case especially where mistakes had been made in the equipment of the electric plant or where the rates for electricity were too complicated for the average consumer. Moreover, for cooking gas is still used almost exclusively. Cheap and reliable electric cooking apparatus should be developed and a low rate should be charged for cooking by electricity. To permit extended use of electric lighting by very small consumers a flat rate should be charged.—*Elek. Zeit.*, March 16.

Electricity Meters.—An account of the extended discussion which followed the recent paper of Ratcliff and Moore before the (British) Institution of Electrical Engineers. Various speakers referred to the question whether amp-hour meters, as generally favored in Great Britain, or watt-hour meters, as preferred in the United States and Continental Europe, are preferable. A. E. Jepson said that if ampere-hour meters are used and the voltage is slightly above normal, the loss of revenue resulting would soon pay for the extra cost of watt-hour meters. The testing of meters at a certain temperature is important, since the usual temperature of 60 deg. Fahr. is too high. W. Grant said that a consumer on a lighting circuit is supplied with energy at a definite declared pressure, and if the pressure rises above the normal he did not see that the supply authorities could legitimately charge for the excess due to the rise. W. Cramp thought there is some tendency among electrical engineers to strain after too much accuracy, not that a meter could be too accurate, but simply that obtaining the last 0.5 per cent might cost too much. The accuracy of electricity meters is already far in advance of anything met with in the gas world. It seemed almost hopeless to expect alternating-current meters to be very accurate. As regards the question of stray fields, it had always been a wonder to him that manufacturers do not construct their permanent magnets of such a shape that the yoke of the magnet shields the poles. This would largely avoid the errors existing at present. He thought that the reason for the accuracy of the Aron meter under very varied conditions is largely the fact that the timing mechanism is driven independently of the mechanism which registers the energy. E. E. Sharp referred to the question of ampere-hour versus watt-hour meters, and gave results of tests made by putting watt-hour and ampere-hour meters in series over periods up to twelve months. The readings showed only such small differences as one would expect between any two meters of the same type. W. Lawson said his experience with the electrolytic meter to a large extent refuted the wholesale condemnation of the authors. Of the 800 electrolytic meters installed in Birmingham only 2 per cent have been returned as defective. The figures should be compared with 8.9 per cent for mercury motor ampere-hour meters out of 2700 installed during the last four and one-half years. Electrolytic meters are largely used for small consumers, for whom it is undesirable to make a large outlay. They are cheap to buy and maintain. R. Amberton, in discussing the question of ampere-hour versus watt-hour meter, said that it is often assumed that the latter is a more or less perfect instrument. This is not the case, however. The authorities require a reasonably accurate meter at the lowest obtainable price, and at the present time this combination is best obtained with the ampere-hour meters.—Lond. *Electrician*, April 7.

Compound-Wound Balancer.—W. E. Rogers.—An article on the use and limitations of the compound-wound balancer, which consists of two compound-wound generators or motors coupled together mechanically, and in series electrically, across the outers of a three-wire system, for keeping the potential differences equal between the outers and the middle wire. Fig. 1 (in which A' A'' are series coils, B' B'' shunt coils, C a rheostat and S the starting switch) shows a common form of con-



A', A''. Series coils; B', B'', Shunt coils; C, Rheostat; S, Starting switch.

Fig. 1—Common Form of Balancer Connection.

nections for such a machine. As long as there are no serious faults on the outers this arrangement operates very well. But if one of the outers becomes "dead" to earth the neutral carries a current of short-circuit magnitude. This produces such a defect upon one of the balancing machines as to cause it to try to run away, while the other operates as an overloaded or short-circuited generator. It is, therefore, necessary to provide an automatic means of limiting the current returning by way of the station earth plate. Even when the current is limited by a resistance in the earth connection it is advisable also to protect the balancer by having a low resistance R always in parallel with the series coils, as in Fig. 2, whch shows a very simple mode of wiring the balancer. The circuit-breaker CB is set to open at a desired predetermined value.—Lond. *Elec. Review*, March 31.

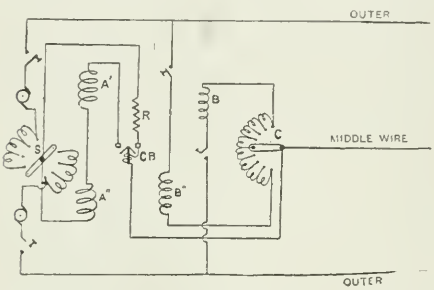


Fig. 2—Circuit Arrangement with Protecting Resistance.

Energy Rate.—R. Arno.—A paper discussing his recent proposition of a rate in which a certain charge is made for the wattless power furnished to an insulation. This result is obtained by simply modifying the voltage circuit of an ordinary wattmeter so as to introduce a certain phase difference between the flux and the tension in the circuit. The quantity measured by such a meter is called "a complex charge," giving a measure of the sum of the real power and a certain fraction of the difference between apparent power and real power. By means of such a complex-charge meter and an ordinary wattmeter the power-factor can be directly determined. The system is discussed with numerical examples and its advantages are compared with those of other rates.—*Atti del' Assoc. Elettrot. Italiana*, July and August, 1910; *La Lumière Elec.*, April 1.

Energy Rate.—L. Choulet.—The conclusion of the long serial in which the author discusses under which conditions either one of the following three rates will be suitable: Either flat rate, or, secondly, a meter charge with a price per kw-hour determined by a two-term formula (taking account of both kilowatts installed and kw-hours used), or, thirdly, a meter charge with a single price per kw-hour. Finally, special rates for motor service are discussed.—*L'Industrie Elec.*, March 25.

Wires, Wiring and Conduits.

Impregnated Wooden Poles.—R. Nowotny.—An article giving statistical data on the life of wooden poles impregnated with copper sulphate in Austrian practice. The mean values of the life in nine different districts are 11.4 years, 15.8 years, 12.8 years, 14.3 years, 8.9 years, 12.3 years, 14.5 years, 9.3 years and 21.9 years respectively. The mean life for the whole of Austria is 12.8 years. The life depends on the climate and the nature of the soil in which the poles are planted. The average life of such poles in Germany is 14.5 years and that in France and in Holland 15 years.—*Elek. u. Masch.* (Vienna), March 5.

Electrophysics and Magnetism.

Relativity.—N. Campbell.—A paper on common sense in the theory of relativity. The author endeavors to show that this theory is not nearly so abstruse as most people think. He emphasizes the fundamental physical assumptions rather than the mathematical niceties of the theory. The assumptions made by the principle of relativity are stated and an attempt is made to render some of them more plausible at first sight. A difficulty connected with the composition of velocities is examined and found to be due to verbal confusion. The confusions introduced by the word "real" are discussed. The relation between dynamics and relativity is considered briefly.—*Phil. Mag.*, April.

Discharges in Gases.—A. B. Meservey.—To study the process of ionization in gases at very low pressure the author has made experiments on sparking in a non-uniform field. He employs the field between two concentric cylinders. For every value of the diameter of the inner cylinder two different sparking potential curves are obtained, corresponding to the two directions of the field. For smaller diameters the two curves cross near the critical pressure, and that for a negative inner electrode is higher on the side of the lower pressure, but they tend to coincide as the field approaches that between parallel plates. The minimum sparking potential depends upon the diameter of the inner electrode, and is always lower when that electrode is negative. The minimum sparking potential is always higher than that for parallel plates when the inner electrode is positive, while the lower values when the inner electrode is negative are below that for parallel plates. The lowest values obtained were 311 volts for air and 240 volts for hydrogen. The results obtained at pressures down nearly to the critical pressure may be explained on the theory of ionization by collision. Below that the results are entirely in harmony with the supposition that at these pressures some kind of radiation is produced by the impact of negative ions on the electrode under the action of a fairly strong force. In the second part of his paper he discusses the effect of a continuous discharge upon sparking potentials at low pressures.—*Phil. Mag.*, April.

Ionization by Alpha Particles.—T. S. Taylor.—An account of an experimental investigation of the ionization of different gases by the alpha particles from polonium and the relative amounts of energy required to produce an ion. The ionization curve obtained in various gases and vapors with polonium as the source of rays is of the general form $I = c\,(r - x)^{-1/3}$, where I is the ionization, c is the constant for any one gas depending upon the total ionization produced, and consequently upon the energy required to produce an ion in the given gas; r is the average range of the alpha particles in the cone of rays, and x is the distance from the source of rays. The agreement between the theoretical and the experimental curves confirms the assumption made in previous papers by the writer and by Greiger that the ionization produced by the alpha particle is proportional to the energy consumed. The values of the ratio of the total ionization produced by the alpha particle in different gases to the total ionization produced in the air as found by Bragg have been confirmed by a more direct process. The energy of the alpha particle consumed in the production of an ion depends upon the nature of the molecule ionized. It apparently requires less energy to produce an ion in the gases or vapors which have heavy or relatively complex molecules than it does in those gases of lighter or less complex molecules.—*Am. Jour. of Science*, April.

Insulation.—In the annual report of the (British) National Physical Laboratory attention is called to the importance of air spaces in insulating materials subjected to electric stress. The effect of such air spaces, when the stress is sufficiently high to cause ionization of the air, is to increase the energy loss in the insulation and consequently heating, and to promote the deterioration of the material. Experiments made on this point have led to an investigation of the very interesting and important question of the critical electric stress in air at the surface of a conductor. The method adopted was to measure by an electrostatic wattmeter the loss between a suspended wire and a concentric metal cylinder. The results of these experiments were in close agreement with those of E. A. Watson.—Lond. *Electrician*, March 31.

Resistance Wire.—A note on a recent British patent (14,743, March 30, 1911) of the British Thomson-Houston Company (General Electric Company of this country). An alloy which can be rolled and drawn and is suitable for resistance wire or heating elements consists of 20 parts by weight of iron, 62 parts nickel, 12.5 parts chromium, 5 parts manganese and between 0.1 per cent and 0.4 per cent of carbon. This alloy oxidizes only very slowly at a red heat.—Lond. *Elec. Eng'ing,* April 6.

Units, Measurements and Instruments.

Resistances with Current and Potential Terminals.—G. F. C. Searle.—The first parts of an article in which the author points out that, although conducting systems with current and potential terminals have been in use for many years, the general theory of conduction through such systems has received little attention. The usual proof of the important theorem that current and potential terminals may be interchanged without affecting the potential difference on the main resistance involves the condition that the whole of any one junction is at the same potential. This condition is approximately satisfied in the case of a network of fine wires, but not in a "low resistance" or "shunt." In dealing with such a system proof is needed of the reciprocal relation which shall be independent of the form of the system. Helmholtz has given such a proof, and a simple direct one is due to Heaviside. Bromwich, employing Green's theorem, also gave a solution. Useful information regarding the properties of conducting systems with three and four terminals is obtained, and it is shown that a triangle of resistances may be replaced for all purposes by a three-rayed star of resistances. In the case of a four-terminal resistance one can construct even low-resistance systems such that the want of infinite conductivity at the junctions can produce no sensible error. The discussion of the design of such resistances shows the great advantage of connecting each current and each potential terminal to the main resistance by a rod or wire, the length of such being at least three times its greatest width. The resistance of such a system is very definite. In the case of low resistances capable of carrying currents of the order of 1000 amp slight changes in the connections at the terminal lugs have been found to produce appreciable changes in the potential differences in the main resistance. These defects are easily remedied. Potential "tongues" in sheet resistances are shown to be an advantage. For the comparison of four-terminal resistances with other resistances five methods are discussed, the most important of them being the Thomson bridge, which possessses an advantage not previously realized.—Lond. *Electrician,* March 31, April 7.

Electric Temperature Measurements.—J. Rautenkrantz.—An illustrated paper describing the measurements of temperature with electric-resistance pyrometers, with thermoelectric pyrometers and with optic pyrometers, and the application of these different pyrometers in commercial practice. Resistance pyrometers are said to be suitable for temperatures up to about 900 deg. C., and are especially useful where measurements are to be made within narrow limits of temperature changes. The accuracy is higher than with the thermo-element. Thermoelectric pyrometers can be used for temperatures up to 1600 deg C.: they have the advantage that no auxiliary source of current is required and that they are simpler and cheaper. The accuracy can be made pretty high if care is taken to keep the cold end at a constant temperature. Optical pyrometers are suitable for temperatures up to about 4000 deg. C.; they are not subjected to wear and tear, but they cannot be made recording. The accuracy of the three types in practical use when some care is taken is about 1 per cent. In the discussion which followed Satori mentioned that optical pyrometers cannot be used for measuring the temperature of metallic-filament lamps, and that they are strictly exact only for the so-called black body radiation.—*Elek. u. Masch.* (Vienna), March 12 and 19.

Non-Inductive Resistance.—In the annual report of the (British) National Physical Laboratory it is stated that when high accuracy is wanted in methods of measuring inductance or capacity it is usually desirable that all the resistances should be as non-inductive as possible, and that their small "residual" inductances should be accurately known. Many different types of nominally non-inductive coils have been tested and it has been found that 10-ohm coils have commonly an inductance of from 0.3 microhenry to 5 microhenries, 100-ohm coils up to 15 microhenries and 1000-ohm coils to 500 microhenries. A box is under construction in which the self-inductance for none of the coils will be above 0.1 microhenry. In order to measure the inductances of such coils with a bridge and mutual inductometer use has been made of the fact that a copper and a manganin coil of exactly similar gage of wire wound side by side and of similar length should give equal inductances at ordinary frequencies, while their resistances are very different By this principle a resistance box of constant inductance can be constructed.—Lond. *Electrician,* March 31.

Voltage Division.—P. Ludewig and G. Teuchert.—In the calibration of voltmeters an arrangement is usually employed which permits an easy variation of the voltage at the terminals of the instruments. The source of emf is connected to the terminals of the resistance with one or two sliding contacts. It is evident that the voltage which is taken off from the two sliding contacts depends on the resistance of the circuit between these two contacts (that is, the joint resistance of the voltmeters in the case of a voltmeter test). A similar arrangement is used for medical purposes when a gradually increasing current is to be passed through the body of a patient. If the resistance between the two contacts from which the current is taken off is raised by equal amounts, the voltage between the two contacts will be raised by equal amounts only if the resistance of the system through which the current is passed is infinitely large. The author gives curves showing the variations from this limit rule if the resistance is not infinitely large, but has several different values.—*Elek. u. Masch.* (Vienna), March 19.

Peltier Effect.—F. W. Jordan.—A description of a new method for measuring directly the Peltier effect.—*Phil. Mag.,* April.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—J. E. Taylor.—A paper read before the (British) Institution of Electrical Engineers. After referring briefly to the position and arrangement of the radio-telegraph station as regards freedom from extraneous noises, the author discusses local inductive disturbances, interference between stations, atmospheric perturbations and variations in the transmitting efficiency of the atmosphere. Suggestions are made as to the method of minimizing such interferences. In contrast with coupling methods of reducing interference, various plans of divided circuits have been proposed or used in which the impulses conveyed by one branch are annulled by those conveyed by the other, except to the extent necessary for the interpretation of the signals required. In these methods the required signals are "tuned in" as against tuning out undesirable impulses. One of these methods is S. G. Brown's "bridge" method. The basis of the bridge scheme is shown in Fig. 3.

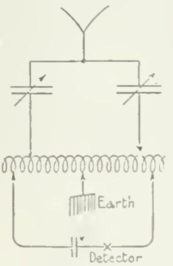


Fig. 3—"Bridge" Scheme of Interference Preventer.

If the two branches of the divided circuit are absolutely symmetrical all received impulses will divide equally and no effect will be produced on the detector, which occupies a position corresponding to the galvanometer in a Wheatstone bridge. A very slight disturbance of the balance by shifting the point of the earth-wire connection to right or left will determine signals on the detector from the branch best tuned to the received impulses. If these impulses consist of a sufficiently long train of waves discrimination is effected between these and other impulses (even if of the same periodicity) if such other impulses are of a more rapidly damped character. It is not abundantly clear that devices of this kind possess advantages over, or involve any further principle than, that of reduced coupling. Greater promise of satisfactory elimination of disturbances and perturbations is afforded, in the writer's view, by the adoption of non-earthed directive aerials, at any rate so far as the shorter waves in practical use are concerned. For communication over short distances between fixed stations simple balanced directive aerials disposed to radiate in the line of communication give promise of very satisfactory results. These take the form of a vertical triangle, the apparatus being connected in circuit at the midway point of the base line, no earth connection being used.—Lond. *Electrician*, April 7.

Miscellaneous.

British Patents.—An abstract of a report of the (British) Comptroller-General of Patents, Designs and Trademarks in 1910.—Lond. *Electrician*, March 31.

Book Reviews.

American Producer-Gas Practice and Industrial Gas Engineering. By Nisbet Latta. New York: D. Van Nostrand Company. 557 pages, 247 illus. Price, $6.

Mr. Nisbet Latta's recent book on American producer-gas practice covers the entire range of making combustible gases from all types of fuels. Its fifty-page opening chapter gives practical directions for operating the various commercial types of producers with an exposition of the underlying principles which govern their action, data on producer linings, special grates, producer measuring instruments, etc. In view of some of the new Belgian producer grates with conical hearths, the author's strictures on angle-of-repose grates and management of fire may be taken somewhat liberally, but, on the whole, the chapter gives a very fair outline of the "state of the art" at present. In the next two chapters considerable space is devoted to types of scrubbers and cleaners, and works details. The chapter on producer types is exceedingly comprehensive and includes descriptions of the newest forms of lignite, straw, wood refuse, tan bark and bagasse producers, besides the usual coal types. The former are bound to become of more and more commercial importance in this country, as they already have in Europe. Gas power from industrial and agricultural refuse is the inevitable solution of the energy-production question, aside from that which can be indefinitely drawn from forest-protected water-power sites. These same producers are also treated numerically in the chapter on solid fuels, which gives, besides the yields from all grades of coal, data on the wood-refuse fuels in heat units per pound and cubic feet of gas obtained in practice per pound. There are four chapters devoted to the movement of gases, their physical and chemical properties and gas analysis. The chapter on gas engines is not very exhaustively treated, since the subject is *per se* matter sufficient for a separate work. The matter treated in the succeeding chapters on industrial gas applications, covering forge-shop and steel-plant ovens, gas-fired steam boilers, gas-burnt lime and cement kilns, brick kilns and iron-heating furnaces, etc., gives data not easily obtainable outside of a large technical library and will be found of much use in general practice for the industrial engineer. The subject of preheating air by stoves and economizers is gone into in a succeeding chapter, and, as in all the rest of the work, practical data of temperature and results of tests are given along with the descriptions of apparatus. The final chapters are assigned to useful information on heat radiation, temperature, pyrometry, flues and chimneys, masonry construction and tables likely to be of use to the engineer engaged in this class of work. Having such pertinent matter at hand in a single volume will save considerable searching through the usual pocketbooks, etc., wherein these figures are also to be found, but only after a long and exasperating search through several volumes.

Electric Wiring. By Joseph G. Branch. Chicago: Branch Publishing Company. 272 pages, 93 illus. Price, $2.

The question-and-answer form of presentation makes unwieldy some of the useful material on wiring subjects given in this work. The subject matter is quite elementary, but the discussions appended to various sections of the text of the National Electrical Code make this part useful to those seeking a better understanding of the Underwriters' rulings. The scope of the book is also amplified by digressions into the first principles of generating machinery, alternating currents and outside-line construction.

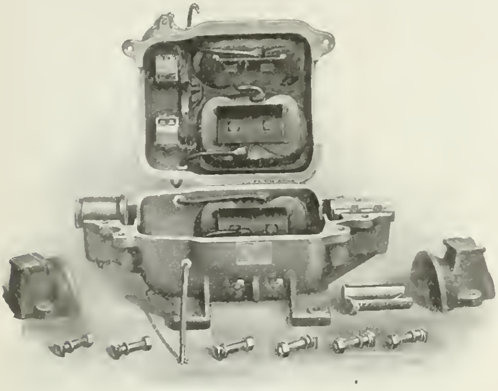
Thermodynamique et Chimie. By Pierre Duhem. Second edition, revised and enlarged. Paris: A. Hermann & Sons. 579 pages, 173 illus. Price, 16 francs.

In engineering one is so accustomed to find thermodynamics treated as an applied science in relation to the properties of heat engines that it is surprising to find a textbook like this in which thermodynamics is treated as a pure science in relation to chemistry. Although thermodynamics is thus treated in this work, yet the discussion is of a very practical character, relating perpetually to observed chemical and physical data. In fact, one might say after studying this interesting volume that thermodynamics had here been dealt with by the author as a pure science in the manner of an applied science. The book is a masterly treatise on an obscure and relatively recent branch of physical chemistry. It indicates what a wealth of study and observation has been expended in recent years upon the borderland between chemistry and physics. It will be of much interest to advanced students of these two sciences.

New Apparatus and Appliances

DIRECT-CURRENT CRANE AND HOIST MOTOR.

The Western Electric Company has brought out a direct-current, series-wound, reversible, totally inclosed crane motor, available in ratings ranging from 24 hp to 240 hp. The motor is inclosed in a horizontally split steel frame, the upper half of which is hinged on one side. This construction totally incloses the motor and at the same time provides for quick and thorough inspection of all parts. When the motor is in operation inspection of the commutator and brushes is facilitated by means of large openings, having tightly fitted malleable iron covers, held in place by locknuts. The field coils are form wound, thoroughly insulated and rendered moisture-proof by impregnation with a special insulating compound. The armature coils are also form-wound and thoroughly insulated before being placed in the slots of the laminated iron core. The coils are held securely in position by means of strong steel wire bands and the sections of the coils projecting from the slots are covered by a strong canvas cover, which protects them from possible injury. The brush holders are mounted on a single yoke of simple but strong construction, and the brushes themselves are of treated carbon with riveted pigtails, held firmly against the commutator by a coiled steel spring. This coiled-spring construction and the fact that the box brush has a close fit prevent vibration and insure even wear. A heavy rolled-steel shaft of practically one diameter throughout is used. An equal extension is provided on each end of the motor, so that the pinion and brake ends are interchangeable. Large and heavy bearings of cast iron and babbitt metal, lubricated by means of oiled rings and oiled grooves, cut in the linings, insure cool running under all conditions. When desired these motors can be equipped with a back gear, solenoid brakes and drum-type controllers with resistances for speed regulation.



Direct-Current Crane and Hoist Motor.

OPEN FEED-WATER HEATER.

The Cookson cast-iron heater shown herewith is provided with an oil separator of ample dimensions and has a cut-out valve within the separator to permit the heater to be cut out for cleaning and exhaust inlet and outlet connections in a direct line to permit the heater to be inserted in a vertical exhaust line without disturbing the pipe except to remove a short length to admit the separator. Separation is accomplished by change of direction of the current and expansion as follows: Exhaust steam enters the separator from the bottom and leaves through the outlet at the top. As the steam leaves the engine exhaust pipe it passes first through a tube projecting inwardly on the inlet flange and cut to open on an angle opposite the opening on the heater inlet tube. The steam is then divided by a "V"-shaped ribbed baffle cast on the under part of the heater inlet tube, which deflects the current to the separator walls. The steam currents therefore make nearly a right angle and must travel back again before they reach the exhaust outlet or the inlet tubes to the steam chamber of the heater. Meantime the oil and water particles, due to their greater weight, are dashed against the separator walls, which are ribbed their full length and breadth. Oil and water carried down these ribs fall into a well formed around the exhaust inlet tube, but out of the steam current. This well drains through a balanced floor trap and empties into the heater overflow pipe. All steam not going to the heater passes through a tube on the outlet flange similar to that on the inlet flange, but sloping downward and with angle opening cut in the opposite direction to that on the inlet, thus compelling the steam to travel in opposite direction to that in which it entered. Steam for the heater passes through the central horizontal tube, which is faced on the outer end to form a tight seat for a valve actuated from the outside of the separator. This valve may be opened or closed at will to regulate the inflow to the heater. It is claimed by the manufacturers that the cut-out valve construction is simple, inexpensive and easy to keep in order. The cold water comes in near the top of the heater to a spray box. A balanced valve in the water line regulates the flow of cold water. The trays are readily removed through the upper door. Gases liberated in heating go to the top of the heating chamber, from which a vent permits them to escape to atmosphere or into the exhaust outlet. The water is prevented from rising above a desirable level and provision is made for skimming the reservoir surface by an overflow plate that extends horizontally the depth of the heater and drains an even sheet of water into the overflow pipe. Suspended impurities which are too heavy to float are removed by the filter bed. The filtering material, usually coke, is supported by a removable perforated cast-iron plate which prevents any from getting to the lower or settling chamber. This lower chamber has at the bottom two flat surfaces sloping to a common gutter at the center. Any minute particles that pass through the filter naturally fall toward this gutter and are removed by opening the blow-off valve. Every part of this heater can be taken down with a monkey wrench, and as the parts are interchangeable any may be duplicated. Where there is no back-pressure valve in the exhaust line provision against pressure within the heater is unnecessary and the trap is replaced by a water seal. The Cookson heater is made by the Bates Machine Company, of Joliet, Ill.

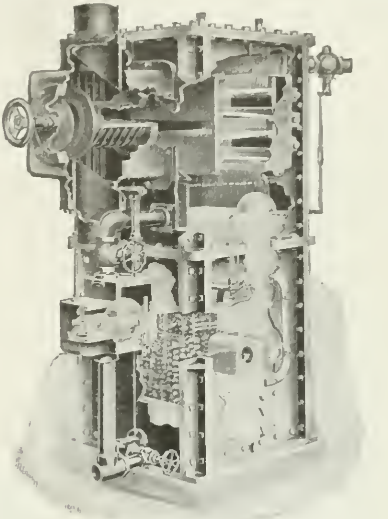


Fig. 1—Phantom View of Feed-Water Heater.

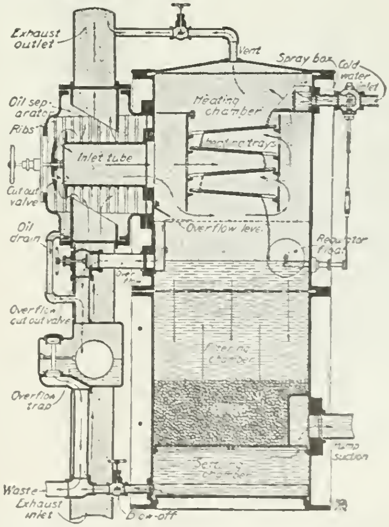
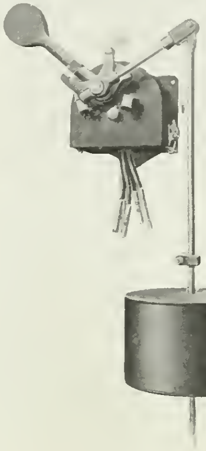


Fig. 2—Cross-Section of Feed-Water Heater.

AUTOMATIC FLOAT SWITCH.

The automatic float switch here shown embodies several features that render it desirable for the control of motors driving pumps that empty into reservoirs, or drain sumps, sewers, etc. The switch is operated by a cylindrical steel float which plays on a vertical rod between brass stops which are adjusted to the upper and lower water levels. When the float presses against either stop a U-shaped tripping lever attached to the float-rod engages a pivoted weight-arm and carries it upward and around past the vertical position. The weight-arm then falls, engages an arm on the switch drum shaft, and snaps the switch open or closed, according to the direction in which the weight-arm is thrown. A buffer receives the force of the weight-arm's fall. When the float-rod is attached to the tripping lever, as shown, the pump will be started when the float presses on the lower stop and hence is properly arranged for filling reservoirs. With the rod attached to the other side of the lever the switch is adjusted for drainage purposes, as the motor will be started when the float presses against the upper stop. The switch is of the drum type with renewable contacts and fingers. The switches are made in two styles—double-pole for direct current and single-phase alternating-current motors, and three-pole for polyphase motors. They are made by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.



Automatic Float Switch.

PROTECTIVE OIL SWITCH.

The selection of the proper protective device is a matter of importance. If a device whose breaking capacity is just enough to take care of the present load is selected the future growth of the company will necessitate its replacement. This replacement may entail other considerations, not only on account of the cost, but also on account of the fact that larger devices necessarily take up more room, and often generating and substations are in such places that it is impossible to get the necessary increase of room. On the other hand, if devices are selected which will have an ultimate breaking capacity large enough for any possible increase of the station the amount of money invested is abnormal in relation to the protection obtained, as the devices are, necessarily, expensive for the amount of power they now control and the increased cost of investment may affect the price of energy. Protective oil switches for alternating-current work are at present divided into two classes —one for small stations and one for very large stations. The Condit Electrical Manufacturng Company, Boston, Mass., has, however, developed a line of oil circuit-breakers occupying a position midway between those for small stations and those for extremely large stations. These oil switches open upward as do the oil switches for the largest stations and have the same dimensions, outward appearance and mechanical features as the smaller ones. Due to this breaking upward and to other features of design, the switches are said to be capable of opening extremely heavy short-circuits on large stations. Switches are often installed on motors which are close to the generating station and unless a switch of large breaking capacity is used a short-circuit is likely to cause a great deal of damage. Fig. 2 herewith shows some of the details of the switch construction. It will be noted that the break takes place at the bottom of the can, that the cans are heavy and that there is a large space above the oil can to allow the gases to expand. This switch is made hand-operated and electrically operated, in ampere capacities as high as 3000 and for voltages as high as 60,000.

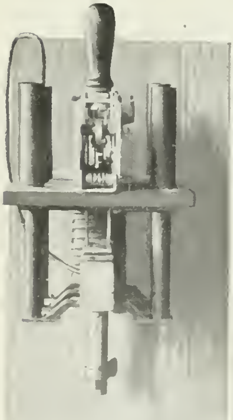


Fig. 1—Oil Switch Closed.

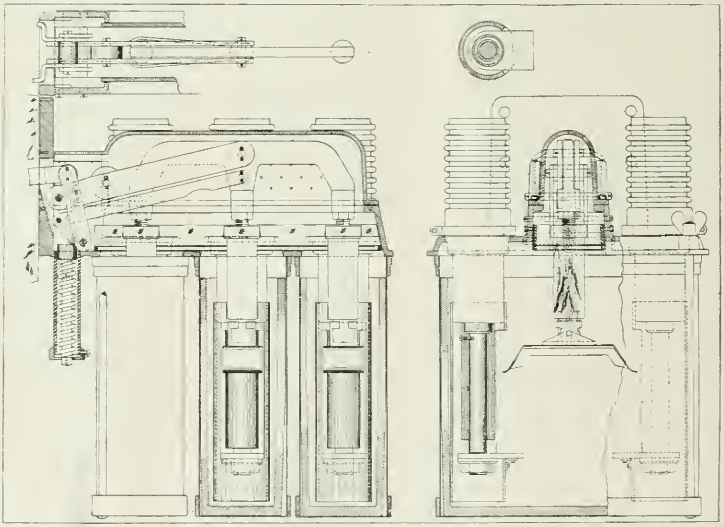


Fig. 2—Details of Oil Switch.

A NON-ROTATING SYNCHROSCOPE.

The synchroscope illustrated herewith is said to behave just like an ideally perfect rotating synchroscope but to have none of the disadvantages of the rotating type. The lamp method of synchronizing machines has the important advantage of being infallible in its indications; however, it is unfortunately very insensitive to differences in phase. For instance, a difference in phase of 16 deg. causes a change in voltage of only 1 per cent, and, therefore, a slight error in the judgment of the brightness of the light may result in a violent shock when the switch is thrown in. Furthermore, with lamps there is no way of knowing whether the incoming machine is fast or slow, and, therefore, much time may be lost in wrong manipulation of the speed.

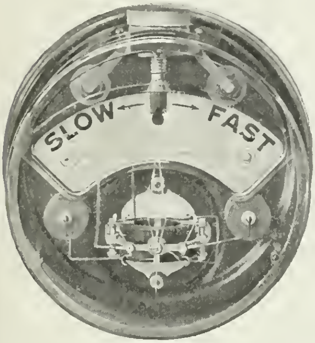


Fig. 1—Phantom Front View of Synchroscope.

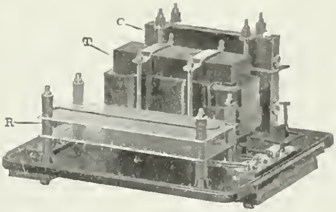


Fig. 2—Auxiliary Devices.

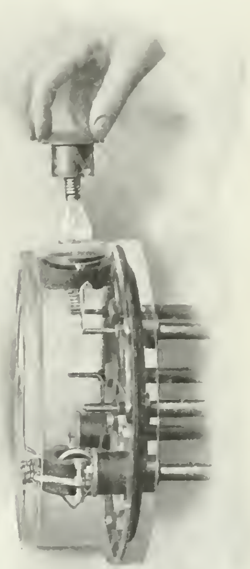


Fig. 3—Phantom Side View of Synchroscope.

Because of the infallibility of the lamp method of synchronizing, it is customary to install lamps with the rotating synchroscope to guard against any serious disaster; however, this expedient has the disadvantage of requiring the attendant to divide his attention between two objects.

The synchroscope here shown is so combined with a synchronizing lamp that its indications are visible only by the light of that lamp. The instrument proper consists of a new Weston type electrodynamometer movement essentially the same in construction as the single-phase switchboard wattmeter which was described in our issue of March 30, 1911.

The movable coil is connected in series with a condenser across the incoming machine, while the fixed coil, which is wound with fine wire, is connected in series with a slightly inductive resistor across the line. The pointer stands normally in the middle of the scale, which is made of translucent glass. The synchronizing lamp is mounted behind the pointer and when lighted throws a shadow of the pointer on the scale.

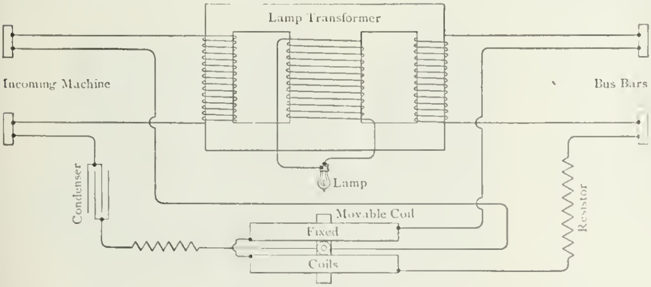


Fig. 4—Circuit Connections.

It is well known that a good electrodynamometer wattmeter will show no deflection when the currents in its fixed and movable coils are in exact time-quadrature; therefore, in this instance, because of the condenser, the instrument will accurately indicate when the emfs impressed across the coils are exactly in phase coincidence or in phase opposition, and the pointer will take up a definite position for each value of phase displacement depending upon the torque produced in the windings.

When the emfs of the machines to be synchronized are not of the same frequency the phase displacement between the two will change continuously through complete cycles of 360 time-degrees and therewith the average torque will rise and fall, first in one direction and then in the other, thereby causing the pointer to swing back and forth over the scale. Each swing of the pointer corresponds to a shift of the time-phase from quadrature lag to quadrature lead, or vice versa, and, therefore, just coincides with a period of light or darkness; that is, the pointer is seen only during every other swing and appears to rotate smoothly and silently in one direction. The direction of apparent rotation indicates whether the incoming machine is fast or slow, and the speed of rotation is a measure of the amount by which the frequencies differ.

When the frequency is right the pointer will come to rest and the lamps will remain lighted, and when perfect synchronism is attained the pointer will stand at the exact middle of the scale.

Just what goes on in the circuits of the instrument is shown in Fig. 5, which is based on two waves which have different frequencies. Assume the two waves at the top of the diagram to be the emf waves of two machines to be synchronized, then these waves also represent the currents in the primaries of the lamp transformer and the resultant (shown dotted) is the current active in the lamp. The shaded band shows where the current is not sufficient to light the lamp, and when the maximum extends beyond this band the lamp will glow. The periods of light and darkness are indicated for this particular instance by the light and dark bands below the curves.

The middle set of curves is constructed from the top set by assuming the fast wave as belonging to the incoming machine; therefore the fast wave is advanced in phase a quarter period on account of the condenser. The instantaneous product of these two currents gives the torque active in the coils of the instrument. This torque has been calculated for the present case and is represented by the wave which bounds the shaded areas. The periodic reversal of the average torque is shown roughly by the sloping straight lines. This diagram shows that the pointer always moves from left to right during the light period when the machine is fast.

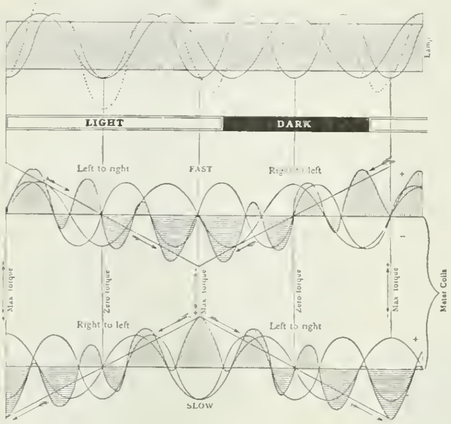


Fig. 5—Performance of Synchroscope.

The bottom group of curves is exactly similar to the middle set, except that the slow wave is considered as belonging to the incoming machine. In this case it is seen that the pointer moves from right to left during the period of light.

The chief advantage of the new synchroscope is its infallibility; however, its great accuracy is also of extreme importance, especially where large machines are to be synchronized. The independence of the indication of fluctuations in frequency and voltage is quite remarkable. For instance, a 60-cycle, 110-volt synchroscope when under test at from 40 cycles to 80 cycles per second and from 95 volts to 130 volts was still accurate within 1 deg. of true synchronism and permitted the coupling of machines absolutely without shock.

The construction and arrangement of the parts is shown in the illustrations herewith. The condenser lamp transformer and resistor are mounted in a separate box as indicated in Fig. 4.

The application of these principles to the operation of a synchronizing device is the invention of Mr. B. P. Romaine. The commercial form of the instrument as described above has been placed on the market by the Weston Electrical Instrument Company, Newark, N. J.

LIGHTING AND IGNITION SYSTEM FOR AUTOMOBILES AND MOTOR BOATS.

The "Matchless" electric lighting and ignition system for automobiles and motor boats, manufactured by the Esterline Company, Lafayette, Ind., comprises a positively driven, magneto-type direct-current generator, a storage battery and an automatic, self-closing, low-voltage release, overload, reverse-current controller. The generator is made to connect directly to the pump shaft in the same manner as an ignition magneto, without the use of a speed governor or speed-controlling device. It is supplied with complete ignition equipment, which can be omitted if desired, so that the ignition magneto can be retained or dispensed with as the user may desire. If desired the generator may be driven by gears or a silent chain in case the ignition equipment is not used.

The use of a machine without the usual speed-controlling devices, it is claimed, adds greatly to the reliability of the system, and the driving of the generator to a speed at all times in direct proportion to engine speed enables the makers to combine the lighting and igniting equipment in one outfit.

The use of a permanent magnet generator is made possible by the type of electric controller used. The controller has four distinct functions, as follows: To connect the battery to the generator when the voltage of the generator has reached the point where it will charge the battery; to limit the current through the battery to the normal charging rate when the generator is running at high speed; to disconnect the battery from the generator whenever the voltage of the generator is less than that of the battery; and to prevent the connection of the battery to the generator when the car is driven backward. The controller consists essentially of a die-cast metal case, over which is placed a permanent magnet with pole pieces projecting into the case and a pair of coils surrounding the pole pieces, but capable of motion relatively to the pole pieces. The force moving the coils is obtained by the reaction between the field of the magnet and the current in coils surrounding the projecting pole pieces. The moving parts of the controller are mounted on phosphor bronze leaf springs ½ in. wide set rigidly in an insulating block; these springs serve the double purpose of supporting the coils and leading the current to them. The coils simply float in a magnetic field. The operation of the controller is such that all electrical circuits are opened and closed at the instant the current is zero—that is to say, no currents whatever are broken, there is no sparking or burning of the brush contacts. With the car at rest or running at slow speed the connection between the battery and the generator is open, but when the voltage of the generator becomes sufficient to charge the battery the circuit between the battery and the generator is closed. Should the speed continue to increase, as soon as the charging current reaches the normal charging rate of the battery one of the coils comes into action and prevents the current from exceeding the normal charging rate. The space occupied by the controller on the dash is 2½ in. x 6 in. and it extends only 1½ in. from the dash; the weight complete is 2½ lb. The case is waterproof, dustproof and ornamental in appearance. There are four positions of the switch—lamps out of circuit for day running, side and tail lamps for city streets and use while the car is standing at night, head and tail lamps for touring, and all lamps in circuit.

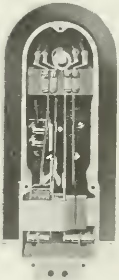


Fig 1—Automatic Controller.

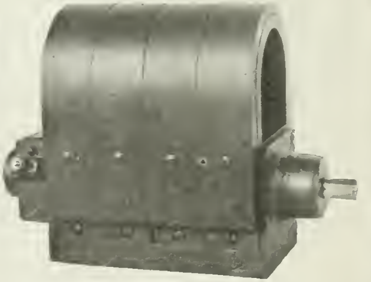


Fig. 2—Magneto-Generator.

All wiring is on the engine side of the dash, where it is not exposed to view. Openings are provided in the front of the controller for plug connections to an exploring lamp for use in locating trouble, filling gasoline tank, etc. The generators are made in two sizes; the smaller size has a capacity of 7½ amp continuously at 6 volts and the larger machine has a continuous capacity of 12½ amp at 6 volts. The shaft is particularly heavy and rigid; the laminations of high-grade sheet steel are keyed to the shaft and the windings are embedded in slots in the core. After winding, the armatures are impregnated by the vacuum process, making them oil and moisture-proof. Hess-Bright ball bearings are used and are provided with oil chambers and oil-retaining rings, which effectually prevent the oil from entering the armature windings and commutator dust or dirt from the outside entering the bearings. The generator is geared or connected directly to the engine shaft or an intermediate shaft without any clutches, brakes or speed-controlling devices. Two carbon brushes are used in each holder. An inclosed junction box is supplied with each equipment. This box is of sheet metal with a removable cover and contains a small insulated panelboard with provision for the necessary fuses for each circuit and connections for all wires. It is stated that this junction box greatly facilitates the wiring of the car and gives an orderly arrangement to the circuits. The points for connection in the box and the wires leading in are labeled so that an inexperienced person can connect up the system. An 80 amp-hour battery is used with the small size and a 100 amp-hour battery with the large size.

MOTOR-DRIVEN AIR COMPRESSORS FOR GARAGES.

The motor-driven air compressor illustrated herewith is specially adapted to the needs of garages for inflating tires and for cleaning the upholstery and machinery of the cars.

The compressor is of the single-acting piston, single-stage compression type. It has two horizontal cylinders and vertical tubular valves. The latter have no springs and seat automatically by gravity and pressure. One intake valve and one discharge valve are located in each cylinder head, and the arrangement of the intake air passages forces the incoming air through an air strainer, thus filtering the air and preventing trouble from dirt-clogged tire valves.

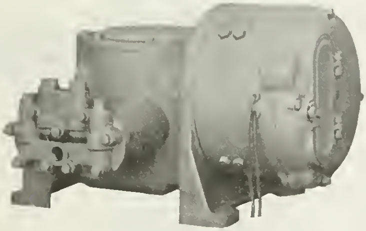


Fig. 1—Motor-Driven Air-Compressor for Garages.

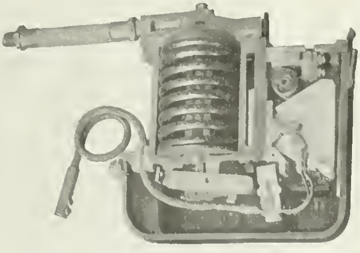


Fig. 2—Air-Compressor Governor Mechanism.

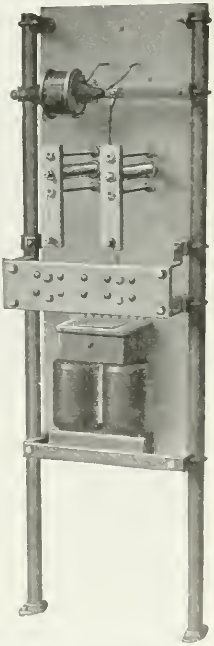
The motor drives the compressor through a herringbone gear. The gear is mounted on the crankshaft between the connecting rods, thereby equalizing the bearing on the teeth and reducing any tendency to vibration. In the design of the motors the armature and commutator diameters have been given dimensions most suitable for the required service, and all four poles are provided with field coils. The motors are rated on half-time basis—5 minutes on and 5 minutes off.

The air pressure in the tank is automatically regulated by means of a governor, which stops the motor when the desired maximum pressure is reached, and starts it up again when, by use, the pressure of the compressed air falls below a predetermined minimum. The governor is of the electrical circuit-interrupter type. It is made in two forms, for direct-current and for alternating-current supply. Both forms operate on the same principle, are of similar construction, and differ only in the number of electrical contacts, the direct-current form having two sets of contacts instead of one.

The above described equipment has been developed for the market by the General Electric Company, Schenectady, N. Y.

REGULATOR FOR METALLIC-FILAMENT LAMP CIRCUIT.

The resistance of the metallic-filament lamp increases as it gets hot, making it especially adapted for use on series circuits. On such circuits when lamps burn out and are short-circuited by their film cut-outs the increase in resistance in the remaining lamps prevents to a large extent an abnormal rise of current. That this is not the case with carbon lamps is well known. For example, suppose that after a severe storm 30 per cent of the lamps had burned out and become short-circuited. With carbon lamps and no regulator the rise of current in the remaining lamps would be 73 per cent, resulting in their immediate destruction. Had the resistance been constant the rise would have been 43 per cent, and with tungsten-filament lamps and no regulator it would have been cut down to about 25 per cent.



Rear View of Switchboard for Series Regulator.

The regulator shown herewith will keep the current practically constant for all ordinary conditions. Under abnormal conditions, as illustrated above, it will still limit the current to a perfectly safe amount.

Provision is made to reduce the current to normal value, if desired, while the large percentage of lamps is still out. In other words, the regulator is automatic and requires no attention. However, if a change in current is desired it can be handily accomplished.

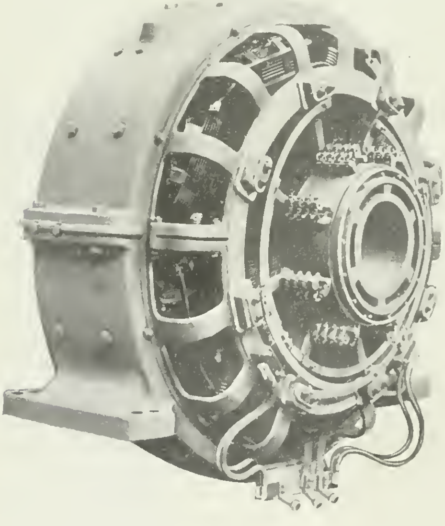
The regulator is essentially an inductance in series with the lamps working in the secondary circuit of a transformer, having several taps for the accommodation of partial load conditions. The inductance is also tapped at various points, and these taps are brought to a gang-plug switch, making it very convenient to use any desired point. The switchboard, which enables the system to be handled in its most convenient manner, is a component part of the outfit, which has been placed on the market in this form by the Packard Electric Company, Warren, Ohio. The claims made for this system, which has now been in successful operation for over a year, are as follows: No moving parts; high efficiency and power-factor; normal power-factor on partial load; long life and dependable service. The apparatus also embodies the element of low cost.

INTERPOLE GENERATOR.

In the direct-current generator illustrated herewith ventilation has received particular attention. The design of all the windings is such as to give shallow coils, with the result that the heat in any part has only a very short distance to travel to the surface from which it is radiated. This, with a complete system of air circulation, insures an absence of hot spots and a high degree of uniformity of temperature. These features enable the generators to withstand heavy overloads without injury.

Most electrical troubles in a direct-current generator arise from faulty commutation, especially during overloads. They begin with sparking, which burns away the copper and brush, causing high mica, roughness of surface, flashing, break-downs in insulation and deterioration in brushes, brush holders and commutators.

In a non-interpole generator sparking is primarily due to a local magnetic field surrounding a coil which is being commutated. This field sets up an emf in the commutated coil, in such a way as to oppose the reversal of the current in the coil, and thus tends to cause sparking as the coil or commutator bar leaves the brush. This action increases with the current or load and is especially destructive to the commutator on heavy overloads. By advancing the brushes to bring the armature coils within the field near the tips of the pole pieces during commutation the sparking may be sometimes lessened.



Interpole Generator.

In the generator here shown the proper conditions for commutation are obtained by the use of small poles, interspaced between the main poles. The interpole windings, which are in series with the armature, serve to set up a magnetic field which annuls the effect of the field formed by armature magnetization and generates in the commutated coil an emf which assists the reversal of the current. Since the interpole coils are in series with the armature, the interpole field strength varies in proportion to the load and thus has the proper corrective effect at all loads. Experience has proved that with the interpole generator sparkless commutation is obtained under practically all conditions, from no load to very heavy overloads.

This machine has been developed for the market by the Westinghouse Electric & Manufacturing Company in ratings from 25 kw to 1000 kw. The line embraces generators wound for all standard voltages with speeds conforming to the best engine practice.

SEWING-MACHINE MOTOR-CONTROLLER.

In the sewing-machine motor-controller shown herewith a sliding arm is operated by means of a shaft which, when installed, is connected to an ordinary treadle by a rigid rod. Starting, stopping and varying the speed of small motors driving sewing-machines, saws, lathes, etc., by means of a foot treadle permits of using the hands for other purposes.

The entire mechanism, which is inclosed in a cast-iron case 6.5 in. high and 4.5 in. deep, is designed for installing under the machine board. It has been approved by the National Board of Fire Underwriters and is built to withstand the usage encountered in manufacturing establishments.

To start the motor the shaft is pulled down by pressing on the toe of the treadle. This causes a steel-contact disk to bridge the two lower steel-contact posts. A greater pressure moves the sliding arm over the contacts and increases the speed as desired, four separate speeds being provided. When pressure is released from the treadle, the arm and disk return to the "off" position, thereby opening the circuit. When quick stopping is desired, pressure is applied to the heel of the treadle, thereby forcing the sliding arm to the upper contacts and giving a strong dynamic braking.

Motor-Driven Sewing-Machine Controlled by Treadle Controller.

As the disk and contact posts are of steel, they become magnetized by the coils in the rear of the controller and a firm contact is secured when the motor is running. In stopping, the tendency is for the disk to remain in this position against the tension of a small spring mounted below the disk. When the upward motion of the controller shaft causes the tension of the spring to overcome the magnetism, the disk leaves the contact posts with a sharp snap, thus breaking the circuit quickly and preventing arcing.

This controller is made by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

Industrial and Commercial News

THE WEEK IN TRADE.

CONTINUED dullness is the summary for another week of business. Few changes have taken place in the depression in the majority of lines, and manufacturing and selling interests, as a whole, seem inclined to discount all rumors of early activity. A moderate volume of business is being done, however, for immediate needs, but conservatism prevails in all transactions. While, on one hand, advices state that slackness in buying has resulted in low stocks which will require early replenishment, with a resultant increase in trade, there is also evidence that stocks in various lines have not been greatly reduced by reason of the dullness of the season, and that this creates no necessity for purchasing new supplies. Curtailment in many lines, notably dry goods and furnishings, is attributed to unseasonable weather. Hide and leather markets are dull, though buying seems more general. Demand for shoes continues to be fair. Textile lines are reported unchanged, with only light demand for cottons and woolens. Slight increase in building is in keeping with the period of the year. Hardware dealers are said to be mildly active, but the volume of trade is below normal. Net earnings of railroads are less than the returns for the corresponding period last year, and aside from a few car and rail orders the roads are not in the market for any encouraging amount of equipment. Interest is increasing in the outcome of tariff legislation. While the extent of time yet necessary for recovery from the effects of the depression of 1907 cannot be stated, there is a decided belief that progress is being made in readjustment and that trade will show marked expansion before the end of the year. Crop conditions are fully as encouraging as heretofore, although heavy rain is again reported in some sections as delaying the season. Collections are slow to fair, depending upon the locality. Business failures for the week ended April 20, as reported by *Bradstreet's*, were 233, as compared with 233 for the previous week, 193 for the same week in 1910, 247 in 1909, 254 in 1908 and 157 in 1907.

THE COPPER MARKET.

EXCESSIVE production and limited consumption continue to be the features of the copper trade, and no improvement is looked for until these factors become more closely related. Prices remain practically unchanged, with electrolytic on a 12-cent basis and standard quoted close to 11.70, with the market dull. Prices in Europe are declining slightly. A small speculative movement is reported abroad, together with transferring of stock from this country to European interests. Several heavy inquiries, aggregating 150,000,000 pounds, are said to have been received during the week at prices ranging from 12 to 12⅛ cents. Copper will not be affected to a marked extent in new tariff schedules, and despite reports to the contrary, increased business in this line is not looked for after Supreme Court decisions in the trust cases. Movements of large tonnages will be required to cause briskness in the industry. The relation between prices of copper securities and reports from the mines undoubtedly exerts as much influence on the copper situation as do reports of current sales. A closer relation between producing interests might result in curtailment of production. While figures for April are expected to show a decrease in the excess of production shown for March, the actual value of the figures is doubtful, by reason of falling off in imports and expected increase in exports, together with slight curtailment in output. At the present rate imports for the month will be between 12,000 and 14,000 tons while exports, including April 24, were 24,800 tons, showing heavy increase over figures for the early part of April. The daily call on the Metal Exchange April 24 quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.70	11.80	.....
April	11.70	11.80	11.75
May	11.80	11.90	11.85
June	11.80	11.90	11.85
July	11.80	11.90	11.85

The London market, April 24, was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	54	11	3	55	3	0
Standard copper, futures	54	11	3	55	2	6

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.30c			11.67½c		
London, spot	£56	15	0	£53	12	6
London, futures	57	12	6	54	5	0
Best selected	60	5	0	57	10	0

INDUSTRIAL AND COMMERCIAL NOTES.

Electric Motors for International Bridge.—Tests will be made shortly on the equipment now being installed for operating the International Bridge, which crosses the new barge canal and the old Erie Canal at Buffalo, N. Y. The structure is of the swing type. Some 200 trains of the Grand Trunk system are to cross it daily. For this reason and since trouble has been experienced in this section by vessels breaking from their moorings in heavy winds, three sources of energy have been provided in order that the bridge may be opened and closed quickly and damage avoided. Each of the three systems is to be of sufficient size to operate the bridge independently of the others. A 100-hp Otto gas engine, direct-connected to a special generator, forms one source of energy. The second is a 100-hp motor-generator set, with a Crocker-Wheeler motor and a Garwood generator, energy being furnished at 2200 volts from the Niagara Falls Power Company. In addition to these is a Gould Storage Battery system, which will be used most of the time. About two and a half minutes will be required to open and close the bridge. The battery is to be of sufficient size to operate the bridge forty times without recharging. When this is necessary one of the other units will be used for the purpose. The installation has involved a large expense but has been considered justifiable in view of the necessity for certainty of operation.

Improvements in Flaming-Arc Lamps.—H. M. Hirschberg, president and manager of the Excello Arc Lamp Company, who has recently returned from his annual trip to Europe, states that, with recent improvements, the life of flaming-arc lamps has been increased from 70 hours to 125 hours, and that under very favorable conditions this has been extended to 150 hours. Mr. Hirschberg noted continued increase in the use of these lamps abroad, but found that the electrical trade and trade in general was rather quiet for this period of the year, reflecting business conditions in this country. As a matter of further interest, Mr. Hirschberg says that white carbon seems to be giving more satisfaction at this time than yellow and that his factories at present are shipping only the white carbon arc lamps. After June the factories will be able to make prompt deliveries in any quantities. Among other things Mr. Hirschberg visited the Berlin Electrical Show, which he found similar to but not equal to the last show held in New York City.

Smith Waterwheel Units.—The S. Morgan Smith Company, of York, Pa., has been awarded a contract by the Honk Falls Power Company, of Ellenville, N. Y., for an additional pair of waterwheels for the plant at High Falls, N. Y. This new unit will develop 1000 hp and will be a duplicate of the one furnished by the same company in 1910. The Honk Falls Company sells energy to the Ellenville Electric Company, Kingston Gas & Electric Company, Poughkeepsie Gas & Electric Light Company and to the Rondout Power Company. The Monument Mills, of Housatonic, Mass., have also placed a contract with the S. Morgan Smith Company for a pair of waterwheels for their plant at Glendale, Mass. These will be direct connected to a Westinghouse generator and will have a rating of 775 hp. Energy will be transmitted to the Monument company's mills at Housatonic. One of these waterwheel units has been ordered by the Standish Worsted Company, of Plymouth, Mass.

Denver Improvements.—Henry L. Doherty & Company, who acquired the Denver Steam Heating Company about a year and a half ago, will spend nearly a half million dollars in improving the system. Most of this money will be used in bettering the mains. The Denver Gas & Electric Company has secured a city contract for lighting 500 magnetite lamps.

Foreign Trade Comments by American in Far East.—W. C. Redfield, second vice-president of the American Blower Company, who left New York last November on a trip to study conditions of trade in markets throughout the world, writes from Calcutta, giving information of value to American manufacturers and merchants interested in foreign trade. Mr. Redfield's letter, in part, is as follows: "I have now traversed Japan, the Philippines, Hong Kong, Java, the Straits Settlements and Burma to India, and I cannot say that thus far I have found any prejudice against American goods. Indeed, certain classes of American products have been everywhere in evidence. Among these are sewing machines, typewriters, toilet articles and soaps, locomotives (in Japan), petroleum products and others. These are precisely those that have been most carefully and steadily brought before and kept before the attention of buyers in these various lands. I ought also to add that American cameras and photographic supplies were seen everywhere except in Java; there no films of any kind could be had, only plates. I have run across neglect in packing even after attention was called to it. In one case oil stoves were formerly bought in America and the American product was concededly better, but, even after warning, the American goods were so badly shipped that one-half of one shipment arrived broken. Now the dealer buys in Europe and pays a higher price. He told me he did not want to do this but he had to, for American makers would not listen to him. Complaint is made that American houses trust young irresponsible boys to do their mailing instead of having some clerk of fair responsibility attend to this important service. The result is misaddressed letters so that responses are not received, and the regular habitual neglect to prepay proper postage causes extra charges. A large Boston house wrote to Manila on June 8, and on June 25 followed it up with a sharp letter insisting on an immediate reply. A New York firm referred an inquiry from Panama to its Manila agent. These are some of the things that handicap Americans. I do not find prices to be the obstacle. Several American manufacturers I have met tell me their prices are lower than their European competitors'. This is true of locomotives for example. Foreign trade does not essentially differ in its basis from domestic trade. A man in larger trade does not assume that Texas and Florida use the goods that sell in Maine; he finds out what are wanted or not wanted and acts accordingly, and this is all there is underlying export trade, but because it is just outside the immediate horizon and men are busy they often do not even inquire about it, and when they do and find it takes time and care and patience they take the near and obvious and let the other go."

Westinghouse Turbines.—Among recent sales by the Westinghouse Machine Company, of Pittsburgh, Pa., is a 5000-kw, 2300-volt, three-phase, 60-cycle turbo-generator to the Dayton Lighting Company. This unit is of the latest double-flow type and will run condensing on a Le Blanc condenser. Two 1000-kw turbine units of the single-flow type, furnished by the same company, are in operation at the plant. The Westinghouse Company has also recently received an order from the Weymouth Light & Power Company for a 625-kw single-flow, high-pressure turbine to be installed in the power house at East Weymouth, Mass. The turbine will use steam at 150-lb. pressure and will exhaust into a vacuum of 27 in., maintained by a Le Blanc jet condenser. Approximately $50,000 has been expended in improvements about the plant, which will make it one of the most up-to-date generating stations in Massachusetts.

Clarion River Power Company Organized.—Joseph R. Paull, H. W. Douglass, J. P. Fife and others, of Pittsburgh, are preparing to apply to the State Department at Harrisburg, Pa., for a charter for the Clarion River Power Company. The company plans to spend about $3,000,000 in erecting hydroelectric plants in Clarion County, Pa., for supplying energy to neighboring cities. Granting of the charter is opposed by the Pittsburgh Flood Commission and others who are interested in the building of storage dams across the Clarion River with a view to preventing floods in the Pittsburgh section. Residents of the townships in which the power company is applying for rights do not favor the charter and have signed petitions which are to be presented to the State Water Supply Commission. George H. Maxwell, executive director of the Flood Commission, said: "I notice that one of the parties applying for the Clarion River water rights has said that if a reservoir were built at the mouth of the river it would serve the same purpose as that advocated by the Flood Commission. I want to say that this is absolutely not so. Persons building such a dam for power purposes would have to keep the reservoir full at all times, and when there were floods water would run over its dams just as in other flood times. The Flood Commission would keep the reservoirs as nearly empty as possible that they might care for the increased flow of water, and have them filled only at the end of the flood season, when water would be stored to be used in the dry seasons. The opposition of the Flood Commission before the State Water Supply Commission at Harrisburg will be vigorous and determined. Pittsburgh was the first in the field and Pittsburgh should be given precedence by the State Water Supply Commission. If the plans of the Flood Commission are not carried out, Pittsburgh and other towns will lose $100,000,000 by floods."

General Electric Units for Water Company.—The Washington Water Power Company has placed an order with the General Electric Company for two waterwheel-driven generators, said to be the largest ever constructed. The units will be used in the Long Lake plant. They will have three-phase generators of the horizontal type, and will have a capacity of 13,000 kva., and will de designed to be able to carry a continuous overload of 25 per cent. They will operate at a speed of 200 r.p.m., and will generate current at 4000 volts. Four of these generators will eventually be installed at this plant. They are driven by I. P. Morris horizontal twin turbines each of 22,500 capacity at full gate, operating under a head of 170 ft. The potential of the transmission line will be 60,000 volts for the present, although the plant is designed for 110,000-volt operation.

New Power Stations in Texas.—In addition to the proposed hydroelectric plants on the Devil's and Pecos Rivers, in Texas, as mentioned in our issue of April 20, further developments are being planned on the Colorado River, in the vicinity of Kingsland. C. H. Alexander, of Dallas, who heads the company now building a hydroelectric station at Marble Falls, is active in the new project. The plant will have a rating of about 10,000 hp and will be operated in connection with the Marble Falls station. Energy is to be transmitted from these two plants to points within a radius of 150 miles. This system would include San Antonio, Waco, Austin, Georgetown, San Marcos and a number of smaller communities.

Sales of Mechanical-Draft Apparatus.—Recent orders taken by the Buffalo Forge Company, Buffalo, N. Y., for mechanical-draft apparatus of considerable size include, among others, orders from the Cambria Steel Company, Johnstown, Pa.; the American Smelting & Refining Company, New York, N. Y.; the Burgess Sulphite Fibre Company, Berlin, N. H.; Knickerbocker Portland Cement Company, Hudson, N. Y., and several export orders from its agents in Germany, Japan and South America. The Buffalo Forge Company reports the export business as particularly active so far this year and with excellent prospects of exceeding any former season.

Street-Lighting Equipment for Richmond, Va.—The Morris Iron Company, of New York, has been awarded a contract by the city of Richmond, Va., for furnishing 200 arc-lamp brackets to be used on the poles carrying transmission lines. The five-lamp ornamental tungsten clusters used on the main streets of the city were furnished by the Frederick Iron Works, which have been succeeded by the Morris Iron Company. The company has also received a number of orders for export, covering its outdoor fixtures, the most recent being from Limon, Costa Rica, for 100 cast-iron arc-lamp posts.

Catalogs and Prices Wanted.—Hugh G. Palmer, chief engineer of the Fox River Electric Power Company, Yorkville, Ill., requests that catalogs and prices relating to electric generators, motors, wire, fixtures, supplies, etc., be sent to him. It is said that the Fox River Electric Power Company is about to begin the construction of a $100,000 hydroelectric plant with generating station on the Fox River near Yorkville for supplying energy to Yorkville, Plano, Sandwich and other places.

General Electric Car Equipment Sales.—The Third Avenue Railway Company, of New York City, has ordered from the General Electric Company thirty-five motors and equipments for storage-battery cars on its system, and the Second Avenue Railroad Company, of New York, has contracted with the same company for ten double equipments, which are in addition to the 200 sets purchased in December, 1910.

Financial.

The Week in Wall Street.

Downward prices and occasional flurries of activity indicate the tone of transactions on the New York Stock Exchange since last report, with the market at present in dull condition after the depression of midweek trading. Sales of stock for the week were 1,692,933 shares, compared with 579,106 for the previous week. Repetition of various opinions as to causes of dullness and prospects for revival of activity has been frequent throughout the week, but, at best, there is nothing advanced which can be relied upon for immediate encouragement. Supreme Court decisions on the Standard Oil and American Tobacco cases are still withheld. Conjecture is divided as to whether decisions will be deferred until the October term, many interests believing that they will be rendered in May, rather than extend trade restriction by further uncertainty. There have been few developments in trade conditions to direct speculative interest in the stock market, and there is no doubt but that the narrow trading is mere manipulation. There is said to be more caution at present than heretofore on the part of commission houses in advising customers on action in the market, which is a reflection of the unsettled state throughout the Street. There is abundant evidence of large crops to assist the situation. Reports from agricultural districts are fully up to expectations based on earlier advices, although excessive moisture is said to be delaying matters in some localities. Increasing quietness is shown in the suspension of construction work in many sections, the closing of various mills and the shutting down of blast furnaces in several plants of the Steel Corporation. A cash gain of $9,400,000 is shown in the week-end bank statement, making a total surplus reserve of $39,800,000, which is approximately three times larger than the figures for the corresponding period of the previous year. There has also been an increase during the week in the volume of money coming into New York, and money will continue to be cheap throughout the month. Rates April 24 were: Call, 2¼ @ 2⅜ per cent; ninety days, 2½ @ 2¾ per cent. The quotations in the table are those of the close April 24.

NEW YORK.

	April 17.	April 24.	Shares Sold.		April 17.	April 24.	Shares Sold.
All. Ch.....	7½	7⅜*	300	Int. Met., pf.	52⅝	49½	11,000
All. Ch., pf..	29	26	900	Mackay Cos..	93½*	93½*	
Amal. Cop...	62⅛	63	67,200	Mackay C.,pf.	76¼	74⅞*	316
Am. D. T...	20½*	20½*	——	Man. Elev...	139	137	284
Am. Loco...	37¼*	35¾*	750	Met. St. Ry.	15*	15*	——
Am. Loco. pf.	104½*	104	402	N.Y.&N.J.Tel.	139½*	139½*	——
Am. Tel. & C.	83*	83*	— —	Steel, com...	76⅝	73⅞	388,000
Am. T. & T..	145⅞	145	3,090	Steel, pfd...	120	119	5,615
B. R. T.....	77⅞	76⅞	6,120	W. U. T...	72¾*	72*	1,120
Gen. Elec...	150½	150½	1,800	West'h, com..	65½	65	400
Int. Met....	18½*	17½	5,100	West'h, pfd..	117	117*	200

PHILADELPHIA.

	April 17.	April 24.		April 17.	April 24.
Am. Rys...........	44½	44	Phila. Elec.........	16¼	16¼
Elec. Co. of A......	11¾*	11⅞	Phila. R. T........	17¾	17⅛
Elec. St. B'ty......	53¼	52	Phila. Trac........	83¾*	82½*
Elec. St. B'ty., pfd.	30*	30*	Union Trac........	45¾	45⅛

CHICAGO.

	April 17.	April 24.		April 17.	April 24.
Chi. City Ry.......	186*	186*	Chi. Tel. Co.......	120	122*
Chi. Rs., Ser. 1....	85*	85*	Met. El. Co.......	22⅛*	22⅛*
Chi. Rs., Ser. 2....	23½*	22	Met. El., pfd......	68	67*
Com. Edison.......	126	125⅜	Nat'l Car..........	114½	115*
Chi. Subways......	4¾	5	Nat'l Car, pfd......	120	120*

BOSTON.

	April 17.	April 24.		April 17.	April 24.
Am. T. & T........	145¾	145	Mex. Tel..........	3½*	3½*
Cum. Tel..........	150*	150	Mex. Tel., pfd.....	6½*	6½*
Edison E., Ill......	284¼	285¼*	N. E. Tel..........	142	141
Gen. Elec..........	151*	151½	W. T. & T.........	19*	18*
Mass. E. Ry........	16¾	16	W. T. & T., pfd....	94*	94*
Mass. E. Ry., pfd..	87	87			

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*Last price quoted.

Shares sold for week, April 17 to April 22.

Financial Notes

Earnings of General Electric Company.—The annual report of the General Electric Company for the year ended Dec. 31, 1910, shows marked gains over the business of the previous year. Total receipts from all sources were $74,707,689, against $54,102,051 for eleven months in 1909. Expenses were $63,134,601, including $4,661,175 charged to depreciation of plants, showing net receipts of $10,855,692, as compared with $6,493,671 for the eleven months ended Dec. 31, 1909. Surplus for the year was $5,641,324, while the total surplus is given as $23,022,706. Vice-president Lovejoy states in part: "Sales billed and orders received during the past year were the largest for any year since the organization of the company. . . . Our high-voltage direct-current railway system has most satisfactorily fulfilled the requirements of interurban electric railways and steam railroad companies. The reliability of this system has been fully demonstrated by its continued successful operation on many electric and steam railways. A number of these railways have during the past year placed orders with us for additional equipments. Over 85,000 hp of our 1200-volt direct-current motor equipments are in service or on order. Our facilities for the manufacture of Curtis steam turbines have been taxed to the maximum during the past year. Increased facilities are being provided to meet the demand. Curtis steam turbines of our manufacture in excess of 2,600,000 hp are now installed or on order in the United States and abroad. Several turbine-generators of 27,000-hp rating each are now in process of manufacture for the Commonwealth Edison Company of Chicago and the New York Edison Company. . . . Our incandescent lamp business shows substantial growth. The rapid improvement in quality and efficiency of incandescent lamps—and more particularly the development of the high-efficiency metal-filament 'mazda' lamp—have added greatly to the popularity of incandescent lighting, enabling illuminating companies to give to their customers superior light at lower cost and to expand their business rapidly. The business of our foreign department was larger this year than for any previous year. This growth of our export business is due to the superior quality of our apparatus and further strengthening of our subsidiary companies and selling agencies in various parts of the world. We are constantly establishing new relations and seeking new outlets for our product."

Virginia Railway & Power Company Merger.—Plans are announced as completed for the merging of the Virginia Railway & Power Company, of Richmond, Va., and the Norfolk & Portsmouth Traction Company. Both companies control large interests in the lighting and traction properties in the State. The Virginia Railway & Power Company is capitalized at $12,000,000 and controls the water-power in the James and Appomattox Rivers, with generating stations at Richmond and Petersburg. In addition to controlling lighting and traction interests in these cities, the company lights neighboring localities, including Manchester and Northside. The common stock outstanding is $7,500,000, with $4,500,000 of 5 per cent preferred stock. The Norfolk & Portsmouth Traction, which owns the Portsmouth Electric & Gas Company, is capitalized at $6,000,000. In addition to these interests in Norfolk and Portsmouth the company leases the Norfolk Railway & Light Company. Outstanding common stock is given as $3,000,000, and there is also $3,000,000 5 per cent preferred stock. Reports of the Norfolk & Portsmouth Traction Company for eight months ended Feb. 28, 1911, show gross receipts of $1,400,079, an increase of $115,823 over 1910 figures; operating expenses were $788,088 and the net earnings $612,071, representing a gain of $52,936 over the figures for the same period of the previous year. The merger is planned to become effective July 1, 1911.

Telephone Opposition in the Southwest.—The Postal Telegraph Company is starting work on a new line in Texas, Louisiana, Mississippi, Arkansas, Oklahoma, Kansas and Missouri, to meet competition with the American Telephone & Telegraph Company, which controls the lines in the Southwest. A fifty-year contract which still has many years to run before expiration is now in force between the American Telephone & Telegraph Company and the Postal company, giving the latter an outlet in the territory; but Postal interests plan, nevertheless, to build their own lines. Representatives of the Mackay companies have been obtaining rights-of-way, and material for the lines has been distributed throughout a large part of the territory. Bell interests have been arranging, through the Southwestern Telephone & Telegraph Company, which is established in the section now entered by the Postal company, for a merger of the independent long-distance lines between Houston, Galveston, San Antonio and points in northern Texas.

Kings County Electric Light & Power Company Earnings.—Reports for March and for the first three months of the present year show continued increase in the business of the Kings County Electric Light & Power Company. Gross earnings for March were $378,802, an increase of $30,703 over returns of March, 1910; operating expenses were $102,054, an increase of $29,099, showing an increase in net earnings of $10,004. Gross earnings for the first three months of 1911 were $1,218,878, an increase of $147,238; operating expenses were $579,320, an increase of $87,561, and net earnings were $639,557, which is an increase of $50,677 over the earnings for the corresponding period of 1910.

United Railways & Electric Company of Baltimore Bond Interest.—Commenting on payment in June of the interest on the income bonds of the United Railways & Electric Company of Baltimore, Hambleton & Company state in part: "The interest on United Railway income bonds is payable June and December. It has to be earned in the preceding six months and declared by the board of directors semi-annually. As there are $14,000,000 United Railways income bonds, it takes $560,000 per annum to pay the full 4 per cent. Taking the income account, the extraordinary expenses, elimination of floating debt, etc., and estimating that certain items entering into charges in 1910 will not appear subsequently, there can be no doubt, as we view it, that full interest will be earned. The net income of the company last year was $1,226,853.54 (see *Electrical World,* April 13). From this was deducted $864,048.66 written off for extraordinary expenditures, leaving $362,804.88 to be carried to the credit of profit and loss. In looking over the items making up this total of $864,048.66, called extraordinary expenses, we find certain items that will not be a charge on the company in other years, and, therefore, in estimating what amount may be applicable to the payment of the interest on the income bonds these items may be eliminated. We also find that the company paid out of its earnings last year its total remaining floating debt, $375,000, and on account of current accounts, $32,500. We find also other items which may be eliminated, such as accrued taxes, $47,000, and settlement of park tax in Annex, $61,000. We find in the charge of extraordinary expenditures, improvements to power plant, $142,000, and annual rental payments made prior to Dec. 31, 1909, $135,000. As the company will soon begin to receive current from the Pennsylvania Water & Power Company, it will not be necessary to spend additional amounts on improvements to power plant, and the item $135,000 rental payments made prior to Dec. 31, 1909, will not appear again and can be eliminated. It certainly looks as if the United Railways will be able to pay full interest in cash on $14,000,000 income bonds."

Pacific Coast Power Company Preferred Stock Issue.—The Stone & Webster Corporation is offering $772,000 6 per cent cumulative preferred stock of the Pacific Coast Power & Light Company, at 100, to yield 6 per cent. The stock is redeemable at 110 and accumulated dividends. The company owns $4,125,400 par value of the stock of the Seattle Electric Company and $1,637,400 of the Seattle-Tacoma Power Company. Both of these companies have been in operation a number of years, and pay dividends of 7 per cent and 6 per cent per annum respectively. The Pacific Coast company is building a hydroelectric plant on the White River within 20 miles of Seattle and 15 miles of Tacoma. It is said that the site is capable of a development of 80,000 hp. The station now being built will have a rating of 27,000 hp.

Pennsylvania Railroad Tunnel Lease Extension.—The Public Service Commission for the First District, New York, has approved an extension of eleven months in the operating agreement between the Pennsylvania Railroad and the Pennsylvania Tunnel & Terminal Railroad Company, for which the former is now acting as agent. The Terminal company operates the electric division of the Pennsylvania Railroad between New Jersey and Long Island City by way of the tunnel under the North River. In the Terminal company's petition for an extension of the present lease, which expires at the end of May, it is said that the Pennsylvania Railroad has been unable up to the present time to obtain sufficient data to enable terms to be drawn up for a long lease of the property.

Report of San Joaquin Light & Power Company.—Increases in both gross and net earnings are noted in the annual report of the San Joaquin Light & Power Company, of Fresno, Cal., for the year ended Dec. 31. The company is consolidated with the San Joaquin Electric Company and owns and operates the Coalinga Water & Electric Company, the Power, Transit & Light Company at Bakersfield, Cal., and the Merced Falls Gas & Electric Company, of Merced, Cal. Gross income for the year was $1,052,462, an increase of $297,496, and the net income increased $188,493. After deducting interest charges, the balance represented a gain of $145,539 over the corresponding item for the previous year.

Automatic Telephone Service in Chicago.—It is asserted that the receivers for the Illinois Tunnel Company will have in service by June 1 the 20,000 automatic telephones necessary to comply with the terms of the company's franchise. It is estimated that the gross receipts from this telephone service will be about $1,500,000 a year, of which perhaps half will be net earnings. This is equal to 5 per cent on $15,000,000, but will not go very far on the $30,000,000 of bonds and receivers' certificates and the $45,000,000 of stock of the Chicago Subway Company, which controls the Illinois Tunnel Company. However, it is hoped to increase the number of telephones in use so that it will be much larger, ultimately, than the initial 20,000.

Syracuse and Utica Telephone Companies Sold.—Bell Telephone interests, represented by the Friendship Telephone Company, have secured control of the Onondaga Independent Telephone Company, of Syracuse, N. Y., and the Home Telephone Company, of Utica, N. Y., together with subsidiaries controlled by these companies. The transaction involved a cash payment of $1,250,000. This purchase has no connection with interests of the Rochester Telephone Company, which continues as an independent concern.

New Stock Issue by Niagara Falls Power Company.—The Public Service Commission of the Second District, New York, has granted permission to the Niagara Falls Power Company to issue $26,200 of capital stock. The proceeds of $22,900 stock formerly authorized are to be used for acquiring 491 shares of the Tonawanda Power Company. Of the 2500 shares of the capital stock of the Tonawanda company 2009 shares are now owned by the Niagara Falls Power Company.

Annual Meeting of Marconi Wireless Company.—Charles A. Terry, of New York, Major S. Flood-Page, of London, and Godfrey C. Isaacs, of New York, were elected directors of the Marconi Wireless Company of America at the annual meeting. They are to serve for five years. Other elections were: John W. Griggs, president; Guglielmo Marconi and John Bottomley, first and second vice-presidents.

New Jersey Utilities.—The New Jersey State Board of Public Utility Commissioners has approved the lease of rights and franchises of the Princeton Light, Heat & Power Company to the Public Service Electric Company, and the lease of the Burlington Electric Light & Power Company to the same interests.

Philadelphia Rapid Transit.—President Kruger, of the Philadelphia Rapid Transit Company, will hold a conference during the week with the finance committee of councils in connection with the $10,000,000 fund to be used for the rehabilitation of the company.

DIVIDENDS.

Cape Breton Electric Company, Ltd., semi-annual, preferred, $3 per share; common, $2 per share; both payable May 1.

Edison Electric Illuminating Company of Brockton, semi-annual, $4 per share, payable May 1.

Pacific Gas & Electric Company, quarterly, $1.50 per share, payable May 15.

Pacific Power & Light Company, quarterly, preferred, 1¾ per cent, payable April 25.

Sierra Pacific Electric Company, quarterly, preferred, $1.50 per share, payable May 1.

Union Utilities Company, of Morgantown, W. Va., quarterly, one-half of 1 per cent.

REPORTS OF EARNINGS.

Period.	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
AMERICAN LIGHT & TRACTION COMPANY.					
March, 1911	$306,478	$8,357	$298,122	......	......
" 1910	275,348	9,421	265,927	......	......
GENERAL ELECTRIC COMPANY.					
Year, 1910	$74,707,689	$63,851,996	$10,855,692	......	......
" 1909	54,102,051	47,608,380	6,493,671	......	......
KANSAS CITY RAILWAY & LIGHT COMPANY.					
March, 1911	$656,062	$354,952	$301,109	$197,944	$103,165
" 1910	622,555	347,084	275,471	174,893	100,578
KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY.					
March, 1911	$378,802	$192,854	$185,947	$113,977	$71,970
" 1910	339,008	163,754	175,253	103,322	71,931
NASHVILLE RAILWAY & LIGHT COMPANY.					
March, 1911	$156,961	$95,379	$65,582	$38,079	$23,503
" 1910	149,276	87,720	61,556	38,168	23,389
NEW ORLEANS RAILWAY & LIGHT COMPANY.					
Year, 1910	$6,245,223	$3,521,738	$2,244,843	$1,601,554	$643,289
" 1909	6,034,325	3,328,901	2,232,243	1,571,769	660,474
8 m., NORFOLK & PORTSMOUTH TRACTION COMPANY.					
Feb., 1911	$1,400,079	$788,008	$612,071	$500,918	$111,152
" 1910	1,284,256	725,121	559,135	513,140	45,994
RIO DE JANEIRO TRAMWAYS, LIGHT & POWER COMPANY.					
Year, 1910	$10,960,180	$5,567,088	$5,433,576	$3,096,433	$2,337,143
" 1909	7,527,559	4,459,252	3,438,495	2,888,887	1,149,608
SAO PAULO TRAMWAYS, LIGHT & POWER COMPANY, LTD.					
Year, 1910	$2,949,293	$962,337	$1,986,955	$383,862	$1,603,093
" 1909	2,439,486	846,627	1,592,859	371,986	1,220,873
UNITED RAILWAYS OF ST. LOUIS.					
March, 1911	$982,271	$692,497	$293,245	$229,545	$63,700
" 1910	972,494	705,876	270,297	233,708	36,589

General News

Construction News.

CHICO, CAL.—Preparations are being made by the Pacific Gas & Electric Company and the Sacramento Valley Power Company for the construction of a conduit system in Chico, work on which will begin in the near future.

DORRIS, CAL.—The Siskiyou Light & Power Company has applied to the Board of Trustees for a franchise to supply electricity for lamps and motors in Dorris.

HAMILTON, CAL.—The Northern California Power Company has commenced work on the construction of its transmission line from Hamilton to Princeton.

HANFORD, CAL.—Preparations are being made by the Hanford & Summit Lake Railway Company to extend its railway from Hardwick to Jamison, a distance of 26 miles. Work on extension will begin in about thirty days.

HANFORD, CAL.—The farmers living along the county road between Hanford and Guernsey are considering the question of securing electrical service from the San Joaquin Light & Power Company. As yet no definite action has been taken.

JACKSON, CAL.—Notice of appropriation of 20,000 in. of water from Mokelumne River has been filed by Leopold D. Caminetti. The water is to be diverted to Rock Canyon, 5 miles west of Jackson, and will be utilized to generate electricity.

LAKEPORT, CAL.—Application has been made by J. A. Foster and J. L. Davis to the Board of Trustees for a franchise to erect transmission lines for the distribution of electricity for lamps and motors in Lakeport.

LIVE OAK, CAL.—The proposition to form a lighting district in the town of Live Oak will soon be submitted to a vote. D. D. Green is town clerk.

LODI, CAL.—Arrangements are being made by the California Traction Company to begin work immediately on the construction of an extension of its railway from Lodi to Woodbridge.

OAKLAND, CAL.—Plans have practically been completed by the Oakland Gas Light & Heat Company for extensive improvements to its electric lighting system, which will involve an expenditure of $500,000. A contract has been awarded for the installation of a 15,000-kw turbo-generating unit. The boiler capacity will be increased by 10,000 hp. Cables and electric wires will be placed underground in the central portion of the city. Frank A. Leach, Jr., is manager.

PASADENA, CAL.—The Pacific Electric Railway Company will double-track its California Street line the entire length, work on which will begin at once.

PASADENA, CAL.—The City Council has awarded the contract for the installation of the underground conduit system for electric light and telephone wires on South Orange Grove Avenue to S. M. Keros, of Los Angeles, Cal., for $33,700.

PORTOLA, CAL.—A temporary electric generating plant operated by steam power will be installed in the Portola Lumber Company's mill to furnish electricity for lamps and motors in Portola. The company owns water rights on Grizzly Creek, 2 miles above Portola, where, it is understood, it will develop and erect a permanent plant. Not a post office.

REDWOOD CITY, CAL.—The Southern Pacific Company has applied to the Board of Trustees of Redwood City for a fifty-year franchise to build a double-track electric railway through Redwood City, with extensions to the Woodside district.

SAN FRANCISCO, CAL.—The Board of Supervisors has passed a bill authorizing the Board of Public Works to construct shop buildings for the Polytechnic High School and for heating, ventilating, plumbing, gas-fitting and electrical work for the school, the cost not to exceed $103,000.

SNELLING, CAL.—Negotiations have been closed whereby the Merced River Land Company has purchased 2600 acres of land located one mile west of Snelling, including Grubb ranch. The company will install an electric pumping plant on the Grubb ranch in the near future. The headquarters of the company are located in Los Angeles. W. O. Huse is manager.

SONORA, CAL.—The Tuolumne River Power Company is reported to have transferred its holdings in Tuolumne County, consisting of a large tract of timber land, 65 miles water ditch, water rights, power sites and irrigation rights on the Tuolumne River, to the Yosemite Power Company, for approximately $650,000. The sale marks the beginning of a large power plant with an ultimate development of 75,000 hp, involving an investment of about $10,000,000. John Hays Hammond is said to be interested in the project.

GUNNISON, COL.—At an election held recently the proposition to issue $90,000 in bonds for the installation of an electric light plant and water-works system is reported to have been carried.

BRIDGEPORT, CONN.—It is reported that G. C. Batcheller & Company, of Bridgeport, Conn., are contemplating the erection of a building for a power plant.

BRIDGEPORT, CONN.—The New York, New Haven & Hartford Railroad Company, it is reported, is contemplating discarding the Seaview Avenue power house of the Connecticut Company in Bridgeport, and will erect a substation, for which electricity will be supplied from the power station at Cos Cob to operate the local street railway system.

BROOKLYN, CONN. The People's Light & Power Company, of Danielson, Conn., has submitted a proposition to the village of Brooklyn offering to extend its transmission lines to Brooklyn, provided a sufficient number of contracts for electrical service can be secured.

JACKSONVILLE, FLA.—Bids will be received by W. W. Bostwick, Jr., chairman Trustees for Water Works and Improvement Bonds, until May 4, for building superstructure, including brick work, mill work, plumbing, heating, etc., for municipal power station, plans and specifications for which are on file in the office of the board, Jacksonville, Fla., and of the consulting engineers. Copies of plans and specifications may be obtained on application to the Scofield Engineering Company, of Philadelphia, Pa., consulting engineer. A deposit of $25 will be required for same.

ST. PETERSBURG, FLA.—J. J. Farnsworth, of Ft. Lauderdale, Fla., is reported to be interested in a project to construct an electric light plant from St. Petersburg to John's Pass, 7 miles in length.

SOUTH JACKSONVILLE, FLA.—At an election held recently the citizens voted to issue bonds to the amount of $60,000, the proceeds to be used for the installation of an electric-light plant and water-works system. Work will begin on construction of the plants as soon as the bonds are sold.

OGLETHORPE, GA.—At an election held April 12 the citizens voted in favor of the proposition to issue $18,000 in bonds, the proceeds to be used for the construction of an electric light plant and water-works system. It is understood that bids for construction of the plants will be received about July 1. J. P. Nelson is mayor.

SWAINSBORO, GA.—At an election held recently the citizens voted to issue bonds to the amount of $40,000, the proceeds to be used for the construction of an electric light plant and water-works system.

GRANGEVILLE, IDAHO.—Plans are being considered by the Grangeville Electric Light & Power Company for the extension of its transmission lines from Cottonwood to Vollmer and Ilo, work on which will begin at once.

KAMIAH, IDAHO.—The Nez Perce Water & Power Company, of Nez Perce, is reported to have been granted a franchise by the Council to supply electricity for lamps in Kamiah. Z. A. Johnson, of Nez Perce, Idaho, is president of the company.

MINIDOKA, IDAHO.—The contract for furnishing equipment for the Minidoka irrigation project, including one 360-hp motor, two 600-hp motors and necessary switchboards to control motors and control panel for two 500-kw transformers, has been awarded to the Westinghouse Electric & Manufacturing Company, for $14,000.

CAIRO, ILL.—Plans are being considered for the installation of an ornamental street lighting system on Eighth Street, between Washington and Commercial Avenues.

COAL CITY, ILL.—Preparations are being made by the Illinois Valley Light & Power Company for the erection of an electric transmission line from the valley to the E. C. Haeger Brick and Tile Works.

LA SALLE, ILL.—Preparations are being made by the Chicago, Ottawa & Peoria Railway Company for the construction of three substations, contracts for which will be awarded in the near future, one to be located at Morris, one at Minooka and one at Joliet. Each building will cost approximately $5,000.

MT. CARMEL, ILL.—The City Council has granted the Mt. Carmel & Olney Interurban Railway Company a franchise to lay its tracks in this city, work on which, it is reported, will begin at once.

RUSHVILLE, ILL.—It is reported that plans are being considered to take over the railroad extending from Littleton to Macomb and equip it for electrical operation, extending it through Rushville and Mt. Sterling to Beardstown. H. C. Bolingsley, of Chicago, Ill., is said to be interested in the project.

YORKVILLE, ILL.—Bids will be received until May 10 at the office of F. W. Simpson, secretary, Yorkville, Ill., for the construction of a hydroelectric plant, including the building of a dam across Fox River at Millhurst, Ill., construction of power house with wheel pits and tail races complete for four 210-hp turbines; four 175-kw generators with switchboards and instruments complete. Plans and specifications can be seen at the office of F. W. Simpson, Yorkville, Ill., and at the office of H. D. Hallett, engineer, Aurora, Ill.

BLOOMINGTON, IND.—Surveys are now being made for the construction of an electric railway to connect Bedford, Oolitic, Harrodsburg, Smithville, Sanders, Clear Creek and Bloomington. Application for franchises for the proposed railway will soon be made.

HOBART, IND.—It is reported that the Gary, Hobart & Eastern Traction Company is planning to construct an electric railway from Hobart to Gary, Ind., a distance of about 5 miles. It is understood that contract for building the railway will be awarded about the middle of May. U. P. Hord, of Aurora, is president.

KENDALLVILLE, IND.—It is reported that plans are being considered to install an ornamental street lighting system in Kendallville.

ZIONSVILLE, IND.—The Zionsville Water & Light Company is contemplating the installation of either oil engines or a producer gas plant to take the place of its present steam plant. W. H. Palmer is manager.

BONAPARTE, IA.—The Council is reported to have granted a franchise for the installation of an electric light plant in Bonaparte. Electricity for operating the system will be supplied from the power plant of the United Woolen Mill.

CEDAR RAPIDS, IA.—The Cedar Rapids & Iowa City Railway & Light Company is contemplating the purchase of a 3000-kw or 2000-kw turbine and an 800-kw generator to be direct-connected to a compound engine. The purchase of a 500-kw, 60-cycle, two-phase rotary converter is also under consideration.

JEWELL, IA.—The Ames Engineering Company, of Ames, Ia., is reported to have been awarded the contract to install an electric light and power plant in Jewell, at a cost of $12,000.

MARENGO, IA.—The contract for installing an electric-light plant at the poor farm has been awarded to the Ames Engineering Company, of Ames, Ia., to cost $2,000.

NEWMARKET, IA.—The proposition to grant the Lee Electric Light Company, of Clarinda, Ia., a franchise to install an electric light plant in Newmarket will be submitted to a vote at an election to be held May 1.

EMPORIA, KAN.—The City Council is contemplating changing the motive power at the pumping station from steam power to electricity. The equipment will include two 3,000-000-gal. pumps and booster pump and about 3½ miles of transmission line. Bids for the above will probably be called for early in May. Fred. H. Smith is city clerk and Matthew Brown city engineer.

EMPORIA, KAN.—The citizens are reported to have voted at a recent election to grant a franchise to a Dayton syndicate which operates electric light and street railway systems in Lawrence and Parsons, Kan. The franchise includes the leasing of the municipal electric light plant. Albert Emanuel, Conover Building, Dayton, Ohio, is president of the Parsons Railway & Light Company, of Parsons, Kan., and the Lawrence Railway & Light Company, of Lawrence, Kan.

LA CYGNE, KAN.—It is reported that the proposition to issue $30,000 in bonds for the installation of an electric light plant and water-works system was carried at an election held recently. It is understood that new plants are to be installed. The J. S. Worley Company, of Kansas City, Mo., has charge of the engineering work.

WATERVILLE, KAN.—It is reported that bonds to the amount of $30,000 have been voted, the proceeds to be used for the installation of an electric light plant and water-works system.

RICHMOND, KY.—The power plant of the Richmond Electric & Power Company is reported to have been destroyed by an explosion, entailing a loss of about $10,000. It is understood that the plant will be rebuilt at once.

ELTON, LA.—The Elton Telephone Company, recently organized, with a capital stock of $5,000, proposes to erect telephone lines to furnish telephone service in Elton and surrounding country. W. H. Tupper, George Kinzer, F. E. Powell and others are interested in the company.

SHREVEPORT, LA.—The City Council has appropriated $1,000 to employ an engineer to make investigations and prepare plans and estimates of cost for a municipal electric light plant in Shreveport.

ROCKLAND, MAINE.—The Rockland, South Thomaston & St. George Railway Company is planning to build approximately 3½ miles of new track and may possibly erect a small power station during the summer. Alfred S. Black is president.

SYKESVILLE, MD.—Bids will be received at the office of the Governor of Maryland, Union Trust Building, Baltimore, Md., until May 8 for the construction of a power house and a building known as cottage "E" at the Springfield State Asylum, Sykesville, Md. Copies of plans and specifications can be secured at the office of Parker, Thomas & Rice, architects, Union Trust Building, Baltimore, Md., for which a deposit of $5 will be required, which will be refunded on return of plans.

BOSTON, MASS.—Sealed proposals will be received by the trustees of the Boston City Hospital, Boston, Mass., until May 2 for furnishing generator, switchboard and electric wiring at the Boston City Hospital. Specifications and blank form of proposal may be obtained at the office of Densmore & LeClear, engineers, 88 Broad Street, Boston, Mass. Separate proposals will also be received for a steam engine at the same place and date, and also for power house and pipe tunnels. John H. McCollom is superintendent.

BROCKTON, MASS.—The Edison Electric Illuminating Company of Brockton is contemplating extending its transmission lines through Hanson to Bryantville to supply electricity for lamps.

HUDSON, MASS.—Arrangements are being made by George A. Brothers, superintendent of the municipal electric light and power plant, for extending the transmission lines of the municipal electric light plant from Gleasondale to Stow lower village, the cost of which is estimated at about $5,000. The system was extended to Gleasondale, which is a part of Stow, five years ago.

LEE, MASS.—The Smith Paper Company, of Lee, Mass., is contemplating equipping its five mills for electrical operation. It is understood that the change will not be made at present.

MANSFIELD, MASS.—The South Eastern Massachusetts Electric Company, recently incorporated with a capital stock of $150,000, proposes to purchase and develop existing plants now operating in the counties of Norfolk, Bristol and Plymouth. Philip Cabot, Charles S. Davis, of Boston, Mass., and Frank H. Coyne, of Foxboro, Mass., are interested in the company.

DETROIT, MICH.—A new factory is being erected by the Douglas & Lomason Company, of Detroit, Mich. The machinery in the plant will be equipped for electric motor drive throughout, electricity for which will be supplied by the company's own plant.

DETROIT, MICH.—The Piedmont Graphite Company, which is now located in Atlanta, Ga., is reported to be planning to move its plant to Detroit. The company has purchased a site on Jefferson Avenue, on which it will erect a large plant. It is said that the electric process will be used for graphite refining.

KALAMAZOO, MICH.—A deed of transfer has been recorded in the registrars' offices at Kalamazoo, Marshall, Allegan and Jackson, Mich., conveying all the property of the Jackson Light & Power Company to the Commonwealth Power Company.

PENTWATER, MICH.—Plans are being made to construct an electric railway from Pentwater to Walkerville via Crystal Valley, 20 miles in length. The capitalists who propose to build the road demand a bonus of $50,000 from the towns along the route of the proposed railway.

DULUTH, MINN.—The City Council has passed a resolution authorizing the city engineer to prepare estimates of the cost of construction of a municipal electric light, heat and power plant, to give substantially the same service as now furnished by the Duluth-Edison Electric Company. An appropriation of $2,500 was made to secure the assistance of an electrical engineer.

EVELETH, MINN.—The contract for erecting ornamental lamp standards, complete, for the new lighting system on Grant Avenue has been awarded to John S. Swanson, of Duluth, Minn., for $4,796. The plans call for forty-six lamp standards, each carrying five lamps.

MINNEAPOLIS, MINN.—The Minneapolis, St. Paul & Dubuque Railway Company is planning to extend its railway from Northfield to Owatonna, Minn., a distance of 32 miles. It is expected to have it in operation by September 1.

NASHWAUK, MINN.—Bids will be received until May 1 for furnishing direct-current meters (new and second-hand). John H. Carlson is village clerk.

REDWOOD FALLS, MINN.—The Wherland Electric Company is reported to be contemplating extending its transmission lines to Franklin, Minn.

ST. PAUL, MINN.—The State Legislature has passed the bill permitting the organization of a company to distribute the power generated at the large dam to be constructed in the Mississippi River, near Minnehaha Creek. Under the present plans the United States government reserves a certain amount for use at Fort Snelling, after this a certain amount is allotted to the State institutions and the remainder is to be controlled by the proposed corporation. The organization will be composed of representatives of the Twin City and those of the University of Minnesota. The municipality and the university will receive electrical energy at cost and the balance sold at a profit.

BISMARCK, MO.—Plans are being considered for the construction of an electric interurban railway to connect Bismarck and Sunlight, 20 miles in length. The proposed railway will be known as the Bismarck, Belleview Valley & Western Railway.

CHILLICOTHE, MO.—Sealed proposals will be received until May 8 by Ira G. Graham, city auditor, at the office of the City Clerk, Chillicothe, Mo., for furnishing material and construction of a complete municipal electric light and power plant as follows: Section 1—Concrete work, floor machinery and building foundations. 2—Brick power house complete, excluding foundations and floor. 3—Radial brick or concrete chimney. 4—Steam boiler and equipment. 5—Boiler feed pumps, heater, separators, traps and all pipe work. 6—Two steam engines, 7—Two generators, 125-kva and 250-kva, and exciters, switchboards and regulators. 8—Pole line, transformers and street lighting system. 9—1000-ft. deep well for water supply. 10—Steel tower and tank, having a capacity of 5000 gallons. Plans and specifications are on file in the office of the city clerk, Chillicothe, Mo., and at the office of Fuller-Coult & Company, engineers, Chemical Building, St. Louis, Mo. Bids may be submitted on the whole or on any section or combinations of sections thereof. Extra copies of plans and specifications may be obtained from the engineers on payment of $5 to cover the cost of printing.

KANSAS CITY, MO.—Surveys have been completed by the West Missouri Electric Railway Company for its proposed electric railway from Kansas City to Grandview, Belton and Harrisonville, Mo., 34 miles in length. It is understood the contract for building the road has been awarded to the Spitcaufsky-Wagner Contracting Company, of Kansas City, Mo. H. A. Nagle, of Kansas City, Mo., is chief engineer.

ST. LOUIS, MO.—The Public Service Commission has signed the bill regulating the rates to be charged for electricity in St. Louis, Mo., to take effect Oct. 22, 1911. Under the new law the maximum rate for electricity is reduced from 12 cents to 9½ cents per kw-hour and the minimum charge from $1 per month to 50 cents per month.

HELENA, MONT.—Bids will be received at the office of the State Board of Examiners, Helena, Mont., until June 17 for furnishing electrical fixtures for the Capitol Building additions, etc., in accordance with specifications, which may be seen at the office of the State Board of Examiners, or at the office of Link & Haire, architects, Helena, Mont. A. N. Yoder is secretary of the board.

CHAPPELL, NEB.—It is reported that bids opened by the village of Chappell, April 8, for the construction of an electric light plant and waterworks system were rejected. New bids will be received until May 8. The cost of the work is estimated at $12,900. W. E. Donner, of Grand Island, Neb., is engineer.

OMAHA, NEB.—The Nebraska Transportation Company has awarded the contract for the construction of an interurban railway to extend from Omaha through Arlington, Bertha and Salthill to Sioux City, with branches from Elk City to Madison and Norfolk, and from Bertha east to Decatur and west to West Point, to the Baker Construction Company, of Omaha, Neb. The entire system will include about 284 miles of track. The power house will be located on the Platte River, near Elk City, and will have an output of about 21,000 hp. The railway complete will cost about $8,000,000 and will be completed in about two and a half years.

ELIZABETH, N. J.—The installation of an ornamental lighting system on Broad Street, Elizabeth, is under consideration. Albert C. Stein is interested in the project.

SOCORRO, N. M.—The property of the Socorro Electric Light & Power Company was sold at auction April 1 to the bondholders, C. T. Brown, Joseph Price, James G. Fitch and E. A. Drake, for $17,700. The plant is in operation and giving good service.

AUBURN, N. Y.—The Auburn Light, Heat & Power Company has been awarded an extension of its street-lighting contract in Auburn for a period of five years, and was also given a ten-year contract for furnishing ornamental lamps in the business section of the city.

AUBURN, N. Y—It is reported that negotiations are under way for the consolidation of the gas and electric light companies of Auburn, Geneva, Seneca Falls and Waterloo. E. H. Palmer, of Geneva, N. Y., president of the Auburn Gas Company, it is said, will head the new enterprise. The new company will be known as the Empire Gas & Electric Company.

CATSKILL, N. Y.—The Catskill Traction Company will soon begin work on making surveys and securing right of way for the construction of two extensions to its railway system, one to extend from Catskill to Alsen and Cementon and the other from Leeds to Cairo.

EPHRATAH, N. Y.—The Mohawk Hydroelectric Company has received authority from the Public Service Commission, Second District, to construct and operate transmission lines to supply electricity in the town of Ephratah. The company has been granted permission to issue bonds to the amount of $53495, the proceeds to be used for carrying out the work.

JAMESTOWN, N. Y.—The Jamestown Street Railway Company has commenced work on an addition to its central power station on West Eightieth Street.

LOCKPORT, N. Y—The Upson Company, of Lockport, N. Y., it is said, will enlarge the old Franklin Mills in East Lockport, instead of building a new plant. Both electric and water-power will be used, and it is understood that the company will be in the market for small electric units, overhead trolley conveyors, shafting, etc. Charles A. Upson, of Lockport, N. Y., is president of the company.

MARION, N. Y.—The Public Service Commission, Second District, has authorized the Marion Power Company to construct and operate an electric light plant in Marion and to erect a transmission line along the highway between the towns of Marion and Williamson. The company will secure Niagara power through the Rochester Railway & Light Company. Application has been made by the Marion Power Company to the commission for permission to issue $8,000 in capital stock and to execute a mortgage for $10,000, the proceeds to be used to pay for construction of its new plant.

NEW YORK, N. Y.—Kopp Brothers, Irving Place and Sixteenth Street, New York, N. Y., are reported to be contemplating the installation of two 150-kw generating units. O. E. Goldsmith, 30 West Thirty-eighth Street, New York, N. Y., is consulting engineer.

POUGHKEEPSIE, N. Y.—The Public Service Commission, Second District, has authorized the Poughkeepsie Light, Heat & Power Company, of Poughkeepsie, the Newburgh Light, Heat & Power Company, of Newburgh, and the Hudson Counties Gas and Electric Company, of Cornwall-on-Hudson, to consolidate under the name of the Central Hudson Gas & Electric Company.

ROCHESTER, N. Y.—Bids will be received at the office of the secretary of the Board of Contract and Supply, Room 37, City Hall, Rochester, N. Y., until May 3 for the electric lighting and power wiring of buildings 2, 3 and 4; also erection of boiler house at Exposition Grounds. Specifications are on file at the office of Gordon & Madden, architects, Sibley Block, Main Street, Rochester.

SMITHTOWN, N. Y.—The Long Island Lighting Company has applied to the Town Board for a franchise to erect and operate transmission lines for the distribution of electricity in Smithtown. It is understood that the Long Island Lighting Company has acquired an option on the controlling interest of the North Shore Electric Light & Power Company, of Port Jefferson, and it is proposed to consolidate the plants in Port Jefferson, Northport, Amityville, Islip and Sayville. Improvements and extensions, involving an expenditure of about $50,[illegible] are under consideration.

SYRACUSE, N. Y.—Plans are being prepared by the city of Syracuse for the construction of a vocational high school, including a power plant machine shop, foundry and woodworking shop. Henry C. A[illegible]en, city engineer, has charge of the plans.

DURHAM, N. C.—The Southern Power Company has purchased a site in Durham, on which it proposes to erect a distributing station, which will provide for 20,000 hp. The company is now extending its high-tension transmission lines to Durham.

GREENSBORO, N. C.—Cesar Cone, president of the Proximity Manufacturing Company and the White Oak Cotton Mills, has made arrangements with the Southern Power Company, of Charlotte, N. C., for furnishing secondary power for the mills, which will be delivered at the White Oak power station. Preparations are now being made to install the necessary apparatus for this change, which will involve an expenditure of several thousand dollars.

GREENVILLE, N. C.—Arrangements are being made by the American Spinning Company to change the motive power of its No. 1 mill from steam to electricity, which will require the installation of a 600-hp motor, contract for which has been awarded. Electricity for operating the mill will be secured from the Greenville transmission line of the Southern Power Company.

LINWOOD, N. C.—The Fairmont-Silver Telephone Company, recently incorporated by G. C. Palmer, of Silver Hill, N. C., and others with a capital stock of $20,000, proposes to erect a telephone line from Southmount and Silver Hill to Lexington Post office address, Linwood, R. F. D., No. 2.

RALEIGH, N. C.—The Carolina Power & Light Company has filed an amendment to its charter increasing its capital stock from $3,750,000 to $7,500,000. Charles E. Johnson, of Raleigh, is president of the company.

MILTON, N. D.—The installation of an electric light plant in Milton is reported to be under consideration. C. Holley is said to be interested in the project.

VELVA, N. D.—The Council is reported to have granted John I. Moore a franchise to install and operate an electric light system in Velva.

AKRON, OHIO.—Plans and specifications are being prepared by H. von Schon, consulting engineer, Detroit, Mich., for the Northern Ohio Traction & Light Company for its water-power development on the Cuyahoga River.

AMANDA, OHIO.—The Crystal Paper Company is reported to have awarded contracts for the erection of a paper mill and power house, 50 ft. x 500 ft.

CINCINNATI, OHIO.—The Cincinnati Short Belt Railroad & Traction Company is contemplating the construction of an electric railway through Duck Creek Valley, Madisonville, Oakley, Norwood, Bond Hill and the Mill Creek Valley, from Red Bank to Chester Park. It is planned later on to extend the railway to the Ohio River line and to connect all railroads in the Cincinnati zone to facilitate switching traffic. Peter Eichels, of Cincinnati, Ohio, is interested in the project.

CINCINNATI, OHIO.—The Alvey-Ferguson Company, of Louisville, Ky., is reported to be contemplating the erection of a large manufacturing plant in Oakley, a suburb of Cincinnati, where it has purchased a site. It has not yet been stated whether the company will install its own power plant or purchase energy for lamps and motors from a large central power plant in Oakley. The company manufactures conveying machinery.

COLUMBUS, OHIO.—It is reported that an Eastern syndicate, represented by J. J. Henry, which is contemplating the construction of a large power plant in the Hocking Valley, near Beaumont, has secured options on the electric light and power plants at Nelsonville, Logan, Lancaster and other towns in the Hocking Valley. It is understood that the company proposes to supply electricity to the above towns from the proposed plant.

LOGAN, OHIO.—The village of Logan is reported to be preparing plans for the construction of an electric power plant.

TOLEDO, OHIO.—Sealed proposals will be received at the office of the clerk of the Board of Education of the city school district of the city of Toledo until May 15 for furnishing material and installing an electric light and power system, interior telephone system, an electric time clock and program bell system, in either or both school buildings now in course of construction, known as the Morrison R. Waite High School and the Jessup W. Scott High School, according to plans and specifications which can be seen at the office of the department of architecture of the Board of Education. Copies of plans and specifications can be secured on application to the director of schools. A deposit of $25 will be required for each set furnished, of which $20 will be refunded upon return of the plans. George L. McKesson is director of schools.

BARTLESVILLE, OKLA.—Contracts will be placed by the Bartlesville Interurban Railway Companyy for the construction of a new boiler-room at its power plant in Bartlesville. The company is also contemplating the purchase of a 500-kw turbine set, one 400-hp water tube boiler and 50-kw transformers.

GUTHRIE, OKLA.—It is reported that the Oklahoma Railway Company is planning extensions to its local systems in Oklahoma City and Guthrie, Okla., and for construction of interurban lines. The interurban railway, which now runs from Oklahoma City to within six miles of Edmund is to be extended to Guthrie. It is said that the company has negotiated for a sale of bonds to the amount of $12,000,000. John W. Shartel, of Oklahoma City, Okla., is vice-president.

TULSA, OKLA.—The Tulsa-Sand Springs Interurban Railway Company is reported to be contemplating extending its railway to Collinsville and from there it may be extended to Oologah, where a connection will be made with the Iron Mountain Railroad. Charles Page is said to be interested in the company.

BAKER CITY, ORE.—At an election held April 12 the citizens voted to issue $25,000 in bonds for the construction of a hydroelectric light plant. J. W. Bailey, of Baker City, Ore., city engineer, has charge of the work.

BAKER CITY, ORE.—It is reported that the Western Granite Company, of Baker City, Ore., is contemplating the installation of an electric generating unit at its quarry.

CULVER, ORE.—The Cove Power Company has begun work on construction of a power plant on the Crooked River, 2 miles west of Culver. A contract for a large part of the work has been awarded to Brown & Van Valkenburg, of Culver, Ore.

WALLOWA, ORE.—Plans are being made by the McCully-Rumble Power Company, recently organized, to erect a power plant on the Wallowa River, about 20 miles from this city. The company proposes to generate about 1000 hp and supply electricity to all towns and rural communities in Wallowa and Union Counties and to the farming district between Joseph and La Grande. F. D. McCully, of Joseph, and E. W. Rumble, of La Grande, are interested in the company.

ALTOONA, PA.—The Penn Central Light & Power Company is planning to make improvements and extensions to the Warrior Ridge plant, including the installation of a 2500-kw turbo-generator set, with necessary boilers and other equipment. A number of changes will also be made to the local plant.

HARRISBURG, PA.—The contract for the installation of electrical fixtures in the Technical High School has been awarded to Lloyd, Garrett & Company, of Philadelphia, Pa., for $3,500.

HELLERTOWN, PA.—The Hellertown & Richlandtown Street Railway Company, recently organized with a capital stock of $360,000, proposes to construct an electric railway from Hellertown to Richlandtown, a distance of about 6 miles. The proposed railway will provide both passenger and freight service. The officers of the company are: A. R. Trumbauer, president; Jacob Apple, secretary, and W. B. Frankenfield, treasurer.

PARKER, PA.—It is stated that applications are to be made to the State Department for charters of incorporation for water power privileges on the Clarion River in Clarion County. Nine separate charters are to be asked for in as many townships. It is proposed to erect a large dam on the Clarion River at Clarion, with power plant to cost approximately $3,000,000. Joseph R. Paull, H. W. Douglass and J. P. Fife, of Pittsburgh, Pa., are interested in the project

PHILADELPHIA, PA.—The Philadelphia Electric Company has purchased a site on West Thirtieth Street, on which, it is said, it will erect an auxiliary power plant.

PHILADELPHIA, PA.—Plans are being considered by Chief McLaughlin, of the Electrical Bureau, for lighting the Southern Boulevard with electricity. The present plan provides for the installation of 190 arc lamps of 2000 cp, arranged in pairs to be erected on ornamental standards, similar to those on Market and other streets in the center of the city, and 420 tungsten lamps of about 70 cp each on the side of the service driveways flanking the boulevard. The latter lamps will be erected on 10-ft. poles, one lamp to each standard, inclosed in a 16-in. globe. For the erection of the arc lamps and standards, with the necessary wires and conduits, there is about $75,000 available.

STEELTON, PA.—Plans are being considered by the Steelton Light, Heat & Power Company for the construction of an auxiliary plant for use in case of emergency. The proposed plant will have an output of about 400 hp. Energy for operating the local system is secured from the hydroelectric plant of the York Haven Water & Power Company at York Haven. The company also contemplates the erection and equipment of a new substation in Steelton.

TITUSVILLE, PA.—The capital stock of the Titusville Light, Heat & Power Company has been increased from $5000 to $150,000.

CHESTERFIELD, S. C.—The Chesterfield Light & Power Company will receive bids at once for the construction and equipment of an electric light plant. Proposals should be addressed to W. D. Craig, Chesterfield, S. C. The company was recently incorporated with a capital stock of $5,000 by W. D. Craig, D. P. Douglas and J. H. Welsh.

JACKSON, TENN.—Contracts have been awarded for equipment for the municipal electric light plant as follows: To the General Electric Company, of Schenectady, N. Y., for generator, arc lamps, etc., and for engine to the Hooven, Owens, Rentschler Company, of Hamilton, Ohio, the total cost aggregating $14,750. T. H. Hartmus is secretary of the Water Works Department.

MANCHESTER, TENN.—Bonds to the amount of $25,000 have been voted for the installation of a municipal electric light plant and waterworks system in Manchester.

ALICE, TEX.—T. M. Stevens has secured a franchise to supply electricity for lamps and motors in Alice. A 10-ton ice plant will be installed in connection with the electric plant.

BROWNSVILLE, TEX.—The City Council has refused the application of the Brownsville & Gulf Railway Company for a franchise to rebuild its track through the center of the town and to operate a motor car line between Brownsville and Matamoras, Mex. The City Council recently declared the track to be a public nuisance.

COLEMAN, TEX.—The contract for the construction of the new electric light plant in Coleman has been awarded to the Briggs-Weaver Machinery Company, of Dallas, Tex.

COLORADO, TEX.—The Southwestern Telegraph & Telephone Company has purchased the plants and holdings of the Texas & Pacific Telephone Company, including local exchanges at Merkel, Roscoe, Sweetwater, Colorado and Westbrook, and toll lines from Abilene to Big Springs.

DALLAS, TEX.—Plans are being prepared by the East Texas Traction Company for the construction of an interurban electric railway between Dallas and Terrell, a distance of about 30 miles. C. L. Wakefield is interested in the project.

DEL RIO, TEX.—Preliminary surveys are now being made for a large hydroelectric plant and irrigation project to be established on the Pecos and Devil's Rivers in the Del Rio section by a syndicate in which ex-Governor David R. Francis, of St. Louis, Mo., is interested. The cost of the enterprise is estimated at about $5,000,000.

FORT STOCKTON, TEX.—It is reported that local capitalists are organizing a company to construct and operate an electric light and ice plant in Fort Stockton.

GALVESTON, TEX.—The federal government, through Major C. P. Howell, United States engineer in charge of the Galveston district, has awarded the contract for laying telephone, electric light and power cables and an 8-in. water main on the dike from a point opposite Fourteenth Street to the site of the government immigrant station, to C. K. Spalding and Thad Parsons.

LLANO, TEX.—We are informed that the city is not contemplating improvements to the municipal electric light plant, as reported in the issue of April 20. Electrical service in Llano is supplied by the Llano Milling & Manufacturing Company.

PALESTINE, TEX.—Ralph E. Hoskat, of Dayton, Ohio, and associates have submitted a proposition to the citizens of Palestine offering to construct and operate an electric street railway system in Palestine, provided a bonus of $30,000 is given to the company.

MORRISVILLE, VT.—The citizens have voted to authorize the superintendent and commissioners of the municipal electric light plant to enter into a contract with the village of Stow to supply electricity for lamps in the latter place for a term of ten years.

NORFOLK, VA.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 27 for furnishing and installing dry-dock pumping equipment, including two motor-driven dry dock pumps, one motor-driven drainage pump, and one motor-driven bilge pump, all complete with necessary piping and accessories, at the navy yard, Norfolk, Va. Plans and specifications can be obtained on application to the bureau or to the commandant of the navy yard named. R. C. Holliday is chief of bureau.

CASTLEROCK, WASH.—It is reported that Collins & Byerly will erect a hydroelectric plant on the Toutle River, about 8 miles from Castlerock, work on which has begun. About 1000 hp will be developed.

ELLENBURG, WASH.—Application has been made to the County Commissioners by Paul Richards for a franchise to construct and operate an electric motor railway system on the highways in Kittitas County.

NORTH YAKIMA, WASH.—Plans are being prepared by H. E. Doolittle, city engineer, for the proposed municipal electric light and power plant, to cost approximately $250,000.

VANCOUVER, WASH.—A site has been purchased by the Mount Hood Railway & Power Company on Fifth Street Road, near the Garrison in Vancouver, on which it will build a substation. The cost of the substation and distributing system in Vancouver will involve an expenditure of $25,000.

WALLA WALLA, WASH.—Preparations are being made by the Pacific Power & Light Company for the erection of a transmission line from Walla Walla to Dayton, via Dixie, Prescott and Waitsburg, work on which will begin in the near future. The cost of the line is estimated at about $50,000. The power plants at Waitsburg and Dayton will soon be taken over by the Pacific Power & Light Company.

ELLENBORO, W. VA.—The American Under Current Company, recently organized, to manufacture apparatus for a new system of electric traction, is planning to erect a factory about one mile from Ellenboro. In connection with the plant the company will build a demonstrating track, which may eventually connect the towns of St. Marys and Pennsboro. It is understood that a power plant will also be installed.

MORGANTOWN, W. VA.—The Union Utilities Company, of Morgantown, W. Va., is contemplating the purchase of three gas compressors and three 3-phase, 60-cycle, 2200-volt motors for its power plant in Morgantown.

ALTOONA, WIS.—At an election held recently the citizens voted to grant the Chippewa Valley Railway, Light & Power Company, of Eau Claire, Wis., a franchise to supply electricity for lamps and motors in Altoona.

MENASHA, WIS.—The City Council is contemplating enlarging the municipal power plant and installing two Deisel engines of 225 hp, the cost of which is estimated at $30,000.

MANITOWOC, WIS.—Plans have been completed by the Aluminum Goods Manufacturing Company for the construction of a factory building, 300 ft. x 400 ft., and a power house and service tower. The power house will be equipped with a direct-connected electric generating unit, with a rating of about 300 hp. All machinery will be motor driven.

REVELSTOKE, B. C., CAN.—The by-law appropriating $50,000 to complete the municipal power plant has been approved by the ratepayers. The city, it is said, is contemplating supplying electricity to operate the shops of the Canadian Pacific Railroad Company.

VERNON, B. C.—The Couteau Power Company is planning to build an electric railway between Vernon and Lumby, [illegible]0 miles in length. The power plant will be located at Shuwap Falls. The company will furnish electricity for lighting.

FREDERICTON, N. B., CAN.—Application has been made to the New Brunswick Legislature for a charter for the Eel River Light, Heat & Power Company by H. A. Connell, George McPhail, of Woodstock, N. B.; John G. Murchie, George A. Murchie and George Andrews, of St Stephen. The company will be capitalized at $300,000 and proposes to develop water-power on the Eel River and lakes thereon to generate electricity. It is estimated that 4000 hp can be developed under a head of 70 ft., which will be transmitted to Fredericton, Woodstock, St. Stephen, St. Andrew and McAdam.

QUEBEC, QUE., CAN.—It is reported that the Quebec Railway, Light & Power Company has been awarded the contract for lighting the South Shore, opposite the city of Quebec, for a period of ten years.

New Industrial Companies.

THE ACME HOISTING MACHINE COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $50,000 by F. R. McCune, George S. Cornell and John M. Patke. The company proposes to manufacture hoisting, illuminating, excavating and carrying machinery.

THE AUTOMATIC SAFETY APPLIANCE COMPANY, of La Salle, Ill., has been chartered with a capital stock of $100,000 by A. G. Hulling, W. H. Traver and T. Baird, of La Salle, Ill. The company proposes to manufacture elevator appliances.

THE BOYSE CARMICHAEL MANUFACTURING COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $100,000 for the purpose of manufacturing electrical and gas appliances. The incorporators are: D. B. Carmichael, C. W. Boyse and J. J. Elias, of Chicago, Ill.

THE BUTTE ELECTRIC SUPPLY COMPANY OF UTAH, of Butte, Mont., has been incorporated with a capital stock of $250,000 by F. E. Brazier and others. The main offices of the company will be located in Butte, Mont.

THE CALL SWITCH & FROG COMPANY, of Denver, Col., has been incorporated with a capital stock of $50,000 to manufacture the Call automatic railroad switch and other railroad supplies. The company will begin work at once on the erection of a factory in Denver, Col.

THE FEDERAL MINIATURE LAMP COMPANY, of Cleveland, Ohio, has been chartered with a capital stock of $30,000 by S. M. Lee, H. M. Vansvail, J. E. Kewley and W. G. McKittrick.

THE HOGAN MOTOR COMPANY, of New York, N. Y., has been chartered with a capital stock of $30,000 by John J. Hogan, of West Haven, Conn.; James R. Taylor, James V. Simpson, both of Mt Vernon, N. Y. The company proposes to manufacture machinery, engines, motors, etc.

THE JEFFRIES ELECTRIC & MANUFACTURING COMPANY, of Cleveland, Ohio, has been chartered with a capital stock of $10,000 by S. S. Jeffries, H. W. Culbertson and others.

THE MILLS-ANTHONY COMPANY, of Toledo, Ohio, has been incorporated by Benjamin Mills, Daniel W Miller, J. A. Kieler, George E. Anthony and J. J. Waldvogel. The company is capitalized at $10,000 and proposes to deal in electrical specialties.

THE NEW YORK SERVICE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 by M. D. Ferris, A. Begg and J. W. Crandall, of New York, N. Y. The company proposes to do a general contracting and mechanical engineering business and to manufacture machinery, etc.

THE RANDALL TELEPHONE COMPANY, of Augusta, Me., has been chartered with a capital stock of $1,500,000 to manufacture and deal in telephone instruments, etc. E. M. Leavitt, of Augusta, Me., is president and manager.

THE UNIVERSAL ELECTRIC MANUFACTURING COMPANY, of Bradford, Pa., has been incorporated with a capital stock of $1,000,000 by Elisha B. Cutler, Charles E. Foster, George W. Foster, Charles W Randall and William H. Olsmtead, all of Bradford, Pa. The company proposes to manufacture and sell all kinds of electrical appliances and devices.

New Incorporations.

MONTGOMERY, ALA.—Articles of incorporation have been filed for the Lee Street Terminal Company with a capital stock of [illegible]. The company proposes to construct and operate electric and [illegible] works in Montgomery. The officers are: W. J. Hannah, president; S. H. Roberts, vice-president; F. B. Powell, secretary and J. W. Winchester, treasurer.

SAN FRANCISCO, CAL.—The West Coast Power Company has been incorporated with a capital stock of $500,000 by S. E. Bretherton, H. P. Anewalt, I. J. Broberg, M. F. Vandal and G. O. Perry.

MINONK, ILL.—Articles of incorporation have been filed for the Union Light & Power Company by F. Z. Ames, S. C. Kipp and J. S. Webber, of Minonk, Ill. The company is capitalized at $100,000 and proposes to operate a heat, light and power plant.

Personal.

MR. J. E. FRIES read a paper before the Cleveland branch of the American Institute of Electrical Engineers on Monday, April 17, on the subject "Power Factor."

MR. A. C. EINSTEIN president and general manager of the King Electric Company, St. Louis, Mo., has been elected president of the Columbian Club of St. Louis.

MR. NELSON G. PHILLPS, formerly of the Peoria Gas & Electric Company, has been appointed new-business manager of the Hoopeston Gas & Electric Company, Hoopeston, Ill.

DR. C. P. STEINMETZ, of Schenectady, recently delivered a series of two lectures on "Electrical Energy" before the students of the College of Engineering of the University of Illinois.

MR. KEMPSTER B. MILLER, consulting engineer, Chicago, delivered a lecture on the topic "The Work of the Telephone Engineer" at the Throop Polytechnic Institute, Pasadena, Cal., on April 10.

MR. H. VON SCHON has been retained as consulting engineer by the Northern Ohio Traction & Light Company in connection with the development of water-power on the Cuyahoga River near Akron, Ohio.

MR. THOMAS F. KELLY, contract agent of the Hamilton Electric Light & Power Company, Hamilton, Ont., has been appointed assistant master of transportation for Canada of the National Electric Light Association.

MR. C. A. HOWE, who has been appointed general manager of the Holophane Company, Ltd., of Toronto, Canada, has been located in Chicago for the past four years and is now vice-president of the Electric Club of Chicago.

MR. FRED. RIEBEL, formerly manager of the repair department of the Westinghouse Electric & Manufacturing Company at Pittsburgh, has been appointed superintendent of the Bedford Power Company's steam and water-power system at Bedford, Ind.

MR. M. A. MARCA ROMERO, formerly electrical and mechanical engineer of the Empresas Electricas Asociadas, Lima, Peru, has been selected by the government of Peru to visit the United States in the interest of the first school of aviation founded in South America.

MR. GEORGE N. REINHART, electrical engineer, Frankfort-on-the-Main, Prussia, who has been in this country for the past three months inspecting the various high-tension transmission systems, will depart for his home abroad the steamship *Cleveland* on April 27.

MR. H. M. SLAUSON has resigned as general sales manager of the Opalux Company, New York City, to take effect May 1, to accept a position as New Jersey representative of the H. W. Johns-Manville Company. Mr. Slauson's successor will be Mr. C. H. McCormack.

MR. H. F. PARSHALL, consulting electrical engineer, London, England, has been appointed chairman of the board of directors of the Central London Railway. Mr. Parshall was born in Milford, N. Y., forty-five years ago and is well known among engineers in this country.

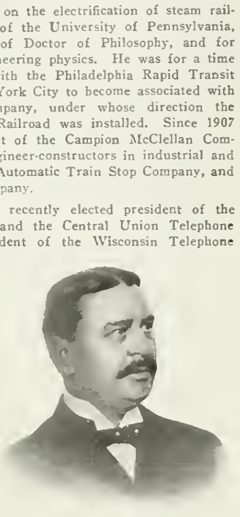
MR. J. G. ROSSMAN, of New York, has been appointed business manager of the Winnipeg municipal hydroelectric plant, to assume duties on May 15. Mr Rossman was born in the State of Georgia thirty-nine years ago, and is at present in the employ of Westinghouse, Church, Kerr & Co., New York City.

MR. WALTER R. ARMSTRONG, the newly appointed president and general manager of the Federal Miniature Lamp Company, has devoted much time during the past four years to developing a high-efficiency incandescent lamp for automobile head lanterns, having been associated in this work with a large number of storage-battery, generator and automobile manufacturing concerns. His experience in lamp [illegible] dates back to 1886, and he has made special study of [illegible] novel types of lamps for the past twenty years.

MR. JAMES CAMPBELL has been selected to succeed Mr. John I. Beggs as president of the Milwaukee Electric Railway & Light Company and the Milwaukee Light, Heat & Traction Company. In association with Mr. Campbell will be Mr. J. D. Mortimer, who will succeed Mr. Beggs as general manager of the companies. Mr. Campbell is president and Mr. Mortimer vice-president of the North American Company, which is interested in the following companies through ownership of stock: The Detroit Edison Company, the Union Electric Light & Power Company, the United Railways Company, the St. Louis County Gas Company, the West Kentucky Coal Company and the two companies first mentioned above.

MR. WILLIAM McCLELLAN, of the Campion McClellan Company, has been appointed electric engineer to the Public Service Commission of the Second District of the State of New York. Mr. McClellan was actively engaged in the installation of the 11,000-volt single-phase railway equipment of the Erie Railroad, and has maintained steadily an especial interest in electric railway work. He is a member of the American Institute of Electrical Engineers and has served as chairman of its railway committee. He is a member of the New York Railroad Club and has served as a member of the committee on the electrification of steam railroads. Mr. McClellan is a graduate of the University of Pennsylvania, from which he received the degree of Doctor of Philosophy, and for which he served as instructor in engineering physics. He was for a time engineer in charge of construction with the Philadelphia Rapid Transit Company. In 1905 he came to New York City to become associated with Westinghouse, Church, Kerr & Company, under whose direction the single-phase equipment for the Erie Railroad was installed. Since 1907 Mr. McClellan has been vice-president of the Campion McClellan Company, New York and Philadelphia, engineer-constructors in industrial and public service work; a director in the Automatic Train Stop Company, and president of the McClellan Lines Company.

MR. BERNARD E. SUNNY, the recently elected president of the Michigan State Telephone Company and the Central Union Telephone Company, will also be elected president of the Wisconsin Telephone Company and the Cleveland Telephone Company, in pursuance of the policy of grouping the executive control of operating companies recently adopted by the parent Bell organization. Mr. Sunny is president of the Chicago Telephone Company, vice-president of the American Telephone & Telegraph Company, and a director of the General Electric Company, Western Electric Company, Chicago City Railway Company, First National Bank of Chicago and Public Securities Corporation of Chicago. He has filled several civic positions, and has taken an intelligent and progressive interest in politics. For three years he was president of the Civic Federation of Chicago, and the Armour Institute of Technology has conferred on him the honorary degree of doctor of engineering. Mr. Sunny began his career as a telegraph operator in Brooklyn, next engaging in the telephone business, becoming superintendent of the Chicago Telephone Company in 1879. In 1888 he was elected president of the old Chicago Arc Light & Power Company, which was merged into the present Commonwealth Edison Company a number of years ago. In 1891 he became Western manager of the Thomson-Houston Electric Company and afterward of its successor, the General Electric Company. This position he held until 1908, when he returned to the Chicago Telephone Company as its president. He is a member of the American Institute of Electrical Engineers and of many other societies and clubs. Mr. Sunny's career has been a remarkable one, as few men have been conspicuous both in the telephone and electric light and power industries and in the manufacturing and operating sides of the industries in each case.



B. E. SUNNY

MR. ANGUS S. HIBBARD, second vice-president and general manager of the Chicago Telephone Company, and for many years identified prominently with the telephone service of the city of Chicago, will remove to New York early in May, to take a position on the staff of Mr. Theodore N. Vail, president of the American Telephone & Telegraph Company. It is understood that Mr. Hibbard will engage in the work of co-ordinating the telephone and telegraph systems throughout the country, as proposed by Mr. Vail in his recent annual report. Mr. Hibbard has been prominent in the technical, commercial and social life of Chicago. He is a native of Milwaukee and received his early education at the Milwaukee Academy and the Racine College. For nearly all his business life he has been identified with the telegraph and the telephone. After service with the Wisconsin Telephone Company he was made general superintendent of the predecessor of the American Telephone & Telegraph Company in New York in 1886. He came to Chicago in 1893 as general manager of the Chicago Telephone Company, and has filled that position ever since, being promoted to the vice-presidency in addition. He was perhaps the first telephone manager to introduce the lamp-signal system in telephone switchboards on a large scale. He has invented and patented a number of useful devices for telephone work. He is a member of the American Institute of Electrical Engineers, of which he was manager from 1892 to 1895 and vice-president from 1895 to 1897. He is also a member of the Chicago Association of Commerce and of many clubs, including the University and Union League Clubs of Chicago. Mr. Hibbard is a musician of more than ordinary ability, and has composed many songs which have been sung with great success. For seven years he was president of the Apollo Musical Club of Chicago, and he is now an honorary member of that organization.

Obituary.

MR. HENRY M. WATSON, a past-president of the American Street Railway Association and a director of the International Railway, Buffalo, N. Y., is dead. Mr. Watson was born in Unadilla, N. Y., May 18, 1835, and in 1879 organized the Bell Telephone Company, Buffalo, N. Y., being president of the company up to the time of its absorption by the New York Telephone Company, about a year and a half ago. Mr. Watson was also a director in the New York Telephone Company.

MR. RUTHERFORD D. RUBRIGHT, auditor of the Edison Electric Illuminating Company of Brooklyn, died April 20 after a short illness. Mr. Rubright was thirty-five years old and came to the Brooklyn Edison company from the Westchester Lighting Company in November, 1909. Prior to that he had been chief clerk in the accounting department of the Consolidated Gas Company, and he was at one time clerk and accountant with the Elmira Water Works Company. He was highly regarded in Brooklyn, and the offices were closed early last Thursday as a token of respect. The interment was at Corning, N. Y., where his mother and sister still reside. Mr. Rubright was a bachelor.

MR. JOHN DENNIS KEILEY, electrical engineer of the New York Central & Hudson River Railroad, died of pneumonia at his residence, Yonkers, N. Y., April 21. Mr. Keiley was born in Brooklyn Feb. 6, 1871, and received his primary education in the Christian Brothers' School of that city. He later entered the St. Francis Xavier College, of New York City, and upon the completion of his course went to Johns Hopkins University, where he took a four years' scientific course, specializing in electrical engineering. Upon finishing this course, in 1893, he undertook some civil engineering work in South Carolina. In 1897 Mr. Keiley's services were secured by the Brooklyn Rapid Transit Company in connection with the reconstruction of the Brighton Beach Railroad, and after a few months he was made assistant engineer. His natural work, however, was in the electrical field, and his opportunity came when train movement tests were inaugurated by the Brooklyn Heights Railroad Company. While engaged in this work he invented an instrument to record automatically the movement of the trains and simultaneously the readings of electrical instruments. This device was called by his associates the "Keileyograph," a name which it still bears. Mr. Keiley's excellent record led to his appointment as assistant master mechanic, in which capacity he acted as technical adviser to the vice president of the Brooklyn Rapid Transit Company, a position which he retained until 1903. When the Electric Traction Commission of the New York Central Railroad was organized Mr. Keiley was asked to become assistant electrical engineer. He entered upon this work Feb. 1, 1903, and immediately began to solve the problems which attended the first great trunk-line electrification. His unbounded enthusiasm, broad experience and clear, logical mind were the inspiration of all with whom he was associated. His familiarity with civil, mechanical and electrical engineering, in addition to his high mathematical talent, was of the greatest assistance to the commission, and in recognition of his valuable services he was appointed electrical engineer in 1906. Among Mr. Keiley's inventions are a self-ventilated armature, the Keileyograph and a hand-brake system for street cars. He also developed many of the practical details of the New York Central type of under-contact third rail. His most valuable contribution to the art of electric railroading was the circuit-breaker house system of third-rail connection, which has been the means of saving vast sums of money in copper cables and of increasing the safety of electrically operated railways. In 1907 Mr. Keiley, collaborating with Prof. S. W. Ashe, brought out a book entitled "Electric Railways." Mr. Keiley was a member of the Engineers, Transportation, and New York Railroad clubs.

Trade Publications.

METALLIC FILAMENT LAMPS.—The General Incandescent Lamp Company, Electric Building, Cleveland, Ohio, is issuing revised price lists on its "Mazda" and tantalum lamps. The price lists are rather unusual in form, the cover being a greatly enlarged reproduction of the G. I. label.

DIRECT-CURRENT GENERATORS.—The Triumph Electric Company, Cincinnati, Ohio, has issued Bulletin No. 421, giving a complete description of its belted generators of the steel-frame type, rated at from 0.5 kw to 100 kw in bracket form, and from 100 kw to 500 kw in pedestal form.

GLASS FITTINGS FOR ELECTRIC LAMPS.—In publication No. 616 of Veritys, Ltd., Aston, Birmingham, England, are shown numerous illustrations of crystal glass fittings for use with electric lamps. The fittings are shown with pendent, ceiling and bracket fixtures and with portable lamps.

GENERATING SETS.—The Gregory Electric Company, Chicago, Ill., has issued an interesting circular in which attention is called to the generating equipment of the Boley (Okla.) Light & Power Company, which has been installed and is owned and operated by colored men in a negro town, the first of its kind in America.

BUSINESS NOTES.

THE DOMESTIC EQUIPMENT COMPANY, formerly of 1304 Masonic Temple, has moved to 28 West Lake Street, Chicago.

JENKINS BROTHERS, valve manufacturers, have moved their New York headquarters from 71 John Street to 80 White Street.

THE WALL-WIN COMPANY, 27 William Street, New York, has taken over the business of the Electric Motor & Equipment Company, Newark, N. J.

THE MASSACHUSETTS CHEMICAL COMPANY and the WALPOLE RUBBER COMPANY will move their New York offices to 80 Reade Street on May 1.

THE A. O. SCHOONMAKER COMPANY has moved from 221 Fulton Street to 66 Park Place, New York, where it will have on hand a complete line of mica for insulating purposes.

WALPOLE RUBBER COMPANY.—Mr. E. C. Green has again become associated with the Walpole Rubber Company, as general purchasing agent, with headquarters at the factory office in Walpole, Mass.

MR. WILLIAM S. TURNER, formerly manager of W. S. Barstow & Company, has opened an office in the Spaulding Building, Portland, Ore., where he will conduct the business of consulting electrical engineering.

THE COLUMBIA INCANDESCENT LAMP COMPANY has moved its Philadelphia office from the Real Estate Trust Building to the Philadelphia Bourse Building, where the offices and warerooms will both be located.

THE CUTLER-HAMMER MANUFACTURING COMPANY announces the removal of its Chicago office from the Monadnock Building to 122 South Michigan Avenue (1339 People's Gas Building), where it will have more spacious quarters.

THE TRIUMPH ELECTRIC COMPANY has moved its Boston office from 101 High Street to 92 Pearl Street. Mr. C. A. Cotton is district office manager. This change of location was made for the purpose of obtaining more commodious quarters.

KALENBORN & PAHL.—Messrs. A. S. Kalenborn and A. J. Pahl have opened an electrical repairing establishment at 37 Stevenson Street, San Francisco, Cal. The firm will also undertake tests on hydroelectric plants and on motor-driven installations.

MR. CHARLES T. PHILLIPS, consulting electrical engineer, has moved his office from the Crocker Building to the Pacific Building in San Francisco, where he will be associated with Mr. W. F. Lamme, formerly consulting engineer of the Westinghouse company.

THE NEW DEPARTURE MANUFACTURING COMPANY, of Bristol, Conn., manufacturer of ball bearings, is enlarging its already extensive corps of engineers. Mr. Victor E. Page, of Pawtucket, R. I., for some years past managing editor of the *Automobile Journal*, is the latest recruit of the forces.

JAS. A. GREEN & COMPANY, Inc., with offices at 226 South La Salle Street, Chicago, and 509 Overland Building, Boise, Idaho, have taken over the engineering and construction business formerly conducted by James A. Green. The company will continue to pay particular attention to irrigating, hydraulic and hydroelectric work.

IRWIN ELECTRIC COMPANY.—As a result of the purchase by Mr. W. H. Irwin of the interests owned by Mr. J. H. Shores in the Joimer-Shores-Irwin Electric Company, the firm name will be changed to the Irwin Electric Company. This firm of engineers, contractors and supply dealers has its headquarters at Spartanburg, S. C.

ADAMS-BAGNALL ELECTRIC COMPANY.—Owing to a typographical error the new address of the Chicago office of the Adams-Bagnall Electric Company was given in our issue of April 20 as 217 instead of 417 South Dearborn Street, which latter address is the correct one according to the new system of street names and numbers used in Chicago.

THE HOLOPHANE COMPANY.—Mr. C. A. Howe, manager of the Chicago office of the Holophane Company, is about to leave Chicago to become treasurer and general manager of the new Holophane Company, Ltd., of Toronto, Ont., which will manufacture and sell Holophane products in Canada. Mr. Howe has been manager of the Chicago office of the Holophane Company for four years and has been nine years with the company. Mr. H. D. Howe, general purchasing agent of the Holophane Company, Newark, Ohio, will remove to Toronto to become secretary of the newly organized company.

FEDERAL MINIATURE LAMP COMPANY.—The Federal Miniature Lamp Company has recently selected for its president and general manager Mr. W. R. Armstrong, who has made a special study of miniature and novel types of lamps for the past twenty years. Mr. Armstrong's chief assistants in the operation of the company are Mr. O. V. Maurer, formerly factory expert of the Fostoria Incandescent Lamp Company and now on a tour of investigation in Europe; Mr. R. O. Poag, formerly of the engineering department of the National Electric Lamp Association, and Mr. B. F. Whelan, formerly of the Buckeye Electric Company.

THE ALPHA ELECTRICAL SUPPLY COMPANY has been formed with the following officers: Mr. John F. Walsh, president and treasurer; Mr. Albert F. Thatcher, vice-president; Mr. George J. Osburg, secretary. Mr. Walsh has been connected with the Royal Eastern Electrical Supply Company for the past six years. Formerly he was connected with the Manhattan Electrical Supply Company and the Stanley-Patterson Company. Mr. Thatcher is at present New York sales agent for the Lynn Incandescent Lamp Company, Lynn, Mass., and the Helios Manufacturing Company, of Philadelphia. Mr. Osburg has been connected with the Fullerton Electric Company for the past two years. The new company will occupy offices at 130 West Thirty-second Street, New York, where a complete line of electrical supplies will be carried and a general jobbing business will be conducted.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 18, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

989,568. ELECTRIC FURNACE; M. R. Conley, New York, N. Y. App. filed June 14, 1910. Resistance furnace in one piece, having a melting chamber with a closed bottom, an integral body of less width than the melting chamber and connecting with the walls of the melting chamber near the bottom, the body being of better conductivity than the walls of the melting chamber.

989,576. TELEGRAPHY; P. B. Delany, South Orange, N. J. App. filed May 1, 1907. Auto-dot transmitter, one movement of the key giving a plurality of dots. Comprises a weighted springy vibrator, normally attracted by an electro-magnet, so as to keep it under tension, the circuit being released at will to permit it to vibrate at its normal rate, and a transmitting contact with which the vibrator successively makes contact as it vibrates.

989,577. TELEGRAPHY; P. B. Delany, South Orange, N. J. App. filed Aug. 24, 1910. Automatic telegraph for way circuits, having a transmitter, an electro-magnetic receiver, a resistance shunting the latter, and a chemical recorder shunting the electro-magnetic receiver and the resistance, whereby the circuit is maintained stable regardless of the number of stations, and whereby a chain from one system to the other does not disturb materially the working condition of the circuit.

989,584. ELECTRIC CONTROL FOR ELEVATORS; E. L. Dunn, Worcester, Mass. App. filed June 5, 1908. For passenger elevators which may be used for freight; includes an operating box, an indicator, limit circuits closed by the main switch, a stop solenoid switch, test switch, slow-speed connections, the box being inoperative at all proper times and foolproof. Two clutches operate the direction switches and magnetically release an operating box hand wheel. The signal lamp acts as a protective resistance to keep the solenoid from heating.

989,588. COOLING DEVICE FOR TELEPHONE-TRANSMITTERS; C. E. Egnee, Stockholm, and J. G. Holmstrom, Saltsjo-Storängen, Sweden. App. filed Aug. 18, 1909. A strained diaphragm which is prevented from losing its tension by heat where it supports the electrode, by means of a spirit containing cooling liquid.

989,596. METHOD OF PROTECTING ARTICLES FROM EARTH CURRENTS; H. Geppert, Karlsruhe, Germany. App. filed Feb. 24, 1909. The article to be protected is connected with a negative pole of a circuit and anodes sunk into the earth are connected to the positive pole.

989,609. REGULATING MEANS FOR ELECTRIC MOTORS; C. De Kando, Budapest, Austria-Hungary. App. filed Sept. 26, 1907. For polyphase induction motors for railways. Regulates by means of electro-magnetically controlled devices which respond to variations in the amount of current supplied to one motor for governing the amount of current supplied to the remaining motors.

989,618. PENDENT SNAP SWITCH; R. E. Leve, New York, N. Y. App. filed April 6, 1910. Locks the switch in either position and strikes it a hammer blow by means of a toggle with a hammer at the knuckle, which strikes the switch blade.

989,623. LAMP SOCKET; N. Marshall, Newton, Mass. App. filed Oct. 19, 1908. The contacts are mounted upon a porcelain base inclosed within a metallic shell and cap, with a central aperture in the top, an insulating bushing projecting through the aperture, the shell and cap having latching devices arranged about the axis and a locking shoulder engaged by axial movement between the cap and shell.

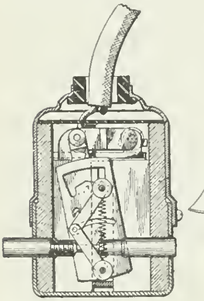
989,671. ELECTRIC FURNACE; A. Voelker, Beuel, near Bonn, Germany. App. filed Aug. 15, 19[illegible]. Electric furnace for turning raw quartz into a semi-liquid hot state and to free bubbles from the quartz during its discharge, the furnace having a covered part with central bottom opening and two prisms of carbon forming the poles, the upper pole in the cover of the hearth being fixed and the lower pole closing the bottom opening and moving downward when supporting the body being formed.

989,687. SELF-STARTER; T. E. Barnum, Milwaukee, Wis. App. filed March 14, 1907. Controller for electric motors having the main switch, a resistance controlling switch, a single electro-magnet for operating them, the winding having two movable cores, each connected to one of the switches.

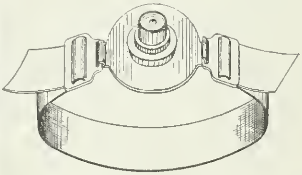
989,698. ARC LAMP; W. F. Davis, Grand Rapids, Mich. App. filed April 20, 1909. For locomotive headlights, etc., with automatic means for adjusting the carbons, including a drum turned by a spring to move the carbon holders toward each other, a lever, a clutch on the lever to hold the drum, a solenoid to move the lever in one direction, a stop to release the clutch and a spring to move the lever in the opposite direction and separate the carbon holders.

989,711. ELECTRIC MEASURING INSTALLATION; B. G. Jamieson, Chicago, Ill. App. filed Feb. 14, 1908. For testing measuring instruments while on the switchboard. Associates a switch mounted upon or near the instrument so as to connect it with the service circuit or with the testing circuit, and when an ammeter is being tested short-circuits the service conductors which lead to and from the ammeter before the meter is connected to the testing circuit.

989,730. ELECTRIC TRACK SWITCH: J. P. Tierney, Booterstown, and J. Malone, Phibsboro, Ireland. App. filed Jan. 31, 1910. For tramways. The switch tongue is moved in either direction by an electro-magnet whose winding is connected to one end of the current-carrying conductor and at the other end to a contact in advance of the junction. The magnet is pivotally mounted to move in a horizontal plane, so as to return the switch tongue when the magnet is again energized.



989,618.—Pendent Snap Switch.



990,158.—Contact Disk.

989.738. BATTERY HOLDER: G. N. Waterbury, Jr., Washington, D. C. App. filed Jan. 14, 1910. A cell holder or cage for dry cells, with an electrical spring contact for effecting an electrical contact with the positive terminal of a dry cell and for engaging either a vertical positive terminal or a horizontal positive terminal.

989,761. TELEPHONE LOCK AND CALL-REGISTER; E. L. Buxbaum, Chicago, Ill. App. filed May 17, 1909. To be attached to an ordinary telephone for locking it normally and registering the calls. The locking bar for the hook is contained within a casing secured to the stem of the 'phone, the casing containing a register and a device controlling locking bar, which device actuates the register.

989,762. SYSTEM FOR REGISTERING CALLS AND LOCKING TELEPHONES; E. L. Buxbaum, Chicago, Ill. App. filed Dec. 2, 1909. Particularly for private exchanges, including a combined register, a signal and locking device, the signal notifying the persons near the telephone whether or not the user registered when making the call. Means at central actuate the subscriber's register and signal to indicate the length of the conversation.

989,763. SYSTEM FOR REGISTERING TELEPHONE CALLS; E. L. Buxbaum, Chicago, Ill. App. filed Aug. 5, 1910. For registering outgoing calls simultaneously at subscriber's station and central by means of an actuating magnet for the register controlled by wires extending to the central station, where a controller is located, together with a signal controlled by the register.

989,768. TELEPHONE SYSTEM; A. H. Dyson, Chicago, Ill. App. filed Feb. 21, 1902. Complete metallic and central energy system with subscriber's line relay, line signal lamp, local resistance closed by the relay, supervisory lamp, operater's connecting apparatus to bring the same into shunt with the line lamp to extinguish the latter, the supervisory lamp being adapted to remain unlighted because of the resistance. A second resistance in parallel with the first, when the line relay armature is retracted, causes the supervisory lamp to be illuminated by the increased current through the parallel resistances.

989,791. APPARATUS FOR INSULATING; M. Meirowsky, Cologne-Ehrenfeld, Germany. App. filed Oct. 19, 1910. For insulating form wound armature coils by winding thereon insulating material, preferably mica which is heated by hot rolls while being wound upon the form.

989,792. TELEGRAPH RELAY; Z. McD. Miller, Pittsburgh, Pa. App. filed Sept. 8, 1904. A pair of oppositely wound electro-magnets with tubular cores in axial alignment and an armature near the poles pivoted upon an axis parallel to the cores. The magnet has an open magnetic circuit to avoid residual magnetism.

989,795. SANITARY TELEPHONE MOUTHPIECE; J. B. O'Hara, Philadelphia, Pa. App. filed April 2, 1910. Mouthpiece with a cap in which is a cup which contains a disinfectant and a gasket between the cup and the inside of the cap, one edge of the gasket engaging the mouthpiece when the cap is applied.

989,798. ELECTRIC MOTOR; G. H. Pfeil, Swissvale, Pa. App. filed Feb. 4, 1910. Bushing for insulating the commutator from the armature shaft of the motor with high resistance consisting of two sections overlapped at their meeting edges, each section having a sleeve portion and an inwardly inclined end flange to retain the segments.

989,799. ELECTRIC SIGNALING APPARATUS; E. Pope, Quebec, Canada. App. filed Feb. 26, 1909. Selective signal for circuits having a multiplicity of stations, each station having a station contact selector, a ground contact selector, the selectors being moved synchronously by a clock train and means for arbitrarily making or breaking connection between the gear and the clock train by vibrating the contact carrying bearings on a pivoted frame.

989,802. ART OF EXTRACTING METALS, SUCH AS GOLD, SILVER, COPPER OR NICKEL FROM THEIR NATIVE ORES; W. D. Rennie, Hackensack, N. J. App. filed April 19, 1910. Electrolytic process by subjecting a mixture of water, powdered ore and fluorspar to electrolytic action until all the metal is deposited on the cathode of the cell.

989,803. MIXTURE OF COMPOSITION FOR USE IN THE ART OF EXTRACTING THE PRECIOUS METALS, GOLD AND SILVER, FROM THEIR NATIVE ORES; W. D. Rennie, Hackensack, N. J. App. filed April 19, 1910. A mixture used in the process of patent 989,802, consisting of water, powdered ore, fluorspar and bromin salt in certain proportions.

989,804. MIXTURE OF COMPOSITION FOR USE IN THE ART OF EXTRACTING THE PRECIOUS METALS, GOLD AND SILVER FROM THEIR NATIVE ORES; W. D. Rennie, Hackensack, N. J. App. filed April 19, 1910. A mixture for use in the process of patent 989,802, which adds cyanide or potassium to the mixture of patent 989,803.

989,814. AUXILIARY TELEPHONE-RECEIVER; W. Schwarzhaupt, Cologne, Germany. App. filed June 15, 1910. Auxiliary receiver for telephones enabling the use of both ears; the auxiliary receiver is connected by a tube to the main receiver and has its end beveled in parallel with the diaphragm.

989,847. AUTOMATIC REVERSING STARTER; J. Hofle, Budapest, Austria-Hungary. App. filed Oct. 24, 1910. Includes a change over switch for determining the direction of rotation of the motor, a resistance switch for interposing and cutting out resistance, a series circuit-breaker and dash pot for the switch lever of the resistance switch. The parts are mechanically connected, so as to insure starting with all resistances in and insure breaking the circuit only at the series circuit-breaker.

989,853. ADJUSTABLE HOLDER FOR INSULATING LOOMS; E. H. Kruse, Fort Wayne, Ind. App. filed Oct. 8, 1909. The insulating sleeve or loom which surrounds the rubber-covered wire protects it when passing through lath and plastering. The holder includes an adjusting screw and conical member for passing between the loom-covered wires to grip them and hold them in position.

989,854. ADJUSTABLE SWITCH BOX; E. H. Kruse, Fort Wayne, Ind. App. filed Oct. 14, 1909. Switch box to be used where plastering is done and to avoid the use of washers to even the plastering with the edge of the box. Provides brackets on which the box is adjustably mounted, with adjusting screws.

989,856. TELEPHONE; W. C. Lockwood, San Juan, Porto Rico. App. filed Jan. 29, 1909. Sends magnetic-induced currents and electrically induced currents over the line by vibrations of the transmitter diaphragm by providing a coil with a double primary winding and maintaining a closed circuit through one of the windings and a variable circuit through the other, the line being connected to the secondary winding.

989,892. APPARATUS FOR GENERATING ELECTRICITY; E. C. Brice and R. N. Hudson, Lexington, Ky. App. filed March 29, 1910. A battery with jar, an apertured support on the bottom, the porous cup in the top of the support, a carbon conductor receptacle within the cup, a thin porous cup within the receptacle, a vertical metal conductor on the bottom of the thin cup, having a projection to which leading wires are attached.

989,900. ELECTRICAL HEATER; J. B. Fey, Columbus, O. App. filed Feb. 11, 1910. For heating air which passes through the heater by means of a casing consisting of disks connected by an annular series of rods, around which resistance wire is wound with a deflector to cause the air to circulate.

989,960. ELECTRICAL CREMATORY; L. H. Giddings, Pasadena, Cal. App. filed Feb. 3, 1910. A retort with a slotted floor heated by electrical resistance, the slots enabling the production of a draft.

989,970. ANNUNCIATOR; C. J. Henschel, New York, N. Y. App. filed Aug. 7, 1908. An arrangement of magnet, armature and drop. Details.

990,032. ELECTRICAL RELAY; E. E. Clement, Washington, D. C. App. filed Dec. 23, 1905. A relay for breaking more than two pairs of contacts. The electro-magnet has contact springs operated by an armature over which an inclosing shell is arranged, the armature being a bell crank and operating a plurality of studs for the contacts.

990,069. SEPARATOR FOR STORAGE BATTERY PLATES; F. L. Sessions, Columbus, O. App. filed Oct. 8, 1909. Passageways extend through the plates, all parts of the ends of the passageways being offset relatively to each other in a direction parallel to the main frame of the separator.

990,103. MAGAZINE ELECTRIC ARC LAMP; J. Brockie, Forest Hill, England. App. filed July 22, 1910. A magazine contains a plurality of carbons, which are fed, one at a time, to the carbon holder. Instead of the magazine being directly linked to the regulating lever increasing the work upon the regulating armature, the regulating lever in the present instance is connected to the magazine in such a manner that an appreciative relative movement is given to the carbon holders in part of its stroke only, and further movement starts and stops the motor mechanism which feeds the carbons out of the magazine nozzles.

990,120. ELECTRIC SWITCH BOX; M. M. Disler, Canton, O. App. filed May 25, 1910. A switch having a casing which is divided into compartments with a rock shaft extending across the compartments and carrying contacts and operated by a push handle.

990,124. ELECTRIC HEATER; H. B. Gale, Natick, Mass. App. filed Dec. 29, 1910. A resistance consisting of conductive sections with radiating arms separated by insulation and a casing conforming in interior shape to the external form of the sections.

990,158. CONTACT-DISK; E. L. Moses, Buffalo, N. Y. App. filed Dec. 23, 1909. For therapeutics. A disk is made of stamped metal having the pocket carrying the felt pad. This forms the electrode.

990,161. CLOSURE FOR OPENINGS OF OUTLET BOXES; H. T. Paiste, Philadelphia, Pa. App. filed Oct. 24, 1908. A box has an opening with two plates, a screw to hold the plates so as to partially or completely close the opening, this forming a sectional wall cabinet, the outlet openings when not in use being held tightly closed.

990,180. BRIDGING BLOCK FOR DYNAMO-ELECTRIC MACHINES; F. W. Young, East Orange, N. J. App. filed Aug. 19, 1908. For holding windings in slots. The blocks act as wedges and consist of a core with a folded sheet iron envelope extending across one side of the core and folded over the opposite edges, which prevents eddy currents and magnetic leakage.

990,183. RELAY; C. G. Ashley, Chicago, Ill. App. filed Nov. 19, 1908. For propagating electrical waves, particularly as a relay in a long-distance telephone line, i. e., as a repeater to amplify the current. Two windings are out of inductive relation for connection in different circuits and a rotating inductor movable with respect to the windings is provided, one winding effecting eddy currents in the conductors, which are caused to be in primary inductive relation with the other windings.

990,200. RACK FOR ELECTROPLATING DEVICES; W. H. Rogers, Muncie, Ind. App. filed July 29, 1910. A rack for holding the articles in a bath consisting of horizontal shells with notches to receive the articles.

990,206. FOOT-WARMING ATTACHMENT FOR ELECTROTHERMAL GARMENTS; P. E. Charles, Portland, Ore. App. filed Oct. 12, 1910. Separable boots or slippers, in the lining of which resistance wire is wound with terminals that run to the supply wires of the heating circuit.

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THE ICE BUSINESS FOR CENTRAL STATIONS.

This issue contains a goodly number of reports from central stations, mostly small, which have found it desirable to take up the artificial-ice business. At the present time and with the efficient and easily-cared-for ice machinery which is now available it is pretty certain that artificial ice can compete with the natural product on very favorable terms in almost any part of the United States. The natural-ice business is apparently a somewhat uncertain one. At the beginning of every summer natural-ice companies moan their plaints in the papers. Either the winter has been exceptionally severe, so that the ice is too thick to handle economically, or it has not been severe enough so that good ice has formed for only a brief period and in small amounts, or there has been too much snow, so that ice is porous and will melt quickly. Every year something happens to make plausible the annual boost in price, and while the cause of the complaints is thus made obvious, they are more or less the result of real conditions.

Every winter is not a good ice winter, and ice is expensive both to store and to transport. Every summer is a good ice-making one for the artificial plant, and its storage charges are nominal. Moreover, the artificial ice, while perhaps no better than, and perhaps not as good as, the best natural ice, runs much more uniformly and is on the whole of considerably better grade. Moreover, the water can be distilled or sterilized before freezing so as to remove the dangers which have been found to exist in the natural product. All these things put the artificial-ice industry in a good strategic position, irrespective of the comparative cost. There is good reason to believe, besides, that the average cost of artificial ice, where reasonably cheap energy is available, is, if anything, rather less than the cost of the natural ice plus storage and distribution charges with the ordinary amount of transportation. The actual cost of artificial-ice making varies, of course, much with the cost of energy and general conditions. Under favorable circumstances it may get down to the neighborhood of $1 a ton in the cans, or it may run to nearly twice this amount.

Electric-light stations, as the reports herewith published show, are in a particularly good position to undertake an economical refrigerating business. In the first place, during the months when ice is chiefly required they always have large spare capacity, both steam and electric, and if motor-driven ice machines are used a beautifully steady load is available for filling up the equipment to its point of maximum efficiency. There are two lines in which activities of central stations can be properly exercised. First, cold storage, on at least a small scale, bringing the convenience of cheap cold storage into the smaller cities and towns. Second, the central station can actually take up the artificial-ice business as such, including its general sale and distribution. Which of these directions it is profitable to take and whether both should be undertaken are things to be determined wholly by local conditions, but, as a rule, in any given locality, and particularly in the smaller places, the electric-light plant is in a better position to get economical energy than any other industrial plant in the locality.

There are no large manufacturing profits to which the cost of energy is entirely subsidiary, and hence central stations can supply themselves with energy for these special activities at an exceptionally reasonable figure. Moreover, on account of the nature of the demand for energy in electrical distribution it is a positive advantage to the station to have a steady load which can be kept off the peak, for the most part, to bring the generating equipment to its maximum efficiency and so further reduce the cost of supply. Most central stations are looking for something to fill up the valleys in the load curve, and we know nothing better adapted to this service than the production of artificial ice. In how far it would pay large central stations to undertake ice making in which they would have to compete with other operators on a large scale is a matter of some doubt, but in places of relatively small size, and particularly those in the warmer parts of our country, the chances for success are of the best, as the reports we publish in this issue clearly show. In fact, there are not a few cases in which the ice plant provides a reasonable profit which the electric service by itself has scarcely been able to show. In the warmer sections and in small places the transportation, storage and distribution charges against natural ice are at a maximum, so that competition from this source can be very easily met. Ice manufactured on the spot and at about the rate needed and distributed immediately has an immense economic advantage.

The practical question at which many central-station managers would hesitate is the desirability of going into, as a business proposition, a line of activity far removed from the one to which they are accustomed. This difficulty is real and must be considered most seriously in large centers of population. In the smaller places the new line of operations is much less difficult. The central-station forces know the people of the community exceedingly well and can pretty accurately judge the size and character of the market for artificial ice. The bookkeeping and collecting departments are used to handling small items and are generally not so busy throughout the summer months as to require any large increase of force in undertaking the sale of ice. The distribution of the product is the main new line of operations to be undertaken, and the managers of small central stations are generally no novices in the problems of transportation which make up this particular task. Altogether it is certain that the ice business in nearly every case where it has been undertaken by central stations has proved a success, often a conspicuous success. It certainly deserves to be tried in a very large number of cases on account of the particularly desirable character of the load in its effect on the ordinary business of a central station.

TEACHING THE YOUNG TO RESPECT ELECTRICITY.

With the rapid extension of wires carrying electricity in all sections of the country boys and girls—more particularly the boys, of course—should be taught to have a wholesome respect for any electric circuit. There is an old-fashioned saying that fire is a good servant but a bad master. The truth sought to be conveyed by this proverb is equally applicable to electricity, and the fact is one that should be impressed on the young. The rising generation should be familiarized with electricity as an agent that is doing useful work in many departments of human endeavor, but at the same time as something that is not to be trifled with. This does not mean, of course, that the child is not to be permitted to amuse himself, and perhaps to acquire some rudiments of practical knowledge, by playing with electric toys operated by a cell or two of dry battery. But it does mean that the active boy shall be brought to have some such precautionary knowledge of electricity as he has of gravitation. He knows that he can jump off a step 2 ft. high with impunity, but that if he falls from the limb of a tree 30 ft. high he will probably be hurt and possibly killed. Inasmuch as it is impossible to tell by looking at electrical conductors whether they are carrying dangerous or innocuous currents, the boy should be taught, at home and in school, to let all electric wires severely alone for his own protection. If this fact were fixed firmly in the boy's mind, a youngster would be no more inclined to throw a loose wire over a high-potential circuit "on a dare" than he would to jump off a high building. Here and there a young life could be saved if the truth of this comparison were deeply impressed on the youthful intelligence.

STEALING ELECTRICITY.

Central-station managers in many of the large cities have been annoyed by occasional instances of the theft of electricity, often accomplished by placing a jumper around the watt-hour meter on the customer's premises so that energy could be secured without actuating the meter. Of course the amount of electricity secured by fraudulent means is small in any city compared with the total output. Nevertheless the practice is one to which the sellers of electricity are and must be resolutely opposed. Owing to the intangible nature of this product the older laws against larceny were inadequate to prevent theft of this nature, and in many of the states statutes have been passed with the explicit intention of preventing the stealing of electricity. One of the more recently enacted of these statutes is in the State of Missouri, where the law has been in force about two years.

Generally stated, the purpose of the Missouri law is declared to be "to prevent and punish unlawful conversion and wrongful use of electric current, commonly known as electricity." However, the law is designed also to check unlawful interference with electrical appliances, and penalties are provided both for the fraudulent user of electricity and the person who uses a knowledge of electrical apparatus to enable wrong to be committed. The law is divided into three sections. The first relates to those who use devices to "beat" meters, the second reaches those who tamper with electrical equipment, and the third applies to those who accept or receive electrical energy unlawfully diverted by some device intended to defraud. The offense is declared to be a misdemeanor in any case and is punishable by a fine of from $50 to $500 or by imprisonment from three to twelve months, or by both fine and imprisonment.

Of especial interest is the manner in which this law has been applied, particularly in St. Louis, where the electric-service company has been active in fighting the electricity thieves. The first conviction was secured about a year ago, and since then one prison sentence and half a dozen fines have been imposed. At first the St. Louis courts were disposed to be lenient, but the penalties are now becoming more severe. The prison sentence was passed in the case of an ex-counterfeiter, who displayed considerable skill in lighting his flat without paying for it. He made connection with a feed wire outside the building, using a water pipe in the kitchen for a ground connection. This man was sent to the workhouse for six months. The other offenders, saloon keepers, restaurant keepers, small tradesmen, etc., were fined from $50 to $100. The central-station company's inspectors and "secret-service" men have proved vigilant, and the St. Louis company is entitled to hearty commendation for its efforts, which have a widespread moral value.

SUBTRACTIVE PRODUCTION OF DAYLIGHT.

We are so much accustomed to take daylight on faith as a natural and invariable standard of color, and so little accustomed to measuring the color of daylight at different times and seasons, that the information of its variation comes at first as a shock to the sense of standards and a disillusion to the sense of moral rectitude in the established order of things. When, however, we learn that there is a very material difference between the color of daylight on a bright day at noon and at bright sunrise, likewise a still greater difference between the color of daylight on a bright noonday and at a cloudy sunrise, we take some philosophic comfort from the reflection that only Zoroastrians maintain the perpetual perfection and invariation of the sun. Moreover, on second thoughts it is self-evident that the color of daylight is a function of altitude, terrestrial latitude, season of the year, state of the weather and the atmospheric momentary contents of moisture and dust. The apparent colors of flowers, tapestries and dyes are manifestly different in hue as well as in intensity under different combinations of conditions. The change of hue in a rose under cloud and under sunshine is evidently not a mere matter of intensity. The difference lies not in the petals but in the color of the incident light.

The change in the color of daylight must be due either to change in the colors emitted by the sun or to change in the colors absorbed by the atmosphere. Concerning changes in the colors emitted by the sun we know little. In and near a sun-spot the color of the emitted light evidently varies much, but taking the sun as a whole the color of the emitted light seems not to vary appreciably. For practical purposes at least all of the change in daylight color occurs in the passage of the sun's rays through the earth's atmosphere. If the air absorbed energy equally from all parts of the spectrum occupied by the sun's radiation, then whatever the depth of air through which the radiation had to pass the relative proportions of spectrum energies would remain constant; that is, the color of the residual light would be constant. But the absorption is greater for the shorter waves of light or for the blue end of the spectrum. Hence when the sun's light has to reach us through a long oblique course in the atmosphere, at sunrise or sunset, the blue and green rays have been absorbed in transmission more than the red and yellow, so that the sunrise and sunset light is reddish by comparison with the color of daylight from the zenith sun. The latter comes down to us in the shortest possible path through the air with a maximum of blue and violet.

Accepting "daylight" with all due reserve and grains of salt as a standard white light, we speedily recognize that a gas flame gives a relatively very yellow light, a carbon incandescent lamp a light not quite so yellow, and so on for all the various artificial illuminants. Although some arc lamps emit a considerable proportion of light in the blue, yet, in general, gas and electric lamps do not emit a white light like daylight. They are too lavish at the red and yellow parts of the spectrum. With the exception of the carbon-dioxide tube lamp and the so-called intensified arc lamp artificial illuminants make no pretense to imitating daylight white. Moreover, particular luminous sources, such as the mercury-vapor lamp, give special colors of light that are saliently different from daylight. The tungsten, Nernst and carbon-arc lamps give light coming nearest to daylight white, but which at best differs therefrom very evidently. The first result of a color difference between artificial light and daylight is a sense of imperfection in the artificial light, which is a subjective impression and can to a greater or less extent be overcome by habit. The second result is that color-matching by night cannot be made to agree with color-matching by day. The average individual is neither often called upon to make color matches by night nor particularly desirous of making the attempt, but nearly all painters and workers in color compositions are perforce reduced to quitting their vocations after dusk. Consequently, an artificial reproduction of daylight has practical as well as merely esthetic value.

Excepting the lamps mentioned above daylight-imitating luminous sources are usually synthetic devices. That is to say, they give associations of colored lights so assorted as mutually to compensate for one another's color deficiencies and so to build up a resultant white. In the article by Messrs. H. E. Ives and M. Luckiesh appearing in this number the opposite expedient is adopted of taking a single luminous source, by preference the tungsten lamp, and absorbing from its light as nearly as is practicable the relative excesses of superabundant color intensities so as to reduce the residual light to nearly a daylight white. This means cutting off the red and yellow beams with a lavish use of the absorbent and thus greatly diminishing the specific luminous output of the source expressed in lumens per watt. It is evident from the nature of the process described in the article that the method is not advocated as a household economy. Daylight lamps would, on this basis, be at least as much worse in efficiency than carbon-filament incandescents as tungsten lamps are better. The change, if adopted wholesale, would be a step backward in national nocturnal economics. But the method is very simple and ingenious. It is so simple that for special color work at night the advantage of being able to accomplish the work that would otherwise have to await the coming dawn may be so great as far to outweigh the relative inefficiency of the process. All that is needed is a box for the tungsten lamps and a specially prepared colored-glass window. Similar considerations apply to the use of incandescent lamps in a photographic developing room. Strictly speaking, only a faint light of red color may be used in developing ordinary photographic pictures. On the basis of economy and luminous efficiency only a single candle should be used behind a ruby-glass window. In practice, however, convenience often dictates the use of a fairly powerful incandescent lamp placed in a box with several red and yellow glass sliding covers. It is to be hoped that if the device described is found to be satisfactory the manufacture of these incandescent artificial daylight sources may be taken up commercially for the benefit of those who have to work in color compositions by night

The International Electrical Congress at Turin in September.

We learn that the American Institute of Electrical Engineers has appointed a committee representing not only that body, but also indirectly the Bureau of Standards, the United States Committee of the International Electrotechnical Commission, the National Electric Light Association, the Association of Edison Illuminating Companies, the American Electrochemical Society and the American Street Railway Association, to aid the Italian executive committee in the work of preparing for the coming International Electrical Congress at Turin, so far as relates to American representation. As has already been announced in these columns, this congress is scheduled to be held at Turin from Sept. 9 to 20, 1911, during the period of the Italian International Exhibition of Industry and Labor. Americans connected with any of the above organizations who intend to attend the congress in Turin, or who may desire to adhere to the congress in order to secure a copy of the *Transactions* of the congress without attending its meetings, will assist the committee by communicating their intentions to the secretary of the American Institute of Electrical Engineers.

A. I. E. E. Meetings..

The annual convention of the American Institute of Electrical Engineers will be held in Chicago on June 26, 27, 28, 29 and 30, 1911. The headquarters will be at the new Hotel Sherman. There will be a reception on Monday evening, June 26, and the technical sessions will open on Tuesday morning. The convention committee will have charge of the local arrangements. The members of this committee are as follows: Mr. Louis A. Ferguson, chairman, and Messrs. W. L. Abbott, B. J. Arnold, H. M. Byllesby, W. Lee Campbell, T. P. Gaylord, William B. Jackson, J. W. Johnson, John D. Nies, W. P. Sidley, B. E. Sunny, Fay Woodmansee, P. B. Woodworth and J. G. Wray.

The following is a partial list of the papers that will probably be presented: *Economical Design of Direct-Current Magnets*, by Mr. R. Wikander; *Catenary Span Calculations*, by Mr. W. L. R. Robertson; *Currents in Inductors of Induction Motors*, by Mr. H. Wiechsel; *Multiplex Telephony and Telegraphy by Means of Electric Waves Guided by Wires*, by Major G. O. Squier; *Electrolysis in Reinforced Concrete*, by Prof. C. E. Magnusson; *Induction Motor Design*, by Mr. T. Hoock; *The High-Efficiency Suspension Insulators*, by Mr. A. O. Austin; *The Electric Strength of Air*, by Prof. J. B. Whitehead; *Electrification Analyzed, and Its Application to Trunk-Line Roads*, by Mr. W. S. Murray; *Telegraph Transmission*, by Mr. F. F. Fowle; *The Cost of Transformer Losses*, by Messrs. R. W. Atkinson and C. E. Stone; *The Cost of Railway Electrification*, by Mr. B. F. Wood; *Induction Motor for Single-Phase Traction*, by Mr. E. F. W. Alexanderson; *Magnetic Properties of Iron at 200,000 Cycles*, by Mr. E. F. W. Alexanderson; *Electric Storage Batteries*, by Mr. Bruce Ford; *The Characteristics of Isolated Plants*, by Mr. P. R. Moses, and *Elevator Control*, by Mr. T. E. Barnum. There will also be two papers on educational topics.

PRESENTATION OF EDISON MEDAL.

The ceremonies attending the presentation of the Edison medal to Mr. Frank Julian Sprague will be held in the auditorium of the Engineering Societies Building, New York City, on Tuesday evening, May 16. The program as arranged will include the presentation of the medal and certificate of award to Mr. Sprague by Prof. Dugald C. Jackson, president of the Institute, and a number of addresses will be made indicating the result of Mr. Sprague's work along the lines of electric railway development and the use of electricity in the navy. Among the speakers and subjects will be: *The Development of the Electric Railway*, by Mr. W. B. Potter; *Social Results of the Introduction of the Electric Railway*, by Prof. F. H. Giddings; *The Relation of Governmental Control to the Development of Electric Railways and the Electrification of Steam Lines*, by Dr. George F. Swain. There will also be an address on the subject *The Results of the Use of Electricity in the Navy*. Representatives of the government, state, municipality, national engineering societies and civic organizations have been invited to participate in the presentation.

At this meeting the board of directors will submit its report for the fiscal year ended April 30, 1911, and the result of the membership vote for the offices to be filled for the ensuing administration year will be announced.

Program of the National Electric Light Association Convention.

The program of the National Electric Light Association convention provides for two sessions daily for four days. There will be a total of sixteen sessions, in a number of instances parallel sessions being held. There are twenty-four papers in the program and nearly forty committee reports. Below are given the general items of the program:

The first general session will be held Tuesday morning, May 30. On Tuesday evening the public-policy committee will present its report on the plan of welfare work. On Wednesday morning there will be three sessions, the technical, commercial and accounting respectively. In the afternoon will be held the second general session and the second accounting session. On Thursday morning the transmission section will hold its first session, the commercial section will hold its second session and the accounting its third session. In the afternoon there will be held the second technical session and the third commercial session. On Friday morning the transmission section will hold its second session, the technical its third and the commercial its fourth. The third general session of the convention will be held on Friday afternoon.

GENERAL SESSIONS.

At the first general session on Tuesday the items will include the address of President Freeman, the report of the committee on membership, of which Mr. H. H. Scott is chairman; the report of the committee on progress, of which Mr. T. C. Martin is chairman, and a paper entitled *Master and Men*, by Mr Paul Lupke.

At the second general session, on Wednesday afternoon, Mr. Louis A. Ferguson will present a paper entitled *Electrical Exhibitions;* a paper entitled *Company and Company Section Bulletins* will be read by Mr. E. A. Edkins, and the following reports will be presented: "The Insurance Expert," by Mr. W. H. Blood, Jr.; "The *Bulletin* Question Box," by Mr. M. S. Seelman, Jr.; "The Library Committee," by Mr. Arthur Williams; "The Solicitors' Handbook," by Mr. Arthur Williams; the report of the secretary, by Mr. T. C. Martin, and the treasurer's report by Mr. George H. Harries. There will also be a topical discussion on the work of the company sections.

At the third general session, on Friday afternoon, the committee on rate research, of which Mr. John F. Gilchrist is chairman, will present its report; Mr. T. C. Martin will present the report of the committee on memorials, and Mr. Frank W. Frueauff will present the report of the committee on form of section organization. The following papers will be presented at this session: *Valuation of Properties as Related to Rates*, by Mr. W. F. Wells; *Reasons for Variations in Rates Under Varying Conditions of Operation*, by Mr. N. T. Wilcox; *The Standardization of Electrical Selling*, by Mr. Douglass Burnett, and *Economies in Operation Possible Through Time Study*, by Mr. L. B. Webster. As this will be the concluding session of the convention, the nominating committee will submit its report and the election of officers will take place. A vote will also be taken on certain changes in the constitution.

TECHNICAL SESSIONS.

At the first technical session, on Wednesday morning, reports will be presented by the following chairmen of the committees indicated: Mr. Farley Osgood, overhead-line construction committee; Mr. W. K. Vanderpoel, preservation of poles committee; Mr. W. L. Abbott, underground construction committee, and Mr. G. A. Sawin, meter committee.

At the second technical session, on Thursday afternoon, Mr. R. B. Williamson will present a paper entitled *The Ventilation of Turbo-Generators*: Mr. H. O. Troy will read a paper on *The Progress and Development in Self-Cooled Transformers,* and the following reports will also be submitted: The committee on prime movers, by Mr. I. E. Moultrop; the lamp committee, by Mr. W. F. Wells, and the committee on electrical apparatus, by Mr. L. L. Elden.

At the third technical session, on Friday morning, Mr. W. H. Blood, Jr., as chairman, will present the report of the committee on the grounding of secondaries, and papers will be presented as follows: Mr. P. M. Lincoln, *Grounding Low-Tension Circuits;* Mr. W. A. Layman, *Recent Important Improvements in Single-Phase Motors,* and Mr. F. D. Newbury, *Relation of Motor Load to Station Equipment.*

ACCOUNTING SESSIONS.

At the first accounting session, on Wednesday morning, Mr. John L. Bailey will present the report of the accounting committee, and papers will be presented by the following: Mr. John T. Brady, *Tracing Storeroom Material;* Mr. T. W. Buxton, *The Purchasing Department,* and Mr. Alex. Holme, *The Advantage of a Job-Cost System.*

At the second accounting session, on Wednesday afternoon, three papers will be presented as follows: *Handling Customers' Orders,* by Mr. R. F. Bonsall; *The Collection of Bills,* by Mr. E. J. Bowers, and *Electric-Vehicle Accounts as Applied to a Department of a Central-Station Plant,* by Mr. Herman Spoehrer.

At the third accounting session, on Thursday morning, a paper will be presented by Mr. Franklyn Heydecke on *General Office Accounting,* one by Mr. H. M. Edwards on *Depreciation,* and one by Mr. William Schmidt, Jr., on *The Extent to Which a Tabulating Machine Can Be Used in Accounting Work.*

COMMERCIAL SESSIONS.

At the first commercial session, on Wednesday morning, the following committees will submit reports through the chairmen indicated: "Electricity in Rural Districts," Mr. J. G. Learned; "Power," Mr. E. W. Lloyd; "Electric Vehicles," Mr. J. T. Hutchings.

The second commercial session will be held on Thursday morning and will be devoted to an executive session of the members of this section.

The third commercial session will be held on Thursday afternoon, when Mr. Clare N. Stannard will present the report of the committee on residence business and Mr. M. S. Sloan will present the report of the committee on industrial lighting. The report of the committee on improved wiring and equipment standards will be presented by Mr. M. C. Rypinski, and Mr. F. H. Gale will present the report of the committee on electric heating, refrigeration and kindred appliance sales.

At the fourth commercial session, on Friday morning, Mr. C. W. Lee will present the report of the committee on electrical and central-station advertising; Mr. H. J. Gille the report of the committee on competitive illuminants, and Mr. T. I. Jones the report of the committee on the functions of a sales department.

TRANSMISSION SESSIONS.

The transmission section will hold its first session on Thursday morning. The session will be opened by the presentation of the report of Mr. H. L. Doherty on the April conference of the N. E. L. A. on the governmental control of water-powers; Mr. B. E. Morrow will read the report of the committee on protection from lightning, and Mr. Fred Darlington will present a paper entitled *The Utilization of Central Stations for Supplying Electricity to Operate Railroads.*

At the second session of the transmission section, on Friday morning, Mr. H. A. Wagner will present a paper entitled *A New Method of Reducing the Investment in Central-Station Boiler Plants,* and Mr. George H. Walbridge will present a paper on *Determining Cost of Production in Steam Properties Under Varying Conditions.* At this session there will be a topical discussion on methods of operating transmission systems.

Expiration of General Electric-Westinghouse Patent Agreement.

The agreement made by the General Electric Company and the Westinghouse Electric & Manufacturing Company in 1896, by which there was to be an exchange of licenses on overlapping patents, expired April 30, and will not be renewed, another such agreement being no longer considered necessary. Each company, however, still retains licenses of the other, which will expire with the patent or patents thus covered. The agreement was merely technical and related solely to the exchange of licenses. At the time it was made it was found that both companies held patents whose claims overlapped, and that each was therefore in continual danger of patent litigation. To avoid this it would be necessary for the companies' engineers to sacrifice many details which approached the line of demarcation between the patents in question, so that neither company enjoyed its full patent rights, and the art as a whole was handicapped. Many of the important patents covered by the agreement have since expired, although many others, such as those covering the incandescent lamp, are still in force. The Board of Patent Control, comprising representatives of both companies, went out of existence with the expiration of the agreement, but either company may license the other if similar conditions again obtain.

Organization of Scranton Company Section, N. E. L. A.

At a meeting held in Scranton, Pa., April 26, the Scranton Company Section of the National Electric Light Association was formed with an initial membership of fifty out of 300 employees. Mr. Duncan T. Campbell, general manager of the Scranton Electric Company, acted as temporary chairman until the organization was perfected. The officers elected were as follows: Mr. Frank Howard, superintendent of distribution, president; Mr. George Dewey, new business department, vice-president; Mr. H. H. Hammond, meter department, secretary; and Ely Harris, treasurer. During this month it is planned to hold a banquet in the Board of Trade rooms, to which the president of the N. E. L. A. and the executive secretary will be invited. Energetic efforts will then be made to increase the membership considerably, so that by the time of the annual convention over one hundred will be enrolled.

Meeting of Boston Section, A. I. E. E.

The regular monthly meeting of the Boston Section of the American Institute of Electrical Engineers was held at the Edison Building, Boston, April 26, with Mr. J. F. Vaughn in the chair. A paper was read on "Problems in Telephone Traffic Engineering," by Mr. F. P. Valentine, general superintendent of traffic of the New England Telephone & Telegraph Company, Boston, Mass. Mr. Valentine discussed in considerable detail the engineering organzations and also reviewed the general methods of training technically educated men necessary in order to secure their largest usefulness. He cited various lines of attack which have been followed in endeavoring to improve the efficiency of the service as a whole, including the preparation and interpretation of peg counts, load curves, time tests of operating movements, study of advisable forms of phraseology and the training of operators for modern switchboard service. The paper showed that the telephone interests have been putting into practice for many years the principles of so-called scientific management and business efficiency which have lately received wide publicity, and the author pointed out that in the past four years wages of operators have increased 17 per cent as a result of traffic engineering progress, while at the same time if the methods of four years ago were in use to-day the annual cost to the company of handling its business would be increased $900,000.

Convention of the American Electric Railway Association.

The annual convention of the American Electric Railway Association will be held Oct. 9-13 at Atlantic City, N. J. A conscientious effort was made by the association to find a Western city possessing ample facilities for so large a gathering as usually attends the convention, but none could be found having the requisite accommodations available in October at the time of the convention. It is understood that the hotel association at Atlantic City will provide better meeting halls this year than were provided last year.

Meeting of Boston Edison Section, N. E. L. A.

The meeting of the Boston Edison Section of the National Electric Light Association, held on April 25, was devoted to a discussion of the work of the Boston Edison Laboratory, the following papers being read: "Standardization," by Mr. S. R. Keyes; "Laboratory and Station Testing," by Mr. C. L. Kasson, and "Steam and Coal Testing," by Mr. R. E. Dillon. At the conclusion of the meeting a visit was made to the company's laboratory, where a number of high-tension experiments were performed and the equipment and methods of the department further explained.

Mr. Keyes outlined the work performed by the standardizing division of the laboratory, discussing the equipment by which the accuracy of meters and instruments is tested, reviewing the advantages of the Clark and Weston cells as standards of potential, and touching upon the value of standardized resistances. The company has adopted the Weston cell as its primary standard, on account of the low temperature-voltage coefficient, and one of four such cells is sent half-yearly to the Bureau of Standards at Washington for verification. The oldest of these cells has been in use nine years, and the voltage has dropped only 0.056 per cent. The resistances are also checked periodically. Weston laboratory instruments are used as secondary working standards, Kelvin electric balances and Siemens dynamometers also being employed. The company has three storage batteries for constant potential work, and two precision series transformers. Extensive photometric work is also carried on by the department.

Mr. Kasson outlined the range of electrical testing handled by the laboratory, touching upon the instrumental comparisons, repair work on small apparatus, equipment and methods of testing employed. By means of transformers any current from zero to 1500 amp may be obtained, and any potential from zero to 75,000 volts. Among the articles tested regularly by the laboratory are watt-hour meters, instrument transformers, station shunts, indicating meters of various kinds, insulators, wires, switches, and samples of wood, asbestos, fiber, paper, rubber, marble and other materials. In addition to the foregoing lines of tests special investigations are frequently made.

The station testing includes meter checking, relay or circuit-breaker testing and setting, battery testing and trouble work. There are about 2500 alternating-current and direct-current indicating and integrating switchboard meters in the generating plants and substations, these being tested according to a prearranged schedule, so that the cost shall be uniform per month. About 850 meters per month are calibrated under the present schedule. Secondary standards are used in the station work. All relays in the same group are tested so far as possible in the same month. The relay test consists of applying current to the disconnected relay coils and observing the action and the time element under certain current values. The switches are then tripped out by operating the relays. The test is made by an artificial source of power, a variable load, ammeters and timing apparatus consisting of a telegraph sounder and a metronome. Occasional tests are made on the station storage batteries to determine the efficiency, output and condition of the battery. The test consists of preliminary discharge, final charge and discharge runs, during which readings are taken of the amperes and volts, together with the specific gravity, potential difference and temperature of the individual cells. Tests of vehicle batteries have also been made, including tests on the vehicles themselves. Meter, transformer and wiring troubles are also investigated.

In addition to the work in the laboratory and stations, the department does the electrical testing of cables and transmission lines. This work consists of high-potential, insulation and ohmic resistance tests, and tests of electrostatic capacity and electrolytic action. The high-potential tests are made on new cables to determine whether guarantees are fulfilled, and on old cables to eliminate weak spots. The test consists of applying an alternating potential of two or more times the working potential, between the conductors and between the conductors and the lead sheath, for periods of from five to thirty minutes. A portable testing set will shortly be added to the laboratory equipment which will permit the testing of 5 miles of cable at 30,000 volts. This will be mounted upon two 5-ton electric trucks. A considerable number of high-potential tests have been made on cables up to 10 miles long by the use of two station transformers, a transmission line, a turbine and the necessary auxiliary and exciting apparatus. A test made on a line to the Newton substation required the use of two 500-kw transformers at Newton and a 5000-kw turbine at the L Street generating station, both of which were loaded nearly to the full current rating. Insulation resistance tests are made by a standard resistance and galvanometer, together with a source of direct current. The cable resistance is determined by comparison with a standard 0.1-megohm resistance, and is given in terms of megohms per mile. The insulation resistance is sometimes measured directly by the use of a meggar. The ohmic resistance of cables or lines is measured by passing direct current over a long loop formed by two conductors, and measuring the drop in voltage and the current flowing. The electrostatic capacity of cables is measured by comparing the cable with a standard capacity with the aid of a ballistic galvanometer. In the electrolytic tests the difference and polarity of potential between the cable sheath and other surrounding media are measured, and the direct current actually flowing in the sheath is recorded. An ammeter and a multi-scale voltmeter equipped with a reversing switch are used, the observations being tabulated or plotted on a map.

Mr. Dillon described the methods of sampling coal for calorific and chemical tests, outlining the precedure of the laboratory in analyzing fuel. An important point brought out was an improved method of determining the amount of sulphur present in coal samples. The usual method, that of Eschka, requires about two days. The company has developed a method which enables the work to be done in about three hours, an important saving in view of the large amount of analytical work which has to be done yearly in connection with the fuel supply. The method consists of washing into a beaker the residue that is left in the bomb calorimeter after the heat-unit determination has been made, adding enough water to bring up the volume to 100 cu. cm. The solution is then filtered and barium chloride added, the result being a precipitation of barium sulphate. The solution containing the precipitate is then poured into an apparatus from which the percentage of sulphur in the sample can be read directly.

Boston Electric-Vehicle Publicity.

Continuing its policy of electric-vehicle development in the eastern Massachusetts field, the Boston Edison company has lately purchased advertising space six columns wide and a foot high in the Boston dailies, and has made a special effort to point out that the electric vehicle means a quicker, cleaner Boston, bringing old friends together and putting the business man practically in two places at once. In a recent advertisement the company emphasized the fact that the electric vehicle stands first for city and suburban motoring, for the reasons that its possible speed is greater than would ever be required in such service; that its quick and simple handling in congested streets make it the ideal city car; that its appeal to women is undeniable in view of the absence of a chauffeur; through its facilities for comfortable transportation between home and office and to places of amusement, and on account of its continuous working powers without frequent repair-shop visits. The company admits the usefulness of the gasoline car for long-distance service, but points out that it indorses the electric vehicle for its own traffic requirements, as evidenced by the replacement of over fifty horses, buggies and gasoline cars with electric cars. When it is realized that the area to be covered extends from the Rhode Island state line as far north as New Hampshire, the purchase of these electric vehicles actually means that they have been proved capable of economically covering 550 sq. miles every day of the year. Actually, the replacement will affect over 150 horse-drawn vehicles and gasoline automobiles. The advertisement includes a drawing of a number of representative electric vehicles carried by Boston agencies operating in front of the Leif Ericson statue on Commonwealth Avenue. The company is maintaining a distinctly impartial attitude in its campaign, as regards different makes of vehicles.

Nebraska Electrical Association Convention.

The Nebraska Electrical Association held its fourth annual meeting April 24, 25 and 26 at the New Lindell Hotel, Lincoln, Neb. President B. C. Adams, general manager of the Lincoln Gas & Electric Light Company, called the first session to order about 11 a. m., and introduced Mr. George J. Woods, president of the Commercial Club of Lincoln, who said he was glad to welcome the Nebraska Electrical Association because its members were live wires and nearer chain lightning than any other convention members that came to Lincoln. He extended the courtesies of the Commercial Club rooms to the association while in the city. The reply to this address was made by Mr. H. A. Holdrege, of Omaha.

Secretary J. Bell, of David City (who was appointed by the executive committee to fill out the unexpired term of Mr. Frank McMaster, who left the State during the year), then presented in abstract the minutes of the last meeting of the association. The financial report showed a balance of $321.38 in the treasury and a generally prosperous condition. The secretary gave some of the details of the affiliation with the National Electric Light Association, which has had the effect of helping the Nebraska Association financially. The fiscal year of the association was changed to correspond with that of the National Electric Light Association. An auditing committee was appointed consisting of Messrs. George E. Shaberg, of Lincoln, and P. B. Egan, of Nebraska City. On motion of Mr. H. A. Holdrege the action of the executive committee in affiliating with the National Electric Light Association was approved. A nominating committee was then elected, consisting of Messrs. H. A. Holdrege, Patrick B. Egan and Crawford Kennedy, of Lincoln.

Secretary Bell, reporting on legislation, said that although many bills affecting electric-light companies had been proposed none had passed except a law providing for the punishment of persons tapping wires and stealing electricity. Mr. Holdrege, on behalf of the Omaha Electric Light & Power Company, invited the association to meet in Omaha next year.

Monday afternoon those in attendance were taken in automobiles by members of the Commercial Club of Lincoln for a ride around the city, ending at the Country Club.

The session on Tuesday began with a paper entitled "Coal Used in Nebraska," by Mr. R. E. Burger, of Fremont. He mentioned the points about coal which should be considered in its selection, such as cost of transportation, handling, ash, etc., and also touched on furnace design. Mr. Burger gave the general characteristics of the coals which are on the Nebraska market from surrounding states, and the results of certain tests showing Kansas coal to be the best. One general conclusion reached was that if coal giving the greatest number of heat units per dollar were purchased one would not be far astray

Mr. L. J. Schwingel, of Holdrege, Neb., led the discussion. Mr. F. H. Brooks, of Lincoln, emphasized the importance of having the furnace designed for the coal to be used. Mr Holdrege discouraged the use of some low-grade fuels. Various members then gave figures on coal used per kw-hour in their respective plants.

A paper on oil as a boiler fuel was given by Mr. T. O. Kennedy, of Lincoln. The author described the various precautions necessary in burning oil economically and safely. He also gave figures on the relative values of coal and oil as fuel in Nebraska plants. Mr. F. H. Brooks told of an installation of oil burners in his company's plant, and the reason for its use. There then followed a brief discussion on engines operating with crude oil.

A committee was appointed to consider the question of dues from manufacturers and supply men in the Nebraska association. This committee consisted of two central-station men and two supply men, as follows: Messrs. L. J. Schwingel and Joel Roberts, of York; G. A. Seabury, of Kansas City (General Electric Company), and S. G. Peticolas, of Omaha (Westinghouse Electric & Manufacturing Company).

Tuesday afternoon Prof. G. H. Morse, of the Nebraska State University, read a paper on electric-lighting by-products in which he discussed some of the possibilities of utilizing the equipment of an electric-light plant for other purposes during low-load periods. He discussed storage of various kinds, including heat storage for local consumers' use on the principle of the fireless cooker. Under the head of electrolytic by-products he considered the manufacture of bleaching liquor for laundries, fertilizing compounds, sterilizing water, ozonizing air, manufacture of hydrogen and oxygen gases, etc. His paper closed with a dissertation on the manufacture of ice as a by-product. This was discussed by Messrs. L. J. Schwingel, J. R. Cravath, of Chicago, G. A. Seabury, and others, most of the discussion being on ice manufacture and electric cooking with stored heat.

Mr. C. J. Snyder, of Omaha, read a paper on new business, describing some of the methods used at Omaha and the success attained in wiring old houses, of which 1227 were connected in 1910. In the discussion Mr. Charles C. Smith, of Exeter, gave some of the plans he had used in promoting business in a small town. The subject was also discussed by Messrs. J. G. Boyd, S. G. Peticolas and B. C. Adams.

Tuesday evening the Lincoln Gas & Electric Light Company and the Lincoln Traction Company gave a dinner to the association at the Lincoln Hotel. Mr. Crawford Kennedy, of the Lincoln Gas & Electric Light Company, acted as toastmaster, and a number of informal speeches were made.

Wednesday morning's session was opened with a paper on "Household Motors," by Mr. S. G. Peticolas. The paper was devoted chiefly to the general utility motor for various household purposes. Mr. J. E. Schuff, of Lincoln, led the discussion, which was taken part in by Messrs. B. C. Adams, E. V. Capps, of Beatrice; J. G. Boyd, of the Columbia Incandescent Lamp Company; S. F. Dibble, of the General Electric Company; A. L. Pond, of the Ft. Wayne Electric Works; F. H. Brooks and others. Whether this kind of business should be handled by the central station or turned over to supply dealers was also discussed in detail.

Mr. C. M. Axford, of the General Electric Company, Kansas City, Mo., prepared a paper on "Street Illumination," which was read in his absence by Mr. Hain, of the same company In it sign and outline lighting, which has been made more feasible for small towns than formerly by the tungsten lamps, was considered. Ornamental street lighting was also treated and the various arguments in favor of such lighting from the merchants' and citizens' standpoint were stated Mr Burger discouraged the ornamental street-lighting idea, and Messrs. Brooks and Schuff told of some Lincoln experiences with the ornamental-lighting system, which is not yet completed. Further ideas were advanced by Messrs. E. V. Capps, Joel Roberts, J. R. Cravath and C. C Smith. Mr. Schwingel gave some information on cement ornamental posts.

The committee appointed to consider manufacturers' dues in the association recommended that these be placed at $2.50 per representative in attendance at a convention and $10 maximum for any one company. This decision of the committee was accepted. The following officers were elected: President, Mr. H. A. Holdrege; vice-president, Mr. F. H. Brooks; secretary-treasurer, Mr. J. Bell; executive committee, Messrs. L. J. Schwingel, C. C. Smith and J. E. Schuff.

Vice-president-elect Brooks then spoke a few words of appreciation of the services of Retiring President B. C. Adams. The secretary was instructed to convey to the Commercial Club the appreciation of the association for courtesies extended.

Southwestern Electrical Association Convention.

The seventh annual convention of the Southwestern Electrical and Gas Association, held at Houston, Tex., April 27-29, was marked by a record attendance of the central-station men of Texas and Louisiana, more than 600 delegates, associates and visitors having registered at the convention hall. The meetings were held in the session room of the beautiful new Houston municipal Auditorium, the principal floor of which was given over to an electrical show, the first in the history of electrical development in the Southwest.

The convention was opened Thursday morning by President W. B. Tuttle, of San Antonio, and its delegates were welcomed to Houston by Mr. W. H. Wilson, city attorney, on behalf of Mayor H. B. Rice. Mr. James Dillon, of Houston, responded for the association. Twenty-nine new member companies were admitted to the association, and honorary membership was conferred upon Prof. F. C. Bolton, of College Station, and Mr. H. S. Cooper, of Galveston.

In his official address President Tuttle took occasion to remark upon the present favorable tendency toward publicity in corporation management. Heretofore, he said, the public has seen only the collection side of the corporation's business and has often neglected to consider the huge outlays for operation, maintenance and new construction. It fails to realize, for example, that a corporation often puts back into a community more than its net earnings during the same year, while the coming of the company's service may greatly increase real-estate values and improve the healthful conditions of the homes it reaches. Although all other commodities have steadily risen in price, central-station service alone has decreased in cost, and the ride purchasable for a nickel has grown in value, satisfaction, speed and comfort from the horse car to the modern electric-railway car. Public-corporation managers, concluded Mr. Tuttle, are conducting "a square business in a square way," and the people are displaying willingness that the company should have the income which it rightly earns.

Mr. R. G. Soper, of Dallas, Tex., opened the regular program with a paper on the "Industrial Development of Fuel Gas," citing a number of commercial uses for such gas, and suggesting that gas solicitors adopt the tactics of electrical new-business salesmen in furthering the development of the fuel-gas business.

BOILER ECONOMY AND FLUE-GAS ANALYSIS.

At the afternoon session Mr. M. L. Hibbard, engineer for the San Antonio Gas & Electric Company, presented a paper on "Boiler Economy and the Application of Flue-Gas Analysis," showing the great savings in fuel burned which may sometimes be effected by intelligent use of the carbon-dioxide recorder Mr. Hibbard discussed the chemical relations for complete combustion for both coal and oil, and analyzed the plant conditions under which flue-gas tests and analyses might be expected to show a fuel saving above the expense incurred in making the tests. Examples in which flue-gas analysis effected substantial fuel savings were also cited in the paper. In discussing the subject Prof. A. C. Scott, of the University of Texas, recounted comparative tests of a Dutch-oven and chain-grate stoker furnace, using in each both lignite and high-grade fuels. The Dutch oven showed superior results using lignite of 8000 units to 9000 units fuel value, and attained a flue-gas content of 8 per cent CO_2 with hand firing, while the modern grate is much below this with the same low-grade fuel. Mr. F. G. Frost, of Houston, told of the results obtained there with oil burners, attaining a boiler efficiency of from 12 per cent to 14 per cent, beyond which the magnitude of other losses decreases the net input into the heating surface. Mr. H. S. Cooper, of Galveston, declared that the type of oil burner employed in reality affects the results less than the character of the draft and the spraying action of the fuel to be obtained.

RAILWAY RETURN CURRENTS.

Mr. E. E. Nelson, of the North Texas Traction Company, of Ft. Worth, next discussed the "Investigation and Care of Return Railway Circuits." Mr. Nelson's remarks were confined chiefly to bonding between rails. Many troubles in electric-railway operation, he declared, can be traced to poor bonding. The resistance of a steel rail in ohms, said Mr. Nelson, equals 0.6 divided by the weight of the rail in pounds per yard, and its carrying capacity, in equivalent circ. mils of copper cross-section, equals 16,000 multiplied by the weight of 36 in. of rail. For bond contact surfaces a current density of 100 amp per square inch is taken as good practice. A fishplate well bolted will carry easily 50 amp. Mr. Nelson gave some practical hints about the selection and installation of bonds, fishplates and other track equipment for electric-railway duty. The bonds must be flexible and free, so that they can move without damage with the "giving" of the rails. Mr. Nelson recommended the use of short bonds under the fishplates, where the copper is protected from thieves. In drilling holes for bonds he warned against getting oil or other lubricant on the contact surfaces. Where there is large leakage of current from the rail to the ground the base of the rail is more rapidly destroyed than the tread, especially in case the ties have been impregnated with preservative salts, such as chloride of zinc. Bond resistances are usually expressed in terms of equivalent rail lengths. He said that a No. 0000 bond on a 70-lb. rail in good condition will show a resistance equal to that of from 1 ft. to 2 ft. of rail.

In the discussion which followed Mr. M. L. Hibbard, of San Antonio, told of usng a city arc circuit for conducting voltage-drop tests in a street-railway system, the lamps being lowered from their brackets as for trimming, and contact made with their wires through test jumpers. At the station the two sides of the arc circuit were linked through a voltmeter. Mr. H. S. Cooper pointed out that the leakage from a return conductor to the surrounding earth is a function of its potential difference from the surrounding medium rather than inversely as its carrying capacity, as might be intimated. Mr. W. L. Wood, of Texarkana, suggested the application of solder with a blow torch around bond terminals, sealing the contact against the entrance of moisture. Objections to this method were raised by Mr. Nelson, who pointed out the disadvantages of heating the bonded joint after completion.

STEAM CONSUMPTION OF WATER-GAS PLANTS.

A paper on the steam consumption of moderate-sized water-gas plants by Mr. L. B. Moorhouse, of San Antonio, was of interest to central-station men who take advantage of the combined boiler operation of water-gas and electric plants. A water-gas plant producing 1,000,000 cu. ft. of gas per day, said Mr. Moorhouse, would need 1500 lb. of steam per hour for the generators, or about 45.5 boiler-hp, 38.6 hp for the blower, 19.7 hp for the exhauster, and about 14.5 hp for the pumps. Allowing for leakage and radiation, the total boiler-hp required would be at least 125. The presence of water in steam going to the generator will decrease the efficiency of the gas-making process. Of course, several of the auxiliary uses for steam in the above plant might be replaced to advantage by electric motors, improving the efficiency above that of small steam engines and providing motor loads for the electrical end of the combination plant.

QUESTION BOX.

One of the characteristic features of the Southwestern convention of great value to operating men is the "Question Box," under the editorship of Dr. A. C. Scott, professor of electrical engineering at the University of Texas. This year 217 electrical questions have been answered, in many instances by several companies, and all the replies arranged in printed form in the handsome 110-page souvenir program issued by the association. Special interest is evidenced in electric meters, nearly sixty questions having been propounded on this subject. On Thursday afternoon a brief discussion of several unanswered queries in the Question Box brought up the subject of boiler compounds and water purification. Mr. J. E. Carroll, of Beaumont, declared that in his experience the design of a boiler often affects the deposit of scale more than the water used, a properly constructed boiler depositing the scale where it can be removed in the process of blowing off. Mr. M. L. Wood, of Texarkana, said that he had found feed-water heaters of little or no service in removing scale-forming ingredients from feed water. Mr. W. B. Tuttle, of San Antonio, said that even a small plant having trouble with boiler scaling might benefit from the installation of a water-purifying apparatus. The comparative advantages of surface and barometric condensers under different conditions of service and water supply were then discussed by Messrs. E. L. White and C. C. Douglass.

ACCIDENT PREVENTION.

Beginning the Friday morning session, "The Cause and Prevention of Accidents" was the subject of a paper by Mr. C. W. Kellogg, Jr., manager of the Texas securities department of Stone & Webster. Mr. Kellogg spoke of the large percentage of gross earnings frequently paid out by public-service companies to settle accident claims, citing an electric-railway case where the proportion reached the high total of 19 per cent. Damages arising from accidents have been especially expensive in Texas. All street-railway accidents, said the speaker, may be traced to the failure or unexpected behavior of either equipment or the human element, the majority being step accidents of the latter kind, as shown by detailed reports which Mr. Kellogg submitted. Open cars, for example, have 59 per cent more accidents than prepayment cars. Types and positions for fenders, gongs, motormen's step-mirrors and other safety devices were also discussed. Mr. Kellogg denominated as fallacies the notions that new men are more likely accident breeders than old employees, and declared that street-car train men in general are possessed of a good order of intelligence. Tables which he produced showed that while the minimum of accidents per trainman is attained in the first month, and not again until the sixth year of service, the majority of accidents happen during the period between the seventh and twelfth month. Instruction for trainmen and minor attentions to their comfort were recommended as increasing the satisfaction and loyalty of employees. Means of attracting the public's attention to safety measures and precautions were also touched upon. In discussing accidents on lighting-company lines, more of which in Texas, said Mr. Kellogg, result fatally than in the case of the street railways there, the speaker advocated better maintenance and inspection and the adoption of safety precautions, such as arc-lamp cut-out hangers, wider pole-pin separation on cross-arms, grounding of transformer secondaries, etc. Mr. Kellogg also urged against too light a regard for the dangers of live 2200-volt alternating-current distribution wires. In the discussion which followed points of railway-accident prevention and defense were brought up by Messrs. T. C. Brown, of San Antonio; W. L. Wood, of Texarkana, and E. D. Kelly, of Terrell. Mr. J. A. Walker spoke of the difficulties sometimes experienced in grounding secondaries effectively in the dry climate of parts of Texas, and Mr. G. H. Cushing, of San Antonio, reported good results with galvanized-pipe grounds driven alongside the pole, the butt of which, he said, naturally holds moisture. Such grounds are invariably able to blow a 3-amp fuse on 110 volts even in his dry climate, which he takes as a good standard of grounded connection.

DEVELOPMENT OF THE MOTOR-SERVICE BUSINESS.

In a paper on the development of motor-service business Mr. P. A. Rogers, commercial agent for the Dallas Electric Light & Power Company, pointed out that the small motor customer using up to 25 hp exists in by far the greatest number and, although usually technically unqualified to make his own selection of apparatus, his load is in the aggregate important and desirable business for the central station. Mr. Rogers referred to newspaper advertising as a means of reaching this class, but declared the only effective method to be personal solicitation, applying skilled salesmanship and electrical knowledge to the customer's problems. The author recommended that the solicitor make his study of the conditions and determine their solution before submitting any proposition to the customer. Such a proposition should be stated in the simplest form possible avoiding leaving the selection from a number of proposals to the customer, who may become confused and choose equipment not to his own best interests. While Mr. Rogers laid out no detail of procedure for working up motor-installation cases he urged personal solicitation and education of the prospective customer as the most important requirement in building up a motor-service business. In the discussion which followed the subject of motor drive of cotton gins as a desirable central-station load was brought up by Messrs W. A. Guthrie, of San Angelo; E. D. Kelly, of Terrell; C. H Cushman, of San Antonio, and C. W. Kellogg.

With Dr. Scott presiding, the Question Box discussion was again opened on the subject of producer plants, particularly those using Texas lignite as fuel. While several manufacturers have withdrawn their apparatus and certain plants have ripped out lignite producers or are now using bituminous fuel, several operators who have had from three to four years' experience with lignite producers expressed themselves as thoroughly satisfied with this form of motive power, declaring it to be, in their estimation, the future form of power for the Southwestern States, where great deposits of lignite are available at low cost

Mr. John I. Beggs, formerly president and general manager of the Milwaukee Electric Railway & Lighting Company, who was a visitor to Houston Friday afternoon, was invited to address the convention. Mr. Beggs spoke appreciatively of the responsibilities of public-utility corporation management, expressing the warmest interest in the work of the Southwestern association and the properties represented by it

LEIGHT-WEIGHT CAR CONSTRUCTION.

A paper on the construction and operation of light-weight cars in Houston, by Mr. R. T. Sullivan, superintendent of the local company, was read by Mr. David Daly, general manager of the company, in Mr. Sullivan's absence. Mr Sullivan's paper described the reduction in weight of 30 per cent attained by the new Houston cars weighing only 30,000 lb., which seat forty people. The economy effected by this decrease in weight, wrote the author, is also felt in power-plant investment, power consumption, maintenance of equipment and rolling-stock investment Mr Sullivan's paper considered briefly the determination of the proper size, weight and headway for cars operating under various conditions of service in the same city, and suggested that a double standard of equipment might be found best for the ideally operated city system. Mr. R. B. Stichter, general manager of the Texas Traction Company, called attention to the great significance of the saving effected by weight reduction in the case of interurban cars having long daily runs where the energy saving would be expected to amount to [illegible] watt-hours per ton-mile, besides consequent reduction all along the line of investment, operation and maintenance

Mr. W. H. Riblet, superintendent of manufacture of the Houston Gas Company, closed the technical program on Friday afternoon with a paper on "Naphthaline," detailing the process of manufacture of illuminating gas at Houston.

ELECTION OF OFFICERS

On Saturday morning the nominating committee, consisting of Messrs. C. H. Dunbar, E. S. Fletcher, L. B. Moorehouse and Thomas Cook, proposed the following officers of the association for the ensuing year, their election being unanimously voted by the convention.

President, Mr. J. E Carroll, Beaumont: first vice-president, Mr. E T. Moore, Dallas: second vice-president, Mr. D. G. Fisher: fourth vice-president, Mr. H. M. Moore, Austin. Mr Dan G. Fisher, of Dallas, was re-elected secretary. The following were chosen members of the executive committee: Messrs. W. B. Head, Stephensville; W. B. Tuttle, San Antonio; J. B. Carroll, Beaumont; A. E. Judge, Tyler; E. D. Kelly, Terrell; G. H. Clifford, Ft. Worth; E. T. Moore, Dallas; D. G. Fisher, Dallas; W. L. Wood, Texarkana, and J. E. Johnson, Stamford.

CONVENTION HALL AND ELECTRICAL SHOW.

The convention was unusual in having for its headquarters and meeting place the large Auditorium Building. Besides the sessions and the electrical show in the same building, comfortable reception-rooms were arranged in the spacious lobbies, from which the general public was excluded. Although the local hotels were comfortably taxed by the presence of the convention, the association headquarters were maintained at the Auditorium Building. The streets leading to this structure were brightened by double festoons of electric lamps, and at several points in the city electric signs bade welcome to the delegates.

The electrical show, held under the auspices of the association, opened in the large main hall of the Auditorium on April 27 and continued until April 29, during the days of the convention. The exhibits at this, the first electrical exhibition of the kind in the Southwest, embraced domestic electrical appliances for the general public as well as equipment and supplies of interest to operating men. The decorative scheme included a huge star and crescent, 20 ft. in diameter, at the center of the ceiling, formed by the solid massing of several hundred frosted carbon lamps. From this centerpiece there depended in all directions streamers of similar frosted lamps. Local popular interest was keen in the electrical show, to which no admission was charged, and the exhibit space was thronged during the hours the doors were open. The electrical show arrangements were in charge of a local committee, of which Mr. M. B. Wheeler was chairman, the other members being Messrs. C. A. Newning, David Daly, Clarence George, A. J. Binz, J. S. Bonner, F. E. Ebersole, Lee Johnson, E. G. Pike, W. H. Chapman, G. C. Bradley, L. C. Dilzell and H. W. Bates.

ENTERTAINMENT.

The entertainment committee wisely adopted the plan of arranging its recreation features following the principal sessions of the convention. A number of ladies visited Houston and were entertained on Thursday afternoon at the Country Club and in the evening at a reception at the Electrical Show. On Friday evening the Sons of Jove rejuvenation was held. On Saturday there was a boat trip down the Houston ship channel to the famous San Jacinto battleground, where a shore dinner was served. On Sunday the delegates visited Galveston over the line of the new interurban railway, inspecting the midway power house for the road and the great concrete causeway which will carry the cars across the waters of Galveston Bay. At Galveston automobiles were ready to take the party on a tour of the island.

Pacific Coast Meeting of the A. I. E. E.

The meeting of the American Institute of Electrical Engineers held in Los Angeles from Tuesday, April 25, to Friday, April 28, was highly successful. The attendance totalled 189 members and 134 guests. On the opening day the registration exceeded 200.

At the Tuesday morning session the meeting was called to order by Chairman J. E. Macdonald, of the Los Angeles Section, who introduced Mayor George Alexander. In welcoming the visitors to the metropolis of southern California, Mayor Alexander stated that the city would ultimately have available about 100,000 hp for distribution through its own system. The first paper on "Transmission Applied to Irrigation," by Messrs. O. H. Ensign and James M. Gaylord, of Los Angeles, was read by Mr. Ensign, followed by a paper on "Transmission Systems from the Operating Standpoint," by Mr. R. J. C. Wood, of Los Angeles. The discussion of the two papers was combined and was carried on by Messrs. A. H. Babcock, C. L. Cory, E. F. Scattergood, Paul M. Downing, Ralph Bennett, C. W. Koiner, L. J. Corbett, J. A. Lighthipe and Ralph D. Mershon.

TRANSMISSION APPLIED TO IRRIGATION.

In the paper by Messrs. Ensign and Gaylord the conditions leading to the use of transmitted energy for pumping in connection with irrigation projects were stated to be as follows: (1) In some cases high lands which cannot be reached by the diversion works constructed for a gravity system can be reached by pumping water from the gravity canals into canals feeding such high-land reservoirs. (2) The irrigated area may be advantageously extended by pumping from wells, thus drawing on underground sources and tending to keep the water plane down, this plan being particularly desirable in certain cases. (3) Pumping may also be applied to the drainage of low land, water being pumped to either irrigation or waste ditches.

The authors described two irrigation projects carried out by the United States Reclamation Service. One of these, known as the Minidoka project, involves a rock-filled dam with concrete core located near the foot of the rapids in the Snake River, and the other project is located on the Salt River, where a storage reservoir, diversion works and canals are constructed in connection with the well-known Roosevelt dam. The electrical generating equipment on the Snake River consists of five 1400-kva, three-phase, 60-cycle alternators directly connected to vertical-shaft turbines. The energy from this station is transmitted at 33,000 volts over a transmission line 22 miles in length to three pumping stations, each having a lift of 31 ft. Pumping station No. 1 contains five pumps, four for lifting 125 cu. ft. per second and one 75 cu. ft. per second. Station No. 2 contains four pumps, each designed for 125 cu. ft. per second. Station No. 3 contains three pumps, two for 125 cu. ft. per second and one for 75 cu. ft. per second. All of the motors for driving the pumps are of the vertical-shaft, self-starting synchronous type, designed for operation at 2200 volts. The rotors are provided with squirrel-cage windings to permit starting them as induction motors.

The estimated monthly cost of operating the pumping system, based on actual cost during the season of 1910 exclusive of ditch tending, amounted to 78 cents per acre per season. This estimate was based on a depth of 3 ft. of water during the year over an area of 50,000 acres.

The energy generated at the Roosevelt dam will be used in pumping to prevent the rise of ground water to a point dangerously near the surface, and to supplement by means of drawing on the underground supply the water stored in the reservoir and delivered by the natural flow of other streams. It is estimated that when finally completed there may be over 100 pumping plants similar to plants that are now installed on the Prima Indian reservation, where there are ten wells and pumping equipment costing about $105,000, which serve for irrigating about 10,000 acres of land.

THE OPERATION OF TRANSMISSION SYSTEMS.

In the paper by Mr. Wood the requirements for the successful operation of transmission systems were stated to include the following elements, namely: The requisite amount of power must be transmitted with reasonable voltage regulation, interruptions must be reduced to a minimum, flexibility of operation should be assured and ease of repair must be maintained. The author claimed that the permissible amount of regulation is determined not only by financial considerations, but by the conditions surrounding the transmission of energy, such as the interconnection of the stations at which the energy is produced. He stated that when a transmission line is part of an interconnected network and energy may be transmitted in either direction the voltage regulation must be low. In case energy is supplied to a transmission system from hydroelectric and steam plants located at opposite ends of the line, the transmission line should operate with only one-half the voltage regulation that would be permissible if it were a one-way transmission.

In discussing the reliability the author stated that in designing a transmission line it is best to base the calculations on the worst climatic conditions recorded over at least thirty years and to allow a factor of safety of 2.5. In designing switch installations abundant space should be provided around the galleries and busbar compartments. The lack of a few extra feet between switches may necessitate an entirely new building in case additions are made within a few years. The author expressed the opinion that in many large systems greater reliability could be obtained by dividing the system into several parts, limiting the amount of power to about 50,000 kw per part.

Discussion.

Prof. C. L. Cory in discussing the paper of Messrs. Ensign and Gaylord expressed his gratification at the apparent attainment of a standard in irrigation work which approximated that which prevailed in other branches of energy transmission. It was evident from the nature of the service, however, that more time would be required for acquiring a proper load and getting a proper financial return, due to the fact that the development of the agricultural resources would be comparatively slow. In New Mexico irrigation would not be required before February and the demand would not continue over five months out of the year. Mr. Corbett stated that in the Spokane districts the irrigation season was specified in most contracts as 100 days. He considered the plan for pumping out the surface water as a valuable feature in irrigation, as if the water was permitted to remain too long the soil became "sour."

In the discussion of Mr. Wood's paper Mr. Downing said that in the bay districts the lightning trouble was not so serious as the leakage due to deposits on the insulators causing flashovers.

Mr. Lighthipe, referring to early experience in transmission and distribution, said it was difficult to predict what would be required in the future as the area of distribution increased, but that a voltage of 150,000 might be reached.

ELECTRIC FURNACES.

"The Refining of Iron and Steel in Induction-Type Furnaces" was the title of a paper by Mr. C. F. Elwell, which in the absence of the author was read by Mr. C. W. Koiner. Mr. E. W. Paul, in discussing the paper, said that steel is now sold to comply with a specification requiring a chemical analysis of the product. In the Bessemer process this is a matter of guesswork, while the open-hearth process more nearly meets the conditions. The electrical process eliminates most of the phosphorus and appears to avoid the possibility of chilling a charge, which is an important advantage.

Mr. J. J. Frank said that in investigating an arc furnace he had found that one of the chief difficulties is in handling the electrodes. These are 8 in. x 24 in. in size, and in case of breakage the carbon falling into the mass adds to the impurity of the metal. There is another type of induction furnace in which the primary winding is a copper tube which was cooled by water passing through it. Professor Sorenson was of the opinion that a special type of transformers would be required for a furnace of the type described. Mr. Budd Frankenfield did not consider the smelting project merely an off-peak proposition. It might be found desirable to build up an industry of this character to utilize the power from the Owens River aqueduct, rather than build an extensive network for the distribution of small amounts of power.

A mathematical paper by Mr. George A. Campbell, entitled "Cisoidal Oscillations," was abstracted by Professor Cory. Other papers presented were the following: "Continuity of Service in Transmission Systems," by Mr. M. T. Crawford; "Electricity in the Lumber Industry," by Mr. E. J. Barry; "A Power Diagram Indicator for High-Tension Circuits," by Prof. Harris J. Ryan; "New Automatic Telephone Equipment," by Mr. Charles S. Winton; "Auto-Manual Telephone Systems," by Mr. Edward E. Clement; "Some Recent Developments in Railway Telephony," by Mr. Gregory Brown. The papers were well discussed, the discussion on the telephone papers being particularly complete. Below are given brief abstracts of the papers by Messrs. Crawford and Barry.

CONTINUITY OF SERVICE IN TRANSMISSION SYSTEMS.

In his paper Mr. Crawford reported the results of a number of years of operation of the Snoqualmie Falls transmission system of the Seattle-Tacoma Power Company. Up to 1910 the generating station contained 12,000 kw in generators and 15,000 kw in step-up transformers, and during 1907, 1908 and 1909 the transmission line was operated at 30,000 volts. In December, 1909, the transmission emf was raised to 60,000 volts. In November, 1910, an additional generator rated at 8750 kw was installed, together with 7500 kw in transformers. The transmission line consists of several sections, a straightaway transmission from the generating station to Renton, with branches from this point to Seattle and Tacoma. From Snoqualmie Falls to Renton, over a distance of 20 miles, there are two pole lines. From Renton to Seattle, a distance of 13 miles, there are also two pole lines. From Renton to Tacoma there is a single-pole line having a length of 26 miles, and another having a length of 34 miles. An independent single-pole line extends from Snoqualmie Falls to Everett, a distance of 40 miles. Other short branch lines are in use, the total length of transmission being 172 miles. Three-phase transmission circuits are used throughout, with 7-ft. x 9-ft. spacing, and also 7-ft. equilateral triangular spacing. The wire from Snoqualmie Falls to Renton is No. 0000 seven-strand aluminum, from Renton to Seattle and Tacoma the wire is No. 00 seven-strand aluminum, and No. 4 solid copper wire is used on the other circuits. For 30,000-volt operation the insulator employed was of the triple petticoat porcelain type, 6 in. in diameter, placed on locust-wood pins impregnated with paraffine. For 60,000-volt operation the insulators are of the four-piece brown-porcelain type, mounted on malleable cast-iron pins. When operated at 30,000 volts use was made of multi-gap lightning arresters with series resistance. When the equipment was changed to 60,000 volts aluminum-cell electrolytic lightning arresters were installed at each end of each line.

During the latter part of 1907 considerable trouble was caused by the burning of wooden pins. The threaded tops of these pins, which had been in service for nearly seven years, were softened to pulp, apparently by the action of nitric acid formed from the air and moisture by leakage currents. After the injured pins were replaced by malleable-iron pins the system gave practically continuous service during the year 1909. Since the equipment was changed in 1909 for operation at 60,000 volts, there have been only two shut-downs out of twenty-three cases of trouble, thereby showing that the method of operation is equally successful at the increased voltage as at the lower voltage. During the years 1907, 1908, 1909 and 1910 the following service interruptions occurred: Ten due to defective line construction, failure of switches, insulators, etc.; six to failures in transformers; fourteen to malicious interference, blasting stumps, etc.; eighteen to winds, fires, floods, fogs, etc.; two to lightning; three to mistakes by employees, and thirteen unknown, the total being sixty-six. Of this total fourteen represented complete shut-downs, seven of which occurred during the half of 1909 when the system was run on one line during working hours in order to permit the reconstruction for higher voltage. During the other three and one-half years the average was two cases of shut-down per year.

ELECTRICITY IN THE LUMBER INDUSTRY.

An outline of the uses to which electricity is put in the mills of the Potlatch Lumber Company, at Potlatch and Elk River, Idaho, was given in the paper by Mr. Barry. The Potlatch mill, with an equipment capable of producing 750,000 ft. of lumber per day, is one of the largest in the West. The generating equipment at Elk River consists of one 800-kw, 600-volt, three-phase, 60-cycle turbo generator and a 500-kw unit of the same type. At Potlatch there is a 1500-hp Corliss engine belt-connected to a line shafting for the sawmill and a 1100-hp Corliss engine for driving the planing mill. The exhaust from the 1500-hp engine operates a low-pressure turbine, which drives an 800-kw, 60-cycle turbo-generator, which supplies energy for driving the machinery in a box factory, a blower on the saw-dust conveyer and the machinery in the machine shop, car shop and pump houses. It also supplies energy for lamps in the mill and town, and for operating a 200-hp motor in a local brick-making plant. Use is made of storage-battery locomotives for conveying the lumber from the sawmill to the dry kiln, and from the dry kiln to the planing mill.

Meeting of the Electric Vehicle Association of America.

The regular monthly meeting of the Electric Vehicle Association of America was held in the Engineering Societies Building, New York City, April 25, Mr. C. A. Littlefield presiding in the absence of President Blood and Vice-president Williams. The secretary announced that the present membership of the association is 181, and that an electric-vehicle parade will probably be held during the week beginning May 29, while the convention of the National Electric Light Association is in progress.

The paper of the evening was presented by Mr. R. L. Lanphier, of the Sangamo Electric Company, and was entitled "The Ampere-Hour Meter for Electric Vehicles." The author described the two types of ampere-hour meter built by his company for automobile service, both of which are familiar to our readers. The paper was discussed by Messrs. C. A. Littlefield, of the New York Edison Company; W. F. Kennedy, formerly of the Studebaker Automobile Company; G. E. Russell, of the General Electric Company; R. L. Lloyd, of the Philadelphia Electric Company; R. M. Lloyd, of the General Vehicle Company, and J. Bradshaw.

Mr. Bradshaw was of the opinion that the combination of an ampere-hour meter and the hydrometer would be an excellent means of keeping vehicle batteries in good condition. He said that there is still a field for some form of indicating hydrometer which will, in connection with an ampere-hour meter, make the storage battery much more serviceable than it is at present. He also stated that the ampere-hour meter was not serviceable for enormous ranges and that while the watt-hour meter was accurate to within thirty-five times its lowest range of rating, the ampere-hour meter was not.

Mr. Lloyd stated that the General Vehicle Company found when using the ampere-hour meter that if 8 per cent more charge was put in the battery than was taken out the batteries were kept in good condition. It is very easy to ascertain by means of the ampere-hour meter when the battery is fully charged. His company rates its batteries at 6 hours' discharge rate, and charges them at a 6½-hour rate.

Los Angeles Aqueduct Power Utilization.

Inasmuch as the recent charter amendments adopted in Los Angeles provide for the establishment of a bureau of electric service by the city, under the supervision of the Board of Public Service Commissioners, to develop and distribute electrical energy produced by the Los Angeles aqueduct now under construction, Mayor Alexander, of that city, urges the immediate organization of the bureau. The Mayor has addressed a letter to the public service commissioners in which he says that the work should be taken up at once. There are four principal points along the aqueduct at which electrical energy may be advantageously developed.

The first site mentioned is at San Francisquito No. 2, where a maximum of 32,000 hp may be developed. The cost of the plant, including the transmission to the city from this point, would be about $2,300,000, which would leave $1,200,000 of the authorized bond issue of $3,500,000 for the distributing system.

San Francisquito No. 1 is named as the second site. Here it is possible to develop a maximum of about 60,000 hp, and the cost of the plant would be about $3,300,000, leaving for the distributing system only $200,000.

At San Fernando about 9000 hp could be developed. The cost for a plant here would be $750,000, leaving for the distributing plant $2,750,000. However, it would be hardly practicable to erect a distributing plant, at the expense required, for the distribution of this comparatively small amount of energy.

The fourth site is at Haiwee, including Cottonwood Creek Nos. 1 and 2 and Division Creek. The amount of energy available is about 10,000 hp and the cost of the plant would be $1,500,000, leaving for the distributing system $2,000,000.

Mayor Alexander estimates that the cost of a complete distributing system for the city will be about $4,250,000. With complete development of the hydroelectric power at all points an auxiliary steam plant would not be necessary, but with only partial development $500,000 would probably be allowed for an auxiliary plant. The amount of electrical energy consumed in Los Angeles, exclusive of that for railway purposes, is about 20,000 hp. While disclaiming expert knowledge, the Mayor gives it as his opinion that the city should proceed with such partial development of the hydroelectric power of the aqueduct and the transmission of energy to the city as would provide for present needs and those of the immediate future, using the balance of the proceeds of the power bonds now voted toward building or acquiring a distributing system. If this plan is followed an additional bond issue of about $3,500,000 will be required, allowing about $500,000 for an auxiliary steam plant. The Mayor believes that the citizens would vote for the additional bond issue without hesitation. It is therefore urged that the electric service bureau be organized at once and proceed to formulate a plan for a complete distributing system, relying upon the people to back it up in the enterprise. Action on this matter was temporarily deferred until an opinion can be had from the city attorney defining the authority of the Board of Public Service Commissioners in the matter

Sample Machinery for Determining Electrical Equipment of Panama Locks.

The *Canal Record* of April 12 contains some interesting information about the placing of awards by the Isthmian Canal Commission for sample machines to be used in operating the Stoney gate valves and the cylindrical valves to be employed in the operation of the locks on the Panama Canal. These sample machines will be tested on the Isthmus under conditions approximating those of actual use, and upon the results of the tests will depend the awarding of the contracts for the whole quantity, which will cost about $905,000. Tenders for this machinery were opened on Sept. 16 last, but the bids for the principal items were so high that no awards were made. At the prices then offered the material now to be furnished would cost more than $1,400,000. New bids were opened on Feb. 25, and, including some from foreign manufacturers, twenty-two bids were received in response to the second advertisement. The difference in the prices offered is about $500,000.

The total number of Stoney gate-valve machines to be used in the locks is 114, while the number of cylindrical-valve machines required will be 118. Both types will be operated by electric motors, and, for the purpose of testing, sample motors have been purchased from the Allis-Chalmers Company, Westinghouse Electric & Manufacturing Company, General Electric Company (two on an alternative bid), and Allmänna Svenska Elektriska Aktiebolaget (General Electric Company of Sweden), the last award being conditional. Two sample motors have been purchased from each of the manufacturers named.

Two electric limit switches for the Stoney gate-valve machines and two for the cylindrical-valve machines are to be purchased from each of the following bidders: Cutler-Hammer Manufacturing Company, Westinghouse Electric & Manufacturing Company, General Electric Company, and Allmänna Svenska Elektriska Aktiebolaget. The total number of limit switches to be purchased under this contract is 144 for Stoney machines and 118 for cylindrical machines.

Electricity in Ice Plants.

Mr. Augustus C. Smith, sales engineer of the Cataract Power & Conduit Company, Buffalo, N. Y., read a paper on ice making in Chicago on April 26 at a joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers. In beginning his paper Mr. Smith pointed out that one of the problems to solve in applying electric energy to ice making is the question of using pure or distilled water. The question asked is: If it is necessary to boil the water, then why not produce live steam and operate steam-driven ammonia compressors, thereby getting power as a by-product at small cost? Another point to be considered in electrical operation is flexibility of speed control in the electric motor as compared with the steam-driven compressor. This consideration is more serious because in most cases the motor available for the central-station energy is of the alternating-current induction type.

Where pure water is obtainable the plate system of ice making has helped to solve the first of these problems by taking the water as received and applying proper systems of filtration and agitation. The author proceeded to describe a 100-ton electrically driven ice plant in Buffalo using the plate system (see also *Electrical World*, March 30, 1911). At first two-speed and three-speed induction motors were applied to ammonia compressors, but this arrangement, even with switching devices changing the poles of the motor and motor pulleys of different sizes, did not provide the flexibility of speed necessary. Finally the standard type of variable-speed induction motor was applied, having external resistance control and giving a flexibility of speed range for the compressor equal to that of the steam-driven compressor, but at the cost of less efficiency at reduced speeds. The power-factor, however, remains practically constant at all speeds. Therefore, in ice plants where during certain seasons of the year there is a wide difference in output and variable-speed motors are used better economy can be obtained by having two or more compressor units proportioned with relation to each other according to the local operating requirements.

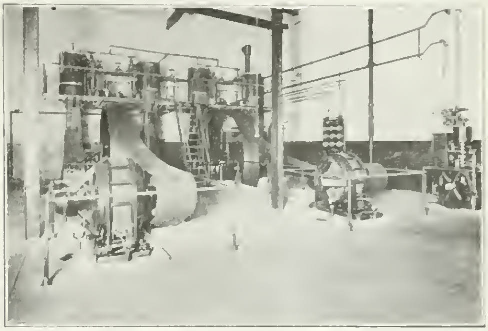
In the engine-room of the ice plant using the plate system, the compressor, rated at 100 tons output daily, is driven by a 200-hp, three-phase, 25-cycle, 2200-volt induction motor. The external resistance control in the secondary of the motor gives a range in speed in thirteen steps for normal to 50 per cent of normal. It is also possible to disconnect one side of the compressor, operating only the other side as a single engine, thereby increasing the flexibility of the plant. A 30-ton unit is now being added. The water in this plant is taken from the city supply, filtered and turned into the tanks, producing excellent, clear ice. During the process of freezing the water is constantly agitated by means of air, which is supplied by a small blower operated by a 7½-hp motor. In addition there are two water pumps, one brine pump, an ice saw, two tilting tables, an ice elevator and two cranes, each driven by a three-phase, 25-cycle, 440-volt induction motor, the sizes ranging from 2 hp to 7½ hp. The following figures show the production and energy consumption monthly for the year 1910 in this plant:

ENERGY CONSUMPTION OF AN ELECTRICALLY OPERATED 100-TON ICE PLANT USING THE PLATE SYSTEM.

1910.	TONS OF ICE.		Maximum Horsepower.	Horsepower-Hours.	Maximum Horsepower per Ton.	Horsepower-Hours per Ton.
	Month	Daily Average				
January.	......	....	...	10,314	...	...
February.	1,420	50.7	145	98.214	2.86	69.2
March.	1,400	45.2	153	105.845	3.38	75.6
April.	1,168	38.9	139	78,933	3.58	67.6
May.	1,786	57.6	138	101,798	2.40	57.0
June.	1,037	34.6	278	120,720	8.00	116.4
July	2,294	74.0	280	201,791	3.78	88.0
August.	1 800	58.1	290	209,200	4.98	116.2
September	2,244	74.8	283	198,157	3.78	88.3
October.	1,115	36.0	149	117,363	4.13	105.3
November	1,019	34.0	141	98,320	4.14	96.5
December.	1,356	43.7	139	104,398	3.19	77.0
	16,639			1,445,053	.	86.8

Considerable variation in results from month to month is shown in this table. This illustrates the necessity of a division of compressor units as previously suggested, and, indeed, this improvement is being arranged in this plant. It will be noted that the total annual production is 16,639 tons of ice, with an energy consumption of 1,445,053 hp-hours, equivalent to 86.8 hp-hours per ton of ice on the average during the year.

Mr. Smith also described a 100-ton can-system ice plant electrically operated and supplied with energy by the central-station company in Buffalo. In the can system the water is first distilled or evaporated, and in doing so it is customary to raise the water to high-pressure steam, using this steam for power purposes, and thereafter condensing it for ice after taking out the engine oils, dirt, etc. As the condensed steam from the plant machinery is never sufficient to supply all the water needed for ice, a considerable amount of live steam is also used. It would be considerably more expensive to operate a can-system plant by purchased electric energy and evaporate the water by the usual boiler method than by the operation of a steam plant where the necessary power is obtained as a by-product, the exhaust steam being used for making ice. To overcome this excessive cost when using purchased energy, supplementary distilling apparatus is used in connection with a comparatively small boiler equipment, so that for a given amount of fuel a considerably greater amount of distillate is obtained than by the usual boiler evaporation.



Engine-Room of 100-Ton Can-System Ice Plant Electrically Operated.

The boiler-room equipment of this can-system plant consists of two 85-hp horizontal tubular boilers with mechanical stokers.

The illustration shows the engine-room of this plant, where two vertical ammonia compressors are each belt-driven by a 175-hp, 500-r.p.m., three phase, 25-cycle, 2200-volt variable-speed induction motor. By means of the speed control of these motors the compressors can be operated at thirteen different speeds continuously; that is, from 72 r.p.m. to 11 r.p.m.

The controlling apparatus for this plant is arranged around the corner, where the primary incoming line panel is equipped with disconnecting switches and an automatic oil switch. From this panel the conductors are carried first to individual motor panels and thence to the motors. The resistance control, with its resistance, is connected through a drum controller to the rotor of the induction motor.

The efficiency of this type of motor is low at reduced speed, as the total energy input remains nearly constant for all speeds. It does, however, provide a flexibility of speed control practically equivalent to that of the steam-operated compressor, which is an essential item. During the four winter months only one compressor unit is operated. Varying conditions of operation indicate that the engine-room design of electrically driven ice plants should be given careful consideration, so that the compressor units may be so proportioned that the compressors can be operated singly or together at or near full rating, to suit the varying conditions of plant output throughout the year. This will permit the motors to be operated at or near their normal full speed, which is desirable. Of course, the engine-room design can be carried to such a degree of refinement that the first cost will overbalance the operating efficiencies. This must be guarded against.

In addition to the motor-driven ammonia compressors this can-system plant is equipped with two 20-kw, 2200-440-volt transformers supplying energy to motors driving four brine agitators, a condenser pump, a pumping-out machine, a soft-water pump, a water-softener mixer and two cranes.

The following table gives operating data in relation to this electrically operated 100-ton ice plant using the can system:

ENERGY CONSUMPTION OF AN ELECTRICALLY OPERATED 100-TON ICE PLANT USING THE CAN SYSTEM.

1910.	TONS OF ICE.		Maximum Horsepower.	Horsepower-Hours.	Maximum Horsepower per Ton.	Horsepower-Hours per Ton.
	Month.	Daily Average				
January	1,768	57.0	123	87,070	2.16	49.24
February	1,549	55.3	137	79,450	2.48	51.29
March	1,903	61.4	221	93,760	3.60	49.27
April	2,732	91.1	232	164,558	2.55	60.23
May	2,651	85.5	257	165,488	3.01	62.42
June	3,024	100.8	300	188,666	2.98	62.39
July	3,442	111.0	314	219,265	2.83	63.70
August	3,503	113.0	300	208,123	2.65	59.41
September	3,514	117.1	291	209,027	2.49	59.48
October	3,379	109.0	283	185,177	2.60	54.80
November	982	32.7	137	88,070	4.19	89.68
December	1,853	59.8	129	93,914	2.16	50.68
	30,300	....	...	1,772,568	....	58.50

From these figures it will be seen that the total annual production is 30,300 tons of ice with an energy consumption of 1,772,568 hp-hours, equivalent to 58.5 hp-hours per ton of ice average for the year, with a maximum of 63.7 in July and a minimum of 49.24 in January (excluding November from consideration).

A comparison of the cost of producing 100 tons of ice in twenty-four hours by a steam-operated plant, based on a boiler evaporation of 8:1 and a coal cost of $2.50 a ton delivered, with the daily evaporation of 250,000 lb. of water, demonstrates that electricity can be applied successfully to commercial plants, especially on a large scale. The author pointed out that the question of relative cost of production between a plant operated by purchased electric energy and one run by steam rests entirely with the rate at which electric energy is obtainable. In Buffalo, of course, where electric energy obtained from the great water-power plants at Niagara Falls is distributed, the rates are low.

Electricity applied to ice plants offers the same advantages over steam as in other industrial plants. There is no question as to the quality and purity of the product, whereas in steam plants there is always the uncertainty of contamination from engine oils, grease, dirt, etc. The operating cost of the electric plant should be compared rightfully with that of a steam plant which will give the same guarantee of purity of production. Again, with the application of electricity to ice making and the elimination of coal, all the troubles and annoyances incident to the use of coal, such as provision for storage space, handling facilities, etc., are done away with. These all have their influence on plant location. This question of possible plant location is important, as in the future in large cities it is probable that a number of comparatively small ice-making plants will be located each with respect to the territory to be served, as opposed to large-sized producing plants with distributing stations.

Mr. Smith remarked in relation to the plant using the plate system that there had been some troubles in operating the plant owing to conditions encountered and that the results obtained would be better under proper conditions. He also said that this class of business—that is, commercial ice making by central-station energy—is most desirable from a central-station viewpoint. On the basis of the monthly maximum demand, the load-factor of the plants described ranged from 86 per cent to 99.7 per cent, with an average of 89.3 per cent. Considering the load-factor for the whole year, however, the average load-factor was 65 per cent.

Discussion.

Mr. G. T. Seely presided at the meeting, and in opening the discussion remarked that in Chicago to utilize the central-station energy it would be necessary, apparently, to make raw-water ice, although the people have been educated to the use of distilled-water ice for the artificial product, and it seems doubtful whether electricity can be supplied from a steam-driven central station at a price enabling it to be used to make ice from distilled water.

Mr. E. W. Lloyd, general contract agent of the Commonwealth Edison Company, emphasized the fact that it takes less than 50 kw-hours to make a ton of ice. The central stations are looking for summer load, and the ice plants supply it. In Chicago two ice manufacturers are about to start up, with plants in which electrical energy will be used to manufacture raw-water ice. They seem to have some secret process by which clear raw-water ice may be produced. Mr. Lloyd believes that the value of distilled-water ice has been greatly exaggerated and that much ice is sold under this name which is really raw-water ice. He thinks the latter is the coming thing in the artificial-ice business and that it will prove satisfactory to the public. As to the price of electricity in making ice, the speaker thinks that ice can be made at a handsome profit to the manufacturer with electricity supplied from steam-driven central stations. Ice plants are ideal for the new off-peak rate of the local electric-service company. This rate provides for an annual charge of $15 per kw-year, plus possibly 0.4 cent per kw-hour for energy under the conditions that obtain in ice making. This particular rate is made with the provision that the consumer refrain from using electricity in the months of December, January and February between the hours of 4 p. m. and 8 p. m.

Mr. W. B. Jackson commented on the fact that the load-factor in the Buffalo plants was reduced from 89 per cent on the monthly basis to 65 per cent when figured annually. This was owing to the heavy demand in summer months and was a very good fault.

Mr. Smith said that there are two raw-ice methods. One is called the cell system, in which the water is frozen in tanks without tops or bottoms. This system is arranged so that the impurities rise to the top of the cake of ice in the can and are cut off. There is also the so-called "center-freeze" system, which is a straight-can system with separate means for freezing a core in the center of the can, by this means removing the impurities at the center. Manufacturers of raw-ice systems should have the co-operation of central-station men. The field is very large and important.

Mr. H. E. Niesz, general manager of the Cosmopolitan Electric Company, after remarking on the desirability of ice-making load for central stations, said that the difficulty seems to relate to the character of the product. The ice makers say that the public wants distilled-water ice, and therefore they install steam-driven compressors, because they have to have distilled water. If the public can be educated to use raw-water ice it will not be difficult to get the makers to purchase electrical energy at commercial rates from steam-driven central stations. Or, as an alternative, if a way could be devised to distil water very cheaply the manufacturers could afford to do this and still buy electricity. The situation appears to be that a cheap method of distilling water must be devised, or the public must be educated to use raw-water ice.

Mr. Fay Woodmansee said that the central-station men might bend their energies to operating small refrigerating plants on customers' premises. He also suggested that the central station might sell water from steam-turbine condensers to ice companies.

Mr. Smith thought that in the long run the business of the ice manufacturers would be more valuable to the central station than that of the small consumers.

Mr. W. L. Abbott, chief operating engineer Commonwealth

Edison Company, told of the practical difficulties in the way of utilizing water from steam-turbine condensers for making ice. The first is the lack of space for the apparatus used in the making, handling and storage of the ice; second, the process would take from the steam turbine one of its great advantages, which is returning pure distilled water for use in the boilers. Mr. Abbott referred to the economical size of ice-making plants. These plants should be of such a size that the product can find a market within easy teaming distance—say, a radius of two miles. This means about a 150-ton plant, and this consideration is in favor of the use of electrical energy.

Prof. P. B. Woodworth, of Lewis Institute, corroborated Mr. Lloyd in saying that a great deal of alleged distilled-water ice is really raw-water ice. Electrical men should assist in the education campaign for the use of raw-water ice. Lewis Institute will be glad to make analyses of ice to determine the number of bacteria or other harmful contents.

Other speakers made the point that what the people want is clear ice; they do not care particularly whether it is made from distilled or raw water. There is no particular prejudice in favor of distilled-water ice, but the appearance of the ice is very important. Mr. George H. Jones, Commonwealth Edison Company, said one of the best hotels in Chicago makes all of its ice from raw water. Mr. Smith remarked that the ice used in hotels, even high-class hotels, is often not of a character that private consumers would accept.

Mr. F. F. Fowle asked why cold-storage warehouses could not be economically taken on as a central-station proposition. He also spoke of the benefits to be derived by combinations of public utilities in small cities. For instance, water-works pumping is almost on a parallel with ice making as a summer load. The public utility company in a small city may well distribute electricity, gas, water and ice. Messrs. Paul P. Bird, J. H. Delany and George H. Lukes also spoke briefly.

Valuation of Consolidated Public-Service Corporations.

The interesting resolution of Alderman Pringle introduced in the Chicago City Council on March 6 (*Electrical World*, March 23, 1911, page 716), intended to prevent duplication in valuation, for rate computation, where public-service corporations are combined, has not been adopted by the aldermen. At the last meeting of the retiring City Council, on April 17, Alderman Pringle moved the adoption of the resolution (reported favorably by the committee on gas, oil and electric light), but after debate consideration of the report was deferred. According to the resolution, if adopted, it will be "the sense of this Council that in all consolidations and combinations of public-service corporations in this city the construction account of the purchasing company shall be charged only with the cost of the property actually used by and useful to the purchasing company in the furnishing of the service involved."

Stealing Electricity by Cable Tapping.

In its vigorous campaign against electricity thieves under the Missouri law of 1909 the Union Electric Light & Power Company of St Louis has encountered some ingenious expedients to obtain electrical energy without paying for it. Often a "jumper" was used to by-pass the meter, but the proprietor of a rooming house on Seventh Street adopted a different method. In this case service had been given in proper form to electric fans during the summer. At the end of the heated term the proprietor informed the Union company that he would have no further need of electricity and it was turned off, but the secret service men of the company, passing the place some time later, observed that the electric lamps were on in broad daylight Knowing that the central station had no agreement with the proprietor to furnish electricity, they went to police headquarters and got a detective to accompany them to the rooming house. The detective asked the proprietor what kind of light he was using and was told "just gas and coal-oil lamps." The detective then presented the electrical men and stated that they wanted to go upstairs and trace some wires. As they proceeded the wife of the proprietor attempted to block the way. The detective, however, opened a door in spite of her and disclosed the electric lamps in use. The proprietor had tapped the cable after the removal of the meter and was able to feed incandescent lamps all over the house without cost to himself. In this case the defense was that the proprietor had no knowledge of electric lamps in the rooms upstairs. Judge Calvin N. Miller took the view that the case clearly came within the meaning of the new statute. He imposed a fine of $100. This is considered one of the most important cases made under the law.

Amended Public Utility Law of New Jersey.

The new public utilities law passed by the New Jersey Legislature at its closing session went into effect on May 1 and makes changes of great importance in the policy of that State respecting public-service corporations. It gives the commission the rate-making power and the right to make appraisals.

The present board is to constitute the commission until the expiration of the term of office of each commissioner, when a successor is to be appointed for six years in each case. The commissioners are not to be under thirty years of age and may be removed by the Governor for neglect of duty or misconduct in office. They are to have salaries of $7,500 annually, whereas the old law provided for salaries of $6,000. No commissioner or employee shall have any connection with or hold any securities in any public utility operating within the State, or hold any other position of profit or trust under the government of the State or of the United States. The total expenses, including salaries, shall not exceed $100,000 per annum. The previous law limited the annual expenditure to $50,000.

The board shall have general supervision and regulation of all public utilities. Public utility is defined to include substantially every plant or equipment for public use under privileges granted by the State or any political subdivision thereof. The board is given power to investigate, upon its own initiative or upon complaint in writing, any matter concerning any public utility. The clause regarding valuation gives the board power to appraise from time to time the property of any public utility whenever in the judgment of the board it shall be necessary for the purpose of carrying out any of the provisions of the act. The board has power, after hearing upon notice by order in writing, to fix just and reasonable rates whenever it shall determine existing rates to be unjust, unreasonable, insufficient or unjustly discriminatory or preferential. Every public utility shall be required to file complete schedules of every classification and of every rate. Power is given to the board to fix just and reasonable standards and measurements. The board shall have power to fix adequate and serviceable standards for the measurement of quantity, quality or other conditions pertaining to the product or service rendered, and to prescribe reasonable regulations for the examination and tests of product or service. It also has power to establish reasonable rules and standards to secure the accuracy of meters and appliances for measurements and to provide for their examination and test

The board has power by its agents to enter upon any premises occupied by a public utility for the purpose of making examinations and tests and to set up on such premises any apparatus necessary therefor. It may fix the fees to be paid by any consumer for examination or test. The fee shall be repaid to the consumer if the appliance is found defective or inaccurate to the disadvantage of the consumer, and in that event shall be paid by the public utility.

Full power is given to the board to require safe, adequate and proper service and the maintenance of property and equipment in condition to enable such service to be furnished. Any reasonable extension of existing facilities may be required where in the judgment of the board it will furnish sufficient business to justify construction and maintenance, provided that the financial condition of the public utility reasonably warrants the original expenditure required.

A section of the law relating to accounting gives power to the board to require every utility to keep its records and accounts so as to afford intelligent understanding of the conduct of its business, and to that end to require every utility of the same class to adopt a uniform system. Public utilities may be required to furnish annually detailed reports of finances and operations in such form as may be prescribed. A definite provision for a depreciation account states that whenever in the judgment of the board it may reasonably be required every public utility may be directed to carry a proper and adequate depreciation account, in accordance with such rules as may be prescribed by the board. The board shall ascertain and after hearing fix by order proper and adequate rates of depreciation of the property of each public utility, and these rates shall be sufficient to provide the amount required, over and above the expense of maintenance, to keep such property in a state of efficiency corresponding to the progress of the industry. Every public utility shall conform its depreciation accounts to the rates so ascertained, and shall set aside the funds so stipulated out of earnings and carry them in a depreciation account. The income from investments in this fund shall likewise be carried in the account. The fund shall not be expended otherwise than for depreciations, improvements, new constructions, extensions or additions.

Notice of accidents may be required and the board may make such investigation and order with respect thereto as in its judgment may be just and reasonable.

When any public utility shall increase existing rates or change classification the board shall have power to determine whether the change is just and reasonable. The burden of proof shall be upon the public utility. Pending determination the change may be suspended for a period not exceeding three months. It shall, furthermore, be the duty of the board to approve any change when satisfied of its justice and reasonableness.

No public utility may make any unjust or unreasonable, unjustly discriminatory or unduly preferential rate, or adopt any unjust or unreasonable classification. No utility shall adopt or maintain any price or measurement which shall be unjust, unreasonable, unduly preferential, arbitrarily discriminatory or otherwise in violation of the law, or provide or maintain any service that is unsafe or inadequate, or withhold any service which it can reasonably be demanded to furnish when ordered by the board.

Securities payable in more than one year from the date shall not be issued until authority shall have been obtained first from the board. The board shall approve any such issue maturing in more than one year from date when it is satisfied that the issue is in accordance with law, and the purpose of the issue is approved by the board. The capitalization of any franchise to be a corporation is expressly forbidden. No utility shall capitalize any franchise in excess of the amount, exclusive of any tax or annual charge actually paid to the State or any political subdivision thereof, as a consideration of the franchise, or capitalize any contract for consolidation, merger or lease, or issue securities against any contract of this nature. These provisions shall not prevent the issue of securities, subject to the approval of the board, by any lawfully merged or consolidated public utilities not in violation of the law.

Discrimination, gratuity or free service to any local, municipal or county official is hereafter forbidden. Without the approval of the board no utility shall dispose of its property, franchises, privileges or rights, or merge either in whole or part with any other public utility. No public utility shall make upon its books any transfer of stock of any other public utility unless authorized by the board.

One unusual provision gives the board power to require every public utility to file a statement, verified by oath, giving the authority, powers and duties of every officer, director or head of department in such form as to disclose the source and origin of each administrative act or other action of the corporation.

No privilege or franchise hereafter granted by any political subdivision of the State shall be valid until approved by the board. When, after hearing, the board determines that the privilege is necessary and proper for the public convenience and to serve the public interests properly, the board shall have power to impose conditions as to construction, equipment, maintenance, service or operation. Every municipality operating any public-utility service shall keep the accounts thereof in the manner prescribed for the accounts of similar public utilities. Witnesses subpœnaed at the instance of parties other than the board shall not be entitled to compensation from the State for attendance or travel at the rates otherwise provided of $1 for each day's attendance and 3 cents for every mile of travel unless the board shall certify that their testimony was material to the matter investigated. If the person subpœnaed fails to obey the command without reasonable cause, or refuses without lawful cause to be examined, or produce a book or paper when ordered to do so by the board, application may be made by the board to the Supreme Court for an order directing such person to show cause why he should not comply. The court shall examine such person and order compliance. Any failure to obey this order may be punished by the court as a contempt. No person shall be excused from testifying or producing any record when ordered so to do by the board upon the ground that it would incriminate him, but no person shall be prosecuted for any act concerning which he shall have testified or produced documentary evidence under oath, except that no person so testifying shall be exempt from prosecution for any perjury committed in the testimony.

In default of compliance with any order the person or public utility affected shall be subject to a penalty of $100 per day for every day of continuance of the default. Any person who shall knowingly and wilfully do or join with others in causing any corporation to do or solicit, or knowingly and wilfully instruct any officer, agent or employee of any corporation to do, any act forbidden by the law shall be guilty of a misdemeanor. Similarly the neglect to do anything required by the law shall constitute a misdemeanor. Any public utility which shall perform any forbidden act or neglect to perform any required act shall be guilty of a misdemeanor.

Any order made by the board may be reviewed by certiorari or by petition to the Supreme Court of the State within thirty days. The Supreme Court shall have jurisdiction to set any order aside when it clearly appears that there is no evidence to support the order or that the board is without jurisdiction The allowance of a writ of certiorari or the institution of any proceedings for the review of an order shall not stay the order, unless the Supreme Court shall so direct.

Massachusetts Legislative News.

Attorney-General James M. Swift has sent in a report to the Massachusetts House of Representatives declaring that, in his opinion, a bill requiring street-railway companies to carry free on their passenger cars United States letter carriers in uniform would be unconstitutional. The opinion points out that in 1901 Attorney-General Knowlton advised the Legislature that a bill requiring the transportation of letter carriers at a rate less than that collected for ordinary passengers was unconstitutional so far as the Boston Elevated Railway Company was concerned, and the present opinion holds that a general statute would be unconstitutional as applied to street-railway companies as a whole. The right of the Legislature to fix fares is undoubted, but it cannot under pretence of regulating fares and freights require a street-railway company to carry persons or property without reward. The rate fixed must be reasonable, and a requirement that any class of persons be carried free is not a reasonable or proper exercise of the distinctly rate-making power. The opinion also holds that such a course cannot be justified as an exercise of the usual police powers of the Legislature on the ground of promoting the safety, health or proper convenience of the phblic.

In a special message to the Senate and House of Representatives on April 26 Gov. Eugene N. Foss severely criticised the high cost of electric energy in the isolated plant serving the State House, in connection with an investigation of the cost of the general service of the capitol. At the instigation of the Governor Messrs. C. L. Harpham and H. L. Coe investigated the cost of administration in connection with the State House, and the latter found that the cost of energy per hp-year at the State House is $220 and that for average service in business concerns this cost is from $35 to $40 per hp-year. The Governor called attention to the fact that the investigation was conducted by an experienced engineer, and says further: "Under exceptional circumstances such privately supplied power, running twenty-four hours per day, might reach $85. Mr. Coe finds that this inefficiency extends even to the fire-room, where the average coal shoveled per man per eight-hour shift is 2.5 tons against at least 5 tons shoveled in good practice. * * * I believe that the sergeant-at-arms is not responsible for these excessive costs. The trouble is with the grossly unbusinesslike methods under which these different lines of work are intrusted to him." It is probable that the Governor's message will arouse still greater interest in the question of purchasing electricity from the Boston Edison company, which has been under protracted consideration in capitol circles during the present session.

Maryland Commission News.

The Maryland Public Service Commission has received a petition from the Susquehanna Transmission Company, of Maryland, requesting authority to issue $1,031,000 first-mortgage bonds at 5 per cent in order to meet the terms of an agreement entered into with the Pennsylvania Water & Power Company whereby the latter corporation agreed to supply the funds for the construction of the transmission company's lines, in return for which it was to receive bonds at $1,000 par value for $900, to the amount of the loans. The transmission company set forth in the petition that it had already been provided with funds by the Pennsylvania Water & Power Company to the amount of $928,237.02, with which it had practically completed the construction of its physical properties and now desires to deliver the bonds promised to its creditor.

The Hagerstown & Clear Spring Railway Company has petitioned the commission for the privilege of exercising its franchise. It is understood that construction work will begin on the road, and the request filed asks for the further privilege of issuing bonds and stock from the sale of which the money to carry on the work will be derived.

Mr. Joseph H. Jacobs has appealed to the commission to ascertain whether or not 10 cents can be charged for sending a telephone message through a hotel exchange when local messages are supposed to be handled at 5 cents each. Mr. Jacobs' complaint is directed against the Chesapeake & Potomac Telephone Company. He asserts that on April 19 he made a local call from the Hotel Kernan, for which he was forced to pay 10 cents, the message having passed through the exchange in the hostelry mentioned. He wants to know if the charge is legal. The complaint of Mr. Jacobs raises a point that is of considerable public interest. Several hotels charge 10 cents for putting local calls through their exchanges. It has generally been supposed that the extra 5 cents was added on by the hotels and that the telephone company received no benefit therefrom. Mr. Jacobs' complaint will determine this.

The Chesapeake & Potomac Telephone Company has filed a petition with the commission asking that an order be passed authorizing it to purchase the capital stock of the Western Maryland Telephone Company, of Allegany County. The entire capital stock of the Western Maryland Company amounts to $100,000, and the petition asserts that after negotiations looking to the mutual advantage of both telephone companies and the improvement of the telephone service to the public the Chesapeake & Potomac Company obtained a written option, dated April 11, 1911, for the purchase of all of the capital stock of the Western Maryland Company, which was signed by the voting trustees of the property. Under the terms of this option, which the commission is asked to approve, the Chesapeake & Potomac Telephone Company agrees to pay the holders of the Western Maryland Company's stock $40,000 in cash and $40,000 in the common stock of the American Telephone & Telegraph Company, being 400 shares at par value of $100 per share

Ohio Commission News.

The committee on railroads and telegraphs of the Ohio Senate has reported out the public utilities bill. Because of numerous amendments it differs materially from the draft passed by the House of Representatives recently. Physical valuation as a basis for determining rates was stricken out and the market value of stocks, with proper consideration for surplus, depreciation and other charges, is to be used in its stead. The bill also gives the proposed commission the right to prevent competition by forbidding the exercise of a new franchise granted by municipal councils.

Street and interurban railways, water transportation, union depot, freight line and equipment, sleeping car and express companies are classified as railroads under the amended bill and as such will be amenable to the present railroad laws. In addition, the commission will have control over the issue of stock and bonds, and its authority will be otherwise extended to a certain extent.

All other utility companies, such as telephone, electric light, telegraph, etc., come under the head of utilities and will be subject to the new bill. However, many of the stringent requirements have been eliminated with regard to these and such additions as have been made do not impose serious burdens.

The requirement that physical connection be established between telephone companies has been omitted, but the provision for joint use of conduits, poles, subways and other equipment was allowed to stand, so long as the capacity is not fully required by the owners. The Langdon provision for the establishment of units of measurement of service was replaced by the general provision that the commission may fix the details of reports to be made to it and use its own discretion as to fixing standards of measurement.

The section relating to stock control remains as fixed by the Langdon amendment in the House, with the exception of giving companies the right to issue stock and bonds for the reorganization or readjustment of indebtedness and capitalization. In the case of receiverships companies are exempted from stock control up to the limit of the old indebtedness and the securities issued for new capital. The commission has the right under the revised bill to withhold all information from the public if it sees fit. The House bill limited the time for which such information could be withheld to six months.

The commission shall have the right to pass upon a rate contract made with city councils, except in the case of street railways, but the company must give bond to safeguard the consumer when rates are called in question. The company must continue to furnish service under a new ordinance when ordered to do so by the commission. But the old provision permitting a receivership in case of violation of such orders is omitted. Council may compel the construction of extensions, subject to the consent of property owners.

Although the bill does not take away the right of municipal councils to grant franchises, the commission may forbid the exercise of a grant if it deems that it is not a public necessity or convenience. In this way the commission may prevent competition, according to the friends of the House bill.

Under the rewritten section relating to consolidations, utility companies may take this step on consent of the commission, but will not be allowed to increase rates or capitalization until so permitted by the commission. It permits one company to purchase the business and franchises of another or to lease or purchase stock control, the latter being forbidden in the House bill.

The provision limiting the ownership of stock of one corporation by another to 25 per cent was eliminated and orders of the commision may be enjoined and carried through all the courts. The original bill permitted a review of such orders by the Common Pleas Court, but legal proceedings could go no further.

As the vote for the bill in the House in its more rigid form was very large, there is some question as to its concurring in the changes reported by the Senate committee, but there is a well-grounded belief that it will go through the Senate without trouble. Some complaint has been made to the effect that the bill, as it now stands, is for the purpose of permitting the consolidation of telephone companies and that its friends expect no other decisive results from it. The state railroad commission is made the public utility commission by it.

Massachusetts Commission News.

The Massachusetts Railroad and the Boston Transit Commission, sitting as a joint board, sent a report to the Legislature on May 1 recommending the abandonment of the plans for building the so-called Riverbank subway in Boston and the construction of a double-track subway in the Back Bay from the intersection of Commonwealth Avenue and Beacon Street to the present Park Street station. The estimated cost of the Boylston Street subway, which would be about 2 miles long, is $4,700,000, or about $1,000,000 more than the Riverbank estimate. If the new subway is built, which appears probable, it will provide a rapid transit electric route from the business district of Boston to the Allston, Brighton, Waltham, Watertown and Newton suburban municipalities, and it will form a symmetrical addition to the group of radial high-speed trunk lines which are peculiarly efficient under the Boston conditions.

CURRENT NEWS AND NOTES.

Rate Ordinance in Toledo.—At its last regular meeting the city council of Toledo, Ohio, passed an ordinance fixing the rate for electric lighting at 8 cents per kw-hour. with a discount of one cent, if the bills are paid within ten days. The minimum charge is reduced from the present figure of $1 to 50 cents a month.

Overruling of Low Telephone Rates.—By making permanent an injunction to restrain the city of Louisville, Ky., from putting into effect telephone rates providing for a maximum charge for business service of $66 a year the Federal Court in that city has upheld the Cumberland Telephone & Telegraph Company in its long fight with the city. The existing rate for business instruments is $90 a year, and the court sustained the contention of the company that the proposed rate would be confiscatory.

Serious Gasoline Explosion in St. Louis.—By an explosion of the fumes of gasoline from a railroad oil-tank car in St. Louis on April 22 seven persons were killed and six severely injured. The car is said to have contained 4000 gal. of gasoline and was not provided with a vent, apparently. Gas accumulated under pressure and escaped when the cap of the tank was removed. A fire in an adjacent watchman's shanty is believed to have caused the explosion, and almost immediately everything inflammable near the car was aflame. Four of the dead were members of one family in a nearby cottage. The chief inspector of the Fire Prevention Bureau of St. Louis speaks of the handling of gasoline as a great menace to life and property and deplores the fact that no ordinance exists in that city to regulate the handling and storage of this dangerous commodity.

Delay in Making Illinois Public-Service-Commission Law.—Seven bills proposing public-service commissions in Illinois were introduced at the present session of the Legislature in Springfield, but none of them will be adopted at this session. Both the Senate and the House voted on April 28 to refer the subject of commission regulation of public utilities to a joint commission of Senators and Representatives to report to the next General Assembly or to a special session of the present one.

Denial of Reported Merger of Kentucky Telephone Company.—In an interview at Toledo, Ohio, Mr. Edward H. Cady, president of the Central Home Telephone Company of Louisville, stated that there is absolutely nothing in the report of a contemplated merger of the Independent telephone interests of Kentucky. He says that no negotiations are under way to that end and none are contemplated. Mr. Cady is in position to speak on this matter because of his connection with the Louisville Company

Dissatisfaction of Chicago Aldermen with Hagenah Gas Report.—The elaborate investigation of the People's Gas Light & Coke Company, of Chicago, by Mr. William J. Hagenah, made for the Chicago City Council, has not been received with enthusiasm by the present Council committee on gas, oil and electric light. Politics is mixed up in the matter, the political complexion of the Council, and hence of the committee, having changed as the result of the spring election. A second expert may be selected to make a new report. Mr. Hagenah made an extended investigation and recommended a net rate of 77 cents. The new city administration has declared for 70-cent gas. The present rate is 85 cents.

Denial of Lamp Manufacturers of Allegations in Suit.—Answers have recently been filed to the suit brought in the United States Court at Cleveland, Ohio, by the following: Capital Electric Company, Denver, Col.; Franklin Electric Company, Hartford, Conn., and the Gilmore Electric Company, Boston. Each of them denies the charges in the petition and states that it is not guilty of disobeying the anti-trust laws. Rumors have been afloat in Cleveland to the effect that the government would be satisfied with an agreement offered by the companies involved in the suit whereby certain features deemed illegal by the Attorney-General's office will be eliminated. District Attorney Day of Cleveland, in an interview with a local paper, refused to discuss the matter in any way.

Meeting of Electric Vehicle Club.—The regular weekly electric vehicle luncheon given by the Boston Edison Company to further the development of the electric truck and pleasure automobile was held at the company's offices on April 26. About twenty representatives of electric vehicle manufacturers and allied interests were present and an association was formed under the name "Electric Vehicle Club," Mr. L. D. Gibbs, of the Boston Edison Company, being elected permanent secretary. A chairman will be chosen at each meeting. Various committee reports were received, including one upon the location of signs and their wording, and a report upon organization. An investigation is to be made of the rates for charging vehicle batteries in the eastern part of Massachusetts, although it is believed that the regular Edison rates work out fully as well as the special tariffs that have been and are being charged for the service. A committee on charging stations is to investigate conditions within 50 miles of Boston, making a list of such points, which will be printed for general distribution to vehicle users and other interested parties.

Fireproofing Electric-Car Wiring.—The Denver City Tramway Company, upon the recommendation of the Rocky Mountain Fire Underwriters' Association, is improving its car wiring by the use of flame-proof braids for fireproofing the car body in the neighborhood of cables and the like.

Conduit Wiring in Telephone Buildings.—On the recommendation of the Rocky Mountain Fire Underwriters' Association the Colorado Telephone Company is beginning the rewiring in conduit of all of its buildings in Colorado and New Mexico for all lighting and motor-service circuits.

Joint Engineering Meeting in Chicago.—The next joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers will be held at the rooms of the former on May 24. Mr. S. G. McMeen will read a paper on telephone work in San Francisco and vicinity.

Patents.—At a meeting of the American Society of Mechanical Engineers to be held in New York on May 9 the general subject for discussion will be patents. Among those who will discuss the subject are Messrs. E. W. Marshall, D. Howard Heywood and Edwin J. Prindle. The purpose of the meeting is to outline to the engineer and manufacturer the fundamental principles of the patent law.

Morbid Relic Hunters.—A transformer and distributing pole at one of the principal street intersections of a Southern city which was utilized by a mob in a recent lynching has been so chopped and hacked by relic hunters as actually to weaken the structure, making it necessary for the central-station company to sheath the pole for a height of 10 ft. with heavy galvanized iron to prevent further mutilation and weakening.

Ozone and the Fly.—One of the interesting claims made to further the use of electric ozone-making machines is that the use of ozone in deodorizing the air is of distinct value in the campaign to abolish the common house fly on the score of health. It is pointed out that the fly usually seeks the place where offensive odors are present, apparently attracted by the odor, and as ozone is a deodorant the ozone machine helps to make conditions unfavorable to the flies.

Central-Station Conference at University of Illinois.—A recent central-station conference held under the auspices of the department of electrical engineering of the University of Illinois, at Urban, Ill., was attended by about forty plant managers. It was held to establish closer relations between central-station men and the electrical engineering department of the university. Papers on various subjects of interest to operating men were read by Dean W. F. M. Goss, Prof. Ernst J. Berg, Prof. J. M. Bryant and Mr. R. Y. Williams.

Electric Vehicles at Dallas, Tex.—In Dallas, Tex., there are now in service about sixty-five electric vehicles, all of which are pleasure cars. The Dallas Electric Light & Power Company is arranging to install an electric truck in its own service to demonstrate locally the utility of battery-driven commercial cars. The city already has one exclusive electric garage, but the majority of the vehicles are stabled in private garages. The net charge for vehicle energy is 4.5 cents per kw-hour, with a minimum of $2 per month.

Proposed Ornamental Lighting Around Chicago City Hall.—The combined County Building and City Hall in Chicago occupy a full city block. It has been proposed to install a scheme of ornamental electric lighting, with handsome posts, about this imposing building, and Holabird & Roche, the architects, have prepared plans and specifications for such an installation, which is estimated to cost about $12,000. If the full scheme is carried out it will be necessary for the city and county to co-operate, but the county commissioners seem in no hurry to take action on the suggestion. The matter now rests with the finance committee of the City Council so far as the city is concerned.

Ohio State University Student Inspection Trip.—About 100 students of the departments of mechanical and electrical engineering of the Ohio State University, accompanied by four instructors, spent three days in Chicago, two days in Milwaukee and one day in Gary, Ind., on an inspection trip covering the week ended April 29. The university issued a special forty-eight-page bulletin descriptive of the establishments visited at each place. Each student was provided with a copy of this bulletin interleaved for use in note-taking. The inspection trip is part of the student's regular university work, and he is required to submit a written report, together with his original notes taken during the trip.

One Method of Encouraging the Use of Electricity.—Although at the same time tacitly admitting the shortcomings of municipal ownership, the progressive manager of a town plant in a conservative community wields a gentle club over his tardy prospective new customers by explaining to them that if they fail to use electricity to replace their oil lamps the tax rate will be raised to meet the deficit in the plant's operation, so that they will have to pay anyhow. Therefore, they might as well, he points out, benefit from the use of electricity. This kind of argument usually starts a stampede for service, and kerosene standpatters that could be reached in almost no other way soon become delighted electrical customers.

Block Lighting in Chicago.—Chicago has several so-called "block-lighting" electric plants doing a central-station business within an area included in a city block. Perhaps the largest of these is the Gunther Electric Company, which does business in the block bounded by West Adams Street, South State Street, Quincy Street and South Dearborn Street. On Dec. 31, 1909, according to the report of the city electrician this company was supplying electrical energy to 12,000 incandescent lamps, 200 arc lamps and motors having a rating of 380 hp. Recently the Chicago City Council passed an ordinance giving authority to this company to maintain and operate a vault under a portion of the surface of the alley in the block named. The ordinance was passed March 27, 1911, and will expire Dec. 17, 1919. During the life of the ordinance the company is to pay $183.48 a year for the privilege conferred. The vault in question is now constructed, and it is provided that the annual compensation shall date from Dec. 18, 1909.

New York Electrical Society Meeting.—At a meeting of the New York Electrical Society held on April 28 Mr. Frank A. Patterson described in outline the electrical equipment of the New York Public Library, which was designed in 1897. In the basement is located a generating station consisting of two 500-kw and two 200-kw, 250-volt direct-current generators for supplying energy to 700 hp in motors and about 20,000 carbon-filament incandescent lamps. All of the apparatus around the building is electrically driven. The building is equipped with a complete printery and bindery, every motion of which is operated by motors. The books are carried by electricity to their proper positions from the printery and bindery, after they have been repaired, likewise by electricity. The ventilators and book conveyers are all operated by motor. There is a complete fire-alarm system, with an automatic thermostatic fire alarm added to the manual alarm in the sections where the rare books and manuscripts are stored. As time is an essential element in a library, fine clocks, made synchronic electrically, have been set up wherever needed by the public and the attendants. There is also a fine electrical system of watchmen's clocks. The electric wiring is thoroughly fireproof, iron conduit being used throughout. A complete description of the wiring of the book stacks appeared in our issue dated Oct. 17, 1908.

Revenue from Electrical Inspection.—The Department of Electricity of the city of Chicago reports that the revenue received by the city from fees for electrical inspection in 1910 amounted to $131,798. The amount collected in 1906 was $64,845, showing a marked increase in four years.

Purchase Plan Abandoned in San Bernardino.—As a result of a report made by Mr. C. W. Koiner, chief engineer of the municipal electric light plant of Pasadena, the City Council of San Bernardino, Cal., has abandoned the idea of purchasing for municipal operation the local plant of the Lytle Creek Power Company. The price asked was $180,000, while the value fixed by the Koiner report was $98,886.

Proposed New York State Department of Electricity.—A bill has been introduced in the State Senate at Albany providing for the creation of a department of electricity for the State of New York. The measure aims at the consolidation of the jurisdiction pertaining to electrical supervision now in the hands of local authorities. It provides for a state commissioner of electricity at a salary of $5,000 a year, and carries an appropriation of $25,000.

Reduction of Rates in Ontario, Cal.—The City Council of Ontario, Cal., has instructed the city attorney to prepare an ordinance which will have the effect of reducing the rate for electrical energy from 13 cents to 11 cents a kw-hour. The monthly minimum of 90 cents will be unchanged. The Ontario Power Company asked, but unavailingly, that the present rate remain until Jan. 1, 1912, when it was promised that the reduction should be made.

Engineering Education.—The nineteenth annual meeting of the Society for the Promotion of Engineering Education will be held at Pittsburgh, Pa., on June 27, 28 and 29. The headquarters will be at the Carnegie Technical Schools. At the meeting special attention will be given to the reports of the committees on the teaching of mathematics to engineering students and entrance examinations for technical schools. The secretary of the society is Prof. H. H. Norris, Cornell University, Ithaca, N. Y.

Gas-Producer Experiments.—At the Experiment Station of the United States Bureau of Mines, Pittsburgh, Pa., several trial runs have been made with an experimental gas producer, using coke as fuel, with which limestone has been mixed in varying proportions, the purpose being to flux the ash and form a liquid slag, thus avoiding clinker and ash troubles and consequent shutdowns. Liquid slag has been readily made which runs freely from the producer. The high temperatures necessary are very efficient in the generation of gas.

Train Dispatching by Telephone.—According to a recently issued bulletin of the Interstate Commerce Commission, the use of the telephone in transmitting train orders continues to increase steadily. During the year 1910 there was an increase of 15,373 miles of railroad on which the telephone is used for this purpose. On Jan. 1, 1911, the telegraph was used for train dispatching on 175,211 miles of railroad in the United States and the telephone on 41,717 miles. The bulletin also shows that at the beginning of the year 71,969 miles of railroad in the United States were operated under the block-signal system, 17,711 miles of which were automatic.

Credit Where Credit Is Due.—In an article entitled "Modern Alternating-Current Coal Docks at Duluth, Minn.," in our first issue for April, certain of the statements relating to the extent of the coal-handling operations around the Duluth-Superior harbor were misleading in that to the former place was given whole credit for developments many of which should have been credited to the latter place. Of the whole number of coal docks around the harbor only one-third, and not the whole, are at Duluth, fourteen of the twenty-one coal docks being at Superior; moreover, the average amount of coal handled by a Superior dock is larger than that handled by a Duluth dock.

Reliability of Single-Phase Railway Service.—From reports of train operations in New York State during January, recently given out by the Public Service Commission, it appears that the New York, New Haven & Hartford made the best showing of all roads in the State, with 90 per cent of its trains on time. The report is especially interesting in view of the fact that the New Haven is extending its single-phase electrification to its Harlem division and another branch, and is reported as planning an extension to New Haven. It has been unofficially stated several times recently that the New York, New Haven & Hartford had practically no motive-power delays in handling the entire passenger traffic of its New York end by single-phase electric locomotives and multiple-unit trains, notwithstanding the necessity for changing from steam to electricity at Stamford.

Inviting Death as a Sign of Bravery.—The *Chicago Daily News* of April 10 tells the simple, pathetic story of the death of thirteen-year-old Stanley Ciesielski. "Early in the afternoon before the arc lamp at West Thirty-fifth Place and Gage Street was lighted Edward McMahon, thirteen years old, climbed a pole and hooked some bailing wire over the main feed wires leading to the lamp. After the current was turned on the boys dared each other to touch the wire. Stanley was the only one to accept the dare. Walking boldly to the wire he grasped it with both hands. The shock which he received threw him off his feet and a moment later his frightened playmates picked him up and carried him to his home. Dr. O. L. Mitchell, 3500 South Halstead Street, was called and pronounced him dead." The moral that parents and teachers should impress on children the danger of fooling with electric wires is obvious.

Independent Telephone Connection for Chicago.—By order of the court the Illinois Tunnel Company, controlling the automatic telephone system now nearing completion in Chicago, has been authorized to enter into contract with the Interstate Independent Telephone & Telegraph Company, joining the two systems for the interchange of business. The Interstate company is an Independent organization doing a telephone business in northern Illinois. Both companies are in the hands of receivers. The contract will give the automatic telephone people in Chicago direct connection with the large number of Independent telephone subscribers in Illinois and surrounding States. Heretofore the Independents have been unable to obtain connection with Chicago. The connections between the two systems will be made at the intersection of South Forty-sixth Avenue and West Twenty-second Street, on the western edge of the city, each of the companies having agreed to extend its lines to that point.

Extension of Street Lighting in Budapest.—In an article which was published in the *Electrical World* of Oct. 21, 1909, a description was given of the first trial street-lighting equipment installed by Mr. E. de Fodor as general manager of the Budapest General Electric Company. The results that have since that time been obtained show that with the flaming-arc lamp a street lighting can be obtained that is far ahead of all other kinds of artificial lighting in respect to even distribution and economy. The arc lamps in use there are of the 15-amp Alba type, and are connected three in series on a 110-volt circuit. The operating company has recently been authorized by the Municipal Council to extend the arc-lighting system in various important avenues. In addition to the 200 arc lamps already in use about 380 new lamps will be installed. It may be mentioned that last year the city bought out the gas company and has since been experimenting with "press gas," but the results have by no means proved as satisfactory as was anticipated.

GAS AND OIL-BURNING ICE-ELECTRIC PLANT AT MUSKOGEE.

Rapid Development of Electricity for Lighting, Motors, Etc., in a Twelve-Year-Old Oklahoma City.

MUSKOGEE, Okla., is one of the municipal phenomena of the Southwest. From a typical Indian village and frontier post fifteen years ago, the city increased 450 per cent in population between the census returns of 1900 and 1910, and to-day has a verified population of 28,000, with fine office buildings, hotels, banks, paved thoroughfares, street cars, residence sections, etc., that would be creditable to an older community of three times its size. A large factor in the growth of the city has, of course, been the local central-station company, which has kept step with the needs of the expanding municipality, in turn enjoying a development of its own business that has required the addition of one new generating unit after another to care for the increasing lighting and motor load.

Even more phenomenal than the increase in population of Muskogee has been, for example, the doubling of the local electric-lighting peak during the last year, increasing from 725 kw in 1910 to 1600 kw in 1911. The local central station also claims to have the greatest number of electric signs per capita—5.5 for each 1000 population—in any city in the country, all but twenty-nine of the 130 signs having been erected during the past twelve months. The day motor load has meanwhile increased to a gratifying degree, and a number of unusual installations are connected to the central-station company's lines. Characteristic of the Oklahoma country, the best is considered none too good for any purpose, consequently electricity receives many opportunities to demonstrate its utilities which might not be available in an older community.

The Muskogee Gas & Electric Company supplies alternating-current electrical service and also natural gas to consumers in the city, its local electrical generating station being one of the few plants in cities of over 25,000 in which ice manufacture is carried on in combination with the production of electricity. The central-station company also generates and supplies 550-volt direct-current energy for the local street-railway system. Part of its alternating-current output is transmitted at 6600 volts to Ft. Gibson, 10 miles distant, which is lighted from the Muskogee plant, the transmission line traversing a growing factory district on the way.

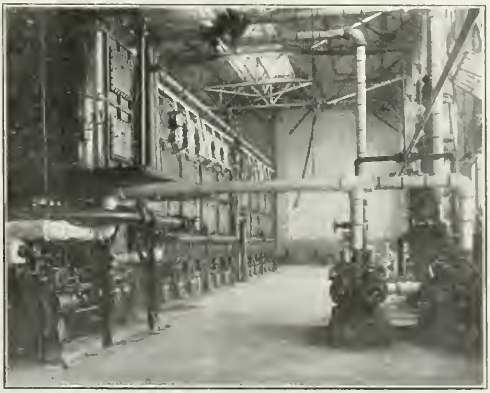


Fig. 1—Gas and Oil-Fired Boilers in Muskogee Generating Station.

As might be expected from the rapid development of the city, the Muskogee steam-power plant has been largely a growth by the successive addition of machinery and buildings to keep pace with the demand for its output. The plant building, including the engine-rooms, boilers, ammonia compressor room and ice tanks, occupies a floor space, roughly, 110 ft. x 250 ft. The new engine-room building is a steel structure, with brick walls. The other buildings are of brick.

GAS AND OIL-FIRED BOILERS.

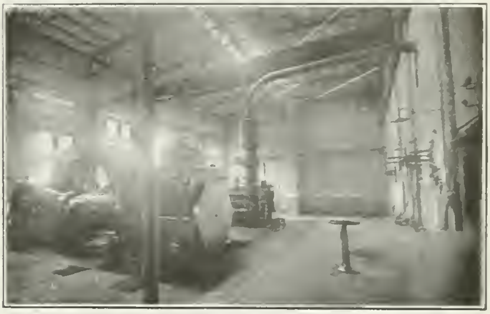


Fig. 2—1500-kw Cross-Compound Engine-Driven Alternator in New Engine-Room.

In the boiler-room, Fig. 1, natural gas from the Bartlesville field, 65 miles distant, is ordinarily employed as fuel, although for use in case of insufficient gas supply oil burners are provided beneath each boiler, fed from a large storage tank buried underground outside the plant. There are four 520-hp and two 250-hp Babcock & Wilcox boilers now installed, provision being made for additional settings. The 520-hp boilers have three fire-doors and the 250-hp unit two fire-doors. Each fire-door is arranged with five Kirkwood burners, a spiraled series of tubes in the mixing nozzle imparting a whirling motion to the mixture. An adjustable trapdoor on each burner enables the air supply to be regulated at will. Inside the setting, at a distance of about 6 ft. from the burners, the flames are broken up by a firebrick checkerwork structure. For the gas thus used under its steam boilers the Muskogee Gas & Electric Company would charge a similarly large user 5 cents per 1000 cu. ft. This gas has about 950 heat units per cubic foot. The natural pressure on some of the gas wells in the Bartlesville district reaches 800 lb. per square inch. The transmission pressure averages 200 lb., and at the city limits this is reduced and fed at 50-lb. pressure into a 12-in. main which encircles the city. High-pressure lines brought in from this main convey the gas to the power plant, where a final regulating valve holds the pressure on the 8-in. burner header at from 6 oz. to 8 oz. per square inch. The quantity of gas used is measured by a proportional-flow meter. All regulation of the header pressure on the burners is done by hand. The flue gases from the furnaces are led to a 200-ft. concrete stack, 14 ft. in diameter.

The emergency oil fuel for use in the special burners under the boilers is stored in a 30,000-gal. tank, ventilated by a flue and buried in concrete below the ground level just west of the boiler-room. A steam-driven pump delivers this oil at 30-lb. pressure to the burners, where it is mixed with steam issuing from a jet under about the same pressure obtained by reducing valves.

GENERATOR EQUIPMENT.

The new engine-room building is a steel-frame structure approximately 213 ft. x 61 ft. and 40 ft. high to the lower chords of the roof trusses. The latest and largest unit to be installed is a 2000-hp Allis-Chalmers cross-compound Corliss engine direct-connected to drive a 1500-kw General Electric 2300-volt, 60-cycle, three-phase alternator at 100 r.p.m. This engine, shown in Fig. 2, like all the other engines in the station, operates non-condensing. The engine-room has been designed for a duplicate of this unit, and the foundations are now being prepared for the new set, on account of the demand for its output.

Next to the 1500-kw generator unit is a 400-kw alternator direct-driven by an Allis-Chalmers cross-compound engine at 100 r.p.m. Two 300-kw Westinghouse 550-volt direct-curent railway generators, now belt-driven by Fulton engines, are to be arranged for belted operation from General Electric 2300-volt synchronous motors, leaving the engines in place for future emergency service. The motor-driven railway generator sets will enable the principal railway load to be carried from the large alternators. In addition to these 300-kw railway machines there is a 450-kw, 550-volt General Electric generator belt-driven from a 600-hp Corliss engine in an areaway opening into the main engine-room. The excitation apparatus for the plant comprises one 50-kw and one 20-kw motor-driven set and a 50-kw generator driven by a vertical marine-type engine.

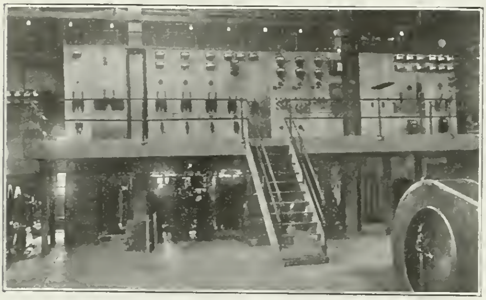


Fig. 3—Switchboard Gallery in Engine-Room.

These machines and the outgoing feeder lines are controlled from a white-marble switchboard, Fig. 3, mounted on a gallery overlooking the engine-room floor. Beneath this platform are the three 100-kw, 2300/6600-volt transformers for the Ft. Gibson transmission, the three fifty-lamp and two 100-lamp constant-current transformers for the Muskogee street lighting and the automatic feeder regulators for the local single-phase commercial service. A distinct three-phase "power" or motor-service circuit is provided for all motor business, and no single-phase motor of over 1-hp rating is allowed on a lighting circuit where the third-phase wire is available. The engine-room is traversed by a 25-ton Whiting crane. The interior brickwork of both the engine-room and the boiler-room is finished in white enamel.

AMMONIA COMPRESSORS AND ICE PLANT

Installed in a separate room, 46 ft. x 62 ft., adjoining the main engine-room is the ice-making machinery, which comprises a 50-ton and a 15-ton steam-driven ammonia-compression plant, each complete with individual auxiliaries and freezing tank, and arranged for independent operation. The 50-ton ice machine comprises York Manufacturing Company twin vertical compressors driven by a horizontal tandem-compound steam engine. The 15-ton machine, made by the Vilter Manufacturing Company, is a horizontal ammonia compressor driven by a horizontal, simple, Corliss-valve engine.

Distilled water for the ice plant is stored in a 6-ft. x 12-ft. x 6-ft. tank after traversing six York charcoal filters. Brine for the cold-storage room is circulated by one of a duplicate set of 24-in. centrifugal pumps driven by 5-hp motors. A 10-hp motor drives an air compressor for operating an air hoist over the ice-can tanks. The 50-ton can tank has its brine circulated by two 5-hp motor-driven propeller agitators, while the 15-ton tank is agitated by a single 5-hp motor.

The combination of the ice equipment with the electrical plant, even in a station as large as that at Muskogee, enables the steam-production, boiler, fuel and labor expenses to be reduced and shared between the two departments, while the ice plant secures the supervision of an expert engineer. To a degree other real-estate, labor, office and overhead charges are also shared. The ice plant provides a steam load for the boilers during the slack summer season and its motor-driven auxiliaries utilize the generator output over long-hour periods when such electrical load is best spared. The resulting operation is thoroughly satisfactory from both the executive and operating standpoints. During about nine months of the year the small ice machine suffices to produce the 10 tons or 15 tons daily for which there is demand during the winter, while the remainder of the year the two machines are run, raising the plant to its 65-ton capacity.

MUSKOGEE'S WELCOME ARCH.

A feature of Muskogee's streets which attracts the attention of every main-line "Katy" railroad passenger, as well as of all visitors to the city, is the electric arch, illustrated in Fig. 4, which spans the main street near the Missouri, Kansas & Texas Railway depot. This double-faced sign is 94 ft. wide, 65 ft. high, and at its center clears the street by 42 ft. It contains 1500 lamps, the majority being 5-watt low-voltage tungstens. The letters in the word "Welcome" are 8 ft. high, and in the name "Muskogee" are 6 ft. At the heads of the columns bordering the arch huge torches or flambeaux, significant of the oil and gas-well fields on the edge of which the city stands, are simulated by colored lamps and flashers. This civic arch, which cost $3,100, was erected and presented to the city by the Muskogee Gas & Electric Company, the city paying only for the sign's operation every night from dusk to midnight. As an example of rapid construction it may be mentioned that this sign was up and burning twenty-three days after the order was placed with the Thomas Cusack Company, Chicago.

LAMP AND MOTOR SERVICE.

As already noted, the peak lighting load at Muskogee has increased more than 100 per cent during the last year, rising from 725 kw to 1600 kw in twelve months. The total connected load of the system, omitting, of course, the railway demand, is now 4200 kw in lamps and motors, divided among 3000 customers. A total of 436 hp in motors is now in use. In spite of the rapid growth of the load during the preceding year it is interesting to note also that as much business has already been contracted for during the first 100 days of 1911 as was closed during the entire twelve months of 1910.

The rates for lighting service at Muskogee range from 14 cents per kw-hour for the first 25 kw-hours down through 13 cents, 11 cents and 10 cents for each successive 25 kw-hours; then 6 cents, 5.5 cents and 4.5 cents for the next 100 kw-hour portions; 4 cents for the next 3600 kw-hours, and finally 3.25 cents, 2.5 cents, 2 cents, 1.75 cents, 1.5 cents and 1.25 cents respectively for each of the successive 1000 kw-hours. The minimum service charge is $1 for each meter installed.

The motor rate, applying to installations of 1 hp and over, begins at 5.5 cents per kw-hour for the first 500 kw-hours, diminishing to 3.25 cents for the next 2500 kw-hours, 2.72 cents for the next 3000, 2.5 cents for next 4000, 2.45 cents for next 5000, 2.4 cents for next 5000, and 2.35 cents, 2.3 cents and 2.2 cents for the next successive 10,000 kw-hour portions successively. The minimum service charge is $1 per horse-power of connected rating.

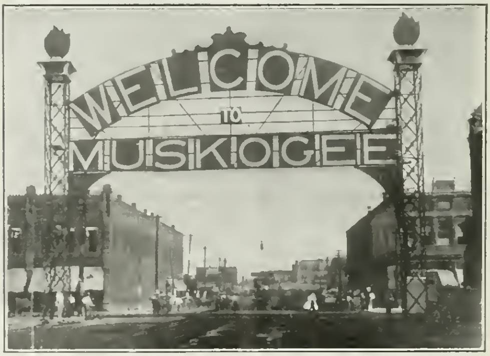


Fig. 4—Welcome Arch Presented to City of Muskogee by Muskogee Electric Company.

Twenty-six electric vehicles are already in use on Muskogee's streets, including the three trucks of the central-station company. The majority of the cars are stabled in private garages equipped with rectifier sets. The minimum monthly charge for such charging service is $7.50, exceeding which the rate begins at about 5 cents per kw-hour. The average car's consumption does not exceed the minimum, so that the income per vehicle is estimated at nearly $100 per year.

ELECTRIC SIGNS.

Muskogee has 130 electric signs, containing 15,000 sign lamps, two-thirds of which are 5-watt tungstens supplied from low-voltage transformers. With a ratio of more than five signs to each 1000 of population Muskogee claims to have more electric signs per capita than any other American city. These signs are operated on a flat rate, the company furnishing renewals and patrol service to turn them on at dusk and off at midnight. When the company supplies the sign also it charges 18 cents per 2-cp carbon lamp and 20 cents per 4-cp tungsten lamp per month; for panel signs the rate is 36 cents per 4-cp carbon and 50 cents per 8-cp carbon lamp. Providing the same service of energy, supply, renewals and patrolling for signs owned by the consumer the rates are 12 cents per 2-cp carbon lamp or 4-cp tungsten, and for panel signs 28 cents per 4-cp carbon lamp and 40 cents per 8-cp carbon lamp. Prompt payment entitles the above rates to 10 per cent discount.

A number of spectacular displays are in use in Muskogee, including many standard and unique designs. In Oklahoma some of the progressive banks, untrammeled by financial conservatism, keep their cashiers' windows open day and night. Fig. 5 illustrates the appropriate display adopted by the Muskogee Day and Night Bank, showing by a chaser flasher a coin dropping from the hand into the bank below.

A special "lighting district" has been formed in Muskogee for the purpose of erecting and maintaining a curb-post lighting installation on the streets of the business section. It is proposed to erect 400 three-lamp posts, each carrying one 60-watt and two 40-watt tungsten lamps. Unlike many similar installations, it is provided that no curb posts be installed at the curb corners of street intersections, the spacings being adjusted instead so that each post is about twice the width of the walk from the curb intersection. In this way an observer stationed at the center of the roadway intersections will see eight lampposts instead of four on the corners.

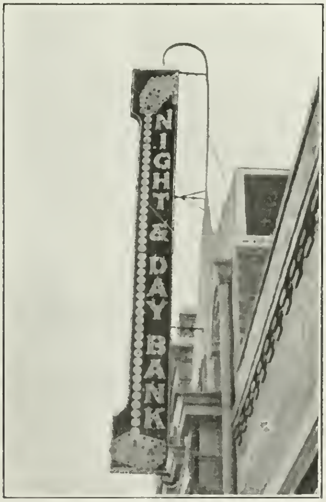


Fig. 5—Novel Flasher Sign at Night Bank, Muskogee.

Among the motor customers of the Muskogee Gas & Electric Company are a model electrically driven bakery capable of producing 40,000 loaves of bread a day, several motor-driven refrigerating plants, motor-driven elevators, feed-grinders, printing presses, etc.

The Muskogee Gas & Electric Company is controlled and operated by H. M. Byllesby & Company, Chicago, Mr. H. C Hoagland being general manager at Muskogee, and Mr. W. R. Emerson secretary-treasurer. Mr. H. I. Ward is superintendent of the electrical department, Mr. J. F. Owens is superintendent of the gas department, Mr. W. G. Miller is chief engineer and Mr. N. B. Hickox is manager of the new-business department.

ELECTRICAL ICE-MAKING IN THE NORTHERNMOST AMERICAN CITY.

As pointed out in these columns, several ice-making plants in cities have already found it profitable to purchase central-station energy for operating their ammonia compressors, under these conditions competing without difficulty with natural ice and with the product of fuel-burning ice factories. From the central-station standpoint the presence of such a long-hour customer on its lines improves the company's load-factor, assuming off-peak duty for its generating equipment. On account of the twenty-four-hour character of the load the motor-driven ice factory usually also gains the advantage of a minimum rate for the energy it consumes, so that the arrangement is a mutually satisfactory one for both customer and company.

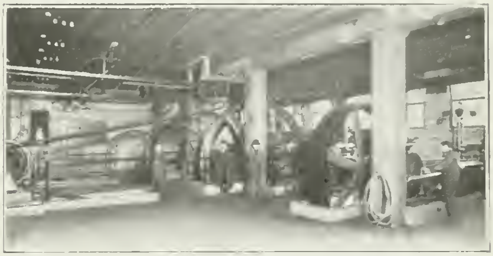


Fig. 1—Ammonia Compressor in Factory of Seattle Ice Company.

In general, as might be expected, cities in the South and Southwest have led in electrical ice-making. But as evidence that such ice manufacturer is not limited by climate or location it is significant that the northernmost large city in the United States, Seattle, Wash., in north latitude 48 deg., has had a 300-ton motor-driven refrigeration plant in successful operation for nearly two years, the energy for the compressors being purchased from the local central-station company

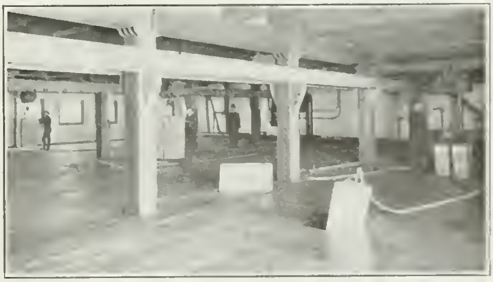


Fig. 2—Freezing Tanks Showing Method of Harvesting Ice by Electric Cranes.

The Seattle Ice Company occupies a four-story modern brick building, the compressor room containing five 60-ton ammonia machines. Four of these compressors are motor-driven, the fifth being a steam-driven unit reserved for emergency use only. The motor-driven compressors are arranged in two pairs, each comprising a right-hand and left-hand crank unit, mounted on a common shaft, to which is keyed a 7-ton flywheel. Through a continuous-rope drive, with four-to-one speed reduction, and idler slack adjuster, each flywheel, double-compressor unit is connected to a 160-hp, 60-cycle, three-phase alternating-current motor running at 350 r.p.m. Details of this rope drive, including the pit construction, idler-adjuster arrangement and protected passageways beneath the strands are shown in the compressor-room illustration, Fig. 1. In the foreground is seen the auxiliary 60-ton compressor driven by a 16-in. x 36-in. Hamilton heavy-duty engine, which is held for standby service. The ammonia condensers, oil traps and liquid receivers are installed on the floor above the compressor apparatus.

Fig. 3—Refrigerating Ice-Storage Room.

While some of the refrigeration produced in the plant is used to maintain at low temperature the large cold-storage space in the building, which has a capacity of 4000 tons, part of the liquefied ammonia is expanded in three 35-ton ice-making tanks employing the shell brine-cooler system of operation. In this cooler construction the usual ammonia-expansion pipes are replaced by a shell expansion tank, not unlike a five-tube boiler in form, the brine being forcibly circulated through the tubes, while the ammonia undergoes expansion inside the boiler-like vessel, extracting heat from the brine passing through the tubes. By this construction the usual racks of pipes are removed from between the cans in the brine tank, allowing closer spacing of the cans with consequent saving of space. The can structure is so arranged that the cans are free to rise slightly with the current produced in the brine by the circulation agitators. There are six of these bronze agitating propellers, two for each 35-ton tank, each pair being driven at 150 r.p.m. by a 5-hp motor. The shell-type brine cooling system is also declared to increase the tank efficiency of the freezing process, since the tank structure can be made more compact and can be better insulated. Less brine is consequently required to accomplish the same results.

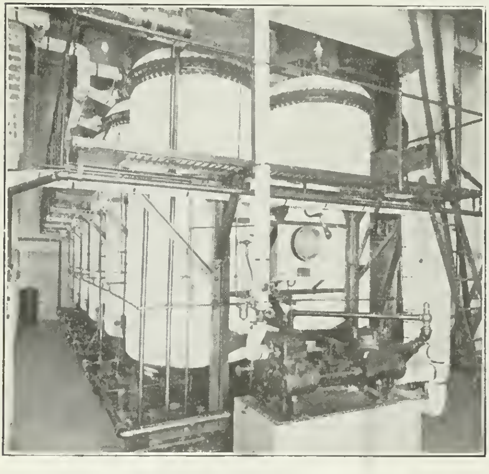


Fig. 4—Water-Purifying Apparatus.

As shown in the view of the tankroom, Fig. 2, the ice is harvested by electric crane hoists, which lift the cans out of the tanks and convey them to the three double automatic ice dumps, where the ice is thawed loose from the cans and discharged to the shipping platform or to the storage floor, shown in Fig. 3. Distilled water for ice-making is furnished by the distilling apparatus shown in Fig. 4.

The ammonia vapor is condensed, under pressure from the ammonia pumps, in seventeen sections of atmospheric-type single-pipe condenser, each section being 24 pipes in height and 20 ft. in length. The compressors, shell-type brine coolers, ice dumps, etc., of this motor-driven ice factory were furnished by the Triumph Ice Machine Company, Cincinnati, Ohio. Mr. J. C. Sterrett is general manager of the Seattle Ice Company.

SUBTRACTIVE PRODUCTION OF ARTIFICIAL DAYLIGHT.

By Herbert E. Ives and M. Luckiesh.

Most forms of artificial light are very unlike daylight in color. Common illuminants, such as gas flames and incandescent electric lamps, have the color of incandescent solids at comparatively low temperatures, such as 2000 deg. C., while the color of daylight corresponds more nearly to an incandescent solid at a much higher temperature, about 5500 deg. C. This means that, when giving the same measured illumination, our common illuminants as compared with daylight are deficient in blue light and have an excess of red light. This difference is really very large, and were it not met by a comparatively great power of adaptation in the eye would seriously interfere with our comfort under artificial illumination. In Fig. 1 are shown the relative intensities of the various spectral colors in an average daylight (curve *a*) and in the tungsten lamp (giving one of the whitest of artificial lights) when the two are giving approximately the same illumination. Whatever disturbance of vision this change from daylight color may cause, there is one practical necessity which even the adaptive power of the eye cannot entirely meet, namely, the selection and matching of colors in materials such as paper, cloth or ribbon. If color combinations are to be used in daylight they cannot be made by artificial light, for matches and color harmonies under the one light are not such under the other. Purples (red plus blue), for instance, because of the deficiency of artificial lights in blue, appear under them of a red tinge. Blues look very dark or black, while reds are disproportionately bright as judged by their daylight values.

For certain technical purposes it consequently becomes of importance to secure artificial daylight for use in the absence of the natural article. One way of doing this is by the use of absorbing media over the lamps to absorb the excess of yellow and red radiation. This may be termed the subtractive method, to distinguish from the additive method, the latter being illustrated by the combination of a mercury-arc lamp with tungsten lamps. The nature of the absorption and the method of calculating the resultant loss in efficiency in this subtractive method have been treated elsewhere by one of the present writers.[1] From that investigation it appears that the transmission of the absorbing screen should be the reciprocal of the relative brightness of the illuminant and daylight at each part of the spectrum. Since that work was done more extensive data have been obtained on the color value of daylight and on this basis the necessary absorbing medium to transform tungsten lamp-light into "daylight" has been calculated. It should have the transmission throughout the spectrum shown in Fig. 2, curve *a*. Curve *b* shows the luminosity or brightness distribution in the tungsten lamp; curve *c*, the same after transmission through the medium *a*. Comparison of the areas of *b* and *c* shows the resultant candle-power to be 15 per cent of the original. This is the "daylight efficiency" of the tungsten lamp, and corresponds to about 10 watts per mean spherical candle.

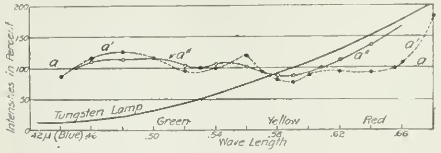


Fig. 1—Relative Intensities of Spectral Colors.

The present paper is an account of an attempt to obtain colored glasses and other media approximating the curve *a*. Before describing the results of this work a few words are necessary as to the degree of exactness with which the requirements must be met; for it must be understood at once that none of the usual absorbing media may be expected to conform exactly in transmission to the curve *a*. In the first place attention must be called to the variable character of "daylight." Varying as it does from the deep blue of the clear sky, through the clear white of the noonday sun to the yellow of late afternoon sun and clouds, daylight is far from a definite thing. For purposes of specification an average may be chosen more or less arbitrarily—the curves of Fig. 2 represent what there is good reason for believing to be a fair average.[2] When the problem is that of producing artificial daylight the variability of natural daylight gives a certain latitude. The variation in daylight is of a perfectly definite character; it consists in a very uniform increase or decrease in the intensity of the spectrum toward one end or toward the other. An increase toward the blue end corresponds to blue sky; toward the red end, to low sun. As long, therefore, as the difference between the artificial and the average daylight given in Fig. 1 is of the nature of a progressive increase in intensity toward the blue end of the spectrum, or vice versa, the difference not being large, it will merely mean approximation to a slightly different quality of daylight and need not be serious.

Two physiological peculiarities of the eye eliminate the necessity for performing the practically impossible task of exactly reproducing the composition of daylight. First comes adaptation. If there is presented to the eye an illumination which approaches white in character the eye will quickly grow accustomed to it and will form a color scale to fit, just as a man in a wind will incline his body so as to preserve equilibrium. But while adaptation is of great assistance it cannot do everything, and if a radiation is missing, or nearly so, the eye cannot supply it entirely. Adaptation will not make it possible for the eye to distinguish purple from red under candle light, but if a light is nine-tenths of the way from candle light toward white, and of proper character, the eye may be depended upon to do the rest. The second physiological factor is the possibility of subjective or physiological mixture. Thus a white light can be matched by mixing merely red, green and blue, or by mixing yellow and blue. Consequently an artificial white might be made whose spectrum had several humps or depressions, yet the total light might be a good white. If, then, it be found impossible to avoid having certain bands of excess spectral transmission in the absorbing medium, it is often possible to distribute these so as to produce a white.

What characteristics should a "white" light have to make it suitable for color matching? While a white may be made in which certain colors are entirely missing, as stated above, such a light would be unsuitable for color matching; the fewer the colors present the less suitable would the light be. A two-color white (yellow-blue) would not illuminate a true red, and that color would appear black—a case corresponding very nearly to the mercury-vapor lamp. For the ideal white all the colors should be present and in the proportions of daylight. A study of the colors of most natural objects, however, reveals the fact that those colors are very rarely pure isolated spectral hues, but rather long diffuse bands of spectral light. A pure yellow is practically never met with in nature; in fact, yellow fabrics are all merely white minus blue and some green. As a consequence a white light consisting of isolated colors may yet possess enough colors to have very little disturbing effect on ordinary colored objects. Just how many spectral colors should be present is not a matter easily capable of exact statement, but certainly there should at least be the three—red, green and blue—and preferably more.

Now we may apply these general considerations, plus some experience and experiment, to the case of artificial daylight and state the following requirements:

1. The total light should appear white—that is, should have the integral color of such a spectral distribution as Fig. 1 indicates, or should vary from it by being only slightly bluer or redder in the manner that daylight varies.

2. All the spectral colors should be present, but if gaps or irregularities exist in the spectrum the three principal colors—red, green and blue—are necessary. Additional colors in equal, or nearly equal, intensity will improve the color-matching performance of the light.

These requirements fall far short of being exact specifications, but at present it is difficult to see how the various factors to be considered can be reduced to more exact terms. A rather large experience factor has of necessity been introduced in studying the problem. In the work which follows the deviations allowed from the desired character are justified, and under the circumstances can only be justified, by the experience of the writers as to the actual permissible amount of deviation from the conditions outlined above.

Some sort of blue glass or other medium is called for. Colored glass is preferable to dyed films or solutions of colored material, because of its practicability in handling and in permanence. . The more diffuse and gradual absorptions of metallic salts are capable of incorporation in glass, and it is these, rather than the narrow absorptions of most dyes, that are called for in this problem. A study of a large selection of samples of colored glass revealed two shades which might be used—ordinary pot blue or cobalt blue and signal green. The first alone transmits blue, an isolated spectral band of yellowish green, and the deep red. Used alone over a tungsten lamp it gives a purple light, because of the transmitted red. Signal green alone makes the light too green, but it reduces the red that

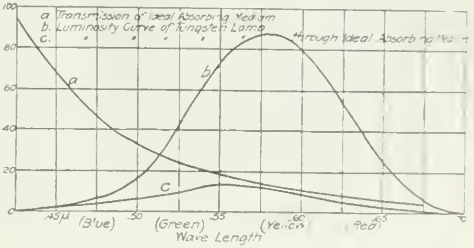


Fig. 2—Transmission and Luminosity Curves.

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[1] Herbert E. Ives, *Bulletin Bureau of Standards*, June, 1909

[2] *Trans.* Ill. Eng. Soc., March, 1910.

the cobalt blue transmits. A combination of the two appeared promising. Wedges of these glasses were ground and tested for transmission at various thicknesses on the spectrophotometer. From the measurements a combination of the two glasses was chosen which approximates the curve desired. A grave defect of this combination is the pronounced band of yellow-green transmission of the cobalt. In order to reduce this recourse was had to dyes. A peculiarity of the ordinary dyes is that their absorptions are very narrow and abrupt, so that they are not suited to securing the gradual absorption called for by Fig. 2, curve *a*. For the purpose of decreasing the transmission in a narrow spectral region, however, dyes are good. A dye—rozazeine—was found by trial which has an absorption band so situated as to cover very well the undesirable yellow-green band of the cobalt glass.

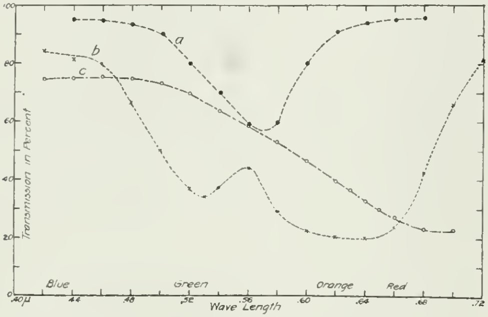

Fig. 3—Experimentally Determined Transmission Curves.

With these two glasses plus a gelatine film flowed upon one of them and containing a specified amount of dye an absorbing combination was obtained which produces with a tungsten lamp a very satisfactory approach to "daylight." In the spectrum the total light is "white." No gaps and no bad depressions or humps exist, and the three elevations are in red, green and blue. In short, the conditions outlined above are approximated.

The next question which arose was whether glasses could be obtained in stock thicknesses and depths conforming closely to the depth of color chosen from study of the wedges. Fortunately, two of the standard glasses carried by one of the large glass companies were quite near the desired character. The spectrophotometrically determined transmission curves of these, and of the dye in the depth used, are given in Fig. 3. Fig. 4 shows the transmission of the combination, compared with the theoretical one, while Fig. 1 shows the spectrophotometric curve of this artificial daylight in terms of the average daylight used as standard. The full line *a''* is the combination obtained by study of the wedges of cobalt and signal green, the dotted line *a'* that of the glasses found upon the market. The latter glasses are of slightly different character from the cobalt and signal green, and give in some respects a better combination. Probably starting with these as a basis, it would be possible for a skilled glass worker to produce glasses even better, to combine these two in one, and perhaps even find a glass substitute for the dyed film. The latter would be especially desirable, as rozazeine is like many similar dyes in not being perfectly permanent.

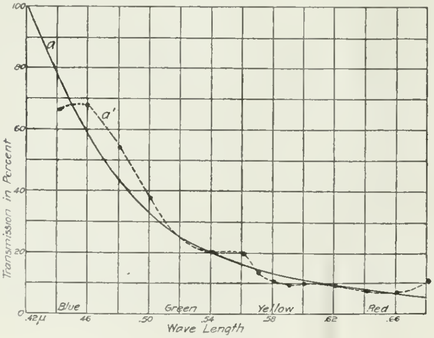

Fig. 4—Comparison of Transmission Curves.

With these glasses a "daylight window" has recently been constructed for the purpose of demonstrating the principle in a lecture on "artificial daylight." This consists of a tin box 16 in. x 12 in. x 20 in. holding six 60-watt frosted-tip tungsten lamps. The bottom of the box (16 in. x 20 in.) consists of the two glasses, one coated with the gelatine film containing the dye, the other a rough glass acting as a diffuser. The whole box rests upon legs 15 in. high. The surface to be illuminated is placed beneath, where an illumination of about 30 ft.-candles is obtained, this value being ample for purposes of color-matching. The color of this window has been measured on an Ives colorimeter, in terms of the average daylight, which was determined by one of the present writers[1] with that instrument. The readings—average daylight being equal parts red, green and blue—were:

Red	Green	Blue
100	85.4	75.8

These have been reduced to color sensation values by the method used in a former paper.[2] The sensation values, expressed so that their sum is unity, are:

Red S	Green S	Blue S
35.5	34.0	30.5

These are plotted in a color triangle (Fig. 5) along with several other illuminants. The center of this triangle is "average daylight," the corners are pure red, green and blue sensations, while the distance of a color from the center is a measure of its deviation from average daylight. On this scale of measurement and scheme of representation this particular artificial daylight is nearer the average daylight striven for than is any other artificial illuminant.

The window made up has proved extremely satisfactory on test. The light appears "white" and all colors assume their daylight appearance under it. It has been temporarily used for lighting a desk, and the soft white color has proved very pleasing. It constitutes a very satisfactory demonstration of the possibility of producing daylight by the subtractive method.

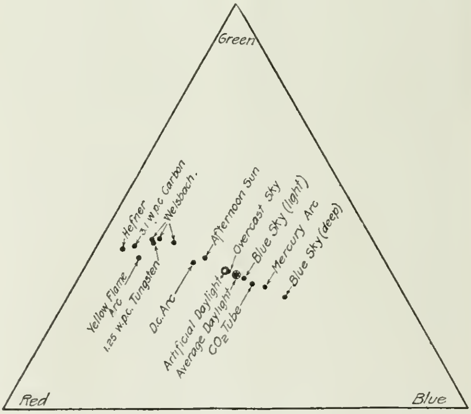

Fig. 5—Color Triangle.

The specific consumption is high, being from 10 watts to 12 watts per candle. On the other hand, the first cost is extremely low. Such a window may be used on an ordinary lighting circuit and its component parts are all easily renewable.

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[1] *Trans.* Ill. Eng. Soc., November, 1908.
[2] *Trans.* Ill. Eng. Soc., March, 1910.

OPERATING 2200-VOLT DISTRIBUTION WITH 1100-VOLT TRANSFORMERS.

Last February the People's Water & Light Company, of Harrisburg, Ill., changed its distribution e.m.f. from 1100 volts, single-phase, 60-cycle, to 2200 volts. This change was made to reduce distribution losses on the primary lines, the growth of the town making such a change imperative.

In this particular case an interesting condition was found in the fact that very few new transformers had to be purchased, even though there were a number of transformers which could not be reconnected for 2200 volts. Out of a total of fifty-two transformers with a rating of 254.8 kw there were thirty-nine with a rating of 216.6 kw which could be reconnected for 2200-volt operation. There were thirteen with a total rating of 38.2 kw which could be connected only for 1100 volts.

With the aid of a map of the distribution system plans were outlined whereby the 1100-volt transformers could be connected up in pairs with both primaries and secondaries in multiple while the plant was operating 1100 volts, and could afterward be changed so that the primaries could be connected in series and the secondaries remain in multiple, as before, when the change to 2200 volts was made.

It was found that the rating of the transformers in service was such that it was necessary to take only three of the 1100-volt transformers out of service in making the change. The other ten were banked in pairs. In some cases the secondary circuits were rebuilt so as to place more consumers on one secondary with a single transformer or pair of transformers to feed it instead of two or three transformers, as before.

After all the preparatory work had been done the actual change was made between daylight and dusk one Sunday, after previous notice to consumers that service would be off during the daylight on that day. It was thought that perhaps some of the 1100-volt transformers would burn out on account of the increased voltage between the primary coils and the grounded secondaries when the 2200-volt service was begun, but nothing of the kind occurred. The 1100-volt transformers were of the oil-insulated type. The secondary circuits were all grounded as a safety precaution before the change of voltage and the banking of transformers was made. Otherwise the risk of injury to consumers through defective insulation between the primaries and secondaries would have been more than the company would have cared to assume. The change was accomplished on the day designated without any mishap, although shortly after the work began a rain came up which made it necessary to hold parasols over the transformers while the lids were off for changing the connections. Simultaneously with the change of distribution voltage a new generator was being slipped into place at the power house. The change was made under the supervision of Mr. L. F. Payne, manager.

LARGE MOTOR LOADS.

By Alton D. Adams.

Population is some measure of possible motor loads, but other important factors control in large degree the result. Some of these factors are illustrated in the seven motor loads of exceptional size relative to population that are here analyzed. Each of these motor loads is carried in connection with the regular lighting business by the general electric supply system in the city named.

That the motor loads here considered are of exceptional size relative to the respective populations served may readily be seen from the fact that they range from 73 to 155 connected horse-power per 1000 inhabitants, while the great connected motor load of 44,065 hp on the Boston system amounts to but 62 hp per 1000 persons in the cities and towns served.

Unfortunately it is not possible to carry the analysis of the Boston load very far, as many of the motors there are served through the same meters that supply lamps, so that lighting and motor outputs and incomes are too well mixed to be separated.

The seven electric supply systems that have been selected because of their relatively large power loads are located at Hartford, Conn.; Barre, Vt., and Springfield, Holyoke, Fitchburg, Attleborough and Greenfield, Mass. Figures relate to the rated power of connected stationary motors and to the income from this class of service in the fiscal year of 1909.

The seven connected motor loads range from 1350 hp in Greenfield, with its population of 11,268, up to 10,591 hp in Hartford, with an estimated population of 112,000. Populations given in Massachusetts are the figures of the State census of 1905. Springfield with its connected load of 6428 hp has the largest motor capacity of any city in the State outside of Boston, the next largest load, that at Lowell, being 5335 hp.

Barre, Vt., leads the group with 155 hp of motors connected for each 1000 of the population, and the lowest figure is 73 hp per 1000 at Holyoke. For Springfield the connected horse-power is 74 per 1000 of its 86,486 inhabitants, while the next largest load, at Lowell, represents 48 hp for each 1000 of the 110,786 people there. The Greenfield motor load is 120 hp and the Attleborough 127 hp per 1000 inhabitants.

Motor incomes per inhabitant range from $1.13 at Springfield to $3.66 at Barre, and Attleborough stands high with $2.71 on this basis. In income per rated horse-power of the connected motors Barre again leads with $23.68 and Greenfield foots the list with $13.36. Only one other plant, that at Attleborough, reaches $20.63 per horse-power.

For the five Massachusetts plants the average cents per kw-hour received for motor load varied from 1.82 at Holyoke to 2.85 at Attleborough. The average rating of the connected motors ranges from 4.7 hp in Attleborough to 12 hp at Holyoke.

The five Massachusetts plants under consideration have the largest connected motor loads in proportion to population of all in the State. At Hartford, Barre, Springfield, Holyoke and Greenfield a part of the electric supply was from water-power during the year named, and at Fitchburg and Attleborough all of the energy was generated by steam.

In the Hartford system 30 per cent of the energy was generated by water-power and the remainder by steam. The greater part of the 10,591 hp in motors there is used by the factories and is in the main a day load.

The Springfield electric system has two waterfalls within two miles of each other on the Chicopee River with a total combined fall of 50 ft. At the smaller of these two falls the energy generated during the year was 21 per cent of that in the entire electric system, and the output from both waterfalls was probably as much as one-half of the total. On both the steam and water-power stations the average load during the 8760 hours was 33.2 per cent of the maximum combined load of the year. This high average load was due to the 6428 hp of motor load that yielded an income of $15.21 per horse-power for the year with an average rate of 2.5 cents per kw-hour for the energy actually supplied.

Over 6000 hp of the motor capacity connected to the Springfield system was operated with three-phase alternating current, and the leading lines of manufacture were machinery, metals and printing. The average rate of 2.5 cents per kw-hour paid for motor load may be compared with the station cost of 0.8 cent per kw-hour for all energy generated in the Springfield system, including amounts paid for rent of water-power, but not including depreciation charges or salaries of officers. Soft boiler coal cost $4.37 per long ton for the year, and the cost of coal per kw-hour of all the energy generated by both steam and water was 0.32 cent beside the cost of the water-power.

At Barre the granite industry is the backbone of the notable load of 4650 rated horse-power in a service area with only 30,000 people. Three-phase alternating-current power is distributed and motors are used both at the quarries and in the granite-cutting sheds. Rates for energy to these motors are 4 cents to 2 cents per kw-hour according to the amount consumed per month, the rate of 2 cents applying where 2500 kw-hours or more is used per month. The average yearly income of $23.68 per horse-power from these motors is earned during a working year of only about 2300 hours, or some 288 days of eight hours each, conforming to union regulations in the granite industry. Load-factors with these motors in the granite industry are high. Thus for the motors of one consumer 1485 kw-hours was used per rated horse-power during the year, and in another instance 1629 kw-hours was used per horse-power.

During the year the electric supply system operating these Barre motors generated 73 per cent of its total energy output at two water-power plants on the Winooski River, one at Middlesex and the other at Bolton Falls. The remaining energy was generated at the steam-driven plant in Montpelier.

In the Holyoke electric system a substantial but undetermined part of the energy is generated by water-power. Boiler coal cost $4.64 per long ton at the generating station and 0.59 cent per kw-hour of output in addition to the cost of water-power during the year. Rates for power ranged from 4 cents to 1.3 cents per kw-hour, and the average on the total sales for this purpose during the year was 1.82 cents, the lowest among the list of plants. On this rate basis the motor income was $16.48 per rated horse-power. The combined lighting and motor service gave a ratio of 26.6 per cent between the average and the maximum loads of the year. In this instance the figure of 73 motor-hp per 1000 of the population does not represent the entire capacity of the city to absorb electric power, as the Holyoke Water Power Company also distributes electric energy to motors in the same territory. More than 3500 hp of the 3667-hp total of connected motors on the Holyoke system are alternating-current type, and the average size of 12 hp, the largest in the list of plants, denotes their use in heavy manufactures, of which cotton goods and paper are the leading lines in that city.

Fitchburg power service yielded an income of $18.09 per connected motor horse-power during the year on rates that averaged 2.16 cents per kw-hour. The electric system showed a ratio of 30.2 per cent between the average and maximum loads for all classes of service during the year. In this system all of the energy was generated with soft coal and coke costing $4.88 and $4.07 per ton respectively. The fuel expense amounted to 0.74 cent per kw-hour generated, and the total station expense, including fuel, supplies, labor and repairs as charged, but not depreciation, salaries or general expenses, was 1.23 cents. A large percentage of the Fitchburg power sales were for operation of cotton-mill machinery at the rate of 1.8 cents per kw-hour, and there were more than sixty motor users.

The fiscal year for Fitchburg, like that of the other Massachusetts plants, ended with June 30, 1909, and the maximum station load of that year came at 5:30 p. m. on a December day with 57 per cent of the peak as motor load. On this same day, which probably required the maximum amount of lighting for the year, 60 per cent of the total station output went to the motor load.

Attleborough led all the Massachusetts plants with a connected motor load of 127 hp per 1000 inhabitants and a power income of $2.71 per person in the population. This load yielded $20.63 per rated horse-power and 2.85 cents per kw-hour consumed. Important among the factors contributing to these notable Attleborough results is the demand there for power in small units by a relatively large number of manufacturers of jewelry and silverware. This town of 12,000 people contained in 1905 108 manufacturing establishments, or 1 per cent of the total number in the State, and the average capacity of installed engines and waterwheels in all these establishments was only 35 hp each. For the 348 motors connected to the electric system the average capacity was 4.7 hp, the lowest among the list of plants, while in Boston, where the proportion of small motors is naturally large, the average size is 4 hp.

All of the electric energy at Attleborough was generated by steam coal that cost $3.87 per long ton and 0.68 cent per kw-hour generated for all purposes. The total station cost on the same basis was 1.09 cents per kw-hour. For the combined lighting and power business the average load during the year was 22.1 per cent of the maximum.

In Greenfield the high figure of 120 connected motor horse-power per 1000 of the population was obtained with an average income of $1.60 per inhabitant and $13.36 per rated horse-power, this latter figure being the lowest in the list. The average rate per kw-hour used by motors was 2.83 cents, while the station expense for all energy generated by steam and water-power combined was 0.6 cent per kw-hour. The average load for the year was 25.3 per cent of the greatest.

LARGE MOTOR LOADS DURING 1909.

Location of Plant.	Population of Cities Served.	Motor Horse-power Connected to Plant.	Motor Horse-power per 1000 Population.	Motor Income per Inhabitant.	Motor Income per Horse-power.	Average Cents per Kw-hour Motor Load.	Average Rating of Motors in Horse-power.
Hartford	112,000	10,591	94	$1.83	$19.47	....	....
Springfield	86,486	6,428	74	1.13	15.21	2.50	8.3
Barre	30,000	4,650	155	3.66	23.68	....	...
Holyoke	49,934	3,667	73	1.21	16.48	1.82	12.0
Fitchburg	33,021	2,771	84	1.52	18.09	2.16	9.1
Attleboro	12,702	1,621	127	2.71	20.63	2.85	4.7
Greenfield	11,268	1,350	120	1.60	13.36	2.83	5.3

In the above table the more important figures for the seven motor loads under analysis are combined.

HYDROELECTRIC DEVELOPMENT IN CANADA.

Station of the Erindale Power Company, Ltd., on the Credit River at Erindale, Ont.

The hydroelectric station of the Erindale Power Company, Ltd., of West Toronto, Ont., was placed in operation last September. It has many features of interest, chief of which is the peculiar formation of the power-house structure, resulting in a materal reduction in initial cost. The station is located at Erindale, on the Credit River, 4 miles from Lake Ontario. The river rises in the hills 75 miles back of the lake, and has a minimum flow of 120 cu. ft. per second. A dam is thrown across the river, which, as shown in Fig. 4, turns on itself in a very short distance. The structure, which is 700 ft. long, comprises a 100-ft. concrete spillway, the remainder being an earth embankment with a core wall of reinforced concrete 8 ft. wide at the bottom and 2 ft. wide at the top. In addition there are buttressses spaced every 20 ft. along the embankment. The core wall when complete will be 40 ft. above the riverbed, and the spillway 34 ft. above the riverbed. The foundations are set 18 ft. below the bed of the river. Three sluiceways are provided at one end of the spillway to handle extreme floods in spring.

Fig. 1—Portal of Intake Tunnel Leading to Power House.

By means of the dam a lake is impounded covering a section of 125 acres and yielding a head at the station on the other side of the hill ranging from 53 ft. to 60 ft. The portal to the tunnel leading to the power house is built of reinforced concrete, 24 ft. square and 33 ft. high, with two 7-ft. x 10-ft. openings for gates. The latter are made of wood, and behind them is a coarse rack having a steel section at the bottom and an upper section of wood. The idea of this composite rack is to prevent ice freezing to it, and thus to eliminate troubles from anchor ice.

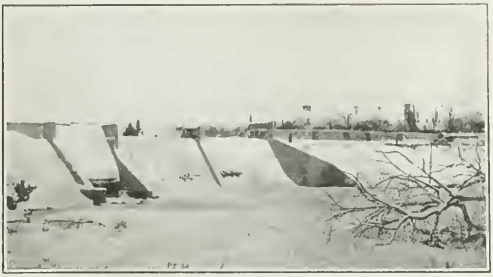


Fig. 2—Down-Stream Side of Dam Across Credit River.

The tunnel leading under the hill from the portal to the bulkhead back of the station is 900 ft. long and 12½ ft. in diameter. It has a horseshoe cross-section and is made of reinforced concrete. Four hundred feet of it pass through shale and the remainder through clay and quicksand. The tunnel has a minimum thickness of 18 in., which was increased as the occasion demanded. At the end of the tunnel, just as it emerges into the bulkhead, there is another rack made of steel.

The bulkhead, as is shown in Fig. 6, has a fan-like shape, the penstock to the waterwheels leading directly from it with a straight drop of 24 ft. from the floor of the tunnel to the wheels. The latter are single-runnner, horizontal Canadian machines, discharging through the side of the penstock toward the power house through a 90-deg. turn in a draft tube to the tailrace 9 ft. below the power house, whence the water is returned again to the river. The Canadian runner has vanes which stand out to the full diameter of the case and receive a live stream of water in impact throughout their depth, carrying it naturally downward to a curved discharge bucket, on which it reacts in leaving the wheel. The turbine therefore belongs to the full-diameter or Swiss-type machine. It is provided with alternate moving and stationary gates, the moving gates being balanced on a heavy steel pivot pin fully equipped for adjustment. In the Canadian wheel the area of the discharge is just equal to that of a cross-section at the named diameter, while with the American type of wheel the discharge area is expanded to more than double that of the named section. The wheels, which are of the combined impulse and reaction type, 50 in. in diameter, were built by Charles Barber & Sons, Meaford, Ont., and are rated at 840 hp when operating under a head of 56 ft. At present the wheels are operating under a 53-ft. head, which will be increased to 60 ft. in the course of a few weeks. Each wheel is controlled by a Woodward governor and is connected to an Allis-Chalmers-Bullock three-phase, 60-cycle, 13,200-volt machine running at 200 r.p.m. The radial system employed in the layout of the equipment allows plenty of space at the generators, where it is needed, and just as much space as is required at the waterwheels. In fact, a parallel arrangement would not possess any added advantages. By means of the type of construction employed at the bulkhead and penstock a saving of approximately $8,000 was effected.

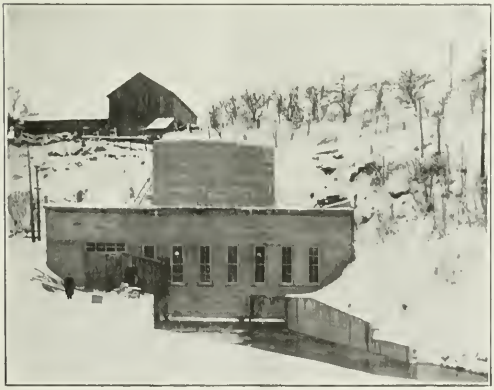


Fig. 3—Bulkhead, Power House and Tailrace.

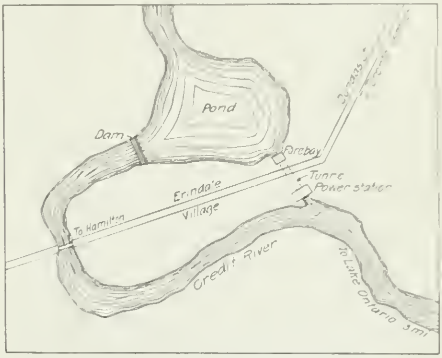


Fig. 4—Location of Plant.

The development was started by a Toronto company organized by the York Loan Company a little over six years ago. This company completed about two-thirds of the tunnel and the foundations of the dam about one-third way across the river It also purchased the two generators, but while the latter were still on the flat cars the company failed, and nothing was done for four years. The Erindale company bought in the property at receiver's sale and, although the generators stood outside

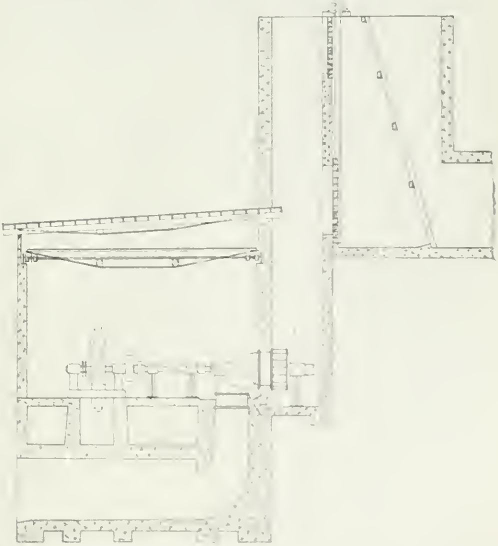


Fig. 5—Bulkhead Flume and Cross-Section of Power House.

exposed to the weather just as they came from the shop for over four years, the construction was such that not a coil broke down when they were placed in operation. In drying out the machines a bridge megger was used with excellent results. At the start the insulation resistance was so low that the instrument would not record it, but after operating on a short-circuit under 150 per cent full-load current for 195 hours a reading of 8 megohms was obtained. Operation under these conditions was continued until a final reading of 150 megohms was obtained at the end of 315 hours.

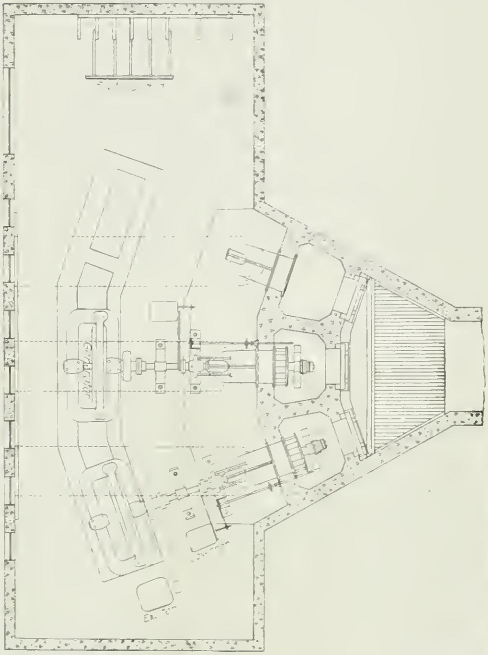


Fig. 6—Plan of Power-House Bulkhead and Flume, Erindale Power Company.

The switchboard was built by Messrs. Ferranti, of England, and comprises two generator panels, two feeder panels and one exciter panel. The high-tension oil switches on the generator and feeder panels are manually operated and have brush contacts. The switches with the series transformers, shunt transformers, conductors, etc., are placed in concrete cells 9 ft. back of the panels. The exciter panel has main switches for connecting with three exciters, which may be operated in parallel, and the direct-current busbars run across the generator panels and connect with the field switches of the machines. Lightning arresters of the spark-gap and arrester type are connected to the line through disconnecting switches.

A wooden-pole line carrying a single circuit of No. 0 aluminum wire on Locke porcelain insulators, spaced 24 in., connects the Erindale station with a substation in West Toronto, 15 miles distant. Thirty-foot wooden poles are used, and these are spaced about 130 ft. apart. The potential is stepped down to 2200 volts, two-phase, in T-connected Allis-Chalmers-Bullock transformers rated at 300 kw each and located in the station of the Interurban Electric Company in West Toronto. For the purpose of improving the power-factor of the system a 300-kw, two-phase, 60-cycle S. K. C. over-excited synchronous motor is provided in the substation.

At New Toronto there are two 200-kw transformers wound for 13,200 volts primary and 2200 volts secondary, built by the Canadian Westinghouse Company. A third transformer of similar capacity is held in reserve, and all are protected by expulsion fuses and Garton-Daniels lightning arresters. At Swansea there are two 250-kw transformers, built by the Canadian General Electric Company. At Humber the Interurban Electric Company, which is closely affiliated with the Erindale Power Company and purchases its entire output, operates a combination plant comprising four generators, four engines, two pairs of waterwheels and seven boilers. There are two 180-kw, two-phase, 2200-volt, 60-cycle machines belt-driven from 36-in. waterwheels, operating under a head of 25 ft., and there is an 180-kw machine belt-driven from a Robb engine. In addition one of the 180-kw machines belted to the waterwheels is connected through a friction clutch and belt to a buckeye engine and the other is similarly connected to a tandem-com-

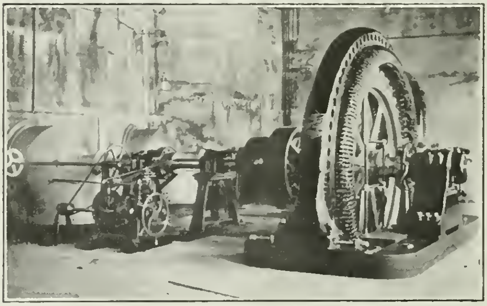


Fig. 7—Interior of Generating Station, Erindale Power Company.

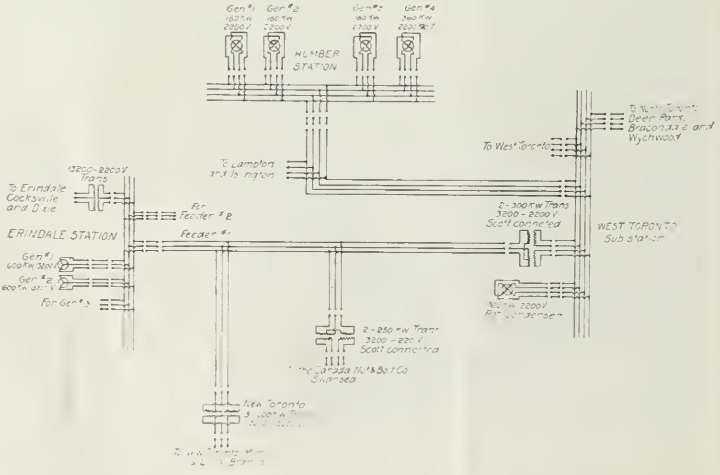


Fig. 8—Diagram Showing Transmission and Distribution System.

pound Robb engine. The fourth unit is rated at 360 kw, and is driven direct from a cross-compound Robb engine. The electrical equipment of the Humber station was furnished by the Canadian Westinghouse Company. The engines operate condensing and receive steam from six return-tubular boilers rated at 150 hp each and one water-tube boiler rated at 200 hp. The boilers were built by the Canada Foundry Company and operate under a pressure of 120 lb. A two-phase, four-wire line of No. 00 copper and a duplicate line of No. 3 copper connect the Humber station with the substation at West Toronto. The connected load on the combined system comprises about 2500 hp in motors ranging in rating from 50 hp to 1 hp, 28,000 incandescent lamps and 150 arc lamps. The rate for motor circuits is $15 per hp-year for ten-hour loads and 2 cents per kw-hour on a meter basis. The rate for lighting is 8 cents net. The Interurban Electric Company, Ltd., distributes the energy in West Toronto, North Toronto, New Toronto, Wychwood, Swansea, Islington, Erindale, Cooksville, Dixie, Long Branch, Mimico and Lambton. The company is at present negotiating for the purchase of 1000 kw in bulk and will then use its water-power station at Erindale for peak-load service, storing the water in the pond formed by the dam for this purpose.

The officers of the company are as follows: Messrs. Charles Holt, president; J. Kirkes Meyers, vice-president; H. Waddington, director; Eli S. Edmondson, managing director, and Thomas Henry, chief engineer and superintendent.

ELECTROLYTIC PURIFICATION OF BOTH WATER AND SEWAGE AT OKLAHOMA CITY.

An electrolytic plant capable of treating 750,000 gal. of sewage in twenty-four hours has been in operation in Oklahoma City, Okla., since March 29, and the water-works department is beginning to install electrolytic apparatus for manufacturing precipitate capable of treating 4,000,000 gal. of water supply in twenty-four hours, replacing in part the lime-and-iron process now in use there. Both of these plants, though using distinctly different processes, are in the nature of experimental installations, and the success of their operation will determine the use of similar equipment capable of handling respectively the entire water supply and sewage disposal of the city. The preliminary installations, however, are on a large scale, well adapted to show the operation of the systems in full size. In the case of the water-works 40 per cent of the 10,000,000 gal. now pumped daily is being arranged for electrolytic precipitation, while the present sewage-disposal apparatus comprises about one-fifth that necessary to treat the entire discharge of the city, which drains into several different basins.

At the city water-works plant two 60-hp motor-driven low-duty centrifugal pumps lift the water from the level of the creek to that of the sedimentation basins and storage wells, from which the high-duty steam pumps force it into the city mains at 60 lb. pressure per square inch. This pair of low-duty centrifugal pumps, which as now motor-driven at 475 r.p.m. are together capable of handling 15,000,000 gal. a day, were formerly individually driven by 400-r.p.m. steam engines. The substitution of the motor drive, operated from a pair of 150-kw four-valve engine-driven 220-volt direct-current generators, has not only increased the output and efficiency of the centrifugal pumps themselves, but the steam taken by the engine-generator sets—operating the pumps, plant and grounds lighting, filter-washing pumps, machine shop, etc.—is even less than that formerly required by the pump engines alone.

The water supply of Oklahoma City is now purified by a precipitation process, hydrate of lime and iron sulphate being added to form a floccular precipitate which settles to the bottom during its passage of a long settling basin, the precipitate carrying with it the impurities and other foreign material present in the solution. Iron sulphate, a by-product of steel manufacture, is the expensive ingredient of the above process, and it is the purpose of the electrolytic apparatus to produce an equally effective precipitate from such simple materials as iron borings and table salt at reduced cost. The scheme thus involves making the precipitate by electrolysis in a voltaic cell outside the settling tanks, afterward adding this flocculant to the water, just as is done with that made from the more expensive lime and iron mixture. The new electrolytic equipment is being installed under the direction of Mr. V. G. Shinkle, engineer and manager of the Oklahoma City water supply department.

SEWAGE DISPOSAL.

The electrolytic scheme used at the local sewage-purification plant, which was started March 29, 1911, is an adaptation of that employed at Santa Monica, Cal., and is the only plant yet erected outside of the original installation on the Pacific Coast. In this process the raw and untreated sewage is directly traversed by large low-voltage currents, the electrolysis of the solution liberating nascent elements which speedily effect the conversion of objectionable matter present. A 7½-hp. 220-volt alternating-current motor, operated from the Oklahoma City Gas & Electric Company's lines, drives the 3-kw direct-current generator shown in Fig. 1, which is capable of delivering currents up to 900 amp at 1.5 volts to 3 volts. The third machine on the shaft is the exciter for the low-voltage generator which supplies the large currents for electrolyzing the sewage.

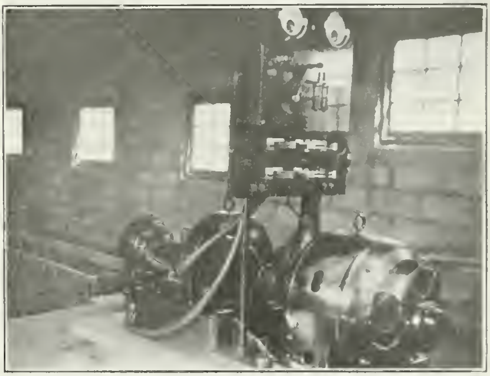


Fig. 1—Motor-Generator Set Supplying 900 Amp. for Electrolytic Purposes.

The electrodes are 10-in. x 24-in. x ⅜-in. iron plates, grouped in batteries of twenty-seven as shown, adjacent plates being of opposite polarity, and ten such batteries being installed in each flume through which the sewage flows. Each such flume is designed to treat 250,000 gal. per twenty-four hours, the three flumes making the present capacity 750,000 gal. a day. Heavy copper busbars convey the current from the low-voltage generator to the copper channel caps on each plate, the travel of the current through the sewage electrolyte being about 0.5 in. The copper caps on the plates increase their conductivity and also aid electrolytically in the purification process. The group of 270 plates in one flume requires a current of about 270 amp at 2.5 volts, 1 amp per 24-in. x 10-in. plate being found the best operating current density. When the current is turned on the electrolyte over the plates quickly becomes milky with fine bubbles of hydrogen and oxygen. The latter, in its nascent form, attacks and destroys objectionable organic compounds present in the water and oxidizes other materials, while the ferric oxides also formed are said to exert chemical effects adding to the purifying action.

After the electrolytic action has proceeded in one direction from twelve to twenty-four hours, and sludge has collected about the cathodes, the direction of current flow is reversed, cleaning the former cathodes and also reducing unequal destruction of the anodes. Bacterial ratios are said to be decreased from 700 to 7; the nitrates are reduced from 7 to 4 and largely converted into ammonia, while the phosphates remain unchanged and assimilable.

Using 900 amp at 2.5 volts, or 2¼ kw, to treat 750,000 gal. per twenty-four hours in the three flumes, the cost of operation of the present disposal plant, at 4 cents per kw-hour, would be $2.16 per day, or $790 per year. This represents energy consumption only and does not include renewals, labor, etc.

The present purification plant at Oklahoma City has been installed, under agreement, without cost to the city pending its satisfactory operation and acceptance. In the event of the adoption of the system for sewage disposal five similar equipments will be required at different points on account of the diverse channels of sewage drainage at Oklahoma City. The Oklahoma law regarding stream pollution requires that the sewage be rendered innocuous in some way. A large septic tank was first provided in the case of the sewer whose contents are now treated electrolytically, but even with this tank foul and putrefactive products were discharged into the stream. The electrolytic sewage-disposal plant at Oklahoma City was installed by Mr. A. J. McMahan, under patents issued to Messrs. C. P. Chandler and L. G. Lautzenhiser, of Santa Monica, Cal., where the first plant of this kind is in use.

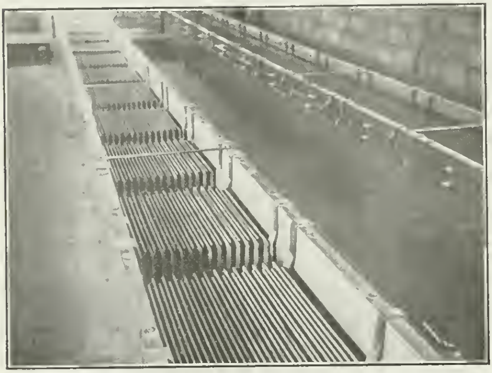


Fig. 2—Flume Containing Electrode Plates for Electrolysis of Sewage.

LENTZ POPPET-VALVE STEAM ENGINE IN GALESBURG (ILL.) LIGHTING PLANT.

As a result of the attention which the steam turbine has received in this country during the last five years progress in the development of the reciprocating engine has been partially lost sight of. In the smaller sizes, however, the reciprocating machine is still able to hold its own with all other comers in the steam field, while, indeed, in Europe improved types of engines have been developed, and are in general use, that give economies of performance and steam consumption that are unknown to the average American plant engineer. Among these improved forms of engine, reports of which have been given in the *Electrical World* from time to time, are the Wolf locomobile and Lentz machines, the last named of which is now built in this country under foreign license.

A Lentz engine of American manufacture has just been erected in the municipal street-lighting station at Galesburg, Ill., where it drives a 200-kw, 2300-volt, 60-cycle alternator. The engine is of the tandem-compound, condensing type, with poppet valves operated from a cam shaft, and resembles in general outlines the familiar horizontal, tandem, double-acting type of gas engine.

The Galesburg engine is rated at 240 hp, but is capable of developing 300 hp. Its high-pressure and low-pressure cylinders are 13½ in. and 23 in. in diameter respectively, with a stroke of 21 in. The comparatively high speed at which the engine runs, 164 r.p.m., enables a smaller and less costly type of alternator to be used than would be required at a lower speed. Steam at 160 lb. per square inch pressure and containing 125 deg. of superheat is obtained from a new installation of two 300-hp Erie vertical water-tube boilers, capable of delivering 100 per cent overload. Each boiler comprises an upper and lower steel drum connected by vertical tubes, the entire boiler being suspended from the upper drum with the lower drum free. Baffle plates conduct the heated gases from the Dutch-oven furnace through the tubes in three passes. The tubes are mounted at 5-in. and 6-in. distances, so that any tube is accessible for repairs if necessary. These boilers also supply steam for a 140-hp Corliss engine driving three arc generators through a jackshaft and for a 25-hp high-speed engine.

The Lentz engine is operated condensing, exhausting into a Dean jet-type condenser. Complete, this 240-hp engine weighs 48,000 lb., but on account of its reduced weight of moving parts it is carried on an extremely light concrete foundation, the construction of which makes all parts of the engine accessible. Operated condensing the engine is guaranteed to develop a hp-hour on 2 lb. of coal.

In construction this engine presents many novel features of design. The accompanying illustration reveals its general resemblance to the horizontal type of gas engine, with cam-operated poppet valves, etc. In this steam engine, however, the cam-shaft speed is, of course, the same as that of the engine, instead of half engine speed as in the gas engine. The admission valves are at the top and the exhaust valves below, all being cam-operated for both the high-pressure and low-pressure cylinders.

Throughout the entire engine no elastic packing is used, the stuffing boxes being formed by a series of cast-iron rings, turned and ground within 0.001 in. and fitted into the carefully bored stuffing box. These rings do not touch the piston rod, but inserted between them are several "floating" square-sectioned rings which fit the rod to an accuracy of 0.001 in. The rings thus form a series of chambers. Any steam escaping from the first chamber is expanded and condensed in the next, and so on, each chamber being automatically drained of its condensed water. Oil may be kept circulating in the stuffing box if necessary, but the water of condensation is itself sufficient to prevent leakage and no leakage is shown past the outermost ring.

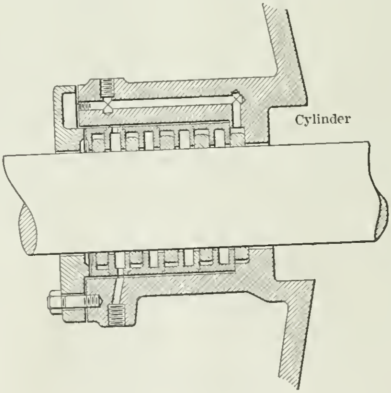


Fig. 1—Piston Stuffing Box.

The valves are of the double-seated drop type. No packing is used on the valve spindles, but they are also ground to fit, within 0.001 in., the long bushings through which they pass. The cam roller is in contact with the cam except when the valve is seated, so that the operation of the cam movement is practically noiseless.

The full-speed cam shaft is driven from the engine shaft by bevel, steel friction wheels pressed tightly together. To prevent slips, however, teeth are cut at one side of the wheels and these extend beyond the friction surfaces, meshing to provide driving action. The eccentrics for each of the eight valves are mounted on this cam shaft, and by a sliding-wedge arrangement in the shaft the throw of the eccentrics can be varied over any value, from zero to their maximum crank effect. The motion of this sliding wedge is controlled by a combined inertia-centrifugal governor also mounted on the shaft. Inclosing the flyballs of this governor is a heavy inertia ring, attached to the flyball motion through knee-joints in such a way that any slight change in speed (which reacts first on the inertia ring before affecting the balls) will assist the throw of the flyball movement. As a result of this unique application of the inertia principle the operation of the governor is very rapid and close speed regulation is obtained over sudden and large changes in load. By means of a handwheel on the governor shaft, controlling the eccentric wedge motions, the governor can be set at any predetermined speed while the engine is running. The governor is set to control the speed within 2 per cent throughout the entire range from full load to no load.

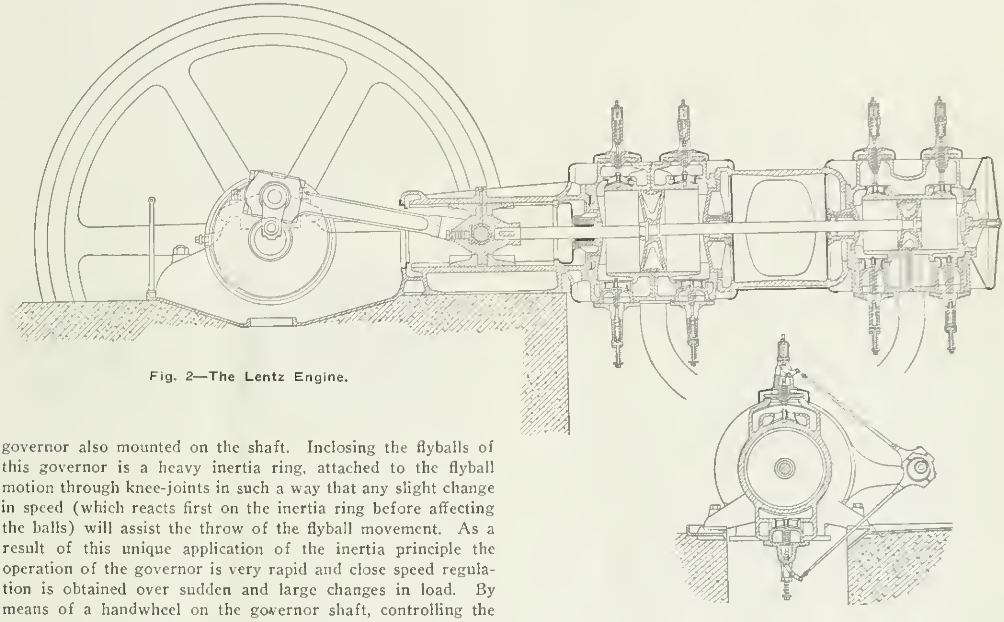


Fig. 2—The Lentz Engine.

The Lentz engine at Galesburg, Ill., together with the new vertical boilers, was built by the Erie City Iron Works, of Erie, Pa., and was installed by W. A. Day & Company, Chicago. Mr. W. A. Knutzen is city electrician of Galesburg and has charge of the street-lighting plant, in connection with which this engine is in use.

SHORTENED STANDPIPE SOLVED WATER-HAMMER TROUBLES.

The 1000-kw hydroelectric plant of the White River Power Company at Ashland, Wis., is located at the end of 1350 ft. of 9-ft. supply pipe, which throughout its length from the dam to its down-stream end (where it drops suddenly 20 ft. toward the waterwheels) is nearly horizontal, having a grade of barely 6 ft. in the 1350-ft. distance. Engineering experience would indicate that such a pipe line should be laid at a uniform angle from the dam to the wheels, but this portion of the installation was made by a local contractor who completed the work before engineering advice was invited upon the undertaking.

From the end of the nearly level pipe, therefore, the 9-ft. penstock bends suddenly downward entering, at an angle of 40 deg., the steel-plate receiver, 9 ft. in diameter and 23 ft. long, situated just behind the rear wall of the generating station. From this receiver are led the supply pipes to the two 900-hp Morgan Smith twin 24-in. runner, wicket-gate turbines, driving the two 500-kw, 2200-volt Westinghouse alternators These 900-r.p.m. units are controlled by Lombard type-D oil-pressure governors. There is one belted exciter and one waterwheel-driven exciter, the latter unit being equipped with a Woodward mechanical governor. From the wheels the discharge water passes through steel-plate draft tubes 12 ft. long to the tail-race.

As was to be expected from the long horizontal penstock pipe ending in the short inclined section, considerable water hammer developed with changes of load on the equipment. The decrease in gate aperture caused by a reduction in load of 75 kw or 100 kw produced inertia effects in the waterwheel lines that were quite terrifying to those operating the station. Such enforced changes in velocity of the water in the 1350 ft. of 9-ft. pipe developed tremendous pressures, water being even forced from under the bolts and rivets of the receiver and waterwheel casings.

To remedy this state of affairs, it was determined to erect a standpipe at the end of the long horizontal flume, where the latter started its downward plunge. An opening was cut in the top of the pipe, and from this, surrounded by a reinforcing header of heavy concrete, a 13-ft. vertical standpipe was carried up to a point about 8 ft. above the crest of the dam. The unusually large diameter of standpipe, 13 ft., rising from a 9-ft. header, was selected to insure the proper accommodation of the overflow water delivered by the heavy hammer effect. The standpipe was carried 8 ft. above the dam in an effort to save the spilling of water that would otherwise take place during heavy rises in the pipe.

With the new standpipe in position, efforts were again made to operate the waterwheels, but the same hammer effect asserted itself almost as badly as before. It was then realized that the increased head due to the water rising in the standpipe caused almost as much regulation trouble as the unspent inertia effect of the flume contents itself, so it was accordingly proposed to shorten the standpipe to a point where this effect would cease, even at the expense of spilling water over the top of the pipe The standpipe was accordingly cut off, a foot at a time, until a point was reached, about 2 ft. above the level of the dam, at which the governing action of the wheels took place without water hammer, and from this time on the plant operated successfully.

NOTES ON THE ECONOMICAL PRODUCTION OF STEAM.

By John B. C. Kershaw.

It may sound like a truism to assert that all types of boilers should be reserved solely for the production of steam. In view of the general practice of using boilers for purifying and warming the feed water, it may be as well to reassert the opinion of those best qualified to judge results that a boiler is designed for making steam and that to use it for other purposes is neither economical nor wise.

The amount of steam which can be produced from a clean boiler, fed with water at the boiling temperature, is double and even treble the amount that can be generated by a dirty boiler fed with cold or merely warm water. Not only is the efficiency of the boiler (measured in pounds of water evaporated per pound of fuel from and at 212 deg. Fahr.) increased by this method of work, but the expenditure upon cleaning and repairs is reduced, since less scale and dirt are separated inside the boiler and the strains set up by temperature differences are reduced. Even if the calcium salts be separated in the form of mud, which can be removed by blowing down the boiler periodically, it should be remembered that heat is lost with every gallon of water blown off in this way. The less blowing down is resorted to the higher the efficiency of the boiler as a steam producer will be. To secure the best possible conditions for steam production in boiler working it is therefore necessary to maintain as far as practicable clean boiler plates or tubes and an adequate supply of feed water raised to the temperature of the water inside the boiler. The importance of clean boiler plates is generally recognized in so far as this relates to freedom from hard scale on the water side of the plate, and most engineers in charge have their boilers periodically blown down and cleaned from adherent scale. It is doubtful, however, whether the question of using a purer water supply and scaling less frequently is sufficiently studied in its economic aspect. If a boiler could be run for ninety days instead of for thirty days before blowing down and cleaning were required the saving effected both in labor and the heat losses involved when a boiler is laid off for cleaning might more than balance the extra cost of the purer water supply. This question is one, of course, which can only be studied with all the data for each separate installation, and every engineer must therefore work out the answer for himself. A naturally pure water is required for the experiment. A water that has been chemically purified is hardly suitable for boiler working on these lines, since the salts which accumulate in the boiler, though soluble, may cause damage as they become more concentrated. Another point in relation to this question of clean boiler plates or tubes that is often overlooked is that boiler plates and tubes have two sides and that, while the importance of keeping the water side clean and free from thick deposits of scale is generally recognized and acted upon, the possibility of the heat side of the plates or tubes being equally dirty and in need of chipping is rarely acknowledged. It is a fact, however, that considerable gains in boiler efficiency have been obtained by thoroughly cleaning the fire side of the tubes of water-tube boilers. It is not merely that soot and dust collect in angles and places where the design makes a kind of pocket, but a hard scale often forms on the outside of plates and tubes, which can only be removed by chipping. The practice of sweeping the soot and dust from the sides and bottom flues and plates of the boiler when blown off for cleaning purposes should therefore be supplemented by scraping and chipping the fire side of plates and tubes when any hard incrustation is found upon these which might retard heat transmission. In this connection it is useful to note that soot is a very bad heat conductor and that plates or tubes coated with soot lose from 25 per cent to 50 per cent of their conductivity. The gains due to smoke prevention or abatement are therefore not entirely confined to the promotion of cleaner skies outside, but extend to the internal condition of the boiler and lead to increased efficiency.

As regards the actual gains in efficiency due to the use of a feed water at the temperature of the boiler much has been printed in the technical press bearing on this subject. The writer is one of those who believe that the gain is now actually established and that the answer to the question, Why does a boiler plate or tube transmit heat more rapidly when the water in contact with it is boiling than before it has attained the temperature of ebullition? is to be found in the diagram shown herewith. This represents the curve of the heat units absorbed by 1 lb. of ice at the absolute zero of temperature in its passage from the solid through the liquid to the gaseous state compared with the similar curve for steel when heated through the same range of temperature. The portion of the curve marked *D E* is that which calls for study in connection with this question, since it represents the heat absorption (966 lb.-Fahr. units) which accompanies the conversion of 1 lb. water at 212 deg. Fahr. into steam at the same temperature. Now it is evident that the heat absorption from the source of heat at this point in the production of steam from water must be much more rapid than when the water or steam is receiving what is known as sensible heat—that is, heat which can be measured by a rise in the thermometer. The water side of the plate must lose more heat in a given period of time, and thus be more quickly cooled, than when no steam is being made, for steam is a more mobile fluid than water and will escape more quickly from contact with the heated plate. There is no contradiction of the law that the rate of heat flow is proportionate to the square foot of the temperature difference between the two sides of the steel plate or tube, for when ebullition is occurring this temperature difference is greater and the rate of heat flow is greater. The classical observations of Sir William Anderson in 1872 may be referred to here. The writer has proved the correctness of these observations by laboratory experiments, using glass vessels, and has no reason to doubt that similar results would have been obtained with iron or steel vessels.

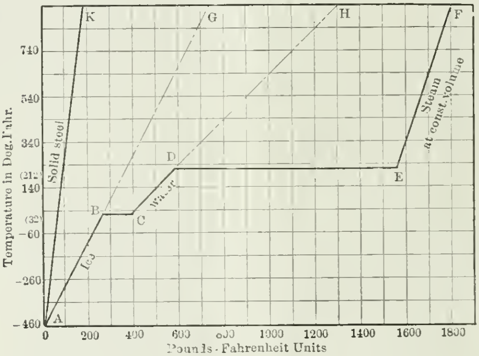


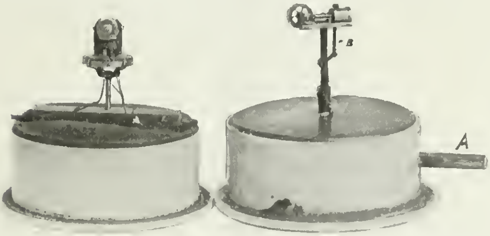
Diagram Showing Effect of Heat on Water.

Those engineers who have persisted in their disbelief of the accuracy of the figures for actual steam-raising trials showing greater boiler efficiencies with hot boiler feed than with cold feed, because this was, they supposed, in contradiction to the law of heat-transfer, will, it may be hoped, change their attitude in this matter and be prepared to accept hot boiler feed as one of the most important factors in obtaining high boiler efficiencies. Good circulation of the water in the boiler is another factor which requires attention in many cases. Finally, as the production of wet steam is a common fault of most boiler installations unprovided with superheaters and leads to great heat losses by condensation in steam pipes and engine cylinders, the more general use of superheaters is recommended. Jacketing for steam cylinders is closely allied with this subject of superheat and the prevention of heat loss by condensation before the steam has performed its work in the cylinder.

LETTERS ON PRACTICAL SUBJECTS

MINIATURE STEAM ENGINE AND ELECTRIC MOTOR.

The tiny electric motor and steam engine illustrated herewith, the picture being a trifle large than actual size, are interesting examples of miniature mechanical workmanship. They were made by the writer, and have been exhibited at international exhibitions. The little steam engine is made of 14-carat gold and Stubbs steel. It is put together with screws and not soft-soldered. It has a slide valve and is less than ⅜ in. long over all and 3/16 in. wide. The height is ⅛ in., except the flywheel, which is 5/32 in. in diameter. The other dimensions are of interest. The intake and exhaust pipes are less than 1/32 in. in outside diameter. The bore of the cylinder is 0.06 in., the stroke being 0.07 in. The crankshaft, with center throw, was turned from a piece of Stubbs steel, and the main bearings are 0.0175 in. in diameter. The slide valve moves 0.0175 in. by an eccentric on the main shaft. The complete engine weighs 6 grains and slips easily into a 0.22-calibre short cartridge shell. It will run with compressed air or steam. The pipe supplying the steam or air is shown at *A* connected to the smaller pipe *B*, the latter being a spectacle-frame wire bored out. Operated on a single cell of dry battery the little motor runs with a slight humming noise. It stands on a hard-rubber base less than 5/16 in. in diameter and is of about the same height. It has a "dumb-bell" armature wound with No. 40 silk-covered copper wire, and the field core is wound with 11 in. of wire of the same size. The binding posts are of gold, perfect in detail and 1/64 in. in diameter. In making this electrical trinket the commutator demanded most exacting work. It consists of two copper segments properly insulated and yet the outside diameter is less than 1/32 in.

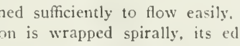


Miniature Steam Engine and Electric Motor (Very Slightly Enlarged).

Waterloo, Ia. S. A. Asquith.

PROTECTING GAS PIPES AGAINST ELECTROLYSIS.

After a number of experiments in the effort to insulate and protect its service-pipe runs against electrolysis the Laclede Gas Company, of St. Louis, is now covering its wrought-iron piping with layers of pitch and paper, which seem successful in solving a vexatious problem. The wrought-iron pipe, in sizes from 2 in. to ¾ in., is first coated with a tar-and-pitch mixture, heated and thinned sufficiently to flow easily, and onto this a 4-in. paper ribbon is wrapped spirally, its edges overlapping. This paper covering is then tar-painted and again wrapped with paper, the process being repeated until four successive coats of tar and paper have been applied. Pieces of pipe thus insulated have been placed in the ground under the most distinctive conditions of electrolysis, along with other lengths not so treated. After being taken up at the end of two years the unprotected pipes were badly pitted and almost completely consumed, while the insulated piping was virtually in the same condition as when laid. Although no test has yet been made carrying the insulated pipe to total disintegration, it is believed that pipe so treated will have its life at least doubled, and if this is true an expenditure for insulation equal to that of the cost of the bare pipe is justified. Only service runs are being so treated, the cast-iron mains being less subject to corrosion and electrolysis than the service pipes. The tar and paper coating is very hard when cooled, and the pipe lengths need be handled with no more care than bare pipe.



Applying Paper to Tarred Pipe.

East St. Louis, Ill. J. L. Fitzhugh.

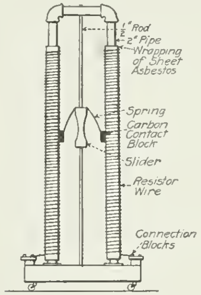
COMBUSTION RECORDER ON NATURAL-GAS-BURNING PLANT.

The steam-plant engineer familiar with coal as a fuel who attempts to draw conclusions from his old friend, the carbon-dioxide recorder, applied to a flue conveying away the products of natural-gas combustion will probably suffer several surprises when he examines such an analysis for complete combustion. After setting his burners to give their best bunsen flames and with a cloudless sky unsullied by his chimneys he may congratulate himself that he is accomplishing perfect combustion of the fuel gas. Turning, then, to his recorder analysis, however, he will perhaps find some such reading, in percentage volume, as follows: CO_2, 4.4; oxygen, 11.2; CO, 0; stack temperature, 355 deg. Fahr. The preceding was an analysis which plainly worried one plant operator who had been accustomed to relying on his recorder for accurate coal-combustion data. Seeking enlightenment on the subject, he found that natural gas is chiefly composed of methane, CH_4. This at once suggested that the principal product of burning the natural gas might be expected to be H_2O, or water vapor, exceeding by far the carbonic gas produced. Having no means to determine the amount of water vapor present in the stack, a chemical friend undertook to work out the index of relation between the H_2O and CO_2 produced and found that the conditions of best combustion of the 966-heat-units gas used were being fulfilled with 11.6 per cent by volume of CO_2 passing up the chimney. Although the plant records indicate an efficiency of 1 kw-hour produced for each 40 cu. ft. of gas burned under the boilers, the troubled engineer has not yet been able to boost his actual CO_2 content up to the figure theoretically attained by simple chemical reasoning.

Pittsburgh, Pa. John L. Sand.

A HANDY PORTABLE RHEOSTAT.

A handy pipe-frame wire-wound rheostat capable of very finely graduated adjustments and useful for many purposes, such as loading machines, discharging batteries, etc., is shown in the accompanying sketch. The frame is made up of lengths of 2-in. iron pipe connected by the cross-piece and elbows, and firmly mounted on a wooden platform, which may be equipped with rollers to make the apparatus portable. Around the vertical pipes sheet asbestos is wrapped and on this is wound the resistor wire, in a single layer, care being taken to leave a slight air space between adjacent turns of the wire. In the cross-piece, half-way between the elbows, a hole is drilled to receive the vertical rod on which slides the movable contact, the lower end of the rod being firmly fixed in the platform. On this smoothed rod a rider is arranged to slide. This rider carries a pair of brass spring pieces ending in carbon blocks which bear flatly on the turns of the rheostat wire. The lower ends of the resistor coils are connected to binding posts on the platform base. When the slider is at the top of the rod all of the resistor is in circuit, and when dropped to the bottom the resistor is cut out. The friction and pressure of the springs on the coils hold the slider in position at any point desired. As the carbon contact blocks bridge several turns of the wire there is no sparking during the movement of the slider from one point to another. The vertical position of the resistor coils assists in dissipating the heat rapidly by a sort of chimney action and the margin of space around the bottom of the platform prevents the hot rheostat from being brought into contact with anything which could be damaged. Aside from these points the rheostat is inexpensive to build, and in serviceability will many times repay its cost. The resistor wire should be wound in opposite directions around each leg of the rheostat so as not to magnetize the pipe by the heavy currents flowing.



A Handy Portable Rheostat.

Cleveland, Ohio. A. S. Johnson.

FOUNDATIONS FOR ELECTRICAL MACHINERY.

In some cases after a machine is aligned on a foundation preparatory to being grouted in, the space between the foundation bolts and their casings is filled with grout. Bolts should never be thus "grouted in" in pocketed foundations, because the reason for pocketing is that the bolts may be removable. It is believed that where a machine is well grouted to a foundation it is not necessary to fill the casings with cement. The bolts will hold the machine down to the foundation and the grout between the bedplate of the machine and the face of the foundation will prevent lateral movement. Where wooden casings are used they should be removed from the foundation if the bolts are to be grouted in before the grout is poured. Where wooden casings are to be removed they should be tapered slightly from one end to the other so that they can be removed easily.

Many types of foundation washers are used. Three of the most common, arranged on their bolts, are shown in Fig. 1. That shown at *A* and detailed in Fig. 4 is especially designed for foundation applications. At *B* an ordinary building washer is shown. In Fig. 3 are given the dimensions and weights of one manufacturer's line of building washers which are approximately typical of all. Each manufacturer's line appears to differ slightly from those of others. Washers can be proportioned from the equations given in Fig. 3. Washers proportioned from the equations will differ somewhat in dimensions from those for which dimensions are tabulated. Cast-iron building washers can be used for foundation washers with safety where the bolts that carry them are to be cemented in, but it is probably better to use a stronger and larger washer, like that of Fig. 4, where casings are arranged around the bolts.

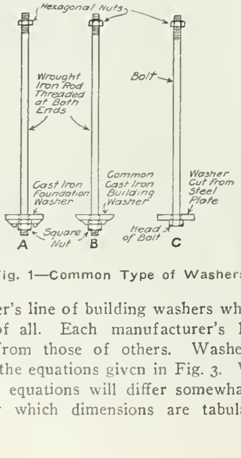

Hexagonal Nuts
Wrought Iron Rod Threaded at Both Ends
Bolt
Cast Iron Foundation Washer
Common Cast Iron Building Washer
Washer Cut From Steel Plate
Square Nut
Head of Bolt
A
B
C

Fig. 1—Common Type of Washers.

Washers like that shown at *C*, Fig. 1, can be cut from steel plate where regular cast-iron foundation-bolt washers (Fig. 4) are not available. As shown in Fig. 2, the plate washer is merely a square piece of steel plate with a hole drilled or punched through it. The length of each side of a punched washer may, for the same size of bolt, be made equal to the length of side for a cast washer, as given in Fig. 4. The thickness of the punched washer should be less than the thickness shown in Fig. 4 for cast washers, because wrought iron (mild steel) is considerably stronger than cast iron. A plate washer should be about one-half the thickness of a cast-iron one, as given in Fig. 4.

Tabulated above Fig. 4 are the dimensions of a line of cast-iron foundation-bolt washers that has given very satisfactory service. The area of face of each washer is ample to maintain the pressure on the masonry when the bolt is stressed to its safe strength. The washers are thick enough so that they will not crack, even if the load is imposed on them unevenly. Small bosses on the lower face prevent a square nut on the lower end of a foundation bolt from turning. The pattern is so simple that any foundry can make good castings from it.

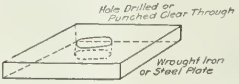
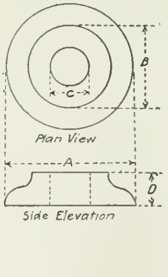

Hole Drilled or Punched Clear Through
Wrought Iron or Steel Plate

Fig. 2—Washer Made from Steel Plate.

Pockets for foundation-bolt washers are provided, as indicated in Figs. 5 and 6, in foundations from which the bolts must be removable. Occasionally a foundation bolt is broken off at the threaded portion and it is difficult to replace the bolt unless pockets are provided. Again, it is sometimes not feasible to place the bolts at the time the foundation is being constructed, possibly because the bolts have not been received from the manufacturer of the machine, who sometimes furnishes them. In such instances pockets must be provided. A pocket is a hand hole or chamber from the side of a foundation (or, in some cases, from a tunnel through a large foundation) extending to a point somewhat beyond and directly under the lower end of a foundation bolt. The pocket is only large enough so that a foundation-bolt washer can be inserted and so that the nut on the bolt can be turned on or off.



Dia. of Bolt = *d*	A.	B.	C.	D	Wgt. in Lbs.
½	2 5/8	1 3/4	9/16	5/8	½
5/8	3	1 7/8	11/16	3/4	3/4
3/4	3 1/4	2 1/8	13/16	7/8	1 ¼
7/8	3 3/4	2 ½	15/16	7/8	1 ½
1	4	2 3/4	1 1/16	1 1/8	2 ½
1 1/8	4 3/4	2 3/4	1 3/16	1 1/8	3
1 1/4	6	3	1 5/16	1 3/8	5 3/4
1 ½	6 1/4	3 1/4	1 5/8	1 ½	6
1 3/4	7 1/4	3 3/4	1 7/8	1 3/4	9 ½
2	8 1/4	4 1/4	2 1/8	2	17 ¼
2 1/4	9 1/4	4 3/4	2 3/8	2 1/4	20
2 ½	10 1/4	5 1/4	2 5/8	2 1/2	27 ¼
2 3/4	11 1/4	5 3/4	2 7/8	2 3/4	36
3	12 ¼	6 1/4	3 1/8	3	46

For sizes not given in table the dimensions given by the following equations may be used.

Diameter of bolt $= d$

$A = 4\,d + \frac{1}{4}$ in.

$B = 2\,d + \frac{1}{4}$ in.

$C = d + \frac{1}{8}$ *in.*

$D = d$

Fig. 3—Dimensions of Round Cast-Iron Washers.

Pockets in stone or brick masonry foundations are readily constructed from stone or brick. The roof of each pocket consists of a slab of stone with a hole for the bolt drilled through it. Forms of wood around which the concrete is tamped are usually employed for the formation of pockets in concrete foundations. Figs. 7, 8 and 9 show some types of pocket forms. In Fig. 7 the bolt casing is of wood and the pocket form is a box without one end or bottom. In building the foundation in which this arrangement was used the footing course of the foundation was first placed and then the form for the upper portion of the foundation was located and erected on the footing. The position that each foundation bolt should occupy was determined and supports for the casings (see Fig. 7) were arranged accordingly. The piece of board forming the top of the pocket form was cut to dimensions, taken from the foundation drawing, and nailed in correct position to the bottom end of the casing. The three wooden pieces constituting the sides and one end of the form were assembled and placed in the location that they should occupy under the casing and the top piece of the pocket form supported by it. Then the casing was slid up out of the way and the pocket form was filled with sand. Enough concrete was thrown around the outside of it to prevent its shifting or spreading. The top board of the form, with the casing attached to it, was then brought down into position and nailed to the three sides already in place. The pocket forms for the other bolts were similarly prepared and the foundation was poured. When the form was removed the sand poured out of the pockets and the boards composing the pocket form were pried out with a bar. Sand within pocket forms prevents them from collapsing because of the weight of concrete above them or because of heavy tamping.

DIMENSIONS OF CAST-IRON FOUNDATION-BOLT WASHERS.

Dia. of Bolt.	Wgt. of W'sher	A.	B.	C	D.	E.	F.	G	H.	I.	J.
7/8"	8 lb	6	3 1/2	1 1/8	1 5/8	1/2	3/4	5/8	1/2	3/8	1/2
1 "	15 "	8	4 1/4	1 3/8	1 3/4	1/2	1/2	3/8	5/8	3/8	1/2
1 1/4"	30 "	10	4 1/2	1 5/8	2 1/8	7/8	3/4	1/2	3/4	3/4	1/2
1 1/2"	45 "	12	5 1/2	1 7/8	2 1/2	3/4	7/8	1/2	7/8	5/8	1/2
1 3/4"	60 "	14	5 1/2	2 1/8	2 7/8	1	1	5/8	1	1/2	1/2
2 "	100 "	16	6	2 3/8	3 1/4	1 1/8	1	5/8	1 1/8	7/8	1/2
2 1/4"	135 "	18	7	2 5/8	3 5/8	1 1/4	1 1/8	3/4	1 1/4	3/4	1/2
2 1/2"	154 "	20	9	2 7/8	4	1 1/4	1 1/8	1	1	1	1/2

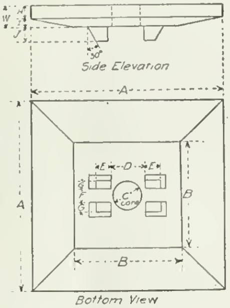


Fig. 4—Dimensions of Flat-Foundation Bolt Washers.

Sometimes a slab of stone is used, as shown in Fig. 8, to form the back of a pocket and the sides of the form are supported by sand on the inside and a few shovelfuls of concrete on the outside. After the cavity formed by the side pieces and the back stone has been filled with sand the top board of the form, which supports the casing, is nailed to the side pieces. When the foundation has set the boards of the pocket form are pried out and the slab of stone remains. The casing shown in Fig. 8 is a piece of wrought-iron pipe and would have to be held at the top of the foundation form by a templet or by a support like that shown in Fig. 7. Where the foundation bolts are available or where temporary bolts, which can be of smaller diameter than the foundation bolts, can be secured the pocket-form arrangement of Fig. 9 is convenient. The casing (Fig. 9) is cut to a length exactly the distance between the top of the foundation and the roof of the pocket. The top of the foundation bolt is located accurately in the foundation form by a templet. The casing is arranged concentrically with the bolt by one of the methods previously shown and is clamped between the bottom face of the templet and a board which forms the top of the pocket form. A slab of stone constitutes the back of the pocket. The boards composing the sides of the pocket form (Fig. 9) are prevented from collapsing by another board nailed between them at the bottom and by nails driven through the top board and into them. It is not practicable to use sand in a pocket form with the arrangement of Fig. 9. It should be noted that with this arrangement the templet locates the casings and the positions of the pockets and that the elevation of the tops of the pocket forms is determined by the length of the casings. If the templet is laid out accurately and the casings cut to correct length the pocket forms, almost automatically, locate themselves both laterally and vertically. There is little chance for error and only few measurements have to be made by the concrete men.

The sides and back of a pocket are sometimes built with bricks, as illustrated in Fig. 10. Through this method practically all form work is avoided. A piece of board must be used as a form for the roof of the pocket. It can be supported by a bolt, as shown in Fig. 9. In building this type of pocket, the bolt, casing and the board constituting the top of the form are first suspended from the templet as shown. The brickwork sides and back are then built around the edges of the board. The sides are built first and braced inside with temporary bricks or with pieces of board. Then the back is built. Assume now that a foundation has been erected, that the foundation bolts are accurately located in it and that an electrical machine is to be installed on it. The machine is transported to the foundation and arranged on it with the foundation bolts projecting through the corresponding holes in the bedplate of the machine. The bedplate is not allowed to rest directly on the foundation, but is held about 1 in. above it with wooden blocking or iron wedges, as indicated in Fig. 11. This 1-in. space between the foundation and the bedplate is ultimately filled (see Figs. 11 and 12) with grout, which is a mixture of, say, two parts sand and one part cement. Grouting is necessary to insure that the bedplate will rest firmly on the foundation and to provide for any inequalities between the top surface of the foundation and the bottom surface of the bedplate. Before the grout is poured the machine is carefully adjusted to the right elevation and leveled by manipulating the blocking between the bedplate and the foundation. If the foundation bolts are set in casings slight lateral adjustments can be made. Grouting should be provided for in determining the lengths of foundation bolts, and it should also be allowed for in the elevation measurements on the foundation erection drawings.

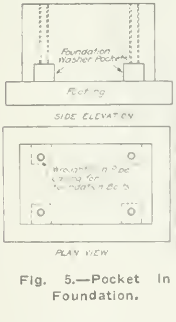


Fig. 5.—Pocket In Foundation.

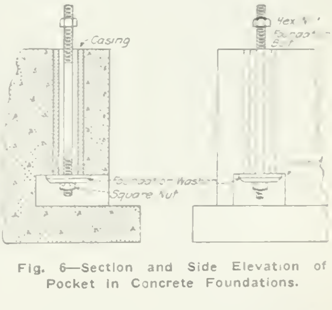


Fig. 6—Section and Side Elevation of Pocket in Concrete Foundations.

After the machine has been leveled, aligned and adjusted to elevation dams to impound the grout are constructed entirely around the bedplate, as indicated to the left of Fig. 11. If the volume to be filled with grout is not great the entire space under the bedplate is filled with it, as shown in Fig. 11. Dams are built of pieces of plank and are held in position with bricks, stones and clay or mortar.

The grout is mixed to the consistency of thick cream. It is poured into the inclosure and permitted to flow and fill the area under the bedplate. It should be agitated through any openings in the bedplate while it is flowing so that it will flow uniformly and fill all cavities. If it is desired to have the space between foundation bolts and their casings fill with grout the orifices at the tops of the casings are left open and the grout as it enters the casings is churned with a piece of wire or a stick. These openings at the tops of the casings can be plugged with blocks and paper wads if the casings are not to be filled.

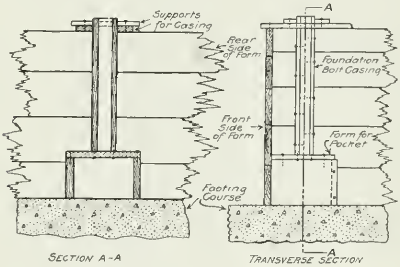


Fig. 7—Forms for Washer Pocket.

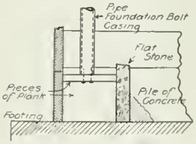


Fig. 8—Stone Forming Back of Pocket.

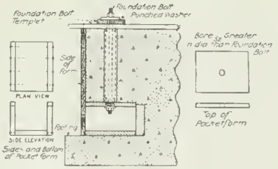


Fig. 9—Bolt Supporting Top of Pocket Form.

After the grout has stiffened somewhat the dams are removed and the grout is neatly cut away from the bedplate, as shown at the right-hand end of the bedplate of Fig. 11.

Plaster of paris has been recommended for grouting where it is necessary that a material be used that will set quickly. Mr. J. F. Hobart claims that plaster mixed with one-half of its weight of water will sustain a load of 500 lb. per square inch after setting one hour; that at twenty-four hours its crushing strength exceeds 1000 lb. per square inch, and that after twenty-four hours of setting it exceeds 2300 lb. per square inch. The weight of water used for mixing should exceed one-half the weight of the plaster. If less water is used the mixture will not pour easily. Plaster grouting must be mixed and poured quickly and should be prepared in small batches, as it sets very rapidly. Objections to plaster are that it absorbs moisture and oil readily and that it will not withstand the action of acids to the same extent as cement.

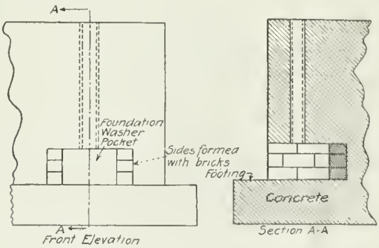


Fig. 10—Pocket Made with Brick.

Some manufacturers of electrical machinery mount their medium-sized and small generators on two slide rails like those shown in Fig. 12, *B*, instead of on a self-contained bedplate, as indicated at *A*. Slide rails should be avoided. They usually require more foundation bolts than do bedplates (there are eight bolts required at *B* as against four at *A*) and it is much more difficult to level, adjust and align two slide rails than it is one bedplate. An inspection of Fig. 12 will make evident the truth of these statements.

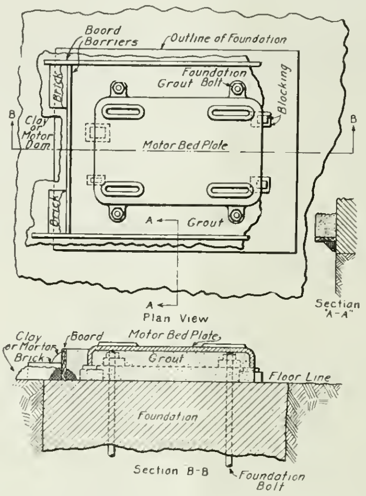


Fig. 11—Motor Bedplate Mounting.

It is specified in the National Electrical Code that generators and motors operating at pressures in excess of 550 volts must have their base frames permanently and effectively grounded and that when operating at pressures of 550 volts or less they should be thoroughly insulated from the ground wherever feasible. Wooden base frames are recommended for insulation. Where frame insulation is impracticable it is specified that "the inspection department having jurisdiction may, in writing, permit its omission, in which case the frame must be permanently and effectively grounded." Electrical machines carried on masonry foundations are seldom insulated from the ground. Wooden stringers inserted for insulating purposes between a machine and a foundation would provide a yielding support which under severe service would soon permit a machine to throw itself from alignment. In general, authorization having been secured, the frames of all electrical machines mounted on foundations should be grounded.

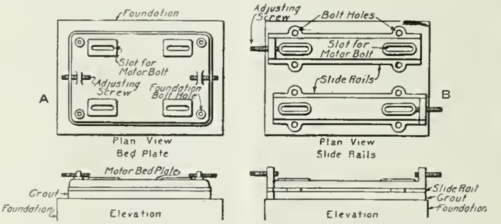


Fig. 12—Standard Mountings of Electrical Machinery.

Pittsburgh, Pa. Bruce H. Page.

QUESTIONS AND ANSWERS

Why is it that a tungsten lamp consumes so much more current when first switched on than it does a minute after? F. C. M.

The resistance of a tungsten lamp is less when cold than when the filament has been heated. Therefore more current is permitted to flow at the instant of starting. The resistance increases after the lamp has been burning a moment and then remains stable.

Is it possible to utilize the cooling water from transformers for boiler-feed purposes? If not what are the objections to its use? D. B.

Transformer cooling water has often been employed for boiler-feed purposes and the practice is commendable, especially where city water must be used and is sold on a meter basis. There is no reason why a transformer cannot be employed as an auxiliary feed-water heater.

What is the relative output of a double-current generator compared with a direct-current generator? E. M. N.

If a certain number of taps are placed along the armature windings of a direct-current generator, and these taps are connected to proper collector rings, alternating current can be taken from the collector rings at the same time that direct current is taken from the commutator. A machine operated in this way becomes a double-current generator. With equal outputs at the direct-current and alternating-current ends the machine could have the following relative permissible outputs, the output as a direct-current generator being considered as unity: At 100 per cent power-factor the permissible output with two rings would be 0.95; with three rings, 1.02; with four rings, 1.05, and with six rings, 1.07. When the power-factor on the alternating-current side is less than 100 per cent the permissible total output is reduced, the value for 90 per cent power-factor being as follows: Two rings, 0.89; three rings, 0.99; four rings, 1.02, and six rings, 1.04.

Is it possible to take a half-way tap from the secondary of one transformer in a three-phase delta-to-delta-connected 2200-to-220-volt distribution system, and use this wire as a third, or neutral, wire in a 110-volt lighting system? Could all the lamps be placed on one phase of such a system by using a larger transformer, or should the load be evenly divided between the three transformers, using a neutral tap on each of the secondaries? Are there any objections to grounding the three middle taps through spark gaps in groups or singly? Where should the voltage regulators be placed in such a system? B. E.

So far as the lighting load is concerned the three-wire arrangement suggested will operate satisfactorily. However, the load on the three-phase system would be unbalanced and the voltage relations would be distorted. If the lighting load forms only a small part of the total load on the system fair results can be obtained by placing all of the lamps on one transformer of properly increased size and regulating the voltage with reference to only this one transformer, the voltage of the remaining transformers being allowed to take care of itself. In this case the motors would take the major portion of their load from the lightly loaded phases. If the lighting load forms a large part of the total load on the system it would be better to divide it equally between the three phases, in which event the three-wire arrangement could be used on each of the three phases. However, the most satisfactory arrangement involves the use of separate circuits for the motors and lamps. The lightning arrester spark-gaps should not be placed in a common group, but should be widely separated.

Will you kindly give values that are assignable to the various types of arc lamps, that is, the mean spherical candle-power, power consumption and the specific consumption in watts per candle-power? D. L.

The performances of standard open and inclosed-arc lamps using carbon electrodes are as follows: A 9.6-amp direct-current open-arc lamp fitted with a clear globe and having an electrode life of fourteen hours consumed 461 watts and gave a mean spherical candle-power of 389, or showed a specific consumption of 1.2 watts. A similar lamp fitted with flat carbon electrodes having a life of seventy-five hours showed a power consumption of 490 watts and gave 240 mean spherical candle-power, or a specific consumption of 2 watts. A 5.25-amp multiple direct-current inclosed arc having an electrode life of 125 hours and consuming 610 watts gave 163 mean spherical candle-power with a clear inner and opal outer globe, 220 mean spherical candle-power with clear inner and outer globes, and 115 mean spherical candle-power with opal inner and outer globes, or specific consumptions of 3.7 watts, 2.8 watts and 5.3 watts respectively. A 3.5-amp direct-current multiple inclosed carbon-arc lamp having an electrode life of 125 hours and fitted with various inner and outer globes showed a power consumption ranging from 387 watts to 393 watts and yielded from 63 to 120 mean spherical candle-power. The lowest specific consumption of six tests was 3 watts and the highest 6.25 watts per mean spherical candle-power. A 6.6-amp direct-current series inclosed-arc lamp fitted with opal inner globe alone showed a power consumption of 565 watts with 307 mean spherical candle-power, and when fitted with a clear inner globe alone a power consumption of 565 watts with 414 mean spherical candle-power, or specific consumptions of 1.4 watts and 1.8 watts respectively, the electrode life being 120 hours. Tests on four 6.6-amp alternating-current series inclosed-arc lamps consuming 502 watts gave mean spherical candle-powers ranging from 155 to 216 and specific consumptions of from 3.2 watts to 2.3 watts The power-factor of the lamps was 82 per cent. A 7-amp alternating-current multiple inclosed-arc lamp having an electrode life of seventy-five hours and a power-factor of 70 per cent showed with a clear inner globe alone a power consumption of 530 watts and gave 178 mean spherical candle-power, or a specific consumption of 3 watts. The same lamp fitted with an opal inner globe gave 133 mean spherical candle-power, or a specific consumption of 4 watts. An intensive carbon-arc lamp having an electrode life of twenty-five hours and fitted with an opal globe, the lamp being rated at 5.5 amp on multiple circuits, showed a power consumption of 650 watts and gave 333 mean spherical candle-power, or a specific consumption of 1.9 watts. A 4-amp magnetite and metallic-flame series-arc lamp having an electrode life of 175 hours and fitted with a clear globe had a power consumption of 304 watts and gave 273 mean spherical candle-power, or a specific consumption of 1.1 watts. A 6.6-amp magnetite series-arc lamp fitted with an opal globe consumed 482 watts and gave a mean spherical candle-power of 360, or a specific consumption of 1.3 watts. Direct-current flaming-arc lamps connected two in series with an electrode life of approximately seventeen hours consumed from 405 watts to 667 watts and yielded candle-powers ranging from 638 to 1311, the specific consumption ranging from 0.94 watt to 0.47 watt per mean spherical candle-power. Alternating-current flame-arc lamps having power-factors ranging from 88 per cent to 91 per cent showed power consumptions ranging from 500 watts to 640 watts. A 12-amp lamp fitted with opal globe and operating two in series when fitted with electrodes yielding yellow, white and pearl-white light respectively showed power consumptions of 630 watts, 640 watts and 616 watts respectively, the mean spherical candle-power being 965, 470 and 302. The specific consumption of the lamps in the order given was 0.65 watt, 1.3 watts and 2 watts. A 6.6-amp multiple regenerative flaming-arc lamp had a power consumption of 449 watts and yielded 775 mean spherical candle-power, or a specific consumption of 0.58 watt, the life of the electrodes being seventy hours. It is interesting to note in this connection that the specific consumption of the tungsten-filament incandescent lamp is approximately 1.3 watts per mean horizontal candle-power. In order to compare the incandescent lamp with an arc lamp whose performance is given in mean spherical candle-power it is necessary to multiply the value of the mean horizontal candle-power of the incandescent lamp by its spherical reduction factor. The latter depends on the type and characteristics of the lamp used.

Central Station
Management, Policies and Commercial Methods

SAVING IN COST OF ICE DELIVERY.

A Southern combination ice-electric plant which formerly hired wagons to do its ice delivery at $2.50 per day for driver, team and wagon last year replaced three such wagons with one gasoline automobile truck, which costs $5 a day for operation, including the wages of driver and helper (both of whom deliver ice) and also $1 a day for gasoline. The automobile-delivery wagon cost $1,000 and about $100 a year is spent in keeping it in repair. Though nominally a 1000-lb. wagon, the car usually leaves the station with five 300-lb. blocks of ice aboard, its load decreasing, of course, as it progresses on its rounds. The greatest time-saving effected by the automobile occurs in getting to and from its delivery route, enabling several trips a day to be made where a wagon could make only one.

FLOODED-AMMONIA SYSTEM WITH FORE COOLING.

A gain in efficiency and output of at least 25 per cent is said to result from the use of an improved flooded-ammonia system which is being employed in a number of combination ice and electric plants headed by Mr. C. W. Dawley, of McAlester, Okla. The improvement is the invention of Mr. Mayhew, chief refrigerating engineer of this chain of plants in Oklahoma, Arkansas and Texas. Besides the advantages of flooded operation due to higher contact efficiency in the heat exchange at the freezing coils, whatever anhydrous ammonia liquor passes through the coils unevaporated is trapped back to a fore-cooling tank, reducing the temperature of the water almost to the freezing point before it enters the cans. In this way a great saving of heat is effected, resulting, in practical operation, in increasing the output from 20 per cent to 25 per cent.

COMBINATION ICE-MAKING PROFITS IN TOWN OF 5000.

The electric-light business in a Southern town under 5000 population was operated for several years at a loss until an opportunity came for putting in an ice plant in combination. The 25-ton compression plant, together with a 20-ton tank, cost $20,000 to install, including additional buildings, one boiler and a 100-ton cold-storage room. The ice-plant operating expense is made up as follows: Fuel, $200; salaries, office, supplies, etc., $200; water, $100; total, $500 a month. The ice plant is operated eight months a year on account of the long season, and ice is sold wholesale for $6.50 a ton and 50 cents per 100 lb. at the platform. The annual income from this plant has been $10,000 for the ice department alone, although the electric plant still barely pays expenses.

ICE BUSINESS MAKES ELECTRIC SERVICE POSSIBLE.

St. James, Mo., with 2000 population, is an example of a small community in which electric service is made possible by the operation of an ice plant in combination. In this case, as seems not infrequent in ice-electric plants, the ice equipment is the principal revenue producer, while the electrical business is done virtually at a loss. The plant comprises 75 kw in electrical equipment and a twenty-ton steam-driven compression plant, sharing a common set of boilers. The plant has received the best possible construction, inside and out, and cost $27,000, of which $19,000 is invested in the ice machinery. Being the only artificial ice plant in its neighborhood, ice is shipped to surrounding towns, justifying the twenty-ton equipment installed, which would ordinarily be excessive for a town of 2000 population. The 200 electrical customers benefit from this ice production by getting night electrical service, the losses during the establishment of the electrical business being recouped from the ice plant.

COMBINATION-PLANT INVESTMENT AND INCOME IN OKLAHOMA.

A combination ice-electric plant in a growing town of 4000 population in northern Oklahoma has a 12-ton ammonia compressor steam-driven by a Corliss-gear engine. The ice-making equipment, including compressing machinery, tank, cooling tower, delivery wagons and the proportional share of the boiler capacity, represents an investment of $17,000. Ice is sold locally at 20 cents to 50 cents per 100 lb. depending on the quantity used, and some surplus is disposed of in wholesale car lots at $3 to $4 a ton. The average price received for all ice sold is 37 cents per 100 lb.

Last year the income from the ice part of the business was $5,000 after subtracting the cost of labor, gas, fuel and other operating charges, but making no allowance for depreciation. Assigning 5 per cent for such depreciation, the net income is thus seen to reach about 23 per cent on the original amount invested.

The profits made in the ice department of the business are in marked contrast to the results produced by the electrical department, the annual gross income of which is approximately the same as that from the ice business. On account of the far heavier investment and operating costs of the electrical end, however, such profits as are found remaining on the books at the end of a year's run are practically eaten up if due allowance be made for proper depreciation losses. This unbalanced condition of ice and electric incomes, always in the favor of the ice plant, appears common in small combination plants and deserves investigation from other managers with purely electric stations who find their electric income alone either satisfactory or insufficient.

PRIME MOVER FOR ICE PLANT AND ELECTRIC DAY LOAD.

The combination ice-electric plant of the Atoka (Okla.) Ice & Power Company is unusual in having a combination prime mover for its electric generator and ammonia compressor. As a result during the summer time, when the ice machine is in continuous use, twenty-four-hour electric service is available for driving fans and operating electric irons. From the day business which it has been possible to establish in this way, Mr. L. B. Griffing, manager of the company, now feels justified in instituting twenty-four-hour service throughout the year, and does not contemplate shutting down again after starting his day service May 1.

Although this combination arrangement of compressor and electric engine effects a saving by requiring the minimum of apparatus investment, some losses are involved in compromising the high speed required by the generator with the low speed of the compressor unit, besides the other objections of inflexibility of the set. The installation comprises a 125-hp Corliss engine, running at 70 r.p.m. and driving a 25-ton horizontal

Wolff-Linde ammonia compressor. From the 10-ft. flywheel on the shaft a belt is carried to the 75-kw, 2300-volt, 60-cycle, three-phase alternator running at 514 r.p.m.

Heretofore, from Sept. 1 to April 30, the ammonia cylinder has been operated idle, the engine being run twelve hours nightly to drive the alternator only. From May 1, however, the output of the ice machine requires twenty-four-hour operation of the engine, and this incidentally furnishes day service for electric fans and motors at a time of the year when they are most welcome. For meeting the peak load, with the compressor in service, an auxiliary generator driven by a 65-hp engine is also arranged to be operated from 8 p. m. to 10 p. m. As a result of the day load now established by summer operation, the plant is to furnish twenty-four-hour service continuously.

BUTCHERS' SAVINGS WITH MECHANICAL REFRIGERATION.

By replacing ice cooling of cold-boxes with mechanical refrigeration using central-station motor service, butchers, florists, confectioners and others are usually able to show a saving over their former ice bills. Especially is this true in the Southern States having protracted heated seasons, where natural or artificial ice is correspondingly scarce and costly.

For preserving foodstuffs in any climate, however, mechanical refrigeration has the important advantage of producing a "dry" cold which can be carried to any low temperature desired. With ice, of course, only a humid cold, not below 32 deg. to 35 deg., can be obtained in the ice-box, but with refrigeration sub-freezing temperatures are easily reached and the dirt and annoyance of ice delivery are all avoided.

Alley Brothers & Company, butchers at Muskogee, Okla., who do their own slaughtering, last year installed a 7½-ton ammonia-compressor refrigerating machine driven by a 15-hp motor. This equipment maintains continuously a temperature 27 deg to 36 deg. in four large ice-boxes of the following dimensions: One box 14 ft. x 16 ft. x 11 ft., one 6 ft. x 8 ft. x 11 ft., and two 3 ft. x 6 ft. x 11 ft. These boxes are charged with warm, freshly killed meat, so that the load on the refrigerating plant is heavier than it would be if used only to preserve meat already chilled or frozen. The average consumption of the outfit has averaged about 1100 kw-hours per month, the same motor being used to drive, through shafting, a meat chopper, sausage machine, 200-lb. lard agitator and a 12-in. grindstone. The Alley company is quoted by Mr. Norman B. Hickox, contract agent of the Muskogee Gas & Electric Company, which supplies the service, as declaring that the cost of this mechanical refrigeration is from one-half to one-third that formerly paid for equivalent ice, being about the same for refrigerating the four boxes as for icing one 6-ft. x 8-ft. x 11-ft. box

INVESTMENT AND INCOME FROM 25-TON COMBINATION ICE-ELECTRIC PLANT.

A certain 25-ton combination ice-electric plant in a town of 8000 population on the same line of latitude as Little Rock, Ark., represents an investment of $40,000 in the ice department of its business. The first cost was divided as follows: Buildings, $12,000; ice-making equipment, including steam-driven compressor, boiler, can tanks, etc., erected, $22,000; 75-ton ice-storage room, $3,500; delivery wagons, $2,500. The equipment is all of the best, installed by competent engineers, and the buildings are of modern concrete and steel construction, with cork-board insulation, etc.

The steam-driven compressor plant produces approximately 3 tons of ice per ton of coal, an average figure in plants of this size, despite the claims of machinery manufacturers and others. The cost of making and delivering a ton of ice in the town mentioned is about $4.50, including all plant expenses, fuel, delivery charges, overhead, etc. The plant expenses alone run about $2 per ton, of which from $0.80 to $1 is for fuel alone. Including plant labor and delivery labor, stable expenses, management, etc., the cost of placing a ton of ice in the customer's refrigerator thus reaches $4.50.

The average rate for which this ice is sold is about $6.50 per ton. Last year during a season of 150 days 4000 tons of ice were produced, quantities of from 25 tons to 35 tons being pulled on different days as required. A small quantity of ice was kept stored in the cold-storage space when possible, providing an extra supply for hot days. The cost of refrigerating this stored ice has been computed to be about ½ cent to ¾ cent per ton per day, with the ice-making machine in operation to furnish other refrigeration. Of course, were the ice machine operated solely for this purpose of "holding" the stored ice the cost would be higher per ton.

For the 4000 tons of ice frozen and delivered last year the company received $26,000 gross income. The operating expenses in producing this ice were $18,000, including fuel, labor, plant expenses, delivery expenses, management, office costs, 10 per cent depreciation on the equipment, taxes, insurance, etc. This left $8,000 net revenue, which applied on the total investment of $40,000 represents the gratifying income of 20 per cent to meet interest, profits, etc.

STEAM-DRIVEN COMPRESSOR IN AN ICE-ELECTRIC PLANT.

The main generating unit of the Okmulgee (Okla.) Ice & Light Company in its new combination ice-electric plant is a 200-kw Westinghouse horizontal, four-cylinder, gas-engine-driven, direct-connected alternator operated on natural gas, which costs 10 cents per 1000 cu. ft. This set is run twelve hours daily, from 6 p. m. to 6 a. m. A 100-kw, four-cylinder, double-tandem gas-engine unit was formerly in use for the light-load daylight service, but on account of mechanical difficulties with this engine it has been dismantled and will be replaced by a more modern type of unit. In the meantime a spare 190-hp simple Corliss-gear engine, left in the plant for emergency service, is being used for belt-driving a revolving-armature alternator in place of the dismantled small gas-engine unit. This engine set receives steam from the boilers provided for the steam-driven compressor engine, but no by-product use is made of its exhaust.

The water at Okmulgee is obtained from the city mains and is not suitable for raw-water ice-making. This precluded the installation of a gas-engine-driven compressor plant making raw-water ice without the use of evaporator apparatus. It was, therefore, decided to install steam boilers furnishing steam to a 25-ton engine-driven compressor machine. The plant installed is a 25-ton Ruemmeli-Dawley outfit, making can ice in 300-lb. blocks. The compressor engine furnishes all the distilled water required for ice making, and no provision is made for collecting the exhaust from the spare electrical engine.

The brine is circulated by a 5-hp motor-driven centrifugal pump, and the agitator propellers in the freezing tank are also run by a 5-hp motor. For operating the 10-ft. fan producing draft through the cooling tower a 15-hp motor remains to be installed.

The natural gas used at Okmulgee is from the nearby Oklahoma field. It contains approximately 900 b.t.u. per cubic foot and costs the company 10 cents per 1000 cu. ft. Last year 2643 tons of ice were made in this plant, burning under the boilers 26,538,000 cu. ft. of gas, or 9900 cu. ft. per ton of ice. The ice plant is run as needed during nine months in the year, on some days from 20 tons to 29 tons of ice being pulled. In connection with the plant is a 40-ft. x 40-ft. storage-room artificially refrigerated for holding its contents at the freezing point.

During an average twelve-hour run, producing 365 kw-hours, at a mean load of 30.4 kw, the gas meter on the large gas-engine set has shown a consumption of 31,550 cu. ft. of gas, or about 86.5 cu. ft. per kw-hours at this partial load. Under other conditions, producing 930 kw-hours at an average 77-kw load, the engine's consumption was reduced to 33,800 cu. ft., or 35 cu. ft. per kw-hour.

INVESTMENT AND INCOME OF A SMALL ICE PLANT.

The ten-ton live-steam absorption ice plant of a Missouri combination ice-electric station cost $20,000 complete when built five years ago. This cost, which includes all charges assignable to the ice-making department of the station, is divided as follows:

Machinery, freight and erecting	$13,000
Cold-storage rooms, 100 tons capacity	3,000
Part of building used for ice-making	2,000
Boiler investment chargeable to ice	1,200
Well and pump	800
Total	$20,000

The ice plant operates four months each year in its town of 3600. During nearly all these days full can capacity is pulled, while during the heated term the plant can be pushed to turn out eleven tons when needed. The ice sells at from 30 cents to 80 cents per 100 lb., averaging about $6.40 per ton. During the four summer months of 1910 20,000,000 lb. of ice was sold, providing $6,400 earnings for the season. The cost of labor and fuel for producing this ice was $3,340, to which must be added $400 fixed expenses for insurance and taxes. Subtracting 5 per cent for depreciation on the equipment, the net profit on the investment is seen to have reached $2,300, or almost 12 per cent. Coal in this region costs $3.50 a ton. The electrical equipment operated from the same 250-hp boilers comprises 140 kw total rating in engine-driven generators. The ice machine uses steam at 40 lb. pressure per square inch.

In the case of the above plant the ice cold-storage compartments have proven one of the best investments in the plant. If this equipment were to be enlarged for a greater output it would doubtless pay to extend the cold-storage rooms first, leaving the ammonia equipment of the present capacity until the station demand reaches a point where the ice machinery could be at least doubled to advantage. The presence of the cold-storage space enables ice to be frozen during slack periods and stored against the hot days. The cost of such storage capacity is much less than equivalent ice-making apparatus, and although the refrigeration required to store ice costs about 1 cent per ton per day, these charges will often be found less than the interest on the ice-machine investment. Eventually, of course, the ice apparatus will have to be enlarged, but such a move should not be undertaken until it is shown that the machine can at least be profitably doubled in capacity. Where an exhaust absorption machine is used, of course, the refrigeration of cold-storage space can be done without the expenditure of additional energy or steam, and almost without cost, making ice storage during slack months relatively inexpensive and a smaller rating of ice-making capacity sufficient.

HINTS ON MARKETING CENTRAL-STATION ICE IN SMALL TOWNS.

In perhaps no other business—at least in none with which the central station is likely to deal—are employees exposed to such temptations for "knocking down" illegitimate cash sales as in the manufacture and delivery of artificial ice. Unless the central-station manager new to the ice business considers and guards against these opportunities for loss, he is likely to be the victim of considerable petty thievery which may make no small difference in his profit-and-loss account. Take, for example, the case of a plant in a small town of 3000 to 6000 inhabitants, producing ten tons of ice per day and employing five delivery wagons. If these delivery men—for whose work often only the roughest kind of labor is available—feel disposed to add a dollar or more each to their daily wages, through unreported sales of ice to customers, the company will sustain a dead loss from its profits of $5 a day, or $150 a month. Delivery-wagon drivers are all too prone to collect such illegitimate bonuses, and the company must be on its guard to provide checks against these practices. The frequency and annoying persistency with which they occur have almost forced some managers into the disposal of their output wholesale to contracting delivery men for retailing, but when the central-station manager gives up his retail business he sacrifices a large item of profit. Ice which costs $2 a ton to make and $1 a ton to deliver can often be sold to retail customers at an average price of $6 per ton, leaving a net profit of $3 per ton. The same ice could probably be sold to a contractor delivery man for not more than $3 a ton, leaving to the manufacturer a profit of only $1 a ton on ice which costs him $2 to make. Although spared the annoyance of delivery, the ice plant thus cuts its income to one-third by adopting the wholesale plan of disposal.

To make a retail delivery business a success, however, some adequate means of checking must be applied to the wagon drivers and plant employees, so that every cake of ice manufactured is accounted for (barring allowance for shrinkage due to melting) from the time it leaves the cans until it reaches the customer's ice-box. After an experience of four years in ice making, a small Missouri central station operating a combination ice and electric plant in a town of 3500 population detected irregularities in its delivery system and installed a complete checking system, since which it is assured payment for all ice produced. This plant is now one of the most successful ice-electric stations in the country, last year returning an income of 13 per cent on its ice equipment from four months' operation, after deducting charges for interest, depreciation and taxes.

As each block of ice comes down the chute it is counted by an automatic register, and at a given hour each day an inventory is made of all ice in the storage room. The platform man is provided with a cash register on which he rings up all sales made at the plant. As each delivery wagon starts out with its load of ice the quantity taken is recorded, record also being made of the amount returned at the end of the day. The wagon driver is thus charged with all ice which he fails to return, allowance being made, of course, for the amount which has melted, according to the temperature of the weather and the size of load carried. For all ice thus taken the driver must turn in either cash or the company's regular tickets. In addition to this he must turn in receipts covering the entire amount, signed by the customer and showing that the ice has actually been delivered. No opportunity is thus afforded for the illegitimate sale of ice either at the plant or on the wagons, and the company has the assurance that it receives payment for all ice manufactured.

STEAM CONSUMPTION OF ICE-ELECTRIC PLANT.

After nine years' experience in the operation of his present combination ice and electric plant, Mr. C. E. Lahman, manager of the Vinita (Okla.) Electric Light, Ice & Power Company, has made a careful study to determine the kind of ice-making equipment best adapted under local conditions as an auxiliary to his new 250-kw electrical generating station, which is now nearing completion. The old plant comprises a 175-kw engine-driven generator and a 12-ton Corliss engine-driven ammonia compressor, both sets using steam from a common set of boilers. The plant property is also fortunate in having an 1150-ft. artesian well showing 50-lb. pressure at the surface of the ground and delivering about 500 gal. per minute of 70-deg. water to the overhead cooling tower without artificial pumping.

The new generating station will contain one 100-kw and one 250-kw alternator, each direct-driven by an equivalent simple Corliss engine, arranged to be operated condensing if desired. After study of local conditions, low-pressure absorption ice-making equipment was decided upon, utilizing at a slight back-pressure the exhaust from the auxiliary pumps together with that from the smaller engine unit, which will be operated part of the year non-condensing. The larger set will be run condensing at all times when it is in operation. The small 100-kw engine-driven set will be useful during light-load periods to supply twenty-four-hour electrical service without running the large unit. When exhausting at about 5 lb. per square inch back pressure into the 30-ton absorption ice machine it will require about 41 lb. of steam per indicated hp-hour. Assuming an average load of 100 hp on the electrical unit, the engine will take about 98,400 lb. of steam per twenty-four hours. The steam-driven ammonia pump for the absorption plant will require about 4603 lb. per twenty-four hours, making a total of 102,643 lb. of steam needed with the absorption apparatus installed.

Were a compression plant installed under these conditions, using a good simple Corliss-gear engine-driven machine, Mr. Lahman estimates that such a 30-ton compressor alone would take 49,428 lb. of steam per twenty-four hours. The small engine-generator set could then be operated condensing at an improved efficiency, and, under these conditions, carrying an average 100-hp load as before, it would require but 74,160 lb. of steam per day. The total demand on the boilers, however, in this case would be 123,588 lb. of steam per twenty-four hours, or 20 per cent more than that with the generator engine running on back pressure.

In the case of the Vinita plant the marked advantage gained by the absorption system will be the by-product manufacture and storage of ice during the winter months at almost negligible operating expense, at the same time releasing the small generator engine during much of the year for operation condensing at the same high efficiency as were a compression plant installed. The exhaust from the ammonia pump alone, discharged into the absorption machine, will produce about 10 tons of ice per day, besides refrigerating the 1500-ton cold storage with which the plant will be provided. The small engine, as already noted, will be arranged for exhausting into the station condenser line and can be thus operated condensing during all but the hottest months of the year, when it is desired to push the ice-plant output to its limit.

The provision of so unusual an ice-storage space, with a capacity of 1500 tons, in connection with a 30-ton ice plant will make it possible to manufacture ice from the ammonia-pump exhaust alone during the winter with minimum steam consumption and at no reduction in generator efficiency, preserving this ice for the hot days of summer consumption when demand for it is greatest. In the Vinita instance, therefore, Mr. Lahman is well satisfied that he has made the proper selection of ice-making apparatus.

PREVENTING TUNGSTEN STREET-LAMP BREAKAGES IN WINDSTORMS.

Some recent experiences of the Lawrenceville (Ill.) Light & Water Company, of which Mr. Cale R. Gough is the manager, have brought that company to the practice of maintaining enough current in its series-tungsten street lighting circuit on excessively windy days to keep the lamp filaments hot and ductile to prevent breakage. This company has never until recently experienced any abnormal breakages on its tungsten street-lighting circuit, which now comprises seventy-eight 100-watt, 6.6-amp series-tungsten lamps and nine 450-watt tungsten lamps, together with six inclosed-arc lamps. During some very high windstorms in March, however, during daylight hours, six lamps were broken. These lamps are equipped with the regular filament cut-out in the base, which is supposed to be punctured by a moderate voltage when current is turned on to the circuit and a lamp filament is broken. With the six lamp filaments broken, however, the combined resistance of all of these filaments in series was too much for the 2200 volts which were applied to the circuit when an attempt was made to start the street lamps. The result was that the circuit could not be started until after most of these broken lamps were located.

As the result of his experience Mr. Gough has concluded that it is better on excessively windy days to keep the street-lighting circuit in operation with enough current to keep the lamp filaments ductile, thus accomplishing two objects; first, a reduction of the lamp breakage, and, second preventing interruption to service the following night because of inability to start the street circuit should a number of lamps become broken during the day. The cost of keeping current on the circuit during the few windy days in each year that it is advisable is small compared to the loss of revenue and reputation and cost of lamp renewals which might otherwise result. This is especially true in a station operating with gas engines, as at Lawrenceville, where the kw-hour cost of fuel is low. In such a plant the fixed and maintenance expenses are considerably more than the fuel bill, and these latter expenses are not appreciably changed by such practice.

SELLING HOT WATER FROM A HEATING SYSTEM.

A central station operating in a town of about 5000 and having an extensive hot-water heating system some two or three years ago began the practice of selling hot water to various consumers along its hot-water heating mains. For this purpose service was maintained the year around. It was claimed by the management at the time that hot-water main repairs were less by keeping the system hot in this way than when it was shut down during the summer, and that this, together with the revenue obtained from hot water sold, resulted in a net gain to the company. Subsequent events, however, have proved the fallacy of this.

After two or three seasons' operation the plant began to have serious difficulties in keeping the water in its system hot during cold weather and investigation revealed the fact that the heaters were almost completely filled with scale. This was, of course, caused by the water which was pumped into the hot-water system just before it entered the heater in order to make up for the water sold and leakage in the system. The amount of water taken out by purchasers and leaks was so great that excessive scale in the hot-water heaters resulted. Of course, softening of water introduced in the hot-water system would have prevented this result, but it would seem that the sale of hot water from a heating system of this kind should be carefully safeguarded wherever it is undertaken.

THE ELECTRIC-VEHICLE OPPORTUNITY FOR THE CENTRAL STATION.

There are 5000 builders of horse-drawn vehicles in this country. Last year $250,000,000 was spent on motor-driven conveyances, mostly pleasure cars. There are, however, 500 commercial vehicles in use to every one pleasure vehicle. The above figures afford some idea of the future which awaits the central station in the supply of off-peak energy to battery-operated vehicles.

There were eighteen electric automobiles in St. Louis in 1907, said Mr. Hermann Spoehrer, secretary and treasurer of the Union Electric Light & Power Company, of St. Louis, before the Missouri Electrical Association, April 14, in discussing the subject of the electric vehicle's significance to the central station. To-day, as a result of the Union Electric company's stimulation by inaugurating adequate electric-garage facilities, there are 500 electric machines in St. Louis, the average income from which is $8.50 per month in the case of cars stabled in private garages.

The original electric garage in connection with one of the central-station company's substations is now retained for pleasure-car purposes, being augmented by a new commercial-truck garage in the business section, as has been described in the *Electrical World*.

Experience has demonstrated that with electric trucks 85 per cent of the hauling in a city can be done successfully. A large New York concern which rents delivery wagons to merchants is now replacing its horse-drawn wagons by electrics. The large dry-goods house of Scruggs-Vandervoort-Barney in St. Louis conducted exhaustive comparative tests on gasoline and electric delivery wagons, the result of which was the complete victory of the electric machine, in spite of its being charged with 33 per cent depreciation per year. This heavy depreciation has not been nearly realized, as the cars are still in good condition after four years' use. The Anheuser-Busch brewing interests in St. Louis have a model electric garage with fifty-six electric trucks in use.

Comparing the demand, consumption and revenue of electric vehicles with other energy-consuming devices, Mr. Spoehrer presented the following table:

Type of Vehicle.	Estimated Kw-hours Annual Consumption.	Income at 4 Cents per Kw-hour.	EQUIVALENT NUMBER OF		
			500-Watt Arc, 4 Hours, 300 Days.	50-Watt Lamp, 1 Hour, 300 Days.	Flatirons, 3 Hours Daily.
5-ton........	11,000	$440	17	752	144
3.5-ton......	9,360	374	14	624	120
2-ton.........	7,440	297	11	496	95
2000-lb	5,520	220	9	368	70
1000-lb..........	4,560	182	7	304	58
Pleasure car	2,400	96	4	160	30

This table shows the income assured from an electric vehicle in terms of the equivalent number of lamps or irons required to consume the same quantity of energy. But with a single large customer like a vehicle the overhead costs of meter reading, accounting, billing, etc., are greatly reduced. For example, in the case of the pleasure car, instead of thirty separate customers' meters to be read, and thirty customers' bills to be made out and collected, there is only one such account to earn the same revenue. Ninety per cent of vehicle charging is done from 8 p. m. to 12 p. m., and not only does the vehicle load improve the daily load-factor, but, on account of the larger use of electric cars during the summer time, the battery-charging load is greatest at a period when other customers' consumption is least.

Mr. Spoehrer urged that central-station men acquaint themselves thoroughly with the operation and performance of electric vehicles, instead of leaving the customer to work out his own selection, which, particularly in the case of commercial cars, may prove entirely unadapted to the need. It is important that the first local power wagon in a community be carefully selected and intelligently handled, as the performance of this machine will be viewed with interest by other prospective users. The life of a battery will depend largely upon the care given it by garage men, and readings of the cell conditions should be made at frequent intervals, so that any progressive deterioration can be detected and corrected. A battery properly cared for will last two to three times as long as one getting inferior attention, such as is often accorded it in the average gasoline garage by inexperienced help.

SHOWROOMS OF PUBLIC SERVICE ELECTRIC COMPANY.

The new showrooms of the Public Service Electric Company are located on the first floor and in the basement of the Public Service Building, Broad and Bank Streets, Newark, N. J. On the main floor are located one of the offices of the publicity department, the cashier's, gas-order and electric-order departments, the electric contract agent's office, a consultation room and a fixture room. A public telephone booth and a writing desk have also been placed on this floor for the convenience of consumers. Gothic architecture has been followed throughout the building and the furnishings of the showrooms, such as lighting fixtures, signs designating the various departments, etc., conform to the Gothic period.

Heavy bronze fixtures of Gothic design with brackets to match are used to light the main-floor showroom. In one section of the first floor electricity is used for lighting; in another, gas; and in another, combination gas and electricity. One of the especially pleasing features of the showrooms is the room set apart for the practical display of high-class lighting fixtures, domes and portable lamps. The walls and counters in this room are covered with green velour and the ceiling stenciled with gold decorations. This is a very effective way to show lighting fixtures and reading lamps to their best advantage. The consultation room is inclosed by green velour curtains, having two settees upholstered with the same material. In this room a customer may in comfort discuss any matter with the salesmen. It is used, however, principally by those desirous of seeing designs and sketches of fixtures and of going over the lighting plans of their houses with the fixture salesman.

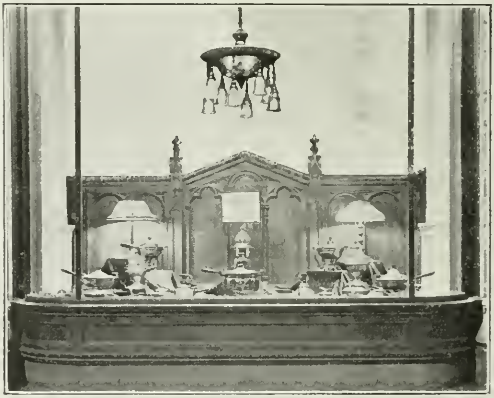


Fig. 1—Window in Broad Street, Showing Electrical Appliances.

The display on the main floor has been confined to the higher priced portable lamps, fancy silk and tapestry shades, electric floral pieces, floor standards, torchères, small electric appliances, cabinet gas ranges and water heaters. These displays are arranged in individual groups and in this way the display is more pleasing and effective.

Two large windows on Broad Street, a large one and several smaller ones on Bank Street, allow ample space for attractive window displays. Copper and nickel chafing dishes, percolators, toasters, milk warmers, hot-water cups, electric heating pads, etc., are shown in groups in glass cases. Decorative silk shades and electric floral effects are also displayed in a similar manner. The torchères and piano lamps are placed in various parts of the showroom, giving individuality to the different pieces and adding to the decorative effect of the room as well. Electric and gas reading lamps are arranged in groups on tables placed in different parts of the showroom. In the electric contract department fixtures are placed for the demonstration of tungsten lamps and the various shades and accessories recommended to be used with them.

The first floor and basement showrooms are connected by a broad marble staircase, at the head of which has been placed a very ornamental sign. Here there are a number of complete exhibits, viz.: the electric kitchen, the gas kitchen, the gas and electric laundry, the power, gas and electric industrial-appliance exhibit, the lumichromoscope, the color booths, and the refrigerating and ice-making plant. The electric kitchen is fully equipped with all electric cooking appliances such as a range, kitchen cabinet, plate-warming closet and oven, toasters, percolators, etc. A fully equipped laundry is shown in which are placed an electric washing machine, a gas-heated, motor-driven mangle, a gas-heated clothes dryer, an instantaneous automatic water heater, a refuse incinerator, and gas and electric irons. The laundry is lighted by both electricity and gas. The power exhibit is placed opposite the kitchens and laundry. The display is arranged on two wooden platforms, and motors are connected to the various machines shown. Included are a rectifier for automobile charging, a complete woodworking and air-compressing plant, an electric hoist, a dough mixer, meat chopper, coffee mill, beer pump, an exhaust fan, etc. As all machinery shown can be operated, the exhibit is surrounded by a metal railing for the better protection of the public.

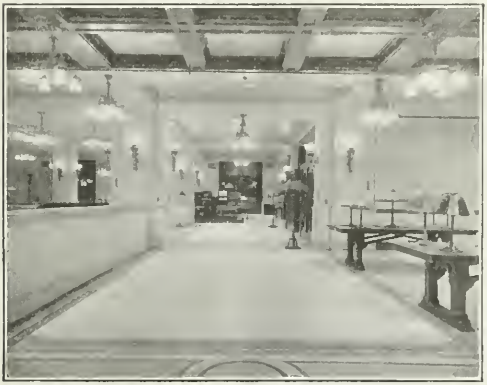


Fig. 2—Main Floor of the Public Service Building.

A domestic-size refrigerating and ice-making plant is operated daily and proves of interest to many. It is of practical use as well, furnishing ice and refrigeration when cooking is being carried on by demonstrators during the first two weeks of each month. The space underneath the sidewalk lends itself very advantageously for an industrial-appliance exhibit. In this exhibit a very representative line of blast and atmospheric furnaces and electrically heated and motor-driven small appliances used in the various lines of manufacture, trade or profession are shown and can be demonstrated, as they are all connected, ready for use. All kinds of gas or electric tailor irons, electric soldering irons, glue or wax pots, drills and motors are also to be found in this exhibit.

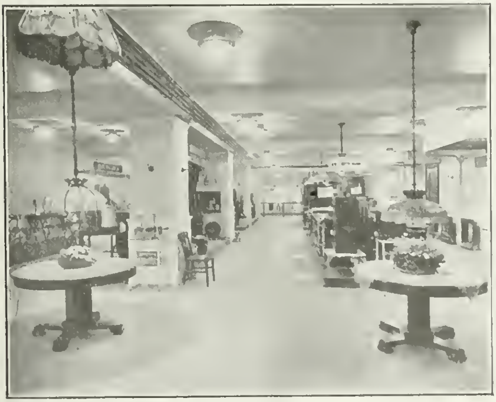


Fig. 3—View of Basement from Stairway.

Connected with the illuminating department a lumichromoscope is shown, which affords the public an opportunity of comparing the effects of different types of illuminants on various colors. Several styles of illuminants are shown, consisting of the carbon, Nernst and tungsten lamps, electric arc and the Moore tube, as well as four types of gas illuminants, including the Bray burner, the upright and inverted Welsbach lamps and the inverted Welsbach lamp with amber mantle. The difference of the color values of these units is seen upon ribbons, which are placed lengthwise, each ribbon running through every booth. In the rear of the basement four color booths are placed. These booths are about 4 ft. square and each booth is lighted by a 25-watt tungsten lamp. The booths are papered in white, red, green and yellow. The object, of course, is to show the absorption of light by the different wall papers. These exhibits, showing as they do the effect of illuminants on color values and the absorption of light, have proved both interesting and instructive to those who have seen them.

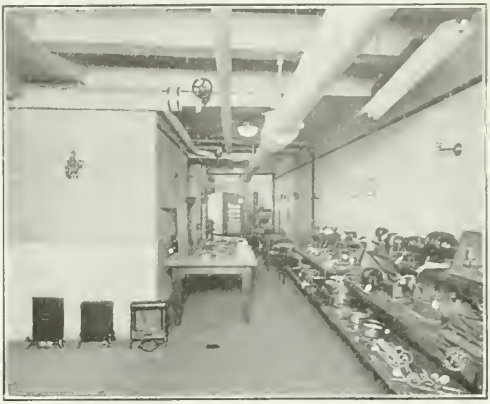


Fig. 4—Small Motors and Appliances Exhibited in Basement.

Vacuum cleaners are shown in operation and the prospective customer receives a practical demonstration of how to use one. A full assortment of electric heating stoves is also shown. Electric alabaster-ceiling units contribute to the artificial lighting of the basement. Some of the other features worthy of mention are the electric piano and the electric switchboard. The lighting fixtures used in stores and factories and for outdoor illumination have not been overlooked, as they, too, are displayed in a fitting manner in the basement.

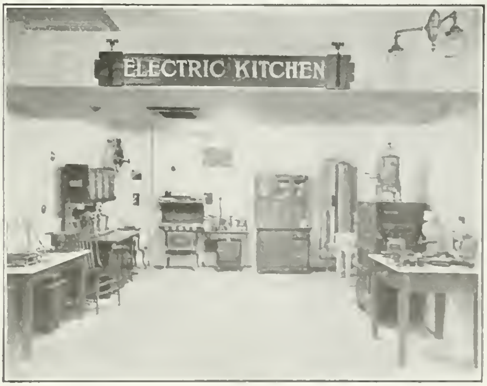


Fig. 5—Electric Kitchen in Basement.

Wiring and Illumination

ORNAMENTAL CURB LAMPS IN IOWA.

Mr. R. M. Parker, of Ft. Dodge, Ia., presented a paper on "Ornamental Curb Illumination" at the Iowa Electrical Association convention at Davenport on April 20. He said that there are many styles of ornamental iron posts used for such installations, varying in weight from 570 lb. to 1500 lb. each. He advocated the use of a post costing about $55, carrying five lamps for large cities and three lamps for small cities. Reviewing the arguments for and against the upturned lamps, he stated that the upturned globe has a better appearance and is less likely to be broken by the retaining screws. Further, there is no chance for dirt to collect in the bottom of the globe. The objection is that ice forms around the neck of the globe in winter and prevents its being taken off for cleaning or lamp renewals. The wiring to such posts should be in lead-covered cables in conduit. The circuit should be brought to some switch box controlling a number of posts. The cost of turning on and off the lamps is about 50 cents per post per month. In working up this business the interest of the merchants should be aroused and a committee of merchants should be formed for each block, consisting of men in the block, to solicit others in the block. Another plan is for the central-station company to solicit this business block by block, but the objection is that if some merchants fail to join in the scheme there are dark places which make a ragged appearance on the street. In addition to Des Moines and Davenport there are twenty cities in Iowa having such ornamental lamp-posts, there being a total of 662 posts. The average cost per post for nineteen cities was $71 each. However, some of the larger cities have posts costing installed from $100 to $125 each. He emphasized the importance of a solid foundation for such posts. In Ft. Dodge a large concrete block is placed under each post so that it will withstand any shock it is likely to get. Mr. A. L. Dodd said that in Charles City twenty blocks in the residence district are equipped with tungsten lamps in ornamental iron posts, one lamp for a block, with underground supply through steel-covered No. 6 wire buried in parkways.

Prof. A. H. Ford suggested that the regular arc lamps be taken off the corners when curb lighting is installed so as not to spoil the effect. The globes used will make or mar the appearance of the installation. Thin opal globes showing the lamps through with a dull-red color produce a slovenly appearance. The globes should be either rough inside or be built of some smooth diffusing glass like "Alba," which will not show the lamp filament. Curb lighting makes more show-window lighting necessary. Where windows are lighted on a flat rate and the lamps turned on and off by patrolmen the same man can turn on the lamps at the posts.

AN ELECTRIC IRON INSTALLATION.

By George Travert.

A method of supporting the conducting cord of an electrically heated iron is shown in Fig. 1. The feature of the arrangement that deserves attention is the sliding support for the helical spring that carries the cord. The ordinary method of supporting the cord of an electric iron is to tie it to a spring which is attached in a permanent position and the fact that the location of the spring is fixed hampers the movements of an operator using the iron. With the scheme suggested in Fig. 1 the spring is fastened with an "S" hook (see Fig. 2) to a porcelain insulator which is arranged to slide back and forth on a wire. As the iron is pushed to and fro the porcelain insulator follows its movements and, as the spring will stretch, ironing can be done over a considerable area. It should be noted that at all times the conducting cord is supported well out of the way of the operator.

Spiral springs, like that illustrated in Figs. 1 and 2, are usually furnished by the manufacturers with all sadirons, so that the only additional material that is needed to make such an installation is the insulator, the iron wire and the turnbuckle. The iron wire, Fig. 1, is made up in a screw-eye, inserted in the wall at one end and into one eye of a small turnbuckle at the other end. Such a turnbuckle can be supplied by any first-class hardware house. The turnbuckle provides means for keeping the wire tight. The hook end of the turnbuckle engages with a screw eye inserted in the wall. It is well to arrange the iron wire somewhat to the rear of the line along which the iron will be used, as shown in Fig. 3. This is done to prevent the cord from striking the hand of the ironer.

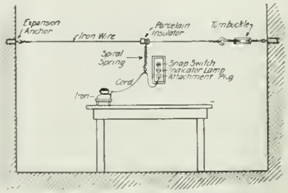


Fig. 1—An Electric-Iron Installation.

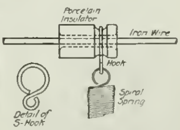


Fig. 2—Method of Supporting Spring.

A convenient method of wiring an electric iron is shown in Figs. 1 and 4. The visible components of the circuit are shown in Fig. 1 and the wiring diagram is given in Fig. 4. An incandescent lamp of small candle-power is connected across the branch circuit to the iron on the iron side of the double-pole switch. So long as the switch is closed and the iron connected to the supply source the lamp will glow and indicate the fact that the iron is "alive." This device not only tends to make the operator careful in his use of energy, but it assists in preventing the fires that are sometimes caused by an electric iron being left on a wooden ironing board while connected to a supply source.

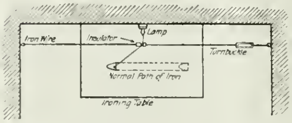
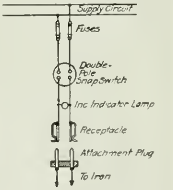


Fig. 3—Plan View of Installation.



. 4—Wiring Diagram.

ELECTRICAL EQUIPMENT OF A MODERN ENGLISH THEATER.

By J. A. Seager.

Although state aid of the drama has not up to the present been adopted in Great Britain and, therefore, the theaters ot London may not possibly be of quite such a fine architectural order as those found in Berlin or Vienna, the taste of the British theater-going public is sufficiently keen to appreciate any endeavor made to provide an adequate setting to musical and dramatic entertainments, and for this reason some of the modern theaters of the British metropolis are lavish in their appointments. Particularly is this the case in the "theaters of varieties," corresponding to the American vaudeville houses. Many of these are most artistically treated and excellently equipped, and one of the most recent is the Palladium Theater of Varieties.

The electrical supply is provided by the St. James and Pall Mall Electric Light Company, Limited, on the three-wire system, 220 volts between outers. A pressure of 110 volts is employed for lighting, and 220 volts for motors, fans, etc.

Special supply mains are brought into the back of the building for the stage lighting and into the front of the building for the house lighting. A small alternative supply is also provided for the house lighting in accordance with the rules of the London County Council by the London Electric Supply Corporation.

The electrical stage equipment comprises a stage switchboard, a stage regulator and dimmers, a "special effect" switchboard, an electric stage elevator and the stage fittings, consisting of seven borders 52 ft. long, each with 250 lamps, 250 footlights, besides strips, bunches and proscenium side lamps, altogether over 2400 lamps in three different colors. In addition, there are eighteen spot lamps, nine on the stage and nine in the auditorium.

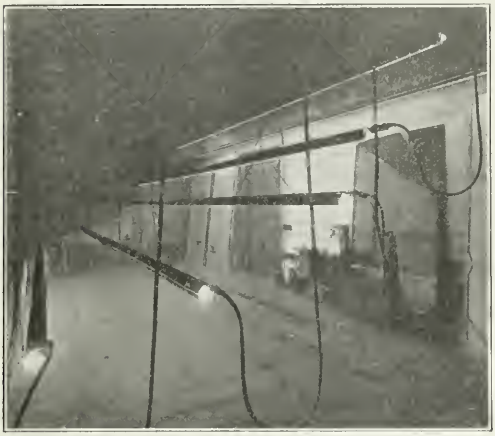


Fig. 1—Arrangement of Borders.

The electrical equipment in the theater comprises a large "house" switchboard, a smaller alternative switchboard, an electrically driven "Vortex" suction cleaner plant, electric fans, and, of course, all the necessary distributing fuseboards and fan-regulating boards. The electrical fittings were specially designed by Messrs. Siemens Brothers' Dynamo Works, Limited, to correspond with the general style and decorations of the building, and are of the Georgian type. The Auditorium is lighted from the roof by means of two fifty-lamp electroliers, each 12 ft. high and 9 ft. in diameter, as well as by a large number of smaller fittings. Prismatic glass reflectors play a large part in the distribution of light. In addition, there are electric signs, and the exterior of the building is illuminated by twenty-two flame-arc lamps. All incandescent lamps are of tantalum and "Onewatt" metal-filament types. The total number of lamps in the whole building is close to 4000, and altogether the electric lighting and motor load represents over 400 hp. All the electric circuits are protected by Siemens "Zed" fuses, which insure the absolute security of the installation, owing to the great ease and rapidity by which the blown cartridge can be replaced and to the fact that it is impossible to replace one by another of a larger or smaller capacity. Part of the building is wired on the "Stannos" system and the remainder with rubber-covered wires drawn into enameled steel conduits. There are upward of thirty miles of wire installed,

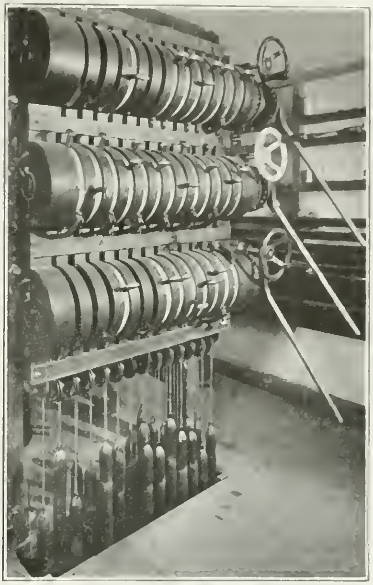


Fig. 3—Dimmer Control Board.

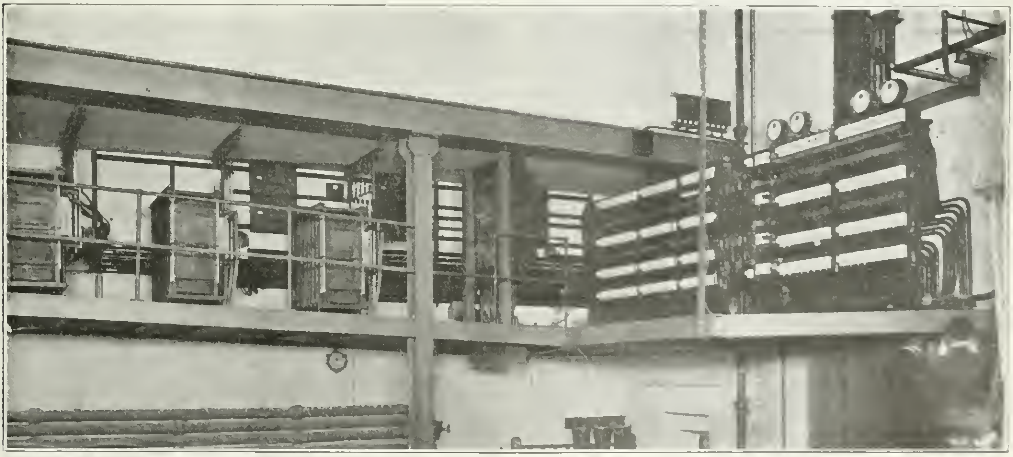


Fig. 2—Stage Switchboard.

and about eight miles of conduit. In addition to the electric lighting there are several telephone systems and electric bell circuits.

The supply company's cables for the stage-lighting effects consist of two lead-covered and armored cables, each 0.8 sq. in., and one of 0.4 sq. in. section. The cables from the meter-room to the stage switchboard consist of four lead-covered and armored cables of 0.5 sq. in. section and two of 0.25 sq. in. section, which form two 110-volt circuits on each side of the three-wire system and one 220-volt circuit for the fans and other motors.

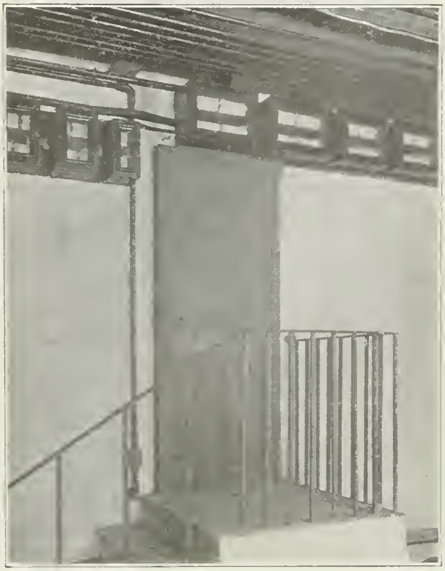


Fig. 4—Typical Wiring and Conduit Arrangement.

The stage switchboard is probably the largest of its kind that has yet been installed in Great Britain and it controls incandescent lamps and arc lamps taking approximately 2100 amp at 110 volts. In order to obtain the necessary scenic effects master switches are provided, by means of which nearly all the lamps can be switched on and off simultaneously. In order to comply with the regulations of the London County Council all connections have been arranged on the front of the board and this has necessitated a somewhat special design so as to accommodate the larger number of lugs, etc., without interfering with the operation of the switches and fuses. The switchboard is divided into four horizontal sections, two on each side of the three-wire system. The circuits for each section of the lighting load are divided on the two sides of the system, so that under all conditions it will be approximately balanced. The circuits are grouped into four sections—stage lighting through dimmers, general stage lighting, stage spot lamps and those auditorium spot lamps which are controlled from the stage. An additional panel carries the master switches referred to above. There are in all about ninety circuits provided, and on each are fitted double-pole fuses of the "Zed" type and a single-pole knife switch. A slate panel at one end of the board is equipped with a number of circular orifices in which a stock of spare fuse cartridges is kept ready for immediate use.

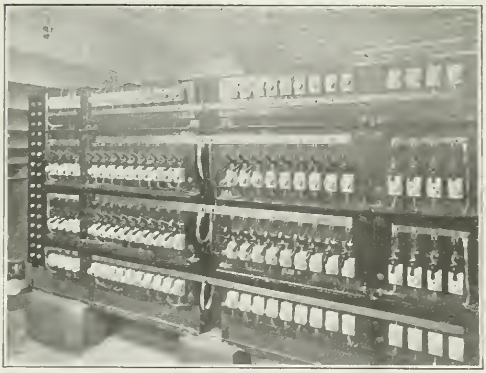


Fig. 5—House Switchboard.

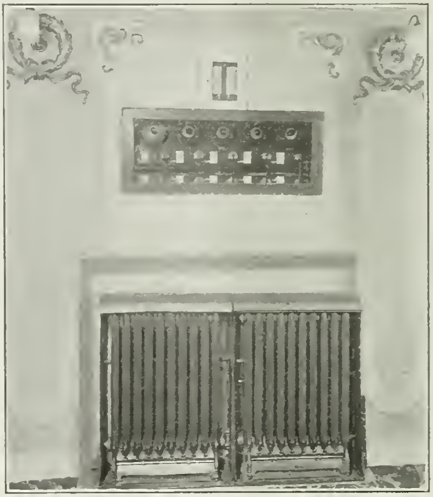


Fig. 6—House Distribution Box with Fan Regulators.

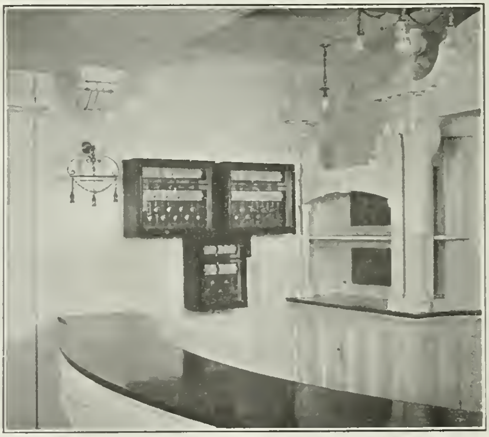


Fig. 7—House Distribution Board.

The complete control of the stage lighting in respect of color, dimming, etc., is effected from the dimmer board. This permits of producing in each separate group of lamps, entirely in accordance with the will of the operator, all desired variations and combinations of light intensities and colors. The resistors employed at the Palladium differ in construction from those usually found in England, metal grids being used in place of liquid resistances. Every desired variation of light may be obtained by means of regulating wheels combined in the mechanism, all the lamps of one color in each border, strip, etc., being always controlled by one of these wheels. The latter are revolved by means of small levers, and are constructed in the form of pulleys, over which a cord, held in tension by a counterweight, leads to the sliding contacts of the resistance.

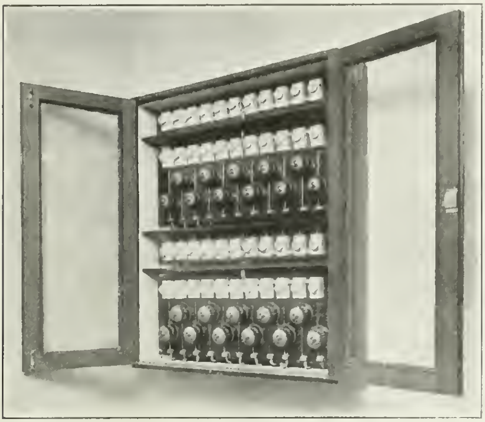


Fig. 8—Distribution Box.

It is possible gradually to dim the lamps of one color while simultaneously another color, which is quite dim, may be increased to full intensity, so that not only is regulation of light intensity achieved, but also a mixture of the colors and a transition from one color to another with any desired total light intensity. All regulating wheels for the same color are mounted in one row and may be coupled together on to a common spindle, so that by turning a single hand-wheel situated at the side uniform movement of all the coupled levers is obtained and any desired groups of lamps of one color may be brightened or dimmed simultaneously. The coupling of the regulating levers is effected by hand-brakes which grip the cord pulleys, whereby the latter are moved all together by the common spindle. The hand-wheels can also be fitted with a fine regulation in order to obtain a specially slow and steady movement of all the coupled regulating levers. The cord pulleys are provided with scales and pointers, which permit of reading off the light intensity at any moment. By this means any particular adjustment of light can be noted and be reproduced later on as desired. The total current arranged for on the Palladium stage dimmers is 1140 amp. The number of regulating wheels is thirty-three, arranged in three rows. A switchboard for special lighting effects is situated at the back of the stage for providing light for properties and effects introduced by the various acts as required.

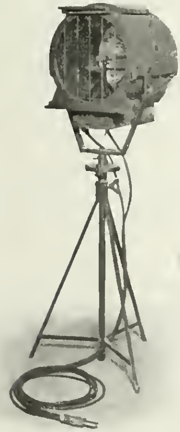


Fig. 9—Spot Lamp for Stage.

In order to provide a raised platform for special scenic effects and to facilitate the removal of scenery and properties to the basement, a portion of the stage floor, measuring approximately 20 ft. x 10 ft., is arranged as an electrically driven elevator. The control is of the semi-automatic push-button type, with separate push buttons for the up and down journeys. By the arrangement adopted the elevator comes to a standstill immediately the push button is released, and, therefore, permits of obtaining very correct adjustment of level.

A complete vacuum cleaning service is installed consisting of a Siemens "Vortex" cleaner located in the basement underneath the stalls and connected to a system of pipes which run to eleven outlets distributed throughout the house. The machine is driven by a 5-hp, 220-volt direct current motor.

The system is characterized by absence of gearing, valves and reciprocating parts and is automatic and noiseless in operation. About 500 ft. of 2-in. and 1½-in. steel piping is run in the walls and serves nickeled connection pieces at the outlets. Flexible hose in lengths of 16 ft. can be connected to any one of the outlets so as to reach all seats, etc. The nozzles and other fittings are connected by simple conical plug and socket joints.

The circuit wires for the borders are carried from the stage switchboard through the dimmers and connected to the various multiple stage plugs which are fixed on the border bridges. Similar plugs are mounted at one end of each of the borders, to which the wires from the lamps are connected. Suitable lengths of flexible multiple connecting cables are supplied for the purpose of connecting the borders to the bridges and to enable the borders to be disconnected easily when it is required to raise or lower them. These flexible lengths of cable are fitted with plug sockets at each end, and at the points where the wires in the cable are connected to these sockets they are laid in grooves formed in the handle portion of the socket and strongly bound round with leather. The plugs are so arranged that it is impossible for them to be inserted in the wrong manner and are fitted with a locking attachment to prevent accidental disconnection. The arrangement permits of easy detachment and replacement. A number of spot lamps are provided, one being fixed on each border alternately at the

Fig. 10—Chandelier in Auditorium

right and left ends of the borders. These lamps are connected to a multiple way switch on the stage switchboard. This switch is of the rotating type, and when the handle is moved round rapidly the lamps are switched on in rapid succession for the fraction of a second only, whereby a forked-lightning effect is produced.

The spot lamps are extremely powerful and similar in construction to those usually employed for marine work. The larger projectors, of which three are in use in the biograph room at the back of the roof and two in the projector room in the center of the roof, take a current of 45 amp each The small lamps which are fixed at the sides of the proscenium and on the stage bridges, as well as the portable ones, take 35 amp each.

A switchboard is situated in the front of the building similar in general design to the stage switchboard, and consists of three sets of panels controlling the general house lighting, exterior arc lamps and that portion of the auditorium lighting also controlled from the stage switchboard but which has to be cut-out for certain acts. Fifty-four circuits are provided for, each of which is fitted with double-pole fuses of the "Zed" type and a single-pole knife switch. A smaller switchboard connected to the alternative supply is also mounted in the same situation. There are fourteen "Typhoon" fans about 50 in. in diameter mounted on the ceilings under the balconies for assisting in the ventilation of the auditorium, and a number of table fans are provided for the saloons, etc. The wiring on the stage and in the auditorium is controlled from a number of distribution boxes which are in turn fed from the main switchboards. The distribution boards have several special features. The fuses and switches are fixed on the enameled slate panels in an improved manner, so that the back of the slate is free from any drilling, screws or connections. This feature has resulted in the attainment of very high insulation resistance. All terminals, busbars and connections are on the front of the slate and the greatest care has been devoted to securing easy wiring and accessibility. The cabinets are of hand-polished teak, or sheet or cast iron, and are asbestos-lined, glazed with plate glass and fitted with circuit labels and strong lever locks in accordance with the architect's specifications.

Regulating switchboards for the fans are provided on the walls at the back of the gallery promenades. Fig. 4 shows some of the wiring and circuit arrangements and is indicative of the substantial manner in which these essentials have been constructed.

The boxes are fitted with telephone instruments which are connected to a telephone exchange in the Louis XV saloon. By this means the occupants of the boxes can communicate with the various refreshment rooms, or with each other. Loud-speaking telephones are fitted on the stage, connecting with the royal box and the stage manager. The instruments on the stage have short trumpets; the speaking is very distinct and can be heard clearly from a distance of 5 yd. to 10 yd. Intercommunication telephones are fitted in other parts of the house and on the stage for the convenience of the theater staff.

LETTER TO THE EDITOR.

Slide-Rule Errors.

To the Editor of Electrical World:

SIR:—In your first issue of April Mr. W. L. Durand in discussing the errors of slide rules gives some interesting figures from sixty actual tests, the conclusions drawn in discussing the observed data of which are erroneous and may lead to confusion. His data were:

Number of observations, sixty; greatest error, 0.15 per cent; least error, 0.00 per cent; number of plus errors, twenty-nine; number of minus errors, thirty; difference between the sum of the plus and minus errors, 0.60 per cent; "average of all the errors," 0.06 per cent.

He takes 0.60 per cent ÷ 60 = 0.01 per cent as the error of each operation, when it should be, of course, considered as the average systematic error introduced by engraving errors or by the warping of the rule itself.

He also states that "the probable error for any one operation should not exceed one-tenth of 1 per cent." Neglecting the systematic error, the probable error can be calculated by the ordinary formulas

$$v = 0.6745\,\epsilon = \sqrt{\frac{\pi}{2}}\,\eta,$$

where v = probable error of a single observation, ϵ = mean error (square root of the mean square), and η = mean of the errors (arithmetical mean without regard to sign), which in this case is 0.06 per cent.

$\eta = 0.06$ per cent.
$\epsilon = 0.075$ per cent.
$v = 0.05$ per cent.

In the use of the slide rule the errors are in a series of observations, such, for example, as in taking out the product of several numbers. By some peculiar process of reasoning Mr. Durand arrives at the conclusion that the probable error of a single operation depends upon the number of operations in a series, and also that the probable error of a calculation involving five operations is no greater than that of a single operation. For the probable error of a calculation involving five operations we should, of course, have a probable error of

$$\sqrt{5}\,v = \sqrt{5} \times 0.05 \text{ per cent} = 0.11 \text{ per cent}.$$

As before mentioned, a warping of the rule may introduce systematic errors, which will depend upon the part of the scale used. For example, I have used a 20-in. rule which was bowed only 3/32 in., yet this made the slide 0.1 per cent longer than the rule. They were the same length as closely as could be read when the rule was straightened by pressing against a flat surface. The accuracy actually attained on a good 10-in. rule is often given as 0.2 per cent.

The matter of the uniform percentage accuracy of the logarithmic scale, such as that of the slide rule, has often been discussed, as, for example, in Edgcumbe's "Industrial Electrical Measuring Instruments."

Bureau of Standards, Washington. P. G. AGNEW.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Self-Exciting Three-Phase Commutator Generators.—R. RÜDENBERG.—Three-phase commutator machines the stator and rotor circuits of which are connected together can be made self-exciting under suitable conditions to transform mechanical energy into the electrical energy of three-phase currents. The author discusses the behavior of such machines when loaded. The problem is discussed only for the special case in which the stator and the rotor have the same number of turns and the resistances and leakage reactances are the same in the stator and the rotor. The author shows that when such a three-phase machine is loaded with a non-inducting load it is able as a generator to give at full voltage a current which is approximately four times the value of the short-circuit current when the machine operates as a motor.—*Elek. u. Masch.* (Vienna), March 12.

Induction Motor.—A note on a recent British patent (4871, April 6, 1911) of H. Maxwell (Schenectady, N. Y.). To improve the torque of induction motors with squirrel-cage rotor windings, the connections between the rotor conductors and the short-circuiting rings are doubled back upon themselves so as to have an appreciable length and resistance with minimum self-induction.—Lond. *Elec. Eng'ing,* April 13.

Lamps and Lighting.

Metallic-Filament Lamps.—An account of life tests of metallic-filament lamps made at a testing laboratory in London. Four lamps made by each of fifteen factories were tested, and were not specially selected for the purpose, but were ordinary commercial lamps of 25 cp made for use on 200 volts. Curves are given for the four lamps of one company which show that after 2000 hours not only were these lamps still intact when taken off the test, but also that the candle-power of each lamp is represented as practically a straight line, showing that the light given initially was maintained throughout the run. The total watts taken by the lamps and the watts per candle-power also remained practically constant throughout the run.—Lond. *Elec. Eng'ing,* March 30.

Tungsten Filament.—A note on a recent British patent (19,932, April 6, 1911) of A. G. Bloxam (Siemens & Halske A. G.). It covers a process of manufacturing a ductile alloy of tungsten with nickel by heating a mixture of tungsten and nickel powders or oxides of these metals, which are afterward reduced in order to obtain a ductile rod of alloy. At a certain critical temperature (1510 deg. C. for an alloy of 90 per cent tungsten and 10 per cent nickel) the alloy changes, so that when cold it is ductile enough to be rolled and then drawn into filaments The nickel is volatilized so as to leave a pure tungsten filament by passing a current through the filament in a vacuum.—Lond. *Elec. Eng'ing,* April 6.

Inclosed-Arc and Metallic-Filament Lamps.—The author discusses the competition between metallic-filament lamps and inclosed-arc lamps and says there is no reason why the latter should be supplanted by the former. He gives an estimate of cost for a shop to be lighted by eight lamps, each of 50 cp, and finds that the inclosed-arc lamp is considerably cheaper than the metallic-filament lamp installation.—Lond. *Elec. Review,* March 31.

Traction.

Single-Phase Traction.—O. Bandow.—A paper discussing some of the work done by the Bergmann Company on single-phase traction. The author shows that for a relatively low number of revolutions per minute and correspondingly low speed, such as is required for freight locomotives, and if the frequency is sufficiently high, the repulsion motor is electrically equivalent to the series motor, but on account of the simple method of control of the repulsion motor the latter is superior to the series motor. On the other hand, for high speed the series motor is superior to the repulsion motor. The author finally discusses why the electrical equipment of trunk-line railroads is making relatively slow progress. This is due to the large amount of capital required, and it must be made sure in each case that the change will be profitable. To make heavy electric traction pay, the price of electrical energy should preferably be not more than 0.5 cent per kw-hour and certainly not higher than 1.25 cents per kw-hour.—*Elek. u. Masch.* (Vienna), April 2.

Electric Traction in Sweden.—I. A. Öfverholm.—An illustrated article stating that the first section of the Swedish State railway system to be converted to electric traction is the 80-mile single-track line between the mining center of Kiruna and Riksgränsen, on the frontier of Norway. Energy will be supplied from a hydroelectric station, some 120 miles distant from the middle of the line, over a 50,000-volt, single-phase transmission line. The energy will be supplied at 15,000 volts, 15 cycles, to heavy locomotives, with commutator motors of the compensated-series type. Besides a few passenger trains eight heavy ore trains, each consisting of forty ore trucks and two locomotives, and weighing 2050 tons, will run daily from Kiruna to Riksgränsen, and as many in the return direction.—Lond. *Elec. Eng'ing,* April 6.

Installations, Systems and Appliances.

Small Electric Plants.—A. W. Schleyen.—In districts with very small populations electric-distribution systems are not profitable and isolated plants are preferred. The author gives recommendations on the erection of such small isolated plants and suggests the standardization of gasoline engines, generators, switchboards and storage batteries for such purposes so that they can be built in large quantities and at a relatively low price. In that case such small plants would become profitable. —*Elek. u. Masch.* (Vienna), March 26.

Small Electric Lighting Plants.—C. B. Walker.—A paper read before the Birmingham and District Electric Club. The author, after discussing the main features of a private plant for electric lighting, describes a plant which is entirely automatic in its working, being self-starting, self-stopping and self-regulating.—Lond. *Electrician,* March 31.

Electricity in Mines.—R. Nelson.—The author gives an analysis of the accidents which have occurred in British mines due to the use of electricity, the analysis being made up entirely from material contained in the annual reports of the British inspectors of mines. He also makes some suggestions as to the safeguards to be observed in the construction and operation of apparatus.—Lond. *Electrician,* April 7.

Wires, Wiring and Conduits.

Insulating Compound.—A note on a recent British patent (9933, March 30, 1911) of R. G. Sharp. A filling for cable troughs consisting of pitch and an equal quantity by weight of merely ground whinstone or granite. The two substances are well mixed together when the pitch is in a molten condition.—Lond. *Elec. Eng'ing,* April 6.

Reinforced-Concrete Poles.—M. Foerster.—A translation in abstract of his recent German paper on reinforced-concrete poles for arc lamps.—Lond. *Electrician,* April 7.

Electrophysics and Magnetism.

Absorption of Electrons.—O W. Richardson and H. L Cooke.—An account of an experimental investigation of the heat liberated during the absorption of electrons by different metals The heating effect due to the difference of the potential energy of an electron inside and outside of a conductor, which the authors previously established for platinum, occurs in other metals. The effect is of the same order of magnitude in all cases, the measured values ranging from about 4.5 volts to 7.5 volts. The values are influenced very considerably by the nature and state of the thermionic emitter. The measured effect is not influenced by changes in the pressure of the residual gas in the apparatus, provided this be reasonably low. Under certain conditions, not yet completely determined, the thermionic emission from osmium becomes unstable, and there are two ranges of stability, one at low and the other at high temperatures.—*Phil. Mag.,* April

Variation of the Ionization with Velocity for the Beta Particles.—W. Wilson.—A note on a recent Royal Society paper Rays of different speeds were separated by means of a magnetic field from the heterogeneous beam given out by the active deposit from radium. The relative numbers of particles corresponding to the different speeds were determined by measuring the charges gained per second by an insulated copper vessel which was placed in the path of the rays and was thick enough to absorb them completely. The corresponding ionizations were determined by a separate experiment, and were corrected for scattering of the rays by the walls of the ionization vessel The results obtained were as follows. The ionization produced per centimeter by beta particles in free air varied inversely as the square of the velocity between the limits examined. The ionization in a thick copper vessel was not connected with the velocity by any simple law, but can be approximately represented by $I = k(c - v)$, where I is the ionization, v the velocity of the particles, and k and c constants.—Lond. *Electrician,* March 31.

Alpha Particles.—T. S. Taylor.—An investigation on the ionization of different gases by the alpha particles from polonium and the relative amounts of energy required to produce an ion. The energy of the alpha particle consumed in the production of an ion depends upon the nature of the molecule ionized. Apparently it requires less energy to produce an ion in the gases or vapors which have heavy or relatively complex molecules than it does in those gases of lighter or less complex molecules. —*Phil. Mag.*, April.

Röntgen Radiation.—J. C. Chapman.—An account of an experimental investigation of the homogeneous Röntgen radiation from vapors. The object was to show that the same type of homogeneous radiation is emitted by the elements, whether they are in the solid state or in the form of vapor.—*Phil. Mag.*, April.

Radioactivity.—W. Duane.—An account of experiments in which the author endeavors to measure the heat generator of radio substances.—*Am. Jour. of Science,* April.

Electrochemistry and Batteries.

Action of Electric Discharges of Nitrogen Gas.—A note on a recent lecture by R. J. Strutt on a chemically active modification of nitrogen produced by electric discharges. The following facts have been established experimentally: Pure nitrogen from whatever source subjected at a low pressure to the jar discharge undergoes some modification which causes it to glow for a short time after it has been sucked away from the discharge. The glow which is emitted while the gas returns to its normal condition is not destroyed by the removal of ions. It is weakened by heating, intensified by cooling. This seems to favor the view that it is due to the re-combination of dissociated atoms. The modified nitrogen acts on ordinary phosphorus, combining with it, and at the same time forming much red phosphorus. It combines with sodium and also with mercury at a gentle heat (say, 150 deg. C.), forming in the latter case an explosive compound, and in each case developing the line spectrum of the metal concerned. It also develops the line spectra of other metals, probably combining with them. It develops the band spectra of compounds when these are vaporized in it, giving in many cases spectra of substances too unstable to be examined at the temperature of the Bunsen flame. It attacks acetylene and substances like ethyl iodide or chloroform, setting the halogen free when there is one, and combining with the carbon to form cyanogen. This is proved by the brilliant cyanogen spectrum produced and by direct chemical tests, such as the formation of Prussian blue. It attacks nitric oxide with the formation, strangely enough, of nitrogen peroxide, a more oxidized substance.—Lond. *Electrician,* April 14.

Electric Steel.—An illustrated translation in abstract of a recent German paper on the electrical production of steel at the works of the Eicher-Hüttenvereins Le Gallais Metz & Company at Dommeldingen, in Luxemburg.—Lond. *Electrician,* April 14.

Units, Measurements and Instruments.

Proposed International Symbols.—D. Robertson.—The author does not agree with Trotter's recent recommendation to avoid script letters for magnetic quantities. He emphasizes that there are not sufficient letters in the alphabet to assign one to each of the physical quantities, and hence most of them must be used more than once. It is, therefore, desirable to distinguish between them by taking different styles of letters for different groups. He uses grotesque (block) type for the geometrical and mechanical quantities, ordinary type for electrical and script for magnetic ones. In addition he employs italics for thermal ideas, and heavy italics for algebraic work, and he looks for another font for luminous things. He is opposed to the proposed use of suffixes to indicate the various values of an alternating quantity.—Lond. *Electrician,* April 7.

Testing Transformer Iron.—L. W. Wild.—An abstract of a paper on an investigation of the system employed by the Bureau of Standards in Washington, in which a number of strips, each 10 in. x 2 in., are built up into a square with interleaved joints with special bent corner pieces. Coils are slipped over two opposite sides of the square, and an alternating-current wattmeter is used in conjunction with an electrostatic wattmeter to determine the losses in the iron. The final conclusion is that the method is not very suitable for the particular alloys tested, and that if it should be decided that the interleaved method with rounded corners is the most accurate it is hardly necessary to trouble about cutting the corners round. If the amount of waste material at the corners is deducted from the gross weight the results obtained will not differ by more than 1 per cent from the results that would have been obtained had the corners been rounded. It appears, however, to the author that the interleaved method is still the best available method of testing transformer iron. It is generally agreed that if accurate results are to be obtained the strips must be annealed after being cut, and this can be done properly only by the manufacturer. There is no special virtue in using wide strips. Strips, say, 10 in. x 1 in. would be in many ways preferable to strips 2 in. wide. Corner effects could be reduced by one-half and, with the same area of iron the length per turn in the magnetizing coil would be reduced, thus reducing the *IR* drop and improving the form factor.—Lond. *Elec. Eng'ing,* April 6.

Galvanometer Used as Electrometer.—W. Peukert.—An illustrated article on the use of mirror galvanometer of the Deprez-d'Arsonval type as a substitute for the electrometer for alternating-current voltage measurements. This possibility is due to the fact that such a galvanometer is in principle of the same construction as an electrometer since the movable coil of the galvanometer corresponds to the needle of the electrometer and the magnet system to the quadrant. If, therefore, the coil is connected to one pole of the voltage to be measured and the magnets to the other pole there will be a deflection which can be measured as in the ordinary use of the galvanometer and which is now an indication of the voltage. The normal position of the coil in the galvanometer is such that the sensitiveness of the instrument when used as an electrometer would be low. It is, therefore, necessary to turn the coil out of its normal initial position when it is to be used as an electrometer. It is easiest to produce this deflection by direct current. The arrangement is indicated in Fig. 1. The coil *s* is connected to a small storage battery *e* in series with an adjustable resistance *r*. The alternating-current voltage to be measured is *E* and when connections of *E* to *m* and *s* are made as indicated there will be a deflection. By giving different values to the resistance *r* and measuring in each case the deflection due to the alternating-

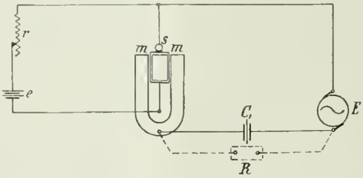


Fig. 1—Arrangement of Apparatus.

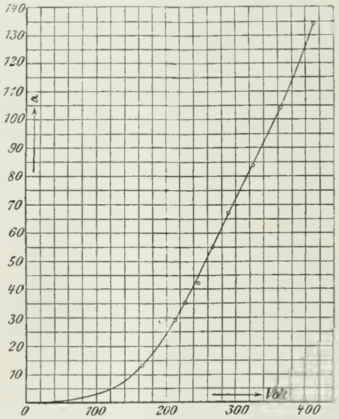


Fig. 2—Diagram Showing Readings on Galvanometer Used as Electro-Meter.

current voltage E it is possible to find such a value of the adjustable resistance r that the deflection of the instrument when used as an electrometer is a maximum. The scale can be varied by condensers C in the well-known manner. Fig. 2 gives the results of a test of a galvanometer when used for measuring alternating-current voltages from 0 volt up to 400 volts. The abscissas are volts, the ordinates deflections.—*Elek. Zeit.*, March 13.

Wattmeters at High Frequency.—E. Behne.—A paper on errors shown by wattmeters at high frequencies. The author shows in which way the wattmeter reading is influenced by mutual induction between the stationary and the movable coils and by the self-induction of the latter coils. Numerical data are given for 500 cycles per second. The formulas show that the errors can be avoided if the induction of the movable coil is compensated by a suitable capacity. Experiments showing the effectiveness of the method are described.—*Elek. u Masch.* (Vienna), March 26.

Localizing Fractures in Submarine Cables.—R. R. Black. The author first gives the general laws concerning the resistances and the emfs located at exposures in broken cables in sea water. He then discusses various methods of localizing fractures in cables and their sources of error with special reference to the reduced-current method.—Lond. *Electrician*, April 7.

Earth Inductor.—J. E. Ives and S. J. Mauchly.—An illustrated description of a new form of earth inductor for measuring the vertical component of the earth's magnetic field directly without the use of the magnetometer and the ordinary rotating earth inductor.—*Phil. Mag.*, April.

Definitions.—The Austrian Electrical Committee gives definitions of thirty-eight important terms used in electrical engineering. They are partly identical with those recently recommended by the German Association of Electrical Engineers. A number of symbols and several rules on rating are also recommended.—*Elek. u. Masch.* (Vienna), April 2.

Telegraphy, Telephony and Signals.

Oscillatory Currents in Coupled Circuits.—G. W. O. Howe. —An illustrated abstract of a paper read before the Physical Society in London. The author describes the method of demonstrating with an oscillograph the currents in coupled oscillatory circuits containing capacity and inductance. The oscillation of energy between the circuits is discussed mathematically and the conditions are shown to agree with experimental results. The quenching of the spark in the primary circuit is finally considered.—*Lond. Electrician*, April 14.

Miscellaneous.

Electricity in Agriculture.—J. H. Priestley.—A lecture before the Farmers' Club in London on electricity as a factor in crop production. The bulk of the lecture was a recapitulation of the experiments which have been carried out by J. E. Newman, in conjunction with Sir Oliver Lodge and Lionel Lodge, and with the co-operation of Raymond Bomford, of Evesham, supplemented by experiments by Priestley himself. In these a network of wires erected over the land under cultivation is kept charged with positive electricity at high potential. He also dealt with the application of electric light in greenhouses for stimulating plant growth, and mentioned experiments with a glass-tube mercury-vapor lamp and also with a quartz-tube mercury-vapor lamp. The results of the experiments so far seem to indicate that plants exposed to the lamps grew more rapidly and, if anything, were more sturdy than plants not exposed in this manner. There were no signs of the lanky, unnatural extension of the plant usually associated with forcing. An account of the discussion which followed is also given. —Lond. *Elec. Eng'ing*, April 6.

Phase.—A note on the different meanings which the term "phase" has gradually assumed, its original meaning being that of a certain moment in a periodic phenomenon. The author does not like the term single-phase and two-phase currents and recommends single-wave and two-wave currents.—*Elek. u. Masch.* (Vienna), April 2.

Book Reviews.

Workingmen's Insurance in Europe. By Lee K. Frankel, Ph.D., and Miles M. Dawson. New York: Charities Publication Committee. 480 pages, 145 tables. Price, $2.50.

Work Accidents and the Law. By Crystal Eastman. New York: Charities Publication Committee. 350 pages, 3d full-page illus. Price, $1.65.

These two handsome volumes are a striking proof of the growing interest in the "conservation of life" as the highest and most important of all natural resources. They constitute part of the Russell Sage Foundation issues and are a distinctly valuable addition to the data of the subjects of which they treat, data that are useful alike to the economist, the industrialist and the philanthropist. The first book, on workmen's insurance, is larger than the other in scope and suggestiveness; but the second, by its poignant and tragic examples, drawn from real observation at close hand in Pittsburgh, drives the lesson home.

The Frankel and Dawson book is in four parts, namely, insurance against accidents; insurance against sickness and death; insurance against invalidity and old age; and unemployment insurance. These topics are again subdivided to show what is done by public and private means in cases of accident; and also in regard to sickness, maternity, funeral and other expenses. The subjects of invalidism and old age and of pensions to widows and orphans are also treated most carefully. A most valuable part of the work is that which treats of defects in the various systems and the need of a complete and connected plan that shall prevent economic waste under whatever guise it may appear in the attempt to cure the greater economic waste at which the whole policy is aimed. In many ways Chapter XVII, for this reason, is the one that American students will perhaps find most interesting, as well as the chapters that follow it detailing various reform projects in Germany and Austria.

Such literature as this deserves the closest study. We have only the beginnings of such insurance in America, but it is fast becoming a national as well as a local issue. The work of the National Civic Federation and the educational efforts of the Museum of Safety and Sanitation in New York are symptomatic of aroused attention on the part of the public, and meantime the legislator is getting busy. No greater fields of industrial employment exist than those affected by electricity, and it is our common duty to help make those fields as safe and secure as possible for all who enter them.

Vorlesungen über Technische Mechanik. By Dr. August Föppl. (In six volumes.) Vol. VI. Leipzig: B. G. Teubner. 490 pages, 30 illus. Price, 12 marks.

This is a carefully written textbook on certain problems in higher applied mechanics, prepared for advanced students of mechanics and mathematics. The principal subjects treated are single and double pendulums, the gyrostat, the centrifugal governor, planetary motions and wave motion. The treatment of these problems is essentially that of the physicist and mathematician rather than that of the engineer—that is, from the standpoint of pure rather than of applied science. The book will be of interest to advanced students of higher mechanics. Although belonging to a set of six volumes by the same author, this volume is practically complete by itself in the department it covers.

Notes on Mechanical Drawing. By Horace P. Fry. Philadelphia. 55 pages, 34 plates.

This textbook has been prepared especially for the use of students in mechanical engineering at the University of Pennsylvania, and contains instructions in the preparation of detail sketches, shaded drawings, dimension sheets, lettering, tables, problems in elementary descriptive geometry, etc. Data on bolt and screw threads, sizes, dimensions, etc., are also included for the aid of draftsmen.

Conduit Wiring. By Laurence M. Waterhouse. London: Simplex Conduits, Limited. 180 pages. Third edition.

The third edition of "Conduit Wiring," bringing its total issue to 20,000 copies, appears with the matter on conduit work largely rewritten and revised, while special chapters have been included on electrical break-downs, lamps, illumination, ventilation, cabling, etc. Tables of wiring capacity and illustrations of model conduit installations are included in the pages. Several interesting opinions on the alleged electrical-wiring hazard, quoted from the British Fire Office Engineers, leave no room for doubt that, over there as here, modern approved conduit construction is regarded as providing the maximum safety from electrical fires.

Les Substances Isolantes. By Jean Escard. Paris: Gauthier-Villars. 313 pages, 182 illus. Price, 10 francs.

A descriptive treatise on the various insulating substances employed in electrical industries, their methods of test and their limitations. The principal chapters are on general considerations, the characteristics of insulators, the metalloidal insulators, mineral insulators, guttapercha and resins. Much attention is given to the nature and properties of the insulators employed on high-tension conductors, both aerial and subterranean. Methods of construction, analysis and testing are given. The book will be useful to high-tension manufacturers and engineers. It contains an unusually long list of insulating substances and gives much useful information concerning them.

New Apparatus and Appliances

SHOCK-RESISTING QUALITY OF ELECTRIC AUTOMOBILE.

One of the most remarkable incidents of the fatal New York Central explosion of last December was the lifting of a trolley car from its tracks and overturning it on a passing automobile. That same automobile, after a brief sojourn in the repair shop, is back in service. Its running gear, which was submitted to such great strain, was found to be practically uninjured. There are a few new spokes in one forward wheel, a new steering knuckle on the front axle, new tires and body, but the chassis, axles, wheels and even the springs were not damaged, while only four of the forty storage-battery cells were cracked. The automobile was an electric machine used by Mr. S. G. Rhodes, of the New York Edison Company. It was built by the Baker Motor Vehicle Company, Cleveland, Ohio.

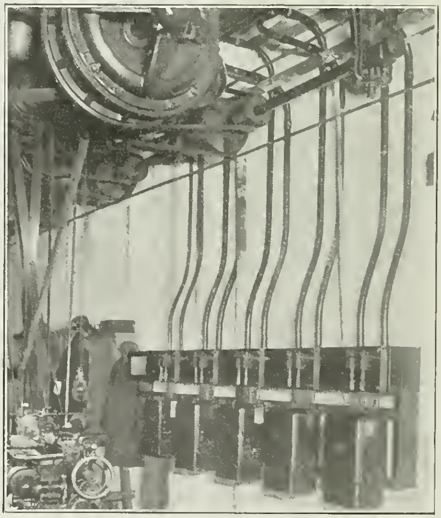
MOTOR-STARTING AUTO-TRANSFORMERS.

A motor starting auto-transformer consists of an inductive winding with taps, a switch for connecting the taps to the motor and a hand-operated lever handle and automatic release mechanism for operating the switch. The winding comprises a coil for each phase wound on a separate leg of the laminated core and provided with several subvoltage taps, any one of which may be selected, by trial, as suitable for the starting requirements of any particular case. The switching device in the starter here shown consists of pipe contacts, immersed in oil, and carried by a switch shaft extending through the sides of the compensator case. To one end of the switch shaft is attached the hand-operated lever, and to the other end the external spring return lever, through the medium of which the automatic release devices operate in conjunction with the hand-operated mechanism.

The automatic release mechanism consists of overload and no-voltage relays, tripping levers and spring-return levers, which operate automatically to return the switch to the off position from either the starting or running positions, if it should happen to be carelessly or accidentally left on the former, or in case of overloads or voltage failure when it is being held on the latter.

The spring-return levers are mounted on the switch shaft and are actuated by a spring against the tension of which the switch is thrown by the lever handle to either the starting or running positions. Consequently, if at any time the switch should happen to be left on the starting position, the tension of the spring will automatically return it at once to the off position. On the other hand, when the switch is thrown to the running position, the tripping lever of the no-voltage relay engages the external spring-return lever and holds the switch in that position until the spring-return lever is released either by hand or by the dropping of the plunger of the no-voltage relay, in case of either overload or voltage failure, thus permitting the spring to return the switch to the off position.

The no-voltage relay consists of a solenoid coil and plunger In case of voltage failure, with the switch in the running position, the de-energizing of the solenoid coil allows the plunger to drop, thereby depressing the tripping lever and releasing the spring-return lever, thus permitting the spring to return the switch quickly to the off position. Therefore, by inserting a normally closed push button in the energizing circuit of the no-voltage release coil, it is possible to stop the motor from a remote point. In the off position both the compensator and the motor are disconnected from the line and are thus effectually protected from the returning full-line voltage.



Starting Auto-Transformers Controlling Induction Motors.

The overload release comprises two series trip coils inserted in the running circuit. By the use of oil dash pots they are unaffected by the usual rush of current at starting, but can be adjusted to operate on a slight increase in current above normal and to open the no-voltage relay circuit, thus allowing the switch to be snapped back from the running to the off position by the action of the spring, as already described. The overload relays are employed where fuses are undesirable, and like the latter are mounted on a separate panel. They are more convenient in all cases, however, as their use saves the expense and time lost in replacing fuses.

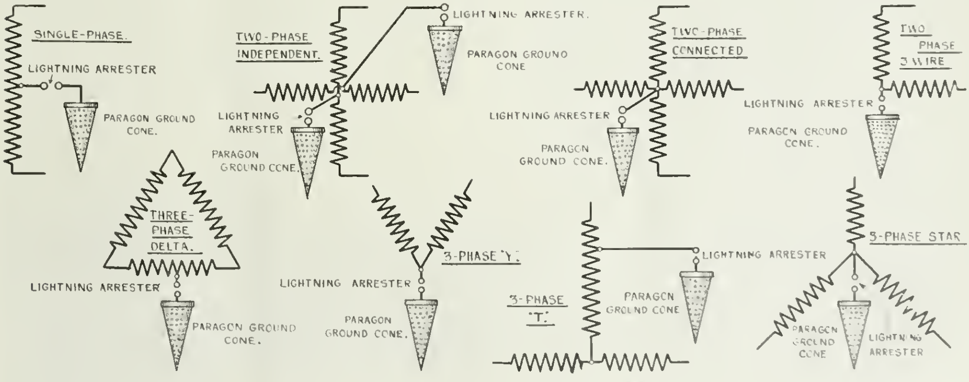
These starting auto-transformers are built by the General Electric Company in two types, the wall-suspension type and the floor type. The former includes sizes for motors of from 5 to 100 hp. Those of the floor type are suitable for motors of larger rating.

GROUNDING OF SECONDARIES.

Following the recent action of the Underwriters' National Electric Association in recommending the grounding of secondary circuits up to 150 volts, the Paragon Sellers Company, of Chicago, which makes a circuit-grounding cone, calls attention to the various methods of making ground connections possible by this device, as shown by the accompanying diagrams. Many electric-light companies ground their secondaries either to water mains or to home-made grounding devices. Other companies have put the matter off because they have been prohibited from using water mains or have been unable to secure reliable ground connections at a reasonable cost.

Undoubtedly the best ground connection is to a water system. In some cities, however, this is prohibited owing to the fear of injury to the underground pipes due to electrolysis. Whenever a transformer breaks down or a circuit is crossed, there is only a momentary flow of current to the ground, until the fuse or the circuit-breaker opens. This momentary flow is alternating in character and therefore has no electrolytic effect. Hence the water main can be safely used for this purpose, and it is usually recommended whenever it is practicable to make it without undue expense. But where water mains are not available, or where a portion of the street, sidewalk or basement must be torn up in order to get to a water connection, some other method of grounding must be used.

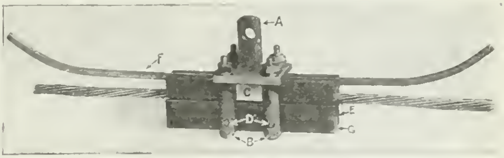
Under these circumstances the advantages of the ground cone are evident. Iron pipes or rods or copper plates are sometimes found to be unreliable. Moist earth is a prime essential. This must be obtained without rusting or corroding the metal. The Paragon ground cone consists of a perforated cone of pure copper filled with charcoal. It presents a large discharge area and allows moisture to be retained by the charcoal. A hollow braided cable into which the ground wire is to be run and soldered is an integral part of the cone. No salt is required to produce moisture and the cones are easily installed by using a 6-in. post-hole auger. The accompanying diagrams, showing the manner in which the cones are connected for various classes of service, are of considerable interest.



Various Methods of Grounding Transformer Secondaries.

SUSPENSION CLAMP FOR HIGH-TENSION CONDUCTORS.

In the transmission of energy at high voltage using suspension-type insulators it is the common practice to use stranded conductor either of copper or aluminum. In order to suspend the conductor from the lower unit of each series a clamp of some form is used. Heretofore most of the clamps were made of metal, but in a new design, invented by Mr. R. A. Willson, general superintendent of railways, Washington Water Power Company, of Spokane, Wash., and employed with great success on transmission lines since their construction early in 1910, use is made of two wooden clamping blocks in place of the metal clamps. One of the chief advantages of this clamp is that, the wood being soft to a certain degree, the clamping members will not injure the cable. This is especially advantageous where aluminum cable is used, as it is well known that aluminum cable can be seriously injured by being clamped too tightly.

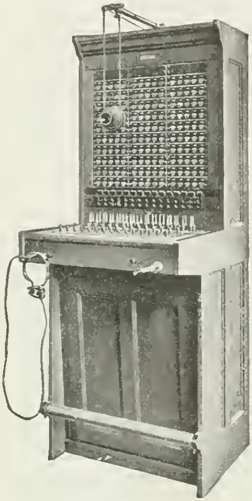


Suspension Clamp for High-Tension Conductors.

Referring to the accompanying illustration, the clamp is attached to the clevis casting of the lower insulator unit by means of the suspension member *A*, which is attached to the clamping members *E* by means of the U-bolts *B*. Grooves are provided at the top and bottom *G* of the clamping members for the insertion of arcing horns or rods. The illustration shows the arcing rod *F* placed at the top, where it is ordinarily used. In order to prevent destruction of the clamp or cable by a flash-over the arcing horn is electrically connected to the cable by means of the aluminum strip *C*. The screws *D* are for the purpose of facilitating the assembly of the clamp on the line as they prevent the members from dropping apart. The clamp is pivoted at *A* so that breaking of the conductor will allow the clamp to swing, thus preventing kinking of the conductor. The clamp is somewhat more expensive to produce than some other designs, but the results in service seem abundantly to justify the expenditure

Mr. Willson has made arrangements with the Ohio Brass Company, of Mansfield Ohio, to manufacture and market this clamp.

CONVERTIBLE TELEPHONE SWITCHBOARDS.



Switchboard for 165 Lines.

The telephone switchboard here illustrated has been designed for use by small telephone companies. The type is known as the magneto convertible non-multiple switchboard, being so arranged that it can be used originally for magneto service and then converted at will for central-battery operation. Oftentimes it is advantageous to make the change from magneto to central battery gradually. The switchboard here shown allows both kinds of service at the same time. One or more sections equipped for magneto service can be installed, and when the time comes for changing to central-battery operation the transition can be made without any loss of equipment.

The switchboards are made in two sizes, one arranged for 330 magneto or common-battery lines, thirty pairs of cords and thirty transfer circuits, and the other for 165 magneto or common-battery lines, fifteen pairs of cords and fifteen transfer circuits. They are so designed and constructed that any number of sections can be readily lined up together, so as to make a switchboard with several positions without making a single change in the woodwork of the cabinet, and the sections when so arranged present the appearance of one continuous cabinet. They have been developed for the market by the Western Electric Company.

GAS-ELECTRIC CAR.

The General Electric Company has just delivered a gas-electric car to the Buffalo, Rochester & Pittsburgh Railway. On April 18 the car proceeded to its destination over the lines of the New York Central Railroad with a party aboard consisting of Mr. William K. Vanderbilt, Jr., Mr. Harold Vanderbilt, Mr. A. H. Smith, Mr. P. E. Crowley, Mr. Horace E. Andrews, Mr. Edward F. Peck, Mr. J. R. Lovejoy, Mr. E. W. Rice, Jr., Mr. W. B. Potter, Mr. Arthur W. Jones, Mr. Henri G. Chatain and Mr. Frank E. Case. Owing to the absence of smoke, cinders and gas the passengers enjoyed the advantages of electric-railway travel in addition to the comforts of Pullman service.

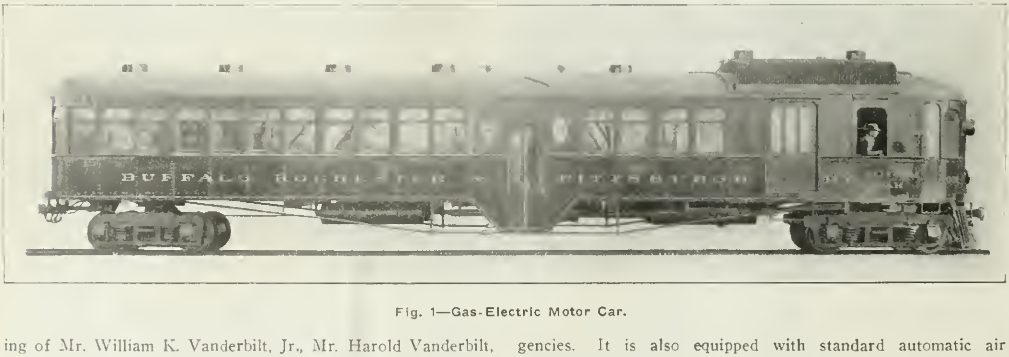


Fig. 1—Gas-Electric Motor Car.

This type of car is well adapted for use on branch lines which at present may be operated at a loss by steam and where the amount of traffic does not warrant electrification, and its use on such lines will reduce operating expenses and increase traffic.

The car is 66 ft. long, 14 ft. high and has a seating capacity of forty-nine in the passenger compartment and twenty in the smoking compartment, with two passengers per seat. The seats are sufficiently wide to accommodate three persons, and hence, if desired, the passenger compartment will accommodate sixty-nine and the smoking compartment twenty-eight, the total then being ninety-seven.

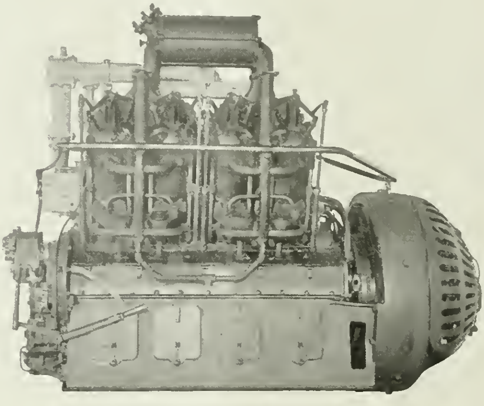


Fig. 2—Gasoline-Engine Set.

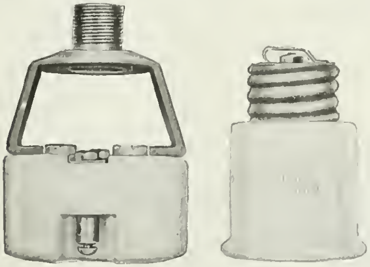
The car derives its power from a gasoline engine and transmits it to the wheels by means of an electric drive, thus avoiding any direct mechanical gearing or connection between the engine and the wheels. The engine is directly coupled to an electric generator, forming a compact power plant located in the engine compartment. The motors are of the standard railway type mounted upon the axles. The car is operated by means of a suitable controller in a manner similar to ordinary electric-trolley cars. A 100-gal. storage tank supplies sufficient gasoline to carry the car over 200 miles.

The car is provided with automatic and straight air-brake equipments and auxiliary hand brake for use in case of emergencies. It is also equipped with standard automatic air signals.

The car made the trip of 244 miles from Schenectady to Rochester by way of the Auburn division without delay of any kind. The smoothness of operation and ease of control were subjects of most favorable comment, and the speed attained on the heavy grades of the Auburn road was satisfactory in the highest degree.

SERIES INCANDESCENT LAMP SOCKET.

The series socket illustrated herewith has been especially designed for use with tungsten-filament lamps, although any type of lamp can be used. The "push-in" feature of the series socket used in the past has been entirely eliminated, thereby avoiding the breakage of the filament when putting the lamp in. This has been accomplished by arranging the socket to screw into the receptacle, instead of pushing in. The socket carries a cut-out which operates in case the lamp burns out or is broken, and the receptacle is arranged with a short-circuiting device which automatically closes the line when the socket is removed. The socket is so designed that it can be used with all types of fixtures now in use. It is made by the Philadelphia Electrical & Manufacturing Company, 1228 North Thirty-first Street, Philadelphia.



Incandescent Lamp Socket.

THREE-PHASE TRANSFORMER OF 10,000-KVA RATING.

The Pennsylvania Water & Power Company generates power from the Susquehanna River at McCall's Ferry, where it will have an ultimate rating estimated at 100,000 hp, as noted in our issue for Oct. 20, 1910. At present the energy generated is transmitted 40 miles to Baltimore and transmission lines to other cities are contemplated.

The Baltimore substation is at present equipped for 40,000 kva and space is provided for additional transforming and switching apparatus. The present equipment consists of four 10,000-kva, three-phase transformers, which, because they are the largest transformers ever built, are of particular interest. They are of the water-cooled type and are used to step down the 25-cycle emf from 70,000 volts to 13,200 volts for distribution.

The appearance of one of these transformers is shown in the illustrations, but these do not give an adequate idea of their size. The tank is elliptical, having an over-all length of 15 ft. 11 in. and an over-all width of 8 ft. 8 in. The height to the top of the terminal is over 16 ft., and the joint between case and cover is 11.5 ft. from the floor. The total weight of each transformer complete with oil is about 145,000 lb., or nearly 75 tons.

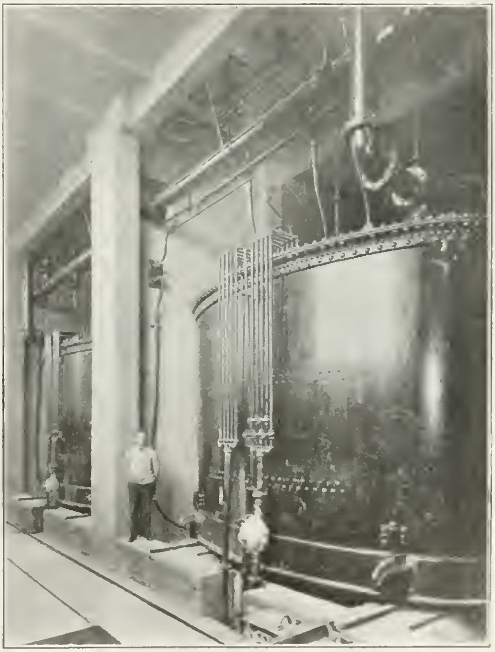
The transformers are of the core type, water-cooled. The cooling water is visible at its exit, so that any stoppage or inequality of flow in the parallel cooling coils can be detected easily. The tanks are of boiler iron with welded seams and crowned cover and bottom.

The condenser type of terminal bushing is used, as the specifications called for bushings to withstand a test of 180,000 volts for one minute. These bushings are made up of alternate layers of insulating and conducting material which, by producing a uniform distribution of dielectric stress in the insulation, enable the use of the minimum of material.

The method used in installing these large transformers is also of interest. On account of railroad clearances and the great weight of each unit, the core and coils, the tank, cover, base and details, and the oil were received from the factory separately. At the Baltimore substation a railroad siding runs directly into the station. Paralleling the siding in the station are the transformer compartments, built of concrete. On receipt of the transformers in the substation it was necessary to assemble them, one at a time, on a truck running on a track having the same center line as the siding, but wider gage. Lifting and moving were done with an electric hoist. After each transformer was assembled the truck was pushed along its track to the proper compartment, and the transformer rolled in on its own wheels, the floor of the compartments being at the level of the rails on the truck. The oil, received in tank cars, was pumped into the tanks after the transformers had been thoroughly dried out.

Underneath each transformer is a pit connected with a 1[illegible]-in. main for draining the tanks in case of emergency. The top of each transformer is connected through a back-pressure valve to an 8-in. main to relieve any possible rise of pressure in a tank. The arrangement is such that oil blown out of one transformer cannot enter another.

The cooling system is arranged to preclude a shut-down from lack of cooling water. Normally water is obtained from a well near the substation. Connection is also made to the city mains for use in case of deficiency of the well, and a large storage tank on a steel tower, erected outside the substation, is built for use in case of failure of both sources. In connection with this emergency system there is a spray cooling system, which makes it possible to re-use the cooling water, the storage tank supplying only the deficiency caused by leakage and evaporation. Normally the heated water is discharged into a nearby stream.

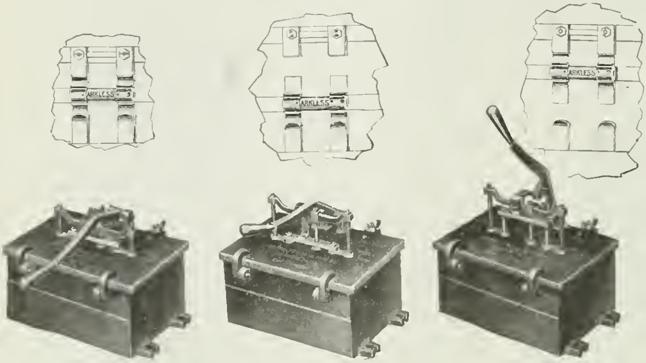


10,000-kva Transformers.

The transformers were furnished by the Westinghouse Electric & Manufacturing Company, and were built at East Pittsburgh, Pa.

MOTOR STARTER WITH FUSING DEVICE.

The three-phase motor starter here illustrated is arranged to take care of the heavy starting current by paralleling the fuses and to fuse the circuits properly for the running load. When throwing on the switch the fuses are paralleled by a copper bar as is noted in the small sketch of Fig. 1. It is necessary to hold this lever down until the motor has reached speed, at which time by removing the hand the lever is automatically thrown out and the paralleling device removed from circuit. This leaves the fuses protecting the motor, as is noted in Fig. 2. When it is desired to throw off the switch it is necessary merely to pull out the lever, as is noted in Fig. 3. The switch is "quick make" and "quick brake" with no intermediate position, and can be operated successfully by the most ignorant workman—that is, it is "foolproof." It has been placed on the market by the Detroit Fuse & Manufacturing Company, Detroit, Mich.

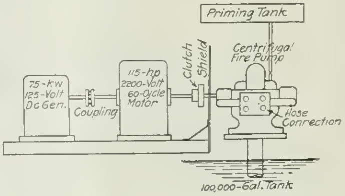


Figs. 1, 2 and 3—Starting, Running and Off Position of Switch.

FIRE PUMP COMBINED WITH MOTOR-GENERATOR SET.

For operating direct-current motors driving machine tools in its shops at Erie, Pa., from the alternating-current primary distribution lines of the Erie County Electric Company, the Burke Electric Company has installed a 115-hp motor-generator set, comprising a 2200-volt, 60-cycle, three-phase motor driving at 1120 r.p.m. through a flexible coupling a 75-kw, 125-volt direct-current generator. The motor element of this set in addition provides auxiliary fire protection for the 60,000 sq. ft. of buildings in the group. For this purpose the opposite end of the motor shaft is fitted with a clutch which when engaged drives a Dayton double-discharge centrifugal pump capable of delivering 1200 gal. of water per minute from a 100,000-gal. concrete-lined tank outside the buildings. A priming tank, always kept filled, is mounted just over the pump, so that putting the unit into service is simply a matter of opening the direct-current generator switch, closing the clutch and opening the priming valve.

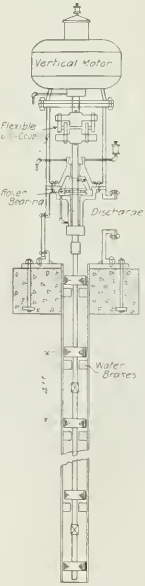
Inasmuch as the motor element is kept in continuous service, running almost constantly throughout the day, there can be little possibility of this unit failing to respond when called upon for emergency use. The centrifugal pump is equipped with a four-nozzle header, producing a nozzle pressure of about 80 lb. when delivering to four lines of 2-in. hose, or 110 lb. when delivering to one nozzle. The pump delivery line is also arranged for connection to the city water mains and to the automatic sprinkler apparatus in case of any impairment of city service. In spite of the virtually continuous test to which the motor is put, the pump element is started up frequently to make sure that all parts are in order. The water mains and sprinkler lines with which the buildings of the Burke factory group are fitted are provided with accessible valves so that by the proper arrangement of these any building can be supplied with water, over one of two or more routes, from the motor-driven centrifugal fire pump described.



Fire-Protection Pump Combined with Motor-Generator Set.

DEEP-WELL PUMP.

The improved form of deep-well pump shown in the accompanying sketch is adapted for depths up to 150 ft. where necessary, although operated to best advantage at depths of 80 ft. and less, where it is declared to show high hydraulic efficiencies. An 8-in. pipe is first sunk, forming the casing of the well. In this there revolves at 1200 r.p.m. the steel shaft shown, carrying impeller lifts at 4-ft. intervals. These impeller screws are inclosed in cylindrical casings which bear against the well pipe, being water-lubricated. Just before the water reaches each impeller screw it has its churning, whirling motion arrested by the pairs of water-brakes shown. These brakes enable the next pair of impellers to react on and lift the water, as would be otherwise impossible were the water rotating nearly as fast as the screws themselves. The entire shaft with its runners is carried on a roller bearing with self-oiling bronze bushings. The motor drives the shaft through a unique flexible coupling comprising two opposing quills of steel fingers interwoven by a leather belt through which the driving action is exerted. The well shaft is itself flexible to adapt itself to errors of alignment in the well boring.



Improved Deep-Well Pump.

One of these pumps at Oklahoma City, Okla., in the plant of the local electric company is delivering 450 gal. per minute from an 8-in. well, 40 ft. deep, and has made unnecessary the drilling of additional wells which were first thought to be needed. Another similar pump, at Wichita, Kan., is said to be raising 750 gal. per minute from a 38-ft. well at an expenditure of 13 kw at the motor. This deep-well pump was devised and is being manufactured by Mr. W. S. Gregg, a consulting engineer of Kansas City, Mo.

Industrial and Commercial News

The Week in Trade.

Owing to a tendency toward price concessions, a more hopeful view is taken of prospects for an early movement in general trade, and although a definite basis seems lacking, there is a belief that the situation has been slightly improved during the week. Retail trade has benefited by good weather and banks are exchanging more outside checks than in the early part of the month. With the volume of April business less than that of March and February, further disappointment was found in the Steel Corporation's report, which is considered an indication of the state of general trade. Net earnings were greatly under expectations, in addition to being the smallest in all but nine quarterly periods in the history of the company. With the light demand for iron ore, as shown in the reduction in price of the lake ores, and with the light demand for grain, the soft coal trade having an outlet on the lakes is threatened with a tie-up, since shipping interests with no grain or ore to carry south are not disposed to offer facilities to coal operators for transporting their product. A fair volume of business is being done in necessities and the activity abroad continues to help the export trade. The exports from New York for the week amounted to $20,044,484, which is an increase of $6,502,755 over the figures for this period in 1910. Imports were $16,908,701, showing nearly $1,500,000 less than for the same week last year. Stock markets have been irregular, and only a small amount of business has been transacted. Bond markets have been active and a fair amount of money has found its way into investment securities, while prices are slightly better. Advices from farming sections give no cause for concern in the outlook for crops, grain, winter wheat and fruit reports continuing to be favorable, and while the weather in the cotton districts has not been so warm or dry as might be desired, the crop is expected to be larger than that of last year. Collections are slow to fair. Business failures for the week ended April 27, as reported by *Bradstreet's*, were 240, as compared with 233 for the previous week, 189 for the same week in 1910, 268 in 1909, 282 in 1908, and 163 in 1907.

The Copper Market.

Events of the week indicate manipulation in the trade, and excepting for one large sale of some 15,000,000 lb. to brass interests at approximately 12⅛ cents at ninety days, the net changes in the situation are unimportant. There is but little action on the part of buyers in any lines, demand from domestic consumers is light, and there are indications that the majority of lines are well supplied for May and June, at least. Demand abroad has been slightly increased, with a small advance in standard copper, but the activity was only temporary, the market showing a decline at the end of the week. There seems to be a well-defined impression that the United Metals company will abandon its policy of making fixed prices, thus placing the copper trade on a competitive plane, but inasmuch as price cutting by Amalgamated interests can be easily met by competitors who have a lower cost of production, there would seem to be no logical basis for such action on the part of the Amalgamated company, except for moving present stock. Rational curtailment on the part of the big producers would assist the situation. In view of light demand producers cannot afford to stand expenses of production indefinitely, so that unless early change occurs in the situation enforced curtailment may follow. Heavy imports have been a feature of the week, making totals for the month nearly 15,000 tons. March imports, as given by the government report, were 13,500 tons and total imports for the first quarter of the year were 37,500 tons, an increase of 2500 tons over the figures for the first quarter last year. Exports for the month were 27,466 tons. The daily call on the Metal Exchange May 1 quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.60	11.70	.....
April	11.60	11.70	11.65
May	11.65	11.75	11.70
June	11.65	11.75	11.70
July	11.65	11.75	11.70

The London market, May 1, was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	54	1	3	54	12	6
Standard copper, futures	54	1	3	54	13	9

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.30c	11.65c
London, spot	£56 15 0	£53 11 3
London, futures	57 12 6	54 3 9
Best selected	60 5 0	57 5 0

Industrial and Commercial Notes.

Georgia Power Company.—C. O. Lentz, chief engineer of the Georgia Power Company, says that rapid progress is being made in the construction of the development of the company at Tallulah Falls, and that bids for equipment will be received up to the end of this week at the office of the Northern Contracting Company, New York. The specifications for the first instalment at Tallulah Falls call for the following: (a) Three 10,000-kva, 60-cycle, 6660-volt, three-phase, water-wheel type alternators; (b) nine 3333-kva, single-phase, water and oil-cooled transformers; (c) one 20,000-kw, 110,000-volt, three-phase, outgoing line equipment; (d) two 300-kw, direct-current, 250-volt exciter generators, for direct connection to two reaction water-wheels, also for direct connection to a 450-hp induction motor, the water-wheels, both exciters and the induction motor to be mounted on a common bedplate; (e) one 450-hp induction motor for direct connection to both exciters. The ultimate capacity of the station will be six units of item (a), nineteen units of item (b), four units of item (c), two units of item (d) and one unit of item (e). Contracts for the towers for the 230-mile transmission line have been let to the American Bridge Company, together with the steel work required in the construction of the station. The American Steel & Wire Company has been awarded a contract for 2,000,000 lb. of wire for the transmission line. Part of the insulators for the circuit between Tallulah Falls and Atlanta, the outer zone of which will be reached by the lines now building, will be furnished by Thomas & Sons Company, of New York, and the balance by the Ohio Brass Company. It is expected that the first instalment will be in operation within a year and a half.

Electrical Equipment for Pittsburgh Steel Mill.—Dilworth, Porter & Company, Ltd., a Pittsburgh steel manufacturing concern which is enlarging its mill, will install electric drive and has ordered from the General Electric Company one 1500-kva mixed pressure turbine, which will run from the company's present rolling-mill engines. In addition to this unit the company will also install one 25-kw turbo-exciter, one 700-hp, one 350-hp and six 7-hp mill motors, two 20-hp totally inclosed motors, two 75-hp vertical motors, and three 40-kw transformers, together with switchboard, controlling apparatus, etc., all of which will be furnished by the General Electric Company The 700-hp motor is to be connected by rope drive to an 18-in mill and the 350-hp motor will be directly connected to a spike rod mill, the 20-hp motor driving the bull heads for the same. The 7-hp motors are of the reversing mill type and will drive tables, cooling beds, etc., while the vertical motors will drive pumps for supplying condensing water for the turbine, as well as water for general use around the mill. Low tension current for the 20-hp and 7 hp motors will be supplied by the small transformers. A recording wattmeter with transfer switch mounted on the power-station switchboard will enable a record to be made of the operation of either of the large motors.

Dams on the St. Lawrence River.—The Canadian Light & Power Company is planning an expenditure in the neighborhood of $15,000,000 for building a large station in addition to construction now going on at the foot of the Beauharnois Canal and has applied to the Dominion government at Ottawa for authority to build dams across the St. Lawrence River near Coteau, at the head of the rapids. All of the projected work will be situated in Canadian territory.

Westinghouse, Church, Kerr & Company.—Among recent plants installed by Westinghouse, Church, Kerr & Company is a 600-kw gas producer plant for the estate of the late E. H. Harriman, at Arden, N. Y. The equipment consists of three 200-kva Westinghouse generators and a gas producer set furnished by the same company. Three producers have been installed to date, and provision has been made for an ultimate plant rating of 1000 kw. In addition to supplying energy for the needs of the Harriman estate the plant will furnish lighting service in the immediate neighborhood, and also to the residential district at Tuxedo Park. Westinghouse, Church, Kerr & Company have also finished work on the plant of the Worcester Electric Light Company, Worcester, Mass., 6000-kw equipment in turbines having been installed, with provision made for an additional 2000-kw unit in the future. The building and stack are of reinforced concrete. The plant will operate condensing, and is equipped with Sterling boilers and Taylor stokers. The additions to the plant of the Hartford Electric Light Company, on which these engineers have been busy since 1904, have been completed, and two additional 4000-kw General Electric horizontal-type turbines, with additional switchboard and boiler equipment, have been installed. The installation of these two 4000-kw units makes the nominal rating of the plant at present 21,000 hp.

Telephone Train Dispatching.—The Central Vermont Railway has installed a system of train dispatching telephones between St. Albans and Windsor, Vt., with a branch from Montpelier Junction to Williamstown, a distance of 150 miles. Selectors and telephone sets have been installed at each of the thirty-eight way stations on the division, the Van Akin telephone arm being used by the way-station operators. The Chicago, Milwaukee & Puget Sound Railroad Company will also be using the telephone very shortly to dispatch its trains between Mobridge, S. D., and Deer Lodge, Mont., a distance of 755 miles, and an order has been placed by the company for seventy-five sets of telephone equipment. The Pennsylvania Railroad, which is already operating a number of its divisions with telephone equipment, as recently mentioned, has just placed an order for telephone equipment for use on its Bellwood division. All the telephone equipment used on these roads was ordered from the Western Electric Company.

Storage Battery Cars on Salisbury & Spencer Railway.—A demonstration of the storage battery car was made last week by the Federal Storage Battery Car Company upon the system of the Salisbury & Spencer Railway system, control of which has been acquired by W. J. Oliver, as mentioned in our issue of April 13. The test was made on the line between Concord and Salisbury, N. C., and was witnessed by officials of many Southern railroad, central station and manufacturing interests, who expressed themselves as favorably impressed with the performance of the car. Le Roy Scott, sales manager of the Federal company, who conducted the test, states that with fifty-two passengers the energy consumed in a 4-mile trip over grades from 1.2 per cent to 6.8 per cent was 1.8 kw-hours, averaging 0.450 kw-hours per car-mile. Mr. Scott advises that the Salisbury & Spencer officials intend to install a number of these cars upon the system.

Southern Power Company.—The Harris Trust & Savings Bank, of Chicago, is offering for sale $1,000,000 of first-mortgage 5 per cent gold bonds of the Southern Power Company. The Southern Power Company owns and controls modern hydroelectric plants having a rating of about 108,000 hp. This equipment will soon be increased to 130,800 hp and will furnish electrical energy to the southern cotton mill district of North Carolina and South Carolina, including the cities of Charlotte, Greensboro, Winston-Salem, Salisbury, Spartanburg and Greenville. The territory served has a population of about 600,000. In addition to supplying electricity to more than 100 cotton mills, the company supplies energy at wholesale to a number of local distributing companies. J. B. Duke is president of the company. In the year 1910 the gross earnings of the company were $1,263,479 and the net earnings $807,937. The bonds run for twenty years, from March 1, 1910. They are offered at par and accrued interest.

Large Arc-Lamp Order from Cincinnati.—The Union Gas & Electric Company, of Cincinnati, has placed with the General Electric Company what is said to be the largest single order for arc lamps ever received by a manufacturer. This order calls for 6000 of the company's latest type series luminous-arc lamps, including a complete mercury-arc rectifier station equipment for 9000 lamps. The order, twice as large as any previous lamp order, and reaching a total value close to half a million dollars, is significant of the rapidly increasing popularity of this type of lamp. When the 6000 new lamps are installed in Cincinnati the city will rank in illumination with Boston, St. Louis, Toledo, Montreal and Baltimore, which use the same type of lamp and are considered among the best lighted cities on this continent.

Electric Flatiron Contracts.—The recent order received by the General Electric Company from H. M. Byllesby & Company for 5004 electric irons, as mentioned in the issue of April 6, and the order of the Southern California Edison Company, of Los Angeles, for 6000 similar irons, are indicative of the commercial status of the electric flatiron and of the attitude of the larger central station companies in placing orders. Heretofore orders have usually been in lots of a few hundred, the supply being replenished at frequent intervals during the flatiron season, this method involving risk of delay in the midst of a campaign. The present practice is to estimate early in the year the requirements for a season's campaign, placing contracts in sufficient time to insure having a full stock on hand when required.

Blewitt Falls Transmission Line to Be Started.—President Charles E. Johnson, of the Yadkin River Power Company, says that no time will be lost in completing the new plant of the company at Blewitt Falls, on the Pee Dee River, Richmond County, N. C., and in the construction of the large transformer station near Raleigh. The Phoenix Construction Company, which has the contract for building the transmission line, has opened an office in Raleigh in preparation for the work. The line will extend from the plant to Raleigh and to towns in the vicinity, including Louisburg, Henderson and Wake Forest to the north and as far as Goldsboro to the east. The plant was started by the Rockingham Power Company, as described in the *Electrical World* March 23 and April 20, 1911.

Westinghouse Traction Equipment Sales.—The Metropolitan Street Railway Company, of Kansas City, Mo., has placed an order with the Westinghouse Electric & Manufacturing Company for 100 street railway motors. This is additional to an order for 200 motors placed last year by the Metropolitan with the Westinghouse company. The Sioux City Service Company has recently ordered a large number of modern interpole motors of 30 hp each to replace all old types of motors now in service. Foreign business secured by the Westinghouse company during the last week includes orders from the San Juan Traction Company, of Porto Rico, and the Rio de Janeiro Tramway, Light & Power Company, Rio de Janeiro.

New England Lines Industrial Bureau.—President C. S. Mellen of the New York, New Haven & Hartford Railroad and representatives of the Boston & Maine and Maine Central Railroads have completed plans for the formation of the New England Lines Industrial Bureau, which is to be opened in Boston in May. The purpose of the bureau is to further development in all forms of New England industry, especially in farming, dairy and manufacturing lines, by co-operation between the railroads and industrial interests. William H. Seely, general freight and passenger agent of the Central New England Railroad, is to be head of the bureau.

Clarion River Power Company.—The State Water Supply Commission at Harrisburg, Pa., has heard protests during the week against the granting of charters to the Clarion River Power Company and others, who are planning to build dams and stations on the Clarion River, as outlined in the issue of April 20. Representatives of business and residential interests were present and were active in opposing the approval of the charters.

New Unit for Columbia Electric Street Railway, Light & Power Company.—Messrs. J. G. White & Company, of New York, have purchased a 2500-kw turbo-generator from the General Electric Company for the plant of the Columbia Electric Street Railway, Light & Power Company, Columbia, S. C. Babcock & Wilcox boilers will be installed to furnish the additional steam requirements.

Bulletins Wanted.—Walter L. Hibbard, who is conducting an electrical engineering, contracting, supply and general machinery business at Fitchburg, Mass., wishes to receive catalogs, bulletins and other descriptive matter pertaining to equipment in these various lines.

Financial.

The Week in Wall Street.

REVIVAL of interest in the bond market, with investment securities finding a ready sale at advanced prices, is probably the chief feature of note in New York markets. This activity has been a source of considerable comment, inasmuch as an active bond market usually imparts a corresponding tone to stock transactions. The belief has, therefore, been freely expressed that the long-awaited impetus has been given to the market. There is, however, an abundance of evidence at hand to favor the view that the briskness in bond sales is due rather to the absence of speculative interest and more to the fact that conservative investment is being sought for the excess of idle funds. The week's transactions in stocks were slightly in excess of those of the previous week, the shares sold amounting to 1,725,941, compared with 1,692,933, as reported for the week preceding. In the earlier part of the week trading was irregular, with the general trend of prices toward a higher level, while near the end of the week the activity was more marked, a number of issues gaining a point, and in some cases even a fraction in excess of this. While more interest was evidenced during the week than in several weeks past the trading was, in the main, of professional character. Current matters exerting an influence on the market included the small earnings of the Steel Corporation for the first quarter of the year, the postponement of rulings in the trust cases, the advances in cotton prices to the top level of the year and the status of the Mexican revolts. The record for April is the lowest since August, 1900, sales at that time aggregating 3,949,000, against 4,706,000 for the month just closed. Such improvements as may come in the state of general trade will be gradual, and the present season of the year, at best, is not one to accelerate a change. With announcement of the decisions, settlement of tariff revision and fulfilment of expectations for large returns from the farming districts, it would seem likely that conditions would show improvement. Money continues to be easy, rates May 1 being: Call, 2@2½ per cent; ninety days, 2½@2¾ per cent. The quotations in the table are those of the close May 1.

NEW YORK.

	April 24.	May 1.	Shares Sold.		April 24.	May 1	Shares Sold.
All. Ch.	7⅜*	7½*	100	Int. Met., pf.	49½	51⅞	6,900
Al. Ch., pf.	26	28	400	Mackay Cos.	93½*	90½*	100
Amal. Cop.	63	63⅞	90,550	Mackay C., pf.	74⅞*	74⅞*	—
Am. D. T.	20½*	20½*	—	Man. Elev.	137	136*	525
Am. Loco.	35¾*	38	400	Met. St. Ry.	15*	15*	—
Am. Loco. pf.	104	104⅞*	110	N.Y.&N.J.Tel.	139½*	139½*	—
Am. Tel. & C.	83*	83*	—	Steel, com.	73⅞	76¾	438,180
Am. T. & T.	145	146½	3,610	Steel, pfd.	119	119¼	8,717
B. R. T.	76⅞	79⅛	16,853	W. U. T.	72*	73¾	1,310
Gen. Elec.	150½	159	13,400	West'h, com.	65	69	6,200
Int. Met.	17½	18¼	4,600	West'h, pfd.	117*	117½	400

PHILADELPHIA.

	April 24.	May 1.		April 24.	May 1.
Am. Rys.	44	44	Phila. Elec.	16¼	16½
Elec. Co. of A.	11⅞	12*	Phila. R. T.	17⅛	18
Elec. St. B'ty.	52	52¾	Phila. Trac.	82½*	82¼
Elec. St. B'ty., pfd.	30*	30*	Union Trac.	45⅛	46

CHICAGO.

	April 24.	May 1.		April 24.	May 1.
Chi. City Ry.	186*	186*	Chi. Tel. Co.	122*	121
Chi. Rs., Ser. 1.	85*	80*	Met. El. Co.	22⅛*	22⅛*
Chi. Rs., Ser. 2.	22	22*	Met. El., pfd.	67*	67*
Com. Edison	125⅜	125	Nat'l Car	115*	114*
Chi. Subways	5	5¼	Nat'l Car, pfd.	120*	120*

BOSTON.

	April 24.	May 1.		April 24.	May 1.
Am. T. & T.	145	146½	Mex. Tel.	3½*	4½
Cum. Tel.	150	150*	Mex. Tel., pfd.	6½*	6½*
Edison E., Ill.	285¼*	286*	N. E. Tel.	141	142¾
Gen. Elec.	151½	158	W. T. & T.	18*	19½
Mass. E. Ry.	16	18¾	W. T. & T., pfd.	94*	94
Mass. E. Ry., pfd.	87	88			

*Last price quoted.
Shares sold for week, April 24 to April 29.

Financial Notes

United Gas Improvement Company's Report for 1910.—The total income of the United Gas Improvement Company for the year ended Dec. 31, 1910, was $8,159,530, an increase of $510,295 over the previous year. The total expenses were $1,080,477, leaving net profits of $7,079,053, an increase of $422,944 over this item for the previous year. After deducting $725,500 which was applied to the sinking funds, there was left a balance for dividends of $6,353,553, from which dividends amounting to $4,338,872 were paid. The surplus for the year was $2,014,681, showing a falling off of $158,556 from the surplus in 1909. The total surplus of the company is given as $25,625,098. President Thomas Nolan reviews a number of the financial transactions of the year and says in part: "In February, 1910, we purchased more than a majority of the stock of the Conshohocken Gas Light Company, West Conshohocken Gas Light Company and Conshohocken Electric Light & Power Company, and forty-two acres of land on the Schuylkill River, near West Conshohocken, with the idea that when the business of the Merion and Radnor Gas & Electric Company outgrows the capacity of the present plant at Ardmore these companies should be consolidated with the Merion & Radnor Gas & Electric Company and a new plant built on the new site. In the summer of 1910 was acquired more than a majority of the stock of the Northern Indiana Gas & Electric Company, and in January, 1911, was completed the merger into that company of the South Bend & Mishawaka Gas Company and the Plymouth Lighting Company. We believe that there is a great future for business, particularly for electricity for power purposes, in the territory of this company, which is destined to become one of the great industrial centers of the United States, including as it does the district from Chicago to Gary, as well as the flourishing cities of Michigan City, South Bend, Mishawaka and Plymouth."

American Telephone & Telegraph Company.—In keeping with the progress made each year, as noted in these columns from time to time, the statement of earnings of the American Telephone & Telegraph Company for three months ended March 31 shows the total revenue from all sources to be $9,111,294, representing an increase of $221,943 over this item for the first quarter of the previous year. The amount deducted from this for expenses was only $842,497, leaving net earnings of $8,268,797. The ratio between total revenue and expenses is proof of efficient management and economical operation. When interest charges were deducted there was left a balance of $6,834,475, from which dividends of $5,095,218 were paid, the difference being carried to reserve funds or to profit and loss. The balance available for dividends represents 2.59 per cent on the $253,335,600 outstanding capital stock, compared with 2.66 on the $256,475,300 stock outstanding for the corresponding period of 1910. This quarterly per cent is at the rate of 10.36 per cent yearly on the present outstanding stock. The revenues of the company have shown remarkable increase in the past eleven years, the total net earnings in that time available for dividends amounting to $152,907,334, of which 75.45 has been paid to stockholders and the balance applied to reserve funds.

Augusta-Aiken Railway & Electric Corporation Bonds.—Redmond & Company, of New York and Philadelphia, are offering $2,400,000 5 per cent sinking-fund gold bonds of the Augusta-Aiken Railway & Electric Corporation at 94 and accrued interest, paying about 5.5 per cent. These are due Dec. 1, 1935, and will be secured by a direct first mortgage on the entire railway and lighting properties, subject only on a part thereof to an issue now limited to $967,000 and which is annually being reduced. A gradually increasing sinking fund, beginning in 1916, it is estimated, will retire over $1,300,000 of these bonds by maturity. The Augusta-Aiken company controls and operates the entire street-railway and electric-lighting system of Augusta, Ga., and its suburbs, together with the railway to Aiken, S. C. Gross earnings of the company for the year 1910 were $614,031 and operating expenses $335,748, leaving net earnings of $278,283, from which, after deducting charges, was left a surplus of $103,283.

Improvement in South American Utilities.—Both the Rio de Janeiro Tramway, Light & Power Company, Limited, and the Sao Paulo Tramway, Light & Power Company report increases in returns for 1910. Gross earnings of the Rio de Janeiro company increased about $3,400,000 and net earnings were some $2,325,000 larger than in the previous year. Electrification of the various lines of the company was completed during the year and the large increase in the passengers carried is attributed to this. Telephone, lighting and traction properties are reported in satisfactory condition. An addition of 83,000 incandescent lamps was made to the system, the number of arc lamps increased 3075 and the connected load in motors was also largely increased. Increase was made by the Sao Paulo company, some 12,000 lamps being added to the system, and corresponding additions were made to the motor service mains.

Telephone Extensions at Los Angeles.—The Sunset Telephone Company is making improvements and extensions costing about $75,000 on its lines between Los Angeles and Huntington Park. The Home Telephone Company is reported to be behind on its orders for service in Huntington Park

St. Cloud Water Power Company.—In advertising for sale $250,000 of first-mortgage 6 per cent gold bonds of the St. Cloud Water Power Company, of St. Cloud, Minn., the Colonial Trust & Savings Bank, of Chicago, gives some interesting information about that company. The properties of the St. Cloud Water Power Company and the Union Power Company were consolidated under the former name on April 1. The combined net earnings of the two properties were $23,447 in 1910. The replacement value of the St. Cloud Company is largely in excess of the bonded debt, and in addition the company has valuable flowage and riparian rights on the Mississippi River. There is available at its power development site 3700 computed horse-power at low water. Messrs. J. G. White & Company, of New York, are the engineers for the company. The bonds are offered at par and accrued interest.

Interborough Rapid Transit Note Issue.—The proceeds of the $10,000,000 Interborough Rapid Transit Company's one-year 4.5 per cent notes, which have been sold to J. P. Morgan & Company, will be used to take up the $4,584,000 three-year 6 per cent notes which mature May 1, 1911. These three-year notes were part of an issue of $25,000,000 6 per cent convertibles which was originally made to retire $15,000,000 notes falling due in May, 1908, together with $6,250,173 promissory notes, and for payment of various obligations resulting from acquisition of property. Cost of equipment and construction is said to have exceeded $7,500,000 since May, 1908, and since that date payments have been made from current earnings. It is planned to use the balance of the new issue to reimburse the treasury for these expenditures.

Westchester Lighting Company Bonds.—Announcement is made that $2,481,000 additional first mortgage 5 per cent fifty-year gold bonds of the Westchester Lighting Company have been listed on the New York Stock Exchange, making the total listed and outstanding $8,397,000 out of $10,000,000 authorized. A portion of the $2,481,000 bonds amounting to $1,391,000 held in the treasury of the Westchester Lighting Company have been known as treasury bonds. The present issue of bonds and also all the bonds issued and to be issued under the first mortgage by resolution of the executive committee received the guarantee of the Consolidated Gas Company, which owns the Westchester company.

Chicago Consolidated Traction Company.—Judge Grosscup, of the United States Circuit Court, has entered an order discharging John M. Roach, David R. Forgan and A. L. Drum as receivers for the Chicago Consolidated Traction Company. The order, which was entered on April 21, will be made permanent unless adverse action is taken within thirty days. Mr. Roach was named as a special receiver without bond to meet claims. The receivers were appointed in June, 1908, and the property has since been sold and divided, the Chicago Railways Company acquiring the lines inside the city and the County Traction Company the lines in Cook County outside the city limits.

Oregon Interests Transferred.—The properties of the Klamath Falls Light & Water Company, of Klamath Falls, Ore., have been purchased by the Klamath Falls Power Company, the transaction involving about $500,000. The purchase includes two plants in Klamath Falls, the transmission lines throughout the city and those extending to several towns about 25 miles away. The company is said to be a subsidiary of the Siskiyou Electric Light & Power Company, of Yreka, Cal., which was recently denied a franchise for transmitting energy to Klamath from its station on the Klamath River, about 20 miles distant.

Santa Barbara Gas & Electric Company.—At a recent meeting of the directors of the Santa Barbara Gas & Electric Company it was decided to ask stockholders to ratify a bond issue of $1,000,000. The new bonds are to bear 6 per cent interest, the plan being to substitute them for the 5 per cent issue of the same amount which it has been found difficult to float. This plan will not increase the bonded indebtedness of the company, and will offer a more attractive bond to investors. At present $680,000 of the 5 per cent bonds are held as security for loans. The 5 per cent bonds will be called in as soon as the 6 per cent issue is placed on the market.

Missouri & Kansas Telephone Company.—In line with a large percentage of public utilities, the returns of the Missouri & Kansas Telephone Company for the year ended Dec. 31, 1910, showed a notable increase. Gross earnings were $3,182,397, compared with $2,859,161 for 1909, and net earnings were $681,242. While no dividends have been paid since 1906, the surplus for 1910 is $144,631, which compares favorably with a deficit of $315,247 in 1909. The company now has nearly 370,000 stations, which represents nearly three times the total in 1906, and development has increased nearly as rapidly in all branches of the company's interests.

La Crosse Water Power Company.—As previously noted in these columns, the La Crosse Water Power Company, of La Crosse, Wis., failed to meet its bond interest on April 1. Certain holders of the bonds have requested Fred Vogel, Jr., president of the First National Bank of Milwaukee; Frank O. Wetmore, vice-president of the First National Bank of Chicago, and Harrison B. Riley, president of the Chicago Title & Trust Company, to act as a bondholders' committee to investigate the affairs of the company and to take such steps for the protection of the owners of the bonds as they find desirable.

Western Maryland Telephone Company.—The Chesapeake & Potomac Telephone Company is making negotiations to acquire the capital stock of the Western Maryland Telephone Company, of Allegany County, amounting to $100,000. A petition has been filed by the Chesapeake company with the Public Service Commission stating that an option has been obtained on all the stock, the Chesapeake & Potomac Telephone Company agreeing to pay $40,000 in cash and $40,000 in the common stock of the American Telephone & Telegraph Company.

Atlantic & Pacific Telegraph Meeting.—The following directors were elected at the annual meeting of the Atlantic & Pacific Telegraph Company: Theodore N. Vail, Newcomb Carlton, C. W. Atkins, A. R. Brewer, B. Brooks, Thomas F. Clark, George H. Fearons, E. J. Hall and J. B. Van Every. At the directors' meeting the following officers were elected for the ensuing year: President, Theodore N. Vail; vice-president, Thomas F. Clark; treasurer, A. R. Brewer; acting secretary, F. W. Lienau.

Western Gas & Electric Company to Redeem Notes.—The Fidelity Trust Company, of Philadelphia, has given notice that the Western Gas & Electric Company will redeem and pay all of its collateral trust notes dated Dec. 1, 1910, due June 1, 1915, at 101 and accrued interest, on June 1, 1911, at the Philadelphia office of the trust company.

DIVIDENDS.

Amalgamated Copper Company, quarterly, 50 cents per share, payable May 29.

Connecticut Railway & Light Company, quarterly, common, 1 per cent; preferred, 1 per cent; both payable May 15.

Montreal Light, Heat & Power Company, quarterly, 2 per cent, payable May 15.

National Carbon Company, quarterly, preferred, 1¾ per cent, payable May 15.

United States Steel Corporation, quarterly, common, 1¼ per cent, payable June 29; preferred, 1¾ per cent, payable May 29.

REPORTS OF EARNINGS.

Period.	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
BIRMINGHAM RAILWAY, LIGHT & POWER COMPANY.					
March, 1911	$227,023	$117,007	$110,016	......	......
" 1910	214,798	113,912	100,886	......	......
CUMBERLAND TELEPHONE & TELEGRAPH COMPANY.					
March, 1911	$598,511	$349,744	$248,766	$50,644	$198,122
" 1910	568,336	320,729	247,607	47,523	200,083
MASSACHUSETTS ELECTRIC COMPANIES.					
Qtr. Mar., 1911	$1,830,361	$1,250,983	$579,378	$459,754	$119,624
" 1910	1,767,153	1,256,599	510,554	470,532	40,022
MONTREAL STREET RAILWAY COMPANY.					
March, 1911	$371,922	$234,484	$137,508	$46,423	$91,085
" 1910	336,197	220,790	115,407	40,675	74,731
NORTHERN OHIO TRACTION & LIGHT COMPANY.					
March, 1911	$190,186	$110,850	$79,336	$44,329	$35,007
" 1910	173,424	99,159	74,265	43,291	30,974
PHILADELPHIA COMPANY.					
March, 1911	$1,884,369	$1,084,509	$809,860	......	......
" 1910	1,916,662	974,350	942,312	......	......
ROCKFORD ELECTRIC COMPANY.					
March, 1911	$33,145	$19,636	$13,509	$6,742	$6,767
" 1910	29,255	18,216	11,039	5,395	5,643
SCRANTON ELECTRIC COMPANY.					
March, 1911	$60,305	$26,631	$33,674	$11,427	$22,247
" 1910	58,945	31,498	27,447	9,719	17.727
TWIN CITY RAILWAY & LIGHT COMPANY.					
March, 1911	$220,758	$127,574	$93,184	$66,518	$26,666
" 1910	198,777	113,315	85,462	62,238	23,224
UNITED RAILROADS OF SAN FRANCISCO.					
March, 1911	$657,176	$363,397	$293,779	......	......
" 1910	648,203	381,772	266,431	......	......
VIRGINIA RAILWAY & POWER COMPANY.					
March, 1911	$185,328	$100,062	$87,868	$55,058	$32,809
" 1910	173.127	79,649	96,143	54,935	41,207

General News

Construction News.

ATTALLA, ALA.—The Etowah Light & Power Company is reported to be preparing plans for extensions and improvements to its electric plant and water-works plants, to cost about $50,000. The company was recently granted a twenty-year franchise.

BIRMINGHAM, ALA.—The Senate has passed a bill giving the city of Birmingham power to acquire and operate its own electric-light and water-works systems.

FORT SMITH, ARK.—Negotiations are under way for the consolidation of the Pan Long-Distance Telephone Company, of Fort Smith; the Southern Telephone Company, of Fordyce, Ark., and the Kinloch Telephone Company, of Missouri, with Fort Smith as the central point. The Southern Telephone Company controls all of the independent systems in Arkansas and the eastern portion of Oklahoma, and has purchased the system of the Kizer Telephone Company, with exchanges at Mena and Ashdown, including an automatic system with double copper wire, costing about $300,000. The Southern company is now building a line from Little Rock to this city, and will connect with the Kinloch system at Fayetteville.

IMBODEN, ARK.—It is reported that George Dutton, of Imboden, has purchased the plant and holdings of the Imboden Light & Power Company.

ANAHEIM, CAL.—Sealed proposals will be received by the Board of Trustees at the office of the city clerk, Anaheim, Cal., until May 11 for furnishing and installing the following equipment at the municipal electric-light plant and water-works system: One compound automatic steam engine; one 150-kva, 220-volt, three-phase, 60-cycle, alternating-current generator; exciter for generator; one switchboard panel; building foundation and erecting engine and generator. Specifications may be obtained on application to Edward R. Merritt, city clerk, or to A. L. Lewis, superintendent of the municipal electric-light plant and water-works system.

BAKERSFIELD, CAL.—Announcement has been made by the San Joaquin Light & Power Company of a reduction of 25 per cent in the price of electricity for all purposes to take effect from July 1. The company expects to have its transmission lines completed from the new generating plant at Crane Valley into Bakersfield, which will enable the company to furnish the service at less cost than at present.

BURLINGAME, CAL.—Application has been made to the Board of Trustees for a fifty-year franchise to construct and operate an electric railway in the East District. Ansel H. Easton is interested in the project.

CLAREMONT, CAL.—The City Council has granted the Pacific Gas & Electric Company a franchise in this city for a term of fifty years.

HANFORD, CAL.—Nicholas Maaskant is reported to be contemplating the installation of an electric-light plant on the ranch he has recently purchased near here, known as the Peter Daggs place.

HAWTHORNE, CAL.—The citizens have voted to establish a lighting district in Hawthorne. Bids will soon be called for by the Board of Supervisors for furnishing and maintaining seventy-five street lamps.

JACKSON, CAL.—James O'Brien, of Amador County, has located 40,000 in. of water in the Consumnes River, to be diverted near the old Hughes bridge between Plymouth and Placerville. The water will be carried down the stream 6 miles, where a power plant will be erected. The water will be used to generate electricity, for irrigation and other purposes.

LOS ANGELES, CAL.—The Pacific Electric Railway Company is planning to build an extension of its railway from Glendale to Burbank, a distance of 4½ miles, contracts for which will be awarded soon.

LOS ANGELES, CAL.—Initial steps have been taken by Mayor Alexander toward the organization of a power and light bureau for the purpose of developing power to generate electrical energy along the line of the aqueduct and constructing plants for generating and distributing electricity for lamps and motors. The Mayor has submitted a communication to the Public Service Commission calling attention to four separate propositions, giving four distinct locations where power may be developed, as follows: San Francisquito No. 2, San Francisquito No. 1, San Fernando and Haiwee. The amount of electrical energy that could be developed at these four places is respectively as follows: 32,000 hp, 60,000 hp, 9000 hp and 10,000 hp. The respective cost would be as follows: $2,300,000, $3,300,000, $750,000 and $1,500,000.

MARYSVILLE, CAL.—The Pacific Gas & Electric Company has announced a reduction in the price of electricity for lamps in the business district of Marysville. To get the benefit of the reduction it will be necessary for the merchants to install a meter and use electricity amounting to more than $7.50 per month. The maximum rate is 8 cents per kw-hour and the minimum 3 cents per kw-hour.

MARYSVILLE, CAL.—The Pacific Gas & Electric Company contemplates abandoning its present ditch and flume system carrying water for 8 miles around the sides of a mountain to the Coalgate plant east of Marysville, and to build a large tunnel through the mountain to carry the water to Coalgate. The company proposes to substitute steel towers for the present poles of the transmission line from Coalgate to San Francisco. Eventually all the main transmission lines will be carried on steel towers.

OROVILLE, CAL.—Plans are being prepared by Clark Standiford for the construction of a tramway up Butte Mountain. The proposed car line will be operated by electricity and will cost about $10,000.

PASADENA, CAL.—The Home Telephone Company is planning to erect a new exchange building in South Pasadena within the next six months, to cost about $50,000. Automatic equipment will be installed.

PATTON, CAL.—Plans have been prepared by N. Ellery, state engineer, for a gas and electric plant to be installed at the State asylum for the insane at Patton. It is said that there is about $12,000 available for equipment for the plant.

PLACERVILLE, CAL.—Notice of appropriation of [illegible] miners' in. of water of the Middle Fork of the Consumnes River has been filed by Henry A. Meyers. It is proposed to build a dam across the Middle Fork of the river and utilize the water to generate electricity and for irrigation purposes near the town of Plymouth.

QUINCY, CAL.—Arrangements are being made by the Plumas Power Company, recently organized, for the construction of a series of hydroelectric power plants to supply electricity for lamps and motors in the Indian Valley. It is said that the transmission line will be extended immediately to Taylorsville and Crescent City.

QUINCY, CAL.—Notice has been filed in the office of the county recorder of appropriation of another large water-power location, claiming 130,000 in. of water in the North Fork of the Feather River, by P. F. Bullington, of Chico, and H. S. Goodman, the water to be diverted by means of a dam located at or near the mouth of Wallace Creek. From there the water will be conducted down the west bank of the North Fork, by means of ditch and tunnel, 2 miles, to a power house to be located at the mouth of Yellow Creek.

SAN BERNARDINO, CAL.—The city of San Bernardino has engaged C. W. Koiner, general manager of the municipal electric-light plant of Pasadena, Cal., to appraise the power plant and distributing system of the Lytle Creek Power Company of San Bernardino. The city is contemplating purchasing the plant to be owned and operated by the municipality.

SOUTH PASADENA, CAL.—Bids will be received by the Board of Trustees until May 8 for installing conduits, wires, post and lamps for lighting certain portions of certain streets in accordance with plans and specifications. William L. Cox is city engineer.

TURLOCK, CAL.—Bonds to the amount of $500,000 have been authorized by the directors of the Turlock Traction Company, the proceeds to be used for the construction of an electric railway between Turlock and Denair, 4 miles in length. S. N. Griffith, of Turlock, is interested in the enterprise.

MIDDLETOWN, CONN.—The Middletown Electric Light Company is contemplating extending its transmission lines to Rockfall and Middlefield to supply electricity for lamps and motors in those places.

WASHINGTON, D. C.—Proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 13 for electric-lighting machinery and accessories at the United States Marine Corps Rifle Range in Washington, D. C.

WASHINGTON, D. C.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 13 for furnishing one 12-kw gasoline engine belted generating set, 200 amp-hour storage battery and accessories, wiring material, etc., at the United States Marine Corps Rifle Range, Winthrop, Md. Plans and specifications can be obtained on application to the above office. R. C. Hollyday is chief of bureau.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until May [illegible] for furnishing the following supplies at the various naval stations and navy yards: Washington, D. C., Schedule 3510—15,000 ft. [illegible]-proof cable, etc. Brooklyn, N. Y., Schedule 3515—Miscellaneous magnet wire, etc. Bids will also be received until May 16 as follows: Washington, D. C., Schedule 3529—125,000 ft. ingot copper, etc. Applications for proposals should designate the schedule desired by number.

ATLANTA, GA.—The Atlanta Hydro-Electric Power Company is reported to have completed plans for the construction of a hydroelectric power plant, to cost about $3,000,000. The work will include the construction of a high dam and power plant, capable of developing 30,000 hp, and the erection of a transmission line to Atlanta, Ga. The office of the company is located at 1014 Candler Building, Atlanta, Ga.

BARNESVILLE, GA.—At an election held recently the proposition to issue $15,000 in bonds, the proceeds to be used for extensions and improvements to the municipal electric-light plant, was carried.

BUCHANAN, GA.—Preparations are being made for the installation of a municipal electric light plant. A committee consisting of G. N. Moore and H. S. McCalman has charge of the work.

VIDALIA, GA.—It is reported that the city is contemplating making improvements to the municipal electric-light plant. It is understood that a new generator and other machinery will be installed.

TWIN FALLS, IDAHO.—Plans have been completed for the construction of an electric interurban railway to extend from Twin Falls to the Great Shoshone and Twin Falls on the Snake River. W. L. Cherry and associates are interested in the project.

BLOOMINGTON, ILL.—The circuit court has handed down a decision that the Union Gas & Electric Company has no legal right to operate its system in Bloomington, the company not having received a franchise from the City Council to erect its lines in the streets of the city.

CERRO GORDO, ILL.—The local electric light plant, owned by U. M. Rader & Company, has been purchased by George B. Conover, of Buffalo, N. Y. It is understood that Mr. Conover will continue operating the plant for the present, but later will make arrangements to secure electricity from the transmission lines of the Illinois Traction system.

CHICAGO, ILL.—Judge Kohlsaat, in the United States Circuit Court, has authorized the receivers of the Independent Telephone & Telegraph Company to enter into a traffic agreement with the Illinois Tunnel Company, giving the independent company an entrance into Chicago. Under the proposed agreement connection will be made with independent exchanges in Illinois, Indiana, Kentucky, Ohio, Michigan, Missouri, Tennessee, Iowa, Wisconsin and Minnesota. The agreement runs until 1929 and provides for the division of tolls, 40 per cent to the Illinois Tunnel Company and 60 per cent to connecting lines. F. A. Dolph is receiver of the telephone company.

GEORGETOWN, ILL.—The Georgetown Electric Light Company is reported to be contemplating the construction of a new power house at the Sharon Coal Company's mine, south of this city. Three generators will be installed. The plant will furnish electricity for lamps and motors in Indianapolis, Sidell, Ridgefarm and other towns.

JACKSONVILLE, ILL.—The construction of a new interurban railway, to be known as the Pana, Girard & Jacksonville Railway, is reported to be under consideration. W. O. Myers and Charles Russell, both of Chicago, Ill., are said to be interested in the enterprise.

MANTENO, ILL.—The Village Board has granted the Kankakee Electric Light & Power Company, of Kankakee, Ill., a franchise to furnish electricity for lamps and motors in Manteno for a period of thirty-five years. The Board has also entered into a five-year contract with the company for lighting the streets of the village.

MATTOON, ILL.—The Coles County Telephone & Telegraph Company is reported to have purchased the telephone systems at Oakland and Isabel, giving it complete control of all telephone lines in the county. The consideration is said to be $13,000.

PEKIN, ILL.—The plant and holdings of the Pekin Light, Heat & Power Company and the Citizens Gas & Electric Company have been sold to Hodenpyle, Walbridge & Company, of New York, N. Y.

PEORIA, ILL.—Preparations are being made by the Trustees of the Bradley Institute for the construction of a new power plant for the institute to cost about $65,000. New heating and lighting systems will be installed. M. W. Whitmeyer is the architect and C. O. Poppin is mechanical engineer.

ROCKFORD, ILL.—The Rockford & Interurban Railway Company has increased its capital stock from $1.050,000 to $4,000.000.

ROCKFORD, ILL.—The contract for the installation of lamp standards and lamps for the ornamental lighting system on North Main Street from State to Mulberry Street has been awarded to the Warner Electrical Company.

INDIANAPOLIS, IND.—Bids will be received by the Cincinnati, Madison & Western Traction Company until May 30 for the construction of an electric railway to connect Hanover, Madison, Scottsburg and Lexington, a distance of 41 miles.

RICHMOND, IND.—Preliminary surveys have been completed by the South Bend, Richmond & Southwestern Traction Company for the construction of its proposed electric railway to connect Richmond, Union City, Brownsville and Harrison, a distance of 110 miles. F. C. Charles and Charles W. Jordan are interested in the company.

VINCENNES, IND.—The Vincennes North & South Traction Company, recently incorporated with a capital stock of $100,000. proposes to construct and operate interurban railways. The directors are. E. D. Logsdon, B. M. Willoughby and J. M. House.

HUMBOLDT, IA.—The Humboldt Electric Light & Power Company and the Northern Roller Milling Company are reported to be contemplating the construction of a dam on the Des Moines River and a 1200-hp power plant, to cost about $80.000. Max Toltz, of St. Paul, Minn., is engineer.

HUMBOLDT, IA.—Plans are being considered by the Northern Iowa Power Company for improvements to its water power holdings on the west fork of the Des Moines River, which will increase the power secured from 1000 to 1200 hp. The work contemplated includes the construction of two solid concrete dams, widening mill race, the erection of a large steel and cement fireproof power house. Three large waterwheels and three generators will be installed. Space will be provided for the installation of an additional unit when necessary.

KEOKUK, IA.—The Keokuk Electric Railway & Power Company is in the market for one 800-hp cross-compound Corliss engine with condenser for 140 lb. steam, one 300-kw, single-phase, 133-cycle, 1100-volt, 3-bearing, composite-wound, Westinghouse generator, with exciter and switchboard panel, and one 400-kw, 550-volt generator for railway service with switchboard panel, for its power house in Keokuk. A. D. Ayres, of Keokuk, is general manager.

LANSING, IA.—The City Council has granted the Upper Iowa Power Company, of Decorah, Ia., a franchise to install and operate an electric-light plant in Lansing.

MOUNT VERNON, IA.—Application has been made to the Council for a franchise by the Dows-Smith Company, of Cedar Rapids, Ia., and F. J. Cross, of Monticello, Ia., for the installation of an electric-light plant in Mount Vernon.

ROLAND, IA.—At an election held recently the proposition to issue $10,000 in bonds, the proceeds to be used for the installation of a municipal electric-light and pumping plant, was carried.

WEBSTER, IA.—The City Council has voted to call a special election to vote on the proposition to issue $25,000 in bonds, the proceeds to be used to purchase equipment for the municipal electric plant.

HILL CITY, KAN.—The proposition to install a municipal electric-light plant and water-works system in Hill City will be submitted to a vote of the people.

QUENEMO, KAN.—The Council has engaged I. C. Bushong, of Ottawa, Kan., to prepare plans and specifications for the proposed electric-light plant for this city, to cost approximately $6.000.

LANCASTER. KY.—The local electric-light plant is reported to have been destroyed by fire, causing a loss of about $10,000. It is understood that the plant will be rebuilt at once.

LOUISVILLE, KY.—The Louisville Railway Company has applied to the General Council for a twenty-year franchise to build a crosstown line in Louisville to connect the Twenty-eighth Street line at the West End and the Barrett Avenue line at the East End.

WILLIAMSBURG, KY.—It is reported that the Proctor Coal Company is planning to construct a tunnel through Proctor Mountain and develop a coal tract on Wolf Creek. The company will install an electrical haulway and electrical mining machinery, and will also double the output of its electric power plant to meet the increasing demands made upon it.

NEW IBERIA, LA.—The Teche Land Company is reported to have purchased a site of 100 acres on which it proposes to erect an electric-light plant, sewerage plant and water-works system.

OPELOUSAS, LA.—Preparations are being made to enlarge the municipal electric-light plant and water-works system, which will double the output of the station. Work has commenced on construction of the addition to the power house.

BANGOR, MAINE.—It is reported that arrangements are being made by the Bangor & Aroostook Valley Railway Company for the construction of the so-called Allagash extension this year. The proposed railway will cost about $7,750,000, and calls for about 157 miles of track. A. R. Gould, of Presque Isle, Maine, is interested in the project.

FARMINGDALE, MAINE.—Contracts have been awarded by the Central Maine Power Company for the construction of its proposed new power plant to be located at Farmingdale on the Kennebec River. The company already has several plants, the most important of which is located near Waterville on the Sebasticook River.

BALTIMORE, MD.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until May 15 for furnishing an electric freight elevator in the United States appraisers' stores, Baltimore, Md., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising architect.

BALTIMORE, MD.—Bids will be received by the Board of Awards at the office of J. Sewell Thomas, City Register, City Hall, Baltimore, Md.. until May 10 for supplying ornamental lamp-posts, specifications for which may be obtained at the office of Robert J. McCuen, superintendent of lamps and lighting. J. Barry Mahool is president Board of Awards.

BALTIMORE, MD.—Several manufacturers have taken advantage of the offer of the Department of Lamps and Lighting of Baltimore to exhibit arc lamps for street lighting in Baltimore. The lamps are to be erected by the manufacturers free of cost to the city. The city is contemplating changing the style of lamp in use in the business section of the city. The Board of Awards has rejected the bids for lamp standards for the city hall plaza, on the ground that there were irregularities in the specifications in the bid submitted by the lowest bidder.

BALTIMORE, MD.—The Highways Commission has granted the Towson & Cockeysville Electric Railway Company a franchise to build an electric railway from Townson to Cockeysville.

BALTIMORE, MD.—The Susquehanna Transmission Company, a subsidiary of the Pennsylvania Water & Power Company, of McCall's Ferry, Pa., has applied to the Public Service Commission for permission to issue $1,131,000, the proceeds to be used to pay for the erection of the transmission line from the McCall's Ferry power plant of the Pennsylvania Water & Power Company. The line is nearly completed, and it is estimated that it will require only about $200.000 to complete the work.

HAGERSTOWN, MD.—The Hagerstown & Clearspring Railway Company is reported to have completed surveys for the construction of its proposed electric railway along the old National Pike from Hagerstown to Clearspring, Md. It is understood that the company has secured funds to build the railway and that contracts are to be awarded for construction of the proposed road in the near future. L. N. Downs, of Hagerstown, is president of the company.

PITTSFIELD, MASS.—It is understood that work will soon begin by the Berkshire Street Railway Company on its proposed railway between East Lee and Huntington. Work has already been started in Otis.

SPRINGFIELD, MASS.—The State Railroad Commissioners have granted the Springfield Street Railway Company permission to build an extension across the Ludlow Bridge over the Chicopee River into Ludlow, and also to build an extension in Palmer.

WILMINGTON, MASS.—The citizens have voted to accept the report of the committee recommending the installation of a street-lighting system in the town. An appropriation of $1,500 has been made to light 15 miles of highway with 200 incandescent lamps for the remainder of the year. The service will be supplied by the municipal electric-light plant of Reading, Mass.

WORCESTER, MASS.—The Worcester Consolidated Street Railway Company has applied to the City Council for a franchise to construct extensions and to double-track three of its lines in Worcester.

BENTON HARBOR, MICH.—The City Council has granted the Benton Harbor-St. Joe Railway & Light Company a thirty-year franchise to extend its tracks in Benton Harbor and also for an extension to Dowagiac.

MARQUETTE, MICH.—Bids will be received by the Light and Power Commission until May 20 for the construction of two concrete dams on Dead River, near Marquette. Bonds to the amount of $100,000 have been voted for the construction of the dams and other improvements to the hydroelectric plant on the Dead River. Charles Retallic is superintendent.

AURORA, MINN.—The contract for the installation of an engine and generator, electric conduit, wiring, plumbing and heating system for the new high school in Aurora has been awarded to the Tritchle Electric Company, of Virginia, Minn., for $4,590.

MINNEAPOLIS, MINN.—Plans are being considered by the Electric Short Line Railroad Company for the construction of an extension from Minneapolis to Clara City, 120 miles in length. Frank E. Reed, of Glencoe, is secretary.

MORRIS, MINN.—Plans are being considered by S. Stewart, owner of the local electric-light plant, for improvements to the system, including the installation of a 200-hp engine, dynamo and other improvements.

ST. CLOUD, MINN.—It is reported that the Granite City Railway Company is planning to build a 7-mile extension to its Wade Park car line in St. Cloud, for which a franchise has already been secured.

ST. PAUL PARK, MINN.—The South St. Paul Electric Light, Heat & Power Company has been granted a twenty-five-year franchise to supply electricity for lamps and motors in St. Paul Park. The company will extend its transmission line into St. Paul Park in the near future, probably by the way of Inver Grove and the Inver Grove bridge across the Mississippi River.

ST. VINCENT, MINN.—The installation of an electric-light system in St. Vincent, to cost $4,000, is reported to be under consideration.

WABASHA, MINN.—Plans are being considered to organize a company to be known as the Minnesota-Wisconsin Power Company to supply electricity for lamps and motors in the cities of Wabasha, Lake City, Red Wing, Hastings and Winona. It is said electric energy will be supplied from the local electric plant, which will be enlarged to meet the increased demand.

TUPELO, MISS.—At an election held April 22 the citizens voted to issue bonds to the amount of $50,000, the proceeds to be used for improvements to the municipal electric-light plant, construction of city hall and street paving.

KANSAS CITY, MO.—The City Council has granted the Metropolitan Street Railway Company a franchise to extend its tracks over certain streets in Kansas City.

KANSAS CITY, MO.—The Kansas City Electric Light Company has awarded a contract to the Electric Storage Battery Company, of Philadelphia, Pa., for installation of a storage battery plant at the substation to be erected at Sixth and Walls Streets, at a cost of approximately $100,000.

ST. LOUIS, MO.—The Southern Traction Company of Illinois, of East St. Louis, Ill., has been granted a franchise by the City Council to operate its railway in St. Louis over the Free Municipal Bridge and on the streets in the downtown section of St. Louis.

CARSON, NEV.—The Secretary of the Interior has awarded contracts for electrical apparatus, consisting of alternators and switchboards, for the Truckee-Carson irrigation project to the General Electric Company, of Schenectady, N. Y., for $8,213, and for furnishing hydraulic turbines to the Pelton Water Wheel Company, of San Francisco, Cal., for $9,740.

RENO, NEV.—Rights of way are being secured by the Truckee River General Electric Company for a high-tension transmission line from its new plant near Verdi to Virginia City. Condemnation proceedings have been commenced in the district court to secure the same.

MANCHESTER, N. H.—The Southern New Hampshire Development & Power Company, recently granted a charter, is planning to erect a dam across the Lamprey River at West Epping and storage dams on the Lamprey River in the towns of Raymond, Deerfield and Candia. The company is capitalized at $100,000, and proposes to supply electricity for lamps and motors in Hillsboro and Rockingham counties. The incorporators are: Jeremiah Campbell, of Boston, Mass., Herbert C. Daggett, of Winthrop, Mass.; George H. Guptill and Charles F. Gardiner, of Raymond, N. H., William S. Goodrich, of Epping; Arthur W. Dudley, of Brentwood, and Clarence M. Platt, of Manchester.

BURLINGTON, N. J.—The Public Service Utility Commission has approved of the lease of the property and franchises of the Burlington Electric Light & Power Company to the Public Service Electric Company.

MADISON, N. J.—The New England Engineering Company has submitted a report to the Council in connection with improvements and extensions to the municipal electric-light plant, in which the cost is estimated at $18,000.

NEWARK, N. J.—The Elizabeth, New Brunswick & Trenton Railroad Company, recently incorporated, is planning to build an electric railway to extend from Newark to Trenton. The company is capitalized at $500,000. It is understood that the proposed railway will eventually be taken over by the Public Service Corporation.

PRINCETON, N. J.—The State Board of Public Utility Commissioners has approved of the lease of the Princeton Light, Heat & Power Company to the Public Service Electric Company and the Public Service Gas Company. The Public Service Electric Company will take over the electric plant and distributing system and franchises, and the Public Service Gas Company the gas property and franchises.

BROOKLYN, N. Y.—The Public Service Commission has granted the Nassau Electric Railroad Company permission to build its proposed extension between Liberty and Georgia Avenues, extending along Georgia Avenue to Atlantic Avenue and connecting with the existing track of the Brooklyn, Queens County & Suburban Railroad Company in Georgia Avenue.

CENTRAL ISLIP, N. Y.—Sealed bids will be received until May 1[illegible] by the State Commission on Lunacy for additional equipment for power plant, including one direct-connected engine and alternating-current generator and changes in switchboard for the Central Islip State Hospital, Cetral Islip, N. Y. Bids will also be received at the same time and place for fire escapes for hospital.

JAMESTOWN, N. Y.—The Electric Light Commission has authorized the Mayor to contract with the General Electric Company for 150 magnetite arc lamps and appurtenances. The equipment will call for two complete outfits, calling for seventy-five lamps each, to cost $6,959. The lamps will take 6.6 amp and be operated on 2300-volt, 60 cycle, alternating current circuits.

MIDDLEPORT, N. Y.—The Public Service Commission, Second District, has authorized the Middleport Gas & Electric Company to begin work on the erection of its transmission lines in Hartland to furnish electricity for lamps and motors in that town.

NEW YORK, N. Y.—The Council has granted the Union Railway Company a franchise to build an extension on St. Ann's Avenue from 161st Street to the Southern Boulevard, in New York.

NEW YORK, N. Y.—Plans have been filed with the Superintendent of Buildings, Rudolph P. Milier, by the New York Telephone Company for the construction of a seventeen-story building, at a cost of $1,400,000, to be located at Walker and Lispenard Streets. Cyrus L. W. Eidlitz is architect.

NEW YORK, N. Y. Bids will be received by C. B. J. Snyder, superintendent of school buildings, Park Avenue and Fifty-ninth Street, New York, N. Y., until May 8 for installing electric equipment in new Public School 165, on Hopkinson and Lott Avenues and Amboy Street, Brooklyn, and for installing electric equipment in new Public School 95 on West Houston and Clarkson Streets, New York.

RICHMOND, N. Y.—Bids will be received at the office of the President of the Borough of Richmond, Borough Hall, St. George, New Brighton, N. Y., until May 9 for furnishing material required and installing railing and pedestal lamp posts on Jay Street and South Street retaining walls, railing and tablets on Stuyvesant Place retaining wall, and curb lamp posts on Jay Street, South Street, Hyatt Street, Stuyvesant Place, Central Avenue, Arrietta Street and Griffin Street, in connection with part of the street improvements authorized for the St. George ferry approach, contract No. 6. The material required is estimated as follows: 3800 lin. ft. of railing; thirty lamp posts furnished and placed on pedestals, forty lamp posts furnished and placed on curb line and one double-lamp lamp post placed on concrete base, complete. Plans and specifications and form of contract may be obtained at the office of the engineer of the borough, Borough Hall, St. George, Staten Island, N. Y. George Cromwell is president.

SYRACUSE, N. Y.—Preparations are being made by the Syracuse Lighting Company to extend the zone of the ornamental lighting system, both north and south of the canal, work on which will begin in the near future.

SYRACUSE, N. Y.—The Bell Telephone Company has secured control of the Onondaga Independent Telephone Company, of Syracuse, and of the Home Telephone Company, of Utica, with subsidiary companies controlled by both companies. The deal is said to have involved a cash payment of $1,250,000.

WATERTOWN, N. Y.—The City Council has granted the Black

River Traction Company a franchise for the Washington Street extension.

OXFORD, N. C.—The Oxford Electric Light Company, recently incorporated with a capital stock of $15,000, is reported to be contemplating supplying both gas and electrical service in Oxford. A. H. Powell, of Oxford, N. C.; C. M. Calvert, of College Park, Md., and Charles F. Nesbitt, of Washington, D. C., are interested in the company.

BARBERTON, OHIO.—The City Council is reported to have granted the Barberton Light & Power Company a franchise to erect transmission lines on the streets of the city for a term of eight years.

CLEVELAND, OHIO.—The Cleveland Light & Power Company has increased its capital stock from $150,000 to $250,000.

CLEVELAND, OHIO.—The Lincoln Electric Company has filed a certificate with the Secretary of State showing an increase in its capital stock from $10,000 to $200,000.

DAYTON, OHIO.—Plans are being prepared by the Dayton & Troy Electric Railway Company and the Oakwood Street Railway Company, of Dayton. Ohio, for the construction of a joint power house, to be located at Tipp City, to cost about $150,000.

COALGATE, OKLA.—The plant and holdings of the Oklahoma Electric & Refrigerating Company have been acquired by S. W. Lane, of Coalgate. The officers of the new company are: S. W. Lane, president: M. D. Paydrick, vice-president: J. W. Jacobs. secretary, and H. W. Reager, superintendent.

MUSKOGEE, OKLA.—It is reported that arrangements have been completed by the Grand River Power Company for the construction of a dam on the Grand River at Muskogee, work on which will begin at once. C. N. Haskcel, of Muskogee, is interested in the enterprise.

SNYDER, OKLA.—It is reported that contracts have been awarded by the Board of Trustees for the construction of a new electric-light plant, to cost about $25,000.

KLAMATH, ORE.—The Klamath Power Company has taken over the plants and holdings of the Klamath Falls Light & Water Company. The deal involves about $500,000 and includes the purchase of two electric light and power plants in Klamath Falls and all of the water pipes and electric transmission lines throughout the city, and also from Klamath to Merrill, 22 miles to the south, and to Bonanza, 25 miles east. The company is said to be a subsidiary of the Siskiyou Electric Light & Power Company, of Yreka, Cal. The Siskiyou company was recently denied a franchise to transmit electricity from its large power plant on the Klamath River, 20 miles distant, to this city.

OREGON CITY, ORE.—The officials of the Canby Canal Company are reported to be contemplating the construction of an electric railway from Canby to Molalla, with feeders extending to Beaver Creek, Meadow Brook, Colton, Needy and Macksburg.

EASTON, PA.—The General Chemical Company is reported to have awarded the contract for construction of a power house to Gilpin-Guernsey Company for $50,000.

PHILADELPHIA, PA.—It is reported that only one bid was received for the work in connection with the installation of an ornamental lighting system on South Broad Street boulevard, which was submitted by Edwin H. Vare, for $69,900. The work is to be done under the supervision of the electrical bureau and includes the installation of four lines of electric conduits for cables to feed 420 tungsten lamps and 190 arc lamps.

POTTSTOWN, PA.—The Pottstown & Phœnixville Railway Company has applied for a charter in Pennsylvania to build an electric railway from Spring City to Saratoga, via Royersford. The incorporators are: George N. Malsberger, Harry F. Swinehart. of Pottstown, and C. Taylor Leland, of Philadelphia, Pa.

SOMERSET, PA.—Preparations are being made to begin work on the construction of an electric railway between Somerset and Rockwood. G. C. Winslow is chief engineer.

UNION CITY, PA.—The Keystone Electric Light Company is reported to have been granted a franchise to install an electric-light plant and transmission lines in Union City. L. D. Shreve is interested in the project.

WASHINGTON, PA.—It is reported that contracts will soon be awarded for the construction of the first section of the new Fairmont & Pittsburgh traction system. The work will begin at Blacksville and extend north to Waynesburg, a distance of 13 miles.

WELLSBORO, PA.—Surveys are being made by the Tioga Traction Company for its proposed electric railway between Wellsboro and Mansfield. The company is also contemplating building a branch to Blossburg. J. F. Fisher is chief engineer.

WYOMISSING, PA.—The citizens have adopted the recommendation of the special committee appointed to establish a municipal electric-light and power plant. The committee has been authorized to proceed at once to make preparations for construction of the plant. Bonds to the amount of $60,000 will be issued for the proposed system.

ABBEVILLE, S. C.—The construction of an electric railway from Abbeville to Antreville, a distance of 12 miles, is under consideration. Surveys have already been made for the proposed railway under the direction of W. H. H. Newell, civil engineer, of Anderson, S. C.

CAMDEN, S. C.—The construction of an electric railway to extend from Camden to Sumter, a distance of 30 miles, is reported to be under consideration. R. E. Sharpe. of Rembert, S. C., is interested in the project.

CHATTANOOGA, TENN.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until May 26 for furnishing an electric passenger elevator for the United States court house and post office at Chattanooga, Tenn., plans and specifications for which may be obtained at the above office. James Knox Taylor is supervising architect.

GALLATIN, TENN.—The Nashville-Gallatin Interurban Railway Company has applied for a charter to construct and operate an electric railway between Nashville and Gallatin, a distance of 30 miles. The capital stock is placed at $750,000. H. H. Mayberry, John A. Pitts and R. W. McLemore are the incorporators.

RIDGEDALE, TENN.—The Eastern Tennessee Power Company, of Parksville, Tenn., it is said, is planning to erect a substation at Ridgedale, where electricity transmitted from its plant on the Ocoee River will be transformed for distribution for lamps and motors. The cost of the building and equipment is estimated at about $75,000. J. G. White & Company, 43 Exchange Place, New York, N. Y., are engineers.

DENTON, TEX.—Arrangements have been completed whereby the Denton Traction Company will extend its street-car system into the north part of the city and to the College of Industrial Arts. A bonus of $3,000 was raised by the citizens to secure the extension. R. J. Wilson is manager.

EAGLE DAM, TEX.—Bids will be received at the office of the United States Reclamation Service. 605 Federal Building, Los Angeles, Cal., until May 15 for furnishing equipment for steam power plant for the Rio Grande River project of New Mexico and Texas. The equipment to include three 625-kva steam turbo-generating units, two steam turbine-driven exciters, controlling switchboards, including three feeder panels, three condensers with circulating air pumps, four water-tube boilers two boiler-feed pumps, one feed-water heater, steam and feed-water piping and other apparatus. The plant will supply electricity to operate derricks, cableways, hoists and heavy excavating machinery for construction work.

FT. STOCKTON, TEX.—The City Council has granted W. F. Zarbach and Charles A. Shroff, of Cleveland, Ohio, a ten-year franchise to construct and operate an electric-light and ice plant in Ft. Stockton. The cost of the proposed plant is estimated at about $20,000.

HEARNE, TEX.—It is reported that the city has voted to issue bonds for the construction of an electric-light plant.

HOUSTON, TEX.—It is reported that the W. E. Ule Construction Company has secured the contract for the construction of an electric interurban railway to extend from Houston to La Porte and Sylvan Beach. A. Foster Irwin is said to be interested in the project.

LONGVIEW, TEX.—Bonds to the amount of $90,000 are reported to have been voted, the proceeds to be used for electric-light system, paving, etc. C. A. Bodenham is Mayor.

MISSION, TEX.—It is reported that the Mission Land & Improvement Company is contemplating the installation of an electric light and power plant and water-works system in Mission. Steps have also been taken by the company to install an ice and pre-cooling plant.

PORTLAND, TEX.—The installation of an electric-light plant and water-works system in Portland is reported to be under consideration.

PORT LAVACA, TEX.—Application has been made to the City Commissioners by W. E. Shell for a franchise to install an electric light plant and water-works system in Port Lavaca.

TROUP, TEX.—The local electric light plant is reported to have been purchased by R. C. Schumate, of Zephyr, Tex. It is understood that the new owner will make improvements to the plant.

LOGAN, UTAH.—Mosiah Evans and associates are making arrangements to erect a transmission line from the power plant in the Bear River Canyon to supply electricity for lamps and motors in Logan.

BRISTOL, VA.—The Bristol Traction Company, recently organized, has purchased the properties of the Bristol Belt Line Railway Company in Bristol, including all the electric railways in operation. It is understood that improvements and extensions, involving an expenditure of about $100,000, will be made by the new company. The Holston Valley Railway, owned by the new company, will be equipped for electrical operation between Bristol and Big Creek Park, a distance of 10 miles. Fred Dulaney, of Bristol, Va., is manager.

HAMPTON, VA.—The Newport News & Old Point Railway & Electric Company is reported to be contemplating making improvements to its power plant, including the installation of one 575-hp boiler. W. J. Payne, of Richmond, Va., is president.

LYNCHBURG, VA.—Arrangements are being made by the Postal Telegraph Company to place its trunk wires underground on Jefferson Street.

BREMERTON, WASH.—The Puget Sound Southern Railway Company has applied for a franchise to construct and operate an electric railway in Bremerton. It is understood that the company proposes to seek a franchise in Charleston, 4 miles distant, and to build a line between the two cities. Plans have been prepared for extending the system ultimately to Port Orcard. Clifton, Union City, Shelton and into the Grays Harbor district. Electricity for operating the proposed railway will be furnished by a hydroelectric power plant.

HOQUIAM, WASH.—The Council has granted the Gray's Harbor Railway & Light Company, of Aberdeen, permission to extend its system to Hoquiam.

MONTESANO, WASH.—An election will soon be called to submit the proposition to issue bonds to the amount of $125,000, the proceeds to be used to purchase the plant of the Montesano Water & Light Company, to be owned and operated by the city.

NORTH YAKIMA, WASH.—The ranchers of the Selah Valley have decided to ask the Yakima Valley Transportation Company to extend its electric-railway system through the valley. It has been decided to give the company 9 miles of right-of-way, including about 32 acres of land for the building. The proposed railway is to extend through the valley to the entrance of the Wenas.

PORT ORCHARD, WASH.—Bids will be received until May 20 by the Board of Control, at Olympia, Wash., for the construction of a power plant in connection with the new hospital at the Veterans' Home, to be erected in Port Orchard.

SPRINGDALE, WASH.—The Washington Water Power Company is preparing to build a steam railroad from Springdale to the site of its new power plant on the Spokane River, 22 miles in length, to transport material for the construction of its plant.

WENATCHEE, WASH.—Plans are being considered for the construction of an electric railway in Wenatchee and through the Wenatchee Valley. Application will soon be made to the City Council in Wenatchee and to the Chelan County Commissioners for franchises for the proposed railway. Louis W. Pratt and Walter M. Harvey are interested in the project.

WHEELING, W. VA.—A movement is on foot among the residents of Mozart Hill and vicinity to organize a company for the purpose of constructing and operating an electric railway from the top of the incline above Forty-third Street, Wheeling, to Sherrard, and also to purchase and operate the old inclined railroad at Mozart Park.

WHEELING, W. VA.—The Consumers' Electric Company and the Wheeling Electrical Company are reported to have been consolidated under the name of the Wheeling Electric Company. The Consumers' Electric Company is constructing a large electric plant, contracts for which, it is understood, have been awarded.

CEDARBURG, WIS.—The Milwaukee Northern Railway Company is reported to be contemplating an extension of its electric railway to West Bend this summer.

LA CROSSE, WIS.—The construction of an electric light plant at Lake Como is said to be under consideration. Julius Burkhart, Leonard Fey and Wenzel J. Hickisch, of La Crosse, Wis., are said to be interested in the project.

LA CROSSE, WIS.—Plans have been completed by the La Crosse Water Power Company for the construction of a third dam and power house to be located on the main channel of Black River, 8 miles above Hatfield. Plans are also being prepared by the company for the construction of a fourth dam and second power house between Hatfield and Black River Falls, to cost approximately $500,000.

STOUGHTON, WIS.—The contract for the construction of an electric-light plant on the Yahara River to supply electricity for lamps and motors in Stoughton has been awarded to the Power Engineering Company, of Minneapolis, Minn. The proposed plant will cost about $75,000 and will develop 250 hp.

SUN PRAIRIE, WIS.—At an election to be held May 9 the proposition to issue $9,000 in bonds, the proceeds to be used for improvements and extensions to the municipal electric-light plant, will be submitted to a vote.

VANCOUVER, B. C., CAN.—The City Council has given the Western Canada Power Company an extension of nine months from April 23 in which to complete its system and furnish power in Vancouver.

VANCOUVER, B. C., CAN.—Plans are being prepared by the British Columbia Telephone Company for extensions and improvements to its system this year, which will involve an expenditure of about $1,000,000. William Farrell is president of the company.

VANCOUVER, B. C., CAN.—The Howe Sound Power Company has filed notice of application of 40 cu. ft. per second of water from Furry Creek, to be utilized for power development purposes.

VANCOUVER, B. C., CAN.—Contracts have been awarded by the British Columbia Electric Railway Company for the installation of an additional generating unit at the Lake Buntzen generating station, consisting of a 10,000-hp Doble water wheel, which will be supplied by the John McDougall Company, of Montreal, Que., Can., and an alternating-current generator, manufactured by the Canadian General Electric Company, of Toronto, Ont., Can. The contract for the penstock to supply the new unit was awarded to McDonald & Godson.

PORTAGE LA PRAIRIE, MAN., CAN.—The power committee of the City Council has engaged W. E. Skinner, of Winnipeg, Man., to make a report of the cost of the erection of a transmission line from Winnipeg to Portage La Prairie, including transformer station and distributing plant, in order to be able to give an answer to the proposition submitted by the City Council of Winnipeg to furnish electric energy from the Winnipeg municipal plant at Point du Bois.

WINNIPEG, MAN., CAN.—Tenders will be received by the Board of Control until May 15 for installing six 500-kw step-down transformers for substation No. 1. Specifications and further information may be obtained from Smith, Kerry & Chace, engineers, Carnegie Library Building, Winnipeg, Man. M. Peterson is secretary of Board of Control.

MIDLAND, ONT., CAN.—The ratepayers have voted in favor of the by-law authorizing the town of Midland to secure electrical energy from the Hydroelectric Power Commission and to expend $13,000 for the erection of a distributing plant.

TORONTO, ONT., CAN.—Tenders will be received by the Chairman of Board of Control, City Hall, Toronto, Ont., until May 23 for steel crossing towers. Specifications and forms of tenders may be obtained from the Toronto Hydroelectric System, City Hall, Toronto. G. R. Geary, Mayor, is chairman of Board of Control.

WELLAND, ONT.—The Niagara Falls, Welland & Lake Erie Railway Company has awarded the contract for construction of its street railway system in the town of Welland to Hendrick H. Leach & Company. C. J. McLaughlin is president of the railway company.

MONTREAL, QUE., CAN.—E. A. Robert, president of the Canadian Light & Power Company, has submitted plans to the Dominion government in connection with a large hydroelectric development at Cedar Rapids, on the St. Lawrence River, which will involve an expenditure of from $15,000,000 to $20,000,000. The plans include large chutes over the Coteau and Cedar Rapids, about 25 miles above Montreal.

MELVILLE, SASK., CAN.—The ratepayers have voted in favor of the by-law authorizing an expenditure of $23,000 for the construction of an electric-light plant.

PRINCE ALBERT, SASK., CAN.—Tenders will be received by the City Commissioners until May 31 for the following equipment: A.—One 100-hp cross-compound engine, with necessary condensing apparatus, steam piping installed complete. Bids on engines of the following classes will be considered: (1) Horizontal cross-compound, Corliss engine, 125-150 r.p.m. (2) Vertical cross-compound, Corliss engine, 125-150 r.p.m. (3) Vertical cross-compound, quick revolution engine, forced lubrication. B.—One 600-kw, 2200-volt, 60-cycle, three-phase engine type alternator, exciter, switchboards, automatic regulator, installed complete. C.—One 72-in. x 18-ft return tubular boiler, suitable for 150 lb. working pressure. Specifications will be furnished on application to the City Commissioners, or to R. Wright, city electrician.

WEYBURN, SASK., CAN.—The municipal electric light and power plant, operating in connection with the water works and sewerage systems, has been completed and put in operation. The equipment consists of a 250-kw alternating-current generator direct-connected to a cross compound Corliss engine; a 75-kw generator and Corliss engine and a 7-panel switchboard. The pumping equipment includes one 50-hp gasoline engine and one 50-hp motor attached to two 8x12 double-acting pumps, having a capacity of 300 gallons per minute each. The plant now supplies electricity for 30 street lamps and 6000 incandescent lamps.

ANGOSTURA, SONORA, MEX.—Preliminary surveys are being made for the construction of a hydroelectric power plant and irrigation system in the Yaqui and Bavispe valleys. It is proposed to build a dam 180 ft. high on the Bavispe River, near Angostura, which will form a water storage reservoir of large capacity. The Richardson Construction Company, of Los Angeles, Cal., is reported to be interested in the project.

New Industrial Companies.

THE BEAVER ENGINEERING COMPANY, of Newark, N. J., has been incorporated with a capital stock of $100,000 by C. M. Myers, A. L. Myers and M. G. Hammerschlag, of Newark, N. J. The company proposes to manufacture electric motors, dynamos, electrical machinery, etc.

THE BECK AUTOMATIC ELECTRIC SAFETY & SIGNAL SWITCH COMPANY, of St. Louis, Mo., has been chartered with a capital stock of $50,000 by Morris Tucker, Arthur Beck and Charles Beck.

THE CHISHOLM TRANSMITTER & TELEPHONE INSTRUMENTS COMPANY, of New York, N. Y., has been incorporated with a capital stock of $750,000 by T. E. Wing, P. W. Russell, B. D. Wacadon and R. Bennett, of New York, N. Y. The company proposes to manufacture and deal in telephone instruments.

THE ELECTRIC GRANITE SAW COMPANY, of New York, N. Y., has been incorporated to acquire and operate quarries, etc. The company is capitalized at $350,000, and the incorporators are: J. J. Smith, J. C. Wait, of the Bronx, and P. Ryan, of Brewsters, N. Y.

THE ELECTRIC HEATER COMPANY, of Cincinnati, Ohio, has been chartered with a capital stock of $50,000 to manufacture electrical devices. The incorporators are: T. F. Bailey, H. F. Bchecker, F. I. Mowry, William H. Miller

THE ELECTRIC SEAL & STAMP COMPANY, of New York, N. Y., has been incorporated by D. A. Sterling, W. C. Lovatt and C. J. Kleber, of New York, N. Y. The company is capitalized at $25,000 and proposes to manufacture electric seals, electric stamping machines, etc.

SAMUEL GARVIN & COMPANY, of Chicago, Ill., have been incorporated with a capital stock of $15,000 by F. William Keagh, Alonzo C. Heckler and Samuel Garvin.

THE IDAHO ELECTRIC MANUFACTURING COMPANY, of Pocatello, Idaho, has been incorporated by John A. Tupper, M. E. Hughes, Timothy Kinney, Pocatello, Idaho, and others. The company proposes to manufacture electric ranges.

THE INTERNATIONAL ACCESSORIES MANUFACTURING COMPANY, of Portland, Maine, has been chartered with a capital stock of $1,000,000 to manufacture and deal in motors and machinery of all kinds. A. F. Dunham is president and M. S. Wells treasurer, both of Portland, Maine.

THE LOS ANGELES ELECTRIC VEHICLE COMPANY, of Los Angeles, Cal., has been incorporated with a capital stock of $200,000 by S. Hendricks, P. L. Lindley, W. K. Crawford, C. E. Nester and J. A. Lightpipe

THE RICHEY TELEPHONE LOCK & CALL REGISTER COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $100,000. The incorporators are: C. V. Richey, E. H. Booth, of Washington, D. C., and R. T. Ward, of Baltimore, Md.

New Incorporations.

ELBERTON, GA.—The Elberton & Eastern Railway Company has been organized to build an electric railway to connect Elberton, Tignall, Washington and Lincolnton. The company will be capitalized at $500,000, and the incorporators are: M. A. Pharr, of Washington, Ga.; James A. Moss, W. J. Adams and J. J. Wilkinson, of Tignall; W. O. Jones, Z. B. Rogers, and others, of Elberton.

NORTONVILLE, KY.—The Norton Traction Company has been incorporated with a capital stock of $100,000 by Frank E. Mehr, of Columbus, Ohio; Frank G. Hoge, of Nortonville, Ky., and T. F. Callard, of Hopkinsville, Pa. The company proposes to build an electric railway in Nortonville.

AUBURN, MAINE.—The Crystal Co-operative Association has been incorporated with a capital stock of $175,000 for the purpose of dealing in real estate and water-power sites, and also proposes to supply electricity for lamps and motors. H. Vrooman, of Providence, R. I., is president, and J. E. Young, of Brookline, Mass., treasurer.

KITTERY, MAINE.—Articles of incorporation have been filed for the Newmarket Electric Company with a capital stock of $100,000 by Edwin G. Eastman, Exeter, N. H.; Fred B. Philbrick, of Newmarket, N. H., and Horace Mitchell, Kittery, Maine.

PORTLAND, MAINE.—The Victor-American Power Company has been incorporated by Clarence E. Eaton, Albert F. Jones, Albert A. Richards, B. M. Maxwell and Clarence G. Trott, all of Portland, Maine. The company proposes to supply electricity for lamps, motors, heating, etc.

KANSAS CITY, MO.—Articles of incorporation have been filed for the Costelow-Canham Electric Company with a capital stock of $3,000 by John F. Costelow, E. E. Canham, Jr., and E. E. Canham, Sr.

BERNARDSVILLE, N. J.—Articles of incorporation have been filed for the Bernards Electric Company by S. S. Childs, T. B. Smith and C. M. Henry, of Bernardsville, N. J. The company is capitalized at $500,000 and proposes to supply electricity for lamps, heat and motors.

AUBURN, N. Y.—The Empire Gas & Electric Company has been incorporated with a capital stock of $900,000 by J. A. Seymour, F. Sefton and G. W. Bowen, of Auburn, N. Y. The company proposes to supply electricity and gas.

LINWOOD, N. C.—The Fairmont-Silver Telephone Company has been incorporated by G. C. Palmer, of Silver Hill, N. C., and others. The company is capitalized at $20,000, and proposes to erect a telephone line from Southmount and Silver Hill to Lexington. Post office address, Linwood, R. F. D., No. 2.

HANKINSON, N. D.—Articles of incorporation have been filed for the Hankinson-Carleton Electric Company with a capital stock of $25,000 by M. E. Phillips, E. L. Carleton, John H. Cahhan, J. G. Eager and George F. Phillips, all of Jamestown. The company proposes to supply electricity in Hankinson.

VAN BUREN, OHIO.—The Hills & Dales Railway Company has been incorporated with a capital stock of $25,000 by William Stroop, Edwin P. Matthews, of Clayton, Ohio; Albert C. Rice and O. J. Emrick. The company proposes to build a street railway.

ARCHBALD, PA.—The Archbald Light, Heat & Power Company has been incorporated with a capital stock of $5,000. The directors are: Frederick W. Stillwell, Y. M. C. A. Building, Scranton, Pa.; Alvan Markle, of Hazleton, Pa.; C. D. Simpson, of Scranton, Pa., and James Butler, of Moosic, Pa.

ARONA, PA.—The Arona Electric Company has been incorporated with a capital stock of $5,000. The directors are: George T. Smith, Cain and Dursan Avenues, Pittsburgh, Pa., treasurer; F. J. Taylor, of Homestead, Pa., and William H. Larimer, of Wilkinsburg, Pa.

ASPINWALL, PA.—The Redstone Electric Company has been granted a charter with a capital stock of $5,000. The directors are: C. R. Turton, of Aspinwall, Pa.; C. C. McBride, of Ingram, Pa., and W. F. Craig, of Swissvale, Pa.

DUNMORE, PA.—The Dunmore Electric Company has been granted a charter by the Secretary of State. The directors are: C. D. Simpson, Louis W. Healy, of Scranton, Pa., and James Butler, of Moosic, Pa.

Personal.

MR. DAVID G. HOWEY has been appointed superintendent of the Kilbourn Municipal Electric Light Plant, Kilbourn, Wis.

MR. HORACE F. HILL, of Indianapolis, has been elected general manager of the Chicago Telephone Company, succeeding Mr. Angus S. Hibbard, resigned.

DR. OTTO FEUERLEIN, manager of the incandescent lamp factory of Siemens & Halske, Berlin, Germany, arrived in this country on April 24 to remain until June 1.

MR. PAUL P. BIRD, until recently smoke inspector for the city of Chicago, has taken a position with the contract department of the Commonwealth Edison Company, Chicago.

DR. C. P. STEINMETZ will be the chief speaker at a meeting of the Toronto Section of the A. I. E. E. to be held on May 5. His subject will be "The Nature of Transients in Electrical Circuits."

MR. D. McF. MOORE will deliver a lecture on vacuum tube lighting before the Commercial Association of the Public Service Corporation of New Jersey in Newark on April 4.

MR. W. T. SHARP, who was formerly connected with the Citizens Railway, Light & Power Company, of Newport News, Va., has been appointed superintendent of the Emporia (Va.) Hydroelectric Power Company.

MR. THEODORE N. VAIL, president of the American Telephone & Telegraph Company, has been elected a director of the New York, New Haven & Hartford Railroad Company, succeeding the late Nathaniel Thayer, of Boston.

PROF. C. L. DE MURALT, of the electrical engineering department of the University of Michigan, will address the Toledo section of the A. I. E. E. on May 5, his subject being "Modern Developments in Trunk Line Electrification."

PROF. C. L. CORY, of the electrical engineering department of the University of California, has been appointed consulting and investigating engineer by the Berkeley City Council to determine the proper rate for electricity at that place.

DR. K. G. FRANK, the representative in this country of the Siemens & Halske and Siemens-Schukert companies of Berlin, Germany, sailed for Europe on the steamer *Cleveland* on April 27. Dr. Frank will remain in Europe until Sept. 1.

PROF. ALEXANDER GRAHAM BELL will be honored as the inventor of the telephone by his birthplace, Brantford, Ontario, Canada, where a memorial will be erected, to be in readiness for the formal celebration on Dominion Day, July 1, 1912.

MR. H. A. SINCLAIR, who served as treasurer of the New York Electrical Society for twenty-five years, has been presented with a testimonial in recognition of his faithful service throughout this period, during which the membership increased from about 100 to almost 1000.

MR. WILLIAM J. WILGUS, formerly chief engineer in charge of electric traction of the New York Central & Hudson River Railroad, has been awarded the Telford gold medal for the paper read by him at a recent session of the Institution of Civil Engineers of Great Britain.

MR. BION J. ARNOLD has been appointed chief engineer of the Chicago Association of Commerce committee on model downtown streets. Mr. Arnold is also chief subway engineer for the city of Chicago, so that this new appointment will in a measure supplement the older one.

MR. A. A. GRAY, general manager of the *Electrical Review and Western Electrician*, has been appointed vice-president of the Electric Club of Chicago, succeeding Mr. C. A. Howe, who resigned, owing to his removal from the city. Mr. Gray will succeed Mr. Howe also as chairman of the speakers committee of the club.

MR. W. H. WELLS, district manager of the Edison Electric Illuminating Company of Brooklyn, in accordance with the company's usual method of filling vacancies from its ranks, has been transferred to a similar position at the main office to fill the vacancy caused by the resignation of Mr. Parker H. Kemble.

MR. H. C. STERLING, for a number of years superintendent of the municipal electric light and water-works plant at New London, Wis., is now manager of the Constantine Hydraulic Company, with headquarters at Three Rivers, Mich. This company has a hydroelectric plant at Constantine, Mich., and supplies electrical energy to several towns. Mr. Sterling has been a familiar figure at conventions of the old Northwestern Electrical Association and of the present Wisconsin Electrical Association.

MR. J. C. WOODSOME, formerly superintendent of the Dallas (Tex.) Electric Light & Power Company, has been appointed general manager of the Tampa Electric Company at Tampa, Fla., succeeding Mr. J. A. Trawick, who has removed to Keokuk, Ia., to take charge as manager of the hydroelectric development now under construction utilizing the Mississippi River at that point. Mr. Woodsome is succeeded at Dallas by Mr. Herbert Nash, Jr., who comes from the Stone & Webster plant at Houghton, Mich., where Mr. Woodsome was also formerly stationed.

MR. GEORGE A. DAMON, managing engineer for the Arnold Company, Chicago, Ill., has been appointed dean of the School of Engineering of Throop Polytechnic Institute, Pasadena, Cal. Mr. Damon was born in Chesaning, Mich., on April 7, 1871. He was educated in the grammar school at Detroit and the high school at Ypsilanti, and was graduated from the latter in the class of 1889. Meanwhile, Mr. Damon had gained experience as a freight clerk with the Michigan Central Railroad at Ypsilanti. Subsequently he entered the University of Michigan, but his work at the university was interrupted in 1893, when he took charge of the educational exhibit of the university at the World's Fair in Chicago. Shortly thereafter Mr. Damon became connected with the Fisher Electric Company, which he served in the drafting room and shop. In the fall of 1894 he returned to the University of Michigan and completed his course. In September, 1895, Mr. Damon became connected with Bion J. Arnold, who had recently opened an office in Chicago as a consulting engineer, and he has been connected with Mr. Arnold continuously since that time. At first, Mr. Damon's work with Mr. Arnold was along consulting engineering lines, but when the Arnold Electric Power Station Company was organized Mr. Damon became prominently affiliated with the work which it carried out in different parts of the country. In 1908 and 1909 Mr. Damon served as first assistant to Mr. Arnold in the work which he carried out as consulting engineer to the Public Service Commission of the First District of New York. In 1910 Mr. Damon directed the investigation by Mr. Arnold of transportation facilities in the Pittsburgh district for the Mayor in connection with the plans for a greater Pittsburgh. Since January, 1911, he has been in Los Angeles, Cal., in charge of the appraisal of the property of the Southern California Edison Company, and has recently taken up the preliminary studies for Mr. Arnold of the transit problems of Los Angeles. His work at Throop Institute will not interfere with his duties in connection with the Arnold Company.

MR. PARKER H. KEMBLE, district manager of the Edison Electric Illuminating Company, of Brooklyn, N. Y., has been appointed general sales manager of the Toronto Electric Light Company, Toronto, Ont. Mr. Kemble was educated in the arts and sciences at Harvard, the Technology School in Dresden, Germany, and the Massachusetts Institute of Technology. His theoretical training was supplemented by practical experience in marine and mechanical engineering in the shipyards of William Cramp & Sons, Philadelphia. Later he joined the engineering staff of the Boston Elevated Railroad Company, where he was employed in the design of power stations and cars. When the Windsor Locks Electric Lighting Company, the Enfield Electric Light & Power Company and the Enfield Gas Company were consolidated into the Northern Connecticut Light & Power Company of Windsor Locks, Conn., Mr. Kemble was engaged to rebuild and operate the combined system. An account of this interesting work appeared in our issue of May 5, 1910. Prior to joining the staff of the Brooklyn Edison Company Mr. Kemble was employed by the National Electric Light Association as acting executive secretary in the preparation and handling of the Atlantic City convention. His wide experience and training made him a valuable asset of the Edison company and fit him admirably for his new post. Mr. Kemble is a member of the American Society of Mechanical Engineers and the Society of Naval Architects and Marine Engineers. He is also an associate member of the American Institute of Electrical Engineers, United States Naval Institute and American Society of Naval Engineers.

PARKER H. KEMBLE.

MR. NORMAN MACBETH, for twelve years consulting engineer in the gas and electric lighting fields, and for the past two years engineer in charge of the illuminating engineering laboratories of the Welsbach Company, on May 1 assumed the position of illuminating engineer of the Westinghouse Electric & Manufacturing Company and the Westinghouse Lamp Company. Mr. Macbeth was born in Stayner, Ontario, Canada, in 1873. From 1890 to 1897 he was engaged in the practical work of installing gas and electric equipment, in the latter year giving part of his time to the manufacture of aluminum reflectors of his own design for show-window lighting with gas lamps. From 1897 to February, 1909, he acted as consulting engineer, devoting his attention to gas and electric lighting problems and giving special attention in the former part of this period to the inspection of meters and the adjustment of rate and bill complaints. Through his knowledge of the subject, his practical turn of mind and his adherence to sound business ethics, Mr. Macbeth succeeded in establishing for himself an enviable reputation. A portion of his time during the latter part of this period was devoted to constructing as well as consulting illuminating engineering. In 1908 he engineered in Philadelphia, the first complete installation of inverted gas lamps to be designed in accordance with illuminating engineering principles. His work with the Welsbach Company began in February, 1909. During the two years in this service he has created a well-equipped department of illuminating engineering as applied to gas lighting. Mr. Macbeth has been a frequent contributor to the technical press and to the proceedings of the Illuminating Engineering Society. He was the first to work out the "flux polar diagram" for determining the mean spherical candle-power from the polar distribution curve. He is the inventor of the "Macbeth Illuminating Engineering Calculator," considered as useful in making calculations in illumination as the regular slide rule is in other engineering problems. Mr. Macbeth is a member of both the American and British Illuminating Engineering Societies; the Franklin Institute; the National Electric Light Association; the National Commercial Gas Association and the American Association for the Conservation of Vision. He was one of the lecturers in the Johns Hopkins University course in illuminating engineering given under the auspices of the Illuminating Engineering Society.

NORMAN MACBETH.

Obituary.

MR. ROBERT H. WATSON, secretary and treasurer of the Northwestern Electric Company of Chicago and a highly esteemed electrical business man of that city, died on April 26. Mr. Watson had been engaged in the supply business in Chicago for a number of years, and for some time was connected with the Gregory Electric Company. Before that he was associated with the old Knapp Electric Works, and after leaving the Gregory Company was for a time with the Chicago office of the Gould Storage Battery Company. Later he engaged in business for himself under the name of Watson Electric Company, and thereafter formed his connection with the Northwestern Electric Company. He was active in church work and made an enviable reputation for probity and straightforwardness in all his business dealings. He leaves a wife and two daughters and also a son who is, unfortunately, dangerously ill.

Trade Publications.

PROTECTIVE APPARATUS.—Folder 4110, issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., covers the line of static protective apparatus manufactured by this company.

INCANDESCENT LAMPS.—The New York & Ohio Company, Warren, Ohio, is issuing two illustrated folders, one giving a revised price schedule and the other a revised discount schedule for the incandescent lamps.

PROTECTIVE PAINT.—The Joseph Dixon Crucible Company, of Jersey City, N. J., has published a neat folder entitled, "Maintenance Painting for Electric Railways." It gives excellent photographs of street-railway viaducts, power-plant stacks and car trucks painted with silica-graphite paint. The folder explains in a very interesting way the special adaptability of this paint for street railway uses.

INDUCTION WATT-HOUR METERS.—The Sangamo Electric Company, Springfield, Ill., is distributing a 24-page bulletin describing the construction, principle of operation and application of its improved induction watt-hour meter. The bulletin is profusely illustrated. The illustrations showing a radically new type of magnetic circuit will be of particular interest to electrical engineers dealing with alternating-current measurements.

ELECTRIC VEHICLE INSTRUCTION BOOK.—During the past year the charging of electric-vehicle batteries has become a considerable factor in increasing the day load of central stations for the purpose. The Sangamo Electric Company, Springfield, Ill., has issued an attractive instruction book showing the charging connections of the more prominent vehicles, which will interest the managers contemplating the installation of charging apparatus.

ELECTRIC SPECIALTIES.—The Minerallac Electric Company, 400 South Hoyne Avenue, Chicago, has issued three new bulletins relating to its product. The first describes cable and conduit hangers and porcelain bushings. Another is devoted to an electroscope for indicating the presence of dangerous potentials. This instrument is made in two sizes, one intended for pocket use and the other for power house or substation operators. The third bulletin describes the Chicago printing attachment for watt-hour meters.

SWITCH AND OUTLET BOXES.—Catalog No. 25 of the Chicago Fuse Manufacturing Company, 1014 West Congress Street, Chicago, entitled "Stamped Steel Switch and Outlet Boxes," illustrates and describes and lists a complete line of outlet and switch boxes. The catalog is intended to cover all the requirements ordinarily met with in electrical installations where switch boxes or outlet boxes are required, either for old or new work. Several new forms of boxes and ceiling plates, as well as a new universal switch box, with a corresponding line of special covers, are described. A new and useful feature of this catalog is a table showing "Union" catalog numbers and the corresponding catalog numbers of other manufacturers, also shipping quantities per barrel.

BUSINESS NOTES.

MR. CHARLES G. ATKINS, consulting engineer, has moved his office from the Monadnock Building to the Ellsworth Building, Chicago.

THE WESTERN LUMBER & POLE COMPANY has moved from the Charles Building to the new Electric Building, Denver, Col.

THE TRIUMPH ELECTRIC COMPANY has changed its Chicago office address from 275 La Salle Street to 301 Fort Dodge Building.

PATTISON BROTHERS, consulting engineers, have moved their offices from the Fuller Building to the Centurian Building, New York.

C. O. MAILLOUX and C. E. KNOX, consulting engineers, have moved their offices from 76 William Street to 90 West Street, New York.

THE JOHN C. DOLPH COMPANY has moved its insulation factory from 135 West Avenue, Long Island City, to 317 New Jersey Railroad Avenue, Newark, N. J.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, of Plainville, Conn., has removed its New York office from 136 Liberty Street to 114 Liberty Street.

MR. E. H. NAGELSTOCK, formerly with the Gregory Electric Company, has opened an office at 1206 Rector Building, Chicago, for the sale of all kinds of electrical apparatus.

HODENPYL, WALBRIDGE & CO. have dissolved partnership, and the firms of H. D. Walbridge & Co. and Hodenpyl, Hardy & Co. have been formed, with offices at 7 Wall Street, New York.

MR. FAY WOODMANSEE, electrical engineer with Sargent & Lundy, engineers, Chicago, has resigned to engage in the practice of consulting engineering in Chicago with Messrs. C. J. Davidson and E. O. Sessions.

MR. E. O. SESSIONS, engineer in the Chicago office of the General Electric Company, has resigned to engage in the practice of consulting engineering in Chicago with Messrs. Fay Woodmansee and C. J. Davidson.

THE SPRAGUE ELECTRIC COMPANY has removed its Boston office from the Weld Building to 201 Devonshire Street, where more room has been obtained in order to handle expeditiously the company's products in the New England territory.

MR. C. J. DAVIDSON, chief engineer of power plants for the Milwaukee Electric Railway and Light Company, has resigned to engage in the practice of consulting engineering in Chicago with Messrs. Fay Woodmansee and E. O. Sessions.

THE MURRAY IRON WORKS COMPANY has just completed an extensive addition to its boiler shops at Burlington, Iowa, in the shape of a steel frame building 140 ft. by 120 ft., with a large traveling crane down the middle and smaller cranes on the sides.

THE INTERNATIONAL STEAM PUMP COMPANY, New York, has established a publicity department which will hereafter handle its advertising and news matter. This department is in charge of Mr. Henry R. Cobleigh, who has been mechanical editor of the *Iron Age* for the last seven years.

THE STAVE ELECTRICAL COMPANY has removed from 27 West 27th Street to 131 Hudson Street, New York. This move was made necessary by the increasing demand for the company's new long-life flaming arc lamps. Mr. Theodore Stave has recently returned from abroad, where he looked over the factory and arranged for prompt shipments to this country in order to take charge of the trade of the United States with the greatest dispatch.

MR. PERCIVAL R. MOSES, who has moved his office as consulting engineer from 45 West Thirty-fourth Street, to 366 Fifth Avenue, New York, has associated with him for the handling of industrial equipments Mr. John Fallon, formerly mechanical engineer of the Tennessee Copper Company and Stanley G. Flagg & Company; Mr. Arthur V. Farr, formerly with Szepesi & Farr; Mr. Alphonse Kaufman, formerly manager and chief engineer of the Alaska Chemical Company, and Mr. J. N. Walton, recently storage battery expert with the Edison Electric Illuminating Company of Brooklyn.

THE GENERAL ELECTRIC COMPANY OF TEXAS has removed its principal office, at Dallas, from the Prætorian Building to its new commodious brick warehouse building, where a floor area of 300,000 sq. ft. is available. The present three-story building is arranged for the addition of a fourth floor when necessary. Mr. V. E. Raggio is manager of the Dallas office, and Mr. A. N. Feineman is assistant manager. Mr. William Taussig, of Chicago, assistant to the president of the Texas company, Mr. J. W. Johnson, of Chicago, will be stationed at Dallas during the next six months The General Electric Company of Texas does business in the States of Texas and Oklahoma.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Geo. S. Emery, 11 N. Royal St., Mobile, Ala. Annual convention in November.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next semi-annual meeting at Toronto, Canada, September or October, 1911.

American Electro-Therapeutic Association. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York. Next meeting at Philadelphia, Pa., Sept. 5, 6 and 7, 1911.

American Institute of Consulting Engineers. Secretary-Treasurer, Eugene W. Stern, 103 Park Ave., New York City. The Council meets the first Friday of every month.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September. Annual convention, Chicago, June 26-30, 1911.

American Electric Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia. Annual convention, Atlantic City, N. J., October 9-13, 1911.

American Electric Railway Engineering Association. Secretary, Norman Litchfield, Interborough Rapid Transit Company, New York. Annual convention, Atlantic City, N. J., Oct. 9-13, 1911.

American Electric Railway Association. Secretary, H. C. Donecker, Engineering Societies Building, 29 West 39th St., New York. Annual convention, Atlantic City, N. J., Oct. 9-13, 1911.

American Physical Society. Secretary, Ernst Merritt, Cornell University, Ithaca, N. Y.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Annual Convention, May 16, 17 and 18, 1911, at Little Rock, Ark.

Association of Iron and Steel Electrical Engineers. Secretary, James Farrington, Steubenville, Ohio.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Boston, Mass., June, 1911.

Association of Railway Electrical Engineers. Secretary, J. Andreucetti, Chicago & Northwestern Railway, Chicago. Next annual meeting (Hotel La Salle, Chicago), November 6 to 10, 1911. Semi-annual meeting, Washington, 1911.

Association of Edison Illuminating Companies. Secretary, N. T. Wilcox, Lowell, Mass.

Canadian Electrical Association. Secretary, T. S. Young, 220 King St., West, Toronto, Can.

Colorado Electric Light, Power & Railway Association. Secretary, F. D. Morris, 323 Hagerman Building, Colorado Springs, Col. Annual convention, Glenwood Springs, Col., September 13-15, 1911.

Electric Vehicle Association of America. Secretary, Harvey Robinson, 124 West 42d St., New York. Meetings, fourth Tuesday of each month.

Electric Club, Chicago. Secretary, N. F. Obright, 1500 American Trust Bldg., Chicago. Meets every Wednesday noon, 303 Wabash Ave., Chicago.

Electrical Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Annual meeting at Buffalo, N. Y., June 20, 1911.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursday of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo. Next meeting in Kansas City, Saturday, June 10, 1911.

Electrical Salesmen's Association. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Credit Association of Chicago. Secretary, Frederic P. Vose, Marquette Building, Chicago. Annual meeting Chicago, November 2, 1911.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of directors meets second Thursday of each month.

Empire State Gas and Electric Association. Secretary, Charles H. B. Chapin, Engineering Societies Building, 29 West 39th St., New York.

Florida Electric Light & Power Association. Secretary, H. C. Adams, West Palm Beach, Fla. Next meeting, Jacksonville, Fla., April 4 and 5, 1911.

Illinois State Electrical Association. Secretary H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago. Annual convention, Chicago, 1911.

Independent Electrical Contractors' Association of Greater New York. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

Indiana Electric Light Association. Secretary, J. V. Zartman, Indianapolis, Ind. Annual meeting, August 23 and 24, 1911.

Internal Combustion Engine Association. Secretary, Chas. Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

International Association of Municipal Electricians. Secretary, C. R. George, Houston, Tex. Next meeting, St. Paul, Minn., 1911.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

Iowa Electrical Association. Secretary, W. N. Keiser, Dubuque, Ia.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Independence, Kan., Sept. 21 and 22, 1911.

Maine Electrical Association. Secretary, Walter S. Hyman, Waterville, Maine.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electric Association. Secretary, Herbert Silvester, 18 Washington Boulevard, Detroit, Mich. Annual convention on board the S.S. Minnesota, June 19-22, 1911.

Minnesota Electrical Association. Secretary, T. C. Gordon, Little Falls, Minn.

Mississippi Electric Association. Secretary, A. H. Jones, McComb City Light and Power Co., McComb City, Miss. Annual convention, Gulfport, Miss., June 20-21, 1911.

Missouri Electric, Gas, Street Railway & Water Association. Secretary, N. J. Cunningham, Springfield Gas & Electric Co., Springfield, Mo.

National Arm, Pit & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National District Heating Association. Secretary, D. L. Gaskill, Greenville, Ohio. Third convention, Fort Pitt Hotel, Pittsburg, June 6-8, 1911.

National Electric Contractors' Association of the United States. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Niagara Falls, July 19, 1911.

National Electric Light Association. Executive Secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York. Annual convention, New York City, May 29-June 3, 1911.

National Electric Light Association, New England Section. Secretary, Miss O. A. Bursiel, 39 Boylston St., Boston, Mass.

National Electric Light Association, Pennsylvania Section. Secretary-Treasurer, Van Dusen Rickert, Pottsville, Pa.

National Electric Light Association, Nebraska Section. Secretary-Treasurer, S. J. Bell, David City, Neb.

National Electric Light Association, Georgia Section. Secretary-Treasurer, H. M. Corse, Columbus Railroad Company, Columbus, Ga.

National Electric Light Association, Baltimore Section. Secretary, A. W. Hawkes, Jr., Continental Building, Baltimore, Md.

National Electrical Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn. Next meeting, New York, March, 1911.

National Electrical Credit Association. Secretary, Frederic P. Vose, 343 Marquette Bldg., Chicago.

National Fire Protection Association. Secretary R. Sweetland, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1913.

National Independent Telephone Association. Secretary, Joseph B. Ware, Grand Rapids, Mich.

Nebraska Electrical Association. Secretary, Frank McMaster Beatrice, Neb.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month

New England Electrical Trades Association. Secretary, Alton F Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New Orleans Electrical Contractors' Association. Secretary, L. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

New York Electrical Society. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York

Northwest Electric Light & Power Association. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July 25-28, 1911.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, Prof. I. E. Sanborn, Ohio State University, of Columbus, Ohio. Next meeting at Youngstown, Ohio, May 18 and 19, 1911.

Order of Rejuvenated Sons of Jove. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Bldg., Chicago, Ill. Annual meeting Denver, Col., Oct. 16-18, 1911.

Pittsburgh Electric Booster Club. Recording Wattmeter, O. R. Rombach, 919 Liberty Ave., Pittsburgh, Pa. Meetings, fourth Monday of each month.

Society for the Promotion of Engineering Education. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y. Annual meeting at Pittsburgh, June 27, 28 and 29, 1911.

Society of Wireless Telegraph Engineers. Secretary, E. B. Moore, 39 Trinity Place, Boston. Monthly meeting, first Saturday of each month, at the Massachusetts Institute of Technology, Boston.

Southwestern Electrical & Gas Association. Secretary, D. G. Fisher, 1316 Commerce St., Dallas, Tex.

Street Railway Association of the State of New York. Secretary, C. G. Reel, Kingston, N. Y. Annual meeting at Cooperstown, June 27 and 28, 1911.

Vermont Electrical Association. Secretary-Treasurer, A. B. Marsden, Manchester, Vt.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 145 Monroe St., Chicago, Ill.

Western Society of Engineers, Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Wireless Institute. Secretary, Alfred N. Goldsmith, College of the City of New York, New York.

Wisconsin Electrical Association. Secretary, George Allison, Stephenson Building, Milwaukee, Wis. Next annual meeting, Milwaukee, January, 1912

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 25, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

990,219. SUPERVISORY SIGNALING SYSTEM; W. G. Blauvelt, New York, N. Y. App. filed Oct. 26, 1910. The central station has a plurality of supervisory signals, all positioned and adapted to signal one and the same central operator, there being automatic mechanism at central for successively bringing the signal devices under the control of the substation.

990,229. INDIVIDUAL PROTECTOR UNIT AND MEANS FOR MOUNTING SAME; F. B. Cook, Chicago, Ill. App. filed Aug. 2, 1909. Cable terminal with protector units which may be connected with the cable after it is installed. The protectors consist of sheet metal plates carrying hooks and hollow binding posts and a notched base plate engaging the hooks, each unit having a pair of spring forks to clamp the corresponding pair of binding posts.

990,234. TERMINAL FOR ELECTRIC CABLES; C. W. Davis, Edgeworth, Pa. App. filed June 19, 1909. Terminal head for protecting the cable where it is connected with the air line by means of a thimble, a non-conducting sleeve and a resilient stopper between the cable and the sleeve.

990,235. JUNCTION BOX STRUCTURE FOR ELECTRICAL CONDUCTORS; C. W. Davis, Edgeworth, Pa. App. filed July 1, 1909. A casing with an offset in the lower wall which supports a partition, pole pieces through the partition and busbars in the offset portion of the wall in line with the partition, the terminals being in oil.

990,236. DAMPER REGULATOR; R. J. Davis, Chicago, Ill. App. filed Aug. 29, 1908. Automatic regulator for furnaces operated by weights controlled by electromagnets whose circuits are controlled by thermostats.

990,237. DAMPER REGULATOR; R. J. Davis, Chicago, Ill. App. filed Jan. 3, 1910. Improvement on 990,236 for varying the adjustment of the damper.

990,265. ELECTRICALLY HEATED TOOL; H. Hertzberg, New York, A. A. Low, Horseshoe, and M. J. Wohl, New York, N. Y. App. filed Nov. 4, 1907. Soldering iron with hollow handle containing the circuits and heating units. The chambered mass of solid metal contains the heating units.

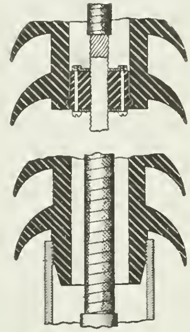
990,274. STORAGE BATTERY; E. J. Knapp and E. D. McLaughlin, Milwaukee, Wis. App. filed March 28, 1910. An electrode in the form of an overlapping shell which may be corrugated or perforated with an overlapping porous container inside the shell and active material within the container.

990,275. TELEPHONE TRANSMITTER; S. A. Kolenski, Boston, Mass. App. filed May 23, 1907. An antiseptic auxiliary diaphragm of celluloid is arranged in front of the sound diaphragm.

990,285. ELECTRIC SWITCH DEVICE; R. D. Moyer, Tampa, Fla. App. filed April 4, 1910. A plurality of rotatable disks with an oscillatory circuit-closing device actuated thereby, an electrical device for rotating the disks, step by step, the circuit of the latter being intermittently closed by a third disk.

990,342. ELECTRIC CLOCK AND LIKE INSTRUMENT; H. Creese, London, Eng. App. filed Dec. 10, 1909. A rotary body or disk carrying weighted arms which are projected successively at one side of the disk while the other weighted arms approach the center, thus giving driving effect; the arms are projected by electromagnets.

990,343. ELEVATOR SAFETY DEVICE; F. J. Crouch and H. E. Lloyd, Seattle, Wash. App. filed Sept. 9, 1910. Door lock for elevators with a bell crank, a bracket, a lever engaging the bell crank, a spring and a latch movable with the door to engage the lever, the parts controlling the circuit of the elevator motor.



990,234.—Terminal for Electric Cables.

990,355. JUNCTION OR TERMINAL BOX; L. Gudeman, New York, N. Y. App. filed June 8, 1910. A sleeve with plug openings, metallic conducting blocks lengthwise in the sleeve with passages in the line of the openings.

990,365. TELEPHONE REPEATER CIRCUIT; C. A. Kruckow, Halle-on-the-Saale, Germany. App. filed June 10, 1907. A symmetrical inductance consisting of two inductance coils with a circuit in series with a winding of each of the coils, a battery and a variable resistance controlled by the inductive helix of one half, a second circuit containing in series a winding of each of the inductance coils and an inductive helix controlling the variable resistance of the other half.

990,398. ELECTRIC CABLE; A. E. Sink, New York, N. Y. App. filed July 9, 1909. A plurality of insulated strands entwined longitudinally, one being grounded while another serves for transmission with an adjustable resistance in the grounded strand, the latter acting inductively to neutralize the induction within the transmitting strands.

990,461. BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES; J. M. Smith and H. A. Knoener, East Orange, N. J. App. filed Aug. 22, 1908. A guide for the brush block with a weight engaging it, resisting the throwing off of the brush and a spring engaging the block independently of the weight.

990,464. CONTROLLER FOR ELECTRIC MOTORS; F. T. Taylor, New York, N. Y. App. filed July 10, 1909. For operating an electric motor in stages and automatically varying the range of operation by means of a plurality of concentric contact rings over which passes a radial arm carrying spring pressed contact plugs, which arm is driven by gears, geared to the motor.

990,468. TELEPHONE SYSTEM; F. G. Agrell, Stockholm, Sweden. App. filed Feb. 15, 1908. Call distributing system for a multi-party line, a switching circuit automatic means for connecting one end to the line and manual means for connecting the other end of the switching circuit with another circuit, and a supervising indicator to indicate a reverted call.

990,471. CIRCUIT-BREAKER; J. D. Bradford and B. R. Moore, Sacramento, Cal. App. filed March 21, 1910. A hollow body having a tapered end, the end wall having a slot through which the wire extends with a plug fitted within having an opening registering with the slot through which passes a second wire.

990,478. COUPLING FOR CONDUCTOR WIRES; A. D. Duvall and W. E. Dawson, Atlanta, O. App. filed Nov. 4, 1910. Portable coupling for the lineman, including a plate with a hook to receive one wire in which it is fastened by a set screw, a splice wire being passed through the other end of the plate.

990,483. CIRCUIT MAKING AND BREAKING MECHANISM; B. P. Hayes, Topeka, Kans. App. filed July 28, 1909. Stationary key, for telegraph transmitters, a movable key arm, character devices and a rocking beam with an arm for actuating the key arm and for engaging the character devices.

990,484. CASE FOR TELEGRAPH TRANSMITTERS; B. P. Hayes, Topeka, Kans. App. filed March 5, 1910. A keyboard transmitter case comprising a body, a seat pivoted within the body, which seat can be anchored against pivotal movement.

990,485. TELEGRAPH TRANSMITTER; B. P. Hayes, Topeka, Kans. App. filed May 17, 1910. Keyboard transmitter for telegraph with a circular closer, a motor, individually operated, character members, each actuating the telegraph key, and a keyboard for releasing the character members to control the motor.

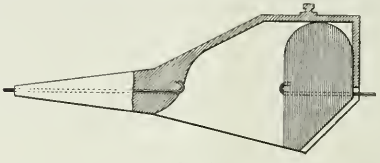
990,486. RAILWAY BLOCK SIGNAL SYSTEM; L. Johnson, Ames, Ia. App. filed Sept. 15, 1909. Lets a plurality of cars within a block and indicates by electric lamps a warning to the approaching train.

990,489. PROCESS OF ELECTRICAL WELDING; N. Macneale, Cincinnati, O. App. filed Nov. 21, 1910. An electric welding machine with holding jaws, a bridge removably inserted between the jaws to establish electric contact in a way so as to preheat one of the pieces to be welded which is of lesser resistance than the piece to which it is to be welded.

990,492. BRUSH HOLDER; R. E. Noble and L. E. Mitchell, Chicago, Ill. App. filed July 11, 1910. A brush holder with a bracket to which a casing is adjustably secured, a trip pressing against the brush, and a strip pressing against the casing, with a spring pressing the strips apart.

990,493. ELEVATOR; C. O. Pearson, New York, N. Y. App. filed March 12, 1909. Friction drive traction elevator with a gas engine for supplying the motive power. The engine drives an electric generator, and there is a fluid pressure power transmission mechanism between the engine and the sheave, including a pump which is driven by the engine, a motor driven by fluid under pressure from the pump and electro magnets for varying the output of the pump to vary the speed of the motor.

990,508. PLUG RETAINER; J. J. Taylor and L. K. Hoss, Cherryvale, Kans. App. filed Jan. 24, 1911. Telephone cord plug retainer, the socket having an enlarged lower end with a metal plate on the bottom and a sleeve on the cord engaging the plate and movable laterally out of engagement to permit the plug to drop through the socket.



990,471.—Circuit Breaker.

990,512. ELECTRIC SWITCH; T. E. Barnum, Milwaukee, Wis. App. filed April 23, 1909. Operated from a distance by a circuit which includes an electrical magnet, the switch member being biased toward one position, and an operating solenoid having a movable plunger and a pivoted member carried thereby, which engages the switch member on opposite sides of the axis upon intermittent energization of the solenoid.

990,527. TELEPHONE MUFFLER; F. W. Cook, Denver, Colo. App. filed March 12, 1910. For confining the sound to prevent another from overhearing by means of a collapsible casing or muffler to fit over the transmitter and having a ring to cover the mouth.

990,602. HEAT-REGULATING SYSTEM; W. D. Smith, Chicago, Ill. App. filed Jan. 29, 1908. Heat regulator with a valve, an electric switch with a mechanical connection between the valve and the switch, the valve being moved by electromagnets with a thermostat to control the circuits, the device being applied to a steam radiator.

990,617. ELECTRIC COOKER AND TOASTER; R. Wiles, Chicago, Ill. App. filed Jan. 21, 1911. A cooker and toaster consisting of two pivoted bases, each containing a heating coil which may be arranged flat or turned up face to face.

990,620. RAIL BOND; J. M. Atkinson and L. A. Scovil, Chicago, Ill. App. filed Aug. 15, 1902. Two terminal ends are welded to opposite sides of the body or strands of wires and are there welded, the head being surrounded by a metallic casing, the body, head and casing being compressed together and welded to form a homogeneous structure.

990,634. ELECTRICAL RAIL BOND; H. B. Conway, Boone, W. Va. App. filed Nov. 7, 1910. A bolt with a tapered head and tapered bushing is inserted in an opening in the rail sections, and a nut draws the parts together.

990,638. TELEPHONE METER SYSTEM; G. Deakin, Oakland, Cal. App. filed Sept. 10, 1908. The meter is associated with the subscriber's line and records a unit when first answering. The lines for terminating calls are divided into a class which controls the calling line meter and another without a meter.

990,647. ALTERNATING CURRENT MOTOR; W. E. Goldsborough, Lafayette, Ind. App. filed May 1, 1903. A field ring with armature, armature coils and impedances in leads from the coils, an iron core with short-circuited winding which can be brought into adjustable inductive relation with the impedance. For induction motors.

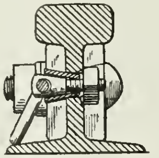
990,661. METHOD OF REGENERATING STORAGE BATTERIES; C. Luckow, Cologne, Germany. App. filed Oct. 26, 1909. Replaces the electrolyte by water, reverses the current through the battery, then turns the acidified water into a saline solution by adding salt, reverses the current again and replaces the concentrated solution by the working electrolyte.

990,685. TELEPHONE SIGNALING SYSTEM; E. M. Tormin, Newton Center, Mass. App. filed March 29, 1910. For notifying a subscriber that his line is busy, etc., by means of an electrically operated vibrator with a pair of contacts which are automatically opened and closed.

990,709. INCANDESCENT ELECTRIC LAMP; H. T. Crane, Cincinnati, Ohio. App. filed June 12, 1905. The reflection member of a lamp is formed on the fitting section which is screw-threaded and surrounds the base of the lamp to form a reflecting envelope.

990,765. ELECTRIC FURNACE; J. H. Nau, New York, N. Y. App. filed Oct. 30, 1910. For refining molten pig iron by means of an oscillating hearth into which the electrodes project.

990,767. ELECTRIC SWITCH OR CONTROLLER; R. E. Noble and L. E. Mitchell, Chicago, Ill. App. filed Aug. 12, 1908. For electric cars or locomotives, including a switch and blow-out magnet, the contact member comprising a fork, carrying wheels which are held separated by a spring.



990,634.—Electrical Rail Bond.

990,771. SIGNALING DEVICE; F. J. Poinan, Rochester, N. Y. App filed March 6, 1909. Automobile signal to be applied to the lamp and to inform the operator when the lamp burns low by means of a thermostat within a zinc cylinder which is mounted above the lamp burner in the chimney.

990,790. CIRCUIT INTERRUPTER; E. M. Tormin, Newton Center, Mass. App. filed Oct. 7, 1910. For notifying that the line called is busy by means of an electric vibrator consisting of an electromagnet vibrating an oscilating armature which controls the contacts.

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MARCH EXPORTS.

The general figures of electrical exports in March are of the same encouraging nature as those of earlier months in the year, even with a small decline in heavy electrical machinery, the amount of that item being $639,338 as compared with $699,261 in March, 1910. However, the exports of electrical instruments and apparatus were much larger than before, the value being $915,001 as compared with $783,371. Hence the grand total is $1,554,339 against $1,482,632, or a gain of $71,707. When it is remembered that gains are being made constantly, and have now continued so long, it is pleasant to note that they are maintained even while the general course of trade is slow and disappointingly dull. It is also curious to observe how political troubles affect business, for in both items Mexico falls behind last year to the extent of about $100,000 for the month. On the other hand, Japan, which took only $17,183 in heavy electrical goods in March a year ago, when feeling the full effect of her depression after the war, has risen to $131,600, while her demand for the lighter goods has risen also from $24,595 to $110,300. These are really impressive figures, and such gains if duplicated all along the line would indicate a revival of world-wide trade activity.

ELECTRICAL OPERATION OF A SHIPPING TERMINAL.

The use of motors in the handling of freight at important termini is a well-recognized source of economy not only in cost of labor, but in time, which is equally important in the transshipment of freight from rail to water transportation. In another column will be found a very complete account of the electrical equipment established at the water-front terminal of the Boston & Albany Railroad at East Boston. Several transatlantic lines stop there at the piers of the railroad company, and the recent installation is for the purpose of facilitating the transfer of freight from the railway to the holds of the steamers. A large part of the motor work is in connection with a grain elevator of 1,000,000-bushel capacity, although there is also a considerable conveyor equipment for general freight handling. The plant is especially interesting as an example of the extension of central-station service, since it was found in this case that the energy could be purchased from the central-station company more advantageously than it could be generated on the spot. The energy for the operation of the plant is, therefore, derived from the L Street generating station in South Boston, on the other side of the harbor. The energy is brought into the transformer stations by underground cables at 13,200 volts three-phase and distributed for motor work at 440 volts. Even at this fairly high voltage the cable installation is a heavy one, the supply for the grain elevator requiring no less than nine 1,500,000 circ. mil cables.

One unusual feature of the elevator equipment is the control of the three-phase motors. All of them save one for the passenger elevator are equipped with squirrel-cage secondaries. These give a highly efficient and extremely simple motor when operated at full speed, but require rather heavy currents at starting, so that a special and very practical system of starting has been installed for the entire building. Instead of reducing the starting voltage at each motor by a special transformer. the starting current is derived from a special set of auxiliary busbars arranged to operate at either 40 per cent or 58 per cent of the normal running voltage. When it is desired to start a motor the operator signals the switchboard annunciator for that particular motor. The switchboard operator then connects the motor to the auxiliary bus and then at the proper time transfers it to the full-voltage bus. When the circuit ammeter shows the motor is at full speed the switchboard operator signals back to the motor operator and the load is thrown on. Any motor can at once be stopped by a push-button control, and in addition a very ingenious stopping device is applied to the series of motors operating the grain distributors in the elevator. In case anything goes wrong the motor operator need merely press a button, when an automatic stopping mechanism at the switchboard cuts out in proper succession all the conveyor motors so that there will be no piling up of the grain at any point of the system when an emergency stop is made. The conveyor is thus left in proper condition for starting whenever the particular trouble is remedied. The elevators are equipped with shoveling machines for emptying cars and with car-pulling drums for handling the loaded cars in the elevator so that there is no necessity for sending steam locomotives further than the convenient tracks outside.

In addition to the elevator equipment there is a considerable equipment of motors for other service and also of lamps for lighting the piers and offices. The piers are lighted by well-distributed tungsten lamps. A particularly ingenious part of the lighting equipment is the installation of a series of switches whereby the night watchman on duty at the piers can always keep a lamp lighted ahead of him while on his beat, so that there is no occasion for carrying a lantern on the piers. A very complete motor-driven fire-protection plant is installed for service on the piers, and experiments are being made with remote control of the water valves so that in case of fire a push button at any hose valve will immediately turn the water into the dry-pipe systems and permit their prompt use. Altogether the electrical equipment of the piers is remarkably complete and efficient and the automatic switching devices for various purposes are exceptionally ingenious and well planned. The whole installation is one of great value to the shipping facilities at the East Boston piers and is a part of the plan to make these piers a great transatlantic terminus. Recent railroad combinations and connections whereby large amounts of Western freight will be delivered at this point add greatly to the industrial importance of the whole plant.

PERIODIC VARIATIONS OF LAMP-FILAMENT RESISTANCE.

It is very evident that with an alternating current in an incandescent-lamp filament the temperature of the filament will not be quite steady, as in the case of the corresponding strength of continuous current supply. The filament's temperature will throb slightly, with a frequency double that of the current. If the resistance of the filament were constant at all temperatures, this throbbing of the temperature would not affect the current strength. But since the resistance of a filament does vary slightly with the temperature, even when the latter is very high, and especially in the case of metallic filaments, it follows that the wave-form of the current must be more or less affected thereby. Consequently, the wave-form of the lamp current will not be identical with that of the terminal potential difference, although the difference may not be very marked.

In an article on this subject by Mr. O. M. Corbino, recently published in the *Physikalische Zeitschrift,* a very ingenious experimental demonstration is made of this derivation in current wave-form, with the aid of the Braun-tube oscillograph. The cathode beam is operated upon electromagnetically, so as to deflect the spot of light on the fluorescent screen: but instead of producing the usual deflecting action by the full current strength, in the ordinary way, a differential action is produced between the current supplied to the lamps under test and the current supplied to a parallel circuit containing an unvarying resistance. The resulting electromagnetic action virtually magnifies the deviations in the lamp current due to resistance variation, and the oscillographic picture so presented enables the cyclic oscillation in the temperature of the filament to be determined. According to the measurements cited in the article, the maximum cyclic variation of temperature in 16-cp, 105-volt osram lamps was 15 deg. C., and in 32-cp osram lamps 10 deg. C., the frequency of the alternating current being 42 cycles per second. With a frequency of 60 cycles per second, as used in the United States, such lamp filaments should show still smaller oscillations of temperature. The experiments are interesting not only for the sake of the measurements they contain, but also as indicating the development attained in the use of the Braun-tube oscillograph. At first, this instrument was used merely as an indicator of the deviating influence of a magnetic field on cathode rays. Later, quantitative measurements of this deviation were produced. The next step was to make the instrument a photographically recording oscillograph. After that it became, in the hands of Professor Ryan and others, a recording wattmeter. In the research here considered it becomes a differential-current oscillograph.

DIRECT VERSUS DIFFUSED LIGHT.

If one wishes to stir up a lively discussion at any meeting of illuminating engineers it is only necessary to bring up the question of direct versus diffused light. Diffused light is also commonly known as indirect light and is received by diffuse reflection from various solid surfaces, or from the sky or clouds. Most of our lighting, both natural and artificial, is a combination of direct and diffused. The war mainly wages over which should have the preponderance in artificial lighting. The advocates of both methods fall back on analogies to natural lighting in support of their claims. The advocates of diffused or indirect artificial lighting systems point to the fact that daylight as it is ordinarily received in occupied rooms is practically all diffused light. To be sure, there is a certain amount of direct sunlight on clear days, but it is seldom utilized for working purposes, as the common use of window shades demonstrates. Daylight, as we ordinarily use it inside of buildings, is really diffused lighting from sky and clouds, sometimes filtered through diffusing ceiling-windows, but more frequently through side-wall windows. The opponents of the diffused artificial lighting idea point, on the other hand, to the fact that the world seems more cheerful to the majority of individuals and animals when there is direct sunlight, and that the diffused light of a cloudy day has a generally depressing effect. If we are to take outdoor lighting as indicating the ideal in artificial lighting, it would appear that we should have to provide for combination direct and diffused lighting most of the time, and for diffused lighting the remainder of the time. If we accept existing daylight lighting conditions as an acceptable ideal toward which to work with artificial lighting, there is evidently no argument against diffused lighting in itself. The main room for argument is as to the method of its application.

The engineering calculations relating to a particular form of indirect lighting, involving the use of incandescent lamps surrounded by inverted reflectors for directing the light upward toward a diffusing ceiling, are discussed in an article by Mr. James R. Cravath in this issue. In contradistinction to the point-by-point method of calculation which would prove cumbrous in indirect illumination problems, the author employs a method which can best be designated as wholesale, in that it treats the problem as a whole rather than in parts. Such a method is well suited for use with illuminating problems involving single or multiple reflection and should give reliable results when the experience coefficients are selected with due regard to the conditions under which the lighting equipments will be employed. The author has observed that the efficiency of delivery of light from the lamp to the working plane in medium-size rooms varies from about 29 per cent to 37 per cent, according to the character of the reflecting surfaces, thereby indicating an absorption of from 71 per cent to 63 per cent. It would seem that by selecting the proper absorption coefficients according to the character of the reflecting surfaces one could readily determine the efficiencies for any chosen arrangement of indirect lighting installation by means of the wholesale method.

CHROMATIC ABERRATION AND VISUAL ACUITY.

It is now generally believed on experimental grounds, and has long been supposed, that different colors of light travel through space with the same speed, at least within the limits of the visible spectrum; so that, for example, a momentary gleam of red light and a similar momentary gleam of blue light, emitted simultaneously from the sun, would reach the earth simultaneously. On the other hand, it is well known that inside transparent material substances, such as water or glass, the speed of light is not only lowered, but lowered differently for different colors; so that, in general, the colors toward the violet end of the spectrum are retarded more than those toward the red end. The analysis of white light into a variegated spectrum band, on passing through a prism, is, in fact, attributable to this differential retardation within the substance of the prism. It follows from the above fundamental facts that when any simple lens is accurately constructed of a single uniform transparent substance, such as flint glass, the focus of the lens is different for rays of different colors. The violet rays, being the most delayed, will come to a focus nearer to the lens than the red rays. Consequently, a luminous image in white, or heterochrome light, formed by the lens, will have a rough and variegated border, whereas in homochrome light the image so formed might be sharp and homochrome. This defective focusing of a lens, due to the different refrangibilities of different colors of light, is known as chromatic aberration. It naturally constitutes a serious difficulty in the constructon of telescopes, since it tends to produce star images that instead of being sharp and white are blurred and fringed with color.

In the case of the telescope, and of optical instruments generally, chromatic aberration is reduced to a working minimum by using compound lenses, or lenses comprising a plurality of transparent elements in series, usually cemented together so as to form a solid aggregation, the refractive qualities of the different elements being different and compensatory, so as to annul mutually their individual chromatic aberrations and to produce an achromatic combination. For instance, one element of the compound lens is of flint glass and the other of crown glass. The accurate predetermination of the various surfaces in large achromatic compound lenses constitutes a large and complex field of applied mathematics. In the structure of the human eye there is in effect a compound lens, one element of which consists of aqueous humor in a lenticular chamber fronted by the cornea, and the second, the more important, element is the crystalline lens. It has been held, largely on supposition, that this combination of elements results in an achromatic compound lens. Nevertheless, physical analysis of the eye as an optical instrument has long since demonstrated that the chromatic compensation is far from being complete, and that a certain amount of chromatic aberration should be expected in the optical apparatus of the eye. In other words, it has long been known that the artificially created telescope is far superior as an achromatic mechanism to the natural eye of man, in spite of the fact that the former is only 300 years old, whereas the latter has been worked on by Nature for many millions of years. Nevertheless, it is only fair to recognize that if the mammalian eye possesses very distinct chromatic aberration the ordinary mammal is contentedly unconscious of the fact.

In a very interesting article in this issue Dr. Louis Bell describes certain simple experiments by which he demonstrates to any contented man the reason for discontent in the possession and inheritance of a chromatically aberrant eye. He shows that in daylight, with its preponderance in the yellow, the tendency is for the eye to focus on the yellow light and ignore the imperfect focusing of the red and blue ends of the spectrum, an absentmindedness that is much helped by the relatively feebler sensibility of the return to those extremes of color. Consequently, the ordinary man derives focal and optical comfort from pursuing a middle policy in regard to the color spectrum. The remarkable proposition that Dr. Bell's observations point to in connection with the mercury-vapor light is that the well-known utility of this light for drafting, and for scrutinizing purposes in general, is largely attributable to its being essentially monochromatic: so that the chromatic aberration of the eye is eliminated, and so that all of the rays focus sharply on the retina. This is a startling proposition to a believer in the natural perfection of human sensibilities, but the evidence as presented in the article is strong. If the reading value of a homochrome light is nearly double that of an ordinary heterochrome light, the economy for reading purposes of homochrome light sources is virtually increased in like measure, and their gain, from a purely utilitarian standpoint, is as though they consumed only half their recorded power. In other words, if 2 ft.-candles is the illumination necessary for satisfactory reading with heterochrome light, then only a little over 1 ft.-candle is required with homochromatic light, with a corresponding possible economy in power consumption. Of course, from an esthetic viewpoint, the argument is all the other way, because it is known that for comfort and a pleasurable outlook on our immediate environment a white light is desirable and, esthetically, a monotonous homochrome light is an abomination of desolation.

Denver-New York Telephone Connection.

By the use of Pupin loading coils telephonic communication between New York and Denver over a distance of 2000 miles was begun by the American Telephone & Telegraph Company on May 8. Use is made of phantom circuits so that multiplex telephony and telegraphy can be employed simultaneously over the same wires without interference. Between New York and Chicago, and between Omaha and Denver, there are two separate parallel metallic circuits which are operated in phantom; between Chicago and Omaha there is only one circuit, so that multiplex telephony cannot yet be employed between these two points.

No. 8 copper wire is used to obtain the highest practicable telephonic circuit conductivity. The old glass insulators have been replaced by about 285,000 porcelain insulators in order to minimize the leakage. The capacity has been neutralized satisfactorily by inserting Pupin inductance coils at 8-mile intervals. It is estimated that the changes introduced involved a cost of about $100,000. At present the charge for telephoning between New York and Denver will remain at $11.25 for each three minutes, which rate has been in use for some time for telephoning on the relay plan.

Transportation Arrangements for N. E. L. A. Convention.

Arrangements for transportation to the National Electric Light Association convention in New York from May 29 to June 2 have been completed by Mr. C. D. Hodskinson, as master of transportation for the association. Reduced fares have been authorized to New York City for the occasion by the following passenger associations: Trunk Line, New England, Central, Eastern Canadian, Southeastern and Transcontinental. For all of the associations with the exception of the one last mentioned the fare for the round trip will be one and three-fifths of the single-trip first-class fare, the return trip tricket to be issued on the certificate plan, with an extra charge of 25 cents for each certificate viséd. The Transcontinental Passenger Association, which embraces the States of California, Oregon, Washington, Arizona and Nevada, and also British Columbia, has authorized the sale of round-trip tickets from the Pacific Coast and adjacent states and from British Columbia. The fare for the round trip from main-line points in the States of California, Washington and Oregon and from British Columbia will be $108.50, with slightly less fares from intermediate points in Arizona and Nevada. These tickets will be on sale beginning May 16. No special reduced fares have been authorized by the Western Passenger Association and the Southwestern Passenger Association, which embrace the territory west of Chicago, Peoria and St. Louis, and include the States of Idaho, Utah and New Mexico, and the territory southwest of St. Louis, including Texas, Arkansas, Oklahoma and Missouri (south of the Missouri River) and Louisiana (west of the Mississippi River).

The territory of the associations authorizing reduced fares covers the States of New York, New Jersey, Pennsylvania, Maryland, Delaware, West Virginia, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut; the District of Columbia; the territory west of Buffalo, Pittsburgh, Wheeling, Parkersburg and Huntington, to and including Chicago and St. Louis, and north of the Ohio River, including Cincinnati, Louisville and Cairo; the territory in Canada east of and including Port Arthur, Sault Ste. Marie, the St. Clair and Detroit Rivers, and the territory south of the Ohio and the Potomac and east of the Mississippi River.

For the convenience of those intending to attend the convention it should be stated that full one-way first-class fare tickets can be purchased to New York on the certificate plan at numerous railway stations not earlier than May 25 (May 26 from Southeastern points) and not later than May 31. The purchaser should obtain a certificate when buying the ticket. These certificates should be deposited with Mr. Hodskinson, as master of transportation of the association, immediately upon reaching the headquarters of the association in the Engineering Societies Building, New York City. The address of Mr. Hodskinson until the opening of the convention will be 70 State Street, Boston, Mass.

Members of the New England Section of the National Electric Light Association have received a notice from Mr. Harry M. Hope, assistant master of transportation, 147 Milk Street, Boston, Mass., setting forth the arrangements being made for the running of a special train from Boston to New York on May 29, in connection with the forthcoming convention. The New England Electric Light Special will leave the South Station, Boston, at 10:02 a. m., on May 29, leaving Providence at 11:06 a. m., New London, 12:36 p. m., and New Haven, 1:45 p. m., arriving in New York at 3:30 p. m. The train will consist of two dining cars, one buffet smoking car, one baggage car and a sufficient number of parlor cars to provide adequate space for all the New England members. The train will be equal in every respect to the best limited trains running between Boston and New York, and special tickets for it will be issued which will entitle the holder to a special luncheon on the train, with a souvenir menu, in addition to transportation accommodations. A round-trip rate of fare and three-fifths on the certificate plan has been granted by the New England Passenger Association from all points in the territory governed by that association to and from New York. Tickets sold on the plan will go on sale May 25 to 31 and will require the holder to begin the return journey not later than midnight, June 6, and call for a continuous journey. It is planned to make the special train the finest ever sent out of the New England States. The cost of the service will be less than that on the best limited trains, and only 132 passengers are required to guarantee the provision of the special train.

Electricity Supply on the Isthmus.

A new 500-kw, 2200-volt, three-phase, 25-cycle turbo-generator is to be installed in the electric generating and air-compressor plant near East Balboa on the Isthmus of Panama, replacing all of the present electrical generating equipment at that point. A recent accident to the plant curtailed the production of electrical energy for lighting purposes and the Pacific Division plant at Miraflores has been carrying part of the night load. The East Balboa plant has been supplying alternating current for lighting in Ancon, Balboa and East Balboa and direct current for the operation of the cranes on the Panama Railroad wharf and for the motors in the Pacific Division machine shop. These motors will be superseded by alternating-current machines when the new generator is in operation.

The committee of engineers which had the matter in charge considered the feasibility of furnishing all electrical energy in the area between Balboa and Pedro Miguel (Pacific Division) from the Miraflores station, but it was concluded that this plant could not assume the extra day load safely without danger of interruption to the work on the Pacific Division. Under the new arrangement the Balboa and Miraflores plants will be operated in parallel. The former will carry its present day load, the steam turbine of the new generator being driven by the exhaust steam from the air compressors. This will not only constitute a fuel economy, but obviate any necessity for additional boiler capacity. The Miraflores plant will assume the night load. In addition to the electricity required at Balboa during the day there is sufficient energy in the exhaust steam to enable the Balboa plant to transmit from 100 kw to 200 kw to the system now operated by the Miraflores plant.

It has also been recommended by the committee that the present circulating-water system for the condenser at the Balboa plant be retained, but that a centrifugal pump driven by an electric motor be substituted for the circulating pump now in use.

Oil-Switch Patents Decision.

The United States Circuit Court of Appeals for the First Circuit, sitting at Boston, has issued an opinion sustaining the General Electric Company in suits involving Frank O. Hartman et al., regarding oil-switch patents 800,916, 789,597 and 714,436. The court holds that Messrs. Hewlett and Emmet, of the General Electric Company, for the first time conceived the idea of supporting the switch structure independently of the oil tank, so that the latter could be detached from the switch merely by unfastening it. The oil-submerged switch necessarily consists of two parts, the operative switch and the comparatively inert oil tank. Before the work of Hewlett and Emmet these parts had been so connected that their separation, though often necessary, was difficult and took time. Hewlett and Emmet made separation easy and rapid without affecting the operation of the switch as a switch, of the oil as oil, or of the tank as a tank. Except as to arcing, the switch worked much as if it were in air. Patentable invention of a meritorious sort is found. The General Electric Company is also sustained in the further development by Hewlett and Emmet of the plan of mounting the movable element of the switch or circuit-breaker, so that in opening the circuit it takes a downward movement in the oil, thereby effecting the contact on the under surface of the fixed terminal, which is rendered self-cleaning by the engagement of the parts, and from which the carbon falls and settles in the bottom of the containing vessel. By reason of this downward movement of the movable contact the arc is stretched through a progressively increasing depth of liquid, thereby subjecting the arc stream to increasing pressure and also giving the insulating vapors developed a longer path to travel in the cool liquid before reaching the air. This results in a decreased fire hazard, since it sometimes happens that the vapors liberated by the heat of the arc escape in sufficient volume to reach the top of the vessel and may be ignited there. The court holds that any conception and device which furnishes means for removing even slight interferences with the successful operation of the high-potential switch as a contrivance for controlling powerful and dangerous currents of electricity, and which in any degree, however slight, lessens fire hazard, presents an important improvement in the art pertaining to the use of electricity. The lower court held that these improvements might have reasonably resulted from the exercise of ordinary mechanical skill, but the upper court holds that such questions as the better effect of the electrical contact in the upper part of the vessel, where the oil is cleaner, the effect of lengthening the arc, and the effect of forcing developed insulating vapors to a longer travel in cool liquid before reaching the air are not problems for the ordinary skilled mechanic, but questions which enter into the broader inquiry whether the art is advanced through an inventive idea which suggests and provides a better and safer use of an exceedingly dangerous force.

Central-Station Progress in Massachusetts.

Figures deduced from the returns filed by central stations with the Massachusetts Gas & Electric Light Commission show that rapid expansion in the uses and purchase of electricity characterized the fiscal year ended June 30, 1910. From the proof-sheets of the forthcoming annual report of the commission it appears that the total income of the electrical supply companies of the State for 1910 was $11,206,004, compared with $10,558,070 in 1909, or a gain of 6.1 per cent. The gain of 1909 over 1908 was only 1.5 per cent. The principal source of earnings was the sale of energy for commercial arc and incandescent lighting, which totaled $6,505,692 for 1910, compared with $5,943,998 in 1909. A substantial gain also was enjoyed in the sale of energy for motor service, the 1910 income being $2,313,393, and that for 1909 $1,949,460. The popularity of the incandescent electric lighting in public street illumination is indicated by a decrease in sale of energy for municipal electric arc service from a total of $1,450,637 in 1909 to $1,400,028 in 1910. The income from public incandescent electric lighting on the other hand rose from $522,032 in 1909 to $575,251 in 1910. In the past two years the amount of income derived by Massachusetts central stations from the sale of energy for municipal arc lighting has decreased by about $79,400, the incandescent street-lighting income having increased by about $87,000. In the past two years the revenue derived from steam-heating service has risen from $26,368 to $29,827. The sale of lighting energy by contract rates has greatly decreased during the past year.

The total operating expenses for 1910, exclusive of interest, depreciation, dividends and sundries, were $6,738,093, contrasted with $6,279,046 in 1909. The net profit for 1910 was $4,467,911, and the gas companies made $817,986 of this profit in their electrical departments, leaving a profit of $3,649,925 for the purely electric companies. Income from rents, jobbing, etc., amounted to $544,881, making a total for the electric companies of $4,199,806, compared with $3,641,142 in 1909. From the foregoing were made interest charges of $428,929; dividends, $2,411,202; depreciation, $425,969, and sundries, $785,578. The apparent net profit for the year was $143,128.

The most important single items in the operating expenses for the year 1910 were: Coal, $1,255,700; taxes, $963,766; wages of operators at stations, $653,807; repairs and renewals of lines, $535,818; general salaries, $515,925; wages for care of lamps and meters, clerical labor in distribution department, and salary and commission of collectors, $373,908; general office expenses, $372,258; incandescent lamps, $326,979; salaries of officers, $247,057; energy purchased, $233,108; insurance, $173,198; steam-plant repairs, $151,910; rentals of real estate used for plant, $127,852, and repairs and renewals of meters, lamps and motors, $113,175. The tendencies in these items from year to year reflect the lines of economical administration which are being followed in Massachusetts, and it is noteworthy that so large an increase in revenue should be secured with an added fuel expense of only $50,000 for the entire State. The approximate total energy generated and delivered at the switchboard for the year was 240,000,000 kw-hours. The magnitude of the item of taxes in comparison with station-labor cost is an impressive index of the extent to which the central station is contributing to the support of the municipal and State governments. Taxes were nearly 50 per cent greater than station wages and about three-quarters as large as the fuel expense. In the past two years taxes have increased about 18.5 per cent in total amount in Massachusetts central-station practice. The tendency for station-labor cost to decrease from year to year in spite of greater total outputs of energy is due in large measure to the concentration of generating plants in large installations of high efficiency.

Hydroelectric Development at Mammoth Spring, Ark.

Mammoth Spring, Ark., is the largest spring in the world. Its surface area is eighteen acres. Its origin is a mystery, as its source is in subterranean waters. The depth has been sounded 96 ft. with an anvil and then the underground current was so strong the plummet could go no further. The flow of water is uniformly regular and constant and amounts to about 500,000 gal. of pure water daily.

In 1854 John A. Deadrick built a little 4-ft. dam to get enough fall to grind a grist of corn. This was all the work this enormous spring did until in 1881 the Mammoth Spring Improvement & Water Power Company purchased the spring and built a dam of cut stone across its outlet. In this manner 800 hp was developed, a portion of which was utilized to run a cotton mill. The following year the Mammoth Spring Flour Mill was erected with an output of 500 bbl. daily. All the output of this mill was shipped south. In 1898 a second dam was built about 2 miles below the first one. This dam was a plain wooden structure, but power was developed to light up the town of Mammoth Spring and also Thayer, Mo., just over the State line.

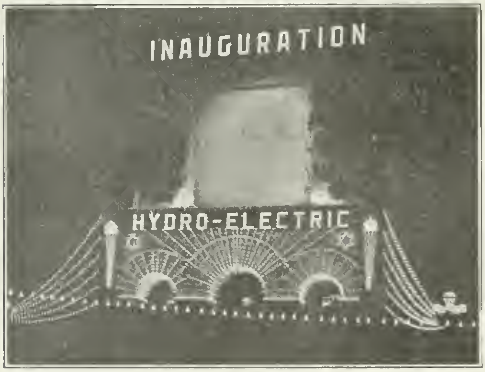
In 1907 Mr. E. C. Bellamy became general manager of the Mammoth Spring Light & Power Company. He found by actual measurement that the fall of Spring River is 10.4 ft. per mile for the first 16 miles down stream, so he soon determined to build a modern dam below the second dam and develop sufficient power to be transmitted to distant points. The new dam was begun in 1908 and is now completed. It is 610 ft. in length with a 24-ft. head and a net working head of 19.5 ft. The present equipment consists of one 300-kw generator and one 150-kw generator with space for increased installation. These generators are directly connected to two pairs of 35-in. horizontal waterwheels. The transmission line to Mammoth Spring consists of white cedar poles, storm-guyed, with porcelain insulators, galvanized hardware and lightning arresters. No. 0 bare copper wire, the transmission emf being 2200 volts. It is part of the present plan to extend the line as far north as West Plains, Mo., and from Mammoth Spring, Ark., up to this point No. 4 bare copper wire will be used at an emf of 33,000 volts.

A total of 2600 hp has been developed now, and it is expected to develop eventually 20,000 hp. The towns of Mammoth Spring, Ark., and Thayer, Koshkonong, Brandsville, Fruitville and West Plains, Mo., will be illuminated by means of the power thus developed on Spring River.

A huge electric sign will be erected over the power house at dam No. 3. A similar sign will be placed near the station at Mammoth Spring, Ark.; another at Brandsville, Mo., and still another at West Plains.

Official Inauguration of Toronto Hydroelectric System.

The official inauguration of the Toronto hydroelectric system was celebrated May 2. The ceremonies commenced with a banquet at the King Edward Hotel, Toronto, which was attended by the Mayor, Board of Control and City Council of the city of Toronto, the Cabinet Ministers of the Province of Ontario, the members of the Hydroelectric Power Commission, together with representatives of the city electrical department and a number of prominent citizens and guests from out of town.



Illumination in Toronto on Inauguration of Hydroelectric Service.

The street lamps of the Toronto hydroelectric system have been in service for some time, but for the occasion of the inauguration they were turned out and the route from the King Edward Hotel, where the banquet was held, to the city hall, was lined by torch-bearers 20 ft. apart on both sides of the road. The red fire of their torches gave an exceedingly striking appearance to the streets.

The button was pressed by Sir James P. Whitney, Premier of Ontario, who used for this purpose the finger of the Honorable Adam Beck, in graceful acknowledgment of the activity of the latter gentleman on behalf of the hydroelectric power movement in Ontario. At the moment of pressing the button the entire street-lighting system was turned on and the decorations shown in the illustration were lighted. The principal feature of interest in these decorations was a miniature imitation of Niagara Falls, the source of the city's electric supply—90 miles away. The banks of the river were represented by painted scenery and the falls themselves by real water illuminated by white and green beams from searchlamps placed on adjoining buildings. Eight searchlamps (not shown in the illustration) were placed in the city hall tower and produced a most striking effect.

The crowd which witnessed the celebration was variously estimated at from 40,000 to 100,000. After the button had been pressed a reception was held within the city hall and a number of citizens visited the electrical department, where light refreshments, cooked by electricity, were served.

Arkansas Public Utility Convention.

The Arkansas Association of Public Utility Operators met in fourth annual convention at the Marion Hotel, Little Rock, on May 3. With ideal weather conditions the convention opened on Wednesday morning for registration of members, and in point of numbers in attendance this convention broke all records for the Arkansas association.

The regular work of the morning session, consisting of reports of committees and the president's address, was deferred till after the afternoon session and the forenoon was very pleasantly spent in renewing old friendships and forming new ones.

At 2 p. m. President Byron C. Fowles, of Pine Bluff, called the convention to order and Mr. W. W. Wood, Jr., general manager of the Texarkana Gas & Electrical Company, presented a paper on "The Effect of Natural Gas on Municipalities." Mr. Wood outlined the rapid growth and development of the cities in older natural gas districts and predicted great benefit to the State of Arkansas from the pipe line now being built from the Caddo (La.) fields. All the principal cities from Little Rock south will be connected by branches to the main pipe line leading to Little Rock. After counting over the many advantages of gas as a domestic and commercial fuel the author called attention to the great saving effected by its use in the electric plant at Texarkana. The saving is shown in cost of fuel, labor and boiler maintenance. The ease of regulation renders the gas-fired boiler almost automatic and the steady, uniform fire enables the boiler to operate at higher loads than when coal-fired. Another advantage is the freedom from necessity of expensive coal handling and storage facilities. For emergency use a tank of fuel oil is provided and oil burners are piped into each boiler. Once a week these oil burners are started and are used to carry the station load for about one hour.

Discussion by Messrs. Hegerty, Fowles, Mitchell and Riedel brought out the information that the Caddo gas fields are considered the largest yet opened and, Mr. Wood thinks, will not be exhausted in twenty years. Mr. Wood stated that $700 covered the expense of equipping his boilers with the "Equitable" burners and that the saving effected was about $13,000 during the first year. He recommended the use of gas with not to exceed 7 oz. pressure and explained in detail the necessity of care in proper mixture of air with gas to secure the highest efficiency.

In answer to a question about gas lighting the author stated that the great heat of natural-gas light prevented its use, especially in the South. Practically all of about 250 customers who changed from electric lighting to gas lighting on the advent of cheap gas were glad to return to electricity during the first summer following.

Following the discussion of Mr. Wood's paper Mr. J. M.

Hewitt, manager of the Mariana Light & Power Company, presented a paper entitled "The Rate Question," tracing the developments of rates for electricity. He emphasized the fact that all costs should be determined and, after adding only reasonable profits, such rates should be adopted that all classes of business would produce about equal returns. Rates should be so made as to invite new business, especially that with desirable load characteristics. The author showed the desirability of proper accounting, so that whenever one's rates are brought into public discussion the reasonableness of those rates can be proved.

In the very general discussion following the reading of this paper the consensus of opinion was that a company's books should not be so exposed to the public that the political demagogue might derive information to use in fighting the company, but that only before a court of proper jurisdiction should they be opened. Mr. Hewitt recommended that a competent outside engineer, acceptable to the City Council and to the company, be brought in and made arbitrator in any rate controversy. Mr. Wood advised the use of extreme tact and diplomacy in the treatment of all public relations, as well as absolute fairness and squareness.

Mr. W. C. Maguire, manager of the Arkadelphia Electric Light & Water Company, read a paper on "Water." This paper outlined the disadvantages of the flat water rates and the great desirability of getting meters and meter rates established. The author also pointed out the necessity of pure and constant supply through a correctly designed and maintained system. In the discussion Mr. Hegarty referred to the govermental policy of water conservation, expressing the hope that this policy will be so modified as to allow development to proceed wherever desirable.

The practice of rendering water bills quarterly was criticised, and then the method of "continuous-meter readings" was explained and recommended by Mr. Hegarty and Mr. Thorpe, who have been using that system in the Little Rock Railway & Electrical Company for the past three years.

The concluding business of Wednesday was the reports of the executive and legislative committees and the president's address. Mr. D. A. Hegarty, of Little Rock, being chairman of both committees, presented a combined report explaining the reasons for the failure to organize a tri-state association with Mississippi and Tennessee. Since the State Legislature has been in session several months of this year, the legislative committee has been on the alert watching the progress of all bills aimed at corporations and has assisted in developing sentiment in the Legislature opposed to freak corporation laws. By showing the unfair points of several proposed bills these bills have been tabled or lost. To Mr. Hegarty the highest praise is due for his watchfulness over any proposed legislation affecting the corporate interests of the State.

In his address President Fowles told of the present very healthy condition of the association and urged all the members to make still greater efforts for the advancement of its interests.

On Thursday morning Mr. M. Q. Woodward, new-business manager of the Pine Bluff Corporation, presented a very able paper on "New Business." The necessity for an active new-business policy he showed from two viewpoints. First, the owners of a plant go to a large expense to install and operate that plant, and then, in many cases, do not attempt to secure all the business that is to be had in their territory. This he considers a neglect of duty by the owners. Second, the public in most places grants a monopoly to the plant and the public can be best served only when all are satisfied users of the plant's product.

The best adjuncts of a new-business department are a complete knowledge of the proposed customer's need and unfailing tact in approaching him. Definite, one-thing-at-a-time advertising is a great help.

Finally, the rates must be such as to make the use of the service economical. The paper was discussed by Messrs. Fletcher, Hegarty, Fowles, Wood, Leake, Brown and Riedel. Mr. Fowles described his company's success in motor-service business, it now having 780 hp connected and the load-curve of the plant showing its peak in the daytime.

The value of sign business, auto-charging, flatirons and all heating devices was discussed at length.

Mr. D. A. Hegarty, general manager of the Little Rock Railway & Electrical Company, then read a very complete paper on "Roadbed Construction," describing the most up-to-date methods. He called attention to the unwisdom in the conditions forced upon some railways by their franchises requiring the use of special rail shapes. He thinks that the interests of the public are amply safeguarded by the competent engineers in charge of railway work.

Messrs. Hardin, Wood and Griffith discussed the merits of creosoted pine and steel ties, soldered rail bonds, ground return cable laid in concrete, and the different forms of pavement to be used between rails.

On Thursday afternoon Mr. F. C. Bragg, manager of the Electric Construction Company, Little Rock, Ark., read a paper on the "Relations Between Contractors and Central Stations." The author called attention to the fact that the greatest prosperity can come to a central station only when it has the good will of all its customers. Hearty co-operation between contractors and the central station can do very much toward maintaining and creating this friendly feeling of the public. The discussion following the paper was joined in by most of the central-station men, and all expressed the desire to help every contractor who is treating the public fairly and to do all they can to eliminate the "curbstoner." They recommend the passage in all cities of ordinances requiring the examination, bonding and licensing of all persons doing electrical work.

Next on the program was to be a paper on "Municipal Plants of Arkansas," by Mr. W. H. Walkup, of Batesville. Mr. Walkup reported that for some reason he received only three replies to the letters sent to sixteen municipal plants and two of these three had been keeping complete records for too short a period to be of value at this time. The replies received came from cities which are under commission form of government instead of aldermanic. The convention thanked Mr. Walkup for his efforts and requested him to cover the same topic next year.

The afternoon program was closed by a paper on "Feeder Regulators," by Mr. C. E. Allen, of the Westinghouse Electrical & Manufacturing Company, Pittsburgh. The paper was devoted to a description of the single-phase induction regulator and its relay and auxiliary devices. Numerous questions were asked after its reading.

President-Elect J. M. Hewitt.

The Friday morning session was opened with a paper on "General Accounting, Public Utility Corporations," by Mr. W. J. Thorpe, auditor Little Rock Railway & Electrical Company. This was a very complete description of the excellent accounting system in use in Little Rock. By this system the exact condition of revenues and expenses is shown at the end of each month, interest, taxes, depreciation, etc., being applied monthly. Discussion by Messrs. Fowles, Wood and Hegarty followed, who recommended the accurate keeping of storeroom accounts and "scrap" sales. The "Thatcher" cylindrical slide rule was said to be of great help in arriving at unit costs for the monthly statement.

Following the discussion of the above paper the association went into executive session and considered all business before it. A vote of thanks was extended to all the authors of papers, to the Marion Hotel and to the Little Rock Railway & Electrical Company for the free transportation extended to delegates.

The secretary was unable to make a report on account of incomplete records.

The following officers were elected for the ensuing year: President, J. M. Hewitt, of Mariana; vice-presidents, Messrs. W. L. Wood, Jr., Texarkana; J. W. McLendon, Fayetteville, and W. C. Maguire, Arkadelphia; secretary, Mr. W. J. Thorpe, Little Rock; treasurer, Mr. Ed. Hardin, Hot Springs; executive committee, Mr. D. A. Hegarty, chairman, and Messrs. S. A. Stearns, A. E. Main, C. J. Griffith, W. H. Walkup, W. C. Maguire, B. C. Fowles and Ed. Hardin.

The question of a proper salary for the secretary was referred to the executive committee. Mr. D. A. Hegarty was appointed chairman of the legislative committee, with power to choose his assistants.

The entertainment features of the convention were most enjoyable. On Wednesday night there was a theater party at the Majestic Theater; on Thursday night at the New Capitol Hotel a banquet for the men, and at the Marion Hotel at the same time one for the ladies of the convention. At the men's banquet, in addition to the many toasts by the members, Toastmaster Hegarty called upon Mr. J. B. Parker, editor of the Fort Smith *Southwest American*, and Mr. Arthur Turner, State Senator from Jonesboro. Both of these gentlemen commented on the more kindly attitude of the public to the public-service corporations and predicted better times to come as a result of the upright management of corporations.

For both these banquets the association thanked the Class B members who so bounteously provided it.

The afternoons were made pleasant for the ladies with numerous automobile rides.

The convention closed on Friday afternoon, May 5, with a visit to the power house of the Little Rock Railway & Electrical Company and the Little Rock municipal plant.

Closing Sessions of A. I. E. E. Pacific Coast Meeting.

Our issue for May 4 contained an outline of the Pacific Coast meeting of the American Institute of Electrical Engineers at Los Angeles from April 25 to 28, together with abstracts of the papers and discussions at the opening sessions. Below are given abstracts of the papers and discussions at the remaining sessions.

TELEPHONY.

Among the papers presented three dealt with the general subject of telephony, as follows: "New Automatic Telephone Equipment," by Mr. Charles S. Winton, of Chicago; "The Semi-Automatic Method of Handling Telephone Traffic," by Mr. Edward E. Clement, of Washington, D. C., and "Some Recent Developments in Railway Telephone Systems," by Mr. Gregory Brown, of New York.

The paper by Mr. Winton contained an outline of automatic telephone apparatus of interest chiefly from a historical viewpoint, together with a description of equipments that have recently been developed and will, in all probability, be put in practical use in the near future.

Mr. Clement discussed the limitation and waste necessarily involved in manually operated exchange systems, outlined the characteristic features and limitations of automatic methods and explained the principles involved in the automanual system, and the manner in which they are applied to avoid waste and secure increased economy and efficacy.

Mr Brown showed that although the telephone has been in use on railroad divisions for less than four years, it has been found to have a great many advantages over the telegraph which the railroads were quick to appreciate. He said that at the present time about 37,000 miles of road are equipped with the telephone, and there have been no instances thus far in which accident of any kind can be traced to the use of the telephone for railroad work.

Discussion.

It had been arranged that Mr. S. G. McMeen, of the telegraphy and telephony committee, would preside, but being unable to serve, by reason of illness, he was most satisfactorily represented by Mr. Kempster B. Miller. The telephone papers by Messrs. Winston and Clement were jointly discussed. Mr. Leo Keller quoted extensively from letters received from a foreign electrical engineer, and said that if a semi-automatic led to a full automatic system he believed it to be a step in the right direction, and that a flat rate was suitable for the automatic, and the measured service for the manual system. Chairman Miller thought that the attitude of the public is the determining factor. Either system now in extensive use, whether automatic or manual, seems to meet the requirements, and it is good service that the subscribers want. Mr. A. H. Griswold believed that it is the most reliable system that is wanted, not the most rapid. Mr. Newell called attention to the universality of numerals as written in nearly all languages and the difference in pronunciation of the names of figures. This leads to confusion in certain cosmopolitan cities, and consequently the dial of the automatic is better adapted for service in such localities. Mr. Keller said that the automatic is for that reason preferred in Havana, and also by the Chinese in San Francisco. Mr. A. H. Babcock, speaking from his own experience, pointed out the difficulty of repeating through the central exchange certain call numbers which were correctly received and transmitted by the operator in a private branch but were subsequently misunderstood.

Mr. R. W. Pope thought that the more satisfactory service given through the private branch exchange had not been considered in discussing the comparative merits of the systems. For four years his connections had been made through a private branch exchange, and it appeared to him the service was far more satisfactory, although possibly not as quick as when working directly with central.

Chairman Miller reminded the speakers that in the discussion of the merits of the different systems an advance had been made in that whichever system might be advocated there appeared to be a general agreement that all of them were giving good service.

In discussing Mr. Brown's paper Mr. L. B. Cramer spoke of the successful use of the telephone upon the electric railway through the Willamette Valley, where, however, some trouble had been apparently caused by interference with the circuits by telegraph operators, due to the impression that the introduction of telephones might make their services unnecessary.

Mr. Pope expressed the opinion that this interference was more mischievous than malicious, many of the operators being quite young and failing to appreciate the responsibility of their duties. It was his experience that the simplicity of the Morse system and its applicability to the railroad service, especially train dispatching, is not fully appreciated by those who are not thoroughly trained in reading by sound with the Morse code. At the minor way stations, where the agent is a practical operator, he can keep an ear on what is doing on the wire without in all cases dropping his other work to the same extent as when answering and listening to the telephone. The transmission of written messages by Morse is more accurate and convenient with the telegraph. The whole question is to be settled by actual experience, as the telephone has certain advantages which might or might not outweigh its disadvantages.

Chairman Miller said that dispatchers object to the necessity of wearing a harness in order to keep the telephone and transmitter available and their hands free for writing. The convenience of the telegraph for recording communications and its accuracy must be admitted.

Prof. C. L. Cory said that the comparative merits of systems must be viewed from two standpoints—that of the user or subscriber, and that of the engineer or inventor who had devoted many years to the development and perfection of the various systems. Perfect communication than cannot be interfered with is the ordinary face-to-face conversation, and the more closely this can be realized in completing the artificial connection between two individuals separated by a considerable distance, and the more perfect the transmission of the ensuing conversation, the better will be the whole telephone service. To attain this perfection is the object of the engineer, and all improvements introduced should have this end in view.

Mr. S. J. Lisberger stated that in the distribution system of the Pacific Gas & Electric Company, in San Francisco, the officers had been confronted with the problem of quick communication between the main station and nine substations. Originally a central exchange switchboard had been installed, but calls were sometimes congested, as was especially the case during the fire. It appeared necessary to introduce either an intercommunicating or an automatic system. Mr. McMeen worked out the problem, using an automatic set at each substation operating over the wires of the Home Telephone Company. A call may now be completed in three seconds, and by the use of a magneto ringer all substations may be summoned for a general call. This plan has given entire satisfaction.

Mr. Winston, replying to an inquiry as to handling a "reverting call" by the automatic system, explained that this is a call for a subscriber on the line where the call originated. No solution of this problem has been found. No system, either manual or automatic, is ideal. Conflicting calls will interfere with each other. It does not appear to him that a combination of the semi-automatic and the full automatic is feasible. After the connection is established with the semi-automatic, the operator is disconnected. In re-establishing a connection the subscriber may or may not reach the same operator. The original cost of automatic apparatus, and the cost of maintenance, are prohibitive for small plants. The quality of service is not the final test, but rather the financial result—the "almighty dollar."

Mr. Clement, in closing the discussion on his paper, said that he believed that the semi-automatic would be reached in the future. The subscriber after giving the required number hears the impulses and the ringing, and knows that attention is being given to his call. The operator's duties are confined to setting up the numbers, and she is not overworked. The operator does not know who is calling. The recall of the same operator is neither necessary nor advisable. He does not consider the percentage of foreign subscribers sufficiently large to have much weight in favor of the full automatic. The semi-automatic will do anything that the automatic can do and anything that the manual can do.

Mr. Gregory Brown, in closing the discussion on his paper, said that a loud speaker has been developed for use with the block signal system, and also for dispatchers. It has been found satisfactory, excepting that its articulation is inferior. There is no doubt that the telephone has proved of value in railway service. In sending out the orders the dispatcher speaks the words no faster than he can write them down himself, and consequently the person receiving can also write them down. Then as each word is repeated back it is underscored as many times as there are stations to which the order was originally sent.

HIGH-TENSION TRANSMISSION AND UTILIZATION.

The afternoon session on Thursday was presided over by Mr. Ralph D. Mershon, of the high-tension transmission committee. the first paper presented being one by Mr. M. T. Crawford on "Continuity of Service in Transmission Systems." A paper by Mr. E. J. Barry, entitled "Electricity in the Lumber Industry," was also presented. Abstracts of these papers appeared in our issue for May 4. At the final session on Thursday evening Prof. Harris J. Ryan presented a paper on "A Power Diagram for High-Tension Circuits."

Professor Ryan described the methods developed by him for using the cathode-ray pointer to trace an energy cycle. The cathode rays produced in a Braun-Ryan tube are deflected electrostatically by means of the changing charge on "quadrants" surrounding the ray stream in a radial direction. The pressure of the high-tension circuit applied to the quadrants causes a proportional displacement of the ray-pointer in one axis; the pressure drop between the terminals of a condenser in series with the high-tension circuit is applied to the other pair of quadrants and gives the ray-pointer a quadrature velocity proportional to the current. The ray-pointer is thus made to trace a diagram that incloses an area proportional to the emf-current-time product. Alternating current will produce a closed diagram or "card" having an area which is proportional to the energy of the circuit delivered per cycle. At constant frequency, therefore, the card area measures the power applied in the circuit. The form of the card tells of many things besides the amount of power just as the steam-engine indicator card does in steam engineering.

The pressure and current ranges of the instrument are controlled by values of the capacities of the condensers employed. The capacities of the operating condensers may be varied indefinitely so that the working range of the instrument may be varied also indefinitely. The instrument has been used to measure the dielectric loss that occurred in a one-quart sample of insulating oil, caused by moisture or other impurities. The values encountered were 0.03 watt at 9000 volts: this was the smallest high-tension power measured in the trying-out tests. The highest power measured was a corona loss of 750 watts that occurred at 130,000 effective volts on a high-tension laboratory line.

Discussion.

In discussing Mr. Crawford's paper Mr. P. M. Downing said that he had experienced but few cases of poles burning. He had never installed electrolytic arresters on high-voltage lines. Very little trouble has been caused by lightning in central California. During the past winter wires were severed in two instances, but no further damage was caused. A reverse power relay for low voltages, especially in net works, is much needed. The manufacturers have produced an instrument which is inoperative when the voltage drops below a certain point. He has used an induction indicator, which shows on which circuit the trouble is.

Mr. E. F. Scattergood thought the objections to automatic devices were greater than the advantages, as when one goes out several others go with it, making a serious addition to the original trouble and resulting in an interference with the load. It is better to risk the transformers than to have the circuit-breakers go out, thus perhaps disturbing the entire system. The discussion was continued by Messrs. C. O. Poole and Ralph Bennett.

Mr. R. Bennett, in the discussion of Mr. Barry's paper, said that there is a great opportunity for labor-saving devices in the lumber industry. Modern mills have two engines, one in front and one in rear, and operate a monorail trace made of a single I-beam elevated 25 ft., by which lumber can be landed at various parts of the yard, thus reducing the cost of storage

In reply to inquiries as to the availability of the power diagram instrument in portable form for practical use, Professor Ryan said that he had been assured by a manufacturer that he would undertake to place it on the market, and that in its present experimental form it is sufficiently portable.

GENERAL CONVENTION NOTES.

Before the adjournment of the meeting resolutions expressing the thanks of the Institute to members of the local committee for their courtesies and hospitality were adopted, as reported by a committee consisting of S. J. Lisberger, of San Francisco; L. B. Cramer, of Portland, Ore.; M. T. Crawford, of Seattle, and J. J. Frank, of Pittsfield.

All the sessions of the meetings were held in the Hotel Alexandria, and the entire arrangements as planned by the local committee were most successfully carried out to the entire satisfaction of all.

The social features and technical visits were thoroughly appreciated. They were so arranged as to be carried out without interference with the various sessions. Special entertainment was provided for the ladies during the sessions. On Tuesday evening the members made a trip to Redondo Beach over the Los Angeles Pacific Electric Railway, and after an inspection of the Redondo oil-fuel power plant were regaled with a bounteous Pacific shore dinner, returning to the city by another route. On Wednesday night there was an excursion up Mount Lowe, including a dinner at the unique Alpine Tavern. On the return trip a fine searchlight view over the valley was enjoyed from the station at Echo Park. Friday was devoted to a most enjoyable trip over the Southern Pacific Railway, a distance of 70 miles, into the orange district. Teams and automobiles met the train and conveyed the party numbering 225 to the Santa Ana and Mill Creek power houses of the Southern California Edison Company. A luncheon was served near the last power house visited. Returning via Redlands by train to Riverside, dinner was served at the Glenwood Mission Inn, and after an organ recital in the cloister by Professor McClelland, of Salt Lake City, an informal farewell meeting was held. A few of the party remained over for a visit to Santa Catalina Island on Saturday.

Electric-Vehicle Publicity.

At a meeting of the Electric Vehicle Club of Boston on May 3 Mr. C. Brewer Smith, as advertising expert, stated that within a few days he would call upon the various dealers in the interest of a centralized campaign of publicity, and said that a prominent Boston newspaper publisher had promised to devote more attention to the electric vehicle in the future as a result of the concentrated advertising to be displayed. A miniature sign was exhibited as a result of a conference with a prominent billboard house, calling attention to the advantages of commercial and pleasure vehicles of the electric type. As stated in a previous issue, several signs will be installed in and near Boston for this service, with free energy and maintenance by the Edison company. Mr. Frank J. Stone, Boston, emphasized the desirability of placing the name of the electric-vehicle manufacturer on the battery box or on the running boards of pleasure vehicles, if the owners permit. He felt that the advertising of the names of gasoline-car makers on the radiators should be offset by effective displays in electric machines. Mr. Day Baker said that his company almost always received permission to print the words "Electric Truck" or "Electric Wagon" on the battery box. The average man in the street does not distinguish between gasoline and electric vehicles, and the use of the above form of publicity is a distinct benefit to the industry. Mr. Baker also emphasized the vital importance of additional charging stations in eastern Massachusetts, and said that unless owners of electric trucks can be assured of securing a boosting charge of an hour or so at certain points, the gasoline machine is bound to drive the electric vehicle out of certain fields. In one case this had actually happened, although it was shown that the owner had failed to guarantee the central station a definite weekly business.

Col. E. W. M. Bailey, Andover, Mass., advocated the preparation of a card index of charging points, to be filed with the secretary of the club. He cited various unhappy experiences on the road through the inaccuracy of published lists of charging stations, and pointed out that unless such information is reliable it is likely to do the industry genuine harm. Mr. W. E. Eldredge, Boston, for the committee on prospective customers, said that if the proposed letter from the Boston Edison Company is sent to prospective customers on behalf of electric vehicles, its influence is certain to be more effective than correspondence from interested dealers. Mr. Mansfield said that the Edison company will maintain a list of prospective customers for the benefit of the club, the list being assembled from inquiries which are constantly being received by the company.

A committee was designated to consider the best methods of launching a parade of electric trucks in connection with the workhorse parade, which is held on May 30, yearly, at Boston. Already owners of about fifty machines have signified their willingness to enter, and it is expected that the contrasting of the most modern trucks with the horse-drawn wagons will prove educational to the public in the interests of electricity. Another committee was appointed to investigate the desirability of a floral parade of electric pleasure vehicles in June. Other recommendations were one for larger signs indicating the location of charging stations, which was referred to the New England section of the Electric Vehicle Association of America, and one asking dealers to notify the Edison company regularly of their sales, so that the latter may be in full possession of the most convincing data of progress.

Rate Situation in St. Louis.

Mr. Alten S. Miller, president of the Union Electric Light & Power Company, St. Louis, Mo., has made a public statement in reference to the new schedule of rates prescribed by the city. Although the new rates are not satisfactory, the company is anxious to reach a compromise agreement and will submit a new schedule and ask the Public Service Commission to review the rates. Mr. Miller added that the company is willing to lower the rate for residence consumers.

In reference to the situation the directors of the company state that they have asked the attorneys to request a review of the new rate ordinance, in accordance with the law under which the Public Service Commission was created. Application for review in such a case must be filed within twenty days of the approval of the ordinance. The directors believe that certain provisions in the ordinance are against the interest both of the company and its customers, and that the company is therefore obligated to ask for court review. Reduction of the residence rates should be made in such a way as to stimulate business and bear some relation to the cost of service if it is to result in benefit to the community as a whole. If satisfactory arrangements to this end can be made with the city, the company is willing to put price reductions into effect within two or three months.

The statement of the directors says, furthermore, that they regret the necessity of delay in the reduction of rates, and the putting off of the date on which the municipal regulation becomes effective, but that this delay results necessarily from the inability of the company to accept the ordinance as it was passed. The method of reduction of the maximum rate and several of the provisions embodied for regulation make the acceptance of the ordinance impossible. When two parties are anxious to agree there should be some solution for small differences. The directors believe that the problems may be quickly solved and in a manner satisfactory to the municipal authorities.

Hearing on Proposed Dam Across the St. Lawrence.

The application of the Canadian Light, Heat & Power Company for permission to construct a dam across the St. Lawrence River, mention of which was made in these columns last week, was considered by Sir Wilfrid Laurier and the Minister of Public Works at Ottawa. The company wishes to build a dam across the St. Lawrence from Coteau du Lac to Clark's Island, both points being in Canadian territory. It is proposed to develop 62,000 hp from a point at the head of the Beauharnois Canal, just above the Cedar Rapids, the water being returned to the river at St. Timothy, just below the Cedar Rapids. For the navigation of boats the company proposes to build a sluiceway to give sufficient depth to pass the rapids. The company's application was opposed by representatives of the Cedar Rapids Company, the Beauharnois Power Company, the Richelieu & Ontario Navigation Company and the Dominion Marine Association. The navigation company maintained that the current through the sluiceway would be so swift as to preclude navigation. Both power companies claim that their power would be seriously affected if the dam were built. At the suggestion of the government engineer, it is proposed to refer the matter of damming the St. Lawrence to a commission of experts.

Ohio Legislative News.

The 200 amendments made to the Public Utilities Bill by the sub-committee have been adopted in their entirety by the Ohio Senate. The most important amendments to this bill were outlined in these columns last week, and in the debate on the Senate floor the greatest emphasis was placed upon those features which permit the formulation of rates upon the basis of capital instead of physical value; restraint in forming new companies and granting new franchises without a certificate of public necessity from the Public Utilities Commission, and the taking away from municipalities of the right of home rule in franchise matters.

A bill has been introduced in the Senate giving city councils the right to examine the books of electric light, gas and water companies in order to secure information upon which to base rates for service to be put into new franchises. A company may be required to submit a statement showing detailed facts on which to base the rate; cost of all construction work; amount expended in permanent improvements; present value of plant, exclusive of franchises or good-will; present as compared with original cost of construction; par value and market value of stocks and bonds; yearly expenses of supplying its product: gross receipts; depreciation, etc. The bill was prepared by Mayor George Marshall of Columbus, in order to open the way for securing information from the natural-gas company, which is seeking a new grant.

Canadian Hydroelectric Commission News.

After a conference with the chairman of the Hydroelectric Commission of Ontario the city representatives of Guelph, Ont., have been informed that the cost of energy at Guelph will be $25 per hp-year for the next year and a half, or until December, 1912. After that the price will be reduced gradually until it reaches $20 per hp-year. The city commission will not be allowed to install motors free of charge.

Mr. H. L. Drayton, K.C., corporation counsel of Toronto, has been appointed a member of the Civic Commission to manage the hydroelectric business. At a meeting of the newly appointed commission Mr. P. W. Ellis was chosen chairman. The question of rates was not taken up pending the report of the commission's electrical engineers and business manager.

Massachusetts Legislative News.

The committee on public lighting has sent in an adverse report on House Bill 1131, which provides that all electricity furnished by any corporation or association to any customer shall be separately metered and charged for per kw-hour at a single uniform rate for lighting to all customers without regard to the quantities furnished to them respectively, and the House has sustained the action of the committee. The committee on street railways has voted leave to withdraw House Bill 1369, which provides an elaborate method of establishing either the state or city ownership of street railways. During the present session, as in preceding years, the Legislature has persistently refused to interfere with the regulation of rates of public-utility companies in the belief that adequate supervision of these matters is already exercised by the various state commissions, and unless the temper and composition of the General Court changes radically in the future the efforts of various irresponsible elements to undermine the regulating practices of the State will be doomed to failure from the start. An adverse report has been sent in by the committee on street railways upon Senate Bill 260, which requires street railway companies to provide special service for workingmen and women at reduced rates of fare during certain hours of the morning and evening. Only five bills remain to be reported upon by the committee on public lighting, these covering questions of dividends, surplus, meter charges and rate discrimination.

Maryland Commission News.

The Maryland Public Service Commission handed down a decision in the case of the Allied Committees of the Suburbs of Baltimore growing out of the commission's order directing the withdrawal by the United Railways of the residents' books issued on the Catonsville, Govanstown and Emory Grove lines. In the opinion handed down the commission takes the view that the form of the ticket heretofore issued was unduly discriminatory, as it is not open to purchase by all persons who may desire to use the railway, but it is only open to residents, and it, therefore, refuses to order the restoration of the tickets. The commission recommends the issuance of some form of commutation tickets open to the general public.

The case of the Belvedere Hotel Company against the Western Union & Postal Telegraph Companies will probably be decided by the Public Service Commission in a few days. Mr. George Blakiston, president of the hotel company, offered both companies offices in the hotel, but these offices were not satisfactory to the companies and they removed their instruments. Mr. Blakiston appealed to the Public Service Commission, asking it to compel the restoration of the telegraph offices in the hotel, basing his petition on the ground that it is a public necessity. He claimed that in the course of last year there had been some 83,000 registered guests who had spent one or more nights at the hotel, and he thinks that the telegraph offices ought to be re-established as a matter of public convenience.

Wisconsin Commission News.

The Marshfield Municipal Water, Electric Light & Power Plant has requested the commission to investigate its electric rate situation and to recommend a rate schedule which will eliminate the inequalities and discriminatory features of the present schedule. The physical valuation of the property will be determined by the commission and will serve as the basis for an informal investigation and report to be made in the near future.

The Board of Public Works of Waupun has filed certain amendments to its water and light rate schedules and has asked for their approval by the commission. By this amendment the board seeks to discontinue the free use of water and electricity for libraries, schools, churches and other public buildings. The amendment provides further that when service shall be discontinued for any consumer, upon his request, or for any other reason, a charge of $1 shall be made for a reconnection. Permission was also requested by the board for authority to discontinue all flat rates and to install meters in all premises and charge a meter rate. The commission notified the board that the desired changes would undoubtedly produce a more equitable rate schedule, but that technically these changes could not be authorized, since the change would involve an increase in rates. It was suggested that if adjustments satisfactory to the consumers could not be made it would be advisable for the board to make a formal application for a readjustment of rates.

The Chippewa Valley Railway, Light & Power Company has filed an amendment reducing its energy rate for motor service in Eau Claire. The amendment grants a reduction to consumers using 20 hp or more when the readiness-to-serve charge plus the charge for energy exceeds 4 cents per kw-hour consumed. The readiness-to-serve charge will then be canceled and the total bill computed on the 4-cent basis.

The Madison Gas & Electric Company, having been compelled to lay considerable underground conduit by reason of paving work ordered by the city in certain business streets, has filed an amendment to its present rate schedule stating that the company will install its conduits and cables from the main ducts to the curb free of charge to the consumer, provided the consumer or property owner signs a contract for the installation of the conduit and cables from the curb to the terminals inside the building. The cost schedule for underground service is as follows:

Conduit: One duct—First 12 ft., $1 per foot; excess, $0.50 per foot. Two duct—First 12 ft., $1.15 per foot; excess, $0.60 per foot.

Cable: Three-conductor, lead-covered cable, installed, 50 cents per foot, provided the connected load does not exceed 10 kw.

Inside iron conduit will be installed for 30 cents per foot. A flat charge of $6 will be made to cover the cost of all extra equipment necessary, including a suitable service switch, terminal board, etc.

Florida Commission News.

The Florida Senate has passed without a dissenting vote the McCreary bill to extend and enlarge the powers of the Railroad Commissioners of the State so as to give them the exclusive power and authority within the State to regulate charges and service of all persons, firms or corporations carrying on a telephone business within the State of Florida and for other purposes.

AMERICAN ELECTRICAL ENGINEERS—XXXII.

H. Weichsel.

Hans Weichsel was born at Frankfort-on-the-Main, Germany, Feb. 27, 1878, where he received his primary and high-school education. Realizing the great benefit of practical training, at the early age of fourteen he secured a position in a factory, where he worked during vacations and holidays, thus becoming a very proficient mechanic by the time he had finished his high-school work.

After graduating from the high school he entered the Technical University of Darmstadt, where he devoted all of his time to electrical and mechanical engineering. At the end of the second year he was appointed assistant professor in this department, which position he retained for one year. Again feeling the need of practical experience he left the university to accept a position with the Maschinenfabrik, Magdeburg, where he acquired an extended knowledge of steam-engine work, and especially of flywheel governors, and took an active part in the design of a large vertical triple-cylinder engine. Returning to the university, he took the degree of E.E. in 1900, passing each examination with highest honors.

Upon graduation he accepted a position in the engineering department of the Helios Company, Cologne, where he was brought into close contact with the single-phase commutator motor, which this company was exploiting actively at that time. This led to a concentration of interest on the design of single-phase commutator and induction motors, which branch was adopted as a specialty. Later on he was engaged by the Siemens & Halske Company, of Berlin, and while with this concern became familiar with the manufacture of electric vehicles and electric-railway equipment. The branch of alternating-current motors, however, appealed to him so strongly that soon afterward he returned to that line of work. From 1902 to 1904 Mr. Weichsel was engineer in charge of the Magneta Works, of Zurich, Switzerland, and while there made a special study of the phenomena of "current impulses," in connection therewith inventing forms of ballistic dynamometer and wattmeter for the measurement of the power, effective current and effective voltage of a "current impulse."

In 1904 Mr. Weichsel came to this country, partly on a pleasure trip and partly to investigate American electrical engineering practice and designing methods. Becoming much interested in what he saw, he accepted a position with a consulting engineer in New York City, thereby enabling himself to study more completely details of American practice. Later he decided to remain in the United States, and in order to resume his work as an electrical engineer took a position with the Westinghouse Electric & Manufacturing Company, with which he remained until 1906. During this period he became familiar with the American methods of designing alternating-current machinery. At the end of that year he joined the engineering staff of the Wagner Electric Manufacturing Company, of St. Louis, with which he is now connected as the head of the department of motor and generator design. Mr. Weichsel has designed for this company a complete line of polyphase induction motors and alternating-current generators and has also enlarged the line of well-known Wagner single-phase induction and repulsion motors. Concurrently a complete study has been made of the theory and practical method of calculation of these various types of machines.

H. Weichsel.

Patents have been granted to Mr. Weichsel for alternating-current commutator motors, a starting device for motors and a magneto inductor without movable contacts. He has always taken much interest in literary work and has been for many years a regular contributor to the *Annalen der Physik*. He has also contributed articles on the subject of "The Ballistic Dynamometer and Wattmeter" to the Vienna *Zeitschrift für Elektrotechnik* and on "Single-Phase Series Motors as a Universal Choke-Coil" to the *Elektrotechnische Zeitschrift*, of Berlin. Recently he published a complete treatise on "Winding Coefficients of Single-Phase Motors" in an American technical journal. His latest contribution to American technical literature was an article on "The Losses in Single-Phase Rotors," which appeared in these columns April 20 and 27, 1911.

Mr. Weichsel is an associate members of the American Institute of Electrical Engineers, a member of the National Electric Light Association, the Verbund Deutscher Elektrotechniker, the Academy of Science, the Engineers' Club and the League of Electrical Interests of St. Louis.

CURRENT NEWS AND NOTES.

Customers' Repairs.—In a paper recently read before the Commonwealth Edison Branch of the N. E. L. A. in Chicago the interesting fact was brought out that nine telephone lines are needed to take care of the incoming calls of the customers' repair department of the Commonwealth Edison Company. The average cost of making these repairs is 32 cents.

Boston Edison N. E. L. A. Section Excursion.—The Boston Edison Section of the National Electric Light Association participated in an excursion on Saturday afternoon, May 6, to the United States Arsenal at Watertown, Mass., where the process of steel making, heavy testing methods and other features of interest were exhibited by courtesy of the Commandant.

Central-Station Activity in Ohio.—Mr. D. L. Gaskill, president of the Greenville (Ohio) Electric Light & Power Company and secretary of the Ohio Electric Light Association and the National District Heating Association, at a meeting of the Electric Club of Chicago on May 3, at which he was a guest of the club, said that last year was the most successful in the history of the central stations of Ohio. Marked improvements are in prospect, for many stations are nearing their maximum rating in output, and it will be necessary soon to tear down and build greater. In the field of electric heating, particularly the introduction of a practicable electric kitchen range, the outlook is especially promising.

Large Hotel Telephone Installation.—In the McAlpin Hotel, which is now being built at Broadway and Thirty-fourth Street, New York, the telephone installation will consist of 100 trunk lines and 1800 stations. It is estimated that there will be transmitted from these stations 500,000 messages annually at a service cost of $28,334. The main telephone switchboard will contain sixteen regular operating positions. There will be three sub-switchboards, as follows: One two-position switchboard with seventeen booths in the main corridor; one with sixteen stations in the engineering department, and one with twelve extensions for the use of the office force. There will also be a complete telautographic equipment of sixteen instruments.

Special Meeting of Boston Section, A. I. E. E.—A special meeting of the Boston Section of the American Institute of Electrical Engineers was held at the Massachusetts Institute of Technology on May 5, Chairman J. F. Vaughan presiding. The electrical engineering laboratories of the Institute were open to visitors in the afternoon and at 6 o'clock dinner was served at the Technology Union. At 8 o'clock a paper was read by Prof. Harold Pender on "Transmission Line Graphics," and several ingenious methods developed by the author in solving line problems were discussed. Following the reading of the paper a discussion took place, Dr. A. E. Kennelly and Mr. N. J. Neall being among the speakers. About eighty persons attended the meeting.

New York Companies Section, N. E. L. A.—Mr. Nikola Tesla will address the members of the New York Companies Section of the National Electric Light Association at the monthly meeting to be held on May 15 in the Engineering Societies Building. Following his talk there will be a series of papers on the following subjects: *Securing Business on the Instalment Plan; Its Advantages and Disadvantages*, by Mr. A. A. Pope; *Value of the Electrical Sign as a Business Getter*, by Mr. Jesse Richards; *Value of the Show Window as an Advertising Factor*, by Mr. Joseph F. Becker; *How Best to School Our Commercial Men*, by Mr. F. C. Henderschott. After the business meeting there will be a vaudeville entertainment, and refreshments will be served.

Supply Men at Del Monte.—The convention of the Electrical Supply Jobbers' Association at Del Monte, Cal., on April 25, 26 and 27 gave an opportunity for a most enjoyable visit to the Pacific Coast by many members and friends of the association, a number of whom were accompanied by their wives. The California members were most hospitable and provided a program of entertainment that was greatly appreciated. There were no formal papers read, the discussions at the sessions of the convention being devoted to the present business situation. Between sessions there were games of golf, tennis, trap shooting—one source of information gives this as "crap shooting," but this is evidently a mistake—billiards, etc., and prizes were awarded to the winners.

Maintenance of Service.—In a paper recently read before the Commonwealth Edison Branch of the National Electric Light Association in Chicago Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company, said that maintenance of service is the first commandment of the company. Not once in sixteen years has the pressure been off the mains of the central-station company in the central business district of Chicago, and only once in that time has it been low enough to affect the service seriously. However, constant "troubles" are encountered in maintaining the service, particularly in outlying districts, and Mr. Abbott described the emergency methods used in meeting these accidents. In doing so he gave a general perspective view of the whole operating department.

New York's Rejection of Federal Dam Offer.—On the ground that it is now the policy of the State to conserve and develop for its own use or under its control all its water rights, Governor Dix of New York has sent to Washington notice that the State cannot accept the federal government's agreement to build the new dam at Troy and to make other improvements in the Hudson River between Waterford and Troy, for which the government had appropriated about $5,000,000. The new dam was to be of concrete, with locks large enough to accommodate the traffic of the barge canal, which enters the river about 2 miles above the proposed site for the dam. As a result of the action of the State authorities, it was said the dam might now be built by the State without aid from Washington. The federal government's agreement and appropriation were made on condition that the State cancel the water-power contracts with the Troy Hydraulic Company at the present dam, and the government insists on controlling the power rights in connection with the new dam. The improvement planned by the federal government is actively favored by the Chamber of Commerce and other interests in Troy, and much opposition to the action of the State officials has developed.

Convention of the Ohio Society of Mechanical, Electrical and Steam Engineers.—The twenty-third meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers will be held in the Elks' Club Auditorium, Youngstown, Ohio, May 18-19. The program embraces the following papers: *Flue-Gas Analysis*, by Mr. Joseph W. Hayes, of the Combustion Appliance Company, Chicago, Ill.; *The Engineering Features of the Columbus Garbage Reduction Plant*, by Mr. I. F. Osborn, Columbus, Ohio; *Industrial Motor Control*, by Mr. D. Martignone, of the General Electric Company, Cleveland, Ohio; *Load Regulation by Means of Storage Batteries*, by Mr. J. H. Tracy, Electric Storage Battery Company, Philadelphia., Pa.; *General Comments Concerning Hydroelectric Development in the Central West*, by Mr. Paul M. Lincoln, Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.; *Centrifugal Blowers*, by Dr. Lowenstein, of the General Electric Company, Schenectady, N. Y. Inspection trips will also be made to the Youngstown Sheet & Tube Company's works, Ohio works of the United States Steel Corporation, General Fire-Proofing Company, Trussed Concrete Steel Company, Republic Rubber Company and other interesting works in the vicinity of Youngstown. Mr. O. F. Rabbe, of Toledo, Ohio, is president of the organization, and Mr. F. E. Sanborn, of the Ohio State University, Columbus, Ohio, is secretary and treasurer.

New York Section I. E. S.—At a meeting of the New York Section of the Illuminating Engineering Society to be held in the Engineering Societies Building on May 11 Dr. R. S. Woodworth, professor of psychology, Columbia University, will present a paper entitled "Psychology of Light."

Railway Telegraph Superintendents' Convention.—The annual convention of the Association of Railway Telegraph Superintendents will be held in the Hotel Brunswick, Boston, on June 26 to 30. Mr. P. W. Drew, 114 West Adams Street, Chicago, is secretary of the association.

Meeting Baltimore Section, A. I. E. E.—At the final meeting of the Baltimore Section of the American Institute of Electrical Engineers on May 10 Mr. B. Dyer, of the National Carbon Company, presented a paper on "The Manufacture and Uses of Carbon Products." The paper was illustrated with lantern slides, and supplementing it was an exhibit of carbon in its various manufactured forms.

"Sun-Kissed" California Oranges Electrically Ripened.—The final ripening process in the preparation of California oranges for the market is the exposure of the fruit to steam vapor, which imparts the golden yellow color described on the labels by "sun-kissed" and other appetizing terms. In fact, however, electric heat is employed to a large extent in producing this steam vapor, electric immersion coils in open tanks of water in the ripening rooms producing the warm humidity required to give the final tint to the orange of commerce.

Electrolysis Agitation in Bradford.—The Commercial Natural Gas Company, of Bradford, Pa., is apprehensive that escaping electricity from railway return circuits has caused damage by electrolysis to the underground gas mains and water pipes of that city. Mr. Charles T. Sloane, Jr., of Buffalo, was recently retained as an expert to make tests on differences of potential on underground metallic structures. The city officials, representatives of the water department and of the gas company and of the Western New York & Pennsylvania Traction Company are interested in the investigation.

Excursion to McCall's Ferry, Pa.—The following organizations will participate in the excursion to McCall's Ferry, Pa., on May 21: The Baltimore Section of the American Institute of Electrical Engineers, the Engineers' Club of Baltimore, the Washington Section of the American Institute of Electrical Engineers and the Washington Society of Engineers. Through the courtesy of the officials of the Pennsylvania Power & Water Company a complete inspection will be made of the hydroelectric station of the company on the Susquehanna River, which transmits electrical energy at 70,000 volts to Baltimore.

St. Louis League of Electrical Interests.—Like the electric clubs in some other cities, the St. Louis League of Electrical Interests has decided to hold luncheon meetings weekly. The place of meeting is the private dining-room of the City Club on the top floor of the Board of Education Building, Ninth and Locust Streets. Here the members of the league will gather every Tuesday noon for luncheon, after which there will be a meeting, with a speaker, or some entertainment features. Mr. F. D. Beardslee is secretary of the club and Mr. Fred Johnson is chairman of the entertainment committee. The first of the weekly meetings was held on May 9.

Electricity for Harvard Class Day.—The traditional Japanese lantern, with its candle equipment, will be superseded this year at the Harvard class day exercises by electric incandescent lamps. The class day committee has decided to light the yard and delta around Memorial Hall with 4500 lamps, 3500 of which will be of the electric type, and a similar arrangement will be made in connection with the so-called senior spread. The change has been brought about as a result of the extinguishment of the picturesque but unreliable candle lanterns last year by a rainstorm which burst upon the ceremonies at their height. The lamps will be placed inside Japanese lanterns to preserve the artistic effect while securing rainproof operation. Energy will be supplied for this service by the Cambridge Electric Light Company.

Spring Meeting of A. S. M. E.—The local Pittsburgh committee of the American Society of Mechanical Engineers, of which Mr. E. M. Herr is chairman, has completed arrangements for the spring meeting to be held in the Hotel Schenley and the Carnegie Institute from May 30 to June 2. Trips will be made to the plants of the Universal Portland Cement Company, the Westinghouse factories, the works of the National Tube Company and of the Mesta Machine Company.

Sons of Jove at New Orleans.—A subscription dinner and entertainment was given by the Sons of Jove residing near New Orleans, La., in Noy's Restaurant at Spanish Fort, near the city, on May 6. Mr. H. F. Cameron is statesman for the order in Louisiana and Mr. Robley S. Stearnes presided as toastmaster at the dinner. The committee in charge of the affair comprised Messrs. W. E. Clement, contract agent for the New Orleans Railway & Light Company, chairman; M. S. Hart. J. W. A. Richardson and M. E. Hart.

Commonwealth Edison Branch of N. E. L. A.—At a meeting of the Commonwealth Edison branch of the National Electric Light Association in Chicago on May 2 Mr. E. F. Smith, chairman, announced that the membership of the branch has now reached 1020, an increase of 110 per cent since Nov. 1, 1910, when the present officers took charge. It was announced that the Commonwealth Edison Company has agreed to pay the expenses of six delegates from this branch to the New York convention of the N. E. L. A. An election to select these delegates is now proceeding. Mr. W. L. Abbott, chief operating engineer of the company, read an illustrated paper on "Maintenance of Service," giving some interesting facts about the operating branch of the business. There was a brief discussion in which Messrs. H. B. Gear, J. C. Manley and A. G. DeClercq took part.

The Edison Medal of the A. I. E. E.—The address on "Electricity in the Navy," to be made at the presentation of the A. I. E. E. Edison medal to Mr. Frank J. Sprague, noted in our issue for May 4, will be delivered by Commander S. S. Robison, of the Bureau of Steam Engineering, United States Navy. The award of this medal is made by a committee of the Institute consisting of twenty-four members, three of whom are appointed by the president each year to serve for a term of five years, three elected by and from the board of directors each year to serve for a term of two years, and the president, secretary and treasurer of the institute ex officio. The medal was designed by Mr. James Earle Frazer, and bears on its obverse a portrait of Mr. Thomas A. Edison and on its reverse an allegorical conception, "The Genius of Electricity Crowned by Fame." The first award was made, in 1909, to Prof. Elihu Thomson, and the second award, in 1910, to Mr. Sprague.

Cambridge Low-Pressure Turbine Plant.—The Cambridge (Mass.) Electric Light Company expects to place a low-pressure steam turbine equipment in operation within the next two weeks at its Western Avenue power plant, which is located in the southern part of the city on the north bank of the Charles River. The company is completing the installation of new equipment of a total value of nearly $135,000, including two low-pressure turbo-alternators of 500-kw and 1500-kw rating, switchboard relocation, conduit and cable extensions. Under the supervision of Prof. Ira N. Hollis, of Harvard University, consulting engineer for the company, an exhaustive investigation has been made of the possibilities of low-pressure turbine service, and, as stated by the company at a hearing last summer before the Massachusetts Gas & Electric Light Commission, the management expects to reduce the steam consumption from 22 lb. to a net of 15 lb. per kw-hour by the installation of this type of unit.

THE ELECTRICAL EQUIPMENT OF THE BOSTON & ALBANY'S EAST BOSTON DEEP-WATER TERMINAL.

Entire Service Supplied from Mains of Boston Edison Company.

The operation of large tidewater terminals by electricity affords one of the most attractive fields for application of central-station power and lighting service that have lately been developed. The loading and unloading of vessels, the transfer of grain and other commodities between cars, elevators, ships and warehouses, the protection of merchandise in storage and transit from fire losses, and the heavy cost of delays at ports introduce problems of large engineering interest into the design of facilities for the safe and economical handling of products of the soil and factory. One of the most conspicuous examples of an electrified freight terminal is just at the point of completion on the waterfront property of the Boston & Albany Railroad at East Boston, Mass., where the railroad company has expended about $4,000,000 in the reconstruction and improvement of its grain elevators, piers, yard and warehouse facilities. The Cunard, Leyland and other transatlantic steamships dock at the piers of the railroad company at this point. Included in the improvement is a new fireproof grain elevator of 1,000,000 bu. capacity, costing approximately $1,000,000, and equipped with about fifty induction motors aggregating nearly 2200 hp. All the electricity used in the lighting and power service of the terminal is supplied by the Edison Electric Illuminating Company of Boston from its main generating plant at South Boston, on the opposite side of Boston Harbor.

Electric power is used on the terminal property mainly for the operation of the car-pulling, hoisting, cleaning, dust-gathering, shoveling, conveyor and shipping equipment of the grain elevator; for the driving of conveyors running through elevated galleries and serving the various steamship piers for delivery to the holds of vessels; in the operation of high-powered centrifugal fire pumps, and the minor auxiliary applications. The buildings on the property are all lighted by electricity; the yard is illuminated by flaming arc lamps placed at advantageous points, and several important systems of signaling and communication by telephone and otherwise are in service in connection with the routine operation of the terminal and its protection against fire. Although the demand for energy is somewhat intermittent on account of the variations in the arrival of vessels and cars, it is often maintained in considerable volume for many hours of the day and night, and the possibilities of the equipment provide for the needs of the port for many years, with special reference to the deepening of Boston Harbor by the United States government. The present installation of grain-handling equipment accommodates five ships of the largest size and tonnage, which can be loaded simultaneously with grain and other commodities, and the conveyor-belt system provides for the delivery of 40,000 bushels per hour. The piers at which the Cunard and Leyland Line ships dock are among the largest on the Atlantic seaboard, each being 780 ft. long and 240 ft. wide.

From the electrical point of view, the most interesting feature of the terminal is the use of electric power in the grain elevator, where the labor requirements have been cut to the minimum. A striking feature of the motor service is the installation of a system of control centralized in a switchboard room on the ground floor of the elevator, and including in its equipment all the starting and motor-controlling devices necessary for regular operation, only emergency stopping buttons being provided at the motors themselves. With the exception of a motor which operates a passenger elevator, all the motors are started from the switchboard room upon receipt of an annunciator signal from the operator at the particular machine which is to be operated. A separate circuit is run in iron conduit to each motor, and the control is effected by the use of a double set of busbars with compensator connections, by which subnormal voltage is applied to the individual motor in starting, without the installation of any starting coils or transformer connections outside the switchboard room.

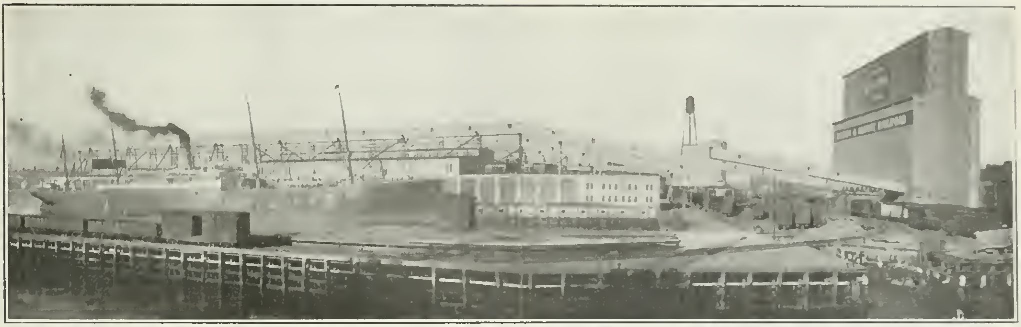


Fig. 1—General View of the Boston & Albany Railroad Piers, Warehouses and Elevators.

The railroad company investigated the desirability of constructing a central-power plant on the property for the electrical service, but on account of an equitable arrangement made with the Boston Edison company this plan was abandoned. A steam-heating and pumping plant has been built on the terminal property, and in one section of this building the Edison service is brought in by underground cables carrying three-phase current at 13,200 volts and 60 cycles. The pumping station is a brick and steel structure with concrete foundations, and a section about 25 ft. long by 21½ ft. wide has been set apart for the switching apparatus required by the incoming electrical feeders. Five panels for 6600-volt present and 15,000-volt ultimate service are installed. The cables are brought through potheads into concrete switch cells, and oil switches are provided in each of the three incoming lines which serve the terminal. The connections provide for duplicate feeder lines from the Edison plant in South Boston, with an emergency line connected with their East Boston substation. Two 300-kw step-down transformers, reducing the voltage to 440 three-phase, for the operation of fire-pump motors, are installed in the switch room of the pumping station and connected with the busbars through oil switches by underground cables carried beneath the floor. From the entrance of the Edison service two No. 0000 three-conductor, lead-covered cables installed in underground conduit are run to a special transformer station located near the grain elevator, and from this building practically all the electrical distribution of the terminal is controlled and measured.

The transformer station is a brick and steel structure 50 ft.

long by 22 ft. wide, one story in height, located about 200 ft. north of the grain elevator. The Edison high-tension service is brought into the building by pothead cable connections and passed through automatic oil switches to a set of three-phase horizontal busbars located inside concrete cells in one corner of the building. The switchboard in the transformer house contains six power panels and seven lighting panels. Four of the power panels are used in the main control of the grain elevator, piers 3 and 4 (leased by the Cunard and Leyland companies) and the seven-story warehouse. Two spare power panels are provided for future service. The lighting panels include the main control switching equipment for the illumination of the entire terminal, including the grain elevator, seven-story warehouse, piers 3 and 4, freight offices and yard. Two spare lighting panels are provided.

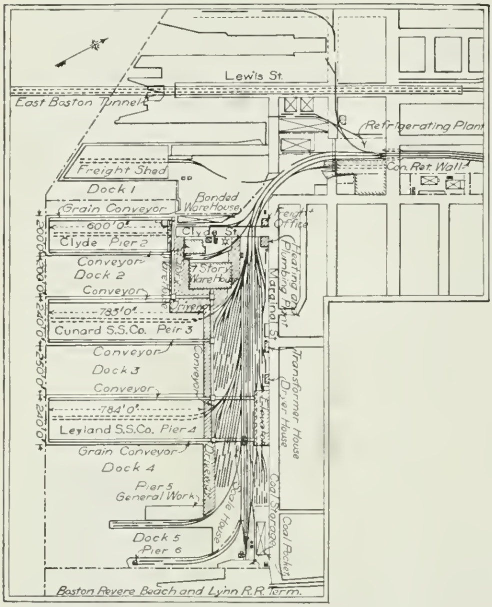


Fig. 2—Boston & Albany Railroad Terminal, Showing Location of Elevator and Piers.

Each power circuit is equipped with an indicating wattmeter, a recording wattmeter and an oil switch with automatic trip, operated on overload. Similar equipment is installed on the lighting panels, and the switchboard is further provided with special current and potential terminals so that tests of the accuracy of switchboard instruments can be made from the front of the panels without the necessity of temporary wiring at the rear of the board. All the current used in lighting service is metered by the Edison company before it leaves the transformer-house switchboard, and the power consumption is also metered in the same building. A demand meter is installed on the board near the last power-control panel. In general, the terminal lighting and pier motor service is supplied by underground cables running from the transformer station to the south side of the yard tracks, where a riser terminating in a pothead connects with overhead feeders running to distribution centers in the various piers and warehouse buildings. The aerial feeders are run on insulators attached to the steel structure of the grain-conveyor galleries, and are anchored at towers of the latter with eye-bolts, turnbuckles, strain insulators and cable clamps. Between these points, where the feeders cross the steel braces of the galleries, they are supported on glass cable insulators carried on locust pins set in 4-in. x 5-in. cross-arms attached to the structure.

The electrical supply for the grain elevator is derived from the transformer plant by nine 1,500,000-circ. mil cables carried in underground conduit from the power panels to the switchboard-room of the elevator. Two No. 0 three-conductor cables are also installed in the underground service to the elevator for lighting purposes. The switchboard equipment of the operating room of the elevator consists of fifteen panels, with switches and other apparatus for power service and a two-panel board for lighting. All motors operating the conveyor belts in the conveyor galleries are controlled from the switchboard-room in the same manner as the motors in the elevator proper.

The elevator is 269 ft. long x 73 ft. wide, and has a total height of 185 ft. 8 in. from the base of the track rail in the yard to the ridge of the cupola roof. The building contains 192 steel storage bins, 72 ft. deep; nineteen elevators or grain "legs," scrubbers and cleaners, belt conveyors, a dust-collecting system, car-puller equipment and scales. A Hess grain-drier equipment is installed in a separate building just outside the elevator proper. All the motors are of the General Electric Company's induction type, and all except that on the passenger elevator in the elevator are equipped with rotors of the squirrel-cage type. The motors in general are free from load at starting, and are brought up to full speed by the switchboard operator before the load is applied. The motor starting is accomplished by hand operation of the switches. The signal system consists of a push button, annunciator and electric bell service between the switchboard-room and each motor-driven machine, the circuits being operated at 75 volts. An ammeter is installed in each motor circuit at the switchboard to indicate when the motor has attained full speed, and when this occurs the operator signals the machine attendant, who applies the load. In regular operation a machine attendant who desires to start a conveyor, leg or other apparatus presses a button, which rings a bell and throws a drop in the switchboard-room annunciator. The switchboard operator closes the motor switch, throwing the unloaded motor upon a special set of auxiliary busbars carrying either 40 per cent or 58 per cent of the normal voltage, and the motor immediately accelerates to full speed, the normal voltage being applied at the proper time by the switchboard attendant, who throws the motor circuit upon the normal or 440-volt bus. When the ammeter indicates that the motor has reached its full speed the switchboard attendant pushes a button that rings a bell at the machine, indicating that the load may be applied. The operation takes but a few seconds, and all complications of special starting and stopping equipment are eliminated at the machine itself. The subnormal voltage on the auxiliary busbars is obtained by connections with one of two compensator coil installations, and the operator selects either 40 per cent or 58 per cent of normal voltage, depending upon the distance of the motor from the switchboard-

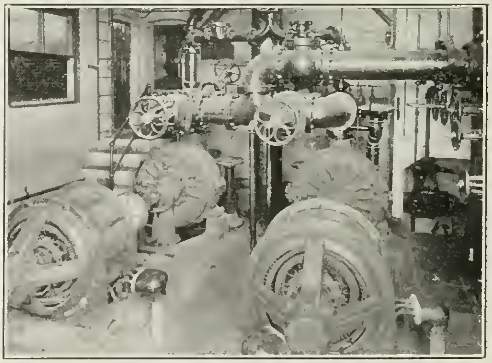


Fig. 3—Induction Motors Driving Two-Stage Centrifugal Pumps.

room and its size and general operating characteristics. Any motor can be stopped by the pressing of a button placed immediately by the machine, so that emergencies can be taken care of without loss of time, and in connection with the belt conveyors the wiring has been arranged to provide for the successive stopping of all motors involved in a sequence, proceeding from the grain elevator outward toward the piers through the galleries containing the distributing belt conveyors. In case an attendant in a gallery notes that something is wrong he presses the emergency motor stop button located near the ordinary signaling button, and this operation immediately sets in motion an emergency stopping-switch mechanism in the switchboard-room, which passes a contact arm over a group of relay circuit-closing points connected with the tripping coils of all oil switches controlling the motors driving the grain-conveying apparatus. The motors nearer the elevator on the shipping system are stopped first in order to avoid serious trouble through the piling up of the grain at any point in the delivery and distribution system, and the process of stopping proceeds seriatim down through the galleries until the last motor on the shipping system is reached. This may or may not be the motor at which the attendant operated the emergency button, but in any case the system as a whole is stopped from the proper end and the grain conveyors left in condition to start again as soon as the particular local difficulty which occasioned the shut-down is remedied. The galleries and elevator are provided with an intercommunicating telephone system, so that little time is ordinarily lost in locating and attending to troubles that develop in any locality.

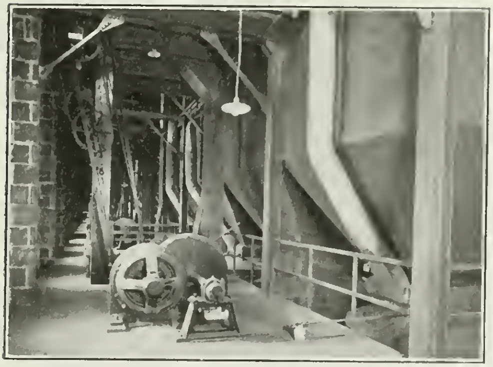


Fig. 4—50-hp Motor Driving Elevator Leg.

In the elevator the equipment is installed so as to take the utmost advantage of the action of gravity. Grain delivered from the cars is passed by motor-driven shovels into screened bins, from which it is hoisted to the garner floor near the top of the elevator monitor. It is dropped by gravity through the scale floor to the distributing section, where an ingenious system of radial steel spouts feeds it to the numerous bins beneath. The larger hoppers of the scale system hold 96,000 lb. of grain each. The distributing floor below the scale floor is equipped with a 36-in. 4-ply reversible belt conveyor running its entire length and provided with a reversible tripper and two movable loaders. In the shipping section of the elevator are three belt conveyors feeding the outgoing conveyor system leading to the towers and galleries of the terminal yard. In general the distributing belts are 36 in. wide each and run at a speed of about 1200 ft. per minute. The conveyors running above the piers are installed 66 ft. above the floor of the wharf and discharge into the steamship holds through spouts of telescopic design equipped with 30-ft. steel booms controlled by hand-winches. The entire elevator is designed to facilitate the rapid transfer of grain from any bin to any other, and by the use of the appropriate system of spouts, legs and conveyor belts the grain can be passed through cleaning, weighing, storage or drying processes with the minimum loss of time. The elevator is equipped with a dust-collecting system connected with about sixty sweeps installed on the different floor levels, and the dust gathered is forced by motor-driven fans through a pipe system to a dust house, where it is packed in bags by special machinery and sold for mixed feedstuffs.

The principal motors required for the elevator service are given in the following tabulation:

Number.	Horsepower Rating.	Speed R.P.M.	Service
1	100	720	Drives 80-in. dust-collector fan on first floor
1	75	720	Drives 70-in. dust-collector fan on top floor.
1	75	720	Drives drier-plant machinery and belt conveyor.
1	75	720	Drives short shipping belt and belts in gallery
1	75	720	Drives short shipping belt and belts in gallery
1	75	720	Drives belt conveyors between certain towers
6	55	514	Drive six receiving elevator legs.
6	55	514	Drive six shipping elevator legs.
5	55	514	Drive five cleaner legs.
1	35	600	Drives two elevator legs for drier plant
1	35	600	Drives car puller machinery on first floor
1	35	900	Drives shovel line shaft.
1	20	1200	Drives reversible belt in cupola (distributing floor).
5	20	1200	Drive Eureka double cleaning machines first floor.
1	15	1200	Drives reversible shipping belt conveyor
5	15	1200	Drive five single Eureka cleaning machines on first floor.
1	10	....	Drives passenger elevator in elevator building
1	5	1200	Drives dust-packing machinery in dust house
3	100	720	Driving belt-conveyor system (temporary connection)
1	75	720	Driving belt-conveyor system (temporary connection).

The passenger elevator has a capacity of 2000 lb. at a speed of 75 ft. per minute and is equipped with electromagnetic push-button control at each floor, with safety circuit-closing device on all gates. The interior of the car is also provided with push-button control for each floor, the buttons being fitted with platinum contacts. Each of the single and double receiving separators in the grain-cleaning machines has a capacity of 5500 bu. per hour. There are twelve shovel machines for emptying cars, there being two in connection with each receiving elevator, arranged to unload cars on either of

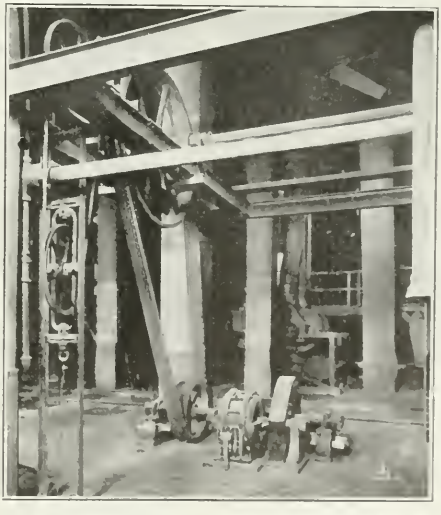


Fig. 5—35-hp Motor Driving Automatic Shovel Equipment.

two receiving tracks which enter the building. The car-puller is of the heavy geared type, located in the basement of the elevator, and it is equipped with four drums carrying ⅝-in. steel cable, installed to pull cars in and out of the house on either track. This electric hauling device obviates the necessity for the entrance of a steam locomotive into the elevator under any normal conditions of operation. In addition to twenty-four steel distributing spouts serving the steel grain bins, one loading spout is provided at the front of the first receiving elevator to enable cars to be loaded when necessary, although this work is rarely within the province of the elevator. Bagging spouts are also provided on the north side of the elevator for the benefit of the local trade. Mechanical trippers are installed on the belts to facilitate the discharge of grain at points where it is necessary to change its direction of flow. These trippers can be set to discharge at various points, and are arranged to be propelled by the driving power of the belt along the gallery, as desired. Concentrator rollers are provided in the belt installations at the loading points of shipping conveyors, to prevent the grain from spilling off the sides of the belts. The elevator buckets for the receiving, shipping, cleaning and transfer legs are each 7 in. x 7 in. x 20 in. in dimensions. The elevator boots are of cast iron, and a flexible system of slack adjustment by idlers and pulley movement is in service. The grain drier has a capacity to dry and cool 15,000 bu. of damp grain with 7½ per cent moisture by weight in twenty-four hours. A ball-bearing safety device is installed at the driving pulley end of the legs to prevent its slipping backward in case of an interruption in the power supply.

The switchboard in the elevator-operating room is built of white Italian marble panels, there being thirteen panels for motor controls, three for compensator controls and two for lighting control service, with a single panel for incoming main service. On account of the shape of the room, the board is installed in three sections, the total length of the sections aggregating about 51 ft. Ammeters and voltmeters are used on the board and, as stated, each motor circuit is provided with an ammeter, with a bypass connection which enables the operator to read with fair accuracy the relation between the current and the motor speed when handling the motor-starting system. In general, the motor-feeder panels are provided with an ammeter and a double-pole oil switch installation in two sets of switches, one of which connects the motor to one set of busbars and the other to the auxiliary busbars. The switches controlling the motors driving the belts in the towers, drier house and dust-collector fan equipment, shipping and receiving elevators, car-pulling machinery, shovels and dust-packing machinery are oil switches of special automatic type, provided with two overload series trip coils and an auxiliary trip coil for opening the switch. The auxiliary trip coils are connected with the circuits of the system for the automatic control of the motor switches by push buttons, the auxiliary trip coils operating at 75 volts, as above mentioned. About eighty-one push buttons are in service on emergency motor trips. Selector switches are installed on the compensator panels, by which either 40 per cent or 58 per cent of normal voltage can be thrown upon the auxiliary busbars, these switches being interlocked so that the two voltages cannot be applied to the buses at the same time. The lighting circuits are controlled through knife switches and the panels are equipped with inclosed fuses in each branch and ammeters and a test voltmeter. The board as a whole is equipped with two 4-point plugs and two 2-point plugs and thirty receptacles for testing voltage and grounds. The incoming mains are connected to busbars on the incoming-mains control panel, and a current transformer for a totalizing ammeter is included in the circuit before other connections are made. Cross-connecting cables running beneath the floor are provided to the second section of the power board, all lugs being large enough to receive a 500,000-circ. mil cable.

The motor-starting compensators are of the inclosed type, each consisting of three coils connected in star, without switches or other operating mechanism. The coils are of the floor type and are immersed in oil. The taps are taken at points giving the fractional voltages above mentioned, and the compensators may be used in multiple on either of the voltages if desired. A lamp signal system, with red and blue indications, is installed in connection with the work of the weigher and the elevator attendants, the code applying mainly to the operation of mechanical valves on the elevator bins and spouts.

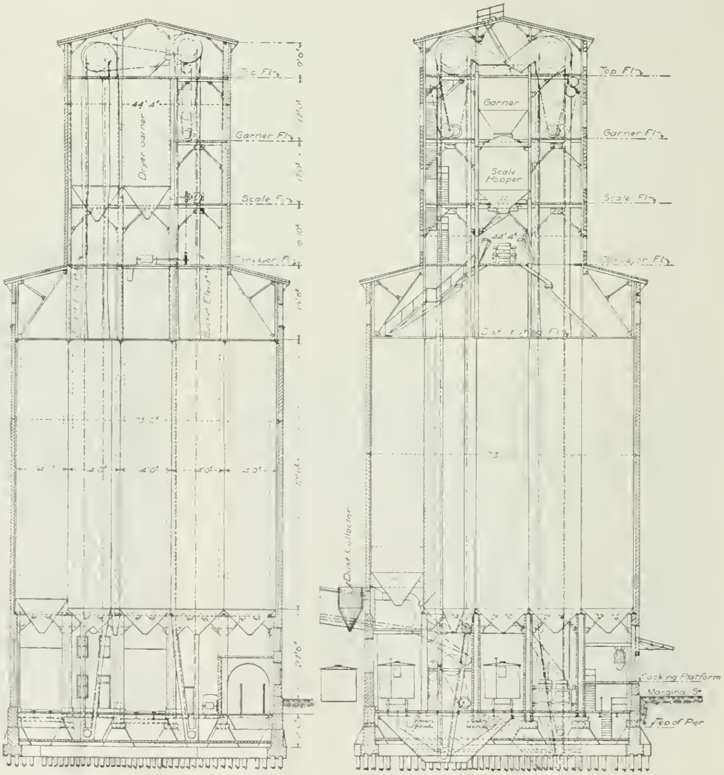


Fig. 6—1,000,000-Bushel Elevator for Boston & Albany Railroad.

All wiring for the power and lighting service in the elevator is carried in iron conduit, except where pendent connections are provided to incandescent lamps. A separate conduit, with all conductors in each circuit in one pipe, is run from the switchboard to each motor. The lighting circuits are run as feeders to distribution panel boxes in the usual manner, with subdivisions in the various departments controlled from local box fuses and switches. The feeder circuits to the different motors in the elevator and galleries are as follows:

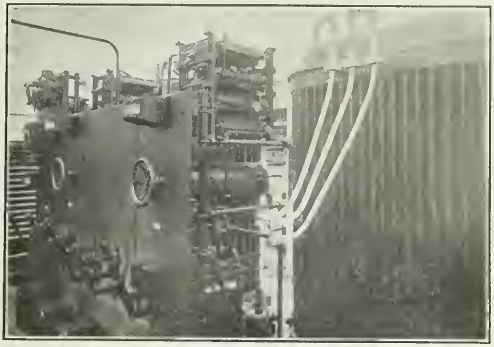


Fig. 7—Panels Controlling Induction Motors in Pump Station.

Horse-power of Motors.	Size I & S.	Diameter of Conduit in Inches	Motor Service.
100	00	2	Dust-collector 80-in. fan.
75	0	2	Fan, drier equipment, belts, conveyors.
55	1	2	Receiving and shipping legs, cleaner legs
35	4	1½	Elevator legs, car puller
20	6	1¼	Belt, cupola, also double cleaning equipment.
15	8	1	Single cleaning machines.
10	10	1	Passenger elevator
5	10	1	Dust-packing machinery.

In general, the motors are located either on the floors of the elevator adjacent to the apparatus driven, on special subbases designed for direct-connected service, or on platforms separated from the machinery, both belt and rope driving being in service. The driving of the elevator legs is effected by twelve ropes, 1 in. in diameter, each connecting the motor pulley with the head pulley of the leg mechanism. The separation of the motors from the complex mechanism which they drive enables electrical matters to be handled with the utmost ease, keeps the wiring away from moving belts and other parts, provides for easy inspection and enables the mechanical connections of the motors to be made thoroughly efficient. The elevator is lighted in the main by 16-cp lamps, placed where they will give effective illumination, notably in the vicinity of machinery, scale beams, deck spouts, passageways and stairs. The distribution circuits are all controlled in the panel boxes above mentioned, with the exception of those in the stair tower of the elevator, which are wired for cutting on or off from each end of the tower. The distribution circuits for lighting are so wired that the difference of potential between any lamp and the busbars in the panel box from which the lamp is controlled will not exceed 1.5 volts. A maximum of twelve lamps is connected to any single lighting distribution circuit and the circuits are arranged so far as practicable to divide the load evenly between the two sides of the three-wire system. The lighting distribution circuits are of the two-wire type. About 400 lamps are in use in the elevator and 120 lamps in the towers and galleries. The office of the superintendent of the elevator, that of the weigher, and the switchboard-room are heated by five electric radiators, one of 4000 watts rating being in the superintendent's quarters and two of 4000 watts rating being in the switchboard-room. The

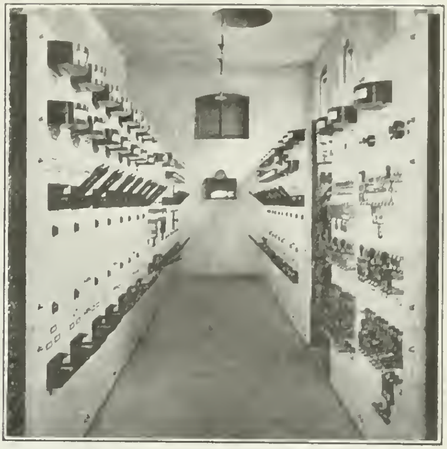
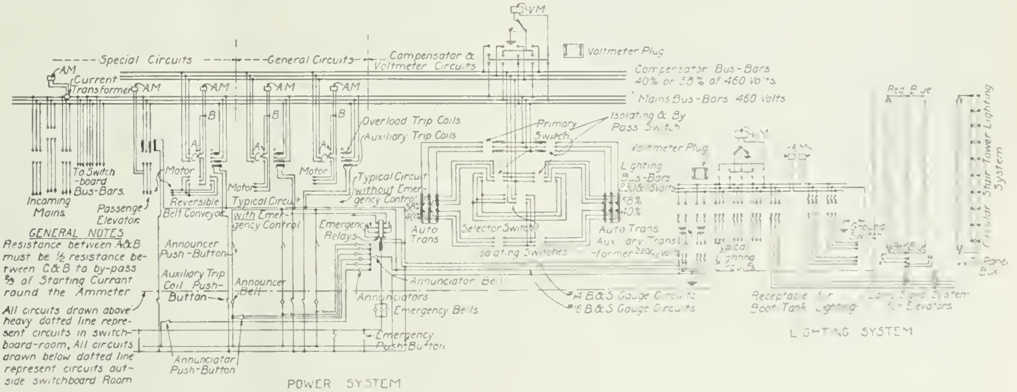


Fig. 9—Switchboard Room.



Special Circuits
General Circuits
Compensator & Voltmeter Circuits
AM
Current Transformer
B
A
C
Overload Trip Coils
Auxiliary Trip Coils
To Switch-board Bus-Bars.
Incoming Mains
Passenger Elevator
Motor
Reversible Belt Conveyor
Typical Circuit with Emergency Control
Typical Circuit without Emergency Control
58%
40%
Auto Trans
Emergency Relays
Selector Switch
Isolating Switches
GENERAL NOTES
Resistance between A&B must be ½ resistance between C&B to by-pass ⅔ of Starting Currant round the Ammeter
All circuits drawn above heavy dotted line represent circuits in switchboard-room, All circuits drawn below dotted line represent circuits outside switchboard Room
Announcer Push-Button
Auxiliary Trip Coil Push-Button
Announcer Bell
Annunciator Bell
Annunciators
Emergency Bells
Emergency Push Button
Annunciator Push-Button
POWER SYSTEM
VM
Voltmeter Plug
Compensator Bus-Bars 40% or 58% of 460 Volts
Mains Bus-Bars 460 Volts
Primary Switch
Isolating & By Pass Switch
Voltmeter Plug
Lighting Bus-Bars 230& 5Volts
Auto Trans
Auxiliary Transformer
#4 B&S Gauge Circuits
#6 B&S Gauge Circuits
Typical Lighting Circuits
Ground
Red
Receptacle for Boot Tank Lighting
for Elevators
Stair Tower Lighting System
Panel Box
LIGHTING SYSTEM

Fig. 8—General Wiring Diagram.

heaters in the weigher's office are installed in two 2000-watt units. No steam distribution is installed in the grain elevator, there being no occasion to heat the bins, garner, scale distributing and gallery sections.

The conduits for the general motor and lighting service are carried from the switchboard-room to the stair tower at the northwest of the elevator and thence proceed in the form of risers to the top, garner, scale, belt conveyor and distributing floors of the elevator. For the panel boxes on the first floor of the elevator the conduits cross the switchboard-room below the floor and run directly to the panel boxes on the west wall, rising through the floor to make the connections. For all motors on the first story and the first story platforms of the elevator, and for all motors and panel boxes in the belt-conveyor system, the conduits are run to the east end of the superintendent's office below the floor. The first floor conduits continue on this level; the first story platform conduits rise, for motors on the sacking platform, to the under side of this platform and, for motors on north and south motor platforms, to the under side of the bins. The conduits for the gallery under the shipping platforms take the same general course as the conduits for motors on the motor platforms. All conduits for the belt-conveyor system are run to a central distributing tower and thence branch to the various points of consumption. All conduits are carried to the extreme point where the conductors, and not the conduits, make connections. All lamps in the belt-conveyor system are suspended direct from the conduit, pendent lamps being used only in the elevator building, drier plant and other places where it is not feasible to carry conduits to the lamps. Provision is made for attaching portable lamps to the elevator-boot tanks, for temporary inspection or repairs.

The contact-making device which stops the motors in case an emergency button is pushed is designed to allow an interval of 30 seconds to elapse between the opening of the first switch and the last, and also is arranged to open the common main for all the cricuits after all the trip coils on the motor oil switches have been actuated, so that the system will return to its starting point electrically. The main wiring for auxiliary systems takes the same general course followed by the power and lighting feeders. The neutral of the three-wire lighting system is grounded, and the lead covering of all cables is grounded. The telephone system of the elevator and galleries is of the intercommunicating type, with thirty-two stations. Ringing current is supplied by the 60-cycle, 75-volt service, and the talking current is obtained from dry batteries having a normal potential of 24 volts between outer terminals. Telephone extension bells are installed in the galleries away from the instruments, as well as at the sites of the latter.

The lighting of the piers is accomplished mainly by incandescent lamps, 40-watt tungstens being used in the offices, immigration rooms, etc., and 60-watt lamps hung about 20 ft. from the floor in the sheds of the first story. About 1000 lamps are in use in the two piers at which the Cunard and Leyland line ships dock and these are supplied by feeder circuits running from the transformer station near the elevator to distributing switchboards and branching circuits running from the latter near the entrances to various centers of local distribution in the buildings. The three-wire system is used as in the grain elevator. Each pier is provided with a power and lighting panel containing triple-pole knife switches and fuses for lighting and power service, and a recording wattmeter is used on both piers in the lighting leads. Feeders are carried at least 30 ft. above the rails wherever they cross the yard tracks. A No. 0000 electric elevator service cable is run from the service panels in the piers to a dock elevator installation used in passenger service on Pier No. 3. Provision has been made of separate switches whereby the night watchman on the pier can always keep a 60-watt tungsten lamp in service ahead of him in making rounds so that it is unnecessary to carry a lantern on the piers.

The pumping plant and distribution service for fire protection are unusually complete. The pumps are drivin by induction motors and a contactor switching installation is provided in the pumping station whereby an auxiliary pump motor is arranged for automatic starting and stopping in connection with the height of a float in a 100,000-gal. elevated tank that furnishes the initial pressure and protection in connection with the sprinkler system on the piers. The main fire pumps are of the Platt Iron Works manufacture, of the centrifugal type, and each is capable of delivering 1500 gal. per minute against a head of 125 lb. per square inch. The auxiliary pump, which automatically supplies the elevated tank with water, is capable of delivering 150 gal. per minute against the foregoing pressure. A complete watchman's clock system is in service, and the railroad company is experimenting with an electric push button installation at monitor nozzles and hose valves so that when a fire occurs, by pressing the button, a solenoid equipment at the main water valves will be operated and water turned immediately into the dry pipe systems. An annunciator system will also be installed in connection with an elaborate sprinkler system which is now in service. There are also A. D. T. connections planned for the system.

The principal electrical contractors on the terminal work are as follows: Grain elevator and electrical installation complete, with all mechanical features of the former, Witherspoon-Englar Company, Chicago, and motors, General Electric Company, Schenectady, N. Y. The improvements at East Boston were begun mainly as a result of a disastrous fire which occurred about two and one-half years ago. All of the improvements have been carried out under the direction of the engineering department of the Boston & Albany Railroad

ELECTRICALLY DRIVEN TURBINE SINKING PUMPS FOR MINES.

By E. W. Jansen.

THE application of electricity in mines is far more advanced abroad than in the United States. Especially in Germany electricity is extensively employed for winding engines, rock drills, pumps, fans and other motors and for lighting. Among these applications one of the most interesting is undoubtedly the electrically driven turbine sinking pump for draining the bottom of a pit while sinking new shafts, and the object of this article is to give a description of the electrical equipment of such pumps without going deeply into their construction or mechanical details.

The electrically driven pump offers great advantages over its steam competitor. It does away with the usual serious hindrance to workmen on account of escaping steam and of increased temperature in the shaft. As the fresh steam has to be led in from the surface the condensation in the pipe line is considerable even with lagging. Due to the latter, the weight of the line is far in excess of the electric cable. Another important point to be considered in the design of sinking pumps is the amount of space they require with reference to the cross-section of the shaft. In this respect the electric outfit is decidedly superior. Still another disadvantage of the steam-driven equipment is caused by its swaying in the shaft, due to the reciprocating motion. Besides overcoming a number of the disadvantages of the steam-driven pump, the electrically driven turbine pump has a much higher efficiency.

In a few instances electrically driven pumping outfits of the reciprocating type are found. These have the disadvantages of swaying and are larger and heavier than the turbine outfits. Another method used abroad for draining the pit while sinking new shafts is the water-lifting device built on the Tomson principle, or so-called bailing process. This necessitates the installation of a large, heavy winding engine with drum and a battery of boilers, which in most cases is of far larger size than needed for the raising of ore after the shaft is in operation. The cost of operation is two to one as compared to the electrically driven turbine pump. This result was actually ascertained by comparing two installations working under similar conditions in the potash mining district in Germany.

The motor driving the pump is mounted directly over the latter with a heavy casting between them, to which both are bolted, and the two are joined to each other by a flexible leather band coupling. As shown in Fig. 1, the whole pumping outfit, consisting of motor, pump, delivery and suction pipe with sieve, and certain control apparatus, is mounted in an iron frame. From the pump the water is pressed through two pipes which run along the iron frame to the upper platform, where they join by means of a siamese connection. In this section is a check valve and directly above it a regulating gate valve.

Two stages or platforms are provided with connecting ladder for the attendant. The frame containing the apparatus is suspended in the shaft by a steel rope from the surface and lowered from time to time by means of a winch as the depth of the shaft progresses. During the sinking of the shaft the equipment has to be raised frequently while the pit is being blasted to prevent flying missiles from striking the machinery.

The end of the steel rope is fastened to a beam or other support on the level of the winch and passes under a pulley mounted in the framework of the pump. This winch raises and lowers the pump at the rate of from 3.5 ft. to 7 ft. per minute, corresponding to a speed of from 7 ft. to 14 ft. per minute of rope being wound on the winch drum. A corrugated-iron roof over the framework protects the attendant against injury from falling missiles and water.

The steel ropes are also employed to steady the pipe line by means of iron bands at intervals of approximately 8 ft. to 10 ft., as shown in Fig. 2. The electric cable is clamped to the same iron bands, also shown in Fig. 2. In order to avoid friction and a possible clamping of the steel ropes passing through the eyes at both ends of the iron bands these are lined with bronze.

As the depth of the shaft increases new sections of pipe are added at the top, while the cable is lengthened by unreeling it from a drum specially constructed for this purpose. The pipe sections are from 8 ft. to 10 ft. in length.

In very deep shafts the winch and drum are placed in a pumping-room excavated in the side of the shaft about 600 ft. beneath the surface and the water delivered from the sinking pump is carried to a reservoir or basin in this cavity, from which it is pumped to the surface by means of a stationary centrifugal, a turbine-pumping set, or a belted duplex pump.

In some installations the depth of the shaft is not so great, but the quantity and quality of water is such that it has to be pumped to the surface in several stages. In the installation at pit V of the Consolidated Alkaliwerke Westeregln, a potash mine in the vicinity of Magdeburg, Germany, the first stationary pumping set is placed 285 m (935 ft.) beneath the surface. The shaft is now being deepened and upon reaching a depth of 428 m (1480 ft.) another stationary pump will be installed. Upon completion of the shaft the third one will be erected at the lowest level at a depth of 544 m (1780 ft.). In this instance a special cavity was excavated just above the first stationary pumping set for the winch and drum.

The suction pipe projecting from under the frame has at its lower end a specially constructed coarse sieve to prevent small stones and other solid matter from being drawn into the pump. The length of the pipe varies according to conditions, but is found in lengths up to 25 ft.

The length of the delivery line sections and suction pipe limits the depth which may be drained without stopping the motor. The size and construction of the centrifugal or turbine pump depends on the conditions for which it is designed—that is, the greatest delivery head. The parts subjected to wear and tear, particularly the impellers and diffusion vanes, are made of hard bronze, the actual composition of which depends on the amount of salt in solution and percentage of foreign matter in the water. At the beginning of sinking a shaft the delivery head is much smaller than the normal head for which the pump is constructed, and as the sinking progresses the head increases. These varying conditions may be met by temporarily reducing the number of stages by removing runners and substituting blanks.

The motor used for these turbine-sinking pumps is an inclosed, vertical-shaft alternating-current motor with a special water-cooled frame or casing. Due to the difficult conditions under which it has to operate, the three-phase induction motor with squirrel-cage rotor is preferable. This type has been found most reliable as it possesses the simplest construction and needs the least repair. It has been found that direct-current motors are not suitable as the frame must be constructed to have the collector and brushes easily accessible, and experience has shown that they cannot operate successfully in the damp conditions for any length of time. The motor used is of the fully inclosed type with upper bearing of the thrust and lower of the collar type, both equipped with oil-lubricated ball bearings. The frame is constructed with a water jacketing so divided that the cooling water touches all parts For this jacketing water is taken from the lowest stage of the pump, a reducing valve being inserted to reduce the pressure A water purifier with fine sieve is built in the pipe leading to the motor to prevent clogging of the jacketing through impurities. In cases where the pit water possesses chemicals in solution or is exceedingly muddy and warm special cooling water is led in from the top. This was the case in the Alkaliwerke Westeregln installation mentioned previously. With large-size, high-speed

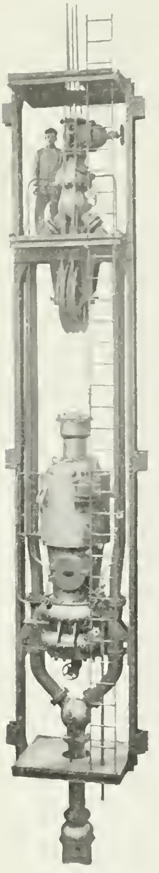


Fig. 1—Pump and Motor Mounted in Iron Frame.

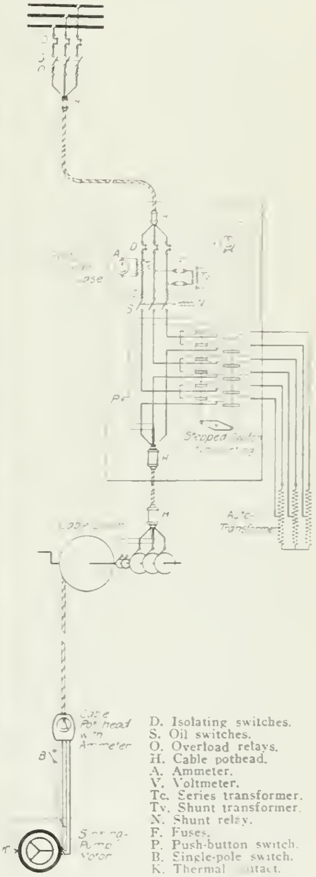


Fig. 2—Diagram Showing Electric Wiring.

motors special water-cooling coils are built into the oil reservoirs for the bearings. The same water for cooling the motor is used for the turbine pump, which is also jacketed. A fan is constructed on the rotor of the motor to circulate the inclosed air, bringing it in contact with the water-cooled sides of the frame. The casing also possesses valves for cleaning the jacketing and letting the water run off when out of use.

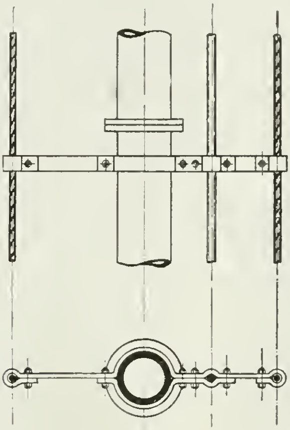


Fig. 3—Details of Pipe-Line Cable and Steel Ropes.

With the turbine pumps there is always the possibility of their sticking and becoming clogged, and of foreign matter being caught and carried along with one of the impellers, thereby greatly overloading the motor. To prevent the motor from becoming unduly warm a thermal contact or fuse is built into the side of the motor, which is connected to the release of the main switch. With overheating of the motor this contact fuses, actuates the no-voltage release and throws off the motor. As a precaution against moisture the windings of the motor have a special damp-proof insulation.

The normal rating of these motors is from 50 hp to 225 hp, corresponding to a delivery of from 1 cu. m to 3 cu. m per minute (13,200 gal. to 792,000 gal. per hour), and the normal synchronous speed may be taken at 1500 r.p.m. The average height for the pressure head may be taken as 200 m (756 ft.). The weight is approximately 25 per cent greater than open-type motors with horizontal shafts for the same output and speed. Motors with outputs as high as 500 hp have been built.

The equipments shown in Figs. 1, 4 and 5 were built by the Siemens-Schuckert Werke. The turbine pumps were delivered by Gebrüder Sulzer, of Winterstur, Germany. The one shown in Fig. 1 was constructed for the Société des Mines de Jarny, at Jarny, France. It delivers 5 cu. m per minute (66,000 gal. per hour) against a head of 225 m. (738 ft.). The motor has an output of 400 hp at 2000 volts, 50 cycles.

The equipment illustrated in Fig. 4 was built for the Aachener Hüttenverein at Rote Erde, near Aachen, Germany. The pump is able to deliver 4 cu. m per minute (52,800 gal. per hour) with a head of 75 m (246 ft.), running at a speed of 1460 r.p.m. (1500 r.p.m. synchronous speed on a 50-cycle circuit). The motor is constructed for 100 hp at 325 volts.

Illustration No. 4 shows an outfit delivered to the Dutch State Limberg Mines for Pit Wilhelmina at Heerlan, Holland. The pump has an output of 1 cu. m per minute (13,200 gal. per hour) with a delivery head of 235 m (771 ft.) at 1450 r.p.m. The motor is constructed for 90 hp at 500 volts.

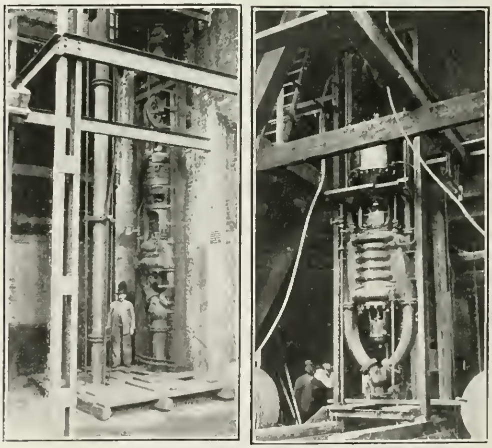
For the smaller-sized equipments 500 volts is usual, while the larger ones are run at higher voltages due to the saving which is obtained by smaller conductors and corresponding cheaper and lighter cable. The highest voltage allowed by the state commission governing mines is 3000 volts. The cable is of the rubber-insulated type with steel armoring, but without lead sheath. The construction is such that it can hang its full length without fastening. Besides the three conductors for the motor the cable contains two light conductors for the thermal contact in the motor. Spare wires are provided for this circuit, as it has been found that these are quite liable to rupture due to their small cross-section. On account of the cable being wound on the drum, all conductors are of the multi-strand type. The conductors for the motor leads are dimensioned on the basis of low current intensity, about 50 per cent of what is allowed for conduit work, as the temperature of the surrounding atmosphere in the shaft is high, and the chance for radiation when wound in layers on the drum is poor. In order to give the cable sufficient mechanical strength cross-sections of less than 50 sq. mm (approximately No. 0 B. & S.) are seldom used. Lighter cables can be used only in shallow mines.

The reel or drum for unwinding the cable is of special design with a diameter of ½ m (approximately 1⅝ ft.), the width depending on the length of cable. The drum is turned by means of a hand crank and reduction gearing with a ratio of five to one. If the cable used hangs its entire length free, the cable drum must have at least triple-reduction gearing and two sets of brakes with two pawls and ratchets in accordance with the requirements of the law. On the opposite side from the manipulating gear are five slip-rings or a five-pin plug and socket for the electrical connection. If the drum is set up in a place where there is liability of weather-damp the slip-rings are immersed in oil.

The other end of the cable terminates in a pothead located near the regulating valve at the upper platform of the pump framework. The pothead is of special design with an ammeter inclosed in a water-tight case, with series transformer if necessary. Besides the ampere scale of the instrument, a second one showing horse-power delivered is also given.

Two gas pipes of sufficient diameter are connected to the bottom of the pothead for protecting the leads to the motor and thermal contact. A single-pole knife-blade switch in a water-tight case is connected to one of the leads to the thermal contact. It is mounted just under the pothead so that it can easily be reached by the attendant on the platform.

Besides the above-described apparatus there are also in an easily accessible position the water purifier for the cooling water, the regulating valves for the different cooling-water circuits and manometers for the suction and delivery heads.



Figs. 4 and 5—Pump Installations at Aachen, Germany, and Heerlan, Holland, Respectively.

Current is led to the slip-rings of the cable drum from a switch-gear case. These cases are built up entirely of sheet iron and are totally inclosed so that all electrical conductors are protected from mechanical injury or accidental contact. The dimensions are approximately 3.5 ft. square and 6.5 ft. high. Inside the case is the main switch, which is of the oil-immersed, three-pole, single-throw type, with two inverse time-limit overload relays and one shunt release. It is hand-operated and the operating gear is of the "free-handle" type, consisting of a two-handle operating lever with release trigger, it being impossible to hold the switch in while an overload exists. The overload relays are of the hot-wire type, the time necessary for opening the switch depending on the amount of overload. This style is chosen so that the switch is not unnecessarily opened by a heavy starting current. For the same reason fuses are omitted as they would have to be of such a large size that they would not protect the motor in normal service. It may here be remarked that fuses are much less frequently employed abroad than in the United States, due to the fact that with an overload usually only two fuses blow out and the third causes unbalancing of the system by remaining in, which has had disastrous results in several instances. The action of the relay is to open the shunt or no-voltage release circuit, thereby opening the switch. The auxiliary circuit for the release is suppled with energy by a potential transformer connected across two of the leads. The two conductors of the motor thermal contact are connected to this circuit so that if either the single-pole switch at the motor is opened or the thermal contact fuses the switch is thrown out. Usually a press button is mounted on the front of the case so that the switch may be easily opened from there. In parallel with the release circuit is usually a voltmeter. The circuit is protected from the high-tension circuit by two suitable fuses. In the bottom of the switch case is a stepped switch with contacts immersed in oil, and an operating gear of the lever type with pointer indicating the "off," "starting" and "running" positions. The lever is held in any of these positions by means of a catch. Leads are taken from here to the auto-transformer, which is of the oil-cooled type with taps taken from the middle of the two windings, which are V-connected.

In the starting position the transformer is connected to the line and the motor leads are taken off at points giving a voltage at the motor of half the full value. The motor starts with a torque corresponding to this reduced voltage, and when full speed has been reached the lever is thrown over into the running position, in which the motor is connected directly to the line and the transformer is cut out of the circuit.

Besides this apparatus the switch case also contains three isolating switches and an ammeter with series transformer. The two instruments are placed in the case behind thick plate-glass windows.

A diagram of connections from which the relation of the various apparatus described above may be seen is shown in Fig. 2.

If the cable drum and switch case are placed in an excavation in the side of the shaft, the current is brought in by a three-phase cable of special construction. The conductors are first insulated by a special impregnated paper covering which has a dielectric strength of about 2.5 times that of manila paper. This is then covered with a lead sheath, and this in turn is wound with a jute impregnated covering, which is covered with a steel armoring of rectangular-shaped heavy steel wires. About this is placed another covering of asphalt-impregnated jute to prevent rusting of the armoring. This type of cable is preferable in place of the ordinary armored cable in order to withstand the tensile strain arising from being hung vertically in the shaft. The ordinary steel-strip spiral armoring would pull together, thereby endangering the insulation. If the cable is installed in a shaft in which the water is of acid nature, the cable receives a further coating of tar, which is applied to it after being installed.

The pump equipments, as described above, are used in a large number of mines in Europe, the Siemens-Schuckert Werke alone having installed sixty equipments with a total of 12,035 hp up to April, 1910. It is to be regretted that in this phase of mining the Americans are far behind their foreign competitors. The writer believes that a careful investigation of foreign methods and machinery on the part of American engineers cannot fail to result in greater progress in American mining

CHROMATIC ABERRATION AND VISUAL ACUITY.

By Louis Bell, Ph D.

It was long supposed that by some hocus pocus the refracting system of the human eye was achromatic. Therefore, the eye was not infrequently cited as an example of the infinite superiority of the works of the Creator over the handiwork of man. It remained for Wollaston in the early part of the last century to find out that the media of the eye are dispersive as usual, and that the eye as a whole suffers from chromatic aberration in about the same way as any other refractive system of similar constants. Fortunately the dispersion of the media of the eye is rather small, so that the magnitude of the chromatic aberration is considerably less than would be found, for instance, in a simple glass refracting system of the same focal length. That the result is not more troublesome in ordinary seeing is due to this fact and to the very low luminosity of the extremes of the visible spectrum.

The effect of the chromatic aberration is to make the violet rays come to a focus further to the front than the red rays, while the yellow and green rays take an intermediate position. In focusing by the act of accommodation these intermediate rays of high luminosity are automatically brought into focus on the retina, the red focus lying behind it and the violet focus in front of it. As the writer pointed out some time since in Vol. XLIII of the *Proceedings* of the American Academy of Arts and Sciences, it is only in virtue of a very high maximum point in the luminosity curve of the eye that we are able to see distinctly at all. And it is this same fact which prevents the chromatic aberration being conspicuous under ordinary circumstances. Were the extremes of the spectrum highly luminous there would be no definite focal surface for which accommodation could be adjusted.

Fig. 1 shows the luminosity curve of the eye for uniform distribution of energy in the spectrum, and Curve 2 of this illustration, which shows the luminosity at ordinary intensities, displays the greatly predominant effect of the yellow and green. In point of fact, the difference in refraction between the ends of the spectrum in the eye amounts to about 2 diopters in a total of about fifty-nine, which corresponds to a distance of between 0.5 mm and 0.7 mm in the focal surfaces for the red and violet rays In a structure of so short focal length as the eye this is enough to interfere very seriously with vision, as may be shown by an exceedingly simple experiment described by the writer in the paper just mentioned, as follows:

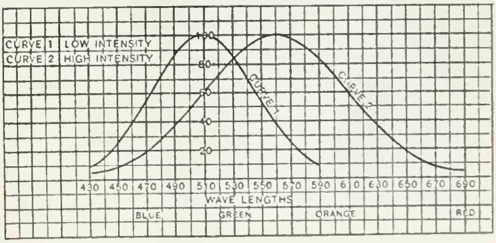


Fig. 1—Luminosity Curves for Uniform Distribution of Energy.

Procure a piece of very dark paper and a sheet of some vivid reddish-purple tissue. The Dennison violet tissue known as V 5 answers very well. Cut from the tissue a dozen strips about 5 mm wide and gum them upon the dark background leaving spaces between the strips about equal to their width Examination of this paper with the spectroscope shows that there is strong absorption in the yellow and green, the light reflected being chiefly from the two ends of the spectrum, hence the grid thus prepared, instead of showing strong luminosity in the usual place, upon which the eye can focus, provides two focal surfaces which nowhere coincide and which differ in position by nearly 0.5 mm. Such a grid when viewed at a distance of from 15 ft. to 20 ft. becomes an indeterminate blur. However, when looked at through a deep-red glass or a bit of gelatine dyed deep red with safranine the blue rays are eliminated and the grid stands out with startling distinctness. A suitable violet screen will produce a similar result, though the observation then requires correcting glasses of somewhere about — 1.5 diopter because the violet focal surface lies so far forward of the retina. If the retina were possessed of high sensitiveness for the ends of the spectrum, one would be driven to colored spectacles in order to secure any decent degree of acuity.

In passing it should be mentioned that, as is well known, the sensitiveness changes in low light, the maximum luminosity shifting into the full green, as shown in Curve 1, Fig. 1, hence the focal surface of maximum luminosity in very dim light is pushed forward from the retina and the eye becomes in dim light slightly myopic. This effect is complicated, however, by a slight change of the refracting power of the eye in the same direction owing to the widening of the pupil and the consequent exposure of corneal surface of slightly increased curvature.

A glance at Fig. 1 shows that, while the luminosity curve presents a very strong maximum, the luminosity of the ends of the spectrum cannot be left out of account, and one might reasonably expect a gain in acuity by the suppression of these extreme rays. In other words, the more nearly monochromatic the light effective in forming the retinal image the sharper in general that image must be. Hence in the case of artificial light which is strongly colored, and therefore gives greatly predominant luminosity in a comparatively narrow region of the spectrum, there should be more or less increase in the acuity of vision. Such distribution of luminosity is found in the light of some of the flaming-arc lamps, in that of the mercury-vapor lamps, in the light of the firefly, as has been well shown by Ives and Coblentz in Vol. VI of the *Bulletin* of the Bureau of Standards, and in that displayed by the somewhat similar luminescence due to photogenic bacteria.

The present paper gives some of the results obtained in an investigation of the effect of such reduction of the chromatic aberration on the seeing power of the eye. The luminescent sources just referred to are too faint for investigation under conditions that give normal vision. The light of the flaming-arc lamps, while showing the effect conspicuously, is too subject to fluctuation for easy photometric investigation so that most of the experiments here recorded were performed with the mercury-vapor lamp.

In a strict technical sense the light of the mercury-vapor lamp, like that of the flaming-arc lamp, is far from being monochromatic, but so far as effective luminosity goes the spectrum of the former is perhaps the closest approximation to monochromatism of the light of any commercial illuminant. It consists essentially of four lines, a strong pair in the yellow-green of wave-lengths 579 $\mu\mu$ and 577 $\mu\mu$ respectively, another extremely brilliant line of wave-length 546 $\mu\mu$ and hence of a somewhat fuller green, and a brilliant deep-blue line of wave-length 436 $\mu\mu$.

There are in addition to these a very faint crimson line, a faint blue-green line and a pair of weak lines in the far violet. A rough measurement of the intensity of these lines made with a wedge photometer behind a direct-vision spectroscope using the method of extinction showed that about 90 per cent of the visible light of the mercury-vapor lamp is due to the three brilliant lines close together in the green. Of the remaining small proportion, by far the largest part of the visible light is due to the deep-blue line, which gives the bluish cast apparent in the mercury tube. As has been shown by Sir William Abney in his "Colour Measurement and Mixture," it takes only a very small proportion of strongly colored light to add a perceptible tinge to ordinary white light, and a few per cent admixture of any pronounced color in any combination of colors shifts the apparent hue very materially.

There is a very strong subjective element in our perception of color, which is conspicuous in any attempt to photometer colored lights. This subjective tinge of hue is very striking in using the Lummer-Brodhun photometer, the color being much less conspicuous by itself than when seen in sharp conjunction with the light of an incandescent lamp.

The low luminosity of the blue mercury line leaves the green lines enormously predominant, and in viewing objects illuminated by the mercury-vapor lamp the eye focuses itself with respect to these, which are sufficiently close together to give nearly coincident focal surfaces. In a similar way, in viewing objects illuminated by an ordinary yellow flame-arc lamp the eye focuses for the surfaces determined by the orange-yellow and yellow-green bands, which lie near together in the spectrum and which are responsible for a very large proportion of the light.

In examining the conditions of visual acuity the first task was to determine the relative intensity of the mercury-vapor lamp and the tungsten lamp used as sources of illumination. For this work reliance was placed in the result obtained by the flicker photometer, which seems by general consent the most suitable instrument for direct comparison of lights differing widely in color. The particular form used was a Simmance-Abady flicker instrument, which replaced the usual Lummer-Brodhun screen on the photometer carriage. Tungsten secondary standards varying in rating from 40 watts to 150 watts were kept on the left end of the 2.5-meter photometer bar. At the right-hand end the mercury-vapor lamp or other illuminant was placed above the usual double-mirror arrangement for directing the light along the bar. The mirror factor was checked several times during the investigation and the mirrors were kept scrupulously clean.

The flicker photometer was tested by reversal and was found to reverse with great precision. The ratios found between a 100-watt and a 40-watt tungsten lamp varied on reversal less than 0.4 per cent, an amount within the average error of setting. It then seemed desirable to ascertain whether any idiosyncrasy in the light of the mercury-vapor lamp is troublesome in its measurement with the flicker instrument. Having determined by flicker the ratio between a tungsten standard and the mercury tube in a certain definite position, the following procedure for checking this value was adopted:

After considerable search a green signal glass was found of which a polished disk 2.6 mm thick reduced the tungsten standard to approximately the same apparent color as the mercury arc. This it did by greatly reducing the intensity of the red end of the spectrum, leaving the remainder of the continuous spectrum intact. The next step was the determination of the coefficient of transmission of this screen, using the flicker photometer to ascertain the ratio between a screened and an unscreened tungsten lamp. The coefficient thus obtained, 10.8 per cent, depends then merely upon the comparison by flicker photometer of two tungsten lamps, one of which is screened by green glass, and does not involve the discontinuous spectrum of the mercury light. Finally the screened tungsten lamp was compared directly with the mercury-vapor lamp by means of a Lummer-Brodhun screen, a comparison extremely easy to make on account of the close similarity in color. There was thus obtained a value for the candle-power of the tube in nowise depending on the suitability of the flicker photometer for measuring the tube. The value found for the candle-power of the tube in this way varied by a trifle less than 1 per cent only from that determined by direct comparison of the tungsten standard and tube by means of the flicker photometer. It is, therefore, evident that, at least under the conditions of its use here, the flicker photometer furnishes as valid a comparison between a tungsten lamp and a mercury tube as it does in ordinary heterochromatic photometry.

For the acuity measurement the first device employed was the acuity wedge, shown in Fig. 2. Here *BB* indicates the photometer bar. The photometer head was removed from the carriage and in its place was set a 60-deg. wooden prism about 5 cm on a side and about 15 cm in height, with its rear face parallel with the photometer bar. Perforated screens limited the direct beams of light so that they fell fairly upon the sides of the wedge. These screens were continued in the front by another dead-black screen with an aperture *e*, about 20 mm wide and 50 mm high, through which the observer looked toward the forward angle of the prism, the eye being placed at convenient reading distance in front of the slit *e*. The ordinary sliding velvet screens *s'* and *s''* screened the light from the observer as usual. A standard tungsten lamp was placed at *S* and the mercury lamp in its customary position at *L*. Over the two front faces of the prism were then drawn tightly two parallel columns of printed matter, black on white with identical sizes of type. Then, looking through *e*, the observer balanced for equality the distinctness, shifting the wedge back and forth until a point was found where the paragraphs were equally legible on the two sides of the wedge. This particular proceeding was adopted to get the equivalent of a null method in the acuity measurement and to take advantage of a rapidly varying function of acuity—that is, the illumination—as the thing to be measured. The printed matter used varied over the ordinary sizes of book and newspaper type, the first thing used being a double column from the editorial pages of the *Engineering Record*. Afterward some small-type paragraphs from the same journal were tried, but most of the experiments were made with the standard test type of the American Ophthalmological Society, advantageous on account of its unfamiliarity.

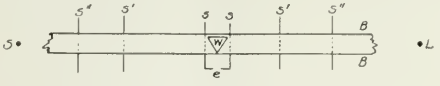


Fig. 2—Arrangement of Acuity Wedge.

Five observers participated in these acuity tests, all of them being experienced in photometry. Settings for equal acuity proved to be more consistent for any one observer than would have seemed at first sight probable. A typical set of readings, neither better nor worse than most, is here given.

J.	J.
129.6	135.4
137.7	130.6
136.4	128.9
132.9	130.1
128.9	134.4

The readings are in centimeters from the standard lamp on the photometer bar. There were considerable variations, as might be expected, in the average results reached by the several observers. Particular care was exercised to see that the observers got no clue as to where a balance had been found by the others. At least three of the five had no knowledge of the results being reached, and before calling each of them in to observe the carriage was shoved into an entirely impossible position. The ratios between the mercury lamp and the incandescent standard thus found by the five observers were as follows: B, 9.00; K, 8.04; J, 10.25; G, 12.9; W, 12.65.

Now, the real ratio between the luminous intensities as determined in the manner already described was 1:5.42. The apparent candle-power of the tube as determined by equal ease of reading was, therefore, on the average 1.95 times the actual photometric candle-power. This quantity, therefore, measures the difference in acuity sought. It should here be added that the actual intensity of the illumination on the type in these measurements ranged from about 15 meter-candles to 20 meter-candles on the tungsten side.

There was a marked sense of sharper definition on the side of the mercury tube and several of the observers could only be persuaded by careful inspection that the type on this side was not actually larger than that on the other. There was also a perceptible added strain on the accommodation on the side of the tungsten lamp in making these judgments of acuity, the comparatively slight difference in focus being at once obvious.

To get, if possible, a still closer estimate of the effect of the quasi-monochromatic mercury light on acuity a second series of experiments was conducted with a modified acuity photometer. This is shown in diagram in Fig. 3, where, as before, *BB* are the photometer bars, and *s, s', s''* the usual screens. Instead of the prism, however, a table 15 cm square was placed upon the photometer carriage. At *b* a vertical plate with clips to retain the target was placed. A vertical blackened brass septum *c* projected forward nearly to the axis of the photometer bar and served to separate the two halves of the target while presenting merely a thin black edge to the eye. Two mirrors, 5 cm x 8 cm, were then placed on adjustable bases at *dd*. The light from the two sources to be compared fell upon these mirrors, and illuminated the target at *b* at nearly normal incidence. Between the inner edge of the mirrors is left an opening about 4 cm wide through which the target could be observed. Two rods *ff*, sliding under the table, carried a blackened plate *g* with an eye-hole fitted with three adjustable diaphragms, 3 mm, 5 mm and 8 mm in diameter respectively. Just in front of the eye-hole was a support for carrying auxiliary lenses when these were used. At *e* another adjustable support carried a lens split on the vertical diameter, the right hand being plain glass, the left-hand half of +0.25 diopter. This lens was used in many of the subsequent experiments to eliminate the difference in focus between the two sides of the target already referred to. With this apparatus experiments were carried out with the smaller test type of the American Ophthalmological Society, but chiefly with the wavy dotted lines of the target shown in Fig. 4. This choice was the result of many experiments in acuity targets presenting relatively high sensibility without involving the reading of sentences which might become more or less familiar. The diagram shown in Fig. 4 was printed in black on white, in white on black, and also in black and in white on numerous colors from deep reds through the spectrum to violets. The wavy dotted lines gave on the whole more definite settings than did the paragraphs previously used and gave also better agreement between the several observers. The readings, for instance, obtained by observer J ran as follows: 131.7, 129.2, 125.0, 125.6, 123.5, 123.5, 126.7, 125.4, 128.8, 128.5, and the results obtained for the ratio between the lamps by the five observers were as follows. Black on white—B, 9.74; K, 9.62; W, 9.37; J, 9.89; G, 10.10. From these readings the mean apparent candle-power of the tube was 1.76 times the actual photometric candle-power, the intensity of illumination on the tungsten side being of the same order as before. As a check on this a precisely similar target with white lines on black was tried and four observers obtained on it the following ratios: B, 9.02; W, 7.76; J, 9.66; G, 9.95, showing again increased acuity on the side of the quasi-monochromatic light of quite the same order of magnitude as before.

Some experiments were made on a yellow flaming-arc lamp, with the result of obtaining qualitatively the same impression of increased sharpness as with the mercury-tube lamp. The fluctuations in the light, however, were too great to permit of coherent settings, although there was no doubt as to the nature of the phenomenon. The experiment gave useful information as to the character of the phenomenon dealt with, since

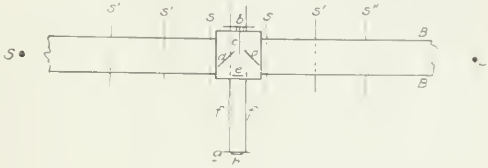


Fig. 3—Acuity Photometer.

the effective luminosity of the flame-arc lamp lies fairly near to that of the tungsten lamp instead of being materially displaced into the green, as with the mercury-tube lamp. Hence the increased acuity must be chiefly, if not entirely, due to the monochromatic character of the light rather than to the difference in color. Theoretically, as was shown by Lord Rayleigh years ago, the resolving power of any dioptric system increases as the wave-length of the light decreases, a fact often taken advantage of in photomicrography, and, therefore, one might have enhanced acuity with a greenish light, since Lord Rayleigh's theory applies to the human eye. The experiment with the flame-arc lamp, however, showed that this factor in the case is at least not conspicuous, so that the results seem to be due simply to lessened chromatic aberration. The intensities at which the observations were made preclude any material effect due to Purkinje's phenomenon. The conditions also included extreme contrast, so that the effect of variations in Fechner's fraction may also be left out of account. One must therefore conclude that the quasi-monochromatic light of the mercury-tube lamp and other nearly monochromatic sources actually does give at ordinary reading distances, such as those here taken, materially increased acuity for details in white on black or black on white. Such a monochromatic source shows, as judged by acuity measurements, roughly from one and one-half to two times its real photometric value, when compared with light of continuous spectrum derived from ordinary incandescence.

The experimental fact certainly is that the nearly monochromatic source enables equal acuity to be attained at an illumination much lower than is necessary in the case of the light of the continuous spectrum in about the proportion stated. This does not, of course, imply that the visual acuity rated according to Snellen's scale varies in this ratio. Reduced to Snellen's scale, on the basis of König's data, as given in *Sitzungsber. Berl. Akad.* 1897, 559, the change in acuity would be equivalent to something like a change from 5/5 to 6/5 or 5/4. How far this same difference would hold for a monochromatic source of violet or deep red remains to be seen, and the writer hopes later to look into this matter. Nor do these experiments include tests of the relation between illumination and acuity for distant vision, in which, as Dow has shown in an article in the *Illuminating Engineer* (London, Vol. II, page 233, etc.), the power of the eye to focus light of different colors changes radically from the conditions of near vision. This fact, indeed, has already been mentioned in considering the visibility of the violet grid as a test of chromatic aberration. Dow's experiments, like those here cited, indicate that the blue-green end of the spectrum is advantageous for near vision. Ashe, as shown in an article in the *Electrical World* of Feb. 25, 1909, finds also an advantage in acuity belonging to the shorter wave-lengths at moderate distances. Dr. Stuhr, working under the direction of Prof. L. Weber at Kiel, as shown in an article in the *Illuminating Engineer* (London, Vol. II, page 345), finds also a similar gain in acuity as one passes away from the red end of the spectrum. The results of these investigations would appear to show the actual application of Rayleigh's theorem to vision, but how far this was complicated by the effect of chromatic aberration one cannot say without knowing precisely the kinds of red, green and blue light used in them.

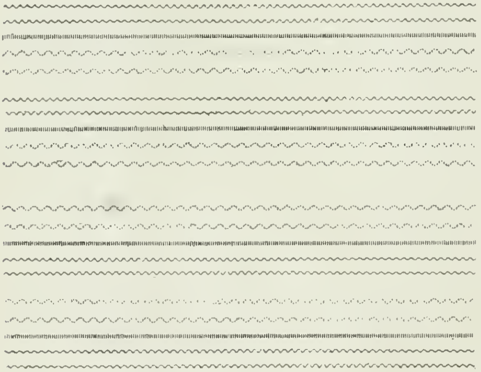


Fig. 4—Testing Target.

The only other recent investigation of acuity by lights of different kinds is the very interesting research of Broca and Laporte recorded in the *Bull. Soc. Int. des Electriciens,* June, 1908. These experienced investigators found no material difference in acuity between any commercial illuminants due to color, even as between the light of the mercury-arc lamp and that of an incandescent lamp, and their results are therefore apparently at variance with the results here recorded and the results of the investigations just quoted. The explanation of the results of Broca and Laporte is, however, an extremely simple one. In their experiments they first adjusted the reading photometer to apparent equality of brightness and then, leaving the target in that position, measured the acuity. They were, therefore, in about the condition which would have been reached in the experiments here recorded if the wedge *w* in Fig. 2 had been adjusted to equality of apparent brightness and acuity comparisons had then been instituted. To test this matter four of the observers made careful settings of the wedge for luminosity balance, when covered with plain white paper. The results were as follows: B, 8.41; K, 6.86; J, 10.93; G, 10.1. The balance thus reached is of the same order as that found for the balance by acuity, the comparison in each case being between the tungsten lamp and the mercury-tube lamp. In other words, Broca and Laporte practically eliminated their difference of acuity by their balance for apparent brightness. This same source of error has been pointed out by Ashe. Had Broca and Laporte established equality of brightness for their target by the flicker photometer, or even by an equality-of-brightness photometer used in the way indicated by Ives in an article in the *Transactions* of the Illuminating Engineering Society (Vol. V, page 711), they could not well have missed finding a difference in acuity. It should here be pointed out that the results obtained, both by the writer and by Broca and Laporte, by the equality-of-brightness method are not in the least in contravention of the work of Ives here quoted, since that investigator merely shows that under particular conditions even with considerable color difference the equality-of-brightness method and the flicker method may give substantially coincident results, while he emphasizes the decided superiority of the flicker instrument for heterochromatic photometry on the score of its much greater sensibility and ease of setting. In general, the flicker photometer does not agree with contrast comparisons which vary in the direction here found.

The writer's experiments merely make it apparent that a nearly monochromatic light has, through its great reduction of chromatic aberration, a power of revealing detail considerably greater than its photometric intensity would indicate. It acts as if it were a light of much higher candle-power than it really is. In fact, the assumption that the gain in acuity is due to a real difference in candle-power instead of the spurious difference indicated by the equality-of-brightness comparison would lead to an efficiency of light production in the mercury tube which is, in the writer's judgment, quite inadmissible. Unless the flicker photometer, contrary to all the investigations that have been made of it, is wholly untrustworthy, this difference is due chiefly to the large decrease in chromatic aberration. If one were to take the other horn of the dilemma he would have to credit the mercury arc and the yellow flaming arc with truly prodigious light-giving efficiency. There is no reason, however, to distrust the correctness of the results reached by the flicker method, particularly in view of the researches of Ives.

The writer desires here to express his deep obligation to Dr. Charles H. Williams for most efficient assistance in planning and carrying out the tests here recorded.

THE THREE-TRANSFORMER METHOD OF CHANGING FROM TWO TO THREE PHASES.

By F. T. Wyman.

The method in common use for changing from two phases to three phases, or the reverse, is one involving the use of two transformers with either the secondaries or primaries T-connected. In this method, which is illustrated in Fig. 1, the voltages are subject to distortion not only when the secondary loads are unbalanced, but also under balanced non-inductive loads. If one of the transformers becomes inoperative, then only one phase remains active on either the three-phase or the two-phase side, so that the whole system is out of commission until a new transformer can be installed. Consequently, in order to insure continuity of service a spare transformer must be continually carried in stock.

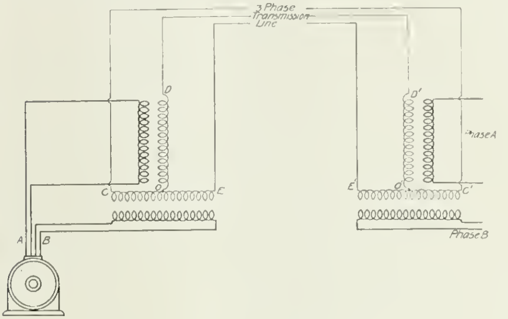


Fig. 1—Transformation with Two Transformers.

A three-transformer method of obtaining the same results, which seems to possess some merits, although it has not been applied practically to any great extent, is shown in Fig. 2. The transformers are shown Δ-connected on both the primary and secondary sides, although the transmission-line side can be either Δ-connected or Y-connected as the requirements of transmission demand, and the neutral of the Y-connected system may be grounded if desired.

In comparison with the two-transformer method, the three-transformer method possesses the advantage of allowing the two-phase voltages to be obtained from the same transformer coils connected for and delivering three-phase voltages; however, the two-phase voltages are not equal in value to the three-phase voltages, and the ratio is not a convenient one, being 1.00-to-0.866 = 1.155-to-1.00.

If one of the transformers in the three-transformer system should become inoperative, then the two remaining ones can immediately be temporarily V-connected and carry the load until the other is repaired, thus avoiding the necessity of carrying a spare transformer in stock. When a spare transformer is kept in stock its rating is only two-thirds as great as a spare transformer for a two-transformer scheme.

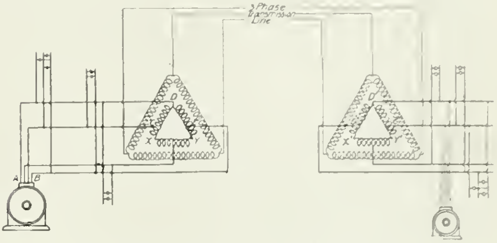


Fig. 2—Transformation with Three Transformers.

The three-transformer scheme possesses a disadvantage as compared with the two-transformer scheme in that "interconnected" two-phase generators or motors cannot be used, as destructive local currents would be produced in the windings. It is superior to the two-transformer scheme in its greater freedom from unbalancing of voltage and larger factor of safety for continuity of service.

Central Station

Management, Policies and Commercial Methods

ELECTRIC-APPLIANCE DEMONSTRATIONS FOR THEATER PATRONS.

The new offices of the Union Electric Light & Power Company of St. Louis share a building with the Shubert Theater in that city, and the sales and demonstration rooms of the electric company adjoin on either side, and can be entered from the theater lobby. The demonstration room is kept open evenings until after theater hours, and provides a pleasant reception room for theater patrons, both before and after the performance. Persons waiting for friends, carriages, etc., are invited to step into the electrical reception room, where electric household heating and motor devices, fixtures and even an electric automobile are exhibited. The room is invitingly arranged, and is comfortably equipped with chairs and writing tables. Visitors show a lively interest in the electric appliances, and a number of good sales have been traced to these demonstrations, which secure the attention of a good class of people. At 1:30 Wednesday and Saturday afternoons, the matinee days, a dainty electrically cooked luncheon is served to visitors. Creamed asparagus on toast and percolator coffee is a sample menu, the offering being varied in various simple combinations. Ladies display much interest in the operation and results obtained with electric cooking devices, and frequently order appliances for their own use.

LIABILITY FROM FAILURE TO HAVE WIRES INSULATED.

A verdict of $5,000 against a light and power company was the result of the company's failure to have its wires properly insulated at a point where they crossed a public street, in a recent decision of the Kansas Supreme Court (Winegarner vs. Edison Light & Power Company). The action was brought to recover damages for the death of the employee of a house mover in the city of Wichita, Kan. His principal duty was the driving of a team to convey materials used in house-moving operations. When not so engaged it was his duty to assist in any way in the business, and he was accustomed to handle electric wires when it became necessary to do so in moving buildings under them. In accordance with the requirements of the ordinances of Wichita a permit had been obtained from the city clerk for the moving of a certain building. The house mover the day before the work was to be done had given notice to the electric light company of his intention to move the building, and the employees of the company next morning removed the wires near the building and remained in the neighborhood, subject to call in case they were needed. The building was moved along the street to a point where other wires of the company crossed it, strung at a height of about 20 ft. The comb of the roof was higher than the wires, and the wires were raised by the house mover. The building stopped after the wires had been partly passed. The mover did not call upon the electric company's men to handle the wires, but testified that he intended to attend to them himself. He was detained, however, in talking to a man who sought to engage his services, and the employee, being disengaged at the time, climbed upon the roof, evidently to attend to the wires. In some way he came in contact with the wires, which were uninsulated, and was immediately killed. It was not shown that the electric light company had actual notice that the house was to be moved past the place where the accident occurred. It was held, nevertheless, that the company was bound to have its wires crossing streets so insulated as not to be dangerous to persons coming in contact with them. In other words, the company was bound to know that houses are occasionally moved under its wires and to make proper provision against accident, and was not entitled to be notified whenever such an operation was to take place.

EMERGENCY LINE AUTO WITH SEARCH LAMPS.

An emergency repair automobile in use by the line department of the Cincinnati Union Gas & Electric Company is equipped with a pair of powerful search lamps which render valuable service in illuminating pole tops or other places where rush repair jobs must be done after nightfall. The 8-in. reflector search lamps are supplied with acetylene gas from a compressed-gas storage tank carried on the car, and the lamps are mounted on trunnions so that they may be turned to throw their beams in any direction required. The repair automobile also carries an emergency repair tool-box, and has everything aboard necessary to make ordinary line repairs. When a hurry-up call is received at the garage where the car is stabled, the machine is first run by the homes of the men who will be needed on the job. After picking these up, no time is lost in getting to the scene of the trouble, for the car is a speedy one. For protection against wet weather the seats for the linemen are covered. In case it becomes necessary to replace some piece of line apparatus the car can be dispatched back to the storeroom for it, with the minimum delay to those on the job.

CORPORATION REGULATION IN OKLAHOMA.

The electric-light companies operating in Oklahoma enjoy —or rather suffer—a degree of regulation by the local State Corporation Commission which is probably unequaled in any other state in the Union. Much of the power of the Oklahoma commission, however, is manifested in instructions for the companies to make out numerous and lengthy reports, question blanks, etc. The monthly report sheet which every public-service corporation must file with the commission comprises a large tabulated page analyzing operating expenses and receipts according to the commission's approved system of uniform accounting. This system divides company accounts under forty-two headings, eight pertaining to plant revenue and income, six to operating expenses, four to plant maintenance, eleven to accounts, etc., and thirteen to general expenses.

The blank for the annual report is a weighty 9-in. x 11-in. book of thirty-six pages, having about fifty lines per page. These are taken up with questions, answer spaces, tabular spaces, etc., totaling over 1000 entries if all questions are answered as required. As may be surmised, some of the questions asked are very searching. One inquires details of all options, etc., held by the respondent company; another requires that there be set down the affiliations, connections, etc., with any other corporations of each and all directors, officers, etc., of the respondent company. The proper answering of this mass of queries involves much onerous labor, which, of course, falls most heavily on the small-plant manager. One company in a town of 8000 population by employing an expert accountant familiar with its books and with the commission report form was able to have its report completed after four days of continuous hard work by the expert. A small-plant manager who worried along alone might require a month of spare time to complete such a report. The blanks are sent out July 1 and must be returned properly filled by Oct. 10. In addition to the last report there was appended a list of fifty-seven questions, each 100 to 150 words in length, and covering a broad and unique range of inquiries. Failure to comply with the Oklahoma commission's instruction involves a fine of $500 a day, each day's delay constituting a new offense.

ORGANIZATION CHANGES IN CHICAGO COMPANIES.

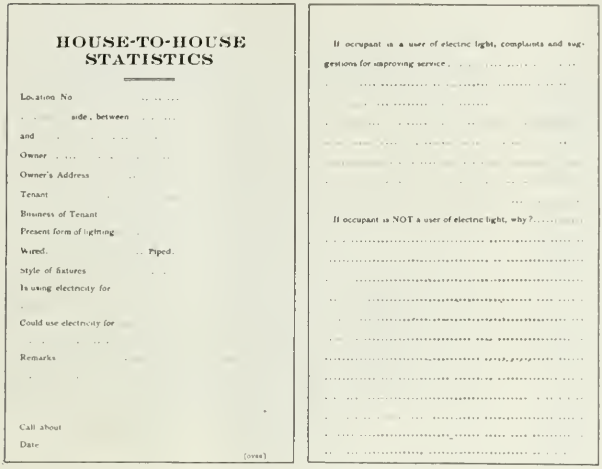
An executive order issued by President Samuel Insull, of the Commonwealth Edison Company, Chicago, makes some interesting changes in the operating and engineering departments of that company. The effect of these changes is to extend the general scope of the engineering department, which is located in the Market Street building, three floors of which will be necessary for the accommodation of this department. All engineering work for the underground system, heretofore done by the street department, and all work for the overhead system and on customers' premises, heretofore done by the inspection department, and all illuminating engineering have been grouped as a division of the electrical engineering department. Mr. H. B. Gear has been appointed engineer of distribution in charge of this division of the engineering department, with Mr. P. F. Williams as assistant. The engineer of distribution reports to the electrical engineer, Mr. R. F. Schuchardt. The position of general inspector is abolished, and all work in connection with installation and renewal of incandescent lamps is placed under the general charge of the chief operating engineer, Mr. W. L. Abbott.

Owing to general expansion of the business and increase in load it has become necessary to divide the territory of the North Shore Electric Company surrounding Chicago into three operating divisions, each in charge of a chief operator. These divisions are known as the north, west and south divisions. The north division will include the territory north of an east-and-west line coincident with the northern limits of Chicago. The south division will include the company's territory lying south of an east-and-west line coincident with the center of Seventy-ninth Street, Chicago. The west division will include the portion of the company's territory west of Chicago between the north and south divisions. The division chief operators will be held responsible for the electrical service in their divisions. They will report to the mechanical engineer, Mr. J. L. Hecht.

HOUSE-TO-HOUSE CANVASS AT HAMILTON, ONT.

Like most other public-service corporations, the Hamilton Electric Light & Power Company, Limited, has had its share of complaints, which, while not more than ordinary, nevertheless meant dissatisfied customers and the possibility of their becoming users of other commodities, such as natural gas, selling at 45 cents, or artificial gas, selling at $1 per 1000 cu. ft. To get at the bottom of these complaints a house-to-house campaign was decided upon because by this means the company could get in touch with the tenants of every house, flat, etc., where electricity could be used, ascertain the grievances of its present customers, and in addition find out why tenants were using other commodities in preference to electricity.

Six men were considered a large enough staff for the work of canvassing Hamilton with its 75,000 population, and these were thoroughly informed on the company's policy, etc. For the first few days the men stayed out only a few hours and the rest of the day was given over to sessions in which the complaints and questions (out of the ordinary) each man had received were discussed. In addition to special calling cards the canvassers were furnished with report blanks and a special number of the company's monthly publication, *The Electrical Bulletin*, which, in addition to short articles on complaints and co-operation, had information regarding rates. The canvassers in all their calls dealt directly with the man or woman of the house, and not with servants, housekeepers, etc. This oftentimes necessitated an extra call or a trip to the office of the man of the house. The blanks explain themselves. Strange as it may seem, it is not a custom in Hamilton for a landlord to wire his house and supply the fixtures, or if he does wire the house he seldom furnishes the fixtures. In many instances a tenant will wire (concealed) the house and furnish the fixtures or drop cords, and when he vacates the premises remove the fixtures or sell them to the incoming tenant. In other cases a tenant will wire (open work) the house and furnish his own drop cords or fixtures, and then when he moves out he either sells or removes everything.


HOUSE-TO-HOUSE STATISTICS

Location No

side, between

and

Owner

Owner's Address

Tenant

Business of Tenant

Present form of lighting

Wired. Piped.

Style of fixtures

Is using electricity for

Could use electricity for

Remarks

Call about

Date

(over)

If occupant is a user of electric light, complaints and suggestions for improving service

If occupant is NOT a user of electric light, why?

Canvassers' Report Blank.

RECAPITULATION OF 1096 CALLS MADE IN ONE WEEK BY SIX CANVASSERS.

Houses wired, piped, etc.	
Wired only	184
Piped only	316
Wired and piped	320
Neither wired nor piped	276
Illuminant used.	
Electricity	369
Gas	400
Oil	327
Reason 727 tenants are not using electricity.	
Not wired	309
Afraid of electric light	6
Not wired—too expensive	98
Wired—too expensive	65
Not wired—satisfied with gas	188
Wired—satisfied with gas	37
May move out, not decided to stay	18
Wired—no fixtures	6
Complaints of 369 tenants.	
None	326
Accounts somewhat high	18
Accounts very high	20
Meter not read right	1
Objects to meter rent	1
Meter does not register right	1
Lighting dim	2

A few days after the campaign started newspaper reporters were apprised of the fact, with the result that the issues of that day contained front-page articles on the efforts the company was making to satisfy all its customers, etc. A week later further newspaper articles told how the campaign was progressing. This publicity helped the men considerably in their work and was good advertising. The canvass worked out well and the canvassers, although they made only the one call, closed contracts daily and turned in good prospects which regular men followed up to advantage. From thirty-five to forty calls were made a day. This may seem many as compared to a regular canvasser's visits, yet when it is considered that they were purely missionary calls it will be appreciated that the work was not unduly rushed. When calling on customers the men endeavored to place irons, etc., and turned in numerous applications for irons and toasters on trial as well as many inquiries for other articles, such as vacuum cleaners.

The reports as turned in by the men were gone over daily and the data transferred to a regular follow-up system, filed according to street and number. Memoranda of prospects needing immediate attention were given to the company's regular canvassers for further attention. The information with reference to those residents not using electric light was filed and followed up subsequently with advertising matter.

The complaints of customers were given special attention. A letter was immediately sent to the customer stating that a representative had reported his complaint and that it would receive immediate attention. The complaint was then turned over to the proper department and thoroughly investigated. Where the complaint was based on a high bill the meter was either tested or changed, as seemed advisable. Blackened lamps were changed and smaller candle-power carbon and tungsten lamps were substituted in places. A letter was then sent giving the results of the investigation and stating what had been done to improve the service, etc. Other complaints were looked after in the same thorough manner, as it was realized that if complaints are made and not properly investigated it works against the company.

By investigating the different complaints and improving the service in some places the company made many good friends and found that taken altogether the house-to-house canvass with prompt attention to complaints was the best advertising.

STREET RAILWAY CHANGES FREQUENCY TO MAKE STANDBY SERVICE AVAILABLE.

In adding 2500 kw additional steam-turbine equipment to its generating station, where a 1500-kw engine and a 1500-kw steam turbine are now in use, both driving 25-cycle generators, the Oklahoma City Railway Company has chosen to install 60-cycle equipment, making its alternating-current system available for interconnection with that of the 8600-kw plant of the Oklahoma Gas & Electric Company in case of emergency. To this end it was first decided to re-equip the entire plant for 60-cycle generation, but it was later concluded to continue operating the Westinghouse-Parsons 1500-kw, 25-cycle turbine set, running the two turbines of different frequencies as entirely separate plants but paralleled on the 550-volt direct-current side of the rotary-converter and motor-generator sets. The engine-driven unit will be held in reserve.

On account of the characteristics of 60-cycle rotary converters, motor-generator sets have been installed at Oklahoma City to convert the 6600-volt, 60-cycle energy into direct current for the trolley circuits. Six 500-kw synchronous motor-generator sets are being used, two of which will be installed at the power plant and four at the substation. Two of these units are equipped with 100-kw booster generators, making them virtually three-unit machines. The new equipment, which was furnished through the Oklahoma City office of the General Electric Company of Texas, also includes a 1000-kw transformer for the transmission line to the substation and a new switchboard. The interchangeability thus possible between the generating systems of the street railway and central station companies obtained by the change to 60 cycles lends stability of course to either system in case of interruption or breakdown of its power plant.

EFFECT OF WEATHER ON LIGHTING BILLS.

The accompanying illustration shows part of an ingenious weather chart which is used by the New York Edison Company. The full chart presents graphically the number of clear and rainy days for a series of three years, arranged so that anyone can see at a glance where there has been greater call for artificial light this year as compared with the two years preceding. This graphic statement is sent out by the New York Edison Company to its patrons whenever bad weather during the past month will necessarily have caused an increase of the customers' bills. For instance, the chart recently sent out shows that, whereas for the first quarter of 1910 there was 62 per cent of clear weather in comparison with 38 per cent of dark days, for the same months in 1911 the amount of bad weather was noticeably greater. This method is a part of the New York Edison Company's efforts to keep its customers informed on their own lighting conditions and to maintain the friendliest possible relations with users of its service.

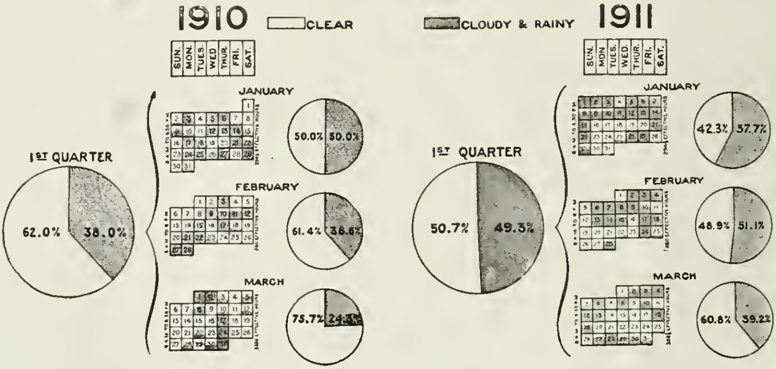


Chart Showing Percentage of Clear and Rainy Days.

CENTRAL-STATION DRIVE IN A PAINT FACTORY.

A motor load like that of a paint factory, which is made up of many long-hour grinding operations, is desirable business for the central-station company as well as the customer. The latter avoids the trouble and upkeep of an isolated plant, and enjoys the advantage of operating any part of his factory overtime without the expense of running the whole power plant. On the other hand, the continuous grinding and mixing processes involved in paint-making insure a good load-factor for the central-station's service.

The factory of the Peaslee-Gaulhert Company, paint maker, Louisville, Ky., has been recently converted to central-station service from its former operation by isolated-plant power. There was originally installed a 250-hp Skinner engine, direct-connected to drive a 125-kw, 220-volt direct-current generator at 200 r.p.m. Steam was generated in a battery of two Vogt boilers, equipped with automatic stokers. For a small plant the installation was a model one in every respect. Besides the lighting, this plant supplied energy for nearly 200 hp in 220-volt direct-current motors used to drive various machines in the paint factory. When central-station service from the lines of the Louisville Lighting Company was determined upon it was decided, rather than to re-equip the factory with alternating-current motors, simply to replace the old prime-mover unit by a synchronous motor-generator set, which by field adjustment could be made to take a leading current and thus improve the line power-factor. Accordingly a 135-hp, 2200-volt, two-phase self-starting synchronous motor, with self-contained exciter, was arranged to drive a 220-volt direct-current generator at 900 r.p.m. By increasing the field excitation of this synchronous motor it can be made to take a 20-per-cent leading current, which is of benefit to the central station in offsetting the lagging power-factors of other induction-motor loads. The steam-boiler equipment is now run at a reduced pressure to supply steam for heating the factory only, and the engine-driven set has been set aside preparatory to taking down.

In a paint factory of this kind advantage is taken of gravity routing to convey the products under process of manufacture from one machine to another, the raw material starting on the top floor and finding its way down, story by story, until at the bottom it is ready for kegging. The crude stock is delivered to the factory from cars on the company's private switch tracks and raised by two 10-hp electric elevators to the desired floor level. Liquids are lifted to storage tanks on the top floor by means of a 12-in. motor-driven centrifugal pump, oils, varnishes, turpentine and other materials being handled successively by the same pump.

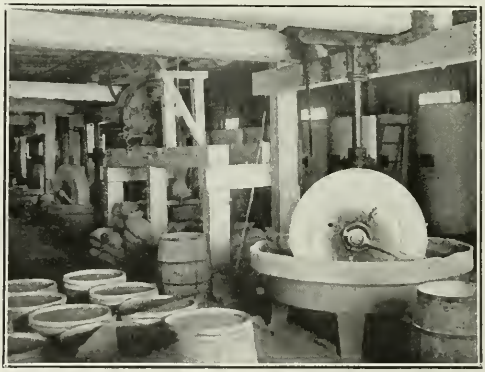


Fig. 1—Motor-Driven "Chasers" for Mixing Paint Ingredients.

On the top story the dry ingredients of the paint body, with the necessary oils, driers, etc., are thoroughly mixed together by the great motor-driven "chasers" shown in Fig. 1. These chasers consist of large circular pans around which huge solid-iron wheels and paddles slowly rotate. These machines accomplish thorough mixing of the paint ingredients before the latter are delivered to the grinding mills below. One 25-hp slow-speed motor, geared to a horizontal shaft, drives five such

72-in. chasers, the vertical shaft about which the wheel revolves turning at the rate of about 14 r.p.m. Clutches are arranged so that any chaser can be started or stopped without interfering with the operation of the others.

In a second type of paint-mixing chaser, shown in Fig. 2, rotating paddles are relied on to effect a thorough incorporation of the paint ingredients. The arrangement of the paddles or rakes is such that the material is continually worked over from the top and bottom of the pans. Some of these mixers are steam-jacketed, keeping the material warm during manipulation. The 22-hp motor, belted to a line shaft, as shown in Fig. 2, drives four 48-in. and six floor-type mixers, which are used for compounding special batch mixtures.

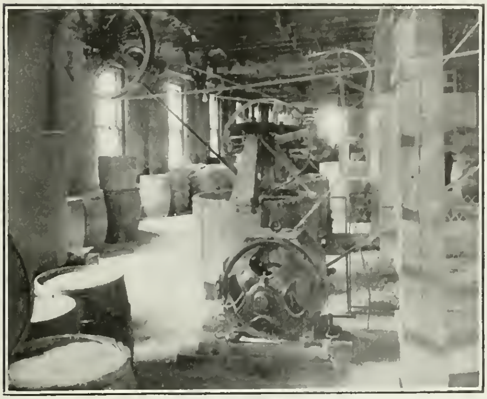


Fig. 2—Motor Operation of Steam-Jacketed Tub-Type Mixers.

From the mixing floor the paint material drops through gates to the grinding machines on the story below. These grinders are of three types—roller mills, burr or stone mills and iron mills. In the roller mills three 14-in. rollers, geared to revolve at increasing speeds from the first to the third, are mounted in a row. In passing between either pair of rolls, one member of which is revolving at higher speed than the other, a combined crushing and grinding action is given the paint material. This grinding is further effected by arranging one or more of the rolls with a cam motion to give a sidewise movement, which also aids in distributing the material on the rolls. Several roller mills are shown at the right in Fig. 3. In the burr and iron mills flat grinding surfaces of stone-to-stone or metal-to-metal, as the case may be, reduce the material to a finely ground condition. A row of burr mills is shown at the left in Fig. 3. In the case of both the burr and roller mills in the picture, it will be clearly seen how the raw material is supplied to the mills from the mixers above, while the ground product is passed on to the floor below or in the case of special batches which are to be kegged without ready-mixing it is collected in containers. By means of a line shaft one 20-hp motor drives six roller-mill units and also six burr mills. A 20-hp motor on the same floor drives four 30-in. burr mills and three 20-in. mills. A 20-hp motor installed on the floor below, where it drives a number of color mixers, is also belted up to a shaft on the grinder floor and operates five 20-in., two 18-in. and eleven 15-in. burr mills, and eleven 12-in. iron mills.

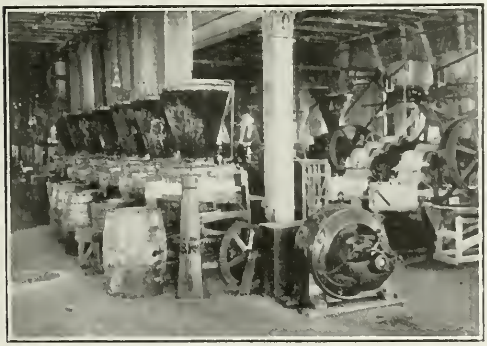


Fig. 3—Burr Mills and Roller Mills for Grinding Paint Bodies.

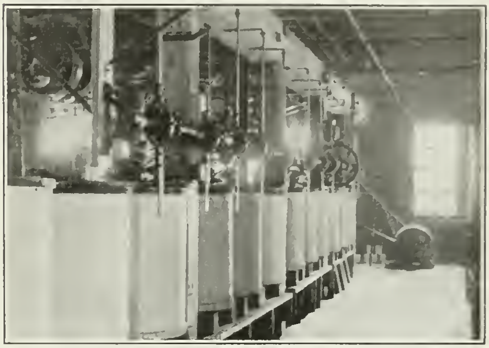


Fig. 4—Mixing Tanks for Preparing Ready-Mixed Paints.

After being thoroughly ground, if the paint body is to be made up into ready-mixed goods, it is dropped from the grinding mills into great mixing tanks on the floor below, where the liquid solvents are added and the whole mass thoroughly stirred into intimate mixture by powerful paddles. In the Louisville factory there are thirty vertical 150-gal. mixers and four 450-gal. horizontal "Jumbo" ceiling mixers, all of which are driven from a line shaft by the same 20-hp motor which operates the grinding mills last mentioned. These mixers are arranged with friction clutches so that any one or more tanks can be operated without interfering with the others.

A putty mill driven by a 20-hp separate motor is shown in Fig. 5. The chaser used is in general similar to that illustrated in the paint-grinding processes shown in Fig. 1. Two huge cast-iron wheels are used, and the machine complete weighs about four tons. Plows attached to the vertical rotating shaft undercut the contents of the pan and throw them continuously under the rollers, effecting a thorough mixing action on the dry materials and oils out of which the putty is made.

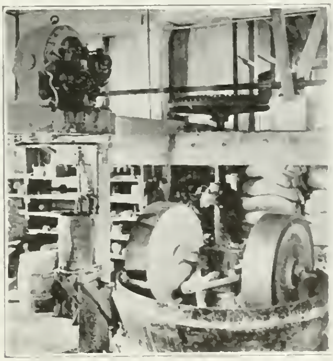


Fig. 5—Motor Geared to Putty Mill.

The factory described has an output of about 3500 gal. of mixed paints per week and also produces about 12 tons of leads, zincs and paste goods. Electricity is used for lighting throughout the plant, and the 220-volt tungsten lamps which have been employed have been reported to give very satisfactory life and service. A 3-hp motor is also used to drive two printing presses in the label department. The paint-maker's heaviest season is during the spring months, and the plant described consumes energy at a relatively high load-factor during its ten-hour working day. An average month's bill recently showed a consumption of about 20,000 kw-hours for the motor and lighting loads above described. Mr. Roscoe Woltz is the motor expert for the Louisville Lighting Company and had charge of the conversion of this equipment to central-station drive. The photographs reproduced herewith were obtained for illustrations in *Chained Lightning*, the monthly publication issued by the Louisville company.

ELECTRIC SIGNS IN BALTIMORE.

The Consolidated Gas, Electric Light & Power Company of Baltimore is conducting an aggressive advertising campaign for "Brighter Baltimore." From illuminated signs on billboards, cleverly writen advertising copy in all of the leading dailies of the Monumental City and circular letters to the leading merchants the central station is endeavoring to install electric signs throughout the business section. And it is succeeding. During recent weeks many public-spirited merchants are using energy for this purpose. Among the new signs that have been erected in Baltimore are the Teddy Bear sign on the New Theater and the new Victoria sign on the Victoria Theater. The new Bay Line pier will have a waving flag, as well as the monogram of the company depicted in electric signs that will be seen down the harbor. The Chesapeake & Potomac Telegraph Company has purchased from the Federal Sign Company a sign for the roof of its big office building on Light Street. This sign will be 72 ft. in length and about 12 ft. in height and will be one of the largest so far erected.

Wiring and Illumination

CURB LIGHTING IN FT. WAYNE.

Several months ago the property owners and business men in the central district of Ft. Wayne, Ind., decided to introduce a system of ornamental curb lighting. The accompanying illustration shows the attractive lamp standards which have been installed, the photograph showing the Anthony Hotel in the background. These posts are known as the "Fort Wayne Ionic standards." Each supports five tungsten lamps. The property owners agreed to purchase and install the lamps and posts, while the city, which operates a municipal plant, arranged to supply the necessary electricity. The lamps are connected to two circuits, one supplying the larger units on the tops of the posts, which are lighted all night, and the other the four lower lamps below the brackets, which, with the topmost lamp, operate until midnight. The lamp surmounting the post is rated at 100 watts, and each of the others at 60 watts. The globe for the former is 14 in. in diameter and those for the latter are 10 in. The shafts and capitals of these posts, which were designed and manufactured by the Western Gas Construction Company, are of pure Ionic design.

Curb Lighting in Ft. Wayne, Ind.

THE ENGINEERING OF INDIRECT ILLUMINATION.

By Jas. R. Cravath.

Although many articles have appeared giving details of the methods used for calculating direct illumination and planning such installations, very little has been written on the methods of planning installations of indirect lighting. A description of some of the methods worked out by the writer for the handling of this class of work in numerous indirect lighting installations during the past three years may be of interest in view of the increasing use of semi-indirect and indirect methods of lighting.

Of course, the first thing to be determined is whether the room in question is suited to indirect lighting. The first requisite is a light-colored ceiling. Pure white is the best reflector, and the nearer white the color of a ceiling the more efficient will be the reflection from it. It is usually desired to introduce some tint which may be more pleasing than dead white for decorative reasons. The addition of any tint lowers the efficiency, but a cream tint, for example, lowers the efficiency less than does green, which is a very inefficient reflector; in fact, considerable cream tint can be introduced without seriously affecting the efficiency of reflection. Brown and red are, of course, very inefficient. The color which is likely to be most deceptive is gray. Even the lighter tints of gray are poor reflectors, as they contain much black, gray being really a mixture of black and white.

Next after the color of the ceiling comes the question of its surface and contour. This immediately brings up the question of the type of indirect lighting which is to be installed.

The present article will deal only with indirect lighting from fixtures hung in the centers of the areas to be lighted and well away from the walls. Indirect lighting from coves will not be considered here, as it usually requires special shapes of ceilings in order to get reasonably good efficiency. Indirect lighting of the type which will be considered—that is, from inverted reflectors on pendent fixtures—can be carried out with ceiling outlets located in the centers of small rooms and in the centers of bays of large rooms, the outlets in general being located as for direct lighting. Such indirect lighting does not require any special architectural treatment of the room. In general the best conditions for it are the ordinary flat ceilings with a smooth surface. Corrugations in the ceiling tend to lower the efficiency for reasons which will be explained later, and in some cases arches and beams will lower the efficiency. Of course, by using enough electrical energy indirect lighting can be accomplished with ceilings of unfavorable shapes, surface or

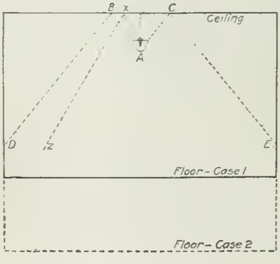


Fig. 1—Section of Room.

color, but these factors must be fully recognized and allowance made for them when planning the installation.

Fig. 1 shows a typical case of indirect lighting from a fixture hung in the center of a small room with a flat ceiling. It represents a cross-section of such a room. An inverted reflector with a lamp in it, located at *A*, throws a cone of light to the ceiling. Most of the flux of light strikes the ceiling between the points *B* and *C*. From *B* and *C* to the walls there should be a gradual tapering off of the illumination on the ceiling if a pleasant effect is to be produced. The reason for confining most of the flux of light to the center of the ceiling is to secure the best efficiency possible. For example, the ray *AX* in Fig. 1, if reflected from the ceiling at the same angle as its incidence, will take the path *XZ* and reach the working plane in the room directly from the ceiling with only one reflection. On the other hand, rays given off from the lamp and reflector at angles more oblique than the angle of the ray *AB* would strike the ceiling outside of the area between *B* and *C*, and if regularly reflected—that is, reflected at the same angle as that of incidence—would strike the wall and would necessarily undergo another reflection before reaching the working plane.

In these two cases just noted the assumption was made that the ceiling gives "regular" reflection like a mirror, with the angle of incidence equal to the angle of reflection. This assumption is necessarily made for the purpose of arriving approximately at the correct principles to follow in the design of indirect illumination. As a matter of fact, however, it is known that every calcimined or painted ceiling is not a regular reflector, but an irregular or diffuse reflector. Such ceilings are slightly rough. Each minute portion of the ceiling must be considered as a reflector by itself, and the minute portions are at an infinite number of different angles with reference to the general plane of the ceiling.

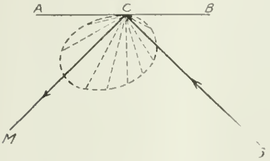


Fig. 2—Diffuse and Regular Reflection.

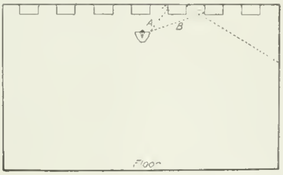


Fig. 3—Loss with Irregular Ceiling.

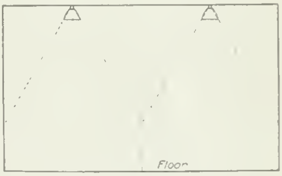


Fig. 4—Cones of Light.

The effect of diffuse reflection is shown in Fig. 2, where *AB* represents the plane of the ceiling and *SC* a beam of light striking the ceiling. If the ceiling were a regular or plane reflector the beam would be reflected from the ceiling at the same angle as the angle of incidence and would take the path *CM*. As a matter of fact it is diffused in various directions and takes various paths as indicated by the dotted lines. The subject of diffuse reflection was recently investigated by Mr. F. H. Gilpin and reported in the Illuminating Engineering Society *Transactions* for 1910. Fig. 2 is taken from an actual test by Mr. Gilpin on a certain sample of paper; it shows the relative amount of diffuse reflection in various directions in one of his tests. From this it is seen that, although the ceiling is far from being a regular reflector, nevertheless the intensity of reflection at the angle equal to the angle of incidence is greater than at any other angle. Hence in the theory of indirect illumination design it is proper to consider primarily the regular reflection from the ceiling.

It is common for those seeing indirect lighting fixtures for the first time to express wonder that there is no shadow of the fixture itself immediately under the fixture. If the ceiling were a perfectly plain mirror it is evident that there would be such a shadow. However, from an inspection of Fig. 2 it is seen that it is impossible for such a shadow to exist, because of the diffuse reflection of the light from all parts of the ceiling surrounding the fixture outlet. As a matter of fact the lightest place in the room is the point directly underneath the fixture, except in rare cases, where a very large bowl type of fixture is placed too close to the ceiling.

The influence which the shape of the ceiling may have on efficiency can easily be seen from Fig. 3, which represents the cross-section of a room having a ceiling with a large number of beams. Even though the beams are light in color they considerably interfere with efficiency. For example, the ray *A* would strike one side of a beam and if regularly reflected would be reflected to the ceiling, undergoing a second loss by reflection before it could be reflected back to the working plane. The ray *B* would be reflected from the side of the beam to the ceiling, thence to the side of another beam and thence to the upper part of one wall, so that it could not reach the working plane until after a fourth reflection. Of course, the fact that the ceiling and wall surfaces are diffuse reflectors modifies the assumption considerably, but by proceeding along the lines which give the highest efficiency on the assumption that the ceiling and walls are regular reflectors one may be sure of obtaining the maximum results.

In the lighting of small rooms, say, from 10 ft. to 20 ft. square, the common practice for the majority of conditions is to locate an outlet at the center of the ceiling. This is good practice both for direct and for indirect lighting. When planning the lighting of larger interiors the space to be lighted should if possible be divided up into squares with an outlet at the center of each square, or rectangle, just as would be the case with direct lighting. When planning direct lighting each lamp is assumed to throw a cone of useful light which will cover a certain area or circle. For example, the room which is shown in cross-section in Fig. 4 has two direct-lighting units. The cone of light from each covers a certain area. If the reflectors are translucent considerable light will be given off outside of the cones indicated. The object of the designer of efficient direct illumination, however, is to confine a considerable portion of the flux of light within a certain cone, and to locate the outlets so that the cones will cover the area to be lighted. In practice in a large interior the cones of light overlap each other and, in fact, considerable overlapping is always desirable on account of the reduction of objectionable shadows.

In the planning of indirect-lighting installations one must deal also with the fact that properly designed indirect-lighting units give cones of light just as do direct-lighting units. Thus in Fig. 1 *BCED* represents the lower part of a cone of light obtained by reflection from the cone *ABC*. The diameter of the base of the cone in Fig. 1 can be increased by lowering the fixture *A* or decreased by raising the fixture nearer the ceiling. To be sure, there is no well-defined cone in either the direct or indirect installations referred to, but there are certain limits within which one must work if good results are desired.

Referring again to Fig. 1, the cone of light of which *DE* is the base is just sufficient to cover the working plane with the floor located as in case 1, indicated by the solid line. If the height of the room be so increased that the floor is located as in case 2, Fig. 1, indicated by the dotted lines, and if the fixture be left in the same position relative to the ceiling, it is evident that much more light will be directed to the walls than in case 1. The flux of light striking the wall represents a certain loss, which may be considerably greater than in case 1. Thus it is impossible to light high rooms as efficiently as low rooms by indirect lighting. In case 2, Fig. 1, better results could be obtained by using a more concentrating reflector, or raising the reflector *A* nearer the ceiling, so as to reduce the diameter of the base of the cone of light that less may strike the wall.

On account of the diffuse reflection from ceilings and walls it is impossible to control the flux of light very accurately with indirect lighting, and in high, narrow rooms the efficiency must necessarily be lower than in low, wide rooms. The same thing is true with direct lighting, but the light can be more nearly controlled when one is dealing with the reflection from reflectors over lamps than when dealing with diffuse reflection from ceilings.

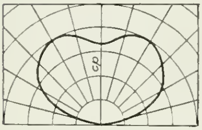


Fig. 5—Relative Distribution of Light from a Distributing-Type Indirect Reflector.

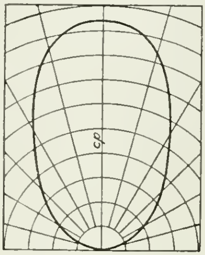


Fig. 6—Relative Distribution of Light from a Concentrating - Type Reflector for Indirect Lighting.

Some early experiments with indirect lighting of this type led the writer to believe that in small, high rooms marked differences in efficiency would be secured by raising and lowering the reflector. Thus in a room 9 ft. x 9 ft. and 11 ft. high it was found by rough tests that more illumination could be obtained at all points in the room by using a concentrating reflector placed close to the ceiling than by using a more diffusing reflector hung down some distance from the ceiling. Subsequently more accurate tests showed conclusively that, while this principle is both theoretically and practically correct, nevertheless the actual difference observed by raising and lowering the reflector within a considerable range is not what was at first supposed; in fact, in many cases the difference is so small that general appearances of the fixtures and the appearance of the light distribution on the ceiling carry more weight than the difference in light distribution on the working plane with any one of several heights of fixture suspension.

In Fig. 5 is given the polar candle-power curve from a type of reflector designed for indirect lighting of this character and classed as of the distributing type. With this reflector the lamp filament is about even with the top of the reflector and considerable light is given off to light the far corners of small rooms, in which it may be hung in the center. In Fig. 6 is given the polar candle-power curve of a reflector for similar uses, classed as of the concentrating type. The distribution of light obtained on the working plane with the reflector shown in Fig. 5, under given conditions, is shown in Fig. 7. This is a curve showing the ft.-candle illumination along a radial line, beginning at a point directly underneath the reflector. The test was made in a very large room with a ceiling 13.5 ft. high and the reflector 36 in. from the ceiling. Reflection from surrounding walls, etc., enters into the curve Fig. 7 to some extent. For the lighting of a large general office with reflectors of this kind at the ceiling height mentioned remarkably uniform illumination can manifestly be obtained by placing lamps at outlets 20 ft. apart.

With types of reflectors the candle-power distribution of which is illustrated in Figs. 5 and 6 the lamp filament is placed vertically within the reflector. It has not been found feasible to design reflectors which will permit spacing of outlets more than 20 ft. apart when very uniform illumination is desired in a large area with ceilings 14 ft. high, although very good results would be obtained with 24-ft. spacing. This is because of the limitations of the cone of light given from a reflector or group of reflectors at a single outlet. For example, the portion of a cone indicated by *DBCE* in Fig. 1 represents what might be called the cone of useful light from a reflector of the type of distribution shown in Fig. 5. The cone for Fig. 6 would have a narrower angle. The area of the base of this cone, as before explained, will be dependent on the distance the reflector is hung from the ceiling and on the ceiling height. In order to serve as a rough guide in determining distances of reflectors from ceiling and probable wall losses in various sizes of rooms it is well to prepare for each type of reflector used a piece of tracing cloth or transparent celluloid having the angle *ACE* marked upon it. A cross-section of the room should be drawn, for example, as in Fig. 1. Then by laying the angle *ACE* marked on tracing cloth over the cross-section of the room the amount of area that can be covered and the suspension height of the fixture can be determined at once. As before stated, however, considerable latitude can be allowed in fixture height. It is, however, manifestly uneconomical to hang a fixture with a distributing type of reflector very low in a high, narrow room.

In the lighting of large interiors with flat ceilings with indirect illumination of this kind, a safe general rule is that outlets can be spaced in the centers of 10-ft. to 24-ft. squares if the ceilings are 10 ft. to 14 ft. With very high ceilings the number of outlets can be considerably reduced. It is simply a case of drawing a cross-section of the room to scale and applying the critical-angle diagram spoken of to determine what the safe procedure may be.

DETERMINING THE NUMBER AND SIZE OF LAMPS.

The following very simple rule is used to determine the number and size of lamps for any given area to be lighted:

Multiply the average ft.-candles desired by the area in square feet, and divide this product by the percentage of efficiency. The result will be the number of lumens which the lamps must provide in order to compensate for all losses and deliver the required average number of ft.-candles. The percentage of efficiency is derived from actual tests on installations of a character similar to those under consideration.

Having determined the total number of lumens necessary by the foregoing rule, use can be made of lamp manufacturers' tables which show the lumens for various lamps operated at various voltages. It is then only necessary to provide enough lamps to give the lumens required. American makers of tungsten lamps are now publishing the lumens given by various sizes of lamps as a part of the regular information on these lamps. The number of lumens given by any lamp may be obtained by multiplying its mean spherical candle-power by 12.57. The mean spherical candle-power of the larger sizes of tungsten lamps, such as are mostly used for indirect lighting, is obtained by multiplying the mean horizontal candle-power by 0.78. In the absence of manufacturers' tables this suggestion may be of value for rough work.

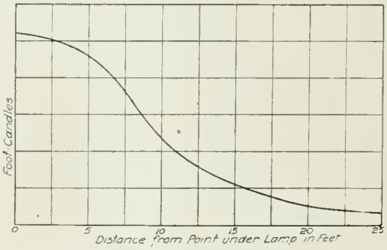


Fig. 7—Illumination from One Lamp (Reflector Shown in Fig. 5).

On account of the fact that the efficiencies of tungsten lamps of a given wattage rating are being changed from time to time by manufacturers, it is no longer feasible to use tables of watts per square foot, or watts per lumen, based on a constant efficiency of tungsten lamps, since the tables would have to be revised every time the lamp manufacturers change the lamp efficiencies. It is, therefore, more feasible to use one table which is of fairly permanent character, giving the efficiency of utilization of light, or, in other words, the percentage of efficiency from the lamps to the working plane in the room. This efficiency is the figure referred to in the foregoing rule for estimating illumination. Table I gives efficiency figures from tests on indirect lighting under certain conditions, which the writer believes to be thoroughly reliable. In estimating illumination according to these rules a liberal allowance should be made in addition for dirt on reflectors and lamps. What this allowance should be will depend much on the local conditions of the installation. It is usually safe to assume it to be 25 per cent, both for direct and indirect lighting for fairly average conditions.

TABLE I.—EFFICIENCY CONSTANTS FOR INDIRECT LIGHTING FROM CENTRALLY LOCATED FIXTURES WITH EFFICIENT MIRRORED REFLECTORS AND CLEAN GLASSWARE.

Room.		Color.		Per Cent Efficiency from Lamp to Working Plane.
Height, Feet	Dimensions, Feet.	Walls.	Ceiling	
8.5	12 x 16.5	Lt. Green	Lt. Cream	29.5
9.8	15 x 15.2	Dark Green	Lt. Cream	28.0
9.8	12.7 x 12.7	Lt. Figures	Lt. Cream	37.0
14.5	57.6 x 70	Lt. Cream	Lt. Buff	36.0

For the convenience of those who may wish to have the lumens output of various American tungsten lamps before them while reading this article Table II is given, showing the maker's rating in lumens of the various sizes of American-made tungsten lamps operated at top, middle and bottom voltage, according to the makers' standards of efficiency adopted in 1910. The manufacturers' policy is to keep the rated watts and the number of hours of life constant and vary the efficiency from time to time as improvements in lamp manufacture make it possible to do so. Consequently Table II is likely to become out of date at any time.

TABLE II.—LUMENS GIVEN BY TUNGSTEN LAMPS OF 1910 AMERICAN MANUFACTURE. (SUBJECT TO CHANGE WITH IMPROVED LAMP EFFICIENCIES.)

Rated Watts.	Voltage.	Lumens
25	Top	187
	Middle	173
	Bottom	160
40	Top	319
	Middle	298
	Bottom	277
60	Top	498
	Middle	464
	Bottom	463
100	Top	830
	Middle	773
	Bottom	722
150	Top	1245
	Middle	1160
	Bottom	1083
250	Top	2168
	Middle	2009
	Bottom	1873

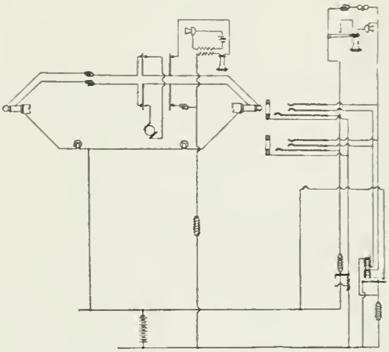
Although the number of tests given in Table I is small, yet it is believed that they are thoroughly accurate for the conditions stated and that with judgment the engineer can use them for a majority of cases which come up in practice after making allowance for conditions differing from those shown in the table.

RECENT TELEPHONE PATENTS.

COMMON BATTERY SWITCHBOARD.

There have been patented many schemes for common-battery switchboards wherein a differential relay was used to control the line signal. In many of these, however, the two coils of the differential relay were in different parts of the circuit where, no matter how careful the detail design, the leakage factor of practical working will be sufficient to destroy the balance. In the system patented by Messrs. D. L. Temple, of Chicago, and C. L. Goodrum, of Atlantic City, this difficulty is overcome. Furthermore complete supervisory signals are provided without the necessity of relays in the cord circuits.

By referring to the cut it will be noted that one winding of the differential line relay is permanently associated with one side of the line. The actuating circuit may be traced out to the hook switch and thence back through an auxiliary relay to the battery. Closing the circuit at the substation causes the actuation of the line relay and the display of the line lamp. Upon the response of the operator the plug tip registers not only with the usual tip contact, but it also engages a fourth or extra contact. By so doing the second winding of the line relay is cut in parallel with the first and thus both are subject to the same current fluctuations and a differential balance is insured at all times.



Temple and Goodrum Telephone System.

Inspection of the auxiliary relay will show that when it is actuated a short-circuit is removed from resistance in the sleeve wire of the jack. This is the part of the circuit which includes the supervisory lamp of the cord circuit. Thus if the resistance be high enough the supervisory lamp will not glow when the relay is actuated, but will glow with the resistance short-circuited. This patent is assigned to the Stromberg-Carlson company.

IMPROVED MOUTHPIECE.

Recently several patents have been granted to Mr. L. Steinberger, of Brooklyn, for special designs of mouthpiece. There is now at hand another modification. This improved mouthpiece has the usual contour, but it is made as near a solid piece as practicable. The front face is slightly hollowed out to form a shallow basin. Conical sound passages lead from this basin through to the base of the mouthpiece block. Some of the passages have their taper toward the diaphragm and some have the reverse taper. The idea is to provide a practically unbreakable mouthpiece which will be efficient.

MESSAGE METER.

Mr. G. W. Lorimer, of Piqua, Ohio, has obtained a patent for a message-counting device adapted to the requirements of a special type of automatic-exchange system. Provision is made to prevent a registration before actually initiating a switch or call. The meter is also locked until connection is established. No further connection may then be initiated until a count has been recorded.

LETTERS TO THE EDITOR.

"Synchronizing Reactance."

To the Editor of Electrical World:

Sir:—With reference to the article "Synchronizing Reactance" published in the *Electrical World* of April 20, 1911, I beg to call attention to the fact that the underlying principle of this synchronizing method was described in a German patent, No. 214,057, filed Oct. 27, 1907, and issued to me on Sept. 23, 1909. The function of my "Spannungswandler" of this patent corresponds to that of the "synchronizing reactance" of the above article. Although my patent employs additional means for indicating the proper moment of synchronism, on the basis of a pending American application, filed prior to the German, I am entitled to claims which broadly cover the synchronizing method described in the article.

New York C. A. Lohr.

Regenerative Control.

To the Editor of Electrical World:

Sir:—I wish to call attention to a slight mistake which crept into the last line of my letter as published in your issue of April 27. Unfortunately it makes no sense as it stands. I had written "there is no doubt that regeneration has reached a stage where it is bound to bring about revolutionizing commercial saving." In other words, I wished to convey, without going into a lengthy explanation, that regeneration had reached a point where it can be proved to bring about not only a saving of energy and brake-shoe maintenance, but such a saving as to leave a sufficient net balance in dollars and cents after everything in the way of additional repairs, additional interest on first cost and additional sinking-fund charges has been debited against the savings to revolutionize electric traction completely. As it reads now, "bound to revolutionize commercial saving," it does not even hint at the idea I had in mind. I should be glad to have you correct this last line so as to convey my thought.

Davenport, Ia. J. Gustaf V. Lang.

Characteristics of Various Illuminants.

To the Editor of Electrical World:

Sir:—A statement in the editorial appearing in the *Electrical World* for April 20, which discusses the article "Comparison of the Operating Characteristics of Various Illuminants," by Mr. Isador Ladoff, has led me to check up the total operating costs of some of these units. Mr. Ladoff has, of course, aimed to present data on the cost of energy alone for the different lamps, and it is not my desire to make any criticism of his article. However, I do feel that there is an unfortunate tendency to compare illuminants solely on the basis of energy consumption per unit of light flux generated, and that this tendency is strengthened rather than discouraged by the statement in the editorial that the relative positions of the four classes of illuminants would remain substantially unchanged by the inclusion of incidental charges. I can scarcely agree with this statement. The necessity for a complete analysis of the cost of lighting with the various illuminants cannot be too strongly urged. This point has been emphasized in recent numbers of the *Electrical World* by the letters of Mr. J. S. Codman, Jan. 12, 1911; Mr. Sydney W. Ashe, March 2, 1911, and Mr. R. Hillberg, April 6, 1911, yet its very general neglect seems to warrant a repetition of the fundamental considerations in a cost comparison.

In determining the total operating cost of any system of commercial or industrial lighting three items must be considered:

(a) Fixed charges, which include interest on the total investment, depreciation on permanent parts, and other expenses which are independent of the number of hours the lamps are used. Frequently this item forms the greater part of the total operating expense, yet it is almost invariably omitted from cost tables.

(b) Maintenance charges, which include renewal of parts, repairs, labor and all costs, except the cost of energy, which depend upon the hours of burning.

(c) The cost of energy, which depends upon the hours of burning and the rate charged for energy.

A charge of 6 per cent on the total investment is the lowest rate which will cover the items of interest, taxes and insurance. The allowance which should be made for depreciation is more difficult to determine, for obsolescence rather than the actual wearing out of parts usually determines the life of a lighting unit. The model lighting systems of six or seven years ago can profitably be replaced by the more efficient lamps of to-day, and there is every reason to believe that the rapid progress in the development of lighting units will continue. The careful investor will therefore consider a depreciation rate of not less than 12.5 per cent per annum when computing the total operating expense for a proposed installation. In the case of lamps which require renewal of parts at frequent intervals, the cleaning of globes and reflectors is usually included in the cost of trimming. Although mercury-vapor and incandescent electric lamps do not require frequent trimming, they should be cleaned at regular intervals. Thus this cost becomes a separate and fixed charge.

In order to compare the cost of illumination with two different units, it is further necessary that this comparison be based upon equal illumination from the two units under average service conditions. It is important, therefore, that in the case of units which are in practice used with a diffusing globe the values of candle-power obtained with this equipment rather than with clear globes should be considered. The comparative steadiness of the two light sources must also be taken into account. A discussion of this point will be found in the letter by Mr. Charles L. Tremaine in the Feb. 23, 1911, issue of the *Electrical World*. As was pointed out in the letter by Mr. Ashe, the ratio which the average candle-power of a lamp bears to the initial varies greatly with different lighting units. The illuminants which fall in the third and fourth groups according to the classification given in the editorial are particularly at a disadvantage in this respect.

	10-amp Inclined Flame-Arc Lamp.		1000-watt Cluster Tungsten-Filament Lamps.	
Terminal volts		55		110
Terminal watts		550		940
Cost of reflector-socket		.....		$7.00
Cost of lamp		$60.00	4x2.75	11.00
Total investment		60.00		18.00
Investment in permanent parts		60.00		7.00
Annual fixed charges:				
Interest at 6 per cent		$3.60		$1.08
Depreciation at 12.5 per cent		7.50		0.87
Cleaning		.....	12x0.05	0.60
Total		$11.10		$2.55
Maintenance per 1000 hours:				
Globes	1x1.50	$1.50		.....
Economizers	2x0.20	0.40		.....
Electrodes	60x0.15	9.00		.....
Trimming, inspection and cleaning	60x0.075	4.50		.....
Repairs		1.00		.....
Lamp renewals		......	$\frac{1}{1.7}$x11.00	$6.47
Total		$16.40		$6.47
Energy cost per 1000 hours at 1 cent per kw-hour		$5.50		$9.40
Total annual operating cost, 4000 hours operation, energy at 2 cents per kw-hour:				
Fixed charges		$11.10		$2.55
Maintenance	4x16.40	66.60	4x6.47	25.88
Energy	2x4x 5.50	44.00	2x4x9 40	75.20
Total		$121.70		$103.63

To illustrate the importance of these considerations I have analyzed the total operating cost of illumination with a 10-amp inclined flame-arc lamp and with a cluster of four 250-watt tungsten-filament lamps under conditions which are commonly met with in industrial lighting. The life of the tungsten-filament lamps has been taken at 1700 hours, corresponding to operation at low efficiency, which is the most economical at costs of energy below 4 cents per kw-hour. The rated life of seventeen hours has been assumed for the electrodes of the flaming arc.

From the table in Mr. Ladoff's article it appears that a tungsten filament lamp is more than five times as expensive as an inclined flame-arc lamp when only the cost of energy for total light flux generated is considered; yet in actual practice it is found that a higher illumination can be obtained from a 1000-watt cluster than from the 10-amp arc with the standard globe equipment. Even if the illuminations be regarded as equal it is seen that the total operating cost under conditions which are typical of industrial lighting is considerably in favor of the 1000-watt cluster.

On the other hand, if the same units were used for 1000 hours per year on a commercial circuit with energy at 10 cents per kw-hour there would be a saving of more than 20 per cent in favor of the flame-arc lamp. This emphasizes the necessity for making a complete cost analysis.

H. H. Magdsick.

Cleveland, Ohio.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Armature Reaction of Three-Phase Generators.—W. Rogowski.—The first step of Blondel's theory of armature reaction is to resolve the armature current into a watt component and a wattless component (with respect to the emf induced by the field). It is then possible to proceed in either of the following two ways: (a) The real field in the loaded machine is resolved into three imaginary fields; first, the exciter field, due to the mmf of the excitation; second, the counter field, due to the ampere-turns of the wattless current, and, third, the cross mmf, due to the ampere-turns of the watt current. The emfs induced by each of the three fields are calculated and combined to find the resultant emf E, which was to be determined. (b) In the second method the field of the loaded machine is resolved into only two imaginary fields, namely, the main field (equal to the sum of the exciter field and counter field in case a) and the cross-field. The emfs induced by the main field and cross-field may be E_1 and E_2 respectively. Now the following two problems are solved. First, how many ampere-turns must be given to the excitation at no load in order to get the emf E_1. If $Z_1 - X$ ampere-turns are required when Z_1 is the number of ampere-turns of the excitation of the loaded machine, then X is called the number of "counter-turns" (Gegenwindungen) of the machine. Secondly, how many ampere-turns are required on the cores in order to produce E_2 at no load? If Y ampere-turns are required, Y is called the number of "cross-turns" (Querwindungen) of the machine. Reversely, if X and Y are known, the two emfs E_1 and E_2 can be found directly from the no-load characteristic curve and by combining them the desired emf E of the loaded machine can be found. The author shows that there is something arbitrary in the conception of the counter-turns and cross-turns. Further, the second method (b) seems to be somewhat roundabout. However, it is justified by the fact that the counter-turns and cross-turns can be easily calculated by the wattless and watt ampere-turns of the machine, that they depend very little on the iron saturation, and that by a glance it is possible to judge from the no-load characteristic curve the magnitude of the emfs induced by the armature and the magnet field. The author shows that it is possible to avoid whatever is arbitrary in the definition of the counter-turns and cross-turns and describes a simple method for determining them.—*Elek. Zeit.*, March 23.

Single-Phase Commutator Motors.—J. Reyval.—A review of a recent paper of Niethammer on the properties of a single-phase commutator motor, with two sets of brushes perpendicular to each other. It has the properties of the series or repulsion motor on starting and at the same time the property of an induction motor of practically constant speed in normal operation.—*La Lumière Elec.*, April 8.

Lamps and Lighting.

Fluctuation of Temperature of Alternating-Current Lamps.—O. M. Corbino.—The author shows how the Braun cathode ray tube can be utilized to determine the resistance fluctuations of a metallic-filament lamp when operated by alternating current. He experimented with osram lamps of 16 cp and 32 cp at 105 volts and 42 cycles. He finds that the temperature of the 32-cp filament fluctuates about 10 deg. C. above and below the mean temperature, while the corresponding amplitude of the fluctuation of the 16-cp lamps is about 15 deg. C. He finally shows how to determine from his experiments the ratio of thermal capacity and the temperature-resistance coefficient of the filament at the temperature of normal operation. In order to increase the temperature of the filament to such a degree that its resistance varies by 1/1000, one-tenth of a gram calorie is required for each gram of its mass.—*Phys. Zeit.*, April 15.

Metallic-Filament Lamps.—A note on a recent British patent (24,549, April 13) of F. Skaupy, of Berlin, Germany. In order to reduce disintegration of the filament and consequent blackening of the bulb, the stem of the filament carrier is made hollow and contains a small quantity of halogen compound, the gas from which tends to prevent the disintegration. The hollow stem is in communication with an open sphere or bulb at the free end of the stem, and any deposit from the halogen compound is retained in this.—Lond. *Elec. Eng'ing*, April 20.

Metallic-Filament Lamps.—A note on a recent British patent (23,535, April 13) of G. F. Attwood, of Newark, N. J. Metallic filaments are particularly susceptible to breakage adjacent to the supports because the rigid connections render them less flexible at these points. According to this invention, the filament is fused to the extremity of the support as usual, but its movement at this point is limited by coiling the filament a few turns round the support. The use of two or more filaments in parallel for low-voltage lamps similarly coiled round the supports at their extremities is also covered by this patent.—Lond. *Elec. Eng'ing*, April 20.

Metallic-Filament Lamp.—A note on a recent British patent (15,621, April 6, 1911) of F. Skaupy. It describes the insertion into metallic-filament lamp bulbs of chemical compounds, which, when heated by the normal working of the lamp, will give off halogen vapors. If the pressure of the gas is so small as to be hardly measurable, its presence is said to diminish the disintegration of the filament and consequently blackening of the bulb.—*Lond. Elec. Eng'ing*, April 13.

Generation, Transmission and Distribution.

Steam Plant.—F. L. Richter.—The conclusion of his illustrated article on steam plant exhibits at the World's Fair in Brussels in 1910. In the present instalment the author deals with steam turbines and condensers.—*Elek. Zeit.* April 6.

Traction.

Electric Traction on Main Lines in Europe.—J. B. Sparks.—An abstract of a paper giving a review of the present status of heavy electric traction in Europe. In Germany the Prussian authorities have adopted the single-phase system at 10.000 volts, 15 cycles, and a large sum of money has been granted for the equipment of some 05 miles of double track between Magdeburg, Leipsic and Halle. A 16-mile section of this line has already been equipped and several different types of locomotives are undergoing trials. Some 180 miles of line in Silesia will also shortly be equipped on the same system. The State railway authorities of Bavaria and Baden respectively have also adopted the single-phase system of 10,000 volts, 15 cycles, and short main sections between Salzburg and Freilassing, in Bavaria, and between Basle and Zell, in Baden, are already being equipped. Plans have also been prepared by both states for the conversion of a large number of other lines. The Austrian State Railways will shortly have 29 miles of line near Trieste working on the single-phase system at 10,000 volts, 15 cycles, and plans have been prepared for a large number of lines south of the Danube. The Austrian South Railway Company intends to introduce three-phase traction on certain of its lines, and the same system may be employed for some of the State railways. A new main line, to be worked on the single-phase system at 10,000 volts, 15 cycles, is being constructed in the northeast of Austria to provide an additional connection between the railway systems of Bavaria and Austria. The Hungarian State railways will shortly have an important suburban system at Budapest, working electrically at 10,000 volts, 15 cycles, single-phase, and a portion of the main line between Prague and Vienna is also to be equipped shortly. Plans are also ready for a 56-mile section of the important line between Fiume and Budapest. The Swiss Federal Railways have decided to adopt the single-phase system at 15,000 volts, 15 cycles, and the St. Gothard Railway will probably be the first to be equipped. A short section of the Loetschberg Tunnel line, now under construction, is already working electrically on this new system. The equipment of the Simplon line, which is worked at 3000 volts, 16 cycles, three-phase, is to be extended at the Italian end of the line. The conversion of the 12-mile Giovi Tunnel line to 3000 volts, 16 cycles, is practically completed, as is also the Mont Cenis Tunnel line. A number of other main sections are shortly to be converted, but not necessarily on the three-phase system. The French State railway authorities are considering the introduction of electric traction on lines near Paris, and will assist in the conversion of the belt line just inside the fortifications. The Chemins de Fer du Midi have adopted single-phase at 12,000 volts, 16 cycles, and are already equipping a 70-mile main line section between Pau and Montrejeau, while it is probable that the whole 250 miles of line between Toulouse and Bayonne will be working electrically in a few years. The P. L. M. Company is making experiments on an electrically equipped track at Grasse, and has in view the conversion of the main line section between Cannes and Ventimiglia. The Swedish State Railway authorities have also adopted the single-phase system at 15,000 volts, 15 cycles, and an 80-mile line in the north is being equipped. Plans have also been prepared for the conversion of the whole system of lines south of Stockholm, and the necessary water-power has been secured. In Norway a 30-mile line is being converted to single-phase, working at 10.000 volts, 16 cycles.—Lond. *Electrician*, April 21.

Installations, Systems and Appliances.

Effect of Tariff on the Financial Results of Central Stations.—Norberg Schultz.—On the basis of statistical data collected from various European central stations the author investigates the effect which a change of tariff has on the financial results. Figs. 1 and 2 show the results obtained by the central station of Christiania in Norway, where up to 1898 a meter tariff was used, while later on flat rates were introduced, the mean receipts per kw-hour sold being gradually reduced from 15 cents downward. In Fig. 1 the abscissas give the average receipts in cents per kw-hour sold, while the ordinates give the average hours during which the kilowatts installed were used. It is seen that the hours of use remained practically constant as long as the average price of the kw-hour was above 7.5 cents. When the price decreased below this value the hours of use increased rapidly. In Fig. 2 the abscissas represent again the price of the kw-hour in cents received by the central station, while the ordinates represent the yearly receipts in dollars per kw-hour installed. With decreasing prices of the kw-hour the yearly receipts per kilowatt decrease, but on the basis of the experience of the last years in Christiania it seems that they tend to reach a minimum limit of $25 per kilowatt installed. Similar results are obtained from the statistical data of several other stations all of which use essentially flat-rate tariffs, and in all of them the limit value of the yearly receipts per kilowatt installed seems to be $25. While the conditions in general are similar in stations which use meter tariffs, the minimum limit of the yearly receipts per kw-hour seems to be in this case less than before, the figures for three stations being $18.75, $12.50 and $15 respectively. All the statistical data seem to prove that the flat tariffs give a higher yearly receipt per kilowatt installed than meter tariffs. The author finally investigates the effect of a change of tariff on the maximum load factor and the diversity factor and gives some general results, although it would seem that in this case there is a much greater difference between different stations. The article is illustrated by numerous diagrams.—*Elek. Zeit.*, March 23 and 30.

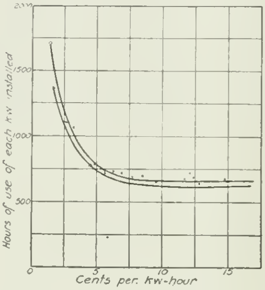


Fig. 1—Variation of Hours of Use with Rate for Energy.

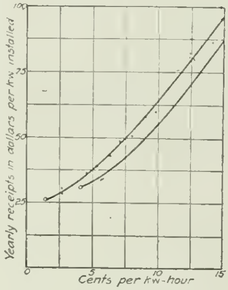


Fig. 2—Variation of Yearly Receipts with Rate for Energy.

Electricity Supply in Country Districts.—W. B. Woodhouse.—A paper read before the Yorkshire Section of the (British) Institution of Electrical Engineers, in which the author first reviews the effect of legislation on the development of electrical industries in Great Britain. The author next refers briefly to the various conditions which govern the cost of electricity. In a typical case the total costs are divided in the following proportion: Capital charges, 50 per cent; coal, 25 per cent; wages, etc., 15 per cent; management, 10 per cent. As the capital expenditure on small undertakings is about equally divided between generating machinery and mains, it is obvious that if a generating station can be avoided, as by taking a bulk supply, the expenditure and the risk are immediately halved. With respect to the distribution of energy the author considers only country districts. In a rural or agricultural district the needs for electricity may be divided under three main heads: Street lighting, cottage and house lighting, motor service supply to farmhouses. In such districts as these electricity supply can only be given at a cheap rate by the use of overhead mains. Underground mains would cost 75 per cent more; or, to regard the matter in another way, energy could be supplied for private lighting at 2 cents per kw-hour less if overhead wires are used. The lighting of country roads by electricity has many advantages over gas lighting. Freedom from disturbance or flickering during wind, rain or frost, better distribution of light between lamps and, therefore, more satisfactory illumination and lessened cost are among them. The use of electricity on farms is steadily increasing. Apart from the saving in cost the greatest advantage for the farmer is the fact that energy is available whenever needed, and when threshing is to be done there is no delay such as frequently happens when a portable engine is required. Electric energy may be obtained from an overhead line at any convenient point; the electric motor may be mounted on a farm wagon and set to drive a threshing machine, a turnip or hay chopper, a pump, or be used for any purpose for which motor service is required on a farm. Moreover, the farmhouse and buildings may be well and cheaply lighted. The small first cost of equipment, the general simplicity and ease of operation, and the small cost of upkeep are all important advantages, while the use of electric light in barns and buildings reduces fire risk to the lowest level. In a number of cases the electric company's supply has been used for cottage lighting, an inclusive charge per week being made for the supply of energy and lamps, there being no restriction on the hours of lighting. In one such case a group of fourteen cottages are supplied with energy, each cottage being lighted by two 60-watt lamps and two 120-watt lamps. The annual consumption of energy per cottage is 160 kw-hours. The consumption is large on account of the use of carbon lamps. The same illumination from metallic-filament lamps would reduce the consumption to 54 kw-hours per annum, or $4.32 per annum at 8 cents per kw-hour. In another case a group of twelve cottages are lighted each by three 16-cp tantalum lamps at an annual cost of $3.77. Six other cottages each lighted with four 60-watt lamps use an average of 78 kw-hours per annum, costing 12 cents a week at a price of 8 cents per kw-hour.—Lond. *Electrician*, April 14.

Electric Equipment of Barracks.—An illustrated description of the electrical equipment of Victoria Barracks, Windsor. The arrangement is in two halves. Energy is obtained from public mains which supply on the direct-current, three-wire system, the pressure being 220 volts across the outers. After passing through the usual cut-outs, the mains are led into a three-way link box, whence the two lighting circuits are tapped off from one outer and the neutral, while a motor circuit for the elevator is taken from the two outers. This link box makes it possible to change half the building from one side of the system to the other, if necessary. As regards the system of wiring employed, solid drawn-steel screwed tube is used throughout.—Lond. *Electrician*, April 14.

Wires, Wiring and Conduits.

Insulation Resistance in Networks.—F. Leprince-Ringuet.—The conclusion of his mathematical paper on the permanent control of the insulation resistance of an alternating-current network by means of simple voltage measurements. Tests of this kind made in existing installations, especially in the mines of Lens, have shown that the simple voltage measurements are sufficient to determine the danger which may exist to the attendants. The author prefers such voltage measurements to regulations concerning the amount of permissible stray current. As to the question whether the neutral point should be earthed or insulated he concludes that its insulation is preferable as it presents less danger for the security of the workmen. But it is necessary to control every day the condition of the network and its insulation resistance by simple voltage measurements.—*La Lumière Elec.*, April 8.

Electrophysics and Magnetism.

Condensation Nuclei.—G. Owen and H. Pealing.—An investigation of condensation nuclei produced by the action of light on iodine vapor. Camphor, naphthalene, benzoic acid and iodine do not sublime in the form of particles sufficiently large to act as condensation nuclei for water vapor. When moist air (or oxygen) containing iodine vapor is illuminated nuclei are produced possessing the following properties: The nuclei are very unstable, disappearing in a few seconds in the dark. They do not carry an electric charge. They are not obtained except in the presence of oxygen and water-vapor. They grow under the action of the light, but, generally, do not attain a size greater than that requiring a pressure-fall of 18.5 cm in order to catch them. The light required for their production need not be very intense nor of a high degree of refrangibility. No nuclei are produced after the iodine has been in the apparatus for some days. The cessation of the action is probably due to a state of chemical equilibrium having been attained. The equilibrium is destroyed by rinsing the glass walls of the apparatus with water. Glass-wool possesses the peculiar property of facilitating the formation of the nuclei, the number produced when iodine-laden air is admitted into the apparatus through a plug of glass-wool being much greater than the number obtained on placing iodine directly in the cloud-chamber. This property becomes less and less marked as the wool gets more and more saturated with the iodine. The action of the glass-wool is regarded either as being of a catalytic nature or as evidence of the wool being an unexpected source of contamination for the iodine vapor during its passage through it—*Phil. Mag.*, April.

Elementary Quantity of Electricity.—Two papers with respect to the experimental investigations of Ehrenhaft, who from experiments with ultramicroscopic particles concluded that they often carry charges much less than the so-called elementary quantity of electricity. A. Joffe points out another source of error in these experiments, while Ehrenhaft replies to the criticisms of Regener, Millikan, and Fletcher and maintains his original position.—*Phys. Zeit.*, April 1.

Gamma Rays.—W. Wilson.—A description of an experiment which was made to determine if the absorption coefficient of iron for gamma rays varies with the temperature. A negative result was obtained.—*Phil. Mag.*, April.

Electrons.—J. W. Nicholson.—A theoretical paper on the damping of the vibrations of a dielectric sphere (which is his proposed model of an electron) and the radiation from a vibrating electron.—*Phil. Mag.*, April.

Units, Measurements and Instruments.

Electricity Meters.—J. T. Irwin.—A further discussion of the recent paper of Ratcliff and Moore. The author deals especially with the effect of wave form on the reading of an induction meter. If both the emf and the current have not a sinusoidal wave form, he shows that the total power is the sum of the powers due to the fundamental third, fifth, seventh .... waves, each considered separately, and if the reading of a meter is made independent of frequency it will also be independent of wave form as long as there is no appreciable change in the permeance of the magnetic circuits. Further if the meter reads correctly at one particular frequency and if one of the curves is a sine wave of this frequency, it does not matter how distorted the other is, the meter will still register correctly. That is to say, if the pressure wave form of an alternating-current system is kept a sine wave, then an induction type meter can be used to register the energy on very distorted waves of current such as arc-lamp circuits, rectifiers, etc., but this is by no means true where the voltage differs from a sine wave. It would be equally true that for a sine wave current it would not matter how much the voltage was distorted. In practice the meters always read slow, and the higher the value of the harmonic in the resultant wave the slower the meters read. This is due to the fact that they do not register correctly the power given by the higher harmonics. The curve in Fig. 3 was obtained by the author for an induction meter, tested on a varying frequency at unity power-factor. It shows that a meter which was correct at its normal frequency of 50 cycles per second was 15 per cent slow at 150 cycles and 23 per cent slow at 250 cycles. The author concludes that each type of meter should be tested at frequencies much higher than those at which it is to be used and rejected if not up to a definite standard. The standard need not be a very rigid one.—Lond. *Electrician* April 14.

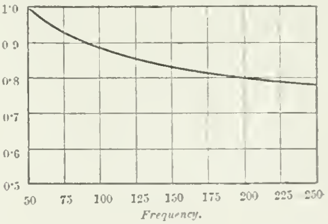


Fig. 3—Effect of Varying Frequency on Induction Meter.

Magnetic Testing of Sheet Iron.—J. Epstein.—A long paper illustrated by diagrams in which the author shows how his well-known apparatus for iron testing can also be used for determining direct-current magnetization. Directions are given of details of the tests. For the measurement of the losses improvements of the original arrangement are described. By subdividing the primary coils into parallel groups stray fluxes are avoided. By simply turning a switch, the same arrangement of the apparatus may be used either for determining the losses or for determining direct-current magnetization.—*Elek. Zeit.*, April 6 and 13.

Electric Contacts.—G. Lippmann.—An abstract of a French Academy paper in which the author points out that if two wires are in contact current will pass through the contact point only when the contact point is maintained under a certain pressure. Such a pressure is not necessary if the contact is made between a metal and an electrolyte. Good results without pressure are obtained, for instance, if one of the electrodes is a strip of paper impregnated with a calcium chloride solution and placed on glass while the other electrode is a simple piece of gold foil. Likewise there is an effective contact without pressure between two amalgamated silver wires while the contact between platinum and mercury is not necessarily effective.—*La Lumière Elec.*, April 8.

Meters.—An official communication of the Reichsanstalt by which three new types of meters of the Aron Company are admitted for calibration. They are a direct-current motor meter, a single-phase induction meter and a three-phase induction meter. Their construction and operation are described in detail.—*Elek. Zeit.*, Apr. 6.

Meters.—An official communication of the Reichsanstalt by which induction meters for balanced three-phase systems of the Siemens-Schuckert Company are admitted for calibration. They are simply modifications of this company's single-phase induction meters.—*Elek. Zeit.*, March 30.

Telegraphy, Telephony and Signals.

Long-Distance and Wireless Telephony.—A note on a recent British patent (7656, April 13) of C. E. Egner and J. G. Holmstrom, of Stockholm, Sweden. A telephone transmitter for dealing with heavy currents has a vessel containing a cooling liquid attached to it so that the bottom of the vessel is in contact with the chamber containing the granules. The heated liquid rises and thus creates a circulation of the liquid. Another method of cooling the transmitter consists of filling the vessel with paraffin wax or other solid body, which is melted by the heat produced.—Lond. *Elec. Eng'ing*, April 20.

Wireless Telegraphy.—K. Fischer.—The author shows that probably there is a relation between meteorological conditions and the maximum distance to which wireless messages may be transmitted. The author recommends quantitative measurements especially with reference to the proposed connection of Germany with its West African colonies by wireless telegraphy. —*Elek. Zeit.*, April 6.

Carbon Granules for Telephone Transmitters.—A. Brookes.— The author points out that the secret of the successful transmission of speech telephonically lies largely in the variation in resistance caused by the carbon granules when the transmitter is spoken into. Hence it is of extreme importance that these particles of carbon shall be of the highest standard of efficiency. One of the troubles with them is what is known as packing. The best way to eliminate packing now recognized in the modern manufacture of transmitters is to insure absolute uniformity in the size of the granules, the use of sharp-cornered granules in preference to spherical, a correct design of the carbon cell and the entire absence of moisture in the cell. The process of manufacturing carbon granules is briefly described. —Lond. *Electrician*, March 31.

Miscellaneous.

Lightning Flash.—R. Rinkel and L. Weber.—An illustrated description of a very heavy lightning flash by which a high tree was badly damaged. The authors conclude that the mechanical forces which must have been acting are so great that they can be explained only by assuming a direct disruption of the tree due to electrostatic charges.—*Elek. Zeit.*, April 6.

Book Review.

Das Elektrische Bogenlicht. By Ewald Rasch. Braunschweig: Friedrich Vieweg & Son. 176 pages, 52 illus. Price, 7 marks.

A brief engineering textbook on the electrical properties of the carbon arc lamp. The mechanism of the arc lamp is left almost untouched. The circuits and generators of current for arc lamps are not discussed. The laws of the production and distribution of light from the arc under different conditions are developed at some length and are discussed in detail. There are eight chapters in the book. No. 1 gives an introduction to the phenomena of the voltaic arc. No. 2 discusses the alternating-current arc, the direct-current arc, the inclosed arc and the open arc. No. 3 treats of the principal electrode substances and their physical properties. No. 4 discusses the theory of electrical discharges in gases at ordinary pressures. No. 5 relates to spark discharges. No. 6 discusses the relations of current and voltage to the dimensions of the carbon arc. No. 7 takes up the distribution of radiant energy in space from the arc. No. 8 treats of practical luminous results obtained with arc lamps. The book is clearly written and illustrated with numerous diagrams. It will be of interest to the technical student of electric lighting.

New Apparatus and Appliances

SINGLE-PHASE CURRENT IN ELECTRIC RAILWAY SERVICE.

By F. H. Dimock.

Single-phase operation of electric railways is especially adapted to handling passenger and freight trains (heavy or light) over long distances and to interurban service with either single cars or multiple-unit trains, although it is only under exceptional circumstances that it may at present be considered economical for street-railway operation in the compact distribution systems of cities and towns.

Transmission and distribution of energy from power plants to moving cars or trains by the single-phase system is simple and economical, and a high efficiency is obtained.

The first great economy of single-phase systems is in the first cost of installation, whether energy be locally generated or purchased. The first cost of rotary converters and intermediate feed wires is dispensed with, and a further saving is effected in first cost of substations. Instead of comparatively large buildings at frequent intervals the single-phase system requires only small substation buildings at long intervals. These need be nothing more than shelters for transformers, and in many cases outdoor transformers may be used.

The second great economy of alternating-current operation is found in the item of fixed charges and operating costs. Since the first cost of apparatus and installation is lower than for direct current the items of depreciation, interest, taxes and insurance are less as a direct consequence.

In operating expense the first saving apparent is that of attendants at substations. The moving machinery required for conversion to direct-current requires constant attendance, with day and night operators, while the stationary transformers, whether sheltered or standing outdoors, require little attention other than visits at convenient intervals.

In the matter of energy consumption the records obtained from a number of operating companies show that the kw-hours generated per car-mile are considerably lower for single-phase equipments than for direct-current equipments operating cars of the same general dimensions and design, under similar conditions, from a substation-fed trolley.

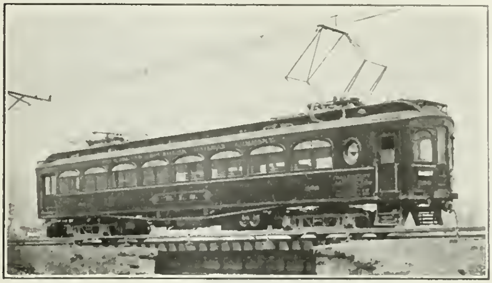


Fig. 1—Single-Phase Motor Car of Rock Island Southern Railway.

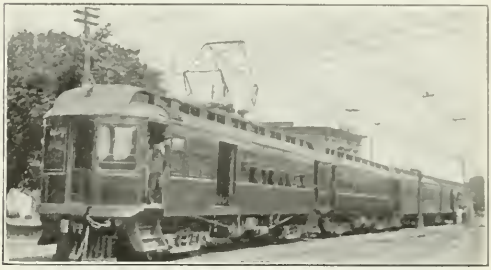


Fig. 2—Single-Phase Train of Erie Railroad.

The first cost and weight of single-phase rolling stock equipment is somewhat greater than that of direct-current apparatus and the maintenance charges are somewhat higher, but the saving in first cost of the complete electrification, fixed charges and operating expenses overbalance these considerations.

From an operating standpoint the single-phase system has numerous favorable features. It is capable of the highest speed and yet the speed control is entirely flexible and unlimited. Any desired variation can also be provided for by transformer taps.

An important feature of advantage for interurban roads and main lines is its adaptability for multiple-unit train operation. A single-phase system laid out with the minimum copper and substation requirements can operate trains of many cars. Among numerous instances it may be mentioned that the Chicago, Lake Shore & South Bend Railway recently operated an eleven-car train, made up of six motor cars and five trailers, for a distance of more than 60 miles over its line without interfering in any way with the regular service maintained. A number of the single-phase roads now in operation regularly operate trains of from two to five cars without having found it necessary to add any feeders to the overhead lines as laid out for single-car operation.

Another advantageous feature is found in the voltage step control of single-phase equipment, in which every speed is an efficient speed. A fact not widely known is that this control renders the equipment much better adapted for bucking snow than the direct-current resistor-equiped car. Last winter the Glen Cove single-phase line of the Long Island (N. Y.) railroad was reported as keeping its schedule when all direct-current lines on Long Island were badly tied up in a heavy snowstorm. All single-phase lines report less trouble than others in snowstorms.

Opponents of single-phase operation have frequently asserted that it was unsuited to heavy service, and a paper read last summer went so far as to assert that single-phase projects were practically abandoned in America. It was an amusing coincidence that this paper came out just before the Boston & Maine Railroad signed contracts for the single-phase electrification of the Hoosac Tunnel, and that at the same time the New Haven interests ordered additional Westinghouse single-phase locomotives. The New Haven had also, after three years of trial, placed contracts for single-phase electrification of its Harlem River division and has planned to extend single-phase electric operation to all traffic over the whole division between New York and New Haven. At the same time also equipment was being built for an entirely new single-phase interurban line in Illinois (the Rock Island Southern) and other single-phase roads were increasing their equipments. Another notable example is found of thoroughly satisfactory operation of single-phase apparatus in the St. Clair Tunnel, where all of the traffic of the Grand Trunk Railway has been handled electrically for nearly three years.

Road	Miles of Road.	Trolley		Schedule		Class of Service.
		Voltage.	Cycles	Local.	Express	
Chicago, Lake Shore & South Bend Railway.	76	800 6,600	25 25	33	65	Freight and interurban passenger
Denver & Interurban Railway R. R. Co	54	550 11,000	D.C. 25	30		Steam railroad passengers
Erie Railroad Co.	34	11,000	25	26		Steam railroad passengers
Ft. Wayne & Springfield	21.6	6,600	25	26.5	45	Interurban passengers and freight
Grand Trunk Railway	....	...	...	...	.	
St. Clair Tunnel	3.7	3,300	25	10		Steam railroad, freight
Hanover & York Street Railway	18.58	6,600	25	26		Interurban passengers and freight.
Indianapolis & Cincinnati Traction Co.	108	3,300	25	37	47.7	Interurban passengers and freight.
Long Island R. R.	4.85	2,200	25	28		Suburban passengers.
Maryland Electric Railway	24.93	6,600	25	36		Steam railroad passengers.
N. Y., N. H. & H. R. R.	34	11,000	25	26	60	Steam railroad passengers
Pittsburgh & Butler Street Railway.	38	6,600	25	25	50	Interurban passengers and freight.
San Francisco, Vallejo & Napa Valley R. R.	33.84	3,300	25	23	54.5	Interurban passengers and freight.
Spokane & Inland Empire R. R. Co	130	6,600	25	21		Steam railroad, freight and passengers
Visalia Electric Railway.	22.2	3,300	15	31	62	Steam railroad freight and passengers
Rock Island & Southern Railway			25			Interurban passengers and freight

Recent information shows that, after exhaustive investigation of electric systems, the Prussian government has adopted single-phase motors with an aggregate rating of 1900 hp and a speed of 74.4 miles per hour for the standard electric locomotive for trunk-line service. The Vienna-Pressburg and another Austrian railroad are now to be operated with 15-cycle, 10,000-volt, single-phase energy, as is also the Rhattisch Mountain Railroad in Switzerland.

From lists recently published in the *Elektrische Kraftbetriebe und Bahnen* of single-phase railways equipped by two of the German manufacturing companies it appears that these companies have equipped thirty-two railways with 433 single-phase locomotives or motor cars of an aggregate horse-power of 206,145, which surely indicates progress and satisfactory performance. In England the London, Brighton & South Coast Railway, 9 miles in length, was equipped with the single-phase system and put it into operation in December, 1909. Its report for the first six months of 1910 shows the enormous increase of 91 per cent in passenger traffic, and the system has been so successful that the company is now reported to have determined upon immediate similar equipment of its entire line of nearly 500 miles of track.

In France the Midi Railway is now equipping some 150 miles of double track on the single-phase system and a few tramway lines are giving it a trial.

Full particulars as to all single-phase railways in America are not at the moment available, but a partial list of roads equipped by the Westinghouse Electric & Manufacturing Company is given in the accompanying table.

Since the single-phase alternating-current series motor operates equally well on direct current some railways have cars and locomotives equipped with control apparatus for both systems, and direct-current trolleys, or third-rail shoes, in addition to the single-phase pantagraph trolley. This arrangement was at first considered to be favorable for single-phase roads, since it permits operation through city streets and elsewhere over the tracks of connecting direct-current roads, and at the same time secures single-phase economy for the main line, but its applications has restrictions.

On main-line railways, where terminal connections render provision for both forms of operation imperative, it is perfectly practicable. This is fully shown in the successful operation of the New York, New Haven & Hartford Railroad, which is obliged to enter the New York City passenger terminal over 12 miles of direct-current electrified line; but where it is not essential it is undesirable and should be avoided. Provsion of double control equipment increases first cost and adds materially to the weight and to the maintenance charges. In some instances where it has been attempted on interurban roads with city connections the weight of the cars has been found detrimental to ordinary tracks in city streets, with a resultant condition of understrains on cars and equipment, but it has been amply demonstrated that single-phase operation over suitable tracks through city streets is entirely satisfactory; and when interurban roads have their own lines through or into cities and towns local and through conditions are equally well served.

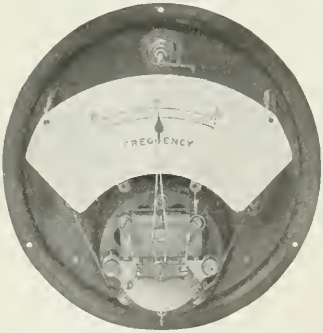


Fig. 1—Interior of Frequency Meter.

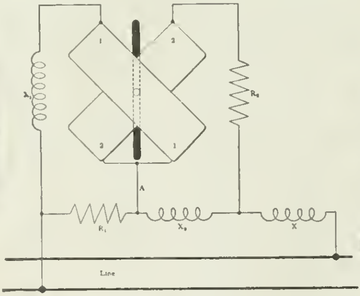


Fig. 2—Circuit Diagram.

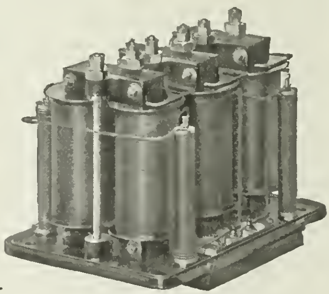


Fig. 3—Reactors and Resistors.

The practical success of single-phase current in railway service is now thoroughly proved in so many installations in the United States and abroad that it must soon become familiar to many who have been opposed to its use. Its scope includes practically all of the railway field in which length of line is greater than the few miles that can be served economically from direct-current converters.

SWITCHBOARD FREQUENCY METER.

In the frequency meter here illustrated the principle of operation is based on a Wheatstone bridge arrangement of resistors and reactors which is balanced at only one definite frequency, the degree of unbalance being indicated by a differential meter calibrated to read directly in cycles per second.

The meter is a soft-iron instrument of a special type, consisting of a pivoted iron needle mounted in a magnetic field produced by two flat rectangular coils placed in mechanical space quadrature to each other, as shown in Fig. 2. One of the field coils is connected in series with a resistor across the line, and the other is connected in series with a reactor across the line. A reactor is connected in parallel with the first coil and the resistor, and a resistor is connected in parallel with the second coil and the reactor, and then the entire bridge combination is connected in series with a reactor, the purpose of which is to damp out higher harmonics, and thus render the indications free of errors due to wave distortion. The constants of these circuits are adjusted to give equal current through the coils for some given frequency; that is, the bridge is balanced and there is no current through the lead *A*. Under these conditions the resultant field lies along the diagonal of the square formed by the coils, and the needle aligns itself therewith. Any change in frequency changes the reactance of the reactors and upsets the balance, thus allowing more current through one coil and less through the other. This action causes the resultant field to deflect to one side or the other, depending upon which coil carries more current.

By suitably designing the instrument and properly choosing the constants of the electric circuits, the scale has been made open and uniform. Therefore, it can be read with a fair degree of accuracy from a considerable distance, based entirely upon the relative position of the pointer on the scale.

As may be readily understood from a consideration of the principle of operation of this instrument, the accuracy and reliability of its indications are largely dependent upon the proper design and construction of the reactors used to produce the reactance.

In general appearance the type of reactor used with these frequency meters resembles a core-type transformer. The core is built up of very thin laminations bolted firmly together to prevent vibration and insulated from each other to minimize the eddy currents.

By using a special high-permeability, low-hysteretic alloy core material in conjunction with proper construction, the core losses and temperature errors have been reduced to negligible quantities. The reactance is varied by means of two air-gaps arranged so as to be easily susceptible of precise adjustment. The air-gaps are located in the middle of the exciting coils and thus the shielding action of the coil turns is utilized to prevent the formation of stray or leakage fields, such as would be formed if the air-gaps were entirely outside of the coils. Leakage fields if present would seriously impair the accuracy of the instrument and render it very sensitive to variations in voltage.

This frequency meter is designed for from 110 to 125 volts, but it may be operated at from 75 to 150 volts without introducing a total error greater than 1.5 per cent. The above instrument is manufactured by the Weston Electrical Instrument Company, of Newark, N. J.

WATER AND STEAM FLOW METERS.

In order to use water, steam, gas or electricity economically it is necessary to know not only the amount available by generation or otherwise, but more particularly the amount actually delivered or distributed. While very satisfactory forms of watt-hour meter have been developed for measuring electricity, until recently the devices for measuring steam, gas, water, etc., have not been nearly as accurate. However, several types of flow meter have recently been developed by the General Electric Company. These include both the recording and indicating types—the former making a continuous graphic record of the rate of flow, and the latter giving readings of instantaneous values of the same. The unit of measurement varies with the commodity measured—being pounds per hour for steam, cubic feet per minute for air and gas, and gallons per minute for water.

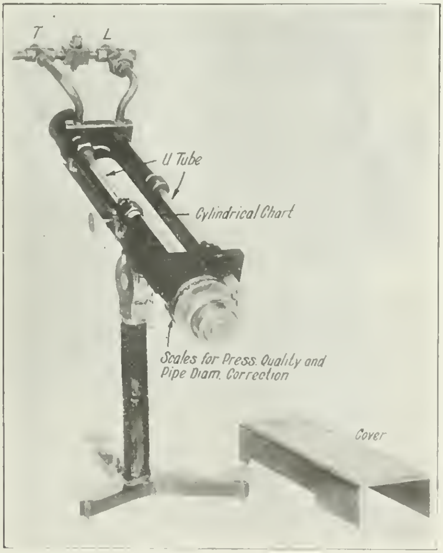


Fig. 1—Indicating Steam Flow Meter.

The recording water flow meter comprises a nozzle plug for screwing into the pipe at the point where the flow is to be measured, thus being exposed to the pressure of the water, a meter element which measures the pressure set up in the nozzle plug and a recording mechanism which makes a graphic record of the rate of flow. The nozzle plug has two sets of orifices—the "leading set," located parallel to its axis, extending across the main and facing the direction of flow, and the "trailing set," consisting of three holes located on the opposite side of the plug near the middle and at right angles to its axis. The two sets of orifices open into separate longitudinal chambers leading to the outer end of the plug. The nozzle plug is suitably arranged for use on either vertical or horizontal mains, and its introduction causes no appreciable drop in static pressure even at very high rates of flow.

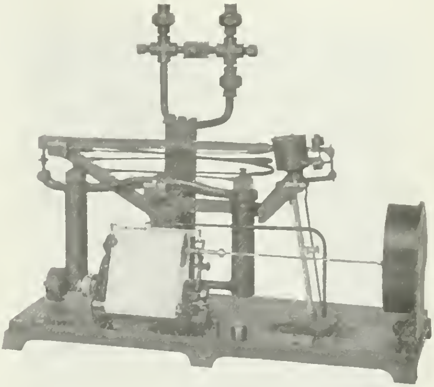


Fig. 2—Recording Water Flow Meter with Automatic Pressure Compensation.

When the plug is inserted in the main the water impinging against the orifices of the leading set develops therein a pressure equal to the static pressure plus a pressure due to the velocity head; while the pressure set up in these of the trailing set is equal to the static preſsure minus the pressure due to the velocity head, thus causing different pressures in the longitudinal chambers leading to the outer end of the plug. The different pressures are communicated to the motor through suitable pipes attached to the outer end of the plug and connected to flexible steel tubing placed within the meter case.

The meter element consists of two vertical cups or hollow cylinders connected together at the bottom by a tube. The U-tube thus formed is filled with mercury to about half the height of the vertical cups and the whole arrangement is supported and is free to move about a set of knife edges like an accurately constructed balance.

The different pressures in the two sets of orifices in the nozzle plug cause the mercury to rise in the left-hand cup and to fall a corresponding amount in the right-hand cup until the unbalanced mercurial column exactly balances the difference in pressure. This action causes the beam carrying the cups to descend on the left-hand side of the knife edges until the moment of the weights on the right-hand side exactly balances the moment caused by the displacement of the mercury into the left-hand cup. The motion of the beam is multiplied by means of levers and actuates the recording pen, the movement of the latter being proportional to the amount of mercury displaced.

The drum carrying the recording paper is driven by an eight-day clock. The paper is calibrated to record the flow in gallons per minute and the rate of flow may be read at any instant, or the average rate calculated for any given length of time.

The indicating steam flow meter is designed for testing work and other purposes such as locating trouble due to leaks, determining efficiency of boilers, etc., where accurate, instantaneous readings of the rate of flow are desirable. This type of meter operates on the same principle and employs the same type of nozzle plug as the recording meter, but differs considerably in details of construction. It can be readily adjusted for various rates of flow and indicates the instantaneous rate of flow in pounds per square inch of pipe cross-sectional area.

REGULATORS FOR BLOWER MOTORS AT A COKE-OVEN PLANT.

The extended use of the by-products in steel and coke plants requires the solution of a great many new problems in the transmission and control of the power for driving auxiliary machinery in such plants. An interesting installation of this kind is that made for the United States Steel Corporation at Gary, Ind., by the Cutler-Hammer Manufacturing Company, of Milwaukee. In order to use the gas from the large coke ovens for gas engines and get the highest efficiency in the extracting apparatus for the by-products it is necessary that the gas be thoroughly cleaned. During the process of extraction it is also necessary to add certain chemicals to the gas and the amount of these parts must be carefully regulated to permit of best results. The control apparatus installed is for the automatic regulation of the amount of gas which goes into the cleaners. The apparatus after once being adjusted will always supply a constant amount of gas so that the operation may be controlled automatically at the will of the chemist who supervises the operation of the plant.

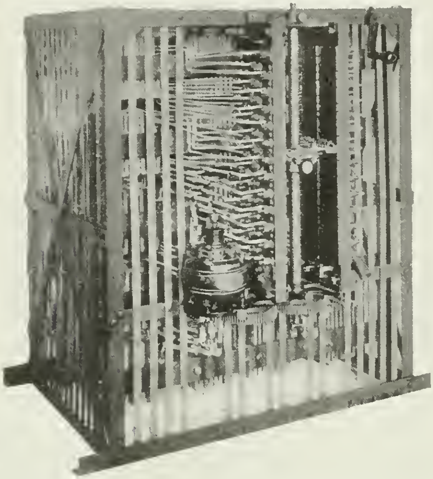


Fig. 1—Motor-Operated Secondary Regulator.

The gas is drawn from the coke ovens and supplied to the cleaners by means of constant-volume blowers. As long as the speed of these blowers is kept constant the amount of gas supplied will of course remain the same even though the pressure on the outlet side should increase, as is actually the case during the process—provided, of course, that the suction remains constant. The alternators in the power house supply energy directly to the auxiliary motors about the plant. It was, therefore, desirable to use alternating-current motors in the present instance.

The amount of gas which can be taken from the coke ovens depends, of course, on the number of ovens in service. In order to adjust the blowers to the number of ovens in service it is necessary to vary the speed of these blowers. It was finally decided to use slip-ring type motors for driving the blowers. There are two groups of such blowers which normally operate in parallel. Each group is divided into three units and the induction motors are arranged for a speed reduction of one-third, so that by running one, two or three blowers the amount of gas drawn from the coke ovens per set can be regulated from two-ninths to full output of the blower set.

In order to have the load equally divided between the blowers it is further necessary that all three blowers run at all times at the same speed relative to each other, and in case it becomes necessary to vary the speed that the speed of the three blowers which work together in one group be changed simultaneously. In order to keep the speed of the induction motors constant it would be constantly necessary for an operator to adjust the regulators in the secondary circuit of the slip-ring type motors. To avoid this unreliable and expensive method an automatic regulator has been designed which operates as follows:

Each motor is controlled by a primary triple-pole circuit-breaker and a motor-operated secondary speed regulator which cuts in and out resistance from the secondary circuit of the motor. A separately excited small generator is mounted on the extended shaft of the blower motors. The field of this generator is excited at a constant voltage and, therefore, the terminal voltage of the generator is proportional to the speed of the big motor. With each set there is also a motor-generator consisting of a squirrel-cage driving motor, a self-excited generator, the purpose of which will be explained later, and three separately excited generators similar to those mounted on the extended shafts of the blower motors. In the field circuits of these latter generators is a regulator mounted on the switch panel by means of which the field strength and, therefore, the terminal voltage may be adjusted at will. These field circuits, as well as the field circuits of the generators on the blower motors, are supplied with current from the self-excited generator of the motor-generator set, which also supplies the power for the driving motors on the secondary regulators. The armatures of the small generators on the motor-generator set and the corresponding armatures on the blower motor shafts are connected in series through a polarized relay, so that in case of any voltage difference at the terminals of the two generators the polarized relay will operate. By means of the field regulators in the small generators of the motor-generator set the terminal voltage of these generators is adjusted to a certain value. Normally the voltage of the generators on the blowers differs from the first mentioned voltage and current, therefore, goes through the polarized relay. This operates the polarized relay and closes the circuit of a reversing relay, which controls the motors on the secondary regulators, and these motors then cut in or out resistance from the secondary circuit of the blower motors until such a speed is obtained

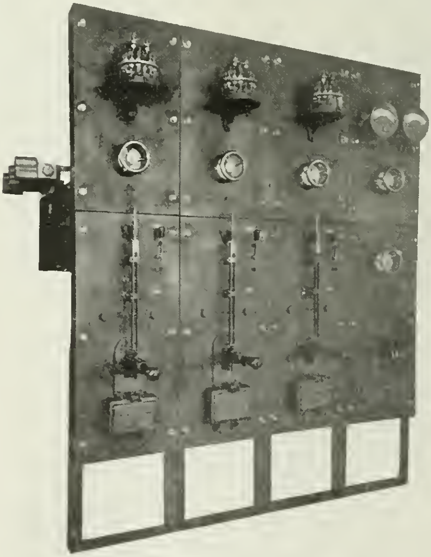


Fig. 2—Control Board for Three 250-hp Slip-Ring Motors.

by the blower motors that the voltage of the generator coupled therewith is equal to the voltage of the corresponding generator on the motor-generator set. If this is the case the polarized relay opens the circuit of the intermediate relay and the motor is de-energized so that the resistance in the secondary circuit of the blower motor remains constant and this blower motor will run at the predetermined speed until the conditions in the system change again. If the load on the blower motor should increase, or decrease, the speed will change correspondingly. This will produce a current in the polarized relay which actuates an intermediary relay and the controller controlling the secondary resistance until this resistance has been adjusted again to correspond to a speed of the blower motor proportionate to the field excitation of the generator of the motor-generator set.

As stated above, it is desired that all three blowers of one set operate at the same speed. For this reason the field currents of the three generators of the motor-generator set are adjusted so that they are equal and then the field excitation of the three generators is changed simultaneously by a field regulator, which is in series with the three parallel field coils. It will, therefore, be seen that when this field regulator is manipulated the field currents of the three generators change simultaneously, so that the three polarized relays are also actuated simultaneously and the secondary regulators regulate the speed of three blower motors to the same value. A voltmeter which indicates the voltage of the generators coupled to the blower motors is calibrated in r.p.m., so that it directly indicates the speed of the three machines.

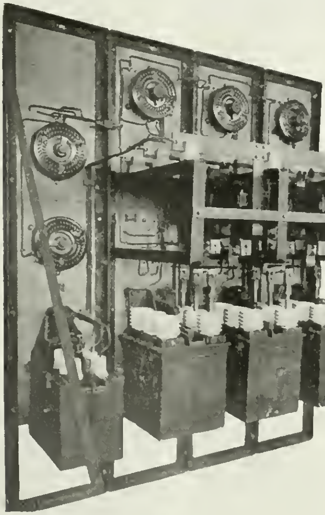


Fig. 3—Rear of Control Board for a Set of Three 250-hp Motors.

If it is desired to cut out one or more of the blower motors this is done by a single-pole reversing knife switch, by means of which a resistance equivalent to the field circuit plus the adjusting resistance of the corresponding generator on the motor-generator set is substituted for the latter, so that the total resistance in series with the speed-adjusting regulator remains the same and the remaining blower motors are regulated in the same manner as before.

The regulation possible with this scheme is within 2 per cent of the speed of the motor, closer setting being possible if desired. The primary circuit of the motor is controlled by overload oil switches and the accompanying illustrations show front and rear views of a panel for the control of one set of three motors. The rear view, showing busbar work, is rather complicated on account of the mass of series transformers which had to be crowded into the comparatively small space.

Fig. 3 shows the secondary regulator. This regulator consists of a "cross-head type" commutator front which consists of three sets of segments over which the cross-head with the necessary contact brushes rides. The cross-head is driven by the small direct-current motor described above. The drive from the motor is through a set of gears and a screw so arranged that in case of overtravel the threads come out of engagement and the cross-head stops in its travel without breaking parts of the apparatus and without jamming the motor. The resistors of this regulator consist of banks of cast-iron grids arranged for effective ventilation.

The motor-generator set consists of five machines, as described above. The small generators, which are naturally sensitive to the fumes and gases in the plant, are entirely inclosed and the commutators are inclosed in glass cylinders to make easy inspection possible. The generators mounted on the blowers are also inclosed in a similar manner to prevent corrosion.

The equipment provides for entirely automatic regulation within the range for which it is designed and this regulation is obtained in a strikingly simple manner, considering the accuracy which has to be obtained and the size and number of machines which have to be controlled, as well as the variation in load which is encountered. The load varies from 87 hp per blower at the lowest speed to 250 hp per blower at the highest speed.

ELECTRICAL EQUIPMENT OF CEMENT MILL.

The electrical features of the plant of the Allentown Portland Cement Company, of Evansville, Pa., are of interest in that the plant is typical of the latest cement-mill practice. The mill has an output of 2500 bbl. per day with arrangements for increasing this to 5000 bbl. per day without interrupting production. The operations in the mills and their sequence are as follows:

At the quarry the rock is loaded onto dump cars with a steam shovel. Two hoists, each driven by a 50-hp, wound-rotor motor, take the cars up an incline to the crusher house. The cars discharge into an elevator, which discharges into a No. 10 Gates crusher. This crusher discharges into a second elevator which delivers the material to three No. 6½ Lehigh crushers, where the material is further reduced.

A 250-hp motor supplies the necessary power for the crushing machinery. It is interesting to note here that although individual drive was adopted through almost the entire plant, line shaft was installed in the crusher house. The reason for this is that the load on a gyratory crusher is intermittent and frequently comes on so quickly that it constitutes a severe shock. By using line-shaft drive a shock produced by any particular machine can be absorbed by the inertia of the other machines and moving parts of the system. The discharge from the smaller crushers is lifted to conveyors which carry the material to the large bins adjoining the driers. The storage bins are equipped with automatic shaking feeds, by means of which a constant flow of material to the driers is effected.

A 50-hp squirrel-cage motor is belt-connected to a line shaft from which three 7-ft. x 56-ft. driers are driven. Each drier is connected to the line shaft by belt-drive and the speed is further reduced through two sets of spur gears and one set of bevel gears. Bearing-ring roller idlers are placed sufficiently close together to preclude large bending moments. The 50-hp motor mentioned also supplies power to the shaking feed arrangement from the stock bins to the driers

From the belt driers the material is carried to the stone storage on a belt conveyor driven by a 40-hp motor. A smaller conveyor driven by the same motor takes the material to the raw mill.

In this mill the material is delivered to two No. 8 Krupp ball mills, each driven by a 40-hp motor. These mills are used in preparing the mixed raw materials for the Fuller mills. The material is discharged from these ball mills on to several elevators driven from line shafting belted to a 40-hp motor. These elevators distribute the material into a storage bin over the Fuller mills by means of a screw conveyor. The material is fed from the bin into eight 42-in. Fuller mills, each driven by a 75-hp vertical belted motor. These motors are operating very successfully and have proved distinctly advantageous as compared with horizontal motors with quarter-turn belts. The material is conveyed from the Fuller mills to a large storage bin over the kilns by means of a bucket hoist driven by a 10-hp motor. The material is conveyed into each kiln by an inclined feed pipe which receives its supply from the screw conveyor. There are four kilns, 8 ft. x 120 ft., each driven by a 30-hp variable-speed induction motor.

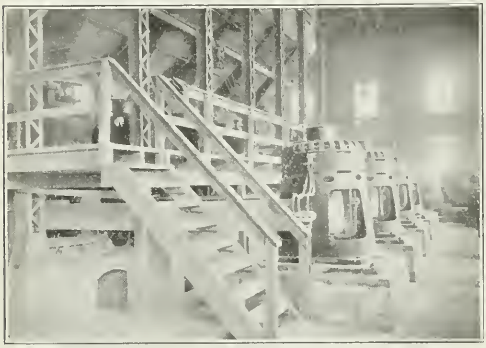


Fig. 1—Vertical Belted Motors Driving Cement Mills.

The coal for firing the kilns is brought from a hopper below the tracks and carried by means of an elevator and conveying system driven by a 40-hp motor to the top of the coal storage. The material is conveyed by gravity into a set of rolls in the pit which reduces the large lumps. An elevator discharges the crushed coal into two 4½-ft. x 30-ft. Matcham driers, from which the material is again elevated and discharged into the bins over the pulverizers. The pulverized coal is carried by a screw conveyor and an elevator to the bins in front of the kilns. One 30-hp induction motor drives the three elevators and the screw conveyor handling crushed and pulverized coal. The pulverizing equipment consists of two 42-in. Fuller Lehigh mills driven by a 75-hp motor. The motor for each kiln is placed in the small pit below the surface of the concrete floor, small openings in which permit the passage of the belt to the pulley on the three-bearing shaft. Further speed reduction is effected through two belts, one bevel-gear and two spur-gear connections.

The speed rotation of the kilns is low, from 1 to 1.5 minutes to the revolution. Provisions must be made in the motor drive to vary the speed of the kiln to suit the charging conditions in burning. In some alternating-current installations, using induction motors, a motor-generator set has been provided to supply direct current for operating the motor for the kilns, but in the plant under discussion alternating-current slip-ring motors with wound secondaries were chosen and have operated with entire satisfaction, the speed changes being obtained by varying the resistance in the secondary of the motor.

Two kilns discharge into a common bucket elevator, which feeds the material into the rotary coolers. There are four coolers operated by a 50-hp motor. The two bucket elevators for these are driven by a 20-hp motor. A belt conveyor takes the material from the coolers and delivers it to an elevator discharging on to a belt conveyor, which distributes the clinker to the storage.

From the storage, where the clinker is permitted to season, it is taken to the gypsum house by means of a belt conveyor driven by a 10-hp motor. An elevator driven by a 10-hp motor takes the material to the finishing mill, where it is discharged into a rotary screen, with 0.75-in. holes. The material which passes through them goes directly to the eight Fuller-Lehigh finishing mills, each of which is driven by a 75-hp vertical-type motor. The coarse material is fed into a No. 8 Krupp ball mill, and the resulting product from the ball mill is discharged into the same elevator that delivers the material to the Fuller mills. The ball mill is driven by a 40-hp motor. Between the rows of finishing mills there are two conveyors discharging into the common elevator that delivers the material to a screw conveyor connecting the finishing mills with the storehouse; this system is driven by a 40-hp motor. Three screw conveyors, driven from a 30-hp motor, carry the material from the bins in the stock house to the bagging house, and a 20-hp motor supplies the power for the elevator that delivers the cement to bins above the baggers. Two pairs of Bates valve-bagging machines are used for bagging the cement, each pair being driven by a 30-hp motor.

Each building has its separate control panel, distribution to which is made from the power house, about 1300 ft. distant, by means of No. 0000 wire. Energy is generated by three Westinghouse 937-kw, 600-volt, three-phase, 25-cycle generators directly connected to Wetherill cross-compound engines. The exciter unit consists of a 150-hp induction motor driving a 100-kw, 125-volt generator; an engine-driven 110-kw, 125-volt generator is provided as a spare. There is a small lighting set consisting of a 110-kw, 600-volt, three-phase, 25-cycle generator driven by a Skinner engine. The twelve-panel switchboard consists of two exciter panels, three main generator panels, a lighting-generator panel, a load panel and five feeder panels.

In a cement plant the power demands are more exacting and the operating conditions are more severe than in other manufacturing processes. The presence of great quantities of highly abrasive dust, the inflammability of the finely powdered coal, the heavy torque required by the machinery and the nature of the load all go to make up a problem in motor drive that requires the most careful consideration for its solution. Induction motors have proved excellent for the purpose. The Allentown Portland Cement Company's plant furnishes one of the best examples of motor drive for cement mills. Great simplicity has been effected in the lay-out of the machinery. Individual drive on the principal machines, including those of burning and grinding departments, offers the advantage that expensive and troublesome clutches are unnecessary and also that during the shut-down periods of any particular machine the entire friction load of that unit is nil. With line-shaft drive the use of even one machine of a department means a heavy friction load.

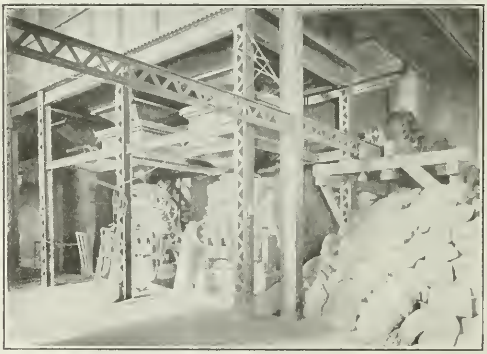
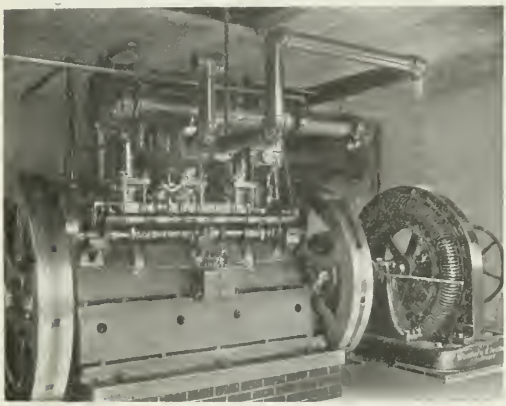


Fig. 2—Motor-Driven Cement-Bagging Machine.

A MODERN CENTRAL STATION FOR A SMALL TOWN.

An excellent example of a small, waterwheel-driven central station, with gas-engine auxiliary equipment, is that afforded by the City Electric Light, Heat & Power Company's plant at Monticello, Ia. This town received its first electric-light service in 1893, when the Monticello Electric Company was organized. The electrical equipment consisted of a 60-kw, 125-cycle, single-phase alternator and one "twenty-light" arc machine. The plant was driven by waterwheel power furnished from the Maquokita River. Two steam engines were used as auxiliary power.



View of Central Station, Showing Alternator and Auxiliary Gas-Engine Equipment.

Last fall the new plant of the City Electric Light, Heat & Power Company was put into operation. This plant was designed by Mr. F. J. Cross, who also controlled the company. On Jan. 1, however, he sold it, and the new management has since bought out the old company, the new plant being the only one now in operation.

The electrical equipment of the present operating plant consists of one 125-kva alternator. Two new waterwheels furnish the power. As an auxiliary source of power a 150-hp Nash gas engine has been installed. This engine is of the vertical three-cylinder type, and operates on producer gas furnished by a Smith automatic gas producer. It is estimated that it will be necessary to operate the producer-gas plant for about three months of the year during the time when the water is low. The gas engine is always ready, however, and in case the wheels are temporarily put out of commission, because of accident or ice jams, it will be found an adequate source of power.

The generator, which is of the Western Electric Hawthorn waterwheel type, is a 2300-volt, 60-cycle machine, so connected that it can be run either by the waterwheels or the gas engine. This is accomplished by providing the generator with a special shaft which extends at both ends. One end is directly connected, through a friction clutch, to the gas-engine shaft, while the other end is directly connected through a similar friction clutch to the shafts of the waterwheels. This arrangement provides a very flexible and efficient combination. The generator can be operated with either one or both of the waterwheels, or by setting the friction clutch on the gas-engine side the combined power of the two wheels and the engine can be obtained.

At present the output of the station consists of a combined lamp and motor load, the peak being about 200 hp. The company has about 250 customers, and close to 5000 lamps are in service. There are also between twenty-five and thirty motors of various sizes on the line. This number is relatively large considering that Monticello is not a manufacturing town. The plant represents an excellent central station for a small town from the standpoints of both operating economy and efficiency. The fact that in a town of only 2100 inhabitants the local company has 250 customers, using 5000 lamps, is a good indication of the success with which day-and-night service has met, and indications point to a still larger list of customers.

NON-SPILLABLE MERCURY WATT-HOUR METER.

In the watt-hour meter here shown the armature floats in the mercury in which it is immersed, a small, solid non-metallic float being riveted to the center of the copper disk in order to give the necessary lifting effect for the weight of the entire moving system, including the immersed armature, the aluminum damping disk and the shaft above, as shown in Fig. 1.

The armature acts like a plunger in a dashpot filled with very heavy liquid, so that it is impossible for any sudden jar or shake to be transmitted to the jewel bearing in such a way as to produce an excessive strain upon it. The mercury chamber element, Fig. 1, is designed somewhat like an invertible inkwell, so that it is impossible to spill mercury, no matter in what position the meter may be turned or placed in shipment or at the time of installation. This is also shown very plainly in Figs. 2 and 3. The shaft of the meter is made in two parts, the lower one, which carries the armature, passing up through the sapphire guide ring in the long shell projecting down from the cover of the mercury chamber, while the upper and larger shaft, which carries the damping disk and the worm for driving the recording train, is keyed freely to the lower shaft, being thus properly driven from the armature. The ring jewel guide is very accurately gaged to give a clearance of about 0.001 in. to 0.002 in. on the armature shaft. The non-spillable feature of the mercury flotation meter renders it especially desirable for use in street-car and similar service where the meter will be subjected to excessive shocks and jars. The meter is manufactured by the Sangamo Electric Company, Springfield, Ill.

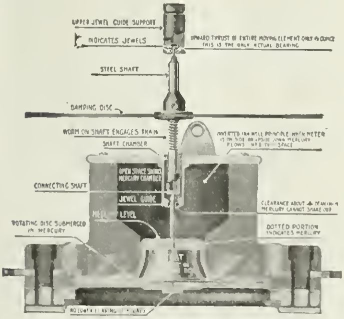

UPPER JEWEL GUIDE SUPPORT
INDICATES JEWELS
THIS IS THE ONLY ACTUAL BEARING
STEEL SHAFT
DAMPING DISC
WORM ON SHAFT ENGAGES TRAIN
SHAFT CHAMBER
CONNECTING SHAFT
JEWEL GUIDE
LEVEL
ROTATING DISC SUBMERGED IN MERCURY
MERCURY CANNOT SHAKE OUT
DOTTED PORTION INDICATES MERCURY

Fig. 1—Sangamo Mercury Element.

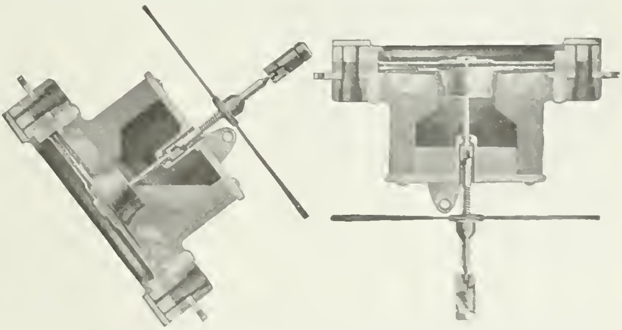


Fig. 2—Sangamo Mercury-Motor Element Half Inverted and Inverted.

Industrial and Commercial News

The Week in Trade.

With only casual interest shown in the price shading of a few commodities, no increase has occurred in the actual turn-over, and business in general seems quieter than in the preceding week. Retail demand for furnishings has receded on account of the change in the weather, with a reaction upon wholesale and jobbing trades. Metal markets continue dull, and demand for iron and steel is reported still further decreased. The prospects for structural steel are said to be good, particularly in the East, but present business is not heavy. Pig-iron production in April was 4 per cent under that of March, and foundry business is quiet, with likelihood of further dullness on account of the machinist strike. A feature of the week was a resolution in Congress for investigation of the Steel Corporation and the sugar and woolen trusts. Although ultimate good may possibly come from these probings, there is a strong feeling that the present situation has not been benefited by this additional agitation. The tariff legislation is exerting a retarding effect upon the trade of the country, for with a prospect of lower duties and decreased prices, there is but slight disposition on the part of buyers or manufacturers to commit themselves for later on. The Supreme Court decisions are expected in many quarters before the recess, with the more optimistic expecting early activity to follow. However, with many of these uncertainties removed trade will be in a position for rational advancement. Stock markets have been a shade more active during the week, and bonds continue to be in demand at higher levels. Western interests are said to be feeling more ill effects of the Eastern depression than heretofore, and in spite of the large harvests expected, the buying in the great farming sections is not on a plane with that of previous seasons. Collections are slow to fair. Business failures for the week ended May 4, as reported by *Bradstreet's*, were 234, as compared with 240 for the previous week, 191 for the same week in 1910, 214 in 1909, 288 in 1908, and 154 in 1907.

The Copper Market.

Volume of new business during the week was much smaller than that of the week preceding, and the market has shown a decidedly weaker tone. Some price concessions are reported to have been made, resulting in a few small sales of electrolytic for June and July shipment at prices approaching 12 cents, delivered. There has been mild speculation both in this country and abroad during the week, and although prices have varied, the net declines registered for the week are not important. Active demand is practically over for the season as regards this country, and little new business is being obtained from wire drawers or electrical companies. Output, despite the light demand, continues to be approximately 4,000,000 pounds per day, offering no encouraging feature for satisfactory business. Contrary to expectations in some quarters for a decreased surplus in April, the report of the Copper Producers' Association for the month showed an increase in the surplus supply of 3,548,000 pounds, which makes the total surplus the largest since August, 1910. Deliveries showed a loss in April of 10,624,000 pounds, as compared with the showing in March, and this decrease offsets the slight curtailment in production. In view of the increased stocks shown at the end of the month and the decreased demand expected from now on, the likelihood of enforced curtailment in production becomes of greater moment. The situation may be bettered ultimately if the Amalgamated interests abandon the plan of setting fixed prices and assist in the establishment of an open market.

The exports for the month, including May 8, were 7,328 tons. The daily call on the Metal Exchange, May 8, quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.60	11.70	....
May	11.60	11.70	11.65
June	11.65	11.75	11.70
July	11.65	11.75	11.70
Aug.	11.65	11.75	11.70

The London market, May 8, was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	54	0	0	53	18	9
Standard copper, futures	54	11	3	54	11	3

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.30			11.65		
London, spot	£56	15	0	£53	11	3
London, futures	57	12	6	54	3	9
Best selected	60	5	0	57	5	0

Industrial and Commercial Notes.

Southern California Edison's New Station.—The Southern California Edison Company is now building a power station at Long Beach, Los Angeles County, California, in which will be located a 12,000-kw steam turbine unit. The new station will operate in conjunction with the company's other plants, which consist of six hydraulic developments and one other large steam auxiliary supplying power in the counties of Los Angeles, San Bernardino, Riverside and Orange. The ultimate capacity of the station is not decided upon at the present time, but buildings and foundations are designed to provide for a duplicate of the equipment now being installed. The general layout is on the "unit" system, so that the plant may be extended indefinitely as such extension becomes justifiable, the company having purchased a parcel of land comprising about ten acres with this object in view. The site is considered to be a most advantageous one for many reasons, principally, however, on account of its location, which borders on the entrance to what is known as the Long Beach Inner Harbor. This channel will be used to provide water for condensing purposes, supplying all of the sea water which will be required, and at this location the works will not be subjected to the violence which would be offered if they were located on the open beach. There are eight boilers of the Stirling type to be installed, each of which will deliver continuously 30,000 lb. of steam per hour at 225 lb. pressure and 125 deg. superheat. For the entire present installation this evaporation is at the rate of 2880 tons of water per day. Crude oil will be used for fuel, and a large storage tank of concrete will be provided. Auxiliary tanks will be located adjacent to the boiler room, so that the oil pumps for each unit may be relatively near their source of supply. The oil will be received either in tank cars or through an oil main which passes the company's property. The switchboard is to be located in the generator building, although the transformers and switches are to be installed in the transformer house. Electricity will be generated at 11,000 volts, and a part of the energy will be distributed at this voltage, although the transformers will provide for transformation to 30,000 volts and 60,000 volts, and the long-distance transmission will be accomplished at the latter voltage. Double busbar systems are provided throughout for 11,000, 30,000 and 60,000-volt circuits. Frederick Sargent, of Chicago, has been retained as consulting mechanical engineer. The Southern California Edison Company's engineering department is supervising the construction work, and has made all of the designs and plans except the architectural details, which were designed by Parkinson & Bergstrom, of Los Angeles, who have been retained as consulting architects.

Berkshire Street Railway Changes.—Charles S. Mellen, president of the New York, New Haven & Hartford Railroad, has succeeded Lucius S. Storrs as president of the Berkshire Street Railway Company. The New Haven road purchased the Berkshire interests last year, and is reorganizing the street-railway system. C. O. Richmond becomes vice-president. The directors of the Berkshire Railway Company are now as follows: William L. Adams, Pittsfield, Mass.; Charles F. Brooker, Ansonia, Conn.; Timothy E. Byrnes, Boston; Frank Curtis, Sheffield; William Skinner, Holyoke, Mass.; Charles S. Mellen, Stockbridge, and Robert Tytus, of Tyringham. The officers are: Charles S. Mellen, president; C. O. Richmond, vice-president; Augustus S. May, treasurer; H. M. Kochersperger, controller.

Doherty Interests Hold Convention in New York.—Representatives of a large number of bond and banking houses, both in this country and in Canada, attended a convention in New York May 3 and 4, under the auspices of Henry L. Doherty & Co., for the purpose of discussing the present status of public utilities and methods of increasing interest in their securities. The condition of general trade was discussed, and it was generally conceded that the present dullness and absence of public interest in speculative markets would result in a continuation of the abundance of idle funds and the present low rates in the money market. This condition was felt to be decidedly favorable for increasing public interest in the offers of public utility companies as a source of conservative investment. The prospects for increased activity in general trade in the near future were not considered especially bright, in view of the approach of summer and the disquieting influence to be expected from the next Presidential campaign. The conservative attitude held at present by the larger interests was considered as an indication that there will be few large developments in general trade until many of the present uncertainties are dispelled. The hesitancy of investors in purchasing securities was attributed, in a large measure, to the many government and State investigations into the affairs of the larger corporations, and also to the delay of the Supreme Court in rendering decisions in the Standard Oil and American Tobacco cases. A large number of those present considered that adverse decisions would have a favorable effect upon the investment markets, particularly in the sale of securities of the larger gas and electric companies. The point was made that the latter are not classified as combinations which operate in restraint of trade, for, although a great many interests are merged under the one control, the operations are distributed in most cases over the entire country. In spite of the quietness which has been observed in general trade during the past few months it was noted that public utilities have continued to show improvement throughout the period of depression, owing to the fact that the commodities which they furnish are in demand the major portion of the time, and that with increased population the return to these companies is correspondingly increased.

Oil Engine Industry.—There is an increasing demand from small central stations, and from farming, irrigation and manufacturing localities when central-station service is not available, for small oil engine-generator units. While the initial cost of these engines is usually slightly larger than that of gas engines, the manufacturers claim that good fuel economy and simplicity of operation offset the additional cost. Mietz & Weiss, 128 Mott Street, New York, manufacturers of the Mietz & Weiss oil engines, state that demand has been very brisk recently and that large sales are expected. They have recently filled an order for the government for twelve Mietz & Weiss distant-control engines for use in connection with wireless equipment, and are now building six additional engines for the same service. A large number of machines have been sold to South and Central American interests, and throughout Europe. Recent engine sales which the firm has made are: One 100-hp engine to the town of Andover, Mass.; one 100-hp to the town of Spencer, Ia.; one 100-hp to the town of Gregory, S. D.; one 150-hp to the Croton Falls electric-light plant, Croton Falls, N. Y.; 130-hp to the 'Frisco Mines & Power Company, Kingman, Ariz.; 75-hp to C. W. Hunt Company, West Brighton, N. Y.; 64-hp to the town of Medway, Mass.; 50-hp to the Albion Electric Light & Power Company, Albion, Neb.; 75-hp to the town of Walthill, Neb., and 50-hp to the Gibbon Electric Light Company, Gibbon, Neb.

Anglo-American Cable Service.—With the return of President Vail, of the American Telephone & Telegraph Company and the Western Union Telegraph Company, from London this week full details are expected of the terms of the agreement by which these companies and the Anglo-American Cable Company will co-operate in furnishing transatlantic service. The preliminary steps in this matter were described in the *Electrical World*, June 20, 1910. The outline of the plan as understood in this country is that the companies will be operated under American management, and that the English interests are to receive each year a fixed guarantee amounting to 3¾ per cent upon the total capital stock of $35,000,000. The agreement will have to be ratified by the stockholders of the English company, and until this is done the details may not be made public. The transaction will give the Western Union Company control of eight Atlantic cables and will afford a means of better service to the public at reduced rates, and furnish increased returns to the companies. Under present conditions the cable service experiences a daily peak load in business hours, this load being of short duration owing to the difference in time between this country and England. At other times the cables are very lightly loaded, service being furnished chiefly for journalistic and personal messages. The new arrangement is an outcome of the success of the day and night letter plan of the Western Union, and is to be operated on a similar basis.

St. Louis Company Opposes Ordinance.—The Union Electric Light & Power Company, of St. Louis, has brought a suit before the city to enjoin it against enforcing the recent ordinance of the City Council which reduces the price of current for dwellings from 12 cents to 9½ cents per kw-hour. The company gives five reasons for the injunction, stating that a price of 9½ cents per kw-hour as a maximum does not give a proper return on the investment entailed in furnishing the service; that the requirements of the ordinance for free meters, discontinuance of deposits, removal of charge for installation of service and limiting the term of contracts to one month as a maximum are unreasonable; that the Public Service Commission, which recommended the lowering of prices, undervalued the properties of the company; that the city has no authority to establish rates, and that the present rate of 12 cents per kw-hour is just. A. S. Miller, president of the company, is preparing to sever his connection with the company, and A. C. Einstein, of St. Louis, president of the Suburban Electric Light & Power Company, the King Electric Company and the St. Louis County Gas Company, may be elected to succeed him. Mr. Miller plans to take up consulting engineering work in New York.

Cuban Telephone Service Increasing.—W. M. Talbott, president of the Cuban Telephone Company, which is an American concern with English and American capital, says that telephone business on the island is rapidly increasing, that over 6,000 telephones are now in use, and that the company is now installing long-distance lines. Mr. Talbott attributes the success of the company to the improved service in the last few years. The automatic telephone, requiring no operators, is in use. The company gives unlimited service, and the rate depends on the class of telephone, the charge for an office telephone being $84 per year, and a residence telephone $60. The company is installing 1200 miles of pole line throughout the island, and expects to have this completed within two years. A new local system is being completed at Cienfuegos, and it is expected that the provinces of Matanzas and Santa Clara will be connected with Havana by the first of the year. Mr. Talbott adds that the franchises for local services are held under old Spanish grants on limited periods, that these are now expiring, and that the company is replacing old systems in the various towns in succession. The hard woods of the island are used for poles.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions to present plants at Sterling, Mass.; Cumberland Gap, Tenn.; Mankato, Minn.; Ann Arbor, Mich.; Custer, S. D.; Waynoka, Okla.; West Palm Beach, Fla.; Shreveport, La.; Minneapolis, Minn.; Seattle, Wash.; Barnett, Va.; Dayton, Ohio; Canton, Ohio; Anamosa, Ia.; Columbia, Mo.; Rockville Centre, N. Y.; Holyoke, Mass.; Oklahoma City, Okla.; San Francisco, Cal., and Gibson City, Ill

Cheap Fare for Jones & Laughlin Employees.—The Jones & Laughlin Steel Company has awarded contracts to J. C. McGuire & Company, of New Brighton, Pa., for the construction of a street railway between Woodlawn, New Sheffield and their new Aliquippa Works. The road is to be known as the Woodlawn & Southern Street Railway Company, and will be built for the benefit of workmen at the Jones & Laughlin plant. The fare will be 2½ cents, and will be the lowest in the State.

Westinghouse Company to Enlarge Plant.—A pattern shop is to be added during the year to the foundry plant of the Westinghouse Electric & Manufacturing Company at Trafford City, Pa., and a foundry for turning out large castings will also be erected. When completed the Trafford City plant will handle the entire foundry work of the company, employing in the neighborhood of 3000 men.

Northern Ohio Traction & Light Company.—Announcement has been made that the capital stock of the Northern Ohio Traction & Light Company has been increased by $3,000,000 preferred stock.

Financial.

The Week in Wall Street.

BOND transactions continue to be the sustaining element of the New York market, and the sales of the past week have not only been greatly in excess of the good showing of the week preceding, but have been the largest since the beginning of the year. Total transactions amounted to $25,151,000, comparing with $12,786,000 for the first week in May, 1910, and with $23,730,000 in the last week of January, 1911, the largest week up to the present. This active trading is encouraging not only in its volume, but also in the extending of the demand to the lower grades of securities, in addition to the demand for the higher-grade issues which were the features of the initial activity. This wider scope is held to indicate, in the Street, that not only is investment being sought for idle funds, but that the purchasing of nearly all classes of securities serves to show a return of public confidence. The trading in stocks has not shown any notable change in activity, in spite of the condition of the bond market, but the time is yet too short for the influence of the bond market to be of benefit in this quarter. Sales for the week were 2,269,399, compared with 1,725,941 for the previous week. The belief is entertained by many business men of standing and experience that returning activity will be accompanied by far more conservative business methods than those of the past, due to a change in human nature they believe to be an underlying factor in present conditions.

NEW YORK.

	May 1.	May 8.	Shares Sold.		May 1.	May 8.	Shares Sold.
All. Ch......	7½*	7½	10	Int. Met., pf.	51⅞	53¼	10,250
All. Ch. pf...	28	27	600	Mackay Cos..	90½*	90½	20
Amal. Cop...	63⅞	63	38,800	Mackay C.,pf.	74⅞*	75⅝*	800
Am. D. T...	20½*	20½*	———	Man. Elev..	136*	135*	415
Am. Loco....	38	38*	500	Met. St. Ry.	15*	15*	———
Am. Loco., pf.	104⅞*	104⅞*	———	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	83*	82½*	300	Steel, com...	76¾	74½	400,510
Am. T. & T..	146½	148⅞	17,100	Steel, pfd....	119¼	119	5,150
B. R. T.....	79⅛	78¾	28,890	W. U. T....	73¾	74½	14,060
Gen. Elec....	159	156¼	6,630	West'h, com..	69	68*	2,200
Int. Met.....	18¼	19	6,350	West'h, pfd.	117½	117*	———

PHILADELPHIA.

	May 1.	May 8.		May 1.	May 8.
Am. Rys...........	44	44	Phila. Elec.........	16½	16½
El. Co. of A.......	12*	12*	Phila. R. T........	18	17¼*
Elec. St. B'ty......	52¾	52¾*	Phila. Trac.........	82¼	82½
Elec. St. B'ty., pfd.	30*	30*	Union Trac.........	46	45¾

CHICAGO.

	May 1.	May 8.		May 1.	May 8.
Chi. City Ry.......	186*	186*	Chi. Tel. Co........	121	124*
Chi. Rs., Ser. 1.....	80*	80*	Met. El. Co.........	22⅛*	22⅛*
Chi. Rs., Ser. 2.....	22*	21¾	Met. El., pfd.......	67*	67¼
Com. Edison........	125	125*	Nat'l Car...........	114*	115
Chi. Suhways.......	5¼	4⅞	Nat'l Car, pfd......	120*	120*

BOSTON.

	May 1.	May 8.		May 1.	May 8.
Am. T. & T.......	146½	148¾	Mex. Tel...........	4½	4*
Cum. Tel...........	150*	150*	Mex. Tel., pfd......	6½*	6¼*
Edison E. Ill......	286*	287¼	N. E. Tel..........	142¾	143
Gen. Elec..........	158	157	W. T. & T.........	19½	20¼*
Mass. E. Ry.......	18¾	18½	W. T. & T., pd.....	94	94½*
Mass. E. Ry., pf....	88	88			

*Last price quoted.
Shares sold for week May 1 to May 6.

Money markets have not been greatly changed by the activity of the bond market, and rates are practically the same as last reported. Rates May 8 were: Call, 2@2¼ per cent; ninety days, 2½@2¾ per cent. The quotations in the table are those at the close May 8.

Financial Notes

Pacific Gas & Electric Company for 1910.—In the annual report of the Pacific Gas & Electric Company for 1910 an increase in returns for the year and for the past five years is shown. Gross revenue in 1910 was $14,229,228, of which $369,264 is in suspense owing to the San Francisco rate cases. The undisputed gross revenue is therefore $13,859,963, which is $527,462 more than the earnings in 1909. The amount charged to maintenance was $1,243,859, and to operating expenses, taxes, reserve for uncollectible accounts, casualties, etc., was $6,677,481, making total expenses for the year of $7,921,341. Net revenue was $5,938,622, and interest charges $3,006,156, leaving a balance of $2,932,466, as compared with $2,812,403 in 1909. Total deductions, including dividends of $600,000 on preferred stock, $733,402 applied to sinking funds and $47,220 for amortization of bond discount and expense, left a balance of $1,551,844, against $1,502,956 for the previous year. The report states that in 1906 61.5 per cent of the net revenue was required to meet fixed charges, while in 1910 50.6 per cent was required for this purpose, and that while over $17,000,000 has been spent on additions to plant in the last five years there has been only a slight increase in fixed charges. In 1906 the average rate of interest paid on obligations was 5.10 per cent, against 4.98 per cent in 1910. During the five years retirement or cancellation of bonds aggregated $2,513,405, and further, bonds with par value of $1,140,000 were purchased for sinking funds, but not canceled. The company serves over 100 communities in California. On Dec. 31 there were 240,934 customers, of which 82,721 purchased electric service; 152,403 gas; 5110 water for domestic uses, and 700 took water for irrigation purposes. The output of the stations in 1910 was 366,867,336 kw-hours, and the passengers carried on the street-railway system in Sacramento were 10,691,475, earnings per car mile being 23.3 cents.

Northern Texas Electric Company.—Estabrook & Company and Parkinson & Burr have purchased $1,000,000 three-year 5 per cent coupon notes of the Northern Texas Electric Company. These are the direct obligation of the Northern Texas Electric Company, and are to be secured by a first mortgage upon the property of the Ft. Worth Southern Traction Company, which is to be organized under the laws of Texas, and the greater portion of whose stock will be owned by the Northern Texas company. The Ft. Worth Southern Traction Company will operate an electric railway, some 30 miles in length, between Ft. Worth and Cleburne, Tex. A balance of $428,559, available for interest on the notes is shown in the earning statement of the Northern Texas Electric Company for the year ended Jan. 31, 1911, amounting to over eight times the $50,000 required. The notes are being offered by the bankers at 99 and interest, to yield 5⅜ per cent.

Mutual Union Telegraph Bonds Extended.—The $5,000,000 first-mortgage thirty-year 6 per cent bonds of the Mutual Union Telegraph Company, a subsidiary of the Western Union Telegraph Company, matured May 1, and holders were offered the privilege of receiving cash for them at par or exchanging for a new issue of 5 per cent thirty-year bonds at par. Most of the holders took the new bonds, and others, holding about $1,000,000, cashed in their bonds at the Chase National Bank, which acted for Blodget & Company, a bond house, which had purchased from the Western Union the right of extension for its own account. The Western Union, which owns nearly all of the $2,500,000 stock of the Mutual Union Company, held $3,043,000 of the maturing bonds for which the new 5 per cent issue was exchanged.

Great Western Power Company Extension.—Negotiations for the purchase of the City Electric Company, of San Francisco, by the Great Western Power Company, as reported in the issue of April 6, are being brought to a close. Edwin Hawley, president of the Great Western company, has sold securities of this company to a banking syndicate, and $4,000,000 of the proceeds therefrom will be used to acquire the properties and interests of the City Electric Company. After the merger the plants of the City Electric Company will be connected with those of the purchaser.

Kellogg Switchboard & Supply Company.—The first financial statement of the Kellogg Switchboard & Supply Company has been made public and shows plant and equipment assets amount to $744,864, which does not include either patents held by the company or any valuation of good-will. Inventories are given as $1,071,198, and the capital stock as $1,000,000, with a surplus of $1,211,728 after payment of the year's dividends.

Hudson Companies' Notes Offered.—Harvey Fisk & Sons, of New York, are offering $1,000,000 Hudson Companies 6 per cent secured convertible gold coupon notes. These are a portion of the issue of $10,136,000 sold in 1910, and are secured by a deposit of the trustee of 150 per cent of Hudson & Manhattan Company first-mortgage 4½ per cent bonds, due 1957. The notes are offered at 98½ and accrued interest.

Indianapolis & Louisville Reorganization.—The reorganization plan of the Indianapolis & Louisville Traction Company, which is to be disposed of by foreclosure sale, has been completed, and includes the issuing of new securities as follows: Five per cent thirty-year first mortgage bonds to the amount of $10,500,000, and $600,000 6 per cent cumulative preferred stock, and $600,000 common stock.

Tri-City Railway & Light Company.—President Joseph F. Porter, of the Tri-City Railway & Light Company, which furnishes traction, lighting and motor service at Davenport, Ia., Rock Island and Moline, Ill., says in his annual report that the affairs of the company are in a very satisfactory condition. The gross earnings for the year were $2,513,486, representing an increase of 23.24 per cent over the figures of the previous year. Net earnings were $1,031,519, an increase of 14.8 per cent. Operating expenses and taxes also increased, and amounted to $1,481,967, this amount being nearly 30 per cent higher than in 1909. Deducting interest charges and sinking-fund instalments, there was left a surplus for the year of $550,111, from which dividends amounting to $169,572 were paid on the preferred stock. After total deductions there was left a net surplus for the year of $330,539. In the spring of 1910, the company's railway department secured from the authorities in each of the three cities extensions of franchise rights for a period of twenty years on the Illinois side and twenty-five years on the Iowa side, covering existing tracks and privileges for new extensions. The franchises of the electric companies on the Iowa and Illinois sides of the river now extend into 1935 and 1943 respectively. President Porter states that conditions contingent upon extensions are not burdensome. One of the more important requirements for extension is the placing of feeders in conduits below the surface of the streets in the fire district of Davenport, and this work is reported as progressing rapidly. The company's lines are being constantly extended into the outlying districts in order to reach new customers, and during the year the company has been successful in securing a considerable increase in its load. Various improvements have been made during the year in the stations of the company.

New England Telephone & Telegraph Company.—The annual report of the New England Telephone & Telegraph Company for the year 1910, which has recently been issued, gives gross earnings as $13,171,709, compared with $12,086,782 for the previous year. Total expenses for the year were $9,858,907, and interest charges were $118,808, leaving net earnings of $3,193,994, as compared with $3,183,949 for 1909. Dividends amounted to $2,350,686, leaving a surplus of $843,308. The total number of stations of the New England Telephone Company, Dec. 31, 1910, was as follows: Exchange, 253,795; private line, 5307. For the Southern Massachusetts Telephone Company, exchange, 27,740, and private line, 197. Stations for associate and connected companies were 54,983, making a total of 382,022, an increase of 37,106 stations for the year. There were 734,204 miles in wire, and 10,153 employees. The company announces its decision to give a complete and impartial trial to the schedule of rates for the Boston & Suburban Division recommended Aug. 23 by the Massachusetts Highway Commission. Expenditures for 1911 are estimated at $4,000,000 for new construction and real estate, and $4,400,000 for repairs and depreciation, making a total of $8,400,000.

Ohio Electric Road Insolvent.—United States Judge J. M. Killits has appointed Albert E. Royce and Burton C. Harding, of Bowling Green, Ohio, receivers of the Lake Erie, Bowling Green & Napoleon Railway Company, following the application of Edmund C. Ebert, of Detroit. Mr. Ebert alleges that the company is insolvent and defaulted interest May 1 on $400,000 of its authorized bond issue. The Union Trust Company, of Detroit, is a defendant in the suit. The receivers will take immediate control of the properties of the road, including the lighting plant and hot-water-heating system. The company has been operating the railway between Bowling Green, Pemberville, Woodville and Tontogany, and has made plans for further extension. The company has $750,000 common stock, of which $380,400 is outstanding, and has $250,000 preferred stock, which is outstanding. There are also $1,000,000 5 per cent first mortgage gold bonds, dated Nov. 1, 1903, due Nov. 1, 1913.

Conversion of General Electric Bonds.—Plans have been completed for the conversion of the General Electric Company's $12,875,000 5 per cent ten-year gold debenture bonds of 1907 into stock at par after June 1. With the stock now earning 8 per cent and the bonds 5 per cent, it is expected that the entire issue will be converted. This would make the capital stock of the company $78,054,600, against a capital stock of $65,179,600 on December 31, 1919, and would relieve the General Electric Company of bonded debt, with the exception of $2,047,000 3½ per cent gold debenture thirty-year convertibles of 1892. There are also $1,912,066 5 per cent bonds authorized but not issued. In view of the excellent showing made by the company last year, a number of stockholders have asked for a higher rate of dividend, but action in this matter will doubtless be deferred until the conversion of the bonds is effected.

Bell Telephone Company to Acquire Southern Interests.—Negotiations are said to be under way for the purchase of the Central Home Telephone Company of Kentucky by Bell Telephone interests. A board of trustees of bondholders and creditors, under an agreement between the Central Home Telephone Company, the Mobile Telephone Company and the Independent Long Distance Telephone Company, is now in charge of the affairs of the Central Home company.

McCall's Ferry Transmission Line.—The Susquehanna Transmission Company is planning to issue $1,131,000 first-mortgage 5 per cent bonds to meet the expense of its transmission line from the McCall's Ferry plant of the Pennsylvania Water & Power Company to Baltimore. Construction of the line is nearly finished, and the balance of the work will require an expenditure of some $200,000.

Ohio Lighting Companies Merged.—The Hardin-Wyandotte Lighting Company has absorbed the lighting plants at Forest, Dunkirk, Kenton and Upper Sandusky, Ohio, and has filed a mortgage at Upper Sandusky, securing a $500,000 bond issue in favor of the Citizens' Savings & Trust Company of Cleveland.

Dividends

General Electric Company, quarterly, $2 per share, payable July 15.

Kings County Electric Light & Power Company, quarterly, 2 per cent, payable June 1.

Mobile Electric Company, quarterly, preferred, 1¾ per cent, payable May 15.

Portland Railway, Light & Power Company, quarterly, $1 per share, payable May 12.

Tampa Electric Company, quarterly, $2 per share, payable May 15.

St. Joseph Railway, Light, Heat & Power Company, quarterly, one-half of 1 per cent, payable June 1.

West Pennsylvania Traction Company, quarterly, 1 per cent, payable June 15.

REPORTS OF EARNINGS.

AMERICAN LIGHT & TRACTION COMPANY.

	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
12m., Mar., 1911	$3,933,091	$119,521	$3,813,569	......	......
12m., Mar. 1910	3,463,580	107,445	3,356,135	......	......
BLACKSTONE VALLEY GAS & ELECTRIC COMPANY.					
March, 1911	$86,986	$46,951	$40,045	$29,705	$10,340
March, 1910	81,458	39,707	41,751	29,165	12,586
DALLAS ELECTRIC CORPORATION.					
March, 1911	$129,528	$83,936	$45,592	$27,616	$17,976
March, 1910	114,849	77,241	37,608	26,347	11,261
DETROIT UNITED RAILWAYS COMPANY.					
March, 1911	$772,719	$490,269	$298,058	$177,567	$120,491
March, 1910	725,233	470,407	266,900	161,871	105,029
EL PASO ELECTRIC COMPANY.					
March, 1911	$57,090	$32,720	$24,370	$8,247	$16,123
March, 1910	51,579	29,564	22,015	8,575	13,440
GALVESTON-HOUSTON ELECTRIC COMPANY.					
March, 1911	$116,287	$70,985	$45,302	$24,682	$20,620
March, 1910	105,144	67,673	37,471	23,080	14,391
ILLINOIS TRACTION COMPANY.					
Year, 1910	$6,218,037	$3,665,627	$2,498,226	$1,536,687	$961,539
Year, 1909	5,363,383	3,063,491	1,927,263	1,250,429	676,834
JACKSONVILLE ELECTRIC COMPANY.					
March, 1911	$51,900	$28,376	$23,524	$10,450	$13,074
March, 1910	52,557	26,973	25,584	9,469	16,115
LOWELL ELECTRIC LIGHT CORPORATION.					
March, 1911	$38,673	$23,330	$15,343	$4,763	$10,580
March, 1910	35,037	19,955	15,08[illegible]	4,721	10,3[illegible]1
MINNEAPOLIS GENERAL ELECTRIC COMPANY.					
March, 1911	$110,191	$46,191	$64,0[illegible]	$35,445	$28,555
March, 1910	103,966	41,567	62,399	31,427	[illegible],972
NIAGARA, ST. CATHARINES & TORONTO RAILWAY COMPANY					
Year, 1910	$338,761	$250,719	$88,042	$7[illegible],[illegible]31	$8,[illegible]11
Year, 1909	299,941	207,297	92,644	74,8[illegible]7	17,746
NORTHERN TEXAS ELECTRIC COMPANY					
March, 1911	$142,938	$74,894	$68,044	$25,137	$42,907
March, 1910	128,679	67,[illegible]0	61,289	[illegible]8,786	42,[illegible]03
PACIFIC GAS & ELECTRIC COMPANY					
Year, 1910	$13,859,964	$7,921,341	$5,938,623	$3,006,156	$2,932,467
Year, 1909	13,332,501	7,531,576	5,8[illegible],925	2,[illegible]88,522	2,812,403
PUGET SOUND ELECTRIC RAILWAY					
March, 1911	$143,638	$106,383	$37,255	$52,276	$15,021
March, 1910	157,779	125,178	32,601	50,6[illegible]	*18,006
SAVANNAH ELECTRIC COMPANY					
March, 1911	$53,062	$34,770	$18,292	$18,282	$10
March, 1910	49,907	32,049	17,858	17,847	11
SEATTLE ELECTRIC COMPANY.					
March, 1911	$458,458	$271,838	$186,620	$115,593	$71,027
March, 1910	461,289	279,053	182,246	110,1[illegible]9	72,137
SOUTHERN POWER COMPANY.					
Year, 1910	$1,263,479	$455,542	$807,937	$2[illegible],000	$607,937
Year, 1909	$[illegible],290	313,334	505,956	150,000	355,956

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*Deficit.

General News

Construction News.

COLUMBIA, ALA.—The installation of an electric-light plant and sewerage system in Columbia is reported to be under consideration.

MONTGOMERY, ALA.—The Montgomery Light & Water Power Company, it is reported, has placed contracts for a 1000-kw turbine and will also install a jet type condenser. The cost of the improvements is estimated at about $25,000.

PHOENIX, ARIZ.—Arrangements are being made by the Phoenix Railway Company for the construction of two extensions, one to Ingleside and Scottsdale, and the other on Central Avenue across the new bridge and through Tempe to Mesa.

SAFFORD, ARIZ.—The Safford Water & Electric Company is constructing a dam and storage reservoir in the mountains near Safford and will bring water to the city for its distributing system by means of a pipe line.

ALAMEDA, CAL.—It is expected that a special election will be held in July to vote on the proposition to issue $175,000 in bonds, of which the proceeds of $100,000 will be used for the erection of a new power house for the municipal electric-light plant and for new equipment for same.

BAKERSFIELD, CAL.—Work will begin at once on the construction of the first of the substations to be erected at different points in this county by the San Joaquin Light & Power Company. The first station will serve Moron and Maricopa, the next will be erected at McKittrick and later one at Famosa.

LOS ANGELES, CAL.—Rights-of-way are being secured by the Glendale & Eagle Rock Railway Company for an electric railway which will connect its lines and the Glassell and Workman ranches. The company will also make extensions on certain streets in Glendale.

SAN BERNARDINO, CAL.—The substation of the San Bernardino Valley Traction Company, located at the mouth of Waterman Canyon on the Arrowhead-Hot Springs branch, was recently destroyed by fire, entailing a loss of about $7,000.

SAN FRANCISCO, CAL.—It is reported that Law Brothers, of San Francisco, Cal., are negotiating for a right-of-way for an electric railway through Marin County.

SAN FRANCISCO, CAL.—It is reported that the executive committee of the Great Western Power Company has authorized an expenditure of $1,000,000 to increase the output of the hydroelectric generating station at Las Plumas, on the Feather River, and to start work on the second development above Las Plumas. The present station of the company has an output of 55,000 hp, which will eventually be doubled.

SAN JOSE, CAL.—Preparations are being made by the United Gas & Electric Company for the erection of a high-tension transmission line from San Jose to Alum Rock Park.

STOCKTON, CAL.—The Tidewater & Southern Railroad Company, which is now constructing an electric railway from Stockton to Modesto, is planning to extend the railway to Merced, a distance of 25 miles. K. C. Brueck, of Stockton, is president.

WILLOWS, CAL.—The Sacramento Valley West Side Electric Railway Company, recently organized, is planning to build an electric railway from Woodland north to Kennett, via Red Bluff, Golusa and Redding. C. L. Donohue, of Willows, and E. L. Sisson are interested in the project.

WASHINGTON, D. C.—Bids will be received by the Department of the Interior, Washington, D. C., until May 18, for the erection and completion of a concrete coal bunker and conveyor machinery for the central heating and lighting plant at the Freedmen's Hospital and Howard University, Washington, D. C., in accordance with specifications and drawings, copies of which may be obtained upon application to the chief clerk of the department. Carmi A. Thompson is assistant secretary.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until June 1, for supplying and installing lighting fixtures in the United States buildings at Amsterdam, N. Y.; Keene, N. H.; Marlboro, Mass.; Woburn, Mass.; Olean, N. Y.; Shamokin, Pa.; Webster, Mass., and Lynchburg, Va., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is Supervising Architect.

QUINCY, FLA.—The People's Ice, Fuel & Supply Company, of Quincy, Fla., has secured a location in Port St. Joe, on which it proposes to erect an electric light and ice plant. It is understood that contracts have already been placed for machinery for the plant. Robert Sylvester, of Quincy, is president.

SANFORD, FLA.—Preliminary arrangements have been made by the Citrus Southern Electric Railway Company for construction of its proposed electric railway between Kissimee, Sanford and Orlando, 45 miles in length. J. J. Brophy, of Winter Park, is general manager.

WEST PALM BEACH, FLA.—It is reported that the Ariston Ice & Electric Company will apply to the City Council for a new franchise. The company contemplates making extensions to its plant, including the installation of additional machinery involving an expenditure of $15,000.

WEST POINT, GA.—Plans are being considered for the construction of an electric railway to connect West Point, Hamilton, Talbotton, Forsyth and Monticello.

BONNERS FERRY, IDAHO.—Plans are being considered by the Bonner Water & Light Company for improvements and extensions to its plant. A. H. Featherstone is owner.

CALDWELL, IDAHO.—The City Council is reported to be considering the installation of an electric-lighting system in Caldwell.

ABINGDON, ILL.—The Mutual Union Telephone Company has filed an amendment to its charter increasing its capital stock from $15,000 to $40,000.

BRYON, ILL.—It is reported that surveys are being made for the construction of a large dam and hydroelectric plant in Byron.

CHICAGO, ILL.—It is reported that plans have been completed for the consolidation of the North Shore Electric Company, operating in thirty-two communities north and west of the city, the Economy Light & Power Company, operating in twenty or more towns in Desplaines River Valley, and the Illinois Valley Gas & Electric Company, with plants already in operation and under construction in twenty-eight villages and cities throughout the Illinois valley. The combined capital stock of the three companies amounts to $11,564,000 and funded indebtedness to $9,751,000. Samuel Insull, president of the Commonwealth Edison Company, is president of both the North Shore Electric Company and the Economy Light & Power Company, and also a director of the Illinois Valley Gas & Electric Company.

EAST ST. LOUIS, ILL.—The East St. Louis Interurban Electric Company, recently incorporated, proposes to construct an electric railway from the city of East St. Louis, Clair County, Ill., in an easterly direction to a point in Clinton County, Ill. J. L. Flannigan, W. H. Hauss and Edward L. Cragon, all of East St. Louis, Ill., are among the directors.

FT. SHERIDAN, ILL.—Bids wil be received at the office of the Constructing Quartermaster, Ft. Sheridan, Ill., until June 5 for furnishing and installing a sewage disposal plant, complete, including hydrolitic tank, filters, sludge beds, pumps, motors, electric pole line and connections, sewer main and outlet, etc., at Ft. Sheridan. Bids for the work complete only will be considered. A limited number of plans will be supplied from this office upon deposit of $25, which will be refunded upon return of same. Plans and specifications may be seen at this office and at the office of the Chief Quartermaster, Department of the Lakes, Federal Building, Chicago, Ill.; office of the Depot Quartermaster, Army Building, Whitehall Building, New York, N. Y. Captain M. E. Saville is constructing quartermaster.

GIBSON CITY, ILL.—The City Council has granted A. Hood, of Chicago, Ill., a thirty-year franchise to construct and operate an electric light plant in Gibson City. The franchise provides that iron poles shall be used within the fire limits, the installation of an alternating-current system, meters to be furnished to all consumers free of charge, electricity for lighting the city hall and water-works plant to be furnished free of charge; also to light the streets of the city at reduced rates and a reduction in the price of electricity for commercial purposes. Mr. Hood agrees to install a $50,000 plant and have it in operation by Sept. 1, 1911.

OLNEY, ILL.—The local electric light plant, owned by Arthur Schultz, is reported to have been purchased by H. H. Knipe, of Robinson, Ill., president of the Southeastern Illinois Long Distance Telephone & Telegraph Company.

WASHBURN, ILL.—F. E. Downing, of Decatur, Ill., is reported to have taken over the local electric light plant owned by Messrs. Moll & Shride, of Decatur, Ill.

ANGOLIA, IND.—F. S. Hunting has been appointed receiver for the Angolia Railway & Power Company. The company operates the street-car system, supplies electrical service in the city, furnishes power to operate the pumping station of the city water-works and operates a short traction line between Angolia and Lake James. It is said that there is a mortgage of $100,000 outstanding against the company. The property of the company is valued at $75,000.

BRAZIL, IND.—Specifications prepared by Frank Kaltman, city engineer, for lighting the streets and public buildings for a term of ten years have been approved by the City Council. Bids will soon be called for and if the bids submitted are not satisfactory a municipal electric plant will be installed as planned. The present contract expires April 1, 1912.

CRAWFORDSVILLE, IND.—The City Council has voted to install ornamental cluster lamps on the principal streets of the city. The lamps will be erected on stone lamp standards, costing $30 each. The style of lamp has not yet been decided upon.

INDIANAPOLIS, IND.—The Monon Railroad Company has submitted plans to the Railroad Commission for the installation of electric automatic block signals between Indianapolis and Chicago.

KENTLAND, IND.—The City Council is asking for funds for a franchise for lighting the streets and public buildings for a term of twenty years.

MIDDLETOWN, IND.—Injunction proceedings have been brought to prohibit the Town Trustees from entering into a contract with the Indiana Union Traction Company to furnish electricity to light the city. The citizens voted almost unanimously to install a municipal electric light plant and the money is in the treasury. Later the board decided it would be cheaper to secure the service from the traction company. The citizens are insisting on the installation of a municipal plant.

PRINCETON, IND.—The City Council has ordered all poles and wires removed from the business portion of the city and placed underground. The present arc lamps will be replaced by a system of ornamental cluster lamps.

RICHMOND, IND.—The Richmond & Cincinnati Traction Company has applied for a charter in Indiana for the purpose of constructing an electric railway to connect Richmond, Ind., and Cincinnati, Ohio, which later will be extended to Union City. The company is capitalized at $50,000.

TERRE HAUTE, IND.—The City Council has approved the contract entered into by the Board of Public Works with the Terre Haute, Indianapolis & Eastern Traction Company for lighting the streets and public buildings. The contract is for a period of ten years, under which the company is to furnish arc lamps at the rate of $67 each per year.

YORKTOWN, IND.—Marion Sears, of Yorktown, Ind., is reported to be organizing an electric light company for the purpose of supplying electricity in the towns of Yorktown, Daleville and Chesterfield and to the farmers along the transmission line between the towns. Mr. Sears has made arrangements to secure electricity to operate the proposed system from the plant of the Muncie Electric Light Company, of Muncie, Ind.

ANAMOSA, IA.—It is reported that bids will soon be asked by the Board of County Commissioners of Jones County for the installation of an electric-light plant for the county home building, now under construction. Louis Gardner is county auditor.

DES MOINES, IA.—The Fort Dodge, Des Moines & Southern Railway Company, it is reported, is contemplating equipping its system within the city limits for electrical operation.

DUBUQUE, IA.—The question of installing an ornamental street lighting system in the business district is reported to be under consideration.

DUBUQUE, IA.—It is reported that the La Crosse Telephone Company has secured a site in Dubuque on which it will erect a telephone exchange building, to cost about $15,000.

MONTICELLO, IA.—Fred J. Cross, of Monticello, Ia., has been granted franchises to operate electric lighting systems in the cities of Center Point, Walker, Coggon, Central City. Propositions have also been submitted to other towns in Linn County. It is reported that it is proposed to erect a plant in Central City and supply the service in all the towns from one central plant.

OTTUMWA, IA.—The business men are contemplating the installation of an ornamental lighting system in the business district, covering twenty blocks.

COLDWATER, KAN.—The contract for the construction of the proposed municipal electric-light plant and water-works system is reported to have been awarded to Fred M. Clark, of Savannah, Mo., for $29,180. Plans were prepared by the J. S. Worley Company, Reliance Building, Kansas City, Mo.

FORT SCOTT, KAN.—The plant of the Fort Scott Gas & Electric Company is reported to have been destroyed by fire recently, causing a loss of about $150,000.

WICHITA, KAN.—Sealed bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until May 29 for furnishing and installing an electric passenger elevator, etc., in United States post office and court house at Wichita, Kan., in accordance with drawings and specifications, copies of which may be obtained at the above office. James Knox Taylor is Supervising Architect.

DRY RIDGE, KY.—The citizens of Independence have raised $50,000, the amount necessary to secure the extension of the Cincinnati, Louisville, Lexington & Maysville Traction Company's system through Independence. W. T. S. Blackburn, of Dry Ridge, is president of the company.

LEXINGTON, KY.—Preparations are being made by the Lexington & Interurban Railways Company for the construction of an extension from Lexington to Nicholasville, 22 miles in length.

LEXINGTON, KY.—The Kentucky Traction Company, the Lexington Railway Company, the Bluegrass Traction Company and the Lexington Utilities Company have been consolidated under the name of the Kentucky Traction & Terminal Company. The merger will become effective May 17. The new company will control the Stout railway system of Lexington and all interurban railways running out of Lexington to the surrounding Bluegrass towns.

LIBERTY, KY.—The installation of an electric light plant in Liberty is reported to be under consideration. Messrs. Herren & Condiff are said to be interested in the project.

NORTONVILLE, KY.—The Nortonville Traction Company will soon begin work on the construction of its electric railway in Nortonville. The power station will be located in Nortonville and will supply electricity for lamps. The company is capitalized at $100,000. The officers are: Frank E. Mohr, of Nortonville, Ky., president; T. F. Callard vice-president, and Frank G. Hoge, secretary and treasurer.

SHREVEPORT, LA.—The City Council has engaged Anderson Offutt, of New Orleans, La., electrical engineer, to make investigations and estimates of cost of constructing a municipal electric light plant in Shreveport.

BURLINGTON, MASS.—The Edison Electric Illuminating Company of Boston, Mass., has secured a franchise to supply electricity in the town of Burlington for both street and commercial lighting. Post office address is Woburn.

GARDNER, MASS.—Contracts have been closed by the Connecticut River Power & Transmission Company, through its subsidiary, the Gardner Electric Light Company, with the towns of Westminster, Hubbardstown and Barre, to furnish electricity for lighting the streets and for domestic and industrial purposes. Walter A. Belcher, of Gardner, Mass., superintendent, will have charge of the installation of the several systems.

HOLYOKE, MASS.—The Deane Steam Pump Company is contemplating the installation of a new power plant and expects to be in the market for equipment for a power plant having an output of about 450 kw. Oil, gas and steam plants will be considered. Charles L. Newcomb is general manager.

MILLER'S FALLS, MASS.—The Miller's River Street Railway Company will soon apply for a charter in Massachusetts to construct and operate an electric railway to connect Miller's Falls, Montague, Erving, Wendall and Orange. The capital stock of the company is placed at $70,000. Daniel P. Abercrombie, Jr., of Montague; Charles W. Clapp, of Greenfield; Marcus A. Coolidge, of Fitchburg, and others are interested in the company.

NORTH ATTLEBORO, MASS.—At a special town meeting held recently the citizens voted to extend the municipal lighting system to the Holmes neighborhood, a distance of 4½ miles.

SPRINGFIELD, MASS.—The contract for installing the electrical equipment in the new group power station and heating plant now under construction has been awarded to the M. B. Foster Company, of Boston, Mass., for $10,500.

STERLING, MASS.—The Selectmen have made arrangements with the Connecticut River Power & Transmission Company to supply electricity in Sterling. The service will be furnished from the substation in Clinton, 2½ miles distant. It is proposed to erect a transformer station in Sterling to reduce the current from 13,000 to 2300 volts. The town hall, two engine houses and library will be lighted by electricity and 80 street lamps installed.

WEBSTER, MASS.—Arrangements are being made by the Webster & Southbridge Gas & Electric Company to extend its transmission lines from Webster to Gore, a distance of 2 miles.

ANN ARBOR, MICH.—A special appropriation of $280,000 has been made by the State Legislature for the purpose of erecting a new heating, lighting and power plant at the University of Michigan.

SEBEWAING, MICH.—The question of installing a municipal electric light plant in Sebewaing is under consideration.

THREE RIVERS, MICH.—At an election held recently the citizens voted in favor of the proposition to purchase the Emery water power at a cost of $40,000.

DELANO, MINN.—The Oscar Claussen Engineering Company, of St. Paul, Minn., has been engaged to prepare a preliminary report for remodeling the present municipal electric plant or construction of a new plant to provide the village of Delano with a 24-hour service. When plans are prepared the proposition to issue bonds to secure funds for improvements will be submitted to a vote of the people.

MANKATO, MINN.—Bids will be received by D. Donahue, village clerk, North Mankato, Minn., until May 22 for the construction of water works, consisting of two three-phase, 60-cycle, 220-volt motors direct-connected to pumps. Bids will be received on electric pumping equipment, single-stage centrifugal pumps; alternate bids on gasoline equipment, consisting of engine and triplex pump, will be considered. Separate proposals will be received on reservoirs, pump house, pumping equipment, water mains and well. Plans may be seen at the office of the village clerk or at the office of John Wilson, engineer, Mankato, Minn.

MINNEAPOLIS, MINN.—Dr. P. M. Hall, health commissioner, is reported to be preparing plans for enlarging the municipal incinerating plant and installing additional electric generators so as to enable the plant to supply electricity for lamps for workhouse, Hopewell Hospital and 20 miles of streets in vicinity of workhouse.

PROCTOR, MINN.—Plans are being made by the Duluth Telephone Company for improvements to its local system, involving an expenditure of about $25,000.

WINONA, MINN.—The Wisconsin-Minnesota Power Company has applied to the City Council for a franchise to enter this city. It is said that the new company is contemplating taking over the local electric company.

COLUMBIA, MO.—Bids will be received by John S. Bicknell, city clerk, until May 16 for the construction of an electric light and power plant. Plans can be obtained from H. H. Humphrey, Chemical Building, St. Louis, Mo., engineer, or may be seen at the office of the city clerk.

ST. JOSEPH, MO.—The St. Joseph Railway, Light, Heat & Power Company has announced a reduction of 15 per cent. in rates for electricity for lamps for commercial and residential lighting to take effect from May 1.

ST JOSEPH, MO.—The City Council has authorized City Counselor Norris to take preliminary steps looking to the submission of the proposition to issue bonds for extensions and improvements to the municipal electric light plant for the purpose of supplying electricity for commercial lighting.

HELENA, MONT.—Plans are being considered by the Helena Light & Power Company to double-track its electric railway to the State fair grounds, for which, it is said, bonds to the amount of $100,000 will be issued. J. G. White & Company, 49 Exchange Place, New York, N. Y., are general managers.

VIRGINIA CITY, MONT.—Surveys have been completed and rights of way secured for an electric railway between Alder and Virginia City. L. H. Leber and R. J. Watson are interested in the project.

ANSELMO, NEB.—The establishment of a municipal electric-light plant and water-works system in Anselmo is reported to be under consideration.

NIOBRARA, NEB. Preparations are being made by the Sioux City Service Company, of Sioux City, Ia., for developing that water-power of the Niobrara River. About 10,000 hp will be developed at a cost of $1,500,000.

OMAHA, NEB.—The Omaha & Council Bluffs Street Railway Company has awarded the contract for the construction of a substation at Fifth and Jones Streets to B. J. Jobst. The building will be 60 ft. x 40 ft., one story high, and will cost about $100,000.

PORTSMOUTH, N. H.—The contract for extensions to the heating and power plant at the navy yard at Portsmouth, N. H., has been awarded to the Walworth Manufacturing Company, of Boston, Mass., for $36,560.

PASSAIC, N. J.—Bids will be received by the city of Paterson until May 19 for furnishing and installing a police signaling system, fire-alarm equipment and municipal telephone exchange for the city of Passaic, in accordance with specifications and drawings on file in the office of the city clerk. Thomas R. Watson is city clerk.

RED BANK, N. J.—The Shore Lighting Company, which is a consolidation of the Shore Electric Company, of Red Bank, N. J.; the Seabright Electric Light Company, of Seabright, N. J., and the Citizens' Light & Fuel Company, of South Amboy, N. J., has been taken over by the Public Service Corporation of New Jersey. The electric-lighting business has been turned over to the Public Service Electric Company and the gas business to the Public Service Gas Company. The deal has been approved by the Board of Public Utility Commissioners.

TUCUMCARI, N. M.—It is reported that improvements and extensions will be made to the local electric light plant.

ALBANY, N. Y.—Bids will be received by the Board of Contract and Supply, Albany, N. Y., until May 15 for the installation of a police signal system in the First, Second, Third and Fifth precincts and the equipment of the boxes now in use in the Fourth precinct with lights, etc., to conform with the system to be installed in the other four precincts. Forms of proposals and specifications and form of contract can be seen at the office of the Board of Contract and Supply, City Hall, Albany, N. Y. Isidore Wachsman is secretary of board.

GLOVERSVILLE, N. Y. The city of Gloversville, it is reported, is contemplating the installation of a municipal electric-light plant.

LITTLE FALLS, N. Y.—Surveys are being made by the Little Falls & Johnstown Railroad Company for its proposed railway between Little Falls and Johnstown, via St. Johnsville.

NEW YORK, N. Y.—The contract for furnishing materials and electric wiring and appurtenances for light and power for the Metropolitan Hospital and surrounding buildings, Blackwell's Island, City of New York, has been awarded to the New York Construction Company, 1328 Broadway, New York, N. Y., for $19,740. J. McKee Borden is secretary.

ROCKVILLE CENTRE, N. Y.—At a special election held recently the citizens voted to appropriate $17,000 for the construction of a new power house equipped with two 800-hp boilers. Provisions will be made for the installation of two additional boilers when necessary. The new equipment will also include a coal hoist operated by a motor.

SYRACUSE, N. Y.—The Syracuse, Watertown & St. Lawrence River Railroad Company, recently incorporated, is planning to build an electric railway to connect Syracuse, Watertown, Cicero and Brewerton. The proposed railway will be 7 miles long and will connect with the Syracuse & South Bay Electric Railroad in Cicero and extended to Brewerton. The company is capitalized at $1,250,000, and the incorporators are: J. S. Moore, W. W. Foster and M. H. Knapp.

BURLINGTON, N. C.—The Piedmont Railway & Electric Company, recently incorporated with a capital stock of $1,000,000 is planning to construct electric railways to connect Burlington, Haw River and Graham with the local railways. The charter of the company gives it the privilege of supplying electricity for lamps and motors. E. S. Parker, J. M. Cook and A. L. Davis are interested in the company.

CHARLOTTE, N. C.—The Southern Power Company, of Charlotte, N. C., has awarded a contract to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for furnishing electrical equipment for the interurban electric railway extending from Charlotte to Kings Mountain, 32 miles in length, to cost $300,000. The equipment includes eight locomotives of the motor type, transformers, equipment for cars, etc.

HENDERSON, N. C.—The plant and holdings of the Henderson Lighting & Power Company have been taken over by the North State Hydro-Electric Company, of Raleigh, N. C.

HENDERSONVILLE, N. C.—Plans are being made by C. F. White to organize a company to build an electric railway from the depot in Hendersonville to Osceola Lake, via Columbia Park, 2 miles in length, for which about $10,000 has been subscribed. It is expected to extend the line in the near future, making a belt line through that vicinity.

RALEIGH, N. C.—The Carolina Power & Light Company has purchased the plant and holdings of the Standard Gas & Electric Company, of Raleigh. The Carolina company is now completing the large hydro-electrical development at Blewett's Falls.

RUTHERFORD, N. C.—The North Carolina Interurban Railroad Company has filed notice that it is ready to proceed with the construction of its proposed electric railway, which is to connect Asheville and Gastonia. The proposed railway will be about 92 miles in length.

SALISBURY, N. C.—The W. J. Oliver Company, recently incorporated with a capital stock of $400,000, for the purpose of taking over the Salisbury-Spencer Street Railway & Electric Company, is preparing to extend its railway to nearby towns. The company has a franchise for an electric railway from Salisbury to Concord, a distance of 22 miles. W. J. Oliver, of Knoxville, Tenn.; John M. Beall, of St. Louis, Mo.; T. J. Jerome, of Salisbury N. C., are interested in the company.

WILMINGTON, N. C.—The Tidewater Power Company, it is reported, is contemplating increasing the output of its power house and will install additional machinery, including a 400-hp boiler, improvements to gas plants, etc.

CANTON, OHIO.—Arrangements are being made by the Canton Electric Company for extensions to its property, which will involve an expenditure of $300,000 this year. The present plans of the company provide for an expenditure of $1,500,000 in Canton during the next five years. Work will soon begin on the construction of an addition to the power plant to cost $50,000. The equipment to be purchased will include one 2000-kw and two 4000-kw generators. W. C. Anderson is manager.

CLEVELAND, OHIO.—It is reported that the Euclid Doan Power Company, of Cleveland, Ohio, recently incorporated, is planning to erect a power plant to generate electricity for commercial purposes. S. H. Selbert, Joseph Morgenstern, F. Ethel Whipp, Sidney S. Harvey and A. J. Harvey are the incorporators.

CLEVELAND, OHIO.—It is reported that plans are being made to organize a company to build an electric railway between the southern limits of the city of Cleveland and the race track at Randall, a distance of 7 miles. It is expected that the Cleveland Railway Company will be asked to supply electricity for operating the proposed railway.

CLEVELAND, OHIO.—The Hardin-Wyandotte Lighting Company has filed a mortgage at Upper Sandusky in favor of the Cleveland Savings & Trust Company to secure an issue in bonds. The company has absorbed the electric light plants in Kenton, Dunkirk, Forest and Upper Sandusky, and will supply electrical service to all the above towns from its plant in Kenton. Donald McBride is president and F. S. Whitcomb is secretary, both of Cleveland, Ohio.

DAYTON, OHIO.—Bids will be received by the Board of Trustees of the Dayton State Hospital, Dayton, Ohio, until May 23 for furnishing and installing a 250-kw direct-current generator direct-connected to a slow-speed Corliss engine, and for making certain switchboard changes. Specifications may be secured from A. F. Shepherd, M. D., superintendent Dayton State Hospital.

FOSTORIA, OHIO.—Arrangements are being made by the Fostoria & Fremont Electric Railway Company for the construction of an electric railway between Fremont and Port Clinton, 18 miles in length. J. D. McClinton is secretary of the company.

GREENSPRING, OHIO.—The Village Council is considering the installation of an electric-light plant in Greenspring.

MIDDLETOWN, OHIO.—Notice has been filed with the Secretary of State of the consolidation of the Middletown Gas & Electric Company and the Middletown Lighting Company under the name of the Middletown Gas & Electric Company, with a capital stock of $350,000.

OBERLIN, OHIO.—Attorney Hart, of Cleveland, Ohio, has been appointed receiver of the Oberlin Gas & Electric Company. The company supplies heat, light and power throughout the city and also furnishes electrical service and steam heat to Oberlin College.

MUSKOGEE, OKLA.—It is reported that preliminary surveys are being made for a water-power site on the Illinois River in the Cherokee Nation, about 15 miles above the confluence of the Illinois and Arkansas Rivers. The proposed site is situated about half way between Tahlequah and Gore. The present plans call for the construction of a large dam and hydroelectric power plant to supply electricity to operate the proposed new interurban electric railway which Ex-Governor Haskell is building between Muskogee and Fort Gibson. It is said if power can be secured in the Illinois River, the electric railway will be extended from Fort Gibson to Fort Smith.

OKLAHOMA CITY, OKLA.—The Oklahoma Gas & Electric Company is contemplating extending its system to Britton, to the new college for girls, 1½ miles north of Britton; also east to the State Fair Grounds and to other sections of the city. The cost of the extension to Britton is estimated at about $20,000. The company also contemplates extending its transmission lines to the outlying districts suitable for manufacturing and industrial purposes, if sufficient business is guaranteed to pay for the extension. Extensions to the lighting system will also be made in Linwood, Miller and Classen Boulevard additions, to the State Fair Grounds amusement park, on West Main Street and on West Sixteenth Street.

SKIATOOK, OKLA.—It is reported that the citizens have voted to issue bonds for the installation of an electric-light plant in Skiatook.

WAYNOKA, OKLA.—William Haviland, of Alva, Okla., is reported to be preparing plans for the construction of the proposed electric-light plant and water-works system, for which bonds to the amount of $27,000 have been voted. C. D. Willard is town clerk.

WELEETKA, OKLA.—At an election held recently the citizens voted to issue bonds to the amount of $45,000, the proceeds to be used for the installation of an electric-light plant and water-works system.

PORTLAND, ORE.—It is reported that plans are being prepared by the Oregon-Washington Railroad & Navigation Company for the construction of a telephone system to connect all the general offices in Seattle, Tacoma, Wash., and Portland, Ore., on a single exchange. The cost of the proposed system is estimated at about $70,000.

VALE, ORE.—The Malheur Independent Telephone Company, recently incorporated with a capital stock of $15,000, proposes to obtain control of all of the telephone lines in the county and extend its lines in all directions. The company is now erecting a line from Vale to Watson, a distance of about 50 miles.

OIL CITY, PA.—Bids will be received by the city of Oil City, Pa., until May 19 for replacing the present Gamewell fire-alarm telegraph system, having a two-circuit gravity battery, with a four-circuit storage battery with switchboard complete. Bidders must furnish plans and specification of proposed battery and switchboard. C. W. Mullalley is city controller.

PITTSBURGH, PA.—Preparations are being made by Dilworth, Porter & Company to enlarge their mill, which will be equipped for electric-motor drive. A contract for electrical equipment has been awarded to the General Electric Company, of Schenectady, N. Y.

TYRONE, PA.—The Mountain City Light, Heat & Power Company, now operating a power plant at Tyrone, and owning water rights extending from Huntingdon Township, Huntingdon County, to west of the boundary of Logan Township, Blair County, has been granted a charter. The new charter gives the company water rights in Huntingdon County and Logan Township.

WOODLAWN, PA.—The Woodlawn & Southern Street Railway Company has awarded the contract for the construction of its proposed electric railway from Woodlawn to Aliquippa, with a branch on Franklin Avenue to Woodlawn, extending to New Sheffield, to J. G. McGuire & Company, of New Brighton, Pa. J. I. Moore is interested in the company.

EDGEFIELD, S. C.—The City Council has called an election to be held June 18 to vote on the proposition to issue bonds to an amount not exceeding $15,000, the proceeds to be used for installing an electric-light plant in Edgefield.

GREENVILLE, S. C.—The Greenville, Spartanburg & Anderson Railway Company has applied to the Secretary of State for permission to increase its capital stock from $300,000 to $4,000,000, and to construct an electric railway from Belton to Greenwood.

CUSTER, S. D.—The City Council has granted the Custer Electric Light, Heat & Power Company a fifty-year franchise to supply electricity for lamps and motors in Custer. The company has acquired the property of the paint factory, located on French Creek, within the town limits. Contracts have been awarded for rebuilding the building, and it is expected that contracts for electric apparatus will soon be awarded. E. L. Grantham is president and H. E. Hay secretary.

PIERRE, S. D.—The Sioux Falls & Southern Minnesota Traction Company has applied for a charter in South Dakota for the purpose of constructing an electric railway from Sioux Falls, S. D., to Albert Lea, Minn., via Worthington, Sheppard, Spring Valley, Dresden, Loon Lake, Petersburg, Ceylon, Silver Lake, East Chain and Pilot Grove, Minn. The capital stock of the company is placed at $300,000. The incorporators are: L. B. Wyckoff, of Syracuse, N. Y.; J. J. Davenport, H. W. Knight and Charles S. Sollas, of Chicago, Ill., and G. P. Peterson, of Pierre, S. D.

CUMBERLAND GAP, TENN.—Negotiations are under way between this city and Middleborough, Ky., whereby the latter will supply electricity for lamps in Cumberland Gap. Preparations are being made to develop the water power of Gap Creek for power purposes. A large dam is being built which when completed will supply power for several large manufacturing plants.

AUSTIN, TEX.—Plans are being considered by W. D. Shelby, of Austin, and associates, for the construction of an electric railway in the western portion of the city. The proposed railway will be about two miles in length and will reach the business portion of the city.

AUSTIN, TEX.—The J. T. Cogan Company, of New York, N. Y., has submitted a proposition to the City Council to rebuild the dam across the Colorado River and install a hydroelectric plant in Austin. The plans includes replacing the dam and hydroelectric plant at a cost of $1,000,000, which is to be paid by the city at the rate of $50,000 per annum from the earnings of the water-works and electric light and power departments. An election will be called in the near foture to submit the proposition to a vote of the people.

BRYAN, TEX.—The City Council has purchased the plant and holdings of the Bryan Water, Ice, Light & Power Company, to be owned and operated by the municipality. Improvements and extensions will be made to the plant.

FLORESVILLE, TEX.—The installation of an electric light plant in Floresville is reported to be under consideration. A. B. Crawford, of San Antonio, is said to be interested in the project.

GAINESVILLE, TEX.—Plans are being considered by M. A. Hindman, of Fort Worth, Tex., and associates for the construction of an electric railway to connect Gainesville, Tioga and McKinney. The construction of an electric railway from Gainesville to Sherman, via Whitesboro, is also under consideration.

GRANBURY, TEX.—The Granbury Water, Ice, Light & Power Company is reported to be in the market for a 100-hp gas producer and engine. James W. Hackaday is manager.

HOUSTON, TEX.—The trustees of the Rice Institute are reported to have awarded the contract for the equipment of power plant to the Walworth-English-Flett Company, of Boston, Mass., for $156,950.

TEXAS CITY, TEX.—The Texas City Transportation Company has made arrangements for the installation of an electric telpher system in its warehouses devoted to the New York business. If the system proves satisfactory, all of the warehouses will be equipped with it. The company will also equip its piers with electric cranes to handle freight. Plans are also being made by the company to install shops, which will be equipped for electric motor drive.

OGDEN, UTAH.—The City Council has granted the Oregon Short Line Railroad Company a franchise to build a spur track on Twentieth Street and Wall Avenue.

OGDEN, UTAH.—The City Council has awarded the contract for street lighting to the Merchants' Light & Power Company, recently organized by local business men in Ogden. Under the terms of the contract the company is to supply arc lamps at the rate of $4.75 each per month. The Utah Light & Railway Company submmitted a bid offering to supply street lamps at the rate of $5 per lamp per month. Under the present contract the city pays $6 per lamp per month. The Merchants' Light & Power Company must have its plant in operation within 120 days. Work has not commenced on the proposed plant.

BRATTLEBORO, VT.—The question of providing ornamental lamp standards on Main and Elliot Streets will be submitted to a vote at a town meeting to be held soon. It is estimated that about 50 standards will be required.

BURLINGTON, VT.—The Burlington Light & Power Company has submitted a proposition to the city offering to supply electricity for municipal and for commercial lighting, during the pendency of the injunction proceedings now in court, at less cost than the city can generate the same at the municipal plant.

BARNETT, VA.—Preparations are being made by the residents of West Barnett and farmers along the proposed line to form a company under the name of the Barnett Center Electric Light & Power Company for the purpose of supplying electricity in West Barnett and to the farmers along the route of the proposed transmission line. Arrangements have been made with D. L. Judkins, owner of the local electric plant, to supply electricity for the system. About $5,000 has been raised toward the project. L. H. Thornton has been elected temporary president; Wilbur Wilson, M. A. Roy, J. L. Allen, C. S. Carter and H. J. Brock are interested in the enterprise.

FALLS CHURCH, VA.—The Arlington Electric Company, recently organized, has made arrangements with the Falls Church Telephone Company to use its poles to carry its wires. The company preposes to supply electricity through Alexandria County, and will purchase electrical energy to operate its system from the Washington-Virginia Electric Railway Company.

NORFOLK, VA.—The Norfolk Railway & Light Company is reported to be contemplating extending its railway to Richmond and Washington.

ROCKY MOUNT, VA.—At an election to be held June 14 the proposition to issue $50,000 in bonds, the proceeds to be used to establish an electric-light plant and water-works system, was carried.

GOLDENDALE, WASH.—The local electric light plant, owned by H. W. Fellows, has been purchased by the Pacific States Electric Company, of Portland, Ore. The consideration is understood to be about $55,000. The new owners, it is said, will extend and improve the system.

KALAMA, WASH.—The Washington-Oregon Corporation is reported to be contemplating the construction of a 12,000-hp plant at the old site on the Kalama River.

MARCUS, WASH.—The City Council has accepted the proposition submitted by H. V. Gates, of Hillsboro, Ore., to supply the town with electricity and water. The franchise calls for the installation of a high-pressure gravity water system. Electricity will be supplied from the power plant, located near Meyers Falls. The cost of installing the two systems is estimated at $40,000.

MONTESANO, WASH.—At an election held recently the proposition to issue $125,000 in bonds, the proceeds to be used to purchase the plants of the Montesano Light & Water Company, was defeated.

PASCO, WASH.—The City Council is reported to have engaged E. Tappan Tannatt, State Building, Spokane, Wash., consulting engineer, to make an appraisal of the plant and holdings of the Pacific Power & Light Company, which the city proposes to purchase, to be owned and operated by the municipality.

SEATTLE, WASH.—The County Commissioners are reported to have engaged J. H. Hull to prepare plans and specifications for additions to the lighting and power plant at the Kings County Hospital.

SEATTLE, WASH.—A bill has been passed authorizing an expenditure of $75,000 for the construction of a new power plant to be used in connection with the municipal power plant on Cedar River. The proposed plant will be located on Lake Union at the foot of Nelson Place and will have an output of about 2000 hp. It is expected that plans and specifications will be prepared at once. The present plans call for laying a steel main from the Volunteer Park reservoir to the new plant.

SISTERSVILLE, W. VA.—Bids will be received at the office of the city clerk of Sisterville, W. Va., until May 15 for construction of power house for the municipal water-works system, plans and specifications for which are on file at the office of W. J. Alexander, architect, New Martinsville, W. Va., and at the office of the water commissioner, Sistersville, W. Va.

ARCADIA, WIS.—Vaughn & Meyer, of Milwaukee, Wis., have been engaged to prepare plans for the reconstruction of the municipal electric light plant in Arcadia.

CHATHAM, ONT., CAN.—The Chatham, Wallaceburg & Lake Erie Railway Company is planning to build extensions to Blenheim and Sarnia. Work on the Blenheim extension will begin this summer.

COBALT, ONT., CAN.—The McArthur-Forest Company, which controls the Scottish-Ontario mine at Porcupine, is reported to have secured rights for the construction of a power dam across the Mattagami River at Sturgeon Falls, between the Transcontinental Railroad and Porcupine. The water power will be developed to generate electricity which will be transmitted to Porcupine.

GALT, ONT., CAN.—The rates for electricity in Galt supplied from the system of the Toronto Hydroelectric Power Commission have been announced by the fire and light committee. The cost will be computed on a dual basis of area lighted and electricity consumed. The rate is 4 cents per 100 sq. ft. per month plus 4 cents per kw-hour, with a discount of 10 per cent for prompt payment. The new rates will go into effect June 1 and it is estimated that a saving of about 50 per cent will be effected. A by-law to appropriate $25,000 for extensions to the system will be submitted to the ratepayers on May 26.

GUELPH, ONT., CAN.—The Toronto Hydroelectric Power Commission has informed the city of Guelph, Ont., that electricity supplied by the commission to the city of Guelph would cost $25 per hp per year until December, 1912, after which time it would be reduced gradually until it reaches $20 per hp per annum.

New Industrial Companies.

THE BADT-WESTBURG ELECTRIC COMPANY, of Chicago, Ill., has been chartered, with a capital stock of $2,400, by Francis B. Badt, Paul A. Westburg and Fred M. Rosseland. The company proposes to manufacture and deal in electrical instruments and supplies.

THE BOGARDUS COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $50,000, to manufacture valves, steam gages and engines. The incorporators are: W. L. Barnum, Jr., T. A. Nelson and DeF. M. Neice, of Chicago, Ill.

THE DETROIT AUTOMATIC TELEPHONE COMPANY has been incorporated for the purpose of manufacturing a primary current, direct connection telephone invented by Dr. Leopold F. Mueller. The instrument is so constructed that it will connect an individual with any one or more of a thousand stations by pressing a button. The factory will be located in Detroit, Wyandotte or Adrian, Mich. Dr. Mueller, Charles F. Chisholm and Otto Van Humerich are the incorporators.

THE ECONOMIC RECTIFIER & ELECTRIC COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $25,000 by Arthur C. Ide, Maurice Weigle and Albert L. Letterman.

THE ELECTRICAL PRODUCTS COMPANY, of Saginaw, Mich., has been organized to manufacture an interior telephone designed by John J. Speed, formerly manager of the Valley Home Telephone Company. The new instrument will be called the Speed-I-Phone. The offices of the company are located at 1914-16 South Michigan Avenue, Saginaw, Mich.

THE C. A. FISCHER COMPANY, of West Hoboken, N. J., has been chartered by C. A. Fischer, W. Wollenschlager and C. Struppman, of West Hoboken, N. J. The company is capitalized at $50,000 and proposes to manufacture electrical appliances, etc.

THE GANAHAL ELECTRIC COMPANY, of St. Louis, Mo., has been incorporated by Octavia L. Ganahal, Hubert J. Ganahal and Eric A. Kurgar. The company is capitalized at $2,000 and proposes to do a general electrical contracting and supply business.

THE GERVAIS ELECTRIC MANUFACTURING COMPANY, of Hartford, Conn., has been incorporated by M. J. Smith, E. Raymond Low and Robert W. Smith, of Hartford. The company is capitalized at $50,000 and proposes to manufacture electrical specialties.

THE HIXON ELECTRIC COMPANY, of Boston, Mass., has filed articles of incorporation, with a capital stock of $30,000, for the purpose of manufacturing electrical goods. The directors are: Alfred J. Hixon, 246 Summer Street, Boston, Mass.; C. J. Titus and N. L. Penneck.

THE HOBERT ELECTRIC MANUFACTURING COMPANY, of Troy, Ohio, has been granted a charter, with a capital stock of $20,000, by the Secretary of State, to do business in the State of Illinois.

THE KERITE INSULATED WIRE & CABLE COMPANY, of New York, N. Y., has been granted a charter, with a capital stock of $25,000, to do business in the State of Illinois. The company is a New York corporation and is capitalized at $500,000.

THE RICHMOND LAMP MANUFACTURING COMPANY, of Richmond, Ind., has been incorporated, with a capital stock of $50,000. The company proposes to manufacture carriage, automobile and other lamps. The incorporators are John M. Judson, John C. Ingram and T. W. Judson.

THE SACHS LABORATORIES, Inc., of Hartford, Conn., has been chartered with a capital stock of $50,000 by Joseph Sachs, B. M. W. Hanson, Charles W. Rice and F. C. Nichols, of Hartford, Conn., and C. F. L. Robison, of New Haven. The company proposes to manufacture electrical specialties, etc.

THE SNYDER ELECTRIC COMPANY, of Alexandria, Va., has been chartered with a capital stock of $15,000 to deal in electrical supplies. The officers are: J. Newman Perry, president, and J. A. Sterrett, secretary and treasurer, both of Washington, D. C.

THE SOUTHERN ELECTRIC COMPANY, of Altus, Okla., has been granted a charter, with a capital stock of $10,000, for the purpose of doing a general electrical construction business. The incorporators are: M. E. Woolridge, W. R. Kimberlin and E. E. Traweelmall.

THE SOUTHERN ELECTRIC LIGHT & POWER SUPPLYING CORPORATION, of Norfolk, Va., has been incorporated for the purpose of dealing in electrical supplies. The officers are: A. D. Newcomb, president; T. R. Calls, vice-president; W. J. Simpson, Jr., secretary and treasurer, all of Norfolk, Va.

THE TERRE HAUTE ELECTRICAL PORCELAIN COMPANY, of Terre Haute, Ind., has been incorporate,d with a capital stock of $25,000, to manufacture and sell electrical porcelain. The incorporators are William H. Glover, J. G. Hamilton and E. R. Coleman.

THE UNITED ENGINE & MANUFACTURING COMPANY, of York, Pa., has been incorporated with a capital stock of $20,000. The directors are: Robert E. Manley, 505 Madison Avenue, York, Pa.; William D. Himes, of New Oxford, Pa., and O. S. Trone, of Hanover, Pa.

THE WHEELER-M'DOWELL ELEVATOR COMPANY, of New York, N. Y., has filed articles of incorporation with a capital of $25,000 to manufacture, install and repair hoisting machinery; also to manufacture and deal in electrical apparatus. The incorporators are: L. J. McDowell, F. A. Page and F. L. Harris, of New York, N. Y.

New Incorporations.

CHICAGO, ILL.—The Central Light Plant Company has been incorporated with a capital stock of $50,000 to operate electric light and gas plants. The incorporators are: M. J. Carvey, W. J. Stenson, R. D. Braden, J. V. Suneral and J. D. Campbell, all of Chicago, Ill.

GREENSBORO, N. C.—Articles of incorporation have been filed for the North State Hydro-Electric Company with a capital stock of $300,000 by A. C. Wyckoff, H. L. Parker and F. H. Briggs, all of Raleigh, N. C. It is stated that the company is a subsidiary of the Carolina Power & Light Company and the Yadkin River Power Company.

CLEVELAND, OHIO.—The Electric Utilities Company has been incorporated with a capital stock of $10,000 by A. L. Oppenheimer, W. N. Caldwell, Edward Younger, Leonard C. Loomis and F. J. Castle.

ALTUS, OKLA.—The Southern Electric Company has been incorporated with a capital stock of $10,000 by E. E. Traweek, W. R. Kimberlin and M. E. Wooldridge.

McALESTER, OKLA.—The Salisaw, McAlester & Southern Railway Company has been incorporated with a capital stock of $3,000,000 by William B. Freeman, John Cavanagh, M. J. Smith, William Fuller and A. F. Ringland, of McAlester. The company is capitalized at $3,000,000 and proposes to build an electric railway from Salisaw to McAlester, thence to Honey Grove, Tex., a distance of about 190 miles.

OKLAHOMA CITY, OKLA.—Articles of incorporation have been filed for the Butts Electric Company with a capital stock of $5,000 by W. B. Butts, C. B. Dillingham, C. G. Grimes, of Oklahoma City and L. C. Butts, of Shawnee, Okla.

FORWARD, R. F. D. SOMERSET, PA.—The Forward Electric Company has been granted a charter with a capital stock of $5,000. The directors are: R. C. Lightcap, 107 Allen Avenue, Knoxville, Pa.; S. M. Miller, Pittsburgh, Pa., and A. L. Davis, of Oakland, Pittsburgh, Pa.

HANOVER, PA.—The Hanover Power Company has been incorporated with a capital stock of $5,000 and the following directors: C. J. Kirschner, of Hazleton, Pa., treasurer; Alvan Markle and W. H. Lavall, all of Hazleton, Pa.

HARRISBURG, PA.—Charters have been granted by the Secretary of State to the following companies: The Suburban Electric Company, of East Coventry; the Suburban Electric Company, of East Pikeland, and the Suburban Electric Company, of East Vincent, all in Chester County; the Suburban Electric Company, of Upper Providence, and the Suburban Electric Company, of Limerick Township, Montgomery County. The offices of the companies are located in Pottstown. The directors are: H. M. Blake, 223 South Third Street, Philadelphia, Pa. treasurer; Aaron S. Lord and Herbert G. Williams, of Pottstown, Pa, Each company is capitalized at $5,000.

HAZLETON, PA.—Articles of incorporation have been filed for the Wright Power Company, with a capital stock of $5,000. The directors are: C. J. Kirschner, of Hazleton, Pa., treasurer; Alvan Markle and A. F. Harger, both of Hazleton, Pa.

HEBRON, PA.—The Hebron Electric Light & Power Company has been chartered with a capital stock of $5,000. The directors are: Daniel Weaver, of Lebanon, treasurer; Henry Weaver, of Avon, Pa.; John S. Weaver, of El Paso, Tex.; Jacob B. Weaver, and Raymond S. Bicksler. all of Lebanon, Pa.

KULPSVILLE, PA.—The Towamencin Electric Company has been granted a charter with a capital stock of $5,000. The directors are: Joseph Becker, of Kulpsville, Pa., treasurer; Harry Goodman, Solomon W. Goodman, of Philadelphia, Pa.

MADISON, PA.—The Madison Borough Electric Company has been chartered with a capital stock of $5,000. The directors are: H. C. Miller, of McKeesport, Pa., treasurer; J. S. Tannehill, of Cannonsburg, Pa., and A. E. DuBois, of Pittsburgh, Pa.

MOUNT LEBANON, PA.—The North Irwin Electric Company has been granted a charter, with a capital stock of $5,000. The directors are: C. W. Scheck, of Mount Lebanon, Pa., treasurer; W. F. Craig, of Swissvale, Pa., and S. M. Miller, of Pittsburgh, Pa.

MOUNT PLEASANT, PA.—The Mount Pleasant Township Electric Company has been granted a charter, with a capital stock of $5,000. The directors are: E. B. Beach, Hotel Hamilton, N. S., Pittsburgh, Pa.; A. L. Davis, Oakland, Pittsburgh, Pa., and William H. Larimer, of Wilkinsburg, Pa.

OLYPHANT, PA.—The Lackawanna Light, Heat & Power Company has filed articles of incorporation with the Secretary of State. The directors are: Alvin Markle, of Hazleton, Pa.; Louis W. Healy, of Scranton, Pa., and James Butler, of Moosic, Pa.

PHILADELPHIA, PA.—The Ideal Light Company has been incorporated with a capital stock of $10,000 and the following directors: Julian L. Van Thuyne, 425 Vine Street, Philadelphia, Pa.; Wirt W. Woolverton and Charles F. Wallace, both of Philadelphia, Pa.

PHILADELPHIA, PA.—The Chelton Electric Company has been incorporated with a capital stock of $10,000. The directors are: Alfred M. North, 117 West Chelten Avenue, Philadelphia, Pa., treasurer; Charles C. Aeugle, John H. Nash and James A. McLaughlin, all of Philadelphia, Pa.

SCRANTON, PA.—Articles of incorporation have been filed for the People's Light, Heat & Power Company with the Secretary of State. The directors are: Alvin Markle, of Hazleton, Pa.; C. D. Simpson, and Louis W. Healy, of Scranton, Pa.

SCRANTON, PA.—The Pioneer Electric Company has been granted a charter. The directors are: C. D. Simpson, of Scranton, Pa.; Alvan Markle, of Hazleton, Pa., and James Butler, of Moosic, Pa.

TARENTUM, PA.—The Tarentum, Brackenridge & Butler Street Railway Company has been granted a charter with a capital stock of $100,000 for the purpose of constructing a railway 2 miles in length. The directors are: J. M. Griffith, of Tarentum, president; Otto Sontam, C. H. Battey, F. Flaggenmeier, of Tarentum; C. N. Sehad, of Saxonburg, and J. C. Smith, of Brackenridge.

TYRONE, PA.—The Lower Tyrone Electric Company has been incorporated with a capital stock of $5,000 and the following directors: C. C. McBride, 32 Chapman Street, Ingram, Pa.; Byron Trimble, of Pittsburgh, Pa., and C. W. Scheck, of Mount Lebanon, Pa.

TYRONE, PA.—The Upper Tyrone Electric Company has been chartered with a capital stock of $5,000. The directors are: C. V. Scheck, of Mt. Lebanon, Pa., treasurer; A. E. DuBois, and E. M. Balsinger, of Pittsburgh, Pa.

WILKES-BARRE, PA.—The Wilkes-Barre Township Power Company has been chartered with a capital stock of $5,000. The directors are: C. J. Kirschner, of Hazleton, Pa., treasurer; Alvan Markle and C. B. Houck, of Hazleton, Pa.

WILKES-BARRE, PA.—The Wilkes-Barre Power Company has been granted a charter, with a capital stock of $5,000. The directors are C. J. Kirschner, treasurer, of Hazleton, Pa.; Alvan Markle and C. B. Houck, all of Hazleton, Pa.

JOHNSON CITY, TENN.—The Elizabethton, Milligan & Johnson City Electric Railroad Company has been incorporated with a capital stock of $25,000 to construct an electric railway from Johnson City to Elizabethon, via Milligan, a distance of 8 miles. The incorporators are: W. G. Payne, James H. Smith, A. B. Brannon, W. C. Burchfield, J. N. Inders and J. G. Borchfield.

LENOIR, TENN.—The Lenoir Light & Power Company has been chartered with a capital stock of $10,000 by T. C. Foster, J. R. Browder, H. C. Foster, J. E. Foster and S. P. Witt.

ALVIN, TEX.—Articles of incorporation have been filed for the Alvin Ice, Light & Power Company with a capital stock of $15,000 by W. R. Stockwell, S. O. Smith, B. S. Williams and others..

GRANBURY, TEX.—The Granbury Water, Light, Ice & Power Company has been incorporated with a capital stock of $30,000 by R. Vickery, W. T. Pittman and James W. Rockaday.

TEMPLE, TEX.—The Southwestern Traction Company has been granted a charter with a capital stock of $165,000. The company proposes to construct and operate an interurban railway between Temple and Belton, and also to operate lines within each city. The incorporators are, A. F. Bentley, P. L. Downs, W. S. McGregor, W. C. Haag and W. G. Bentley.

TYLER, TEX.—The Talbert Telephone Company has been incorporated with a capital stock of $25,000 by J. A. Talbert, J. C. Smith and M. Starnes.

SPOKANE, WASH.—Articles of incorporation have been filed for the Mountain Lake Power & Irrigation Company by T. Z. and L. T. Gillett and C. T. Camplan. The company proposes to take over the Carp Lake project, near Goldendale, and will irrigate about 10,000 acres.

LOGAN, W. VA.—Articles of incorporation have been filed for the Logan Electric Company with a capital stock of $25,000 by W. F. Bevill, Charles Bennett, S. M. Bisant, Naaman Jackson and Frank R. Hurst, all of Logan. The company proposes to generate and sell electricity for lamps and motors.

ROMNEY, W. VA.—The Romney Consolidated Telephone Company has been incorporated with a capital stock of $25,000 by John J. Cornwell, G. P. Miller and J. Sloan Kuykendall, of Romney; H. W. Miller, of Paw Paw, W. Va., and S. L. Hoover, of Harrisonburg, Va.

SISTERSVILLE, W. VA.—The Tyler Traction Company has been granted a charter by the Secretary of State to build an electric railway from Sistersville, via Middlebourn, to Shirley. The company is capitalized at $500,000.

FRIESTADT, R. F. D. THIENSVILLE, WIS.—The Ozaukee-Washington Telephone Company has been chartered with a capital stock of $50,000 by P. W. Kraemer and others.

Personal.

PROF. ALEXANDER GRAHAM BELL returned on May 8 from a trip around the world.

PROF. ELIHU THOMSON will be the chief speaker at a banquet to be given by the Electrical Society of the Massachusetts Institute of Technology on May 11.

MR. ALBERT SCHEIBLE has been chosen president of the Purdue Association, of Chicago, an organization in which the electrical engineering graduates of Purdue have always been prominent.

MR. G. K. HEYER, of the Western Electric Company, will deliver an address before the Central Railway Club at Hotel Statler, Buffalo, N. Y., on May 12, his subject being, "Train Dispatching by Telephone."

DR. SVANTE ARRHENIUS, president of the Nobel Physical Institute, of Stockholm, will speak on "Electrolytic Dissociation" at a banquet to be given in his honor in Chicago on May 12 by the Chicago branch of the American Chemical Society.

MR. FRED M. LEGE, JR., general manager and chief engineer of the Brush Electric Light & Power Company, of Galveston, Tex., has been appointed to a similar position with the Galveston Gas Company, which is owned by the same interests as the electric company.

PROF. JOHN H. HUNT, of the department of electrical engineering of the Ohio State University, delivered an address on the subject "Variable-Speed Generators" before the Worcester Polytechnic Institute Branch of the American Institute of Electrical Engineers on May 5.

MR. WILLIAM K. FREUDENBERGER, who has been electrical engineer for the Steptoe Valley Smelting & Mining Company, McGill, Nev., for the past twenty-five years, has been appointed engineering expert for the Public Service Commission of Nevada, effective May 15.

MR. CHARLES A. HOBEIM, who has been with the United Railways Company of St. Louis for the past eight years, has been appointed superintendent of power stations for this company, to succeed Mr F. D. Smith, who is now serving as chief engineer of the Board of Education of St. Louis.

MR. HENRY FLOY delivered a lecture on the Panama Canal before the Middletown Scientific Association, Middletown, Conn., on May 2. The lecture was illustrated with lantern slides from photographs mainly taken by Mr. Floy while on the Isthmus with the American Society of Civil Engineers during March.

MR. J. E. COWLES, formerly electrical superintendent of the Little Rock (Ark.) Railway and Electric Company, is now located at Shreveport, La., as electrical superintendent of the Shreveport Gas & Electric Company. Mr. Cowles was succeeded at Little Rock by Mr. C. E. Rose, formerly of the contract department.

MR. ROBERT T. LOZIER has become associated with Kountze Brothers, bankers, New York, for the handling of securities of well-established public-utility corporations. Mr. Lozier has been a full member of the American Institute of Electrical Engineers for the past eleven years and is at present president of the New York Electrical Society.

COL. W. H. CHAPMAN, vice-president and general manager of the Houston Lighting & Power Company, is recovering from a six weeks' illness of typhoid fever. Colonel Chapman is now past seventy years of age, but except for his recent illness has continued active in the administration of the business affairs of his company for the past sixteen years.

MR. S. G. McMEEN, of Chicago, Ill., who has just completed the installation of the automatic telephone system in San Francisco, on May 1 addressed the students of Throop Polytechnic Institute. The subject of the address was "The Work of the Telephone Engineer," with special reference to conditions found in San Francisco immediately following the earthquake and fire of 1906.

MR. ANGUS S. HIBBARD, who is leaving Chicago to become associated with President Vail, of the American Telephone & Telegraph Company in New York, was the guest of honor at several going-away parties before his departure. The Wisconsin Society of Chicago gave him a meat dish, explaining that a loving cup might lead to temptation, while from the executive committee of the Chicago Association of Commerce Mr. Hibbard received a gold-mounted baton in recognition of his musical ability.

MR. W. M. WHITE, formerly in charge of design for the I. P. Morris Company, of Philadelphia, has become associated with the Allis-Chalmers Company as manager and chief engineer of the hydraulic turbine department. During the past ten years Mr. White designed the hydraulic machinery for some of the largest hydroelectric installations in the country, including the plants of the Hydraulic Power Company and the Toronto Power Company of Niagara Falls, the Great Western Power Company of California, the Washington Power Company of Spokane, Wash., and the Shawinigan Falls Power Company of Montreal, Canada.

MR. CARL A. SYLVESTER has resigned as general manager of the Boston (Mass.) Suburban Electric Companies to become assistant to the general manager of the Rio de Janeiro Tramway, Light & Power Company, Rio de Janeiro, Brazil. Mr. Sylvester will succeed Mr. Walter Pearson at Rio de Janeiro and will leave Boston about June 1, 1911, to enter upon his new duties. Mr. Sylvester, who was born in Newton Center, Mass., was educated in the public schools at that place. He graduated from Harvard in 1902, and immediately entered the employ of the Newton system of street railways and worked in the shops and in the operating and construction departments. He also served for a time with the power department. In 1903 he was appointed assistant general superintendent of the Boston Suburban Electric Companies and later entered the general offices of the company in connection with the purchasing of supplies and as acting paymaster. In 1904 he was made assistant to the general manager. He received the title of assistant general manager in 1906. In September, 1909, Mr. Sylvester was appointed general manager of the Boston Suburban Electric Companies to succeed Mr. Matthew C. Brush, resigned.

MR. B. A. BEHREND, intimately connected with the electrical engineering profession for the last twenty years, whose articles on the "Induction Motor" in our columns in the year 1900 represented the first presentation to the American engineer of the method of treatment of this machine now universally employed, has opened an office for engineering consultation in the John Hancock Building, Boston. As chief engineer of the Bullock Electric Manufacturing Company, Cincinnati, Ohio; as chief engineer of the electrical department of the Allis-Chalmers Company, which he started and organized, and as consulting engineer of the Canadian branches of these companies, Mr. Behrend has for a long time been a prominent figure in the electrical industry of this country. During the last two and a half years, as advisory engineer of the Westinghouse Electric & Manufacturing Company, Pittsburgh, he has been in charge of the power engineering department of that company. Among Mr. Behrend's prominent clients are the Westinghouse Electric & Manufacturing Company and the Niagara Falls Hydraulic Power & Manufacturing Company, and in the past he has given advice to the Carnegie Steel Company and other subsidiaries of the United States Steel Corporation. The large electrical generators in the gas-engine plants of the Illinois Steel Company, the American Steel & Wire Company, the Carnegie Steel Company, and the Indiana Steel Company, Gary, Ind., were designed by Mr. Behrend, who also solved most successfully, for the first time in this country and on the greatest scale ever known, the problem of parallel operation of large gas-engine units. Fifteen 3000-kva units operate in [illegible] at Gary, five at the furnaces of the Carnegie Steel Company at Rankin, Pa., four at the South Works of the Illinois Steel Company in Chicago, and four 1200-kva units at the plant of the American Steel & Wire Company, at Cleveland, representing an aggregate of almost 100,000 kva and including almost all the important subsidiaries of the United States Steel Corporation. Mr. Behrend is a man of broad outside interests. He is a director in a large manufacturing company and he is interested in political, financial and economic questions. He has written a book on the theory of the induction motor and many other scientific and engineering papers. He received a gold medal for his work at the Louisiana Purchase Exposition in St. Louis, 1904, while his company received a grand prize. He has lectured at many universities, including Leland Stanford, University of Wisconsin, McGill University and the Massachusetts Institute of Technology. He is fond of educational problems, on which he has frequently written and spoken. He is a member of the Engineers' Club, New York, a fellow of the American Association for the Advancement of Science, a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers and of the American Institute of Electrical Engineers.

Obituary.

MR. JOHN J. NATE, of Minneapolis, Minn., very well known to telephone men of the Central West, died at the home of his daughter, in Winona, Minn., on April 30. He was born in 1857, and from 1878 to 1895 was employed by the Chicago Telephone Company, being purchasing agent for much of that time. In the year last mentioned he entered the Independent telephone manufacturing field. He was connected with several companies, and for the last nine years had been manager of the Minneapolis office of the Stromberg-Carlson Telephone Manufacturing Company.

Trade Publications.

STREET-CAR OPERATION.—In a treatise for street-railway men being distributed by the Sangamo Electric Company a number of schemes are suggested for comparing equipment, operators, checking line losses, etc. The book should prove of interest to every manager desiring to secure greater economy.

CENTRAL STATION SPECIALTIES.—Catalog No. 6, of the G. & W. Electric Specialty Company, 640 Jackson Park Avenue, Chicago, is a useful and handsome publication of 72 pages profusely illustrated, describing specialties for central-station use. These include potheads of various kinds, sometimes in combination with junction boxes and series switches; safety line disconnectors, series cut-outs, underground switching boxes, high-voltage fuse blocks, high-potential detectors, lubricating brushes, etc. Dimensions and prices are given, and there are many explanatory diagrams. An interesting feature is a dictionary of terms. For instance, a pothead is said to be "a device for sealing in a cable against moisture where taps are made to the cable." An alphabetical index would have made this useful catalog more easy to consult.

DECORATIVE STREET LIGHTING.—"The Illumination of the Streets" is the title of a brochure issued by the Holophane Company. While intended for popular distribution rather than for engineers, the booklet contains some valuable data on the subject and should be appreciated by all who are interested in the so-called "boulevard lighting" installations. The street-lighting units described have several definite advantages over other equipment, according to the data given. The units are designed to give the maximum of even illumination upon the streets and sidewalks with the minimum of objectionable glare. The comparative photometric curves published would indicate that the units are successful in both directions. Artistic appearance, however, has not in this case been sacrificed to engineering considerations. The units are especially attractive and the various designs have a wide range of adaptability. In view of the great interest everywhere manifested in improved street lighting, this publication should prove of more than passing interest.

BUSINESS NOTES.

MR. EDWIN W. HAMMER, electrical and mechanical engineer and patent expert, has moved his offices from 120 Broadway to 55 John Street, New York City.

WALTER B. SNOW, Boston, Mass., has recently added to his publicity engineering staff John S. Nicholl, late of the New York Edison Company, and formerly acting manager for F. W. Horne, importer of American Machinery at Yokohama, Japan.

WALPOLE RUBBER COMPANY.—Mr. E. C. Green has again become associated with the Walpole Rubber Company, in the capacity of general purchasing agent of the consolidated companies, with headquarters at the factory office in Walpole, Mass.

WHEELER MANUFACTURING COMPANY.—Mr. F. S. Broadhurst, formerly in the employ of the C. H. Wheeler Manufacturing Company of Philadelphia, and recently with the Westinghouse Machine Company, has rejoined the former company, assuming the position of sales manager, with headquarters at Philadelphia.

THE CUTLER-HAMMER MANUFACTURING COMPANY has established a department to be devoted exclusively to the design and manufacture of electrical appliances for industrial heating. The department will be under the direct supervision of Mr. W. S. Hadaway, Jr., with headquarters at the factory, 144th Street and Southern Boulevard, New York.

BLANCHARD MACHINE COMPANY.—Mr. Wolcott Remington, designer and manufacturer of oil engines, has associated himself with the Blanchard Machine Company, Cambridge, Mass. He is now engaged in designing a line of stationary and marine oil engines ranging in rating from 10 hp to 100 hp, which will be manufactured under the name of the Blanchard oil engine.

THE TEL-ELECTRIC COMPANY, Houston, Tex., is just completing the occupancy of its new five-story warehouse and storeroom building for general electrical supplies at 602 Preston Avenue. The new warehouse building affords provision for carrying the complete stock of electric lighting and telephone supplies which the company maintains at Houston for the south Texas trade. The distance of Houston from Northern and Eastern electrical distributing points makes necessary large reserve stocks, requiring about 50 per cent more space than would be necessary under similar conditions in less remote localities. Mr. M. B. Wheeler is general manager of the company.

CUTLER-HAMMER DINNER.—The recently issued souvenir of the 1911 annual dinner of the Cutler-Hammer Manufacturing Company, at the Milwaukee Club, recalls an interesting and carefully planned social event. The souvenir is in the shape of a regular bulletin of the company, arranged for filing, and shows that the Cutler-Hammer "boys" know how to play as well as to work. The diners were arranged around a circular table, the suggestion being that each represented the segment of a rheostat. The menu card is printed in the outline of an electric water heater, and there are original verses parodying popular songs, and cartoons of the gentlemen present, accompanied by alleged biographies. The "round robin" of those present embraces the names of H. H. Cutler, F. T. Taylor, A. B. Hubbel, R. M. VanVleet, A. W. Berresford, C. E. Watrous, S. M. McFedries, T. E. Barnum, R. C. Fenner, F. S. Wilhoit, L. L. Tatum, R. H. Mansfeld, A. G. Pierce, C. T. Henderson, C. L. Benjamin, F. L. Pierce, A. P. Munning, N. S. Hopkins and H. F. Vogt. One judges, from the name on the contact arm in the "arrangement of segments," that H. J. Wiegand was toastmaster. It is also a safe bet that Mr. Benjamin had something to do with "roasting" everybody in the souvenir.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 2, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City]

990,853. ADJUSTABLE SUPPORT FOR VAPOR LAMPS; S. E. Flichtner, Englewood, N. J. App. filed Jan. 9, 1905. Tilting frames for starting vapor electric lamps, having a reflector to throw the radiation in one general direction.

990,859. APPARATUS FOR IGNITING MINERS' SAFETY LAMPS; E. A. Hailwood, Morley, England. App. filed Oct. 16, 1906. A casing closed by a door to receive the lamp, door controlling contacts for the ignition circuit.

990,869. ELECTRIC SWITCH-OPERATING DEVICE; B. Henrard, Liége, and Léon Levêque, Antwerp, Belgium. App. filed Feb. 3, 1910. For operating the switches of railroads electrically by means of rubber contacts secured to the current conductor which come in contact with the contact strips at intervals along the track, thus throwing electromagnets for actuating the switches.

990,870. TROLLEY GUARD; C. Heron, Chicago, Ill. App. filed Aug. 9, 1909. Prevents the wheel from leaving the wire. The pole has a hollow shaft rigidly mounted on its fork and projects beyond both sides thereof; a spindle passes through the shaft; guard members are loosely mounted on the projecting portions of the shaft and are rigidly connected to the spindle.

990,875. ELECTRIC STEAM GENERATOR AND HUMIDIFIER; L. B. Holliday, Beckley, and E. J. Weidensall and George R. Kerhs, Wickham, West Va. App. filed March 22, 1910. For heating water by electricity, the electrodes dipping into a container for the water, the container being mounted upon a movable platform.

990,879. TILTING LAMP; F. H. Von Keller, New York, N. Y. App. filed Sept. 22, 1905. Tilting vapor lamp, tilted by an electromagnet, whose pole piece attracts an armature secured to the tilting frame to raise it from an inclined to a horizontal position repeatedly if desired.

990,893. PILOT CELL FOR ELECTRIC STORAGE BATTERIES; R. Macrae, Chicago, Ill. App. filed Nov. 19, 1909. A supplemental wall forms a compartment to accommodate measuring instruments, the compartment communicating with the electrolyte and having an opening sealed by a glass plate to view the instruments.

990,927. ELECTRICALLY HEATED COOKER; C. E. Terwilliger, Santa Cruz, Cal. App. filed Oct. 15, 1910. Self-cooker with electric preheating, including outer and inner shells with heat-retaining filling, and an electric resistance beneath the inner receptable.

990,951. FLEXIBLE ELECTRICAL BRUSH OR COLLECTOR; Ralph Henry Barbour, Tiltwood, Eng. App. filed Sept. 12, 1910. A plurality of fine wire strands of high conductivity, with an encircling armor formed of good conductors, spaced from the fine wire, and of a larger gage.

990,958. ELECTRIC LOCOMOTIVE; W. Cooper, Pittsburgh, Pa. App. filed Sept. 10, 1909. Driving gear and jack-shaft connection for varying the speed ratio between the motor actions and driving actions.

990,964. INDUCTION MOTOR; I. De Kaiser, Wilkinsburg, Pa. App. filed July 6, 1908. Secondary rotor winding for induction motors comprising two sets of spirally superposed plates with teeth in the four slots, the inner ends abutting against each other.

990,966. ELECTRIC RAILWAY VEHICLE; G. M. Eaton, Wilkinsburg, Pa. App. filed Dec. 24, 1909. Jack-shaft parallel to the driving wheels with large driving motors, gears between the jack shafts and motors, side-rod connections between the jack-shafts, and another jack-shaft from which sliding-rod connections run to the driving wheel.

990,967. MERCURY CIRCUIT-BREAKER AND SHUNT FOR SIGNAL RELAYS; E. A. Everett, Detroit, Mich. App. filed July 20, 1908. Automatic circuit-breaker and shunt for railway signals, including a main shunt across the track, circuit controllers in the track circuits and in the shunts which break the track circuit and main shunt and close the emergency shunt, to afford a path for earth currents.

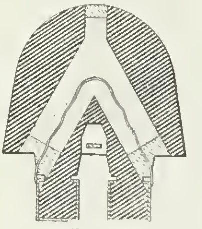
990,971. RAILWAY SIGNALING APPARATUS; A. Forster, Gorlitz, Germany. App. filed July 20, 1908. Semaphore operated by an electric circuit whose terminals end in a contact section adjacent to one of the tracks, which contact section is operated by wheels on the locomotive.

990,972. TELEPHONE CALL DISTINGUISHER; K. W. Gale, Los Angeles, Cal. App. filed Feb. 16, 1909. Desk telephone with call indicator containing an electromagnet in series with the ringing circuit, which actuates a pivoted indicator.

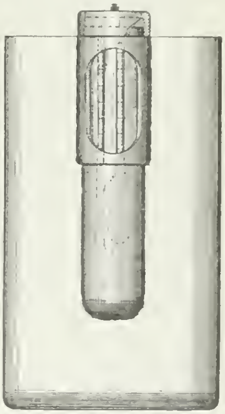
990,985. SYSTEM OF CONTROL; R. P. Jackson, Wilkinsburg, Pa. App. filed Oct. 20, 1904. Makes use of main switches, interlocking switches operated thereby, relay switches for operating the main switches, the relay switches being governed by a master switch and by the interlocking switches. The time period between successive operations is increased by the use of controlling switches into the circuits of which high inductances are included, so arranged that a reversal of the direction of the magnetic fluxes in the iron cores thereof occurs each time the devices are thrown into circuit so as to use residual magnetism.

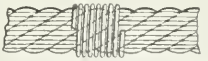
990,987. REEL FOR ELECTRIC CABLES AND THE LIKE; D. J. Jorden, Cleveland, Ohio. App. filed Oct. 9, 1909. For winding electric cables on portable machines such as mine locomotives. A fluid pressure motor operates the reel under a constant pressure.

990,999. POWER-TRANSMISSION APPARATUS; I. I. McGuire and H. H. Graham, Oak Park, Ill. App. filed July 9, 1909. For printing press motors. Two motors are used, one driving at normal high speed, the other to start the press with a clutch coupling controlled by electromagnets for throwing in either motor.



991,007.—Electric Fuse.





990,951.—Flexible Electrical Brush or Collector.

990,893.—Pilot Cell for Electric Storage Batteries.

991,004. METER-TESTING SERVICE CUT-OUT; T. E. Murray, New York, N. Y. App. field Dec. 8, [illegible]. A plurality of separate recesses with circuit terminal plates in the recesses, [illegible] extending outwardly therefrom [illegible] across the recesses, main and branch conductors, circuit connections between the terminal plates and conductors and a removable [illegible] upon two of the contact plates.

991,005. FUSE CASE; T. E. Murray, New York, N. Y. [illegible] Oct. 17, 1910. A fuse case whose walls are of [illegible] material reinforced with metal.

991,006. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed Nov. 19, 1910. For indicating the [illegible] of the fuse by means of an auxiliary fuse in a carrier [illegible] block, the terminals of the auxiliary fuse [illegible] contacts for the carrier, which connect with [illegible] case.

991,007. ELECTRIC FUSE; T. E. Murray, New York, N. Y. App. filed Nov. 26, 1910. For preventing the leakage of the [illegible] blowing of the fuse by arranging the strip in a V-shaped [illegible] so that the [illegible] blowing point will lie near the apex of the angle of the V.

991,008. ELECTRIC FUSE CASE; T. E. Murray, New York, N. Y. App. filed Dec. 13, 1910. The end of the fuse case consists of refractory insulating material with a [illegible] metal plate in the end piece, the case being formed of a metal [illegible] bent to form two tubular shells, one inclosing the other, with an air space between.

991,030. ELECTRICAL CONNECTION; S. Sedoff, Montclair, N. J. App. filed Oct. 6, 1910. For spark plugs and the like. The connections consist of a plate which can be screwed to the support and which carries a post on which a nut is mounted for securing the wire. The post has a split end with a spring action for engaging the sides of a metal block carrying the wire.

991,038. ELECTRIC LOCOMOTIVE; N. W. Storer, Pittsburgh, Pa. App. filed Jan. 3, 1910. Driving connection between electric motors and the driving wheels of a locomotive by means of two jack-shafts directly below the motor axles to which they are gear-connected

991,039. TROLLEY-POLE-OPERATING MEANS; A. A. Strange and W. Anderson, Memphis, Tenn. App. filed Aug. 12, 1909. Pneumatically controlled hollow trolley pole communicating with a piston chamber with a second piston in the trolley pole which carries the trolley wheel, for holding the wheel against the wire, but permitting it to fall out of the path of the suspending wires when it becomes disengaged from the trolley.

991,040. PRESSURE-CONTROLLED OPERATING MEANS FOR TROLLEY POLES; A. A. Strange and W. Anderson, Memphis, Tenn. App. filed Oct. 28, 1909. Trolley pole with cylinder and piston rod for operating it, connections between the rod and pole to move the latter into opposite position when the pressure is admitted to the cylinder, the rod cutting off the pressure supply when the pole jumps the track.

991,044. RESERVE EMERGENCY LANTERN; W. H. Adams, Sound Beach, Conn. App. filed June 18, 1910. Has a base carrying the batteries, a reflector, a switch and a cover with a lamp inside of the reflector.

991,053. ELECTRIC FIRE ALARM; A. C. Farley, Shinglehouse, Pa. App. filed Nov. 15, 1909. A casing containing a sliding rod, a signal, a wire leading from the signal to the rod, an expanding member carrying a contact positioned between the ends of the rod and the wire, a second wire secured to the contact and a battery secured to the last-mentioned wire.

991,080. SYSTEM OF ELECTRICAL DISTRIBUTION; R. M. Palmer, Cambridge, Mass. App. filed Oct. 30, 1909. Improvement on patent 807,960. A high-voltage circuit, a low-voltage circuit containing the translating device, and a relay governed by the high-voltage circuit, a relay in the low-voltage circuit and a circuit controller governed by the last relay.

991,105. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Feb. 8, 1908. The main generator, a circuit, a battery to be charged from the circuit, means for regulating the generator and means connected to the battery terminals and to a point within the battery for regulating the regulator to give a tapering charging current responsive to variations in the battery condition.

991,106. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed May 2, 1908. Main generator, a battery, an auxiliary generator having a field for fixing the polarity of the main generator, and means for reversely connecting the field coil when the voltage of the battery rises to a given value.

991,107. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed July 11, 1908. A combination of a distribution circuit, a storage apparatus connected to the circuit, a regulating dynamo therefor, an exciter for the dynamo, and a dynamo-electric machine coacting upon the field of the regulating dynamo responsive to fluctuations in the circuit.

991,108. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Dec. 28, 1908. A source of electromotive force governed by an auxiliary dynamo-electric machine, a variable resistance in series with the work circuit and means for regulating the dynamo responsive to variations in the resistance, the resistance being controlled in accordance with voltage fluctuations.

991,109. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Jan. 16, 1909. Car-lighting system with variable-speed generator, whose voltage responds to electrical fluctuations in its output and a coil operating on failure of the regulator to cause the regulator to regulate the voltage of the generator.

991,110. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Jan. 27, 1909. Car-lighting system with shunt-wound generator driven at a variable speed by the movement of the car, a work circuit and storage battery fed by the generator, a regulator in series with the field and having a controlling coil, and a vibrating armature for connecting the coil across the generator, with a magnet controlled by the voltage fluctuations to control the armature.

991,111. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Feb. 24, 1909. Car-lighting system with generator on one train unit, batteries on other train units, a feeding conductor for the work circuits, and charging conductor for the batteries, a common return for both, with a switch for disconnecting the batteries responsive to a decrease in the voltage of the generator.

991,112. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed May 16, 1909. Car-lighting system with variable speed generator, work circuit and translating devices, a storage battery supplied simultaneously thereby with means for regulating the generator to maintain its voltage constant when there is no load and substantially constant but at a less value with some load.

991,113. CHARGING APPARATUS; W. A. Turbayne, Lancaster, N. Y. App. filed Aug. 25, 1909. Storage-battery-charging system for car lighting, with a variable resistance and a fixed resistance in series with each other and the battery, a second fixed resistance in parallel with the variable resistance, the variable resistance being controlled in response to current changes in the second resistance.

991,114. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Nov. 5, 1909. Train-lighting system with automatic voltage regulator, including a generator, a regulating armature for the voltage of the generator, batteries in work circuits, and a coil to cause the generator voltage to increase as more work circuits are added.

991,117. RELAY; P. Tune, Wilkinsburg, Pa. App. filed Oct. 19, 1910. Relay of the electromotor type whose movable part is of non-magnetic material which is caused to rotate by alternating currents flowing in the windings of two oppositely arranged magnets forming a stationary field.

991,129. ELECTRICAL CURLING IRON; G. W. Bibbens, Kansas City Mo. App. filed Aug. 31, 1908. Curling-iron tube in which is inserted a heating unit consisting of an inner tube around which a wire is coiled, an outer tube of insulating material fitting over the coil.

991,174. PROCESS FOR THE PRODUCTION OF REACTIONS IN GASES; O. Schonherr and J. Hessberger, Ludwigshafen-on-the Rhine, Germany. App. filed May 18, 1905. Produces electric arcs between a rotating and a stationary electrode, and spreads out the resulting gases so as to spread out the arcs for use in electric furnaces.

991,181. CONTROLLER FOR ELECTRIC MOTORS; F. T. Taylor, New York, N. Y. App. filed July 10, 1909. Controller for electric motors having in combination a plurality of contacts with a member for engaging and disengaging them and to stop the motor when disengaged, the motor being started when the member engages a contact, the contacts being of various sizes to control the operation.

991,189. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; T. E. Barnum, Milwaukee, Wis. App. filed July 6, 1908. An overload device which may be made inoperative for a temporary period when the motor circuit is closed, with automatic means for indicating when the device is free to operate.

991,190. MOTOR CONTROLLER; T. E. Barnum, Milwaukee, Wis. App. filed Aug. 26, 1909. Gang switch, or set of circuit-breakers for starting a motor, with a circuit-breaker connected in the motor circuit and means necessitating the closing of the circuit-breaker prior to the operation of the switches.

991,206. CONTROLLER FOR ELECTRIC MOTORS; A. J. Horton, White Plains, N. Y. App. filed July 6, 1908. An automatically-operated main switch, a pilot switch for the main switch for slow speed of the motor and an automatic accelerator which responds when the pilot switch is moved to another position to increase the speed, the pilot switch having contacts included in the motor circuit for controlling the direction of current.

991,207. TROLLEY; F. H. Howard, Reading, Pa. App. filed Dec. 27, 1909. A hollow wheel with a rectangular bore, a pair of plates secured to a removable shaft passing through the wheel, the plates being curved at their edges to form ball races.

991,208. MULTIPLE NEEDLE HOLDER FOR ELECTROLYSIS; E. W. Johnson, Chicago, Ill. App. filed Feb. 14, 1910. Can be attached to the patient with an auxiliary clamp for securing it to the operating chair; includes a plurality of jointed arms each carrying a needle.

991,219. BURGLARY SAFEGUARDING APPARATUS; E. Maynard, Holyoke, Mass. App. filed April 18, 1910. Lamps are lighted at suitable circuits which run inside the store and are controlled by the doors and windows. The green lamp indicates safety and the red lamp entry by burglars

991,231. TROLLEY; V. Pedersen, Turtle Creek, Pa. App. filed Feb. 13, 1911. Swiveled harp for trolley, including a socket, a pin in the socket which carries a harp plate in which plate a wheel is mounted.

991,234. TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed Feb. 20, 1906. For submarine cables. Two submarine cables have each a polarized relay at one terminal, one relay impressing upon the second cable positive and negative impulses, and the relay of the second cable impressing upon the first cable positive and negative impulses.

991,244. ELECTRICAL WATER HEATER; W. R. May, San Francisco, Cal. App. filed Sept. 28, 1910. A water heater with a valve plate, water-heating coils within the heating chamber of the vasing and an insulating block with perforations through which the water-heating coils are threaded, an inlet pipe, a valve for the discharge of water from the pipe into the heating chamber, and a rotary snap switch for releasing the valve when the switch is actuated.

991,247. ELECTRICALLY CONTROLLED RAILWAY SWITCH; B. Schlater, New Albany, Ind. App. filed June 28, 1909. The first car controls the track switch so that the second car cannot operate it.

991,260. AUTOMATIC TELEPHONE SYSTEM; V. Alexeeff, Ensell, Persia. App. filed June 19, 1908. For making connections between subscribers without calling up central by means of a selecting switch apparatus, including talking contacts, a series of rods, means operated by the line circuit for moving the rod corresponding to the calling telephone to and off the talking circuit, a local circuit, an arm driven by a motor, which arm carries an electromagnet which is brought to the rod corresponding to the telephone of the call subscriber, the magnet being excited by the local circuit.

991,304. MEANS FOR REPRODUCING ELECTRICAL VARIATIONS; P. C. Hewitt, New York, N. Y. App. filed July 7, 1904. For operating vapor electric apparatus to reduce the burr on the positive electrode which causes a resistance and sometimes visible radiations. Utilizes a permanent magnet to shift the point where the current passes from the positive electrode and includes a receiver circuit with telephone and a source of electromotive force in circuit with the cathode of the apparatus and one of the anodes.

991,325. TELEGRAPHIC RELAY; I. Kitsee, Philadelphia, Pa. App. filed July 2, 1910. A relay with a movable and stationary contacts, one of which is of metal and the other of graphite.

991,357. PROCESS OF PRODUCING NITRIC-OXID FROM MIXTURES OF NITROGEN AND OXYGEN AND APPARATUS THEREFOR; H. Pauling, Gelsenkirchen, Germany. App. filed Sept. 27, 1910. Heats the mixed gases to a reacting temperature and permits them to expand without reduction of temperature.

991,372. AUTOMATIC FUSIBLE LIGHTNING ARRESTER; A. Reid, Colorado City, Col. App. filed Aug. 6, 1909. A lightning arrester with a housing, a plurality of fuses and a weighted lever connected at one end of each fuse, with means for connecting the fuses to the line wire and the lever to earth, including a wire with a bracket pivotally connected with each lever and a contact to engage the brackets as the fuses are broken.

991,384. ELECTRICAL RECIPROCATING ENGINE; W. A. Stedman, Millers, Nev. App. filed April 26, 1910. For operating the tamp bars of a stamp mill, by means of a solenoid with separate winding, an operating circuit and a rotary switch.

991,389. TROLLEY POLE; O. W. Swanson, New Haven, Conn. App. filed June 29, 1910. Pole with elongated bearing surface formed of one piece of continuous material bent upon its self to form a curved contact member for engagement with the trolley wire, the curvature of the member being such that the centre of curvature is between the base and the upper terminal.

991,423. TROLLEY-WHEEL-RESTORING DEVICE; J. D. Carey, New Haven, Conn. App. filed Jan. 18, 1911. A yoke with a roller mounted therein, a roller having an eccentric central portion, a central clearance notch and a spiral groove running from opposite ends, the device being attached to the wheel end of the pole.

991,431 CONTROLLER FOR ELECTRIC DRILLS; W. O. Duntley, Chicago, Ill. App. filed Sept. 7, 1906. A switch for an electric drill with a casing containing the switch and secured to the drill at one side of the usual grasping handle of the drill and a switch handle pivoted upon the lower end of the casing and adjacent to the grasping handle, the switch handle being connected to the main switch.

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ELECTRICITY IN THE STONE INDUSTRY.

The utilization of hydroelectric energy for special industries has in late years been growing rapidly. This is, indeed, natural since some of the first energy transmission of any kind was for utilization by particular manufacturing plants. As a rule transmission systems for such purposes are rather commonplace in their engineering design and methods, but in the current issue there is described a hydroelectric transmission system which is altogether unusual, if not at the generating end at least in the final distributing end. It is a plant designed particularly to distribute energy to the important Bedford limestone district in Indiana from which comes so large an amount of valuable building stone. This particular kind of quarrying is one which lends itself very readily to the application of electric energy. When recently exposed the stone is soft and can be cut with the greatest ease by channeling machines. Electric derricks and hoists are then utilized to deposit the blocks in the stoneyard, and thence they are placed on the cars by electric traveling cranes. During the yearly period of greatest activity many of the rock saws are in use twenty-four hours per day, so that except for the three winter months the load on the system is both large and fairly steady.

The development in question is being made by the Southern Indiana Company with special reference to the Bedford stone industry. Bedford is fortunately within 10 miles of available water-power on White River, and within a radius of 3 miles of the substation at Bedford are fifteen quarries and thirty-five mills, so that the transmission distance is really a short one and the load is an ample one to make the transmission scheme worth while. The hydroelectric plant is rather typical of developments in the Middle West. It utilizes a comparatively low head of only 17 ft., and the water supply during some three months of the year is scarcely sufficient for the development intended. It has, therefore, been necessary to equip an auxiliary steam plant to take over part of the load during the period of low water. Ordinarily such a plant would be placed at or near the substation, but in this case condensing water was not readily available at that point and, the transmission line being a short one, the auxiliary plant has been combined with the water-power station, the losses in the short transmission system being much less worth considering than the loss due to absence of proper condensing facilities. The steam plant, consisting initially of two 750-kw horizontal turbo-generators, was first installed to meet the pressing requirements of the quarries for energy, so that transmitted energy is available for this season. The water-power plant now being completed is being equipped with five 1000-kva vertical units operating at 128 r.p.m. Generators are wound for 2300 volts, but the transmission pressure is 22,000 volts. The plant is fitted with the usual remote-control switchboard apparatus, but is so specialized that both the steam and electric plants are completely controlled from the same board, so that the operator after starting up any steam or water-driven unit can synchronize it from the board and control the whole plant completely without leaving his place.

The transmission line itself consists of duplicate three-phase circuits carried on steel towers spaced 300 ft. apart. The tower line is not, therefore, of extreme design. The towers themselves are 35 ft. in height above the ground and the spacing very conservative. It therefore occupies an intermediate position between a steel-pole line and the ordinary long-span tower line, a compromise which is probably a useful and an economical one. The energy transmitted at 22,000 volts reaches the substation at Bedford, with only one diversion on the way, and is thence distributed to the stone quarries. The distributing circuits are operated at 2200 volts with star connection, so that the pressure between lines in the secondary is 3800 volts. The neutral points of these circuits are well grounded at both the substation and the feeding points. Provision is made for motor-generator sets in case it is desirable to deliver direct current to some installations in the neighborhood. The application of motors to the quarry work is now highly specialized, so that a very large amount of labor in cutting and delivering stone can now be handled by electricity. There is a total of nearly 13,000 hp in motor-driven apparatus in the Bedford district, and even this large amount is likely to be considerably exceeded in the near future, since the Bedford stone industry is a thriving one and the advantages of cheap electric energy are keenly appreciated.

THE ENGINEER AS A CITIZEN.

There have recently been many very gratifying indications that engineers are awaking more completely to a realization of their importance in the solution of public problems in the communities in which they live. In years past there has been too much tendency on the part of the average citizen, and even on the part of the engineer himself, to look upon the engineer as merely a convenient accessory to the carrying on of large public enterprises. However, the increasing number of engineers in important executive positions has demonstrated that engineering training and methods of analysis of various problems are almost necessary in great public enterprises. The engineer of the past has perhaps too frequently secluded himself with his technical problems, leaving the broader executive matters to others less fitted by training to cope with them. In fact, there has been an outspoken aversion on the part of some engineers to becoming business men as well as engineers. The talk of "engineering for engineering's sake" is on a parallel with the sentiment among certain institutions of learning of "science for science's sake" and "learning for learning's sake." It is undoubtedly desirable that some such sentiment exist in order to foster the spirit of scientific investigation free from ideas of commercial gain. There must always be the pioneer in scientific work who blazes the trail for the more commercial engineer. Going a step further from pure science, there must always be the highly technical engineer to point the way to the engineering executive or business man. However, it is a serious mistake for engineers to ignore or belittle the importance of the engineering executive man who knows how to bring together the efforts of various engineering specialists in any large undertaking. So much of our modern life depends on engineering achievements that the numerous addresses delivered during the past two years before various engineering bodies as to the part which the engineer should take in civic affairs are certainly commendable. A more complete realization of these things a number of years ago would undoubtedly have put engineers in many positions which are to-day being filled by lawyers and business men without special training and which might better be filled by men from the engineering ranks.

AN IMPROVED FORM OF PRONY BRAKE.

The well-known general type of power-absorption brake for measuring the output from prime movers, called a prony brake, is attributed to the celebrated French engineer of that surname. It is just as well, perhaps, that only the surname is applied to the device, because his full name was Gaspard Clair François Marie Riche de Prony, who lived from 1755 to 1839. The prony brake, as applied to measuring the power of motors, has taken a variety of forms in detail. The principal idea running through all of them is that the load torque applied to the machine under test shall be susceptible of adjustment as well as measurement. It is desirable, moreover, that the application of the brake to the motor shall apply no appreciable stresses other than the measured load torque. The product of this torque into the speed of rotation of the motor, in appropriate units, gives immediately the output of the machine in watts absorbed by the brake. Except in the cases of the smallest machines the power absorbed by a prony brake brings the heat-dissipating power of the apparatus to a severe test and means have to be provided to keep the motor and brake cool.

The particular design of prony brake described by Mr. H. G. Crane in this issue possesses some very noteworthy and convenient features. It is very portable and can be easily transferred from one machine to another, a property that is especially desirable in a classroom laboratory. There are very few parts to get out of order, and the device may lie out of use for many months without becoming deranged. The principal novel features of the design, however, lie in using a spring balance for the tension indicator, a convenience which is rendered possible by the use of a dashpot, and also in the insertion of a tightening screw into the beam, so located that pressure of the hand exerts no component of torque about the motor shaft and, therefore, introduces no error into the measurement. Those who are familiar with mechanical appliances of this kind know how much of satisfaction and convenience depend upon details in design that at first sight appear of small moment. There are various details of this kind in Mr. Crane's design that will commend themselves to the man who applies prony-brake tests in factory or laboratory.

OVER-SPECIALIZATION IN EDUCATION.

Epigrams exhibit sometimes cleverness in phrasing rather than the exact expression of a truth. To some extent this may be the case with the dictum that education consists in knowing "something about everything and everything about something." Nevertheless it is true that the really well-educated man must combine broad general knowledge with exact and detailed information relating to his own specialty. The words quoted carry this idea in a form that is somewhat exaggerated for sententious expression. But the underlying idea is one that must be accepted, and to no class of men is the truth sought to be conveyed more important than to engineers, including electrical engineers, who evince a tendency to become lop-sided in their intellectual development owing to intensive cultivation of engineering knowledge to the neglect of general culture.

The subject is recalled to mind by the address of the Right Hon. James Bryce, British Ambassador to the United States, at the recent anniversary celebration of Johns Hopkins University in Baltimore. The distinguished speaker dwelt on the conflict of modern specialization with the general culture needed for a liberal education. He showed how absorbing scientific studies become, and said that the problem of modern university education is how to find time for specialized studies and also for a survey and comprehension of the general field of human knowledge, which is so necessary in order to make the university graduate capable of seeing the relation of his own particular study to others, and of appreciating the various methods by which discovery is prosecuted. "A university," said Dr. Bryce, "has to think not only of forming specialists, but of making these specialists better by giving them a wide range of knowledge, and still more of sending out men who sustain the level of taste and insight in the whole community and are fit to be its intellectual leaders."

How do these words apply to electrical engineering education? Is a place accorded our electrical engineers among the intellectual leaders of the community commensurate with the value of their share of the world's work? If not, is not the fact due largely to a neglect of cultural studies in college and to a consequent lack in after life of a broad, intelligent interest in all the avenues through which humanity marches forward in its stumbling, halting, but unfailing progress? Do we make presidents, ambassadors, governors, senators, representatives, great administrators, of engineers? Possibly the engineers are not ambitious for places of honor in the state. They may be content to see others fill these positions if let alone to do their work, but it may be that this very tendency is an indication of a defect in education; for what work can be more important than that which has to do with the common welfare of all? After all, men are more important than things. Perhaps engineers as a class are too much interested in the forces and elements ot nature and too little in the general advancement of human society. All men who work must specialize, of course, but none of us should forget, as engineers are particularly prone to forget, that the greatest study of mankind is man.

VISUAL ACUITY.

The human eye is both an optical instrument and a physiological organ. It has apparently been slowly developed, under the laws of Nature, by time under the conjoint influences of constant radiation stimulus from without and constant adaptive selection from within. The origin of the eye as a sense organ in all probability took place in our remote ancestors in the form of a primitive sensitive spot on the otherwise undifferentiated skin. This spot connected itself with the nervous system of the organism through a few specialized fibers and the latter conveyed stimuli of radiant energy or light falling on the skin. There are still on our world creatures possessing no higher development of the eye than this. Gradually development occurred in this piece of sensitive skin, either through accidental variations of strength leading to a survival of the happy fortuitous possessor in the struggle for existence or through the more intense physiological reactions that such accidental improvements set up. After immense ages of time and selection of animal races in the automatic self-assertion of nerve tissue the eye became a highly mobile sensitive optical mechanism, and the brain came down to unfold itself on its inner surface. The retina is actually regarded anatomically as an elongated extension of the brain substance. It is no wonder, therefore, that the external aspect of the eye should furnish a rough indication as to the nature and activity of the mental processes of the individual possessor.

This wonderful retina of the eye is virtually a layer of nerve tissue abundantly nourished by blood vessels. The sensory organs, called from their microscopic appearance the rods and cones, lie at the bottom of the layer. Above them lie nerve ganglia and interconnecting nerve fibers. Above these lie the filaments of the optic nerve, like a mesh of transparent conducting wires insulated in glass tubelets and a network of arterioles, veinlets and capillaries. The shadows of these blood vessels are constantly projected down upon the layer of rods and cones at the bottom, except at the fovea, or central sensitive spot, where the blood vessels do not obtrude. Although microscopists tell us that there is no direct simple nervous connection between the fibers of the optic nerve and the rods and cones—that is, each rod and cone connects with certain ganglia, which in their turn connect with particular fibers of the optic nerve—yet it would seem that each ultimate elementary visual impression requires to be received on an individual rod or a cone, and the ordinary picture of the outer world presented to an observer by the eye is a summation stimulus effect of a very great number of individual stimuli received by these minute terminal sense organs. In order that the image-picture presented to the mind shall be clear it is essential that the retinal structure shall be normal, its physiological activity vigorous and the optical image of the object viewed sharply focused on the retina with suitable luminous intensity. Visual acuity, or the sharpness of visual perception, depends on all of these conditions.

Strictly speaking, there are several meanings that may be covered by the term acuity. It may refer to the sharpness with which two separate objects in close proximity can be distinguished, as, for instance, two companion stars in a telescopic field. Again, it may refer to the sharpness with which the outlines of small objects can be distinguished and recognized, as when we try to read a standard size of type on a printed page at a distance. Again, it may refer to the luminous contrast necessary between a certain portion of the visible field and the remainder, or background, in order that the difference in their illumination may be appreciable, as when a setting is made with a Lummer-Brodhun concentric-field photometer. In all these cases, however, there are included jointly in the examination a test of the optical power of the eye, its sensory capability and the judgment mentally made by the subject who interprets his impressions. The two latter meanings of the term acuity are discussed in an article by Mr Sydney W. Ashe in this issue. It would seem that the test for acuity which depends upon the distance at which a certain size of type can be read is rather crude, even allowing for the degree of illumination, and that for the purposes of laboratory investigations a more precise test might be devised. At the same time it must be recognized that this test has been evolved by oculists after many years of trial, and that, while it leaves room for improvement in examining the eyes of trained observers, yet it meets the needs of practice in professional dealings with the public at large. If in the use of this printed-type test the acuity of the eye examined is seriously defective the defect is very speedily detected, and the only question outstanding is whether the defect lies in the optical arrangements of the eye or in the nervous mechanism which the eye, as an optical instrument, subserves.

Supreme Court Standard Oil Decision.

On Monday the United States Supreme Court handed down an opinion affirming the decree of a lower court adjudging the Standard Oil Company a combination in restraint of trade and ordering its dissolution. The Supreme Court, however, extends the period of reorganization of the company from thirty days, as set by the lower court, to six months. The labor of the court in passing on the case is illustrated in the opinion by the statement that the record placed before it consisted of twenty-three volumes of printed matter aggregating about 12,000 pages.

The opinion gives the following résumé of the charges in the suit against the Standard Oil Company:

"Rebates, preferences and other discriminating practices in favor of the combination by railroad companies; restraint and monopolization by control of pipe lines, and unfair practices against competing pipe lines; contracts with competitors in restraint of trade; unfair methods of competition, such as local price-cutting at the points where necessary to suppress competition; espionage of competitors, the operation of bogus independent companies, and the payment of rebates on oil, with the like intent; the division of the United States into districts and the limiting of the operations of the various subsidiary corporations to such districts, so that competition in the sale of petroleum products between such corporations had been entirely eliminated and destroyed; and finally reference was made to what were alleged to be the 'enormous and unreasonable profits' earned by the Standard Oil Trust and the Standard Oil Company as a result of the alleged monopoly."

While the opinion sustains the judgment of the lower court in the present case, it lays down the principle that the Sherman anti-trust act applies only to contracts and combinations that unreasonably or unduly restrain interstate trade or which are unreasonably restrictive of competitive conditions, and that the criterion to be applied is the direct or indirect effect of the acts involved. "Although the statute by the comprehensiveness of the enumerations embodied in both the first and second sections makes it assiduously certain that its purpose was to prevent undue restraints of every kind and nature, nevertheless, by the omission of any direct prohibition against monopoly in the concrete, it indicates a consciousness that the freedom of the individual right to contract when not unduly or improperly exercised was the most efficacious means for the prevention of monopoly, since the operation of centrifugal and centripetal forces resulting from the right freely to contract was the means by which monopoly would be inevitably prevented if no extraneous or sovereign power imposed it, and no right to make unlawful contracts having a monopolistic tendency were permitted." In a dissenting opinion, Justice Harlan vigorously took issue with the limitation by the court of the Sherman act, which he characterized as judicial legislation, and held that the construction previously put upon the act by the court had recognized its application to every contract which restrained commerce and trade.

The first and second sections of the Sherman anti-trust act are the ones into which the opinion enters at greatest length. The first section declares illegal "every contract or combination, in the form of trust or otherwise, or conspiracy in restraint of trade or commerce among the several states or with foreign countries." The second section declares to be guilty of a misdemeanor "every person who shall monopolize or attempt to monopolize, or combine or conspire with any other person or persons to monopolize, any part of the trade or commerce between the several states or with foreign countries." The court stated that undoubtedly the word "monopolize" as used in the section reached every act bringing about the prohibited result, and the ambiguity, if any, is involved in determining what is intended by monopolization. "This ambiguity, however, is dispelled in the light of the previous history of restraint of trade. Having in this section forbidden all means of monopolizing trade—that is, unduly restraining it by means of any contract, combination, etc.—the second section seeks, if possible, to make the prohibitions of the act all the more complete by embracing all attempts to reach the end prohibited by the first section—that is, restraint of trade by any attempt to monopolize or at monopolization thereof, even though the acts by which such results are attempted to be brought about, or are brought about, are not embraced within the general enumerations of the first section.

"Since, however, the acts which may come under classes stated in the first section, and the restraint of trade to which that section applies, are not specifically enumerated or defined, it is obvious that judgment must in every case be called into play in order to determine whether a particular act is embraced within the statutory classes, and whether, if the act is within such classes, its nature and effect cause it to be restraint of trade within the intent of the act. To hold to the contrary, the statute would be destructive of all right to contract and agreement to combine in any respect whatever as to the subjects embraced in restraint of trade or commerce. There is room left but for one conclusion, which is that the statute was expressly designed not to limit unduly the application of the act by precise definition, but while clearly fixing a standard—that is, by defining the ulterior boundaries which could not be transgressed with impunity—to leave it to be determined by the light of reason, guided by the principles of law and the duty to apply and enforce the public policy embodied in the statute, in every given case whether any particular act or contract was within the contemplation of the statute. In every case where it is claimed that an act or acts are in violation of the statute, the rule of reason, in the light of the principles involved and of the public policy which the act embodies, must be applied."

Taking up the charges against the Standard Oil Company, the opinion states that no disinterested mind can survey the evolution of the company without being irresistibly driven to the conclusion that the very genius for commercial development in organization, which it would seem was manifested from the beginning, soon begot an intent and purpose to exclude others, which was frequently manifested by acts and dealings wholly inconsistent with the theory that they were made with the single conception of advancing the development of business powers by usual methods, but which on the contrary necessarily involved the intent to drive others from the field and to exclude them from their right to trade.

The acquisition which ensued of every efficient means by which competition could have been asserted, the slow but resistless methods which followed by use of which the means of transportation were absorbed and brought under control, the system of marketing which was adopted by which a company was divided into districts and the trade in each district was turned over to a designated corporation within the combination, lead the mind up to a conviction of the purpose and intent which is so certain as practically to cause the subject not to be within the domains of reasonable contention. The various acts of the company give rise to a prima facie presumption of intent and purpose to maintain a dominancy over the oil industry, not as the result of normal methods of industrial development, but by new means of combination which were resorted to in order that greater power might be added than would otherwise have arisen had normal methods been followed, and wholly with the purpose of excluding others from the trade and thus centralizing in the combination the perpetual control of petroleum and its products in the channels of interstate commerce.

Referring to contentions that if the lower court is upheld the company could not conduct its business under jeopardy of punishment for contempt, and that the restraint imposed by the decision was calculated to do injury to the public, and similar expressions of fear, the court replied that the decree was construed not as depriving the stockholders or corporations of the right to live under the law of the land, but as compelling obedience to that law. The decree, therefore, is not amenable to the criticisms directed against it, and cannot produce the harmful results which had been predicted as sure to follow its affirmation.

N. E. L. A. News.

In view of the nearness of the annual convention of the National Electric Light Association in New York City, May 29 to June 3, it is but natural that the activities of the various committees should assume definite shape. The attendance it is expected will be the largest yet recorded, and in order that the work of the convention may move smoothly every precaution has been taken to avoid confusion. The various New York companies on which will fall the brunt of the entertaining have provided lavishly, and the entertainment features have been so timed that they will not conflict with regular sessions. For the convenience of those who are attending a certain session and who may wish to be present when a certain report or paper is being read or discussed at another session being held simultaneously, announcement boards will be provided on which will be posted the topic being considered in each meeting-room. There have been some changes in the list of theaters, necessitated by closed seasons or theatrical contracts. The three theaters available for the membership and guests on June 1 are the Broadway, Winter Garden and Herald Square. The Lyric may be substituted for the last theater before the arrangements are definitely settled.

EXECUTIVE.

At a meeting of the executive committee of the National Electric Light Association held in New York May 11 the report of the secretary showed the organization to be in a most flourishing condition. Over 1800 new members were admitted, making the net gain since the last meeting, held two months ago, over 1600. The association has about $40,000 in cash and securities and no outstanding debts. The membership at the present time has reached 8100.

The sub-committee, of which Vice-president J. F. Gilchrist, of Chicago, is chairman, reported on its trip to the Pacific Coast to inspect the various cities and their facilities with regard to the proposed convention of 1912. After a hearing and discussion of the report of the committee it was unanimously decided to hold the next convention at Seattle, Wash., probably about the beginning of June. It was stated that there is keen interest in the subject along the Pacific Coast and that the trip will undoubtedly result in a large increase in membership in that section, together with a deeper interest in the work of the association.

Mr. E. J. Allegaert, on behalf of the committee on uniform accounting, submitted a report in favor of a system of interchange of accounts among the member companies; the adoption of a standard set of forms adapted to the association's standard classification of accounts, to be distributed to the members, and the advocacy of the adoption of the standard classification by public-service commissions that have not yet acted upon such a matter, and where and when new public-service commissions are created.

CONVENTION NOTES.

The registration for the coming convention has already reached about 2000, which would indicate an actual attendance of at least 4000. The association has secured additional facilities in the Engineering Societies Building by means of which it will be possible to spread out the throng over several floors. On the ground floor the ingenious idea has been adopted of supplementing the foyer by inclosing the large driveway around the building, so that the members can also sit and lounge in the open air. This driveway around both sides and the rear of the building will be made to simulate a vine-clad arbor, and the walk will be covered with crash or carpet. The arbor will be lighted by electricity, and seats will be provided so that members may promenade or lounge about, as desired. The large room back of the foyer has been reserved for the transportation committee, and at the east side of the foyer will be the booths for the registration of delegates and distribution of papers. The office of the *Convention Daily* will be in the directors' room on the mezzanine floor. The largest three meeting rooms will be devoted to the regular sessions, and on the floor above another meeting room has been provided as headquarters for the various state sections, the Sons of Jove and other affiliated or auxiliary bodies applying for such accommodations. The exhibition committee will also have its headquarters on this floor, and the sub-committee on theaters, which will distribute the tickets for the three theaters which have been engaged for Thursday evening of convention week.

The public-policy meeting will be held Wednesday, May 31, at the New Theater, when Secretary Nagel, of the Department of Commerce and Labor, will represent President Taft and deliver an address. The public-policy report will be presented by Past-president Samuel Insull. It is proposed also to make this meeting at the New Theater a notable musical affair, as the orchestra of the New Theater, under Dr. Elliott Schenck, has been retained to render a selection of notable musical successes of the season. The New Theater is the finest playhouse in New York City. It may be noted incidentally that instead of the proposed morning concert for the ladies during the week a performance is to be given by the Miniature Company in the play "Pomander Walk." This company is composed entirely of children, and the performance is said to be excellent.

The baseball game will take place on Wednesday afternoon, May 31, at the baseball grounds in Brooklyn, which are very accessible from headquarters. The competing teams will be those of the Brooklyn and Philadelphia Edison companies.

The regular meetings have been arranged to occupy sixteen sessions, extending through Tuesday, Wednesday, Thursday and Friday, while the program of the last day is perhaps the best of all four days and will command the attention of the members up to the last moment. The final program will be published in these columns next week.

COMMERCIAL SECTION NEWS.

The present membership of the Commercial Section, as nearly as can be ascertained, is 658, although new applications are received daily. It is the ambition of the membership committee to reach the 1000 mark if possible before the convention, as there are a sufficient number of eligible persons to bring the roster up to that number without undue urging. The reports of the various commercial committees promise to be most interesting and valuable. The "power" committee has been working assiduously on the compilation of data relative to "power" conditions in the different sections of the country, and a long list of machinery, together with the horse-power of motors required to drive it, has been got up.

The ornamental-street-lighting committee has collected information from the central stations throughout the country, so that its report should be of inestimable value to the members of the commercial section.

A number of interesting features will be embodied in the report of the residence-business committee, including plans and blueprints showing a complete scheme of wiring recommended for residences, for small motors and electric heating, as well as for lighting, together with plans and recommendations for keeping account of this business.

The committee on electricity in rural districts will present a large number of illustrations showing the various applications of electricity in farming communities.

The sign committee has prepared a bulletin which, it is said, will form an agreeable surprise to members of the section. The advertising committee has some important propositions to bring before the section regarding the exchange of central-station advertising.

SONS OF JOVE REJUVENATION.

Friday, June 2, will be known as Jovian night. The rejuvenation will be national in scope and character and will be preceded by a dinner at which approximately 1000 Jovians, including many of the national officers, are expected. The dinner will be held at 6 o'clock in the great ballroom at Dreamland Park, Coney Island, and will be presided over by Jupiter. The rejuvenation will be conducted by the national officers in full regalia. The regular business sessions of the convention coming to a close on Friday, it is expected that the rejuvenation will be most successful.

Presentation of Willard Gibbs Medal to Dr. Arrhenius.

An event of unusual interest to scientific men took place in Chicago on May 12 when the Willard Gibbs gold medal of the Chicago Section of the American Chemical Society was presented to Dr. Svante Arrhenius, of Stockholm. Dr. Arrhenius, who is president of the Nobel Physical Institute in Stockholm, is about to return to Sweden after a sojourn in this country, during which he has delivered a number of lectures before colleges and learned societies. The Chicago Section of the American Chemical Society took advantage of the occasion to make the award. The Willard Gibbs medal was established by Mr. William A. Converse, former president of the Chicago Section, who stipulated that it should not bear his name. It is named in honor of the late Prof. Willard Gibbs, of Yale University, whose work in science is well known. The medal is given annually to someone who is distinguished for an original contribution to pure or applied chemistry on condition that the recipient deliver an address before the Chicago Section at its May meeting. Dr. Arrhenius took for the subject of his address on May 12 "Electrolytic Dissociation."

The presentation was made in the course of a banquet at which Mr. S. T. Mather, chairman of the Chicago Section, presided. This gathering was held in the Gold Room of the Congress Hotel and was a brilliant and enthusiastic affair attended by perhaps 250 ladies and gentlemen. The first speaker was Dr. Harry Pratt Judson, president of the University of Chicago, who in welcoming the guest of the evening dwelt on the fact that science knows no nationality. Mr. Harry A. Wheeler, president of the Chicago Association of Commerce, spoke of the relation of science and industry and made the epigram that science plus capital equals commerce. The toastmaster then related the circumstances connected with the origin of the Willard Gibbs medal and remarked that Professor Arrhenius is the first recipient of this medal.

Prof. Alexander Smith, president of the American Chemical Society, made the presentation. He briefly recounted some of the events in Dr. Arrhenius' career. He said that the thesis contributed in 1884 by Professor Arrhenius for the degree of Ph.D. contained the fundamental ideas of the hypothesis of electrolytic dissociation, with which the name of the guest of the evening is indissolubly connected. The appearance of this theory marked an era in the science of chemistry. Professor Smith briefly sketched some of Dr. Arrhenius' other contributions to science, including electricity, and in handing the medal to the guest of the evening remarked that the latter had united the chemists of all nations in admiration of his work, and that he was a man like Faraday, Gibbs and Mendeleef.

In responding, Dr. Arrhenius spoke in English without the aid of manuscript. He paid a tribute to Willard Gibbs and coupled the name of Gibbs with that of Helmholtz, the greatest mathematical physicist of his time. It is a great honor, he said, to be associated with the name of Willard Gibbs, and the speaker said that he was deeply touched by this honor, which he appreciated greatly. He then proceeded to give some account of his discovery of the law of electrolytic dissociation, going rather deeply into the chemistry of the subject. He spoke of the early work of Gay-Lussac, Clausius, Williamson and others, and remarked that the idea of dissociation, supplanting the old atomic theory, was almost impossible to believe when first broached. He described his studies in the conductivity of solutions and said that his own "great luck" was that he investigated the most dilute solutions. He found that the molecules that are active in relation to electricity are also active in relation to chemical energy. He told how he wrote to Ostwald and others, and described, often with amusing side remarks that revealed a keen sense of humor, the incredulity of scientific men when his theory was first presented to the world. He related how the new theory fought its way and was accepted, and said that the theory of electrolytic dissociation has now been brought to completeness and accounts for many of the phenomena in relation to solutions. Especially in physiology and biology is the theory of great interest. "It is clear," said the speaker, "that biology will be the most practical science of the coming time. It has to do with life, and we are all living beings." In conclusion the recipient of the medal spoke of the importance of the practical applications of science and praised the practical side of the American character. He expressed the hope that many other members of the society, of which Dr. Arrhenius himself is a member, would receive the medal in coming years.

The last speaker was Chief Justice Harry Olson, of the Municipal Court of Chicago, who represented the many Swedish guests who were present. Referring to Professor Arrhenius' connection with the Nobel Institute, Judge Olson suggested that if the proposed Anglo-American arbitration treaty becomes an accomplished fact the name of President Taft might well be suggested for the Nobel prize for peace.

Meeting of Electric Vehicle Club at Boston.

The regular weekly luncheon and meeting of the Electric Vehicle Club of Boston were held at the Edison Building on May 10 with Mr. A. F. Neale, of the Baker Motor Vehicle Company, in the chair. Mr. Day Baker, for the committee on signs, submitted prices and estimates of cost for locations at Mattapan, Chelsea, Dudley Street and Sullivan Square, Boston, covering the installation and yearly operation of electric signs of very large size advertising electric trucks and carriages. In general, the estimated cost of erecting a sign from the ground or roof support varied from $1,500 to $1,800, including the first year's rental of space, the sign being about 25 ft. wide by 35 ft. long. Free energy and maintenance are offered by the Boston Edison Company. Figures were also presented covering a sign 80 ft. long by 52 ft. wide for tentative erection at a point overlooking Boston Harbor, bearing letters from 6 ft. to 10 ft. high. It was estimated that the first year's service of such a sign, including the investment, could be accomplished for less than $3,500. It was estimated that in most cases the cost of service would be in the vicinity of $750 less for the second year for the smaller signs. The matter was referred back to the committee to enable additional figures to be secured, including a consideration of the wisdom of installing at some elevated point a sign of such size that it would be visible at all points in the central Boston area. Mr. W. H. Atkins, general superintendent of the Boston Edison company, pointed out the advisability of certain sign locations on main avenues of automobile travel to and from the shore resorts near Boston.

The question of publicity was discussed at length. Mr. C. Brewer Smith emphasized the advertising supported by the factories producing gasoline machines and urged that every effort be made to secure liberal appropriations from electric-vehicle makers for newspaper publicity. He commended the spirit of co-operation found among Boston agents of vehicle manufacturers, and outlined the course to be followed in forthcoming newspaper insertions. Mr. Atkins offered the Edison company's main show window on Boylston Street for a week for electric-vehicle display with special lighting to bring out points of interest, and a committee was appointed to work out details. The rate committee reported that it is collecting prices in the hope of later effecting a standardization in the cost of charging. Mr. E. S. Mansfield, of the Boston Edison company, exhibited twelve letters of inquiry received during the week as a result of the company's campaign of publicity on behalf of the electric vehicle. It was announced that over fifty electric vehicles will probably be operated in the procession in Boston on May 30 as a contrast to the horse-drawn teams of the annual work-horse parade.

Mr. Atkins called attention to the necessity of providing parking facilities in the Boston business district for ladies, who are at present debarred by the street regulations from bringing their electric carriages down town and letting them stand. He stated that, if some appropriate space can be secured, the Edison company is prepared to furnish a private police officer to keep watch over the cars and make himself useful generally. A committee of one was appointed to look into the situation. A vote of thanks was then passed to the *Electrical World* for its co-operation in covering the meetings of the club from week to week, after which Mr. W. H. Francis described a recent Western trip in the interest of the electric vehicle, touching upon the excellent work being done at Rochester, Detroit, Cleveland, Chicago, Buffalo, St. Louis and Indianapolis. The greatest interest in the vehicle is where the most care is taken of the cars. Mr. L. R. Wallis, of the Edison company, emphasized the success of the so-called "League Garage" in Detroit under private management, showing that it is unnecessary for a garage to be operated by a central station or a dealer to promote the electric vehicle. Mr. Francis commended the practice of loaning batteries followed by the Fashion Garage of Chicago, and Mr. C. A. White, of the Edison company, reviewed the efforts made by this garage to relieve customers from equipment troubles and particularly to show how simple the electric vehicle actually is. Mr. Atkins offered to enlarge any illustrative matter brought in for display in the Edison company's window, and Mr. Wallis commended a photographic exhibit of the week's sales of one company, which showed the machines lined up in front of the new Museum of Fine Arts, giving an effective background. Mr. Mansfield said that the Edison company is glad to act as a clearing house of information in the electric-vehicle campaign, citing inquiries for a vehicle agent which had lately come to hand. Mr. P. R. Moses stated that the Fall River Electric Light Company is planning to open a public electric-vehicle garage in the near future, the management being desirous of adding to its long-hour business. At a Cotton Centennial to be held on June 19 the company will feature the electric vehicle extensively.

Electric Lighting at "The World in Boston."

In connection with the spectacular features of the "World in Boston" Missionary Exposition, closing on May 20, electricity has been extensively and effectively utilized. The exposition is the first of its kind in America and constitutes an elaborate assembly of missionary data, illustrative material, life-size and model scenes from all the principal countries of the world which are being evangelized, including extensive lectures, moving-picture demonstrations and a "Pageant of Darkness and Light," which is given twice daily with the most dramatic effect. The exposition was opened in the latter part of April by President Taft, who pressed a key at the White House which operated a Western Union telegraph relay in the Pageant Hall of the Mechanics' Building, the relay closing a circuit of twenty-five 4-cp incandescent lamps installed in the form of a cross at the front of the auditorium.

The principal applications of electricity at the exposition are in connection with the lighting of the booths and artificial streets representing the fields of foreign missionary activity in all quarters of the globe; in the stage lighting of the pageant, and in the operation of small motors in connection with moving-picture machines, transparencies and panoramic comments upon specific missionary enterprises. Statistics are graphically portrayed on strips of cardboard driven by motors, the eyes of idols are illuminated by miniature lamps, temples and shrines are economically and safely lighted by electricity with emphasis upon special features of interest, and interrupter flash lighting is used to call attention to the vital statistics of native races. Interest centers on the "Pageant of Darkness and Light," however, which exhibits in a two hours' performance four striking scenes in missionary life in the North, Africa, India and the Hawaiian Islands, including elaborate orchestral and choral accompaniment.

Energy for the pageant service is supplied by a 110-volt direct-current plant located in the basement of the Mechanics' Building, an emergency connection being available with the system of the Edison Electric Illuminating Company of Boston. Two No. 4 copper cables lead from the power plant to a temporary slate switchboard located at the side of the stage, a maximum load of about 660 amp at 110 volts being imposed. Each distribution circuit is separately fused and equipped with a knife switch, and all wiring is covered with circular-loom conduit. Ten spot lamps are installed in the wings and behind the cyclorama upon which the various scenes are painted, four lamps being of the box type without lenses. The stage was wired for the occasion, the available space being ordinarily used as an exhibition platform without theatrical facilities of any particular value. Four rows of border lamps are provided, each being composed of the usual red, white and blue lamps with facilities at the switchboard for independent or combined manipulation. The total number of lamps in the border is 360, all being of the 32-cp size. The same color multiplication is installed in the foot-lamp circuits, with the exception that a double row of white lamps is provided for service at the front of the stage. There are 120 lamps of the 32-cp rating in the foot-lamp service. Gradations in the lighting of the stage are produced by seventeen dimmers, one being installed on each feeder circuit. Spot lamps are used to throw into relief each half of the volunteer choir massed outside the stage at the front end of the auditorium, and the conductor uses an electrically illuminated baton equipped with a tungsten lamp of miniature size and supplied from three cells located on the adjacent floor with flexible cord connection.

Four flaming-arc lamps are employed in the pageant in connection with the production of a sunrise scene in an Indian encampment, supplemented by two open-box lamps located behind the transparency carrying the landscape. Moonlight effects are produced by a spot lamp and transparency, and an automatic shutter is installed to stimulate the effect of rippling water. Two fire logs equipped with three 32-cp half-red incandescent lamps are effectively employed in the Northern scene. In the Far East scene a funeral pyre is displayed, and smoke prepared by chemical action in a tank outside the auditorium is forced out through orifices beneath the pyre by a motor-driven air compressor connected with the tank and outlets by a 2-in. rubber hose about 50-ft. long. By this means the unpleasant odor and heat of the chemical reactions are confined to external quarters opening directly out of doors. In the pyre scene a fire effect is produced by six red lamps of 32-cp rating installed beneath strips of red silk, the latter being blown upward on a framework by two 14-in. fan motors set on the floor at the bottom of the pyre and concealed from the audience by draperies. In the Western scene a volcanic eruption is a feature in which red bridge and foot lamps, the smoke machine, projector lamps and twelve strip lamps under the principal transparency are employed, with a carbon-contact device simulating lightning flashes. The climax of the pageant is a tableau of all the performers and choral staff grouped about a semi-recumbent cross formed in a rock by incandescent lamps of 4 cp. and the performance closes with the tune of "Old Hundred" sung by performers and audience to time given by the electric baton. The entire installation was planned and placed in service under the direction of Mr. P. Sibla, of the Back Bay Stage Lighting Company, Boston, the pageant being under the direction of Messrs. George Pickett, master, and Francis Annersley, assistant floor director.

Additions to New Orleans' Drainage Pumping Systems.

The city of New Orleans on May 8 completed the sale of $7,000,000 of public-improvement bonds, the proceeds of which are to be used in extending the water-supply, sewerage and drainage systems of the city, for which motor driven pumps are employed. The streets of New Orleans lie below the level of the Mississippi River, so that besides pumping the city water supply all of this liquid as sewage must again be lifted out of the city together with all the water of the semi-tropical storms which break upon the city during certain seasons. The surface-water drainage and the sewage-disposal systems are entirely distinct, although each is equipped with a number of automatic motor-operated lift pumping stations, situated at various points on the drain system, and electrically driven from a central generating station. The waterworks pumps deliver about 25,000,000 gal per twenty-four hours, motor-driven centrifugal pumps being used for the low-lift duty. The average annual rainfall over New Orleans' 40-sq. mile area is about 60 in. Except for evaporation this immense quantity of water must be discharged outside the levees by artificial pumping. At present there are seven drainage pumping stations and eight sewage pumping stations. As a result of the new bond issue it will be possible to extend these pumping systems as already planned in accordance with the needs of certain districts of the city. To supply energy for the new pumping load thus created it will be necessary to install 6000 kw or 7000 kw additional rating in steam-turbine capacity at the main waterworks pumping station. Mr. George C. Earl is general superintendent of the water-supply and drainage systems.

Proposed Passenger Subway for Chicago.

Mr. Bion J. Arnold, chief subway engineer for the city of Chicago, is making occasional addresses in that city for the enlightenment of the public in relation to the proposed system of passenger subways, which will undoubtedly be begun in Chicago within a comparatively short time. Recently he addressed the Industrial Club of Chicago, and next day was the guest of the Electric Club at luncheon. On the latter occasion he gave a clear exposition in outline of the proposed subways as recommended in his recent "general statement" report.

Two plans were suggested, but the one recommended would consist, so far as the central business district is concerned, of north-and-south subways at a higher level and east-and-west subways at a lower level, forming ultimately a "gridiron" by means of which a passenger could go from any point in the city to any other point by making one transfer in the downtown district. It is proposed to carry out this plan in various steps. Presumably the city itself will build the subways and lease them to private operating companies. The city has now something over $6,000,000 on hand for this purpose, and by the time it is necessary to begin work on the first step it is probable that the $8,000,000 needed will be in sight. This first step would provide one north-and-south subway through the central district and two east-and-west loop subways, all for surface street railways. The second step would take the elevated railways off the streets in the central business district in a similar manner. Various other steps may be taken after this, if desired, until a very elaborate system, as planned, will have been built, extending as far out to the outskirts of the city as desired.

There will be no grade crossings in the subways. Space is provided for underground public-utility structures in the sub-sidewalk area, as it will be necessary to take the entire space under the street for the subway. The existence of the network of freight tunnels belonging to the Illinois Tunnel Company under the "downtown" streets of Chicago has made the planning of the proposed new passenger subways difficult. The subways as planned will constitute a comparatively shallow system, both for the high-level and low-level subways. (See *Electrical World*, Feb. 16, 1911, page 410.)

Proposed Rocky Mountain Tunnel in Colorado

A bill is pending in the Legislature of Colorado to provide for the creation of a commission of five members, three of whom shall consist of the Governor, Attorney General and Treasurer of the State. This commission is to be known as the Tunnel Commission, and its purpose is to drive a tunnel under the main range of the Rocky Mountains. One of the civilian members of the commission will be an engineer and he will be the supervising engineer of the project, his salary being not over $5,000 a year. The bill authorizes an issue of State bonds of $4,000,000.

The tunnel, if built, will extend through the base of James Peak, having its eastern portal near the town of Tolland, on the line of the Denver, Northwestern & Pacific Railway, commonly known as the Moffat Road, and its western portal near the town of Arrow, on the same railroad. It will be about four miles long at an altitude of 9000 ft. The tunnel is to accommodate a single-track railway to be operated by steam or electricity, although it is to be supposed that electricity will be the motive power selected. The right to use the tunnel is to be given to the Denver, Northwestern & Pacific Railway Company in consideration of the payment of the principal and interest of the bond issue and the cost of maintaining the tunnel. The right to use the tunnel, however, is not given exclusively to the company named, and others may have the same right upon sharing the obligations. One section of the proposed law provides that the tunnel shall never be used for the diversion of waters from the western to the eastern slope of the continental divide for domestic, irrigation, manufacturing or commercial purposes.

The proposed tunnel will shorten the distance on all transcontinental traffic between Denver and Salt Lake nearly 200 miles, provided the Moffat Road is continued to the latter city. The business men of Denver appear to favor the bill, and among them several electrical men have been active in advocating it. It is provided that if the bill is passed it shall not take effect until approved by the people at a referendum vote. The Moffat Road has been built over the Continental Divide, through which it is proposed to tunnel, but its grades and curves are said to be impracticable for heavy freight traffic.

Schoolhouse Lighting Inspection at Boston.

At a recent meeting of the New England Section of the Illuminating Engineering Society an inspection trip was made to the Montgomery Street Evening High School, Boston, under the guidance of Mr. B. B. Hatch, illuminating engineer of the Boston School Committee, and various types of illumination were examined. Mr. Hatch emphasized to the party the influence of the color treatment of the various schoolrooms upon the quality of lighting, stating that the tinting treatment of a room is often the true cause of complaints lodged against the lamp equipment and arrangement. Dark walls and blackboards are capable of creating an impression of poor lighting, even where the actual foot-candles of illumination on the desks are the same as in rooms where complete satisfaction is expressed with the lighting and where there is little complaint of eye troubles. Something more than the mere amount of light delivered to the work in hand must be considered. If the co-operation of the building authorities in the matter of tint cannot be secured the proper results cannot be had in the classrooms. A properly selected color scheme is good for daylight service and artificial illumination alike. Hand-painted buff window shades of duck or canvas have given excellent results at Boston, but the shades must be drawn in the evening in order to get the full benefits of the illumination.

Mr. Hatch stated that in his opinion the blackboard equipment furnishes sufficient relief for the eye in lighter tinted rooms. The use of 60-watt tungsten lamps with prismatic shades about 11 ft. above the floor, the lamps being placed off center with respect to the axis of the room, has given good results with buff trimmings. Placing the lamps off center and using nine lamps in an ordinary 28-ft. x 32-ft. schoolroom provides amply for the scholars in the rear seats. Cheerfulness in the lighting of the front of the room has much to do with the satisfaction of the occupants. In some cases the lighting is subdivided so that the teacher may work after hours without using the entire equipment of the room, and in other cases the dark side of the room is provided with a switch by which it can be cut in during the winter months. Mr. Hatch severely criticised the use of a system of indirect lighting consisting of a Nernst lamp and four 25-watt tungsten lamps arranged to throw the light upon the ceiling before it is diffused through the room. There are about twenty-seven schoolhouses in Boston in which indirect lighting is used. Glass tops are provided to protect the indirect fixtures, but it is almost impossible to keep the apparatus free from dust. When the fixtures were installed every janitor was given a long-handled duster for use on the equipment, but on account of the absence of a tight fit between the horizontal glass plate at the top of the lighting units the maintenance of clean shades has been extremely difficult. Drawing the window shades benefited the first row of desks about 10 per cent in foot-candles and the second row about 6 per cent.

Taking up the question of color values in schoolroom decoration, Mr. Hatch pointed out that the most recently finished buildings are about like antique oak. Lighter tones are gradually getting into service. Ordinarily the ceiling coloring does not affect the eye to any great extent, but in a ceiling containing blue coloring or if the cold-water paint borders on the blue-white, a poorer quality of lighting results than would be the case if cream-white were used. Even the old white ceilings that were left just as the skin coat came out had a tendency to throw back a little blue. Poor results had been obtained from rooms painted a dark olive green upon the design and recommendation of the Civic Art League of Boston. That organization proceeded on the basis of securing harmony of dadoes, tiles, etc., and numerous complaints have resulted from the users of the rooms thus painted. A fair result is obtained from the indirect lighting when the glassware is clean and the lamps are new, with a white or cream-colored ceiling, but trouble soon comes from the lack of proper cleaning facilities. The Boston system of compensating janitors may also be influential, since this is on a piece-work basis with assistants employed by the janitors themselves. Most of the new systems of lighting have been installed for the purpose of improving the illumination of the older buildings. New lighting to cost about $6,000 is now being installed in old buildings, and there is need of much larger expenditures for modernization.

Illumination in Cotton Mills.

In a paper presented by Mr. J. S. Codman, of Boston, Mass., before the recent annual meeting of the National Association of Cotton Manufacturers held at the Massachusetts Institute of Technology, Boston, the question of artificial illumination in cotton mills is discussed. The author confines himself to one problem, the lighting of plain-weave looms, and in the discussion of this subject shows to what extent the dimensions of looms are standardized as well as the arrangement of looms in the weave shed. The most annoying shadow which will be obtained if the sources of light are not correctly placed in looms of this type is the shadow of the hand rail on the warp toward the front of the loom. If this shadow exists, the point of passage of the warp thread through the dents of the reed is in comparative darkness, making it difficult for the weaver to draw the threads through when they break. This shadow will always exist if the preponderance of light comes from the rear of the loom, and therefore, in order to avoid it, it is necessary to place the light sources at the front of the loom—that is, in all the weavers' alleys—and in actual practice this is usually done.

If the light sources in the alleys are placed high enough no lamps will be required at the rear of the looms. One other shadow which is likely to be objectionable is the shadow of the weaver's body. With lamps arranged in the alley opposite the center of each loom this shadow is sure to be objectionable because the weaver reaches from the front part of the loom to the rear, under the arch and over the harnesses, and then draws the thread through the harness and reed so that he cannot avoid his own shadow except when working well to the left of the center of the loom. When at all to the right of the center of the loom the weaver will, on account of his position with his left shoulder forward, cast the shadow of his body on the part of the loom he wishes most particularly to see. If, however, the lamps are arranged symmetrically with regard to the looms—that is, at the point of intersection of the two diagonals drawn through the oblong or square section formed by four looms—this objectionable shadow of the weaver's body will be avoided. Good results cannot be obtained, however, unless the light sources are placed at the correct height and correct light distribution obtains.

The general arrangement for satisfactory illumination thus becomes as follows: Light sources should be placed in the weavers' alleys in order that the preponderance of light may come from the front, and they should be so spaced as to avoid any of them coming between looms. Moreover, the light sources should be hung at such a height and have such a characteristic light distribution that the illumination due to the light source at the left of the weaver should be as nearly as possible the same as the illumination due to the light source at the right of the weaver, so that when the light from one lamp is blocked by the weaver's body not more than one-half of the direct light will be cut off. With reference to the number of light sources, the author states that these should be as few as is compatible with good illumination. Two plans are proposed, and a greater part of the paper is devoted to the study of these.

In one, three light sources are allotted in the alley to eight looms, and in the other, two light sources, the only difference being that in the second plan the middle light source is omitted. The light units investigated in the first plan consisted of single clear-bulb tungsten lamps, equipped with various types of reflectors. The reflectors investigated consisted of three clear-glass prismatic reflectors, known as extensive, intensive and focusing respectively, and two opaque-steel reflectors, extensive and intensive. Of the three types of reflectors the focusing was the best suited to the work, and as compared with the glass reflector the steel-extensive type has a decided advantage, and in the direct illumination of the looms is preferable to the former. It is recommended that with this plan 40-watt lamps be used for looms up to and including the 50-in. size and that 60-watt lamps be used for larger sizes. This recommendation applies to coarse gray goods and represents the minimum wattage of lamps to use. With fine dark goods considerably higher wattage may be necessary, but it is not often that larger lamps than 100 watts will be necessary with this arrangement.

In the plan entailing the use of two light sources instead of three, 60-watt tungsten lamps may be used with a similar size of loom and with coarse goods, and where fine dark goods are made it is seldom that lamps of larger size than 150 watts are necessary. The author is of the opinion that the lighting of weave sheds is best accomplished by a considerable number of comparatively low-power lamps, and that the use of large units, such as arc lamps or tungsten lamps consuming 250 watts or more, is not good practice.

Engineering Specifications.

Mr. Frank F. Fowle delivered a lecture on "Engineering Specifications" before the Armour Institute of Technology branch of the American Institute of Electrical Engineers on May 11. Referring to the importance of a knowledge of engineering specifications and business law, the speaker said that it is now recognized that a purely technical preparation cannot fit the engineer for the greatest sphere of usefulness. Of course, purely technical training is fundamental, but at the same time one should not become so absorbed in it as to lose sight of its proper relations to other things in life. The general purpose of a specification is to give an exact, definite description of certain work to be performed in language so clear and precise that there shall be no doubt or uncertainty about the performance of the work. In general the specification forms a part of a contract, and the engineer should have at least an elementary knowledge of the law of contracts. However, the engineer should not usurp the functions of the lawyer nor the lawyer those of the engineer. They should work in collaboration in the matter of contracts and specifications.

Mr. Fowle considered the subject of contracts at some length and then passed to the treatment of specifications. In general every engineering specification treats of two fundamental things

—first, a full, minute and exact description of the work to be done, and, second, the business relations of the parties to the agreement. This presumes that the contract and the specification are parts of one instrument. When this is not the case the specification treats of the work alone. There are three plans of proceeding with the preparation of a specification—first, complete plans in detail; second, general plans only, and, third, no plan whatever. The first is the plan most generally followed. The second may be adopted where stress is laid particularly on the final results or performance. The third method is likely to lead to bad results, and depends for success upon the undoubted ability and integrity of the contractor.

Electrical engineering specifications may be classified as follows:

1. Machinery and equipment.
    - Construction.
    - Delivery.
    - Installation.
    - Performance.
2. Electric wiring..........
    - Inside.
    - Outside.
        - Underground.
        - Aerial.
3. Complete plants. ....
    - Light, heat and motor service.
    - Transmission.
    - Railway.
    - Telephony, telegraphy and signaling.
    - Electrochemical.

There are no hard and fast rules in preparing specifications, and the engineer must rely on his judgment and experience. It is a dangerous practice to copy from existing specifications in a blind fashion. A good command of clear English is an important qualification in writing specifications. In general it is best to treat only one feature or requirement in each clause and to dispose of it very completely. It is desirable to place a clause near the opening of a specification stating what drawings, maps, plans, etc., form a part of it.

Mr. Fowle proceeded to make a somewhat detailed analysis of a specification. He considered general clauses and technical clauses and then gave several examples of specifications. These related to rubber-insulated signal wire, a 25-watt dynamotor for operating telegraph lines and a standard underground telephone cable.

In conclusion the lecturer gave the following list of works on business law and contracts in relation to engineering: "Engineering and Architectural Jurisprudence" by John C. Wait; "Law of Operations Preliminary to Construction in Engineering and Architecture," by John C. Wait; "The Law of Contracts," by John C. Wait; "Engineering Contracts and Specifications," by J. B. Johnson; "Specifications and Contracts," by J. A. L. Waddell and John C. Wait; "Law and Business of Engineering and Contracting," by Charles E. Fowler; "Contracts in Engineering," by James I. Tucker.

Prof. E. H. Freeman presided at the meeting and opened the discussion. He emphasized the larger work of the engineer in addition to mere technical training, and also spoke of the need of versatility in the engineer. Several others took part in the discussion.

Financing Electric Utilities.

Mr. R. J. Graf, secretary of H. M. Byllesby & Company, was the speaker at the meeting of the Electric Club of Chicago on May 10. His subject was "Financing Public Utilities," but he devoted his remarks principally to electric-service companies. He estimated the total capitalization of the central-station companies of the country at $1,500,000,000. Perhaps 75 per cent or 80 per cent of this is represented by actual book value. The securities of these companies are owned in every State of the Union and in almost every country of the globe. The speaker remarked that in some of the companies with which he is connected as high as 40 per cent of the dividend checks are made out in foreign exchange. The debt which the electrical industry of this country owes to foreign investors is large, although perhaps not generally realized.

Few of the issues of securities of electric-service companies are listed on the great stock exchanges of the country. Of late years, however, the market for such investments has been broadened greatly. Electric-service securities of the right sort are now sought by banks and brokers, who stand willing to purchase almost any amount if the stocks, bonds or notes are backed by the right kind of a financial statement and by the right kind of management. The consolidation of small properties into large operating syndicates has been of great benefit in giving the securities of the small companies a wide market. This consolidation also gives the smaller companies the benefit of highly scientific management.

Possible competition in public-utility service has been a drawback in the sale of securities, but with the growth of intelligent public sentiment this possibility is constantly decreasing. The prospective investor in electric-service securities is primarily interested in the earning capacity of the property. Within the last few years investors have evinced a remarkable interest in securities of this class, owing to their discovery of the excellent earning capacity which properly managed utility companies possess. Mr. Graf cited the year 1907, the so-called panic year, when most electric-utility companies showed an increase in net earnings at the same time that many railroad and industrial companies were showing a decrease in earnings. This fact attracted the attention of investors. The speaker also commented on the high character of the men engaged in the central-station industry, and concluded by saying that the future of this industry seems to promise continued success.

Mr. Harold Almert in opening the discussion said that many bankers agree that public-utility securities form the best class of investments on the market to-day, all things considered. Speaking of the attitude of the public toward utility companies, he remarked that one State has recently enacted a law allowing public-service companies to issue bonds equal to the full value of their tangible property, and also an equal amount of stock, the latter having a speculative value to which the promoters are entitled as a reward for their enterprise. The courts are careful and conservative in reviewing the decisions of state commissions.

Mr. Albert Scheible asked if a better feeling toward the utility is not secured where the securities are owned locally. Mr. Graf answered that at first the central-station companies were almost always financed locally. Now, however, the money is secured often through bond houses that distribute the securities to their own clients and customers and to the general investing public. Mr. Almert told of the case of a Toronto company in which 65 per cent of the stock is held locally by about 4500 owners, the average amount of each holding being perhaps $5,500. He pointed out that the current interest rates in the Southwest, for example, are very high, and it is a better economic proposition to sell the bonds of utility companies operating in that region in older communities where money is seeking investment.

Mr. J. R. Cravath mentioned the rapid growth of the electric-service industry and the bearing of that fact on the finding of money for constantly needed extensions. In many cases in former years it has been the practice to finance extensions out of earnings rather than to use the money to pay dividends. This practice has affected the sale of electrical securities unfavorably and is being done away with.

Uniformity in Telephone Rates.

As a result of the first telephone case considered by the Interstate Commerce Commission it has been decided that, "as between subscribers to a telephone service who are similarly situated, nothing but a difference in the service rendered or facilities furnished can justify a difference in the charges exacted."

The decision, prepared by Commissioner Harlan, was in the case of Mr. William D. Shoemaker, of Drummond, Md., against the Chesapeake & Potomac Telephone Company, the first telephone case considered by the commission since Congress placed telephone companies as common carriers under the commission's jurisdiction. Mr. Shoemaker declined to sign the residence telephone contract presented because the charge demanded—the regular Washington rates—was materially higher than paid for the same service by twenty-seven neighbors in Drummond, old subscribers, who had contracted with the company when it operated the now abandoned exchange at Drummond. The complainant maintained that the rate was unlawful and discriminatory, but did not aver unreasonableness. The commission upheld his attitude as "entirely sound." It held:

"The contracts between old subscribers and the defendant, even though valid when made, cannot, after Congress has undertaken to regulate the rates and practices of telephone companies, be accepted as now justifying different charges as between different subscribers similarly situated, such undue discrimination being forbidden by the act."

Curiously, the ordered discontinuance of this discrimination will increase the company's revenues, as it necessitates increasing the rates of the twenty-seven old subscribers to conform to current rates.

Toledo Rates for Electric Service.

The Toledo (Ohio) Railways & Light Company has offered two plans of service charges to consumers since the City Council passed the ordinance fixing the price at 8 cents per kw-hour, with a discount of 1 cent for payment within ten days. In the first the company offers to furnish energy to all who will use as much as 20 kw-hours per month at 7 cents per kw-hour. The average home, the announcement states, uses 23 kw-hours a month and, under the new offer, there would be a saving of 23 cents a month over the old rate. It is argued that in order to serve the public at so low a rate each home must bear its proportionate share of the expense of installation and cost of production. For this reason a minimum amount of energy for which each must pay is fixed in the contract.

The other plan is to fix a flat rate of 30 cents a month for not more than three rooms and 10 cents a month for each additional room, after which a charge of 7 cents per kw-hour would be made for the first 10 kw-hours and 5 cents per kw-hour for the remainder of the energy furnished. This latter plan is for those who use energy for both lamps and motors for household purposes. In that case there would be no minimum charge of 50 cents per month and the householder would pay only the 10 cents a room in case he closed his home for a time in the summer when the family is absent. City Solicitor Schreiber claims that these rates do not conform to those in the ordinance and that, if the company insists, it will mean a fight. He says the city will not allow the proposed contracts to be carried into effect.

New Rate Schedule in New York.

The New York Edison Company and the United Electric Light & Power Company have promulgated a new schedule of rates which becomes effective July 1. Like the rate schedule now in effect, the system is shorn of all technicalities and is clean-cut, the consumer paying a straight rate regardless of maximum demand, or when or how the energy is used. Such discounts as are available are based on the quantity of electricity consumed. The general rate available to all consumers is as follows:

For the first	250	kw-hrs of monthly consumption	10c	per kw-hr
Next	250	“ “ “ “	9c	“ “
“	250	“ “ “ “	8c	“ “
“	250	“ “ “ “	7c	“ “
“	500	“ “ “ “	6c	“ “
Excess over	1,500	“ “ “ “	for the excess 5c	“ “

These rates include carbon electrodes for and trimming of arc lamps, the supply and renewal of all standard incandescent lamps, or an equivalent allowance in the price of tungsten and tantalum lamps. Where advantageous to the consumer energy for motors may be included under the general rate. Customers making a yearly contract who agree to an average monthly use of not less than 1500 kw-hours, including energy used for motors if desired, may renew their own incandescent lamps, supply electrodes for and trim their arc lamps and otherwise care for their installations. For so doing they will receive a special discount of ½ cent a kw-hour.

The schedule of rates for energy consumed by motors is as follows:

For the first	200	kw-hrs of monthly consumption	9.5c	per kw-hr
Next	200	“ “ “ “	8c	“ “
“	2,500	“ “ “ “	6c	“ “
Excess over	2,900	“ “ “ “	for the excess 5c	“ “

What is known as the "wholesale rate," which applies to those consumers requiring over 100,000 kw-hours per annum and is covered by a guarantee to use not less than that amount, is as given below:

First 100,000 kw-hours yearly consumption	5c	per kw-hour
Next 100,000 “ “ “ “	4c	“ “
Over 200,000 kw-hours excess yearly, at	3c	“ “
500,000 kw-hours yearly consumption, not to exceed		$17,500
625,000 “ “ “ “ “		20,000
833,333 “ “ “ “ “		25,000

The only concessions made from the schedules as given above apply to automobiles, storage batteries and electric refrigeration. In order to encourage the use of electric automobiles and of electric refrigeration the following favorable rates are held out by the company:

	Per Kw-hour.
For the first 2,500 kw-hours of monthly consumption	5c
Next 2,500 kw-hours of monthly consumption	4c.
Excess over 5,000 kw-hours of monthly consumption, for the excess	3c.

The schedule is dependent upon a minimum monthly bill of $25 and includes the agreement that where the amount of energy used does not exceed 50,000 kw-hours monthly the cost shall not exceed $1,500.

Massachusetts Legislative News.

On account of a division of opinion of the committee on street railways a new bill has been prepared for submission to the Legislature in connection with the proposed consolidation of the systems and financial organizations of the Boston Elevated Railway Company and the West End Street Railway Company. The new bill proposes the drawing of a fifty-year lease of the West End system by the Boston Elevated at a rate of 7.5 per cent dividends in place of the existing guarantee of 8 per cent by the Elevated. The protective committee of the West End stockholders is understood to be opposed to the bill and contends that an investigation of the Boston Elevated finances should be held before any legislative enactment occurs. A bill providing for such an investigation received an adverse committee report early in the week, but it is probable that any necessary inquiries can be made under a bill sponsored by the Boston Chamber of Commerce, which provides for the appointment of a commission to investigate the transportation facilities of the metropolitan district. There is little doubt that a way will be found to preserve the operating unity of the Boston transportation system before the lease of the West End to the Elevated company expires, since the duplication of plant and service facilities which would result from a re-establishment of the old conditions of separate administration and operation is everywhere conceded to be impossible economically. A hearing was held on May 8 upon the bill recommended by Governor Foss for the abolition of the Railroad, Gas and Electric Light, Boston Transit, and Massachusetts Highway commissions and the substitution of a public-utilities board for the entire group of services. No evidence of public interest in the proposition was displayed, and there is little doubt that the bill will be killed at the present session and the policy of the State continued with respect to the subdivision of its commission activities. It has been clearly shown that most of the commissions whose work touches that of public-service corporations are so fully occupied that their abolition in favor of a single board would work serious injury to the regulating policy of the State and result in unsatisfactory relations between the companies and the representatives of the commonwealth.

The committee on mercantile affairs has recommended referring to the next Legislature so much of the special report of the Gas and Electric Light Commission upon electrical transmission as related, under Chapter 55 of the Resolves of 1910, to the public ways, waters and private lands, and to the placing of wires under ground in certain cities and towns. The commission reported upon these questions last winter, advising that for the present it appears unwise to pass laws granting the right of eminent domain to transmission companies.

The House has passed to be engrossed the bill (House 978) to exempt from the inheritance tax any shares in any railroad, street-railway or telephone company incorporated in the State if such property pays an inheritance tax in another state or country, and if such state or country grants a similar exemption in favor of citizens of Massachusetts.

Ohio Legislative News.

The Winters public-utilities bill, which was passed by the Ohio Senate by a vote of twenty-two to eight, having been sent back to the House for concurrence in the amendments, was taken up by that body on Thursday, May 11. After an acrimonious debate lasting the greater part of the day, a motion to concur was defeated by a vote of eighty-four to seventeen, and a conference committee was demanded. Speaker Vining named Mr. Winters, of Erie, author of the bill in the House; Mr. Kilpatrick, of Trumbull, and Mr. Langdon, of Warren. For the Senate Lientenant-Governor Nichols appointed Mr. Stockwell, of Cuyahoga; Mr. McGuire, of Tuscarawas, and Mr. Bader, of Hamilton. Senator McGuire had introduced a similar bill in the Senate.

Some uncertainty is felt as to the possibility of securing a satisfactory bill at the hands of this committee. Some of the members are radically opposed to the measure as it passed the Senate and will insist upon the amendments which the House added to the original bill, while others will argue that this is the best measure as it stands that can be secured under the circumstances and that it is much better than none. It is possible that a majority and minority report will be made, and this would make it impossible to secure the passage of either bill at this session.

Maryland Commission News.

An application from the Consolidated Gas, Electric Light & Power Company and allied concerns for authority to issue over $900,000 of new 4.5 per cent bonds was filed with the Maryland Public Service Commission last week. The application asks that permission be given for the issuance of $844,000 4.5 per cent general-mortgage bonds of the Consolidated Gas, Electric Light & Power Company and $60,000 4.5 per cent general-mortgage bonds of the United Electric Light & Power Company. The two issues were authorized at the meeting of the board of directors of the company held on March 15 last. The issues will be used for general construction and improvement purposes. Of the total issue of the Consolidated company $262,000 is to be used for the refunding of obligations. In the application is the statement that the Consolidated has a floating debt of $1,172,000 in short-term notes, and it will be to wipe out a portion of this indebtedness that the $262,000 will be used. The remaining $582,000 will be used for improvements. Of the $60,000 issue asked for the United company the full sum will be devoted to the paying up of obligations. The hearing of the application has been set by the commission for May 23.

A new telephone line from upper Maryland to the town of T. B., Prince George County, in southern Maryland, may be built in the near future as a result of the intervention of the Public Service Commission. The commission several weeks ago received a complaint from Mr. I. S. Brooks, a resident of T. B., regarding the lack of proper telephone service. The commission took the matter up with the Chesapeake & Potomac Telephone Company. Last week a letter was received from Mr. F. H. Bethell, of New York, vice-president of the company, asking that the commission withhold any action until a full report may be secured. Mr. Bethell said that the territory in which T. B. is situated is covered by the Southern Maryland Telephone Company, which has a traffic agreement with the Chesapeake & Potomac company. Mr. Bethell added that he did not believe that the Southern Maryland company would have any objections to the Chesapeake & Potomac building a line from Upper Marlboro to T. B., but that the latter company's consent would have to be secured before definite action could be taken.

New York Commission News.

The New York Public Service Commission, Second District, has received a complaint from the Board of Trade of the village of Adams, Jefferson County, directed against the Black River Telephone Company as to the rates charged for telephone service in that village. It is alleged that the rates now charged are unjust, unreasonable, discriminatory and unfair, and were made in violation of law and of the franchise granted by the village. The company was given a franchise upon the express stipulation that the charges for service in the village and vicinity should not exceed $15 per year for business places and $9 for residences, with a schedule of rates to outlying places.

On March 11, 1911, the rates were increased to $30 per year for business places, $24 per year for two-party line, $18 per year for multi-party line; for residences the charge was made $21 for direct line, $18 for two-party line and $15 for four-party line. The commission is asked to make an order directing that the company be required to reduce its rates to those provided in the franchise in June, 1901. The complaint has been served upon the company and an answer required within twenty days.

AMERICAN ELECTRICAL ENGINEERS—XXXIII.

Nicholas Stahl.

Nicholas Stahl was born at New Castle, Del., July 2, 1876. He received his early education at Muncy, Pa., and subsequently, after preparation at the School of the Lackawanna, Scranton, Pa., entered Princeton University in 1893, winning an entrance examination prize for the excellence of his papers. Four years later he was graduated second in his class with the degree of A.B. His interest was first directed to electrical affairs in 1887 because of severe burns and shock received from careless experimenting with the 500-volt trolley circuit of the Suburban Electric Company, of Scranton.

During his college course Mr. Stahl was actively interested in athletics and a club man. While at Princeton he was awarded "high honors" in mathematics and physics, won the Physical Fellowship and was admitted to membership in the Phi Beta Kappa fraternity. He remained at Princeton during 1897-8 as Fellow in Physics, making a specialty of electricity and particularly of Hertzian waves. Among his experiments in this branch was the establishment of well-defined standing waves 30 ft. long, even through stone walls, using cylindrical parabolloid reflectors of zinc, the nodal points and ventral segments being determined by varying the jumping distance of the spark. This was before Righi, the instructor of Marconi, had developed his short-wave oscillator, and represented a step toward the long waves necessary to long-distance wireless telegraphy. In 1898 he received from Princeton the degree of A.M., and shortly thereafter became the head of the science department and master of the Hamill House in the Lawrenceville School, Lawrenceville, N. J., well known as a preparatory school for Princeton and other colleges. While here he made a study of Röntgen rays and radiography, with especial reference to their surgical application in the location of embedded foreign bodies and the prevention of maladjusted fractures, establishing the superiority of a Wehnelt form of coil interrupter for this kind of work. During this latter period he followed courses of some months at Harvard, and in 1905 took a short course in mechanics and the electromagnetic theory of light at the Technical High School of Charlottenburg, Germany. In 1906-7 he studied electrical engineering at Princeton, under Dr. C. F. Brackett, giving particular attention to oscillographic work, and received in the latter year the post-graduate degree of E.E. from that university.

Since 1907 Mr. Stahl has been with the Westinghouse Electric & Manufacturing Company, of East Pittsburgh, Pa., in various capacities. Wishing to familiarize himself with manufacturing methods, he first entered the shops as an engineering apprentice, and in particular gave several months to construction and testing work on the single-phase locomotives for the New York, New Haven & Hartford Railroad and Spokane & Inland Railroads. After some months in the testing department he entered the railway department as a corresponding engineer. During this time he also acted as a part-time instructor in the Carnegie Technical Schools of Pittsburgh. At present he is commercial engineer in the railway and lighting department, as head of the general contract division, which has charge of the commercial and engineering oversight of many of the company's large negotiations and contracts. Lately he has refused a call to the chair of electrical engineering of one of the prominent Eastern colleges, preferring to continue in more active work.

Nicholas Stahl.

Mr. Stahl has contributed a number of articles to the technical press, among which the following have appeared in these columns: "Distribution and Breadth Coefficients of Alternators" (Nov. 9, 1907); "Three-Phase Power-Factors by Single-Phase Wattmeter" (Aug. 28, 1908); "Experimental Determination of the Hysteretic Exponent" (Nov. 21, 1908), of which a translation appeared in *Elektrotechnik und Maschinenbau* (Vienna) Jan. 24, 1909; "Transformer Currents in Weakened Deltas" (May 26, 1910), and "A Network Problem" (Sept. 8, 1910).

Mr. Stahl is a member of the Princeton Alumni Association of Western Pennsylvania and an associate member of the American Institute of Electrical Engineers.

CURRENT NEWS AND NOTES.

Boston Electrical Show.—The 1912 Boston Electrical Show will be held in the Mechanics' Building from Sept. 28 to Oct. 26, 1912. The manager of the show is Mr. Herbert W. Moses, 39 Boylston Street, Boston.

The International Association of Municipal Electricians.—This association will hold its next convention in St. Paul, Minn., on Sept. 12-15, the headquarters being at the Ryan Hotel. The president of the association is Mr. H C. Bundy and the secretary Mr. Clarence R. George, Houston, Tex.

Revision of Electric-Service Rates in Chicago.—On May 8 at a meeting of the Chicago City Council Alderman Pringle secured the passage of an order directing the committee on gas, oil and electric light to make a study of the rates for electric lighting and motor service as supplied by central-station companies of Chicago. The revision of these rates will come up in July, 1912, and the committee desires to make a careful study of the subject in advance. The Commonwealth Edison Company's primary rate for energy for lighting is 11 cents a kw-hour, having been recently reduced from 12 cents. The secondary rate is 6 cents.

Proposed Chicago Subway.—At a meeting of the Chicago City Council on May 8 Alderman Snow introduced a resolution, which was adopted, calling on the corporation counsel to report what legislation is necessary to enable the city of Chicago to construct a system of subways for the transportation of passengers and merchandise. Other information about the legal and financial aspects of the proposal is also requested in the resolution. The resolution is particularly interesting because it refers to the transportation of "passengers and merchandise," whereas it has been assumed heretofore that the proposed subway was to be entirely for passenger traffic.

Pittsfield A. I. E. E. Dinner.—Elaborate arrangements were made for the fourth annual dinner of the Pittsfield Section of the American Institute of Electrical Engineers on May 4, and they were carried out with a high degree of success. The dinner commemorated the twenty-fifth anniversary of the first commercial application in this country of the transformer and the alternating-current generator. The guest of honor was Mr. William Stanley, who designed the first alternator built in America. A miniature model of the famous Stanley transformer was presented to each of the guests. The toastmaster was President D. C. Jackson. In addition to Mr. Stanley the other speakers included Dr. C. P. Steinmetz, Prof. Elihu Thomson and Messrs. C. F. Scott, T. C. Martin, E. W. Rice, P. A. Russell, F. J. Sprague, F. Darlington and W. S. Moody.

New York Section I. E. S.—At the meeting of the New York Section of the Illuminating Engineering Society held on May 11 Dr. R. S. Woodworth, professor of psychology at Columbia University, delivered an instructive address on the "Psychology of Light." The speaker outlined the relation between purity of color, the admixture of color with black and the intensity of light stimulus, and showed in what respect the physicist differs from the psychologist in explaining the phenomenon of light. His demonstrations were based on the well-known color circle, according to which the colors of the spectrum form an almost complete circle, the final arc being filled in with impure mixed colors. Such a circle seems logical to the psychologist, but is contrary to the wave-frequency theory of the physicist. The nominating committee proposed the following men for election to the offices indicated at the June meeting of the section: Mr Bassett Jones, Jr., chairman; Mr. A. J. Marshall, secretary; Dr H. H. Seabrook and Mr. H. T Owens, managers.

Increase in Motor Load.—So rapid has been the increase in the motor load on the system of the Muskogee (Okla.) Gas & Electric Company that values compiled at one time give almost no indication of the values a few months later. For example, the motor load in 1910 was 436 hp, as reported in our issue for May 4; at the present time the load has reached about 1700 hp, the increase being nearly 300 per cent.

Lignite for Fuel.—In an address before the American Philosophical Society, Philadelphia, on May 5 Mr. Joseph A. Holms, director of the United States Bureau of Mines, showed that the deposits of lignite in the United States cover 116,700 sq. miles, 53,000 sq. miles of which are in Texas and 31,000 sq. miles in North Dakota. Investigations indicate that lignite can be made into briquettes on a commercial scale for use as fuel, especially for domestic purposes.

Cost of Arc Lighting.—At a meeting of the Pittsburgh Section of the American Institute of Electrical Engineers held on May 9 Mr. W. Edgar Reed, consulting engineer, read a paper on the cost of electrical energy as applied to small and moderate-size stations, with particular reference to arc lighting. The author showed that values specified for such service are usually misleading by reason of the failure to take various items into account. The discussion was participated in by Messrs. R. D. Thomas, C. E. Stephens and H. N. Muller. An abstract of the paper will appear in a later issue.

American Association for the Conservation of Vision.—On May 13 the American Association for the Conservation of Vision was incorporated to study conditions and causes which result in blindness and impaired vision, the relation of eye strain to physical and mental health and to human efficiency, and to devise means to prevent blindness. The incorporators are Messrs. Samuel Ely Eliot, T. Commerford Martin and M. C. Whitaker. The president of the association is Dr. F. Park Lewis, Buffalo, N. Y. The secretary is Mrs. Ida B. Hiltz. The headquarters are in the Engineering Societies Building, New York.

Energy Transmission from the United States to Mexico.—A recent dispatch from Douglas, in the southeastern corner of Arizona, practically on the international line dividing that territory from Mexico, says that the transmission line between Douglas and the El Tigre mines in the State of Sonora, Mexico, is now complete except for a short distance across the Yaqui River. This transmission line will supply electrical energy to a number of mines in a large area of northern Mexico, the electricity being generated at the Copper Queen smelter in Douglas. The availability of this energy will enable many mining operators to work properties hitherto lying unused owing to the lack of fuel and water.

Alleged Electrical "Graft."—According to newspaper accounts the Sanitary District of Chicago, a municipal corporation, has been cheated by the distribution of electrical energy in Lockport, Ill., to persons who paid little or nothing for it. The District generates electricity from the water-power of the Chicago Drainage Canal in a station at Lockport, and it is alleged that a condition of wire tapping, meter tampering and juggling of accounts has been found to exist in the case of many customers or supposed customers in that city, which is 30 miles from the main office in Chicago. In general, it appears, things were run loosely in relation to the local distribution in Lockport and several employees were discharged.

St. Louis Section, N. E. L. A.—At the recent meeting of the St. Louis Union Electric Light & Power Company Section of the National Electric Light Association Prof. A. S. Langsdorf, dean of the engineering faculty of Washington University, St. Louis, delivered an illustrated lecture on the oscillograph. He discussed the history of the methods used to study the internal action of alternating-current machinery and referred to various instances where the study of the emf and current curves as given by the oscillograph have assisted in the detection of the causes of trouble. Professor Langsdorf also exhibited an oscillograph, which he operated, showing curves of various kinds on the screen. The audience was also entertained by moving pictures of the principal waterfalls of the United States.

New York Electrical Society Meeting.—The subject for discussion at a meeting of the New York Electrical Society to be held in the Engineering Societies Building on May 18 will be the production and application of the Edison storage battery. The chief speaker of the evening will be Mr. Frank L. Dyer, for many years an associate of Mr. Edison in charge of his patent and business interests. The lecture by Mr. Dyer will be illustrated by numerous lantern slides, and a novelty will be introduced in the form of motion pictures illustrating the advantages of electricity as a vehicle motive power as compared with the horse and gasoline. Among the applications of the battery that will be illustrated are pleasure vehicles, trucks, delivery wagons, ambulances, dock trucks, omnibuses, street cars, inspection cars and submarine boats.

Illinois Waterway Project.—Governor Deneen's waterway bill passed the Senate of the Legislature of Illinois on May 9. At that time, however, it was predicted that the measure would fail to pass the lower branch of the Legislature. The Governor is very much interested in the passage of this bill, and sent a special message to the Legislature in relation to it recently. It is proposed to provide a deep waterway or canal from the present hydroelectric plant of the Sanitary District on the Desplaines River at Lockport, Ill., to Utica, Ill., which is the present head of navigation on the Illinois River. A bond issue of $20,000,000 to effect this improvement has been voted on favorably by the citizens of the State, but the Legislature has declined so far to enact the necessary law. An important feature of the project is the utilization of the water-power which the proposed waterway would provide. The Governor declares that it is only by the acquirement of these water-power sites by the State and the preservation of the public rights in the water-powers along the Desplaines and Illinois Rivers that the State can defray the cost of waterway construction and so retire the $20,000,000 of bonds which it is proposed to issue without expense to the State.

Meeting of the New York Companies' Section of the N. E. L. A.—At a meeting of the New York Companies' Section of the N. E. L. A. at the Engineering Societies Building, New York, May 15, the secretary announced that the membership at that time had exceeded 1300, making the New York Companies' Section the banner section in the association and bringing the total membership of the N. E. L. A. above 8200. Chairman Arthur Williams, who is also chairman of the entertainment committee of the N. E. L. A., outlined the entertainment features for the coming convention, accentuating the fact that the local companies would, of necessity, have to act as hosts for the delegates from all over the country. The speaker of the evening was Mr. Nikola Tesla, who delivered an illustrated lecture on the experiments with high-frequency currents which he made in New York and Colorado Springs and his work on wireless transmission of energy on Long Island. He also illustrated and described for the first time in public his more recent inventions in blowers, turbine pumps and steam turbines. In order to demonstrate that his theories on the latter class of apparatus were not visionary, Mr. Tesla showed actual photographs of pumps, blowers and turbines built, and also had a small model on view in the auditorium which he set in operation during the course of his lecture. The audience filled all of the lower floor of the auditorium, with an overflow in the galleries. Four papers which were listed for presentation at the meeting were held for presentation at the next meeting. A short vaudeville show was given after the lecture.

HYDROELECTRIC ENERGY FOR THE BEDFORD STONE INDUSTRY.

Water-Power Plant, with Steam-Turbine Auxiliary, Operating Quarries and Mills in the Famous Indiana Oölitic-Limestone District.

Of all the applications of electricity for industrial purposes there is perhaps none more interesting or less known than the use of motor drive in quarrying and milling the unsurpassed building stone of the Bedford oölitic district in Indiana. Isolated mill generating plants scattered over the region have already been in operation for several years, demonstrating the efficacy of electric drive, but the month of March marked the beginning of operation of a central power station which will make motor drive possible for every quarry and mill in the Bedford district.

This plant is a combination steam and water-power station developing an ultimate 5000 kw from a 17-ft. fall in the White River, 10 miles from Bedford, and is provided with a steam-turbine auxiliary for relay service during the month or two in the year when water conditions impair the output of the hydroelectric equipment.

Already in the Bedford district electricity is being used with marked success and economy for every step in the preparation of the stone for the market. Motor-driven "channelers" cut deep slots into the rock benches, while motor-driven derrick-hoists rend the severed blocks from their native beds and lift them to the stoneyard. Here motor-operated traveling cranes pile them away or place them aboard cars for delivery to the mills. In the latter a variety of operations are accomplished by electric drive, the blocks being sawed to size, planed, turned in lathes, or formed as desired, by huge motor-driven machine tools. Many of the great saws run day and night, so that the generating plant is assured a good load-factor from the mills, although the quarry demand is less steady during the 10-hour working day and is off altogether for the three winter months.

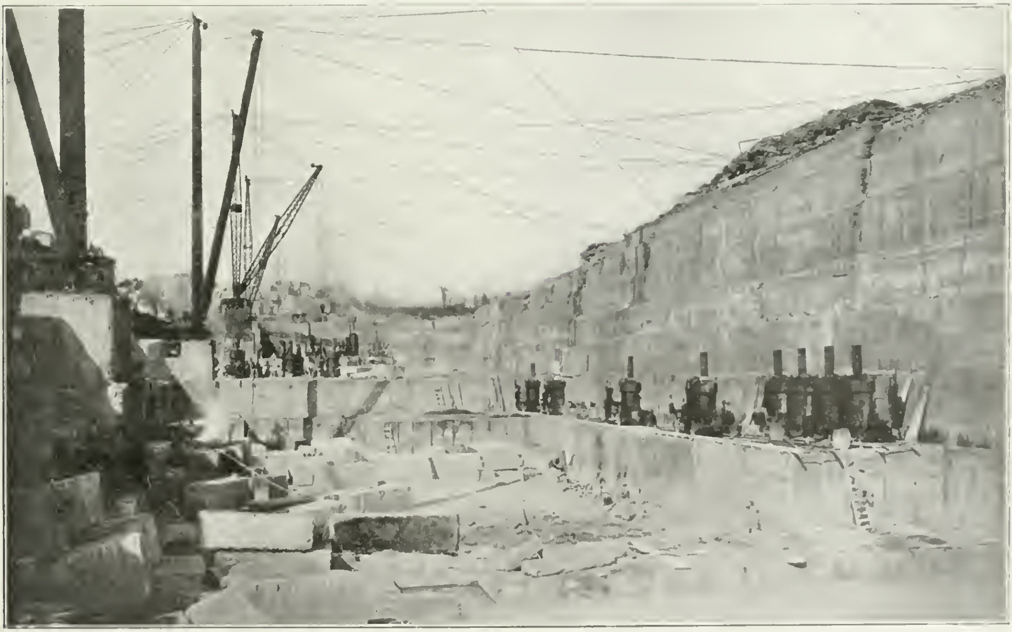


Fig. 1—Motor-Driven Derricks and Steam Ledge Channelers to Be Replaced by Electric Channelers.

There are fifteen quarries and thirty-five mills in the Bedford district, all of which are within a radius of 3 miles of the sub-station at Bedford.

Later, if the present plans of the Southern Indiana Power Company, which is making these developments, are carried out, another water-power station will be built below the present site, co-operating with the same steam auxiliary; and a transmission network will be extended throughout the oolitic limestone field to take in the stone district near Bloomington and Oolitic, Ind.

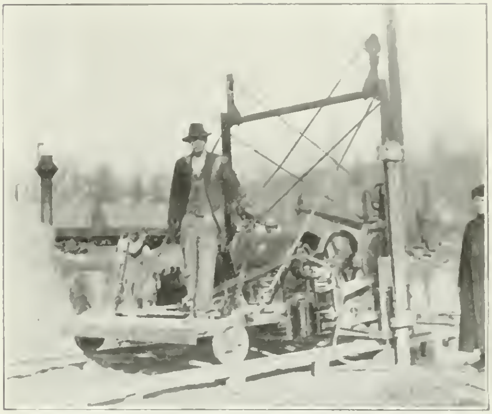


Fig. 2—Motor-Driven Channeler in Use at Bedford.

POWER HOUSE AT WILLIAMS.

The generating station of the Southern Indiana Power Company is at Williams, on the east fork of White River, 10 miles west of Bedford. Here a 17 ft. head is available with an average stream flow of 2200 cu. ft. per second. By conserving this behind a suitable storage dam an ultimate total mean daily output of 5000 kw in water-power during most of the weeks of the year will be assured.

On account of the absence of sufficient condensing water at Bedford, and for simplicity in the control and switching of the high-tension transmission line, the steam-power relay plant has been combined wth the water-power station at Williams. In order that service might be rendered the quarries and mills at the earliest possible moment, the steam plant was completed first, two 750-kw horizontal turbine-generator units being initially installed, to be followed by a 2500-kw unit. In the design of this steam relay plant attention was paid to constructing it with all possible simplicity, in view of the short periods during each year when it would be called upon for aiding the water-power equipment. Although the plant is therefore free from some refinements which might be expected in a station designed for continuous duty, no element is lacking to insure the reliability and efficiency of operation demanded for supplying energy to an important transmission and industrial-plant system.

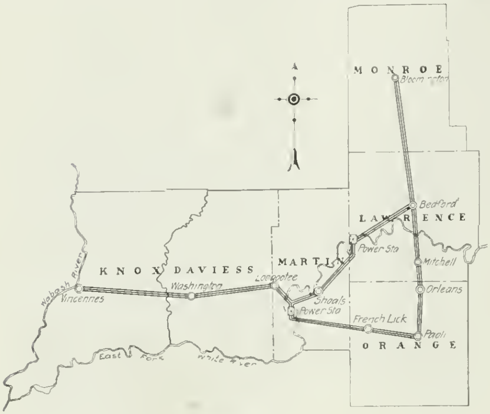


Fig. 3—Distribution System of the Southern Indiana Power Company.

During about 100 days in the year it is expected that low water conditions will require the operation of part or all of the steam plant to aid the waterwheels. For another ten days the spring floods will probably render the hydraulic plant inoperable owing to back water. During these periods steam will be held in the boilers ready to supply any deficiency in the output of the waterwheels.

The power house is a molded concrete structure, the future generator room measuring 175 ft. x 45 ft. over all. Of this length 125 ft. is given over to the water-power units and 50 ft. to the steam-turbine sets. Adjoining the turbine end of the main station is a 50-ft. x 120-ft. concrete building containing the boiler equipment.

STEAM-RELAY EQUIPMENT

The Bedford district is not far from the coal-mining region of Indiana, and coal laid down in the bunkers of the station at Williams costs only $1.30 per ton. Four 408-hp Stirling boilers with Roney stokers constitute the initial steam-generating equipment. These furnaces are provided with induced draft into a 3-ft. x 8-ft. stack, extending 14 ft. above the power-house roof, by two 50-hp engine-driven fans, either one of which is capable of operating all four boilers at full load. Together they can carry a boiler overload of 100 per cent. The blower-engine valves are controlled from pressure gages on the boiler steam lines, being so arranged that in case of drop in pressure due to steam demand the fans are automatically speeded up, thereby increasing the draft and hence the output of the boilers.

On the framework beneath the engine-driven fans is a 2000-hp Cochran open feed-water heater to which the exhausts from the auxiliary pumps and the drains from the main steam pipes are led. The boiler pumps are of the reciprocating type, and all pipe construction is extra heavy and equipped with non-return check valves. The future boiler-room will contain another set of four boiler units like those installed, arranged along the opposite side of the building. Until these extensions are made, and on account of the brief operating periods during which the plant is expected to be in service, no provision has yet been made for storing or handling coal for the stokers.

The turbine-room contains two 600-kw Allis-Chalmers Parsons-type steam turbines, directly connected to 750-kva Allis-Chalmers 2300-volt, 60-cycle, three-phase alternators, the excess generator equipment being provided to allow for reduced power-factor of the station load. A similar 2500-kva steam-turbine set is now being installed. The turbines are supplied with steam at 160 lb. per square inch, and exhaust into Tomlinson jet-type siphon condensers. These condensers are able to carry a 28-in. vacuum with the turbines fully loaded, or a 27-in. vacuum with one turbine 50 per cent overloaded. The wet and dry centrifugal pumps are driven by Kerr steam turbines at 1200 r.p.m. Condenser injection water will be taken through an inlet tunnel from the upper pond level, but for operation until the dam is completed a centrifugal pump has been installed to raise the water from the river to a bulkhead erected in the inlet.

In addition to one 50-kw and one 100-kw, 2300-volt motor-driven exciter set, which can be operated from the generator buses, there is provided a 55-kw high-speed, engine-driven exciter for starting up the steam plant.

The generator-room floor is raised about 25 ft. above the crest of the dam. The foundation and structure are thoroughly waterproofed up to this level as a protection against extreme high water in the river.

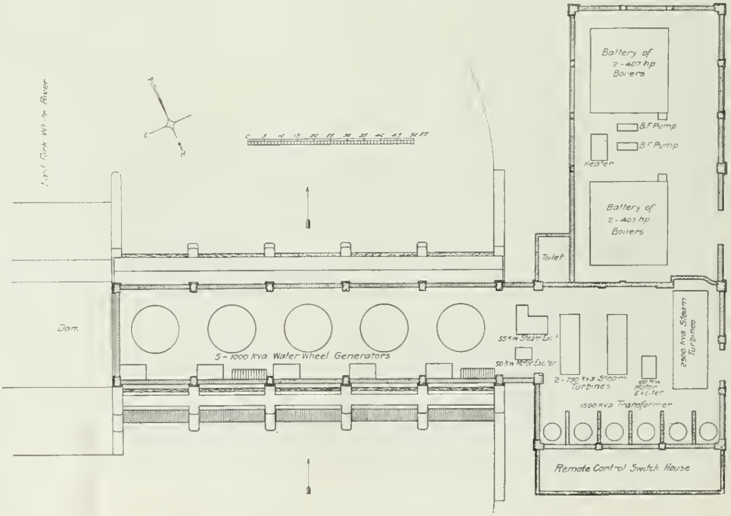


Fig. 4—Plan of Power House.

The condenser intake well is inclosed in the concrete foundations of the plant, and is held at a constant level by a float-controlled valve.

WATER-POWER PLANT.

The east fork of the White River at this point drains an area of 4500 sq. miles, and, as already noted, the flow of the stream is about 2200 cu. ft. per second on an average day of the year. The dam under construction will create a storage pond of about 1000 acres in extent, having a storage capacity of 45,000,000 cu. ft. for each foot of depth. The demand on the generating station, due to the stone industry, will be largely a day motor load. It will accordingly be the practice, in operating the plant, to draw down the reservoir during the day by about 2 ft., allowing the normal stream flow to restore the level during the off-peak hours. The turbines are designed for this reduced head. In this way it will be possible to deliver an ultimate demand of 5000 kw in the hours of the working day.

The dam is of the Ambursen hollow reinforced-concrete type, 300 ft. in length and 17 ft. high. At its north end the power-house foundation forms an extension to the dam 125 ft. in length, making the entire structure 425 ft. in total length. Measured from the mattress of the dam to the roof of the power house the concrete work has an extreme height of 102 ft. In the excavation to make way for the dam and wheel pits, 10,000 cu. yd. of rock and 6000 cu. yd. of earth have been removed, and the completed dam and power-house structure will contain 7000 cu. yd. of concrete. Work was begun at the site in June, 1910; steam-turbine operation was begun in March, 1911; and the waterwheel units will be ready to begin work by July, 1911.

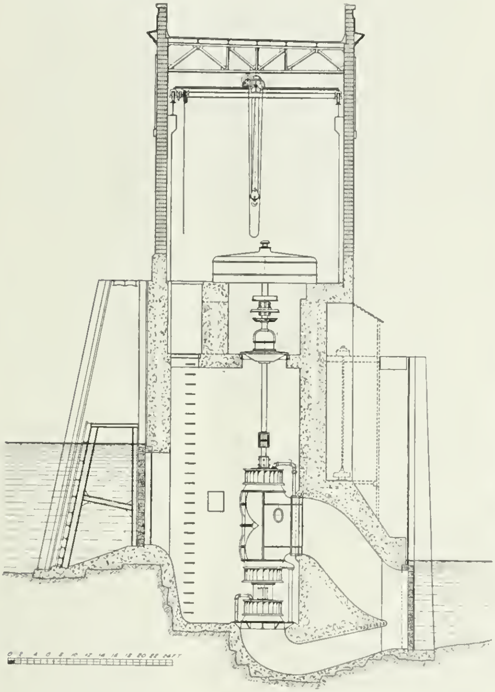


Fig. 5—Cross-Section of Turbine and Generating Room.

The hollow concrete dam is provided with a passageway extending through its interior from shore to shore. Reinforced-concrete buttresses carry the 45-deg. sloping upstream deck of the dam, which resists overturning by the weight of the water which it impounds.

A total of five 1000-kva vertical waterwheel units will be installed in the Williams plant. The initial pair of these will be Allis-Chalmers vertical-shaft machines, each with three 48-in. runners and operating at 128 r.p.m. These turbines will operate efficiently over a range in head from 17 ft. to 12 ft., although speeded at 128 r.p.m. for 16-ft. head operation. Two 1000-kw, vertical-shaft, duplex 72-in. runner units, which will follow the first installation, are arranged to operate at 82 r.p.m. under 15-ft. head. The governors for these machines will be of the Allis-Chalmers oil-operated type. In addition to the 100-kw and 50-kw, 2300-volt motor-driven exciters, as mentioned above, a 27.5-kw exciter unit is arranged on a countershaft so that it can be driven from any of the waterwheel units, in this way enabling the waterwheel alternators to be started up without recourse to the engine-driven exciter in the steam plant.

Water entering the forebay in front of the trash racks will be cleared of floating material by an extension boom. The head gates will be hand-operated. The discharge tubes from the waterwheel runners are arranged with overhead and undershot curves, which has permitted the wheels to be depressed to the lowest possible level.

SWITCHBOARD, SWITCHING, ETC.

The controlling switchboard is mounted on an overhead gallery running along the north side of the generator room. On the same level is the 22,000-volt high-tension apparatus leading to the line exits and transmission line outside. Beneath the switchboard gallery are the step-up transformers in separate concrete-barrier compartments, and behind them the 2300-volt switchroom, which is entirely remote-controlled.

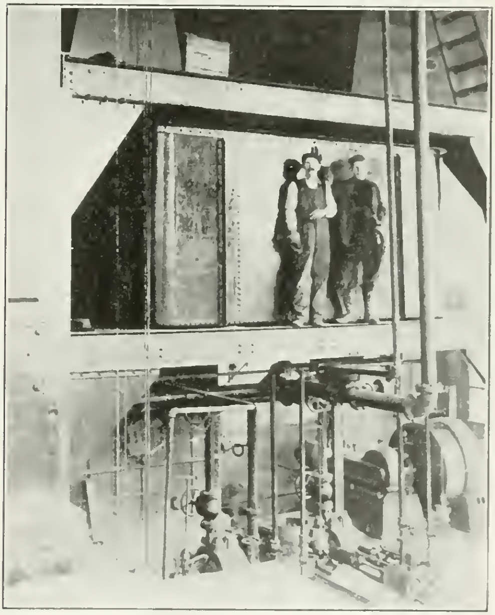


Fig. 6—Feed-Water Heater and Draft Fans in Boiler-Room.

The combination steam and water-power plant at Williams is arranged so that it can be operated, and any machine put into service, by one man. After starting up any waterwheel or steam-turbine unit from the floor of the station, the operator can ascend to the switchboard gallery and from there control the governor setting of any machine, synchronizing and paralleling it with the buses, without leaving his station. The black slate switchboard comprises in all eighteen panels, providing for the future number of steam-driven and waterwheel machines, besides the transformer panels, exciter panels, motor panels, synchroscope and voltmeter panels, etc. The Tirrill regulator with which the board is furnished can be applied to either half of the 2300-volt bus, which is sectionalized by an oil tie-switch. The field circuit rheostats are mounted at the ceiling, 15 ft. above the switchboard handles, from which they are manipulated through sprocket chains inclosed in piping.

As before noted, all the 2300-volt switches are remote-controlled by solenoids, and are mounted in the switchroom beneath the switchboard. In this room are also assembled the various automatic starters and other apparatus needing expert attention. The 2300-volt and control-circuit leads are brought up through the concrete floor in iron conduit, which is extended to a height of about 2 ft. above the floor, thus protecting the inclosed wires and cables from accidental damage or scuffing. All live parts are insulated to withstand full potential, and no exposed charged metal appears anywhere on the switch and busbar structure, except the buses themselves, 8 ft. above the floor. Between the steam and waterwheel generator sections series transformers are inserted into the main buses, the secondaries of which operate watt-hour meters, showing respectively the total generated output of the steam and water-power plants. An alarm bell on the switchboard announces the operation of any circuit-breaker.

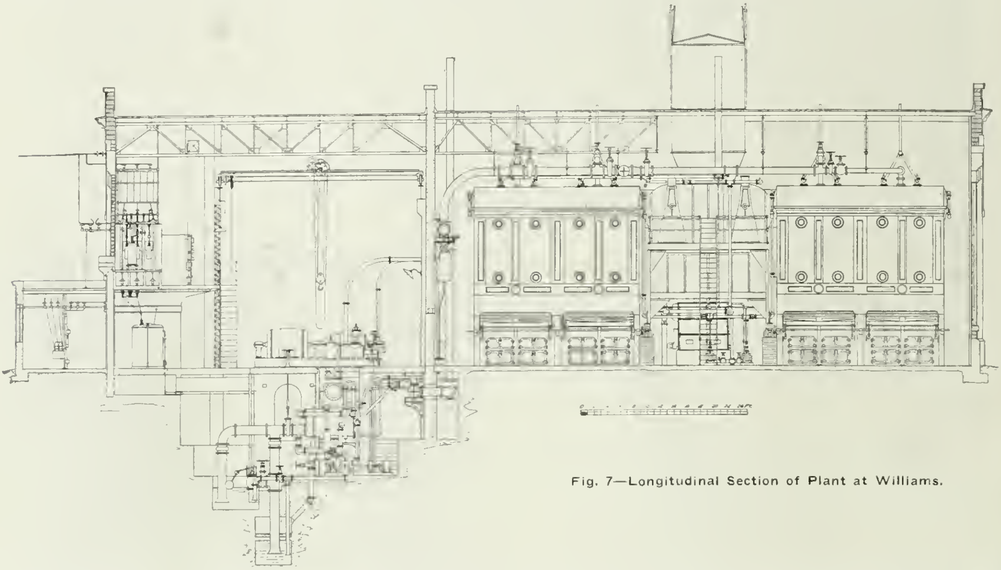


Fig. 7—Longitudinal Section of Plant at Williams.

The transformer compartments, half inclosed, are of reinforced concrete, 12 in. thick. The present equipment comprises three 750-kw units, stepping from 2200 volts to 22,000 volts; later these transformers will be transferred to the Bedford substation, being replaced by three 1500-kw units. Extra compartments are provided for three additional 1500-kw units. The transformers are water-cooled by motor-driven circulating pumps, as the station floor is 25 ft. above the crest of the dam.

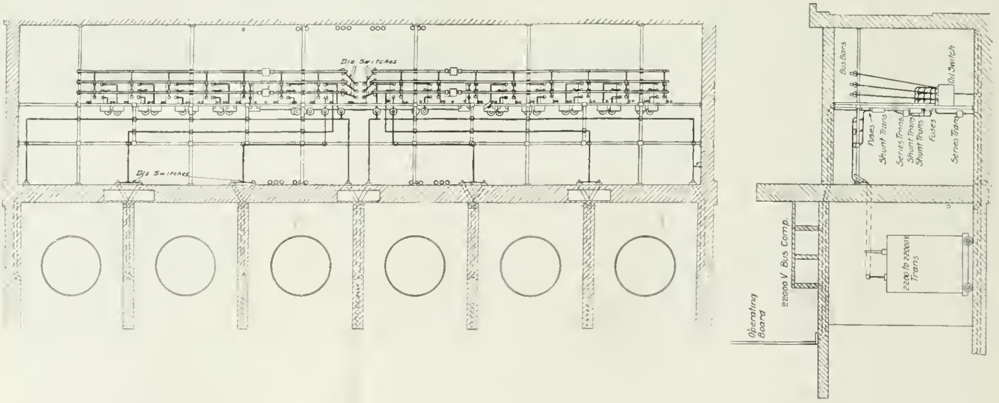


Fig. 8—Longitudinal and Transverse Sections of Switch House at Williams.

From the high-tension terminals of the transformers, through Locke ceiling bushings, the 22,000-volt conductors (all of which are of ¾-in. solid-copper section) are carried up through concrete troughs to the disconnecting switches leading to the oil switch. These high-tension bus troughs are 24 in. x 24 in. in section, and are separated by 4-in. walls of concrete. They are covered over with 2.5-in. concrete slabs, having eye-bolts cast in their tops to facilitate handling. The line circuits pass through disconnecting switches to the solenoid-operated line oil-switch, thence through disconnecting switches, series transformers and choke coils to the line entries. Here they are tapped by discharge paths leading to horn-gaps in series with aluminum-cell lightning arresters. A small aluminum cell, inserted in the ground discharge line, is bridged by a bell, which rings when the arresters discharge.

TRANSMISSION LINE.

The 22,000-volt transmission line, 9.6 miles in length, into Bedford is carried on 40-ft. steel towers, set at 300-ft. distances. Each tower weighs 1000 lb. and has a square base, 5 ft. on a side. Although 40 ft. in height, the legs are set 5 ft. into concrete footings buried in the earth, so that the towers themselves stand 35 ft. above the earth. The towers carry 10-ft. lower and 7-ft. upper cross-arms, supporting, on 33,000-volt insulators, two three-phase circuits of No. 3 hard-drawn copper wire. The wires are arranged at the apices of 36-in. triangles, one circuit being carried straight through, while the other is given two complete turns in the 9-mile distance, for purposes of transposition. The peaks of the poles are arranged to carry a 0.5-in. stranded-messenger ground wire for lightning protection. A telephone circuit between the power house and substation is mounted on the same towers, but is maintained as a private line by the Central Union Telephone Company, the Bell licensee in Indiana.

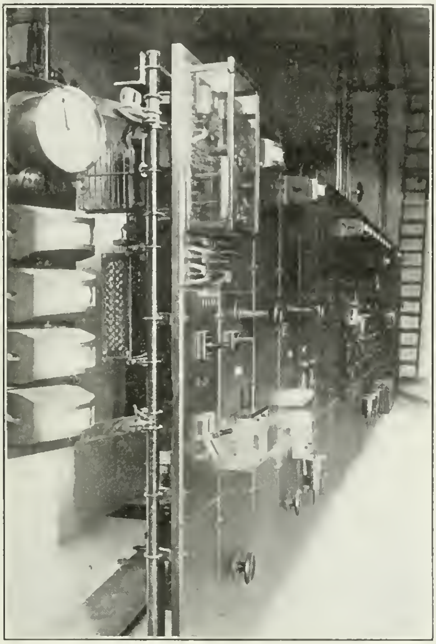


Fig. 9—Switchboard in Power House at Williams.

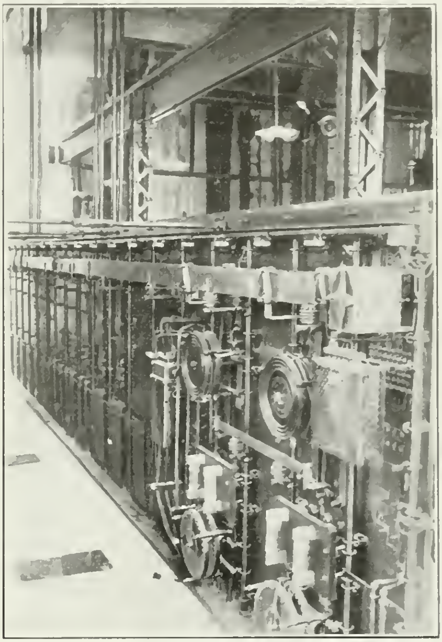


Fig. 11—Rear of Switchboard at Williams Power House.

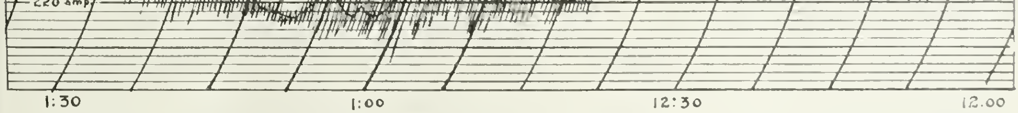


Fig. 10—Curve-Drawing Ammeter Record, Showing Typical Stone-Mill Demand.

Three miles from Bedford the 22,000-volt transmission line is tapped through a special switch tower for supplying energy to operate the Gilberson quarry near by. The disconnecting switches are of the outdoor type and have been fitted with specially designed porcelain-inclosed expulsion-type fuses for this outdoor use. This quarry customer is now served through a bank of 250-kw transformers, stepping down from 22,000 volts to 220 volts. Later, it is the intention to remove this high-tension tap into the transmission line, making provision to supply the service over a 4000-volt feeder from the substation to be installed at Oölitic.

BEDFORD SUBSTATION.

The substation, located on the northwestern edge of Bedford, is a steel-frame building, with walls of "hy-rib" center plastered with concrete. Entering the station through porcelain bushings set in 19-in. square soapstone slabs, the high-tension conductors, insulated against full voltage, are carried through the choke coils and disconnecting switches. Taps are taken off instrument transformers for operating voltmeters, showing the presence of high voltage on the lines, and also for feeding the pressure windings of reverse-power relays having instantaneous automatic trips. In conjunction with the inverse-time-element release of the circuit-breakers at the Williams power house, this arrangement immediately disconnects either circuit showing line trouble when operating in parallel with the other line. Energy to operate the Bedford substation high-tension oil switches is assured by a 40-amp-hour, 45-cell storage battery, which can be charged by a 0.5-kw motor-generator set, run off the station-lighting circuit. From the high-tension oil switch the full-insulated 22,000-volt lines are brought through series transformers and disconnecting switches, in concrete and transite barriers, to the inclosed-trough bus construction leading to the transformers below. Three 500-kw, 22,000-volt transformers are already installed, provision being made for the three 750-kw units to be brought from the Williams station. From each high-tension line wire, outside the station, aluminum-cell arresters are grounded to a common bus, which in turn is connected through a fourth cell, a transfer switch being provided for maintaining the film on the latter ground-cell plates. Static potential indicators hung on the high-tension buses show the presence of high-potential charge on the lines The high-tension entries into the substation have been constructed with apparently the minimum of 22,000-volt conductor. As a safeguard to life, however, all high-tension wiring is insulated to withstand the full potential carried. The transformer windings are connected in delta on the 22,000-volt side, and in star on the 2200-volt side, making a secondary delta pressure of 3800 volts available between line conductors.

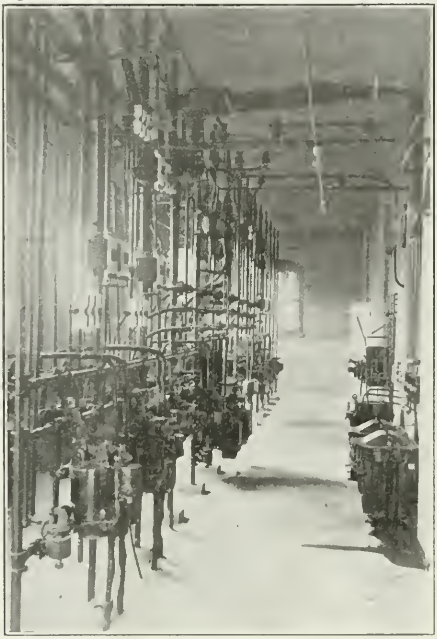


Fig. 12—Remote-Control-Switch Room in Williams Power House.

The switchboard is arranged with transformer panels for both groups of apparatus, and when completed will have fourteen feeder panels, each equipped with ammeters and oil switches with overload tripping device. In the center of the board will be a tie-switch panel for manipulating the high-tension oil switch which will link together the two sections of 22,000-volt busbars.

From the substation fourteen distribution feeders run to the various mill and quarry properties served. The neutral points of these circuits are well grounded at both the substation and customers' installation, so that in case of injury to one secondary transformer of a group the other two can be temporarily operated over the ground path provided.

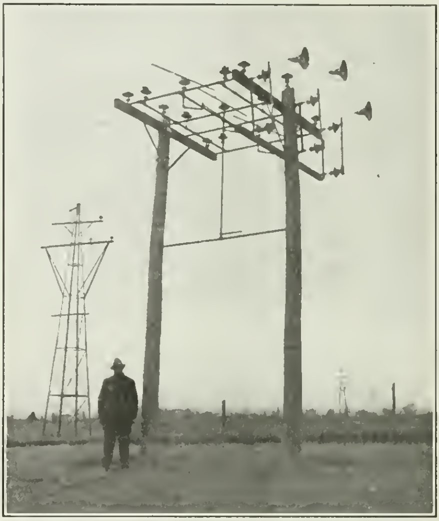


Fig. 13—Transmission Towers and Outdoor Switching Tower.

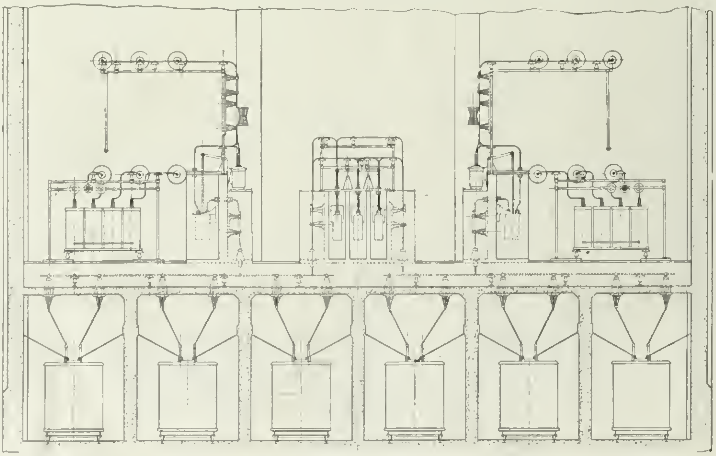


Fig. 14—22,000-Volt Wiring.

Space is arranged in the substation for motor-generator sets should it become advisable to install these to serve direct current to several present isolated-plant installations in the neighborhood of the station. By installing synchronous-motor sets and adjusting the field currents of these, it will be possible to obtain a load with leading wattless current characteristics at the station for offsetting the lagging wattless current taken by the mill and quarry motors. The substation machines would be three-unit sets, comprising 500-kw synchronous motors, each driving two 250-kw, 250-volt direct-current generators, thus making available a three-wire, 250-500-volt system. Wherever possible, however, complete equipment with individual alternating-current motors is being urged for all installations. In some instances, when the customer has a present direct-current plant, he may find it advantageous to install a motor-generator set. By using a synchronous machine for this purpose the station power-factor will be kept high.

Within a radius of 3 miles of the Bedford substation there are fifteen quarries and thirty-five mills, as has been already noted. Similar stone deposits extend 25 miles north of Bedford to Bloomington, and later it is proposed to extend the 22,000-volt transmission in a wide loop up through the district between Bedford and Bloomington, swinging back to the east and returning to the present substation, making it possible to distribute energy from Bedford in either direction around the loop in case of injury to the transmission line at any point. It is also proposed to make use of outdoor switching and transformer substations for each customer reached by the transmission loop, the transformers being arranged to step down in a single reduction from the line potential of 22,000 volts to the installation pressure of 440 volts or 220 volts.

THE STONE QUARRIES.

The famous oolitic limestone beds of the Bedford district were laid down as the old sea bottoms of the subcarboniferous period. The oölitic stone owes its name to its resemblance to masses of fish-roe or eggs, although, of course, its formation has really been due to simple concretionary action about original particles. The Bedford stone is highly valuable for building purposes on account of its fine texture and ease of working. It occurs in great beds of enormous thickness, without lamination or flaws of any kind, except occasional clay pockets and seams. Outcrops of the original stone are exposed in the bottom of stream valleys about Bedford, but the oölitic rock is elsewhere covered by an overburden of stratified limestone which forms the eroded hills of Lawrence County.

In quarrying the fine building stone the top soil and limestone burden must first be removed. For stripping the soil and soft-rock surface material a hydraulic giant similar to those used in mining and operated by a 150-hp motor-driven centrifugal pump has been successfully employed in the Bedford district. After the surface is stripped, the hard overburden is removed by blasting, leaving the valuable building rock exposed in a smooth level floor.

The first operation in quarrying this material is "channeling," or cutting deep vertical slots, forming the sides of the huge blocks, which are afterward wrenched from their footings by the derrick hoists. The cutting tools used are steel rods which are raised and lowered through about 18-in. distances 180 times a minute, meanwhile being slowly advanced across the face of the rock. By this means channels from 8 ft. to 18 ft. deep can be cut, thereby releasing blocks of similar dimensions. Steam-operated channelers have been heretofore used in the Bedford district, but electric channelers have already made their appearance and have shown performances far superior to the old apparatus. Each steam channeler requires the services of three men, and costs $12 a day to operate, including labor, coal, etc. A 12-hp motor-driven channeler, doing the same work, requires only one attendant and costs $1.50 a day for electricity to operate it. For supplying energy to the channelers at work in the pits, Greenfield conductor cable is made up into sections, with special threaded, waterproof connectors which can lie on the wet pit floor, unharmed by the rough service and moisture of the quarries. The standard electrical pressure used for this purpose is 220 volts. At the present time there are 152 steam channelers in use in the Bedford district, the majority of which will be electrified with the extension of central-station service.

After the blocks have been channeled loose from the parent ledge they are broken free of their footings by sidewise pulls of the derrick cranes, which then lift them over to the rough-stone piles for shipment to the mills. Some of the derricks used have 70-ft. masts and 60-ft. booms and require motors of from 35-hp to 12-hp rating. Squirrel-cage windings are employed where the motors drive the hoists through friction wheels. In other cases, when the hoists are directly geared, slip-ring motors are used. The demands on these hoist motors are very severe during the operations of breaking loose the blocks and hoisting them out of the pits. For the major part of the time, however, the quarry hoists run idle, taking small currents at low power-factor. Eighty such derricks and hoists are now in use in the district, a number of these being already motor-operated.

MOTOR DRIVE IN MILLS.

In some instances the stone quarries and mills are under the same ownership and operation, but it is most common for the quarries to sell the stone to separate mills, which are usually located elsewhere in the district. The quarries can be worked during only eight or nine months throughout the year, on account of weather conditions, but in this time enough rock is got out to keep the mills busy the year round. For handling the stone in the yards traveling cranes are required. These are equipped with motors averaging from 10 hp to 30 hp in rating. Sixty-eight such cranes, some steam-operated, are now in use among the Bedford mills and quarries.

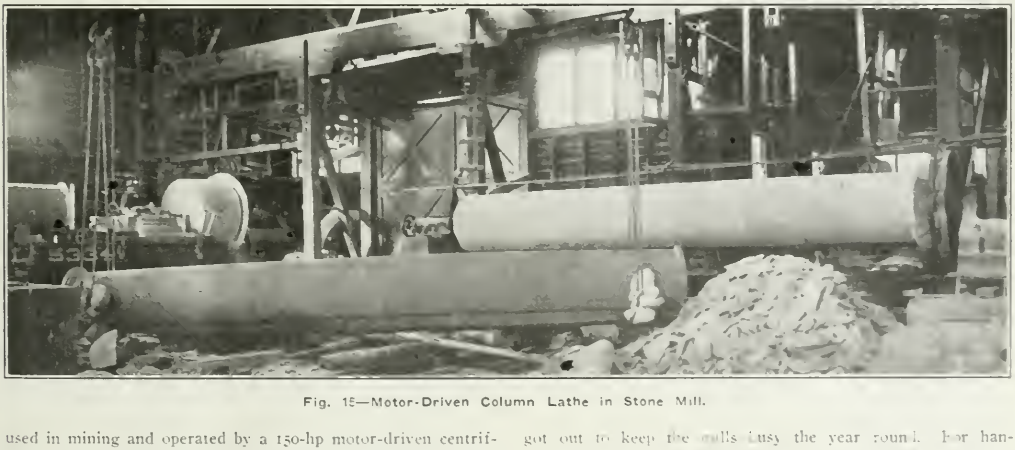


Fig. 15—Motor-Driven Column Lathe in Stone Mill.

In the mills various operations of forming and shaping the cut stone for the market are performed by a special class of machinery. The chief operation is sawing. Three types of stone saws are in use: Reciprocating gang saws, iron-wire gang saws and diamond-pointed circular saws. The reciprocating saws are of the Pitman type and comprise gangs of soft-iron blades [illegible] wide and about 14 ft. long, which are oscillated horizontally over the stone with a 2-ft. stroke, 100 times a minute, being meanwhile fed into the material at the rate of 4 in. or more per hour. Water and quartz sand are fed under the blades, the sand providing the cutting action and the water cooling the blades and removing the dust produced. In some of these gang saws as many as twenty-eight cuts can be taken at one time when getting out 3-in. slabs, the thinnest used for sidewalk flaggings. A test made of such a rough saw, with six blades cutting into a buff-stone block 12 ft. long at the rate of 4.5 in. per hour, showed an average demand of 4.2 hp, with a maximum of 14.7 hp. Eight blades, fed into a 10.5-ft. block of hard limestone, at the rate of 5-in. per hour, showed a consumption of 14.7 hp. Three to eight cuts are usually made at one time; with twenty-eight blades in use, making 3-in. slabs, 45 hp would be required to drive the saw. There are 143 of these reciprocating gang saws in the Bedford district, many of them being operated for twenty-four hours a day.

In the iron-wire gang saws, iron wires, run over pulleys, are pressed into the face of the stone, quartz sand and water being meanwhile fed under the wires as before. A test of an Owen wire saw, with four wires in use making 11-ft. cuts through hard bluestone at the rate of 8 in. per hour, showed a demand of 7.2 hp on the 15-hp motor used, which will accordingly be replaced with a 10-hp motor. Sixteen iron-wire saws are in operation near Bedford.

Diamond-toothed circular saws are used for the finer work. Such saws are provided with several small black diamonds mounted in each tooth, so that the saws themselves cost several thousand dollars each. Water is used to cool the rapidly revolving blades. On test, a Myers single 76-in. saw, with four diamonds in each of its 120 teeth, while cutting a 30-in. kerf through hard bluestone at the rate of 3 in. per minute, showed a demand of 10.5 hp by its 15-hp motor. A small 3-hp motor is used to operate the feed motion for advancing the work under the saw.

Other tools for making special stone shapes are planers, lathes, headers, etc. Tests on a 38-in. planer with a 12-ft. bed showed that while 4.1 hp was continuously required for the cutting motion the demand reached 21 hp at the instant of reversing the bed movement. A 10-hp motor would, however, perform this duty satisfactorily. For making an average cut a certain stone header in a Bedford mill requiring 5 hp, showing an instantaneous demand of 17 hp for reversing. As was also indicated by the preceding test, a 10-hp motor would probably suffice for this drive. Altogether, there are 105 such planers and headers in this stone district. The size of the cuts taken on some of these tools will surprise one familiar only with metal machinery. Roughing cuts 2 in. thick and 6 in. wide are not uncommon, and several tools may be at work on the same stock simultaneously.

For making columns and round surfaces the stone blocks are turned up in lathes, in general resembling metal-working tools. The power taken by these, of course, depends on the work being done, but these machines are usually equipped with motors of from 5-hp to 7-hp rating.

The figures given in the preceding paragraphs for the motor-hp demands of various quarrying and milling operations were obtained from a complete series of tests in the Bedford district, made as a preliminary study for the Southern Indiana Power Company by Mr. C. E. Schutt, of the electrical department of Purdue University.

USE OF ELECTRICAL ENERGY IN BEDFORD DISTRICT.

In the Bedford district, within a radius of 3 miles of the substation, there is now in operation a total of nearly 13,000 hp in power-driven apparatus. Of this amount, 5000 hp is in the quarries, which are worked 10.5 hours per day, from eight to nine months in the year, and 8000 hp is in the mills, all of which operate throughout the twelve months, a large part of their machinery running continuously night and day. In fact, the average load-factor for the mills themselves, based on a 10.5-hour day, has been determined to be about 59 per cent, while for the whole group of mills supplied from the substation the load-factor may be expected to be still further increased by reason of the diversity of demand between the individual mills. The future prospective load in the Bedford district will reach 15,570 hp, including installations which are in immediate prospect. At present there is in use in the stone district a total of seventy-nine stationary steam engines and 189 portable engines, including hoists and channelers. These figures present some idea of the future load which the Bedford Power Company's plant is preparing to take over.

Electrical energy is sold to the quarries and mills according to a rate schedule by which a yearly fixed sum is paid per connected horse-power of motors, to which is added a variable charge depending on the kw-hours used. All metering is done on the secondary or the customers' side of the transformers, the latter and all equipment up to the service terminals being furnished by the central-station company.

In addition to the stone industry the Southern Indiana Power Company also sells energy to the Bedford Heat, Light & Power Company, which operates a steam-driven electric plant and supplies hot-water-heating service during the winter. As the mill and quarry demand comes chiefly during daylight working hours, the lighting load of the local distributing company will be an advantageous one for the transmission company, which is thus enabled to get off-peak business for its equipment. The transmission company is also furnishing the energy for the city pumping for the city of Bedford, operating two 150-hp motor-driven centrifugal pumps from fourteen to twenty-four hours per day.

The Esterline Company, Lafayette, Ind., of which Mr. J. W. Esterline is president, is in charge of the consulting electrical and mechanical engineering for the Southern Indiana Power Company, Mr. D. J. Angus being resident engineer on the work. The construction of the entire plant and distributing system has been done by the Mansfield Engineering Company, Indianapolis, Ind.

Mr. Horace C. Stillwell is president of the Southern Indiana Power Company, Mr. Charles E. Fletcher is secretary and treasurer, Mr. Blaine H. Miller general manager, and Mr. Fred Riebel general superintendent.

SOME ELECTRICAL TESTS OF PORCELAIN.

By Ralph P. Clarkson.

In an article published in the *Electrical World* July 7, 1910, the writer set forth briefly some facts regarding the mechanical strength of porcelain and glass, giving a description of the splendid machines placed at his disposal for the purpose of the tests. The present article is an account of some electrical experiments and is, further, a description of some very simple, but useful, laboratory-made electrical apparatus for work involving a potential of from 200,000 volts to 250,000 volts. This is without doubt the highest voltage ever used in a laboratory or lecture-room for experimental commercial purposes at a commercial frequency.

The transformer used for the tests was built at the Worcester Polytechnic Institute under the direction of Prof. Harold B. Smith, the head of the electrical engineering department and a pioneer in some branches of high-tension work. Since the writer's experiments the transformer has been entirely demolished and a new one capable of producing as high as 750,000 volts has been constructed. The same general method of winding was employed in both and a description of the unit will be of interest.

The 220-kv, 220-kw transformer was of the core type with eight primary coils—four on each leg. In each coil there were fourteen turns of No. 2 B. & S. stranded wire, making a total of 112 primary turns. In the secondary there were 100 coils of flat wire (the equivalent of No. 26 B. & S. wire) having 280 turns per coil, giving a total of 28,000 turns in the secondary winding. The terminals on each primary coil were brought out to a slate panel bolted to the case of the transformer. From each quarter point of the secondary winding taps were brought out. Therefore, by the proper choice of connections to give various ratios of the transformer, different maximum terminal voltages were obtainable. The midpoint of each of the two windings was grounded.

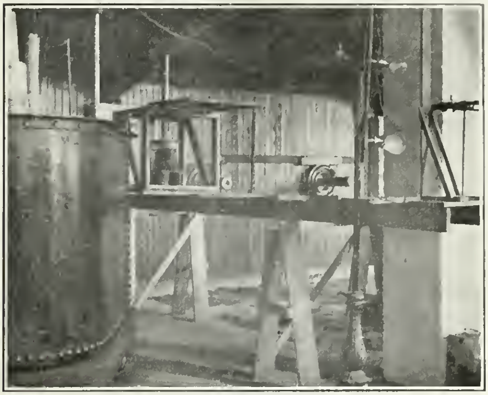


Fig. 1—The Repulsion Voltmeter.

The coils of the transformer instead of being wound progressively along the core of the transformer were wound in spirals, the coil increasing in diameter with each turn, this method being ordinarily called "pancake" winding. Each winding was stitched to a plate of insulating material, and they were piled on the legs one above the other. The whole unit was contained in a large steel tank and submerged in oil. The tank was open at the top and had about 400-gal. capacity. It is shown in the extreme left of Fig. 1 and again beyond the apparatus at the right of Fig. 3.

A special voltmeter was necessary in order to read the very high potential, and one developed at the institute was carefully constructed and gave great satisfaction. The voltmeter itself is shown within the cage in the center of Fig. 1. Fig. 3 shows one of the students reading the scale and at the same time varying the potential by means of the water-barrel of variable resistance. The voltmeter is built to work somewhat on the principle of the gold-leaf electroscope and consists essentially of a swinging plate hung parallel to a similar fixed plate and electrically connected to it, the whole being immersed in oil. The swinging plate carries a mirror and by means of a small telescope the reflection of a scale placed some distance away may be easily read in the mirror and thus the relative deflection due to the repulsion between the charges carried by the plates may be read exactly as in an ordinary galvanometer. The incandescent lamps for lighting the scale and the scale itself may be seen in Fig. 1. The scale is fastened just to the left of the forward end of the telescope and the lamps mounted for convenience of operation on the portable base in front of the scale in such a way as to be vertically adjustable also. The immersion of the plates in oil not only insulated them, but very effectually dampened the movement of the swinging plate and made the instrument practically dead-beat. The glass jar containing the plates was fixed on an insulating standard in the geometrical center of a grounded wire cage through which an insulating tube passed for the entrance of the wire from the voltage source. The wire cage kept the plates at a definite and fixed distance from the "earth" and created a uniform field surrounding the voltmeter. As a precaution the entire roof of the laboratory was covered with wire netting.

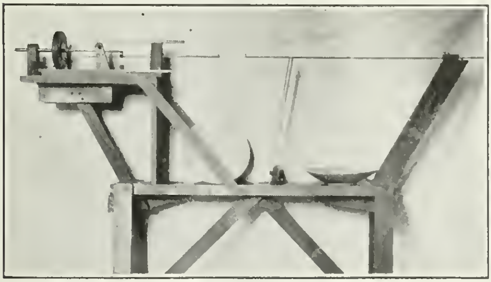


Fig. 2—The Spark-Gap Apparatus.

To calibrate the repulsion voltmeter on very high potential work, such as this proved to be, it was necessary to compare it with some standard of voltage measurement and the spark-gap was the only standard of sufficient accuracy obtainable. Fig. 2 shows the instrument used for measuring the sparking distance. It consists of a stand with one fixed and one movable socket, each of which is adapted to hold securely and electrically contact with a pointed needle (ordinary sewing needles were used). By means of the micrometer wheel at the left the distance between the needle points could be adjusted and accurately determined. The potential necessary to jump the gap formed was taken from a carefully prepared curve obtained from the American Institute of Electrical Engineers. Fresh needles were used for each gap, but in the calculations no account was taken of the condition of the air nor the pressure near the gap of the glass supporting rod shown in the photograph. The diagram of connections is given in Fig. 4.

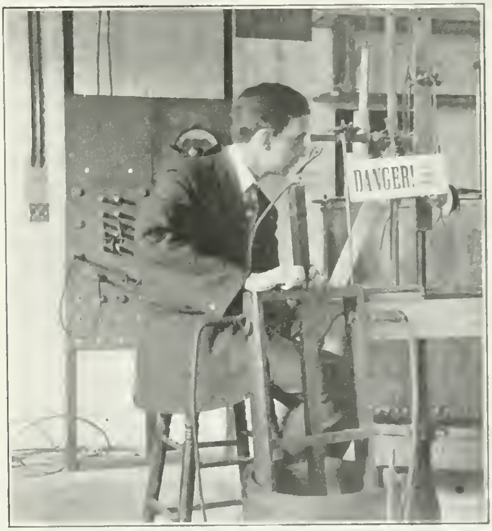


Fig. 3—Method of Reading and Varying Voltage.

A section of the water-barrel of variable resistance is shown in Fig. 5. It proved itself a quick and convenient device for the purpose and, being of some novelty, is worthy of mention. The sketch is self-explanatory, the movable terminal *C*, which is an iron plate, being moved by means of the handle *A*, which may be held in any desired position by inserting the wedge *B*, as shown. The stationary terminal is *D*. The resistance material between the plates is salt water and the instrument may be made as delicate as desired by changing the amount of salt.

Numerous preliminary tests were made on several selected types of high-tension insulators for the purpose of finding how the breakdown occurs most often under very high potential. It was found, as expected, that in every case the first thing that occurred was a substantial surface leakage, which was usually followed by the arc. Only those who have been permitted to see the breakdown of a high-tension insulator can realize the intensity of the occasion and the thrill of mingled awe and fear which passes through the spectator. The hum of the transformer, first low and dull, then gaining in volume and sharpness of tone, intermingling with the deafening crackling of the current as it leaks around the insulator and jumps from point to point, the smell of ozone in the air and the beautiful forms and colors of the corona—then a rippling lighter sound when the arc appears and the metallic click as the circuit-breaker blows—all gives one a sense of helplessness as he thinks of how little has been learned about the control of electricity and how much there is to know!

After the preliminary tests it was desired to find something of the potential necessary to puncture porcelain and the effect of the glaze upon the voltage required. The results are shown in the accompanying table. In order to make the tests a large number of plates, such as are shown on the sparking standard in Fig. 2, were obtained from one of the largest and most successful insulator houses in the country. The plates were all of the same batch and, while made up especially for these tests, were from a standard line of porcelain. Some of them were glazed as in the commercial product. They were 10 in. in diameter, dished shape and ¼ in. thick at the center, tapering slightly to the edge.

The plates were placed between two terminals consisting of brass balls of ¾-in. diameter placed at the center of the plates. In the case of the glazed specimens the lines of force—that is, the preliminary leakage—formed around the plates at a certain potential which was carefully noted. The same plates were then placed in oil and the same terminals arranged as before. In this case, of course, the voltage caused a puncture, the oil preventing any sparking around the edge and over the surface. With the plate in oil, several determinations were taken with each plate to find the voltage at which the puncture took place and every time a determination was made the puncture resulted at another point than previously, the current breaking a new hole instead of passing through the hole first made, although the voltage required to jump a gap in the oil equal to the thickness of the plate was found by subsequent tests to be less than that required to puncture the porcelain. This action appears unexplainable without further experiment. It would be interesting to know just what occurs in the hole in the porcelain immediately after it has been made by the passage of the spark. Why should the plate be punctured at another point rather tban the arc passing through the same path?

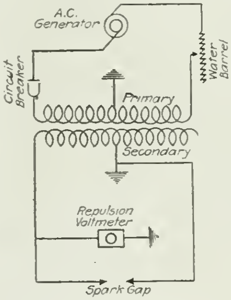


Fig. 4—Diagram of Calibration Connections.

In air the unglazed plates showed very quickly their impracticability for high-tension work, the leakage of lines of force being through the pores of the plate in every direction. The plates were not punctured and no arc was formed, simply a continuous crackling and passing of sparks through the plates from one terminal to another by various paths. This sparking took practically no additional current as does the current arc. When the potential was raised the plates were not punctured, but the arc formed around the edge. In oil, however, the puncture and formation of the arc took place with the first spark that passed, no preliminary discharge occurring. The mechanical tests described in a previous article showed the advantage mechanically of glazing the insulators and these electrical tests brought out very sharply the absolute impossibility of using an unglazed insulator on high-voltage work.

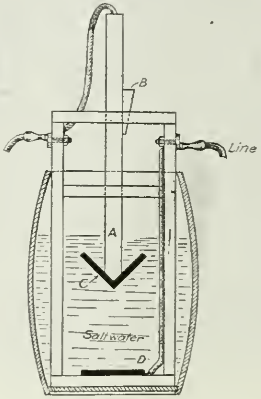


Fig. 5—Water-Barrel Resistor.

Without doubt the surface leakage is the important factor in the breakdown of insulators and any method of decreasing the tendency toward such leakage cannot fail to be of value. The first long step in that direction was the application of glaze to the insulator, then the leakage path was made as long as mechanical strength would allow. A limit was reached in a single insulator and the multiple-disk type of insulator was evolved. That has many distinct disadvantages over the pin type of insulator and, without doubt, a great many advantages. It is seemingly the only adequate insulator for very-high-tension work at present. However, the writer desires to offer as suggestive a few experiments made between November, 1907, and May, 1908, with what at that time, so far as he knows, was a new idea in insulator design, but which has since become somewhat differently developed in the condenser type of insulator, although when that name is used it is usually applied to insulators having alternate layers of insulating and conducting materials.

The following experiments have not been supplemented by further work owing to lack of time, but they may be regarded purely as simple, elementary suggestive work which carefully considered and diagnosed will point the way to a further development of insulator design.

The idea which prompted the work was to cause a redistribution of the electrostatic field surrounding the insulator by placing some capacity on its surface. For a while tinfoil was used, but it was very difficult to fasten this to the surface of the insulators, so aluminum-bronze paint was obtained and that could be applied and dried very readily. It was found that the

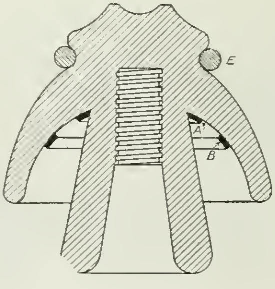


Fig. 6—Insulator.

presence of the metal on the surface of the insulator does make a difference in the surface leakage and the difference is not in proportion to the difference of length over the surface that the spark follows, assuming the paint to be a continuous conductor and the distance of leakage to be the total distance the spark follows minus the length of metal over which the spark passes.

To show one effect of the application of the metal an experiment was performed as follows:

Two insulators, identical in every respect, as far as could be seen, were made by the same company from the same batch of clay, of the same dimensions throughout and had withstood a salt-water test of the same voltage on the same day. They were as near alike as it is possible to get insulators. Each insulator had a single petticoat and was formed about as shown by the sketch.

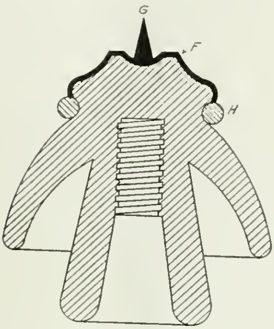


Fig. 7—Insulator.

On one of these two strips of the metal were painted entirely around it as located by *A* and *B* in Fig. 6. Each was ¼ in. wide, and the distance between them was ½ in. The two insulators were placed on the stand together. The unpainted one sparked over at 66,000 volts, while the painted insulator sparked over at 74,000 volts. Both were then carried up to the arcing point and the painted one punctured close up to the joint at *A*, while the other arced around the edge of the petticoat. Several other tests were made with other insulators and the same conditions prevailed. A second experiment was performed in which a cap of metal was painted on the insulator, as shown in section in Fig. 7, by the very heavy line at *F* extending down to the test conductor at *H* and touching it all around the cap. A sharp cone-shaped pointer was placed at the top of the insulator and electrically connected with the metal *F*. In the dark at the point *G* there was found a bright corona which amounted to a blue flame when the voltage was raised sufficiently, the leakage being very great and at that point only.

RESULTS OF EXPERIMENTS.

	Glass.	Porcelain.	
		Glazed.	Unglazed.
Tensile strength in pounds per square inch.			
Average	1,044	1,410	1,096
Lowest	563	870	587
Highest	1,415	2,142	1,923
Compressive strength in pounds per square inch:			
Average	No tests	9,034	14,233
Lowest	......	5,780	7,200
Highest	......	17,580	19,450
Average dielectric strength in volts per millimeter. Sharp needle points in oil	......	16,440	13,680
Leakage distance around edge of porcelain disk	......	29 mm	29 mm.
Voltage required to cause first sparking around	......	52,000	49,500

The third experiment abolished the pointer and in its place a saw-toothed edge was painted around the bottom of the cap extending slightly below the conductor *H*. The leakage was then entirely from the points of the saw teeth, of course, and in the dark the corona at those points was very much in evidence. The points were then embedded in insulation with the result of great modification of the corona; in fact, it was almost entirely averted.

One great difficulty with the use of the aluminum paint in this connection was the blowing action of the sparks, which acted to destroy the sharpness of the various lines and to cover parts of the insulator with fine powder. For that reason the experiments were very long, the insulator having to be cleaned very frequently and each time the paint was applied quite an appreciable time was taken for the drying action.

ACUITY.

By Sydney W. Ashe.

So much attention is being attracted at the present day in illuminating discussions to the subject of "acuity" that the following article has been prepared with a view to giving a simple outline of the subject.

Acuity is a measure of one's ability to perceive detail. Acuity is usually determined by means of a Snellen's chart of test type, which contains rows of various-sized letters. Opposite each row of letters on this chart is marked the reading distance in meters and in feet. If an individual is just able to read the letter at the distance indicated, he is said to have unit acuity. The chart which is illustrated in Fig. 1 has a total height of 28.5 in. The letter *T* at the top is 3.06 in. wide by 3.5 in. high.

Snellen arranged the letters on this chart so that they would be distinguishable by the normal eye under an angle of five minutes. Assuming that the nodal point of the normal eye from the retina is 15 mm, the angular size of the minute corresponds to

$$\frac{2\pi 15}{60 \times 360} = 0.004 \text{ mm}$$

A five-minute angle would, therefore, correspond to a distance of $0.004 \times 5 = 0.02$ mm on the retina of the eye. It is clear that letters intended to be seen at a distance of 12 m must have double the lineal size, according to this angular relation, of those which are seen at 6 m.

In measuring acuity it is necessary to select a particular size letter, illuminate it with normal intensity and determine the distance at which an individual can read this letter.

Representing the distance in millimeters of the observer from the chart by *D* and the height of the letter in millimeters by *S*, the relation will be expressed for unit acuity as follows.

$$D = \frac{15\ S}{0.02}$$

Given a certain letter on one of the lower lines of a Snellen's chart, the height of which letter is 4.10 mm, it is obvious that an individual having unit acuity should be able to read this letter at 3 m, for

$$D = \frac{15 \times 4.1}{0.02} = 3000 \text{ mm}$$

In a measurement made by the writer this particular letter was illuminated with 61.4 m-candles (5.8 ft.-candles) intensity by a clear 16-cp lamp 50 cm (1.5 ft.) from the chart. The distance at which the writer was able to read this letter was 3.04 m. The measure of the writer's acuity is, therefore, the relation which exists between the normal distance, 3 m, for unity acuity and his reading distance, 3.04 m, or his acuity is equal to 1.01.

The acuity varies with the intensity of the light upon the illuminated chart, and it varies also with the color. According to the accompanying table it will be noted that the acuity in the above-mentioned test varied from 0.68 with a foot-candle intensity of 3.84 to 1.38 for a foot-candle intensity of 383. These readings were taken with an ordinary 16-cp carbon lamp.

Foot-Candle Intensity	Acuity.
383.0	1.38
171.0	1.24
96.0	1.06
61.4	1.01
15.3	0.90
3.84	0.68

It will be observed, therefore, that the acuity is not constant, but varies with the intensity.

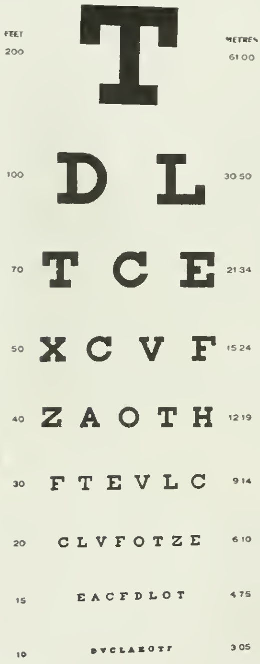


Fig. 1—Snellen's Chart Reduced to About One-Sixth Full Size.

The relation between acuity and intensity can be shown by means of the curve of Fig. 2. The ordinants of this curve measure the acuity and the abscissas measure the intensity. At *o*, for instance, there is zero illumination. At *a* the illumination has been raised so that vision is beginning. From *a* to *b* with a small variation in intensity the eye has reached practically maximum acuity, and from *b* to *c* throughout the wide range of illumination the acuity is only slightly changed, being maximum at the middle, the acuity falling rapidly to zero from *c* to *d*, where the intensity is about that of the sun. The point *a*, or the lowest point of visibility, is called the threshold (Reizschwerte). From *b* to *c* the illumination follows the law of Fechner—which will be stated later—quite closely, but not exactly, for the line is not a straight line, reading its maximum point at *M*. Bouguer knew of this relation for many years, but Fechner at the commencement of the eighteenth century expressed it in the form of a law. Aubert was the one who determined the threshold for the normal eye; the weakest light he was able to distinguish was that on a sheet of white paper illuminated by a candle at a distance of from 200 m to 250 m. In determining his value it was necessary to bandage the patient's eye in a dark room for at least twenty minutes. The fraction in normal persons according to Fechner varies between 0.010 and 0.0055. The acuity of our light senses may be expressed by the inverse fraction of Fechner. If, for instance, the latter be 1/100 it may be said that the acuity of the normal eye is equal to 100. If the illumination is greatly diminished and the fraction rises to 1/50 it is said that the acuity is 50. The law of Fechner is that which shows the sensitiveness of the eye to visual impressions. It is stated by Helmholz practically as follows:

Within very wide limits of brightness differences in the light strength are equally distinguished, or appear equal in sensation, if they form an equal fraction of the total quantity of light compared. In other words, if the parts of the visual field have the same relative brightness, the distinction of detail does not vary materially with great changes of absolute brightness.

Dr. Louis Bell, in "Art of Illumination," calls attention to the fact that Fechner's law fails when extremely brilliant lights are concerned. "Few persons realize, for instance, that the sun is twice as bright at noon as it is when still from 10 deg. to 15 deg. above the horizon. Yet while the eye does not detect very small changes or properly evaluate large ones in a body so bright as the sun, the mere fact that one can see to work or read about equally well from sunrise to sunset is most convincing as to the general truth of the law. Full sunlight at noon is generally overbright for the eye if it falls directly upon the work, but with half of it one can get along very comfortably."

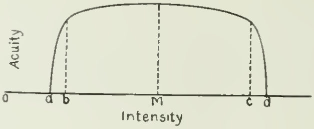


Fig. 2—Variation of Acuity with Intensity.

Given an ordinary stick supported in a vertical position illuminated by two equal light sources at *A* and *B* (Fig. 3) placed at different distances from the stick, each will cast a shadow upon the wall near which the stick is placed. Calling these two sources *A* and *B*, *B* may be moved away from the screen, becoming weaker and weaker, and when the distance of *B* from the screen is nearly ten times that of *A* its shadow ceases to be visible. Assuming *B* is 500 cm and *A* is 50 cm when the shadow is indistinguishable the following relations exist as to the perception, the final result being Fechner's constant:

$$\left\{\frac{1}{50^2}+\frac{1}{500^2}\right\}-\frac{1}{50^2}=\frac{1}{500^2}$$

$$\frac{\dfrac{1}{500^2}}{\dfrac{1}{50^2}+\dfrac{1}{500^2}}=\frac{1}{10^2+1}=\frac{1}{101}$$

With ordinary lamps the law of Fechner may be verified with great exactness, although, as shown in the previous curve, it does not hold for lower and higher light intensities.

STUDIES ON ACUITY.

The first person to study the relation between visual acuity and illumination was Tobias Mayer, who reported his results in 1754. He formulated the law that acuity varied as the sixth root of the intensity of illumination. Reviewing results obtained by Mayer, Posch, Albertoti and Carp, and himself, Cohn states that enormous individual differences in visual acuity are found with the decrease of the intensity of illumination. (*Arch. f. Oph.*, 17, page 305, 1871.)

Uhthoff and Koenig have probably made the most careful investigations of the subject. They varied the intensity of illumination from 1 to 3,600,000. As a source of light they used a 4-cp petroleum lamp. The lowest visual acuity obtained was 0.0015. The maximum acuity was reached with an illumination of 33 m-candles. In his study Cohn found that it was useless to take observations with daylight as a source of light, inasmuch as the eye does not by any means show the difference which the photometers show—that is, within certain limits the low variations of the intensity of the illumination are not attended with any notable difference in acuity.

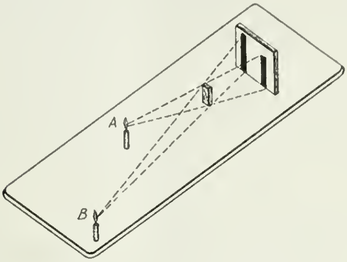


Fig. 3—Bouguer's Principle.

In some studies made by Cohn he found that some eyes had full acuity at only 1.5 m-candles, and one-half acuity at only 0.6 m-candle of illumination. All of the eyes tested had full acuity at 16 m-candles and one-half acuity at 4 m-candles. Dissatisfied with the observations found, Cohn repeated the observations with a number of persons and took the average of all of the readings obtained. For $a = 1$ or unit acuity the intensity was 100; for $a = 0.75$ the intensity was 71; for $a = 0.5$ the intensity was 0.33. More recent and accurate observations made by Koenig on his own eyes with white and colored lights led to the formulation by him of the following expression:

$$S = A\ (\log B - \log C),$$

in which the constant C is inversely proportional to the intrinsic brightness (helligkeitswerthe) of the lamp used. The factor A, on the other hand, is independent of the nature of the lamp. A and C may, however, be essentially different according as cones or rods serve to receive the light stimulus. In the first case A may be ten times as great as in the second. Koenig argued on the basis of the relation of the acuity to increasing intensity of illumination, wherein there is seen a high increase with low intensities and a less rapid increase with high intensities, and that in acuity the different sorts of elements of the sensitive layer of the retina are involved. The first kind are with the lower intensities which are relieved by the second kind even before they have reached the upper limit of their ability with the increase of intensity; the second likewise increase in their power until they have reached their limit. Koenig states as a matter of fact in the determinations which belong to the slowly ascending portion of the acuity curve that fixation is not made with the fovea, but somewhat eccentrically with the increased intensity of illumination; with the more rapidly ascending part of the acuity curve, however, fixation is made with the fovea. With a totally color-blind eye, which Koenig tested, the whole course of the curve corresponded with the slowly ascending part of the curve of the color-perceiving eye, and Koenig concluded from this that incapacity of the cones of such an eye is also the cause of the low acuity constantly associated with this anomaly.

AN IMPROVED FORM OF PRONY BRAKE.

By H. G. Crane.

The brake shown in the accompanying illustrations was designed for the electrical engineering laboratory of Harvard University and has been successfully employed in testing motors of from 1 hp to 10 hp. Several features of this brake are entirely new so far as is known. The illustration, together with the following brief description, will convey an idea of its construction and operation.

Ordinary forms of oil dash-pot, spring-balance and water-cooled brake drum are used. As will be seen by referring to Fig. 2, a small four-wheel carriage rides upon the drum. This carriage is movably attached to the brake arm by means of two studs *SS'* and retaining springs *AA'*. A hand wheel *W* operates a screw which passes through a metal bushing *B* in the brake arm as shown. This screw bears directly against the top of the carriage at *C*. A steel brake band, lined with camel's-hair belting, encircles the brake drum and is adjusted in tension by means of studs *DD'*. When the screw *W* is turned the arm is forced away from the carriage and the brake band brought into contact with the drum with adjustable pressure. At minimum load position the brake band hangs free from the drum and the rotating wheels exert only a slight turning effort on the brake arm, due to their small friction.

The weight of the arm may be counterbalanced, if desired, in order to allow for its effect on the reading of the balance. The zero reading is easily obtained, however, without counterbalancing, by rotating the drum first in one direction, then in the other, and noting the mean position of the scale pointer. The counterbalancing becomes important only when a heavy brake arm is used. As the hand wheel and screw are directly over the center of the shaft, the operator may rest the weight of his hand on it and hold the load constant at any desired point, without causing sensible error in the balance reading. The carriage, when properly made, may be used interchangeably on drums of various diameters. The outlines of two drums are shown in Fig. 2.

Although the small composition metal wheels *EE'* (2-in. diameter, 1-in. face) may sometimes revolve at extremely high speeds, no difficulty has been experienced with their lubrication. A drop of ordinary machine oil, mixed with a little graphite, will serve for a considerable time. These wheels are mounted on a ½-in. shaft, and, to provide for wear, may be fitted with renewable bushings.

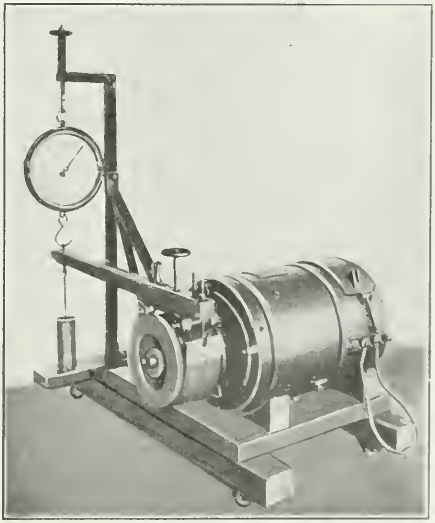


Fig. 1—An Improved Form of Prony Brake.

The illustrations show the brake mounted on the pulley of a small motor of the automobile type. The zero reading due to the weight of the brake arm, dash-pot plunger and adjacent parts is about 1-lb. weight. A screw enables the brake arm to be kept horizontal at all loads in spite of the variable distention of the spring in the spring balance. Fig. 3 shows an end view and longitudinal section of an ordinary form of brake drum. After bringing the motor up to speed, and before the load is applied, water is poured into the chamber within the drum. As is well known, centrifugal force during the running of the motor prevents the escape of this water, but in order to check the escape at starting or stopping the end apertures of the drum may be nearly closed over, if desired.

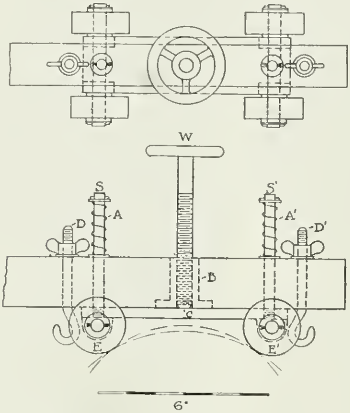


Fig. 2—Plan and Elevation of Brake Carriage.

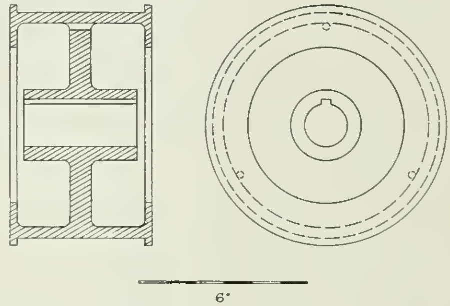


Fig. 3—End View and Longitudinal Section of Brake Drum.

The special advantages of this type of prony brake are:

(1) The ease with which the frictional load can be applied and completely removed, the brake thus being applicable to even the smallest motors, with which even a small initial frictional load would be very objectionable.

(2) The ease with which the frictional load can be varied and controlled by resting the hand on the screw wheel *W* in such a manner as not to alter the frictional couple, the axis of the wheel passing through the axis of the motor shaft when the brake beam is kept horizontal.

(3) The construction is such that the brake may quickly and conveniently be shifted from one motor to another.

Central Station
Management, Policies and Commercial Methods

"WHITE WAY" INSTALLED WITHOUT DISTURBING PAVING.

At Enid, Okla., a "white way" has been installed about the public square, comprising sixty ornamental iron posts at 50-ft. intervals, each carrying two 40-watt and one 60-watt tungsten lamps. The lower 40-watt lamps burn until midnight, while the 60-watt lamps at the tops of the posts are operated all night long. The cost of the electricity for operating the lamps is met by the city.

In laying the 1¼-in. iron conduit under cross streets all tearing up of paving was avoided by forcibly thrusting the pipe through the subsoil. The pipe end was first capped to keep it from filling with dirt, and then by means of a lever-operated jack the pipe was driven through the loam beneath the pavement. By sighting the pipe for a given point on the opposite side of the street it was found possible to reach the target within a few inches when the pipe was driven. Mr. Lincoln Beerbower is manager of the Enid Electric Company.

DISCOLORATION OF ICE BY USE OF BOILER COMPOUNDS.

Many combination ice-electric plants using boiler compounds having soda ash as a base have noticed a tendency to discolor the distilled-water condensate to a reddish hue, resulting in making "red" ice. Obviously, none of the pigment material can come over with the steam from the boilers, and some operators have been at a loss to know how the presence of the boiler compound could affect the color of the ice. The manner in which the discoloration occurs was outlined by Prof. A. C. Scott in a discussion on feed-water purification before the recent convention of the Southwestern Electrical Association at Houston, Tex., April 28. The soda ash, explained the speaker, liberates carbon dioxide in the boiler. Carbon dioxide, being a gas, comes over with the steam, and when the latter is condensed causes the formation of carbonates. These in turn are converted into hydrates, which may attack the iron in the walls of the container, rusting them and producing the reddish iron oxide which causes the discoloration.

In the discussion of this paper dealing with feed-water purification several small-plant operators brought out the point that they had employed successfully boiler compounds composed of the juices of Irish potatoes, which introduced none of the drawbacks of other scale preventives. Mr. W. B. Tuttle, of San Antonio, Tex., declared that any small plant having feed-water troubles would do well to install filters or other means of purification and treat the water before it enters the boilers.

NEW-BUSINESS METHODS IN NEBRASKA.

Mr. C. J. Snyder, of the Omaha Electric Light & Power Company, in a paper before the Nebraska Electrical Asssociation convention at Lincoln in April, told of some of the successful new-business methods used in Omaha. He said that the solicitors in Omaha divide their attention between new and old houses. The wiring of new houses is so generally taken as a matter of course that this part of the work is easy. More effort is required to secure the wiring of old houses. The company has been very successful in that respect, however.

In 1909 1000 old houses were wired and in 1910 1227. In working for this business solicitors always take houses on existing service lines. One of the street-car "ads" which have been most effective in securing the business of wiring old residences was shown, the wording of this advertisement being:

"1227 OLD HOUSES WIRED LAST YEAR. WHY NOT YOURS?"

He then outlined the arguments used by solicitors in displacing steam and gas engines with electric motors. Heating appliances and rectifiers used for automobile charging are considered as non-peak load and, not being figured with the connected load, come on the secondary portion of the bill at a low rate. The company uses street-car and newspaper advertising liberally as it has but a small showroom in which to make a display. Small repairs are made free on electric irons. As a competitor the crude-oil engine has shown itself very economical, but it requires a special operator, and 20 per cent maintenance and depreciation should be figured off each year.

DISCUSSION.

Mr. B. C. Adams, of Lincoln, said that the advertising of the Omaha company in Omaha papers helped all of the electric-lighting companies in the State by advertising electric service in a general way, because the Omaha papers circulate in all the small towns.

Mr. C. C. Smith, of Exeter, Neb., told of methods used in his town, where boys were sent out with push cars delivering electric irons for free trial. He invited the business men to a dinner and proposed a decorative street-lighting scheme. This was carried out with small-candle-power tungsten lamps connected in series multiple as in sign work. The effect was very pleasing. A number of connections had been made specally for operation of electric fans in sick-rooms. He had promulgated the idea that the housewife is more entitled to an electric fan in working about the kitchen than is the business man in the office, with the result that business men had to take their fans home and buy others for the office.

Mr. S. G. Peticolas, of the Westinghouse Electric & Manufacturing Company, Omaha, said that manufacturers are now training men to help central-station men in getting the more important motor business. One company has collected a large amount of data on different motor installations for aid in getting this business.

Mr. B. C. Adams, of Lincoln, said that the small tungsten lamps of low voltage had opened up a new field in sign and decorative lighting, especially in smaller towns and with storekeepers of small means. He cited an interesting case at O'Neil, Neb., where, because of the street being lighted up from the depot to the hotel, the hotel manager noticed such a falling off in bus traffic that he had about concluded to discontinue the bus.

Mr. J. G. Boyd pointed out that there is not only a 5-watt tungsten sign lamp now available, but a 2.5-watt lamp.

CENSUS TABULATING MACHINES FOR STUDYING CUSTOMERS' ACCOUNTS AT ST. LOUIS.

The Union Electric Light & Power Company, St. Louis, has been engaged in making a study of its customers' accounts, investigating the individual and aggregate incomes from various classes of service and the desirability of each kind of business. To aid in studying the thousands of items involved in the monthly bills of its 28,000 customers use has been made of the census type of tabulating machines developed first for the use of the bureau at Washington and employed later for various accounting purposes. With these machines, as will be fully described further on, cards are punched with perforations corresponding to certain data of the customer's monthly bill, and these cards are then electrically separated and finally counted by contact needles in the tabulating machines.

The form of card used is shown in Fig. 1. The first column represents sections of the city, which are further districted by the numbers in the next column. The narrow numbered column gives the months of the year. Street names in the districts are indicated by combinations of letters, and numbered streets by the figures in the next column. The capital letters A to G in this column are used to designate flats or apartments in the same building. The following column shows the house number and the column headed "Class Number" indicates in which one of 250 classifications of businesses the customer is engaged. There are 100 lighting classifications and 150 motor classes, power customers being classed according to the uses of their motors—sewing machines, elevators, etc. The next narrow column shows the kind of energy and the purpose for which it is used.

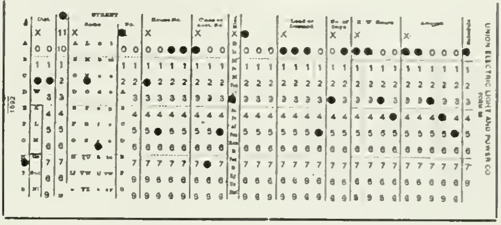


Fig. 1—Tabulating Card Punched for Customer's Electrical Consumption.

An extra three-figure column following this has been provided for any purpose that may be desired later, such as the account number, demand, net average rate per kw-hour, or other data. The customers' ledger cards of the Union Electric Company are filed in geographical or street order, instead of by account numbers, so that it becomes very easy to find any account from a card by referring to the street location. The column headed "Load or Demand" has been used for total connected load, as the company has no maximum-demand meter installed and had no way of arriving at these data. "No. of Days" refers to the interval between two consecutive meter readings, "Kw-hours" represents the monthly consumption, and the last wide column gives the amount of the monthly bill.

The schedule of rates under which the customer obtains his service is shown by the extreme right-hand single-figure column. Where a column group contains no numerical data a single perforation is made over the X at the top, causing the card to be distributed into a special box.

The card shown in Fig. 1 was punched for the December bill of a small grocery store having an installation of ten 16-cp lamps. Beginning at the left, the information punched on the card is as follows: Section H, District 22, of city. December bill (12th month). North Grand Avenue (Ng). House number 2500. Classification number 75, denoting grocery. Kind of service, alternating-current lighting. Blank column. Connected load, 0.5 kw. Days' interval between meter readings, 30. Kw-hours consumed, 34. Amount of bill, $3.45. Rate schedule, Standard.

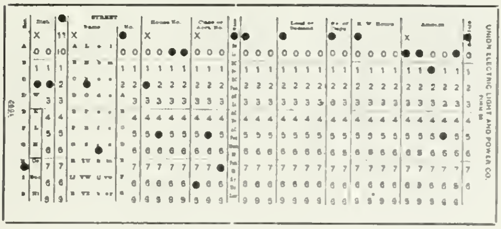


Fig. 2—Card Punched for Same Customer's Sundry Account.

The card in Fig. 2 was punched for a small sundry charge to the same customer. The left-hand side of the card is perforated as before, but the classification number gives way to an account number, 857, indicating the character of the purchase, in this case lamps. All the remaining columns are cleared by punching over the X marks at the top of the columns, except in the case of the amount of the purchase of the lamps, $2.50.

The customers' monthly cards are perforated in a special punching machine arranged with keys like a typewriter and having an automatic spacing device for advancing the card, column by column, as each column is punched. For punching a number of cards in the same district of the city a gang punch is provided in which the dies can be set permanently and as many cards as desired perforated alike, with section, district, month and street, without the tedium of locating each separate punch-hole.

After the cards are punched they are taken to the Hollerith sorter, shown at the left in Fig. 3. This is an electrically controlled motor-driven machine which can distribute 200 cards per minute into eleven different classifications. The sorting is done by an electrically charged needle, under which passes the column for which the card is to be sorted. On reaching the punch hole the needle makes contact through it with a brass roller beneath, closing an electric circuit which opens the assorting slot corresponding to the distance the card had moved before the needle reached the hole. Into this slot the card is carried, being delivered into the corresponding box by a belt carrier. The assorting needle is on a movable slide carriage, and can be adjusted to cover any column. For example, the first sorting is usually done with respect to class of service. The needle would then be set opposite the column marked "Elec," and when the card shown had passed seven-tenths of the way through the sorting mechanism the needle would make contact with the brass roller, opening the seventh slot, into which the card would fall, to be delivered into the box with all the other cards punched for "AC lighting." If it is next desired to divide these alternating-current lighting customers among the 100 classifications of business, the cards from the "AC lighting" box would be run through the sorter again, with the needle set first opposite the units column in the "Class" division. Our grocer's card would then come out in the "5" box, with the cards of a number of other businesses whose designation number ended in 5. These "5" cards would then be sorted for the tens column, our grocer's card appearing in the "7" box with those of all the other grocers using alternating-current lighting. A little consideration will show that considerable time is saved by sorting from the units side of the numbers first.

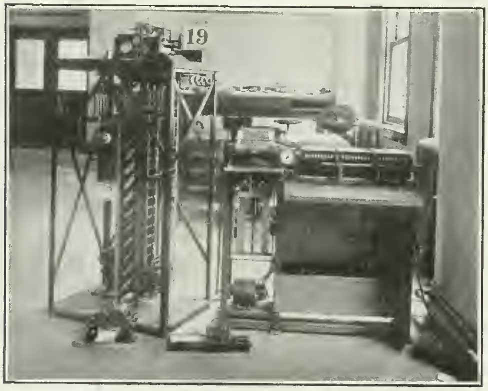


Fig. 3—Sorting Machine, Tabulating Machine and Punches.

If it is now desired to find the total or average, connected loads, consumptions or monthly bills of this class of service, these alternating-current-lighting grocers' cards are taken to the tabulating machine, shown at the right in the illustration. This machine counts and adds three separate four-figure sums on the cards at the rate of 150 a minute. Contact needles similar to those in the distributor are employed in the tabulator, closing circuits to the contact cylinders beneath, as they penetrate each hole. The distance to which the card has just passed before making these contacts controls the figure which is counted on the registering dials in each case. There is, of course, one needle for each place in each of the columns to be added, and the counters are arranged with carrying attachments so that each rotation of a counter moves the next counter up one place. The tabulator used by the Union Electric company is arranged to add in separate sums the columns denoting connected loads, monthly consumption and amount of customers' bills. As each card passes through the tabulator it is counted by a register, enabling class averages to be deduced quickly by dividing sums total by the number of customers.

By the use of these tabulating machines the St. Louis company has obtained some interesting information about the average income from the various classes of customers it serves. For example, the results of the investigation show that the consumers living in the fashionable apartment buildings are nearly as good customers as those in private dwellings, while the per-customer consumption in flats, or the lower class of apartments, is less than that of either of the preceding classes. The average connected loads for these three classes of customers are as follows: Flats, 16 lamps; apartments, 20 lamps, and dwellings, 32 lamps. The average hours' use of the connected load of residence lighting customers in St. Louis varies from 0.36 hour per day in summer to 1.2 hours in midwinter, maintaining an average of 1.2 hours per day for the entire year.

In the table printed above is given a compilation of some of the data secured with the aid of the Hollerith tabulating machines in St. Louis.

AVERAGE CONNECTED LOAD AND HOURS' USE OF PART OF ST. LOUIS LIGHTING CUSTOMERS.

CLASS OF BUSINESS.	NUMBER OF CUSTOMERS STUDIED.		AVERAGE CONNECTED LOAD IN KILOWATTS.		AVERAGE HOURS USE OF CONNECTED LOAD PER MONTH.	
	Alternating Current.	Direct Current.	Alternating Current.	Direct Current.	Alternating Current.	Direct Current
Residence.						
Apartments	1,632	...	1.	...	24.2	...
Flats	6,166	...	.8	...	20.5	...
Houses	7,155	...	1.6	...	20.6	...
Commercial.						
Banks	12	11	1.7	16.8	55.5	87.8
Billboards	6	10	1.6	14.7	157.7	105.5
Billiards, pool, bowling	84	35	1.5	2.0	97.9	185.8
Churches	177	8	6.4	9.4	12.8	18.1
Clubs	92	13	5.5	7.9	53.3	131.4
Commission houses	24	129	.7	1.6	58.7	70.4
Charitable institutions	18	5	3.9	1.2	27.0	65.3
Engravers and printers	28	126	.7	2.6	42.8	75.8
Garages (public)	47	5	2.5	3.2	121.6	118.5
Hospitals	24	6	6.1	2.8	45.0	104.1
Hotels over 7.5-kw	11	14	15.7	28.3	116.5	200.1
Hotels under 7.5-kw	53	160	1.8	1.6	95.0	137.7
Market booths	4	40	.5	1.1	57.5	132.2
Factories	290	319	2.9	2.9	32.6	66.5
Machine shops	16	15	1.1	1.1	30.8	48.8
Offices, business	179	257	1.7	1.5	48.3	72.4
Offices, professional	218	63	.7	.8	34.1	79.8
Offices, feed, coal, ice	96	5	1.0	1.5	57.2	108.6
Picture shows	95	39	7.2	11.7	60.2	119.9
Photographers	35	23	1.6	1.2	32.9	82.6
Restaurants	108	165	.7	1.5	181.0	244.6
Saloons	739	319	.8	1.2	140.9	193.2
Bakeries	143	19	1.6	1.4	87.5	142.5
Barbers	161	80	.5	.7	62.4	109.4
Tailors	105	68	.8	1.4	52.5	122.5
Cigar stores	32	62	.7	1.2	63.8	129.3
Clothing stores	30	62	2.2	7.3	56.5	131.2
Coffee stores	25	15	.8	1.0	53.4	94.9
Drug stores	319	53	1.0	1.9	126.3	209.2
Dry-goods stores	262	34	1.4	2.2	72.0	84.4
Florists' stores	41	12	1.0	1.2	56.6	97.0
Furniture stores	66	27	3.2	20.0	35.6	69.8
Grocery stores	405	44	.9	2.4	72.9	142.3
Jewelry stores	64	56	.8	2.8	69.8	124.8
Meat markets	230	13	.8	1.0	63.6	73.5
Shoe stores	143	56	.7	2.2	59.3	143.8
Theatres (season)	5	8	72.1	74.4	45.5	94.6
Warehouses	56	45	1.6	4.4	43.6	61.9
Wholesale houses	11	82	3.6	9.3	107.7	77.1

The task of securing this customer's account information with the tabulating machine, including compiling data for study of the company's income and comparison of its rates and costs with those obtaining in other cities, is being carried out by a special staff of clerks under the direction of Mr. C. E. Brenton, auditor of the Union Electric Light & Power Company, and is in charge of Mr. H. G. Kislingbury.

STREET ILLUMINATION DISCUSSION AT NEBRASKA CONVENTION.

Mr. C. M. Axford, of the General Electric Company, Kansas City, Mo., read a paper before the Nebraska Electrical Association convention at Lincoln in April which provoked a fruitful discussion on the subject of special street illumination. Mr. Axford first called attention to the reduced cost of operating electric signs with low-voltage tungsten lamps as compared with the former sign lamps. The possibilities of sign and outline lighting in small towns are thus much increased. He suggested that when the main business street has considerable illumination of various kinds on it the company work to get outline or sign lighting on large buildings a little to one side of the regular business center and thus help create another center. By illumination at night it is possible to make one building stand out from its surroundings like a mansion amid a lot of small buildings in the daytime.

The movement for ornamental street lighting, he said, in a majority of cities has been taken up by the merchants with the co-operation of the city officials and the lighting company. The question of glare should be considered, and glare can be avoided by the use of diffusing glassware and proper placing of lamps. A handsomely lighted thoroughfare, Mr. Axford said, creates a good, lasting impression on visitors to a city. He then took up the possibility of confusing ornamental street lamps with sign and window lighting. To avoid this he suggested that all electric signs be placed high.

DISCUSSION.

Mr. R. E. Burger, general manager of the Fremont Gas & Electric Company, said that some central-station managers have opposed ornamental street lighting of this kind because it discourages electrical advertising in the shape of signs and window displays. The Commercial Club at Fremont had recently taken up the question of ornamental street lighting with the idea of having the municipal electric-light plant supply the energy. Agitation of this matter brought up an ordinance compelling companies to take all poles and wires off the street. For these two reasons he was not very enthusiastic about ornamental street lighting.

Mr. F. H. Brooks, of Lincoln, said that the plan of going around with a subscription list to get merchants to subscribe to a scheme for ornamental lighting meant non-uniformity and a failure to get a continuous line of posts down a street. He suggested that the best way of handling these matters in the future would be by means of a state law which would provide that if the majority of the property owners along a street petition the Council for special ornamental street lighting the whole street shall be assessed for the first cost of the installation. He said that such a law is in force in California, where much special lighting of this kind is done.

Mr. J. E. Schuff, of Lincoln, said that at Lincoln before the ornamental post lighting system was started the merchants had a prevalent idea that this lighting would do away with all necessity for window lighting. There were eight poles to the block with five lamps per post. The blocks are 300 ft. long from property line to property line. Now that the system had been tried in sections, all were satisfied that it would not light the windows.

Mr. J. R. Cravath, of Chicago, said that the general effect of an ornamental street-lighting system could not fail to make necessary increased lighting in the windows if any change at all were required. More light in the windows would be necessary to make the windows appear well lighted in contrast to the sidewalk, and there would certainly be no reduction in window lighting.

Mr. E. V. Capps recited his experience at Beatrice, where about 75 per cent of the merchants were in favor of ornamental post lighting, and a contract was practically assured when the proposition came up of taking all the wires off the street. This dampened his enthusiasm decidedly.

Mr. Joel Roberts, of York, thought that ornamental street lighting would increase the amount of window lighting.

Mr. C. C. Smith suggested that at Geneva, Neb., the plan had been adopted of putting brackets on the fronts of the business houses, instead of ornamental posts. Each bracket contains a 60-watt tungsten lamp. This was done through the efforts of the Commercial Club, which guaranteed the payment of the operating expense to the company. The wires are run along the fronts of the stores in a very inconspicuous manner, so that they would not be noticed unless one were looking for them.

Mr. L. J. Schwingel, of Holdrege, said that his company is making ornamental lamp-posts of cement. These posts carry three lamps and the cost of the cement post is about 75 per cent of that for an ornamental iron post of similar appearance.

Wiring and Illumination

2.5-WATT SIGN LAMPS IN ST. LOUIS.

About 2000 2.5-watt 2-cp tungsten sign lamps are now in use on various signs maintained by a local sign company in St. Louis. The first application of these lamps was made in the case of a small sign in which the 5-watt tungsten lamps produced objectionable glare, making it difficult to read the letters at a distance. The customer objected to this glare and as an experiment the smaller lamps were tried, with success. Although he was not aware of the progress of the experiment, which was one of the first practical trials of the small units to be made, the owner expressed himself as gratified that the difficulty had been corrected. The 2.5-watt lamps have since been used in several small and low-hanging displays. The performance of the 2.5-watt lamps in St. Louis has recorded practically the same life and renewals as those of the 5-watt units.

ORNAMENTAL LIGHTING SYSTEMS AT SPRINGFIELD, MO.

Springfield, Mo., a city of 36,000 population, has a variety of ornamental street-lighting systems in various parts of town, including tungsten curb posts, arches, brackets and flaming-arc lamps, affording the local officials an opportunity to compare the several schemes.

In one block eight flaming-arc lamps are suspended at 75-ft. distances over the center of the street. This installation cost 40 cents per curb-foot to erect, not including the poles, the regular line poles being used. The lamps cost 50 cents per curb-foot per year to operate.

Five blocks are equipped with a combined bracket and arc-lighting scheme, using incandescent units. On poles at 75-ft. intervals iron brackets extending 3 ft. from the poles, at a height of 10 ft., support downward-pointing 60-watt tungsten lamps inclosed in 10-in. frosted globes. There are seventy of these bracket lamps. Suspended across the street between the poles are fifteen-lamp stands of 8-cp lamps, the catenary hangers being arranged to form an arch of the lamps, 20 ft. high at the center. This construction is reported by Mr. N. J. Cunningham, secretary and treasurer of the Springfield Gas & Electric Company, to have cost 25 cents per curb-foot for wire, lamps and labor.

Along other blocks in the city curb post lighting is employed. The posts are set at 50-ft. intervals, 125 five-lamp posts being used at the corners and 250 three-lamp posts along the curbs in the blocks. These posts carry 1375 40-watt tungsten lamps inclosed in 10-in. alabaster globes, the top lamps pointing upward and the side lamps downward. The cables are run in lead sheaths. The construction of this special curb lighting cost $1,25 per curb foot. Records kept during 1910 show that the average lamp life was 720 hours and that approximately 12 per cent of the globes had to be replaced. The system is overhauled several times a year and the lamps and globes are replaced and thoroughly cleaned.

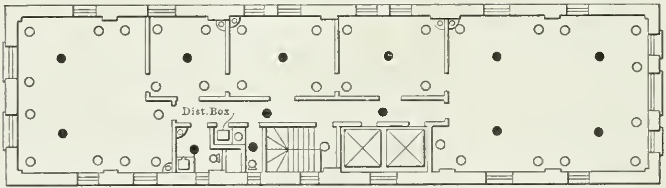
THE WIRING OF A MODERN OFFICE BUILDING.

By J. P. Morrissey.

Standing in its slender form among the monster buildings on the east side of Madison Square, New York City, is the Pullman Building at 17 Madison Avenue. It is 25 ft. wide, 100 ft. deep and sixteen stories high. In its circle it stands out prominently because of its size compared to the surrounding structures. It is a high-grade fireproof office building and has two fast passenger elevators, capable of lifting 2500 lb. at the rate of 400 ft. per minute and equipped to lift 6000 lb. at 100 ft. per minute. The elevator machines are of the electric traction type and are located on the roof. They were manufactured and installed by the A. B. See Electric Elevator Company.

The energy is taken from the mains of the New York Edison Company to a service board in the boiler-room, thence it is carried to the main switchboard and from there to the distribution boxes, to the outlets and to the motors. The service is divided by means of fuse posts and busbars on the service board, and from this board motor and lamp feeders are run to the main switchboard. These feeders are run in conduit exposed on the basement ceiling. The division of lamps and motor circuits at this point eliminates the possibility of the starting of motors from affecting the light due to the heavy starting loads on the motor feeders.

The switchboard is situated in a room just in the rear of the boilers. This room has been set aside for the switchboard, house pump and section tank and is just large enough to accommodate them. From the switchboard a three-wire lamp feeder is run to a center of distribution on the eighth floor, where it splits into two sections, one going up to the sixteenth floor, looping through the office lighting section in each panel on each and every floor from the eighth floor up, and the other section going down to the second floor, looping through the office-lighting section on each panel on each floor from the seventh floor down.



● = Ceiling Fixture Outlet
○ = " Receptacle "

Arrangement of Lighting Outlets.

Another three-wire feeder runs from the switchboard to the riser shaft, thence up to a center of distribution and feeds in the same manner described for the office lamps. This feeder is for the lamps in the public halls and toilets from the second floor to the roof inclusive. A three-wire feeder is run from the switchboard to a distribution box in the store on the first floor for the lamps in the store and basement.

A three-wire feeder is run from the switchboard up to a switch on the stair landing on the eighth floor for the stair lamps, where it divides; one outside leg with a neutral tap is run up to the roof, inclusive, connecting to a lock switch at each floor landing. The other outside leg with a neutral tap runs down to the second floor, inclusive, connecting to a lock switch at each floor landing. These lock switches control lamp-receptacle outlets on each stair landing. A motor feeder is run from the switchboard up the riser shaft to a motor panel on the roof. From this panel the sub-feeders are run to the elevator machine-control boards and the motor generators for the signal system.

The branch circuits for owners' lamps in the basement and first-floor halls are run from the switchboard to the outlets and respective switches. In the basement a motor feeder is run to the switch for the house pump.

From the switchboard a two-wire branch is run to a lock switch in the first-floor entrance hall and from there it runs up to an outlet at the ninth floor in the elevator shaft to which are connected the traveling cables for supplying energy to lamps in the elevator cars.

The service board is located at an accessible point in the boiler-room. The board is made of slate and has mounted upon it a three-pole service switch, proper busbars and fuse posts to divide the service as hereinbefore mentioned for lamps and motors. The board is inclosed in a hard-wood cabinet properly lined.

The space in the room in which the switchboard is located is limited, but the switchboard was designed for the location. The board is made of panels of 1½-in. polished marbleized slate mounted on an angle-iron frame which is embedded in the floor and braced against the wall. Mounted on the face of the board are switches and fuses for controlling the energy in each feeder and branch circuit. Switches are also provided for further use for both lamps and motors. All switches and meter connections are finished in polished copper. Provision has been made for back-connected meters and all energy is metered on the switchboard. Each switch and meter has an engraved polished copper nameplate. The switches are three-pole for lamp and two-pole for motor circuits and are so connected that the fuses are dead when the switches are open. The arrangement of the rear of the board is very unique. No wiring is done on the rear of the board. The service feeders are connected to lugs that are attached to their respective busbars and these are run to the meters and switches. The busbar work is all done near the back of the slate panels. From the switch lugs to a point at the top of the rear of the board rolled-copper rods are run from each section of each switch. At the top ends of these rods connectors are used so that the feeder cables and branches may be connected to these rods. These rods are covered for their entire length with circular loom and they are held in place by a perforated slate slab at the top of the board. This rod arrangement is found to be very good, because in case of rearrangement of busbars or changes they can readily be removed and replaced. Above the switchboard a pull box has been installed. This is made of sheet iron and painted. The feeders and branch circuit conduits come into the sides and top of this box. All the crossing of cables and wire has been done in this box and the front half of the bottom section has been drilled so that the feeder cables and wires come down to their respective lugs in a vertical position. The rear bottom half and the front sections are removable so as to give access to the inside of the box. The bottom of this box is only 1 ft. above the top of the connections, so the cables and wires are covered with circular loom from the bottom of the box to the top of the connectors on the top of the rods. From the pull box conduits are run for the feeders and branch circuits, as hereinbefore described.

The conduit used in this installation is the black-enameled loricated kind called "Richmond." The branch circuit conduit is run from the distribution boxes to the local switches, thence to the ceiling outlet boxes and from distribution boxes to ceiling receptacle outlet boxes, looping through until the arrangement that has been designed has been connected.

The fixture hangers used are what are called "McKnight" hangers. These are made up of two bands of iron 1 in. x 3/16 in. and 12 in. to 16 in. long. The bands are riveted to a threaded ½-in. nipple that is slotted at the top end to admit the bands where they are riveted.

To locate properly the electric lamp outlets and their controlling switches to suit the different arrangements of office furniture and partitions is a difficult problem. No two business interests have the same office arrangement. Of course, new outlets could be located after the furniture has been placed in position, but the work is most unsightly and unsatisfactory, because it would have to be done exposed. A very simple arrangement of outlets has been thought out for the offices. The architect had made his plans with the arrangement of office and other possible arrangement of partitions to suit the tenants. In each office a ceiling outlet was placed for a fixture and this was controlled by a local switch located on the outside wall. The locating of the switches on these outside walls kept all conduits out of partitions, thereby lessening the expense of any changes in the removal of partitions.

Properly located according to all arrangement of partitions are ceiling receptacles. These are installed so the brass faceplate comes flush with the finished plaster. From these receptacles drop cords and special fixtures with screw attachment plugs can be installed. They are so located that it is practically impossible to locate office equipment and have no provision for lamp extensions.

In the boiler-room, coalroom, pumproom and other machinery rooms in the basement and on the roof ceiling receptacles have been installed. In each receptacle a drop cord has been provided made up of a screw attachment plug, 8 ft. of reinforced cord and an "Edison" lamp key socket.

The local switches that are used throughout the building are of the "Metropolitan" detachable pattern. In the offices and toilet-rooms they are of the push type and on the stairs and in the entrance hall they are of the lock type.

There is a public hall on each floor and the lighting outlets are controlled individually from the panel board on the floor. The panel boards are located in the porter's closet on each floor. These panels are installed in a distribution box made of sheet iron thoroughly painted before they were installed. The boxes are made so that when the panels are installed there is a 3-in. gutter on both sides, top and bottom, in which are run the feeder cables and branch circuit wires. The panels are made of 1-in. polished marbleized slate.

Each panel has two sections, one for circuits for the offices and one for circuits for public halls and toilets. The busbars are arranged on the panel so that the feeders connect to lugs at each end, thereby feeding through. The branch circuits are controlled by knife switches connected to the busbars on both sides. The switches are so arranged that the fuses are dead when the switches are open. A fireproofed wood trim and door has been installed on each distribution box, the trim covering the gutter space and the door opening so as to expose only the panel board. On each door a small directory has been placed inside of a copper-finished frame with a plate glass covering it. The directory is made up in the shape of a plan on a small scale and has the outlets located on it and the number of the switch controlling the outlet is marked at the outlet location on the plan.

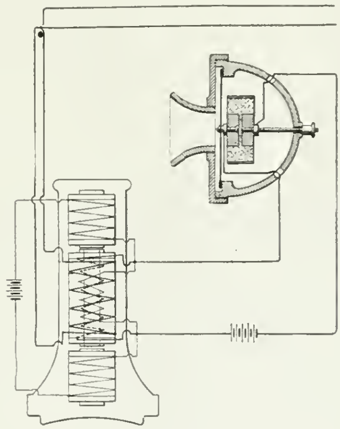
The wire used throughout the building is "Habershaw Redcore." All feeders are designed so that the loss will not be greater than 3 per cent between the switchboard and any lamp at full load.

A house pump has been installed to pump water to the tank on the roof from the tank in the basement. This pump is automatically operated by tank switches, one in the basement tank and the other in the tank on the roof. The tank switches are so arranged that the pump will not work unless the basement tank is nearly full and the roof tank half full. These tank switches work in series so that the pump cannot operate if there is not enough water in the basement tank or there is enough water in the roof tank. The building was designed and the construction supervised by Mr. William H. Gompert, architect; Pattison Brothers were the consulting engineers; Chas. A. Cowen & Company were the builders, and the Porsth Electric Company were the electrical contractors.

RECENT TELEPHONE PATENTS.

ELECTROMAGNETIC RECEIVER.

As usually conceived the electromagnetic receiver merely omits the usual polarizing permanent magnet, having instead a polarizing winding. The receiver brought out by Mr. W. C. Lockwood, of San Juan, Porto Rico, is of more elaborate design, as it includes in addition the induction coil. The accompanying cut shows the arrangement. The usual receiver diaphragm, not shown in the cut, is placed behind the earpiece in the field of the magnet. It will be seen that the transmitter is included in the circuit of both batteries, directly in one and as a shunt of the other. The middle winding is the induction-coil primary, the end windings are polarizing coils, while the heavy line shows the induction-coil secondary.


Lockwood Telephone.

REPEATER.

There have been a number of plans for using a high-frequency generator as relay or repeater for telephone circuits. The generator is of the inductor type. Two windings are provided, each in inductive relation to the inductor but not in inductive relation to each other save through the inductor One set of windings is connected to each line section. If the inductor is revolved and telephone waves be impressed upon one winding the currents set up in the inductor will in turn cause a new and stronger current to be set up in the second winding.

SWITCHBOARD CIRCUIT SYSTEM

In a patent granted to Mr. A. H. Dyson, of Chicago, is described a circuit system for common-battery switchboards. One relay serves to control both line and supervisory lamps. This relay serves as part of the battery-feed circuit. The line-lamp circuit is closed through the front contact of the relay The lamp is of lower voltage than the battery so that a controlling resistance is included in the circuit. When a plug is inserted in an answering jack the supervisory lamp is put in parallel with the line lamp, both in circuit with the controlling resistance. Under this condition neither lamp receives sufficient current to glow. When the relay falls back the line lamp is left on open circuit and the control resistance is partially shunted out through a relay back contact. This patent is assigned to the Western Electric Company.

LETTER TO THE EDITOR.

The Introduction of "Deceleration."

To the Editor of Electrical World:

Sir:—For some time past a controversy has been in progress in the *Proceedings* of the American Institute of Electrical Engineers concerning the propriety of the verb "decelerate" and its attendant noun "deceleration." As sponsor for these words we find no less a person than Dr. Steinmetz, while the chief opponent of their use is Mr. C. O. Mailloux. In the *Proceedings* for March, 1911, Dr. Steinmetz sums up his argument in the form of a syllogism:

"1. It is permissible to add to a living language by the formation of new terms if these terms are needed and are correctly formed.

"2. The verb 'decelerate' is needed, and with it the noun 'deceleration.'

"3. It is derived correctly in accordance with the usage of the Latin language."

In the April number of the *Proceedings* is Mr. Mailloux's rejoiner, which may be summarized as follows:

1. Admitted.
2. Denied, since "retard" and "retardation" are adequate for all the purposes to which the new words might be applied.
3. Denied, both on philological and on literary grounds.

Though making no pretense of being a Latinist, it is in connection with this second minor premise of Dr. Steinmetz's that I beg the privilege of saying a few words. Dr. Steinmetz seems to find an analogy between "scando," "ascendo," "descendo" and "celero," accelero," "decelero." As Mr. Mailloux points out, this last word does not exist in Latin. The prefixes "ad" and "de" when applied to "scando" are prepositional in their character and add a directional idea to the main idea of the verb, but "ad" applied to "celero" is merely intensive and adds no new idea. Hence we do not find, and should not expect to find, "decelero." Dr. Steinmetz's analogy is not only incomplete, but it is absolutely misleading.

Of course, there is nothing to prevent scientists from coining and using words which violate the fundamental principles of philology, but it seems to me that the question is a more fundamental one than that of mere expediency. Our scientific and professional nomenclatures are in a sufficiently confused state as it is, and the introduction of such words as these, which I believe to be absolutely incorrect, but concerning whose legitimacy there is, at least, a reasonable doubt, does not tend to clarify matters. The establishment of a unity of convention among the various sciences would be a step toward the unification of all knowledge to which every thoughtful man must look as to an ultimate good, and the deliberate adoption of technical terms which have not the most complete philological justification postpones rather than promotes the attainment of such unity.

Brooklyn, N. Y. William J. Berry.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

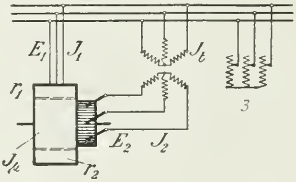


Fig. 1—Connections of Self-Exciting Three-Phase Commutator Generator.

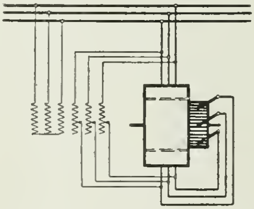


Fig. 2—Modification of Connections of Fig. 1.

Self-Exciting Three-Phase Commutator Generators.—R. Ruedenberg.—The author discusses the behavior of a self-exciting three-phase commutator generator when carrying a purely inductive load. The arrangement is shown in Fig. 1. The stator and rotor circuits, which are indicated by the indices 1 and 2 respectively, are connected with each other through an external regulating transformer which permits one to vary at will the amplitude and phase of the secondary voltage. When the machine is not loaded the adjustment of the regulating transformer determines the frequency of the current and the voltage. The generator may then be connected to an inductance coil 3, which takes wattless current from the generator. By adjusting the inductance coil, the wattless currents supplied by the generator can be varied. With the aid of diagrams the author gives the formulas which determine the behavior of the machine when the external inductance coil is adjusted. He shows especially that this method affords a simple means of reducing the synchronous voltage of the generator to much smaller values than is possible by regulating the self-excitation alone. Tests with such a generator showed that simply by connecting it with a properly dimensioned induction coil the synchronous voltage could be reduced below 5 per cent of its normal value without impairing the stability of running. When the induction coil was disconnected the voltage rose again to its former value. If in the operation of commutator generators it is desired to get simultaneously a variation of voltage and a variation of frequency, it is possible to do this with the same regulating transformer, in which the iron saturation must then be sufficiently high. If, for instance, the rotor and stator are connected in series (Fig. 2) so that the synchronous voltage is impressed on the network, the regulating transformer can be connected between network and stator as indicated. By varying its transformation ratio, with respect both to value and phase, the frequency of the generated three-phase currents is regulated. If the transformation ratio is varied in such a way that the number of turns connected to the stator is reduced, the voltage of the network also decreases. The voltage decreases about in the same proportion as the frequency; with the connections of Fig. 2 the frequency is proportional to the number of transformer turns connected to the stator. Such a generator would, therefore, be suitable for the operation of induction motors at variable speed. The author remarks that the same method of reducing the self-exciting voltage can also be used for direct-current machines, for instance for operation of the Ward Leonard drive. Of course, the induction coil with saturated iron must be connected to such a circuit from which a magnetizing current can be taken, which is not directly possible with pure direct current. But if the direct-current generator is equipped with slip rings, as shown in Fig. 3, and the adjustable induction coil is connected to these, the direct-current voltage can be reduced at will. The author finally shows how it is possible to regulate the frequency of a self-exciting three-phase commutator generator while maintaining the synchronous emf and the field constant.—*Elek. u. Masch.* (Vienna), April 9.

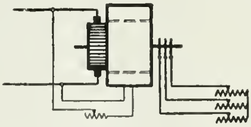


Fig. 3—Method of Reducing the Voltage of Direct-Current Machines.

Mercury-Vapor Rectifier.—An illustrated description of a new mercury-vapor rectifier by Hartmann and Braun for high outputs. The methods by which an increase in output has become possible are described, especially the means of maintaining the vacuum, and some data are given on a converter consisting of two mercury-vapor lamps which furnished a rectified secondary current of 300 amp at 230 volts.—*L'Industrie Elec.*, March 25.

Magnetization Curve.—F. Rusch.—A mathematical paper in which the author describes a simple method and illustrates it with a numerical example for determining the magnetization curve, giving E as a function of the magnetizing current, for the case that the magnetizing winding is distributed in various slots per pole.—*Elek. Zeit.*, March 30.

Circular Diagram of Induction Motor.—R. Silberberg.—The author describes a simple method which permits one to plot in a few minutes the exact and complete Ossanna circular diagram of the induction motor.—*Elek. Zeit.*, March 30.

Lamps and Lighting.

Efficiency of Metallic-Filament Lamps.—R. A. Houstoun.—A paper read before the Royal Society of Edinburgh. If $Q =$ total electrical energy consumed per second, R the total energy radiated per second and L the total luminous energy radiated per second, then he makes the following definitions: $L/Q =$ luminous efficiency; $L/R =$ radiant efficiency of the lamp. For the purpose of defining L, it is usual to take 760 $\mu\mu$ as the upper limit of the visible spectrum. The lower limit is immaterial, as there is little energy in the violet and ultra-violet spectrum of glow-lamps. The luminous efficiency does not measure the commercial value of a lamp, because the eye is very much more sensitive to green than to red light; for example, it is possible for one lamp to have much more energy in its spectrum than a second one, but yet to have that energy so disadvantageously distributed that the second produces a stronger effect on the eye. For determining the radiation efficiency the author employs the following method: The radiation was first measured in the usual way by a thermopile and galvanometer with and without a 1-cm thick water filter, and the percentage of total radiation transmitted through the filter was determined. In this case the radiation from the whole lamp was received by the thermopile. A straight part of the filament of average brightness was then focused by an achromatic glass lens on the slit of a spectrometer with glass prism which was furnished with a Rubens linear thermopile in place of the cross-wires. The same water filter was placed in front of the slit and an energy curve of the filament was taken through the filter. For the region of the spectrum for which water transmits the absorption of light in the glass and the loss of light by reflection at the glass surfaces may be taken as independent of the color. If the prismatic energy curve thus determined be taken and an ordinate set up at the point 760 $\mu\mu$, the area on the side of shorter wave-lengths divided by the whole area gives the fraction of the radiation transmitted by the filter, which is light. It is only necessary now to find what fraction of the incident light is transmitted by the water cell. This was done by measuring the transmission coefficient of the latter when filled with water with a spectrophotometer for four different points in the spectrum. The value found was 0.84. It is somewhat low, as the glass sides of the cell absorbed rather more than usual; it did not vary with the color. The following table shows some of the results obtained:

RADIANT EFFICIENCIES IN PER CENT

Volts	250 Volt Carbon.	250-Volt Carbon.	250-Volt Tungsten.	250-Volt Tungsten
184	1.40	0.72	4.96	5.98
216	1.97	1.48	7.42	9.02
250	3.42	2.42	7.60	9.39
270	3.95	3.43	8.06	9.59

Volts.	130-Volt Tungsten.	130-Volt Tungsten	125 Volt Tantalum	125 Volt Tantalum.
75	1.61	1.69	2.06	3.00
125	6.61	6.43	6.66	6.35
146.5	9.04	8.83	.....	.....
150	....	.....	7.70	9.25

A 50-volt osmium lamp which was also tested gave a percentage efficiency of 2.17 at 30 volts, 3.84 at 45 volts, and 6.52 at 55 volts.—Lond. *Electrician*, April 28.

Exhausting Lamp Bulbs.—A note on a recent British patent (10,870, April 20, 1911) of F. Harrison. In order to exhaust completely the bulbs of incandescent lamps, and particularly those for emfs below 30 volts, red phosphorus or arsenic is inserted in the bulb or on the stem, and the bulb is first exhausted by a pump in the usual way. It is then placed in the electrostatic field or between the terminals of an induction coil or high-tension transformer, so that a bluish glow appears. At the same time a current greater than the normal is passed through the filament, and the phosphorus is heated by a flame until the blue glow disappears, whereupon the lamp is sealed off.—Lond. *Elec. Eng'ing*, April 27.

Generation, Transmission and Distribution.

Battery Economics.—A. M. Taylor.—A paper read before the (Britsh) Institution of Electrical Engineers. The author first deals with the effect of rapid-discharge rates on the amp-hour output and terminal emfs of batteries. The method of discharging large batteries by means of regulating cells has been employed on a considerable scale both in America and in Continental Europe, whereas in Great Britain the tendency has rather been to employ boosters for the discharge. The method employing regulating cells is very simple and reliable, yet it has many disadvantages, especially for rapid rates of discharge, in view of the large number of regulating cells required, the high cost of the regulating switches and the difficulty of maintaining the cells in a healthy condition, as some of them are hardly ever called upon to give a discharge. The author offers suggestions for materially diminishing the cost and inefficiency of booster methods. With a view to emphasizing the extent to which the cost of the boosters may be reduced by a suitable arrangement of boosters and batteries, the author gives, in some detail, an investigation into a particular case in which it is desired to deliver an effective discharge on to the busbars of 2530 kw (at 510 volts) for one hour, or 5140 kw for a quarter of an hour, or 6370 kw for five minutes. Three different methods of obtaining this result are by a battery with regulating cells, by the ordinary booster arrangement of Fig. 4, and the triple series arrangement shown in Fig. 5. The waste of battery amp-hours with the ordinary booster arrangement is very considerable, and in the case of the one-hour rating the author shows that the output of the booster by the third arrangement is reduced by nearly 500 kw-hours. Detailed figures are given for the three systems showing the total cost per effective kilowatt to be $34.30 for the system of regulating cells, $35.70 for the ordinary system of booster with ordinary balancer and $30.50 for the system of triple series parallel booster with static balancer. These figures are for one-hour discharges. The corresponding figures for one-fourth-hour discharges are $20.90, $24.40 and $19.20 respectively, and for five-minute discharges $15.20, $23.55 and $18.70 respectively. In Fig. 6 is shown a diagram of connections for obtaining the "triple series" arrangement of boosters. As shown in the right-hand bottom corner of this diagram, a motor can be employed to drive two double-wound booster armatures, each having two commutators, giving four booster armature windings, which can be coupled in series or parallel; the fourth winding, however, would be used as a reserve. A preferable arrangement, where cost is not a prime consideration, would be to have two separate motors and four single-wound armatures, each under its own field. The author also describes another booster arrangement for a special case and then discusses the increasing use in the United States of batteries as a standby. The author suggests that where batteries are put in on a large scale for lighting purposes it will generally be found preferable to put in those batteries which deal with what may be called "time" peak (as distinct from "instantaneous" peaks), arranged to be operated by hand-regulated boosters; but, since the voltage of a battery alters very considerably with its rate of discharge, it would also seem desirable to have a smaller battery, which might be of the nature of a buffer battery, to take up the "instantaneous" peaks by means of an automatic booster, and so keep the busbar pressure constant, while the main battery would be regulated by hand in such a manner as to enable boilers and engines to be shut down to the maximum possible extent. Finally, the use of storage batteries with alternating current is discussed, and the author offers the following proposals for improving the power-factor in a pure (or mixed) alternating-current system. Referring to Fig. 7, the rotary converter or motor-generator *A* and its battery *C* are used for taking up the peaks of the load in a manner well understood. The second rotary converter, motor-converter or motor-generator *B* is a synchronous machine operated as motor, fed from the alternating-current line and drawing therefrom a leading wattless current sufficient in value to compensate for the lagging wattless currents taken by the consumers' motors. The special feature of the author's proposal is that the rotary converter *B* is enabled to find a useful load for itself by charging the battery *D*, and thus a given kilovolt-ampere motor load can be handled with a much smaller expenditure in synchronous machines than would otherwise be the case. When the evening peak load comes on the charge in the battery *D* is available in assisting the rotary converter *A* to deal with the load; and the motor-generator *B* may be either used to perform phase-changing by itself, or, if not needed for that, is available to assist the motor-generator *A* in dealing with the peak. With respect to H. G. Stott's recent suggestion to provide the extra power by adding exhaust turbines rather than batteries, the author thinks that the turbine scheme has various disadvantages. First, the standby coal required to keep the boilers going through the night will still be required as before. Moreover, the steam units cannot be so economically loaded up at all times of the day and night as by the use of batteries. Another point apparently overlooked is that the scheme introduces the extra equipment at the wrong point; it should be preferably

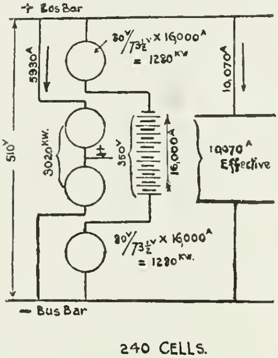


Fig. 4—Diagram of Connections for Ordinary Booster Arrangement.

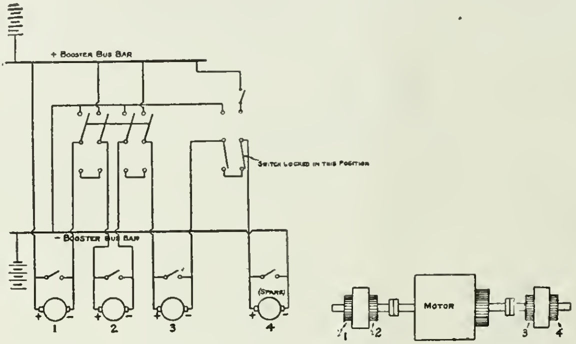


Fig. 6—Diagram of Connections for Triple-Series Arrangement of Boosters.

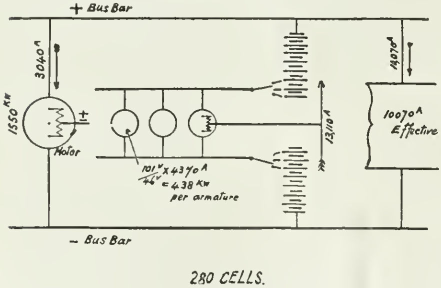


Fig. 5—Diagram of Connections for Triple-Series Arrangement of Boosters.

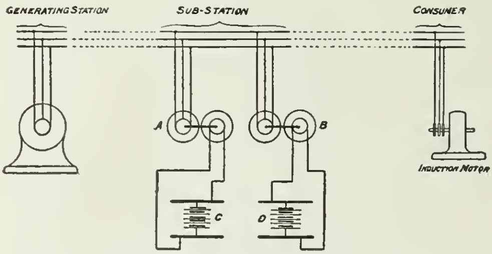


Fig. 7—Arrangement of Rotary Converters for Power-Factor and Load Compensation.

introduced at the substation. The author thinks that for peaks of short duration, say up to two hours, the batteries will be found decidedly the cheaper, and, moreover, a smaller additional staff will be required than with the turbo scheme. The question of power-factor, which must also be considered, is a further inducement toward the use of batteries.—Lond. *Electrician*, April 28.

Swedish Water-Power Plant.—An illustrated description of the Trollhättan power scheme, which makes use of the Trollhättan Falls of the river Göta, which flows from the lake Venern to the sea. The total difference of levels between Lake Venern and the sea is about 144 ft., of which about 105 ft. is actually in the Trollhättan series of falls, and the minimum flow of the river is over 4,000,000 gal. per minute, rising to a maximum value of about 12,000,000 gal. per minute. The enormous storage of Lake Venern, which has a surface of no less than 2150 square miles, can, however, be utilized, so that the total power which could actually be relied upon all the year round reaches the total of 200,000 hp. The water-power rights for the whole river are owned by the state, which commenced in 1906 the construction of a station capable of dealing with some 3,300,000 gal. per minute, corresponding to about 80,000 hp at the turbines. The turbines in the power station are of the horizontal-shaft pattern directly coupled to the generators. The main turbines will be eight in number, each rating at a normal output of 10,000 hp at 187.5 r.p.m., with a net head of 103 ft., but each is capable of developing a maximum output of 12,500 hp. The generators are wound for an emf of from 10,000 volts to 11,000 volts, three-phase, 25 cycles, and a continuous load of 11,000 kva each. They are completely inclosed and are ventilated by air being drawn through the cases from ducts coming under the machine-room floor by fans carried on the rotors. The heated air is expelled into the open air in summer, but can be used in winter for the warming of the various buildings. There are two 350-kw exciting generators, which supply continuous current at from 220 volts to 300 volts. They work in conjunction with a 4000-amp-hour battery. The excitation of the main generators is not controlled, as is usually the case, by series rheostats, but by means of boosters directly coupled to each set which can procure any emf from 110 volts to 220 volts, so that by opposing or aiding the pressure of the continuous-current bars any voltage from 0 to 300 may be applied to the field circuits of the generators. For transmission emfs of either 10,000 volts or 50,000 volts are used.—Lond. *Elec. Eng'ing*, April 20.

Electricity on the Northeast Coast of England.—The third article of this very long and fully illustrated series. In the present instalment the cables and pole lines are discussed. The energy is mainly transmitted by the 20,000-volt trunk system which is now connected to all the principal stations, and at these different feeding points on the system the emf is transformed down for distribution by subsidiary networks. The greater part of the 20,000-volt network is laid underground, paper-insulated, lead-covered cables being employed. There is much overhead distribution in connection with the new mains, but in only two cases are 20,000-volt lines so carried. While the interconnection of the many generating stations and substations affords great security against total failure of supply, it also requires special care to prevent the effects of breakdown in one place from spreading to the rest of the system. The Merz-Price balanced protective gear is employed with great success. The system is based upon the principle that, while normally the amount of current leaving a conductor at one end is equal to that which enters it at the other, as soon as a fault or leak develops this equality disappears. By inserting series transformers at both ends of each core of the cables, and connecting their secondaries in opposition by means of pilot wires with relays in circuit, it is made possible to trip the switches at both ends of the cable when, due to a fault, the balance between the two sets of series transformers is upset and, in consequence, a current flows through the pilot wire. In this way, as a fault affects only the particular pair of series transformers on either side and immediately adjacent to it, causing a current to flow along the pilot wire connecting these transformers, the faulty section is isolated without disturbing any other.—Lond. *Eng'ing*, April 21.

Steam Turbine.—An illustrated description of the impulse steam turbine of the Rateau type built by the British Westinghouse Company.—Lond. *Elec. Eng'ing*, April 20.

Traction.

Speed Indicators for Tramcars.—An abstract of a report of a special committee of the British Tramways and Light Railways Association. The chief conclusions are as follows: There are now on the market speed indicators which, as far as the instruments themselves are concerned, have worked satisfactorily during the tests, although it is not at present possible to state what their life is likely to be when fixed on tramcars. Transmission gears could be made which might withstand for some time the rough conditions met with underneath a tramcar; their first cost and maintenance, however, must be considerable. In view of the first cost and the cost of maintenance of instruments and transmission gear, it would be a serious burden on tramway undertakings to have to equip service cars with indicators. As the proper maintenance of the existing equipment on a car already fully occupies the attention of the staff during the short time available between cars leaving and returning to their sheds, it is most undesirable to add anything more to a car which will require attention, especially if this is not a vital part of the equipment. The electrical form of speed indicator is the cheapest and easiest to fit, but indicators of this type appear unable to withstand the rough conditions of tramway operation. If speed indicators are required at all, they should be fitted only on cars for instruction and test purposes. Except for special test purposes, no speed-recording chart is necessary, and a mileage recorder is not required. No indicator showing the maximum speed attained (by ringing a bell or moving a maximum pointer) is of much value, as the authorized speed varies at different parts of the same route; and, whereas it may be safe to exceed an authorized speed of, say, 16 miles per hour on one part of a route, it may be dangerous on another part of the same route to exceed even 4 miles per hour. Since the most successful form of transmission gear is that in which a belt or chain is driven from one of the car axles, the wear of the wheel will necessitate a constant adjustment of the instrument, otherwise there would be a considerable inaccuracy in the reading of the indicator.—Lond. *Elec. Eng'ing*, April 20.

Single-Phase Supply for Traction in London.—G. W. Partridge.—The first part of an illustrated description of the present installation at the Deptford generating station in London for supplying single-phase energy to the South London line of the Brighton Railway. Specially designed three-phase generators are used, arranged so that they can be employed either for the single-phase supply to the line or for three-phase supply for general distribution. The pressure is kept absolutely constant by means of a Tirrill regulator, in spite of rapid variations in load from 3000 kw to zero, and a simple but effective arrangement of duplicate feeders prevents unnecessary interruptions of supply from momentary short-circuits. Notes on the switchboard, the railway feeders, busbars and the isolating switches are also given.—Lond. *Elec. Eng'ing*, April 27.

Railless Traction.—An illustrated translation of the recent German paper on the railless electric traction system in use in Bremen, Germany.—Lond. *Electrician*, April 28.

Steering Gear.—H. S. Hele-Shaw and F. L. Martineau.—A paper describing a new form of electrically driven steering gear with a new form of hydraulic transmission.—Lond. *Elec Eng'ing*, April 20.

Installations, Systems and Appliances.

German Electrical Industries in 1910.—W. Fellenberg.—A long article giving a great many statistical data on the German electrical industries in 1910. In Greater Berlin the number of workingmen was 29,000 more in 1910 than in 1909, and at least one-half of this increase in workingmen was in the electrical industries. One of the large German electrical firms employs at present 70 per cent men and 30 per cent women. Among the men there are 50 per cent skilled, 30 per cent have gone through an apprenticeship in the works and 20 per cent are unskilled. For the last two classes there is sufficient labor supply in Germany, but it becomes more difficult from year to year to get skilled mechanics and toolmakers. Data are given of the copper, iron, lead, zinc, tin, rubber and platinum markets. Large tables are given of the imports and exports of electrical products. The following figures give an idea of the development of electrical central stations in Germany:

Year.	Number of Stations.	Rating in Million Kilowatts	Connections in Million Kilowatts
1907	1530	0.860	1.100
1909	1978	1.160	1.880
1910	2260	1.380	2.140
1911	2800	1.550	2.560

Characteristic features of the development of central stations in Germany are the increase of the number of municipal stations and the increase of the number of stations which buy electricity in bulk from other larger stations.—*Elek. Zeit.*, April 6 and 13.

Gas Plants and Electricity Stations.—F. Ross.—An article giving statistical data on the increase of the use of gas and electricity in German cities. First, cities with more than 100,000 inhabitants are considered. The increase of production of gas per capita during the last six years was 15.7 per cent, but the statistical data of the author show that this increase of gas production has not been due to an increased use of gas for lighting or for gas engines. On the other hand, the number of kw-hours sold per capita by central stations in cities above 100,000 inhabitants has increased during the last six years 136 per cent, the electric-light connections 68 per cent, and the electric-motor connections 119 per cent. The increased demand for light has, therefore, been covered entirely by electric light. Further, where the electric motor is in the field the small gas engine is no longer used. The author shows that the situation is the same in German cities with from 50,000 to 100,000 inhabitants.—*Elek. Zeit.*, April 27.

Electric Installation of a Club.—A fully illustrated description of the electrical equipment of the new building of the Royal Automobile Club, Pall Mall, London. The supply is at a pressure of 110 volts direct current for lighting and 220 volts for motor service. There are fifty-two general lighting circuits controlled from the switchboard. Each of these circuits is designed for 100 amp; twelve of them supply energy to the basement and are metered separately, being charged at a special rate. There are also twelve motor circuits supplied with energy at 220 volts for working elevators and fans, and two 110-volt circuits, one for supplying energy to the cinematograph in the lecture theater and the other for supplying energy to apparatus in the photograph room. From the sub-boards the wires are run in steel-screwed conduit placed under the floors.—Lond. *Electrician*, April 28.

Wires, Wiring and Conduits.

Hard Copper Wire.—A note on a recent British patent (7657, April 20) of the Elektrochemische Werke Ges. (Berlin). Up to 1 per cent of calcium or molybdenum or smaller percentages of each are added to electrolytic copper instead of aluminum and magnesium, as is now usual, to produce hard wires for overhead lines. Whereas a usual requirement for such wire is a conductivity of 95 per cent with a tensile strength of 40 kg to 46 kg per square millimeter, a wire with 0.35 per cent of calcium is stated to give on test 98 per cent conductivity and a tensile strength of 54 kg per square millimeter. Similarly, a wire with 0.05 per cent of molybdenum is stated to give 96.2 per cent conductivity and a tensile strength of 52.9 kg per square millimeter. By adding 0.35 per cent of both calcium and molybdenum to pure copper, a conductivity of 98 per cent and a tensile strength of 52 kg per square millimeter are said to be obtained.—Lond. *Elec. Eng'ng*, April 27.

Elasticity of Long Wires at Varying Temperatures.—In an account of last year's work at the (Brit.) National Physical Laboratory mention is made of a research undertaken for the British Post Office, the India Office and the National Telephone Company. It concerns copper and bronze wires from 0.194 in. down to 0.049 in. in diameter, stretched in a galvanized water trough 50 ft. in length. The modulus of elasticity and the linear expansion coefficient have been determined both on the 50-ft. length and on short specimens of 6 in. within the temperature range — 12 to + 60° C. In the case of copper wire of 0.158 in. the modulus is 13×10^6 lb. per square inch measured on the whole length, and 17.7×10^6 lb. on the short specimen. In thinner wires the discrepancy is less marked. The discrepancy seems to be due to kinks, and was noticed in wires only when under the first loading. The wire was uncoiled by fixing the free end to the floor and rolling the coil for 50 ft., one hand always gripping the wire to prevent it slipping out. It was found almost impossible, however, to prevent the formation of some kinks. When the material was slightly overstrained on the first loading to take out the kinks the discrepancy vanished.—Lond. *Eng'ing*, March 24.

Wiring.—P. H. Perls.—A review sketching the evolution of the use of different materials in wiring installation, with special reference to the effect which the regulations of the German Association of Electrical Engineers have had on this evolution. —*Elek. Zeit.*, April 13.

Electrophysics and Magnetism.

The Propagation of Magnetic Waves in an Iron Bar.—C. V. Drysdale.—An article illustrated by diagrams in which the author points out that there is a close analogy between the propagation of alternating magnetism along an iron bar and that of alternating current along a cable. Experimental results are given confirming this analogy, the measurements being made with a search coil and the author's alternating-current potentiometer.—Lond. *Electrician*, April 28.

Impedance Paradox.—J. Herzog.—A paper with reference to the article of F. M. Denton in *Electrical World*, Vol. 56, 1910, No. 6. The author discusses the problem with the aid of vector diagrams and explains the paradox.—*Bull. d. Schweiz. Ver.*, Vol. 2, 1911, page 1; abstracted in *Elek. Zeit.*, April 13.

Units, Measurements and Instruments.

National Physical Laboratory.—A very full account of last year's report of the (Brit.) National Physical Laboratory. Those researches dealing specifically with electrical subjects have been or will be abstracted separately in the Digest. The first instalment deals with the engineering department, researches of wind pressure, friction of air in pipes, welded joints, alternating stress at high frequency, abrasion, elasticity of long wires at varying temperatures, shock tests of screw-threads, tests of high-pressure gages, stream lines, aeronautics, air-swirl in the neighborhood of the whirling arm, balloon fabrics and tank department.—Lond. *Eng'ing*, March 24. The second instalment deals with the physics department, electricity, fundamental units, Weston standard cells, standard of resistance, Lorenz apparatus, general electric measurements, inductance, condensers, telephone cables, magnetic tests, wave meters, substandards in electrical engineering and photometry, supply meters, heating of lamp sockets, insulators, micanite, ebonite, direct-current and resistance measurements, cells, heating of cables, thermometry and pyrometry and petroleum flash tests.—Lond. *Eng'ing*, March 31. The third instalment deals with metrology, silica standards of length, defraction gratings, Blythwood machine, porcelain soakages, taximeters, optics, photographic shutters, clinometers and levels, metallurgy and metallurgical chemistry alloys and the observatory department.—Lond. *Eng'ing*, April 21.

Definitions.—Passavant.—With reference to the definitions recently proposed by the German Commission, the author objects to the definition of generator and motor as machines for transforming mechanical power (Leistung) into electrical power and reversely. He emphasizes that it is not the power but the work (Arbeit) or energy which is transformed.—*Elek. Zeit.*, March 30.

Telegraphy, Telephony and Signals.

International Telephone Conference.—Devaux-Charbonell.—The conclusion of his report of the second International Conference of Telephone and Telegraph Engineers recently held in Paris. In the present instalment the papers on standardization, rules for high-tension wires and telegraph and telephone wires when being placed near together, papers on long-distance telephony, on the impregnation of wooden poles and on high-efficiency telegraph systems are summarized.—*La Lumière Elec.*, April 22.

Loud-Speaking Telephone.—An illustrated note on the use of loud-speaking telephones at a crowded tramway stopping place at Blackfriars Bridge in London for facilitating the loading of the cars with passengers. The transmitter is a carbon-granule instrument with carbon diaphragm, and the set is direct-working, no induction coil being used. The receivers are fitted with megaphones.—Lond. *Elec. Eng'ing*, April 27.

Miscellaneous.

American Electrical Industry.—A. Gerard.—A long report based on his observations during a trip through the United States on the American electrical industries.—[illegible] *Inst. Elec. Montefiori*, Vol. 10, third series, [illegible]. Briefly abstracted in *La Lumiere Elec.*, April 22.

BOOK REVIEW.

Die Vektoranalysis und Ihre Anwendung in der Theoretischen Physik. By Dr. W. v. Ignatowsky. Leipzig: B. G. Teubner. Two volumes, 235 pages, 41 illus. Price, 6 marks.

This is an excellent mathematical text-book on vector analysis, written for students of mathematical physics. It deals with the subject in a very practical way, allowance of course, being made for the difficulty of the task. The first volume deals with the theory of vectors and vector algebra. The second volume discusses applications of that theory to mechanics and electrodynamics.

The vector analysis here developed is not to be confused with quaternions, although these sciences have much in common. According to this treatise, and in conformity with many modern writers, the square of a unit vector in any direction is a scalar unit positive quantity; whereas in quarternions it is a scalar unit negative quantity.

The book will be useful to advanced students of physics and mathematics.

New Apparatus and Appliances

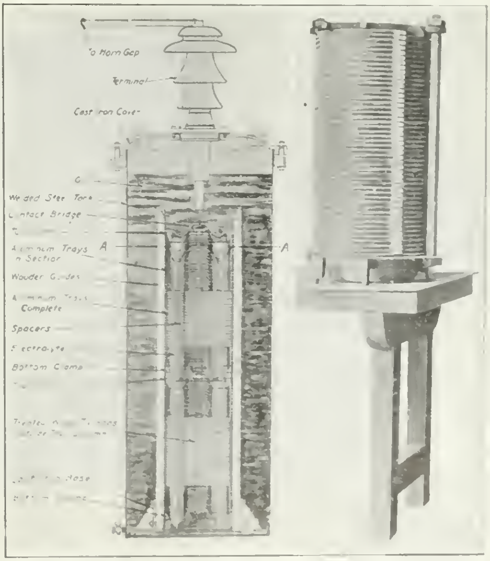
DESIGN FEATURES OF ELECTROLYTIC LIGHTNING ARRESTERS.

Oil in the tanks of electrolytic lightning arresters is in contact with the electrolyte in the trays. It, therefore, soon absorbs moisture from the electrolyte. It has been found that organic substances, such as wood or fiber, when used between electrolytic arrester trays absorb moisture from the "wet" oil and thereby become conducting. They carbonize and difficulties ensue. In order to avoid trouble from this condition in the electrolytic arresters here shown separators of porcelain are used between the trays. The wooden tie rods which bind the tray structure together are not in contact with any trays except the top and bottom ones of each section. The rods are supported in clear oil.

Fig. 3, which is a sectional view of three trays filled with electrolyte, shows how the separators are inserted. Four separators are used between each pair of trays. Each stack of trays and separators is clamped with iron nuts turning on the threaded end of wooden tie rods, as shown in Fig. 2.

In each electrolytic arrester tray there are four holes which, when the trays are stacked, form a vertical oil duct through which oil can circulate. This promotes the discharge of bubbles from the electrolyte and assists in maintaining an arrester at a low temperature when it is operating continuously for a long period. Another feature that assists in the effective discharge of bubbles is the contour of the tray. It will be noted from Fig. 1 that the outer portion of each tray is of such shape and so inclined that bubbles forming in the electrolyte will be discharged directly into the oil. A horizontal lip formed around the tray edge would constitute a pocket which would obstruct the bubble discharge. Therefore such construction has been avoided.

Tray structures for these electrolytic arresters are divided into sections or units, as indicated in Fig. 1. Each section is small enough so that it can be readily handled by one man when he is putting it in or withdrawing it from a tank.



Figs. 1 and 2—Section and Assembly Views of Tray Structures.

Ample oil space is provided between the tray structure and the inner surface of the sheet [illegible] tank, [illegible] the clearance necessary between the trays and tank for sufficient insulation it has been assumed that the oil would always be "wet." Two very desirable things accrue because of the allowance of this liberal clearance. One is that the oil volume, hence the ability of the arrester to discharge continuously, is greatly increased. The other is that it is not necessary to hang a circular screen of some organic insulating material down in the tank around the tray structure in order to prevent arcing between the trays and the tank. These arresters are built by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

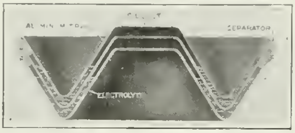
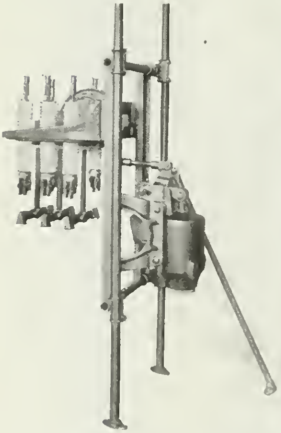


Fig. 3—Sectional View of Trays.

SOLENOID-OPERATED OIL-BREAK SWITCH.

The oil-break switch here shown has been designed for use on circuits where the potential does not exceed 15,000 volts. Use is made of a straight-line operating mechanism which, with the exception of the operating lever and its connecting link, is entirely mounted upon the switch frame. This mechanism gives a vertical parallel movement to the movable contact blades, which obviates the danger of friction or binding and increases the speed of the switch break. This mechanism is adjusted at the factory and requires no further adjustment.

The fixed contacts are of the drop-forged-copper, flared-finger type. The movable contacts are wedge-shaped copper blades, each provided with a slot in the upper extremity, thereby permitting a jet of oil to be forced into the arc on rupturing the circuit. This assists in extinguishing the arc quickly and reduces the disturbance in the oil vesssel.



Solenoid-Operated Oil Switch.

This construction insures clean contact surfaces and good contact under pressure over the entire surface and also prevents burning and pitting the contact surfaces, inasmuch as the arc is not ruptured between the actual contact surfaces, but between the upper extremity of the moving contact and the flared portion of the stationary contact.

The insulators are of one-piece glazed porcelain corrugated to give large creepage surface. Each insulator extends below the oil level and is clamped to the frame by two metal plates and four cap screws, eliminating the use of babbitt or cement. The insulators are interchangeable.

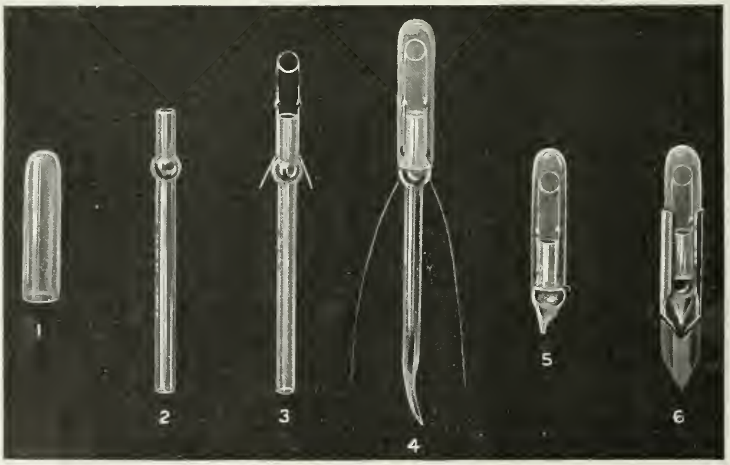
The switch, being a self-contained unit, can be conveniently handled and installed without interfering with the alignment. It has been placed on the market by the General Electric Company.

THE MANUFACTURE OF SMALL INCANDESCENT LAMPS.

Manufacturing an efficient and satisfactory incandescent lamp for switchboard service has been something of a problem, and to turn out these lamps in large quantities is a task of unusual interest and one that involves extremely delicate operations. It must be remembered that the carbon filament contained in this glass globe, 0.25 in. in diameter, has a diameter equal to that of the human hair. When this and the other unusual conditions are taken into account, it may well be said that the efforts of the manufacturers have been highly successful.

To produce a lamp that will give service for the greatest length of time has been the object of much of the development of types. To determine to what extent this has been accomplished some interesting tests have been carried on at the Hawthorne plant of the Western Electric Company. The lamps under test were those which have been adopted as standard for telephone switchboard use.

Life tests regularly carried on by this company show that the lamps have an extremely long life when operated at usual voltages. In fact, the usual 1000-hour life tests show very few unsatisfactory lamps. In order to determine how long these lamps would operate, one of the test lots has been allowed to remain in use continuously since 1903. No change from the original condition of the lamps, so far as a satisfactory signal is concerned, has occurred during the more than 50,000 hours in which the lamps have been in service. Intermittent lighting up of the lamp, similar to that given in switchboard service, in no way shortens the life of the lamp, even when the flashing has occurred over 1,000,000 times.



Actual Size of Switchboard Lamp in Process of Manufacture.
1. Lamp cap. 2. Lamp stem unmounted. 3. Lamp stem with filament complete. 4. Lamp after pumping. 5. Lamp ready for terminal. 6. Finished product.

Early in the development of the lamps the size became fixed with dimensions of 5/16 in. in diameter and 1¾ in. in length. The standard line lamp is designed to give a satisfactory signal on 24 volts, consuming slightly less than 0.1 amp. The problem of placing a filament with a resistance of 250 ohms or more in a glass globe ¼ in. in diameter was well-nigh impossible in the early days, but improved methods in manufacture have made it possible to place filaments with a resistance even as high as 1000 ohms within the standard dimensions of switchboard lamps.

A metal filament, such as tungsten or tantalum, being of much lower resistance than the carbon, is not ideal for the voltages and currents now considered standard for telephone work. Accordingly the development of the filament has been along the lines considered standard for carbon filament.

Cotton of filter paper is dissolved in a strong solution of zinc chloride, one of the most corrosive and troublesome liquids that we have. The result is a solution very similar in appearance to glucose, but full of little air bubbles, every one of which must be removed or the filament will not be satisfactory. Of the so-called cellulose thus formed there are two very pure forms. After it has been dissolved in the zinc chloride it is called amyloid, and when it is squirted through a small die or tube into the alcohol it forms a beautiful thread, not very strong but of wonderful properties. The alcohol removes the zinc chloride, precipitates and hardens the cellulose. The filament is squirted into the form of a ring on the bottom of a glass jar. This ring increases in height until there are at times thousands of feet of the filament in each jar. It is a difficult problem to remove this filament, dry and stretch it without tangling. Amyloid in this form has the property of shrinking almost indefinitely in every direction, and in order to make it suitable as to uniformity in lamps careful drying must be adopted. The average size of the human hair is about 0.002 in. in diameter, and this is just the size of the filament thread after being dried and stretched. Only girls who have perfect eyesight and delicate hands can handle this work at all satisfactorily, and even then the difficulty is very great.

This thread looks very much like a violin string, although it is not nearly so strong, and it is wound in suitable shape on carbon blocks preparatory to changing of the cellulose thread to a pure carbon filament. The blocks of carbon with their load of thread properly attached are then placed in a brass molder's graphite crucible and packed thoroughly with pure powdered carbon. The cover of the crucible is fastened on and the crucible is placed in a gas or oil furnace, the temperature which must reach the highest point that the crucible will withstand.

The filament, being away from all air, changes over to very hard and elastic carbon of a most durable kind. It is tested for quality, resistance and size before being sent to the operators who mount the filaments on the stems. The electrical resistance of the lamps must be within the predetermined limits, and the uniformity of the filament from end to end must be perfect. Thousands of lamps are being made every month by the Western Electric Company with a filament having a cross-section of one-quarter that of the standard. It is almost imposssible to see these filaments with the naked eye, unless in a strong light and with a white background. By great ingenuity and expert workmanship it has been found possible to make a curled filament having a loop in it of over 1000 ohms resist nce when hot, and still be able to place it in the standard-size miniature lamp having a globe 0.25 in. in diameter. This lamp gives a satisfactory signal or illumination with 35 milliamperes of current and gives a satisfactory life on 48 volts, although it is usually operated anywhere from 35 volts to 48 volts.

In order to make the filament within the proper range and to secure a satisfactory service for a long life it is necessary to operate each filament in a vapor of gasoline or other hydrocarbon. When it becomes quite hot in the presence of a hydrocarbon vapor the gasoline is decomposed and a very thin coating of fine carbon or graphite is deposited on the red-hot filament.

The lamp globe is a high-quality glass tube rounded on the front end, 0.25 in. in diameter and about 1 in. in length. The stem, on which has been mounted the filament, is inserted in the open end and sealed so that it is air-tight along the outside portion of the stem. The air is later exhausted through the small hole in the center of the stem and closed up tight so as to prevent the air getting back into the lamp.

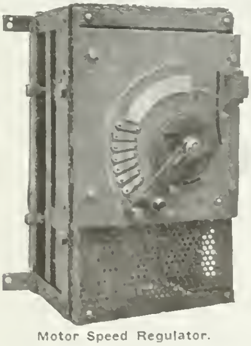
The stem is prepared from ⅛-in. tubing. The mounting wires, where they pass through the glass globe, are made of pure platinum. The filament is fastened to the mount or stem wires by means of a carbon cement, which is of such a character that it will not retain gases which may be occluded within its surface or given off from any binder which may hold the carbon together.

There are two standard ways of exhausting an incandescent lamp—one with mercury-vacuum pumps and the other with the mechanical vacuum pump with the use of red phosphorus for the final removal of the oxygen. The mercury pumps have been discarded for many years by the large incandescent-lamp manufacturers, but for the miniature lamps some manufacturers still retain them in spite of their delicate design and expensive maintenance. The quality of the vacuum in a switchboard lamp must be much higher than that of the ordinary incandescent lamp. The filament is so close to the walls of the lamp that the heat-insulating quality of the vacuum must be well-nigh perfect in order to prevent the heat from the filament rapidly passing into the air. The vacuum must also be very nearly perfect so that the extremely small diameter filament will not be burned by any trace of oxygen remaining.

To all lamps is given a thorough inspection for possible defects. Tests must be made in a few hours which in a way represent the actual operating condition of the lamp in service. As a defect in any part of the lamp may cause failure in the final product very great precautions have been taken to arrange every portion so that the lamps will have the maximum reliability. How well this has been done may be judged from the fact that the great majority of the lamps will operate many thousands of hours before burning out, and that the uniformity of candle-power is all that is necessary for the class of service required.

MOTOR SPEED REGULATOR.

The speed regulator here illustrated combines in one device a regulating rheostat for decreasing the speed of a motor and also for increasing the speed above normal. One operating lever performs the function of starting, increasing and decreasing the motor speed. Increasing of the speed above normal is accomplished by inserting external resistance in the shunt-field circuit of a shunt or compound motor. This regulator provides 100 per cent variation by field control and 50 per cent by armature resistance. It is well adapted for controlling the speed of motor-driven fans and machine tools where large variations are desired and only one voltage is available. The device is compact, has only one lever, automatic release from any point, and renewable segments. It has been placed on the market in sizes from 0.25 hp to 50 hp for 115-volt, 230-volt and 500-volt circuits in two separate types, the fan type and the machine type, by the Cutler-Hammer Manufacturing Company, Milwaukee.


Motor Speed Regulator.

Industrial and Commercial News

THE WEEK IN TRADE.

LAST Monday, after the close of general business, the Supreme Court of the United States announced its decision in the case of the Standard Oil Company, ruling that the Standard Oil Company is a combination in unreasonable restraint of trade. The court sustained the decree of the lower court calling for dissolution of the Standard Oil Company, but extended the period of execution from thirty days to six months, and provided a further modification vacating the injunction against interstate commerce in petroleum and products prior to dissolution. The bringing of the word "unreasonable" into the law is now the subject of extensive comment. The point is recalled that neither the size of a corporation nor the magnitude of its operations makes it liable under the law. The points at issue are whether a combination controls output or fixes prices. The decision is so far-reaching in its effect upon the affairs of the country that it is doubtful if trade will respond at once, now that the ruling has been made known. There has been little change as yet. Good weather has prevailed throughout the week, and a fair amount of new business has been done in retail lines, and, although the activity has been on too small a scale to cause briskness in wholesale and jobbing trades, it has been of an encouraging nature. There are, further, many grounds upon which to base an optimistic view of the situation. Among these may be mentioned the growth of export business, April figures for New York showing $71,841,000, as compared with $48,346,000 for the same month in 1910. There has been no disquieting news from the farming sections and advices still point to large harvests, with the government report on growing wheat indicating a record yield; and the foreign credit of the country is larger than it has been for many years. Business failures for the week ended May 11, as reported by *Bradstreet's*, were 245, as compared with 234 last week, 216 in the same week of 1910, 224 in 1909, 281 in 1908 and 184 in 1907.

THE COPPER MARKET.

THE efforts of the smaller producers to dispose of their products have resulted in lower prices, both in this country and abroad, the market barely reaching a 12-cent basis. The majority of the few contracts have been obtained by the independents as the result of underselling the Amalgamated interests. Some electrolytic sales for June and July shipment were made at prices ranging from 11.90 cents to 12 cents cash, but these have been on too small a scale to cause any change in the dullness of the market. The declining demand for steel products has apparently reacted upon the copper trade, and the wire-drawing interests are practically the only users acquiring supplies at this time in amounts approaching the takings of last year. The rolling mill and foundry interests are showing no improvement and are reported as operating well under capacity. In some cases the foundries are said to be working upon part time. Speculative interest in standard copper continues on a mild scale, both here and abroad. A falling off from 10 to 15 points has occurred in New York, and with offerings from spot to August ranging from 11.60 cents to 11.65 cents bidding has not exceeded 11.55 cents. In spite of the activity abroad, there is only a moderate call for American copper from foreign interests. Imports are now at the rate of 15,000 tons for the month, and with an estimated monthly output of 125,000,000 lb. domestic deliveries will have to approach 65,000,000 lb. and exports must amount to some 60,000,000 lb. in order to effect a balance between output and consumption. With the slackness in the majority of lines and the period of the year there is little likelihood that the showing for May will be greatly better than that of April. Exports for the month, including May 15, were 12,175 tons. The daily call on the Metal Exchange May 15 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.55	11.65	.....
May	11.50	11.60	11.55
June	11.50	11.65	11.57½
July	11.50	11.60	11.55
August	11.50	11.65	11.57½

The London market, May 15, was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	53	8	9	53	8	9
Standard copper, futures	54	1	3	54	1	3

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.30c			11.57½c		
London, spot	£56	15	0	£53	8	9
London, futures	57	12	6	54	1	3
Best selected	60	5	0	57	5	0

INDUSTRIAL AND COMMERCIAL NOTES.

Western Electric Gives Able Assistance.—Record work was done by the Western Electric Company in rushing an emergency switchboard to the exchange of the New England Telephone & Telegraph Company, at Bangor, Maine, on the occasion of the $6,000,000 fire on the evening of April 30. Although the fire was not under control until the next morning, the emergency exchange was started from the New York factory by 11:30 Sunday night. As soon as the fire had reached the telephone exchange word was dispatched to the Boston house of the manufacturers. A telephone message was immediately sent to the executive offices of the Western Electric Company at New York, at which point emergency equipment is kept for such purposes. Notwithstanding the fact that it was on a Sunday, when the activities at the factory were at a standstill, and the added difficulty of the lateness of the hour, a force was quickly assembled and seven trucks were brought to the spot. The equipment, which was sent on to Bangor by way of Albany on the first passenger express Monday morning, weighed 50,000 lb. and filled two cars. It consisted of seven sections of central-battery, lamp-signal board arranged for 3000 subscribers' lines. A power-plant equipment for its operation was included. The switchboard arrived in Bangor at 3 o'clock Wednesday morning, and a force of men immediately began installing it in a dance hall which had been spared by the flames. The emergency equipment will give service at Bangor until a new exchange can be planned and built.

New York Companies Reduce Rates.—The New York Edison Company and the United Electric Light & Power Company have notified the Public Service Commission that, beginning July 1 next they will put into effect a new schedule of rates for electric energy, which will mean a saving to their customers of $1,250,000 per annum, based upon the present consumption of electricity. In making these new rates the companies have yielded to the arguments of the Public Service Commission, which for more than two years has been urging upon them the advisability of a simplification of contract forms and a reduction in the prices charged for energy. The commission's investigation into electric lighting matters was conducted by Commissioner Milo R. Maltbie, through whose efforts the promised reductions have been obtained. In speaking of the changes, Commissioner Maltbie said, in part: "According to the new rates everyone using over $25 worth of energy a month will receive a discount ordinarily ranging from 5 per cent. to 25 per cent." Details of the new schedule will be found in another section of this issue.

Westinghouse Traction Sales.—The $400,000 order received by the Westinghouse Electric & Manufacturing Company from the Southern Power Company, mentioned in the issue of May 11, calls for ten 500-kw motor-generator sets, fourteen 55-ton locomotives and twenty-three 90-hp quadruple motor equipments, together with transmission and substation equipment. This apparatus will be used on the lines of the Greenville, Spartanburg & Anderson Railway and branches controlled by the Piedmont syndicate. The Westinghouse Company will furnish thirty double car equipments to the New York, Westchester & Boston Railway Company, and a number of traction equipments to the Boston Elevated Company.

Converter for McAdoo Road.—The Hudson & Manhattan Railroad Company has placed an order with the General Electric Company for a 1500-kw rotary converter. This is for railway service, and will be a six-phase, 600-volt unit, operating at 200 r.p.m.

Efficient Emergency Service.—Prompt action by large electrical manufacturers has shortened delay in restoring working conditions after several recent fires. Following the $500,000 fire at the Arbuckle sugar refinery, Brooklyn, N. Y., the General Electric Company was awarded a contract to replace all damaged electrical equipment, and most of the new apparatus was available from stock, the balance being of special design, upon which work is rapidly progressing. The generating station at the Arbuckle works contained four 300-kw and one 150-kw General Electric generators, direct connected to MacIntosh & Seymour engines, which operate non-condensing, at 150 r.p.m., and carry a twenty-four-hour load. These units furnish direct current at 230 volts for fifty motors, and have been in service twelve years. When the fire started, at 7:30 p. m., all of the machines were shut down, with the exception of one 300-kw set, which was run to furnish lighting and elevator service. This unit was finally short-circuited by the salt water from the fire-boats and the high-pressure system, and all of the apparatus was thoroughly drenched. When repairs were started, the salt water in the generators was washed out with fresh water, and the generators were surrounded with coke fires, made in galvanized buckets with holes bored near the bottoms for draft. This drying process was carried on for two days, after which the machines were started, and carried loads, with no marked defects. About fifty motors, aggregating 800 hp, were destroyed, together with their individual panels containing circuit-breakers, switches and starting devices. New motors have been ordered from the General Electric Company. There are nineteen 20-hp motors of special design for operating sugar centrifugals being completed at the General Electric shops. These motors have heavily compounded fields, enabling the centrifugals to attain full speed under load in about one minute. The main switchboard, of Vermont marble, was wet by salt water, but was not damaged. It is expected that the refinery will be in operation within one month.

Southwestern Telephone Matters.—With further reference to the building of a new telephone line in Texas, as mentioned in the issue of April 27, it is learned that when the American Bell Telephone Company purchased the control of the Western Union Telegraph Company, some months ago, the Bell Telephone interests also owned the only telegraph lines which compete with the Western Union Telegraph Company in this section. These lines are held by a company known as the Postal Telegraph-Cable Company of Texas, and connected with the extensive Postal Telegraph lines (the Mackay system) throughout the United States. The contract which the Postal company had with the Texas company contained a provision to the effect that in the event of the Texas company and the Western Union Telegraph Company property coming at any time under the same control, directly or indirectly, the contract might be terminated forthwith by the Postal company. Since this happened when the Bell Telephone Company absorbed the Western Union, the Postal Company served notice on the Texas company terminating the contract, which is now running from day to day. This was done so that the Postal Telegraph lines (the Mackay system), throughout the United States, would in no way be involved in the merger. Following this action, the telephone interests in control of the Texas Postal lines offered to sell those lines to the Postal Telegraph-Cable Company, asking what the latter states was an exorbitant price. In view of this the Postal Telegraph-Cable Company proper, whose corporate name in Texas is the Mackay Telegraph & Cable Company, has decided to build its own lines throughout the territory covered by the Texas Postal, and has already commenced work thereon.

Portland, Gray & Lewiston Equipment.—An order has been placed with the General Electric Company for the equipment of the Portland, Gray & Lewiston Railroad, which will run from Portland to Lewiston, Me., a distance of 30 miles. The average radius of curves is to be about 3000 ft. A car will leave each hour from both the Portland and Lewiston terminals, and every other car is to be an express, making the run of 30 miles in 45 minutes. The order includes three substation equipments, each consisting of a 300-kw rotary converter, with transformers and switchboard. The switchboard in substation No. 1 will consist of a 10,000-volt incoming line and transformer panel; one rotary converter panel, and a 600-volt, direct-current rotary converter panel. The energy is received from the Lewiston & Auburn Electric Light Company at a potential of 10,000 volts, the emf being raised to 33,000 volts for transmission to substations Nos. 2 and [illegible]. The switchboard in No. 2 will consist of an incoming line and rotary converter panel, direct-current rotary converter panel, and two 600-volt direct-current feeders. The switchboard of No. [illegible] is the same as that of No. 2, except there is only one 600-volt direct-current feeder. The order also includes an equipment for a general-utility car which will be used in construction work for the present. The equipment consists of a quadruple General Electric, 210-car equipment with type M control.

Earnings of Philadelphia Company.—Gross earnings of the Philadelphia Company for the year ended March 31 were $6,538,840, which represents a decrease of $72,093, compared with the showing of the previous year. Operating expenses amounted to $2,513,910, an increase of $53,758, leaving net earnings of $4,024,930, which are $125,851 under those of the preceding year. This was offset by an increase in other income, of $153,771, bringing this item to $2,505,775, which made a total income of $6,530,705, an increase of $27,920. Charges decreased by $62,376, with a resultant increase of $90,296 in net income, which totaled $5,264,437. The allowance for betterments and improvements was $1,633,827, an increase of $501,030, leaving a balance of $3,630,610 available for dividends, this amount being $500,734 smaller than for the year ended March 31,1910. The balance after payment of dividends, which were $522,613 larger on common stock than paid the previous year, was $772,203, showing a falling off of $1,023,347. Further deductions left a surplus of $451,816, bringing the profit-and-loss surplus at the end of the year to $5,062,594.

Marine Turbines for Government.—The Westinghouse Machine Company has completed two marine turbines with reduction gears for use upon the U. S. collier *Neptune*. One set is now being installed, and the other is to be shipped Saturday of this week, and installed as soon as possible in order to make official trials early in June. The turbine and equipment being installed upon the *Neptune* represent over five years of study and experiment in the works of the Westinghouse Machine Company in developing turbine machinery for the propulsion of ships. The tests of these units are regarded in marine circles as of great importance, owing to the small space occupied by the turbines, decreased weight, and to the fact that with the higher speed permissible by the use of reduction gears it is expected that the steam consumption will be from 20 per cent to 30 per cent less than that necessitated by any other form of marine propulsion.

Pennsylvania & New York Telephone Sale.—Announcement is made that a special meeting of the stockholders of the Bell Telephone Company of Pennsylvania will be held at noon on July 18, to vote upon an agreement for the sale of all outstanding and issued capital stock, franchises and interests of the Pennsylvania & New York Telephone & Telegraph Company to the Bell Telephone Company of Pennsylvania, at $1[illegible] for each share of stock surrendered. A special meeting of the stockholders of the Pennsylvania & New York Telephone & Telegraph Company will be held on the same day at 11.30 a. m. to vote upon the proposed sale

Westinghouse, Church, Kerr & Company Elections.—John F. Wallace, formerly chief engineer of the Panama Canal, has succeeded H. H. Westinghouse as president of Westinghouse, Church, Kerr & Company. H. W. Halsey and F. Q. Brown, of New York, George Westinghouse and J. R. McGinley, of Pittsburgh, and Homer Loring, of Boston, have been elected directors. Mr. Wallace will continue as chairman of the board of the company and also as president of the Electric Properties Company, which is the controlling organization.

Southern Minnesota Utilities.—With the completion of the plants of the Northern States Power Company, it is understood that the electric service properties in the majority of the smaller towns in southern Minnesota will be transferred to H. M. Byllesby & Company, of Chicago. A. S. Huey, vice-president of the Byllesby Company, has been making a tour of inspection of the company's plants on the Apple River, near Somerset, Wis., and announcements relative to the above are expected shortly.

Fire in Canadian Works of Allis-Chalmers Company.—As the result of a fire on May 6, the works of Allis-Chalmers-Bullock, Ltd., near Montreal, Canada, sustained damage estimated at $75,000. The fire started in the winding and testing department.

Financial.

The Week in Wall Street.

With the future policy of so many of the greatest industries of the country depending upon the nature of the decisions of the Supreme Court, there has naturally been a tendency to withhold commitments of any sort, either in stock transactions or in general trade, until the outcome is more clearly defined. Prior to the announcement of the decision of the Supreme Court in the case of the Standard Oil last Monday, the same narrow business prevailed in Wall Street as has been the case in other weeks when the rulings were expected. Trading was merely automatic, and price changes unimportant. The transactions for the week were only 1,079,952 shares, as compared with the narrow total of 2,269,399 for the previous week. There has been a decrease in the activity of the bond market, but the tone continues firm and the lighter volume at present is probably due to the fact that investment demand is temporarily satisfied. Short-term issues are still the dominating feature of the bond market, as was the case last week. In addition to the ruling of the Supreme Court, another feature of the week was the government report of foreign trade for the month of April. The total exports were $158,004,276, showing an increase of $25,000,000 for the same month in 1910. The excess of exports over imports was $7,878,094, comparing favorably with $835,620 for this item in April of the previous year. The present status of the money market clearly indicates the condition of general trade, and any increase of moment in the low rates now quoted would be welcomed as a sign of returning activity. Rates May 15 were: Call, 2@2¼ per cent; ninety days, 2¾ per cent. The quotations in the tables are those of the close, May 15.

NEW YORK.

	May 8.	May 15.	Shares Sold.		May 8.	May 15.	Shares Sold.
All. Ch......	7½	7⅜*	110	Int. Met., pf.	53¼	52	6,100
All. Ch., pf...	27	28*	210	Mackay Cos..	90½	90	200
Amal. Cop...	63	63	10,425	Mackay C., pf.	75⅝*	76¼*	100
Am. D. T...	20½*	20½*	———	Man. Elev....	135*	135	100
Am. Loco....	38*	37⅝*	200	Met. St. Ry..	15*	15*	———
Am. Loco., pf.	104⅞*	106¼*	100	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	82½*	82½*	———	Steel, com....	74½	75⅞	225,725
Am. T. & T..	148⅞	148¼	6,300	Steel, pfd....	119	118⅞	3,484
B. R. T.....	78¾	78¾	12,300	W. U. T....	74½	74¾	2,400
Gen. Elec...	156¼	156	2,100	West'h, com..	68*	69	600
Int. Met.....	19	18¼	7,600	West'h, pfd..	117*	110	———

PHILADELPHIA.

	May 8.	May 15.		May 8.	May 15.
Am. Rys...........	44	44	Phila. Elec.........	16½	16⅝
El. Co. of A......	12*	12⅛*	Phila. R. T.........	17¼*	18⅜
Elec. St. B'ty.......	52¾*	53*	Phila. Trac.........	82½	83½
Elec. St. B'ty., pfd.	30*	30*	Union Trac........	45¾	46¾

CHICAGO.

	May 8.	May 15.		May 8.	May 15.
Chi. City Ry......	186*	186*	Chi. Tel. Co........	124*	122*
Chi. Rs., Ser. 1....	80*	80*	Met. El. Co........	22⅛*	22⅛*
Chi. Rs., Ser. 2....	21¾	21*	Met. El., pfd.......	67¼	67*
Com. Edison.......	125*	128¾	Nat'l Car...........	115	118¼
Chi. Subways.......	4⅞	4¾*	Nat'l Car, pfd......	120*	120*

BOSTON.

	May 8.	May 15.		May 8.	May 15.
Am. T. & T.......	148¾	148¼	Mex. Tel...........	4*	4*
Cum. Tel...........	150*	150*	Mex. Tel., pfd......	6¼*	6*
Edison E. Ill.......	287¼	287	N. E. Tel..........	143	144½
Gen. Elec..........	157	156¾	W. T. & T..........	20¼*	19*
Mass. E. Ry........	18½	18⅞	W. T. & T., pfd....	94½*	94¼*
Mass E. Ry., pf....	88	88½			

*Last price quoted.
Shares sold for week May 8 to May 13.

Financial Notes

American Light & Traction Earnings.—A report of the American Light & Traction Company for twelve months ended March 31 shows continued improvement in the operations of the company. The gross earnings in this period were $3,933,031, comparing favorably with $3,463,580 in 1910, and $2,289,000 in 1907. Net earnings were $3,813,570, representing an increase of $457,435 over this item for the 1910 period. During the twelve months ended March 31, 1911, the dividends paid on the common stock amounted to $1,022,327 in cash and $1,002,505 in stock. The cash dividend for the previous year was $858,794, and the stock dividend, $1,530,917. Operating expenses were $119,521, against $107,445 for twelve months ended March 31, 1910, a small increase relative to the increased business done. The surplus balance shown at the end of the 1911 period was about $7,150,000. This is divided into about $3,707,000 carried as undivided earnings and some $3,450,000 carried as reconstruction reserve. The surplus balance given for March 31, 1910, was $6,243,000, as compared with $6,131,563 for 1909, $4,486,467 for 1908, and $3,488,607 for 1907. The American Light & Traction Company, in the twelve months ended March 31, 1911, earned a surplus available for the common stock equal to nearly 28 per cent on the $10,611,100 outstanding.

Twin City Rapid Transit Business.—Gross business of the Twin City Rapid Transit Company for the first quarter of this year was nearly 6 per cent better than that for the same period last year. Operating expenses increased 9.17 per cent, the higher cost of conducting transportation being the largest item in this increase. This amounted to $622,972, which was 12.51 per cent higher than the figure of the previous year. Maintenance of way and structures decreased, however, being 6.42 per cent under last year's figure. The Twin City company earned 2.14 per cent in the first quarter of the current year upon the $20,100,000 common stock, against 2.03 per cent earned in the corresponding period of the previous year. After charges, taxes and dividends on preferred stock were provided for there was a surplus of $430,270, an increase of 5.04 per cent over the figures in 1910. With a quarterly dividend on common stock of 1½ per cent, amounting to $301,500, there has been discusison of increasing the dividend to a yearly basis of 7 per cent, but no change of the rate is planned for the present.

United Railways Investment Gains.—At the annual meeting of the United Railways Investment Company, which is the holding company for the United Railroads of San Francisco, the Philadelphia Company, the Railroads & Power Development Company, and others, Emil Loeb and Eben Richards were elected directors, succeeding M. Kubierskchy and C. S. Shepard. The annual report of the company for 1910 shows a surplus of $766,468, which is equivalent to 4.79 per cent on the $16,000,000 preferred stock, as compared with 32 per cent for the previous year. President Thalman says in his report to the stockholders that the acquisition of the Sierra & San Francisco Power Company has resulted in a substantial saving in the cost of energy.

Canadian Telephone Service.—The application of eleven independent telephone companies of western and central Ontario for an order directing the Bell Telephone Company to give these companies long-distance connection over its system has been granted by J. B. Mabee, chairman of the Dominion Board of Railway Commissioners. The order is provisional, containing a qualification which makes the act of obeying the board only an experiment. A twelve months' trial will be given to the connection, and in the event of satisfactory service the arrangement may be made permanent through the terms of the order.

Chicago Traction Company Chartered.—The Chicago, Waukegan & Woodstock Traction Company has been chartered, with an initial capital of $50,000,000. Plans will be made within a short time for a road to furnish passenger and freight service between Waukegan, Lake County, and Woodstock, McHenry County.

DIVIDENDS.

American Railways, quarterly, 1½ per cent, payable June 15.

Chippewa Valley Railway, Light & Power Company, quarterly, preferred, 1¾ per cent, payable June 1.

Columbus Railway Company, quarterly, 1¼ per cent, payable June 1.

Federal Light & Traction Company, quarterly, preferred, 1½ per cent, payable June 1.

Georgia Railway & Electric Company, quarterly, 2 per cent, payable May 20.

North American Company, quarterly, 1¼ per cent, payable July 1.

Washington (D. C.) Railway & Electric Company, common, 1 per cent; preferred, 2½ per cent, both payable June.

REPORTS OF EARNINGS.

EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON.

	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
April, 1911	$439,329	$184,780	$254,549	......	......
" 1910	393,600	171,645	221,955	......	......
10 mos., 1911	4,461,606	1,862,267	2,599,339	......	......
" 1910	3,990,346	1,779,457	2,210,889	......	......

LACLEDE GAS LIGHT COMPANY.

	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
Qtr., Mar., 1911	$1,177,378	$567,365	$610,013	$63,456	$546,557
" " 1910	1,169,149	612,601	556,548	51,209	505,338

General News

Construction News.

EUFAULA, ALA.—We are informed that the Eufaula Gas, Electric Light & Power Company, of Eufaula, Ala., is not contemplating rebuilding its plant, as reported in our issue of March 9.

EUFAULA, ALA.—Bids will be received by the city of Eufaula until June 7 for equipment for a new electric plant, specifications for which may be obtained upon application to the W. L. Upton Company, Brown-Marx Building, Birmingham, Ala., consulting engineer.

FT. MORGAN, ALA.—Bids will be received at the office of the Constructing Quartermaster, Ft. Morgan, Ala., until June 2, for motor-driven deep-well pump, electric transmission line, switch panel, transformer, 4-in. cast-iron water main, etc. Plans and specifications may be seen at the above office and copies obtained by deposit of $10, which will be refunded upon return of same. Lieutenant Edwin F. Barlow is constructing quartermaster.

MARION, ALA.—The Marion Electric Company, recently incorporated, proposes to supply electricity and gas in Marion County, and also to deal in gas and electrical fixtures and supplies. The company is capitalized at $10,000 and the incorporators are: T. J. Krouse, Emma L. Krouse and R. K. Coe.

KINGMAN, ARIZ.—Arrangements are being made by the Desert Power & Water Company to issue bonds to the amount of $400,000, the proceeds to be used for enlarging its system. The proposed improvements include the installation of additional machinery and extension of its transmission lines to the chloride district. The company at present supplies electricity to a number of mines in the Kingman district, among them being the Gold Road, Tom Reed and Hercules mining properties.

YUMA, ARIZ.—Contract has been awarded by the Secretary of the Interior at Washington, D. C., to Charles A. Haskin, of Boston, Mass., for a compressed air plant to be used in the construction of the siphon under the Colorado River in connection with the Yuma irrigation project. The lease includes the installation of the plant and the services of the contractor in starting it satisfactorily, together with the services of a competent superintendent during the progress of the work. This syphon, which is to be 1000 ft. long with a diameter of 15 ft., will connect the main canal on the California side with the irrigation system, which is to supply water to the broad valley below Yuma, Ariz. A power plant will be established later at the Arizona end to lift the water to the rich mesa lands in the immediate neighborhood of the town of Yuma.

HARRISBURG, ARK.—Plans are being prepared by L. D. Freeman and J. D. Gant for the construction of an electric railway to connect Marked Tree with Harrisburg and Newport, Ark., 50 miles in length.

BAKERSFIELD, CAL.—Preparations are being made by the San Joaquin Light & Power Company for the erection of a transmission line from the Crane Valley to Bakersfield. The proposed line will carry 60,000 volts and will extend along the west side of the valley, returning via the east side, making a loop of nearly 500 miles. The new transmission line to Waukena will soon be put into commission. Plans are also being made to build an extension to Angiola and Alpaugh. It is proposed to erect a substation at Stoil to distribute electricity in various directions.

BLYTHE, CAL.—Plans are being considered by the Blythe City Ice & Cold Storage Company for the construction of an electric-light and ice plant and creamery in Blythe. The cost of the plant is estimated at $40,000. J. B. Lockard and J. R. Dutcher are interested in the company.

LONG BEACH, CAL.—Plans are being made by the Home Telephone Company for extensive improvements to its local system, involving an expenditure of about $100,000. The work will include re-cabling the entire city and placing the cables in the business district underground.

LOS ANGELES, CAL.—The Board of County Supervisors has awarded the contract for installing electric fixtures in the new hall of records to the Thomas Day Company, of San Francisco, Cal., for $14,000.

LOS ANGELES, CAL.—Bids will be received by Harry Lelande, clerk of Board of County Supervisors of Los Angeles County, until June 5 for furnishing and installing a power plant, including a steam-driven electric generating unit, laundry equipment, steam cooking apparatus, ice plant, etc., at the Los Angeles County farm.

MERCED, CAL.—The Merced Land Company, of Los Angeles, Cal., has purchased a site on which it will erect an electric pumping plant in the near future. W. O. Huse is manager.

MONTEREY, CAL.—Plans are being considered for the installation of electroliers on Alvarado Street from California to Scott Street, the cost of which is estimated at from $4,500 to $5,000. W. H. McConnell is interested in the project.

REDWOOD CITY, CAL.—The Board of County Supervisors of San Mateo has granted a franchise to J. J. Gomes and Benjamin Cuncha to construct and operate an electric light and power system in the county north of Halfmoon Bay.

RIVERSIDE, CAL.—Bids will be received by the Board of Supervisors until May 24 for sale of franchise to erect and operate transmission lines to transmit electricity for lamps and motors along the public roads of Riverside County for a period of fifty years.

SAN FRANCISCO, CAL.—Plans are being considered by the Downtown Association for the installation of an ornamental lighting system, modeled after those in Vienna, decorated with real flowers. It is proposed to suspend flower boxes midway between the top and the bottom of the lamp standards. The flowers on the standards will be watered and cared for by an automatic arrangement. It will require about three months to install the system.

SAN JACINTO, CAL.—It is reported that improvements will be made to the local electric light system and new machinery installed. It is proposed to supply electricity for pumping purposes as well as for lamps.

DENVER, COL.—Application has been made by the Colorado Interurban Railroad Company for a charter to construct and operate an electric railway in the northern part of Colorado to connect Denver, Ft. Lupton, Greeley, Ft. Collins, Longmont and Idaho Creek. The railway will furnish both freight and passenger service. The company is capitalized at $6,000,000. The incorporators are: E. Armour, Charles H. Pierce, Irving Hale, James Leonard and others.

DANBURY, CONN.—The Danbury & Bethel Gas & Electric Company has applied to the State Legislature for authority to increase its capital stock from time to time to an amount not to exceed $600,000. The increase is asked for the purpose of taking up outstanding notes and to make further extensions to its system. The company now has $250,000 in capital stock and bonds to the amount of $150,000 outstanding.

NEW LONDON, CONN.—The Groton & Stonington Street Railroad Company has received authority from the State Legislature to amend its charter giving it the privilege to extend its railway in Mystic and to build an extension to Old Mystic, and has also been authorized to issue bonds to the amount of $100,000.

NEW LONDON, CONN.—Contracts have been awarded for the installation of the new water system at Fort H. G. Wright, N. Y., as follows: Construction of two pump houses, two electrically driven pumps, motors, etc., conduit and cable line to supply electricity to L. B. Jacobs, of Newark, Del., for $6,890; for 200,000-gal. reinforced concrete reservoir to McHarg-Barton Company, of New York, N. Y., for $11,000.

JACKSONVILLE, FLA.—The Board of Trustees of Water Works and Improvement Bonds has rejected all proposals for construction of the power house for the municipal electric plant. The board has decided to do the work.

PALATKA, FLA.—Application has been made to the City Council by F. P. Clarke, of Jacksonville, Fla., for a thirty-year franchise to construct and operate an electric light plant in Palatka. The cost of the proposed plant is estimated at from $40,000 to $50,000.

BARNESVILLE, GA.—Preparations are being made by the Aldora Mills to erect a new building 100 ft. x 240 ft., two stories high. Looms will be installed in the new building to weave the output of the 10,000 spindle plant of the company. The plant will be operated by electricity, which will be supplied by the local transmission system of the Central Georgia Power Company, of Macon, Ga. The cost of the proposed extension is estimated at $150,000.

DALTON, GA.—The City Council has awarded a contract to the Terrell-Hedges Company, of Chattanooga, Tenn., for the erection of the transmission lines for the new electric plant. The cost is not to exceed $5,100.

MARIETTA, GA.—At an election held recently the citizens voted to issue $20,000 in bonds, the proceeds to be used for improvements to the electric light system.

BOISE, IDAHO.—Plans are being considered by the Boise & Interurban Railway Company for the construction of an extension of its system from Boise to Roswell, via the Deer Flat country

LEWISTON, IDAHO.—It is reported that the Lewiston Clarkston Improvement Company has been granted a franchise to supply electricity in Lewiston for lamps and motors.

NEZ PERCE, IDAHO.—The Nez Perce Water Power Company, it is reported, is contemplating developing its water-power to the full capacity. It is estimated that 1500 hp can be developed. Z. A. Johnson is president of the company.

CARTHAGE, ILL.—It is reported that the Carthage Electric Light & Heat Company is contemplating installing additional equipment in its plant with a view of establishing a day service

CHICAGO, ILL.—The Commercial Electric Motor Manufacturing Company has increased its capital stock from $10,000 to $50,000.

CHICAGO, ILL.—The Chicago, Waukegan & Woodstock Traction Company, recently incorporated, proposes to construct and operate a railway connecting Woodstock and Waukegan with the Northwestern and St.

[illegible] uses of these motors. The McKenna motor [illegible], which develops its [illegible]. The company is capitalized at $50,000.

ANDERSON, IND.—The Board of Public Works and the railroads have reached an agreement by which the three steam roads will pay the city $[illegible] per year for electric arc lamps at street crossings of the railroads. This is an increase of $300 over the amount paid last year.

GARY, IND.—Contracts will be awarded by the Gary, Hobart & Eastern Traction Company, of Gary, Ind., for the construction of an electric railway from Hobart to Broadway, Gary, five miles in length. George H. [illegible] is interested in the project.

MUNCIE, IND.—The Muncie Electric Light Company, the Dunkirk Lighting Company, the Redkey Lighting Company, the Hartford City Lighting Company and the Eaton Electric Light Company have been consolidated under the name of the Muncie Electric Light Company. The new corporation is capitalized at $1,000,000. New lighting systems have been installed in Dunkirk and Redkey, and other towns in the territory will be supplied with electrical service in the near future.

ATLANTIC, IA.—A committee has been appointed to take steps toward the installation of electroliers in Atlanta, at an estimated cost of $4,000. Charles Chase, Clyde Campbell and others are members of the committee.

FT. DODGE, IA.—It is reported that the Northern Iowa Power Company is preparing plans for the construction of a large dam north of Ft. Dodge.

MOUNT VERNON, IA.—The Dows-Smith Company, of Cedar Rapids, Ia., and F. J. Cross, of Monticello, Ia., it is reported, have applied to the Council for a franchise to install an electric light plant in Mount Vernon.

NEW MARKET, IA.—The citizens have voted to grant a franchise to the Lee Electric Light Company, of Clarinda, Ia., to supply electricity for lamps and motors in New Market for a term of twenty-five years. The town has also entered into a contract with the company for lighting the streets of the village. A transmission line will be erected from Clarinda to New Market, a distance of 10 miles.

NICKERSON, KAN.—The question of establishing a municipal electric light plant and water works system in Nickerson is reported to be under consideration.

QUENEMO, KAN.—Power for operating the proposed municipal electric lighting system will be supplied by the Quenemo Milling Company. The cost of the system is estimated at about $6,000. I. C. Bushong, of Ottawa, Kan., is engineer.

JENKINS, KY.—The Consolidated Coal Company is reported to be contemplating developing the water power of Elkhorn Creek to generate electricity for lamps and motors in connection with Letcher and Pike Counties coal land developments. Plans have not yet been completed for the hydroelectric power plant. A. T. Watson, of Fairmont, W. Va., is purchasing agent. Executive offices of the company are located in the Continental Trust Building, Baltimore, Md. Jenkins has not a postoffice.

OWENSBORO, KY.—Plans are being considered for the construction of an electric railway to connect Owensboro, Madisonville, Utica and Calhoun, 51 miles in length.

NEW ORLEANS, LA.—The United Public Utilities Company has applied for a charter to own and operate electric railways in New Orleans. The company is capitalized at $1,[illegible]57,600, and the directors are: Lynn H. Dinkins, Silas I. Hyman, S. B. Smeath, S. [illegible], Charles P. Fenner and others.

PATTERSON, LA.—The Patterson Light & Power Company, recently incorporated with a capital stock of $3,000, is reported to have awarded contracts for machinery and equipment for its proposed electric plant in Patterson. The company proposes to supply electricity for lamps and motors in this city. Anderson Offutt, of New Orleans, La., is engineer in charge.

FREEPORT, MAINE.—The plant and holdings of the Freeport Electric Light, Heat & Power Company have been purchased by John R. Graham, of Freeport, Maine. Mr Graham several months ago acquired the property of the Portland & Brunswick Street Railway Company, which supplies electricity for operating the system of the Freeport Electric Company. The Portland & Brunswick Railway extends from Freeport to Yarmouth.

BALTIMORE, MD.—Specifications for contract for supplying the municipal buildings with electricity have been prepared by Robert J. McCuen, superintendent of Department of Lamps and Lighting. The specifications provide for electrical service with and without lamp renewals.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company and allied companies have applied to the Public Service Commission for permission to issue over $900,000 in bonds. The application asks for authority to issue $844,000 of the general mortgage bonds of the Consolidated Gas & Electric Light & Power Company, of which $262,000 is to be used for refunding purposes and the remaining $582,000 for extensions and improvements. Permission is also asked by the United Electric Light & Power Company for authority to issue $60,000 in bonds, to be used for refunding purposes.

FORT HOWARD, MD.—Sealed proposals will be received at the office of the Constructing Quartermaster, Fort Howard, Md., until June 12, for construction of electric light plant and electric lighting system. Further information furnished on application to the above office, and copies of plans and specifications will be furnished upon deposit of $10, which will be refunded upon return of plans.

BARRE, MASS.—The town of Barre has entered into a contract with the Connecticut River Power & Transmission Company for lighting the streets of the village for a term of ten years. The contract calls for the installation of eighty 60-cp tungsten lamps, at the rate of $20 each per year. It is expected to have the system in operation by Sept. 1. The Gardner Electric Company, a subsidiary of the Connecticut company, will supply the service.

CHARLTON, MASS.—The Webster & Southbridge Gas & Electric Company is contemplating extending its transmission line from Southbridge to Charlton Center. The company has a five-year contract for lighting the streets of the town and also to supply electricity to the Masonic Home. The proposed line will be 7 miles long. Application will soon be made for the franchise.

GLOUCESTER, MASS.—The New England Telephone Company has been granted a franchise for an underground conduit system from Gloucester to Manchester, a distance of 7 miles.

HUBBARDSTOWN, MASS.—The town officials have awarded a contract to the Connecticut River Power & Transmission Company to light the streets of the town with electricity for a term of ten years. Under the terms of the contract the company is to supply fifty tungsten lamps of 60 cp at the rate of $20 each per year. It is expected to have the street lighting system in operation by Sept. 1. The service will be supplied by the Gardner Electric Company, of Gardner, a subsidiary of the Connecticut company. W. A. Beecher, of Gardner, is superintendent of the Gardner company.

MANSFIELD, MASS.—F. H. Coyne & Company, of Foxboro, Mass., have submitted a proposition to the Selectmen offering to purchase the municipal electric light plant in Mansfield. It is understood that the company is willing to take over the plant for the amount of the funded indebtedness, which is between $70,000 and $80,000, and agrees to supply electricity to private consumers at the rate of 12½ cents per kw-hour. The present rate is 15 cents per kw-hour. The proposition will have to be submitted to the voters.

NORTH EASTON, MASS.—The question of lighting the town by electricity is reported to be under consideration.

ORANGE, MASS.—The Miller's River Street Railway Company is planning to begin work on construction of its proposed railway as soon as franchises are granted. The proposed railway will be 14 miles long and will connect Miller's Falls, Erving, Earley, West Orange and Orange. The company will purchase electricity for operating the railway. Daniel P. Abercrombie, Jr., is interested in the project.

WARE, MASS.—The directors of the Ware Electric Company have notified the stockholders of the company that Cabot, Thompson & Eustis have offered $135 per share for the stock, provided they can obtained at least 40 per cent of it.

WESTMINSTER, MASS.—The Connecticut River Power & Transmission Company has been awarded a contract by the town of Westminster to supply electricity for lighting the streets of the town for a term of ten years. The contract provides for the installation of thirty-eight 60-cp tungsten lamps, at $20 per lamp per year. The service will be supplied by the Gardner Electric Light Company, of Gardner, a subsidiary of the Connecticut company.

BARAGA, MICH.—Preparations are being made by the village of Baraga for the installation of a municipal electric light plant and water works system.

MANISTEE, MICH.—The property of the Manistee Light & Traction Company, including the electric and gas systems and street railway, was sold May 6 to Francis M. Edwards, of Boston, Mass., for $145,000. It is understood that Mr. Edwards represents the majority of the bondholders.

BROWN VALLEY, MINN.—The installation of an electric light system in Brown Valley is reported to be under consideration.

DULUTH, MINN.—The Duluth-Edison Electric Company has submitted a proposition to the City Council offering to supply electricity for lighting the city along the lines of the contract now in force, providing all arc lamps now in use to be furnished at the rate of $45 each per year. This is to include groups of incandescent lamps, namely, two 16-cp lamps constituting one group and three groups being equal to one arc lamp, the number of arc lamps to be not less in number than now in use. The company offers to supply electricity to light the city hall, police headquarters and jail free of charge, also electricity for the proposed sign on the aerial bridge, the city to furnish the sign, and one arc lamp for each improved park without charge to the city. It also offers to supply electrical energy for lighting all fire halls, city hospital, public library and any other building maintained by the city and for lamps for the canal piers at the rate of 5 cents per kw-hour, and energy for operating the aerial bridge at the rate of $50 per month. The company asks for a ten-year contract, giving the city the right to terminate it at the end of three years upon six months' notice. A plan for a reduction in the price of electricity for commercial and residence lighting is also included in the proposition. The City Council has appropriated $2,500 to secure the services of an electrical engineer to prepare plans and specifications for the construction of a municipal electric light plant. The contract with the Duluth-Edison Electric Company expires Sept. 1. Oscar Claussen, of St. Paul, Minn., and Charles L. Pillsbury, of Minneapolis, Minn., have been engaged as consulting engineers.

LITCHFIELD, MINN.—It is reported that plans are being considered to extend the municipal electric light system around the south side of Lake Ripley. The Council has authorized the installation of twenty-six ornamental lamp standards to cost $2,600.

MINNEAPOLIS, MINN.—The Minneapolis, St. Paul, Rochester & Dubuque Traction Company, it is reported, is contemplating the construction of a new power house on Twenty-sixth Street, in South Minneapolis, to cost about $100,000.

MINNEAPOLIS, MINN.—The Minneapolis Northern Suburban Railway Company, it is stated, will soon begin work on the construction of its proposed railway between Minneapolis and Anoka. About 15 miles will be built at first and gasoline cars operated. It is expected that the railroad will eventually be equipped for electrical operation.

MINNEAPOLIS, MINN.—The City Council is reported to have closed a contract with the Minneapolis General Electric Company to supply electricity to operate the new pumping equipment for a period of ten years at the rate of 4 10 of a cent per kw-hour. The contract provides that the city shall not use current between 4:30 and 6:30 p. m. daily except Sundays, for four months in the year. The new equipment includes two centrifugal pumps, each having a daily capacity of 20,000,000 gal.

ST. PAUL, MINN.—The St. Paul Southern Railway Company is reported to be considering the erection of two power houses, one in Hastings and the other in Lake City, Minn.

VIRGINIA, MINN.—The question of purchasing the local electric light plant to be owned and operated by the municipality is reported to be under consideration.

WAYNESBORO, MISS.—It is reported that M. A. O'Dom, agent, is contemplating the installation of an alternating-current generator, with sufficient output to supply electricity for 1000 lamps.

CARTHAGE, MO.—The Empire District Electric Company, of Joplin, Mo., has purchased the plant and holdings of the Empire Electric Power & Supply Company, of Carthage, Mo. The price paid for the property is said to be $50,000. It is understood that the new owners will extend and improve the service. Dr. C. B. Guinn, of Carthage, Mo., is president of the Empire Electric Power & Supply Company.

CHILLICOTHE, MO.—Contracts have been awarded by the city of Chillicothe, Mo., for construction and equipment of a municipal electric light system as follows: For concrete work, floor machinery and building foundations, boiler and equipment to J. E. Weeks, of Chillicothe, Mo., for $7,289; construction of power house to John Geir, of Chillicothe, Mo., for $5,740; brick and concrete chimney to Metal Concrete Chimney Company, of St. Louis, Mo., at $1,440; for two four-valve steam engines, pipe work and steam specials, two 400 kva generators, pole line complete, including 280 streets lamps, to the Squire Electric Construction Company, of Kansas City, Mo., for $30,405; deep well for water supply to Bloom & Hinckle, of Indianapolis, Ind., for $3,100. Fuller-Coult & Company, engineers, Chemical Building, St. Louis, Mo., have charge of the engineering work.

PLEASANT HILL, MO.—It is reported that plans are being prepared by Rollins & Westover, Beals Building, Kansas City, Mo., engineers, for the installation of an electric light plant for the Reader Ice & Electric Company, of Pleasant Hill, Mo., to cost about $25,000.

SPRINGFIELD, MO.—The Springfield & Western Railroad Company is reported to have awarded the contract for the construction of its proposed electric railway to connect Joplin and Springfield, 60 miles in length. Surveys for a branch railway to extend from Paris Springs to Joplin, via Carthage, Carterville and Webb City, will be completed within two months. Mortimer M. Hollenback, of Springfield, Mo., is chief engineer.

ANSLEY, NEB.—The Village Board has purchased a site from C. J. Stevens on which it proposes to erect a dam and electric light plant.

CHAPPELL, NEB.—The contract for construction of water works system and electric light plant in Chappell was awarded to the Des Moines Bridge & Iron Company, of Des Moines, Ia., for $12,990. W. E. Demer, of Grand Island, Neb., is engineer in charge.

WINNEMUCCA, NEV.—Preparations are being made by the Winnemucca Water & Light Company for extensions to both its water and electric plants. It is understood that a new plant will be built.

AMSTERDAM, N. Y.—Bids will be received at the office of Thomas F. Hazlett, city clerk, Amsterdam, N. Y., until June 6 for lighting the streets and public places. Specifications are on file in the office of the city clerk.

ISLIP, N. Y.—The Town Board has entered into a contract with the Islip Electric Light Company for lighting the streets of the town with electricity for a term of five years. The contract calls for the installation of 130 tungsten lamps of 25 cp at the rate of $17.50 each per year. The village is at present lighted with gas.

NEW YORK, N. Y.—Sealed bids will be received by C. B. J. Snyder, superintendent school buildings, Department of Education, corner of Park Avenue and Fifty-ninth Street, New York, N. Y., until May 22 for installing electric equipment in the addition to and alterations in Public School 40, Borough of Bronx. Blank forms, plans and specifications may be obtained at the office of the superintendent.

ROCHESTER, N. Y.—Contracts have been awarded by the Board of Contract and Supply for electric wiring buildings Nos. 2, 3 and 4 and boiler house for Exposition Park to the Rochester Electric Motor Company, for $12,575.

CLYDE, N. C.—The citizens have voted to light the streets of the village with electricity. The service is to be supplied by the North Carolina Electric Company.

CONCORD, N. C.—Sealed proposals will be received by the Board of Water and Light Commissioners, Concord, N. C., until May 31, for construction of an auxiliary pumping station, furnishing turbine pumps and motors, about 2 miles of 12-in. cast-iron pipe, reinforced concrete, 1,000,000-gal. sedimentation reservoir and a 1,000,000-gal. filter plant. Plans and specifications are on file at the office of George H. Rutledge, superintendent, and copies of specifications and proposal forms, etc., may be obtained at the office of Gilbert C. White, engineer, Durham, N. C.

GREENSBORO, N. C.—The North Carolina Public Service Company, of Greensboro, N. C., will soon begin work on construction of three extensions to its system, including the extension of the Lindley Park line in Greensboro to the Masonic Home and the Pomona cotton mills. Another extension will connect with the line on Elm Street and extend along Mendenhall Street to Spring Garden and connect with the Lindley line near the State Normal School and Industrial College. The third extension will begin at the intersection of Church and Elm Streets and extend along North Elm Street to a point near the city limits near the proposed Greensboro Country Club.

JAMESTOWN, N. D.—Plans are being considered by the Northwestern Telephone Exchange Company for rebuilding its local system, which will involve an expenditure of about $15,000.

WILLISTON, N. D.—The installation of an ornamental street lighting system in the business section is reported to be under consideration.

AKRON, OHIO.—The condemnation proceedings brought by the Cuyahoga Falls Water & Power Company to secure exclusive rights to extensive water privileges and lands in Cuyahoga Valley, near Cuyahoga Falls, have been dismissed by Probate Judge Lytle, because the petition was indefinite in the description of the property sought to be condemned. The company has arranged to appeal the case. The immediate result of a successful termination of this suit, it is said, would be to stop the Northern Ohio Traction & Light Company from completing its large power station at what is known as the Gorge on the Cuyahoga River, where a large dam is to be built. The water rights here are the same as those involved in the condemnation suits.

COLUMBUS, OHIO.—The City Council has passed an ordinance authorizing an issue of $20,000 in bonds, the proceeds to be used to install cluster lamps on ornamental lamp standards on the principal thoroughfares in the city.

COLUMBUS, OHIO.—The State Legislature has passed the [illegible] Senate bill, which provides that the penitentiary managers shall give the city of Columbus the right to erect its municipal electric light wires across the prison grounds, either overhead or underground, in exchange for the right to use the poles owned by the city for the wires from the prison plant. Under this arrangement the State buildings may be supplied with electricity from the prison electric generating plant.

DAYTON, OHIO.—Plans are being considered by the Oakland Street Railway Company for enlarging its power station in Dayton.

DAYTON, OHIO.—The Dayton & Troy Electric Railway Company is planning to build an addition to its power house in Tippecanoe. The plant will be used jointly by the Dayton & Troy Electric Railway and the Oakland Street Railway.

NELSONVILLE, OHIO.—A meeting of the stockholders of the Hocking-Sunny Creek Traction Company, of Nelsonville, Ohio, will be held May 22 to consider the question of completing its railway to [illegible], a distance of 3 miles, and extending it to Lancaster, also the construction of an electric railway from Chauncey to Glouster. It is proposed to increase the capital stock to $900,000. Bonds to the amount of $[illegible] have been sold.

LAWTON, OKLA.—It is reported that Sanderson & Porter, of New York, N. Y., engineers, have made arrangements to purchase the properties of the Comanche Light & Power Company, of Lawton, Okla., and the Lawton & Ft. Sill Electric Railway Company. The new owners propose to complete the railway and to improve the service of the electric plant.

OKLAHOMA CITY, OKLA.—The contract for furnishing and installing the power plant in the State penitentiary has been awarded to S. E. Dunbar, of Muskogee, Okla., for $24,[illegible].

WETUMKA, OKLA.—At an election held recently bonds to the amount of $25,000 were voted, of which the proceeds of $[illegible] will be used for extensions to the water and light plant.

MADRAS, ORE.—The City Council has granted A. E. [illegible] permission to construct and operate an electric light and power plant in Madras.

NYSSA, ORE.—It is reported that surveys are being made by the Kingman Colony for the construction of an electric light plant on Snake River.

ROSEBURG, ORE.—The power station which supplies the city with electricity and water was destroyed by fire recently, causing a loss of about $50,000. The plant is located about [illegible] miles north of Roseburg and is owned by Kendall Brothers, of Pittsburgh, Pa.

SALEM, ORE.—The City Council has voted to purchase the water system of the Salem Light, Water & Power Company at approximately $370,000, the price asked by the company.

PANAMA.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until June 8, for annual estimate for the period ending June 30, 1912, for electrical material, including fittings, fixtures, batteries, carbons, wire, cable, mica, paint, cross-arm pins, insulating material, soldering material, etc. Blanks and general information relating to this circular (632) may be obtained at the above office or at the offices of the assistant purchasing agents at 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 N. Point Street, San Francisco, Cal.

CANONSBURG, PA.—Preparations are being made by the Central District & Printing Telegraph Company for the installation of a new telephone plant in Canonsburg, to cost about $60,000. The new plant will provide for 5000 telephones, but will be equipped for but 2000 at first. The wires will be placed underground.

INDIANA, PA.—Rights of way are being secured by the Indiana County Street Railway Company for the construction of an extension of its system from Clymer to Dixonville. The company is also considering an extension from Dixonville to Marion Centre, a distance of 4 miles.

PHILADELPHIA, PA.—Application has been made to the City Council for an additional appropriation of $14,460 for the new lighting system being installed on the Southern Boulevard between Bigler Street and the Philadelphia Navy Yard.

POTTSTOWN, PA.—The Pottstown & Phoenixville Railway Company has begun work on the construction of its proposed electric railway to connect Pottstown, Phoenixville and Valley Forge, 14 miles in length; the company will be in the market for material for 6 miles of track. The power stations will be located in Pottstown and Phoenixville and the repair shops at Sanatoga and Bonnie Brae. George N. Malsberger is president; Harry F Swinehart, general manager, and Charles Johnson, electric and chief engineer, all of Pottstown, Pa.

SCRANTON, PA.—Work has commenced by the Scranton & Binghamton Traction Company on the construction of its proposed electric railway to connect Scranton, Pa., and Binghamton, N. Y., a distance of 62 miles. W. L. Connel, of Scranton, Pa., is president of the company.

COLUMBIA, S. C.—Bids will be received until May 25 for electrical wiring, plumbing and heating the Young Men's Christian Association Building, Columbia, S. C. Plans and specifications may be seen at the office of Shand & Lafaye, architects, Columbia, S. C., and at the office of R. H. Hunt, of Chattanooga, Tenn. Copies of specifications may be obtained from the architects.

LEXINGTON, S. C.—The Lexington Electric Light & Power Company, recently incorporated, is planning to establish an electric light plant at Barr's Mill. Both water and steam power will be used. The company is capitalized at $10,000. W. W. Barre is president.

ABERDEEN, S. D.—Plans are being considered by the Aberdeen Railway Company to extend its system to St. Luke's Hospital, work on which will begin in the near future.

BIG BEND, S. D.—Bids will soon be called for the construction of a transmission line from the power plant of the Dakota Power Company to Custer, a distance of 24 miles. The transmission line will also be extended to the mining properties in that district, 13 miles from Custer.

SIOUX FALLS, S. D.—The Sioux Falls Traction Company is planning to extend its system to the plant of the Morrill Packing Company, at a cost of about $20,000.

CHATTANOOGA, TENN.—The City Council has granted C. E. James and associates a franchise to construct and operate an electric street railway in Chattanooga. The new system is to have interurban extensions reaching many of the important towns and cities within a radius of 40 miles.

DYERSBURG, TENN.—Bonds to the amount of $30,000 have been voted, the proceeds to be used for improvements to the municipal electric light plant.

GALLATIN, TENN.—We are informed that specifications have been changed for the equipment, including one Corliss engine, two 100-kw alternating-current generators, two switchboards and two electrically driven pumps having a capacity of 500 gal. per minute, for which bids were called May 5. Bids will be called for on the revised specifications. E. L. Anderson is chairman of water and light committee.

JOHNSON CITY, TENN.—Plans are being considered for the construction of an electric railway from Johnson City to Newport, via Conklin, a distance of 55 miles. It is proposed to organize a company with a capitalization of $100,000.

MANCHESTER, TENN.—It is reported that the Riverside Mills property has been purchased by J. F. Boyd, D. D. Hicks, H. H. Trimble and E. C. and Joshua Huffman, all of Shelbyville, Tenn. It is understood that the new owners will rebuild the dam and install an electric plant for the purpose of supplying electricity in Manchester. Application will be made to the Council for a franchise to supply electricity to light the city.

DENTON, TEX.—The construction of an interurban electric railway between Dallas and Denton is being promoted by Alvin P. Owsley, of Denton, and others. The project is meeting with much favor by the residents of the towns along the route. Free right of way is being granted and large subscriptions to the stock have been made by the farmers and others for the proposed railway.

JONESBORO, TEX.—The Spring River Power Company, recently incorporated with a capital stock of $100,000, is planning to install hydroelectric plants on Spring River in this section and erect transmission lines to a number of towns. The officers of the company are: F. R. Land, president; J. D. Brown, secretary; and W. H. Vaughn, treasurer.

KNOX CITY, TEX.—Plans are being made by R. W. Warren and associates for the installation of an electric light plant, an ice plant and steam laundry.

McALLEN, TEX.—The Town Council is reported to have granted A. L. Stang, of El Campo, Tex., a franchise to install and operate an electric light plant in McAllen.

ROSENBERG, TEX.—Arrangements are being made by the City Council for the installation of an electric light and power plant.

SAN BENITO, TEX.—The San Benito Interurban Railway Company is reported to be contemplating extending its railway to Santa Maria immediately. The company also proposes to build an extension upon the land of the San Benito Land & Water Company, requiring 30 miles of main track, in order to afford facilities for transporting this season's crops. S. A. Robertson is interested in the company.

TYLER, TEX.—The City Council has granted a franchise for a street railway system in Tyler for a period of fifty years to Thomas O'Hara and R. E. Hoskot, of Dayton, Ohio. Under the terms of the franchise work must begin on construction of the railway within four months and be completed within eighteen months.

YORKTOWN, TEX.—The Yorktown Light & Ice Company is making extensive improvements to its plant. The company has the contract for supplying power for operating the pumps of the city water works system.

SALT LAKE CITY, UTAH.—The property and franchise of the Utah Independent Telephone Company will be sold at auction on June 5 in Salt Lake City.

RICHMOND, VA.—The Washington & Old Dominion Railroad Company, recently granted a charter, proposes to build an electric railway from a point in Alexandria County opposite the District of Columbia to Winchester, passing through Alexandria, Fairfax, Loudoun, Clark and Frederick Counties. The maximum capital stock is placed at $3,000,000. The officers of the company are: Charles M. Henckley, president; W. B. Emmett, vice-president; Charles E. Howe, secretary, and George Howard, treasurer, all of Washington, D. C.

CASTLE ROCK, WASH.—The City Council has granted the Silver Lake Railway & Power Company a fifty-year franchise to supply electricity for lamps and motors in Castle Rock.

ELMA, WASH.—The Olympia Railway & Power Company, it is reported, has applied for a franchise to erect a transmission line in Elma to supply electricity for lamps and motors in this town.

SEATTLE, WASH.—The construction of an electric street railway from Oxbow to the Lake Burien district is reported to be under consideration. J. R. McLaughlin is said to be interested in the project.

FAIRMONT, W. VA.—Contracts will soon be awarded by the Fairmont & Pittsburgh Railway Company for the construction of the first section of its proposed railway to connect Waynesburg and Blacksville, a distance of 13 miles. Work will begin at Blacksville, on the State line between Pennsylvania and West Virginia. From Blacksville the company, under different charters, has built and is operating a railway to Fairmont and Morgantown. Right of way has been secured from Waynesburg to Bridgeville, where connection is to be made with the Wabash-Pittsburgh Terminal Company's line, which is to be equipped for electrical operation into the Liberty Avenue terminal.

GRAFTON, W. VA.—A charter has recently been granted to the Fairmont, Clarksburg & Grafton Railway Company to construct and operate an electric railway to connect Grafton, Fairmont and Clarksburg, work on which will begin at once. The company is capitalized at $500,000. The officers are: Charles F. Sutherland, of Morgantown, W. Va., president; John H. Roberts, general manager; C. Lee Reynolds, of Pittsburgh, Pa., vice-president; Charles C. Benton, of Pittsburgh, Pa., secretary, and A. B. Corder, of Grafton, treasurer.

MENOMONIE, WIS.—The plant and holdings of the Menomonie Electric Light & Power Company have been purchased by the Chippewa Valley Railway, Light & Power Company, of Eau Claire, Wis. The consideration is said to be $40,000. The Chippewa Valley Company has supplied electricity for operating the local system for some time.

BASIN, WYO.—Bids will be received at the office of James F. Ewers, town clerk, Basin, Wyo., until June 7, for furnishing materials and constructing improvements to the municipal electric light plant and water works system. Separate bids will be considered, as follows: 1. For furnishing material, labor and equipment (except as otherwise required by subsequent items in this notice) and constructing improvements to the water works and electric lighting systems. 2. For furnishing cast-iron pipe and special castings. 3. For furnishing hydrant and valves. 4. For furnishing pumping machinery. 5. For furnishing and erecting mechanical filter of 500,000 gal. capacity daily. All to be shipped f. o. b. Basin, Wyo. Plans and specifications are on file in the office of the town clerk Basin, Wyo., and at the office of Burns & McDonnell, engineers, Scarritt Building, Kansas City, Mo. Copies of plans may be secured from the engineers on payment of $10 to cover cost of the prints. W. S. Collins is Mayor.

CALGARY, ALTA., CAN.—Bonds to the amount of $350,000 will be issued by the Calgary Power Company to provide funds for the completion of its hydroelectric plant, which it is erecting at Horseshoe Falls, outside of Calgary.

GALT, ONT., CAN.—Surveys are now being made near Sheffield for the right-of-way for the proposed electric railway between Hamilton, Galt and Sheffield.

MONTREAL, QUE., CAN.—The National Hydroelectric Company, recently incorporated with a capital stock of $1,000,000, proposes to utilize the water-power of the Carrillon Falls, on the Ottawa River, 35 miles from Montreal. Henry Miles is president of the company and Louis Gosselin is secretary.

MELVILLE, SASK., CAN.—Preparations are being made for the construction of a municipal electric light plant in Melville, bids for which will be received May 25. Enoch Smith, of Melville, Sask., is engineer in charge.

PRINCE ALBERT, SASK., CAN.—Bids will be received by the city of Prince Albert until June 13 for the construction of dam and headworks and canal and power station foundations in connection with the proposed hydroelectric power development on the North Saskatchewan River at La Colle Falls, twenty-five miles east of the city. Plans and specifications will be on file and may be seen after May 23 at the City Hall, Prince Albert, and at the offices of C. H. and P. H. Mitchell, Traders' Bank Building, Toronto, Ont., Can.

New Industrial Companies.

THE BALCO MANUFACTURING COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $5,000 and proposes to manufacture electrical and mechanical machinery. The incorporators are: Howard M. Cox, George L. Cragg and James S. Rosenzweig.

THE BALTIMORE MACHINE PRODUCTS COMPANY, of Baltimore, Md., has filed articles of incorporation with a capital stock of $90,000 to manufacture electrical mechanical instruments and cabinet work. The company is a reorganization of the Viaduct Electric Company. Arthur P. Gorman, Jr., 804 Union Trust Building, Baltimore, Md., is president; Edmund C. Mayo, vice-president and general manager, and Conway S. Hodges, treasurer.

THE DIRECT DRIVE GEAR COMPANY, of Paterson, N. J., has been incorporated by W. S. Evans, I. D. Brokaw, of New York, N. Y., and J. W. Hill, of Newark, N. J. The company is capitalized at $500,000 and proposes to manufacture motor vehicles, engines, machinery, etc.

THE ELECTRIC WATER PURIFYING MACHINE SALES COMPANY OF PENNSYLVANIA has filed articles of incorporation with a capital stock of $5,000. The directors are: J. Lee McKnight, 1765 Frick Avenue, Pittsburgh, Pa., treasurer; James J. Cosgrove and George P. Langfitt, both of Pittsburgh, Pa.

THE A. P. HEYER COMPANY, of Montclair, N. J., has been incorporated by A. P. Heyer, G. D. Smith and W. W. Crane, of Montclair, N. J. The company is capitalized at $50,000 and proposes to manufacture motor cars, motor and electrical vehicles.

HOAGLAND, THAYER, INC., of Newark, N. J., has filed articles of incorporation with a capital stock of $25,000 for the purpose of manufacturing automobiles, motors, engines, etc. The incorporators are: A. M. Hoagland, of Rockaway, N. J.; G. H. Thayer and E. B. Thayer, of Jersey City, N. J.

THE LAFAYETTE ELECTRIC MANUFACTURING COMPANY, of Lafayette, Ind., has been incorporated with a capital stock of $40,000 by Albert Scheitilthe, William M. Baker and B. P. Shrearer. The company proposes to manufacture electrical appliances and devices of all kinds.

THE FRED LEE COMPANY, of New York, N. Y., has been incorporated by T. F. Lee, of Brooklyn, N. Y.; F. F. Green, of New Rochelle, N. Y., and P. M. Dreyfuss, of New York, N. Y. The company is capitalized at $25,000 and proposes to manufacture and repair electrical machinery.

THE NEW ENGLAND ELECTRIC FLOOR SURFACING COMPANY has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $100,000 and proposes to do a business of finishing and other treating of floors. The incorporators are: J. N. Satterfield, of Dover, Del.; B. S. Wellman, of Dayton, Ohio, and H. M. McLarren, of Columbus, Ohio.

THE REPUBLIC SIGN & ADVERTISING COMPANY, of Buffalo, N. Y., has filed articles of incorporation with a capital stock of $25,000 to manufacture and deal in electric signs, novelties, etc. The incorporators are: J. A. Kenny, H. F. Brink and E. A. Becker, of Buffalo, N. Y.

THE SPENCER CONSTRUCTION & EQUIPMENT COMPANY, of Rockport, Ind., has been incorporated by Benjamin F. Hoffman, Robert S. Crowder, John G. Rinslidt, of Rockport, Ind.; E. P. Cox and H. C. Watkins, of Louisville. The company is capitalized at $25,000 and proposes to construct and equip electric and steam railroads, telephone and telegraph lines, bridges, electric light, heat and power plants, etc.

THE STANDARD ELECTRIC & MANUFACTURING COMPANY, of Passaic, N. J., has been chartered by A. Voegtle, R. H. Voegtle and H. J. Voegtle, all of Sharpsburg, Pa.

THE STEWART SPECIALTY COMPANY, of New York, N. Y., has been chartered with a capital stock of $10,000 by Robert Stuart, Frank L. Nugent and Henry C. Spotley. The company proposes to do all kinds of electrical work.

THE VINCENNES TRACTOR COMPANY, of Vincennes, Ind., has been incorporated by J. N. Dyer, Frank L. Oliphant, Edward Watson, Charles Bierhares, B. F. Nesbit, R. M. Robertson and M. M. Alsop. The company is capitalized at $50,000 and proposes to manufacture and sell internal combustion engines, to be operated by gas, gasoline, kerosene and naphtha.

New Incorporations.

DECATUR, ILL.—The Decatur Light & Fuel Company has been incorporated, with a capital stock of $10,000, by John Boland, Robert Baird, William Diefthaler and Herman Cochran. The company proposes to supply light, heat and power.

EAST ST. LOUIS, ILL.—Articles of incorporation have been filed for the East St. Louis & St. Louis Traction Company by L. C. Haynes, C. E. Hewitt, I. B. Saeger, T. W. Gregory and M. W. Schaefer. The company is capitalized at $2,500 and proposes to operate a street railway in East St. Louis and vicinity.

EXCELSIOR, MO.—The Excelsior Water, Gas & Electric Company has been incorporated, with a capital stock of $500, by H. T. Henderson, S. W. Henderson and W. H. Pratt.

MAXVILLE, OHIO.—The Maxville Telephone Company has been chartered, with a capital stock of $10,000, by Samuel S. Hohler and others. Post office address Maxville, R. F. D. Logan, Ohio.

EAU CLAIRE, WIS.—Articles of incorporation have been filed for the Minnesota-Wisconsin Power Company by W. B. Parsons, C. A. Boalt, S. H. Somsen and others. The company proposes to supply electricity for lamps and motors in Nabesh, Lake City, Red Wing, Hastings, South St. Paul and possibly Winona.

MOSINEE, WIS.—The Mosinee Electric Light & Power Company has been incorporated with a capital stock of $6,000 by Arden Paronto, J. P. Kanter and others. The company proposes to install an electric plant in Mosinee.

CALGARY, ALTA., CAN.—The Alberta Railway Company has been chartered with a capital stock of $[illegible]0,000,000 for the purpose of constructing an electric railway from Calgary to Banff, Medicine Hat, Long Coulee, Lethbridge, Macleod and Wood Mountain.

MONCTON, N. B., CAN.—The Moncton Tramways, Electricity & Gas Company has been incorporated to build an electric railway in New Brunswick. The company is planning to build about 5 miles of track this year.

NIAGARA FALLS, ONT., CAN.—The Niagara Falls, Welland & Lake Erie Railway Company has been granted a charter by the Canadian Parliament to build an electric railway to connect Niagara Falls, Welland and Port Colborne, with branches to Port Dover on Lake Erie and to Fort Erie on the Niagara River opposite Buffalo. Work on construction of the proposed railway will probably begin in the spring.

QUEBEC, QUE., CAN.—La Compagnie Hydraulique Stadacona has been incorporated with a capital stock of $1,000,000 for the purpose of generating and distributing electricity, etc. The incorporators are: L. H. Gaudry, A. Potvin and P. E. Bernier, all of Quebec, Que.

Personal.

MR. GEORGE O'NEILL, who has been connected with the Topeka (Kan.) municipal electric-light plant for many years, has been appointed superintendent to succeed Mr. H. K. Goodrich.

MR. RAYMOND L. WITHAM, who has been instructor in electrical engineering at Purdue University for the past three years, has been appointed instructor in electrical engineering design at the Worcester Polytechnic Institute.

MR. H. L. DRAYTON, corporation counsel for the city of Toronto, Canada, has been appointed representative of the Hydroelectric Commission of Ontario on the commission which is to conduct the electricity supply business for the municipality.

MR. R. F. MIDDAGH has been appointed electrical engineer of the Steptoe Valley Smelting & Mining Company, McGill, Nev., to succeed Mr. W. K. Freudenberger, who has been appointed engineering expert for the Public Service Commission of Nevada.

MR. ARTHUR E. SMITH has been appointed superintendent of the sales department of the Little Rock Railway & Electric Company to succeed Mr. C. E. Rose, who has resigned to enter another business. Mr. Smith has been connected with the Little Rock Railway & Electric Company for the past seven years in charge of the meter department.

MR. EDWARD SCHILDHAUER, electrical and mechanical engineer for the Isthmian Canal Commission, is credited with the invention of the machinery that will be used for opening and closing the gates in the locks on the Panama Canal. Mr. Schildhauer was formerly connected with the engineering department of the Commonwealth Edison Company, Chicago.

MR. SAMUEL INSULL has been elected president of the Consumers' Electric Company, of New Orleans, following its recent reorganization. Mr. Alexander Hyman is vice-president and treasurer, and Mr. Esmond Phelps is secretary of the company. On the board of directors with Mr. Insull and Mr. Hyman will be Messrs. C. H. Ellis, W. B. Spencer, W. C. Faust and George Bullock. Mr. M. S. Hart is general manager.

PROF. HAROLD B. SMITH, who has been head of the department of electrical engineering of the Worcester Polytechnic Institute for the past fifteen years, has been granted a leave of absence for a period of two years. Prof. Smith has arranged to spend one year in travel and the remainder of the time in resident study at Berlin and Zurich. During his absence the department will be in charge of Prof. Joseph O. Phelon.

MR. MATTHEW J. KENNEY has been appointed superintendent of the lighting department of the Little Rock Railway & Electric Company in place of Mr. C. E. Rose, who has resigned to enter another business. Mr. Kenney, who has been an employee of the company for the past twelve years, has been in charge of lines and cables of the Little Rock Railway & Electric Company for the past three years, having previously been in charge of substation operation.

PROF. T. C. MENDENHALL, formerly of Ohio State University and later president of Worcester Polytechnic Institute, is on a visit to Japan, where when a young man he occupied the chair of physics in Tokyo University. In Kyoto Prof. Mendenhall was given an official reception by the university. The president of the university, Baron Kikuchi, was a colleague of Prof. Mendenhall at Tokyo, and Prof. Namba, head of the electrical engineering department, an assistant.

MR. C. E. ROSE, who has been superintendent of the lighting and sales departments of the Little Rock Railway & Electric Company some years past, has resigned to take the vice-presidency and general managership of the Arkansas Cold Storage Company. Mr. Rose will not only be the operating manager of the company but will be financially interested in it. He has been connected with the Little Rock Railway & Electric Company since his graduation from Cornell in 1905. Since being in charge of the lighting department of the company the business has more than doubled.

MR. H. H. SINCLAIR has resigned as general manager of the Great Western Power Company, the operating headquarters of which are at San Francisco. Mr. Sinclair still remains with the company, however, in an advisory capacity. His personal interests in Southern California called for so much of his time that he deemed it advisable in justice to himself to relinquish his duties as general manager of the Great Western system as soon as a successor could be found. Mr. M. Fleishhacker, of the Central California Traction Company, of San Francisco, has been chosen as Mr. Sinclair's successor.

MR. JOHN F. WALLACE, formerly chief engineer of the Panama Canal, has assumed active charge as president of Westinghouse, Church Kerr & Company. Mr. Wallace designed the new Chicago & Northwestern passenger terminal at Chicago which has just been completed at a cost of $25,000,000. He also acted as railway expert for the reorganization committee of the Seaboard Air Line, which was reorganized on the basis of his report, and the prosperity of this railroad since its reorganization has more than justified his conclusions and predictions as to its earning capacity.

DR. CLARENCE A. PIERCE has been appointed assistant professor of theoretical electrical engineering at the Worcester Polytechnic Institute to succeed Dr. George R. Olshausen, who has resigned after four years of service. Dr. Pierce received the degrees of B. S. and M. S. from Wesleyan and Ph. D. from Cornell University. He has been an instructor at Cornell University for the past six years. In collaboration with Dr. Frederick Bedell he has published two books on electrical testing. Dr. Pierce has spent five summer vacations in research work at the Bureau of Standards, Washington. He is a member of the two honorary societies, Phi Beta Kappa and Sigma Xi.

DR. SVANTE ARRHENIUS, of Stockholm, Sweden, delivered three lectures at Harvard University on April 25 and 28 and May 1. The titles were, "The Mutual Relations of the Exact Sciences," "The Theory of Electrolytic Dissociation" and "Absorption." On May 16 he delivered the third Weir Mitchell lecture of the Philadelphia College of Physicians. The subject was "The Passage of Micro-Organisms Through Interstellar Space; a Theory Bearing on the Origin of Life on a Planet." On May 17 he lectured in the Doremus Lecture Theater of the College of the City of New York on the subject "Electrolytic Dissociation," this day being the twenty-eighth anniversary of the publishing of his theory on this subject.

MR. FRANCIS E. DRAKE, who for several years has been the managing director of the Société Anonyme Westinghouse, of Paris and Havre, and principal officer in several of the Continental Westinghouse interests, has resigned from the active management of these properties to occupy himself with certain private interests, and, after a period of rest and recuperation, will establish his office at 16 rue Halévy, Paris. Mr. Drake is well known in general electrical circles for his work as director of machinery and electricity for the United States at the Paris Exposition of 1900, and as reorganizing expert of the Union Elektricitats Gesellschaft, Berlin, before the fusion with the Allgemeine Elektricitats Gesellschaft. Mr. Drake is interested in several electric enterprises in Europe, and will carry out, as engineer and contractor, certain tramway and railway lines now in process of development. The efforts of Mr. Drake in behalf of electric traction, especially in the direction of single-phase development, and other aid rendered to French industries recently received the recognition of the French government in the shape of promotion to the rank of officer in the Legion of Honor. Mr. Drake is a member of the Engineers' Club and a life member of the American Chamber of Commerce in Paris.

Obituary.

MR. ROBERT D. FERGUSON, manager of the new-business department of the Evansville Gas & Electric Light Company, Evansville, Ind., was drowned on May 3 as the result of a boating accident. Mr. Ferguson was out alone on the Ohio River in a launch, and in endeavoring to dislodge the boat from a snag he fell overboard in some manner and was never seen again. He was an excellent swimmer, and it is presumed that in falling he was rendered unconscious by striking a submerged log or the propeller blades. In that portion of the river the current is swift, and the bottom of the stream is covered with a thick growth of plants. At the time this was written the body had not been recovered. Mr. Ferguson was a native of Boston and thirty-four years of age. He graduated from Harvard University (Lawrence Scientific School) about nine years ago and shortly thereafter secured employment with the Chicago Edison Company, now the Commonwealth Edison Company. He was connected with various departments of the company. A man of excellent technical ability, he nevertheless preferred the commercial side of the central-station business, and at the time he left Chicago, about five months ago, he was a motor-service agent in the contract department. Mr. Ferguson was extremely popular among his fellow-employees of the Commonwealth Edison Company, and was also getting to be well liked in Evansville. He was unmarried, although a particularly sad feature of his untimely death is the fact that he was to have been married to an estimable young lady in a very short time. He was a cousin of Mr. Louis A. Ferguson and Mr. John W. Ferguson, of the Commonwealth Edison Company. If the body is recovered, it will be taken to Boston for burial.

Trade Publications.

ELECTRIC FURNACES.—Much information relating to electric furnaces and pyrometers is given in a booklet issued by the Hoskins Manufacturing Company, of Detroit, Mich.

DIRECT-CURRENT GENERATORS.—Engine-type, direct-current generators, ranging in rating from 30 kw to 1000 kw, are described in Bulletin No. 461 of the Triumph Electric Company, Cincinnati, Ohio.

TURBO-GENERATORS.—The Allis-Chalmers Company, Milwaukee, Wis., has issued Bulletin No. 1079, covering high-speed generators driven by steam turbines of the horizontal multi-expansion, parallel-flow Parsons type.

CANDLE FIXTURES.—The F. W. Wakefield Brass Company, Vermilion, Ohio, has issued a neatly illustrated booklet dealing with the Colonial design of candle fixtures for use with incandescent electric lamps.

POLE-LINE MATERIAL.—The Mohawk Electrical Supply Company, Syracuse, N. Y., has issued a booklet covering cross-arms, pins and brackets, glass insulators, galvanized hardware and various other line materials.

METAL REELS.—Catalog No. 101 of the Frank Mossberg Company, Attleboro, Mass., covers metal spools, steel reels, steel beams, jack spools, and flanged and flat disks.

EVAPORATORS.—The Briscom-Spencer Company, 90 West Street, New York, has issued Catalog No. 301, devoted to multi-coil evaporators designed for producing distilled water for use in power plants and ice plants.

SELF-CONTAINED GENERATING SETS.—Bulletin No. 130 of the Crocker-Wheeler Company, Ampere, N. J., is devoted to steam-engine-type, self-contained, direct-current generating sets, ranging in rating from 1.75 kw to 21 kw.

INCANDESCENT LAMP STANDARDS.—A bulletin issued by the Flour City Ornamental Iron Works, Minneapolis, Minn., calls attention to the Corinthian standards for use with incandescent street lamps, which have given such good service in Minneapolis.

SPRAY NOZZLES.—A booklet issued by the Buffalo Forge Company deals with spray nozzles, which are particularly desirable for use in the cooling of condensing water. A description is also given of a strainer intended for the protection of the spray nozzles.

WATERWHEEL-DRIVEN ALTERNATORS.—Bulletin No. 4799 issued by the General Electric Company describes in considerable detail several types of revolving-field alternators manufactured by this company. Both horizontal and vertical shaft alternators are illustrated.

STATIONARY TRANSFORMERS.—Transformers ranging in rating from 0.6 kw to 50 kw are illustrated and briefly described in a folder issued by the Triumph Electric Company, Cincinnati, Ohio. The bulletin contains complete data relating to the operating characteristics of each of the transformers.

OIL BREAK SWITCHES.—The General Electric Company has issued bulletins No. 4821, dealing with switches for use on circuits the voltage of which does not exceed 15,000, and No. 4823, referring to switches designed for voltages of from 22,000 to 110,000. These switches are top-connected and are, therefore, adapted to overhead station wiring. There is a double break for each pole and the break takes place in oil. The switches can be fitted with either hand-operated or solenoid-operated mechanism.

STEAM ROAD ELECTRIFICATION.—Circular No. 1517 of the Westinghouse Electric & Manufacturing Company contains a reproduction of a series of talks and illustrations appearing in the technical magazines from Jan. 1 to March 1, 1911, relating to the electrification of steam railroads. Illustrations are given of the electric locomotive equipments of the Pennsylvania Railroad, New York, New Haven & Hartford Railroad, Italian State Railways, Boston & Maine Railroad, Long Island Railroad and the Spokane & Inland Railroad.

RUNNING LIGHT TELLTALE BOARDS.—In Bulletin No. 4816 of the General Electric Company is described a new running light telltale board which has the approval of the Underwriters' laboratories, and affords a reliable means of indicating whether or not the running lanterns are lighted. The board may be located in the pilot-house, and is so arranged that both an audible and a visible warning are given on the failure of any of the lamps. This board is, of course, for use only on vessels equipped with an electric-lighting plant.

STEEL MILL MOTORS. The most severe and trying duty for which a motor can be employed is that of driving rolling mills and similar machinery. The shocks and jars which the motor must withstand are so heavy and overloads so sudden that the ordinary forms of motors are entirely unsuitable for the work. The fact that mill motors are required to stand rougher treatment than the average industrial motors make it necessary to use the utmost care in their selection. On this account the engineering information that is contained in bulletin No. 128 on rolling-mill motors recently issued by the Crocker-Wheeler Company, of Ampere, N. J., is of peculiar importance to anyone interested in this line of work.

ELECTRIC CHANDELIERS.—The Charles Polacheck & Brother Company, of Milwaukee, Wis., manufacturer of gas and electric fixtures, has issued its Catalog No. 18, devoted to electric chandeliers. This is a large catalog bound in cloth-covered boards, its 200 pages being 12.5 in. x 16 in. in size. The large pages give ample space for beautifully executed pictures of electric-lighting fixtures, and, in fact, the catalog consists mainly of a series of handsome plates illustrating all classes of fixtures from simple brackets to the most elaborate chandeliers. A number of the plates showing shades in art glass are printed in colors, and these pictures form one of the most striking features of a catalog which is altogether a notable production. Fixtures for both direct and indirect lighting are illustrated.

SWITCHBOARD INSTRUMENTS.—The Weston Electrical Instrument Company, of Newark, N. J., has issued a general catalog, No. 16, relating to instruments for alternating-current switchboards. The book contains a large amount of useful information regarding the design, construction and operation of the switchboard instruments. It is divided into seven sections. The first two sections treat of the manufacture, design and construction of electrical instruments. The third section is devoted to the operative characteristic of single-phase and polyphase wattmeters; the fourth section explains the theory and operation of a new type of non-rotating synchroscope; the fifth section treats of power factor and power factor meters; the sixth section gives information regarding the theory and the operation of a new type of frequency meter, and the seventh section is devoted to a new line of [illegible] and ammeters for use on alternating-current circuits, and also to the new model permanent magnet voltmeters and ammeters for [illegible] panels. The catalog is well written, excellently printed and handsomely bound. It contains 104 pages and is thoroughly indexed.

BUSINESS NOTES.

THE NATIONAL STAMPING & ELECTRIC WORKS have moved from 216 South Jefferson Street to 410 Clinton Street, Chicago.

THE PEERLESS V BELT COMPANY, of Chicago, will move on June 1 to Cedar Rapids, Ia., where it will have better facilities.

THE STAVE ELECTRICAL COMPANY has moved its main office from 27 West Twenty-seventh Street to 131 Hudson Street, New York.

THE NATIONAL STAMPING & ELECTRIC WORKS, which deal in electrical machinery and make electric water heaters and other specialties, have moved from 216 South Jefferson Street to 410 South Clinton Street, Chicago. F. L. Kohlhase is president of the company.

THE GENERAL ELECTRIC COMPANY OF TEXAS on May 1 opened a Houston office at 730-731 Chronicle Building, Houston, Tex., in charge of Mr. A. O. Jeonings. This office, together with those at El Paso, Tex., and Oklahoma City, Okla., is a branch of the general offices of the company at Dallas.

THE SHELBY ELECTRIC COMPANY, Shelby, Ohio, has opened a branch office at 516 Atlantic Avenue, Boston, Mass., in charge of Mr. C. H. Smith, who has had experience in the incandescent-lamp business for the past ten years, having been connected with both the Westinghouse Lamp Company and the Western Electric Company.

MORRISON & COMPANY.—Messrs. Louis I. Mur[illegible] and R[illegible] Vidal, as representatives of Morrison & Company, Chile, have established headquarters for the present month at 16 Murray Street, New York, at the office of the Goulds Manufacturing Company. Morrison & Company are engineers and importers of engineers' supplies and are contractors to the Chilean Navy and State Railways. Their representatives desire to be placed in communication with the manufacturers of electrical apparatus and general engineering supplies. The firm's headquarters are at Valparaiso, with branch houses at Santiago, Concepcion, Talchanano and San Felipe, Chile.

WESTINGHOUSE, CHURCH, KERR & COMPANY have chosen as their president Mr. John F. Wallace, formerly chief engineer of the Panama Canal. Mr. Wallace, who is also president of the Electric Properties Company, which controls Westinghouse, Church, Kerr & Company, still retains the chairmanship of the board of directors of Westinghouse, Church, Kerr & Company, but on account of his well-known engineering and railroad experience his greater activity in the affairs of the company was considered advisable. Mr. Wallace succeeds Mr. H. H. Westinghouse as president of Westinghouse, Church, Kerr & Company, Mr. Westinghouse having succeeded the late Mr. Walter C. Kerr. As other business affairs require all of Mr. Westinghouse's time, he recommended to the directors that Mr. Wallace be requested to assume the active management of the company as president. Among the directors elected at the annual meeting of the company were Messrs. N. W. Halsey and F. Q. Brown, of New York, George Westinghouse and J. R. McGinley, of Pittsburgh, and Homer Loring, of Boston.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 9, 1911.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

991,475. MANUFACTURE OF ELECTRODES FOR ARC LAMPS; A. Blondel and G. Dobkevitch, Paris, France. App. filed Oct. 15, 1903. Composed of a light-giving mineral substance and borate of barium.

991,480. OIL SWITCH; C. Christensen, Scotia, N. Y. App. filed June 3, 1907. A closed chamber filled with oil with co-operating contacts which separate under the oil to draw an arc and means for maintaining pressure in the chamber.

991,481. CURRENT-CONTROLLING DEVICE; A. J. Cline, Chicago, Ill. App. filed July 8, 1909. For controlling a power station by means of a movable switch operated by solenoids, an auxiliary switch and a controlled circuit, including one of the solenoids and the auxiliary switch which restores the movable switch to normal, the auxiliary switch opening the circuilt when the movable switch is at normal.

991,483. PROTECTIVE DEVICE; E. E. F. Creighton, Schenectady, N. Y. App. filed Sept. 18, 1907. Lightning arrester with spark gap over which insulating fluid flows at a greater velocity than that with which the vapor from the electrode moves across the gap to prevent the formation of an arc.

991,495. ARC LAMP; H. Friedrichsen, Berlin, Germany. App. filed July 10, 1908. Arc lamps with converging electrodes with a shield having a top opening for the electrodes, the openings being covered by plates.

991,502. KNIFE SWITCH; J. J. Hartley, Schenectady, N. Y. App. filed July 5, 1904. A pivot pin for an electric switch with a split shank and a circumferential groove. Other details.

991,511. CIRCUIT BREAKER; E. Johnson, Schenectady, N. Y. App. filed Aug. [illegible]. Automatically tripped switch with a force-multiplying connection between the handle and the switch, including a base, an actuating toggle, an operating handle and a tripping toggle for straightening the actuating toggle.

991,546. CIRCUIT-BREAKER; W. S. Ryan, Muncie, Ind. App. filed Sept. 12, 1908. Automatic solenoid-operated switch [illegible] for holding it closed, a rod adjustably connected with the solenoid core for operating the clutch, the rod and core [illegible].

991,556. HIGH AND LOW-POTENTIAL SELECTIVE SWITCH SYSTEM; R. Stearns, Schenectady, N. Y. App. filed [illegible]. Selective switch for cars comprising a high-potential switch and a low-potential switch so arranged that the first switch [illegible] the potential at the higher value and the latter [illegible] the potential at the lower value.

991,578. INCANDESCENT ELECTRIC LAMP; W. R. W[illegible], Schenectady, N. Y. App. filed Aug. [illegible]. M[illegible] the filament in position on the lamp bulb, [illegible] movable tubular cap inclosing a spiral spring [illegible] carried by the cap.

991,583. BELL DESK INSTRUMENT; C. J. W[illegible], W. Va. App. filed Aug. 5, [illegible]. Te[illegible] levers connected to the bracket and carrying a receiver [illegible] making and breaking devices, so that the [illegible] may be positioned with one hand.

991,590. ELECTRICAL SWITCH; [illegible] Washington, D. C. App. filed April 20, 1907. Te[illegible] keys with selective plungers, selective contacts, [illegible] locking means [illegible] the plungers and a latch plate [illegible] with the locking means to lock any one of the plungers out of normal, the latch plate carrying means to release [illegible] all of the previously depressed plungers.

991,626. INDUCTION MOTOR; C. E. Lord, Milwaukee, Wis. App. filed Sept. 13, 1909. The rotor core carrying squirrel-cage bars with short-circuiting rings, connecting corresponding ends and magnetic material carried by the bars. The short-circuiting conductors have a greater reactance and the secondary circuit has a greater impedance on starting, which diminish at speed.

991,634. AUTOMATIC CUT-OUT FOR ELECTRICAL CONDUCTORS; M. G. Newbould, Napier, New Zealand. App. filed June 19, 1908. For cutting off the current in a section of trolley wire when the wire breaks. Current is taken from two wires, passed around electromagnets to balance an armature controlling a circuit-breaker, which is operated when the current ceases to flow through one circuit by the breakage of the wire.

991,654. TELEPHONE EXCHANGE SYSTEM; N. C. Schellenger, Chicago, Ill. App. filed Feb. 14, 1901. Supervisory and clearing-out signal, there being two indicators or lamps indicating the use of the calling and called lines. Two relays are associated with each indicator, one operated by the switch hook on hanging up the receiver and the other when the receiver is taken off. The former operates a grounded bell.

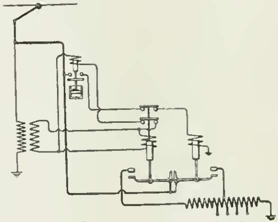
991,661. CONTACT FINGER; H. A. Steen, Milwaukee, Wis. App. filed Sept. 6, 1910. The contact finger with a resilient end, a support to which a spring is connected, which is connected with the contact finger with adjustable connections between them.

991,672. PRINTING TELEGRAPH; G. S. Tiffany, Summit, N. J. App. filed Jan. 3, 1910. A rotating magnetizable member controls the movement of the type mechanism and is operated by a magnet, the movements of the magnetizable member being dampened and the circuits being controlled so as to shift the poles and move the type mechanism.

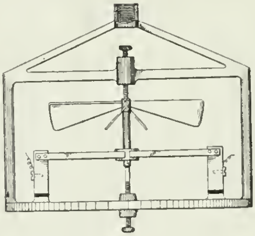
991,684. CHAIN GUIDE FOR ELECTRICAL PULL SOCKETS; D. P. Wolhaupter, Washington, D. C. App. filed Feb. 15, 1911. A two-part casing with two-part guide body, sections of the body being carried by the casing and switch body of the socket.

991,685. PROCESS AND APPARATUS FOR PURIFYING ACID ELECTROLYTE USED IN REFINING COPPER; C. H. Aldrich and J. K. Bryan, Perth Amboy, N. J. App. filed June 25, 1910. A series of heated containers arranged in cascade for fractionally separating the metals from the residue, except the arsenic and antimony, which are separated by electrolysis.

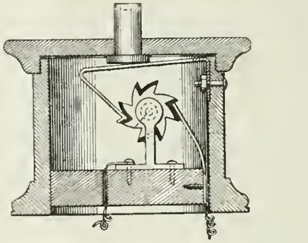
991,695. APPARATUS FOR ELECTROCHEMICAL TREATMENT OF ORES; T. Buhola, Luipaardsvlei, Transvaal. App. filed Aug. 27, 1910. A vat with an electrode in the lower part, movable electrodes in the upper part, the upper electrodes being given a planetary motion and the contents of the vat subjected to an electric current in the presence of cyanide.



991,556.—High and Low-Potential Selective-Switch System.



991,903.—Fire Alarm.



992,077.—Push-Button Switch.

991,729. PORTABLE HEATER; O. C. Knipe, Palo Alto, Cal. App. filed Oct. 17, 1908. A flat body around which the heating element is cast, a non-conducting cover, flexible hinges for connecting the various members together and a metal protecting cover for the series.

991,743. METHOD OF MAKING ARTIFICIAL STONEWARE; R. F. Osborn and J. Roach, Ainsworth, Neb. App. filed May 7, 1910. Passes loose dry sand through a heated zone whose temperature is regulated by an electric current.

991,749. LIGHTNING ARRESTER; A. R. Rheinberger, St. Paul, Minn. App. filed March 29, 1909. An insulator which supports a line wire, electrodes including frusto-conical shells with recesses, insulating elements therein with spaced electrodes and supports depending from the line wire attached to the electrode.

991,767. APPARATUS FOR PRODUCING OZONE; C. G. Armstrong, Orange, N. J. App. filed May 15, 1909. A stack of glass plates carrying sheets of conducting material with a fan for blowing air through the stack, the glass plates being electrified.

991,787. DYNAMO-ELECTRIC MACHINE; W. B. Kouwenhoven and G. B Wilkins, New York, N. Y. App. filed June 8, 1910. Direct-current shunt-field machines with a choke coil in series with the armature of the motor and parallel with the field to protect it.

991,829. ELECTRICAL RELAY; E. E. Clement, Washington, D. C. App. filed June 6, 1906. For telephone exchanges for operating more than two pairs of contact springs. The electromagnet has pole pieces, a yoke piece holding them against the cores and an armature pivoted on the yoke piece which operates the contact springs above the armature.

991,837. WIRELESS SIGNALING SYSTEM; S. Eisenstein, Berlin, Germany. App. filed Aug. 25, 1905. For sharp selectivity. Replaces single-phase current by multi-phase current in operating the discharge gap, different discharges occurring at the spark gaps for each phase.

991,841. RESISTANCE COMPOUND; W. E. Gardiner, Pittsburgh, Pa. App. filed Oct. 6, 1910. For electric heaters, consisting of a mixture of lampblack and boneash.

991,849. TRIPPING DEVICE REGULATOR FOR ELECTRICAL SWITCHES; P. Herd, Johannesburg, Transvaal. App. filed Sept. 4, 1909. For electric motors. A tripping coil, a weighted lever which can be adjusted vertically and which engages and retards the movement of the armature, thus increasing the point of overload release without altering the normal operation, so that at starting the extra normal current will not trip the switch except on overloads.

991,853. ELECTRIC CIRCUIT CLOSER; J. A. Kennedy-McGregor, Birmingham, England. App. filed April 2, 1910. For motor starters. The contact arm is coupled to an operating arm so that an excess of pressure by the operator when starting disconnects the contact arm so that the resistance must be cut out gradually.

991,854. PILOT-LIGHT SYSTEM FOR ELEVATORS; P. T. Kenny, New York, N. Y. App. filed Aug. 1, 1908. For operating signals on holidays when the car is normally on the ground floor by means of push buttons at each floor, parallel switches and restoring mechanism which open the switches for the up buttons when the car is moving up, together with down-restoring mechanism opening the switches for the down buttons when the car is moving down.

991,860. INK DRIER AND STATIC CHARGE REDUCER FOR PRESSES; M. L. Lane, Detroit, Mich. App. filed April 8, 1910. A tubular roller extends along the press cylinder and carries inside of it an electric heater of special construction.

991,877. ELECTRICAL LIQUID HEATER; A. P. Nichols, Seattle, Wash. App. filed Jan. 13, 1910. A superposed series of conducting plates with an insulating covering, with openings for the passage of the liquid, the alternate poles being connected with the poles of an electric generator.

991,897. POSITIVE PLATE FOR STORAGE BATTERIES AND PROCESS FOR THE MANUFACTURE THEREOF; P. G. Salom, Philadelphia, Pa. App. filed July 27, 1909. An initially formed positive plate carrying externally formed active material with solid particles of binding material disseminated through the mass.

991,903. FIRE ALARM; Frank Simonyi, New York, N. Y. App. filed July 21, 1910. Thermostat and electric circuit for operating a signal with a fan for closing the contacts operated by a draft of hot air.

991,912. LIGHTNING ARRESTER; E. W. Vogel, Chicago, Ill. App. filed June 8, 1908. A lightning arrester with a ground terminal and a series of superposed electrically connected annular plates of conducting material surrounding a terminal; certain of the plates have toothed inner edges.

991,928. TELEPHONIC RELAY SYSTEM; C. G. Ashley, Chicago, Ill. App. filed July 24, 1909. For reinforcing telephone currents by means of a unipolar generator having a winding subject to telephonic current, modifying the normal magnetism of the generator, a primary supplied with current by the armature and a secondary which steps up the pressure of the current supplied thereto by the primary and impresses the transformed current upon the telephonic circuit.

991,929. FURNACE; T. F. Baily, Alliance, Ohio. App. filed June 15, 1910. A gas chamber and an electric chamber arranged horizontally side by side, the gas chamber having gas-heating means, the electric chamber electric-heating means, the chambers intercommunicating.

991,957. TROLLEY-POLE ATTACHMENT; F. H. Crane, Cleveland, Ohio. App. filed Nov. 23, 1910. A trolley head to follow the curve, consisting of a cylindrical casing at the end of the trolley pole upon which the trolley wheel is pivotally mounted, the pivot extending within the casing and being provided with brackets and bearings within the casing and a spring for centering the wheel.

991,964. SIGNAL FOR CROSSINGS; T. M. Flaherty, Pittsburgh, Pa. App. filed Sept. 24, 1909. To show the right-of-way by means of an arrow on a cap at the top of a post which is operated by a pawl and ratchet actuated by an electromagnet.

991,973. ELEVATOR-SIGNALING APPARATUS; J. M. Graham, New York, N. Y. App. filed Feb. 25, 1908. The operator in running by the floor leaves the circuits in condition to operate the signal for the next car. Restoring mechanism and resetting mechanism are controlled by the electric circuits leading to the elevator cars and a circuit controller within each car controls the resetting mechanism.

992,009. WATERPROOF SWITCH; D. McL. Lang, Corry, Pa. App. filed Nov. 2, 1909. A casing containing a switch blade and contact blocks with a spring for moving the blade away from the contacts, a cam on the blade and a lever between the ends of the blade to engage the cam.

992,021. ELECTRICALLY HEATED VESSEL; M. Marzetti, Milan, Italy. App. filed Dec. 2, 1909. For coffee-pots and the like. Electrodes of carbon dip into the water to be heated.

992,035. TROLLEY SWITCH; C. P. Nachod, Philadelphia, Pa. App. filed May 21, 1910. Trolley switch operated by the traveling wheel and giving a signal as the wheel passes the switch. A supporting frame extending lengthwise of the trolley wire carries contact strips which are engaged by the wheel.

992,042. WIRELESS TELEGRAPHIC APPARATUS; M. A. Parisano, New York, N. Y. App. filed May 27, 1910. The antenna includes a continuous wire and a plurality of loops which pass through perforated supports. Connections between the loops and sockets are joined to the wire at varied distances from its end and a connecting plug fits the sockets. Lamp bulbs carry micrometer spark-gaps.

992,077. PUSH-BUTTON SWITCH; E. D. Stalfort, Baltimore, Md. App. filed Sept. 14, 1910. Push-button switch with star-wheel contact and alternate teeth, insulated so as to raise the fixed contact out of engagement with the wheel on alternate steps.

992,139. VALVE STARTER ALARM; J. A. Poché (deceased), New Orleans, La. App. filed July 28, 1910. An electric circuit closer is carried by an extension and an electric contact is in the path of the circuit closer to close a circuit when the valve is opened.

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THE CONVENTION CITY.

As the metropolitan capital of the Western Hemisphere, and a city familiar more or less to all Americans, it is needless here to refer to the civic institutions and boundless activities of New York. Looking only at its electrical side, in no other city is public-utility service quite so closely related and quite so necessary to the daily life of the community. Service here means service, and is paramount to all other considerations. Millions are invested in reserve apparatus so that the people may have light and transportation no matter what else may betide. To be sure, in a community numbering over 4,750,000 of human beings, such precautions are necessary; but while the unthinking public appreciates in the main the quality of the service rendered, it has no comprehension of its cost and the eternal vigilance necessary to its accomplishment. Members in attendance on the convention next week of the National Electric Light Association will have unusual opportunities of becoming acquainted with the big side of the central-station industry. Here are grouped the largest steam-driven power stations of the world, magnificent in their layout yet withal conservative in engineering practice. The city is pre-eminently the electrical center of the world, the equipment of whose power houses exceeds by approximately 100 per cent that of the monumental generating stations erected on the American and Canadian sides of Niagara, the next largest center of electric development. The finest and largest steam engines and steam turbines ever built may be seen in New York. The city is smokeless and for the most part poleless. Electric light, railway, telephone and telegraph wires are chiefly underground.

Examples of the most expensive and most enduring construction in power houses, substations, distribution systems, underground, surface and elevated railways, gas holders, etc., are everywhere to be seen. Hundreds of millions of dollars have been expended by the great trunk lines entering Manhattan Borough in electrifying that end of their roads and in erecting monumental terminals. New York has not only to contend with the most complex problem in transportation, but it is also the scene of greatest activity in electric traction construction in the world. The subway system operates daily with ten-car express trains every minute and three-quarters and manages to care for over 1,000,000 passengers daily. Some comprehension of the traffic conditions may be had from the fact that the various city railways carry in round numbers 1,500,000,000 yearly. Incidentally the chief railway generating station possesses the greatest number and the largest exhaust steam turbines ever built and operates at an average economy unequaled by any other large system in the country. Electric light men will find much to interest them in the electric signs, street lighting, lamp posts and the systems of the local lighting companies, particularly in that of the New York Edison Company, which controls about four-fifths of the electric lighting business of the city, a considerably larger proportion than the Consolidated Gas system possesses of the total gas business.

As to the convention arrangements themselves, much that is commendatory may be said. Never in the history of the association have the sessions been held in such ideal quarters, for the Engineering Societies Building is the finest structure of its kind in the world. All the plans that forethought and experience could suggest have been made to avoid confusion and chaos, and indications point to the most successfully conducted convention ever held by the national body. The hotel arrangements have been carefully made and reservations secured in the finest hostelries in the country, all of which are moreover within a few minutes' walk of the convention quarters. Entertainment features have been provided in abundance so as to hold the delegates intact, and in a city like New York this is a wise provision. The convention program itself leaves nothing to be desired. It consists chiefly of committee reports embodying definite suggestions. If conscientious work has been done a new record should result; for in an organization the size of the National Electric Light Association much of the matter to be presented must of necessity be predigested by committees or the convention will become unwieldy. It is predicted that the attendance will be the largest ever recorded and we trust the interest will be commensurate with the size of the gathering.

WHY NOT NATIONAL ELECTRIC ASSOCIATION?

When the National Electric Light Association was established in 1885 the name adopted was a very apt and expressive one. The great possibilities of electric lighting were dimly realized and an enthusiastic band of electrical business men in Chicago, mainly representatives of manufacturers and supply dealers, issued a call for the first meeting in the year mentioned. But in a very few years the association passed into the control of the operating electric central-station companies of the country, and for the last twenty years it has been the great representative of the commercial electricity-supply industry of the United States. It has grown from a membership of seventy-one to more than 100 times that number, and its beneficial influence on the industry it serves has been almost incalculable.

With the development of the art and the expansion of the central-station service, the member companies of the association have come to distribute electricity that is used to supply not only light but also heat and to operate motors for all kinds of machinery. What the association stands for now, and has for a number of years stood for, is electric service. Indeed, the expression "electric-service company" seems to be gradually supplanting "central-station company" as more accurate, since telephone, gas and private water-works companies also provide utilities from central stations. The useful term "electricity-supply company," employed in Great Britain, appears never to have obtained a foothold in this country in popular speech, although it describes precisely the function of the electric central-station company.

In view of the fact that the name "National Electric Light Association" is now inadequate to outline the functions of the association, has not the time arrived to consider its modification to insure comprehensive accuracy? "National Electric Service Association" would be truthful and expressive, but perhaps it would be still better simply to drop the word "light," making the name of the organization "National Electric Association." Would this not be a change for the better as indicating the wide scope of the society? One practical advantage would be that the name would be shortened 25 per cent, and all who are engaged in society organization work or in technical journalism will testify that this is a real advantage. It may be objected that the present name is of historical significance, or possibly there may be some legal objection to the change of name. But it would seem, nevertheless, that the change is desirable, and therefore we venture to offer the suggestion for the consideration of the association. It will be remembered that with the development in electric railroading the old American Street Railway Association altered its name first to American Street and Interurban Railway Association and recently to American Electric Railway Association. So that there is precedent for the so-called National Electric Light Association to change its name to signalize the progressive broadening of its field.

THE MODERN ELECTRIC CLUB.

One of the pleasing indications of the constant vitality of the electrical industry and the wide-awake interest of those engaged in it is the number of electric clubs—often luncheon clubs—in different cities of the Union, but particularly in the West. Such clubs exist in Cleveland, Chicago, St. Louis, Denver, Minneapolis, Omaha, Los Angeles and other cities. They do a great deal of good in making electrical men acquainted with one another and inculcating a fraternal spirit of harmony, and at the same time it is the usual practice to present papers and addresses, not always of a technical or even of an electrical nature, but giving the members something new to think about. Meetings are held weekly or monthly, and it is found that these gatherings arouse a spirit of enthusiasm among men engaged in the various branches of the industry that would be difficult to bring about in any other way.

In Chicago the Electric Club, now three years old, has demonstrated its usefulness and popularity, and may be cited as an example. Here the membership is limited to 500, and the present number of members is 330. This number was considerably larger a year ago, but the present list represents only men who actually take an interest in the club and who pay their dues. Members who fail to pay their dues are dropped from the roll after a reasonable lapse of time, so that the present membership is an actual and not a fictitious list. The club has over $3,000 in its treasury, and may some time procure permanent quarters, although the prevailing feeling is to move slowly in this matter and not to put up too much sail, so that the organization will not be driven on the rocks, as was the case with a former and more pretentious Chicago Electric Club some years ago. The present arrangement is to hold the weekly luncheons in a room set aside for the club at a restaurant.

A feature of the work of the Chicago club has been the providing of speakers at the weekly luncheons. This has proved a drawing card, as the names of the speakers and their subjects are announced in the notices of the meetings mailed to members in advance. During the club year ended Jan. 31, 1911, forty-seven meetings were held, there being no meetings during the month of August. At thirty-eight of these meetings speakers were provided, the other meetings being principally social meetings in charge of the entertainment committee. The average attendance at meetings where speakers were announced was fifty-one and at the purely social meetings forty-five, showing that the privilege of hearing the speakers was appreciated. Several speakers of prominence were secured, including Dr. C. P. Steinmetz, Mr. Bion J. Arnold, Mr. R. R. McCormick, president of the Chicago Sanitary District; Dr. R. A. Millikan, professor of physics in the University of Chicago, and others.

The talks given were not all of an electrical nature, about one-third being on non-electrical subjects. The subjects discussed show a wide range; some of the addresses were scientific or technical, some practical or commercial, and some in lighter vein. Nine of the speakers were connected with public-service enterprises, either municipally or privately operated; six were electrical engineers, five were electrical business men, five were lawyers, and the remainder were scattered among a number of occupations. The club affords a place where electrical men of all shades of opinion may gather, and, therefore, is considered a free and open parliament for speakers of varying views, provided the organization is not used for mere personal advertisement. Electric clubs of this character have proved their value in Chicago and elsewhere, and no doubt the example is one that might be followed to advantage in other cities where electric clubs do not exist at the present time.

THE LUMINOUS EFFICIENCY OF INCANDESCENT LAMPS.

In the Digest of contemporaneous electrotechnical literature reference has been made to an article by Dr. Leimbach, in the *Elektrotechnische Zeitschrift,* on the radiation properties of incandescent lamps. Certain definitions are presented in the article that call for notice before the conclusions can be clearly apprehended. The relative radiating power is defined as the ratio of the radiated power to the absorbed power of a lamp, the light-effect is defined as the ratio of the luminous radiation to the total radiation, and the net efficiency or useful effect is taken as the ratio of the luminous power to the power absorbed. Only four types of lamps are compared, namely, the carbon-filament, Nernst, tantalum and osram lamps. The highest relative radiating power (75.6 per cent) is given to osram, which means that three-quarters of the power absorbed at the lamp terminals is converted into radiation presumably reaching the external surface of the lamp, and one-quarter is lost within the lamp non-radiatively—that is, by conductive and corrective heat. The light effect is also highest in the osram lamp (4.6 per cent), which means that over 95 per cent of the power radiated from the lamp is non-luminous. Consequently the efficiency, or useful effect, of the osram lamp is the highest among those compared, or 3.5 per cent, which means that about one-thirtieth of the power consumed at the lamp terminals is translated into light, the remainder being converted into heat not capable of affecting the eye. Although the luminous efficiency of the best available incandescent lamps is shown to be miserably small, yet this conviction carries with it the comfort that there is much room for improvement. Just as we are led to believe that virtue is self-rewarding but humdrum, and heaven is driven to find its joy in the repentant sinner, so a world of unity-efficiency lamps would be well lit but gloomy, while low-efficiency lamps light up the hearth of hope.

DUPLICATION COST DUE TO COMPETITION OF PUBLIC-SERVICE COMPANIES.

Public-service corporations are willing generally to accept the principle of regulation provided they are protected from competition. It is obviously unjust for a state or municipality to regulate the rates of a public-service utility and at the same time permit the further regulation due to competition. This condition of double regulation exists to some extent in the telephone situation in Chicago. There the principal telephone company is obliged to make rates fixed by a city ordinance and at the same time it faces the prospect of competition from a competitor long dormant, but which is now making active preparations for effective telephone service. Bearing on this situation an interesting resolution was introduced recently in the City Council of Chicago by the chairman of the committee on gas, oil and electric light, which has in charge the revision of telephone rates. This resolution touches a situation that has an interest extending beyond the confines of Chicago, and which relates to all public-service enterprises where competition exists or may exist.

In the preamble of the resolution it is set forth that public-service corporations are natural monopolies, and, when subject to reasonable regulation, can best fulfil their functions when unhampered by competition. History shows, it is said, that such competition must necessarily be of brief duration, ending with the absorption of one company by another. The resolution goes on to show in its preamble that the consolidations mentioned result in the purchase of much duplicate property for which actual expenditure has been made, as well as franchises and rights representing no actual expenditure. It is therefore declared to be the sense of the City Council of the City of Chicago that in all consolidations and combinations of public-service corporations in that city the construction account of the purchasing company shall be charged only with the cost of the property actually used by, and useful to, the purchasing company in the furnishing of the service involved. In any future negotiations looking to the determination of reasonable rates for such service the valuation to serve as the basis for such rate determination shall embrace only such property as has been constructed at the actual cost price and which is not an unnecessary duplication of the property of the purchasing utility, including an allowance for engineering, supervision, interest, taxes and insurance during construction, plus 8 per cent since the date of construction, less the profits which have been taken out of the property, which are not to exceed 8 per cent.

Apparently the Aldermen of Chicago were uncertain whether this resolution should be adopted, and it was accordingly referred back to the committee where it originated. The purpose of the resolution is undoubtedly to protect the public against rates for public service made too high by unnecessary duplication of physical property, and, more than that, by including the valuation of franchises and licenses representing no actual expenditure. Of course, a still better way to meet this situation is not to permit competition to get a foothold where the existing utility is subjected to governmental regulation. In the particular local case to which the Chicago Alderman's resolution applies the competing company had a franchise granted it a number of years ago, before the present-day ideas of periodical revision of rates had obtained acceptance.

Exactly what the effect would be of the acceptance by the Chicago authorities of the principle laid down in the resolution it is difficult to predict. Perhaps the competing utility would have little incentive to sell out if no allowance were made to it for the value of its franchise. The equities of the situation are somewhat complicated; but, at any rate, it is significant to observe that municipal authorities are giving their attention to the anomalous situation presented where there is at once regulation by the authority of the state or municipality and by the force of competition.

A STUDY IN CONSERVATION.

There has been much discussion regarding the effect of deforestation on the flow of streams and upon rainfall, but the definite information on the subject has been very small in amount. Now and then some particular case, like the Paris floods of last year, has been traced with considerable certainty to conditions resulting from the gradual deforestation of the watershed. Data in the United States have been particularly unsatisfactory, even to an extent that has permitted those who are pecuniarily interested in the rapid destruction of forests to challenge the production of definite information. In point of fact the exact analysis of the various causes leading to abnormally high and abnormally low flow of streams requires an accumulation of facts over so long a period that the forest destroyers would have ample opportunity to clean up the rest of the available woodland long before certainty in the matter could be reached. However, Circular No. 176 of the United States Department of Agriculture gives a sufficient amount of information concerning a number of American rivers to make it clear that deforestation is at least highly dangerous to stream flow and probably productive of somewhat disastrous results Both the Geological Survey and the Forest Service have been studying the subject, and, as the circular sets forth, "the results warrant the statement that, unmistakably, floods are steadily on the increase on some of our most important rivers. Particularly is this true of the rivers which rise in the Eastern mountains. The increases seem to be greater on those watersheds where the condition of the surface has been the most changed." This is quite what was to be expected from the general principles involved.

The real conditions are somewhat masked by the irregular variations in rainfall. It has sometimes been claimed that rainfall itself is affected by deforestation, but of this there appears to be no sufficient meteorological evidence, at least as regards ordinary conditions. In a large way it still may be possible that the distribution of rainfall, if not its absolute amount, may be affected by the change of surface conditions produced by deforestation. It would be interesting, for example, to know what would be the probable effect of stripping the northern part of the coast range along the California coast and leaving it as bare as is the southern extension of that range. The facts set forth in the circular before us, however, deal only with the frequency of extreme conditions, either of flood or low water, and where these are obtained by comparison of two successive decades the latter one covers a period in which deforestation has been particularly active. Taking ten important rivers rising in the Appalachian system, it was found that eight out of the ten showed very material increase in the floods during the latter half of the period investigated as compared with the earlier half. In most of these instances the periods of low water had increased as well, which is a natural result of the same conditions as those that would produce increase of flood.

To take one typical example, the Potomac was investigated by means of records covering the period from 1890 to 1907 inclusive. During the first half of this period there were nineteen floods and fifty-four periods of low water. During the second half there were twenty-six floods and seventy-six periods of low water. The same sort of data were found in most of the other streams investigated. This is enough to justify at least the gravest suspicions regarding the effect of the steady deforestation that has been going on. When one comes to analyze the actual effect of deforestation it becomes evident that the most serious result, although fairly chargeable to the fact, is indirect; that is, the destruction of the forest sponge by fire following cutting off of the trees. As everyone knows from experience, vast quantities of saplings are left wherever lumbering goes on, ready to start tremendous fires on small provocation. Once an area is thus burned over its value as an element in the watershed is very greatly diminished, and when several times burned over, as is frequently the case, the results are even more serious. When this burning occurs in a mountainous region and is accompanied by denudation, as often happens, the damage is permanent, and even where there is no denudation it takes a long period of years to remedy the conditions produced. An interesting sidelight is thrown on the subject by a study of rare cases in which floods have decreased within periods similar to those already considered. In at least one of these cases the effect is traced with a high degree of probability to the breaking up of the hard surface of the prairie and its replacement by well-tilled farming land. Farming land appears to be next to forest the best conservator of rainfall, much inferior to forest it is true, but vastly better than barren rock and hard native sod.

The problem of conservation as regards stream flow is chiefly that of protecting the watershed against destruction of the forest sponge. The chief damage is done not so much by the destruction of the larger trees as by the incidental exposure to fires which destroy everything, even going down to the rock and leaving the ground ready for gradual but complete denudation. In a study of the Potomac River made by the Geological Survey it has been shown that more than one-quarter of the effective upper drainage area of the river has already been practically destroyed by fires following extensive cutting. The change produced by this destruction is computed by the Geological Survey to amount in any period of vigorous rainfall to a reduction of natural storage capacity amounting to 6,000,000,000 cu. ft., so that during even a few days of rain this huge extra amount would run off to produce flood instead of being held back to come into the stream gradually after the rain ceased. The effect of this damaging condition is felt over and over again throughout the year. The importance, therefore, of close control of the wooded watersheds of the country stands out clearly enough.

Reasonable supervision of the conditions of cutting, such as is easily exercised when the areas are under government control, is capable of doing much good in the way of preserving the flow of the streams. It is a mistake to suppose that permanent preservation of a given forest growth is the object of such conservation. This would unquestionably hold conditions stable, but they can be held under good control merely by proper regulation—that is, by intelligent forestry directed, first, toward the prevention of the permanent damage that comes from denudation and, second, to such regulation of cutting as shall prevent the destruction of the forest shelter either directly by indiscriminate stripping of the land or indirectly by the fires which always follow reckless lumbering. Bearing in mind the evidence presented in the circular referred to, the bill passed at the last session of Congress for the preservation of the Appalachian watershed is a subject for national congratulation. It comes too late to preserve much that can now never be recovered. It is in time, we hope, to prevent further serious damage. The hydraulic resources of the country are so steadily rising in importance that their preservation is a matter not of sentiment but of general concern.

A NEW FORM OF ARC LAMP.

In a paper abstracted in the Digest three French investigators, MM. Urbain, Scal and Feige, describe a new form of arc lamp which possesses some curious and perhaps valuable properties. The object of the investigation was specially directed toward the production of an arc extremely rich in ultra-violet rays, but incidentally the result was an arc not only rich in the ultra-violet but more than usually efficient as an illuminant. A great deal of nonsense has been talked about the ultra-violet rays, chiefly, we are afraid, by people with strange kinds of protective spectacles to sell. It is undoubtedly true that reckless exposure to ultra-violet rays is inadvisable, like reckless exposure to extremely intense radiation of any kind. In particular, the ultra-violet rays may give one a disagreeable case of sunburn and affect the eyes superficially, with the production of disagreeable symptoms akin to sunburn. Arc lamps, including the carbon arc, the magnetite and the titanium arcs and the quartz-mercury arc, are well-known sources of ultra-violet rays, and occasional cases of trouble to the eyes from these sources appear. It should be mentioned, however, that such accidents seem to be strictly avoidable in the sense that they have occurred only to those who have been exceedingly careless and exposed themselves at short range to the powerful radiations to an extent that would be unwise if they gave off no ultra-violet radiation at all. In other words, the reasonable precautions which one ought to take in dealing with very powerful light sources as such are practically effective against the ultra-violet portion of the radiation of some sources. The only exception to this rule, perhaps, is the Finsen arc between iron terminals, which is relatively weaker in the luminous radiations than the others, but very strong in the ultra-violet. This arc, from which very serious accidents have been reported, is, however, not used for lighting purposes as such, and hence is unlikely to produce any injuries that can properly be classified as accidental.

It was toward the production of an arc of this class, specialized as it were for ultra-violet radiation, that the French investigators bent their efforts. The value of the ultra-violet rays for bactericidal purposes, as in the sterilization of water and various other substances, the bleaching of oil and for electro-therapeutic purposes, is well known. The present investigators endeavored to secure high efficiency in the ultra-violet by driving the temperature of the electric arc to the highest possible point while using electrodes rich in ultra-violet rays. In this way they would be able to furnish in the extreme ultra-violet not only the rays proper to the vapor of the electrodes, but also a large amount of ultra-violet from the electrodes considered merely as hot bodies. Tungsten, the most infusible metal known, seemed to give the best chance for obtaining the properties sought in the arc. They found, however, that it was practically out of the question to form a stable arc between tungsten terminals in an inert gas. Though even a trace of oxygen permitted them to work the arc, the oxides given off then were deposited on the walls of the globe to an extent that defeated further progress. The investigators went on to try various metals as cathodes while preserving the tungsten anode as a source of light, and finally settled upon mercury as the most available cathode. This enabled them to work with a rather short arc either in a vacuum or in an inert gas, the mercury vapor serving the purpose of giving the necessary stability to the arc.

In the ordinary mercury lamp with an iron anode the radiation is derived purely from the mercury vapor, but in the lamp here described the important factor is the anode of highly refractory metal driven to an enormous temperature, the mercury vapor playing an altogether secondary rôle. The authors state that the passage of metallic particles from the positive electrode to the negative is not sensible, so that the arc is relatively permanent in spite of the enormous temperature. It hardly seems possible that this effect would not make itself felt after protracted use, but it appears at least that the conditions of stability are good. The result of this arrangement is that the light produced is due chiefly to the incandescence of the tungsten anode, upon the continuous spectrum of which are superimposed the radiations of the mercury vapor. The color of the light is bluish-white owing to the very high temperature of the anode, and its specific consumption is stated to be only 0.45 watt per candle. This figure is entirely in harmony with the principles of action set forth, corresponding to very high incandescence of the anode. This arc operates on a difference of potential as low as 12 volts, a property which renders it convenient for some conditions of use. It is also, as was intended, rich in the ultra-violet, so that it is applicable to the purposes for which it was originally devised. For ordinary use as an illuminant such an arc, although at times convenient in laboratory use, would seem to possess no great importance, its efficiency going lower than that of the flame-arc, the quartz-mercury arc or even the intensive forms of magnetite arc. As a source of ultra-violet rays its relative efficiency as compared with other sources is not stated, although it is very likely to be good. It is, however, of a great deal of theoretical interest and should prove very useful to the investigator owing to its great power and efficiency, its ability to furnish what is for most purposes a point source, and the fact that it can operate at so low a voltage as to be easily run from a few cells of storage battery.

Invitation to Attendants at N. E. L. A. Convention.

The *Electrical World* extends a cordial invitation to all those attending the convention of the National Electric Light Association to visit its offices at 239 West Thirty-ninth Street, three blocks west of the Engineering Societies Building, the convention headquarters. The *Electrical World's* suite, No. 170, at the Hotel Astor is also at the disposal of its friends during the week, and those who so desire may have their mail directed there with the assurance that it will be held for them or subject to their instructions.

Final N. E. L. A. Program.

Several changes and additions have been made to the program of the National Electric Light Association convention since May 4, when the full program as then arranged appeared on page 1072 of our issue for that date. Two additional sessions and several new papers and reports appear on the final program.

CALENDAR.

On Monday, May 29, the registration office in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, will be opened at 11 o'clock. In the evening will be held the official reception to President and Mrs. Freeman and a dance at the Hotel Astor beginning at 8:30 o'clock.

On Tuesday morning at 10 o'clock will be held the first general session. In the afternoon at 2:30 o'clock there will be three "parallel" sessions, the second general, the first technical and the first accounting.

On Wednesday at 10 a. m. will be held the first commercial session, to be followed by an executive session at 12:30; the second accounting session and the second technical session. There will be no afternoon session on Wednesday. At 8:30 a public-policy meeting will be held in the New York Theater.

On Thursday morning the first transmission, second commercial and third accounting sessions will be held. At 2:30 p. m. the third technical and third commercial sessions will be held.

On Friday at 10 o'clock the second transmission and fourth commercial sessions will be held. The third general session, which will be the final official event of the convention, will be held at 2:30 p. m. on Friday.

ADDITIONS.

Among the new items on the calendar are the executive and public-policy sessions on Wednesday. At the executive session proposed constitutional amendments will be presented by Mr. Frank W. Frueauff. Mr. Arthur Williams will discuss the work of the public-policy committee; Mr. George H. Harries will present the report of the treasurer and the nominating committee will be selected. The public-policy session will be opened with the presentation of the report of the public-policy committee by Mr. Samuel Insull. An address will be delivered by Hon. Charles Nagel, Secretary of the United States Department of Commerce and Labor.

The new reports include one by Mr. Paul Lupke on "Question Box Revision"; one by Mr. E. L. Callahan on "Electric Signs" and one by Mr. W. R. Collier on "Ornamental Street Lighting." Mr. A. S. Loizeaux will present a paper entitled *Load Reports on an Electric System* at the second technical session on Wednesday morning.

Elaborate entertainment features have been arranged for the week. A reception to President and Mrs. Freeman on May 29 will signalize the beginning of the festivities. At 8:30 p. m. sharp the receiving line, comprising the officials of the association and their wives, will form in the grand ballroom of the Hotel Astor and the reception will be conducted from 8:30 to 9:30, during which time Mr. Arthur Depew, organist of Plymouth Church, Brooklyn, will preside at the magnificent organ in the hotel. A promenade roof-garden concert will immediately follow the reception and will be given on the roof of the Astor, to which the delegates may directly ascend from the ballroom in special elevators. An attractive musical program will be rendered by an orchestra and dancing will take place in the grand ballroom coincident with the roof-garden concert. At an appropriate hour a collation will be served in the Belvedere restaurant on the roof. In the event of inclement weather the promenade concert which will follow the reception will be given in the grand ballroom with dancing.

On Tuesday morning, May 30, there will be a daylight excursion for ladies only on the Hudson River. The steamboat will leave the foot of West Forty-third Street promptly at 11 o'clock and after a trip past the Palisades, Yonkers, Tarrytown, Peekskill, Nyack and other points of interest on the New York and New Jersey shores will return at about 3 o'clock in the afternoon. During the trip a concert will be rendered and luncheon will be served.

On Tuesday evening, May 30, the entire convention will be the guests of the Edison Electric Illuminating Company of Brooklyn, which will provide a steamboat ride through the East River and New York Bay to Coney Island. The excursion will give the delegates an opportunity to view the bridges spanning the East River, the lower end of Manhattan Island, Governor's Island, Forts Hamilton and Wadsworth and other points of interest along the shore, by night. It will also give the delegates an opportunity of seeing the most famous seaside resort in the world in all its glory. The boat will leave East Forty-second Street promptly at 8:15 and will leave Coney Island on its return trip at 11 o'clock.

On Wednesday, May 31, the teams of the Brooklyn and Philadelphia Edison Companies will engage in a game of baseball and in the evening the public policy committee will present its report at the New Theater.

On June 1 the committee has provided entertainment for the ladies at 11 o'clock in the shape of a children's presentation of "Pomander Walk," and in the evening all the assembled delegates and ladies will be the guests of the association at a theater party. Three of the largest theaters in the city have been engaged for that evening. On the morning of June 2 the ladies will be taken for an extensive automobile ride to various points of interest in the city. In the afternoon tea will be served at the Hotel Plaza, and in the evening the Sons of Jove will have a rejuvenation at Coney Island.

On Saturday, June 3, the delegates will be the guests of the New York Edison Company on a steamboat ride up the Hudson and East Rivers, which will also include visits to several important power stations. The party is scheduled to assemble at Waterside Station No. 2 at 10 o'clock and will visit the huge plant of the Consolidated Gas Company at Astoria on the way up the East River. Luncheon will be served on board the boat and the party will be landed at the foot of West Forty-third Street on the opposite side of the city at about 5:30 in the afternoon. Arrangements have been made for golf at a number of nearby clubs and a professional chaperon will be available at the Engineering Societies Building for personally escorting shopping, dining and theater parties for the ladies.

N. E. L. A. Convention Daily.

Coincident with the other preparations to make the New York convention of the National Electric Light Association the most notable in the history of the association the plans for the publication of a *Convention Daily* are being matured carefully. The *Daily* will be published for the association by the *Electrical World,* and its office will be on the mezzanine floor of the Engineering Societies Building. There will be five issues, from May 30 to June 3, inclusive, and they will contain the announcements, outline proceedings and general news of the convention, with some special features in lighter vein. The *Daily* will be distributed without charge every morning to delegates, and it is believed that it will be a valuable record of the many-sided gathering that is in prospect.

The St. Louis N. E. L. A. Convention Special.

So many persons expressed a preference to reach New York earlier than Monday afternoon, May 29, as was first planned for the St. Louis-New York convention special that the hour of departure of this train has been changed to 12:20 p. m. Saturday, May 27. A large number of reservations on the St. Louis special are reported by Mr. F. N. Jewett, assistant master of transportation, who will be in charge of the train. A number of persons from the Southwest and territory tributary to St. Louis have arranged to join the special train there, coming through to New York with the party. An all-steel limited train of Pullman cars is promised by Pennsylvania Railroad officials.

A. I. E. E. Election and Annual Meeting.

At the annual meeting of the American Institute of Electrical Engineers held in New York on May 16 it was announced that the following officers had been elected by letter-ballot of the membership:

President, Mr. Gano Dunn, vice-president and chief engineer of the Crocker-Wheeler Company, Ampere, N. J.; vice-presidents, Messrs. D. B. Rushmore, General Electric Company, Schenectady, N. Y.; C. W. Stone, General Electric Company, Schenectady, N. Y., and W. G. Carlton, New York Central & Hudson River Railroad, New York; managers, Messrs. F. S. Hunting, Ft. Wayne Electric Works, Ft. Wayne, Ind.; Farley Osgood, Public Service Corporation of New Jersey, Newark, N. J.; N. W. Storer, Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., and W. S. Lee, Southern Power Company, Charlotte, N. C.; treasurer, Mr. George A. Hamilton, and secretary, Mr. Ralph W. Pope. The vote for Mr. Pope, who has been elected secretary for twenty-seven consecutive terms, was greater than the total vote for the two candidates for the presidency.

The proposed amendment to the constitution giving the directors power to appoint the secretary instead of allowing the membership to vote for this office was not passed, although there were 1666 votes for it as compared with 703 votes against it. The constitution states that at least 75 per cent of the voters must declare themselves in favor of any proposed amendment before it can become a part of the constitution.

Prof. Elihu Thomson, as chairman of the Edison medal committee, outlined the conditions under which the medal was founded and announced the award to Mr. F. J. Sprague. The medal, which was founded in 1904 by the associates, friends and admirers of Mr. Edison, is awarded by a committee of the A. I. E. E. consisting of twenty-four members selected by the president and board of directors. The medal bears on its obverse a portrait of Mr. Edison and on its reverse an allegorical conception, "The Genius of Electricity Crowned by Fame." Last year the medal was presented for the first time, the recipient being Prof. Elihu Thomson. Elsewhere will be found an account of the presentation of the medal.

Following the formal addresses of presentation of the medal by President D. C. Jackson and acceptance by Mr. Sprague, four papers were read on subjects relating to engineering activities with which Mr. Sprague has been associated.

Mr. W. B. Potter discussed the development of the electric railway and showed the active part taken in it by Mr. Sprague. Prof. Franklin H. Giddings, of the department of sociology of Columbia University, explained the effect of the electric railway in minimizing the extreme upper and extreme lower classes of humanity and improving the living conditions of the augmented middle class. Prof. George F. Swain, of the department of civil engineering of Harvard University, presented arguments to prove that the substitution of electricity for steam on railroads represents a luxury for the patrons rather than a necessity in almost all cases and should not be forced upon the railroads until it can be shown to be economically desirable. Commander S. S. Robison, of the United States Navy Bureau of Steam Engineering, described the numerous uses to which electricity has been put in the navy, and outlined the early work done by naval engineers in developing electrical appliances.

Presentation of the Edison Medal to Mr. Frank J. Sprague.

Elaborate ceremonies accompanied the presentation at the annual meeting last week of the American Institute of Electrical Engineers of the Edison medal to Mr. Frank J. Sprague for meritorious achievements in electrical engineering. On the stage of the main auditorium of the Engineering Societies Building were seated past presidents, representatives of local societies, civic organizations, national electrical societies, city officials, the medal committee, the medal founders, the speakers of the evening and other special guests, including Mr. Thomas A. Edison. An escort had been provided for distinguished guests who were conducted in procession to the stage. The processional march was started on signal from a bugle and proceeded, accompanied by music, from the south corridor through the outer hall and down the center aisle of the auditorium. Full evening dress, including white tie and gloves, was prescribed for members who escorted the guests.

Following the formal address and presentation of the medal by Prof. Dugald C. Jackson and acceptance by Mr. Sprague, four papers were read on subjects relating to engineering activities with which Mr. Sprague has been associated, one of which, by Mr. W. P. Potter, related largely to the professional career of Mr. Sprague.

Frank J. Sprague.

In his remarks accepting the medal Mr. Sprague said that he would be remiss if he did not return thanks first on behalf of his beloved alma mater, the United States Naval Academy, where, under the late Admiral Sampson, he had the privilege of being grounded in the essentials of mathematics, physics and engineering, and where he imbibed certain principles, intangible perhaps, but almost inseparable from the training in our great government schools, and which he believes always stand one in good stead in the battle of life. He spoke of the encouragement and ever-present help received from his associates, Johnson and Harding, McPherson, Crosby and Greene, Lundy, Mason and O'Shaughnessey, Carichoff, Hill and Sheppard. Of two of these he spoke with deep feeling—Crosby from West Point and Greene from Annapolis. Each, he said, resigned a commission which was the stepping stone to high rank, influence and possible fame, and cast his lot with a struggling inventor in a new art and an undeveloped field. All through the days of Richmond, often dark ones, and during his absence on account of his critical illness, one in New York and the other in Richmond, fought against heavy odds the battle of the early trolley. After referring to the untimely death of Lieutenant Greene, Mr. Sprague spoke of the present illness of Lieutenant Crosby, who sent his proxy in the form of a letter, to which Mr. Sprague said he attached more value than to perhaps anything else of its character that could be bestowed.

In the letter, after referring to his illness, Mr. Crosby said that no one can know better than himself how thoroughly the honor associated with the presentation of the medal had been earned. Intimate association with Mr. Sprague—beginning in 1887—warranted him in saying that the great work of giving practical economical value to electric traction was based, to an unusual degree, upon the personal work of Sprague. While he sought and generously recognized the efforts of those who aided in the work, yet his individual ideas were always the guidon, set far forward, toward which the struggling squadrons pressed. Difficulties which to the younger soldiers in the field may now seem but as molehills were veritable mountains then, yet Sprague's indomitable spirit and ready genius never flinched before any obstacle, however high its pathless summit seemed. Within the profession it may be that the accomplishments of Sprague are measured at their true value, but a certain inaptitude for seeking lime-light effects has prevented him from receiving all the popular recognition which his work in traction and in other fields should fairly merit; but the award of the medal will tend to balance the unequal scale. Mr. Crosby referred to Lieutenant Greene—a friend dear to Mr. Sprague and himself—as one who has left a memory that is a sweet fragrance. "Old memories of successful struggle and friendly recognition from co-workers in an art, these are the best rewards that come to those who, like Sprague, have victoriously led the forces of progress."

In the course of his remarks, Mr. Sprague said that he was once asked the somewhat difficult question as to just what he considered his particular status and work, and what were his mental processes in what the questioner termed invention. To this inquiry he had, in all candor, to reply that he was simply a constructive engineer, with enough of inventive faculty or imaginative equipment to effect a basis for activities, and an immature financial sense sufficient to entangle himself and his friends in industrial development; to which perhaps might have been added, the possession of enough self-assurance to be willing to venture a long way in support of conclusions arrived at, and a love and capacity for work. As to the mental processes, they are those of an engineer who seeks the solution of problems as they arise. Mr. Sprague said that while this is not strongly individual, and does not spell genius, yet he is content that it is so.

Mr. Sprague expressed the opinion that chance largely determines one's activities and one's success or failure in life, and in this connection the award of the medal to him has a special significance in relation to early associations, to which he then proceeded to make brief references. His cadet life at Annapolis, he said, covered the period when Bell, Gray, Farmer and Edison were arousing the imagination of the scientific world, and some knowledge of their endeavors penetrating the circumscribed surroundings of naval routine, aroused in him a spirit of restlessness. On his way home after graduation he called to see Mr. Edison to explain to him a telephone invention; and later, in 1881, while off Hampton Roads on the training ship Minnesota, he planned to light the ship with electricity from an Edison dynamo, to be driven from the flywheel of an old dismantled steam pump, which scheme did not come to fruition because Mr. Edison could not approve of the proposed motive power. Later he served, in 1882, as juror at the Electrical Exposition in Sydenham, England, and after making a formal report to the Navy Department recommending the general use of electricity in the service, he left the naval service and entered Mr. Edison's employ as assistant. It was during this period, while riding on the Metropolitan underground railroad of London, that his conception of an electric trolley system first took definite form. He recalled the surprise, when in 1883 he reported for duty to Mr. Edison, with which the news was received that Mr. E. H. Johnson had promised him the munificent salary of $2,500, the manner of Mr. Edison betokening a doubt as to his earning capacity.

After a period of activity in connection with the earlier central stations, which was also a period of personal and independent work in stationary-motor development, a request that he should leave the construction department in order to undertake some calculations in relation to the transmission of power, which would have led to an interruption in lines of work in which his interest was increasing, caused him to enter a protest with Mr. Edison, to which the following reply was received: "Sprague: As the construction department is about to be given up, I think the better plan would be for you to resign. Edison." Mr. Sprague said that he did resign and that this is the real reason why he is the recipient of the Edison medal. No man, he said, who thinks that he has within himself the capacity for a reasonable share of independent development, and who wishes to carve out his own career, can ever remain the agent of any one, and surely not the subordinate of a man of such intense activities and of so dominating a personality as that of the great inventor who has left such an imprint upon his age and whom all delight to honor.

Referring to the engineering profession, he said that the difference, for example, between a lawyer and an engineer is that the former is destructively inquisitive and the latter inquisitively constructive. The engineer is trained not only to ask questions and find weaknesses, but to correct them, to build up and not to pull down, to create and not to destroy. His training is along the lines of exactness. Honesty in investigation and conclusion, in design and construction, constitute the very foundation of professional ethics. There is no room for high finance or crooked practice in the determination of strengths of material, centrifugal or centripetal forces, or the factors of safety. The engineer is a necessity because he is the connecting link between conception and realization, between capital and dividend.

Mr. Sprague said that it was his belief, founded on considerable experience, that most inventions of importance are rarely inspirations, but are the simple practical solution of engineering problems presented in the natural course of events, and often are supplemental to, or the logical result of, preceding inventions. This view was illustrated by some of his own experiences. The conception of the trolley system was largely due to the study of Edison's lighting system and circumstances of daily travel on the London underground railway. When he first undertook to solve the problem of making a motor operate at constant speed on a constant-potential circuit under a varying load, he first thought to use a centrifugal governor, but, after studying the theory of the shunt-wound motor, reasoned that since the work done was dependent on the current, and this in turn was determined by the difference of the line and motor emfs and the amount of resistance in circuit, all that was necessary was to change automatically the only variable—the counter emf. Then, too, it seemed as if the motor could be considered, in a certain light, as a dynamo driven by a current whose emf was a function of armature speed and field strength. It followed therefore that to get a constant speed under varying load the field strength should be automatically varied by a reverse winding in series with the armature, which, when the load was increased, would first weaken the field with increase of current on a reduction of speed and would be so proportioned that it would properly restore the speed to normal in a weakened field. This formed the basis of considerable controversy at the time—1884—because it seemed contrary to normal conception. Having got constant speed, the next problem was to overcome the sparking on the commutator, which appeared to necessitate the backward setting of the brushes with increasing current and load. A mechanical movement not proving satisfactory, it followed that the proper thing was to rotate the field in an opposite direction by a series field winding, which had a polar axis at right angles to the normal one, and which would automatically create a corrective resultant.

Mr. Sprague similarly referred to the circumstances which led to the wheelbarrow method of mounting railway motors, and his invention of the multiple-unit system of train control. The last invention, however, was rather inspirational than a logical engineering solution of an existing difficulty. Earlier experiments on rapid transit by electric trains had indicated the necessity of a large proportion of weight on the drivers, and hence the distribution of motors throughout the train. Having in electric elevator development to deal with the idea of distant electrical control, the idea suddenly came to him to individualize the equipment of each motor, and then from one or more master switches simultaneously operate the controller of each equipment.

Generally speaking, he said, it is not invention which demands the most effort or the largest expenditure of time in the electrical field, for the greater burden is found in the grinding experiences of commercial development, overcoming of prejudices, the removal of faults, recovery from failures, and especially the raising of capital and maintaining the courage and confidence of the investor until a dividend is in sight.

In conclusion, Mr. Sprague said that in the engineering profession there are always new paths to blaze, fresh histories to make, unending worlds to conquer. The heritage of greatest value which we can leave to those who bear our names will be that of high aims realized and creative work well done; and the Edison medal will prove a constant and effective incentive to the attainment of the worthy object of any man's honorable ambition.

The paper by Mr. W. B. Potter on the development of the electric railway included an appreciation of the work of Mr. Sprague, from which the following abstracts are made.

Mr. Potter stated that after entering Mr. Edison's employ in 1883 while on a year's leave of absence from the navy Mr. Sprague, in association with Mr. W. S. Andrews, inaugurated in Sunbury, Pa., the first Edison overhead three-wire lighting system, and he was given charge of the installation in Brockton, Mass., of the first Edison three-wire underground system.

The nature of his work with the Edison Construction Company led to greater opportunity for mathematics than for invention, and he consequently resigned and, in association with Mr. E. H. Johnson, organized the Sprague Electric Railway & Motor Company in 1884. The early work of this company was principally with stationary motors, Mr. Sprague designing a differentially wound constant-speed motor, which was exhibited at the Philadelphia Electrical Exposition of 1884.

Mr. Sprague in the meantime had not lost his interest in the electric railway, which began during his association with the Crystal Palace Exhibition, his travels on the London underground adding zest thereto. It was, in fact, at this time, in 1882, that Mr. Sprague devised the modern trolley system, an overhead conductor with a universal upward pressure contact. Later, when applying for a patent and being in interference, he lost date on a technical ruling as to date of invention, for though he was a naval officer on foreign duty, his legal date of invention was only coincident with his arrival in this country in 1883.

Being now in a position to put his ideas into effect, he began, in 1885, the construction of the motors that were used in the Durant Sugar Refinery and Manhattan Elevated demonstrations. The success which attended these first efforts gave such encouragement that Mr. Sprague was able for the first time in the history of the electric-railway development in this country to secure sufficient capital to undertake commercial exploitation on a large scale. The equipment of the Richmond railway and the inauguration of public service on this road, Feb. 3, 1888, was one of the great events in railway history.

As evidence of the public interest at this time, the following has been taken from a circular call to a mass meeting on transportation in New Orleans under date of Dec. 2, 1889: "Lincoln set the negroes free, Sprague has set the mule free. The long-eared mule no more shall adorn our streets."

A number of roads in this country and abroad were equipped by Mr. Sprague prior to the absorption of his company in 1890. Between the years 1890 and 1897 Mr. Sprague gave his attention principally to electric-elevator design, and it was in connection with this work that the multiple-unit idea first occurred to him. The first experimental multiple-unit train was, in fact, equipped in part with devices such as are used in his elevator service. Although not active in railway development during this period, Mr. Sprague still maintained his interest. Having occasion to test the mechanism of a number of elevators in the same building, he arranged a master switch in the basement from which any one elevator could be operated or several simultaneously. It occurred to him that a similar control applied to a train on which each car was equipped with motors would offer a new and better solution of train operation. The result of this idea was the multiple-unit control.

Among the many inventions for which we are especially indebted to Mr. Sprague, and which are now in general use, should be mentioned his method of suspending railway motors on their trucks, his distribution system for trolley lines, the series-parallel connection of railway motors, the application of a master controller to the remote control of a main controller, an electric throttle for regulating the acceleration of cars, and the multiple-unit control.

Mr. Sprague's work in connection with the American Institute of Electrical Engineers, of which he is a past-president, as a member of the commission which passed upon the electrification of the New York Central and his services as consulting engineer need not, Mr. Potter said, be emphasized by further comment.

Mr. Sprague on all occasions has shown the courage of his convictions, pledging his own resources and being gifted with the ability to secure the pledge of others to carry out his work. He has further exhibited unusual energy in developing his ideas into practical form and carrying them through to commercial success, and to this result he has been greatly aided by the spirit which his unbounded enthusiasm has created in his associates.

In conclusion, Mr. Potter said that, although at times given to prophesying, Mr. Sprague is more fortunate than the prophets of old, in that he has lived to see many of his predictions become realities.

Electric Vehicle Club Meeting.

The regular meeting of the Electric Vehicle Club of Boston was held at the Edison Building on May 17, with Mr. N. Rommelfanger in the chair. At the conclusion of the usual luncheon committee reports bearing upon the questions of advertising electric vehicles by large signs, publicity in the daily press, exhibits and parading were received. Secretary L. D. Gibbs announced that one of the most prominent billposters in Greater Boston is considering an installation of electric vehicles capable of carrying paste cans, brushes, framing material and two or three men, together with an electric or gasoline truck for lumber transportation. Attention was called to the fact that the portable house of the Boston Edison company was carried from Dover to Winchester on electric trucks, and the possibilities of securing an all-electric billboard service were touched upon. Detailed consideration is being given by the Edison company to the location of the large signs advertising electric vehicles which have been authorized and which will be, in general, 35 ft. long and 25 ft. high, as recently stated. Mr. W. H. Francis emphasized the importance of calling upon the Edison company's engineers in connection with the design of sign supports, stating that in certain cases where the sign manufacturers' specifications had been followed in detail no little trouble had arisen from inadequate strength in the supports.

An extended discussion took place regarding the wisdom of maintaining electric trucks for demonstrating purposes, the general opinion being that the policy is of doubtful value except in cases where the prospective customer is clearly interested in results, and perhaps willing to meet a portion of the cost. One day's trial service was generally conceded to be a poor index of the economy of the motor vehicle. Regarding publicity, Mr. W. H. Atkins, general superintendent of the Boston Edison company, offered for pushing the electric vehicle the free use of space in forty-six suburban weeklies now taken by the company. Mr. E. S. Mansfield showed a sample inquiry card sent to garages by the rate committee for the purpose of securing data upon service and cost of existing installations. The committee on window displays called attention to several enlargements of electric-vehicle photographs on exhibition in the Edison company's window and announced that additional displays are to be forthcoming. The committee on the parade of electric trucks for May 30 reported increasing enthusiasm among owners of these vehicles and a general disposition to enter machines and products in an effective comparison with the work-horse procession.

At the close of the meeting a 5-ton truck of novel design was exhibited by Mr. W. E. Eldredge. The truck is the first of its kind ever built, and its unique feature consists of the employment of steel-tired rear wheels in place of the usual rubber-tired equipment. The truck is equipped with two motors capable of delivering 18-hp maximum, couple-gear wheel drive, has a platform 19 ft. long and 5 ft. 6 in. wide and a capacity of twenty-five sugar barrels. Its battery equipment consists of forty-eight Nation cells with twenty-one plates each. The front-wheel diameters are 38 in. and the rear-wheel diameters 54 in. The motors are installed in the front wheels, the rear wheels being provided with tires of steel band, 4 in. wide and 1¼ in. thick. The truck is designed for a maximum speed of 5 miles per hour loaded, with a short-haul service under urban conditions, and it is estimated that the use of steel tires on the rear wheels will save about $2 per day, the total cost of operating the truck being about 50 per cent of that of a gasoline truck of the same capacity.

Kentucky Electric Company's New Station at Louisville.

Work is already well advanced on the new generating station of the Kentucky Electric Company of Louisville, which has been designed for an ultimate rating of 64,000 kw. The site occupies an Ohio River frontage of 305 ft., extending back 396 ft. to a 200-ft. front on Washington street. The section of the building first to be completed will be capable of housing 16,000 kw of equipment. Of this there will be installed at once one 4000-kw and one 2000-kw horizontal General Electric steam turbine, in addition to the three 1500-kw vertical turbine units to be transferred from the present plant. A rather unusual feature of the new station will be the condenser well, required on account of the 45-ft. rise and fall which the Ohio River undergoes at this point. The well comprises a circular pit, 30 ft. in diameter and 72 ft. deep, lined with a concrete wall 4 ft. thick and loaded to guard against flotation due to change in river levels. In this pit will be located Alberger vertical surface-type condensers. Adjacent to the plant will be a coal-storage yard, 65 ft. x 305 ft., which is spanned by a motor-operated gantry crane for coal handling. The new station is to be ready for operation by December, 1911. Col. R. E. Hughes is president and general manager of the Kentucky Electric Company, and Mr. L. S. Streng is chief engineer. The consulting engineers for the new station are Sargent & Lundy, Chicago.

Underground Electrolysis in New Orleans.

The New Orleans Sewerage and Water Board has become involved in a controversy with the New Orleans Railways Company, which controls all the street railways of the city, as to the responsibility for the damage to the large and costly city water-works system by underground electrolysis, due to the railway return current, and it is probable that the matter will be taken to the courts. It is claimed that one of the 20-inch mains, near one of the power stations, was found to carry a current of 420 amperes, or about one-fourth of the entire output of the station. The damage, it is claimed, has been going on for about four years, and a bill for $3,000, covering a period of not more than four months, has been rendered to the Railways Company.

There are three large power stations supplying the railway system at 500 volts, and the damage is estimated approximately to extend to at least a half mile in every direction from each station.

Extensions to St. Louis' Underground District.

The lighting department of St. Louis, Mo., has under contemplation an ordinance adding 133 blocks to the underground district of the city. The new underground districts are: Grand Avenue from Market Street to Kossuth Avenue, Kings Highway from Market Street to St. Louis Avenue, and Union Avenue from Market Street to St. Louis Avenue. The present underground district, as fixed by the city in 1898, is bounded by the Mississippi River on the east, west by Twenty-second Street, north by Lucas Avenue, and south by Spruce Street.

Manufacturers and the Patent Situation.

At the meeting in New York City of the National Association of Manufacturers on May 16 to 17 a committee on patents submitted a report which, after giving details of recent new laws, regulations, etc., discusses the United States patent system in general terms.

The opinion is expressed that the majority of people have an altogether erroneous idea as to the value and effect of patents. Politicians for years have echoed the cry that one of the glories of our American civilization is our patent system, but it would be nearer the facts to say that the resourcefulness and ingenuity of the American inventor has raised this country to the position it occupies in the mechanical world, not *because* of our patent system, but *in spite* of it. While there can be no question that the theory of the system is good, in practice there is much that is altogether bad. The procedure in the Patent Office has become unreasonably complicated and intricate, due mainly to the effort to carry out an impracticable ideal, namely, the formulation before the grant of a patent of claims defining precisely the scope of the invention. This procedure has been made the more difficult by the attitude taken by courts many years ago concerning combination claims which has led to a technically strict interpretation of the claims that prevails nowhere else in the world, and to combat which attorneys are compelled to draw numerous claims of various degrees of scope. Interference practice has also become so complicated and intricate that it involves inventors in needless expense and delay in the effort to carry out another impracticable scheme, namely, that of having the Patent Office, which is an administrative bureau, undertake the judicial function of determining questions of priority of invention.

Because of delays due largely to the two foregoing features, manufacturers and the public generally are subject to serious detriment and hardship through being unable to determine what they may safely manufacture or use, it being common experience for patents to be issued (as in the case of the Berliner patent) many years after the inventions have gone into general use, and in many instances these belated patents have the effect of destroying investments made in good faith in the ignorance of the existence of the rights which subsequently matured in such patents.

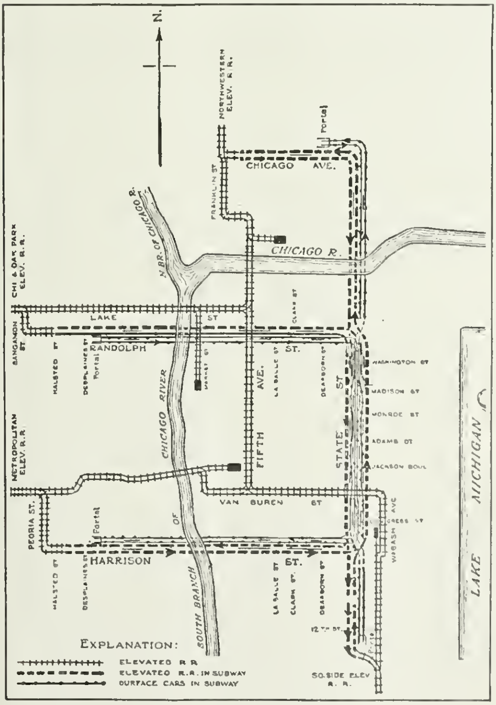
After a patent is granted, both the patentee and defendants are subject to great difficulties in securing prompt adjudication of suits. It takes too long to obtain a decision in the patent courts and the procedure is too expensive for an individual inventor or a small corporation. If patent cases were tried in an open court, as they are in Great Britain, a decision would be reached in a fraction of the time now necessary, and the cost would be in many cases greatly reduced. Such an enormous mass of precedents have been created by the courts and the principles of the patent law have become so over-refined that the attainment of a just result in infringement litigation is needlessly hampered.

While in the consideration of questions of fair competition, as an example, the courts have no difficulty in applying simple and common-sense rules in deciding a patent question, the case is likely to hinge on some abstract principle of patent law that may have been sensible enough in the case where it originated, but which cannot be fairly applied to other cases with different facts and under entirely different conditions. The committee believes that if patent cases could be tried in open court so that a judge would have the opportunity of seeing the witnesses and excluding irrelevant and immaterial testimony, there would be a better chance of the case being decided correctly than when the attempt is made to digest an enormous amount of evidence taken outside the court and upon which the court seeks to decide the case on abstract principles.

In conclusion the committee says that the only way in which reforms in these matters can be brought about is by the awakening of public sentiment, and this end can only be secured by continual agitation upon the part of those who are vitally interested in these questions, so that such a popular demand can be created for the necessary changes that action thereon cannot be denied.

Chicago Subway Situation.

The transportation committee of the Chicago City Council began its investigations preliminary to a selection of the subway plans offered by contributing engineers at a meeting on Monday afternoon, May 21, when Mr. Bion J. Arnold appeared to explain his plans, outlined in the *Electrical World* of Feb. 16. At the later sessions Messrs. John Ericson, former city engineer; George W. Jackson and R. C. St. John, former assistant subway engineer under Mr. Arnold, submitted their ideas to the committee. The hearings are to be completed during the present week, and the council committee will render its decision as soon as possible thereafter.



Map Showing Proposed Subways in Chicago.

Reduced cost of construction, together with through-routing to all sections of the city, are the features which distinguish the St. John plan of subway, the cost of which would be only $15,000,000, it is declared. Five and one-half miles of underground construction are contemplated, containing 21.5 miles of single track at a cost of $700,000 per track-mile. It is proposed to continue the present stub terminals of the elevated roads, utilizing also two sides of the present Union Loop structure, on Van Buren and Fifth Avenue, although later replacing these overhead tracks by subways. There would be no grade crossings in the subway system proposed, but the high level adopted would make it impossible to use the existing river tunnels with this system. Room under the streets is left, however, for a low-level subway above the freight tunnels, which could be utilized for a high-speed subway system later. The hourly capacity of the subway proposed by Mr. St. John is estimated at 250,000 passengers. On State Street, where the subway planned contains two tracks of the elevated railways and four of the surface lines, the sidewalks would be widened to 30 ft. to accommodate the station entrances. Under Harrison and Randolph Streets four tracks would be provided—two for surface and two for elevated-road traffic. The north-and-south State Street subway, from Chicago Avenue to Twelfth Street, with a Franklin Street branch to the Northwestern Elevated railway and a Harrison Street branch to the Metropolitan West Side Elevated system, is estimated to cost $7,500,000. Approximately the same amount would be required for the east-and-west subways in Randolph and Harrison Streets, each extending to portals near Desplaines Street. Chicago now has approximately $6,000,000 available for subway construction, besides an additional income of $1,500,000 per year which can also be utilized for this purpose.

Electric Motor Discussed at Joint Meeting of Engineers at Boston.

At a joint meeting of the Boston sections of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers with the Boston Society of Civil Engineers on May 17, Mr. Fred M. Kimball, of the General Electric Company, read an illustrated paper on "The Electric Motor in the World's Work." The author reviewed the history of motor design and showed that the electric motor has grown from insignificant beginnings to units capable of delivering 20,000-hp each for short periods; while efficiencies have been carried close to 95 per cent. The present annual output of motors aggregates about 1,000,000 hp. Turning to the general question of electric driving, the speaker pointed out that safety, convenience, low maintenance cost and increased production are the objects rather than substantial reductions in the cost of power. Mr. Kimball said that while the general trend of the times is toward individual driving, it is advantageous to use group driving in many cases where a number of tools run from a single motor are similar in design and operating characteristics, and particularly where the individual cycles of performance do not occur in synchronism. When this is the case the diversity factory of the current demand of the group-driven tools enables a smaller motor to be used than where a separate motor is applied to each machine, with resulting reduction in first cost. The overload capacity of the large single motor used in driving the group is generally sufficient to handle momentary peaks of severe character. Thus six wood turning lathes may be driven in group by a 2-hp motor, whereas if individual motors are employed six ½-hp motors may be required. In equipping old tools for electric operation the group-drive often appeals to the manufacturer on account of its lower cost. Where the cost of power is small, the saving in investment by utilizing group drive is frequently sufficient to offset the operating economies of the individual installation.

The well-known advantages of individual driving were reviewed, the chief being the increase of production almost always resulting. This may be from 5 per cent up. An additional output of even a foot of cloth per hour in a modern loom attracts the manufacturer. Backlash, slipping of belts and distortion of shafts all waste energy, but more than this, retard production. The load factor is better with individual drive, and the possibilities of metering the service and checking the tool performance are not yet fully utilized. Where energy is purchased, the individual drive tends to effect savings in monthly bills. The speaker contended that a maximum of three bearings of the self-aligning or roller type should not be exceeded in a group drive, in order to obtain the best results. Too much care cannot be taken to avoid poor alignment, a recent case showing a loss in energy valued at $4 per day in a single factory. The line shafting must be short and the alignment frequently checked, and in new installations the center of gravity of the system should be kept as low as possible. Short belts are advantageous in applying motors to heavy machines, and the modern chain drive has many features of attractiveness.

Mr. Kimball commended the modern cloth pinion, which is one of the latest developments in machine gearing, stating that its strength is nearly double that of a rawhide pinion, with the advantages of silent operation, independence of the action of moisture, heat and cold, and immediate adaptation to the shape of the gear teeth. A pressure of about 9 tons is used in forming these pinions, an excess pressure being inadvisable on account of its tendency to cut into the fibers. In conclusion the speaker stated that about 25 per cent of the textile mills of America are electrically driven. All American industries consume about 20,700,000 hp, and of this from 15 to 18 per cent is electric. There is thus an attractive field for large future applications of electric driving in modern industry.

The Easter Sessions of the Société Française de Physique.

By S. H. Russenberger.

Each year in the fortnight following the Easter holidays the Société Française de Physique holds at Paris a meeting and exhibition intended to bring before its members, who often come from a great distance, the principal scientific happenings of the year. Foreign savants are always present to give an account of their own work, and this year papers were presented by a Dutch, a German and an English scientist.

The Dutch visitor was Mr. Zeemann, to whom is due the discovery of the splitting of the rays of the spectrum by the action of a magnetic field. In examining the spectrum of the sun or of the stars one often sees rays thus divided, which would indicate that the light of these bodies undergoes the action of a magnetic field. Particularly is this the case with the light from sun spots, which Professor Zeemann holds are nothing but a sort of gigantic aurora borealis belonging to the sun.

The German scientist, Mr. Planck, very ably demonstrated that the kinetic theory of Boltzmann, suitably modified and completed by a corpuscular theory of energy, gives to the problem of the relation between energy and temperature a solution much more satisfactory than that furnished by thermodynamics alone.

Sir William Ramsay, the English representative, who is the discoverer of argon, neon, crypton, etc., has recently been occupied in weighing the extremely light quantities met with in the study of radioactivity. He exhibited to the conference minute scales made of quartz filaments which under the microscope indicated weights to the three-millionth part of a milligramme.

Professor Langevin, of the College of France, showed and described numerous interesting experiments that had been performed with a simple quadrant electrometer. Professor Langevin hopes to see the electroscope now used in schools and colleges disappear and be replaced by the electrometer, which will be of much greater value for educational purposes.

The final paper presented was by Commandant Ferrié, who described the wireless-telegraph station of the Eiffel Tower, which his hearers went in a body to visit. This station is particularly remarkable because the antenna is supported by a tower 300 m in height, which permits the receipt of communications from a great distance, even from America. Thus the visitors were able to read in the dispatch book messages that a gentleman signing himself Charles and another gentleman signing himself Adolphe sent to Mlle. Polaire at the moment when that charming actress started on her return to France. These two gentlemen will doubtless be less enthusiastic over the great modern discovery when they learn that their declarations were readable more than 5000 miles beyond the beloved object to whom they were sent. The writer placed his ear to the telephone receiver, but did not have the good fortune to hear a communication of this importance. He simply received the time of day from the station at Gibraltar, situated 900 miles from Paris.

The members then went to visit the two transmitting posts, one of 70 kw, which sends the time to ships in the Red Sea and to the scientific stations of Canada, and the other of 10 kw, which members were permitted to operate. By varying the excitation of the generator it was possible to make vibrations more or less rapid, which produced different sounds. A lieutenant played for the visitors a tune as from a trumpet upon this novel instrument.

Commandant Ferrié drew attention to the sparker at this post. This is formed of a disk opposite which is placed perpendicularly a metallic tube through which passes a strong current of air. This arrangement has the advantage of obviating the wearing out of the parts between which the spark appears. Thus the frequency given is preserved exactly, which is not the case with sparkers in the form of a ball or a point.

The exhibition, as is the case every year, consisted entirely of inventions not yet placed on the market. Even the exhibition rooms were lighted entirely with apparatus invented in the past year. The motive power was furnished by a petroleum engine without valves, the latest novelty of the automobile manufactories. The valves, so easily clogged with dirt, are replaced by a kind of slide made of two sleeves, one of which slips within the other. These sleeves have openings properly placed so as to permit the usual four-cycle events. The speed is regulated by modifying the period during which gas is admitted.

Certain new arc lamps exhibited differ from the old ones in the composition of the electrodes, more or less mineralized, in special forms of mechanism, or in the total absence of mechanism. In the "Astra" lamps of M. Cibié the two electrodes descend by their own weight, the one parallel to the other. The negative electrode is arrested by an inclined stop of non-oxidizable metal. The positive electrode is supported upon a stop carried by the negative, from which it is separated by insulating disks. The arc is magnetically blown toward the lower extremity of the electrodes below the "economizer," a sort of ring of refractory material, which, owing to its excluding oxygen, prevents the electrode that would otherwise be used up first from burning faster than its mate.

In contrast with this device are two lamps absolutely new—that of M. Claude, based upon the incandescence of neon, and that of MM. Urbain, Feige and Scal, in which a very powerful arc plays between a vertical tungsten electrode and mercury. In the latter lamp the light is due both to the incandescence of the tungsten and to that of the mercury vapor. It gives a white light, with very little violet. To start the lamp it is necessary only to shake the mercury a little. The models shown operated at 14 volts, 30 amp, and gave a candle-power for 0.45 watt.

M. Claude's tubes do not consume more than 0.5 watt per candle-power when they are at least 40 m long. When they are only 5 m long the consumption increases to 0.75 watt because of the great drop in potential at the electrodes. Although very much like mercury-vapor tubes, and especially the Moore tubes, in their form, yet they are widely different from these in their operation. In fact, while there is required an emf of 300 volts per meter to produce the incandescence of nitrogen, an emf of only 120 volts is necessary to produce that of neon. Tubes 45 mm in diameter give from 200 cp to 250 cp per meter with neon and only from 40 cp to 50 cp with nitrogen. Finally, and more important than all, under favorable conditions they can work without valves. It is necessary to purify the neon carefully, condensing impurities at the temperature of liquid air in carbon made from cocoanut. Neon emits a superb red light, which sometimes appears to be yellow-orange. The ladies greatly appreciate this method of lighting, which enhances their natural color. It is very certain that in no circumstances would they ever give preference to the mercury-vapor lamps.

The lighting scheme was brilliant, but the exhibition was worthy of it. There may be mentioned an ingenious combination of apparatus by M. Boucherot, a Wheatstone bridge to measure the resistance of armatures in process of manufacture. The current in the bridge is that which traverses the armature. The latter constitutes one of the arms of the bridge, and it is prolonged by a shunt which absorbs 0.1 volt and forms the second arm. The two other arms include a voltmeter and an adjustable resistance. The galvanometer serves equally well as a millivoltmeter. It can when desired be used to measure the current when the latter is diverted to the shunt. It is possible thus without interrupting work in process to determine all the conditions of operation—current, voltage, mean temperature, etc. The apparatus is completed by a thermoelectric arrangement which consists of a galvanometer connected to a thermocouple which is applied to the armature segments to determine the temperature.

In the realm of wireless telegraphy MM. Le Doyen and Ancel showed an electrolytic detector of a special form which is placed upon the hook on which the telephone receiver is hung. The detector is thus not in circuit with the antenna unless the telephone is taken from the hook.

M. Turpain has shown, by means of knitting needles so placed that they serve as a detector, that the antenna is charged progressively at the approach of a storm and becomes more conductive. He has constructed an apparatus which registers this variation of conductivity up to the moment when the discharge occurs. The apparatus indicates the arrival of a storm many hours in advance, often when the barometer has indicated nothing. M. Turpain also exhibited a wireless-telegraph installation which had been struck by lightning without disastrous results. The register had been protected simply by the self-induction of a very short elbow in the cable connecting the antenna to the apparatus.

Coming to the exhibit of M. Herrgott, without quitting the field of electricity one enters that of heat. M. Herrgott makes carpets, cushions, gloves, filters, etc., in which the yarn or thread consists of a nickel filament covered with wool or cotton. Rheostats permit the temperature of the fabric to be graduated with great precision.

The new silica tubes so much employed to-day in chemistry have been adapted by the firm of Grivolas to radiators. The current passing through the conductor within the tubes brings them easily to a red-white heat.

In optics a very interesting field-glass attracted attention. This was invented by M. Violette, a naval lieutenant, for use in target practice. The recoil of artillery has often caused accidents to those whose duty it is to watch the shooting through a field-glass. In adapting to the eye-piece an optical system requiring a long focus the necessity of applying the eye to the metallic mounting was obviated. M. Violette has thus been able to make a glass composed of a cylindrical tube about 30 cm long and 8 cm in diameter. This tube contains the lenses and is extended by a sort of cup made of india rubber, at the bottom of which a hole is pierced. This hole indicates exactly the place where the eye should be applied. The observer can look through the glass during the shooting. At the instant of recoil the india-rubber cup simply forces itself lightly against his eye.

M. Ch. E. Guillaume, assistant director of the International Bureau of Weights and Measures, the ardent advocate of absolute units of measurement, exhibited this year new apparatus which carried still further exactitude of measurement. There were, first, a standard weight of 100 grammes in tantalum, a metal as hard as platinum-iridium, and costing only one-seventh as much, and, second, a simplified linear comparator of average precision, which is made to a scale divided into fifths of millimeters and is intended chiefly for the work of standardization laboratories. The Chinese government has acquired a first model of it. It enables verification to the hundredth of a millimeter to be made in a few minutes.

Space does not permit further description, but it will be understood that no attempt has been made to give here an account of the numerous exhibits of scientific apparatus and experimental arrangements shown that do not relate directly to electricity.

Wisconsin Commission News.

The Wisconsin Railroad Commission has authorized the Janesville Traction Company to issue 1250 shares of common stock, of the par value of $100 each, and $50,000 par value of 5 per cent, thirty-year first-mortgage bonds in denominations of $1,000 each for the purpose of acquiring the property and franchises of the Janesville Street Railway Company, which were purchased at the foreclosure sale on April 5, **1910**, by Hodenpyle, Walbridge & Company. This company owns all of the outstanding bonds and 350 of the 500 shares of stock of the Janesville Electric Railway Company, and is organizing the Janesville Traction Company.

It appeared from the petition in the proceeding that the outstanding bonds of the Janesville Electric Railway Company at the time of the foreclosure aggregated $75,000 and accrued interest, evidenced by unpaid interest coupons, amounted to $89,754, making a total indebtedness of $164,754. The outstanding stock at the time of the foreclosure sale amounted to $50,000. In addition to this there were issued during the foreclosure suit by the receivers appointed in the suit, for improvements under the order of the court, receivers' certificates to the amount of $10,000. The aggregate of stock, bonds, etc., at the time of the receivers' sale was $224,754. Under the law a purchaser at a foreclosure sale may organize and issue stock and bonds to an amount not to exceed the total amount of stock, bonds or other evidences of indebtedness outstanding against the company. No valuation of the property was made by the commission.

The commission has been sending out blank report forms to the various utilities operating in the State calling for information as to methods used by the utilities in connection with the uniform classification of accounts. The object is to determine how well the utilities are complying with the requirements as well as to give the commission certain facts and statistics for its own information.

Maryland Commission News.

The Maryland Public Service Commission has been engaged in hearing the application of the Susquehanna Transmission Company to issue bonds for $1,131,000, the proceeds to be used in discharging an obligation to the Susquehanna Water and Power Company. The borrowing company, which erected the poles and wires conveying energy from the Susquehanna River to Baltimore, has a normal capitalization of only $500. Chairman Ambler, of the Public Service Commission, declared that the issue of $1,131,000 of bonds by a corporation with a capital stock issue of $500 was unprecedented to his knowledge. Attorney Homer, who is representing the transmission company, pointed out that this borrowed money had already been expended, and it was the duty of the debtor company to comply with its part of the agreement and issue the bonds. The question of whether it would be fair to place negotiable bonds such as those proposed by the Susquehanna Transmission Company on the market when they were so scantily secured was debated freely. Mr. Homer gave a résumé of the formation of the transmission company, declaring that in reality it was merely a subsidiary company of the Pennsylvania Water and Power Company, made necessary by the laws of Pennsylvania and the limited character of the power company's charter of incorporation. He declared that when it became necessary for the company to expand its service it became necessary for it to have a transmission line. It could not do this under its own charter and, therefore, the Susquehanna company was formed, and money advanced it for the construction of its lines. This was all done prior to the establishment of the Public Service Commission in Maryland. The application was held under advisement.

Mr. Francis I. Mooney complained to the commission last week because he was compelled to pay the regular rate of $2.50 for thirty calls per month, or an average of 8 1/3 cents per call, when messages can be sent out from pay stations for 5 cents. He has asked the commission to investigate the business methods of the Chesapeake and Potomac Telephone Company. W. Baldwin & Company also made a complaint to the commission stating that they were charged with more 'phone calls than they actually used, and they also request an investigation. All of these matters will be decided when the commission renders a decision on the case which is now before it and which will show one of the most exhaustive studies of the telephone situation ever made in this country.

Ohio Legislative Notes.

The conference committee of the Ohio Legislature, which has been considering the Winters public-utilities bill, has announced that it will not be ready to report until after the recess, which will extend to the end of the month. At best the Legislature will be in session for only a few days then, and it now seems rather doubtful whether action can be taken on the bill at this session. However, many measures are pushed through at the last moment and this one may meet with the same fortune.

The Young telephone bill was reported out by the railroads and telegraph committee of the Senate, when it became apparent that the utilities bill would not reach a vote in the House before the recess. Its friends explained that the bill had been held up because the utilities bill contained about the same provisions and its passage would have accomplished the purpose desired. This bill was amended in such a way as to put the telephone companies under the supervision of the Railroad Commission instead of establishing a special commission, as was originally provided. An amendment has also been inserted which will prevent the inflation of securities in the event of reorganization under any merger that may occur. It was explained that the companies want a bill that will allow consolidations, but that they do not object to reasonable amendments to the present bill. Although efforts were made to advance the bill, this could not be done and it will have to take its chance at the last of the session.

Some of the laws enacted by the present Legislature are as follows:

The Finley bill requiring property owners to permit telegraph and telephone employees to enter properties to repair lines.

The Meinhardt bill granting telephone companies and telegraph companies the right to place their wires underground outside of municipalities.

The Green workmen's compensation bill, which establishes a State fund from which to pay damages for accidental injury of employees. This fund is sustained by fixed contributions from employers and employees in the ratio of 90 per cent and 10 per cent respectively. Employers are at liberty to accept the plan or proceed under the common law, with the exception that a number of their defenses are taken away if they do not operate under the provisions of the bill.

Massachusetts Legislative News.

Governor Foss has signed the following bills of interest to public-utility companies: Resolve 52, which provides that the Boston Transit Commission shall include in its next annual report an estimate of the cost of substituting a subway for the present elevated railway structure between the North Station and Sullivan Square; Chapters 95 and 96, authorizing the towns of Plymouth and Sandwich to purchase securities of the Plymouth and Sandwich Street Railway Company; Chapter 108, authorizing the town of Danvers to sell and distribute electricity to the Middleton Electric Light Company, Middleton and North Reading; Chapter 200, authorizing the town of North Attleboro to incur indebtedness for the purpose of securing a location for the Boston & Providence Interurban Electric Railroad Company; Chapter 267, authorizing the Mayor of the city of Beverly to appoint an underground wires commission with the right to prescribe certain work during the next eleven years; Chapter 290, authorizing the Railroad Commission to regulate the operation of cars of street-railway companies at crossings of industrial railroads; Chapter 293, requiring the names and addresses of the principal officers and directors of gas and electric-light companies to be printed in the annual report of the Gas and Electric Light Commission; Chapter 323, authorizing the Boston & Northern Street Railway Company to purchase the franchise and property of the Old Colony Street Railway Company, subject to terms approved by the Railroad Commission, thus permitting the establishment of a single system of about 1000 miles of track on the north and south sides of Boston; Chapter 345, adding headlights to the jurisdiction of the Railroad Commission over street-railway car equipment, and Chapter 348, relative to the inspection of electric meters. The last provides a nominal change in the wording of the existing law placing the inspection of meters within the board's jurisdiction. Chapter 349 provides that a corporation engaged in manufacturing or selling electricity for lighting, heating or motor service shall not without legislative authority transfer its franchise or lease its works except as provided under jurisdiction of the Gas and Electric Light Commission. Chapter 357 provides for the assent of stockholders when street-railway companies sell their franchises and property or consolidate with other companies and protects the dissenting stockholder by arranging for the appointment of commissioners by the courts to determine the value of dissenting shares on the day that the Railroad Commission approved the sale or consolidation. Chapter 364 provides for placing wires underground in not more than 3 miles of main streets and 2 miles of side streets in Boston yearly. Chapter 371 prohibits the overhead transmission of electricity in Boston at over 5000 volts alternating current or 10,000 volts direct current after June 30, 1913.

The committee on mercantile affairs has recommended to the next Legislature House bill 1277, which provides that any telephone, telegraph or electric-light company owning poles on locations previously granted by the municipal authorities may permit other similar companies to make attachments to such poles without further hearing, provided the approval of the wire inspector is first received. The amended Senate bill 478, confirming the locations of electric lines as desired by the Massachusetts Electric Lighting Association, has been passed to be engrossed in concurrence. The outlook for a bill favorable to the construction of the Boston & Eastern Electric Railroad is brighter than at any previous time in the present session. The committees on street railways and metropolitan affairs, sitting jointly, have named a sub-committee to draft a bill giving the company a certificate of exigency, and also another sub-committee to draw a bill authorizing the New York, New Haven & Hartford Railroad to acquire the Boston, Revere Beach & Lynn Railroad and build a tunnel under Boston Harbor, thus taking the first definite step toward steam-railroad electrification in the Boston district. Governor Foss has signed the bill providing that all gas and electric-service companies using cash-recording meters shall be responsible for the loss by fire of all cash deposited in such meters. House bill 477, providing for the transmission of electricity for street railways or electric railroads, with the right of appeal to the Gas and Electric Light Commission against the adverse decisions of local authorities upon the company's petition for line locations, has been passed to be engrossed. The bill provides for the joint use of pole lines in certain cases and for the proper labeling of all high-potential circuits. House bill 1340, providing that whenever a gas or electric-light company shall apply to the Gas and Electric Light Commission to issue additional capital stock the board should have the power to make such recommendations relative to the price and quality of the gas and electricity supplied as it may see fit, has been rejected by the Senate by a vote of thirteen to eight. Under the existing law the board fixes rates only upon complaint.

Massachusetts Commission News.

Governor Foss has sent a special message to the Legislature again recommending the establishment of a public-utilities board in place of the present State commission. Considerable surprise has been caused by the fact that in the face of a report advising no change, by Mr. C. H. Scovell, who made an expert inquiry into the telephone supervision and other work of the Massachusetts Highway Commission at the request of the Governor, the executive should still adhere to his stand on behalf of a single commission. There appears to be entire popular satisfaction with the present tribunals and there is practically no prospect of the Governor's attacks being heeded in either branch of the Legislature.

The Massachusetts Gas & Electric Light Commission has issued a decision sustaining the appeal of the Worcester Electric Light Company against an order of the Worcester Board of Aldermen granting Mr. Alfred S. Lowell permission to lay and maintain conduits and mains in Foster Street for the purpose of supplying electric service to his premises. The respondent maintains an isolated plant in Worcester at the intersection of Foster and Norwich Streets and desired to supply service to his store at the intersection of Main and Foster Streets by a diagonal line of conduit about 140 ft. in length, crossing Foster Street in order to fulfil its object.

In its decision the commission points out that the consent of the Board of Aldermen granted the respondent deals with an important question of public policy respecting the supply of electricity in Worcester. The commission has had occasion in earlier decisions to pass upon this matter and has reached the conclusion that its duty is confined to passing upon the question of public policy presented by the appeal, and that it has no power to modify or restrict the terms of the aldermanic order itself. Furthermore, the board's jurisdiction seems to be exhausted by one appeal. If the appeal before the commission should be dismissed, the right of Mr. Lowell to engage generally in the manufacture and sale of electricity in Worcester would be settled conclusively so far as the board is concerned, and he might thereafter sell to anyone within reach of the proposed line and extend his lines wherever and so far as the Board of Aldermen should grant the necessary street locations. The commission does not question the sincerity of Mr. Lowell's assurance that he desires this conduit location for the sole purpose of supplying energy to the corporation in which he is interested, but says: "But the meaning and effect of the order of the Board of Aldermen must be determined by its terms and by the conditions which may surround the exercise of the privileges granted thereby and not by any verbal representations made by Mr. Lowell of his intentions with respect to the matter. In fact, no criticism could justly be made of him should some future change of condition or of business not at present anticipated make it desirable or necessary to modify his purpose and exercise to the full the rights acquired under this order."

The commission further says in part: "The legislative policy with respect to the admission of a new company or person to supply electricity in a territory already served by an existing company, and the board's interpretation and administration of that policy, are well known and were not criticised or doubted by the respondent. The essential consideration is not merely the desire or the personal convenience or interest of the party applying for admission, or of those to whom he proposes to supply energy, or of the existing supply company, but rather the general public interest. An electric light company has no necessary or legal monopoly of the territory which it serves. If it is not properly or adequately performing its public duties a situation arises which may not only justify but require this board to admit a competitor. But with this restriction the prevailing opinion based upon experience has been that the community as a whole will be more adequately and economically served by one company than, in the language of the Supreme Court, by 'as many companies or persons as may be minded to put wires in the streets and try their luck.'

"In this case it was not contended that the Worcester Electric Light Company is not properly and adequately performing its public duties. It is true that the respondent had a grievance against the company, but this was found to have arisen out of a mistake and was promptly remedied. But it was urged that the order of the Board of Aldermen is so restrictive in its terms as to confine the use of the proposed line exclusively to the use of the A. S. Lowell Company and that therefore the order should be affirmed. A careful examination of the order fails to give substantial support to such a construction of its terms. While the position of Mr. Lowell is quoted in the order in full and sets forth specifically his purpose, the order permits the laying of a conduit and wires between the two buildings mentioned 'for the purpose of supplying light, heat and power.' It restricts the use of the privilege to the petitioner himself, but this is a restriction commonly imposed in locations granted to electric light companies, and for that matter is probably merely declaratory of the law relative to the privilege given. The order plainly does not authorize the construction of a line 'for private use,' for in that event the line upon construction would become the property of the city by operation of law; whereas this order expressly provides that it shall be forfeited to the city only upon breach of a condition of the grant. Even if the order were capable of the interpretation urged there is serious reason to doubt whether the Board of Aldermen may grant a location for a line not for private use with a valid condition that no electricity shall be distributed thereunder save to certain designated persons or corporations. It must be kept in mind that the law by which the rights of all concerned are to be determined makes the A. S. Lowell Company and Mr. Lowell, whatever his interests therein, two entirely distinct persons. In spite of the seeming identity of interest the case under discussion is not one where an individual or corporation owning a lighting plant has extended the quarters necessary for the accommodation of his or its business by purchasing or hiring a building separated by a public street from premises already occupied. There are statutes which expressly provide for permits for private use, but they are clearly inapplicable to this case." The appeal was therefore sustained and the decision and order of the Board of Aldermen annulled.

The board has issued an order authorizing the issue by the Pittsfied Electric Company of additional capital stock of the par value of $225,000 to meet the cost of additions to plant, covering mainly the building of a steam turbine station at Silver Lake and its articulation with the company's existing system of generation and distribution. The stock is to be offered to the stockholders at a price of $135 per share as determined by the board of directors.

New York Commission News.

The New York Public Service Commission, Second District, has authorized the Port Jefferson Electric Light & Power Company to issue bonds to the aggregate amount of $30,000 with interest at 5 per cent payable semi-annually. The proceeds of the bonds are to be used for the purchase of new apparatus amounting to $8,800, for expenses incurred in improving its plant, $2,700, and for the payment of bills and accounts incurred for capital purposes, $18,500. The company is required to make entries on its books which will properly take care of the replacements of apparatus and material which have taken place and the improvements being made to the plant and distribution system.

The commission has authorized the Delaware County Electric Light & Power Company to execute a mortgage upon all its property to secure an issue of $200,000 par value 5 per cent twenty-year gold bonds. The company is authorized at the present time to issue and sell $25,000 of these bonds at not less than par. The company is given permission to issue and sell 100 shares of its common capital stock at a par value of $100 per share. Of the proceeds of the $25,000 of bonds and $10,000 of stock the sum of $2,000 is to be set aside for the purchase of additional electrical equipment, $1,500 is to be reserved for an extension line to the county house, and the balance of the sum is to be used for rebuilding and putting in proper shape for operation the plant and distribution system formerly owned by the Delhi Electric Company situated at Delhi, Delaware County.

Because the New York Telephone Company refused to install a pay station telephone in the store of McManus Brothers, New York City, they have complained to the commission, asking that an order be entered directing the telephone company to provide this service. The complainants allege that without this facility they are at a disadvantage with their competitors who have pay stations installed. When refusing the request of the complainants the New York Telephone Company stated that the locality in question is amply supplied with pay stations. The New York Telephone Company has been served with a copy of the complaint and an answer is required to be filed with the Public Service Commission of the Second District within twenty days.

The commission has authorized the Northern Wayne Electric Light & Power Company to purchase the franchises, works and system of the Wolcott Electric Light & Power Company in the village of Wolcott for the sum of $33,000. The company is also authorized to begin and complete the construction of a pole line and equipment for the transmission of electricity from the substation of the Rochester & Sodus Bay Railroad Company at Sodus in the village of Wolcott and through the towns of Rose, Huron and Wolcott to the village of Red Creek, and from the village of North Rose to Rose, and the construction of secondary distribution systems in the villages of North Rose, Rose and Red Creek, all in the county of Wayne. The company is also authorized to issue its capital stock to the par value of $75,000, the proceeds to be applied for the purchase of the Wolcott plant and the necessary construction of the lines authorized under its various franchises.

The Plattsburgh Gas & Electric Company has been authorized to issue its thirty-year 5 per cent bonds to the amount of $10,000, the bonds to be sold at not less than 92. The proceeds of the bonds are to be used for extensions and improvements of its plant.

The commission has closed upon its records the complaint of the Lycoming & New Haven Telephone Company against the New York Telephone Company. As a result of the hearing had on the application the New York company entirely receded from the position that the complainant should secure the consent of certain persons operating a competing line before it would enter into a working agreement with the Lycoming company, and now offers the Lycoming company exactly the same agreement for joint service that it is working under with five other local companies in that section, some of which have a greater number of subscribers than the Lycoming company has.

The commission does not agree with the complainant that the switch connection of $6 per subscriber should be reduced to $3, and says that if the complainant's subscribers should greatly increase in number an entirely different situation would be presented.

AMERICAN ELECTRICAL ENGINEERS—XXXIV.

M. W. Buchanan.

Myron Webster Buchanan was born June 4, 1878, at Frankfort, Herkimer County, New York, and received his early education at the Sauquoit Academy, Sauquoit, N. Y. After preparation at the high schools of Bennington, Vt., and Clayville, Oneida County, N. Y., he entered Cornell University, from which he was graduated in 1900 with the degree of M.E. in electrical engineering.

Having been associated with graduates of two preceding classes who had been engaged to complete the organization of an electrical laboratory at the United States navy yard, New York, for the purpose of experimental and inspection work in connection with electrical machinery and supplies, of which the navy had become a considerable purchaser, Mr. Buchanan accepted a position in the laboratory immediately upon graduation in 1900. During the following two years experience of an interesting character was gained relating to almost every kind of electrical apparatus used by the navy at that time, both in the laboratory and after installation on board the vessels. Acceptance and competitive tests of an extensive nature were conducted upon such apparatus as searchlights of domestic and foreign manufacture, incandescent lamps, rubber-insulated wire and cable, batteries, interior-communication accessories, motors and generating sets. At the time of leaving the New York navy yard Mr. Buchanan was in charge of the test of engine-driven generating sets. The popular sizes of ships' generators at that period were 16 kw, 24 kw and 32 kw. As the size of vessels and the demand for more light and electrically operated auxiliary machinery increased, engine-driven generators were increased to 50 kw, then 100 kw, and the demands for space economy were later met by the adoption of the 300-kw turbo-generator, which has been the unit of the generating stations of recent battleships.

M. W. Buchanan.

After a competitive examination, Mr. Buchanan was in 1902 appointed expert electrical aid in the office of the superintending naval constructor at the Union Iron Works, San Francisco. This assignment was especially desirable, inasmuch as this was the only shipbuilding plant contracting for United States naval vessels which designed and built the greater portion of the engines, generators and motors and a considerable part of the minor electrical equipment installed. The duties of the electrical aid extended from the design office to the acceptance tests after installation on shipboard, and required the preparation in book form for each vessel of a complete description with data of design and performance, covering all electrical apparatus under the cognizance of the office. This work also involved some sea duty, the trials of new vessels being held off Santa Barbara, Cal., about a day's voyage south from the Golden Gate. During Mr. Buchanan's term of duty at the Union Iron Works the following vessels were under construction there for the navy: Battleship, *Ohio;* cruisers, *Tacoma, Milwaukee, California* and *South Dakota;* monitor, *Wyoming;* torpedo boat destroyers, *Paul Jones, Perry* and *Preble;* submarines, *Grampus* and *Pike*. The Union Iron Works was a heavy sufferer from the earthquake of 1906 and considerable time elapsed before work could be resumed on the naval vessels. During this period Mr. Buchanan devoted a portion of his spare time to consulting work of a minor character.

In 1907 Mr. Buchanan was transferred to the Navy Department, Washington, D. C., to fill a vacancy in the position of assistant electrical expert to the Bureau of Construction and Repair, and later in the same year, after a competitive examination, was appointed expert electrical aid to that bureau, which position he has since occupied. In this position Mr. Buchanan has been closely in touch with the relations existing between the Navy Department and the contractors and manufacturers who do business with the government. He has actively engaged in the preparation of uniform electrical specifications for the different branches of the Navy Department, with the co-operation of the manufacturers. As a result, specifications for electric motors and controlling appliances for all purposes on shore and on board naval vessels have been developed by the various bureaus of the Navy Department in conference with the manufacturers and have been issued by the Secretary of the Navy for the use of all branches of the department. This work may be said to have been promptly accomplished when the great inertia of the naval organization and the resistance which radical changes in naval practice usually encounter are considered. Mr. Buchanan's personal views on this subject are contained in a discussion on the subject of government specifications for electrical apparatus, printed in the *Professional Memoirs* of the Corps of Engineers, U. S. A., January, 1911.

In connection with his work under the Bureau of Construction and Repair, Mr. Buchanan has been called upon to investigate and report upon a number of subjects, notably electrolysis on shipboard, the capacity of fans for ships' ventilation systems, application of electric heating to vessels, method of obtaining thermometer temperatures of electrical machinery on test, alternating and direct-current electrical equipments for navy yard machinery, especially cranes, and the extension of electric drive to certain of the remaining steam-driven ship auxiliaries.

Mr. Buchanan is a member of the American Institute of Electrical Engineers and of the executive committee of the Washington Section of the Institute.

Since the above sketch was written Mr. Buchanan has resigned from the naval service to enter the engineering department of the Diehl Manufacturing Company, of Elizabethport, N. Y., which concern has during the past two years done much naval and other governmental electrical work.

CURRENT NEWS AND NOTES.

Large High-Pressure Gas Plant.—Contracts have been let for the construction at Lockport, north of Joliet, of a 3,000,000-cu. ft. high-pressure gas plant to supply gas to forty-five cities and towns in northern Illinois.

Philadelphia-New York Wireless Telegraphy.—Overland wireless telegraphy between Philadelphia and New York was placed in commercial service on May 20. The stations are located on the Wanamaker stores in the two places and will be operated as a part of the system of the Marconi Wireless Telegraph Company.

Merchants' Parade in Celebration of Street Lighting.—Thursday, May 25, was set aside by the Business Men's Club of Grand Crossing, a suburb of Chicago, for the celebration of the new installation of tungsten street lighting in the business section. In the evening a parade was held along the brilliantly lighted streets.

Metallic Titanium.—The first publication of the "Engineering and Science Series" of Rensselaer Polytechnic Institute is a paper by Mr. Mathew A. Hunter on "Metallic Titanium." The paper, together with an appendix by Mr. Hunter and Mr. E. C. Jones, gives a thorough account of the properties of this metal and the processes for its reduction.

Michigan Student Inspection Trip.—The senior engineers of the Michigan Agricultural College to the number of forty, accompanied by the heads of the departments of mechanical, electrical and civil engineering, recently made an inspection trip of four days visiting the Pittsburgh district, Buffalo and Niagara Falls. They left Lansing on a special car Tuesday night, May 9.

State Aid for M. I. T.—In order to provide money for a new site the Massachusetts Institute of Technology has been granted by the State $100,000 annually for ten years in return for which the institute binds itself to maintain eighty free scholarships to be apportioned among the forty senatorial districts of the State. The institute is pledged to ask no further aid from the State after the $1,000,000 has been received.

Electrolytic Survey in Denver.—The Denver Union Water Company has just completed an exhaustive electrolytic survey under the direction of Mr. A. M. Ballou, formerly electrical engineer with the Denver City Tramway Company. The tests were unusually elaborate in number and method. Maps have been completed for all districts together with general map showing current distribution, with return feeder arrangements, quantity of current carried by water mains, positive and negative districts for water mains, etc.

Chicago Section, Illuminating Engineering Society.—At the next meeting of the Chicago Section of the Illuminating Engineering Society to be held Thursday noon, June 15, Mr. W. R. Bradley, of the American Luxfer Prism Company, will present a paper on "Daylight Illumination." At the same meeting the nominating committee, comprising Messrs. Francis A. Vaughn, Oliver Hogue, James R. Cravath, George C. Keech and Charles A. Luther, will present its report proposing officers for the Chicago Section during the ensuing year.

Electricity Versus Gas in Boston Street Lighting.—Commissioner Louis K. Rourke of the Boston Public Works Department is formulating plans for the extension of electric street-lighting service into various districts now lighted by gas lamps, anticipating the authorization by the City Council of the purchase of gas-lighting equipment. Mr. Rourke proposes to install 2000 tungsten lamps of 60-cp rating in the section between Roxbury Crossing, Dorchester and Dorchester Bay, reducing the number of gas lamps in service to 9500. The city will save $1.27 per lamp per year by adopting electricity, the price charged by the Edison Electric Illuminating Company for the tungsten-lamp service being $22.31 per year each. The city is considering investing about $280,000 in existing gas equipment and undertaking the municipal operation of the apparatus. If the city does its own gas lighting, automatic lighting and extinguishing devices will be installed, and about 120-lamp lighters will be relieved of duty. It is expected that the adoption of electricity in a section as large as that indicated in Mr. Rourke's plans will conclusively demonstrate the superiority of the tungsten lamp for the service.

Big Dam for California.—An unofficial statement from San Francisco is to the effect that the Great Western Power Company is to build a dam and reservoir at Big Meadows, Cal., which will surpass in capacity both the Roosevelt dam and project in Arizona and the Assouan dam in Egypt. Sufficient water will be stored to irrigate 300,0000 acres.

American Museum of Safety.—The American Museum of Safety has been granted a special charter by the New York State Legislature, thus putting it in the same class with the Metropolitan Museum of Art and the New York Museum of Natural History. The exhibits in the museum rooms in the Engineering Societies Building, 29 West Thirty-ninth Street, now include practical devices for safeguarding human life in almost every field of labor.

W. P. I. Dinner in Pittsburgh.—The graduates of the Worcester Polytechnic Institute who will attend the spring meeting of the American Society of Mechanical Engineers in Pittsburgh will dine together informally at the Fort Pitt Hotel, Pittsburgh, on Monday, May 29, at 7:30 p. m. Mr. R. J. Dearborn, secretary of the Pittsburgh W. P. I. Alumni Association, 745 Hill Avenue, Wilkinsburg, Pa., is in charge of the arrangements.

Chicago Electric Club.—Mr. Thomas I. Stacey, secretary of the Electric Appliance Company of Chicago, entertained the members of the Chicago Electric Club, following its weekly luncheon, Wednesday noon, May 17, with an account of his recent trip to the Panama Canal. Mr. Stacey spoke interestingly and appreciatively of the work being accomplished by American engineers in the Canal Zone, and with the aid of a stereopticon lantern exhibited a number of photographs which he took on the Isthmus.

Meeting of Automobile Engineers.—The Society of Automobile Engineers will hold its annual meeting on June 15 at the Algonquin Hotel, Dayton, Ohio. Among the papers to be presented will be one by Mr. Justus B. Entz entitled "The Question of Long Versus Short Stroke Motors." An important part of the proceedings of the meeting will be the consideration of reports by the general standardization committee, which includes in its membership about eighty of the leading automobile engineers of the country, covering every branch connected with motor-car production.

Water Turbine Efficiency.—The May number of the *Armour Engineer* contains a paper by Mr. Stanley Dean, instructor in civil engineering at Armour Institute, which gives the methods and results of a test of two 5000-hp hydroelectric units installed in the plant of the Schaghticoke Hydroelectric Development Company on the Hoosac River at Schaghticoke, 22 miles east of Schenectady, N. Y. The turbines are of the Pelton-Francis type, direct-connected to 3000-kw alternators, and designed to develop 5000 hp at 300 r.p.m. under a head of 146 ft. The efficiencies at various loads were as follows: 0.53 load, 82 per cent; 0.77 load, 86 per cent; 0.86 load, 85 per cent; 1.02 load, 82.9 per cent. The generator efficiency at these several loads was 95.1 per cent, 96.4 per cent, 96.6 per cent and 96.5 per cent respectively.

Election of Delegates from Commonwealth Edison Branch, N. E. L. A.—After an exciting letter-ballot election the Commonwealth Branch of the National Electric Light Association has elected six delegates to the New York convention of the association to be held on May 29-June 3. The successful ones are Mr. E. W. Goedjen, contract department; Mr. Otto Hanf, treasury department; Mr. J. H. Perry, meter department; Mr. D. H. Nichols, construction department; Mr. J. C. Johnson, Quarry Street station; Mr. J. Aldred, Fisk Street station. The Commonwealth Edison Company defrays all the expenses of these delegates and will have in addition a large delegation of company representatives. The membership list was divided into three divisions and each division elected two delegates. This was to secure a balanced representation. Valid votes to the number of 614 were cast. Members behind in their dues were not allowed to vote, and all defective ballots were thrown out.

Annual Meeting of the Philadelphia Electric Company Section, N. E. L. A.—The annual meeting of the Philadelphia Electric Company Section of the National Electric Light Association was held May 15 and was given over to the election of officers and the chairman's annual report. The latter consisted of a review of the work of the year and a summary of the reports of the various committees. The following officers were elected: Chairman, Mr. Thomas Sproule; vice-chairman, Mr. R. B. MacCreery; secretary, Mr. B. Frank Day. The executive committee comprises the following: Two-year term, Messrs. J. T. Maxwell, J. D. Israel, C. J. Russell and Joseph B. Seaman; one-year term, Messrs. George Ross Green, P. H. Bartlett, A. H. Manwaring and A. R. Granger. The treasurer and three members of the executive committee are to be appointed by the president of the Philadelphia Electric Company. An amendment to the constitution was adopted providing for the appointment of two honorary members to the executive committee. The attendance was 116.

Two-Phase to Three-Phase Transformation.—Due to an error in editorial transcription, there appears in the *Electrical World* of May 11, on page 1167, a statement relative to a certain voltage ratio which is not directly applicable to the diagram of connections referred to. The statement that the two-phase voltages are not equal in value to the three-phase voltages is true of the terminal voltages of the transformers, which, however, are not utilized in the connection illustrated. The fact is that with the arrangement shown in Fig. 2 the three-phase voltages are exactly equal to the two-phase voltages. Moreover, they are obtained directly from three of the four busbars or distributing lines of the two-phase system. Three-phase voltages of 115.5 per cent of the two-phase value may be obtained from the terminal transformer connection; it is to this inconvenient ratio of 1.00 to 1.155 that the statement mentioned above is applicable. The author of the article in question, Mr. F. T. Wyman, in bringing this error to our attention points out that the scheme described is used in numerous installations throughout the United States, 1800 kw of transformers being thus operated in Altoona, Pa.

A. I. E. E. Electrical Show.—The A. I. E. E. student branch of Ohio State University gave an electrical show May 12-13 in the laboratory of the Department of Electrical Engineering of the university. The exhibits were of two general types, those entirely due to the students, which in general related to special uses of electricity not commonly known, and a group of commercial exhibits supplied by manufacturing and commercial companies. All of the apparatus on exhibition was shown in operation. The exhibit of telephone apparatus was very complete. The cooking apparatus on exhibition was operated by students of the department of domestic science, and a coal-mining electrically driven coal cutter and drill were installed in a covered pit, arranged to represent a coal mine. During the exhibition demonstrations were given of the operation of various devices and processes, including the alternating-current rectifier, high-tension transformer, photometers, electric welding, wireless telegraphy, the talking arc, a wireless control arrangement, Geissler tubes, etc. The exhibits in illumination, both interior and exterior, were very complete. The only accident occurred during the exhibition of Geissler tubes in a dark room. The frequency of the spark from the induction coil was such that the fan in the room seemed to be running backward very slowly and a visitor attempted to stop the fan with his finger.

ELECTRICITY IN NEW YORK CITY

FEATURES AND STATISTICS OF THE GENERATING STATIONS OPERATED BY THE PUBLIC SERVICE CORPORATIONS.

NEW YORK CITY is made up of five boroughs, namely, Manhattan, with a population of 2,331,542; Brooklyn, with a population of 1,634,351; Bronx, with a total of 430,980 souls; Queens, with 284,041, and Richmond, with 85,969. The greater city has therefore a total population of 4,766,883. All of the public utilities in the city with the exception of the telephone and telegraph conduct their business under the supervision of the Public Service Commission, First District, State of New York. The following public-service corporations operate electric generating stations in the city: New York Edison Company, Edison Electric Illuminating Company of Brooklyn, New York & Queens Electric Light & Power Company, Bowery Bay Electric Light & Power Company, Bronx Gas & Electric Company, Queens Borough Gas & Electric Company, Flatbush Gas Company, Interborough Rapid Transit Company, Metropolitan Street Railway Company, Coney Island & Brooklyn Railroad Company, Transit Development Company, Third Avenue Railroad Company, Richmond Light & Railroad Company, Staten Island Midland Railway Company, New York Central Railroad and the Pennsylvania Tunnel & Terminal Railroad Company. The amount of energy generated by these companies last year approximated 1,750,000,000 kw-hours. There are of course other companies using electricity in New York City which is generated outside the city; but these are not included in the estimate above given.

It is not the purpose here to describe the various stations in detail, but to point out their chief characteristics and give some statistics regarding them. For the benefit of delegates attending the convention of the National Electric Light Association, the features of the New York Edison Company are stated at greater length in the present article than those of the other companies, because the article on this company published elsewhere in this issue is devoted to the rebuilding of one of its stations. The systems of the other two large distributing companies are described in separate articles so that mere references are necessary here.

Owing to the clear skies ever present in New York one is not usually impressed with its industrial greatness. Not only is it the metropolis of the Western Hemisphere, but it is the Electrical City of the World; for there is more electric power within its confines than in any other place on earth. All of the electricity used is generated in steam-driven stations, the record for greatest efficiency being held by the Fifty-ninth Street station of the Interborough Rapid Transit Company, where a kw-hour is generated from 2 lb. of coal. The latter is not a test figure but is obtained by dividing the monthly output of the station in kw-hours by the pounds of coal burned.

NEW YORK EDISON COMPANY.

The New York Edison Company operates four generating stations. Two main stations adjoin each other at East Thirty-eighth, Thirty-ninth and Fortieth Streets, First Avenue and the East River and are known as Waterside Stations No. 1 and No. 2. So far as operation is concerned both might be considered as parts of a single station and that the largest in the world. The other two stations are located, one at 55 Duane Street and the other at 140th Street and Ryder Avenue. Bor-

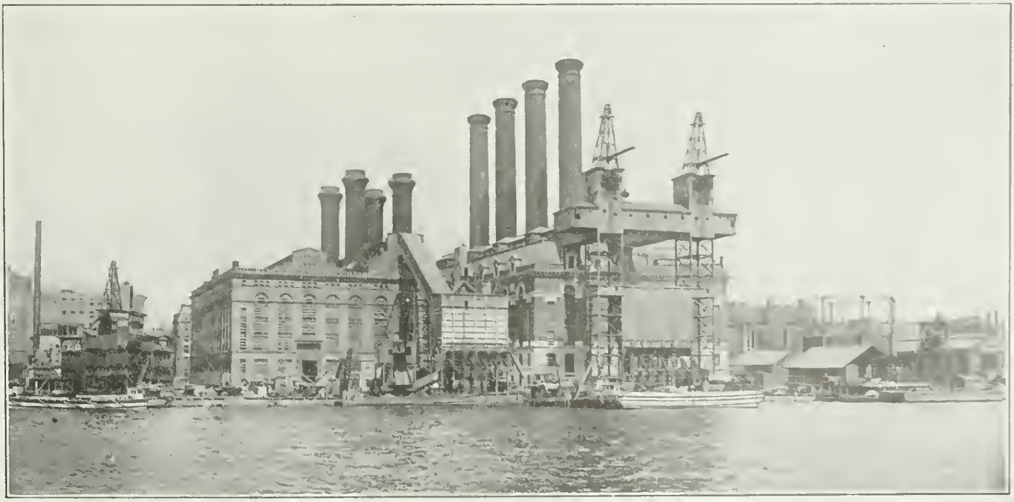


Fig. 1—Waterside Stations of New York Edison Company on East River.

ough of the Bronx. The combined equipment of the two last mentioned is 10,800 kw, whereas the combined capacity of the two Waterside stations is approximately 250,000 kw; No. 1 when complete having a maximum rating of 129,500 kw and No. 2 having a maximum rating of 120,000 kw.

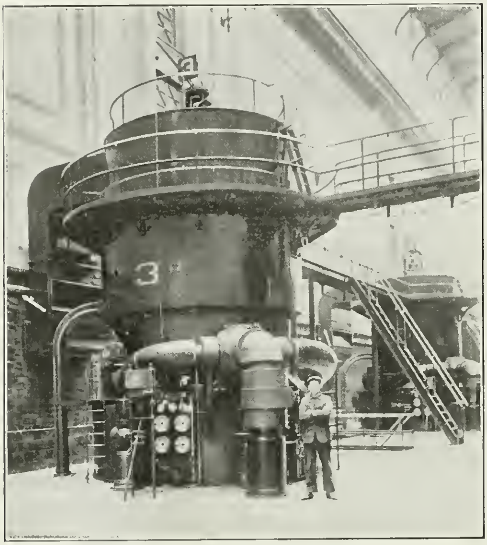


Fig. 2—Turbines in Waterside Station No. 2.

Waterside Station No. 1 was completely described in these pages in January, 1902. The station is at present undergoing extensive changes, a complete account of which is published elsewhere in this issue. The station when changed will contain fifty-four Babcock & Wilcox boilers rated at 650 hp at a working pressure of 200 lb. Twenty of the furnaces will be equipped with Taylor stokers and thirty-four have flat grates and are hand-fired. Semi-bituminous fuel will be used in the furnaces of the boilers equipped with stokers, whereas the others are hand fired with a mixture of No. 3 buckwheat and bituminous coal. There are seven 5500-hp vertical, three-cylinder, compound condensing Westinghouse engines direct-connected to as many 3500-kw, 25-cycle, three-phase, 6600-volt General Electric alternators; two 10,000-kw and one 5000-kw, 25-cycle Curtis units and one 5000-kw and one 9000-kw, 60-cycle Curtis units at present in operation. Three 20,000-kw, 25-cycle Curtis units are now in course of erection. All of the auxiliary apparatus is steam-driven and the maximum load carried by the station last year was 68,800 kw.

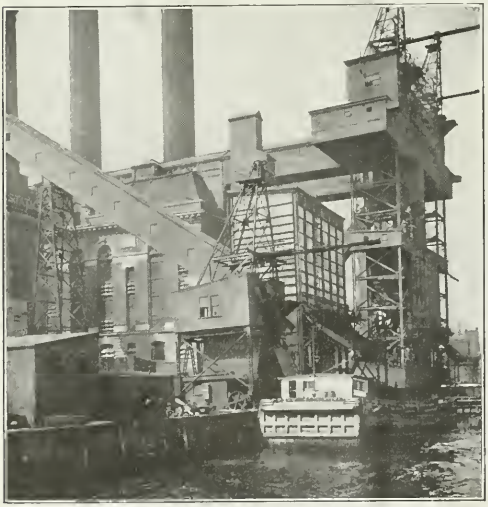


Fig. 3—Coal Conveyors at Waterside Stations.

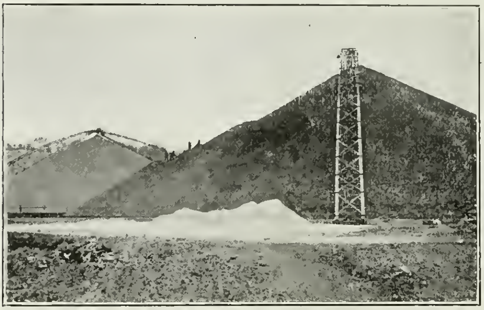


Fig. 4—Coal Storage of New York Edison Company.

Waterside Station No. 2 was completed in 1909 and described in detail in these columns March 4, March 11, March 25 and April 8, 1909. In this station the operating room is on the north side of the building, the boiler house being on the south side to facilitate tying the steam end of the plant to the boiler plant of Waterside Station No. 1, which lies across the street to the south and in which the arrangement is reversed, the boiler house being to the north and the generator room to the south. The operating room contains two horizontal turbines and eight vertical turbines arranged in parallel rows with an aisle in the center. The electrical galleries are arranged along the north wall and under them on the main floor are the

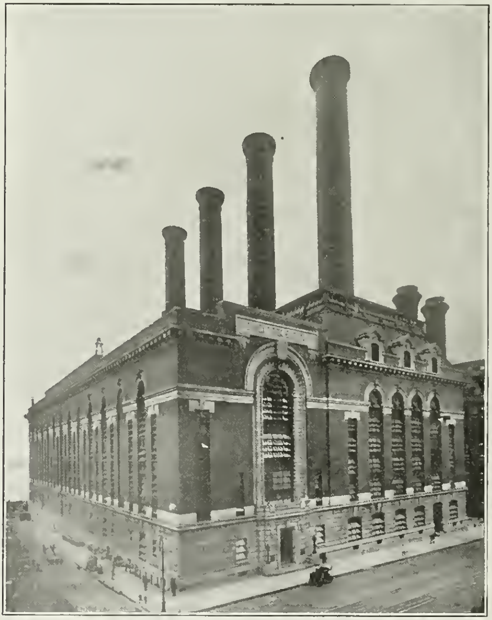


Fig. 5—Waterside Station No. 2.

exciters and motor-generators. In a vault under the sidewalk on this side of the station is the storage battery. The auxiliary apparatus for the turbines is located in the basement under the generating room and the electrical control board occupies the west end of the operating room. The board is semi-circular in shape and the arrangement is such that the switchboard operator has an unobstructed view of the operating floor.

The boiler house contains ninety-six Babcock & Wilcox boilers rated at 650 hp, 200 lb. working pressure and 125 deg. superheat. Thirty-six of the boilers are fitted with flat grates and are hand-fired while the remainder are fitted with Taylor stokers, forty-eight of which are at present being installed. Semi-bituminous coal is burned in the boilers fitted with stokers and a mixture of No. 3 buckwheat and bituminous in the hand-fired boilers. The boilers are installed in eight rows across the boiler house, six boilers in a row, and two floors are occupied. Four stacks are provided, each serving twelve boilers on each floor or twenty-four in all. The coal bunkers occupy the top of the boiler house and the fuel is delivered to the firing floor in chutes. The fuel is hoisted from barges moored at the dock by two 1.5-ton clam-shell buckets, operated by hoisting and trolley engines in twin steel towers. A cable system of cars distributes the coal to the respective bunkers. Ashes are dumped from the pits into cars in the basement of the boiler-room and drawn by an electric locomotive to a pocket on the bulkhead whence they are conveyed into an overhead ash pocket and chuted to scows for final disposal.

The turbine room, a view of which is given in Fig. 6, contains six 8000-kw Curtis, one 14,000-kw Curtis and two 8000-kw Westinghouse 25-cycle, 6600-volt, three-phase machines and two 8000-kw Westinghouse and one 14,000-kw Curtis 7500-volt, 60-cycle, three-phase machines. Each of the Westinghouse turbines drives a 25-cycle, 6600-volt and a 60-cycle, 7500-volt alternator, the twin generators running at 750 r.p.m. The aggregate maximum rating of the generators is 120,000 kw and the peak load carried in 1910 was 83,400 kw. Surface condensers utilizing salt water from the river are fitted to all of the turbines.

The three high-tension cables from the armatures of each of the generators are led through vitrified ducts under the floor to similar ducts on the north division wall leading to the main oil switches, located on the fourth mezzanine floor of the electrical galleries. The feeder oil switches are also located on the fourth mezzanine floor. From these switches are run the outgoing high-tension triplex feeder cables of the distributing system. The third mezzanine is given up to transformer compartments, the second to the selector switches and the first to the high-tension main and auxiliary buses. All of these switches are of the remote-control type and are operated from the switchboard gallery at the west end of the operating room.

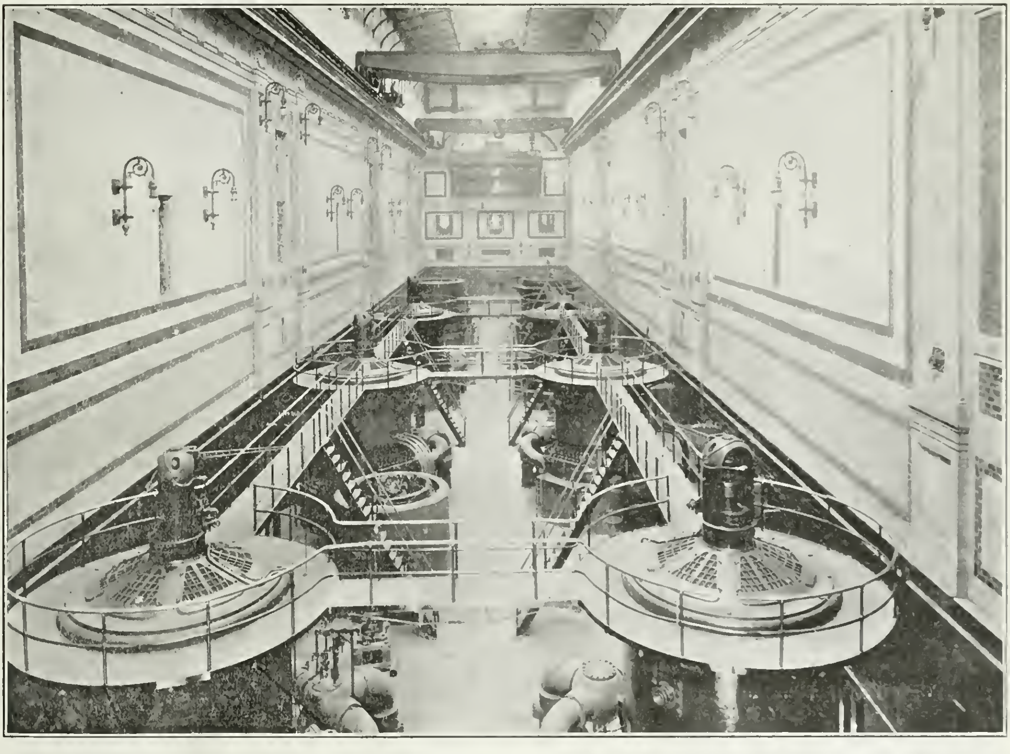


Fig. 6—Waterside Station No. 2 of the New York Edison Company.

From the generating station the energy is distributed in underground cables to substations in various parts of the city. The substations are very substantial buildings as the engravings indicate and contain six-phase synchronous converters of either the horizontal or vertical type yielding direct current at 270 volts. The direct-current switchboards are divided into two independent sections for the positive and negative poles. The low-tension feeder panels are grouped into a positive and negative board, each of which is provided with three sets of busbars mounted on the back of the panel. Each panel has four feeder switches and above each feeder is mounted an edgewise ammeter. The feeder neutrals are not brought to the operating board but are connected to the storage battery and compensator neutral bus. Storage batteries are installed in all stations to insure continuity of service.

The company maintains several branch offices, the largest of which is at 424 Broadway. From the viewpoint of beauty and interior lighting the Harlem office on 125th Street shown in

Fig. 10, is superior to any of the others. In order to be prepared for a coal strike or delayed delivery of fuel the company has an immense coal storage yard at Shadyside, on the New Jersey shore, capable of holding 200,000 tons.

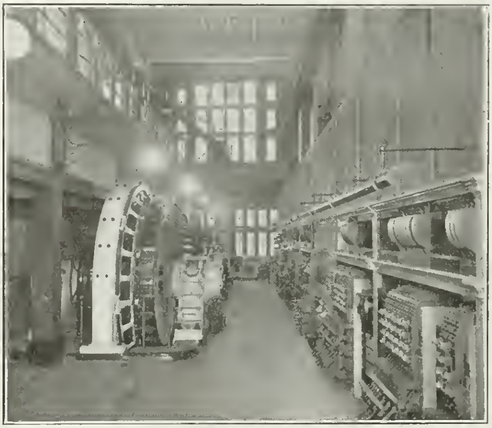


Fig. 7—Water Street Substation, New York Edison Company.

On Jan. 1 the New York Edison Company had 100,059 customers; there were fed from its circuits 38,975 arc lamps and 4,342,933 incandescent lamps; the connected motor load was 263,529 hp; the load in vapor arcs, heating apparatus, batteries, etc., amounted to approximately 9595 kw. There is, of course, a large amount of electric cooking and heating apparatus on the company's circuits of which it keeps no record. The total connected load in 50-watt equivalents on Jan. 1 was 8,584,725.

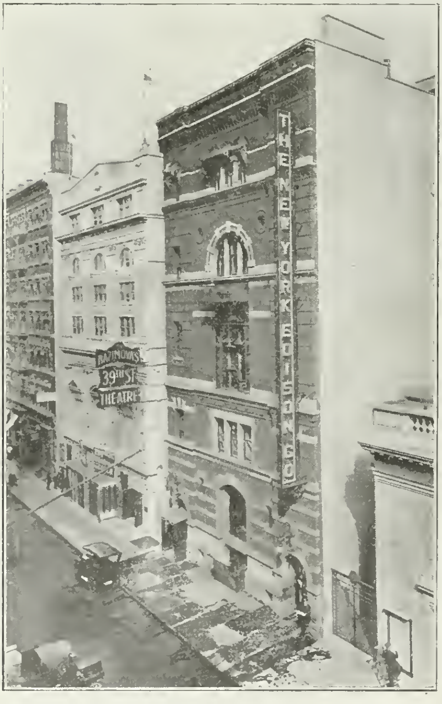


Fig. 8—Typical Substation Building, New York Edison Company.

INTERBOROUGH RAPID TRANSIT COMPANY

The Interborough Rapid Transit Company operates two main generating stations, the one carrying the subway load being located at Fifty-ninth Street, Eleventh Avenue and North River and the other, feeding the elevated railway lines, being located at Seventy-fourth Street and East River.

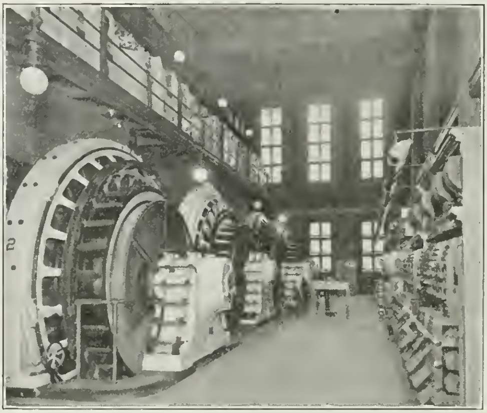


Fig. 9—East Thirty-ninth Street Substation.

The Fifty-ninth Street station is probably one of the most interesting stations in the country, being equipped with five of the largest exhaust steam turbines ever built. The station as originally built was described in these columns Oct. 8, 1904. The power house at present contains nine 7500-kw Allis-Chalmers combined double-horizontal and vertical engines, three Westinghouse turbines rated at 1725 kw each and five Curtis low-pressure turbines, each rated at 7500 kw. The low-pressure turbines are located between and to one side of the reciprocating engines, as indicated in Fig. 11. The relative size

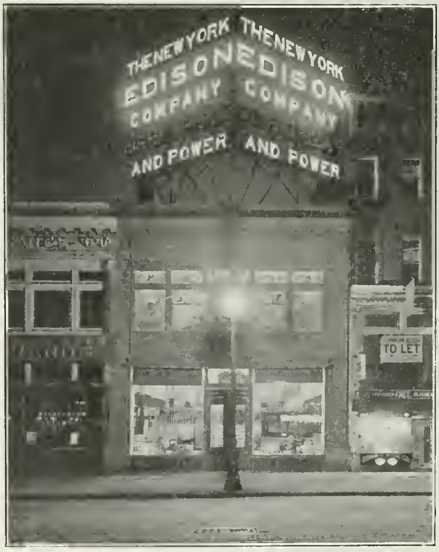


Fig. 10—Harlem Office of the New York Edison Company.

of both units is well shown in this engraving. The dimensions of the engine cylinders are 42 in. and 86 in. in diameter and 60-in. stroke, and the speed is 75 r.p.m. Both pistons on each side of the engine are connected to one crankshaft. Steam enters each hign-pressure cylinder at from 175 lb. to 200 lb. pressure through a 14-in. pipe and from there passes into a receiver through a 16-in. pipe, whence it passes to the low-pressure cylinder. The engines have poppet valves on all the high-pressure cylinders to provide for the use of superheated steam, but the usual Corliss valve gear is supplied to the low-pressure cylinders. The generators driven by the engines are of the Westinghouse revolving-field, flywheel type and are rated at 7500 kw, 25 cycle, three-phase, 11,000 volts.

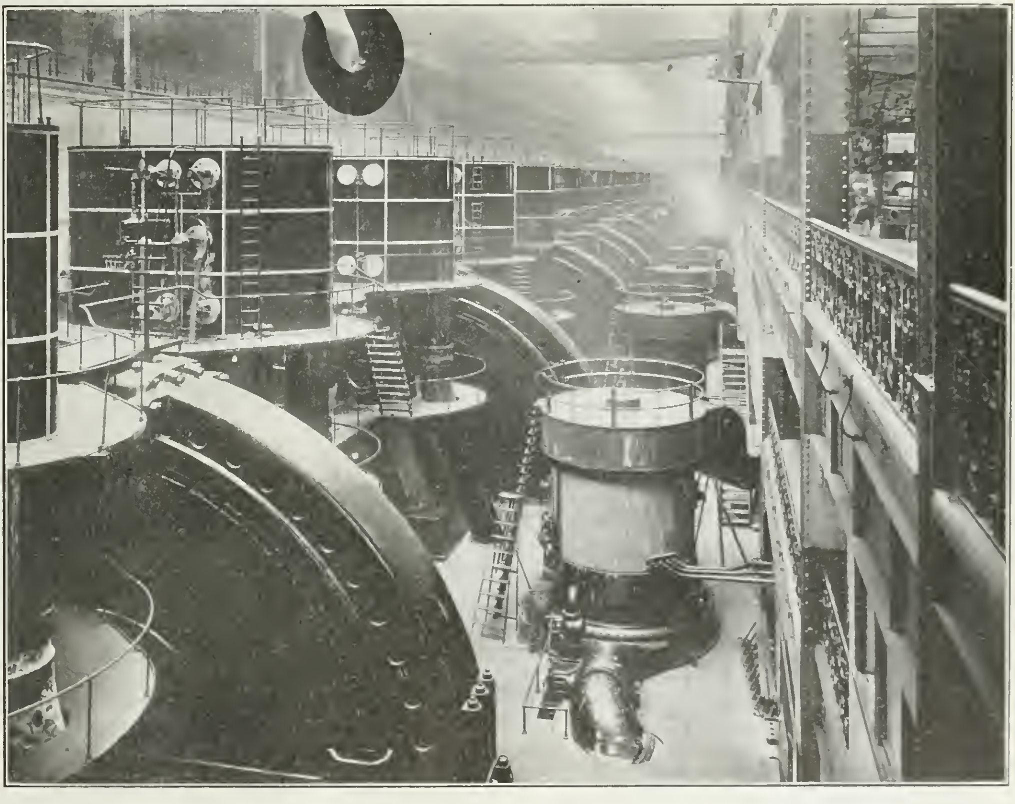


Fig. 11—Generator Room, Fifty-ninth Street Station, Interborough Rapid Transit Company.

In the engines not equipped with exhaust-steam turbines the exhaust piping from the engine starts from the condensers with a 30-in. relief valve. From this valve the pipe drops through the main operating floor to the basement, where the exhausts from two units unite into one 40-in. riser, which is carried to the roof. The condensing system for each unit consists of two Alberger jet condensers with barometric column discharge, two hot wells of concrete and expanded steel, one dry vacuum pump and one cross-compound circulating pump. Each condenser is supported on specially designed steel work placed in front of the engine and is connected directly to the exhaust outlet of the low-pressure cylinder by means of a single elbow on one side and the relief valve of the atmospheric exhaust line on the other. The condenser head or chamber is 50 in. in diameter and terminates at the bottom in a cone-shaped connection to the tail pipe, while the top is provided with a chamber in which the entrained air and vapor collect and to which is connected the air pipe of the dry vacuum pump. On the side 90 deg. from the steam pipe and the exhaust relief valve, the circulating water enters, while directly opposite in the vapor chamber is the air pump connection. Water for use in the condensers is taken in the North River through a concrete tunnel.

The use of the low-pressure turbines has necessitated changes in the exhaust lines and condensers. The jet condensers are not used on the engines to which exhaust turbines are connected, the turbines being equipped with surface condensers instead. The turbine installed is of the vertical three-stage, impulse type, having six fixed nozzles and six which can be operated by hand so as to control the back pressure on the engine or the division of load between engine and turbine. An emergency over-speed governor which trips a 40-in. butterfly valve on the steam pipe connecting the separator and the turbine and at the same time the 8-in. vacuum breaker on the condenser is the only form of governor used. The condensing plant is capable of maintaining a vacuum within 1.1 in. of the barometric when condensing 150,000 lb. of steam per hour and when supplied with circulating water at a temperature of 65 deg. Fahr. The generator is of the three-phase induction type, wound for 11,000 volts, 25 cycles and a speed of approximately 750 r.p.m. The rotor is of the squirrel-cage type with bar winding connecting into common busbar straps at each end. This type of generator was chosen as being especially suited to the conditions obtaining in the station. The absence of fields leads to the simplest possible switching apparatus, as the induction generator leads are tied in solidly through knife switches, which are never opened, to the main generator leads. The switchboard operator has no control whatsoever over the induction generator and only knows it is present by the increased output indicated on his instruments. The method of starting the combined unit is simplicity itself. The engine generator is excited before starting the engine and then the latter is brought up to speed and synchronized in the usual manner. While starting in this way, the induction generator acts as a motor until sufficient steam passes through the engine to carry the turbine above synchronous speed, when it immediately becomes a generator and picks up the load.

The net results obtained by the installation of the turbine units may be summarized as follows: An increase of 100 per cent in the maximum rating of the plant; an increase of 146 per cent in the economic output of the plant; a saving of approximately 85 per cent of the condensed steam for return to the boilers; an average improvement in economy of 13 per cent over the best high-pressure turbine results; an average improvement in economy of 25 per cent (between the limits of 7000 kw and 15,000 kw) over the results obtained by the engine units alone; an average unit thermal efficiency between the limits of 6500 kw and 15,500 kw of 20.6 per cent.

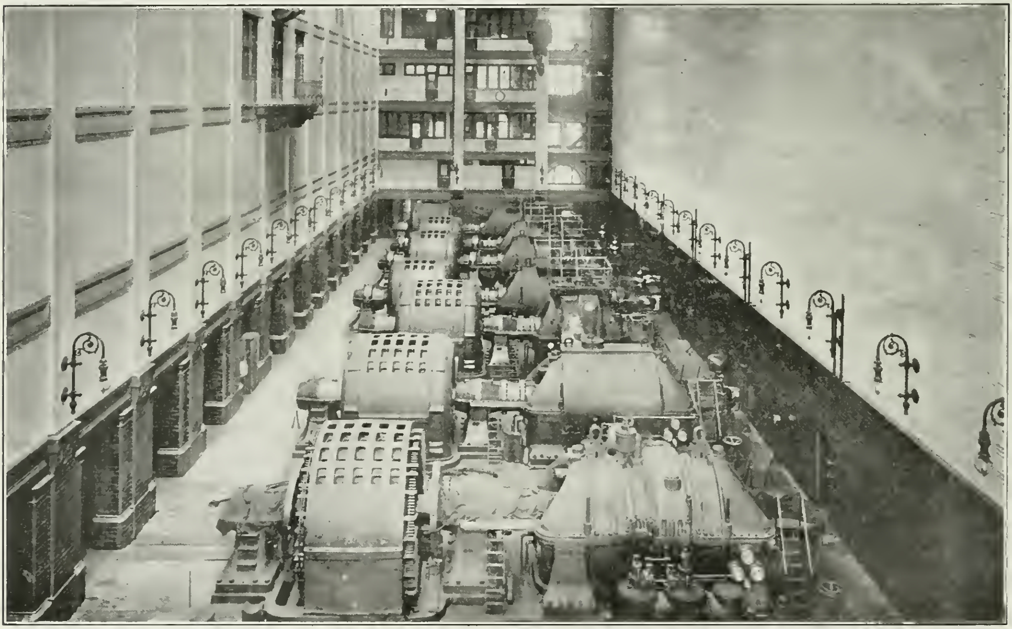


Fig. 12—Main Generating Station of the Transit Development Company in Brooklyn.

The three Westinghouse turbine units are 60-cycle, three-phase, 11,000-volt machines which carry the lighting load of the subway tunnels and stations. The steam for the station is generated in sixty 600-hp Babcock & Wilcox boilers, all of which are fitted with Roney stokers. As at present operated, 85 per cent of the load of the station is carried by the combination engine-turbine units, the straight engine units being used only at times of peak load.

The station feeding the Manhattan elevated system is equipped with sixty-four Babcock & Wilcox boilers rated at 535 hp, the furnaces of all of which are fitted with Roney stokers. The generating equipment consists of eight Allis-Chalmers combined horizontal and vertical Corliss engines driving 7500-kw, 11,000-volt, 25-cycle, three-phase Westinghouse revolving-field alternators and one 7500-kw Westinghouse turbine, the generator of which has the same rating as the other generators of the station. Eight of the feed pumps in this station are electrically driven and one is steam driven. The engines are equipped with barometric condensers and the turbine is fitted with a surface condenser.

The energy from both the subway and Manhattan stations is transmitted to substations, where it is rendered available for railway circuits by six-phase rotary converters. The combined rating of the two stations is 177,675 kw.

BROOKLYN EDISON COMPANY.

The system of the Edison Electric Illuminating Company of Brooklyn is described in detail elsewhere in this issue. The company operates two generating stations, one at Gold Street and the East River and the other at Sixty-sixth Street, Bay Ridge and New York Bay. There is a total of forty-eight boilers, with an aggregate rating of 29,200 hp, at present installed, equipped with either flat grates or Taylor stokers. Five engines, with a maximum rating of 13,500 kw, and four turbines, with a maximum rating of 36,750 kw, each connected to alternating-current generators, comprise the equipment. The maximum load carried by the Gold Street station is 23,500 kw and by the Sixty-sixth Street station, 13,500 kw. The company has on order a 12,000-kw Curtis unit which will soon be installed in the Gold Street station

QUEENS BOROUGH GAS & ELECTRIC COMPANY.

The generating station of this company is located on Baywater Inlet, Far Rockaway. The boiler equipment consists of two 600-hp Babcock & Wilcox boilers and six others of the same make rated at 230 hp. The furnaces are fitted with Treadkill grates and the steam pressure under which the engines are operated is 150 lb. There are two 300-kw and one 600-kw American & British Manufacturing Company (Providence, R. I.) engines driving General Electric generators, one 2000-kw vertical and one 2500-kw horizontal Curtis turbine The maximum load carried by the station is 2800 kw. The company operates one substation at Rockaway Beach, 6 miles from the generating station. The distribution system is 2300 volts, two-phase, and the transmission system 6600 volts, three-phase.

TRANSIT DEVELOPMENT COMPANY.

The Transit Development Company generates all the electricity used by the Brooklyn Rapid Transit system, which operates all of the elevated lines and the greater part of the surface lines in the Borough of Brooklyn. The Transit Development Company has at present in active operation three generating stations, termed the "eastern," "central" and "Williamsburg" stations, located respectively at Kent Avenue and Division Avenue, Third Avenue and Second Street, and Kent Avenue and Wallabout Canal. In addition, the company has in reserve three direct-current stations capable of generating approximately 12,000 kw.

The "eastern" power station is equipped with thirty-six Babcock & Wilcox water-tube boilers rated at 250 hp and operating at a pressure of 160 lb. The furnaces are fed with a mixture of bituminous and No. 3 anthracite, burned on dumping grates. The generating equipment comprises seven cross-compound engines, one rated at 4000-6000 hp. and the other six rated at 2000 hp. The generators are 550-600-volt, compound-wound, direct-current machines, one rated at 2700 kw, four rated at 1500 kw and two rated at 1600 kw. The auxiliaries are steam driven throughout and the maximum peak load carried is 12,000 kw.

At the Third Avenue power station there are thirty-two Aultman & Taylor water-tube boilers rated at 650 hp and operating under a pressure of 175 lb. The furnaces are fitted with dumping grates and a mixture of bituminous and No. 3 buckwheat coal is burned. The generating equipment comprises eight 4000-6000-hp cross-compound engines driving 2700-kw generators. Two of these are 550-600-volt, direct-current, compound-wound machines and six are 6600-11,000-volt, three-phase, 25-cycle alternators. The auxiliaries in this station are steam and electrically driven and the maximum load carried is 25,000 kw.

The main generating station of the company is that located at Kent Avenue and Wallabout Canal. This is a very modern station, equipped throughout with horizontal steam turbines. The steam-generating system consists of seventy-two 650-hp Babcock & Wilcox water-tube boilers operating under a pressure of 180 lb.; thirty-six of the units are equipped with dumping grates for burning a mixture of bituminous and No. 3 buckwheat and the other thirty-six boilers are fitted with stokers for burning bituminous coal. The electric generating apparatus in this station comprises four 7500-kw horizontal single-flow Westinghouse turbines and four 10,000-kw horizontal double-flow Westinghouse turbines generating 6600-11,000-volt, three-phase, 25-cycle energy. The four smaller units rest on reinforced-concrete foundations whereas the larger units rest on steel columns. In these latter units the steam enters the cylinder at the center and flows in opposite directions, thereby doing away with the usual balancing pistons and dummy and eliminating end thrusts. Two of the small turbines are equipped with surface condensers, having motor-driven centrifugal hot-well pumps and engine-driven circulating pumps. The other two small turbines are equipped with surface condensers with single-stage, volute, motor-driven hot-well pumps and turbine-driven centrifugal pumps. The condensing equipment for all of the large units is alike. The condensers are of the two-pass, dry-tube type with turbine-driven, single-stage, volute, hot-well pumps and engine-driven, volute, circulating pumps. The maximum load carried by this station ranges between 65,000 kw and 70,000 kw.

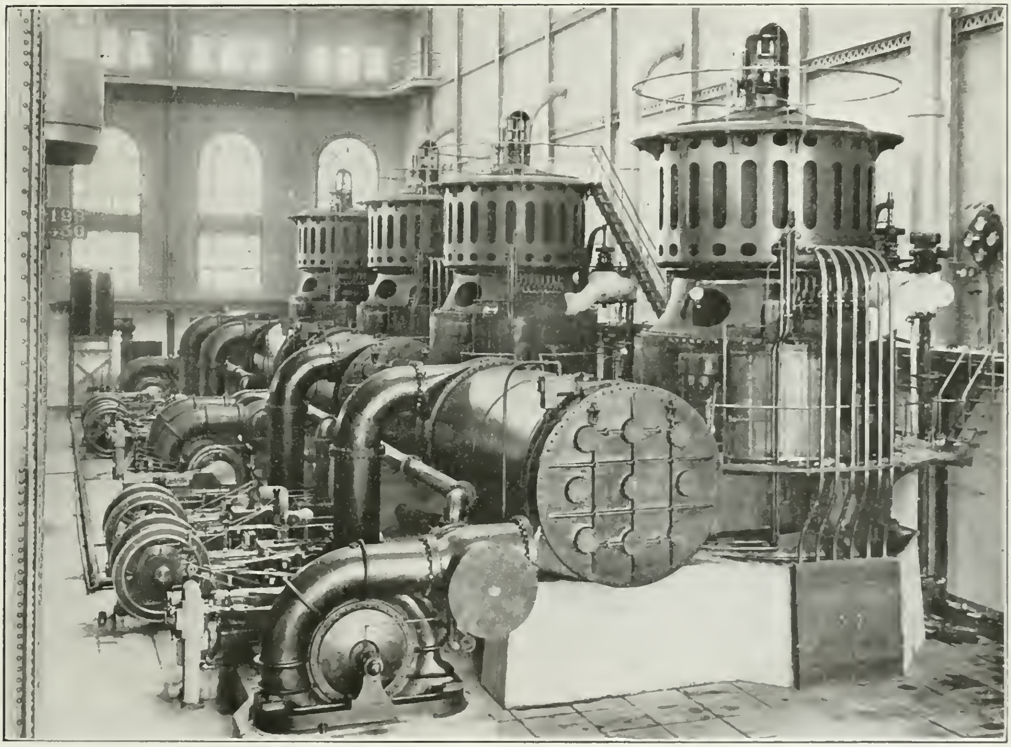


Fig. 13—Port Morris Station of the New York Central Railroad.

NEW YORK CENTRAL RAILROAD.

The electricity to operate the cars and locomotives of the electric lines of the New York Central Railroad is generated in two power stations; one at Yonkers, on the Hudson River, the other at Port Morris, on Long Island Sound. Both stations are almost duplicates, but only the Port Morris, at 138th Street and Long Island Sound, is within the city limits. A view of this station is shown in Fig. 13.

The present station generating equipment comprises sixteen Babcock & Wilcox boilers rate at 625 hp and having a working steam pressure of 185 lb. The furnaces are fitted with Roney stokers on which Clearfield semi-bituminous coal is burned. The products of combustion pass out of two radial brick stacks 15½ ft. inside diameter and 250 ft. above the grates. Fuel is brought to the station either by rail or coal barges. The coal is deposited into concrete-lined hoppers which discharge into the hoppers of two coal crushers; from there the fuel is fed to an elevating conveyor of the bucket type, which carries it to a point over the bunkers, whence it is distributed by four suspended-flight scraper conveyors operating independently. With the exception of the hoist used to unload the coal boats, the coal and ash-handling machinery is driven by electric motors ranging in size from 7½ hp for the ash conveyor to 40 hp for the coal crushers and conveyors. The motors are of the three-phase induction type and operate at a potential of 220 volts. From the coal bunkers fuel is discharged to the hoppers of the stokers through cast-iron chutes and distributing aprons. The ashes are discharged into hand push-cars of 1-ton capacity, which deposit their contents into conveyor hoppers in the basement beneath the boiler-room, whence the ashes are carried up by a malleable-iron bucket conveyor to storage bins over the trestle and loaded thence into cars.

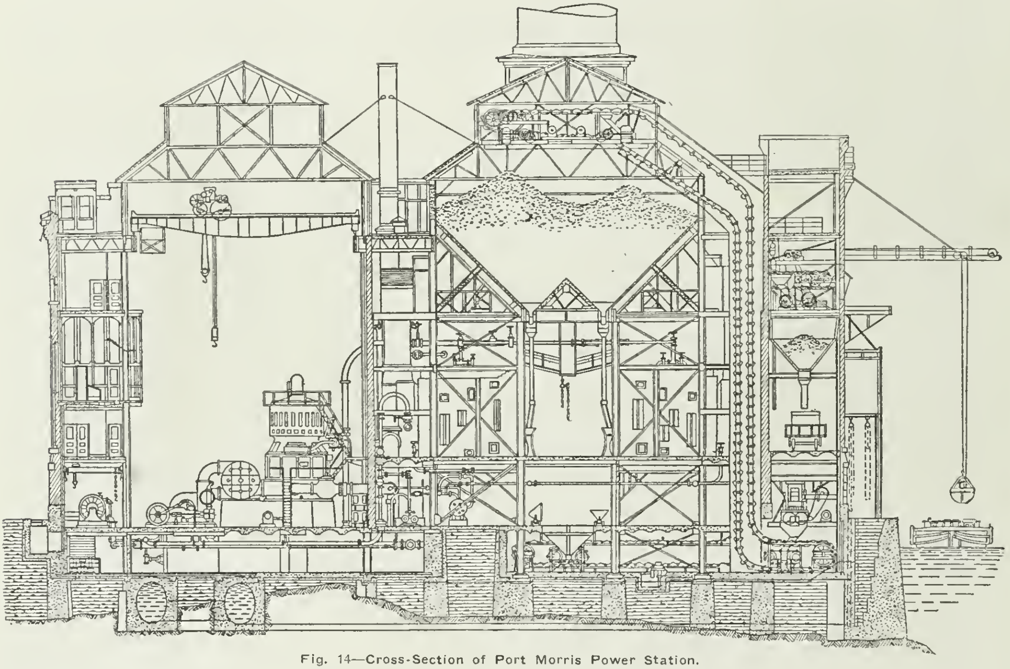


Fig. 14—Cross-Section of Port Morris Power Station.

The apparatus in the station is divided into groups. Each generating unit is provided with four boilers, one feed pump and feed-water heater and a complete condensing plant. The generating room is at present equipped with four 5000-kw General Electric turbo-alternators; the turbines are Curtis five-stage machines mounted on cast-iron bases forming exhaust chambers which are provided with condenser openings and free exhaust connections. The condenser equipment is of the Worthington make and is external to the base of the turbines.

The alternators are of the revolving-field type, generating three-phase current at 25 cycles and 11,000 volts. The armatures are star-connected and the neutrals are grounded through individual cast-iron grid resistors connected to a common ground bus, limiting the ground current under all conditions to the amount necessary to operate the overload relays on the line switches. The exciter system comprises two 150-kw horizontal steam turbines operating non-condensing. There is an additional exciter consisting of an induction motor-generator set delivering 1200 amp at 125 volts. The induction motor, which is a 25-cycle, 200-hp machine, is started by a special switch which puts the transformer windings first in delta then in star connection.

The entire electrical equipment in the station is controlled from the switchboard gallery on one end of the generator room; the lamp and motor circuits in the station being controlled from smaller switchboards situated at either end of the gallery. Separated from the main station is a switch house containing all the high-tension switching apparatus. Two sets of high-tension busbars are provided, each of which is subdivided into two and three sections by tie switches. The high-tension busbars are connected to the generators through a main switch and two selector switches. Each feeder is provided with two selector switches which connect to the two respective high-tension busbars below them. Overload relays are connected in the generator and feeder circuits, and the former has in addition reverse-power relays connected to indicating lamps. The Port Morris station is tied with the Yonkers power station by a transmission line partly underground and partly overhead. The maximum power load carried by the station is approximately 20,000 kw.

PENNSYLVANIA TUNNEL AND TERMINAL RAILROAD COMPANY.

This company generates the electricity used for operating the trains of the Pennsylvania Railroad Company and the Long Island Railroad Company, a subsidiary organization, in and out of Manhattan Borough, New York City. The service plant for the electrical equipment in the Pennsylvania Railroad terminal at Seventh Avenue, Thirty-second and Thirty-third Streets is located on Thirty-first Street, opposite the station.

The station from which the electrical energy for operating the trains is received is located in Long Island City on the East River, almost directly opposite the Waterside stations of the New York Edison Company on the Manhattan shore. The Long Island City station contains at the present time two 3000-kw and three 5500-kw, single-flow and two 8000-kw double-flow Westinghouse turbines driving 11,000-volt, 25-cycle and 60-cycle machines; the two small turbines supplying the electricity and the higher frequency. This station will ultimately be extended to house about 105,000 kw in generating equipment. The boiler room contains thirty-two 525-hp Babcock & Wilcox boilers generating steam at 200 lb. pressure and 200 deg. superheat. The furnaces, which have been remodeled since the station was built, are equipped with arches and the improved type of Roney stokers, on which bituminous coal is burned. The 5500-kw units are fitted with surface condensers and the 3000-kw and 8000-kw units have Le Blanc condensers. It will, of course, be understood that the 25-cycle generators furnish the energy for traction purposes and the 60-cycle machines the energy for lighting the tunnels and station and motor service for pumping and ventilating the tunnels and station. The location of the station on the East River makes it possible to receive coal either by water or by rail, but the plant was designed more particularly to deal with coal brought to the station in barges. The ash and coal conveying equipment is in three parts, a coal-hoisting tower, a cable-way for conveying the coal from the tower to the coal pocket and an ashbin structure. The top of the hoisting tower is about 170 ft. above the dock, and equipment is provided for unloading 400 tons of coal in five hours. The maximum peak load covered by the station is approximately 30,000 kw. In addition to this equipment there is located in the service plant of the terminal in Manhattan two 1000-kw, 60-cycle, three-phase, 240-volt turbo-alternators. These are operated non-condensing during the winter, the exhaust steam being utilized for heating the terminal. During the summer months, and as a relay against accidents, two electric cables passing through the East River tunnels and connecting with two 3000-kw, 60-cycle turbo-generators at the main station at Long Island City, supply the electricity to the service station. The same generators are also used for supplying energy for lighting the tunnels.

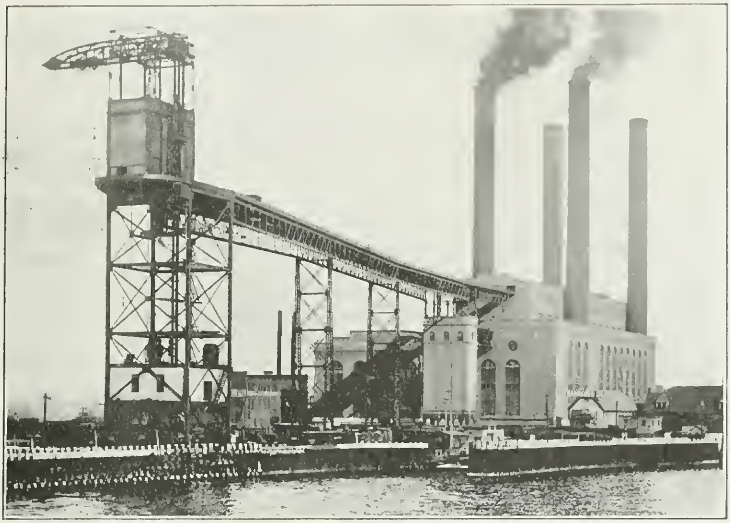


Fig. 15—Main Generating Station of Pennsylvania Tunnel and Terminal Railroad Company.

NEW YORK & QUEENS ELECTRIC LIGHT & POWER COMPANY.

The station of this company is located at Astoria, L. I., and from it substations at Flushing, Jamaica, Maspeth, Long Island City and Bayside are supplied with energy for redistribution. The station is equipped with ten water-tube boilers having an aggregate rating of 4360 hp and operating under a steam pressure of 160 lb. The engine equipment comprises three vertical 850-hp units, driving as many 725-kw Stanley alternators. There are in addition two 3000-kw Westinghouse turbines driving two-phase, 60-cycle, 2200-volt machines. The maximum peak carried by the station is approximately 5000 kw.

FLATBUSH GAS COMPANY.

This company, which is controlled by the Brooklyn Union Gas Company, has a franchise for supplying electrical energy in Flatbush, Brooklyn, and along the Ocean Parkway from Flatbush to Coney Island The generating station is located at 273 Clarkson Street, and the equipment comprises six horizontal tubular boilers rated at 2100 hp and generating steam at 150-lb. working pressure. No. 3 buckwheat coal is burned in the furnaces on pin-hole grates. There are two 450-hp vertical and one 225-hp horizontal cross-compound engine driving two 300-kw and one 180-kw, 2200-volt, two-phase machine. There are also two turbines, a 750-kw and a 2500-kva machine, connected to generators of the same characteristics as the others. The maximum peak load carried by the station is 1550 kw.

BRONX GAS & ELECTRIC COMPANY.

This company operates a station on the west bank of Westchester Creek, from which the annexed district north of the Bronx River, with the exception of the district known as Williamsbridge, is supplied with electricity. The steam equipment comprises four Babcock & Wilcox boilers having a total rating of 1400 hp. The furnaces are fitted with dumping grates for burning a mixture of bituminous and anthracite coal, and the working steam pressure is 160 lb. The engine room contains two 450-hp Ball & Wood vertical, cross-compound condensing units direct-connected to as many 300-kw, 60-cycle, 2300-volt, two-phase General Electric alternators. There are in addition a 750-kw Westinghouse turbo-generator and a 2000-kw General Electric horizontal turbo-generator. The maximum peak load carried last year by the station was 900 kw.

CONEY ISLAND & BROOKLYN RAILROAD COMPANY.

The generating system of this company was entirely rebuilt in 1908, all of the equipment being located in a single station at Ninth Street and Gowanus Canal, Brooklyn. The station contains at the present time two 3500-kw, 11,000-volt, three-phase, 25-cycle General Electric turbo-generators fed with steam from six Babcock & Wilcox water-tube boilers aggregating 3600 hp. All of the boilers are furnished with Webster furnaces and grates designed to burn a low grade of anthracite coal. The boilers operate at a pressure of 180 lb. with 100 deg. superheat. Coal for the station is taken from the barges by clam-shell buckets, which empty into a hopper feeding a scraper conveyor, which passes over three vertical steel pockets, each of about 700 tons capacity. These pockets are located in the canal bank. The boiler room can be extended to house ultimately 6000 hp; there is likewise plenty of room for new turbines and switchboard extensions. Inasmuch as the water in Gowanus Canal at the present time is not fit for use in a surface condenser, being fouled with the refuse of oil refineries and chemical factories, Alberger barometric condensers are employed in connection with the turbines. In order to obviate the usual trouble from leakage of the intake lines when the water in them is under pressure, the intake pipe which carries the water from the canal to the condenser was placed below water level. The circulating pumps are driven from vertical motors located on the turbine room floor, a separate pump and motor being provided for each turbine. Each motor is rated at approximately 100 hp and is of the variable-speed type, so that at light loads in the winter it will not be necessary to run at maximum speed.

METROPOLITAN STREET RAILWAY COMPANY.

The generating station of this company, which operates a number of surface lines in Manhattan Borough, is located at Ninety-sixth Street and East River. The station contains fourteen 325-hp and sixty-six 250-hp Babcock & Wilcox boilers operating at a pressure of 155 lb. and burning a mixture of hard and soft coal in Roney stokers. The station equipment generates energy at 6600 volts, 25 cycles, three-phase, in eleven 3500-kw General Electric units. The engines are of the Allis vertical, cross-compound, condensing type, all of the auxiliary apparatus being steam driven. The maximum load carried by the station is 43,000 kw.

THIRD AVENUE RAILROAD COMPANY.

The power station of this company is located on the Harlem River at 216th Street and Ninth Avenue and the power house is usually referred to as the "Kingsbridge" station. The river affords an abundant supply of condensing water and facilities for the delivery of coal in barges. The mechanical design of the station embraces the multiple-unit idea noticeable in large power stations, but the engine and boiler equipment is divided into four distinct plants, each of which may be independently operated and yet all so thoroughly interconnected that they can form a single unit. The equipment consists of eight vertical, cross-compound engines directly connected to 6600-volt, three-phase, 25-cycle, 3500-kw Westinghouse generators. The boiler plant is composed of thirty water-tube boilers set in batteries of 1000 hp each. The coal bunkers are on top of the boiler room, fuel being delivered to them by conveyors and fed from them by gravity to automatic stokers, with which the boilers are equipped. Ashes are handled by gravity from the ash pits to a conveyor in the basement, whence they are taken to bunkers at the dock, which discharge into barges. One feature of the lay-out is the adoption of a large central condensing plant of the barometric type serving the entire station. Each condenser receives the exhaust from four units. All of the auxiliary apparatus is steam driven.

RATING OF NEW YORK GENERATING STATIONS.

Name of Company.	Rating in Kilowatts.
New York Edison Company	249,000
Interborough Rapid Transit Company	177,675
Transit Development Company	115,500
Edison Electric Illuminating Company of Brooklyn	62,250
Pennsylvania Tunnel & Terminal Railroad Company	40,500
Metropolitan Street Railway Company	38,500
Third Avenue Railroad Company	28,000
New York Central Railroad	20,000
New York & Queens Electric Light & Power Company	8,175
Coney Island & Brooklyn Railroad Company	7,000
Richmond Light & Railroad Company	6,400
Queens Borough Gas & Electric Company	5,700
Flatbush Gas Company	4,030
Bronx Gas & Electric Company	3,350
Staten Island Midland Railway Company	900
Bowery Bay Electric Light & Power Company	660
Total	767,640

RICHMOND LIGHT & RAILROAD COMPANY.

This company operates a power station at Livingston, Staten Island. According to the last report of the Public Service Commission the company has fifteen boilers, having an aggregate rating of 5550 hp, five reciprocating engines, with an aggregate rating of 3900 hp, and three turbines with a total output of 2500 kw. There are three direct-current machines having a total output of 1600 kw, and five alternators with an aggregate rating of 3500 kw.

OTHER COMPANIES.

The Bowery Bay Electric Light & Power Company operates its plant only during the summer months, all of the energy being sold to tenants at the amusement resort known as North Beach, borough of Queens. The equipment comprises five boilers, aggregating 1100 hp, and two engines driving two direct-current generators, with an aggregate rating of 660 kw. The Staten Island Midland Railway Company operates a power station at Grassmere, Staten Island, having a rated output of 900 kw.

NEW YORK EDISON COMPANY

REBUILDING OF WATERSIDE STATION NO. 1 OF THE NEW YORK EDISON COMPANY.

WITHIN the last few years the business of the New York Edison Company has increased to such an extent that the company finds it necessary to add to its generating equipment on a large scale. This will be done by removing four of the eleven very economical 3500-kw vertical marine-type engines at the Waterside No. 1 station, at Thirty-ninth Street and First Avenue, and installing in their place three Curtis six-stage vertical turbines, each rated at 20,000 kw. One of the five smaller turbines now in operation at the station will be rewound for 9000 kw, making the total increase of normal generating capacity 50,000 kw.

The present equipment of the Waterside No. 1 Station consists of the eleven vertical, marine-type engines direct-connected to 3500-kw generators, three 5000-kw vertical turbines and two 10,000-kw vertical turbines, making the present total normal generating rating 73,500 kw. It will thus be seen that without increasing the size of the building, including boiler and engine-rooms, etc., it is proposed to increase the normal output of the station over 68 per cent.

The work will not only involve mechanical and electrical changes, but architectural and structural modifications as well.

As previously stated, at the Waterside No. 1 Station there are eleven vertical, marine-type, compound, condensing engines and each is direct-connected to a 3500-kw alternating-current generator. Four of these engines, Nos. 2, 4, 6 and 8, are at present being dismantled. These engines were designed by the Westinghouse Machine Company in co-operation with the engineering department of the New York Edison Company, and represent the most highly developed type of engine for central-power-station work. While running at a speed of 76.3 r.p.m. (the normal speed is 75 r.p.m.), with a steam pressure at the throttle of 185.6 lb., with a vacuum of 27.25 in., the engines have indicated 5442 hp with a consumption of only 11.93 lb. of dry steam per ihp-hour. Though rated as having its highest efficiency somewhere between 4900 ihp and 5500 ihp, the engine is designed to carry a load of 9000 hp if needed. An examination of the tabulated data of tests made in January and February, 1904, by Mr. Jay M. Whitham, acting as referee for the New York Edison Company and the Westinghouse Machine Company, will give a clear idea as to the economy of these engines.

DETAILS OF ENGINES.

The high-pressure cylinder of the engine, 43½ in. in diameter and fitted with poppet valves, is located between the two low-pressure cylinders, which are 75½ in. in diameter and fitted with valves of the double-ported Corliss type. The stroke is 5 ft. and the normal speed 75 r.p.m. The valves are actuated from eccentrics on a lay shaft which is driven through helical gears by a vertical shaft, which in turn is driven through helical gears by the main shaft. To facilitate synchronizing the speed of the engine can be varied from the electrical control gallery by a pilot switch operating an electric motor which shifts the weight on the governor arm.

The crankshaft, 26 in. in diameter, is built up in three sections, with a 10-in. hole extending from end to end. It is supported in four bearings, three main bearings being each 60 in. long and the outboard bearing 48 in. long. There are three cranks set at angles of 101 deg., 133 deg. and 126 deg. respectively, thus giving a uniform turning moment and making unnecessary a heavy flywheel. A weight of 90,000 lb. in the rim, with an outside diameter of 23 ft., is sufficient to give the required steadiness.

The engine frames are of the "A" type, with a substantial bearing on the bedplate. The latter is made in three pieces, with an extension for supporting the outboard bearing. The space occupied by the generating unit is 918 sq. ft., and the total height from the bottom of the foundation to the top of the engine is 52 ft. ½ in.

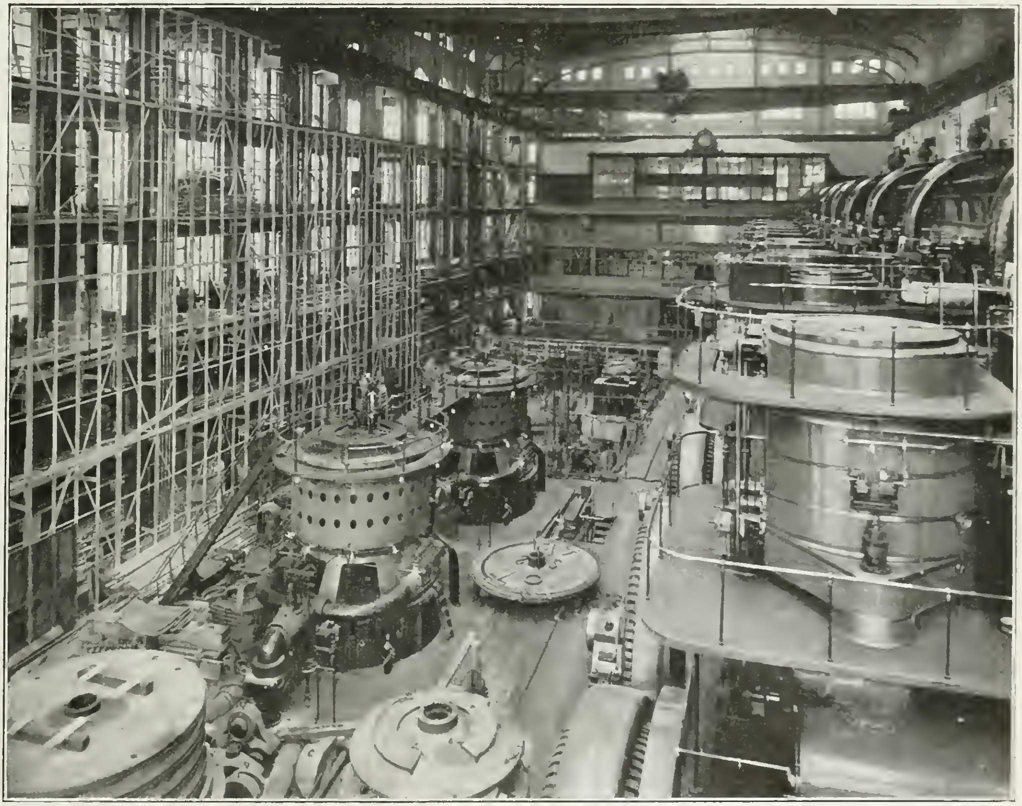


Fig. 1—General View of Operating Room, Waterside Station No. 1, Showing Alterations in Progress.

ENGINE AUXILIARIES.

There is one Worthington two-pass, surface-type condenser for each engine located beneath the operating floor and beside the engine foundation. Originally each condenser contained 3708 straight brass tubes, ¾ in. in diameter and 12 ft. 9½ in. long, but as a result of tests 440 were removed and the effectiveness of the condensing surface was increased. The cooling surface is now 6874.4 sq. ft. There are two 26-in. inlets at the top of the condenser and the outlet to air pump is 14 in. in diameter. The circulating-water inlet and outlet is 16 in. in diameter. The over-all dimensions of the condenser are approximately 8 ft. high x 7 ft. 6 in. wide x 15 ft. 8 in. long. The efficiency of these units is given in Table I herewith.

The air and circulating pumps are of the horizontal-piston type, double-acting and driven in tandem by a Westinghouse-Corliss engine. The steam cylinder is 16 in. in diameter, the air and water cylinders 32 in. in diameter, with a common stroke of 24 in. The rated speed is 34 r.p.m. These pumps are located beneath the condenser, the condensation flowing by gravity into the cylinder of the air pump.

ALTERNATING-CURRENT GENERATORS.

The 3500-kw alternating-current generators, direct-connected to each engine, are of the three-phase, 25-cycle, 6600-volt revolving-field type, and were built by the General Electric Company. The revolving core is keyed to the engine shaft and bolted to the hub of the flywheel, which is extended so as to form a heavy flange on the side toward the generator. The coils are wound with copper ribbon set on edge and give full excitation at 220 volts, thus making it possible to take the exciting energy either from the low-tension board or from the storage battery in case of failure of the exciter sets.

SELECTION OF NEW GENERATING UNITS.

From a consideration of what has already been written in regard to the economical performance of the engines and auxiliaries at the Waterside No. 1 Station, it will be concluded that the reason why the New York Edison Company decided to dismantle units of such efficiency and replace them by turbines whose performance cannot be much better is simply because of the very large increase in output per square foot of floor area which can be gained by doing so.

Where it is a question of increasing the output per square foot of floor area the instalment of the vertical turbo-generator set is, of course, the solution. As indicative of the conservation of area made possible by this means a table of comparative data of steam-power plants is given in Table II. From this it will be seen that the Waterside No. 2 Station of the New York Edison Company has 0.733 sq. ft. per kilowatt of output, which is the least number of square feet per kilowatt output of any of the stations mentioned. At this station there are six 8000-kw vertical turbines, two 14,000-kw vertical turbines and two 7500-kw horizontal turbines. After the new turbines are placed in the Waterside No. 1 Station the square feet of floor space required per kilowatt of output will be a great deal less than that of the other station mentioned.

TABLE I.—STEAM CONSUMPTION TEST OF NO. 8 ENGINE—WATERSIDE NO. 1.

Number of Column.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Number of hours run	1	1	1	1	4	1	1	2	4	1	1
Pressures:											
Steam at throttle, pounds	185.6	184.2	180.7	183.7	183.3	180.6	184.6	184.2	184.4	186.3	181.6
Steam in receiver, pounds	36.8	33.7	29.2	24.7	23.8	20.8	20.9	22.3	19.7	24.4	24.8
Vacuum at low-pressure cylinders, inches	27.25	27.20	27.3	26.75	26.35	27.25	25.19	24.53	25.34	26.90	26.60
Barometer, inches mercury	....	....	....	30.22	30.16	....	30.42	29.86	30.40	30.22	30.22
Temperatures:											
Exhaust from high-pressure cylinders	284.1	279.8		269.3	268.4		263.4	265.0	261.5	268.4	277.2
Inlet to low-pressure cylinders	284.1	279.8	273.7	268.8	269.7	262.3	263.1	264.7	261.8	268.1	276.8
Exhaust from low pressure cylinders	125.6	126.5	126.0	127.8	131.1	127.4	140.8	140.8	140.1	121.7	133.7
Moisture in steam, per cent	0.75	0.74	0.73	0.92	0.71	0.72	0.70	0.60	0.60	0.80	1.11
Revolutions per minute for each test	76.30	75.85	76.36	76.55	76.40	76.48	76.20	76.93	76.43	76.16	74.50
Total average indicated horse-power	5,442	5,536	5,357	5,598	5,275	5,360	5,310	5,233	5,308	4,218	6,326
Water Measurements:											
Hot well discharge	61,996	63,317	61,162	64,243	60,645	62,002	61,598	61,214	62,854	49,974	75,186
Receiver drip	3,456	3,701	3,725	4,189	3,959	3,856	3,880	4,066	3,649	2,978	4,422
Total water per hour	65,452	67,018	64,887	68,432	64,604	68,858	65,478	65,280	66,503	52,952	79,608
Total dry steam per hour	64,961	66,518	64,412	67,802	64,145	65,385	65,020	64,888	66,104	52,529	78,725
Pounds of dry steam per indicated hp-hour	11.93	12.023	12.015	12.11	12.16	12.19	12.24	12.40	12.45	12.45	12.44

DETAILS OF 20,000-KW VERTICAL TURBO-GENERATORS.

As has been pointed out, the question of floor area limited the selection of the new generating units to those of the vertical turbo type. The three new 20,000-kw units will be of General Electric Company design. The generators will be of the four-pole, three-phase, 25-cycle type wound for 6600 volts. The normal speed will be 750 r.p.m. The generators will be direct-connected to six-stage steam turbines designed to operate on 175-lb. gage pressure with a back pressure of 1½ lb. absolute in the exhaust chamber and with steam superheated 100 deg. Fahr. The steam consumption in pounds per kw-hour with a steam pressure of 175 lb. at the gage and with not more than 1½ in. absolute back pressure in exhaust chamber of turbine is guaranteed to be not more than the following figures indicate:

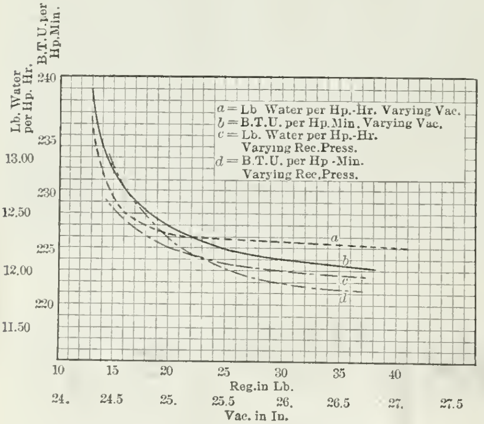


Fig. 2—Performance of 5500-hp Engine.

Kw Output.	Steam Consumption in Pounds.
10,000	15.0
15,000	14.4
20,000	15.0

The dimensions of the base will be 17 ft. 6 in. x 17 ft. The height will be 35 ft. 7 in. It is interesting to note here that the floor area of one of these 20,000-kw units is approximately 297.5 sq. ft., while the 3500-kw engine-generator unit it replaces occupies 918 sq. ft. In other words, six times as much power may be generated in approximately one-third the floor area.

CONDENSING APPARATUS FOR NEW TURBINES.

Each of the new turbines will be connected to condensing apparatus of a highly efficient type as demanded by turbine practice. The condensers will be made up of the condenser base, located directly under the turbine on the same foundation, and a wing condenser on each side. They will be furnished by the Wheeler Condenser & Engineering Company, and will be of the company's "dry-tube" type. The entire condenser will contain 32,000 sq. ft. of 1-in. No. 18-gage tubes and will be complete with hot well and independent air cooler. The condenser base will be furnished by the General Electric Company.

The two hot-well pumps for each unit will be of the 6-in., two-stage centrifugal type and will be direct-connected to a suitable steam turbine. The two circulating pumps for each unit will be 30-in. centrifugals with brass impellers, brass-covered shafts, each pump being direct-connected on a common bedplate to a suitable steam turbine. The manufacturers guarantee one of these units to condense 300,000 lb. of steam per hour with an absolute vacuum of 2 in. and with cooling water of 70 deg. Fahr. or less.

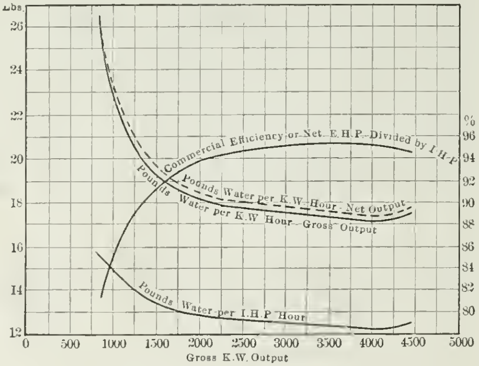


Fig. 3—Performance of 5500-hp Engine

NEW FREE EXHAUST.

A new atmospheric exhaust for the three new 20,000-kw turbines and the present turbines Nos. 10, 12 and 14 will be installed. This exhaust will run along the south basement wall to the East River wall, where it will be connected by a large cast-iron elbow, which is bolted to the foundation by four 1½-in. bolts to the exhaust stack rising about 115 ft. 6 in. above the basement floor. The exhaust head will consequently be above the top of the building.

The exhaust-flue run in the basement will be made of 3/16-in. steel rectilinear sections having inside dimensions of 4 ft. x 3 ft. The length will be about 218 ft., and the height of the center line of the flue from the basement floor will be about 10 ft. 3 in. The length of the sections will range from 9 ft. 7 in. to

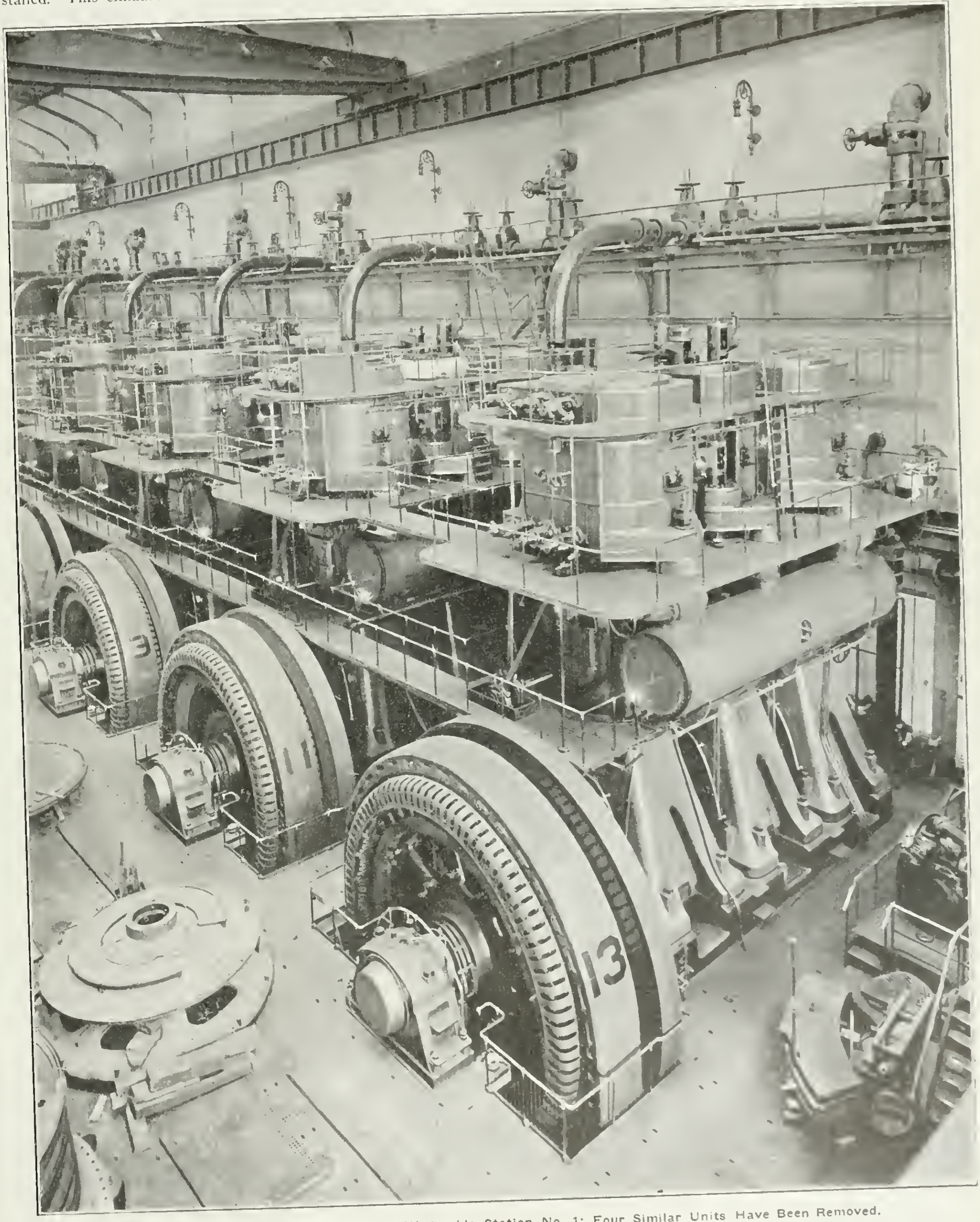


Fig. 4—Remaining Reciprocating Units in Waterside Station No. 1; Four Similar Units Have Been Removed.

11 ft. 3 in. The exhaust stack will be made of ¼-in. steel and have an inside diameter of 4 ft. It is proposed to make the main part in nine sections, eight of 11-ft. 8-in. length and one of 9 ft. The foundation of the stack will be of concrete set on piling. The stack will be held to the building by three sets of saddles and braces.

BOILER HOUSE.

At the present time at the Waterside No. 1 Station there are fifty-four boilers of the Babcock & Wilcox type rated at 650 hp each. They are arranged in two double-tier rows, twenty-eight on the first floor and twenty-six on the second floor, one row on each side of the boiler-room. They are three-drum, double-deck boilers, with 6386 sq. ft. of heating surface, and usually operate on 190-200-lb. pressure.

TABLE II.—COMPARATIIVE DATA OF STEAM-POWER PLANTS.

Building, Approximate.	Metropolitan	Manhattan	Kingsbridge.	New York Edison Company Waterside No. 1.	New York Edison Company Waterside No. 2	Brooklyn Rapid Transit.	Chelsea, Mass.	Long Island.	Boston Edison.
Dimensions	200x244 av.	204⅔x404	243⅔x319	197x272	197½x341½	201x582	175x453½	200x250	250x650
Area (square feet)	48,800	82,400	78,000	53,720	67,478	117,000	79,400	50,000	162,500
Total floor area, including basement	167,600	207,300	190,800	122,200	260,300	233,000	204,100	126,000	325,000
Cubical contents (total) (cubic feet)	5,580,000	9,060,000	8,850,000	6,499,878	9,463,040	12,943,000	8,450,000	4,670,000	....
Cubical contents, engine house	2,633,000	4,180,000	4,850,000	3,514,000	2,824,800	7,647,000	3,000,000	1,900,000	....
Cubical contents, boiler house	2,947,000	4,880,000	4,000,000	2,512,000	6,638,240	5,296,000	5,450,000	2,770,000	....
Cubic feet per kilowatt output	169	226	184	52.6	102.8	259	139	142	......
Square feet per kilowatt output	1.48	2.06	1.63	.436	.733	2.32	1.36	1.51	2.71
Generator output, total kilowatts	33,000	40,000	48,000	123,500	92,000	50,000	55,000	33,000	60,000
Engines:									
Description	Ver. Cross-Com.	Dou. Cross-Com.	Ver. Cross-Com.	Ver. Com. Ver. Turb.	Hor. Turb. Ver. Turb.	Dou. Cross-Com.	Hor. Turb.	Hor. Turb.	Ver. Turb.
Rating, each, normal	4000 hp	8,000 hp	4000 hp	*A	*B	8,000 hp	7,360 hp (El.)	7,360 hp (El.)	6700 hp (El.)
Rating, each, maximum	6200 hp	12,500 hp	6200 hp	....	....	12,500 hp	11,040 hp (El.)	11,040 hp (El.)	....

*A —Waterside No. 1.

No.	Generators.	Engines.
11	3500-kw, 6600-volt, 25-cycle, 3-phase	Vertical compound.
2	10,000-kw, 6600-volt, 25-cycle, 3-phase	Vertical turbine.
1	5000-kw, 6600-volt, 25-cycle, 3-phase	Vertical turbine.
1	5000-kw, 6600-volt, 60-cycle, 3-phase	Vertical turbine.
1	9000-kw, 6600-volt, 60-cycle, 3-phase	Vertical turbine.
3	20,000-kw, 6600-volt, 25-cycle, 3-phase, (being installed.)	Vertical turbine.

*B.—Watfrside No. 2.

No.	Generators.	Turbines
1	14,000-kw, 6600-volt, 60-cycle, 3-phase	Vertical.
1	14,000-kw, 6600-volt, 25-cycle, 3-phase	Vertical.
6	8000-kw, 6600-volt, 25-cycle, 3 phase	Vertical.
2	7500-kw, 6600-volt, 60 and 25-cycle, 3-phase	Horizontal.

At present the last four boilers on the east end of the second and first floors are equipped with superheaters. It is now proposed to equip the entire first tier of boilers with superheaters, and as there are twenty-eight boilers on the first floor this means the addition of twenty-four superheaters. There will also be a change in the stoking with the consequent change in the air-supply ducts, coal downtakes, etc.

TABLE III.—TEST OF CONDENSER OF NO. 13 ENGINE—WATERSIDE NO. 1.

Test No.	Load in Kilowatts.	Pounds Steam Condensed per Kw-hour	Circulating Water, Gallons per Minute.	Ratio Circulating Water, Condensed Steam.	Circulating Water, Inlet Temperature.	Circulating Water, Outlet Temperature.	Vacuum 30-in. Bar.	Velocity Thro' Tubes, Feet per Second
10	4565	17.18	3193	20 6	31.2	85.6	25 2	1 80
11	4507	16.90	3325	22.2	30.0	78.8	25.8	1.88
83	4275	16.71	3060	21.6	31.8	81.8	26.17	1.96
64	4112	16.50	3245	24.3	31.5	77.7	26 4	2.08
76	4000	16.81	3120	23.5	31.6	77.2	26.58	2.00
70	3908	17.07	3098	23.7	32.8	78.0	26.52	1.08
41	3815	16.45	3188	25.8	31.1	74.8	26.78	2.04
53	3705	16.6	3239	27.2	31.0	71.8	26.76	2.07
72	3602	17.31	3140	25.5	31.8	72.8	26.78	2.01
81	3510	15.61	3075	28.5	30.5	70.6	26.46	1.97
27	3427	16.25	3390	30.9	32.8	70.6	28 8	2.17
84	3201	16.6	3095	29.5	31.8	70.7	26.6	1.98
67	3076	16.94	3215	30.3	31.0	67.3	26.74	2.06
52	3008	16.11	2868	30.1	33.0	71.2	26.42	1.84
5	2977	17.33	3188	30.6	47.0	83.5	26.21	1.76
3	2947	16 22	3159	33.5	48.7	81.0	26.22	1.78
31	2857	16.42	3209	34.8	31 2	64.3	27.00	2.05

SUPERHEATERS.

Each superheater will have 767.76 sq. ft. of heating surface, consisting of a forged-steel distributing header, connecting tubes and forged-steel collecting header, with tubes expanded in place so far as space available for insertion of superheater will permit. There will be four 5-in. downtakes and four 5-in. uptakes. The joints at the top of the same will be Van Stone joints. The Babcock & Wilcox Company will supply the superheaters.

MECHANICAL STOKERS.

Ten of the boilers on the first floor of the boiler house will be fitted with Taylor gravity under-feed stokers. On the second floor nine boilers will be equipped with Taylor stokers. New stoker engines and forced-draft apparatus will be installed as necessary.

STEAM PIPING

As superheated steam will be supplied to all the Waterside No. 1 turbines from the twenty-eight boilers on the first floor of the boiler house and the last four boilers on the east end of the second floor, it will be necessary to change all fittings

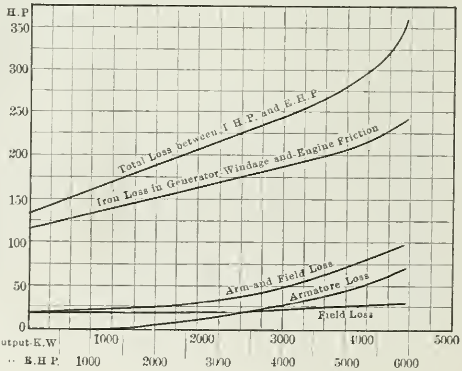


Fig. 5—Engine and Generator Losses.

between these boilers and the turbines to cast steel. At the same time all pipe will be replaced by rolled-steel pipe with New York Edison standard rolled joints.

For turbines Nos. 10, 12 and 14 there was previously an equalizing header in the basement, but this will be removed and each turbine will be connected to the lower run of the main steam header by a direct run. This applies as well to turbines Nos. 4, 6 and 8.

Previously there was a header in the basement for the auxiliaries. This will now be taken down and there will be a 6-in. outlet at each turbine to supply its auxiliaries. Thus each turbine and its auxiliaries will constitute an independent steam unit.

On the direct runs from the lower main header line to each of the turbines Nos. 10-14 and 4 there will be a 6-in. outlet, and at present it is proposed to connect to these a 6-in. header line in the basement and to supply superheated steam to auxiliaries independent of the turbines and engines—that is, for step-bearing pumps, fire pumps, etc. This means that all fittings will be changed to cast steel on such lines.

On the runs to turbines Nos. 4, 6 and 8 from the lower line of main header there will be sections of pipe inserted in such a manner that at any time they can be removed and a Venturi meter connected.

Inasmuch as twenty-two of the twenty-six boilers on the second floor of the boiler house will continue to supply saturated steam to the seven remaining engines and their auxiliaries, and as these boilers have their leaders connected to the upper run of the main header, it will be necessary to provide bends between the upper and lower runs of the main header, since the lower will be supplied with superheated steam. There will, therefore, be placed between the upper and lower runs three S-bends and one U-bend to take care of any difference of expansion.

OILING SYSTEM.

One of the most important parts of a turbine station is the oiling system for the step bearings, sleeve bearings and the hydraulic governors. This system should, above all things, be so constructed that in case of any emergency oil may be secured from another source.

At the present time at Waterside No. 1 Station there are four oiling systems in operation as follows: There is an oil step-bearing system for two turbines (No. 15 and No. 16); an accumulator hydraulic governor system for five turbines (No. 10, No. 12, No. 14, No. 15 and No. 16); a gravity system from a tank house on the roof which supplies cylinder and engine oil to the engines and the reciprocating auxiliaries, pumps, blower engines, etc., and a water step-bearing system for three turbines (No. 10, No. 12 and No. 14).

It is now proposed to have one oil step-bearing system for the three new 20,000-kw turbines (No. 4, No. 6 and No. 8) and two others (No. 15 and No. 16). The water step-bearing system for three turbines (No. 10, No. 12 and No. 14) will remain as it is, as these bearings were designed for water. The hydraulic-governor oil for the new turbines will be supplied by gravity from a new oil-tank on the roof.

ELECTRIC CRANES.

At the present time there are two cranes in the Waterside No. 1 Station which span the engine-room at the curve of the roof. One of these cranes is of 50 tons capacity and one is of 25 tons capacity. The 25-ton crane will be taken down and a new 110-ton Morgan crane with a 10-ton auxiliary hoist will be installed. The new 110-ton crane and the present 50-ton crane will run on the same crane rail. On account of increasing the width of the mezzanines the span will now be 94 ft. 7⅞ in., while before it was 3 ft. 9 in. more than this. The elevation of the crane rails will be 59 ft. 10 in. from the new operating floor. Previously it was 62 ft. from the operating floor.

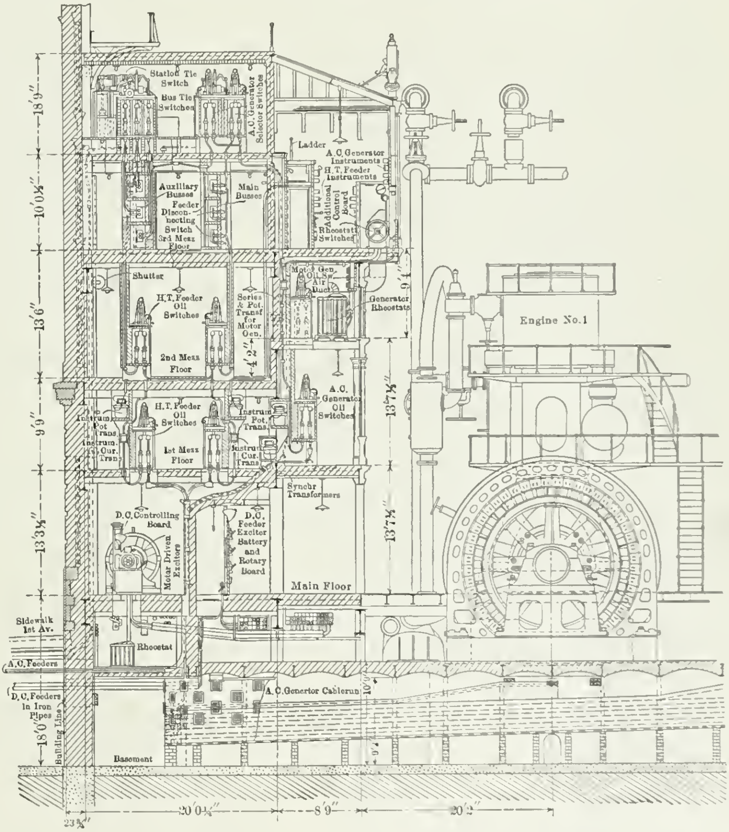


Fig. 6—Cross-Section of Old West-End Electrical Galleries.

ELECTRICAL CHANGES.

In addition to the instalment of the three 20,000-kw Curtis vertical turbo-generator units one of the present turbines (No. 14, rated at 5000 kw and 25 cycles) will have its generator rewound for 9000 kw, 60 cycles. Hence in making the alterations at Waterside No. 1 Station it will not only be necessary to take care of an additional normal equipment of 50,000 kw, but arrangements must be such as to handle an increase of 4000 kw in 60-cycle equipment.

Because of these changes it has been found necessary entirely to alter the south and west-side mezzanine floors and to increase their floor area. The south-side mezzanines will constitute the main electrical galleries, while on the third mez-

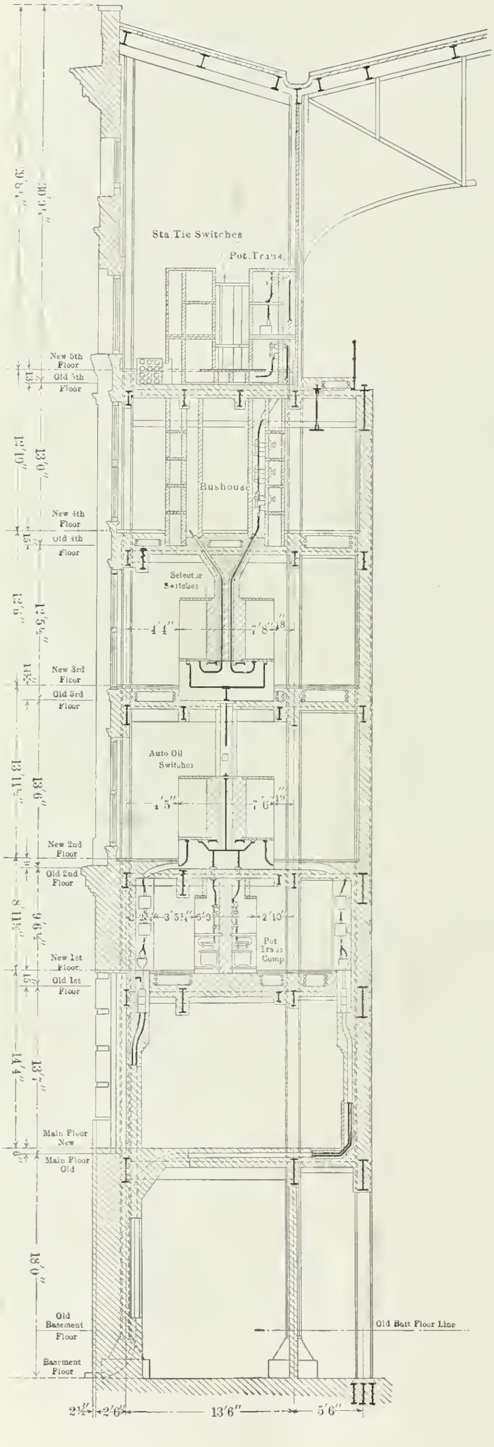


Fig. 7—Cross-Section of New South End Electrical Galleries.

zanine, on the west end, will be located the generator and feed-control boards placed in a horseshoe position. The storage batteries, which heretofore have been located on the south side of the basement, will be transferred to the west end of the basement to the space formerly given over for a cable vault. An entirely new cable vault will be constructed under the sidewalk on the Thirty-eighth Street side of the station.

In designing the new electrical equipment the scheme followed in Waterside No. 2 Station has been followed out as far as possible, and, of course, in some cases an improvement has been effected. Apparatus of the latest type will be installed and only a very small portion of the present electrical equipment will be used.

In order to appreciate the magnitude of these changes and the character, reference should be made to Fig. 6, showing the present arrangement of the apparatus in the west-end galleries at Waterside No. 1 Station, and Fig. 7 showing a cross-section of the south-side electrical galleries, and also Fig. 8, showing the layout of the feeder and generator groups on the third mezzanine floor. The first bus can take care of 54,000 kw, 25-cycle power, the second bus of 49,500 kw, 25-cycle power, the third of 14,000 kw, 60-cycle power. There will be fifty-eight feeders, five exciters, two motor-generator sets and one test set.

On the fifth mezzanine will be located the station tie switches and shunt transformers; on the fourth will be the bus house with main and auxiliary buses; on the third will be the selector switches; on the second the main oil switches, and on the first the transformer compartments. All of the oil switches will be of the General Electric type known as H3.

The high-tension cables will run as directly as possible from the generating units to the mezzanine engine-room wall. A cable tie is made between Waterside No. 1 and Waterside No. 2, connecting each section of the high-tension bus in both stations. The generator and feeder-control boards will be situated on the third west-end mezzanine and they will be of the bench-board type, while previously they were made up of individual pedestals. As shown in the engraving, the concave sides will face each other.

The generator control is to be made up of sixteen control pedestals and the panels will be of blue Vermont marble. The usual instruments will be placed thereon in addition to the engine-signal device connecting with the signal stand adjacent to each engine or turbine. The feeder control is to be composed of seventeen sections and the panels will be of blue Vermont marble. In general, each panel will take care of four feeders.

DIRECT-CURRENT SERVICE.

Heretofore five motor-generators of 500-kw rating have not only supplied Waterside No. 1 Station with energy for lamps and motors, but have also supplied direct-current energy in the neighborhood of the station, part of the generating station having been devoted to distributing purposes as a substation. In the future there will not be any energy supplied from the station to the neighborhood, so only two of the above motor-generators will be kept and they will supply energy to the station only. These sets will be located under the first west-end mezzanine floor.

The direct-current and exciter control boards will remain as they are on the main floor under the west-end mezzanines and the exciters, auto-transformers and the booster set will be located in the same part of the building.

ARCHITECTURAL ALTERATIONS.

The increase of the kilowatt rating of Waterside No. 1 Station from a normal of 67,500 to 123,500 kw has made it necessary to provide larger galleries for the electrical apparatus. The electrical galleries will occupy the five mezzanines on the south side of the building, while the third mezzanine on the west side will be occupied by the feeder and generator control boards. Formerly the south-side mezzanines were occupied by offices, machine shops, storeroom, locker and toilet-room. All of the electrical apparatus heretofore has been located on the west-side mezzanines.

In altering Waterside No. 1 Station the idea was kept in mind to make it as much like the Waterside No. 2 Station as was possible and practical. The architectural changes are as follows:

BASEMENT CHANGES.

Excavations will be made along the south side wall and a cable vault 242 ft. long and 15 ft. wide will be constructed. This vault will be under the Thirty-eighth Street sidewalk. The roof will be made up of I-beams supported on the present Thirty-eighth Street wall and the vault retaining wall of concrete 3 in. thick. Between the beams will be concrete arches. The sidewalk finish will be granolithic. The height of the vault will be 10 ft. and it will be divided into fifteen compartments by concrete walls 2 ft. 6 in. high, thus preventing the spreading of any fire (due to short-circuits, etc.) to another cable. Any leakage past the duct outlets will be caught in a 12-in. trench running the length of the vault to a sump. There will be three doors from the basement to the vault.

MAIN FLOOR CHANGES.

Under the south and west-side electrical galleries the main floor—that is, engine-room floor—will be raised 6 in., but in the engine-room itself, south of a line 5 ft. ¼ in. from the center line between the engines as formerly arranged, the floor will be raised 26 in. This raise will be accomplished in general by placing over the present floor framing 8-in. channels on top of which will rest 8-in. I-beams. From the new main floor to the old main floor there will be steps running the whole length of the engine-room. The present cast-iron floor plates, 1⅛ in. thick, will be used as far as possible.

SOUTH-SIDE MEZZANINES.

The width of the south-side mezzanines will be increasel by erecting a new row of steel columns 5 ft. 6 in. on center lines from the present row of columns. These columns will be thirteen in number and will extend from their foundation below the basement line to the underside of the fifth mezzanine. They will be made up of two 15-in. channels back to back and two 20-in. plates. The spacing will be generally 14 ft. 9 in. apart, though in some cases about twice as much. A 12-in. brick wall with buff-brick finish on the engine-room side will be run up on the center line of this new row of columns to the underside of the crane, thus separating the electrical galleries from the engine-room.

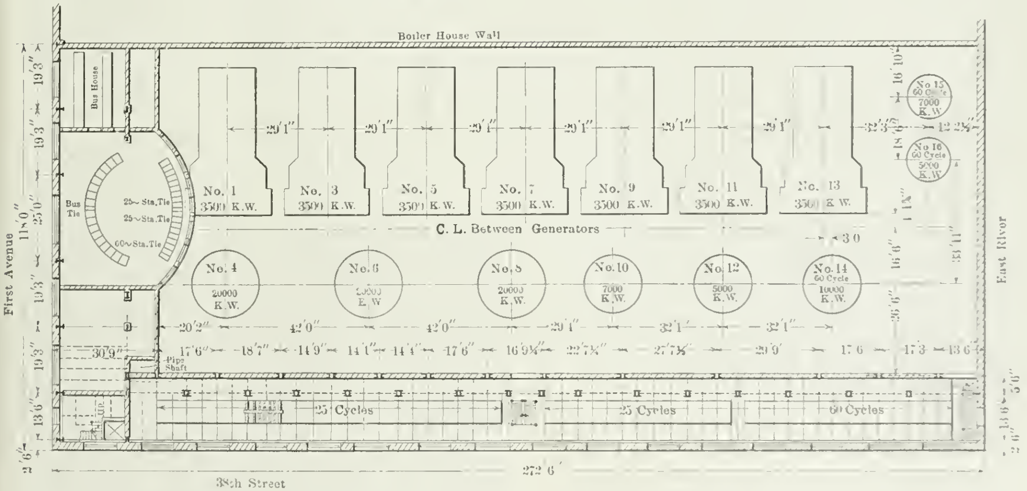


Fig. 8—Arrangement of Feeder and Generator Groups on Third Mezzanine Floor.

In addition to the above an additional row of columns will be placed 13 ft. 6 in. south from the present columns and they will be located generally opposite the new row of columns. Thus the distance between center lines of the two new rows of columns will be 19 ft. These last-mentioned columns will be made up of four 5-in. x 3½-in. angles with a 16-in. plate between. After these alterations the average width of these mezzanines will be about 19 ft.

The main floor under the electrical galleries will be raised 6 in.; the first mezzanine, 15 in.; the second, 9 in.; the third, 14½ in.; the fourth, 15 in., and the fifth probably 30 in. The floor finish of the first, second, third and fourth mezzanines will be alberene, while the main floor under the galleries and the fifth mezzanine will have granolithic finish.

WEST SIDE MEZZANINES.

The main alteration of the west-side mezzanines will be on the third gallery, which will be enlarged so as to accommodate the new feeder and generator control boards.

As on the south side of the building, new columns will be erected for supporting the west-side mezzanines. Four new columns made up of angles and plates will be spaced between the middle present outer wall columns and 6 in. out from their face. Likewise four of the same design will be placed on the center line of the present inside first row. Beyond the present inside second row will be two columns, 5 13/16 in. from the center line, which will run up to support cantilevers of the new bay front of control-room. There will also be another column on the center line of the present second row to support the bay front. The mezzanine will, of course, be separated from the engine-room.

The main floor under the west-side mezzanines will be raised 6 in., the first mezzanine 5 in., the second 5 in., the third 5½ in., the fourth 5 in., and the fifth 7 in. The finish of the floors will be about the same as the south-side mezzanine floors.

In further reference to the reconstruction of the third mezzanine it might be added that the bay front is necessitated by the fact that the feeder and generator control boards will be located in the shape of a horseshoe. This bay front will be constructed of wrought-iron plates on channel upright framing ornamented with wrought-iron moldings. There will be about seven plate-glass windows, thus giving from the control-board room a clear view of all parts of the engine-room floor. Over the parapet of the bay will be placed a clock with embellishment.

The average width of the west-side mezzanines will be about 28 ft. The present wind-brace walkway connecting boiler house and engine-room will, as far as bracing is concerned, be taken care of by the roof of the fourth mezzanine.

It is probable that offices will be located on these west mezzanines.

To increase further the available floor space for electrical apparatus the present elevator shaft, located in the southwest corner of the building, will be shifted 17 ft. 6 in. west and provided with a new ornamental wrought and cast-iron inclosure. This will necessitate a reconstruction of the present entrance and lobby. The floor finish of the vestibule will be mosaic. The wainscoting will be marble, while new entrance doors of Kalamein bronze will be provided.

A new platform of concrete construction will be erected over the new elevator shaft to support the elevator machinery.

The electrical galleries on the south side will be reached by the elevator and by stairs at the east and west ends of the building. These stairs will be of new design and will extend to the fifth mezzanines. There will also be a stairway about the middle of the electrical gallery leading from the first mezzanine to the third.

The steel work has been so designed as not only to take care of additional loads due to electrical apparatus and a new oil house on the roof, but also to carry the new load due to the 110-ton crane to be installed.

UNITED ELECTRIC LIGHT & POWER COMPANY

ALTERNATING-CURRENT DISTRIBUTION IN BOROUGH OF MANHATTAN.

It is singular yet nevertheless true that the magic name of Edison somewhat overshadows that of another New York company doing a gross business of over $2,000,000 yearly. The United Electric Light & Power Company if located in some other city would always be thought of among the large public-service companies of the country; but the influence of a well-known and well-advertised name subordinates it to some extent in the eyes of the general central-station industry, which, when thinking of New York, sees only the name of the New York Edison Company. The United Electric Light & Power Company distributes alternating current exclusively throughout the entire borough of Manhattan. This service is entirely underground, and north of 135th Street on Manhattan Island the service of this company prevails exclusively. The connected lighting load on the system is over 40,000 kw and the motor load approximates 15,000 hp. In round numbers 25,000 customers are supplied with energy from the United company's circuits.

In 1887 the company operated a single-phase, 1000-volt, 133-cycle system. The circuits were of course all overhead and the first alternating-current lighting on a commercial scale in New York City was witnessed in 1889. In 1893 the system was changed over to 60-cycle, two-phase, and subsequently the distribution system was placed underground. The three-phase, 60-cycle energy is generated in the Waterside stations, as is also 25-cycle, 6600-volt energy, and transmitted at 7500 volts and 6000 volts respectively over three-conductor, 250,000-circ. mil cables to two substations, where the 25-cycle energy is changed in frequency, phase and voltage by motor-generator sets and the 60-cycle energy transformed to two-phase energy and distributed on a three-wire system with a potential of 2100 volts between phases and 3000 volts across the outer conductors. The generating equipment of the company is located in the Waterside stations of the New York Edison Company and operated by the latter. The substations are widely separated, one being downtown on Elizabeth Street and the other being far uptown on 146th Street. A private substation is installed in the works of the National Biscuit Company, which is the largest individual user of electrical energy supplied from the company's mains. The general and executive offices of the company are located at 1170 Broadway at the corner of Twenty-eighth Street. Owing to the rapid increase in the company's business it was found necessary to maintain a branch office and showroom in the uptown district at 138 Hamilton Place, near West 143d Street and Amsterdam Avenue. This office, which was opened last September, provides accommodation for the public for the payment of bills, renewing of incandescent lamps and signing of applications. In addition a well-stocked showroom where the latest electrical devices are shown and demonstrated is an attractive feature of no small importance, as the office is in the midst of a high-class apartment-house district. The apparatus displayed is sold at retail and a demonstrator and a salesman are in constant attendance. Small devices, particularly electric flatirons, are sent out on thirty days' trial with excellent results. It is estimated that 100 are thus disposed of monthly, the greater part of which are sold to the users after the trial period has elapsed.

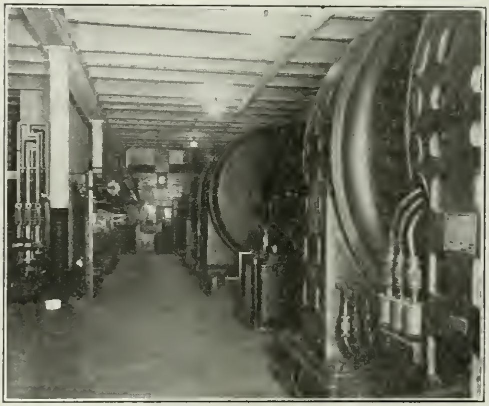


Fig. 1—Elizabeth Street Substation.

SUBSTATIONS.

The two substations of the company are similarly equipped except as to capacity. In the Elizabeth Street substation there are installed two 1000-kw motor generators and three sets of air-blast transformers, each set being rated at 2750 kw. The motor-generator sets are made up of 25-cycle, three-phase, 6600-volt slip-ring type motors driving 60-cycle, 2100-volt, two-phase generators. The resistors in the secondary circuit of the motors are arranged for manual or automatic operation, the

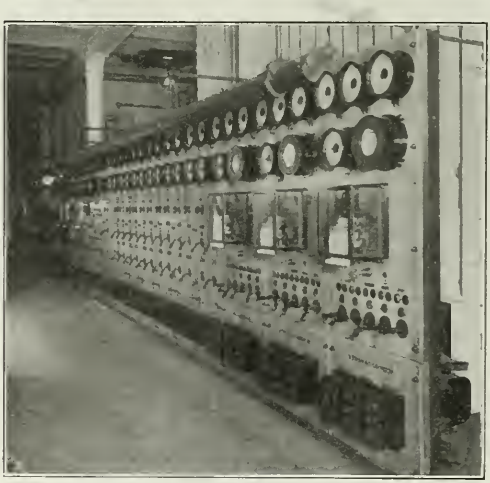


Fig. 2—Switchboard, Elizabeth Street Substation.

latter control being employed when the generators are connected in parallel with the transformer sets on the station bus. The motor-generator sets are held, however, largely in reserve for peak loads. By running the generator of the set as an over-excited synchronous motor and controlling the field circuit the sets may be employed as rotary condensers to improve the regulation of the system, and this is very often done in the uptown substation.

The transformer sets in each of the stations are made up of two 1250-kw transformers connected in parallel and one smaller transformer rated at 250 kw. The transformers are arranged in T-connection for changing from three-wire, three-phase to three-wire, two-phase. It will be noted that the small transformer has only a fraction of the output of the others because the motor load of the company is only approximately 15 per cent of the maximum load and the small transformer supplies the third or "power" leg of the system and maintains the proper phase relation for motor work. The voltage between phases is approximately 2100, but the tension across the outer conductors is 3000 volts and all the lighting load is carried single-phase across these outer conductors. This arrangement possesses advantages in that the bulk of the load is transmitted at a much higher voltage than would be the case where the lighting load fed from the phases independently. The other advantage which the arrangement has is that it is only necessary to regulate what is in effect one phase.

The switch and bus compartments in both substations are built entirely of concrete. The feeders from the Waterside station are provided with overload, inverse time-element relays and are usually operated independently. The switch panels controlling the secondary side of the transformers are provided with a power-factor indicator, voltmeter, graphic wattmeter, synchronizing lamp (operating in multiple with a synchroscope) and an ammeter in each of the three legs of the circuit. The incoming 60-cycle feeders are operated independently of the others on their own set of transformers feeding into either of the buses on the secondary side. A short cross-connecting bus is also provided on the high-tension side so as to permit any feeder to operate any of the transformer sets if necessary. A similar arrangement obtains for the 25-cycle feeders.

While there are two general station buses it is usual to operate on one, as the induction feeder regulators are connected to this bus. It is possible, however, to operate the feeder from the second bus without the induction regulators, thus permitting the regulators and all series and shunt transformers to be removed for cleaning and repairs. When the feeder is connected to the second bus there is of course no means of regulation between the bus and the feeder. A motor generator is, however, started to supply the second bus and this particular feeder, the generator being regulated to suit the voltage demands of the circuit. The feeder panels are provided with an ammeter in one of the outside legs of the circuit, a voltmeter and the usual type of overload and inverse time-element relay. Each feeder supplies its own particular district and is not in multiple with any of the adjacent feeders, either on the 3000-volt distributing side or the secondary network fed from transformers on the customers' premises. By this means the voltage on each feeder is regulated to give constant potential on the distributors, the layout of the latter being such that there is a minimum voltage drop between the feeder terminal and any point on the distributors.

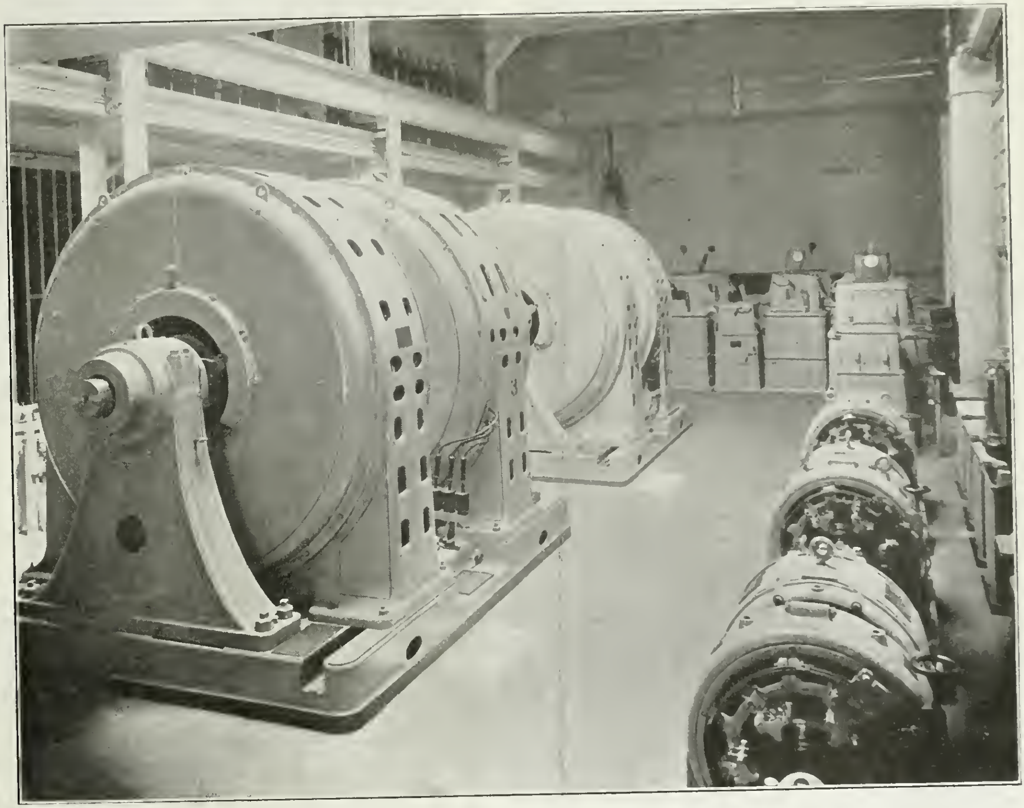


Fig. 3—General View of Equipment in 146th St. Substation.

Each feeder is controlled by an automatic induction-type Westinghouse two-phase regulator. Each regulator is of 85-kva rating and has a range of regulation of 10 per cent above or below the busbar voltage. Each regulator is operated by a 220-volt, 4/10-hp Westinghouse direct-current motor controlled by regulating relays. The relays operate through voltmeter compensators so as to maintain constant voltage at the service end of the feeders. Each feeder has a complete equipment of compensator, relays and regulators. The results obtained are in some ways remarkable.

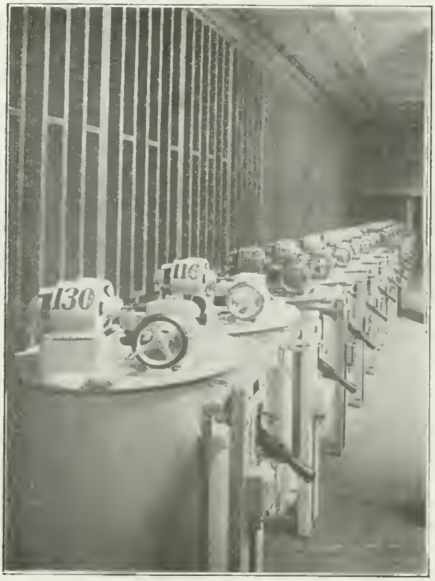


Fig. 4—Two-Phase Induction Regulator, 146th Street Substation.

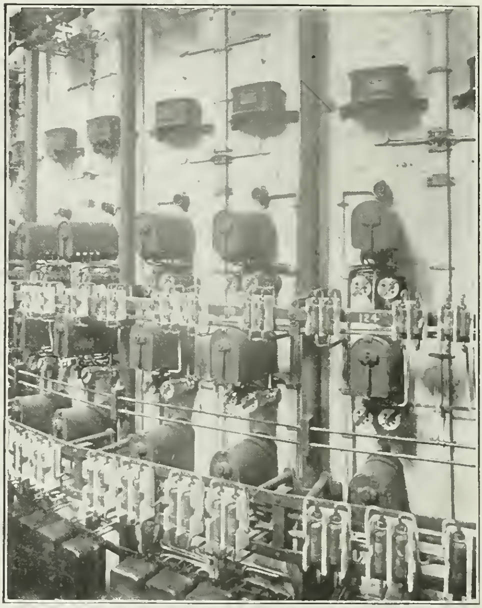


Fig. 6—Rear of Switchboard in 146th Street Substation.

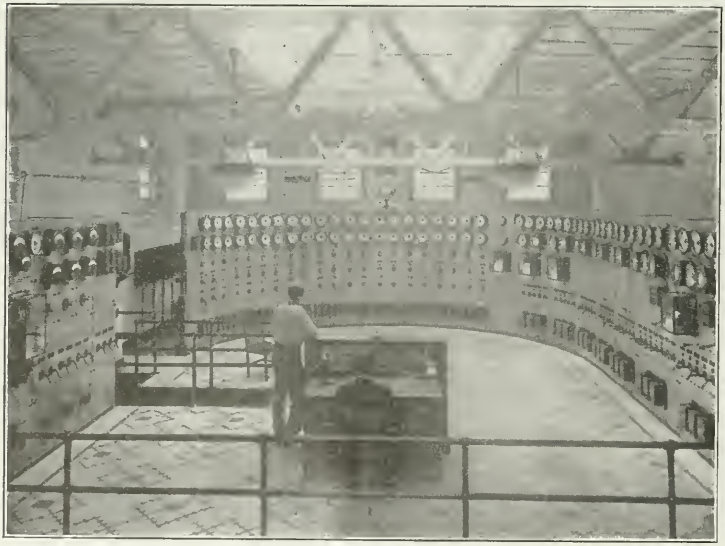


Fig. 5—Switchboard in 146th Street Substation.

DISTRIBUTION.

While the system of the United Electric Light & Power Company is three-wire, two-phase, it is single-phase so far as lighting is concerned. All the lamp circuits are connected across the outer conductors as previously mentioned. For two-phase motor circuits two transformers are used which are connected in the same manner as the large transformers in the substations. All transformers, whether for lamp or motor circuits, are similar; that is, the primary and the secondary are in two sections. The transformer which is connected across the 3000-volt circuit has its primary sections (1500 volts each) in series. The other transformer has its primaries connected in multiple, as the tension between the outer conductor and the middle of the main transformer is just one-half the voltage across the outers. The secondaries are connected to give 200 volts, two-phase, and while the phases are independent they are run three-wire to the motors. In this combination one-half of the motor load is also carried at the higher voltage. Where considerable energy is required by a single customer for motor circuits it is usual to install a set of transformers which feed back into the three-wire, two-phase motor secondary circuits. By this means the number of separate transformer installations necessary to supply energy to a given number of customers in a district possessing a reasonably dense business is materially reduced. The lighting network is laid out for three-wire service with 110 volts between the center and outer conductors. The three-wire mains are of single-conductor lead-covered cable, the three conductors being drawn into the same standard subway duct. Street secondaries are tied together so as to form an interconnected network for four or five banks of transformers. On the secondary side a tap from the middle of the 200-volt secondary supplies the neutral, at which point the transformer is solidly grounded. It will be noted that the motor and lamp secondary systems are separate and distinct so that the lighting system is only remotely affected by intermittent "power" demands such as are afforded by elevator motors, etc. The company has over 500 elevators operated from its mains, some of which are of the most recent development of switch or electrically controlled cars. Needless to state, all are fitted with alternating-current motors.

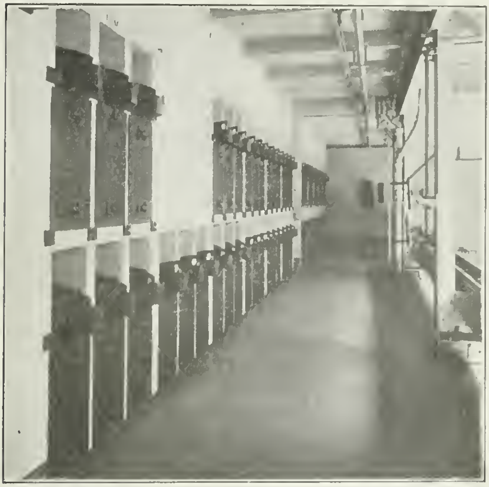


Fig. 7—Concrete Switch Structure at 146th Street Substation.

According to the regulation of the companies operating the underground conduit system in New York City, subway types of transformers have not so far been used in the manholes, and therefore the transformer installations must be made inside the curb line and on property controlled by the consumer. This naturally brings the installation within the jurisdiction of the Fire Underwriters, and the latter in turn prohibit the use of oil transformers. Consequently all the transformers for general distributing work are of the air-cooled type. The transformers are placed in a horizontal position invariably, on the floor or on some suitable support, but never bolted to the walls.

Fig. 8—Exterior of Branch Office.

The ratings of the transformers in general use range from 2 kw to 25 kw, the majority, however, being between 10 kw and 25 kw. There are, however, more 25-kw units installed than all other sizes combined. The transformers have a regulation of 1.3 per cent at unity power factor and have such characteristics that they may be used in multiple in an installation to make up whatever aggregate capacity may be required.

The distribution being entirely underground and the transformers having of necessity to be installed on customers' premises, the number of transformers is comparatively large. There are a number of reasons besides those already mentioned which contribute to this result. For instance, the rating of the transformers which can be installed in a certain location is limited, the transformers themselves must be ventilated, and consideration must be given to the facilities for handling the apparatus in the area of access available. Although a great many installations have an aggregate capacity greater than 25 kw, they are made up of a collection of units, from which it may be inferred that the iron losses are quite heavy. Offsetting these losses, however, are the low average feeder losses from the substation bus to the transformers. The company has service on 150 miles of street and occupies 320 miles of ducts with a total of approximately 950 miles of conductors, including all classes.

Fig. 9—Branch Office Interior.

Fig. 10—Electrically Equipped Apartment Houses.

SPECIAL CONSUMERS.

As an illustration of one of the special classes of consumers supplied by the United Electric Light & Power Company, mention might be made of the principal features of the installation on the property of the National Biscuit Company at

Tenth Avenue and Fifteenth Street. There are approximately 200 motors, aggregating 1500 hp, and ranging in rating from ⅛ to 150 hp, connected to the system, with a lighting equipment approximating 10,000 50-watt equivalents. An installation made up of six 200-kw, 7500-200-volt, oil-cooled transformers connected three-phase to two-phase supplies the energy for this establishment. The transformers are fed through two high-tension feeders direct from the 60-cycle bus at the Waterside station. The switches and buses are installed in concrete compartments, and the arrangement provides for the isolation of any transformer or either feeder without interrupting the service. The regulation is controlled automatically by potential regulators operating on the primary side of the transformers and having a capacity sufficient to compensate for a voltage change 10 per cent on either side of the normal. The regulators, one of which is allotted for each of two secondary buses, are oil-cooled and motor-operated, the motor being controlled by an automatic contact-making voltmeter and relays.

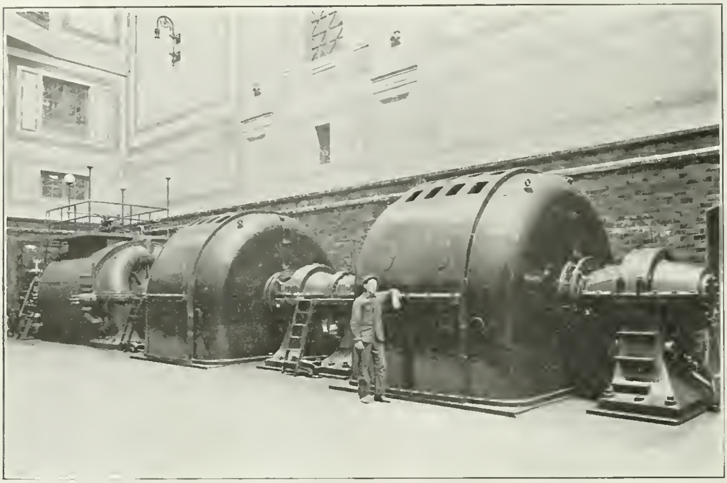


Fig. 11—Combination 25-60-Cycle Unit in Waterside Station.

RESIDENTIAL SERVICE.

An interesting feature of the growth of Manhattan Island is the rapid development in the northern section, known as Washington Heights. Ten years ago a great part of this section was undeveloped ground, with neither houses nor stores, while to-day a large fraction of the population of the borough resides in this locality. The development of the apartment-house business in this section is clearly illustrated in Fig. 12, which shows a block on upper Broadway, West 156th and 157th Streets and Riverside Drive. This block contains modern apartment houses having accommodations for 462 families in suites of from six to twelve rooms, and representing a connected load of 12,000 50-watt equivalents in lamps and 325 hp in motors for the operation of elevators, house pumps, etc. The majority of the houses in this locality use electricity exclusively as an illuminant, the records of the company showing that 85 per cent of the apartment-house dwellers use electricity for lighting and for various other purposes.

Another section of the territory worthy of mention is known as the Pinehurst section, where a high class of apartment houses is being erected and electrically equipped throughout. Fig. 15 shows the development along the Riverside Drive extending north of West 145th Street. The apartment houses shown are all equipped with electric service from the mains of the United company. The greater part of this business is secured by the active solicitation of the representatives of the company, supplemented with an elaborate follow-up system, comprising letters and attractive folders. Owing to the general popularity of electric lighting a number of apartment-house dwellers make unsolicited application to the company for its service. There are at the present time approximately 1100 apartment houses connected to the United Electric Light & Power Company's mains, one-half of which are equipped with alternating-current electric elevators.

COMMERCIAL BUSINESS.

The progress made in commercial lighting in the northern section of Manhattan Borough is well illustrated in Figs. 13 and 14, which show day and night views of St. Nicholas Avenue, looking north.

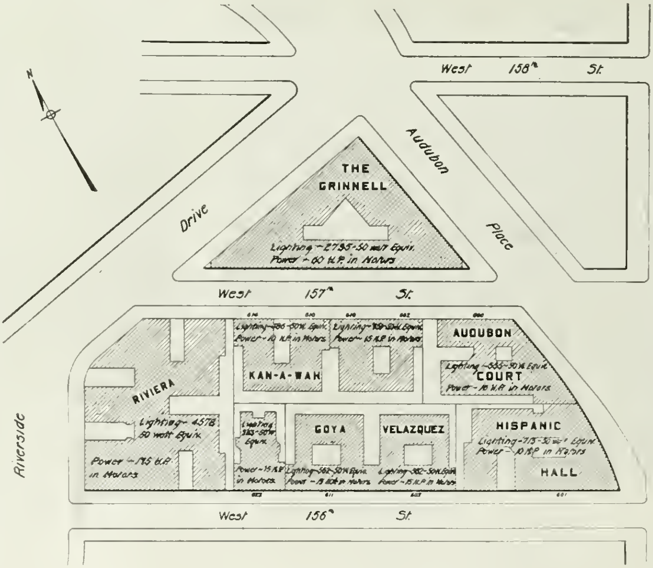

N
West 158th St.
Audubon Place
Broadway
Riverside Drive
THE GRINNELL
Lighting – 2795-50 watt Equiv.
Power – 60 H.P. in Motors
West 157th St.
RIVIERA
Lighting – 4578 50 watt Equiv.
Power – 175 H.P. in Motors
KAN-A-WAH
Power – 10 H.P. in Motors
Power – 15 H.P. in Motors
AUDUBON COURT
Lighting – 555 – 50 W. Equiv.
Power – 10 H.P. in Motors
Lighting 383 – 50 W. Equiv.
Power – 15 H.P. in Motors
GOYA
Lighting – 562 – 50 W. Equiv.
Power – 15 H.P. in Motors
VELAZQUEZ
Lighting – 582 – 50 W. Equiv.
Power – 15 H.P. in Motors
HISPANIC HALL
Lighting – 715 – 50 watt Equiv.
Power – 10 H.P. in Motors
West 156th St.

Fig. 12—Map of Uptown Block of Apartment Houses

The United company's business in the lower or southern section of the borough is largely confined to store lighting and industrial applications. One of the most interesting installations connected in this section is the garage of Gimbel

Brothers, which is equipped for housing and storing 150 electric vehicles. Many of the large electric signs displayed on the Great White Way are operated from the mains of the company, and a large number of the theaters and other public buildings of the city are also numbered among the customers that depend upon its service.

Fig. 13—St. Nicholas Avenue by Day.

The company supplies energy to the city under contract for 44,648 incandescent lamps, 570 arc lamps and 248 tungsten lamps, including maintenance, and also supplies energy to 500 hp in motors belonging to the municipality.

Fig. 14—St. Nicholas Avenue at Night.

OFFICERS.

The officers of the United Electric Light & Power Company are as follows: President, Mr. William R. Addicks; vice-president, Mr. Thomas E. Murray; secretary, Mr. Frank W. Smith; treasurer, Mr. Benjamin Whiteley; assistant secretary, Mr. L. A. Coleman; electrical engineer, Mr. W. E. McCoy; superintendent of installations, Mr. Joseph G. Swallow. Mr. Joseph F. Becker fills the position of sales manager of the company.

Fig. 15—Riverside Drive Apartment Houses.

UNDERGROUND CONDUIT CONSTRUCTION

VARIOUS KINDS OF SUBWAY DUCTS USED IN MANHATTAN AND METHODS OF INSTALLATION.

By Edwin R. Quinby.

THE writer, who has been engaged in the work of underground electrical conduit installations for about twenty-two years, principally in New York City, has watched closely its growth and changes during that period, which practically means its entire career. The first real underground electrical work was started in the year 1886, although some "Edison tubes" and telegraph cables were buried before that time. About twenty-three years ago at a meeting of the National Electric Light Association a resolution was adopted which read somewhat as follows: "Resolved, that the scheme of placing electric-light and power cables underground is commercially inpracticable." Views have certainly changed since then, as to-day this method is the only one considered suitable.

In Table II are shown the amount and types of different underground conduits in New York City, or rather in the boroughs of Manhattan and the Bronx. In the other boroughs, with the exception of Brooklyn, there is very little underground conduit construction, and in Brooklyn the electric-lighting companies, as well as the railway and telephone and telegraph companies, own their own conduits, whereas in Manhattan and the Bronx subway companies rent the conduits.

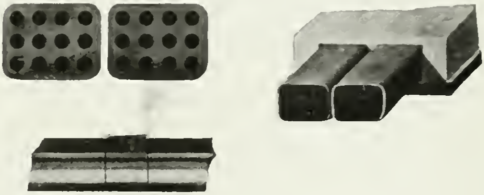


Fig. 1—Multiple-Duct Tile Conduit in Concrete.

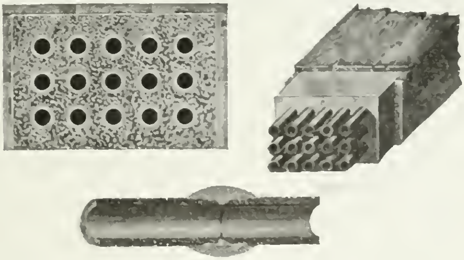


Fig. 2—Fiber Conduit in Concrete.

In the construction of conduits in the borough of Manhattan more different kinds of subsurface structures are encountered than probably in any other city in the world. There are gas mains and branches; water mains and branches for both high and low pressure; steam mains and branches; pneumatic tubes; sewers and culverts; telegraph conduits; electricity supply conduits, including conduits for the underground and elevated railroads and street-car lines; Edison tubes; the subway tunnel; the McAdoo tunnel; the Croton aqueduct, and many new or contemplated structures and building operations. In fact, in New York improvements are always being made, so that the care and maintenance of existing subsurface structures is a difficult task, particularly as at varying depths there is nothing

TABLE I.—ESTIMATE OF COST PER TRENCH FOOT OF ELECTRICAL SUBWAY BASED UPON CONSTRUCTION IN NEW YORK CITY

WROUGHT-IRON PIPE LAID IN CONCRETE AND PROTECTED BY CREOSOTED WOOD

SUBWAY.		DETAIL STATEMENT OF COST, LABOR AND MATERIAL IN FRACTIONS OF DOLLAR.																							GRAND TOTAL.		Center to Center Distance in Feet Between Boxes and Between Manholes.	Dimensions of Trench in Inches Less 8 Inches for Paving.	NUMBER AND ARRANGEMENT OF DUCTS.				
		COST OF LABOR.														Includes Labor & Material.		COST OF MATERIAL.															
								Repaving		Repairs to Pavement for 1 Year.								Pipe	Concrete														
Number and Diameter in Inches.	Character.	Trench	Boxing and Bracing	Concrete.	Pipe Work	Carting	Dump	Belgian Block	Special Block.	Belgian Block	Special Block	Outside Superintendence	Engineering and Office.	Total Belgian Block	Total Special Block	Boxes.	Manholes.	3 In.	Sand and Stone.	Cement.	Black Plank	Spruce	Incidentals	Total.	Belgian Block.	Special Block.			Number of Ducts.	Number of Rows.	Ducts in Row.	Number of Rows.	Ducts in Row.
1 3	Distributing	.100	Laid	bare	.020	.060	.010	.110	.150	.040	.060	.138	.029	.507	.567	.568	..	.180	Laid	bare	..	..	.040	.788	1.295	1.355	Boxes 55	16x26	1	1	1	..	..
2	"	.142	.015	.016	.045	.125	.035	.135	.173	.050	.086	.165	.030	.758	.832	.568	..	.360	.020	.034	.175	.010	.050	1.217	1.975	2.049	"	20x30	2	1	2	..	..
3	"	.175	.020	.022	.063	.130	.040	.158	.206	.065	.103	.170	.030	.873	.959	.568	..	.540	.035	.058	.235	.015	.060	1.511	2.384	2.470	"	26x30	3	1	3	..	..
4	"	.196	.022	.028	.080	.145	.048	.175	.227	.085	.113	.192	.035	1.006	1.086	.568	.	.720	.042	.071	.262	.018	.065	1.746	2.752	2.832	"	30x30	4	2	2	..	..
4	Trunk	.220	.040	.034	.050	.142	.045	.175	.227	.085	.113	.194	.035	1.020	1.100	..	.384	.720	.067	.115	.140	.022	.070	1.518	2.538	2.618	M'holes 260	26x35	4	2	2	..	..
5	"	.220	.040	.040	.060	.180	.055	.175	.227	.085	.113	.196	.035	1.086	1.160	..	.384	.900	.081	.138	.175	.025	.070	1.773	2.859	2.939	"	26x35	5	1	2	1	3
6	"	.245	.040	.040	.078	.185	.060	.180	.227	.085	.113	.200	.035	1.148	1.223	.	.384	1.080	.078	.134	.115	.030	.070	1.891	3.039	3.114	"	35x35	6	2	3	..	..
7	"	.305	.040	.060	.085	.205	.065	.195	.265	.090	.120	.250	.040	1.335	1.435	..	.420	1.260	.090	.157	.140	.035	.075	2.177	3.512	3.612	"	36x35	7	1	3	1	4
8	"	.305	.040	.055	.100	.210	.065	.195	.265	.090	.120	.260	.040	1.360	1.460	.	.420	1.440	.085	.155	.140	.035	.075	2.350	3.710	3.810	"	36x35	8	2	4	..	..
9	"	.300	.040	.070	.105	.220	.080	.180	.227	.085	.113	.280	.045	1.405	1.480		.450	1.620	.118	.204	.115	.040	.075	2.622	4.027	4.102	"	30x40	9	3	3	..	.
10	"	.350	.040	.065	.110	.230	.085	.195	.265	.090	.120	.320	.050	1.535	1.635		.450	1.800	.104	.195	.140	.040	.080	2.809	4.344	4.444	"	36x40	10	1	4	2	3

CAMP TILE CONDUIT LAID IN CONCRETE AND PROTECTED BY CREOSOTED WOOD.

Number and Diameter in Inches.	Character.	Trench	Boxing and Bracing	Concrete.	Pipe Work	Carting	Dump	Repaving Belgian Block	Repaving Special Block.	Repairs Belgian Block	Repairs Special Block	Outside Superintendence	Engineering and Office.	Total Belgian Block	Total Special Block	Boxes.	Manholes.	Pipe 3 In.	Sand and Stone.	Cement.	Black Plank	Spruce	Incidentals	Total.	Grand Total Belgian Block.	Grand Total Special Block.	Center to Center Distance in Feet Between Boxes and Between Manholes.	Dimensions of Trench in Inches Less 8 Inches for Paving.	Number of Ducts.	Number of Rows.	Ducts in Row.	Number of Rows.	Ducts in Row.
4 3	Trunk	.280	.040	.050	.090	.160	.065	.195	.265	.090	.120	.360	.040	1.370	1.470	.	.384	.240	.065	.070	.140	.035	.065	.999	2.369	2.469	M'holes 260	30x36	4	1	4	..	..
6	"	.300	.040	.060	.110	.200	.080	.180	.227	.085	.113	.390	.040	1.485	1.560	.	.384	.360	.073	.082	.115	.040	.070	1.124	2.609	2.684	"	25x42	6	2	3	..	..
8	"	.325	.045	.068	.145	.215	.088	.195	.265	.090	.120	.415	.045	1.631	1.731	.	.420	.480	.076	.084	.140	.040	.075	1.315	2.946	3.046	"	30x42	8	2	4	..	..
10	"	.405	.065	.090	.175	.230	.095	.195	.265	.090	.120	.450	.048	1.833	1.933	.	.450	.600	.095	.120	.140	.045	.080	1.530	3.363	3.463	"	30x46	10	2	4	1	2
12	"	.405	.065	.095	.200	.270	.092	.195	.265	.090	.120	.480	.050	1.942	2.042	..	.500	.720	.110	.145	.140	.058	.090	1.763	3.705	3.805	"	30x46	12	3	4	..	..
14	"	.460	.065	.120	.235	.310	.100	.227	.280	.095	.125	.540	.055	2.207	2.290	..	.500	.840	.140	.180	.175	.080	.100	2.015	4.222	4.305	"	36x46	14	2	5	1	4
16	"	.475	.065	.135	.260	.330	.120	.195	.265	.090	.120	.580	.060	2.310	2.410	..	.520	.960	.150	.190	.140	.080	.100	2.140	4.450	4.550	"	32x51	16	4	4	..	..
18	"	.525	.070	.150	.295	.375	.138	.227	.280	.095	.125	.640	.070	2.585	2.668	..	.520	1.080	.165	.215	.175	.116	.100	2.371	4.956	5.039	"	36x51	18	3	5	1	3
20	"	.615	.070	.175	.315	.405	.165	.227	.280	.095	.125	.675	.075	2.817	2.900	.	.520	1.200	.160	.220	.175	.128	.100	2.503	5.320	5.403	"	38x56	20	4	5	..	..
22	"	.615	.070	.180	.325	.420	.160	.227	.280	.095	.125	.680	.075	2.847	2.930	.	.520	1.320	.175	.235	.175	.128	.100	2.653	5.550	5.583	"	38x56	22	4	5	1	2
24	"	.625	.070	.202	.350	.450	.173	.260	.292	.113	.135	.720	.080	3.043	3.097	..	.520	1.440	.184	.250	.175	.134	.100	2.803	5.846	5.900	"	43x51	24	4	6	..	..
26	"	.625	.070	.215	.370	.455	.170	.260	.292	.113	.135	.730	.080	3.088	3.142	.	.550	1.560	.196	.285	.175	.134	.110	3.010	6.098	6.152	"	43x56	26	4	6	1	2
28	"	.620	.070	.230	.385	.465	.181	.287	.320	.120	.140	.760	.085	3.203	3.256	..	.550	1.680	.205	.300	.203	.150	.110	3.198	6.401	6.454	"	45x51	28	4	7	..	.
30	"	.625	.080	.250	.400	.475	.190	.260	.292	.113	.135	.800	.085	3.278	3.332	..	.550	1.800	.220	.325	.175	.158	.110	3.338	6.616	6.670	"	43x56	30	5	6	.	..
32	"	.690	.080	.260	.415	.520	.220	.287	.320	.120	.140	.815	.090	3.497	3.550	..	.580	1.920	.230	.335	.203	.166	.110	3.544	7.041	7.094	"	45x56	32	4	7	1	4
34	"	.690	.080	.280	.435	.525	.215	.287	.320	.120	.140	.830	.090	3.552	3.605	..	.580	2.040	.250	.350	.203	.166	.110	3.699	7.251	7.304	"	45x56	34	4	7	1	6
36	"	.726	.085	.300	.450	.540	.230	.310	.335	.125	.145	.875	.095	3.736	3.781	..	.580	2.160	.270	.380	.203	.190	.110	3.893	7.629	7.674	"	49x56	36	4	8	1	4
38	"	.726	.085	.300	.470	.570	.230	.310	.335	.125	.145	.880	.095	3.791	3.836	..	.580	2.280	.270	.390	.203	.190	.110	4.023	7.814	7.859	"	49x56	38	4	8	1	6
40	"	.726	.085	.305	.485	.585	.225	.310	.335	.125	.145	.900	.098	3.844	3.889	..	.600	2.400	.275	.405	.203	.206	.110	4.199	8.043	8.088	"	49x56	40	5	8	..	.
42	"	.735	.085	.310	.495	.590	.235	.310	.335	.125	.145	.920	.100	3.905	3.950	..	.600	2.520	.285	.415	.203	.210	.110	4.343	8.248	8.293	"	49x61	42	5	8	1	2
44	"	.735	.085	.310	.505	.590	.235	.310	.335	.125	.145	.930	.100	3.925	3.970	..	.600	2.640	.280	.410	.203	.210	.110	4.453	8.378	8.423	"	49x61	44	5	8	1	4

more or less than a solid-rock stratum. Many of the structures rest on solid rock and great care must be taken in going underneath them, the rock being either wedged out or blasted out with very light charges of powder.

The Consolidated Telegraph & Electrical Subway Company, which builds most of the conduits for electric-lighting and motor service, makes most of its rock excavations by means of air drills receiving air from portable compressors, which in turn are operated by electric motors. This means of rock excavation has proved very economical.

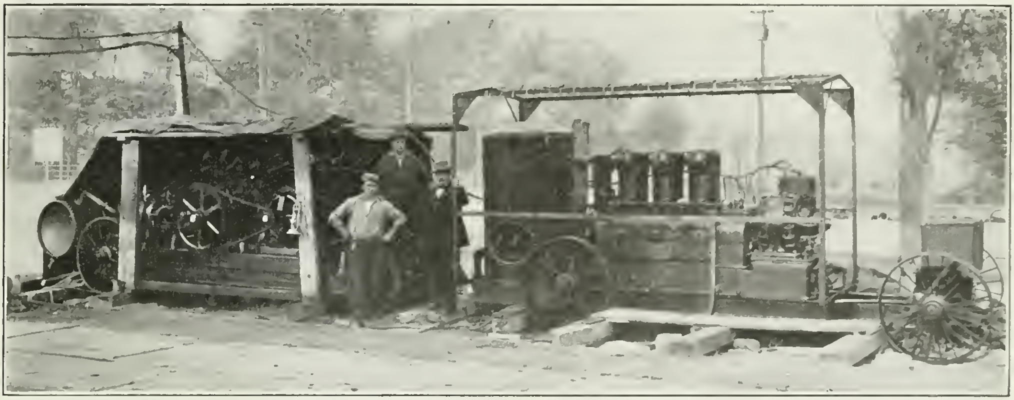
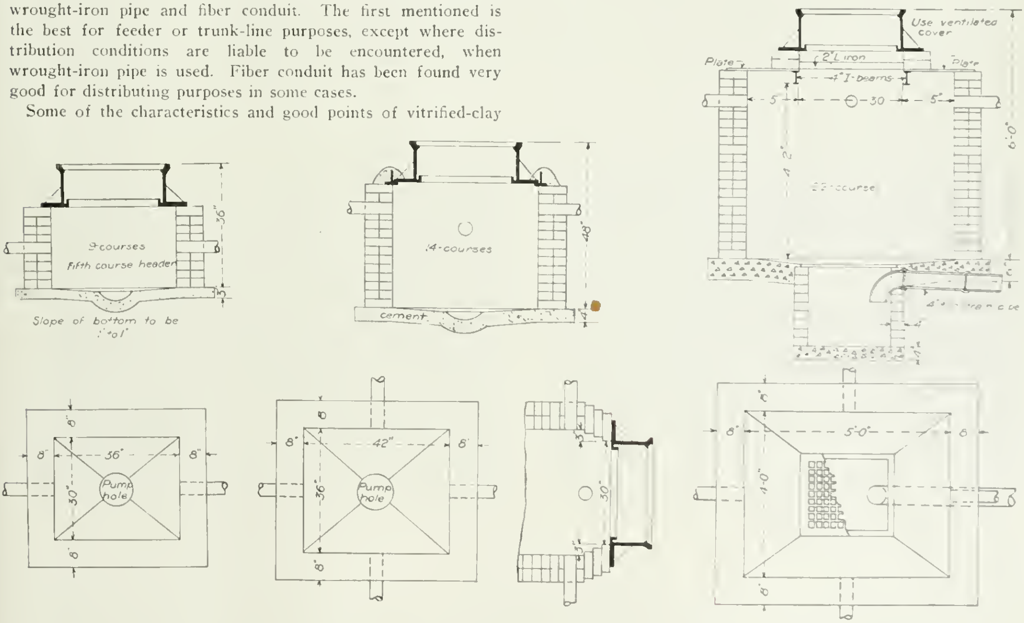


Fig. 3—Chain-Driven and Directly Connected Motor-Operated Air Compressors.

Many different types of conduits have been experimented with, until to-day there are practically only three standards, namely, vitrified-clay conduits (in single or multiple form), wrought-iron pipe and fiber conduit. The first mentioned is the best for feeder or trunk-line purposes, except where distribution conditions are liable to be encountered, when wrought-iron pipe is used. Fiber conduit has been found very good for distributing purposes in some cases.

Some of the characteristics and good points of vitrified-clay conduit are: It is a natural product of the earth and there are practically no deteriorating effects from placing it in the earth. It is electrolysis-proof. It is a very poor conductor of heat and also of electricity. It is practically imperishable if not subjected to mechanical injury. Acids, dampness and gases have no deteriorating effects on it. Its glazed surface facilitates the drawing in and out of cables, and it is not in any way injured thereby when properly laid. When laid in sufficiently large amount—that is, in a large number of ducts—it forms a rigid mass that is not easily injured by being disturbed from outside causes. It is economical to use. Lengths of these conduits from 1.5 ft. to 3 ft. long have been tested for resistance to high-voltage arcs (puncture test) to about 30,000 volts, and the arc runs around the ends, showing them to be practically puncture proof when well glazed, vitrified and free from metallic substances.



Figs. 4 to 10—Types of Manhole Construction.

Fiber conduit is electrolysis-proof and is a very poor conductor of heat and electricity. After being laid it is accessible for distribution purposes, it being an easy matter to cut in branch-service boxes.

Vitrified clay is far superior to fiber for ordinary electrical conduit construction other than distribution purposes. It is more durable and much more acid and gas-proof and it withstands the wear of drawing in and out better. It will withstand burn-outs, short-circuits, punctures, etc., much better.

Fiber conduit has been used in outlying districts for branches and distribution lines-with good results, but its durability and powers of resistance to action of acids and gases are somewhat doubtful, concerning which vitrified-clay conduit has proved through years of constant use its great superiority.

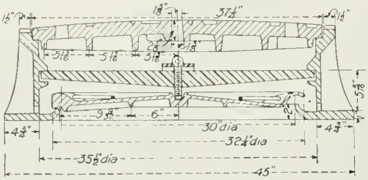


Fig. 11—Details of Large Manhole Cover.

A series of puncture tests made under the supervision of the writer showed that fiber conduit, when perfectly dry, punctures at 27,466 volts, and after immersion in water for twenty-four hours it punctures at 17,100. The puncture is clean and sharp. This is a fairly good result, but is greatly inferior to that with vitrified-clay conduit.

The writer prefers to use vitrified-clay conduit for all trunk-line work, and to use some fiber conduit for distribution purposes on account of its accessibility.

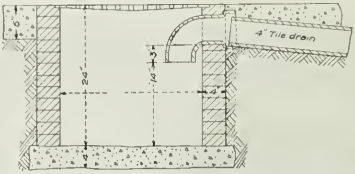


Fig. 12—Details of Manhole Drainage.

Cable-splicing service boxes and manholes used for distribution are shown in Figs. 4 to 10.

The I-beams, plates, etc., in manholes should be protected as much as possible with concrete to prevent oxidation.

A considerable number of methods of ventilation for electrical subways have been tried in New York City during the past

TABLE II.—TYPES AND LENGTH IN FEET OF ELECTRIC LIGHT, TELEPHONE AND TELEGRAPH CONDUIT CONSTRUCTION IN NEW YORK CITY.

COMPANY.	WROUGHT-IRON PIPE.							CASING PIPE.
	1.5 In.	2.0 In.	2.5 In.	3.0 In.	3.5 In.	4.0 In.	4.5 In.	3.0 In.
C. T. & E. S.	33,479.92	10,922.58	97,805.06	6,612,183.97	329,478.65	188,919.75	......	......
Edison	......	2,227.02	12,577.76	333,605.45	73,906.98	35,590.26	5,504.69	......
Empire	......	45,042.20	2,123,073.21	2,858,251.76	......	9,359.60	......	5,012.50
Total	33,479.92	58,191.80	2,233,456.03	9,804,041.18	403,385.63	233,869.61	5,504.69	5,012.50

COMPANY.	KALAMEINED PIPE.		FIBER.			REILLY.	BROOKS.	CEMENT-LINED.	
	2.5 In.	3.0 In.	3.0 In.	3.5 In.	4.0 In.	4.0 In.	3.0 In.	2.5 In.	3.0 In.
C. T & E. S.	......	......	183,597.60	1,844.40	48,634.30	......	......	......	118,652.17
Edison	......	......	......	......	......	......	......	......	......
Empire	133,812.64	30,376.92	......	......	......	855.15	49,714.38	350,683.79	......
Total	133,812.64	30,376.92	183,597.60	1,844.40	48,634.30	855.15	49,714.38	350,683.79	118,652.17

COMPANY.	EDISON THREE-WIRE TUBE.						ZINC.	CREOSOTE WOOD BOX.		
	1 In.	1.25 In.	1.5 In.	2.0 In.	2.5 In.	3 In.	2.5 In.	2.5 In.	3.0 In.	4.0 In.
C. T. & E. S	......	......	......	......	......	......	......	......	......	......
Edison	9,438.64	54,086.98	4,059.16	547,362.95	129,281.15	141,221.45	......	......	......	......
Empire	......	....	......	......	......	......	32,880.00	330.12	410.40	358.40
Total	9,438.64	54,086.98	4,059.16	547,362.95	129,281.15	141,221.45	32,880.00	330.12	410.40	358.40

COMPANY.	WYCKOFF.	DORSET.	SAND BOX.		TILE.	JOHNSTONE.		Grand Totals.	Man-holes.	Service Boxes.
	2.5 In.	2.5 In.	1.25 In.	2.0 In.	3.0 In. to 3.5 In.	A.	C.			
C. T. & E. S.	......	......	.. ...	......	8,180,317.64	127,183.20	48,336.24	15,981,355.48	3,517	27,565
Edison	......	......	5,173.48	93,653.70	61,480.68	......	......	1,509,170.35	273	3,388
Empire	143,789.82	42,947.76	......	......	10,722,058.52	......	......	16,548,957.17	3,945	1,207
Total	143,789.82	42,947.76	5,173.48	93,653.70	18,963,856.84	127,183.20	48,336.24	34,039,483.00	7,735	32,160

twenty-two years. Two of these are worthy of mention as failures, namely, the erection of stand pipes connected with manholes and the use of pressure blowers for forcing air through specially laid tubes with small openings in them where they pass through manholes for the purpose of maintaining an air pressure to keep out explosive gases, the entire system being closed.

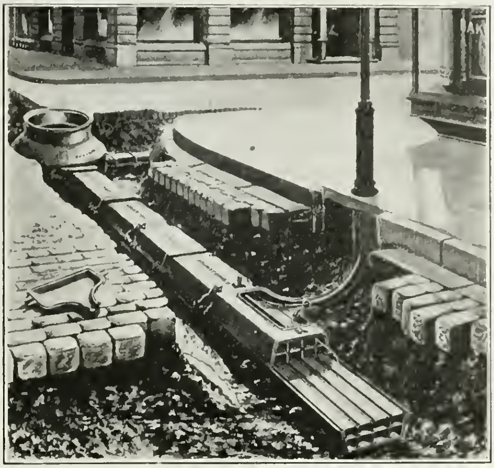


Fig. 13—Johnstone Conduit System.

Experience and investigation showed the latter to be not only a dismal failure, but also a very expensive system. Although large-sized and numerous blowers were installed, the pressure maintained in the system was insufficient except in the immediate vicinity of the blower stations. When manholes were opened for the purpose of working on the cables, etc., the pressure was, of course, removed for the time being, and much time elapsed before the pressure was fully restored after closing the manholes. The manhole castings were then provided with an inner and an outer or street cover. The inner cover was equipped with a rubber gasket to render it air-tight and water-tight and it was also locked in its place by a bar provided with a saddle and padlock, it being deemed advisable to keep the manholes under lock and key.

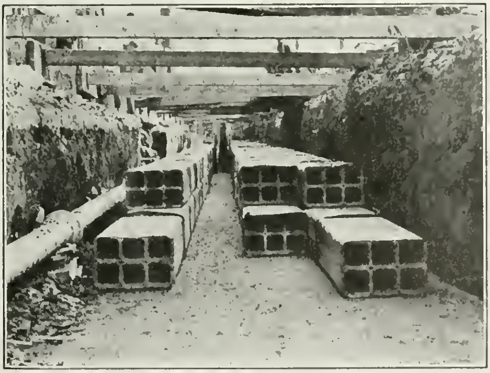


Fig. 14—Tile Conduit.

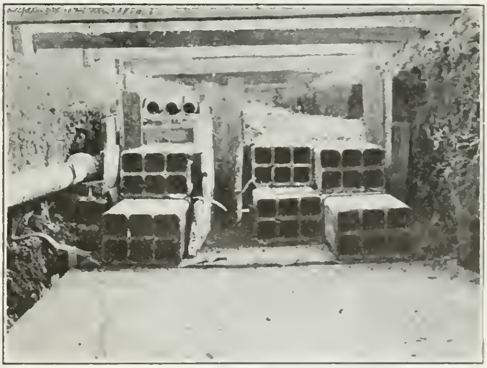


Fig. 15—Tile Conduit.

In the present system of ventilation, the manholes are secured, not with lock and key, but with a seal consisting of a porcelain disk about 1.5 in. in diameter which has proved very effective and economical. The inner cover has been raised 1 in. above its seat by means of lugs placed at three points of its periphery. The outer or street cover is provided with twenty-four holes 1.5 in. in diameter at the top and 1.75 in. at the bottom to prevent accumulation of dirt and consequent stopping them up; thus there are an opening of 42 sq. in. for the escape of gas in the outer cover and an opening of 95 sq. in. around the periphery of the inner cover.

In order to prove that these conditions provided good ventilation samples of gas were taken, first, from a manhole with the solid cover on it and then from the same manhole provided with ventilating covers. Although the percentage of gas in the first place was quite large, in the second case it was hardly perceptible. All of the numerous experiments made pointed to the value of this system. The difference in temperature of the air in the manholes and the atmosphere, which always exists to some extent, is sufficient to create a good circulation.

In draining manholes to sewers care should always be taken that the drain pipe is properly tapped, not so much on account of the danger of the sewer gas exploding as because of its sickening effect on the men at work in the manholes. Sewer gas is not usually regarded as explosive, although one of its constituents, marsh gas, forms an explosive mixture with air. The other gases going to make up what is commonly called sewer gas are carbon monoxide, carbon dioxide, hydrogen sulphide, ammonia, ammonium carbonate and sulphate, and various hydrocarbon compounds. These gases are not particularly poisonous in the proportions usually found, but they have a sickening effect on the inhaler.

It is extremely important that subsidiary pipes or laterals be carefully sealed at the ends, whether entering building vaults or extending up lamp-posts. Some of the so-called gas explosions in manholes have really been simply explosions from the sudden expansion of air and vapor caused by the force and heat of "burn-outs" on cables, and in some cases by the generation of water-gas caused by the heat of the "burn-out," and hence the prevention of burn-outs on circuits is a very important preventive of explosions. In general, the latest practices for prevention of explosion of lighting and sewer gas in conduits are as follows:

Provide the manholes with ventilating covers, as described. Keep the openings of these covers clean. Keep the manholes as clean as possible and as free from water and dampness as possible. Seal up the subsidiaries and laterals carefully at the ends. Have the sewer drains well trapped. Keep the gas mains in the vicinity of conduits in good repair. Keep the gas mains as far away from conduits and manholes as possible. Take all possible precaution against burn-outs. Protect the conduit and cables from mechanical injuries caused by other excavations.

NEW YORK BY NIGHT

GENERAL ILLUMINATION OF MANHATTAN BOROUGH AND DESCRIPTION OF ELECTRIC SIGNS

THE metropolis of the Western Hemisphere possesses a charm peculiarly its own which springs into being with every setting sun. It would seem that with the approaching darkness every available roof, wall and fence becomes a beacon, and the hurry and bustle of the New York day dwindle away in the gay and merry laughter of its night. This is especially true of the "Great White Way," concerning which a great deal has been written. The bewildering confusion of electric signs, with their white and colored lights, some motionless, others in action; the decorative lighting on the streets, buildings and roofs; the swelling throng of theatergoers, are of themselves sufficient to interest and amuse, and the visitor to the city cannot but be strangely impressed with the wonderful showing.

STREET LIGHTING.

The selection of the form of illumination best suited to local requirements and which will best facilitate travel on the streets and make transportation on the roadway as safe at night as during the day cannot be made without careful study and consideration. New York possesses a number of thoroughfares whose illumination compares favorably with the best practice abroad and forms a standard for much of the future work in this country. Moreover, the lamp-posts themselves are works of art which fit in with their respective surroundings and reflect the culture of the city. The various details of ornamentation and the general make-up of the posts are worthy of study, representing as they do the result of years of painstaking labor on the part of the associate general manager of the New York Edison Company. A description of the standard posts will be found in the *Electrical World,* Dec. 8, 1910.

The illumination of Fifth Avenue with its twin arcs makes this well-known thoroughfare very attractive at night and the lighting of Seventh Avenue north of Central Park to its terminus at Central Bridge, a distance of over 2 miles, is beyond question one of the best examples of street illumination in the country. About 26 kw per mile is used. The street is about 150 ft. wide and has a narrow strip of parkway in the

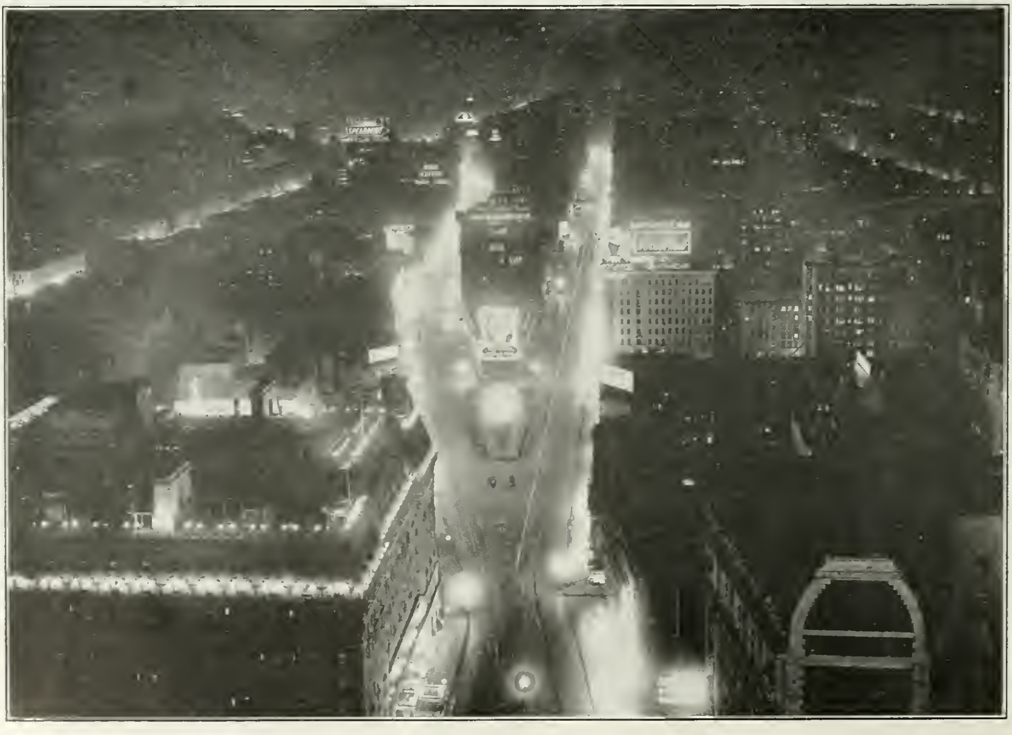


Fig. 1—The "Great White Way," Looking North from Times Square.

center, making it desirable to arrange the lamps in three rows. A rather complete account of this installation, with illumination curves and data, was published in the *Electrical World*, Nov. 7, 1908. The lighting of both of these thoroughfares is beyond general American practice and, in fact, beyond average New York practice, too. It may be interesting to note that the lighting of the public highways in New York is under the jurisdiction of the Department of Water Supply, Gas and Electricity, which so far has manifested commendable progressiveness in the instances cited. The large public squares are at present being lighted by flaming-arc lamps mounted on high posts. This work is more or less experimental and the practice has not as yet become standard. Otherwise inclosed-arc lamps are employed, although flaming arcs are also employed to a limited extent on the various bridge approaches. The four magnificent bridges which span the East River are lighted by inclosed arc lamps which make a splendid spectacle.

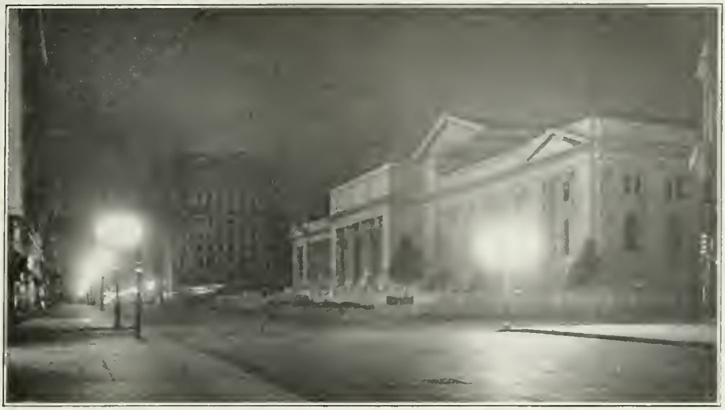


Fig. 2—Fifth Avenue, Looking South from Forty-second Street.

PARK LIGHTING.

The tungsten lamp is very largely employed for park and boulevard lighting in New York, replacing gas and naphtha lamps formerly employed for this purpose. Central Park and Riverside Drive in Manhattan and Prospect Park and Fort Greene Park in Brooklyn, together with a number of smaller parks, are now lighted almost exclusively by this means. The illumination of such places, comprising winding roadways and footpaths lined with trees, necessarily calls for small units mounted low enough to be clear of the overhanging foliage. The results obtained from the use of tungsten lamps for this purpose have been very satisfactory. The lanterns used were chosen by the Municipal Art Commission. That most widely employed consists of three hinged interlocking sections which provide socket and globe-holding devices and means for quickly cleaning and replacing the lamps, reflectors and globes. Many other types of approved standards are also employed. All are made of cast iron and are given a verdi-bronze finish. The tungsten lamps used are rated at 60 watts. The type of glassware varies with the location of the lamps. Along the Mall, for instance, in Central Park and about the public buildings round white globes are employed to diffuse the direct glare of the light and to add to the artistic treatment, while along the paths and roads a clear-glass globe is used. The lamps are fed from underground armored cable placed directly in trenches dug in the soil and afterward covered over again and sodded. The circuits are controlled in sections. Arc lamps, however, are still used around the large lake in Prospect Park, Brooklyn. These are hung from arms extending out over the lake so as to offset the effect of the trees and are especially useful in lighting the lake during the winter when it is frozen over and given up to skaters. The New York Edison and the United Electric Light & Power Companies both supply energy in Manhattan for this purpose, as does the Edison Electric Illuminating Company of Brooklyn in the "City of Churches."

WINDOW LIGHTING.

Electric store-window lighting is everywhere seen in the business districts of New York. Two main classes of illumination are used, one in which the object is to display the goods and the other in which the object is to attract the attention of those passing at a distance from the window. Oftentimes flaming-arc lamps are used on the exterior and tungsten lamps in reflectors or bare in the window. Even during the day awnings are lowered and artificial illumination from tungsten lamps is employed to display the goods in the windows. This practice is becoming quite general. The New York Edison Company uses electricity very liberally in the show windows of its branch offices and maintains probably the most brilliantly lighted show windows in New York. In its West Forty-second Street office the ceiling above the two windows and the entrance is studded with eighty 100-watt tungsten lamps each equipped with a prismatic reflector which concentrates the light directly beneath it. The total downward candle-power in each window is in excess of 25,000 and the illumination at the bottom of each window is 100 ft.-candles. When it is remembered that 10

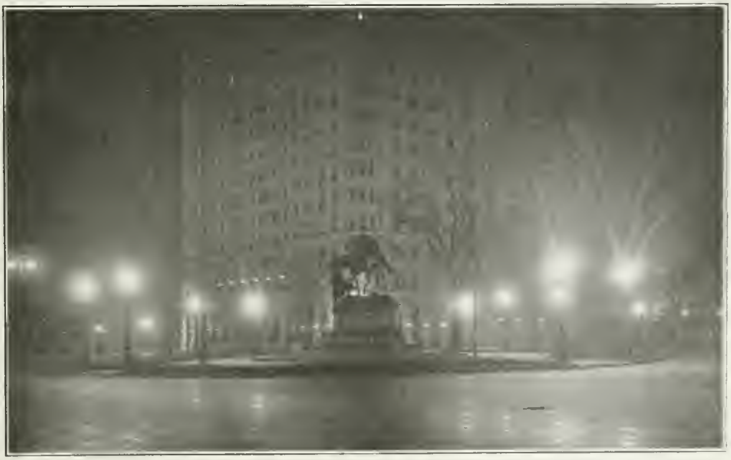


Fig. 3—The Plaza at Night.

ft.-candles is probably the maximum intensity ever required the figures given above will convey some idea of the intensity of illumination in these windows. The lighting is effective because the source is hidden from the eye of the passer-by.

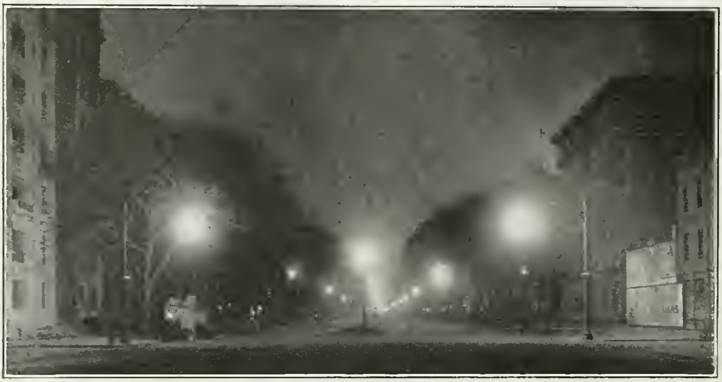


Fig. 4—Seventh Avenue North of Central Park.

Excellent examples of window lighting designed to display goods are afforded by the many large department stores in the shopping district on Sixth Avenue, Fifth Avenue, Broadway and in the vicinity of Herald Square.

DECORATIVE AND SIGN LIGHTING.

There is much decorative and curb lighting in New York; much more, in fact, than one would imagine. The numerous signs, however, serve to divert attention from both. Most of the decorative lighting is found in the hotel district, where lighting standards are maintained on the curb line. Some of the hostelries have their roof copings traced in electric light, while others have standards along the ridges and maintain elaborately lighted roof gardens which may be seen from a distance. Not a few theaters also have roof gardens. New York, however, glories in its signs, which are so numerous that only the largest ones can receive attention. Every theater of any consequence is more than amply equipped with electric signs advertising the name of the attraction and that of the playhouse. During the season the theatrical district is simply one blaze of light, each theater seemingly striving to outdo the others, and inasmuch as a half dozen theaters oftentimes adjoin each other, the effect is dazzling. At the present time many of the theaters are closed for the season, so that the number of these signs is considerably reduced. The Hippodrome, at Sixth Avenue and Forty-third Street, uses more electricity than any other playhouse in the city.

The accompanying illustrations were made from photographs taken within the past week and show as well as engravings can the present appearance of New York's "White Way," signs, streets, parks, etc. Imperfect as the photographic and engraving arts are, the illustrations nevertheless give some conception of the splendor of the city at night.

The sign at the southwest corner of Seventh Avenue and Forty-second Street, shown in Fig. 9, has been one of the longest in service and is considered by many to be the most effective advertising sign in New York. It is 50 ft. high and 56 ft. wide and is designed with red, green, white and purple colors and 2030 lamps. The lady herself is 40 ft. high and her parasol is 15 ft. in diameter. Her shoe is 6.5 ft. long. The falling of the rain and the switching about of the lady's skirt are most realistic. The sign is particularly appropriate for the situation also, since Times Square is one of the windiest spots in the city. The rain effect is intermittent, being switched on and off every twenty seconds. The girl's skirt is in constant motion, apparently flapping in the gusts of wind. This effect is produced by a series of very rapid flashes of the bulbs forming the bottom of the skirt and petticoat.

One of the prettiest signs at present in operation is located at Broadway, Seventh Avenue and Forty-seventh Street at the head of Long Acre Square and is visible for some distance on Broadway and Seventh Avenue. White, red, green and gold lamps to the number of 3725 are required in the design. The total height of the sign is 62 ft. and the maximum width is 50 ft. The diameter of the clock dial is 27.5 ft., the height of the numbers, 4.5 ft; length of minute hand, 9.33 ft.; length of hour hand, 7 ft., and height of lion's heads, 10.5 ft. The display is the latest addition to the "Great White Way" and is a splendid illustration of a sign which, while it is as impressive an advertisement as can be evolved, yet is equally artistic and pleasing to the eye. The action is that of two great streams of water playing from the lions' mouths. The clock shows the correct time at all hours of the day and night, and in the engraving reveals the length of time the plate was exposed in making the photograph. It will, of course, be understood that flashing effects cannot be reproduced in a photograph, which, because of the length of time necessary to take the picture, shows all the effects combined. This is particularly apparent in the huge chariot-race sign described elsewhere in this article.

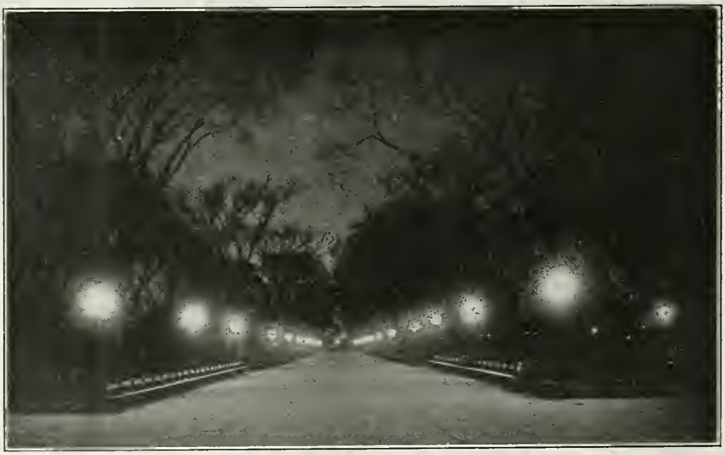


Fig. 5—Tungsten Lamps on the Mall, Central Park.

The location at the head of Long Acre Square is one of the best for advertising purposes in the city and usually contains some of the most effective signs. A sign located at that spot some time ago advertising a beverage contained 2807 incandescent lamps in white and red. The total height of the sign was 57 ft.; its total width, 50 ft. The bottle containing the beverage was 39 ft. long, whereas the trademark and the name of the beverage were shown in letters 13 ft. and 4 ft. high respectively. The mechanism of the sign caused it to make three distinct flashes, the first showing simply the bottle and lettering; the second showing the effect of the cork having popped and the contents of the bottle shooting into the air; the third showing the liberated liquid foaming down the neck of the bottle. The rays denoting the effervesence shot 43 ft. into the air.

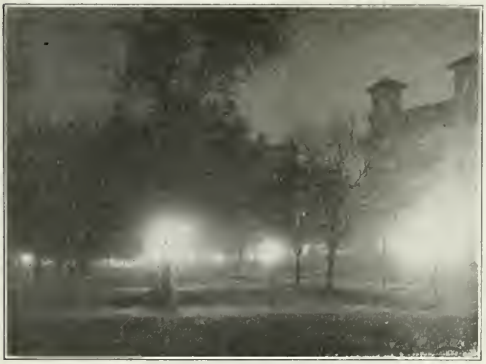


Fig. 6—Riverside Drive North of 108th Street.

One of the largest animated electric signs ever built is located on the roof of the Hotel Normandie, at Broadway and Thirty-eighth Street, and faces toward the south. The sign contains approximately 20,000 incandescent lamps ranging in size from 2 cp to 32 cp, and 100-watt tungsten lamps are employed in reflectors to bring out the sky effect. It is estimated that about 600 hp is required on the structure containing the sign. The latter rises 72 ft. in the air above the roof of the hotel and is 90 ft. wide. It carries a Roman chariot race of such design and proportions that from the street below the vivid scene of light, color and action is reduced to normal

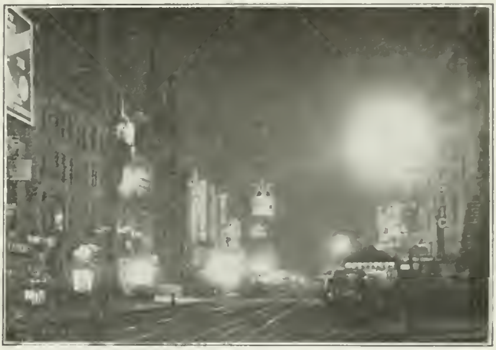


Fig. 8—West Forty-second Street from Times Square.

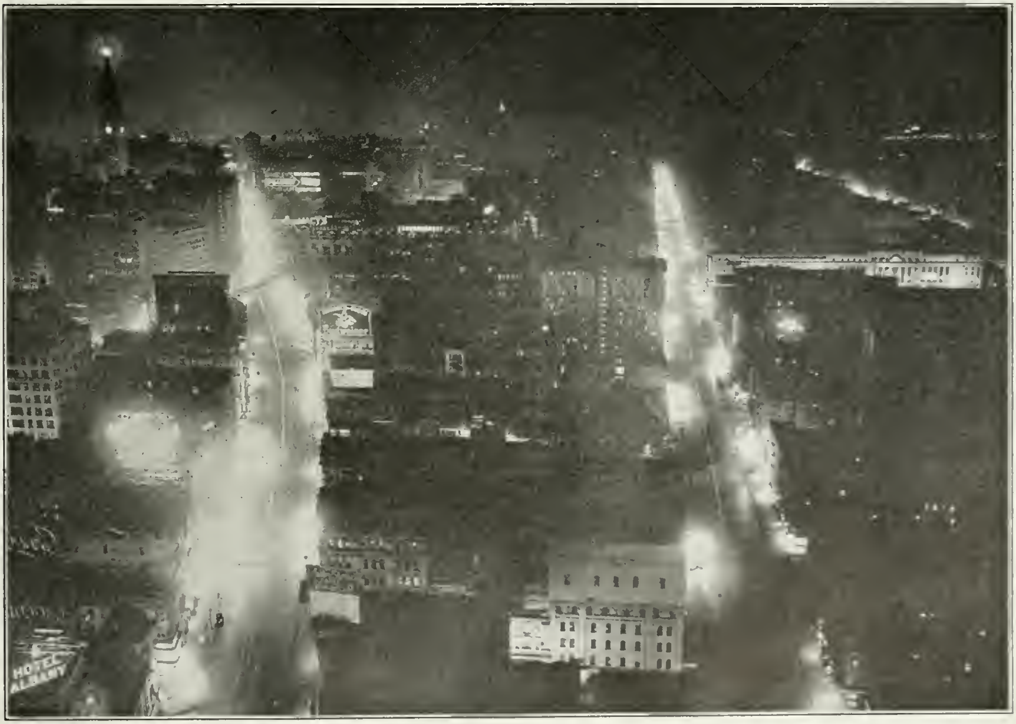


Fig. 7—The "Great White Way," Looking South from Times Square.

size. Fig. 11 shows the sign from a distance, the main chariot driver and horses are 20 ft. high and 40 ft. long and the wheels of the chariot are 8 ft. in diameter. The design of this moving picture is based upon the operation of the lamps in great part. These flash until the walls of the arena appear to be left behind. When the motor-operated switches are thrown in, foremost in the race appears a huge pair of horses outlined in fire galloping madly and drawing the rolling chariot and giant rider on to victory. The arena track apparently moves from beneath the swiftly rolling wheels and plunging horses. Back of the main chariot is another chariot. The front of the stadium wall is decorated with festoons and colored bulbs gracefully draped in artistic clusters. The different figures and stagings are cut out of metal, the chariot traces, capes, breast collars and harness are painted in red and gold and studded with ruby and amber-colored lamps. The roadbed of the arena is painted to simulate tracks and dust and is illuminated with over 1000 bulbs. With one device, the horse's limbs are thrown backward and forward so as to cause the horses to seem to be running at terrific speed. Another device causes the wheels of the chariot to appear to revolve so swiftly that the spokes cannot be seen; another device causes the crimson robe of the leading charioteer as well as his Roman skirt to flutter. Other details are carried out with more or less reality. At the top of the display in mid-air is a great steel curtain, 90 ft. long and 20 ft. high, outlined with a border of lamps. The curtain is suspended directly over the main horses, so as to dominate the display. This space is used for advertising and covers nearly 1800 sq. ft. On this surface each advertisement is displayed in turn, there being room for fifty-four letters and spaces. Rows of eighteen letters each are made of monograms 4 ft. high, each capable of being read from a distance. The sign is lighted every night from dusk until midnight; about 750 switches are operated by means of two 10-hp motors and the flashes are designed to give 2500 impulses of light in a minute.

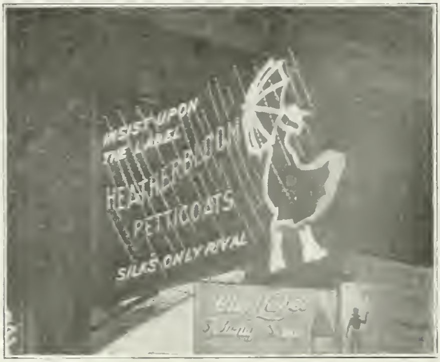


Fig. 9—Sign at Seventh Avenue and Forty-second Street.

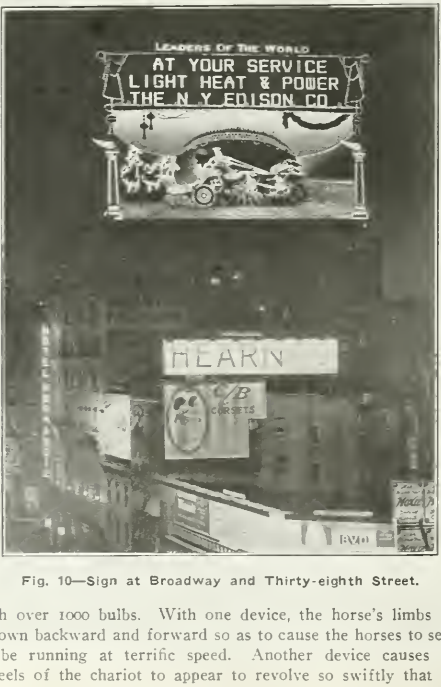


Fig. 10—Sign at Broadway and Thirty-eighth Street.

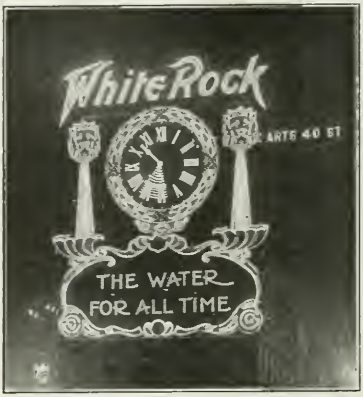


Fig. 11—Sign at Intersection of Broadway and Seventh Avenue.

On the roof of a building at Seventh Avenue and Forty-seventh Street, overlooking Long Acre Square, a sign has recently been placed in operation advertising a certain brand of underwear. This sign is shown in Fig. 12. Its total height is 60 ft. and the total width 108 ft. The height of the largest letter is 17½ ft., whereas the other letters are 6¼ ft. high. The width of the boxing glove is 8 ft. The panel is 24 ft. high by 59 ft. wide and all the lettering in the sign burns continuously.

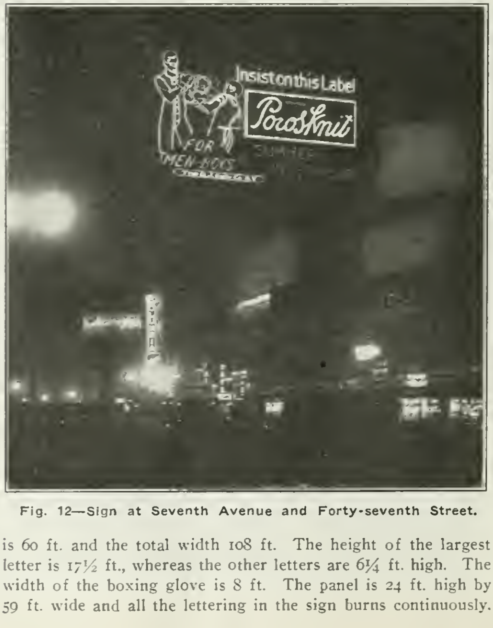


Fig. 12—Sign at Seventh Avenue and Forty-seventh Street.

A total of 3430 lamps is used in white, green and red colors. The action shows two men boxing and is continuous.

On the roof of the Hotel Albany, at Broadway and Forty-first Street, is a sign facing south, advertising a brand of chocolate. The framework is 50 ft. high and 45 ft. wide and the height of the boy is 30 ft. There are 2118 white, green, yellow and red lamps employed. The action of the sign is as follows. The boy at the left end of the sign is flashed on and bows three times. The lamps are then extinguished and the boy at the right is switched on. This boy is shown holding a slate in his left hand, and while the forefinger of his right hand moves up and down with each downward movement a different letter appears on the slate until the word "chocolate" is spelled out. Simultaneously the large word chocolate in the body of the sign is also spelled out. The mechanism of the slate is made up of a monogram box and can be made to flash any letter in the alphabet. The name of the chocolate does not flash.

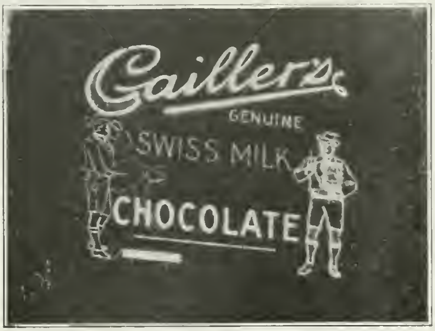


Fig. 13—Sign at Broadway and Fortieth Street.

At Broadway and Forty-ninth Street, visible from Long Acre Square, there has been erected a sign within the past few weeks advertising a make of gloves. The total height of the sign is 56 ft. and it has a width also of 56 ft. The length of the lady's arm is 38 ft., while that of the glove is 34 ft. The letters are 9 ft. and 6 ft. high respectively and 1677 lamps in white, red and blue colors are required in the design, which is shown in Fig. 14. A series of flashes in this sign shows the woman holding a glove in her right hand at arm's length and putting it on her left hand.

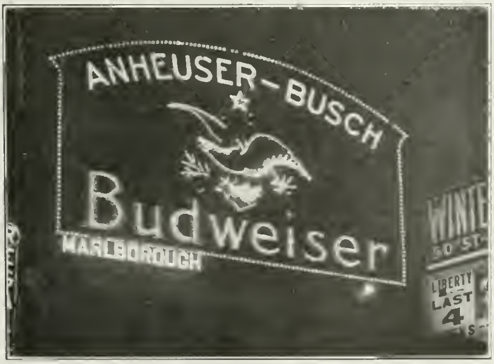


Fig. 14—Sign at Broadway and Thirty-seventh Street.

At the corner of Broadway and Sixth Avenue, overlooking Greeley Square, is an enormous sign advertising a chewing gum. The framework is 48 ft. high by 153 ft. wide, and the package is 52 ft. long and 20½ ft. wide. The length of the spear is 101 ft. and words are made up of letters 14 ft. and 12½ ft. high respectively. A total of 2950 red, white and green lamps burn steadily in this design. A similar sign advertising the same product can be seen on a roof between Eighth Avenue and Broadway at Fifty-second Street.

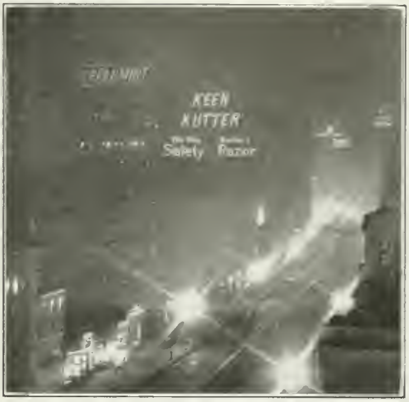


Fig. 15—Broadway Above Fifty-fifth Street.

For some time there was located on the roof of the Hotel Albany and afterward at the corner of Broadway and Forty-second Street a rather taking sign advertising a celebrated silk thread. This sign was 50 ft. high by 46 ft. wide and contained 1900 red, white and green lamps. The action of the sign consisted of the unwinding of silk thread from the spool and a continuous motion of a kitten's paws. The kitten was 36 ft. wide by 30 ft. high, and the spool 15 ft. long and 10 ft. high. The lines of red globes representing silk were made to appear across the kitten until the thread seemed to be all tangled up. The kitten and spool were then switched off for an instant and the entire effect repeated.

On 125th Street a well-known cleansing commodity is advertised on a sign 63 ft. high by 106 ft. wide; the Dutch girl is 63 ft. high and the length of the baton which she wields is 29 ft. There are 3100 white lamps in this sign. The baton and the arm of the girl are in constant motion.

It is a singular fact that the signs along Broadway hitherto have generally appealed to one's thirst rather than to anything else. The forerunners of the present signs have in a great majority of cases called attention to champagne, wine, cognac, Scotch whiskey and the like. Not all of these commodities, however, have ceased to be advertised. For instance, overlooking the North River is a sign 51 ft. high by 103 ft. wide made up of 10-ft. letters advertising a local brand of lager beer. There are 2932 white, yellow and red lamps in the sign, whose

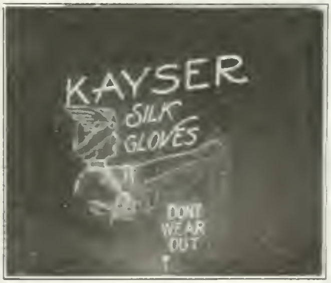


Fig. 16—Sign at Broadway and Forty-ninth Street.

attractive feature consists of a bottle 40 ft. long and 11 ft. wide together with a glass 17 ft. high and 9½ ft. wide. The lettering of the sign burns constantly, while the lamps in the glass and bottle flash in such manner as to give the appearance of liquid flowing from the bottle into the glass, the glass filling up as the bottle apparently empties. When the glass is full the lamps in the bottle and glass are extinguished and then switched on again, whereupon the effect is repeated.

At the corner of Broadway and Forty-sixth Street overlooking Long Acre Square is a 50-ft. x 54-ft. sign advertising a brand of whiskey. The sign represents a man on horseback carrying a banner. The horse from ear to tail is 54 ft. long, his head is 16 ft. high and the length of the sabre carried by the horseman is 14 ft. The letters are 12 ft. high, and the whole design requires 1254 red, white, gold and green lamps. The sign burns steadily with the exception of the banner outline and the lettering contained in it, which are in continuous motion, as it were, giving the effect of a banner being fanned by the wind.

At the corner of Broadway and Thirty-seventh Street is a sign advertising a well-known beverage brewed in St. Louis. The design is 50 ft. high by 72 ft. wide, and the width of the eagle in the trade-mark is 41 ft. The largest letter is 14½ ft. high and there are 2214 white, red and green incandescent lamps in the entire design. The advertisement is brought up on four flashes. At first the name of the manufacturer appears, then the eagle and trade-mark, then the well-known name of the beverage. The sign is then switched off entirely and comes up again all at once, when the original cycle is repeated.

The signs above described are supplied for the most part from the mains of the United Electric Light & Power Company and the New York Edison Company, although a few receive energy from isolated plants located in the buildings on which these signs are erected.

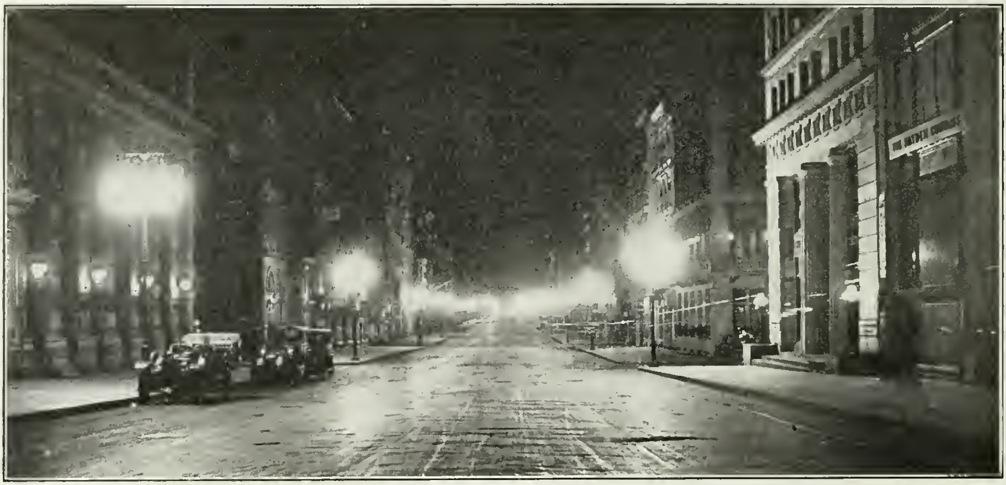


Fig. 17—View of Fifth Avenue at Night Looking North from Forty-third Street.

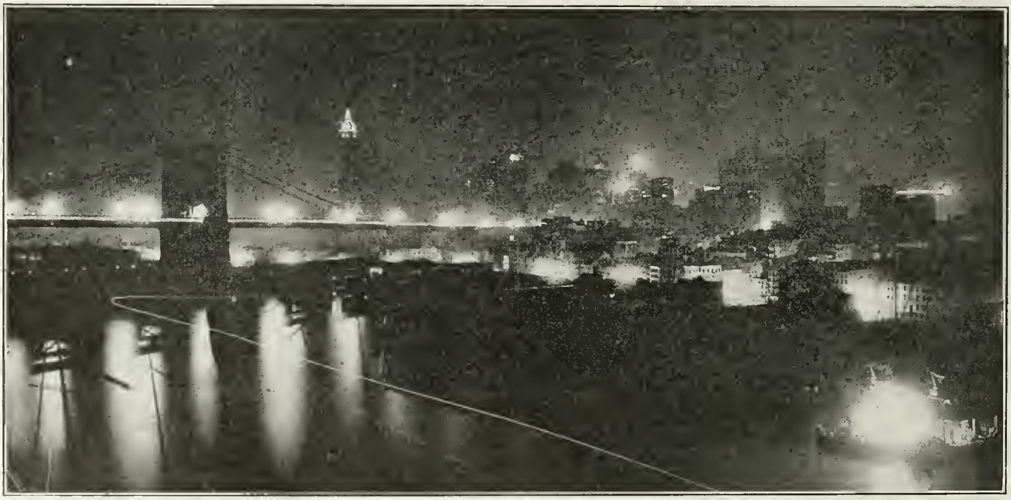


Fig. 18—New York by Night from Center of Manhattan Bridge.

THE BROOKLYN EDISON SYSTEM

GENERATING STATIONS, SUBSTATIONS AND CHARACTER OF LOAD IN CITY OF CHURCHES.

BROOKLYN has a population of 1,635,351 and covers an area of 77.5 sq. miles. It is served with electricity by two companies, the Edison Electric Illuminating Company of Brooklyn and the Flatbush Gas Company, the latter company, however, having a limited output. The mains of the Edison company serve approximately 56 sq. miles, supplying electrical energy to over 26,000 customers. The income per customer is larger than that of any other of the large companies in the country. This is not because of high rates, as the average rate is not high and for customers having a good load-factor is quite low. The large income per customer indicates rather that the field has been fairly well plowed and that each customer has received individual attention. When the company started operations in 1889 the connected load naturally was quite small. On Jan. 1, 1890, there were connected to the Brooklyn Edison system 6600 16-cp equivalents. After twenty-two years of development, or on the first of the present year, the connected load was over 2,000,000 50-watt equivalents, and half of this load was acquired during the past five years.

THE SYSTEM IN GENERAL.

The company operates two generating stations, one at Sixty-sixth Street and New York Bay and the other at Gold Street and the East River. Both stations generate 6600-volt, three-phase, 25-cycle energy, which is transmitted at that potential to substations scattered about the city according to the location of the various centers of distribution. In these substations are installed step-down transformers, rotary converters, direct-current balancers, boosters, storage batteries, motor generators, arc generators, mercury rectifiers, regulators, switchboards, etc., for controlling the machines, batteries and the incoming and outgoing feeders.

Underground direct-current distribution obtains for the business, factory and adjacent residential districts of the city and for the congested district at Coney Island, while 60-cycle, two-phase distribution is accorded the outlying residential and suburban districts, most of the wires being overhead. That section of the borough bounded by Broadway, Fulton Street and the East River, and including a section over a mile wide north of Broadway and south of Fulton Street, together with the district between Prospect Park and the river, is served with three-wire Edison service at 120-240 volts. Customers outside this district are supplied with 60-cycle energy fed from substations at 2500 volts, two-phase, and stepped down to 120 volts and 240 volts at or near the customer's premises.

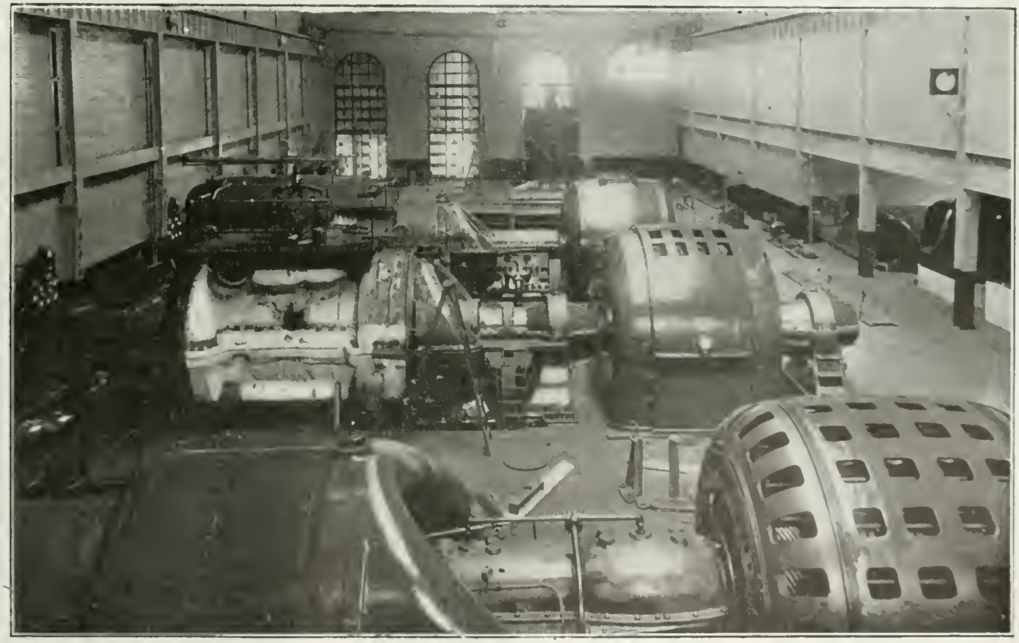


Fig. 1—Main Generating Station, Brooklyn Edison Company, at Gold Street and East River.

The direct-current service is supplied from rotary converters which deliver energy to the substation buses at from 220 volts to 250 volts. The alternating current, which is received as three-phase, 25-cycle energy, is passed through frequency changers, where it is transformed into 60-cycle, two-phase energy and distributed to the line transformers at a tension of 2500 volts.

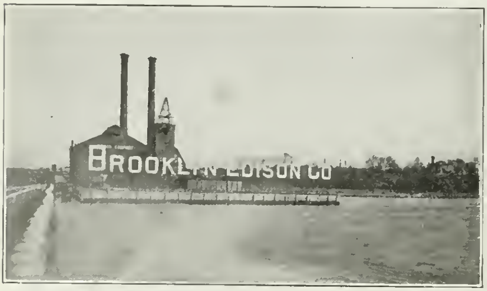


Fig. 2—Bay Ridge Station from New York Bay.

GENERATING STATION.

The Sixty-sixth Street station, which was erected in 1897, has the distinction of being the first station in this country built to generate alternating current at high potential for transmission to distant substations, there to be stepped down and converted for local distribution. At this station there are five engine-driven units, one Hamilton cross-compound, horizontal engine direct-connected to a 750-kw generator; one McIntosh & Seymour twin-compound, horizontal engine direct-connected to a 1500-kw generator, and three vertical Westinghouse cross-compound engines, each driving a 2850-kw unit. All the generators have been re-rated by the company according to their continuous maximum carrying capacity, the units having outputs of 1000 kw, 2000 kw and 3250 kw respectively. The three large engines are equipped with Worthington barometric condensers, while the smaller engines exhaust into a common ejector-type condenser, the circulating water being drawn from and discharged into the bay.

Steam for these units is furnished by twelve Aultman & Taylor boilers rated at 500 hp, six Babcock & Wilcox boilers rated at 550 hp, and six Aultman & Taylor boilers rated at 550 hp, none of which is equipped with superheaters. All the furnaces are fitted with shaking grates on which No. 3 buckwheat coal is burned under forced draft. Coal is brought to the station in barges and elevated by a Mead-Morrison coal-handling system into outside and inside bunkers or stored in an outside bin capable of holding 15,000 tons. A McCaslin conveyor is also installed for transferring the coal from the outside bunker to the inside bunker. The coal is delivered to the operating floor through chutes.

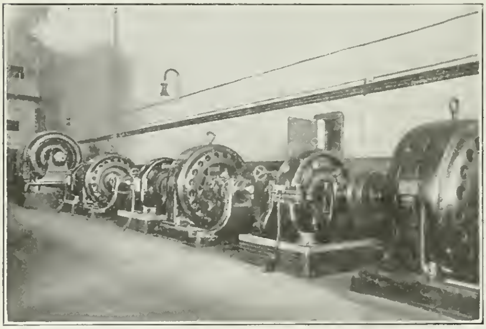


Fig. 3—Exciters and Motor-Generators, Sixty-sixth Street Station.

The switch and bus compartments for handling and controlling the high-tension energy are situated at the end of the operating-room, but separated from it by brick walls. Each generator cable on its way to the busbars passes through two motor-operated, oil-break switches in series, mounted in brick compartments, and the feeder cables pass through similar switches from the busbars to the subways. There are two sets of busbars, each set being divided in two parts by a bus tie switch. The switches are so arranged that any generator and any feeder may be connected to either bus, all of the switches being controlled from an operating gallery situated just inside the wall dividing the bus house from the operating-room, and which affords a view of the entire engine-room. On the operating boards, besides the control switches for operating the oil switches, are mounted also all the instruments required for the synchronizing and control of the generators and feeders, the operator being able to note at all times the condition of the system. All feeder switches are supplied with time limit relays which automatically open the oil switch of the feeder in case of short-circuit. Generator switches are also equipped with relays, but the contacts are connected to light a lamp on the switchboard instead of opening the oil switch. A feature of note in this station is the wiring on the rear of the switchboard, the neat arrangement of which is shown in Fig. 7.

MAIN STATION.

The Gold Street station as it now stands bears no resemblance to its former appearance, having been almost completely rebuilt since 1905. The original installation consisted of six Stirling boilers of 500-hp rating equipped with under-feed stokers, and four 1000-hp Reynolds-Corliss engines driving 750-kw alternators. The growth of the system and the demand for greater output resulted in a complete change in the layout in order to economize space and at the same time greatly increase the output of the station. The present equipment in the Gold Street station comprises one 7500-kw and one 8000-kw Allis-Chalmers horizontal turbine, one 10,000-kw Westinghouse unit and one 9000-kw Curtis outfit. The ratings given are those designated by the Edison company and are based on the continuous maximum load each unit is capable of carrying.

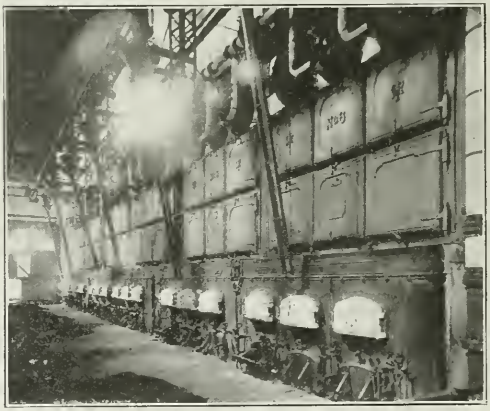


Fig. 4—Boiler-Room, Sixty-sixth Street Station.

BOILERS.

The boiler equipment consists of six 750-hp Babcock & Wilcox boilers and ten 750-hp Aultman & Taylor boilers, fourteen of which are equipped with superheaters. The boilers are equipped with Webster furnaces or arches over the furnaces. Thirteen of the furnaces are fitted with shaking grates divided into eight sections, enabling the fireman to shake any portion of the fire desired. Three of the furnaces are fitted with dumping grates, and all are hand-fired with a mixture of 85 per cent of No. 3 buckwheat and 15 per cent of bituminous. Back of the boiler-room is a new boiler house which, when complete, will house thirty-two 650-hp boilers. At present this house contains eight Babcock & Wilcox boilers fitted with superheaters and Taylor stokers and eight more boilers, to be similarly equipped, have been ordered. Ordinarily each boiler feeds 1000 kw of load, but at times of peak each can carry 1500 kw.

COAL AND ASH HANDLING.

The coal is brought to the dock in barges and hoisted above the top of the coal bunker by a Mead-Morrison coal tower in an automatic clam-shell bucket. The hoist is operated by a bucketman, who raises and lowers the bucket, dropping it open into the barge to dig the coal and opening it when over the receiving hopper, and a trolley man, who guides the bucket in and out on the boom and over the receiving hopper at the top, for the bucketman to dump the coal. With this hoist 150 tons of coal an hour is the average amount handled. The station is equipped with two of these hoists.

The coal is delivered from the receiving hopper through a coal crusher to break the bituminous coal so that it may be properly mixed with the anthracite. From here it is dropped by gravity to self-dumping cable cars, located on a weighing scale. Each car holds 3 tons, and when the scale balances the car is hooked to the cable, which conveys it to any desired point over the coal bunkers, where it is automatically dumped by a tripping device operated by the car man. The coal is drawn through self-closing gates from the bottom of the coal bunker into a 4-ton electrically operated distribution hopper, which travels the entire length of the boiler-room and is handled by coal passers, one on each eight-hour watch, who keep a supply of the proper mixture of coal in front of each boiler that is being fired.

The ashes and clinkers are dropped through the grates into ash hoppers in the basement. On the bottom of each ash hopper is a gate by means of which the contents of the hopper is emptied into dump cars, which are pushed over to the bucket conveyor at the river end of the boiler house. The ashes are then dumped into a receiving hopper and elevated by the conveyor to a large ash hopper equipped with chutes for rapid unloading into barges. The ash equipment is capable of loading a 600-cu. yd. ash scow in twenty minutes. Each ash hopper has a spraying attachment to wet the ashes from time to time. In order to prevent the wet ashes from freezing in winter the large ash bunker is fitted with steam coils.

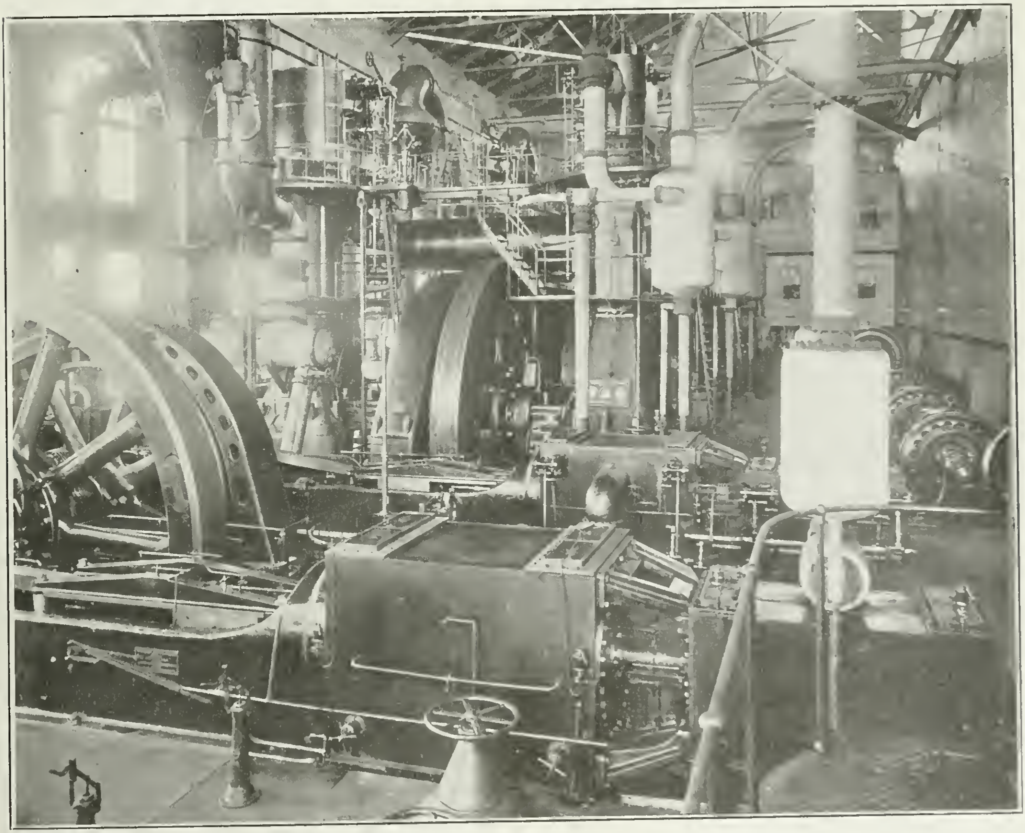


Fig. 5—Generating Station at Sixty-sixth Street, Bay Ridge, and New York Bay.

FEED WATER.

The feed-water mains are two lines of 6-in. pipe, one to each row of boilers. The pipes are interconnected to provide for feeding any boiler from either line, connections from these headers being of 3-in. pipe. The hot-well returns are collected in an 8-in. header leading to the heater, or in a 6-in. overflow line to the discharge tunnel. Two 6-in. connections to the city water mains furnish the make-up water There are three Terry turbine-driven centrifugal four-stage feed pumps for regular surface and one reciprocating pump for emergencies and for boiler cleaning. The centrifugal pumps deliver 1000 gal. per minute against a pressure of 250 lb. per square inch. A 15,000-hp open heater is on the suction side of the feed pumps and takes steam from the auxiliary exhaust header with a connection through 8-in. pipe to the atmosphere. There was originally installed in the Gold Street station a closed heater system, and with this apparatus the engineers were unable to maintain a temperature of more than about 180 deg., with a loss of approximately 12 per cent of the total returned auxiliary steam. Moreover, all of the condensation from the auxiliary steam apparatus was lost. With the open-type heater this steam, which now amounts to about 12 per cent of the total, is condensed, thereby making possible an additional saving and resulting in an increase in feed-water temperature of 33 deg., which amounts to about 3 per cent of the total coal consumption, or an increase of 1.7 per cent in the total economy of the station.

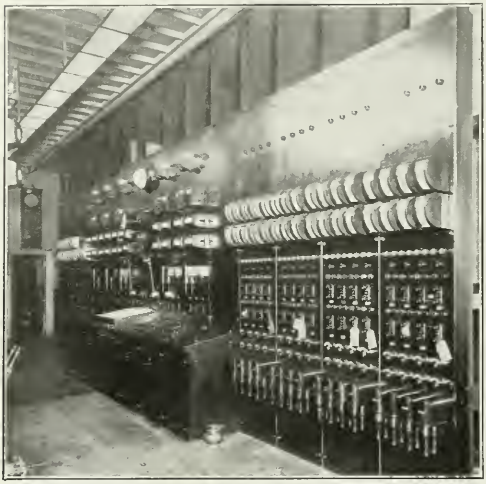


Fig. 6—Control Board in Sixty-sixth Street Station.

FORCED DRAFT.

The boiler breeching connects with one 210-ft. brick stack, 13½ ft. inside diameter and 210 ft. above the grates, and to one Custodus concrete stack of the same dimensions. When the new boiler house is completed it will be equipped with four steel stacks 15 ft. 4 in. inside diameter and 225 ft. above the floor.

The forced-draft system for the boilers consists of an air duct on each side of the old boiler house, extending its entire length, to which eight boilers are connected by air nozzles and dampers. The latter control the air to the individual boilers. Each duct is equipped with three blowers, located one at each end and one in the center. The blower equipment comprises one pair of 40,000-cu. ft. fans direct-connected to a 225-hp Bliss turbine and four pairs of 30,000-cu. ft. Sturtevant fans, two of which are direct-connected to Kerr turbines, one of which is direct-connected to a Terry turbine and the other of which will be connected to a Curtis turbine. In the new boiler house the forced-draft system is made up of a concrete air duct the full width of the firing aisle and running the entire length of the boiler house. Each of the sixteen boilers will be supplied with nozzles and dampers. To this duct there is at present connected two fan units, one a Bliss steam turbine with two Massachusetts fans, which is a duplicate of the units in the old boiler-house basement, and the other a Robinson fan rated at 80,000 cu. ft. per minute, which is driven by a Terry turbine. There is also on order an 80,000-cu. ft. Kerr fan, which will be turbine-driven.

CONDENSERS.

All of the turbines are equipped with surface condensers, the circulating water being drawn through a concrete intake tunnel from the East River and discharged overboard through a second tunnel. A complete description of the condensing equipment appeared in the *Electrical World* June 15, 1907.

The Curtis unit is equipped with a Wheeler condensing outfit, the condenser for which was designed for 20,000 sq. ft. of tube surface, 4000 sq. ft. of which was removed. There are two 18-in. Wheeler circulating pumps driven by a 240-hp turbine run at 750 r.p.m. The dry-vacuum outfit on this unit will be changed to standard Wheeler equipment, to be driven by a Cooper Corliss engine from the floor above. The wet-vacuum pump consists of a 5-in., two-stage Janesville outfit direct-connected to a 30-hp Kerr turbine run at 750 r.p.m.

The larger Allis-Chalmers set is equipped with a Worthington condensing outfit designed for 25,000 sq. ft. of tube surface and remodeled for 16,000 sq. ft. of surface. The circulating pump consists of a 24-in. Worthington side-suction volute pump driven by Harrisburg engines, whose speed may be regulated from 175 r.p.m. in winter to 225 r.p.m. in summer, so as to take advantage of the difference of temperature of the circulating water. The dry-vacuum pump is a standard Blake outfit, and the hot-well pump is a two-stage, 5-in. Janesville outfit driven by a Kerr turbine.

The condensing outfit for the Westinghouse unit is of the Alberger type fitted for 25,000 sq. ft. of surface and operated with 16,500 sq. ft. The circulating pumps comprise twin suction volute pumps, driven by a 300-hp Westinghouse direct-connected motor. A 6-in., two-stage Alberger pump direct-connected to a 35-hp Terry turbine takes care of the hot well, and twin Alberger pumps driven by a Corliss engine comprise the dry-vacuum outfit.

The smaller Allis-Chalmers unit is equipped with Worthington condensing apparatus designed for and equipped with 20,000 sq. ft. of tubing. The circulating outfit is identical with unit No. 1. The hot-well pump comprises a two-stage, 6-in. Worthington outfit driven by a 35-hp Kerr turbine. The Curtis unit was the last to be installed, and it is possible by disconnecting a coupling to use either one or two of the circulating pumps, according to the temperature of the circulating water.

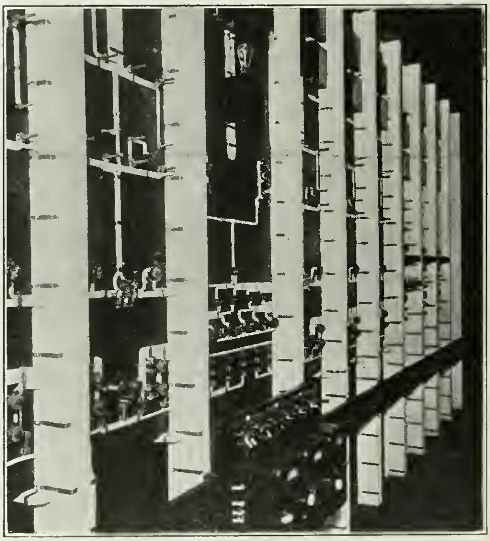


Fig. 7—Rear of Control Board, Bay Ridge Station.

The company has experienced more or less trouble with condenser tubes, and in only one case have the tubes stood up for any reasonable period. In the first unit installed the tubes remained tight and gave satisfactory service for a year, and in that time only twelve tubes have been replaced. All of these twelve tubes have been taken out for exactly the same reason that all of the tubes of the other condensers have had to be taken out after from three to six months' service. The fault has been attributed to the spelter and copper not being properly incorporated, resulting in electrochemical action. The tubes are now bought on a guarantee, the manufacturer agreeing to replace every tube that splits or leaks within a year and also pay the cost of effecting the removal and replacement.

STATION OPERATION.

The boilers when not in use have their fires banked. The fire is first cleaned and spread over the grate and then covered with a thick layer of coal. The dampers are closed, cutting off all draft. During this process the steam pressure in the boiler drops below the pressure of the mains, which causes the automatic stop valve on the boiler to shut, the valve remaining in this condition so long as the boiler fires are banked. When the boiler is again wanted for service the dampers are opened and the fire shaken. As soon as the pressure has been brought up to about 1 lb. in excess of the pressure of the mains the automatic stop valve opens and the boiler is cut in service.

If a boiler has been out of service for some time for repairs or internal cleaning the method of starting up is as follows: The boiler is first filled with water to the lower gage cock and the superheater flooded. The grates are then covered to a depth of 3 in. with bituminous coal and fire from another furnace is thrown in on top of this bed. The fire is then covered with a little bituminous coal and subjected to a small amount of draft. As the fire builds up and the water in the boiler begins to turn into steam, the tube caps at both front and rear are examined for leaks, and the joints around the stop valves, cross-over pipes and superheater connections are also examined. If all joints are found to be satisfactory the fire is gradually increased until the steam pressure in the boiler has reached about 40 lb. The flooding valve on the superheater is then closed and the water blown out. The drip on the boiler bend connecting the automatic stop valve with the header is opened and then the gate valve on the header end of the bend. This permits the steam pressure from the other boilers to come to the upper side of the automatic stop valve. The hand-operated stem on this valve is then opened and the pressure on the boiler carefully watched until it reaches 1 lb. or 2 lb. in excess of the line pressure. At this point the stop valve opens and the boiler is cut in service.

The water tender is responsible for the condition of the fires, the height of the water in the boilers and the steam pressure during his watch. He reports direct to the boiler-room engineer, who is responsible for the entire boiler house and all men connected with it during his eight hours of duty. A daily log sheet is kept showing the number of hours the boiler is under steam banked and shut down. An hourly record of steam pressure, steam temperature and feed-water temperature is also maintained. An hourly record is kept of the steam pressure, inlet steam pressure, the vacuum and temperatures, and the number of hours each turbine is in service.

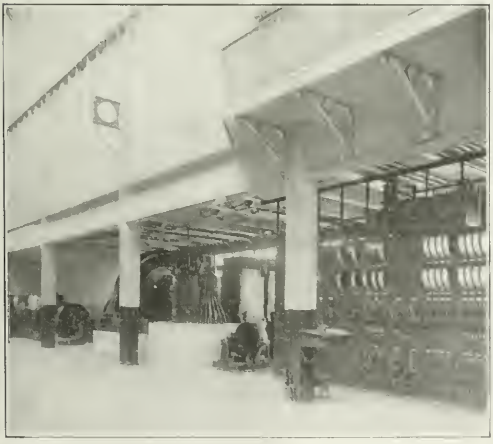


Fig. 8—Direct-Current Board in Gold Street Station.

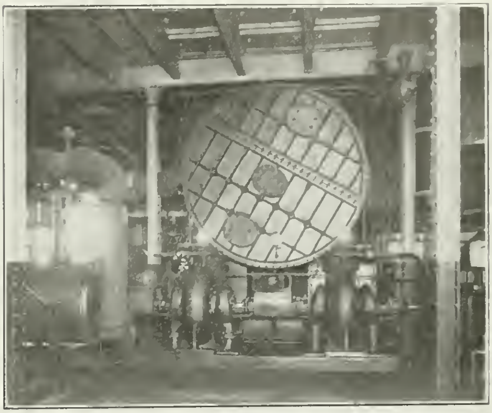


Fig. 9—Condensing Equipment of Curtis Unit.

When placing one of the main units in operation an air siphon on the circulating pump and the condenser is started. This creates a vacuum in the circulating pump and water space of the condenser, allowing the water to flow from the intake tunnel through the circulating pump into the condenser. The circulating pump is then started, after which the auxiliary oil pump is started causing a circulation of oil through the main bearings and the governor of the turbine.

The throttle on the turbine is now opened a trifle so as to admit a small amount of steam to heat up the unit. After from thirty minutes to forty-five minutes the turbine is given steam enough to cause it to revolve at a rate of 75 r.p.m. for a period of five minutes. This is done so that the spindle and casing of the turbine may be heated up evenly and expanded alike around the entire circumference. The throttle is then shut and the turbine brought to rest. When the unit is required for service the operator in the switchboard gallery notifies the engineer by proper signals and the turbine is then brought up to speed rapidly. At the same time the pump oiler starts the dry-vacuum and hot-well pumps so that when the turbine is running at normal speed it has its full vacuum. Water is then turned on to the glands and oil cooler through which the oil from the bearings circulates. The switchboard operator then synchronizes the generator with the system, and as soon as this operation is finished and the switch closed the engineer is signaled to throw the throttle wide open. From then on the bearings must be examined every fifteen minutes and the temperature of the discharge oil noted. The pump oiler is also required to make an inspection of the bearings on the auxiliaries and of the height of the water in the hot well. The assistant watch engineer looks after the turbines and auxiliaries in order to make certain that the oilers attend to their duties. This leaves the watch engineer free to supervise the entire operation of the plant, and he is directly in charge of all of the steam-operating men. When the load is such that it requires two turbines, a third unit is kept hot and the auxiliaries running so that it may be put on the line in from one minute to three minutes. The practice heretofore had been that three turbines were kept running if the load was sufficient for two, and by merely keeping the third unit hot and the auxiliaries running a saving of 5.6 per cent is effected.

SWITCHBOARD.

The low-tension switchboard is on the main engine-room floor on the Gold Street side of the station under the mezzanines.

It has panels for the exciters, station motors, lighting and for the excitation equipment. The high-tension switchboard is of the remote-control type. The main control board is stationed on the first mezzanine, on the eastern side of the operating-room. From here are controlled the generator switches and feeder switches, and the feeder and generator-selector switches, which are of the motor-operated type. The generator and feeder switches are also stationed on the first mezzanine. The latter are rated at 300 amp and are automatic in operation. On the second mezzanine are located the feeder-selector switches, which are motor-operated and rated at 500 amp, the generator and generator selectors, rated at 1200 amp, and the main and auxiliary buses. Each bus is divided into three sections and is planned to accommodate eight generators, three generators at each of the two sections and two generators on the third section. The usual cross-connections are provided to enable either bus to be used.

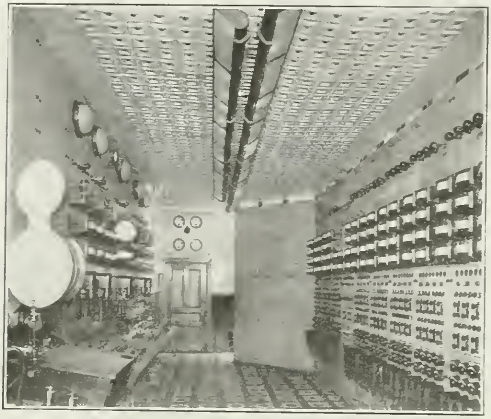


Fig. 10—Control Board, Gold Street Station.

Energy from the generators is transmitted in lead-covered, single-conductor, 10/32-in. varnished-cambric cables to the generator switch, which is of the non-automatic oil type. There is, however, a relay which lights a red lamp as a danger signal to the operator in case of trouble on the generator. From the generator switch the energy is transmitted in lead-covered, single-conductor, 10/32-in. varnished-cambric cable through automatic selector oil switches to either the main or the auxiliary bus. The three-phase, 6600-volt feeders are arranged in groups of two at the generating station and leave the bus through a disconnecting switch, through a selector oil switch (which is non-automatic and controls the group of two feeders), then through two separate automatic oil feeder switches. All feeder cables in the stations are three-conductor, 250,000-circ. mil section varnished cambric.

The two generating stations are normally operated in multiple and are only isolated in case of emergency. The practice of the company is to supply each substation with feeders from both generating stations, the feeders passing over different routes from station to station, so that in case of an accident to the feeders from one source the substation may be fed from the other. The transmission lines from both generating stations are entirely underground and consist of 250,000-circ. mil, three-conductor, lead-covered cables insulated to withstand two and one-half times normal pressure. The trunk subways are subdivided at the manholes, as far as practicable, so that trouble to one feeder cannot be communicated to others.

EXCITATION.

The excitation switchboard is on the turbine-room floor adjoining the substation board and is so arranged that it can be connected to the substation board in the Gold Street generating station. The excitation is supplied by a 250-kw, 125-volt generator driven by a 6600-volt, three-phase, 25-cycle induction motor. A 500-kw battery is kept floating on the excitation bus at all times. There are also a pair of 400-kw, 125-volt direct-current generators driven from a three-cylinder, compound Lake Erie engine. This engine is used as an emergency exciter and is arranged so that it may be put in multiple on the substation bus in emergency.

At the Sixty-sixth Street station the arrangement of the three-phase system and excitation is the same as that at the Gold Street station with the exception that there is no direct-current substation located in that generating station and the steam-driven exciters are only of 100-kw rating.

SYSTEM OPERATOR.

The three-phase, 6600-volt distribution system is controlled by system operators, who are under a chief system operator having charge of all electrical equipment in the generating stations and having direct supervision over all of the high-tension switchboards in the system. A miniature replica of the transmission system is kept by the system operator on watch, and shows the regular running condition of the circuits. The operator is kept advised by the chief engineer as to the capacity of boilers, turbines, engines, etc., that is available. All substation apparatus as it is put in or out of service is immediately reported and noted on the log at that time. This enables the system operator to be familiar always with the equipment which is in operation on the system. Nothing can be taken out or put into service without his permission. If the distribution or electrical construction department wishes a feeder or any piece of aparatus put out of commission it is required to give the operating engineer's office a written notice twelve hours in advance. Immediately upon receipt of this notice the chief system operator and the chief substation operator pass on it, and if in the meantime no emergency has arisen the feeder is taken out of commission in the following manner: The foreman who is in charge of the work calls the system operator on watch, giving his name and department. A red tag bearing his name is then placed on the control switch in the generating station and on the hand-operated switch in the substation. The oil switches are then mechanically blocked to prevent their being accidentally closed. The feeder is then short-circuited and dis-

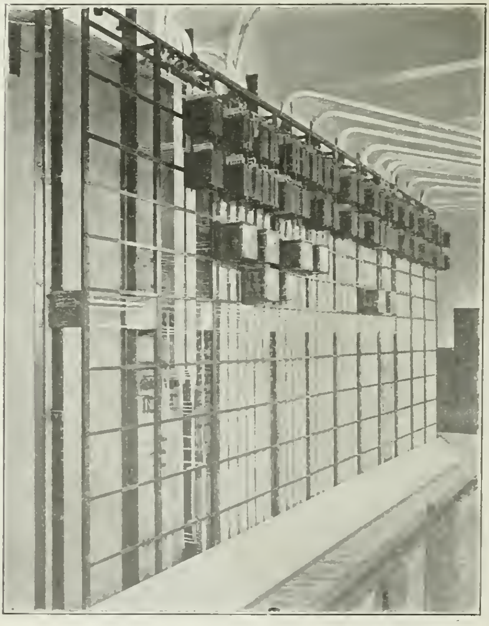


Fig. 11—Rear of Control Board, Gold Street Station.

charged to ground. No feeder or apparatus that has been taken out can be put back into commission again until the foreman or emergency man who ordered on the tag personally orders it removed. These precautions are taken to avoid accidents.

The system operator is provided with a private-telephone exchange with a main board by means of which all substations can be immediately reached over a direct wire. In this way the operator is enabled to call two, three or four substations at one time, giving them all the same orders. It has been found that by this method of communicating with the substations and by a proper method of answering the telephones half the time can be saved in telephoning. The method of answering the telephones is as follows: If a substation calls the system operator, his reply is "System operator." The substation operator then answers (for example): "Sumpter Street, Murray. No. 1 rotary going on, 5:15." This is repeated back by the system operator and the conversation is then completed.

EMERGENCY SERVICE.

Another of the system operator's duties is to keep a list of the men who are liable to be needed in case of a breakdown and to send out a call for as many of them as necessary in case of trouble on the system. A recent instance of this "emergency service" was demonstrated at the Erie Basin dry docks when one of the 400-kw, three-phase, 25-cycle, 440-volt motors on dock No. 4 burned out. The system operator was notified at 7:35 a. m. and at 2 p. m. the dock was equipped with two 200-hp motors, which had been installed in place of the 400-hp unit, and operations were again renewed.

A detailed list of all large motors, transformers, etc., which are in storage at any of the various storerooms is kept by the system operator, and he can immediately tell a customer or any of the company's employees if there is a piece of apparatus in stock which can replace any that has burned out or that has become defective in any way.

At the generating station there is always 2500 kw kept in reserve for the use of the high-pressure fire-pumping stations. In addition to all sudden demands at times required for the high-pressure pumping stations the company feeds two large shipyards which have floating dry docks and which may call for approximately 2000 kw at any time of the day or night.

In case of a general shut-down on the 6600-volt system the operators in the substations shut down, pull out the alternating-current switches of the machines and clear the 6600-volt board thirty seconds after the shut-down occurs. In the battery stations or where there is a supply of direct current from another source the rotaries are allowed to run from direct current.

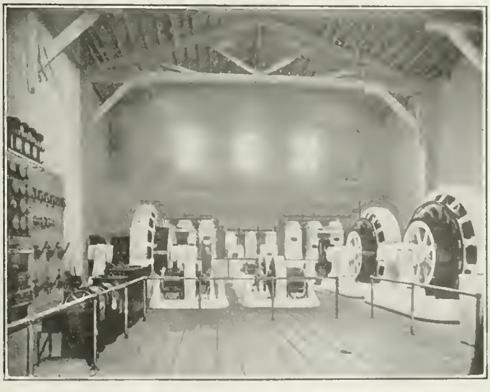


Fig. 12—Dreamland Substation.

When the pilot lamps indicate that service has been restored on three-phase feeders the operator switches on the station load at once in the usual way without further notice. After he has started the equipment the operator notifies the system operator and receives any further instructions required. In the event of any serious substation trouble or where difficulty is experienced in starting after the trouble, the system operator notifies the operating engineer and the chief substation operator regardless of the hour, day or night.

In the case of a partial shut-down, due to local causes or otherwise, the substation operator immediately starts up his equipment and feeds the normal load, unless otherwise notified by the system operator. In case of a shock on the system which does not automatically disconnect any of the feeders or apparatus the substation attendant does not call the system operator until twenty minutes after the trouble. In the event of a shut-down if the booster generators are between a battery and the bus—as, for instance, in charging the battery—or so connected that the load on the generators becomes very excessive, they are disconnected from the bus at once.

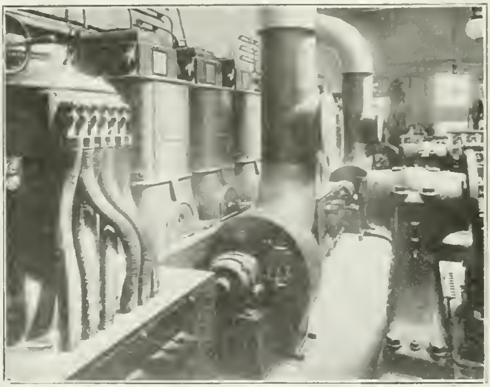


Fig. 13—Transformers and Regulators in West Twelfth Street Substation.

SUBSTATIONS.

The substations of the company are twenty-one in number and their locations and equipment are as given below:

The substation at Rockwell Place and De Kalb Avenue is equipped with four 1000-kw rotary converters, eight 100-light Brush arc machines, one 750-kw battery, one 50-kw booster, and one 90-kw and one 80-kw balancer.

The substation at 1265 Atlantic Avenue contains two 100-kw, one 400-kw, one 500-kw and one 1000-kw rotary converter, together with a 475-kw battery. This equipment will shortly be augmented by the installation of another 1000-kw rotary converter. The other equipment comprises a 50-kw booster and two 90-kw balancers.

A substation at 1171 Myrtle Avenue contains two 200-kw, one 500-kw and two 1000-kw rotary converters, and a battery rated at 500 kw. To this equipment will be added during the summer another 1000-kw rotary. This station also contains two 50-kw boosters and one 90-kw balancer set.

The large substation at West Twelfth Street and Railroad Avenue, Coney Island, from which Luna Park and a large part of Coney Island are supplied with electricity, contains one 100-kw, two 200-kw, two 500-kw and three 1000-kw rotary converters; one 500-kw motor-generator set, one 1000-kw frequency changer, and eight 100-light Brush arc machines, and another 1000-kw frequency changer has been ordered.

The Carroll Street substation is equipped with two 200-kw, one 500-kw and two 1000-kw rotary converters, one 500-kw battery, one 50-kw booster, and two 90-kw balancer sets The Forty-second Street substation, from which the Bush Terminal Company is supplied, is equipped with two 100-kw, one 400-kw and two 150-kw rotary converter sets. The latter are 550-volt machines, whereas all of the other rotary converter sets are 240-volt machines.

The substation at the corner of Dikeman and Ferris Streets, which supplies energy to the Lidgerwood Manufacturing Company, is equipped with two 400-kw rotary converters.

The Gold Street substation, which, as already stated, occupies space on the engine-room floor of the main generating station of the company, contains one 1000-kw rotary, two 400-kw engine-driven generators, which may also be used for excitation, one 500-kw battery, one 50-kw and one 75-kw booster, and one 90-kw balancer set.

The Lexington Avenue substation is equipped with two 200-kw, one 400-kw and one 1000-kw rotary converter, one 400-kw and one 200-kw frequency changer set, one 50-kw booster, and a 90-kw balancer. A 1000-kw rotary converter will be added to this equipment shortly.

The Ainslie Street substation is equipped with two 1000-kw rotaries, with a third unit of the same rating ordered; three 500-kw and one 1000-kw frequency changer, with another 1000-kw frequency changer on order; one 500-kw battery, twelve 100-light arc machines, one 100-kw and one 90-kw balancer, and two 50-kw boosters. A 75-kw booster will also be installed within a few months.

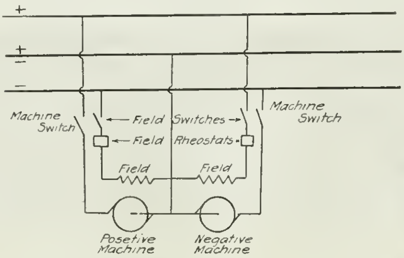


Fig. 14—Diagram of Balancer Connections.

The substation on Hall Street, which supplies a large industrial establishment, is equipped with two 500-kw rotary converters and two 90-kw balancers.

The Lorimer Street substation contains two 200-kw, one 400-kw and two 1000-kw rotary converters, a 750-kw battery, one 50-kw booster, and two balancer sets rated at 50 kw and 90 kw respectively. The company has recently ordered a 1000-kw rotary converter set, which will supplement the substation equipment in this station.

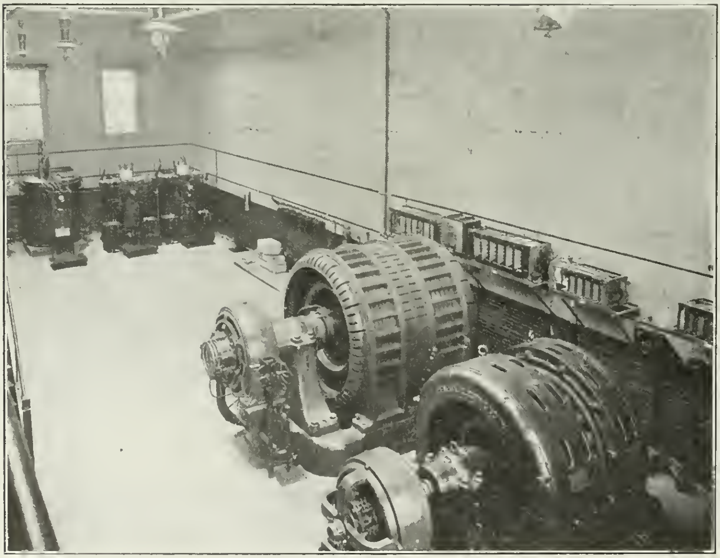


Fig. 15—Hicks Street Substation.

The Pearl Street substation, located in the main office of the company, contains two 200-kw, two 500-kw and four 1000-kw rotary converters, one 1500-kw battery, one 75-kw and two 50-kw booster sets, and a 90-kw balancer.

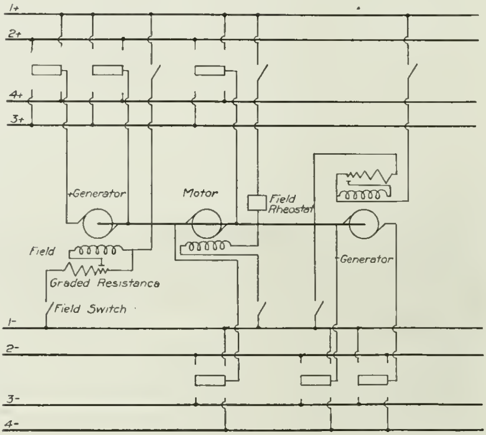


Fig. 16—Diagram of Booster Connections.

The Sumpter Street substation has the following equipment: One 500-kw and two 1000-kw rotary converters, one 500-kw and two 1000-kw frequency changers, eight 80-light mercury arc rectifiers, one 80-kw and one 90-kw balancer, and a 50-kw booster set. A 1000-kw frequency changer has been ordered for this substation.

The Madison Street substation contains a 1000-kw rotary and a 90-kw balancer set. In addition to this equipment there will shortly be installed another 1000-kw rotary converter and a 500-kw battery.

The Dreamland substation, from which the amusement resort of that name at Coney Island receives its energy, is equipped with two 100-kw and three 1000-kw rotary converters. This substation is operated only four or five months in the year, during the Coney Island season.

In the Sixty-sixth Street station the substation equipment comprises one 1000-kw and one 400-kw frequency changer set, with another 1000-kw frequency changer on order. There are also four mercury-arc rectifiers being installed.

The Hicks Street substation contains four mercury-arc rectifiers and one 400-kw and one 1000-kw motor generator set.

The substation in the Brooklyn Navy Yard is equipped with two 200-kw motor-generator sets.

Another Coney Island substation, located at Brighton Beach, is equipped with one 400-kw and four 100-kw rotary converters and a 500-kw frequency changer. In addition there are two 100-kw rotaries used as balancers.

The substation at Canarsie is equipped with one 150-kw motor-generator set and a 300-kw frequency changer.

GENERAL SUBSTATION EQUIPMENT.

The 6600-volt, three-phase feeders are brought into substations, which are equipped with two types of board. The older is of open-construction varnished-cambric cables supported upon insulators; the newer type is of concrete-compartment design. Only two of the substations are equipped with two-bus, high-tension boards. The older boards are all of single-bus construction, with the exception of those in Rockwell Place and Carroll Street. The newer type boards are divided in sections, which gives nearly the same flexibility as the two-bus construction and avoids a great many of the two-bus troubles.

All of the substations are equipped with "K" switches and hand control with the exception of those on Pearl and Ainslie Street, which are of the remote-control type operated by solenoids, although they are also arranged to be operated manually. Two feet above the end-bells at which each cable comes into the substation is a set of removable sleeves covering connectors arranged for disconnecting the feeder for phase testing, etc.

The newer type of substation is equipped with a four-bus direct-current switchboard for supplying a 240-volt, direct-current, three-wire system. There are three types of rotaries in the substations. The older type of rotaries has an induction regulation in the alternating-current circuit between the transformers and the rotary. The synchronous-regulator type has a rotating auxiliary winding on the alternating-current side of the armature and is connected between the rotary armature and the slip-rings. The alternating-current voltage induced in this winding by a separate field flux regulates the alternating-current voltage delivered to the armature. In the split-pole type regulation is obtained by changing the ratio between the alternating-current and direct-current voltages by varying the excitation of the auxiliary poles.

There are located in each direct-current station, as pointed out elsewhere, from one to two balancers. These machines are mechanically coupled together and electrically connected, one from the neutral to the positive bus and one from the neutral to the negative bus. By weakening the field of one it is made to take current from its side of the system and send it out by way of the other machine on the other side. As is seen by the diagram, the field coils are cross-connected.

Each substation is likewise equipped with one or more boosters consisting of a direct-current motor mechanically connected to two low-voltage generators which can be put in series with any feeder or feeders or connected from one bus to another (one on the positive and one on the negative side). It is customary in this way to operate the fourth bus on the direct-current switchboards with from one to three, and sometimes four, feeders on which the voltage may be below normal.

The direct-current feeders are equipped with pressure wires running from the points where they connect to the mains back to the substations, and are connected through fuses to a pressure-wire cabinet, on which are located voltmeters read every fifteen minutes. The voltage is regulated to correspond with a voltage curve which is furnished the operator.

If only one or two feeders drop in feeder-end voltage, a booster is started and the generators (with the field rheostats

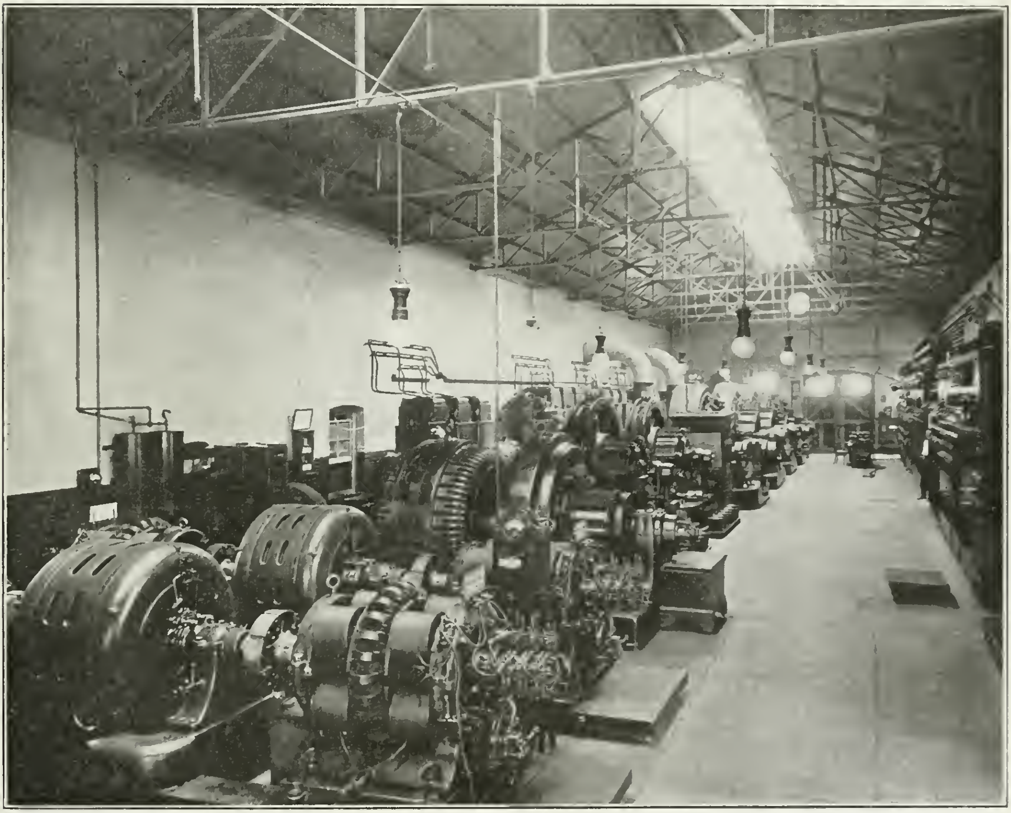


Fig. 17—General View of West Twelfth Street, Coney Island, Substation.

on the weak position) are connected from No. 1 bus to a spare bus. The switches on the feeders having a low feeder end are then closed on this spare bus and opened on No. 1 bus, after which the voltage can be raised on the spare bus by strengthening the booster generator fields high enough to bring the feeder ends up to standard potential.

In the event of the feeder-end pressure on a number of feeders dropping below normal, another rotary is started and while still connected to No. 1 bus it is also connected to a spare bus, the low feeders are put on this spare bus and cleared from No. 1 bus. The voltage is then raised on the rotary until its load is equal to the load of all of the separate feeders, then the rotary is separated from No. 1 bus and the spare-bus voltage brought up by the rotary regulator to a point where all the feeders will have the required feeder-end voltage.

It often becomes necessary to transfer a feeder from a low to a high bus without affecting any others, and to accomplish this it is necessary to put the feeder on a spare bus with a rotary or booster. It is then separated from the low bus and the voltage raised to that of the high bus, after which it is tied in with the latter and the machine used to transfer the feeder can be disconnected from the high bus and shut down or used to assist in supplying this bus with energy.

In separating buses it is necessary to determine whether the separated bus will need to be balanced after it is separated from No. 1 bus or if the load is balanced well enough to maintain a balanced feeder-end pressure with the assistance received from the rest of the system through the mains. If it is evident that the bus will require balancing, a pair of 125-volt rotaries or a 250-volt rotary and a balancer are used to supply energy to this separate bus. Separating buses is avoided as much as possible, as it necessarily means the lowering of the efficiency of a substation as a distributing unit.

In the event of trouble on the direct-current system the switch of the defective feeder or feeders is opened if it is evident from the instruments that more harm than good will result from keeping the feeder in service.

A battery is continuously floating on No. 1 bus and connected to the switchboard by two positive and two negative end-cell switches, both of which are connected to No. 1 bus during the peak load in the evening. During the rest of the day only one end-cell switch is used.

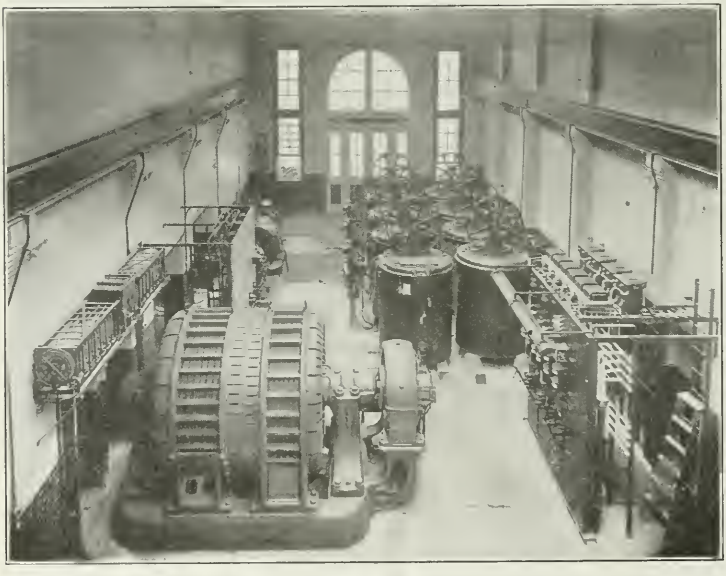


Fig 18—Sumpter Street Substation Addition.

A curve is provided the operator showing the voltage and number of cells required for any bus pressure in order for the battery to float on the bus without charging or discharging The specific gravity and temperature of the electrolyte are taken daily and at the end of a battery charge. The frequency of these charges is determined by the condition of the battery.

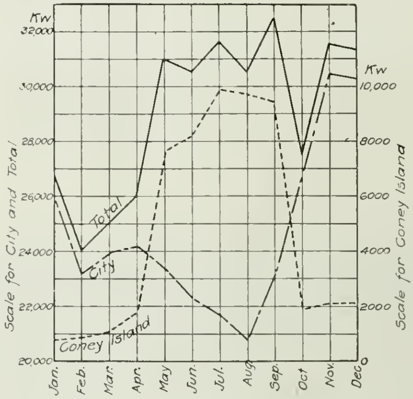


Fig. 19—Maximum Load Curve, Showing Effect of Coney Island Business.

With but two exceptions all rotaries on the system are started as direct-current motors, each station being provided with two starting boxes and a five-point throw-over switch. One of the starting boxes is held in reserve for emergency use. In starting rotary converters the operator is required to ascertain if the rotary is clear of the board and if all starting switches are opened. He then pulls the field switch into the outer clip and closes the negative machine switch on No. 1 bus. The rheostat meanwhile is placed on the full-field position. If the field coils are energized he closes the starting switch on the positive side, brings the rheostat to the short-circuit position by cutting out the resistance and closes the positive-machine switch on No. 1 bus. The field is then closed in the inner clip across the machine armature. After all starting apparatus is cleared the system operator is notified that the machine is ready to go in on the alternating-current side. With the system operator's sanction the oil switch is thrown in and the voltage on the rotary is balanced with the secondary transformer voltage by means of the alternating-current voltmeter on the board. At the same time the frequency is brought to that of the system. Synchronizing is effected by the use of lamps and the knife switches between the transformers and the rotary. The switches are closed when the light is extinguished. The load is picked up by the use of the particular regulating device for this rotary.

In one of the substations, which is located in the Lidgerwood Manufacturing Company's plant, it is customary to shut down for several hours each night. In this case the rotaries, being of only 400-kw rating, are started directly from the alternating-current side by the use of a 50 per cent tap on the secondary of the transformer. When this station was first started there was some difficulty experienced because the rotaries came up reversed. This was overcome by the installation of a 60-amp, 6-volt battery, which is connected to the field coils through a switch before the alternating-current switch is closed on the machine to start. The battery circuit is opened as soon as the machine voltmeter shows a reading.

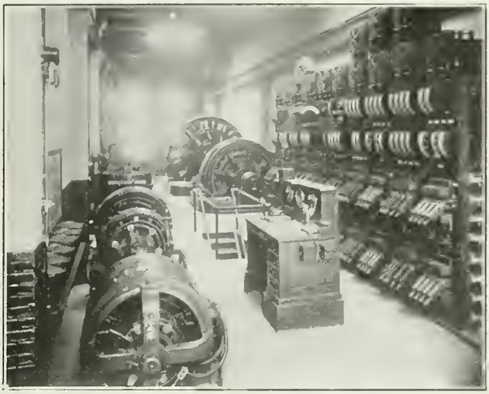


Fig. 20—Atlantic Avenue Substation.

At the West Twelfth Street (Coney Island) station there are a pair of 500-kw rotaries equipped with three-phase, 25-cycle induction motors with the rotor mounted directly on one end of the shaft. This equipment was installed for emergency purposes, it being possible in case of a complete shut-down of the station to bring these two rotaries up to the voltage on the direct-current bus in less than two minutes. This station being primarily a summer station it is not equipped with a storage battery, and in addition to the above-mentioned rotary there is a 500-kw direct-current motor-generator set driven by a 6600-volt induction motor. The generator of this set is so arranged that it can be put on either the positive or the negative side of the system for the purpose of starting either of the pair of 200-kw, 125-volt rotaries from which the remainder of the station can be started. The trouble reports show, however, that this method of starting has not been necessary during the last three years, although both methods are used in practice every Sunday morning.

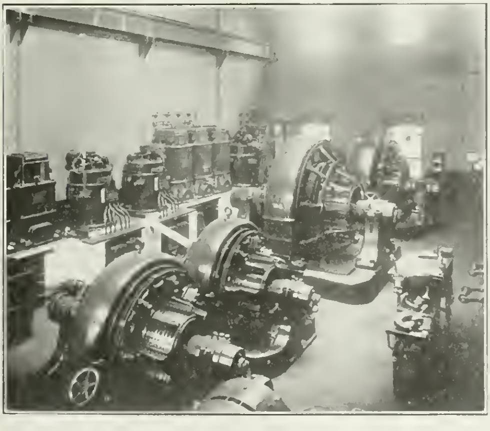


Fig. 21—Carroll Street Substation.

CENTRAL DISTRIBUTION.

The direct-current distribution is entirely underground, the cables being installed in clay or fiber-duct subways with manholes at frequent intervals, following standard practice in this respect. A considerable amount of old Edison tube feeders, consisting of two conductors and a neutral insulated with rubber and a compound, embedded solidly in iron pipe and buried in the ground, is still in the streets, but no new feeders are installed in this system for obvious reasons.

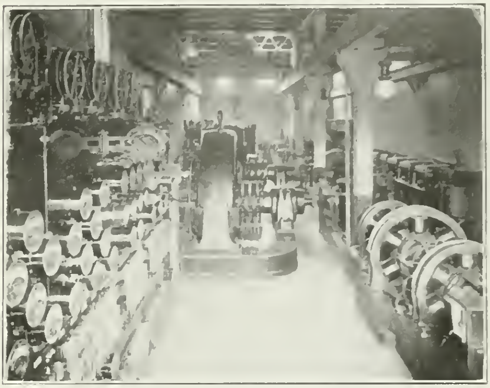


Fig. 22—Sumpter Street Substation.

The outgoing two-phase feeders are run underground in congested districts and on 45-ft. or 35-ft. pole lines in the outlying sections to transformers located to suit service conditions. Where a group of customers is to be served the secondary network is used and large transformers installed. Isolated customers, however, have individual transformers mounted on a pole near the premises. The secondaries of the transformers are wound to give 125 volts, single phase, for lamp circuits and 250 volts, two phase for motor service. The voltage on a two-phase feeder is regulated at the substation by means of contact-making voltmeters automatically operating a relay switch controlling the circuit to the motor on the regulator. The latter is an oil-cooled auto-transformer.

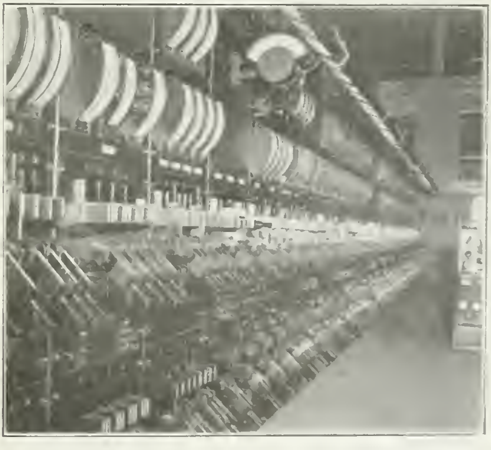


Fig. 23—Direct-Current Switchboard in Pearl Street Substation.

The service of each customer, whether in the alternating-current or direct-current district, is brought into the premises at a point mutually convenient, and the company installs a protected service switch and cut-out, together with a meter, on a board erected for the purpose. Separate meters are installed for motor and lamp circuits where these are subject to separate rates.

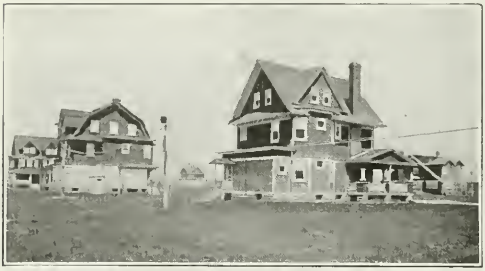


Fig. 24—Back-Yard Pole Line in Suburban District.

BACK-YARD SERVICE

In the high-class residential sections of Flatbush and Bay Ridge the company has standardized a back-yard service system which is operated in conjunction with the telephone company, the latter's cable taking the lower position. A 22-ft. concrete post is used for this purpose and the transformers are connected on the second pole and the secondaries extended along the poles to the end of the block, one transformer feeding a block. The primary service is brought underground to the post and up inside or outside of the post in conduit to the transformer. The service is carried from the pole to the house in standard three-conductor cable and to the meter in flexible iron conduit.

OVERHEAD SERVICES.

The following is the method adopted by the Edison company of installing overhead services: Two buck arms are placed on the pole, immediately under the lower line arm, and the transformer is hung from the upper arm, the foot of the transformer resting against the bottom arm, thus holding the transformer in a perpendicular position. The primary cut-outs are attached to the top buck arm on either side of the transformer and taps are taken from the primary line and lead in to one side of the cut-outs, the primary leads of the transformer being placed in the other. The cut-outs are equipped with inclosed fuses.

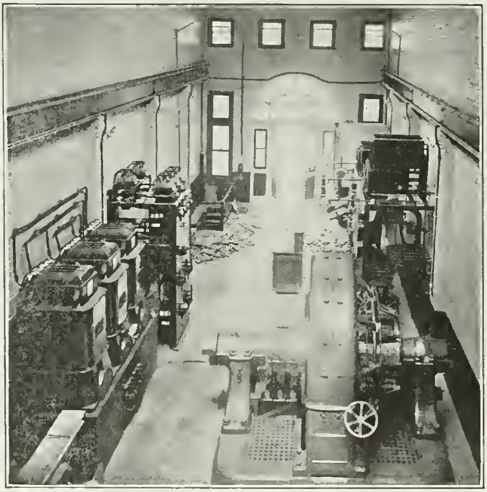


Fig. 25—Madison Street Substation.

The service cable, which consists of a twin-conductor No. 8, a three-conductor No. 8, or a three-conductor No. 4 cable (the size depending on the installation), has 3/32-in. rubber insulation around each conductor, a layer of tape and two layers of braid over all, the spaces between conductors being filled out with jute to give a round finish. The cable thus made up is carried from the pole to a point above the second-story window of the building to be served and is held rigid by being attached to an insulator on the end pin of the bottom buck arm and to a porcelain insulator and pull-off attached to an iron elbow bracket which is fastened to the face of the building with lag screws. From the point where the service cable is wrapped around the porcelain insulator to the point where it enters the building it is incased in flexible iron tubing, the tubing being attached to the face of the building with straps and entering the top of the show window in stores or the cellar window in residences. A drip loop is placed at the top and bottom of the tubing in order to prevent water entering the building. The size of the tubing used depends upon the size of the cable installed and ranges from ¾ in. to 1¼ in. inside diameter.

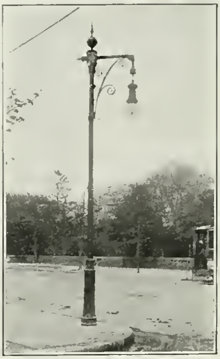


Fig. 26—Short-Arm Lamp-Post.

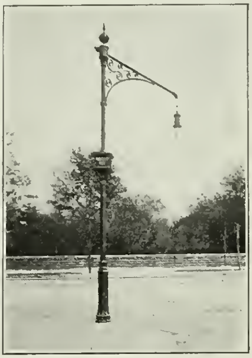


Fig. 27—Long-Arm Lamp-Post.

PUBLIC LIGHTING.

The Brooklyn Edison company supplies energy to over 5000 arc lamps and 658 tungsten lamps constituting the public electric-lighting service. High-tension and low-tension, direct-current and alternating-current series and multiple circuits are maintained for this purpose. The standard size of wire for arc circuits is No. 4, and the direct-current, high-tension series-arc lamps are placed on 25-ft. or 30-ft. wooden poles or suspended from top-mast arms or from side-mast arms extending approximately 12 ft. over the street and 18 ft. above the roadway. The arc lamp used is of the inclosed type rated at 6.6 amp and 70 volts across the arc. In conjunction with these series circuits the company has installed forty-seven series-tungsten lamps consuming 6.6 amp at 11.3 volts. The circuits are supplied with energy from arc machines or mercury rectifiers at 6000 volts and 6.6 amp. The low-tension series circuits are maintained only in Canarsie and feed forty-one lamps, the energy supply being taken from a tub regulator, the primary winding of which receives energy from one phase of a two-phase primary feeder.

Low-tension, multiple alternating-current arc lamps are fed with energy from a secondary bus connected to the secondary side of a transformer. Where underground secondary mains are maintained the lamps are fed from a bus line which is itself fed through iron conduit attached to a pole, the wires in the conduit tapping the underground circuits. Multiple-tungsten lamps are connected to such circuits in some sections of South Brooklyn.

Wherever underground direct-current mains have been installed high-tension series-arc lamps have given place to low-tension direct-current multiple lamps. These are suspended from graceful iron posts almost 29 ft. over all and set in the ground to a depth of almost 3 ft. Iron mast arms, either long or short and supported by a bracket, are installed about 1½ ft. from the top of the pole. A 2-in. iron service pipe is installed between the lamp-post and distribution box and the service, which consists of three No. 8 lead-armored cables, is drawn through this pipe, connected at one end to the street mains and at the other to a magnet-control switch through a cut-out. Convenient points of control are selected for fifteen or more lamps and a two-pole knife switch is installed. From this switch a No. 8 control wire is drawn through ducts and cut in to the switch in each post to be controlled. The direct-current arc lamps are rated for 5.75 amp and 70 volts at the arc and burn 3950 hours yearly.

In Fort Greene and Prospect Parks there is a total of 840 tungsten lamps staggered along the drives and main walks. For feeding these lamps central points of distribution were located accessible to the company's feeders in surrounding streets, small manholes and a subway consisting of one 3-in. fiber conduit constructed and feeders hauled in. Trenches approximately 6 in. wide and 8 in. deep were opened between the manhole and the nearest lamp and also between lamps. A steel-armored cable made up of three No. 4 solid conductors with 11/32-in. insulation and 5/64-in. lead sheath served with tarred jute and wrapped with two 1/32-in. steel tapes in reverse direction was laid from a manhole to the nearest post and looped in every lamp, the conductor reducing in size gradually to a two-conductor No. 8 cable. For the control of the lamps switches are located on convenient posts throughout the parks.

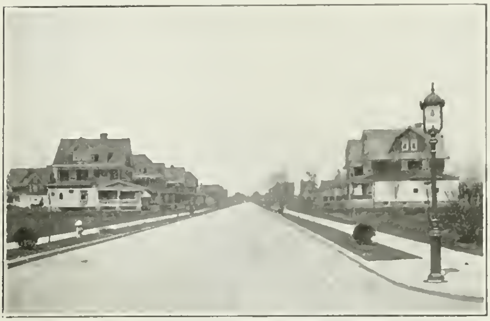


Fig. 28—Tungsten Street Lighting in Suburban District.

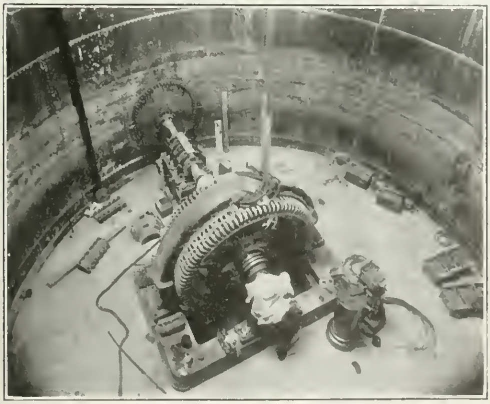


Fig. 29—Gowanus Pumping Station.

HIGH-PRESSURE PUMPING SYSTEM.

There are in operation in both the boroughs of Manhattan and Brooklyn electrically driven high-pressure pumping stations for fire service. The systems in the two boroughs are alike in all essentials. Two pumping stations, each supplying the whole system of high-pressure mains, are allotted to Brooklyn. One is located at Furman and Joralemon Streets and the other at the corner of Willoughby Street and St. Edward's Place. The equipment in the first-named station consists of five and in the second-named station of three six-stage centrifugal pumps electrically driven by 6600-volt induction motors. The pumps were built by the Worthington company and the motors by the General Electric Company. The former are designed to use either fresh or salt water, and each pump can deliver 3300 gal. of water a minute against a pressure of 300 lb. per square inch. The larger station is capable of pumping approximately 22,000,000 gal. of water a day and the smaller station 13,000,000 gal. Each pump is direct-connected by means of a flexible coupling to a 800-hp, 25-cycle, four-pole motor operating at a synchronous speed of 750 r.p.m. and at a full-load speed of approximately 735 r.p.m. Under its contract with the city the company must install and maintain for the exclusive use of the city sufficient generating machinery, cables, etc., to permit of the starting of any three motors in one station simultaneously. For further details regarding this system and the rates received for service see *Electrical World*, March 14, 1908.

Fig. 30—High-Pressure Pumping Station.

Fig. 31—Electric Hoist in Subway Construction.

CANAL FLUSHING STATION

The Gowanus Canal flushing station is the latest city pumping station to be installed on the Edison service. It is located at the head of the canal at Douglass Street and a 6600-volt, 25-cycle feeder carries the necessary energy. This feeder is connected to a high-tension panel, on which are also an oil switch, series and shunt transformers, relays and meters. Another high-tension board containing disconnecting and motor-reversing switches is situated near the transformers. Three Wagner oil-cooled transformers, each of 250-kva rating and connected in delta, reduce the voltage from 6600 volts to 550 volts.

Fig. 32—Electric Hoists Used in Subway Construction.

A 400-hp Westinghouse induction motor is direct-connected to a 9-ft., four-blade turbine pump. The motor is wound for 550 volts, 25 cycles, three-phase and is rated at 400 amp per terminal, 120 r.p.m. at full load. A rheostat controller which varies the resistance in the rotor circuit is used for starting and regulating the speed of the motor. The latter is situated at the bottom of a metal-lined circular pit. The pit is of such a depth that the horizontal motor shaft has the same elevation as the center of the tunnel. The shaft projects through the motor pit into the tunnel and the fan-like pump, which is fastened to the end of the shaft, completely fills the tunnel. The capacity of the pump is 30,000 cu. ft. per minute. Running the pump at intervals, the entire contents of Gowanus Canal can be changed three times daily. By means of a reversing switch which interchanges two of the leads the motor and pump may be driven in either direction. The present plan is to run the pump on the ebb of the tide, when the dirty, muddy water will discharge through a large tunnel crossing the city into the East River. Clean water from New York Harbor will flow in to take the place of that removed by pumping.

Two motor-operated gates control the flow of the water. The gate in the intake tunnel is situated in a small gate house just outside the station, and the gate in the discharge tunnel is inside the station. The gates are raised or lowered by means of two vertical threaded shafts, each having a stationary pinion at its upper end. Two worm gears on a horizontal shaft drive these pinions, and the horizontal shaft is geared to a direct-current motor. The gate motors are each rated at 7½ hp, 110 volts and 850 r.p.m. A hand-operated auxiliary gate, 24 in. square, is used when starting or shutting down the station. A direct-current switchboard is situated at one end of the building. The switchboard contains the lighting panel and the control for the small motors, namely, the two gate motors and a 220-volt sump-pump motor.

SALES DEPARTMENT.

The company's sales department is splendidly organized and capable under present direction of a maximum of efficient and productive work. Commercially, the territory of the company is divided into three divisions with three offices, 360 Pearl Street, 5114 Fifth Avenue and 884 Broadway. At each one of these offices is a district manager and salesmen who report to him, a cashier who represents the treasurer, and a lamp clerk representing the lamp department. There are also appliance displays at each office.

ADVERTISING.

For ten years the Brooklyn Edison company has pursued a campaign of progressive advertising; in fact, it was one of the pioneers in central-station publicity work, and its advertisements have been reproduced and commented upon all over the country. The company has adopted as a slogan the words "Brighter Brooklyn," and this is utilized as a catch word in much of its advertising.

MOTOR LOAD.

About 40 per cent of the business of the Brooklyn Edison company is motor load, and it supplies exclusive service to a great many large industrial enterprises. For instance, the John N. Robins Company, at Erie Basin, operates one of the largest dry docks in the world. Some two years ago this company discontinued the use of its private plant and adopted Edison service for something like 3500 hp in motors. The consumption of this one installation for last year was in excess of 3,000,000 kw-hours. A complete description of this interesting installation appeared in *Electrical World*. The Bush Terminal Company, a very large dock, factory and warehouse waterfront enterprise, has an equipment in excess of 2500 hp; the New York Dock Company, 1200 hp; Morse Dry Dock & Repair Company, 800 hp; J. H. Williams Company, 800 hp; Lidgerwood Manufacturing Company, 800 hp, etc. The list could be continued at some length.

CONEY ISLAND BUSINESS.

The Brooklyn company is peculiarly fortunate in having such a development as Coney Island within its confines, and in this development the company has been one of the primary agencies. The magnificent mass illumination at Coney Island is its main attraction and is famous wherever the English language is spoken and beyond. Coney Island has been copied more or less in miniature all over the country, where there are Luna and Steeplechase Parks and Dreamlands without number. The Coney Island business of the Brooklyn company brings about peculiar and advantageous peak conditions. This business fills in the summer valley and makes the July peak about as high as that of December. Moreover, the annual peak, instead of being, as is customary with Northern central stations, in December, comes in September, when the Coney Island load, not yet

Fig. 33—Coney Island Office.

discontinued, combines with the oncoming city business. The Coney Island load reaches in the summer time as high as 11,000 kw, and this is practically all long-hour business. The company supplies electricty to all the large and small amusement enterprises of this resort. Some of the installations are extensive, Luna Park and Dreamland each taking about 3000 hp.

NATIONAL GOVERNMENT BUSINESS.

One of the large customers of the company is the United States government, the Edison company supplying a lighting service to every building on Governor's Island and the military post, which is army headquarters for the Department of the East. High-tension service is sold, the government maintaining its own cables from Brooklyn to Governor's Island and its own substation and transformer equipment. Up till five years ago this post was lighted by kerosene oil exclusively. General Chaffee, returning from the Philippines, where he found the army barracks electrically lighted, was so surprised at the backwoods equipment so near New York that he interested himself, secured an appropriation, had every building on the island wired and made a contract with the Brooklyn Edison company for the energy supply already mentioned.

The company also supplied 900 hp for the construction of Dry Dock No. 4 at the Brooklyn Navy Yard, this energy being supplied to motor-driven air compressors for the construction of caissons, which formed the foundation of the dock. This was a constant, twenty-four-hour-a-day service.

The company is also supplying service to a great many contractors for temporary work, the construction now going on including the building of the Fourth Avenue subway, a 6-mile tunnel from Manhattan Bridge the length of Fourth Avenue to Forty-second Street.

SMALL-MOTOR BUSINESS.

The small-motor business of the company is by no means neglected, as is evidenced by the fact that within the last eighteen months over 100 gas engines of from 2½ hp to 50 hp have been superseded in this territory by Edison service. Many of these are in clothing and garment-manufacturing shops. The advertising which accomplished much of this work was printed in English and Hebrew. The company pursues this policy in advertising along other lines, sending circulars in Chinese to Chinese laundries, and in other languages to races the representatives of which are frequently unfamiliar with English. This method has met with considerable success.

WIRING OLD HOUSES.

The company has accomplished a great deal toward the wiring and electrical equipment of both old and new buildings by special campaigns directed toward these ends. Some years ago when it was the exception rather than the rule for builders to wire their new properties the Edison Construction Company, whose function was to see that no building constructed in Brooklyn was unwired, succeeded in wiring 1000 buildings in eight months, and in starting the trend toward electrical equipment so strongly that it has never been found necessary to resume operations of this kind because builders and electrical contractors are now wiring practically every new building within reach of Edison mains. The present method of anticipating and developing the wiring is to solicit by means of a special corps of salesmen the wiring of both stores and residences now unequipped, to pay the contractor in full for his work and accept payment from the storekeeper or householder on the instalment plan. This system was operated for some time by means of a subsidiary corporation known as the Tungsten Lamp Specialty Company, the work of which enterprise resulted in the wiring of upward of 2500 stores hitherto illuminated by gas. The present effort under a separate branch of the sales department, known as the new installation bureau, is being largely centered on residences and is effecting the electric equipment of a considerable number of old houses which would otherwise be many years in arriving at the point where wiring would be installed.

APPLIANCE SALES.

The sales of the appliance bureau of the sales department of the company have progressively increased, the number of articles sold in 1910 being 38 per cent in excess of the number sold in 1909. This pace has been exceeded by the results so far in 1911.

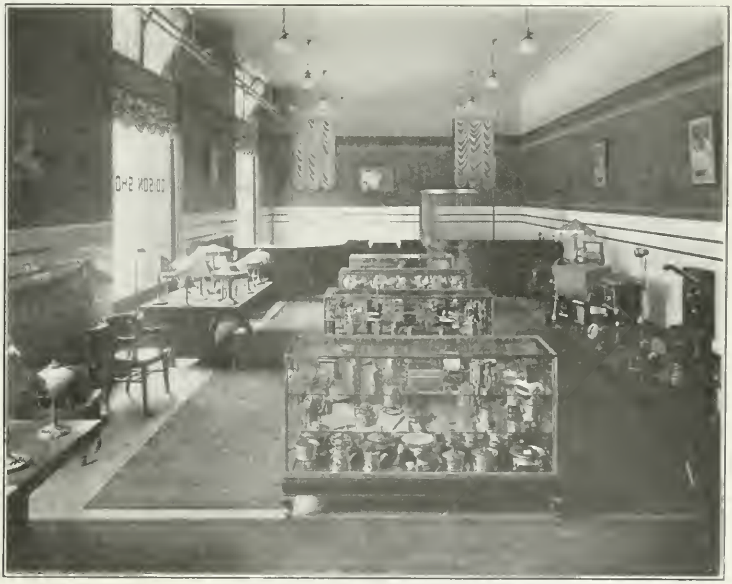


Fig. 34—Edison Shop in Pearl Street Office.

The company has just equipped a really artistic and attractive showroom at its main building, 360 Pearl Street, called and advertised as "The Edison Shop." It is one of the most beautiful display-rooms for electric appliances in the United States.

RELATIONS WITH CONTRACTORS.

The Edison company's relations with the wiring contractors in Brooklyn are very cordial. It has fostered the organization and development of an association known as the Kilowatt Club, where contractors and Edison employees meet monthly on common ground and discuss matters of general interest to both. The contractors are given a dinner annually and usually a summer outing.

WELFARE WORK.

In the welfare work which the Brooklyn Edison company has done in connection with its employees the company has taken advanced ground, and it was a pioneer in all activities of this kind. A mutual-benefit association was organized eleven years ago, the company contributing a considerable sum, and the members paying small dues which entitle them to death benefits, free medical attendance and a weekly payment in case of illness or disability. Some years later the Edison Club was formed. This is an organization maintained by the company at no expense to the employee, and is open to all who work for the company. The clubrooms are equipped with pool and billiard tables, and there are facilities for playing many other games. A small library is maintained and there is a piano for those who are musically inclined. The Edison Club rooms are utilized for the meetings of the many department organizations, among which are included a Meter Testers' Club, an Auditing Department Council, the Fiscal Club and a Sales Department Organization. The Brooklyn Edison Baseball Club has achieved enviable reputation as a first-class and almost unbeaten team.

BROOKLYN COMPANY SECTION, N. E. L. A.

The company was one of the first to take up the company section work of the National Electric Light Association, and has now an energetic and thoroughly progressive company branch numbering in excess of 500 members. A monthly bulletin is issued by this section and it has initiated some high-class National Electric Light Association ideas as to development and co-operation.

EDUCATIONAL WORK.

The company has also, from year to year, offered its employees educational advantages by which their usefulness to themselves and to the company has been enhanced at little or no expense to them. These educational methods have included lecture courses and courses in institutions of learning. The latest plan is to offer employees a course in Pratt Institute in industrial electricity, steam engineering, mechanical engineering or mathematics. The company advances the tuition, which the employee pays back in instalments. If the student completes the course of study to the satisfaction of the education committee of the Edison company, the entire tuition fee is refunded to him.

PROFIT SHARING AND SERVICE ANNUITIES.

Propably the most notable development of its employees' welfare work was the establishment on Jan. 1, 1911, of profit-sharing and service-annuity plans. In this work, which has already been described in these columns, the Brooklyn Edison company took the lead. It was the first of the large corporations to establish real co-operative profit sharing between stockholders and employees. Under this plan the employee receives a dividend on his wages equivalent to that received by the investor on his stockholdings. The conditions under which his share of the profit is received by each employee are such that he is compelled to save and become more interested in the company than he otherwise might be, by reason of the fact that he is a part owner.

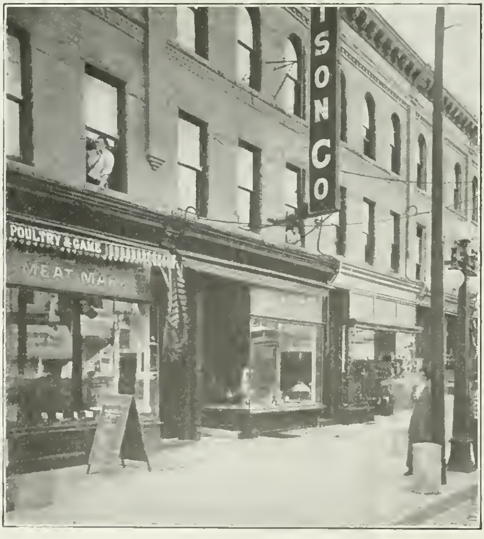


Fig. 35—Fifth Avenue Branch Office.

Prior to the establishment of this profit-sharing system, in July, 1910, the Brooklyn Edison company started an Edison investment fund, administered for the benefit of employees without expense to them. This also has been described in the *Electrical World*. Suffice it here to say that this fund is now in excess of $100,000, all of which belongs exclusively to individual employees of the company.

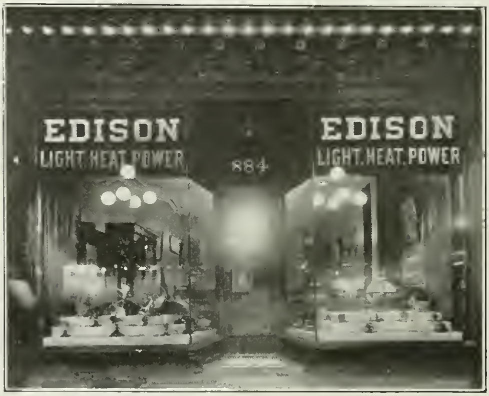


Fig. 36—Broadway Branch Office.

EMPLOYEES' MEMORANDUM BOOK.

In connection with the commercial development of this company it may be worth while to mention the plan of the sales department known as its "Red Book." This is a pocket memorandum book, each page of which is numbered and detachable. The employee is asked to carry this with him on all occasions and put down anything that seems likely to prove of interest to the company, either in the way of possible new business, defective service or any suggestion with regard to development. These memoranda are turned into the sales department, where a record is kept of every lead and the resultant business. At the end of the year the employees whose leads have resulted in the greatest advantage to the company are amply rewarded. This plan has resulted in a surprisingly large amount of new business in addition to supplying valuable information along other company lines.

PUBLIC POLICY.

One of the factors which account to some extent for the phenomenal success of the Brooklyn Edison company is the policy it has adopted for many years in its dealings with the public. It was one of the first of the large corporations to adopt a common-sense plan of taking the public into its confidence in matters affecting business methods and operation. The following is a copy of an advertisement entitled "A Public-Service Corporation's Statement as to Business Methods and Public Policy," which appeared in the Brooklyn papers:

"The Edison Electric Illuminating Company of Brooklyn believes and acts upon the theory that any permanently satisfactory business must be built upon the basis of mutual advantage, and that this mutual advantage consists in giving the public the best service possible at a price consistent with the maintenance of such service and a reasonable profit to stockholders upon their investment. The company's securities represent capital actually invested in the business. The company's rates are so arranged as, with careful and economical administration and the maintenance of a high and even liberal standard of public service, to permit of the payment of a reasonable return on this investment. These rates differ in accordance with quantitative consumption as governed by minimum guarantees on the part of the customer, and in accordance with certain broad divisions of application, as being, for instance, lower for motor energy than for lighting energy, but there are no secret rates and no discrimination as between customers in the matter of rates, all rates being public and the same rate being charged in every case for similar service under similar conditions."

FINANCIAL.

The Edison company has paid its stockholders a dividend of 8 per cent per annum for many years. The gross earnings last year were $4,338,987.55, which was an increase of $605,147.14 over the gross earnings of the year previous, while the operating expenses increased only $183,000. After charging more than $525,000 to depreciation and paying a dividend of over $800,000 it still had a net profit and loss surplus of $187,062.04 on the year's business, an increase of $129,496.42 over the 1909 net. The company's total assets were figured on the first of the year as $27,358,634.61.

OFFICERS.

Mr. A. N. Brady, president; Mr. A. M. Young, vice-president; Mr. W. W. Freeman, vice-president and general manager; Mr. W. F. Wells, general superintendent; Mr. P. R. Atkinson, treasurer; Mr. J. H. Evans, secretary.

BOARD OF DIRECTORS.

Messrs. Frank Bailey, William Berri, A. N. Brady, N. F. Brady, H. C. Du Val, Walton Ferguson, W. W. Freeman, Bernard Gallagher, Seth L. Kenney, Thomas E. Murray, W. F. Sheehan, J. N. Wallace and A. M. Young.

STAFF COUNCIL

Mr. W. W. Freeman, general manager; Mr. W. F. Wells, general superintendent; Mr. P. R. Atkinson, treasurer; Mr. J. H. Evans, secretary; Mr. W. J. Ray, acting auditor; Mr. T. I. Jones, sales agent; Mr. H. P. Wood, operating engineer; Mr. J. W. Lafferty, superintendent of distribution; Mr. G. L. Knight, designing engineer; Mr. E. W. Babcock, superintendent of electrical construction; Mr. G. E. Brown, distribution engineer; Mr. M. S. Seelman, Jr., advertising manager; Mr. H. F. Frasse, purchasing agent; Mr. W. T. Fairbairn, chief inspector; Mr. William Eichert, superintendent meter department; E. A. Baily, secretary.

RETAILING NIAGARA POWER.

System of Depew and Lancaster Light, Power & Conduit Company.

By T. Croft and J. D. Mooney.

When Mr. Ernest Feyler opened a dry-goods store in Lancaster, N. Y., in 1896, he wanted to be abreast of the times by lighting his store with electricity. As there was no lighting company in Lancaster, he decided to install an isolated plant in the basement of his store. When this was accomplished the other merchants in the town were so impressed with the advantages of electric lighting that they prevailed upon Mr. Feyler to enlarge his plant and supply them with energy for lighting their stores.

Business grew so rapidly that in 1898 it became necessary to secure a separate building for service as a power house. A frame building that had served as a blacksmith shop was selected and new machinery was added.

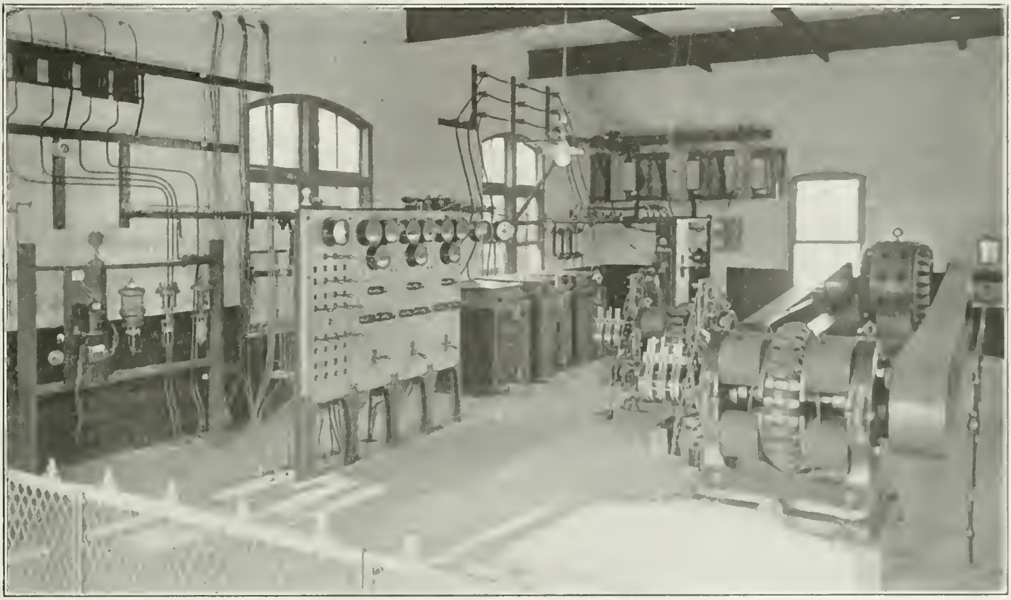


Fig. 1—General View of Generating Station.

In 1901 the Depew & Lancaster Light, Power & Conduit Company was organized, Mr. Feyler receiving a controlling interest in compensation for his plant at Lancaster. Franchises and contracts were then secured in all the intervening territory between the eastern line of Buffalo and the eastern line of the village of Lancaster, embracing two townships and three incorporated villages and covering 75 square miles. Energy was supplied for house lighting at 133 cycles, single-phase; for the series arc lighting direct-current energy was supplied by Brush arc generators. No day service was maintained.

In 1907 the company became convinced that it cost more to generate power than to buy it from the Niagara, Lockport & Ontario Power Company, which at that time was making an active campaign for the distribution of its energy. A new brick substation was built and the old arc machines were moved into this and driven by an induction motor (Fig. 1). Niagara power was received at 11,000 volts, three phase, and stepped down to 2200 volts by means of three 100-kw oil-insulated, self cooling transformers. A four panel lighting feeder switchboard was installed. Twenty-four-hour service was inaugurated at once.

Late in 1907 the company was reorganized and the services of Mr. H. B. Zimmerman as general manager and Mr. A. R. Tremaine as superintendent were secured. The new management immediately started an earnest and aggressive campaign for power business with the result that in three years' time the maximum demand increased from 225 hp to 1000 hp. In order to take care of all the power business in the territory and to avoid the duplication of lines with those of the Niagara, Lockport & Ontario Power Company it was decided to sell large blocks of power at the same voltage at which it was received. Therefore a meter measuring station was erected at a tap off the Niagara lines at Borden and Raleigh roads, Cheektowaga, and the three-phase, high-tension line was extended to Sloan. At Bellevue a 10-kw transformer has been installed to supply a small community there with energy at 110 volts and 220 volts for house lighting. The village of Sloan is supplied by a 30-kw transformer in the same way.

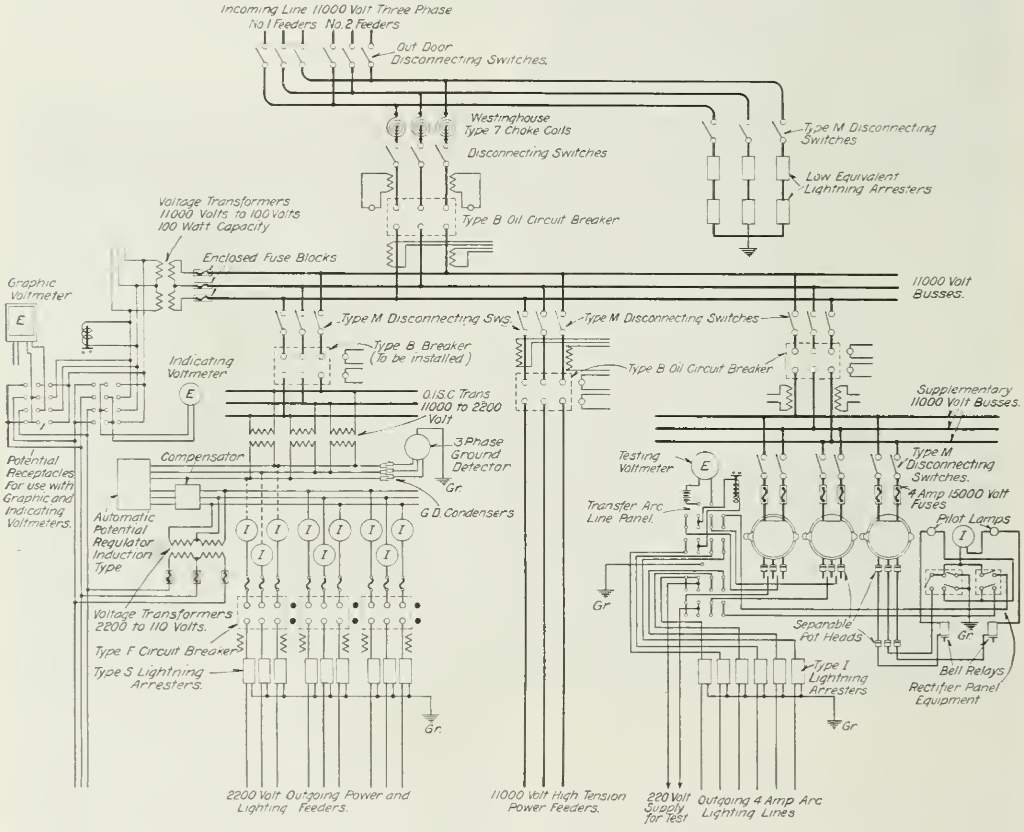

Incoming Line 11000 Volt Three Phase
No 1 Feeders No. 2 Feeders
Out Door Disconnecting Switches.
Westinghouse Type 7 Choke Coils
Disconnecting Switches
Type M Disconnecting Switches
Low Equivalent Lightning Arresters
Voltage Transformers 11000 Volts to 100 Volts 100 Watt Capacity
Type B Oil Circuit Breaker
Enclosed Fuse Blocks
Graphic Voltmeter
E
11000 Volt Busses.
Type M Disconnecting Sws.
Type M Disconnecting Switches
Type B Breaker (To be installed)
Indicating Voltmeter
E
Type B Oil Circuit Breaker
O.I.S.C Trans 11000 to 2200 Volt
Supplementary 11000 Volt Busses.
3 Phase Ground Detector
Gr.
Compensator
G.D. Condensers
Potential Receptacles For use with Graphic and Indicating Voltmeters.
Automatic Potential Regulator Induction Type
I
Testing Voltmeter
E
Type M Disconnecting Switches.
4 Amp 15000 Volt Fuses
Transfer Arc Line Panel.
Pilot Lamps
I
Gr
Voltage Transformers 2200 to 110 Volts.
Type F Circuit Breaker
Type S Lightning Arresters.
Gr.
Separable Pot Heads
Gr.
Type I Lightning Arresters
Bell Relays
Rectifier Panel Equipment
Gr
2200 Volt Outgoing Power and Lighting Feeders.
11000 Volt High Tension Power Feeders.
220 Volt Supply for Test
Outgoing 4 Amp Arc Lighting Lines

Fig. 2—Wiring Diagram of Generating Station.

The arc-lighting contracts in the various villages having expired on Jan. 1, 1910, it was decided to endeavor to secure new contracts permitting the use of metallic-flame arc lamps instead of carbon arc lamps. Five-year contracts were closed with the villages for the new type of lamps, the Westinghouse 4-amp metallic-flame series arc lamp.

Two 11,000-volt feeders convey energy from the Gardenville substation to the Lancaster substation. Outdoor type (22,000-volt) disconnecting switches, mounted outside of the station, are inserted in each of these two 11,000-volt feeders. The load is ordinarily carried by one feeder, but in case of interruption to service, after five minutes, the other feeder is available without notice from the load dispatcher.

A general interior view of the station is shown in Fig. 1 and a connection diagram in Fig. 2. Inside of the station all of the 11,000-volt wiring is supported on 1¼-in. pipe framework and carried on brown-glazed porcelain insulators which are held on iron pins arranged to clamp to the framework pipes. All of the 11,000-volt buses are ½-in. (outside diameter) brass tubing. All joints, taps and elbows in the buses are made with Dossert connectors.

A low-equivalent lightning arrester, part of which is visible in Fig. 3, protects the station, and choke coils are inserted between the line and the station wiring as suggested in Fig. 4. The incoming line panel, shown in Fig. 4, carries a disconnecting switch for each leg of the 11,000-volt, three-phase circuit and an automatic oil circuit-breaker. Leads from the breaker connect to what may be considered station buses. Energy, outgoing from the station, is used for three distinct purposes and hence the switching, metering and other equipment within the station naturally divides itself into three well-defined groups, viz: apparatus for 2200-volt, three-phase lighting and power service, apparatus for 4-amp series arc lighting and apparatus for 11,000-volt, three-phase motor service.

Lightning arresters, visible above the board in Fig. 6, protect the station equipment from static disturbances. In Fig. 7 is shown a view in the rear of the switchboard. It indicates the substantial methods adopted for supporting the wiring.

Where a large amount of energy is sold to a customer it is transmitted to him at 11,000 volts. That energy transmitted at this pressure can be controlled, taps from the 11,000-volt incoming line are brought into the station and through disconnecting switches and an automatic oil switch as shown in the diagram, Fig. 2. The panel carrying these 11,000-volt switches is the center one in Fig. 4.

Energy for arc lighting is received by each of three West-

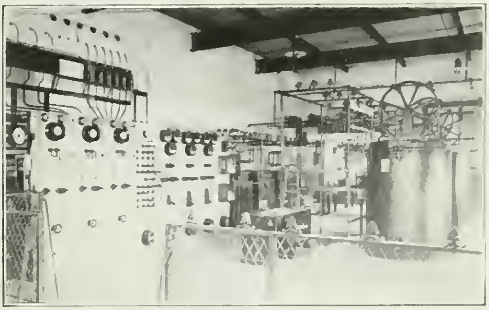


Fig. 3—View of Switchboard and Constant-Current Transformers.

inghouse seventy-five-light rectifiers at 11,000 volts and converted to direct constant current (4 amp). On the constant-potential side disconnecting switches and an automatic oil switch are inserted between the main bus and the rectifier bus, as shown in Fig. 2. The handle and face plate for the 11,000-volt switch for rectifier control are mounted on the panel shown to the left in Fig. 4. The switch itself is mounted on the bus supports in the rear of the panel. A complete diagram of the wiring at the rectifiers is shown in Fig. 2. Each of the rectifiers is connected across one phase of the 11,000-volt, three-phase circuit and a disconnecting switch and a 4-amp fuse are inserted in such of the leads to the rectifiers. In each of the three secondary (direct-current) leads from each rectifier a G. & W. porcelain separable pothead is used to connect the flexible cable of the rectifier to the varnished cambric lead-covered cable to the control panel. A pothead of this type forms a disconnecting switch inasmuch as, by taking off the top portion, the circuit is opened.

All of the 11,000-volt high-tension wiring for the rectifiers

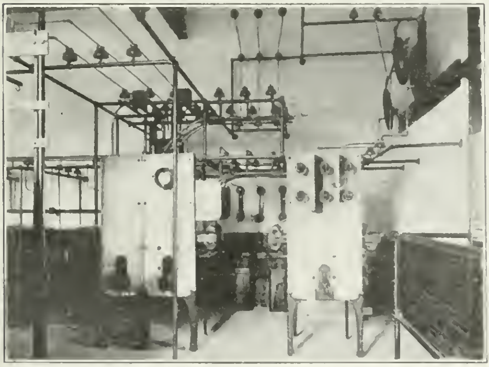


Fig. 4.—11,000-Volt Switches for Rectifier Control.

is suppported on a pipe and strap iron frame. The secondary 4-amp lead-covered cables are carried to the switchboard in wrought-iron conduit equipped with conduit outlet fittings.

For controlling the rectifiers the three panels to the left in Fig. 6 are used. Each of these is fitted with the usual ammeter, indicating lamps, testing plugs and direct-current and rectifier switches. The single-pole knife switches are connected in the relay circuits. The relays operate when the arc-lighting circuits in which they are connected open, and ring a bell and throw drops on the annunciator. The hand wheels on the rectifier panels are to be used for tilting the

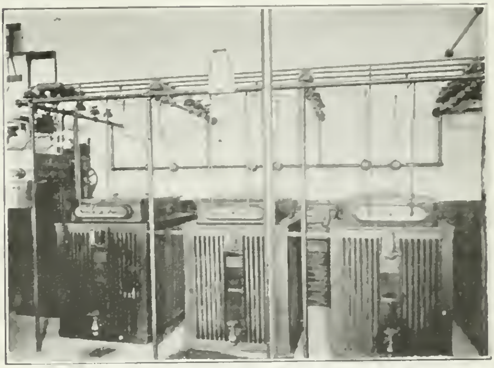


Fig. 5.—Oil-Insulated, Self-Cooled Transformers.

bulbs when starting the rectifiers. A sprocket wheel on the hand-wheel shaft at the rear of the panel will engage with a chain which will operate another shaft. This will turn the bulb-tilting shaft.

The arc line transfer panel (the fourth panel from the left in Fig. 3) is provided with equipment whereby the arc lines can be connected to the rectifiers and tested. Interconnection between the different arc circuits is effected with a single conductor cable having a plug at each of its ends. A relay which is connected with two jacks is mounted on this panel. During the day all of the lines are connected in series and in series with the relay. A 220-volt pressure is impressed across these lines and the relay in series and a small current flows through them. The relay is so connected with the annunciator and bell that if an open circuit occurs on an arc circuit during the day the station attendant is immediately notified by the operation of the annunciator. The testing of the arc lines and cables to the rectifiers is accomplished by means of a 100-volt battery and a 0 to 150 voltmeter. Watt-hour meters for reading the output on each feeder are mounted on the 2200-volt

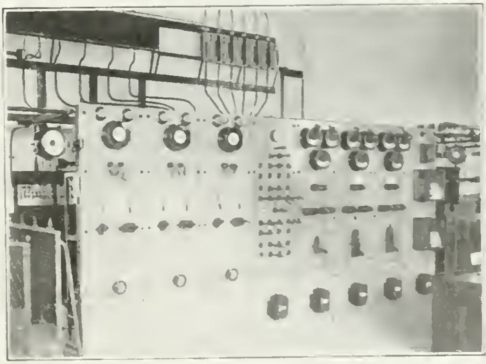


Fig. 6—Switchboard.

feeder panels, the voltage of these feeders being regulated by an automatic potential regulator, induction type. Watt-hour meters also measure the input to the rectifiers and a graphic recording and watt-hour meter is used to measure the entire input to the station at 11,000 volts. A graphic voltmeter on the board can be used for the observation of voltage on either the 11,000-volt bus or the 2200-volt bus.

A new standard mast arm, illustrated in Fig. 8, has recently been adopted by the company. The new mast arms are constructed of 1¼-in. galvanized pipe and in lengths from 8 ft. to 16 ft. They are wire-braced and supported by means of galvanized steel strand fitted with eye-bolts to permit of an adjustment in all directions. The cast-iron pulleys are fitted with sheaves with bronze bearings. The lamps are supported from safety clutches insulated from the hanging rigs by Ajax lamp insulators, to which are attached insulated supports for dead-ending the No. 8 standard duplex cable. This twin cable is attached to the pole on a brown-glazed, split-porcelain insulator which extends 5 in. from the faces of the poles. The lamps are raised and lowered by a cord fastened at the ground end by means of metal rope clamps and snaps, which can be fitted with padlocks when necessary. All metal parts of the mast arms are galvanized and the construction, though light, is very strong. A feature of this construction is the wind brace used to take up the side strains.

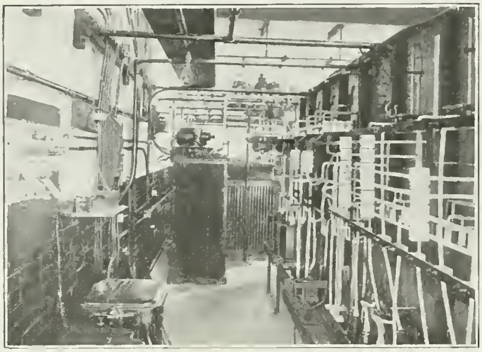


Fig. 7—Back of Switchboard.

The arc-lighting lines are divided into three circuits, all of which are No. 6 triple-braid copper, carried on brown porcelain-glazed insulators. At the point where the line loops to feed the village of Sloan, which point is located at Borden Road, an outdoor-type, double-throw oil switch is installed. This cuts out several miles of arc line and thirty lamps. The villages of Lancaster and Depew are supplied with commercial small motor and lamp service. For this service three-phase, 2200-volt energy is conveyed from the Lancaster station by two feeders. These feeders are run on extra-deep-groove, double-petticoat glass insulators to the power customers in each village. The lighting districts are fed by single-phase extensions from these three-phase feeders. The points of connection are protected by Westinghouse single-pole primary cutouts using inclosed fuses, all metal parts being heavily galvanized. The feeders are protected from lightning by Westinghouse arresters at numerous points. Several customers on this system take power at 2200 volts and have their own transformer houses, in which lightning arresters are also installed These customers use a standard incoming line panel equipped with disconnecting switches, switchboard polyphase watt-hour meters and automatic oil circuit-breakers. The energy in all these cases is measured on the 2200-volt side. All the power service below 10 hp is supplied at 220 volts, either single-phase or three-phase, according to the character of the load. No three-phase motor service is given below 5 hp unless there are other three-phase motors already in use in the same district.

The standard form of line construction with arc lamp and commercial circuits includes 10-ft., 10-pin cross-arms, these in all cases being above the telephone wires. These arms carry the arc, 2200-volt, and 220-110-volt secondary lines. Service wires are run direct from the arm by means of two-wire and three-wire spreader brackets. In the commercial districts the three-wire secondary is fed in separate sections by single transformers, but these sections can be multipled in case of necessity by means of jumpers, as the end of each secondary section is dead-ended on an iron break-arm, bringing the ends of the two sections about 1 ft. apart. During the winter load these ends are sometimes connected together through a single-pole fuse block, thus putting the two transformers in multiple and helping to divide the lighting load on the transformers. The single-phase load is balanced as near as possible at the point of attachment of the single-phase extensions.

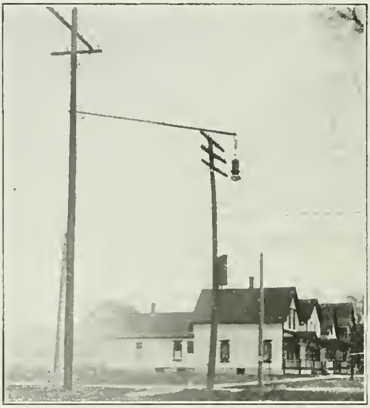


Fig. 8—Standard Arc-Lamp Mast Arm.

In June, 1910, the Depew & Lancaster Light, Power & Conduit Company entered into an agreement with the New York Telephone Company for the joint use of poles. The agreement covers all lines in this territory, and as a result of its terms the lighting company eventually will have all its wires above the telephone wires. The specifications forming a part of this agreement are the same as those in effect between the Public Service Corporation and the Bell System in New Jersey. Work is progressing rapidly toward bringing the construction into accordance with these specifications and this work will be completed by the fall of this year. This means that practically all equipment inside and out has been replaced or renewed by the new management. All engineering work and construction work was done by the company and under the direction of Mr. Tremaine, the superintendent. The construction is model throughout. Nothing is being left undone by the management to give the best possible service to customers, and this progressive policy has won for the company a very friendly feeling in the community it serves.

The company has a neat office building which is divided into a main general office, back of which is the general manager's and directors' room and beyond that the superintendent's room and meter-testing department and storeroom. This arrangement makes for convenience and permits everything to be handled in the most efficient manner.

CONNECTICUT RIVER ENERGY IN WORCESTER.

SINCE the completion of the first plant of the Connecticut River Transmission Company at Vernon, Vt., the supply of hydroelectric service in central Massachusetts, and particularly in Worcester County, has well illustrated the immediate acceptance which low-priced energy finds in a manufacturing community. Eight units of an aggregate rating of 20,000 kw have now been installed at the Vernon station, from which energy is transmitted to Brattleboro, Vt., at 19,000 volts, and to Winchendon, Gardner, Fitchburg, Leominster, Clinton, Sterling, West Boylston, Marlboro and

Worcester at 66,000 volts. The engineering details of this system have already been described in this journal. The high-tension transmission is effected by means of conductors of copper, No. 2 B. & S. gage, carried on 35-lb. porcelain insulators supported on steel towers. Exclusive of a branch line to Fitchburg, there are now about 885 towers on the system, giving an average spacing of 410 ft. between towers, although there is a maximum span of 1940 ft. over the Wachusett Reservoir near Clinton.

Substations are now located at Gardner, 1500 kw; Fitchburg, 4500 kw; Clinton, 4500 kw, and Worcester, 4500 kw. The Fitchburg service now includes the three mills of the Parkhill Manufacturing Company, 1920 hp; the seven mills of the Crocker-Burbank Paper Company, 1400 hp; the De Jonge Paper Company, 900 hp; the Fitchburg Gas & Electric Light Company, 1000 hp, and the Falulah Paper Company, 500 hp. At Clinton the company supplies the Lancaster Mills, 4000 hp, and the Marlboro Electric Company, 800 hp. As the plant of the Lancaster Mills operates at 40 cycles and the frequency of the Connecticut River system is 60 cycles, two 1500-kw motor-generator sets are installed to change the frequency. The motor end of each unit operates directly on 13,200-volt feeders at 60 cycles and the generators operate at 600 volts and 40 cycles. The motors are of the synchronous type and can be used in reverse operation as generators if desired.

At Worcester the company has a substation in the Greendale district equipped with three 1500-kw transformers stepping the main transmission potential from 66,000 volts to 13,200 volts. Both transmission circuits enter all stations and the switching arrangements provide for throwing the load on either of the two lines without interrupting service. All substation switches are electrically operated by current received from storage batteries. Normally the Worcester load is carried on one transmission line and the Gardner, Fitchburg and Clinton load on the other, although the lines can be paralleled at each substation and the load transferred during normal operation without interruption to service. The transformers are of the oil-cooled type, with motor-driven water circulation and a city supply for emergency use. At present four aerial, three-phase circuits leave the Greendale substation, two running into the city of Worcester proper, one to the Osgood Bradley Car Company and one to the Town of West Bolyston, supplying the community with energy for street lighting and for miscellaneous service. The two circuits running into the heart of the city of Worcester are carried to a terminal house on Brookfield Street, where the underground cable system begins and where lightning arresters and switching devices are protecting, testing and interconnecting the circuits and cables. From the substation to Brookfield Street, a distance of 2.8 miles, the two feeders are of No. 2-0, B. & S. gage, stranded copper wire, on a wooden pole line, with space for two additional cross-arms if future business demands.

From the cable station at Brookfield Street two No. 4-0, three-phase, paper-insulated cables are carried underground to the North Works of the American Steel & Wire Company, a distance of about 2400 ft. A No. 1-0, three-phase, paper-insulated lead cable is carried underground from the North Works of the wire company to the South Works at Quinsigamond, a distance of 3.07 miles, in the conduits of the Worcester Electric Light Company, which are leased for the purpose. Under a ruling of the Massachusetts Gas & Electric Light Commission the transmission company is required to confine its sales of electricity to consumers of 300 hp rating or over in the cities of Worcester and Fitchburg, leaving the small power field to the local companies in each case.

The equipment of the principal mills in Worcester supplied by the Connecticut River Transmission Company is as follows:

South Works, American Steel & Wire Company:

One 800-kw motor-generator set taking current at 13,200 volts and delivering it at 250 volts, direct-current service, for general purposes, and one electric furnace for steel making, which consumes from 1500 kw to 2000 kw. In this furnace molten metal from the wire company's open-hearth furnaces is used in about 8-ton charges. Three electrodes, each consisting of four 8-in. carbon sticks, are automatically fed into the metal and current at 100 volts is maintained for periods of from sixty to ninety minutes, during which time various fluxes and alloys are added. It is reported that the quality of steel from this furnace is superior to that of the basic furnaces and that the refining is effected in much less time.

North Works, American Steel & Wire Company:

Two motor generators are installed of 1300-kw total rating Each motor receives alternating current at 13,200 volts and the generators deliver it at 250 volts, direct-current service, operating in parallel with the existing steam-engine plant.

Norton Grinding Company:

This company has fifteen motors installed, ranging from 7.5 hp to 100 hp and rated at 415 hp total. The motors drive lathes, planers and other shop tools, both the individual and group drives being used. The maximum demand averages 250 hp and the daily load-factor about 56.5 per cent in this installation.

Bradley Car Company:

This plant is equipped largely with the individual motor drive. The connected load is 1535 hp, composed of ninety-eight motors ranging in size from 2 hp to 300 hp. The Bradley company has found a material saving in power to result from the use of individual motors, as throughout practically the entire plant power is consumed only in proportion to the work actually being performed. The average load is about 500 hp and the daily load-factor 60 per cent. The Connecticut River Transmission Company makes a practice of carrying its feeders to the premises of consumers and requiring them to install all apparatus for their local needs. Disconnecting switches are installed usually at the entrance point of each customer's service, with both integrating and graphic recording wattmeters for each consumer. About 4000 kw in synchronous apparatus is in service on the system and the power-factor at Vernon is about 90 per cent. A contract has recently been made with the Metropolitan Water & Sewerage Board for the output of the hydroelectric plant which will shortly be built at the Wachusett Dam in Clinton, where water is delivered to an aqueduct for the Boston supply. It is planned to install four 1000-kw generators here. As the reservoir is usually drawn upon in the summer, the power can be used at times when the Connecticut River is likely to be low. Interests associated with the Connecticut River Transmission Company are preparing to develop about 50,000 hp under 800 ft. head on the Deerfield River, and it is probable that the two systems will in some measure be co-ordinated. The writer is indebted to Mr. E. J. Richards, general superintendent of the Connecticut River Transmission Company, for the information which is contained in the foregoing article.

STONE LAMP-POSTS IN BLOOMINGTON, IND.

Stone lamp-posts for a rather extensive curb-lighting system form a unique feature of the attractive city of Bloomington, Ind. These posts are not concrete, but are made of natural limestone. This limestone abounds in the neighborhood of Bloomington, and several companies located there are engaged in producing and milling it. Fig. 2 of the accompanying illustrations gives a perspective view showing the appearance of a double line of these posts along a business street

When it was decided to install a new system of curb lighting the committee in charge of the matter considered at first, as was natural, the installation of ornamental iron posts. The new lighting system was one outgrowth of a public demand for civic betterment, and on investigation it was found that the cost of an iron post of handsome design, such as was wanted, would be too great. It was desired to make the system of lighting uniform, and as the population of Bloomington is only about 10,000 the expense must not be prohibitive. To insure uniformity it was agreed that the city should have sole charge of the new lighting, both as to installation and in relation to future extensions.

Another objection to iron posts that was urged was that they were not impressive or particularly beautiful by daylight. While the type and design of the posts were under consideration someone suggested that they be made of the Indiana limestone, with the marketing of which the city of Bloomington is closely identified. This was considered a happy thought, and after some discussion was finally adopted. As shown by the pictures, the posts are dignified and impressive in appearance and they also serve to direct attention to a leading industry. About 120 of the posts are in service, each surmounted, as shown, by a globe containing a 40-watt tungsten lamp and supporting a crosspiece to which two dependent lamps of similar type are attached.

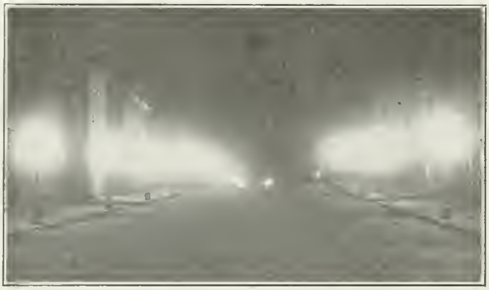


Fig. 1—Night View of Curb Lighting in Bloomington, Ind.

In making the installation the steel-taped cable made by the Simplex Electrical Company was found to be particularly convenient. One notable feature of the installation is that the 120 posts were erected and made ready for lighting service without placing a single conduit box or joint under the pavement. This was made possible by the construction of the stone posts, which have a section of the base sawed out large enough to permit both ends of the cable to be looped into this space, thus allowing the lamps to be connected and the other end of the cable to be continued on to the next post. This space in the base also contains the fuse box. The sawed-out block in the base can be taken out and replaced in a few minutes. The space in the base of the post makes it possible to do away with a conduit box in the gutter, and this cuts down the cost of installation materially.

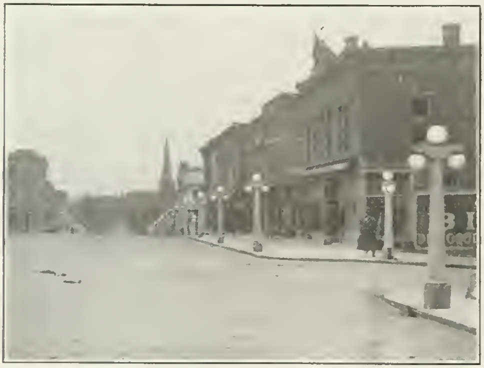


Fig. 2—Stone Lamp-Posts in Bloomington, Ind.

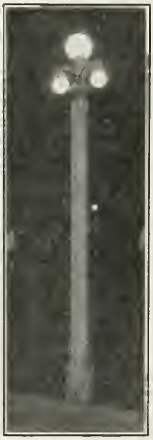
At the time the erection of the posts was under way the streets were being paved with brick. This pavement was laid on a concrete foundation 8 in. deep, over which was placed sand 2 in. deep, the top surface consisting of brick. A 2-in. pipe was pressed into the concrete while it was being laid and was later removed, leaving a depression nearly 2 in. deep in the hard concrete. The posts are spaced 55 ft. apart, and this distance was measured off, allowing about 8 in. of cable to protrude above the sidewalk. The cable was then laid in the depression in the concrete and the only covering over it is the 2 in. of sand and the brick surface of the pavement. The cost of the cable used was 20½ cents a foot. It was necessary to have two pairs of wires, as the lamps are on two circuits. With one circuit the price of the cable would be reduced to 12 cents or 13 cents a foot.

The stone posts illustrated herewith cost $35 each in Bloomington and each one weighs about 800 lb. Aside from the posts the cable and the cast-iron shade holders (the last named costing 35 cents apiece), the rest of the fixture was made with ordinary iron pipe and pipe fittings. In future, however, galvanized-iron pipe and fittings will be employed.

All three lamps on the posts are burned from one-half hour after sunset until 10 p. m. After 10 o'clock the top lamp only is burned, remaining lighted until one-half hour before sunrise. This splitting up of the lighting is made possible by the two-circuit system. The lamps are controlled from the central station, and electricity is supplied by the Central Indiana Lighting Company, Bloomington division, of which Mr. J. N. Moncrieff is manager. The expense to the city for operation is $1 per post per month. This does not include the cost of maintenance, which is assumed by the local Commercial Club. This lighting system was in operation nearly all of the winter of 1910-1911, and it has required no attention aside from the renewal of a few lamps. No cracking or injury to the stone posts from frost has been experienced.

CONCRETE TUNGSTEN LAMP-POST.

The accompanying illustration shows a 12-ft. concrete lamp-post used for park illumination at Oklahoma City, Okla. The post carries one 100-watt and two 60-watt tungsten lamps on its cap, which is of hammered and soldered sheet copper. The shaft is made hollow to admit the wires and to decrease the weight of the material needed. The mold used is in two halves, which open to release the post after the concrete has hardened. The core used to make the internal opening is given a slight draft so that it can be withdrawn as soon as the concrete has set sufficiently to hold its own weight, but before hardening has advanced very far. The cost of making these posts was $4 each for the concrete shaft alone, the post fitted with sheet-copper cap costing $8 complete.


Tungsten Lamp-Post of Concrete.

EXPERIENCE WITH CONCRETE POLES AT OKLAHOMA CITY.

Since 1907 nearly 1000 concrete poles have been erected in Oklahoma City for the distribution lines of the local central-station company, and after an experience with this form of construction concrete poles have been adopted there as standard construction for all principal lines. The poles used in Oklahoma City are of a locally designed hollow type, the feature of which is the tension under which the reinforcing members are placed and afterward maintained in the hardened pole. While the first cost of these concrete poles is about 50 per cent more than that of similar wood poles, the depreciation on the former is practically nil.

The majority of poles in Oklahoma City are of the standard 35-ft. type shown in Fig. 1. These poles are hexagonal in section, 16 in. in diameter at the base and 7 in. at the top, have walls approximately 2¾ in. thick and weigh 2000 lb. each. The internal opening varies from 9 in. at the base to 2 in. at the top. They are set in the ground to a depth of 6 ft. The cross-arms are of steel angles, 2½ in. x 3 in. x ⅜ in., through-bolted to the flat side of the pole through holes cast in the concrete at the time of pouring. Additional holes can easily be bored wherever desired. Steel pins with wood tops are used to carry the insulators.

The poles are poured in models made of ¼-in. galvanized iron, a concrete mixture of one part cement, two parts sand and three parts crushed stone being used. The outer mold, as shown in Fig. 2, is made in two halves, which can be opened to release the finished pole. The core forming the tapered internal opening is arranged to telescope within itself, and must be withdrawn as soon as the concrete has set sufficiently to hold its own weight, otherwise if allowed to remain too long the core may be rigidly held by the concrete.

Running through the full length of the pole above described are twelve ¼-in. twisted or deformed reinforcing bars. The pole is poured with each of these rods under a tension of 11,000 lb., this tension being maintained throughout the setting of the concrete so that in the hardened pole the bars are still continuously subjected to this tension. During pouring the tension is applied by an arrangement of ratchets and screw threads, the reinforcing bars being kinked through hardened-steel tension eyes, which grip them. This tension is not released until the concrete has hardened sufficiently to support the strain itself. The use of the reinforcing bars in tension has been found to improve greatly the performance of the poles, and this application of tension, together with the construction of the molds and cores used for pouring the concrete poles, is the subject of several patents issued to Mr. F. H. Tidnam, general manager of the Oklahoma Gas & Electric Company.

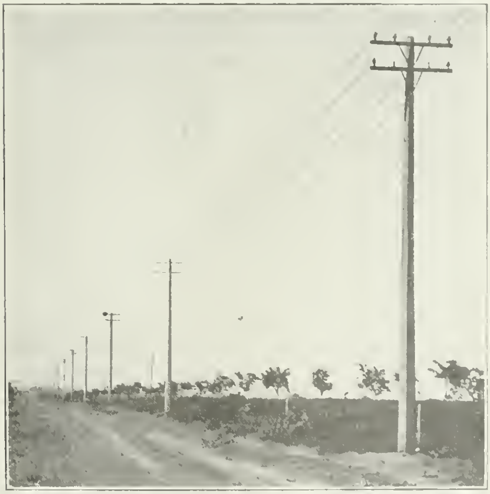


Fig. 1—Hexagonal Hollow Concrete Poles in Oklahoma City.

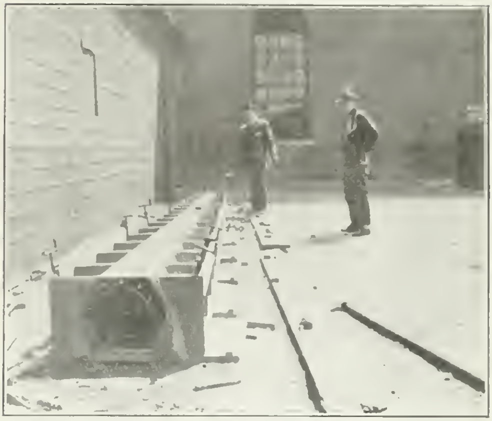


Fig. 2—Concrete Pole in Mold.

The actual manufacturing cost of the 35-ft. pole is $8.50 at Oklahoma City, where cement costs $2 a barrel. The set of forms for such a pole cost about $45. A gang of five concrete men can turn out from seven to eight poles per day, using fourteen forms. The number of cores need be only about half the number of forms, as the cores are pulled as soon as the concrete is partially set. The concrete poles are erected by special derrick wagons, the number of men required in a gang being the same as would be needed for equivalent wood poles. The concrete poles are climbed by extension ladders which can be adjusted to the height of the pole.

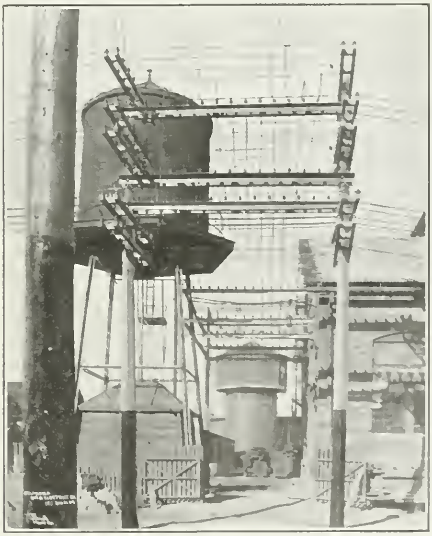


Fig. 3—Concrete Poles at Line Entry to Power House.

Tests of these poles in position, applying 1500 lb. stress to their tops, have shown a possible 2½ ft. deflection without giving way. The poles will safely withstand a horizontal stress of 1500 lb. at the cross-arm height, it is declared. The above test was tried on newly made poles, and the results would probably be much better in the case of older poles, since concrete hardens with age. Evidence of the strength of these concrete poles to bear heavy overhead construction is shown in Fig. 3, where two 40-ft. poles are illustrated carrying weights of 4000 lb. per pole, made up of No. 000 copper feeder cables, angle arms, guy tension, etc. The example shown is the feeder exit from the power plant of the Oklahoma Gas & Electric Company.

Use is also made of the hollow interior of the poles to bring down 2300-volt lines to underground distribution cables, and also, in residence sections, to run down to underground service lines leading under lawns, etc.

Fig. 4 shows the typical concrete-pole alley construction adopted in Oklahoma City, where all distribution lines, so far as possible, are removed from the main streets. Thirty-foot concrete poles are used, carrying 20-ft. steel arms in the case of 18-ft. alleys. Twenty-five-foot concrete poles are also used to a limited extent in Oklahoma City and cost $6 each to manufacture. A number of 30-ft. poles with 8-in. tops, constructed by an adaptation of the 35-ft. forms, have been used for trolley-bracket suspension. Twenty such poles along an interurban railway track have been in service six months.

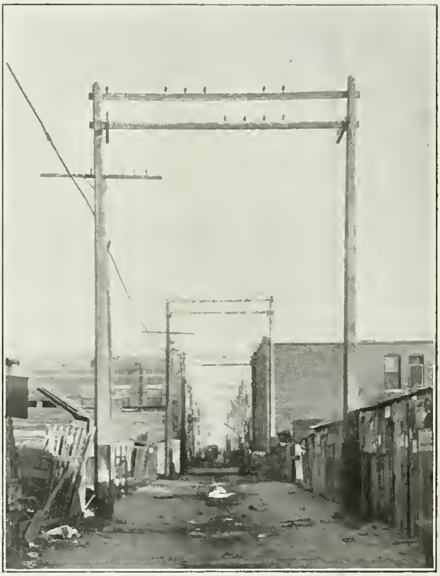


Fig. 4—Distribution Line Carried on Concrete Poles with Steel Arms.

The first concrete poles were erected in Oklahoma City in 1907, and these, after four years' service, show no visible depreciation. To settle the question of whether any moisture could penetrate through the concrete, affecting the steel reinforcing, several of these early poles were taken down and broken open. Examination showed the interior of the pole to be absolutely dry and the steel unchanged. Owing to the hardening of the concrete with age, the poles tested actually stronger after a few years' service than when green. Mr. G. M. Brown, superintendent of lines for the Oklahoma Gas & Electric Company, believes that, while the concrete poles used in Oklahoma City cost perhaps 50 per cent more than wood poles, the fact that those of concrete show no measurable depreciation after long use makes them in the long run really cheaper to install than short lived wood poles.

SOME NOTES ON THE LIMITATIONS AND ADVANTAGES OF HYDROELECTRIC POWER.

By Clarence P. Fowler.

I. LIMITATIONS.

1. *Development Cost.*—Over-optimism on the part of some consulting engineers as to the possibilities of water-power and a failure to recognize some of its limitations as to expenditures necessary to render it useful have resulted in "tying up" no small amount of capital invested in partially completed undertakings of this character. It also not infrequently happens that after a development has been made to take care of some predetermined amount of primary power it is finally discovered, owing to variable stream flow, that the estimated amount of power can be depended upon continuously only by incurring considerable additional expense for providing auxiliary power to make up whatever deficiency is found to exist, thereby increasing both fixed and operating charges and curtailing the margin available for profit originally estimated upon.

The possibilities of water storage have also, in many instances, been pointed out without due regard to the vast sums often required for the erection of suitable works for impounding sufficient water to equalize an otherwise variable stream-flow. Even with the addition of storage reservoirs it is found that silting up of the storage space, a characteristic of rivers in some localities, causes no small amount of expense at intervals to relieve this difficulty.

2. *Proximity to, Extent and Nature of Market.*—There are some cases where the development of hydroelectric energy has attracted industries to such centers, a notable example of which exists at Niagara Falls, where the number and extent of industrial enterprises which have grouped themselves about the great water-power plants there have reached vast proportions. The causes, however, which have been active in locating these industries at the Falls have not been exclusively cheap electric energy, but this essential element in combination with unexcelled transportation facilities by both land and water and a large part of the consuming population of the United States and Canada within a comparatively short radius.

The position held by the developments at Niagara is, of course, unusual, and hydraulic power is for the most part found in remote localities which, owing to topography and other adverse conditions, do not lend themselves well to the establishment of ideal manufacturing sites. In general, then, it is apparent that water-power is subject to limitations as to location, and if energy generated from waterfalls is to become available for industrial uses it usually means electrical transmission over a greater or lesser distance.

While elaborate mathematical demonstrations as to the maximum distance to which energy can be economically transmitted have formed the subject of no little discussion before engineering societies and in the columns of the technical press, yet this matter in the present state of the art boils down in the final analysis to a problem the solution of which falls easily within comparatively well-defined limits determined by engineering and commercial considerations peculiar to the local conditions surrounding any given case. With a given percentage of profit the distance that may economically intervene between the point of generation and that of utilization depends principally upon the total amount of energy that may be marketed, considered in connection with the unit price that may be obtained through its sale, as the following concrete example will show.

Let it be assumed that 10 per cent is the minimum profit allowable upon the total investment after deducting operating expenses and depreciation. Let it further be assumed that the hydroelectric development would require a capital expenditure in generating and receiving plant of $200 per kilowatt delivered, and that 20,000 kw can be sold at an average price of $45 per kw-year with operating expenses at $12 per kw-year. The gross receipts would, therefore, be $900,000 with operating expenses of $240,000, leaving net earnings available for profit and depreciation of $660,000. If depreciation be figured at 3 per cent on the total investment, this item, together with 10 per cent profit on the capital cost of generating and receiving, amounts to $520,000, thus leaving $140,000 available for profit and depreciation on the capital expenditure for transmission purposes, which would permit of an expenditure of something over $1,000,000 for this end of the undertaking. If, now, the transmission system can be built at a cost of, say, $5,000 per mile complete, it will be seen that it would be possible to transmit the above energy over not more than 200 miles under the assumed conditions. Twenty thousand kw is about the maximum amount of power that would probably be advisable to "tie up" in one line, and this gives a reasonable regulation at standard frequency and with limiting line voltage now in use and with load power-factor not below that commonly encountered in such systems.

It is evident, then, that if energy from remote waterfalls is to compete successfully through the medium of electrical transmission with energy locally generated, one of the chief essentials is that the former shall be generated and transmitted in large blocks, a condition which often precludes the possibility of economically developing a water-power.

The nature of the power load as measured by load-factor forms quite an important element in determining the value of hydroelectric energy, as compared with energy generated in steam-electric plants. In large steam-driven electric plants operating at low load-factors of some value in the neighborhood of 20 per cent or below it is the rule to find that this method of energy production outstrips its hydroelectric competitor in the matter of cost. However, as the load-factor increases above a certain value hydroelectric energy shows up to better advantage, this, of course, being due to the fact that the cost of hydroelectric energy is practically fixed and independent of the amount used, whereas in the case of steam-produced power a much larger proportion of the operating expenses depends upon the consumption.

3. *Reliability.*—While the reliability factor of the generating and receiving apparatus of hydroelectric plants is equal to or better than that of the apparatus composing their hydroelectric competitors, and while transmission construction has attained a substantial basis, reliability of the latter being much enhanced by the use of duplicate lines, yet where it is necessary to transmit energy over long distances to reach the market, the importance of which demands uninterrupted service, reliability is a characteristic of the system which should receive careful attention and to insure which large expenditures in reserve equipment at the receiving end of the transmission system are regarded as a necessary adjunct to any well-planned enterprise.

4. *General.*—In summarizing the principal limitations characteristic of plants for the production of hydroelectric energy, enumerated above, the writer cannot do better than quote from the report of Mr. T. C. Martin on the "Technical Aspects of Central Electric Light and Power Stations," 1907, included with the special reports on this topic by the Department of Commerce and Labor of the United States. Of hydroelectric enterprises Mr. Martin has the following significant statement to make: "In every part of the country where water-powers lay undeveloped enterprises on a large scale have been set on foot for the purpose of hydroelectric generation and energy transmission. In fact, the period from 1902 to 1907 may be regarded as one of great speculative activity in this respect, with the result that many plants have come into existence that remain unprofitable, either because the work has been too costly, because there is little market for the energy when developed or because the problems of economical and uninterrupted transmission have not been mastered."

II. ADVANTAGES.

1. *Comparative Freedom from Interruption Due to Strikes and Fuel Supply.*—Owing to the comparatively small number of wage-earning employees required for the operation of hydroelectric plants, together with their freedom from difficulties of fuel supply incident to strikes on railroads and at coal mines, freight congestion, etc., steam-electric energy suffers in comparison with hydroelectric energy in reference to the ability of the latter to produce a non-interrupted revenue. Large investments in fuel are therefore unnecessary with hydroelectric plants to tide them over an emergency in the shape of a fuel famine. In this connection it is interesting to note that one of the largest public-service properties in the Middle West finds it necessary for a precaution against interruption of fuel supply from any cause to carry about 180,000 tons of coal in storage, which amounts to about two months' supply. Even when conservatively estimated this amount of coal represents a large amount of idle capital "tied up" to insure continuous operation.

This necessity on the part of steam plants for comparatively large amounts of working capital as compared with hydroelectric plants gives the latter quite a strategic position as compared with the former and is of great importance, particularly in times of financial stringency such as were experienced in 1907.

2. *Operating Ratio and Depreciation.*—Quite an advantageous operating characteristic of well-managed hydroelectric plants, as compared with steam-electric plants, is the relatively large increase in gross receipts without a corresponding increase in operating expenses, thus cutting down the operating ratio. As illustrating this feature there is given below a five-year statement of the ratio of operating expenses to gross receipts of a well-known hydroelectric development.

Year of Operation	Operating Ratio in Per Cent
1	53.5
2	32.4
3	30.0
4	23.0
5	23.0

During the five-year period tabulated above the gross receipts increased from approximately $110,000 to $460,000, while the operating expenses increased only, approximately, from $58,000 to $108,000.

Owing to the relatively large proportion of total investment in hydroelectric enterprises devoted to construction of a more or less permanent nature as compared with the equivalent steam plants, the amount that is necessary to set aside annually to cover depreciation of plants of the former type ranges probably from not more than one-third to one-half of that required for plants of the latter class.

3. *Competition.*—The measure of success with which hydroelectric energy will meet in competition with steam energy locally produced will depend largely upon the price of steam fuel in the particular locality in question, together with the possible economies attending its use. Our principal fuels are wood, oil and coal. Wood is now almost a thing of the past, and oil, although used somewhat extensively in some parts of the country, is of limited occurrence and ere long may cease to be an important element as a source of energy. Coal is therefore our chief remaining steam fuel, and as coal advances in cost hydroelectric energy furnished under proper conditions promises well to hold its own with energy generated from our most important remaining combustible.

4. *Hydroelectric Development as an Aid in the Conservation of the Fuel Supply.*—That general interest in conservation on this continent has been aroused is evidenced by the attention deservedly given this topic by the federal governments of both the United States and Canada through the formation of conservation commissions. The proposed program of these commissions is very comprehensive in scope, including, as it does, the conservation of all the principal elements of natural wealth as represented in the forests, water-powers, mines, agricultural resources, fisheries and game, and there now exists

a society for promoting the conservation of human life through encouragement in the use of safety appliances. While need doubtless exists for husbanding our natural wealth along all lines above indicated, yet not one of the least urgent of these is the necessity for some prompt measures to check the rapid rate at which our coal deposits are being depleted. United States governmental statistics show that since early in the nineteenth century the average yearly coal production of this country practically doubled each decade, and will, it is estimated, reach the average yearly value of approximately 550,000,000 tons in 1915.

There is perhaps some hope that engine economy may be improved to a slight extent and probably boiler economy to a greater degree, but the demand for fuel is accelerating too vigorously to expect material relief due to any refinements along this line. One must then naturally look for a fuller realization of the conservation ideal to a more general use of the energy of the falling water in the various watercourses.

The most advantageous method of conserving the water-powers is, of course, to use them, and stimulation in such use has been largely brought about through improvements in high-tension transmission coupled with the exhaustion of our fuel supply, and as time goes on increased activity may be expected, and many hydroelectric developments which may now not be considered commercially feasible may then be undertaken, provided legislation does not operate to retard such enterprise; in any event, increase in the number of such developments will naturally be most active in those localities where fuel is scarce.

Even during the past few years the two forces above referred to have been doubtless responsible for the increased development and use of hydroelectric energy. As bearing upon this situation, during the period from 1902 to 1907 the special reports of the Department of Commerce and Labor on "Central Electric Light and Power Stations" record some interesting statistics showing the states in which the most marked gains in rating of hydroelectric plants at the two periods above named occurred. They are given in the first table in the next column.

The special reports above referred to and the reports of the same department covering street and electric railways give the combined output of stations for traction, electric light and motor service in 1907 as approximately 11,000,000,000 kw-hours, of which about 25 per cent, or 2,750,000,000, was generated by water-power. The coal required by the average steam plant which would be used if this water-power were not available would probably amount to 5 lb. per hp-hour, or, roughly, 6½ lb. of coal per kw-hour, or a total annual fuel consumption of about 9,000,000 tons of coal, which, at say $3 per ton, represents an annual monetary saving in the value of our coal deposits of $27,000,000.

State.	Horse-Power Rating of Hyoroelectric Developments.	
	1902.	1907.
New York	128,785	305,950
California	78,933	208,444
Oregon	11,195	102,052
Michigan	16,085	85,738
Minnesota	6,040	71 656
South Carolina	10,415	75,430
Washington	17,238	56,118
Montana	24,000	56,987
Georgia	6,121.	36,335

Further, it is roughly estimated that in the different regions of the United States there may be ultimately available the following amounts of power:

	Horse-Power.
New England, ultimately available	1,500,000
Great Lake region, ultimately available	4,000,000
Piedmont region on Atlantic and South Atlantic slopes, ultimately available	3,000,000
Central North west, ultimately available	1,000,000
Rocky Mountain and Pacific regions, ultimately available	5,000,000
Total	14,500,000

For the sake of conservatism, suppose that 30 per cent of the above amount of power, owing to commercial or engineering reasons, is unfit for development, leaving 70 per cent, or about 10,000,000 hp, available for use. This would then be equivalent to about 75,000,000 tons of coal annually, which would be effective in lowering the estimated yearly average production of the decade ending 1915 by about 14.5 per cent.

Central Station

Management, Policies and Commercial Methods

WEEKLY ELECTRICAL PAGE IN LOUISVILLE NEWSPAPER.

With the issue of May 13 the Louisville *Times* began its second season's publication of a weekly electrical page, following generally the plan used at Cleveland, Ohio. The page carries popularly prepared reading matter on electrical subjects, together with the advertisements of local electrical companies, including the two local central stations, the jobbers, supply dealers and contractors. This weekly page feature is carried for thirteen issues during the slack summer months, when, however, construction and building operations are at their height. The arrangements have been undertaken and carried out by the advertising department of the newspaper, which has, however, the advice and suggestions of local electrical men in the selection and preparation of the reading matter. The starting of the second season of this co-operative advertising in the *Times* indicates that the plan is considered a successful one in Louisville.

DETECTING THEFT OF ELECTRICITY BY REMOVAL OF NEUTRAL FUSE.

A common way of preventing a three-wire meter from registering is to remove the neutral fuse plug, which de-energizes the potential or shunt winding. Energy for 220-volt loads or balanced 110-volt loads is then furnished over the outer wires, without registration by the meter. A means of detecting this kind of theft, in which the meter is usually stopped during only a portion of the month, was suggested by Mr. F. R. Cutcheon, electrical engineer for the St. Paul Edison Light & Power Company, at the Minnesota Electrical Association convention, St. Paul, March 14. The speaker proposed the insertion of an electrolytic-cell element in the shunt-coil connection of suspected meters. The amount of metal that should be deposited on the cathode plate by the shunt current in thirty days being known, it would be easy to estimate the time during which the meter had been out of service by weighing the plate at the intervals of the inspector's calls.

DEMONSTRATION OF CENTRAL-STATION DEPENDABILITY.

At 9:05 p. m. on May 11, while 600 of the leading business men of Louisville, Ky., were present at the annual meeting of the Commercial Club, held at the Galt Hotel (the electric service for which is supplied from an isolated plant), the lamps, which had been dim all evening, suddenly became dark, leaving the assembly room without light. Fortunately the hotel was supplied with standby service from the central station of the Kentucky Electric Company, and as soon as the double-throw switch could be operated the light came on again, this time bright and steady. The incident naturally made an impression upon the business men present, and the electric company took advantage of the interest created to print advertisements in the local papers next day explaining what happened and how the adjournment of the meeting was avoided.

A number of private-plant owners have since made inquiries about central-station service for their own buildings, so that the incident is likely to bear fruit for the electric company. Every man in the room received an impressive demonstration of the dependability of central-station service.

EMERGENCY CENTRAL-STATION SERVICE.

The Piano & Organ Supply Company, of Chicago, which manufactures and repairs piano actions and other musical supplies, has operated its factory electrically for a number of years, generating its own energy in a private plant of about 400 kw. One of the two directly connected generating units was put out of service by the breaking of an engine shaft a few days ago, and as the other was not large enough to carry the load the company faced a partial shutdown. In this emergency the owners appealed to the Commonwealth Edison Company, which met the situation by installing a temporary plant consisting of a 200-hp, 440-volt alternating-current motor belted to a 175-kw direct-current generator, which, with the effective unit of the old plant, carried the load. It was necessary to install service lines for several blocks and to secure apparatus quickly to make the alternating current available for the direct-current motors in use in the factory. The Piano & Organ Supply Company was greatly pleased with the promptness of the central-station company, and it is now figuring on taking out all its direct-current motors, putting in alternating-current, 220-volt motors and relying on the central-station service exclusively. The load consists of about 1000 incandescent lamps and thirty-three motors, having a total rating of 740 hp. Another Chicago factory where central-station service has supplanted an isolated plant recently is that of the Friedley & Voshardt Company, maker of metal ceilings, where about 750 incandescent lamps and 225 hp in motors are in service.

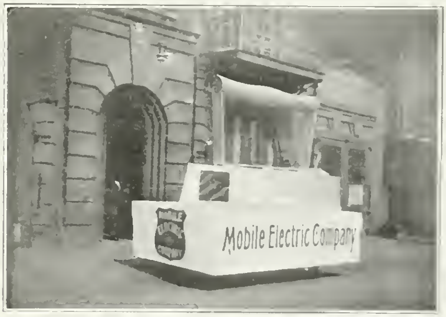
REPORT-BOX SYSTEM FOR PLANT ENGINEERS.

To make sure that the chief engineer in charge of each eight-hour shift gets over the plant at regular intervals the Brush Electric Light & Power Company at Galveston, Tex., has installed telegraph-report boxes throughout the station, which the engineer must pull at one-hour periods. There are six of these boxes in the 4300-kw steam-turbine plant. One is at the rear of the boiler-room, near the blow-offs and other piping; one in front of the boilers; two in the plant basement, and one at each end of the turbine-room. The boxes are connected to the local American District Telegraph watchmen's service, and record is made there of each box as it is pulled. Starting on the full hours the chief engineer is required to pull the boxes, for which he alone has the key, in a prescribed order and at intervals of from one to two minutes. In case any call is not received within six minutes of the appointed time the telegraph company dispatches a man to the plant to investigate, and the cost of this trip, 50 cents, is charged against the employee requiring it. The omission is also reported to the general manager, who requires an explanation from the engineer. The regular inspection of the plant by the responsible engineer of the watch, as secured by this pull-box system, has resulted in improving the maintenance and operation of the plant to a marked degree, and has also served to detect a number of minor irregularities during the hours of 6 p. m. to 6 a. m., when the report system is in operation. Owing to the presence of the service the insurance companies have reduced their charges 10 per cent.

A system of checking employees' time is also in use at the Galveston station by which each man signs his name on a paper roll on which are punched the minute, hour and date. All employees are required to sign this record when they come on or go off duty. Those who cannot write are provided with a rubber stamp. From this employment roll complete records are made up covering each man's time with the company, so that his record is evident at a glance. The signature scheme of time checking also insures the proper computation of the payroll, and in case of an accident is useful in proving what employees were on duty at the time.

AN ELECTRIC COMPANY'S PARADE FLOAT.

The accompanying illustration shows the self-propelled float of the Mobile Electric Company in the trades parade during the recent Mardi Gras celebration in that city. One of the company's electric runabouts was used, and upon this, at a cost of less than $30, was built a huge representation of an electric iron, the light boards being covered with canvas painted with aluminum bronze. The iron was complete with attachment plug. The float, which attracted considerable attention as it rolled through the streets by unseen power, was steered and controlled by a man in the vehicle seat, who peered ahead through a transparent window near the point of the iron. The annual Mardi Gras celebration is an interesting characteristic of Mobile's history, the observance of the carnival customs having taken place there earlier than in any other American city. The Mobile Mardi Gras parades are also noted for the mechanical features of their displays.



Electric Automobile Float in Mobile's Mardi Gras Parade.

KEEPING DISTRIBUTION SYSTEM RECORDS.

A paper by I. L. Craig, of the Citizens' Gas & Electric Company, of Waterloo, Ia., read before the Iowa Electrical Association convention at Davenport, April 10, described the system of keeping records of that company's distribution system. The first demand for such records, he said, comes from the office, where new prospects are daily making inquiries as to where service is available. However, such records demand most attention because of their engineering value. All proposed extensions and additions may best be planned with their aid. For example, in Waterloo the question of readjusting the arc-lighting load came up. By reference to records they were enabled to tell just what lamps could be changed from the overloaded circuit to the other, and, moreover, they discovered these changes could be made so as to shorten the circuits by nearly a mile of wire.

To obtain these records a map of the town was cut up into sections of convenient size, each section being mounted on cardboard or stiff paper. On these sectional maps each circuit is shown with red ink for the primary line, small crosses for lightning arresters and small circles for transformers. The secondary lines are drawn in green ink, with a solid line for three-wire secondary and dotted line for two-wire secondary. All special features are denoted on the map. In checking over transformer lists which had been kept on cards they were found out of date and a recanvass of the system was made by going up the pole to each transformer and taking from the name plate the size, manufacturer's number and primary and secondary voltages. It is especially important in Waterloo to keep the ratio of primary and secondary voltages correct on the records because the ratio 10 to 1 is used near the power plant and 9 to 1 at the ends of feeders on motor circuits.

Sizes and lengths of wires on the different circuits were reported by making a diagram of a pole top in a notebook, each wire being indicated and named with the size specified. The notes specify where the pole is located and for how many poles the pole-top arrangements remain the same. In getting wire measurements it is not necessary to climb each pole, but follow the circuit until a splice occurs, which is readily noticed.

After getting the three different sets of field records together the information is assembled into circuit maps. These maps are all drawn at a scale of 300 ft. to 1 in. If the tracing of a circuit map is laid over a city map of the same scale the lines will fall in their correct position with regard to the streets and alleys. Suitable symbols and a key to the symbols complete the map. A map on a smaller scale is made for the information of the new-business department.

RECIPROCAL LIABILITY INSURANCE FOR SMALL PUBLIC-SERVICE CORPORATIONS.

Insurance companies which make a business of protecting corporations and individuals against liability for injuries to employees and the public at large are said to expend at least 55 per cent of their premium receipts in obtaining this business and administering their own affairs. Even then their net income is slight after paying losses, the result being that in some districts the companies are reported to have ordered an increase of 33 per cent for all renewals of policies.

A plan for reciprocal liability insurance among a number of small central stations, avoiding the heavy business-getting and administrative costs of the regular companies, besides instituting better inspection and a more careful selection of risks, was outlined by ex-Judge Daniel G. Taylor, of St. Louis, before the Missouri Electrical Association April 13. According to his plan, which differs from mutual insurance in having no common fund, each subscriber would pay into the exchange or "attorney" a "deposit" equal to his present annual insurance rate. This amount would not be turned into a general fund, but would be credited to the individual company's account, and then in case of loss on the part of another subscriber a proportional amount of the first subscriber's deposit would be utilized to pay indemnity. All deposit money remaining in the attorney's hands unneeded for damages at the end of the year would be returned to the individual subscribers after deducting the small fixed percentage earned by the central office for administering the business. Judge Taylor declared that at least 30 per cent might be expected to be returned and saved for the companies in this way. In case of excessively heavy losses on the part of its subscribers, the membership might be called upon for additional emergency deposits up to the amount of the annual deposits. The liability, however, is thus individual and there is no general fund. While this inter-insurance plan is new to the public-service corporation field, Judge Taylor declared that other interests have employed it to advantage for some time. The lumbermen, he said, have effected a saving of 30 per cent by means of substituting it for old-line liability insurance, and the laundrymen have registered savings up to 50 per cent.

The advantages offered by such a plan to the small public-service company, he said, would be the avoidance of the usual heavy business-getting and administrative costs, for which a smaller fixed sum would be substituted, while the contributing risks would be better selected and maintained by careful inspection. Interest earnings would also be saved to the member companies.

COMMERCIAL EDUCATION OF CENTRAL-STATION SOLICITORS.

A commercial education for new employees who aspire to become salesmen for public service companies is being recognized as one of the problems which all large corporations must solve as best fits their own particular requirements. The New York Edison Company has been the first central-station company to begin preparations for the establishing of a school which is to be confined to its contract and inspection department.

Other corporations of large magnitude have, however, given considerable thought and attention to this subject. For three years past the Consolidated Gas Company has maintained a school or courses of instruction along technical lines. The courses taught have been mostly "trouble cases," teaching the employee how to locate and remedy quickly the various causes of trouble which the company is called upon to correct, such as a fallen chandelier or a leaking gas pipe, etc.

About five months ago the New York Telephone Company began in a small way to school its new employees who were to be placed in the commercial field. The employee is placed on salary and is sent to "school" for a period of five weeks. The schedule of the school courses is varied and includes such topics as "scope and policies," "duties of departments and their relations," and, of a more specific nature, general instructions divided into courses under the headings of "traffic," "plant," "auditing" and "commercial." Mr. F. W. Hearne, who is directly in charge, states that the results so far have been satisfactory. A total of 102 men has been schooled, out of which ninety-nine have "made good" in their positions. The telephone company is not satisfied, however, that it has yet perfected the ideal courses of instruction. An objection which has been raised is the shortness of the term and the constant cramming of information into the student's mind without sufficient time for assimilation.

The New York Edison Company has not as yet perfected its school. Many ideas have been suggested and a few practically decided upon as advantageous. The courses should be conducted on the university plan; lectures, recitations and examinations, with the asking and answering of questions. For textbooks its solicitors' handbook and the National Electric Light Association solicitors' handbook are considered to be desirable.

There are thirty-one subheads or bureaus in the contract and inspection department, and lectures will be delivered by those in charge of these bureaus. There will also be lectures on salesmanship by men outside of the company who have been successful as sales managers. This is done to broaden as much as possible the scope of the school. Company policy is to receive careful consideration.

A corporation grown large and practically handling the entire business in its field must not forget that its representatives, so far as the public is concerned, are the men by whom the company is judged. The salesmen and inspectors daily come in contact with the public, and the customers expect these representatives to be thoroughly competent to answer every question, and that their answers shall be intelligent. The public holds the company to a strict accounting for any statements which its representatives make. Thus the absolute necessity that the company's representatives should thoroughly understand the company's policies and methods.

Under the old plan a young man came into the company as a record clerk. If he was ambitious to be a salesman he worked his way up through a certain department, and, although he might understand thoroughly the requirements of that department, he may not have understood the many other requirements of the company or the duties which he assumed upon advancing into his new position.

CENTRAL-STATION THEATRICAL ENTERTAINMENT.

After months of preparation the Edison Players' Club of the Commonwealth Edison Branch of the National Electric Light Association presented a musical farce in two acts, entitled "The Mickey-Doo of Titti-Poo," at Orchestral Hall, Chicago, on the night of May 10. The production was elaborately staged and went off smoothly, being greatly enjoyed by an audience of about 2300 persons. About ninety persons took part in the performance, and all of them, both men and women, were employees of the Commonwealth Edison Company, the operetta being a strictly company-talent performance in every sense. The music and libretto were strongly reminiscent of Gilbert and Sullivan's "Mikado," but only as a groundwork, being so modified with original lyrics and "business" that the result was quite a different production. Two of the songs were "A Very Subtle Essence Known as Electricity" and "An Electrical Betrothal," the whole concluding with a rousing chorus, "N. E. L. A."

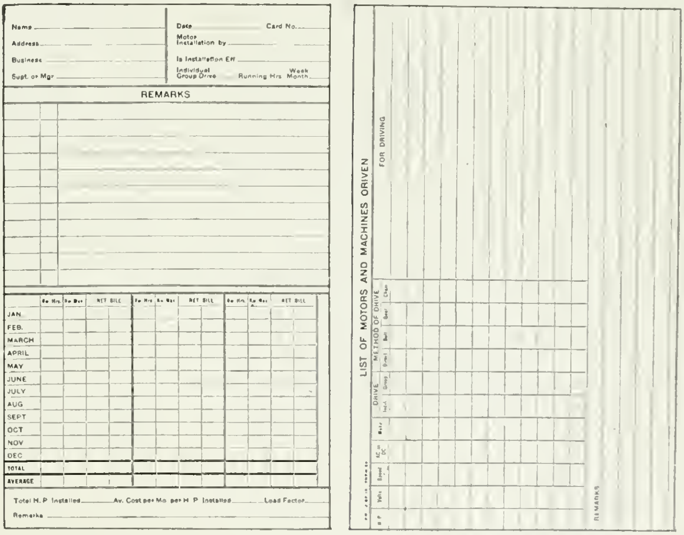
A unique feature of the entertainment was the erection of a burlesque central-station plant on the stage, which finally "went out" with an explosion at the switchboard resulting in the injury of one man, who received most amusing first-aid attentions. The scenery, costumes and electrical effects were original and elaborate. The printed program, too, was provided with an original cover design and many amusing notes and burlesque "ads," the whole being the work of Edison men. Where so many were engaged in an elaborate performance it would be invidious to single out any for praise, but it can be stated truthfully that the whole entertainment was a great success and in a high degree creditable to all who took part in it. The cast of the principal characters was as follows: *Mickey-Doo*, Mr. Michael F. McGovern; *Nanki Poo*, Mr. William R. White; *Koko*, Mr. William C. Berry; *Pooh Bah*, Mr. Harold Wright; *Pish Tush*, Mr. Willard H. Childs; *Yum Yum*, Miss Barbara M. Kuehn; *Pitti Sing*, Miss Kathleen M. Hartigan; *Peck Bo*, Miss Mae J. Leffingwell; *Katisha*, Mr. Henry E. Addenbrooke.

During the evening a telegram was received from President Samuel Insull in New York, who was disappointed in being called away by an imperative business engagement. Mr. John F. Gilchrist, assistant to the president, also out of town, sent a telegram of good wishes. After the theatrical performance there was an informal reception with refreshments, and the evening concluded with dancing.

The occasion served to reveal the existence of decided musical and dramatic talent among members of the large Commonwealth organization, and it also demonstrated in a striking manner the remarkable solidarity of this company, all present entering into the evening's merry-making like the members of one great family. A large number of ladies were present, as many members of the branch brought their wives, sweethearts or relatives. The entire organization of the company, from the president down, was greatly interested in the affair, and the company appropriated a large sum of money to assist in meeting the rather formidable expense involved. The general committee consisted of Mr. L. A. Ferguson, chairman; Mr. E. F. Smith, vice-chairman, and Messrs. J. F. Gilchrist, W. A. Fox, R. F. Schuchardt, H. L. Gannett and E. A. Edkins. The performance was staged under the direction of Mr. William C. Berry.

MOTOR-INSTALLATION RECORD CARD.

The accompanying reproductions show the form of motor-installation record card employed in the offices of central-station properties managed by H. M. Byllesby & Company, Chicago. These 8-in. x 5-in. cards are adapted for filing horizontally in standard cabinets—for easy finding the name of the installation being entered along the narrow blank tab at the right, opposite the monthly columns. This enables any card to be located quickly by running through the file. As soon as a motor prospect is located all available information about his installation is entered in the blanks provided on the card, so that the file gives complete data regarding prospects as well as existing installations of motors. After the prospect has become a customer, his monthly consumptions, demands and bills are all entered in the blanks, which provide for three years' records. These results are then totaled and averaged, and average costs, load-factors, etc., figured. The load factor is always taken based on the twenty-four-hour schedule, so that the figure is not open to misunderstanding due to the length of working day, etc. The assembly of complete records and data on a single card in this way is found of great utility to solicitors and to the office staff in the case of both customers and prospects, making available all the facts of a given installation by reference to a single card.


Name
Address
Business
Supt. or Mgr
Date
Card No.
Motor Installation by
Is Installation Eff
Individual Group Drive
Running Hrs
Week Month
REMARKS
NET BILL
JAN
FEB.
MARCH
APRIL
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC
TOTAL
AVERAGE
Total H. P. Installed
Av. Cost per Mo. per H. P. Installed
Load Factor
Remarks
LIST OF MOTORS AND MACHINES DRIVEN
FOR DRIVING
METHOD OF DRIVE
DRIVE
REMARKS

Front and Back Sides of Motor Installation Record Card.

VISITORS' DAY AT THE ELECTRIC PLANT AND ITS LESSON TO THE PUBLIC.

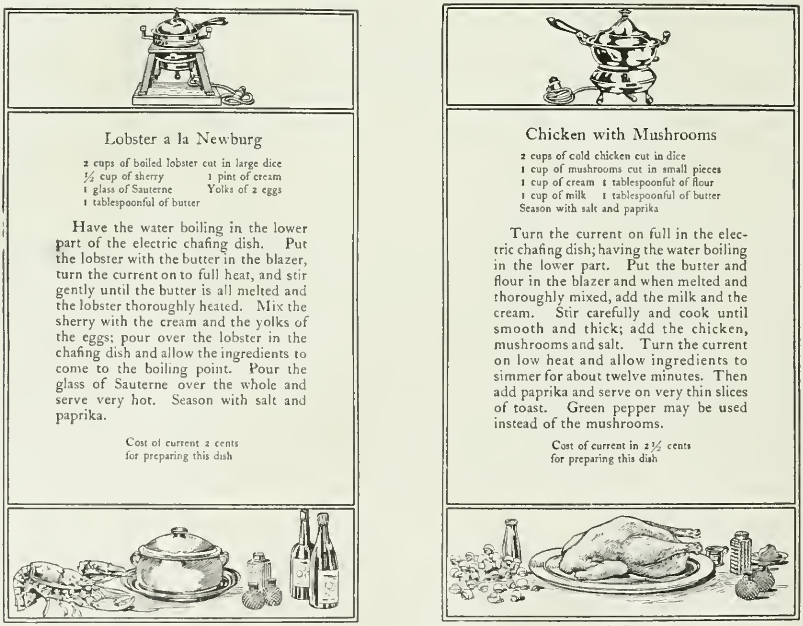
Invitations printed in the newspapers of Nashville, Tenn., announce that every Thursday afternoon is visitors' day at the plant of the Nashville Railway & Light Company, the public being invited to inspect the station on these occasions accompanied by guides who explain the operation of the machinery.

Starting at the coal pile, the visitors are first given some idea of the quantity of coal which is required to operate the plant, care being taken to impress upon them the magnitude and actual cost of the fuel alone for a day's run. Then they are shown the great boilers and gain some understanding of the first step in power production in a steam plant. In the turbine-room the action of the steam on the blades in producing power is explained, and they are furnished with some figures regarding the cost of steam turbines, generators and electrical machinery in general. The size of these cost figures seldom fails to surprise the intelligent and interested visitor, and his respect for the organization that pervades the electric plant increases as he learns that these vast pieces of machinery must be kept running twenty-four hours a day as long as he is to have service, additional units being connected up as the load increases. After being permitted to marvel at the intricacies of the switchboard and wiring equipment, the visitor is soon ready to amend his ideas, if such have been already formed, that the operation of an electric plant is "easy." He also gets more nearly correct impressions of the quality of organization required to keep the system in operation and begins to realize the immense amounts of money which must be spent before the electric company can even begin supplying him with electrical energy and all the conveniences it affords for a few cents per kw-hour.

It is with this idea of impressing its customers with the real complexities and problems of electric-plant operation that the visiting day has been instituted at Nashville. After a visit through the plant with the courteous guides who endeavor to answer all questions, even the most obdurate consumer is likely to be more considerate the next time he has a complaint against the electric company. A good and responsible class of people take advantage of the plant visits, and the company's contract men also make it a point to bring in downtown commercial consumers for an inspection along with the other parties. When first opened the visitors' days attracted crowds of several hundred on Thursday afternoon. As the novelty decreased this number has diminished until the average attendance is now about twenty-five interested persons. At the time of inaugurating visitors' day engraved announcement cards were sent broadcast, but the present newspaper display advertisements now serve to remind people of the recurrence of the Thursday afternoons. From the standpoint of public policy, these visiting days are considered of real value to the company, and Mr. J. P. W. Brown, superintendent of lighting for the Nashville system, believes that such visiting days might be instituted to advantage in many plants to bring consumers to realize better the complex and expensive equipment at the station end of their wires.

NEW YORK EDISON COOK BOOK.

The New York Edison Company has issued a very attractive book of recipes for cooking by electricity which contains many helpful suggestions as to how to get the best results from the various articles of electric heating and the best way to care for them. Each of the thirty-two pages, reduced samples of two of which are reproduced herewith, contains a simple and economical recipe which has been selected with great care. The recipes are particularly adapted to the electric chafing dish or stove which may be used on the dining-room table and connected to the lamp socket.



Lobster a la Newburg

2 cups of boiled lobster cut in large dice
½ cup of sherry 1 pint of cream
1 glass of Sauterne Yolks of 2 eggs
1 tablespoonful of butter

Have the water boiling in the lower part of the electric chafing dish. Put the lobster with the butter in the blazer, turn the current on to full heat, and stir gently until the butter is all melted and the lobster thoroughly heated. Mix the sherry with the cream and the yolks of the eggs; pour over the lobster in the chafing dish and allow the ingredients to come to the boiling point. Pour the glass of Sauterne over the whole and serve very hot. Season with salt and paprika.

Cost of current 2 cents
for preparing this dish

[10]

Chicken with Mushrooms

2 cups of cold chicken cut in dice
1 cup of mushrooms cut in small pieces
1 cup of cream 1 tablespoonful of flour
1 cup of milk 1 tablespoonful of butter
Season with salt and paprika

Turn the current on full in the electric chafing dish; having the water boiling in the lower part. Put the butter and flour in the blazer and when melted and thoroughly mixed, add the milk and the cream. Stir carefully and cook until smooth and thick; add the chicken, mushrooms and salt. Turn the current on low heat and allow ingredients to simmer for about twelve minutes. Then add paprika and serve on very thin slices of toast. Green pepper may be used instead of the mushrooms.

Cost of current in 2½ cents
for preparing this dish

[11]

Two Pages from Electric Cook Book of New York Edison Company.

The particular cooking device is shown at the top of the page and the ingredients and the article to be cooked are displayed at the bottom. The book is tastefully printed in two colors, the illustrations being in a pretty tint of gray and the text in dark brown.

THE COMPUTATION OF ELECTRIC-PLANT INSURANCE.

The chief influence which insurance companies can bring to bear for improvements is the fact that the better the risk from the standpoint of fire hazard the lower will be the cost of insurance. The result is that the insured, by making proper improvements in his risk, not only reduces the immediate cost of his own insurance, but also helps to keep down the total loss ratio and thus to reduce the average rate. The average rate can be controlled only by the ratio of losses to premiums. This loss ratio cannot with safety be more than 60 per cent, for if to this are added the agent's commission, amounting to an average of from 19 per cent to 20 per cent; cost of adjusters and special agents, 5 per cent; office expenses, 13 per cent, and taxes, from 2 per cent to 2.5 per cent, the total is not less than 90 per cent, which leaves a margin of profit very small, especially in view of the risk involved.

Fortunately the loss ratio usually averages a few per cent less than the above figures, said Mr. R. L. Daniel, of the Minneapolis inspection department, in an address before the Minnesota Electrical Association at its St. Paul convention March 16, from which address the facts here presented are taken. The companies thus accumulate a surplus, he said, which acts as a flywheel or, better, a storage battery, distributing the load of any disastrous year over the adjoining more profitable years. The difference between the electricity supply company and the insurance company in this respect, however, is that the insurance company never knows when to expect a "peak load."

Among the special schedules used by the insurance companies is one for electric plants starting with a base rate of 35 cents annual premium per $100 of insurance involved. This means that a standard plant would take a base rate of 35 cents, and for the various respects in which the actual plant falls below the standard additional charges are added to the base rate. In the insurance schedule the standard plant is described at some length, among the requirements being the following:

Walls must be of brick, stone, approved concrete or iron; division walls to be equal to outer walls; partitions non-combustible. Roof of metal, tile or concrete with metal trusses and supports. Floor, brick, cement or stone. Supply-room, testing and oilroom must be of fireproof construction, or cut off from the main plant. In addition to these requirements the heating, lighting and electrical equipment must conform to standard requirements for safety. Transformers must not expose switchboard, electrical machinery or any woodwork. Oil transformers must be in fireproof room. Ashes, as well as oily waste, must be kept in non-combustible receptacles and removed daily.

Basis	$0 35
Frame addition (coal shed)	.15
Frame partition (shop)	.05
Basement	.05
Roof	10
Roof, 3 ft. above boiler	05
Floor-wood	15
Oil-soaked	05
Wood ceiling	.10
Stairs to basement	05
Shop (repairs)	.05
Two barrels of oil in engine-room	.10
Non-standard wiring in attic	10
Wood switchboard	.25
Lightning arresters on wood	15
Oil transformers not in fireproof room.	.10
Boiler-room not cut off	15
Stack not ventilated	.50
No waste cans	.05
No watchman	.15
No chemicals or sand pails.	.10
No standpipe and hose	.15
Volunteer fire department	.15
	$3 10

Chemical extinguishers or pails of dry sand must be installed.

In estimating the rate for a plant which is not standard, charges are made for deficiencies in construction as well as for undesirable conditions connected with the operation. There are certain charges for area, stairway openings, repair work, lack of standpipe and hose, water supply and fire department that apply if the construction of the building is not standard, but where the construction is standard these same charges are waived.

The working of the schedule can best be shown by applying it to a concrete example, taking a plant such as is common in this country. The walls are of brick, 12 in. thick, with 12-in. division wall between boiler and engine-room, extending about 2 ft. above the roof. Floors are of ordinary wood construction, soaked with oil, and the wood ceiling makes a concealed space or loft in which wiring is installed to light the building. The wires are likely fastened to top of joists with cleats. The wooden roof is covered with metal or approved composition. A frame coal shed is attached to boiler-room. The schedule then works somewhat as shown in the accompanying tables.

Possible Credits:		
Cement floor	$0 15	
Would remove oil in floor	05	
Would remove oil in stairs	05	
Non-combustible partition	05	
For shop	05	
Oils in house or room cut off	10	
Standard wiring	.10	
Standard switchboard	25	
Lightning arresters on non-combustible supports	.15	
Oil transformers in room cut off	10	
Fire-door on boiler-room	15	
Ventilator for stack	45	
	$1 65	$1 65
Rate for insurance, per $100, with above improvements		$1 45

* * *

EFFECTIVE CENTRAL-STATION PUBLICITY.

By D. H. Howard

Numerous arguments and various methods have been and now are employed by different merchants and manufacturers in the sales promotion of an unlimited number of commodities, all of the arguments put forth carrying with them a certain amount of conviction. But in the old axiom "The proof of the pudding is in the eating" there is a valuable and most pungent suggestion embodying a certain means of positive, penetrating publicity.

This method of publicity can be adapted to the sale of almost any commodity with very satisfactory results, for it is truthfully said that "a pleased customer is the best advertisement." This is especially true with respect to the supply of electricity for lighting and industrial purposes from central stations as against the private production of electrical energy by means of the isolated-electric plant located within the building or in an adjacent building.

An isolated plant has numerous disadvantages and, except in rare instances, it has very few advantages. In the first place, considering, for example, locations in the heart of the business district, the necessary machinery, in addition to its initial expense and also the expense of operating it, occupies a very valuable space which could be put to much better and more profitable use. Then there are depreciation, the fuel problem, the smoke nuisance, labor troubles and a number of other items which must have consideration. Central-station service is available continuously day and night at the turn of a switch, whereas with the private plant it is necessary to keep the machinery moving at extra expense when overtime work is necessary.

Very few owners of isolated plants consider all the items which should be included in making up the total cost of operating their plants, and, therefore, many of these plants continue to be operated chiefly because their owners do not know what it is actually costing to maintain them. For an accurate and fair comparison of the cost of making electricity and of buying it from the central station, minus the smoke, dirt, occupancy of valuable space, etc., each of the items shown in the accompanying tabulation, which has been carefully prepared by expert engineers, should receive due consideration. In the majority of the cases central-station service will be found to have decidedly the better of the argument.

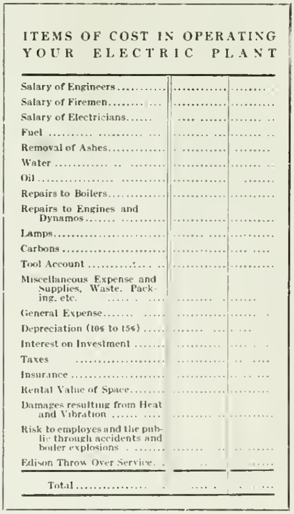
Following these arguments and to furnish "the proof of the pudding," there have recently been inserted in the newspapers of Chicago by the Commonwealth Edison Company a number of display advertisements consisting of illustrations of some of the larger and more prominent buildings in Chicago which are served exclusively with electricity from the mains of the company.

The following large buildings, among others, which formerly operated private plants have adopted Commonwealth Edison service:

	Lamps.	Horse-power.
Hotel Sherman	15,000	500
Siegel, Cooper Co	4,500	700
The Crane Company	5,032	7296
Featherstone Foundry		440
Hotel Metropole	2,800	130
Palmer House	5,000	100
Pugh Terminal Warehouse Co	4,000	900
Weber Wagon Works		400
Briggs House	1,700	60
Steger Building	3,000	250
Warren Springer	1,000	1000

This publicity has been a large factor in influencing the owners of new buildings to decide against the installation of private plants. Furthermore, the facts and figures obtained from customers who are being served from the central station furnish valuable data for owners of buildings who are operating plants in the belief that they are operating for less money than it would cost to purchase an equal amount of electrical energy from the central station.

It is the business of the electricity-supply companies to manufacture electricity in wholesale quantities in large generating stations located outside the business district and deliver this energy to customers day and night without interruption, at a decided saving in cost, to say nothing of the freedom from annoyance in obtaining the required electrical energy.



ITEMS OF COST IN OPERATING YOUR ELECTRIC PLANT

Salary of Engineers		
Salary of Firemen		
Salary of Electricians		
Fuel		
Removal of Ashes		
Water		
Oil		
Repairs to Boilers		
Repairs to Engines and Dynamos		
Lamps		
Carbons		
Tool Account		
Miscellaneous Expense and Supplies, Waste, Packing, etc.		
General Expense		
Depreciation (10% to 15%)		
Interest on Investment		
Taxes		
Insurance		
Rental Value of Space		
Damages resulting from Heat and Vibration		
Risk to employes and the public through accidents and boiler explosions		
Edison Throw Over Service		
Total		

Fac-Simile of Central-Station Tabulation of Operating Costs of Isolated Plants.

The services of the engineers of the company are at the disposal of owners of existing plants, without cost, in making tests of their plants and furnishing estimates as to the cost of the same service from the central station.

Advertisements of this sort are in themselves a recommendation for central-station service and at the same time give the customers valuable publicity which costs them nothing.

MODERN ELECTRIC LAUNDRIES.

In New York City electric laundries are not only being installed in new residences and apartment houses, but in many old residences as well. The complete equipments now in use in a large number of the beautiful residences that adorn Fifth Avenue, Riverside Drive and Park Avenue consist of washing machines, driers, ironers and flatirons. One of the finest installations in New York is that in the residence of Mr. B. N. Duke, at the southeast corner of Fifth Avenue and Eighty-ninth Street. A view of this electrical laundry is shown in Fig. 1. The washing machines are at the left, the drier with one of the sections extended is in the background, and the ironing apparatus is on the right.

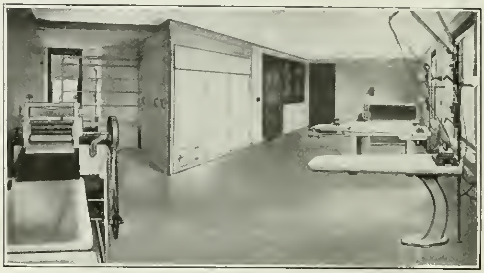


Fig. 1—Laundry in High-Class Residence.

Another laundry laid out very similar to that in the Duke residence is the one in the home of Mr. E. S. Harkness, at Sixty-seventh Street and Fifth Avenue. Some of the others are in the residences of Mr. J. B. Clewes, Eighty-fifth Street and Fifth Avenue; Mr. A. W. Hoyt, 934 Fifth Avenue; Mr. George J. Gould, Sixty-seventh Street and Fifth Avenue; Mr. Edwin Gould, Seventy-fifth Street and Fifth Avenue; Mr. J. B. Duke, Seventy-eighth Street and Fifth Avenue; Mr. Jonathan Bulkley, Sixty-fourth Street and Park Avenue; Mr. Percy R. Pyne, Sixty-eighth Street and Park Avenue; Mr. F. M. Warburg, Ninety-third Street and Fifth Avenue; Mrs. A. L. Douglass, Fifty-seventh Street and Park Avenue; Mr. Edward W. Sheldon, 46 Park Avenue, and Mr. W. D. Hyde, 11 East Seventieth Street. Two out-of-town residences having electric laundries are those of Miss Helen Gould, at Lyndhurst-on-the-Hudson, and Mr. E. H. Hooker, at Greenwich, Conn.

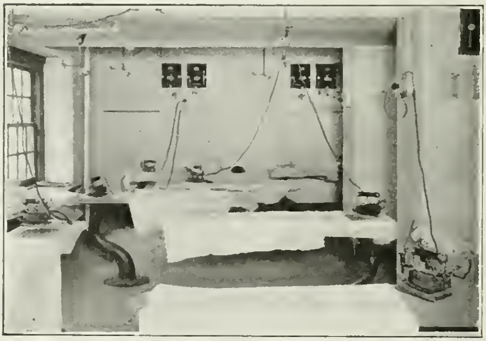


Fig. 2—Laundry in Modern Apartment House.

The electric laundry system has wrought a complete innovation in the family laundry work in apartment houses. In many of the large new apartment houses complete electric laundries have been installed in the basement for the individual tenants. In the mammoth new apartment house now being erected at Eighty-first Street and Fifth Avenue, by the Century Holding Company, are a large number of complete electric laundries for the individual tenants and several other big ones with a very large capacity.

Alwin Court, at Fifty-eighth Street and Seventh Avenue, has an excellent electric laundry equipment for the use of the tenants. In addition to the other apparatus there are twenty-eight electric irons. Each tenant's iron is metered separately, as shown in the view of a portion of this installation. When the iron is not in use the maid removes the plug and with a padlock locks a steel bar across the empty socket. Lockers are provided on the opposite side of the room to hold the irons, cord and plug attachments when not in use. There is a similar installation in the large new apartment house at 44 West Seventy-seventh Street. The irons there number twenty-six. Other apartment houses which have electric laundry equipments exclusively are at 523 Park Avenue, 823 Park Avenue and 829 Park Avenue. Altogether these three apartment houses have no less than twenty-one electric washing machines.

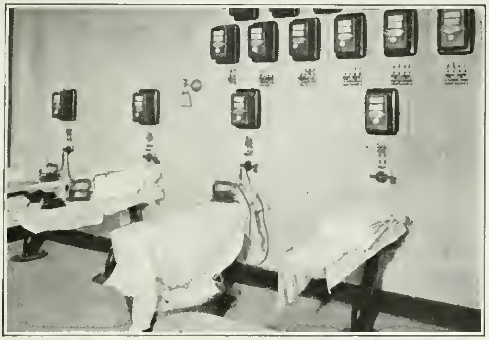


Fig. 3—Laundry in Modern Apartment House.

The machinery used in most of the above installations was manufactured by the Shannon Manufacturing Company, of 124 Lexington Avenue, while the designing and laying out was done by Mr. C. P. H. Gilbert, the architect, in consultation with the heating bureau of the New York Edison Company. Another interesting installation is that of the Automobile Club of America, where six 6-kw driers are used for drying wet garments and robes. The East Side House Settlement, located at the foot of Seventy-sixth Street, also has an electric laundry, while the Deaconesses' Home, on the Cathedral grounds, 110th Street and Morningside Heights, has a laundry electrically equipped.

PART PLAYED BY ELECTRICITY IN BUILDING SKY-SCRAPERS.

There is perhaps hardly anything more spectacular in modern commerce than the business of pushing up new sky-scrapers. At the present time two prominent examples of this in New York City are the construction of the Municipal Building, opposite City Hall Park, and the 80-Maiden-Lane Building. The former is to rise to a height of twenty-seven stories, which will be surmounted by a tower of thirteen floors, making a total of forty stories in all. It is significant of the age that in neither of these undertakings is an ounce of steam being used. Electricity furnished by the New York Edison Company is the motive force throughout.

Work on the 80-Maiden-Lane Building has not progressed beyond the caisson stage, yet here also the two 150-hp electrically driven compressors—kept working twenty-four hours a day—are already showing their superiority over old-time methods. The fifty caissons to reach bed-rock must be sunk to a depth of over 60 ft., at which level the water comes in so rapidly that the sand-hogs toiling below would have very little chance of escape should the compressors stop for even the briefest moment.

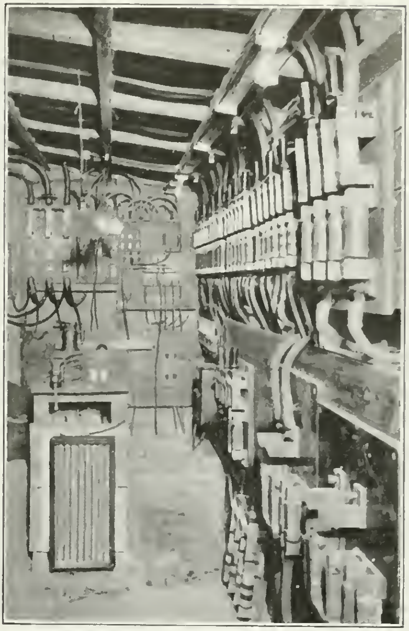


Fig. 1—Contractor's Switchboard.

On the Municipal Building even the hoisting signals are no longer given by hand, for an electric gong in the operator's cage gives an absolutely sure connection, in all weathers, with the street. The motor equipment on this building—averaging an energy consumption of 36,000 kw-hours a month—consists of two 44-hp passenger elevators, eight 80-hp and five 40-hp

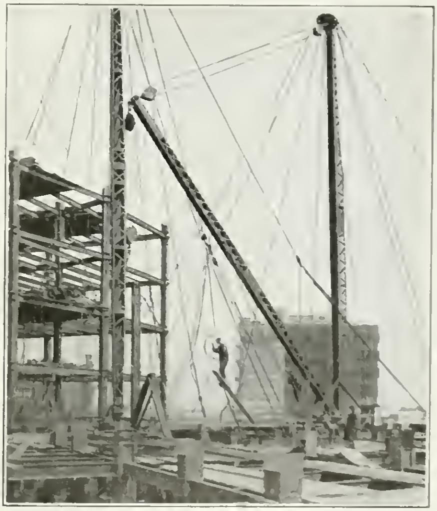


Fig. 2.—Electric Hoist on Municipal Building.

steel hoists, besides two compressors of 50 and 30 hp respectively, which operate the twenty-one riveters scattered over the structure, twelve 40-hp hod-hoists, and four 15-hp concrete mixers, with three water pumps, two of which are rated at 7½ hp and the other at 10 hp.

An interesting feature, during the winter months, was the heating of the different offices about the building by a battery of twenty electric heaters. In this building are two giant girders which were brought across the city, each behind a team of thirty-six horses. These were swung up into their final resting place in the Municipal Building by electric power.

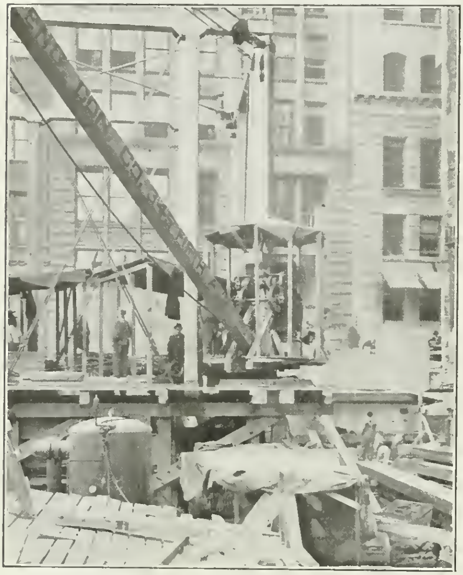


Fig. 3.—Electric Crane on Maiden Lane Building.

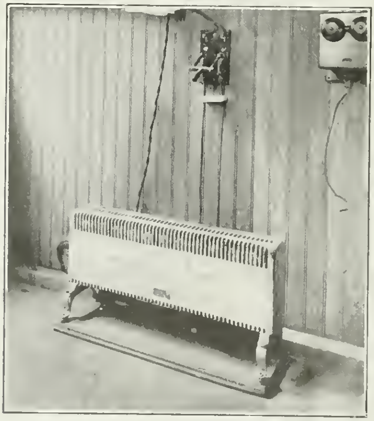


Fig. 4—Electric Heater Used in Contractor's Offices.

Figuring the comparative cost of steam versus electricity in this small item of lifting alone, steam would have meant an expenditure, roughly speaking, of $18, while electricity cost $11! A trivial saving, perhaps, in an enterprise involving millions, but that same $7 is but an indication of the continued economy electricity is effecting in building construction.

Wiring and Illumination

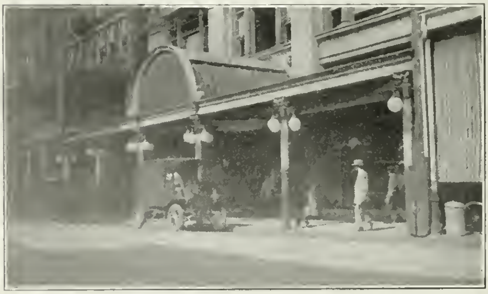
COMMERCIAL LAMPS IN CHICAGO.

The largest number of arc lamps connected to the mains of the Commonwealth Edison Company of Chicago was 17,500 in the year 1907. The commercial use of arc lamps is decreasing in that city, as elsewhere, and the number now operated by the Commonwealth company is about 11,600. The remarkable increase in the use of tungsten clusters has had much to do with the decrease in the number of arc lamps in service. The number of tungsten clusters in use in Chicago is now about 16,000, and the growth of this service has been phenomenal since it was established, something like two years ago. These facts were contained in a recent paper by Mr. W. L. Abbott, chief operating engineer of the company, who gave a curve showing that, although both direct-current arc lamps and alternating-current arc lamps are decreasing in number, the rate of decrease is more noticeable in the case of the direct-current lamps than in that of the alternating-current lamps. At present there are about 7000 direct-current inclosed-arc lamps supplied with energy by the central-station company in Chicago, about 3600 alternating-current arc lamps and about 1000 direct-current series-arc lamps.

"WHITE-WAY" LIGHTING USING SIDEWALK "GALLERY" SUPPORTS IN SOUTHERN CITY.

The erection of "white ways" and ornamental curb lighting in most Southern cities is hampered by the presence of the characteristic "galleries" or roofed sidewalks which protect pedestrians from sun and rain. These galleries are installed very generally throughout the South and Southwest, and any attempt at decorative lighting must consider and avoid them, for they are usually of very permanent construction and of the nature of fixed institutions along the street.

The accompanying illustration shows a piece of ornamental curb lighting at Mobile, Ala., in which use was made of the existing gallery posts for support. Special bracket castings were made to harmonize with the pillars. The four-bracket castings fit together to form the square inclosing the post, which is sealed top and bottom by a split plate clamped around the post. The wires are brought into the fixtures from conduit run along under the gutter of the gallery. Each bracket arm carries a 100-watt tungsten lamp inclosed in a 14-in. frosted globe. This installation was arranged by the Mobile Electric Company, which has interested itself in making use of similar bracket arms for converting all the gallery supports along the street into lighting standards, realizing Mobile's proposed "white way."



Adaptation of Gallery Supports for Ornamental Lighting in Mobile, Ala.

ORNAMENTAL STREET LIGHTING WITH 250-WATT TUNGSTENS.

Mylan Street, Shreveport, La., is lighted by 250-watt tungsten lamps, suspended from crook hangers, on poles erected at 55-ft intervals along the curb. Each lamp is inclosed in a 14-in. Alba ball, and by means of the crook is projected three feet over the curb-line. Mr. J. E. Cowles, superintendent of the lighting department of the Shreveport Gas and Electric Company, reports that five blocks of this kind of lighting have now been contracted for. The installation is made on a three-year contract, adjoining merchants paying 10 cents per linear foot, according to their respective fronts. This ornamental lighting installation is operated nightly until 10:30 o'clock. All costs of installation, maintenance and renewals are met by the company out of the monthly revenue derived from the adjoining merchants.

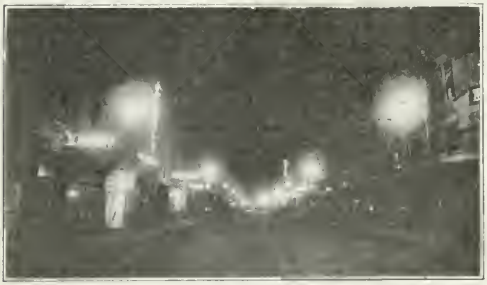


Fig. 1.—250-Watt Tungsten Lamps on Bishops' Crooks at Shreveport, La.

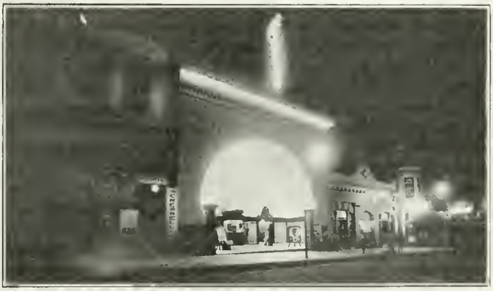


Fig. 2—Exterior Illumination of Theater at Shreveport, La.

* * *

VILLAGE STREET LIGHTING.

A successful new system of street lighting installed in the village of Falconer, N. Y., consists of 150 series-tungsten lamps of 25-cp each, mounted singly, and of four clusters of four 60-watt tungsten lamps. These lamps supplant 181 16-cp carbon incandescent lamps, with more satisfactory results. Each of the 25-cp lamps takes 31 watts and both these lamps and the 60-watt lamps take 5.5 amp. The village is abundantly supplied with shade trees, and in order to place the individual lamps in such a manner as to secure the best illumination some of them are mounted over the street and some over the sidewalk, as circumstances dictated.

Electrical energy is purchased from the Jamestown Lighting & Power Company by Mr. Fred Sprague, owner of the Falconer electric light plant, which was recently destroyed by fire. Mr. Sprague charges the village $13 a year for each of the individual lamps, including maintenance. In addition, he agrees to supply all lighting needed for the village hall, to the amount of $4 a month, free of charge. When the meter reading shows that the amount of electrical energy consumed in the village hall is more than $4 worth in any month the excess is paid for at the rate of 5 cents a kw-hour.

The lighting equipment includes an 8-kw Westinghouse regulating transformer with control panel. An automatic time switch is used so that the street lamps are cut in and out at a stated time. This renders the street-lighting outfit practically automatic in its operation. Although the regulator is loaded nearly to its rated output, no particular trouble has been experienced in throwing the load directly upon the regulator, as the movement of the coils when so loaded is so short that the momentary increase of current flow does not materially affect the tungsten lamps. The village pays about $350 a year more for the new tungsten lighting than it did for a greater number of carbon lamps under the old plan. As the lamp units are larger and the light more satisfactory, the change is considered a desirable one not only by Mr. Sprague but by the village authorities as well.

* * *

RECENT DEVELOPMENTS IN TRAIN LIGHTING.

In the course of a paper on "Recent Developments in Train and Car Lighting" read before the Chicago Section of the Illuminating Engineering Society on April 20 Mr. C. R. Gilman, of Milwaukee, chief electrician of the Chicago, Milwaukee & St. Paul Railway Company, laid stress on the fact that the use of shades over bare lamps is the greatest recent general improvement in electric train lighting. Next to this in importance comes the intelligent use of reflectors, and this involves often a marked reduction in the number of lamps necessary to give a required illumination. Indeed, the decrease in the number of lamps that may sometimes be made by the use of reflectors is amazing, and Mr. Gilman cited an instance in the case of one particular car where reflectors enabled a reduction in consumption of from 8.45 watts to 2.16 watts per square foot of floor area. In this one car the saving in the cost of electricity was over $200 a year.

In the West nearly all of the railroads use the head-end system of train lighting, installing a generating set in the baggage car next the engine and supplementing this source of energy by storage batteries floating on the main circuit in parallel with the generator. The use of tungsten lamps has been particularly advantageous in train lighting and perhaps the potential of 64 volts for this service may now be considered standard.

Mr. Gilman devoted some attention to describing the lighting and fixtures of the "Pioneer Limited," a seventeen-car train running between Chicago and Minneapolis on his railroad. On this train there are 872 12-cp tantalum and tungsten lamps. One advantage of the use of tungsten lamps compared with carbon lamps which is particularly desirable in train lighting is the fact that a substantial reduction may be made in the weight of generating equipment and batteries.

Not much attention has been paid in the past by train-lighting engineers to the intelligent reduction in the number of lamps in a car by the use of reflectors, but this is a subject which will have careful consideration given to it in the future. Referring to the "Pioneer Limited," the speaker described a variety of fixtures used on the train in sleeping-cars, dining-cars, day coaches and mail-cars. In the case of the mail-cars he remarked that a change had been made from trough reflectors to individual reflectors and the latter method may now be considered standard.

In the discussion there was something said about the measurement of intensity of illumination, whether on a horizontal plane 33 in. from the floor or at an angle such as will be formed by a paper or magazine held by a passenger in reading. It seemed to be the general opinion that for all practical purposes the horizontal-plane measurement is sufficient. The Association of Railway Electrical Engineers is endeavoring to standardize the number of ft.-candles of illumination required for certain types of cars.

One particular difficulty in train lighting is the trouble in keeping the lamps, shades and reflectors clean. These parts of the lighting system should really be cleaned after every long trip, but it is difficult to accomplish this. Fixtures for car lighting should be made as simple as possible to enable the cleaning to be done readily. Frosted bulbs are more difficult to clean than clear-glass bulbs, and that is the reason why the latter are often preferred by train-lighting engineers.

Compressed gas is not being forced out by electric lighting. This method of lighting is efficient and economical and gives good illumination. Undoubtedly, however, electric lighting is preferred by the traveling public.

In the head-end systems the generator used has a rating usually of 15 kw or 20 kw. Mr. Gilman said that the first cost of the head-end equipment is much less than that of the car-axle system, although the latter has the advantage, of course, of making each car an independent unit. In a seventeen-car train, for instance, the total cost of the head-end lighting may be estimated as $4,000, whereas it would cost nearly $1,500 to equip each car separately for car-axle lighting. Another point brought out was that there is a tendency to use lighter colored woodwork and decorations in car interiors in order to make the illumination more effective.

Mr. Arthur J. Sweet pointed out that there seemed to be a preponderance of axle-lighting systems on the Eastern roads. He referred to the psychology of the problem. Passengers may think a car dim when it is really lighted sufficiently. The traveling public as well as people generally should be educated to the fact that glare does not mean useful light. Among those who took part in the discussion were Mr. C. W. Naylor, of Chicago; Mr. Francis A. Vaughn, of Milwaukee; Mr. George C. Keech, of Chicago, and Prof. A. M. Wilson, of the State University of Kentucky, Lexington, Ky.

SIMPLE METHOD FOR CALCULATING ILLUMINATION.

By J. R. Cravath.

Probably the great majority of the ordinary commercial calculations of illumination for large rooms during the past few years have been carried on by means of simple constants based on the results of tests in rooms of the same character as those under consideration. During the first few years that illuminating engineering was actively practised the methods used were rather laborious and formidable. Later as the number of available results of actual tests increased it was possible to obtain certain constants for ordinary commercial work in calculating illumination which on the whole were more accurate than the laborious theoretical methods previously applied, because the theoretical methods necessarily involved a number of assumptions which were only approximately correct.

With the aid of figures obtained from practical experience it was possible to predict with tolerable accuracy in advance that for each watt expended per square foot in lighting a room under certain conditions it was possible to obtain an average illumination of a certain number of ft.-candles, dependent on the equipment used and the character of the room. This factor, known among illuminating engineers as lumens per watt, or its reciprocal, watts per lumen, affords a short cut in illumination calculations which has doubtless been made use of in more calculations of illumination the past three years than any other method. The first "watts per lumen" table of this kind appeared in the *Electrical World* for July 11, 1908, in an article by the present writer and Mr. V. R. Lansingh, and the method soon came into general use.

The lumens per watt—that is, the average ft.-candles obtained for each watt per square foot—indicate the over-all "measured" efficiency of an electric lighting installation as far as it is possible to measure such efficiency with a photometer. The term "measured efficiency" should perhaps be used instead of "efficiency," for the real efficiency, or rather efficacy, of any lighting installation is dependent on physiological effect on the eye, which cannot be measured with a photometer. The measured efficiency is the ratio of the light output of the lamps to the average illumination as measured on the working plane selected. Constants based on lumens per watt or watts per lumen take into account two things: first, the efficiency of the lamp itself as a light producer, and, second, the efficiency with which the light produced is utilized in any given installation. It has heretofore been feasible to adopt a single figure covering the over-all efficiency for certain typical rooms and lamp equipments because the efficiencies of lamps of various types have been kept about the same from year to year.

Recently, however, as far as tungsten lamps are concerned, a situation has arisen which seriously raises the question whether it is not best to determine first the efficiency of an installation in utilizing the light produced independently of the efficiency of the lamps themselves. The reason for this is that most American manufacturers of tungsten lamps have adopted the policy of making certain standard wattages and varying the lamp efficiency from time to time as changes in lamp manufacture make it advisable in the opinion of the manufacturers. The general scheme adopted up to date is to maintain the wattage and the hours' life constant for any given size of lamp, and to make the changes, if any, in the efficiency of the lamp. Along with this they have adopted the commendable practice of tabulating the lumens obtainable from the various sizes of lamps when operated at various voltages.

Now, it is evident that if tungsten lamps are to be changed in efficiency at frequent intervals in the future, and that if, as seems likely, the majority of illumination calculations in the immediate future will be in connection with tungsten lamps, the illuminating engineer must have a great number of constants to deal with if he attempts to have at hand constants to apply to the large number of possible lamp efficiencies and lighting installations with which he must commonly deal.

To put the matter in another way, the measured efficiency of utilizing light with a certain set of fixed conditions does not change, but the efficiencies of lamps are being shifted by the manufacturers, or by the particular voltage conditions under which they may be used. For this reason it may very likely prove desirable to use a somewhat different method in the calculation of illumination from that employing watts-per-lumen or lumens-per-watt constants. This method should preferably have one set of constants to apply to the measured efficiency of utilization of the light produced.

A table of lumens effective per lumens generated will show in per cent what the measured efficiency of any lighting installation is likely to be under certain conditions as far as the utilization of the light produced alone is considered. Then by means of tables giving the actual lumens produced by various lamps under the voltage conditions in question the number of lamps of a given size required can easily be obtained. Then as lamp efficiencies change the illuminating engineer need only change his lamp tables, while his tables on measured efficiency of utilization remain the same. That is, the lumens effective per lumens generated would remain the same.

The value of the lumens effective per lumens generated in ordinary commercial lighting systems will vary all the way from about 65 per cent down to 10 per cent and lower, depending on the color of the ceiling, walls and floor of the room, the lamp equipment in the shape of reflectors and diffusing glassware, the amount of dirt on lamps and equipment and other factors.

The calculation of illumination by means of constants of this kind is simple, although requiring one more step than the watts-per-lumen or lumens-per-watt constants heretofore used. The method of procedure is as follows: After deciding upon the average ft.-candles illumination on the working plane which in the judgment of the designer is necessary for the installation under consideration, apply the following rule: Multiply the average ft.-candles by the square feet, and divide this product by the efficiency constant for the given conditions. The result will be the total number of lumens which the lamp must generate. Tungsten lamps are now rated in the manufacturers' table according to the lumens they produce, and the same will doubtless soon be true of other lamps. The engineer then selects lamps of a sufficient number and size to generate the lumens necessary for the installation. The lumens generated by any lamp can be determined by multiplying the mean spherical candle-power by 12.57.

The derivation of the foregoing rule is very simple. Multiplying the average ft.-candles by the square feet of area to be illuminated in reality gives the actual lumens required on the working plane, because one definition of a lumen is the flux of light required to produce an average illumination of 1 ft.-candle over an area of 1 sq. ft. Having ascertained the total lumens required on the working plane it is simply a matter of dividing by the efficiency of utilization in per cent to give the lumens required at the lamps before any of the losses occur.

RECENT TELEPHONE PATENTS.

AUXILIARY DEVICES.

Three patents have been granted to Mr. E. L. Buxbaum, of Chicago, which describe devices for call registering. A counter box is attached to the telephone in such a manner that a locking bar, a part of the device, engages the hook lever. Three counters are provided. One actuates the out-message counter, one the in-message counter and one records the messages which fail of completion. The lock bar is released by counting a message. An auxiliary lock is provided to prevent any counting at all if the owner so desires. In a more complex form two counters are used. One is at the station and one at the central office. Both operate simultaneously either under control of a push button at the station or a key at the exchange.

Mr. J. B. O'Hara, of Philadelphia, has obtained a patent for a disinfecting device for transmitters. A cup-shaped holder is swung across the front of the mouthpiece. This contains absorbent material wet with disinfecting liquid. A screen retains the absorbent. This screen is held by a central pin which passes through the cup and terminates in a finger clip.

In some transmitters a stretched diaphragm is used to increase the efficiency. It is found that if the diaphragm gets hot it expands and loses tension. To overcome this Messrs. C. E. Enger and J. G. Holmstrom, of Sweden, have arranged a cooling device which consists of a tube coiled spirally and placed near the diaphragm. Liquid is forced through the tube and conducts the heat away.

EXCHANGE CIRCUITS.

With the usual supervisory signal system in common battery system one lamp suffices for each cord, this lamp indicating merely the position of the hook switch of the connected station. Mr. W. G. Blauvelt, of New York City, has thought it of advantage for the operator to be able to distinguish between a non-answered call and a call completed. He therefore arranges two supervisory lamps for the calling cord, which are controlled not only by the relays of the cord circuit but also by a "stage" switch. During the first or calling stage the switch maintains one lamp in operative relation to the circuit and upon response of the called party the stage switch advances so that the second or disconnect lamp is alone associated with the circuits. This patent is assigned to the American Telephone & Telegraph Company.

Call distributing systems have been subject to the attention of Mr. F. G. Agrell, of Stockholm, Sweden. He has found that with such a system, wherein the answering operator has no permanent association with the subscribers answered, if a call is made for a station upon the calling line a continuous busy report is given. This arises from the fact that the answering operator does not normally know the number of the calling line. In order to overcome this difficulty he introduces a "reverting" signal which glows if the line tested by a calling cord be the same as that associated with the answering cord.

LETTERS TO THE EDITOR.

Transformer-Principle Electric-Heating Apparatus.

To the Editor of Electrical World:

SIR:—Attention should be called to the fact that the transformer principle for heating apparatus, described on page 875 of your issue for April 6, has been known for a long time, having been proposed by me fifteen years ago. It has been described in the *Zeitschrift für Elektrotechnik*, published in Vienna, Austria.

Zwickau, Saxony, Germany. GUSTAV W. MEYER.

The Tungsten vs. Flaming-Arc Lamp.

To the Editor of Electrical World:

SIR:—In reading Mr. Magdsick's letter in your issue of May 11 I gather the impression that the main object of the writer was to defend the tungsten lamp cluster against the flaming-arc lamp for industrial lighting. I heartily agree with Mr. Magdsick that interest on first investment, depreciation, repairs, etc., should be given due consideration, but at the same time I cannot agree with the prevalent tendency to prescribe tungsten-filament lamps as a universal patent medicine for every case of illumination.

From a casual reading of the letter one cannot help but gain the impression that a flaming-arc lamp would be of no commercial value as an illuminant except when the cost of the energy reaches 10 cents per kw-hour, and that for industrial illumination the 1000-watt tungsten lamp cluster is the only one worth consideration. Mr. Magdsick does not, however, mention that at a 4-cent rate the flaming arc would show a saving of 7½ per cent over the tungsten cluster even if all his figures are accepted as a fair basis for the comparative calculation.

Considering the general lack of provision for the easy access to the tungsten clusters for cleaning and renewals, the figure given for cleaning seems somewhat out of proportion. In many cases dust and smoke would necessitate a far more frequent cleaning than that assumed if a decided impairment of illuminating intensity is to be avoided. Furthermore, it is very questionable whether 1700 hours' life of a tungsten lamp is a fair assumption when used in an industrial establishment where the lamps are frequently subject to considerable vibrations and when accidental breakage has to be included. The highest claim I had previously encountered was 1400 hours, and I should judge that 1200 hours would be a more reasonably conservative basis.

Mr. Magdsick maintains that in actual practice it has been found that a higher illumination can be obtained from a 1000-watt cluster than from a 10-amp arc with a standard globe equipment. If reference is made to a flaming arc, I have reason to doubt that his assertion can be substantiated provided the test is carried out on a perfectly fair basis, that is, under identical conditions and on the basis of proper attention to the flaming-arc lamps (as provided for in the estimate) and after the tungsten lamps have been used approximately one-half their assumed life and these lamps have been taken from an average consignment. But, even granted that the comparison between a 17-hour, 10-amp flaming-arc lamp and a 1000-watt tungsten lamp cluster should balance until the rate reaches between 3 cents and 4 cents per kw-hour, would it not be pertinent to make a comparison between the 1000-watt cluster and the long-life flaming arc as well?

Say that we choose a 10-amp flaming arc with a life of 150 hours instead of 17 hours per trim. The cost of maintenance per 1000 hours then is as follows:

Globes	$1.50
Electrodes, 8 at .25	2.00
Trimming, etc., 8 at .075	.60
Repairs	1.00
Maintenance	$5.10

in which Mr. Magdsick's figures are used as far as globes and repairs are concerned, together with the liberal assumption of eight trims to 1000 hours. Compiling the total cost of 4000 hours at a 2-cent rate for energy, we get

Fixed charges	$11.00
Maintenance, 4x5.10	20.40
Energy	44.00
Total	$75.40

which compared with $103.63 shows a saving of 27 per cent in favor of the flaming-arc lamp. At a 3-cent rate, which is not at all uncommon, the saving would be 31 per cent.

I am ready to admit that the flaming-arc lamp is useful only under conditions where a highly concentrated unit can be utilized to advantage; but wherever these conditions exist the up-to-date flaming lamp is well worth consideration and recognition.

The field of the tungsten-filament lamp is such a great one that it seems a waste of time and energy on the part of tungsten-lamp advocates to preach against the flaming-arc lamp instead of giving it due credit.

J. Gustaf V. Lang.

Davenport, Ia.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Interpole Machines.—F. Punga.—Interpole machines have in general a smaller voltage drop than direct-current machines without interpoles. This is primarily due to the absence of counter amp-turns. In cases where a certain voltage drop is required for operation in parallel the remedy is to use rather broad pole shoes for the interpoles, together with a displacement of the brushes from the geometrical neutral zone. Even a very small displacement of the brushes has a considerable effect on the voltage drop. In case there is found a discrepancy between the calculated voltage drop and the voltage drop found by experiment, one is inclined to attribute this to a displacement of the brushes from their geometrical neutral zone and to overlook another factor which could influence the voltage drop. This factor is the influence of the commutation pole winding on the main poles. In Fig. 1 and Fig. 2 a_1a_2 . . . are the commutation poles and b_1b_2 . . . are the main poles. Only the interpole winding is shown. The method of connecting the commutating pole winding is different in the two figures. In Fig. 1 the connections are on the same side of the main poles. In Fig. 2 they are alternately on different sides. Both methods are used in practice. That of Fig. 2 has the advantage of a better utilization of material. It is seen, however, by a comparison of Fig. 1 and Fig. 2 that the connecting wires of Fig. 2 form half a turn with respect to the main poles, while in Fig. 1 there is no effect on the main poles. If i is the current in the auxiliary pole winding (in general equal to the total current of the machine) the auxiliary pole winding produces $i/2$ amp-turns with respect to the main poles and this number may be positive or negative according to the method of connections. Two otherwise identical machines which are connected according to Fig. 2 and in which the end connections are on different sides may therefore show a difference of i amp-turns in their excitation and with low-voltage machines this may be a quite considerable difference. For instance, with a 240-volt, 240-kw machine the effect may be ± 500 amp-turns per pole, hence the difference between the two machines may be 100 amp-turns. This may be sufficient to endanger the operation in parallel. In the same way as the auxiliary pole winding can have an effect on the main poles there may also be an effect of the compound winding on the auxiliary poles if the connections are made alternately on different sides. As in the preceding case, there is then an increase or decrease of the auxiliary pole amp-turns, according to the direction of rotation and the method of connections. Reversible compound motors (or series motors) should, therefore, always have the connections of the commutation windings on the same side to make sure that commutation shall be perfect. The author finally gives the following rules, which are, however, to be followed only when the amp-turns in the main pole winding or compound winding form a considerable percentage of the auxiliary pole amp-turns or the main pole amp-turns respectively. First, for reversible interpole motors the connections between adjoining auxiliary pole windings and also between adjoining compound windings should always be made on the same side. Second, for machines which rotate always in the same direction connection of adjoining windings alternately on different sides is permissible, but the mutual effect of compound and auxiliary pole windings must be taken into consideration. Third, in special cases (low-voltage motors or motors of very large capacity) the compound winding may be omitted and yet a satisfactory compounding effect may be obtained by the auxiliary pole-winding arrangement of Fig. 2.—*Elek. u. Masch.* (Vienna), April 9.

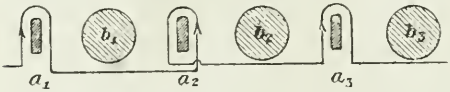


Fig. 1—Interpole Connections Not Affecting the Main Poles.

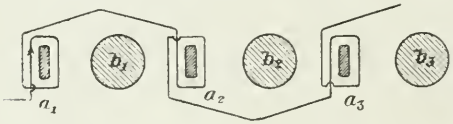


Fig. 2—Interpole Connections Affecting the Main Poles.

Self-Exciting Three-Phase Commutator Generator.—R. Rüdenberg.—A mathematical discussion of the behavior of a three-phase commutator machine when running unloaded as a generator. It is shown that the machine is self-exciting and can be made to generate three-phase currents of any frequency. The self-excitation as well as the frequency of the three-phase currents depends only on the value and phase relation of the ratio of transformation between rotor and stator and they can be adjusted by changing this ratio of transformation. The circular diagrams representing the phenomena are given.—*Elek. Zeit.*, April 20 and 27.

Surging of Three-Phase Generators.—F. Punga.—The author refers to the mathematical theory of the surging of three-phase generators and gives experimental data to show that the well-known formula of Rosenberg for the critical moment of inertia which represents the limit of operation without surging may lead in some cases to considerable errors. The author describes another method of calculating the critical momentum which promises to be more exact.—*Elek. Zeit.*, April 20.

Lamps and Lighting.

Mercury-Arc Lamp with Tungsten Electrode.—E. Urbain, C. Scal and A. Feige.—A French Academy paper on a new mercury-arc lamp in which the arc is formed between an anode of tungsten and a cathode of mercury at a distance of 5 mm (200 mils.) from each other. In the well-known mercury-vapor lamp with an anode of iron there is a considerable distance between the anode and cathode and the tube radiates light all along its whole length, the mercury vapor being luminescent and the anode remaining cold. If an iron anode is approached to the mercury to a distance of a few millimeters a real arc is produced, but the iron is overheated and fuses. The use of a tungsten electrode permits one to form an arc in which the mercury serves only for lighting the arc. This electrode is brought to incandescence under the best conditions which can actually be obtained and the transport of the metal which forms the electrode to the negative pole does not seem to be large, which is of importance for long life. The luminous efficiency of the lamp is particularly high, the specific consumption being 0.45 watt per candle. The lamp operates at a potential difference of 12 volts, but by increasing the pressure of an inert gas in the lamp it is possible to increase the emf. An examination of the spectrum of this new lamp shows that it consists of a continuous and highly luminous spectrum upon which are superposed the rays of mercury. The very intense blue portion in the continuous spectrum is reinforced by the mercury rays, which makes the color of the light very similar to sunlight. This is, therefore, a source of very white light and by employing a quartz tube an intense and very economical source of ultraviolet rays can be obtained.—*L'Industrie Elec.*, March 10.

Candle-Power Measurements.—The final report of the committee on illumination of the German Association (Verband) of Electrical Engineers on revision of the rules for the measurement of mean horizontal candle-power. These rules will be voted on at the coming annual meeting. When the term candle-power is used without further qualification the mean horizontal candle-power is meant if the lamp is used in a vertical position. The mean horizontal candle-power is determined by the method of rotating the lamp. The speed of rotation is to be adjusted so that there is no disturbing flicker in the photometer and no obnoxious distortion of the filaments. If the latter cannot be avoided use is to be made of another method in which the lamp is not rotated; for instance, Brodhun's method of rotating mirrors or the method of making photometric measurements in a large number of directions. Incandescent lamps calibrated by the Reichsanstalt are used as standard lamps. The direction in which the candle-power has been determined must be marked on the lamps and the optical axis of the photometer must be coincident with this direction during the measurement. Instead of standard lamps other incandescent lamps free from errors can be used, especially for measurements lasting a long time. Their candle-power must be determined by direct comparison with a standard lamp. Before being used they should have been operated for at least fifty hours and should have as nearly as possible the same color of light as the lamp to be photometered. The illumination of the photometer screen should not be much above 30 lux. The length of the photometer bench is to be selected correspondingly. For candle-powers up to about 100 hefners a length of 2.5 m and a candle-power of 10 hefners to 25 hefners of the standard lamp are sufficient. The voltage measurement must always be made at the terminals of the incandescent lamp. Two methods of making the measurements are described in detail.—*Elek. Zeit.*, April 20.

Photography and Photometry.—J. S. Dow and V. H. Mackinney.—A paper read before the Royal Photographic Society in London. The authors point out that the connection between photometry and photography is closer than might be supposed, and that each art can come to the assistance of the other. They suggested the actual measurements of the surface brightness of the various objects to be brought out in the field of view of a photograph as a means of determining the correct exposure. They showed a series of photographs in which this principle had been applied, the method being to measure the brightness of the chief objects in the field with the lumeter illumination photometer This instrument enables the brightness of distant objects to be readily determined, and the authors have used it for studying even such objects as buildings, trees, etc., the apparent brightness of which is largely dependent on the state of the intervening atmosphere. The range of surface brightness of objects which are met with in ordinary photography is enormous. Thus, a white surface illuminated by direct bright sunlight may approach 5000 ft.-candles, but on a dull day may be 1 ft.-candle and less, while dark parts of interiors may yield values of the order of hundredths of a ft.-candle. On the other hand, the brightness of actual illuminants is enormous, the electric arc having a brightness equivalent to some millions of ft.-candles. A branch of work in which measurements of surface brightness appear to be especially serviceable is the photography of artificially lighted interiors. One question to be borne in mind was, of course, the actinic value of different illuminants. It was suggested that, although a measure of surface brightness will yield valuable comparative results for the same illuminant, the difference in actinic value must be allowed for when examining interiors lighted by different means.—Lond. *Electrician*, April 21.

Generation, Transmission and Distribution.

Use of Carbon Dioxide Recorder.—W. N. Y. King.—An illustrated article in which the author describes his experience with a Simmance-Abady carbon dioxide recorder during the last two years in connection with a battery of large water-tube boilers mechanically stoked, with chain grates. The author first describes in detail the method of working the instrument and then gives the results of his experience concerning what could be done with the carbon dioxide recorder. One of the most important facts which have been shown by the carbon dioxide records is that the limit of the carbon dioxide obtainable under satisfactory working conditions is set by the highest temperature the grates will bear without rapid deterioration. In the author's plant with the type of stoker employed the carbon dioxide recorded for a whole day's run of eighteen or nineteen hours will vary not more than 2 per cent between the maximum and minimum during the firing hours—that is, from 11 per cent to 9 per cent. When fires are banked and fans shut down the carbon dioxide will drop off gradually to 2 per cent or 3 per cent only. If, in case of necessity, hand-firing is resorted to, the variations shown by the charts amount to 5 per cent or 6 per cent two or three times during each hour—that is, from 7 per cent to 12 per cent or 13 per cent carbon dioxide. From these observations it is evident that the engineer-in-charge has a very valuable means of control over the working of the fires, as it shows very clearly how the regulation of the fuel feed and draught is conducted, and the fireman, conscious that the record is being made, takes a greater interest in his work, with the result that considerable economy is obtained. No difficulty is experienced in getting a uniform number of records per hour, day after day, as the working cycle remains unaltered so long as the water supply is not interfered with; a very suitable chart is obtained by working at a rate of from twelve to fifteen strokes per hour.—Lond. *Elec. Review*, April 14.

Testing of Turbo-Generator.—M. Herrmann —Details of a test of a Bergmann steam turbine running at 1500 r.p.m. and coupled with a 2500-kw, 3300-volt, 50-cycle three-phase generator.—*Elek. Zeit.*, April 20.

Installations, Systems and Appliances.

Flat Rates and Renting of Lamps for Small Installations—An article pointing out that in order to make electric light popular with the small consumer a flat rate and easy terms in making the istallation are most important. The rates printed herewith are charged by electricity works in Bochum in Westphalia, Germany, based on metallic-filament lamps consuming not over 1.1 watts per candle.

Rated Normal Candles per Lamp	Rate in Dwelling Houses per Lamp per Month in Cents	Rate in Offices per Lamp per Month in Cents	Rate in Restaurants and Bakeries per Lamp per Month in Cents
16	12	15	18.8
25	18.8	22.5	28.8
32	25	30	37.5
50	37.5	45	56.25
100	75	90	112.5
200	150	180	225

These amounts are to be paid monthly in advance. The contract lasts for at least a year. The station carries out the installation at its own expense if the consumer agrees to pay an extra charge of 4 cents per month per lamp (with a minimum charge of 10 cents per month) in advance for at least a year or as long as the installation is in use. If this charge has been paid for five years (and it is immaterial who has been paid for it) the installation becomes the property of the consumer or the owner of the house. The installation is maintained by the central station, but the consumer has to pay for maintenance. Lamps are rented under similar conditions. It is pointed out that such easy terms should be allowed wherever there is competition with gas.—*Elek. Zeit.*, April 27.

Standardization Rules.—A set of proposed standardization rules for construction and testing of high-tension apparatus, including oil switches, insulators, lightning arresters, series transformers, etc. There are three sets of rules; first, general regulations; second, special regulations for oil switches, and, third, examples are given for three-phase plants. These rules have been revised by a committee and will be voted on at the next annual meeting of the German Association (Verband) of Electrical Engineers. They are to go in force on Jan. 1, 1912. —*Elek. Zeit.*, April 13.

Electric Heating.—G. B. Barham.—An article on some "uncommon applications of electric heating" dealing with the use of electric heating in connection with the printing press, in laundries, in paper making, textile and other industries, and in bakeries.—Lond. *Elec. Review,* April 14.

Paris Flood.—An account of the Paris floods of 1910 and their effects on electrical apparatus. Measures are suggested for the protection of stations against the invasion of water, and methods of drying and putting into running order fixed machinery and portable machinery are described.—Lond. *Elec. Review*, April 14.

Electrophysics and Magnetism.

Discharge from an Electrified Point.—A. M. Tyndall.—Some experiments chiefly on the pressure of the electric wind and the field in the neighborhood of a discharging point led Prof. A. P. Chattock and the author to adopt certain theories as to the nature of point discharge which at the time were capable of explaining most of the results obtained. The author has since extended the experiments, and has obtained results which are to a certain extent at variance with these theories. From the present results it is suggested that some of the observed effects originally attributed to the action of unclustered ions are due to an emission of uncharged doublets during ionization by positive ions. The apparent velocity of the ions in air, as measured by the wind-pressure method, becomes greater as the current between point and plate increases. This is explained by the presence of a back discharge from the plate, which prevents the method from being applied with accuracy except when the current is small. Evidence is adduced in support of the view that the positive ion in pure hydrogen is a charged molecule. The amount of combination which a point discharge produces in hydrogen containing different percentages of oxygen and nitrogen and the form of the wind-pressure curves in these mixtures are discussed and explanations are offered.—*Phil. Mag.*, May.

Softening of Röntgen Rays in Possing Through Matter.—C. S. Sadler and A. I. Steven.—An account of an experimental investigation in which an apparent softening of a heterogeneous primary beam in the process of transmission through matter has been observed. This effect is shown to be connected with the selective absorption by a substance of those constituents of the beam which can readily excite its characteristic homogeneous radiation. Confirmation of this view has been obtained by an analysis of the primary beam.—*Phil. Mag.*, May.

Magnetization of Iron at Very Low Field Strengths.—W. Kummer, E. Gumlich and W. Rogowski.—Two letters with reference to the determination of the magnetization curve and hysteresis loss of iron at very low field strengths. For very low field strengths the exponent in Steinmetz's law for the hysteresis loss is not 1.6 but 3.—*Elek. Zeit.*, April 13.

Electrochemistry and Batteries.

Ions.—R. A. Millikan.—An account of an experimental investigation of the isolation of an ion with a precision measurement of its charge and the correction of Stokes' law. The method consists in watching a single very small particle of oil moving in an electric field and measuring the change of its motion while it switches electric charges. In conclusion the author gives the following summary of the most important of the molecular magnitudes, accurate values of which are made possible by an accurate determination of e. The Faraday constant is taken as $Ne = 9655$ absolute electromagnetic units; $e = 4.891 \times 10^{-10}$ electrostatic units, the smallest quantity of electricity capable of separate existence; $N = 5.922 \times 10^{23}$, the number of molecules in 1 gram molecule of any substance; $n = 2.644 \times 10^{19}$, the number of molecules in 1 cu. cm of any gas at 0 deg. C. and 76 cm; $a = 2.106 \times 10^{-16}$ ergs, the constant of molecular energy; molecular energy $\epsilon = aT$; $\epsilon_0 = 5.750 \times 10^{-14}$ ergs, the kinetic energy of agitation of a single molecule at 0 deg. C., and 76 cm $\epsilon_0 = 273\, a$; $m = 1.702 \times 10^{-24}$ grams, the weight of the hydrogen atom. Finally the weights and diameter of several molecules are given. The absolute weight of the hydrogen molecule is 3.4×10^{-24} gram; its diameter is 2.28×10^{-8} cm.—*Phys. Review,* April.

Units, Measurements and Instruments.

The Testing of Transformer Iron.—L. W. Wild.—When accuracy is the first consideration transformer iron is best tested in the forms of rings. For routine tests, however, ring specimens are impracticable on account of the cost of winding. For every-day testing transformer iron is generally obtained in strips, which are built up in some form of magnetic square, the strips being threaded into coils ready wound and fixed to a baseboard. The "interleaved butt-joint system with square corners" has been very largely employed. In this the strips are built up with butt joints, differently disposed in alternate layers, so that the joint of one layer is covered by continuous iron in the next. In the system employed at the National Bureau of Standards in Washington, which is called the Washington system, the strips of iron are interleaved with strips of paper or other suitable insulating material of the same thickness as the iron. They are then made up into four bundles, which are wound round with tape and inserted into the coils. Corner-pieces are then cut and bent, each to a different length, and these are inserted between the ends of the strips. A double clamp is finally placed at each corner and is tightened up so that the strips and corner-pieces are held fast together. The two chief objections to the interleaved system are, first, that the difference between the longest and shortest path presented to the flux is great, and, secondly, at the corners the cross-sectional area is increased to twice the normal. At low densities the flux will tend to crowd into the shortest path, and this should increase the specific loss as a whole. At high densities the decrease in permeability will tend to cause the flux to spread out more, and at very high densities, if there is no magnetic leakage, the results obtained will tend to come out correctly. The objection to the interleaved system can partly be overcome by rounding the corners. This renders the cross-section constant at all points of the circuit. The fault that

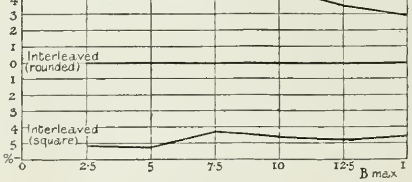


Fig. 3—Comparative Tests of Stalloy.

naturally occurs to one with regard to the Washington system is that the cutting and bending of the corner-pieces are likely so to increase hysteresis locally as to vitiate the total measurement. There is also the practical consideration that the operation of making and fitting the corner-pieces takes a considerable amount of time. In order to arrive at a general idea of the magnitude of errors involved, the author has made comparative tests of four specimens, employing all three systems, the strips used measuring 10 in. x 2 in. The specimens were of special transformer steels sold under the trade names of lohys and stalloy. The results for stalloy are given in Fig. 3. The author concludes that the Washington method is quite unsuitable for stalloy, and it is of rather doubtful utility for lohys. Secondly, if it should be decided that the interleaved method with rounded corners is the most accurate, it is hardly necessary to trouble about cutting the corners round. If the amount of waste material at the corners is deducted from the gross weight the results obtained will not differ by more than 1 per cent from the results that would have been obtained had the corners been rounded. It appears to the author that the interleaved method is still the best method of testing transformer iron available. It is generally agreed that if accurate results are to be obtained the strips must be annealed after being cut, and this can properly be done only by the manufacturer. There is no special virtue, then, in using wide strips.—Lond. *Electrician*, April 21.

Electric Insulators at High Temperatures.—W. W. Stifler.—An account of experimental tests on certain electrical insulators at high temperatures. The insulating power of asbestos seems to break down sharply at about 900 deg. C. It rapidly recovers its insulating properties on cooling. Mica seems to remain an insulator up to about 1000 deg. C. It then breaks down very rapidly with increase of temperature. On cooling the insulating power is recovered quite slowly down to 700 deg. C., but below this temperature it recovers rapidly. On heating again, it follows the curve of recovery. Magnesium oxide is an excellent insulator up to 800 deg. C. When heated above this temperature it becomes quite conducting, but recovers its insulating power on cooling. Sodium silicate breaks down very rapidly above 200 deg. C. or 250 deg. C. The behavior of cæmentium is quite irregular. Apparently heating to 1000 deg. C. improves its insulating properties to some extent, though it cannot be relied upon much above 500 deg. C. The results in the cases of sodium silicate and cæmentium were to be expected from the fact that glass and porcelain conduct electrolytically at high temperatures.—*Phys. Review*, April.

Comparison of Two Self-Inductions.—A. Anderson.—A system consisting of a coil of resistance P and coefficient of self-induction L connected in parallel with a non-inductive resistor of resistance S has an inductance equal to $\frac{LS^2}{(P+S)^2}$. It is therefore possible by shunting a coil with a non-inductive resistance to reduce its effective self-inductance and to make the latter equal to that of another coil whose coefficient of self-induction is less. From this fact the following method of comparing the coefficients of self-induction of two coils is deduced. Referring to Fig. 4, the coils A and B, of which A has the higher self-induction, are placed in the two arms of a Wheatstone bridge, B in series with a resistor R of variable resistance, and A shunted by a variable shunt of resistance S. The resistance of CE is equal to the resistance of ED. If the resistance in the arm DF is equal to that in CF there will be no permanent current in the galvanometer, and if the self-induction in DF is equal to that in CF there will be no transient current when the battery key is put down after the galvanometer key. The method consists in varying S and R till both these conditions are fulfilled. Denoting the resistance of A and B by X and Y, and their coefficients of self-induction by L and N, there is obtained the relation

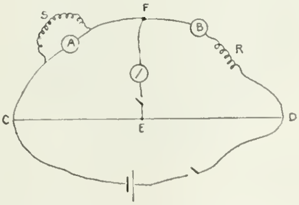


Fig. 4—Comparison of Self-Inductances.

$$\frac{L}{N}=\left(1+\frac{X}{S}\right)^2 \text{ and } \frac{XS}{X+S}=Y\pm R.$$

It is possible that Y may be greater than $\frac{XS}{X+S}$, and in that case the resistance R should be in CF in series with the system consisting of A and S. Any inconvenience of moving the resistor R from DF to CF will be avoided by having variable resistances in both arms. The following is perhaps the easiest way of applying the principle of the method: The self-inductions L and N of the coils whose resistances are R and S are to be compared (Fig. 5). R and S are non-inductive resistors having resistances equal respectively to R and S. There is thus a balance for steady currents. The Q's are non-inductive shunts of equal resistance which are varied till there is no transient current. Then, $N=\frac{LQS}{R(R+Q)}$. Thus N must not be greater than $\frac{LS}{R}$, otherwise the shunts must be applied to S and S_1.—*Phil. Mag.*, May.

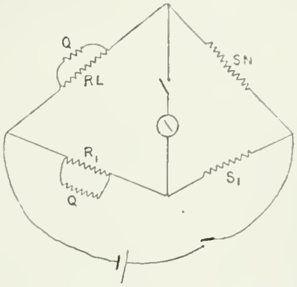


Fig. 5—Comparison of Self-Inductances.

Localizing Fractures in Cables.—G. Wald.—With reference to Black's test described in a recent article on the reduced current method for localizing fractures in submarine cables, the author gives a simple empirical formula by means of which the distance to the break may be found from each reading.—Lond. *Electrician*, April 21.

Faults in Three-Wire Systems.—W. E. Rogers.—An article giving some practical rules on localizing faults in direct-current three-wire systems of smaller size.—Lond. *Elec. Review*, April 21.

Telegraphy, Telephony and Signals.

Telephone Statistics.—Statistical data on the status of telephony in thirty-one different countries (chiefly in Europe and not including the United States). In these countries telephony is furthest advanced in Germany, England, France and Sweden, where the number of telephone conversations in the year 1908 were 252 000.000, 46.000.000, 22.000.000 and 15.000.000 respectively. The total capital invested in telephone plants in these thirty-one countries is $288.000.000. If to this is added the capital invested in the United States ($820.000.000), in Canada ($25 000.000) and in Australia ($10.000.000) the total capital investment in telephone plants in the world is $1,143,000,000.—*Elek. u. Masch.* (Vienna), April 9.

Telegraphy in the British Empire.—C. BRIGHT.—A paper read before the Royal Colonial Institute in London on the telegraph communication now available between the different sections of the British Empire.—Lond. *Electrician,* April 28.

Congress of Telegraphy and Telephony.—F. LUESCHEN.—An account of the proceedings of the second International Conference of telegraph and telephone engineers recently held in Paris.—*Elek. Zeit.,* April 20 and 27.

Miscellaneous.

German Societies.—The annual meeting of the German Association (Verband) of Electrical Engineers will be held in Munich from May 29 to June 1, 1911. The annual meeting of the German Bunsen Society of Applied Physical Chemistry will be held in Kiel from May 25 to 28.—*Elek. Zeit.,* April 20.

Thunderbolts.—W. M. THORNTON.—The author refers to the singularity of ball lightning which lies in the complete isolation of a gaseous sphere having no envelope, yet within which there is energy stored by previous electrical action. This is in the end liberated with explosive violence. He gives reasons for the assumption that these balls consist mostly of ozone in active recombination. The energy liberated on the transition of ozone to oxygen in the volume of fireball is sufficient to account for the explosive violence with which it bursts.—*Phil. Mag.,* May.

Industrial Finance.—L. JOSEPH.—A paper read before the (British) National Electrical Manufacturers' Association in which the author compares American and German with British industrial finance. He thinks that the progress made in the German electrical industries has been in a large measure due to the intelligent and most liberal assistance by the financial circles that have quickly grasped the importance of the new industry. An account is given of the extended discusssion, in which T. Rich, M. S. Myers, G. H. J. Hooghwinkel, H. Hirst, H. Oppenheimer and W. L. Madgen participated.—Lond. *Electrician,* April 28.

BOOK REVIEWS.

THE PRINCIPLES OF ELECTRO-DEPOSITION. By Samuel Field. New York: Longmans, Green & Company. 383 pages, 121 illus. Price, $1.80.

This volume contains an elementary treatise on electro-deposition intended for the use of students, artisans and foremen. The fundamental principles of generators, of electro-deposition and of electrochemical measurement are clearly explained. The illustrations in the book are particularly good. The chapters relate to the following topics: Voltaic cells; properties of electric current; the generator; arrangement of apparatus in the circuit; switchboard and connections; resistances; measuring instruments; quantitative electro-deposition; processes preparatory to plating; general properties of solutions; hydrometers; deposition of copper; copper cyanide solution; deposition of nickel; deposition of iron, tin and zinc; deposition of silver; deposition of gold; electro-brassing; metal coloring; qualitative analysis; applications of qualitative analysis; quantitative analysis; the estimation of cyanide; estimation of constituents of copper solutions; recovery of metals. A series of useful tables is appended.

Although the descriptive treatment in the book is clear and good, it is marred and rendered unnecessarily complicated by referring to British weights and measures as distinguished from the metric. This is the weak point of the book.

MOTION STUDY. By Frank B. Gilbreth. New York: D. Van Nostrand Company. 116 pages, 44 illus. Price, $2.

A plea for conservation of muscular and physical activity in the work of the artisan in any and all manual industries is contained in this little volume. It directs analysis to the scrutiny of the motions involved in any piece of labor, such as bricklaying, with a view to discovering what, if any, means can be adopted for eliminating unnecessary motions of the body or any of its members in the performance of this work, either with or without special tools, aids or new machinery. It is claimed that such analyses and procedures can reduce by a large percentage the time, labor and cost of work in nearly all trades and labor occupations.

THE SLIDE-RULE. By C. N. Pickworth. New York: D. Van Nostrand Company. 119 pages, 34 illus. Price, $1. Twelfth edition.

This book represents a very practical little treatise for explaining the use of the slide-rule, its principles and methods of operation. Numerous examples are offered by way of illustrating the rules laid down. The history of the slide-rule's development is not discussed, but short descriptions of all the well-known existing types of slide-rule on the market are given. The greater part of the book is, however, devoted to the ordinary standard Mannheim slide-rule of four scales and a cursor, two scales being fixed and two moving on the slider. The book will be of service to those who desire to become acquainted with the principles that govern practical manipulation of the slide-rule.

AUTOMATIC SCREW MACHINES AND THEIR TOOLS. By L. C. Goodrich and F. A. Stanley. New York: Hill Publishing Company. 238 pages, 284 illus. Price, $2.

This is a complete and expert treatise on the construction and operation of automatic screw machines, describing with careful detail the mechanical means by which the wonderful, almost intelligent, sequence of operations which these machines perform is made possible. Numerous types of automatic machines are illustrated, including those of practically every leading American manufacturer. Instruction is also given in setting tools and cams for various jobs and in the preparation of tools for making unusual external or internal cuts. Complete tables of cutting speeds, tool feeds, etc., for screw-thread cutting, forming, boring, drilling and finishing are appended. In one interesting form of automatic machine, the Gridley turret lathe, described on page 86, the work spindle and cam shaft are driven by separate adjustable-speed motors, the controllers of which are operated automatically by cams on one of the drums. This arrangement gives a very flexible control of cutting speeds and feeds throughout the cycle of operations required to finish a given piece of work.

LEITFADEN ZUM ELEKTROTECHNISCHEN PRAKTIKUM. By Dr. G. Brion. Leipzig and Berlin: B. G. Teubner. 404 pages, 380 illus. Price, 11 marks.

An elementary textbook of electricity and electrical engineering intended for the use of electrotechnical students. It describes electrical laboratory apparatus as used in technical schools and colleges.

The chapters relate to the following topics: Introduction; electric sources in technical laboratories; laboratory installation in the Dresden Technical College; apparatus for measuring current, voltage, load, electric quantity and electric energy; the measurement of such quantities; resistances and resistance measurement; condensers and coils; primary and secondary cells; magnetic measurements and apparatus; alternating-current and direct-current measurements; general remarks on testing electric machinery; direct-current machines; alternating-current and rotating-field machinery; transformers and induction motors; converters; the photometry of electric lamps.

The book is primarily intended as a textbook for the technical students at the Dresden Technische Hochschule, but it will serve as a textbook for electrical engineering students generally who are familiar with the German language.

How to Read Telephone Circuit Diagrams. By D. S. Hulfish. Chicago: Electricity Magazine Corporation. 260 pages, 570 illus. Price, $2.

The non-electrical man or one unaccustomed to deal with diagrams outlining complicated electrical circuits is often stampeded in the presence of an involved blueprint by a kind of stage fright which is wholly disproportionate to the real difficulty in understanding the message of the draftsman. Mr. Hulfish's book seeks to withdraw this sense of confusion by explaining the simple elements out of which the complicated network of the blueprints may be built. Incidentally, much of the current practice of subscribers', line and switchboard circuits is developed in the explanatory illustrations. The subject of wiring diagrams, intended to show mechanical details for the aid of the installer, is treated separately from that of simplified circuits, in which the electrical action alone is shown. In the explanatory text material accompanying the diagrams much that is obvious is included in the descriptions, but the purpose of the book is doubtless accomplished if it succeeds in robbing the average telephone diagram of some of its fancied terrors of intricate detail. One without experience in diagram reading will certainly find the careful perusal of this book a highly profitable undertaking if he has the patience to follow through its pages.

New Apparatus and Appliances

SMALL DIRECT-CURRENT METERS.

To meet the growing demand for small direct-current meters the Westinghouse Electric & Manufacturing Company a few years ago placed on the market its type L ammeters and voltmeters, which have recently been greatly improved and brought to an equality with many higher-priced instruments now on the market.

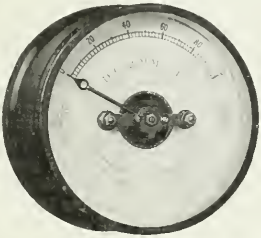


Fig. 1—Direct-Current Ammeter.

The meters are 5 in. in diameter, which makes them very convenient for use on small panels. At the same time the scale is 4 in. and uniformly divided, so that it is fully as legible as some larger meters. The movement of the meters is similar to that of the larger, higher-grade meters made by the Westinghouse company. The principle used is the D'Arsonval, or permanent-magnet, moving-coil principle, but its application in this case is unique, as the magnetic circuit has a single air-gap in which the coil moves pivoted at one edge. This arrangement results in several advantages. The single air-gap can have larger clearance for the same magnetic strength, making it easy to keep it free from dust or iron filings; the complete moving element can be removed and replaced without disturbing in any way the magnetic circuit or its strength, and the entire magnetic circuit can be magnetized, aged and tested as a unit, making variations unlikely. As shown in Fig. 2, the magnetic circuit is self-shielding and iron cases are not required to protect the instrument from stray magnetic fields.

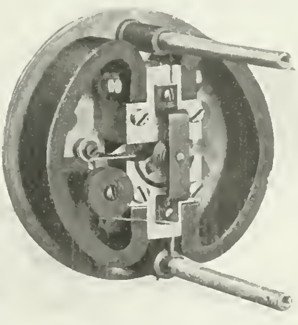


Fig. 2—Self-Shielding Magnetic Circuit.

The moving coil is wound on a light metal frame, the damping effect of which makes the reading dead-beat. The frame is carried on especially hardened steel pivots, bearing polished and carefully fitted sapphire jewels. As the coil is pivoted at one edge it acts as a counterbalance for the pointer. This reduces the total weight on the pivots, making friction a minimum and thus tending toward accuracy and long life. The meter scales are hand-calibrated, which eliminates any slight irregularities of the magnetic circuit that may exist. In case of injury to the calibration through overloads simple adjustments are provided for correction.

The cases of the meters are of molded hard rubber, giving the meters a finished appearance. The meters are attached to the panels by means of brass studs, which serve also as terminals. The line includes ammeters up to 300 amp and voltmeters up to 300 volts.

FEED-THROUGH SWITCH.

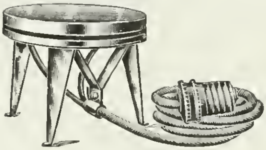
Many heating devices and small portable motor-driven devices, such as drills, vacuum cleaners, etc., are used with long portable cords and are operated at a distance from the attachment plug or switch. For such cases a feed-through switch, which can be installed directly on the cord near the apparatus, permits of turning the current on or off wherever the device is being operated.

The new Cutler-Hammer switch of this type, shown two-thirds size in the accompanying illustration, has an inclosing casing made of a black insulating material, which is the result of years of experimental work. This composition is remarkably tough, has a handsome finish and can be molded with extreme accuracy, so that perfect alignment of the operating mechanism is possible. The rating of this switch is 6 amp and 125 volts, and the mechanism is the same as that used in the other Cutler-Hammer specialties. The switch has been approved by the Underwriters' Laboratories.

Feed-Through Switch.

A BREAKFAST-TABLE ELECTRIC STOVE.

One of the advantages of the electric disk stove is that it can be used cozily on the table for the making of tea, coffee, toast and other creature comforts, including hot toddy, if one is thereto inclined. The stove illustrated herewith is conveniently adapted for this purpose, being only 4 in. in diameter and consuming only 275 watts. It is finished in polished nickel and will be found useful in the sick-room, hospital and office, as well as in the home. It is made by the Waage Electric Company, 674 West Madison Street, Chicago.



Disk Stove.

* * *

LABORATORY RESISTANCE SET.

The laboratory resistance set here shown, while designed primarily for laboratory work, is arranged so that it can be used as a portable outfit at any time desired. The set consists of the switch dial form of Wheatstone bridge, four dials of ten coils each, with a one-dial bridge, the multiples being 0.01, 0.1, 1, 10 and 100. The coils are wound of manganin wire and are said to be accurate to 0.04 per cent in the regular instrument; higher accuracy can be obtained up to 0.01 per cent, thus allowing very accurate readings to be taken. The set should prove useful in central-station work, and in all commercial and technical laboratories where testing by Wheatstone bridge is done.

Portable Resistance Set.

With the rheostat dials use is made of a design of brush which gives a uniform spring contact both on the arm running over the blocks and on the center ring. The brush is composed of a number of laminations of spring phosphor bronze with ground ends which slide over the contacts smoothly and evenly; the contact resistance is claimed to be negligible. The brush is set at an angle, so that in swinging over the blocks it does not mark or line the blocks. The contact surface on the center ring is equal to the contact surface on the stud, and hence on all of the switches the contact surfaces are equal, thereby making the instrument theoretically, as well as practically, correct. An important feature is the fact that there are no flexible leads or connections whatsoever, all connections being permanent and soldered, and the brush is so arranged that it swings in a complete circle in either direction, going from the highest value to the lowest value coil in any decade without having to be turned back over the intermediate blocks.

The set measures 12¾ in. in length by 10 in. in depth by 5 in. in height and weighs about 12 lb. It has been placed on the market by the Thompson-Levering Company, Philadelphia, Pa.

* * *

POLE-TYPE FUSE SWITCH.

In a distributing system covering large areas with a network of primary wires it is desirable to protect each branch circuit by a fuse which will localize troubles arising within the branch, also rendering the latter dead and guarding the public against contact with fallen wires, etc. The lineman hunting trouble or making repairs finds pole switches at branch points extremely helpful, and their use is now common for this purpose.

The Matthews fuse switch illustrated herewith combines the desirable function of both primary fuse and primary switch, serving as a fuse which operates positively, without possibility of danger or injury to men or line equipment, and can be cheaply and safely replaced when blown. The fuse is of the standard expulsion type, discharging its gases positively and breaking the arc and so eliminating the damage and danger of recurrent surges experienced with fuse blocks.

Fig. 1 shows the assembled fuse switch and Fig. 2 shows it with the carrier unhinged and the fuse removed from the carrier. The latter is of specially treated maple and on it are mounted the fuse contact clips. These in turn are connected to plates making contact (when the carrier is closed) with the stationary clips on the marble base at the rear, to which clips the leading-in wires are attached. The lower side of the iron box is closed by a slide of transite, provided with a hole opposite the expulsion fuse, through which the gases can discharge without raising the pressure inside the box, burning it or even rendering it temporarily alive.

The iron door is so designed that it prevents rain from driving in and by the provision of hinge ears and latch lugs on both sides can be made to open right or left, as desired. The latch is simple but effective, and can be opened by striking it with the hook stick. This hook stick, as shown in Fig. 3, is used for pulling open the hinged fuse carrier, which is equipped with an eye at its upper end for this purpose.

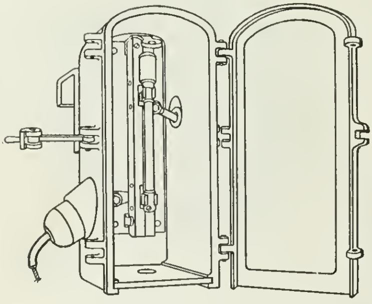


Fig. 1—Pole-Type Fuse Switch Assembled.

The door may thus be opened and the switch pulled to its open position entirely by the aid of the hook stick. If it is desired to remove or replace the fuse the carrier (which is dead in its open position) can be unhinged by sliding it sideways on its pivot and lifting it free of the stud. It may then be removed from the box and the fuse replaced or changed without the slightest inconvenience or danger of shock. As the fuse element is of plain fuse wire a few spools of different sized wire will enable the lineman to change the rating of any fuse box without recourse to the complete assortment of high-voltage inclosed fuses otherwise required.

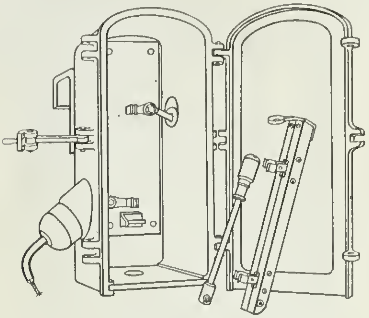


Fig. 2—Fuse Switch with Fuse and Carrier Removed.

The heavy porcelain bushings through which the wires are led into the box are set at an angle which prevents moisture and dirt accumulating and entering the box. The bushings have been tested up to 19,000 volts, under rain conditions.

The use of the fuse switches described localizes troubles to the particular branch circuit where they originate without affecting the operation of an entire district. The opening of the branch fuses on swinging and partial grounds or shorts, not sufficiently severe to open the station breakers, also insures that dangerous live wires are not left exposed to cause accidents. Immediate notification of any trouble is also usually furnished headquarters, since the blowing of the fuse extinguishes service in a limited section, resulting in telephone calls from the consumers affected. The trouble crew can then be dispatched directly to the point of trouble, while the rest of the district remains unaffected.

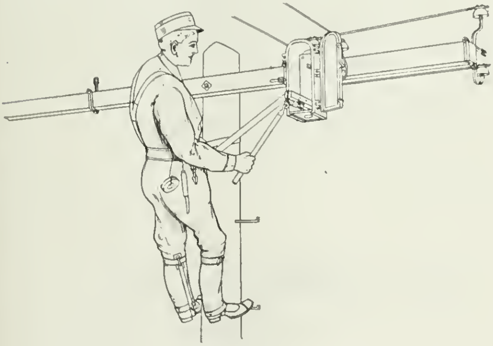


Fig. 3—Operating Pole-Type Fuse Switch with Hook.

W. N. Matthews & Brother, 219 North Second Street, St. Louis, who market this switch, say it is reasonable in first cost and inexpensive to install, since it hooks into place over the cross-arm and requires little space. It is safe to handle and operate, and its maintenance and fuse renewals are inexpensive. The fuse switch illustrated, which is of the type adopted by the Union Electric Light & Power Company of St. Louis after eighteen months' actual service, is designed to interrupt 75 amp at 6600 volts. It is built in styles for operation up to 200 amp and 17,000 volts.

SEMI-PARABOLIC STREET-LIGHTING REFLECTOR.

The street-lighting equipment here illustrated consists of an incandescent lamp placed at the focus of two parabolic reflectors cut away at the rear to allow the lamp to be inserted and at the bottom to permit a downward distribution of the light. The equipment confines the light rays to useful directions, and hence gives a high efficiency of delivery. The candle-power distribution is non-uniform, being minimized in the upward and sidewise directions and augmented in the line with the street, as shown in Fig. 3. The result is a good distribution of illumination along the street surface, even at the midpoints between lamps widely separated, as indicated in Fig. 4.

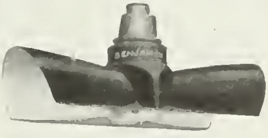


Fig. 1—Reflector for Center Suspension.

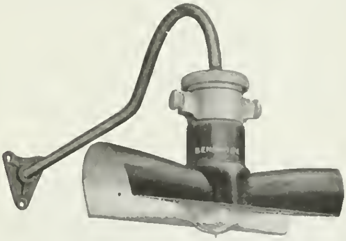


Fig. 2—Reflector for Goose-Neck Suspension.

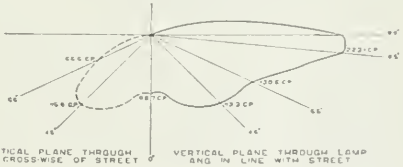


Fig. 3—Distribution of Light from 100-Watt Tungsten Lamp Unit in Reflector

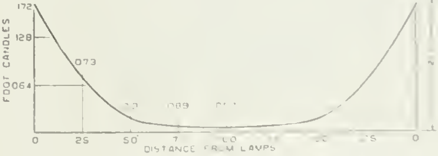


Fig. 4—Distribution of Illumination from Two 100-Watt Street Lighting Units.

This type of reflector equipment, built either for goose neck or center suspension, has been placed on the market by the Benjamin Electric Manufacturing Company, Chicago, Ill.

MOTOR-GENERATOR EQUIPMENTS FOR CHARGING VEHICLE BATTERIES.

When the energy for charging vehicle storage batteries is obtainable at a voltage much higher than that of the battery or the current is alternating rather than direct it is necessary to utilize apparatus for changing the voltage and current to the value and form demanded by the battery. When the supply is alternating mercury-arc rectifiers are frequently used, but when the supply is direct and the voltage high motor-generator sets must be employed if economy is desired, a voltage-reducing rheostat being very wasteful for this purpose.

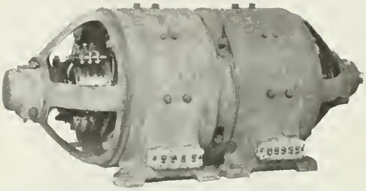


Fig. 1—Motor-Generator Battery-Charging Set.

In Fig. 1 is shown a motor-generator set consisting of a 250-volt or 500-volt direct-current motor directly connected to a 125-volt direct-current generator. These sets are built in ratings ranging from 0.125 kw to 12.5 kw.

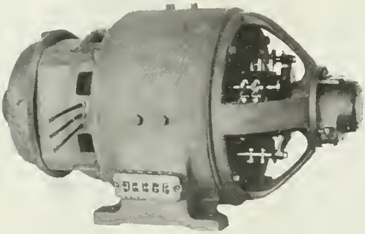


Fig. 2—Motor-Generator Battery-Charging Set.

Fig. 2 shows a set designed for use where alternating current is available. It consists of a 125-volt, direct-current generator driven by a polyphase motor wound for 110, 220 or 440 volts. These sets range in rating from 0.2 kw to 5.0 kw. A characteristic feature of these equipments is their freedom from complicated parts.

In Fig. 3 is shown a charging and running volt-ammeter designed particularly for use with electric vehicles. The instrument is of the permanent type, having two D'Arsonval elements. The ammeter is a millivoltmeter operating from an external shunt connected in series with the circuit; the voltmeter is self-contained, the series resistor being placed within the case. The scales are illuminated by a 2-cp lamp.

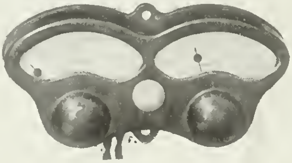


Fig. 3—Combination Volt-Ammeter for Automobile and Garage Equipment.

The above-described machines and apparatus are manufactured by the General Electric Company, Schenectady, N. Y.

MOTOR-DRIVEN MAGNETIC-CUSHION HAMMER.

The electrically driven hammer illustrated herewith is built upon the same principles as the hammer described in our issue for Dec. 2, 1909, but differs from the latter hammer in being more compact. The power is furnished by a series motor which drives a reciprocating plunger at the speed to produce 1800 blows per minute. However, the connection between the motor-driven reciprocating parts and the plunger or hammer element is not mechanical but magnetic, being furnished by a solenoid which lies around the sleeve of the tool element and provides an excellent cushion to prevent the strain and jar of delivery being felt upon the gears and motors.

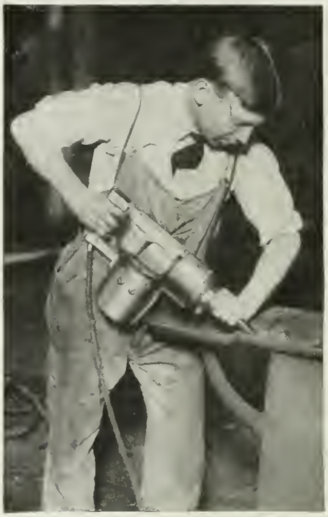


Fig. 1—Hammer in Service.

The motor is totally inclosed, the steel frame forming a part of the tool casing. The brush holders are attached to the casing of the tool, so that the motor head may readily be removed and the brushes examined and repaired. Ball bearings are used throughout, so that the efficiency is high. The power consumption of the motor when the tool is in service is 220 watts, or about equal to the amount taken by two 32-cp carbon-filament incandescent lamps. The motor is wound for either 110 volts or 220 volts, direct current, and may be operated from any convenient lighting outlet.

The hammer complete is 13 in. long and weighs 25 lb. It has been developed for light chipping and calking, for use with drills, chisels, etc., in concrete, brick and stone structures, by the Electro-Magnetic Tool Company, Chicago.

It is claimed that this type of hammer has successfully withstood the test of commercial service as evidenced by the large number of the earlier models now in successful use. In comparison with air or steam hammers the electric type possesses an advantage in that all investment for air compressors, piping, hose, etc., is eliminated, thereby minimizing the first cost and maintenance.

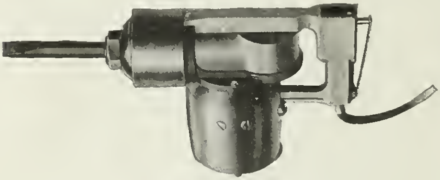
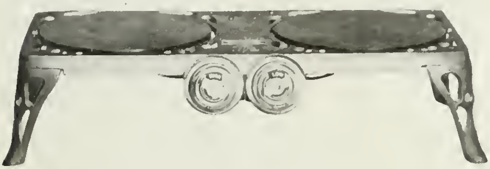


Fig. 2—Motor-Driven Hammer.

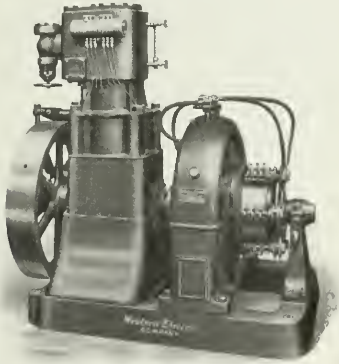
DOUBLE ELECTRIC STOVE.

The double electric stove here illustrated fills the place of the two-burner gas stove, which of late years has become quite popular. This stove is said to be thoroughly fool-proof. It gives three degrees of heat. This device when used with an electric oven meets most housekeepers' summer cooking requirements and no doubt such a combination will be quickly adopted by wide-awake new-business departments. The stove has been placed on the market by the Diamond Electric Company, of Binghamton, N. Y.


Double Electric Stove.

SELF-CONTAINED STEAM-ENGINE GENERATOR SET.

In the accompanying illustration is shown a self-contained directly connected steam-engine generating set designed for electric service in isolated plants or marine installations, or as exciters in large central stations. The engine is of the vertical-cylinder type and may be either single-expansion or tandem-compound, condensing or non-condensing, for pressures ranging from 35 lb. to 160 lb. The generator is a direct-current machine ranging in rating from 2.5 kw to 75.0 kw. The engine and generator are assembled on a common cast-iron base which extends the full width of the generator and provides ample base surface for foundation without increase of the floor area required. These sets are being placed on the market by the Western Electric Company.



Steam-Driven Direct-Connected Generating Unit.

FLEXIBLE INSULATED SHAFT COUPLING.

An insulated shaft coupling that can be used advantageously for connecting electric motors to pumps, sewing-machines, machine tools, wood-working machinery, etc., or gas engines to electric generators, is illustrated herewith. It consists of two cast-iron disks attached to the driving and driven shafts and a central disk for supplying insulation and transmitting the torque from one terminal disk to the other. The coupling can be run in either direction; it is neat in appearance, perfectly balanced and adapted for revolving at high speeds. This coupling is manufactured by the Charles Bond Company, 520 Arch Street, Philadelphia, Pa.

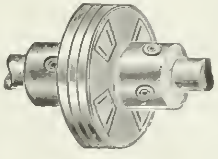


Fig. 1—Flexible Insulated Coupler.

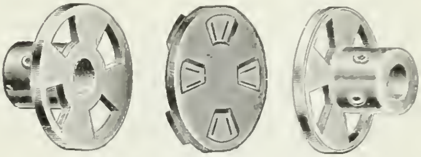


Fig. 2—Parts of Coupler.

WAGNER ENTERTAINMENT ON CHICAGO N. E. L. A. TRAIN.

Those who attended the convention at St. Louis last year have pleasant recollections of the courtesies and attentions devoted to the welfare and comfort of the delegates by the Wagner Electric Manufacturing Company of that city—automobiles to take them to and from the convention hall, candy for the ladies, cigars and cigarettes for the gentlemen, entertainment program on the special trains—evidence everywhere of careful thought and painstaking attention to details without being marred by obtrusiveness, as is sometimes the case with advertising of this character.

This year the Wagner company will provide the train entertainment features on the special train from Chicago. These features are entirely original with it through its advertising department, Ray D. Lillibridge, Incorporated, being first applied on the Street Railway Special train to Denver in 1909. The program consists of a train directory printed just before the train leaves, giving the name, address, business affiliation and location in the train of each person aboard, together with the schedule in detail and interesting features of the route, candy made by Wagner single-phase motors at the plant of the Belle Mead Sweets makers in liberal quantities for the ladies, cigars and cigarettes for the gentlemen; the now quite famous "Wagner Quality" cocktail at dinner for everybody, and complete arrangements for photographing the train and party, together with a print of the result with the Wagner company's compliments for each passenger on the train.

As there is no exhibit or general headquarters for the manufacturers this year the Wagner company has engaged the Louis XVI suite at the southeast corner of the second floor of the Hotel Astor as a rendezvous for its friends. While no hotel in particular has been selected as an official headquarters the Astor will house many of the officers of the association and the Monday night reception will be held there. The accommodations the Wagner company has selected are the same that have been occupied several times by President Taft on official visits to the metropolis and by such notable personages as the Crown Prince of Sweden and Admiral von Koester, who was the Kaiser's representative at the Hudson-Fulton Celebration.

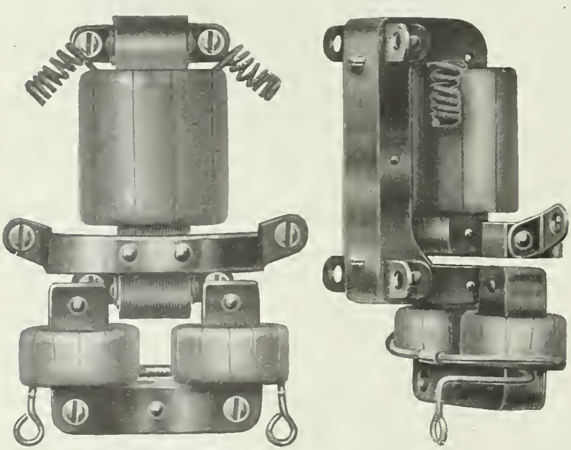
To further the value of these headquarters as a convenience the Wagner company has installed a direct-line telephone (Bryant 1426), doing away with the delay of incoming service and the expense of outgoing calls through the hotel switchboard.

The Wagner delegation will include Messrs. W. A. Layman, vice-president and general manager; F. N. Jewett, sales manager; E. H. Cheney, Chicago manager; John Mustard, Philadelphia manager; Brooks Faxon, Boston manager; E. W. Goldschmidt, New York manager, and Ray D. Lillibridge, advertising manager.

MAGNETIC CIRCUITS OF INDUCTION WATT-HOUR METERS.

The design and arrangement of the magnetic circuits of an induction watt-hour meter permit of a wide variation on the part of a designer as to the relations of the several elements entering into such systems, but in general it may be said that in this country the arrangement of magnetic circuits has been of two types. The first type is exemplified by those designs in which the series and shunt-field cores are embodied in one common magnetic structure, the several pole-pieces being so related above and below the armature of the meter as to produce the desired rotating-field effect.

In the common magnetic-circuit arrangement use is generally made of a pair of series magnet poles located on one side of the disk at a maximum radius and on the opposite side intermediate in position relative to the series-magnet poles above is placed a pole for the shunt magnet. In addition to the main shunt-magnet pole, auxiliary poles extend toward it from the return magnetic circuit at the sides, so that the flux from the shunt magnet through the disk is only a portion of the flux set up by the shunt coil in the lower portion of the laminated structure.



Figs. 1 and 2—Front, Side and Rear Views of Magnetic Circuits.

By this arrangement of a common magnetic structure for the several field magnetisms and the use of a leakage or partial flux proportional to the voltage, a meter is obtained which gives very accurate results over a considerable range in voltage and over commercial variations in frequency, wave-form, etc.

A disadvantage of this design, if it may be termed a disadvantage, is in the difficulty of taking apart the magnetic structure to get at the shunt or series coils in case of damage. There is also some disadvantage in the fact that this structure does not in itself exercise a shielding effect in preventing short-circuits through the meter weakening the permanent damping magnets.

In the second type of structure, differing radically in the details of arrangement, use is made of two large series coils without iron cores and acting upon an aluminum cup. These series coils are located on each side of a shunt magnet embracing the edge of the cup, the winding of the shunt magnet being within the cup and in series with a reactance coil in the lower part of the meter. In the original designs it was thought that the absence of iron in the series coils reduced the reactive or choking effect of these coils in the main load circuit, but experience proved that such reactive effect was negligible, and that a much smaller number of turns could be used when the iron core was employed.

In later designs, therefore, use is made of an iron core with pole-pieces for the two series coils standing in proximity to the armature and with the shunt magnet between the series coils as originally. This arrangement gives a meter of good accuracy under all commercial conditions, but has a tendency to weaken the permanent magnets on short-circuits unless use is made of a shielding device passing around from the series coils and embracing the cylinder.

A third form of meter having independent elements in the magnetic structure is illustrated herewith. This meter is fundamentally the same as the older Gutmann meter except that with the Gutmann meter the series coils were used without iron cores, so that relatively a smaller torque was obtained for the same expenditure of energy than in the present type.

In the latest meter the shunt magnet is a complete unit, both mechanically and electrically, being fastened in the meter independent of the structure of the series-laminated magnet. The latter magnet consists of a simple U-shaped yoke made up as a unit and riveted together, having on the other side of the disk from its poles a return magnetic circuit forming an air-gap between the poles and the return plate in which the armature rotates.

The construction shown in Figs. 1 and 2 permits of easy removal and repair of either shunt or series coils without disturbing the other element. More, the design of the curved magnetic return plate of the series magnet, with its laminations placed edgewise to the field, is such as to give a maximum radius of action for both the series and shunt-magnetic fields. As will be noted, the gap in the shunt-field core stands in between the poles of the series magnet, so that the several poles are in the closest possible relation.

Another advantage of this construction is in permitting the use of a laminated core for the shunt element having only a single air-gap. This insures uniformity and alignment in the gap, and reduces the magnetic leakage which must occur at each joint or gap in a magnetic structure, even when interlaced. Aside from the importance of the several elements of the magnetic circuit, the curved return plate is most useful in preventing severe short-circuits from affecting the permanent magnets as the return plate offers an effective closed path for the surplus magnetic flux from the series magnet during a condition of extreme overload or short-circuit. The shape of this return plate or yoke above the disk is such that the spreading lines of force under short-circuit conditions naturally tend to travel along the curved lines defined by the laminations of the return plate, so that with its front well forward of the plane of the series yoke no stray lines are left to act upon and weaken the permanent magnets.

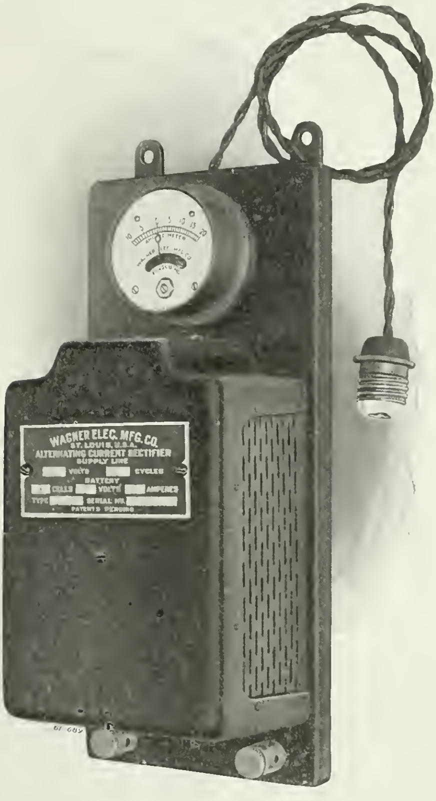
Outside of the two general types of magnetic circuit described a great many other types and modifications of these types have been tried, but abandoned either on account of the complexity and consequent high cost of manufacture or because of some radical fault which resulted in meters being inaccurate over wide ranges in voltage, frequency, load, etc.

The magnetic structure illustrated herewith is employed in the induction watt-hour meter manufactured by the Sangamo Electric Company, Springfield, Ill.

ELECTROMAGNETIC ALTERNATING-CURRENT RECTIFIER.

The alternating-current rectifier shown herewith has been developed particularly for charging small storage batteries, such as are used for automobile lighting and gas-ignition circuits. The rectifier proper consists of a vibrating armature in connection with an electromagnet. The rectifier permits current to pass to the battery only when flowing in the proper direction, this action being attributable to the closing of the circuit to the battery by the electromagnet for only that half of the current wave which is the correct direction for charging the battery.

Combined with the rectifier proper is a resistor of the proper resistance to limit the value of the current reaching the battery and a two-coil transformer to deliver the proper emf for rectification for the battery. The rectified equipment is provided with a lamp-cord terminal having an ordinary extension plug which can be inserted in any convenient lamp socket. The storage-battery connections are made at the two binding posts. It is quite immaterial which binding post is connected to the positive or to the negative terminal of the battery, since the charging will proceed satisfactorily regardless of the way the positive and negative terminals are connected to the rectifier. When so connected the operation begins automatically, the apparatus requiring no attention. If the alternating electric-supply current should be interrupted, the rectifier will automatically operate when the supply of current is re-established. If for any reason the rectifier should cease operating, due either to interruption of the alternating current supplied or to some difficulty in the rectifier itself, it always stops with the main contacts open so that the storage battery cannot be rapidly discharged.



Electromagnetic Rectifier.

The above-described type of rectifier has been placed on the market by the Wagner Electric Manufacturing Company, St. Louis, Mo., in two sizes for 3-amp and 5 amp direct current and for an emf sufficient to charge three lead cells in series. They are designed for use at 110-volt alternating current having any frequency between 57 cycles and 63 cycles per second.

IGNITION MAGNETOS.

The accompanying illustrations show a type of magneto suitable for dual high-tension ignition on one set of plugs. The low-potential current generated by the magneto is transformed by means of a non-vibrating coil to high-potential current for jump-spark work. They are made in different forms for use on small four-cylinder and six-cylinder motors for large, slow-speed four-cylinder and six-cylinder motors, for two-cylinder motors firing at 180 deg. apart and for single-cylinder two-cycle engines. All forms are essentially similar and differ only in general dimensions. Various types of coil boxes are built which can be used for both stationary and automobile work.

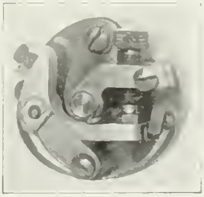


Fig. 1—Magneto Interrupter Mechanism.

The magnets of high-grade tungsten steel are magnetized by the most powerful magnetizer extant, and the coils are rendered absolutely moisture-proof by a special process of insulation and impregnation. High-grade ball bearings are used throughout. The interrupter mechanism is specially designed to facilitate adjustment. Instead of using check nuts the fixed contact is secured by a pinch screw. With this arrangement the work of adjustment is a matter of but a few minutes, requiring only a screwdriver to loosen the pinch screw and a nail, or even a match, to turn the fixed contact screw. In fact, all the parts, which should be regularly inspected, are easily accessible and can be readily taken apart without the use of special tools. The switch is provided with an attachment for starting on spark. It is manufactured by the General Electric Company, Schenectady, N. Y.

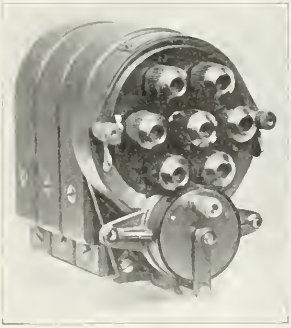


Fig. 2—Three-Magnet Six-Cylinder Magneto.

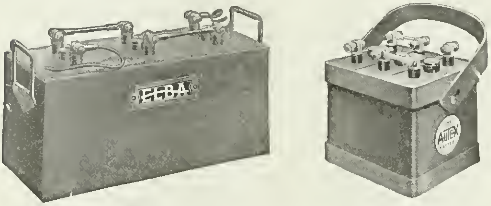
BATTERIES FOR AUTOMOBILE LIGHTING.

There are two distinct systems for lighting of automobiles, the so-called "dynamo-lighting system" and the "straight storage-battery system." In the former a generator and battery are used together, the generator charging the battery while the car is running, or the energy may be taken directly from the generator, in which case the lighting circuit is automatically switched over to a battery when the car is running at slow speed or standing. In the straight storage-battery system all the energy required is taken from the storage battery, which is charged from some outside source. The fact that the storage battery is the foundation for satisfactory lighting of automobiles has resulted in the gradual development of a special type of battery for this purpose which has a higher capacity, higher discharge rate and a more substantial construction than the ordinary type of sparking battery.

The Willard Storage Battery Company, of Cleveland, Ohio, has put on the market a line of storage batteries for lighting purposes, the essential difference between which and the ordinary battery is in the normal discharge rate. An ordinary 6-volt battery rated at 60 amp-hours will give 1 amp for sixty hours, but will not give 6 amp for ten hours. The table shown below will give a general idea of what might reasonably be expected of a 60-amp-hour battery of the type here described.

Discharged at the 7.5-amp rate, battery will give 8 hours of service or a total of 60 amp-hours.

Discharged at the 5-amp rate, battery will give 14.5 hours of service, or a total of 72 amp-hours.



Storage Battery for Lighting.

Discharged at 1-amp rate, battery will give 92 hours of service, or a total of 72 amp-hours.

The highest discharge rate above given (7.5 amp) is the average total current consumption of an equipment for five lamps. From the above it will be seen that an output "rating" of a battery does not convey much information unless the rate of discharge is also given.

The battery here shown is made of three individual cells in which the elements are placed, the cells being made of a special composition of rubber which gives them strength without brittleness and at the same time makes them impervious to acid action.

The jars are placed in a wooden case. Between each jar and also between the jar and the outside case there are spaces filled with a semi-solid compound which acts as a cushion, thus enabling the battery to withstand the rough usage of automobile service without injury.

There is ample space between the plates and the first cover of the cell to allow for proper expansion during charging and also to allow one to see that the plates are fully covered by the electrolyte.

The binding posts and straps to which the plates forming the negative and positive groups are attached are a one-piece construction, and the plates themselves are lead-burned to the top-connecting strap so that the entire group of individual plates, top-connecting strap and terminal binding post form one integral unit.

The construction makes each cell an independent unit and there is no possibility for any connection between cells except such as are made from post to post above the top cover. This has the particular advantage of reducing the local action between cells to practically nothing. Moreover, any cell can be inspected or repaired without disturbing other cells. In the center of the top cover is placed a hollow vent plug having in its center a small hole to allow gases to escape when the battery is charging or discharging. The outside containing case is made of hard wood, which is chemically treated to make it acid-proof, and it is then covered with an acid-proof paint.

It is stated that with a battery of this kind and of the size suited to the maximum current required very satisfactory results have been obtained on "straight storage-battery system" at low expense for the original installation. The smaller types of these batteries are well suited for operating side and tail lamps.

* * *

NEW VENTILATING DEVICE.

The ventilating outfit shown in Fig. 1 is designed for placing simply and inexpensively into top sashes of windows, transoms or ends of sky-windows. The outfit includes 12½-in. motor-driven "Ventura" fan, cast-iron housing, cut worm-geared reversing mechanism, rod, bearing and handle, all ready for connection to plug or ordinary lamp socket. Fig. 2 illustrates an outfit adjusted for supplying fresh outdoor air. A special reversing mechanism makes it possible to discharge the air straight ahead, upward toward the ceiling, downward toward the floor, or at any intermediate location. A simple turn of the hand wheel (Fig. 1) reverses the outfit so that it exhausts from the room. Figs. 2 and 3 illustrate the simplicity of installation. To conserve the lighting effect and add to the appearance the filler which accommodates the ventilating set can be glazed as shown in Fig. 3. The electrical connection can be made from nearby plug or ordinary lamp socket. Any carpenter or millwright can install the outfit at small cost. This device, known as the "Ventura" electric ventilating set, is being marketed by the American Blower Company, Detroit, Mich.

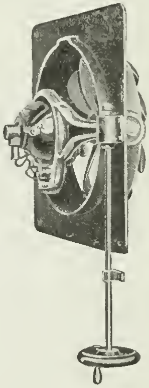


Fig. 1—Ventilating Device for Window Sash.

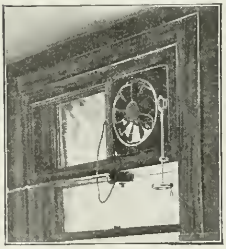


Fig. 2—Ventilating Fan Installed.

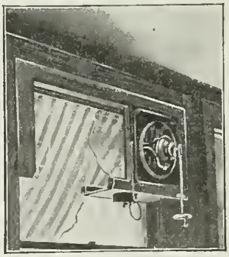


Fig. 3—Method of Installing Ventilator.

PORCELAIN STRAIN INSULATOR.

There are many conditions for which properly designed porcelain strain insulators are well suited. They are largely used in guy wires by street-railway and electric-supply companies. Groups in series are used at dead-ends to take the strain of and to insulate the line wires. The type of strain insulator here shown is made of porcelain said to possess excellent mechanical and electrical properties for the purpose. The glaze is a dark brown, so that the insulators do not readily attract attention in the air. Sharp corners that would be apt to chip have been avoided and the shape of the grooves is such that the wires lie naturally in them. The breakdown emf when the insulators are dry is about 20,000 volts. The approximate ultimate tensile strengths of the insulators, when wired up in guy wires, are, respectively, 14,000 lb., 16,000 lb. and 23,000 lb. for insulators having maximum dimensions of 3⅛ in., 3½ in. and 5¼ in.

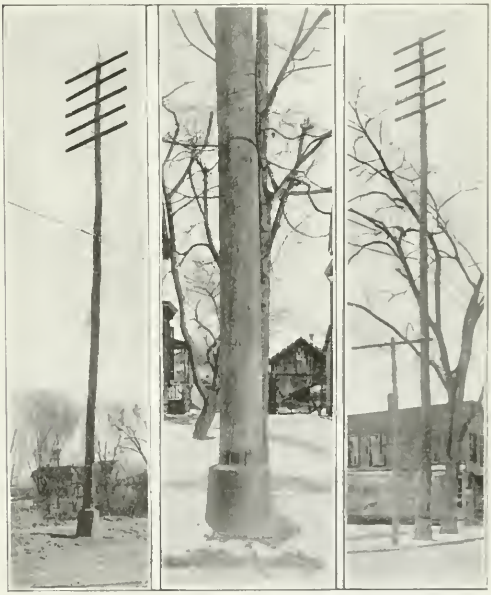
Porcelain Strain Insulator.

Even if an insulator fails either because of excessive stress or through an accident the wires that it carries cannot drop because they are interlinked. Two insulators are often installed in series so that if one breaks the other provides insulation, it being very improbable that two will break at the same time. This type of insulator is made by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

CONCRETE REINFORCEMENT FOR DECAYED WOODEN POLES.

As is well known, the available supply of cedar poles and of chestnut poles, the two species of wood most widely used in electrical work, is rapidly diminishing, and in anticipation of the very limited amount of wood which will be procurable not many years hence, much work has been done on iron and reinforced concrete poles. The result of much of this work has been very satisfactory, and in one or two instances the cost has been brought down to a point comparable with that of wood. Experiments have not been completed along these lines as yet, however, and the central station companies are often in a quandary regarding the up-keep of lines, the poles of which have decayed. It has been estimated that fully 90 per cent of the pole-line troubles are due to decay at the ground line and not to actual breakage, as the upper part of the pole is invariably sound.

The Pittsburgh Reinforcing Pole Company, Pittsburgh, Pa., has a method by which a new lease of life is given to poles which have been rotted at the butt. By means of concrete reinforcing it is claimed that the poles can be made satisfactory for ten years' further use and the wood that would otherwise be scrapped be made to tide over the period of experimentation with substitutes. Usually the point of decay is right above and below the ground level, since the structure of the wood is there most susceptible to fungi and bacteria, which thrive in the condition of moisture found at this point. In the method used by the Pittsburgh Reinforcing Pole Company, the earth is removed for a distance of about 18 in. from the sides of the pole to a depth that will expose the solid portion of the butt. The decayed portion of the pole is then scraped out. One-half-inch steel rods from 3½ ft. to 6 ft. long and pointed at both ends, the upper end being bent at right angles to form a dog or point from 5 in. to 6 in. long, are used for reinforcing. The straight end of the rod is driven into the sound portion of the butt at an angle by the use of a special driving tool. The upper portion of the rod is then brought in toward the pole and the dog driven in to its full length. The length of the rod used is such as to permit the proper anchorage of its lower end in the sound wood of the butt and to allow the portion extending above the ground to be of sufficient length to span the rotted section of the pole and to be driven into perfectly sound wood. The points of the rods are usually driven into the pole from 12 in. to 18 in. above the ground level. Concrete is then filled in around the pole, replacing the decayed portion of the wood and forming a protecting sleeve or envelope. The concrete extends above the ground sufficiently far to cover the upper terminals of the rods and protect them from the elements, forming a sort of collar above ground and tapering from about 3 in. thick at the ground level to about 1½ in. at the top, where it is finished off by a frame designed for the purpose. Where the butt of the pole is partly rotted away, the rotten portion is removed and the space filled with concrete, thus providing an anchorage for the rods either in the solid wood of the butt or in the concrete itself. If the butt of the pole is entirely rotted away, a concrete base of slightly larger dimensions than the pole is used; the pole is cut off squarely and rests upon this concrete base, the upper portion of the rod projecting from the base and surrounding the pole being then bent in and the dogs driven home as in the first case. It is, of course, necessary to support the poles by means of tripods or temporary guying while the reinforcing is being done. The process is very simple and the average cost very low. Illustrations are given herewith of poles which have been reinforced by this process. From the standpoint of continuity of service, safety to workmen and cost, the process possesses advantages over the renewal of poles, as there is no necessity for handling wires, no interruption of service while reinforcing and no old poles to dispose of afterward. Decayed poles which have been reinforced by this method have been subjected to all kinds of tests, the tests demonstrating that the reinforcement can be made of any required strength, even up to that of a new pole.


Figs. 1, 2 and 3—Poles with Concrete Reinforcements

Industrial and Commercial News

THE WEEK IN TRADE.

WHILE there has been a far more cheerful tone during the week, and more improvement is reported in many lines than for many weeks preceding, the actual increase in the volume of new business has not been as large as expected, and totals are under the scale for the period of the year. In many quarters the belief is expressed that substantial increase in activity is still a matter for the future. Discussion of the Standard Oil decision continues in abundance, and opinion is rather divided as to whether or not the announcement of this important ruling has fully cleared the way for extension of trade. The dullness in general trade cannot be attributed solely to the delay in rendering the decision, and further developments along the lines of tariff legislation, ultimate crop returns and a more widely spread feeling of confidence seem needed before an active movement can become general. The business of the week, as a whole, has been of an encouraging nature. A better tone is evidenced in the metal markets. Many of the steel mills, however, are still operating well under capacity, and stocks of pig-iron are being increased at several of the furnaces. Retail lines have done a somewhat larger business, owing to the season, and wholesale and jobbing trades have made minor gains. Cotton markets are also slightly improved. The report on the number of idle cars shows an increase of only 272 between April 26 and May 10, against an increase of 953 between April 12 and 26. There is a feeling that more active purchasing on the part of the roads is to be expected with the advancement of summer. News of the excellent crop situation is greatly assisting the condition of the country. Business failures for the week ended May 18, as reported by *Bradstreet's*, were 235 as compared with 245 last week, 225 in the same week of 1910, 219 in 1909, 284 in 1908, and 165 in 1907.

THE COPPER MARKET.

FOLLOWING the Supreme Court decision, there was a temporary activity in standard copper, and prices advanced a fraction, but the movement induced little additional buying, and the net results at the close of the week showed a decline both in demand and prices. Inquiries are reported in greater volume from domestic consumers, over the week, and a sale of 5,000,000 lb. of electrolytic is said to have been made to foreign interests at 12 cents for July shipment. Another sale of 3,000,000 lb. is also reported for the same shipment. Aside from this, little new business is being obtained from either foreign or domestic interests. The announcement of the Supreme Court decision has caused revival of the possibility of a merger between the great producing interests. Any arrangement resulting in decreased production or in a more rational connection between supply and demand would be of benefit to the present market. With the probability of increased output from some of the new mines of the country the outlook for decrease in surplus stock is not improved. Business in finished products both here and abroad is not active. Prices for electrolytic copper have fluctuated abroad during the week, with the advances of the middle part of the week followed by reactions at the close. Many copper interests are looking for improvement within a short time, on the assumption that large consumers are short of stocks, and that in meeting these needs a large portion of the present surplus will be cleared, causing prices to reach a 13-cent level. The exports for the month, including May 22, now total 19,267 tons. The daily call on the Metal Exchange, May 22, quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.85	12.00	.....
May	11.85	12.00	11.92½
June	11.85	12.00	11.92½
July	11.85	12.00	11.92½
August	11.85	12.00	11.92½

The London market, May 22, was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	54	12	6	54	17	6
Standard copper, futures	55	3	9	55	8	9

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.30c			11.57½c		
London, spot	£56	15	0	£53	7	6
London, futures	57	12	6	54	0	0
Best selected	60	5	0	57	5	0

INDUSTRIAL AND COMMERCIAL NOTES.

Central Station for New Mexican Mines.—The Victor-American Fuel Company, which has been operating steam plants at three of its coal properties near Gallup, New Mexico, decided a short time ago to install a central station and transmit energy from this to its other properties. The company has constructed a fireproof power house of brick, with steel-supported roof, and is installing one 300-hp water-tube boiler and three 100-hp marine boilers. The plant is equipped with steel coal bunkers, which receive coal from a table about 200 ft. away. The ashes from each boiler are emptied into cars passing beneath the boilers, and when filled the cars are run out and the ashes emptied into a pit from which they are conveyed by an aerial tramway to an ash-dumping ground some 2000 ft. from the plant. The initial generating equipment will consist of two 500-kw, 2300-volt, three-phase, 60-cycle, General Electric horizontal condensing steam turbines, operating at a speed of 3600 r.p.m., and space will be left for two additional units. Two continuous-current, 15-kw, 125-volt General Electric condensing turbines operating at a speed of 4500 r.p.m. will serve as exciters. The switchboard will have blue Vermont marble panels, and will consist of two 15-kw, direct-current exciter panels, two 500-kw, alternating-current turbine panels, and four alternating-current, single-circuit feeder panels, with the usual instruments, all of which apparatus is to be furnished by the General Electric Company. There are at present four feeder circuits extending from the power house. One of these goes to the Hoaton mine, some 1¼ miles distant, where about 400 hp in motors are installed; another runs in the opposite direction to the Navajo mine, where there is approximately 800 hp in motors; the third circuit goes to the Bartlett mine, about 1½ miles away, where 275 hp in motors is installed; the remaining circuit goes to the town of Gallup, 5 or 6 miles away, where energy will be used for lighting and motor service. A voltage of 6600 was decided upon as a suitable potential for transmission, as some of the developments were situated from 4 to 6 miles from the plant. All the circuits are protected by General Electric aluminum-cell lightning arresters. In addition to the above apparatus for the generating plant the Victor-American Company has ordered the following apparatus from the General Electric Company for use at the three mines mentioned above: One 112-hp, three-phase hoist motor, with controller and rheostat; two 50-hp, 440-volt hoist motors of the slip-ring type, designed for heavy duty; one 250-hp, 440-volt, variable-speed hoist motor of the slip-ring type, with master controller contactor equipment; two 20-hp squirrel-cage-type induction motors for pumping service; three 35-hp, 440-volt variable-speed motors of the slip-ring type, with automatic self-starting device for driving fans, and three 150-kw, three 75-kw, three 50-kw, 6600-460-volt transformers.

Westinghouse Units for New Haven Road.—The New York, New Haven & Hartford Railroad has placed orders for four Westinghouse-Parsons turbo-generators for its Cos Cob station. These will be 4000-kva single-phase units, which will increase the generating rating of the station at 80 per cent power-factor from 12,000 kw to 28,000 kw. The present boiler equipment will be increased proportionately and the coal-handling plant will be rearranged and enlarged. The Fred. T. Ley Company, of Springfield, has been awarded the contract for erecting the addition to the present building in which the new machinery will be installed. The additional equipment of the station will be utilized for supplying energy to the electrified Harlem River branch, the New York, Westchester & Boston Railway, the Tarrytown, White Plains & Mamaroneck Railway, the local street railway system in Port Chester, N. Y., and the lighting system in Greenwich, Conn. It will also take care of future extensions of the main-line electrification east of Stamford, Conn. The cost of the new equipment will be in the neighborhood of $1,200,000.

Electric Equipments of Office Buildings.—C. E. Knox and C. O. Mailloux, of New York, who designed the elevator system of the Metropolitan Life Insurance Building, New York, have been retained to lay out the entire electrical equipment for the Municipal Office Building of the city of New York, construction of which is described in another section of this issue. No arrangements have been made for the installation of a private plant for this building. The connected load in lamps will be about 1800 kw, and there will be thirty-three elevators of the gearless traction type, which will have a lifting capacity of 3000 lb. at a rate of 600 ft. per minute. Mr. Knox states that this rate of speed is found satisfactory owing to the gradual acceleration acquired by this type of elevator, and that one of the most important features of the gearless traction type elevator is its freedom from danger of overrunning. The Lord Electric Company has been awarded the contract for the electrical equipment of the lower floors up to the first main floor, and will install the wiring, switchboards and elevator feeders. The latter will be furnished by the insulated wire department of the Diamond Rubber Company. In addition to the design of the equipment for the Municipal Building, Messrs. Knox and Mailloux will design the elevator system of the Woolworth Building now in course of erection in Park Place, New York City, in which thirty-four elevators will be installed. Among recent work designed by these engineers are the addition to the plant of the Masonic Hall, New York; the plant and elevator system of the Copley Plaza Hotel, Boston; the design of plant, elevators and lighting equipment of the Raleigh Hotel, Washington, D. C.; the elevators for the Post-Graduate Hospital, New York, N. Y., and the equipment for four new buildings at Columbia University, New York, N. Y.

Henry L. Doherty & Company Notes.—A convention of managers and secretaries of a number of the concerns controlled by Henry L. Doherty & Company will be held in New York on Friday and Saturday of this week. The attendance will be between eighty and one hundred. Many of these officials will also attend the National Electric Light convention. The Montgomery Light & Water Power Company has awarded a contract to Henry R. Worthington for a jet condenser for the 1000-kw turbine recently installed, and has purchased a 300-kw. motor-generator set from the Westinghouse Electric & Manufacturing Company. This is a 2300-volt, 60-cycle, two-phase unit, delivering energy at 550 volts. The Doherty company has awarded a contract amounting to some $100,000 for new steam-heating mains in Denver. This is the first instalment of the $500,000 which is to be used for new mains, as outlined in the *Electrical World* April 27. The Empire District Electric Company has purchased the Empire Power Company, which operates in Carthage, Mo. The Bristol Gas & Electric Company has entered into a twenty-year contract with the Wautaga Power Company for supplying the latter with 1000 hp for resale, this agreement becoming effective Sept. 1. Henry L. Doherty & Company have taken over the entire fourteenth floor at 60 Wall Street, New York, N. Y., their present address, and are remodeling this space for their increased needs. Henry L. Doherty sailed last Saturday for a three months' trip abroad.

Central-Station Service for Cotton Mills.—The Proximity Manufacturing Company, of Greensboro, N. C., which operates a 5500-kw generating station at its cotton mills, has entered into an agreement with the Southern Power Company, of Charlotte, N. C., for supplementary power Since the Southern Company will furnish energy at 11,000 volts, 60 cycles, it has been necessary to provide a motor-generator set consisting of an 11,000-volt, 7750-kva, synchronous motor, operating at 400 r.p.m, and directly connected to a 7050-kva generator, which will furnish a 550-volt current at 40 cycles. The Panola Cotton Mills, of Greenwood, S. C., will take about 450 hp from the Southern Power Company. The plant was designed for motor drive throughout. The main groups will be equipped with 2200-volt motors and for the four-frame drive for spinning, employing 20-hp motors, the emf will be transformed to 550 volts. The motors for this installation, and the motor-generator set for the Proximity Manufacturing Company will be furnished by the General Electric Company.

More Telephone Dispatching.—Within a short time the Missouri, Kansas & Texas Railroad will be using the telephone to dispatch trains on both its Ft. Worth and its Dallas divisions. An order has just been placed with the Western Electric Company for forty-nine of its new selector and telephone equipments. The Dallas division runs from Dennison to Hillsboro via Dallas, a distance of 172 miles, and has a branch line of 22 miles from Dallas to Lewisville On this division selector equipment for twenty-nine stations will be used. The dispatcher will be located at Dennison. The Ft. Worth division extends from Dennison to Hillsboro, a distance of 152 miles, with a branch 9 miles long extending from Egan to Cleborne. It will be equipped with selectors and telephone apparatus for twenty stations. The dispatcher for this division will also be located at Dennison. The Chicago, Burlington & Quincy Railroad, which was one of the first to use telephones for train dispatching, has just placed an order with the Western Electric Company for twenty-seven of its new selectors and associated telephone equipment for use on its St. Joseph division. This new circuit will be installed between Kansas City and Napier, Mo., a distance of 96 miles, and the dispatcher will be located at St. Joseph. For use with the telephones on this division a supply of the new Western Electric moisture-proof cords has been ordered. When this equipment is installed the Chicago, Burlington & Quincy will be operating over 2700 miles of track by the telephone.

St. Lawrence Water-Power Grants.—The Judiciary Committee of the New York State Senate has been considering a bill which repeals the law giving the Long Sault Development Company a franchise to develop water-power on the St. Lawrence River at Massena. The contention is made that the law under which the company received a perpetual franchise in 1907 was unconstitutional. The interests opposing the franchise hold that technically the land under the St. Lawrence River, under New York State control, is a part of the forest preserve, which the constitution states must be forever kept as wild land. John C. Crapser, who represented the company, offered a brief supporting the constitutionality of the grant, and stated that the company would spend $40,000,000 in development of power sites and in safeguarding navigation. Mr. Crapser said that the company, in accordance with the law, paid the State $15,000 last year, and would pay $20,000 this year for use of the river for power purposes.

Electrical Construction.—Among the items printed under Construction News in this issue are announcements of proposed new plants or considerable extensions to present plants at Decatur, Ala.; Grand View, Ark.; Mammoth Springs, Ark.; Fresno, Cal.; Greenville, Cal.; Pasadena, Cal.; Augusta, Ga; Fort Sheridan, Ill.; Kendallville, Ind.; New London, Ia.; State Center, Ia.; Baltimore, Md.; Willmar, Minn.; Tupelo, Miss.; St. Louis, Mo.; Great Falls, Mont.; Albany, N. Y; Buffalo, N. Y.; Tarboro, N. C.; Eugene, Ore.; Claysville, Pa.; Edgefield, S. C.; Chamberlain, S. D.; Radford, Va.; Baraboo, Wis.; Superior, Wis.; Wausau, Wis.; Penetanguishene, Ont., Can.; Rouleau, Sask, Can.; Prince Albert, Sask., Can. and Montreal, Que., Can.

Gregory Electric Company Enlarges Plant.—A large addition is being made to the Gregory Electric Company's present building at Sixteenth and Lincoln Streets, Chicago. The new part has ground dimensions of 80 ft. by 125 ft. and will afford room for trebling the present testing department as well as for a brass foundry and a copper-smelting shop. Additional storage space will also be provided. The addition is a brick and steel structure and will be equipped with a 20-ton crane, making three large cranes in the whole establishment When this is finished, about Aug. 1, the company will have one of the best equipped electrical repair shops to be found anywhere.

Cable Messages at Reduced Rates.—Following lengthy negotiations between Theodore N. Vail, president of the Western Union Telegraph & Cable Company, and H. L. Samuel, Postmaster-General of Great Britain, arrangements have been made by several of the cable companies doing business between this country and England for a reduction of 50 per cent on all non-code messages transmitted across the Atlantic, with the understanding that these are liable to a delay not exceeding twenty-four hours. This arrangement is not related to the proposed Anglo-American-Western Union co-operative plan mentioned in the issue of May 11.

Fire Alarm Equipment for New York.—Fire Commissioner Waldo, of New York City, has awarded a contract to the Star Electric Company, of Binghamton, N. Y., for the installation of 500 new fire-alarm boxes in the borough of Brooklyn. Hitherto all such equipment has been furnished by the Gamewell Fire Alarm Telegraph Company, of New York. It is stated that the bid of the Star Electric Company was at the rate of $88.66 per box; the former Gamewall rate was $165.

Hodenpyl, Hardy & Company.—Announcement is made by the firm of Hodenpyl, Hardy & Company, formation of which was mentioned in the issue of May 4, that the new company is interested in and will manage the major portion of the gas, electric and traction properties formerly managed by the recently dissolved firm of Hodenpyl, Walbridge & Company. The companies managed by the new firm are the Union Railway, Gas & Electric Company and the Commonwealth Power, Railway & Light Company, both of which have their executive offices with the firm. The Union Railway, Gas & Electric Company, through its constituent companies, the Evansville Gas & Electric Company, the Peoria Light Company, the Springfield Railway & Light Company, the Rockford & Interurban Railway Company, the Janesville Traction Company and the Consumers' Gas & Electric Company, owns and operates the gas properties in Evansville, Ind.; Springfield, Pekin and Peoria, Ill., and the electric light and power properties in the cities named, together with the street railway business of Rockford and Springfield, Ill.; Janesville, Wis., and controls the Rockford, Beloit & Janesville Railway Company, operating between Rockford, Belvidere and Janesville. The Commonwealth Power, Railway & Light Company, through its constituent companies, the Consumers' Power Company, the Michigan Light Company, the Cadillac Water & Light Company, the Grand Rapids Railway Company and the Saginaw-Bay City Railway Company, owns and operates the street railway properties in Grand Rapids, Saginaw and Bay City, Mich., and the Interurban Railway between the last two cities, the gas properties in Jackson, Kalamazoo, Pontiac, Flint, Saginaw and Bay City, Mich., and the electric light properties in these cities, together with those in Battle Creek, Lansing and a number of smaller cities and towns, all in Michigan. It also owns and operates a water business in Cadillac, and has developed important water powers on the Kalamazoo, Grand and Muskegon Rivers. It has large power developments under construction on the Au Sable River, from which it is expected to deliver power in the early autumn of this year, and plans additional developments as required.

Elevator Equipment for Chicago Building.—The recently erected Heisen office building in Chicago, which is the tallest building in that city, will be equipped with fourteen elevators of the overhead traction type, having a speed of 350 ft. per minute and a travel of 250 ft. The elevators will be equipped with interpole motors built by the Ideal Electric & Manufacturing Company, of Mansfield, Ohio, which are being installed by the H. J. Reedy Company, of Cincinnati, Ohio. These elevators will have three speeds, 175 ft., 250 ft. and 350 ft. per minute, and are being fully equipped with dynamic brakes and slowing-down features which are taken care of by the controller. The slow-down equipment brings the elevator from high to low speeds regardless of load, and makes accurate stops at landing an easy matter. Each motor is rated at 45-hp.

Electrical Ice Plant.—The Ensley Pratt Ice Factory, Ensley, Ala., with a daily output of 100 tons of ice, has recently been put in full operation and is one of the most up-to-date artificial ice plants in the South. The equipment consists of two Westinghouse alternators, ten induction motors and a standard switchboard. The deep-well triplex pumps are run by induction motors. The entire electrical outfit was installed by A. Froehlich, of Birmingham, who for many years was assistant foreman of electrical construction with the New York Edison Company. Mr. Froehlich will also electrify the large plant of the Birmingham Ice Company.

Mining Machines Installed.—After operating several years with mule haulage and hand-mining, the Darby Coal Company, of Darbyville, Va., has decided to install electric haulage and chain coal-cutting machines, and has placed an order with the General Electric Company for five 6-ton locomotives. Electric energy for operation will be obtained from the company's plant. With this installation the company expects to increase its output and also to effect a reduction in the cost of production.

Pennsylvania to Electrify Suburban Lines.—It is reported that the plans for the improvement of the Broad Street terminal of the Pennsylvania Railroad, at Philadelphia, include, among other changes, the electrification of the suburban lines. The board of engineers in charge of drawing the plans will report within a few days, and announcement of details is expected later.

Financial.

The Week in Wall Street.

TRADING on the New York Stock Exchange in the week following the Standard Oil decision was the largest for any week in over six months. Total transactions were 3,653,630 shares, as compared with 1,079,952 for the week preceding. The activity was most marked on Tuesday, in response to Monday's decision, the total for the day reaching 990,621 shares, accompanied by general advances in price. Since that time trading has been in diminishing volume, but much satisfaction is found in the maintaining of new price levels and in the extension of activity to a wide range of issues. The ultimate results of the Supreme Court decision continue to be the subject of extensive comment. The fact that large corporations, regardless of policy, were open to charges under the anti-trust law was considered a retarding factor in the affairs of the country. The nature of the decision has resulted in a widespread feeling that much of this uncertainty is now dispelled and that both new and existing enterprises are given a much firmer basis upon which to operate. Events of the week have shown a return of public interest in stock transactions, but the degree of interest is small as yet and will probably remain so, until the market becomes more stable. More progress will undoubtedly be made by cautious steps than by attempts to anticipate the outcome of present influences. When the results of present tariff legislation, the crop returns and the trend of general trade become more clearly defined trading in Wall Street will be more attractive to the general public. The activity of the past week caused a slight increase in demand for money, but loans continue to be made at former prices. Rates May 22 were: Call, 2¼@2½ per cent; ninety days, 2¾@3 per cent. The quotations in the tables are those for the close, May 22.

NEW YORK.

	May 15.	May 22.	Shares Sold.		May 15.	May 22.	Shares Sold.
All. Ch......	7⅜*	8¼	1,600	Int. Met., pf.	52	53	5,000
All. Ch., pf..	28*	31	3,450	Mackay Cos..	90	92¾*	500
Amal. Cop...	63	67⅛	128,850	Mackay C.,pf.	76¼*	76½	100
Am. D. T...	20½*	20½*	———	Man. Elev...	135	137⅞*	420
Am. Loco...	37⅝*	43	5,200	Met. St. Ry..	15*	15*	———
Am. Loco., pf.	106¼*	108	300	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	82½*	82½*	———	Steel, com...	75⅞	80⅝	795,800
Am. T. & T..	148¼	148⅞	10,344	Steel, pfd...	118⅞	120¼	8,255
B. R. T.....	78¾	80⅝	53,655	W. U. T....	74¾	79¼	22,300
Gen. Elec...	156	160½	15,187	West'h, com..	69	74	26,900
Int. Met.....	18¼	18¾	5,180	West'h, pfd..	110	117	1,140

PHILADELPHIA.

	May 15.	May 22.		May 15.	May 22.
Am. Rys...........	44	44	Phila. Elec.........	16⅝	16⅞
El. Co. of A.......	12⅛*	12*	Phila. R. T.........	18⅜	18⅛
Elec. St. B'ty.......	53*	54	Phila. Trac........	83½	83½*
Elec. St. B'ty., pfd..	30*	30*	Union Trac........	46¾	46½

CHICAGO.

	May 15.	May 22.		May 15.	May 22.
Chi. Tel. Co.......	122*	123	Chi. City Ry........	186*	186*
Met. El. Co........	22⅛*	24¾	Chi. Rs., Ser. 1....	80*	80*
Met. El., pfd......	67*	71	Chi. Rs., Ser. 2....	21*	21*
Nat'l Car..........	118¼	120*	Com. Edison.......	128¾	128½
Nat'l Car, pfd......	120*	120*	Chi. Subways.......	4¾*	4¾*

BOSTON.

	May 15.	May 22.		May 15.	May 22.
Am. T. & T........	148¼	149	Mex. Tel..........	4*	4*
Cum. Tel..........	150*	153¼*	Mex. Tel., pfd.....	6*	6½
Edison E., Ill.......	287	287	N. E. Tel..........	144½	146
Gen. Elec..........	156¾	161¼	W. T. & T.........	19*	19
Mass. E. Ry........	18⅞	20	W. T. & T., pfd....	94¼*	96
Mass E. Ry., pf...	88½	89½			

*Last price quoted.
Shares sold for week May 15 to May 20.

Financial Notes.

Southern Utilities Merged.—Negotiation have been in progress for the consolidation of the New Orleans Railway & Light Company with interests of the American Cities Railway & Light Company. An agreement has been entered into by a number of the large stockholders of the New Orleans Railway & Light Company and Messrs. Bertron, Griscom & Jenks for the organization of a new company to acquire at least two-thirds of the preferred and common stock of the New Orleans Railway & Light Company and the stocks of the following named companies now owned by the American Cities Railway & Light Company: Birmingham Railway, Light & Power Company; Memphis Street Railway Company: Little Rock Railway & Electric Company, Knoxville Railway & Light Company; Houston Lighting & Power Company. The plan set forth in this agreement contemplates that the new company will issue in payment for the preferred stock of the New Orleans Railway & Light Company its 6 per cent cumulative preferred stock and common stock at the rate of $83 1/3 par value of its preferred stock and $16 2/3 par value of its common stock for each share of preferred stock of the New Orleans Railway & Light Company, and at the rate of $35 par value of its said preferred stock and $25 par value of its common stock for each share of common stock of the New Orleans Railway & Light Company. Should all of the stockholders of the New Orleans Railway & Light Company deposit their stock under this agreement, which will require $15,333,333 of 6 per cent cumulative preferred stock of the new company and $6,666,666 par value of common stock of the new company, the new company will have outstanding capitalization as follows: $10,000,000 eight-year collateral trust 5 per cent bonds, $21,810,083 6 per cent cumulative preferred stock, and $16,643,416 common stock. The preferred and common stock issued over and above that reserved for exchange for the preferred and common stock of the New Orleans Railway & Light Company will be issued for the acquisition from the American Cities Railway & Light Company of the above-mentioned subsidiary companies, together with the sum of approximately $1,500,000 to be used by the new company for working capital. The collateral trust bonds will bear the date July 1, 1911, or thereabouts, maturing eight years from date, and 25 per cent, or $2,500,000, will be paid off at par at the expiration of five years from date of bonds by lot. The bonds will bear interest at 5 per cent for the first six years and 6 per cent for the seventh and eighth years, and will be secured by pledge of all stocks to be acquired by the new company. The bonds will be redeemable as a whole on any interest payment date at par and interest. The agreement is to be declared effective within forty-five days from May 15, 1911. Under this plan, the present preferred stockholders of the New Orleans Railway & Light Company will receive the same dividend return and $16 2/3 of common stock. Messrs. Ford, Bacon & Davis, who for a number of years have been in charge of the operation of the American Cities Railway & Light Company properties and who are familiar with the operations of the property of the New Orleans Railway & Light Company, will, it is understood, still continue their large interests in the new company and the direct charge of its engineering and operation. The shares of stock of the New Orleans Railway & Light Company held in the United States are to be deposited on or before June 15, 1911, with the Hibernia Bank & Trust Company and the Whitney National Bank, of New Orleans, or at the New York Trust Company, New York City.

Northern Colorado Power Company.—For the first time since its organization in 1906 the Northern Colorado Power Company on May 13 issued a financial statement, which shows that the company has assets amounting to $7,755,805. The capital stock is $3,000,000, the authorized bond issue $6,000,000, and the bonds actually issued $2,593,000. The company has absorbed the following concerns: Consumers' Electric Company, of Louisville, Col., supplying the Lafayette, Superior and Louisville district; the Longmont Electric Light & Power Company, of Longmont, Col.; Boulder Electric Light & Power Company, of Boulder, Col.; Berthoud Electric Light Company, Berthoud, Col.; Loveland Light, Heat & Power Company, Loveland, Col.; Laramie Light & Power Company, Laramie, Wyo.; Greeley Power & Light Company, of Greeley, Col., and Cheyenne Light, Fuel & Power Company, Cheyenne, Wyo. The company has built a power house at Lafayette for the interurban electric line, constructed a reservoir of 10,000,000 cu. ft. storage and purchased 110 acres of coal lands. The gross earnings in 1908 were $363,356 and in 1910 $447,940, while net earnings in 1908 were $33,874 and in 1910 $35,562. William J. Barker is president of the company

New York Edison Earnings.—Despite the reduction in rates of the New York Edison Company announced in the *Electrical World* May 18, the earnings for 1911, from present indications, will be in excess of those for 1910. The new rates will apply to the second half of the calendar year, and the decreased income for this period will be balanced by the increase in net earnings for the first half of the year. George B. Cortelyou, president of the Consolidated Gas Company, which owns the stock of the New York Edison Company, is quoted as saying: "New York Edison's gain in gross is normal, in fact, a little above normal. Taking the record of the first four months, the gain in gross over 1910 has been a little larger than in 1910 over 1909." There was an increase of some $1,500,000 in gross earnings for 1910 over those of 1909, and also an increase of $1,100,000 in the net income available for dividends. With a decrease of $625,000 in these items in the second half of 1911, due to new rate schedules, there still remains an increase of some $500,000 in the surplus available for dividends, which would make the 1911 surplus $6,300,000 as compared with $5,821,346 in 1910.

Chicago Elevated Merger Expected.—Henry A. Blair, who has returned to Chicago from New York, where he had been making arrangements for financing a merger of the Chicago elevated systems, states that his negotiations have been satisfactory, and that the National City Bank of New York has agreed to furnish capital in the event of acceptance of his offer to the stockholders of the elevated roads affected. Meetings of the directors of the Metropolitan West Side Elevated Company and the directors of the South Side Elevated Railroad Company will be held early this week for the formal receipt of the offer. The promoters of the merger are largely Northwestern stockholders. It is said that the $30,000,000 notes which will be issued by the proposed holding corporation, which will also be the operating company in case the merger is effected, will bear 4½ per cent. These have been underwritten by Harris, Forbes & Company, and are to run for three years. Proceeds will be used for refunding the Northwestern Elevated 4 per cent bonds which become due in September.

Western States Gas & Electric Stock.—White, Weld & Company are offering $1,800,000 7 per cent cumulative preferred stock of the Western States Gas & Electric Company of Delaware at 100 and accrued dividend. This company owns all of the capital stock of the Western States Gas & Electric Company of California, which is the operating company and is a consolidation of the Humboldt Gas & Electric Company, the American River Electric Company, the Stockton Gas & Electric Corporation and the Richmond Light & Power Company. The Western States Gas & Electric Company of Delaware is controlled by the Standard Gas & Electric Company, which has a cash investment in excess of $1,500,000 in the common stock of the Delaware company. The Standard company, in turn, is controlled and operated by H. M. Byllesby & Company, of Chicago. The preferred stock of the Western States company, now offered, carries dividends at the rate of 7 per cent per annum, cumulative from April 1, 1911, is preferred as to principal and dividends and is redeemable at 115 and accrued dividends on sixty days' notice.

Kerr Turbine Company.—A reorganization has just been made of the Kerr Turbine Company, Wellsville, N. Y., and $125,000 new capital has been added. The stock interests of the company are now controlled by F. P. Merrill, of Hornell, N. Y., and P. B. Hanks, of Wellsville, who, as trustees, have directed the affairs of this company for the past two and a half years. Mr. Kerr is no longer with the company, his position as chief engineer now being filled by J. L. Moore, formerly a designer with the Westinghouse Electric & Manufacturing Company, and later in the engineering department of the Santa Fé Railroad. The present plant will be materially enlarged and a new machine shop is already in course of erection. It is the intention of the new company to incorporate into the Kerr turbine design changes which are based upon two years' experiments and which will improve the steam economy on all sizes from 15 to 20 per cent.

Kings County Electric Light & Power Company.—Gross earnings of the Kings County Electric Light & Power Company for four months ended April 30 were $1,588,796, which is an increase of $174,743, or some 12 per cent, over returns for the same period last year and is attributed to the efficient "new-business" campaign. The surplus available for dividends has increased $21,788, or about 6 per cent, in these four months. At the present rate operating returns will exceed $4,800,000. This will be offset to some extent if the prospective reduction of rates is adopted. A committee has been working for some time upon new rate schedules and a report will be presented to the directors of the company at the regular meeting on June 19.

Winnipeg Electric Railway Increase in Dividend.—A quarterly dividend of 3 per cent has been declared by the Winnipeg Electric Railway Company, placing the stock on a 12 per cent basis. The previous rate was 10 per cent per annum.

Ratification of Virginia Railway Merger.—The final steps in the consolidation of the Virginia Railway & Power Company with the Norfolk & Portsmouth Traction Company have been taken, and the agreement becomes effective July 1, 1911. An outline of the scope of this merger and of the capitalization of both participants was given in the *Electrical World* April 27. Corporate existence of the Norfolk & Portsmouth Traction Company ceases on July 1, 1911. The capital stock of the merged company is to be $20,000,000, of which $8,000,000 is to be preferred stock and $12,000,000 common stock. Prior to Jan. 1, 1914, the preferred stock is to draw non-cumulative dividends of 5 per cent per annum and after Jan. 1, 1914, the preferred stock is to draw non-cumulative dividends at the rate of 6 per cent per annum. The present $4,700,000 of preferred stock of the Virginia Railway & Power Company, and the present $7,450,500 of common stock, are to continue outstanding without change except that the certificates for the stock are to be exchanged for new certificates, which are to state the capitalization of the merged company. The stock of the Norfolk & Portsmouth Traction Company is to be exchanged for the stock of the Virginia Railway & Power Company on the following basis; In exchange for the present $3,000,000 of outstanding preferred stock of the Norfolk & Portsmouth Traction Company preferred stock of the Virginia Railway & Power Company is to be exchanged share for share. In exchange for the present $3,000,000 of outstanding common stock of the Norfolk & Portsmouth Traction Company, common stock of the Virginia Railway & Power Company to the amount of $4,500,000 is to be exchanged on the basis of one and one-half shares of the stock of the Virginia Railway & Power Company for one share of the common stock of the Norfolk & Portsmouth Traction Company. The remaining 3000 shares of preferred stock of the Virginia Railway & Power Company and the 495 shares of common stock are to be disposed of at the discretion of the directors. The officers of the company are: Frank J. Gould, chairman of the board of directors; William Northrup, Richmond, president; Fritz Sitterding, Richmond, Henry W. Anderson, Richmond, and R. Lancaster Williams, Baltimore, vice-presidents; Henry W. Anderson, general counsel; Guy Phillips, New York, secretary and treasurer: George B. Williams, Richmond, assistant secretary and assistant treasurer; W. J. Kehl, Norfolk, assistant secretary and treasurer; Frank J. Gould, William Northrup, Fritz Sitterding, Henry W. Anderson, R. Lancaster Williams, Percy M. Chandler, Guy Phillips, Nathaniel A. Campbell, George H. Taylor, Frank C. Briggs, F. W. Roebling, Jr., Caldwell Hardy, Fergus Reid and James L. Sellman, directors.

Public Utility Offerings.—Perry, Coffin & Burr, of Boston, are offering first-mortgage bonds of a number of public service corporations in various parts of the country. Portland General Electric 5s, due July 1, 1935, are offered at 101 and interest, to yield 4.93 per cent. These bonds are secured by a first mortgage on the entire property, rights, and franchises of the company, which does the electric service business of the city of Portland, Ore., and vicinity, serving a population of some 300,000. The company is owned by the Portland Railway, Light & Power Company. The latter is paying dividends at the rate of 4 per cent on its outstanding $25,000,000 capital stock. Gross earnings of the Portland General Electric Company for the year ended March 31, 1911, were $2,421,284; operating expenses and taxes were $884,595, leaving net earnings of $1,536,689. Plattsburgh Gas & Electric 5s, due September 1, 1939, are also offered at 95 and interest to yield 5.33 per cent. This company controls the entire gas, electric lighting and motor service business in Plattsburgh, N. Y., and vicinity. The bonds were issued with the sanction of the Public Service Commission for the Second District of New York, and are exempt from taxation to holders in that State. A dividend of 6 per cent was paid on the company's $100,000 preferred stock for the year 1910. Gross earnings of the company for the year ended December 31, 1910, were $97,438; operating expenses and taxes were $62,426, leaving net earnings of $35,012. Texas Traction 5s, due January 1, 1937, are offered at 95 to yield 5.31 per cent. The company owns and operates an electric railway 63 miles in length between Dallas and Sherman, serving a population of about 130,000. The territory is said to be one of the most fertile sections of the country. A large amount of the stock is held by local investors. By a special grant of the Texas Legislature the company has recently been granted the right to absorb the Denison & Sherman Street Railway Company, thereby making possible a continuous line from Dallas to Denison. Gross earnings for the year ended February 28, 1911, were $413,522; operating expenses and taxes were $256,042, leaving net earnings of $157,480.

Kansas City Railway & Light Passes Dividend.—In explanation of failure to declare the quarterly dividend on the preferred stock of the Kansas City Railway & Light Company, due June 1, R. J. Dunham, chairman of the board, says: "The dividend has not been passed because of reduced earnings, but because the company wishes to use its surplus earnings over and above interest charges for other corporate purposes, constructions, improvements, etc. The surplus earnings for the ten months ended March 31, 1911, over and above taxes and interest, were $793,305.92, and this was after exceptionally large charges to operating expenses for maintenance, exceeding by $207,000 the maintenance charges of the previous year." The last disbursement on the issue was 1¼ per cent in March.

Henry L. Doherty on Financial Situation.—An analysis of the condition of the country by Henry L. Doherty contains the following summary: "That, in all probability, we have two years of comparative inactivity ahead of us; we probably have two years of easy and cheap money ahead of us; the existing market value of true investment securities is from 20 to 33⅓ per cent below normal, and that during this two year period we will see a substantial recovery in market value by this class of securities; there is no reason to expect anything in the nature of a panic ahead or hard times; the next two years will see fewer investment securities created than the market can absorb."

Hudson Tunnel Bonds Taken.—W. G. Oakman, president of the Hudson Companies, has announced the sale of a block of Hudson & Manhattan Company's first mortgage 4½ per cent bonds in London. The sale was effected through Harvey Fisk & Sons. The amount of the bonds is not given, but the proceeds will furnish funds to meet minor obligations of the Hudson companies maturing Oct. 15, and for completing present construction work, including the connection with the Pennslyvania Railroad for the joint service to Newark, N. J.

New York & Queens Preferred Dividend.—In declaring a quarterly dividend of 1 per cent on its preferred stock, the New York & Queens County Electric Light & Power Company makes a reduction of one quarter of 1 per cent in its quarterly rate. Owing to a floating debt of $350,000, it was decided to place the dividend on a yearly basis of 4 per cent. The dividend is payable June 1 to stock of record May 26.

DIVIDENDS.

Blackstone Valley Gas & Electric Company, preferred, $1.50 per share, payable June 1.

Brooklyn Rapid Transit Company, quarterly, 1¼ per cent, payable June 15.

Cities Service Company, monthly, preferred, one-half of 1 per cent; common, ¼ per cent; payable June 1.

Detroit Edison Company, quarterly, 1¾ per cent, payable July 15.

Eastern Michigan Edison Company, quarterly, 1 per cent, payable July 1.

Northern Ohio Traction & Light Company, quarterly, three-quarters of 1 per cent, payable June 15.

Northern Texas Electric Company, quarterly, $1 50 per share, payable June 1.

Pensacola Electric Company, semi-annual, preferred, $3 per share, payable June 1.

Philadelphia Electric Company, quarterly, 1½ per cent, payable June 15.

REPORTS OF EARNINGS.

Period.	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
BIRMINGHAM RAILWAY, LIGHT & POWER COMPANY.					
April, 1911	$226,936	$117,438	$109,498	......	......
" 1910	214,829	114,669	100.160	......	......
KEYSTONE TELEPHONE COMPANY.					
April, 1911	$98,986	$49,528	$49,458	$24,547	$24,911
" 1910	95,600	46.152	49,538	24.705	24,833
10 m., 1911	$957,903	$477,427	$480,476	$244,672	$235,804
" 1910	931,352	466,980	464,372	252,969	211,403
KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY.					
April, 1911	$369.918	$186,973	$182,945	$105,965	$76,980
" 1910	342,413	163,260	179,153	103,602	75,551
NORFOLK & PORTSMOUTH TRACTION COMPANY.					
April, 1911	$172,584	$99,092	$73,492	$62,233	$11,259
" 1910	155,338	91,988	63,350	65,412	*2,062

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*Deficit

General News

Construction News.

BIRMINGHAM, ALA.—Preparations are being made by the Board of Commissioners to supply electricity from North Birmingham to light the municipal buildings in Birmingham. It is stated that the plant can be equipped to furnish the additional service for about $9,000.

DECATUR, ALA.—Plans and estimates have been submitted to the City Council by J. B. McCreary & Company, of Atlanta, Ga., for the construction of a municipal electric-light plant, to cost approximately $40,000.

GADSDEN, ALA.—The City Council has granted a franchise to L. L. Herzberg, Charles P. Smith, J. D. Dunlap and E. R. LeFevre to supply electricity and gas in Gadsden.

GANTTS QUARRY, ALA.—The Alabama Marble Company, it is reported, is installing an electric power plant, equipped with a 500-kw turbo-generator set The equipment of the plant includes a 30-ton crane. All machinery is equipped for electric motor drive. John Stephen Sewell is vice-president and general manager.

MONTGOMERY, ALA.—It is reported that contracts have been awarded by Richard Tillis for the construction of an electric plant as follows: For erection of building to Algernon Blair, of Montgomery, Ala., and to the Converse Bridge Company, of Chattanooga, Tenn., for steel work. Contracts for equipment have already been awarded. The cost of the entire plant is estimated at $500,000.

GRAVETTE, ARK.—Harry V. Forest, of Kansas City, Mo., is reported to have submitted a proposition to the City Council for the purchase of the municipal electric-light plant.

GENTRY, ARK.—The construction of an electric-light plant in Gentry is under consideration. Harry V. Forest, of Kansas City, Mo., is reported to be interested in the project.

GRANDVIEW, ARK.—Plans are being prepared by the North Arkansas Power Company, recently organized, for the construction of a hydroelectric plant to develop about 3860 hp for transmission to Northern Arkansas and Southern Missouri. The proposed work will include the construction of a tunnel 180 ft. long and concrete dam 300 ft. long to supply water under a head of 25 ft. It is understood that bids for construction will be asked by Aug. 1. E. H. Ingram and J. R. Neff, of Berryville, Ark., and E. D. Munger, of Springfield, Mo., are interested in the project.

JONESBORO, ARK.—It is reported that the Spring River Power Company is planning to erect hydroelectric power plants on Spring River in this section. F. R. Land is president of the company, J. D. Brown secretary, and W. H. Vaughn treasurer.

LITTLE ROCK, ARK.—Plans are being considered by the Little Rock Railway & Electric Company for the installation of a new intake system and condensing system. D. A. Hegarty, of Little Rock, Ark., is general manager.

MAMMOTH SPRINGS, ARK.—It is reported that the Mammoth Springs Light & Power Company is contemplating developing additional water power and extending its transmission lines.

BAKERSFIELD, CAL.—The San Joaquin Light & Power Company has awarded the contract for a 15,000-sq. ft. surface condenser and equipment to Braun, Williams & Russell, Inc., 503 Market Street, San Francisco, Cal.

BERKELEY, CAL.—The Oakland Traction Company has filed application with the City Council for two new street-railway franchises in Berkeley. One is for an extension of the street railway up Spruce Street to Los Angeles Avenue and thence to Northbrae Circle; the second asks for a change in running of the Grove Street cars on Adeline Street in South Berkeley.

COULTERVILLE, CAL.—The Merced gold mines in this vicinity have been purchased by W. F. Seeley, H. P. Dalton and ex-Governor Pardee, of Oakland. Work will soon begin on further developments at the mine, including the installation of electric power.

FRESNO, CAL.—A. G. Wishon, manager of the San Joaquin Light & Power Company, states that the large dam at Crane Valley will be completed by June 1. The dam will be 1900 ft. long and 100 ft. high, and will form a reservoir covering 1200 acres at an elevation of 3000 ft. above the sea. The dam cost about $1,000,000. The company has submitted a proposition to the City Trustees offering a reduction in the price of arc lamps throughout the city from $5.50 per month per lamp to $5 per month, on condition that the City Trustees agree to contract for at least thirty additional lamps, to be located in any part of the city designated by the trustees.

FRESNO, CAL.—Supervisor J. B. Johnson, who was appointed to investigate the cost and practicability of installing a power plant to supply electricity for lamps and motors for the county court house and hospital, has submitted a report prepared by Fairbanks, Morse & Company, of San Francisco, Cal. The estimates submitted call for the installation of two units, one consisting of a 100-hp gasoline engine direct-connected to a 75-kva, 2300-volt, three-phase, alternating-current generator, and the other of an 80-hp engine, direct-connected to a 60-kva, alternating-current generator, each engine to be equipped with a Neher generator, which permits the use of crude oil for fuel. The cost of the above units complete with necessary switchboards and all accessories for operation of plant, with necessary transmission line from hospital to court house and transformers at hospital installed complete, with the exception of building, is estimated at approximately $19,000.

GREENVILLE, CAL.—The Indian Valley Power Company, it is reported, is considering plans for enlarging its electric plant and installing new equipment this summer. A. C. Pratt, of San Francisco, Cal., is president of the company.

HOLTVILLE, CAL.—The installation of an electric-light plant in the Union High School is reported to be under consideration.

JACKSON, CAL.—The Sierra Blue Lakes Power Construction Company, it is reported, is making arrangements to begin work on construction of a large dam, located about one and a half miles below the mouth of Blue Creek.

LA GRANGE, CAL.—Negotiations have been consummated whereby John Hays Hammond has purchased the property of the La Grange Water & Power Company, which, it is said, will be consolidated with the two Tuolumne County power properties purchased about six months ago, which will practically place him in control of the entire hydroelectric output in this part of the State. The three plants combined involve an expenditure of about $20,000,000, and will have an output of 100.000 hp within a year. It is proposed to extend the transmission lines into San Francisco, Sacramento, Stockton, Marysville and other cities in central California.

LOS ANGELES, CAL.—Negotiations have been closed whereby Byron Erkenbrecher and H. F. Calvert, representing a syndicate of Los Angeles capitalists, have purchased the property of the Tejunga Water & Power Company. The price paid for the property is said to be more than $1,000,000. The property includes practically all the water rights on the Tejunga River in Los Angeles County, also ten dam and reservoir sites and rights of way in Tejunga Canyon for pipe and conduit lines. Nine of the reservoir sites are located in the Los Angeles National Forest Reserve, and the right to construct and operate this part of the company's system has been granted by the United States government. The company now has about 1700 acres under irrigation. It is proposed to utilize the water-power to generate electricity. It is estimated that about 8000 hp can be developed Thomas Dack is president, and Homer A. Hanson is general manager of the Tejunga Water & Power Company.

MARYSVILLE, CAL.—The construction of a street car line to Knight's Park is said to be under consideration. It is reported that a company will be organized by local men to finance the project.

PALO ALTO, CAL.—The City Council has adopted an ordinance reducing the maximum rates for electricity for lamps and motors in Palo Alto. The rate for lamps was reduced from 10 cents to 7½ cents per kw-hour and for motors from 5 cents to 4 cents. The charge for electricity for domestic uses is placed at 3 cents per kw-hour. These rates will affect both the municipal electric-light plant and the United Gas & Electric Company.

PASADENA, CAL.—The City Council has passed a resolution authorizing bids to be called for one 1500 to 1650-kw turbo-generator set with Tirrill regulator and exciter for the municipal electric-light plant, to cost about $35,000. C. W. Koiner is general manager of the municipal electric light plant.

QUINCY, CAL.—Notice of appropriation of 50,000 miners' in. of water of the North Fork of the Feather River has been filed by Leroy G. Brown in the office of the county recorder. It is proposed to utilize the water to generate electricity at three different locations on the stream. The present plan is to divert the water by means of a dam at a point about three and a half miles below Nevis and to convey it down the river within a quarter of a mile of Salmon Falls to a power house The water will again be conveyed to a point about one mile below Ban[illegible] Bridge and from there the water will be carried to a third power house near the Sunnyside mine. It is estimated that about 300.000 hp can be developed at the three plants.

REDDING, CAL.—Notice of appropriation of [illegible] in. of water in Bear Creek, in Shasta County, has been filed by C. W. Hill The water is to be utilized to generate electricity

REDDING, CAL.—The Siskiyou Light & Power Company, of Yreka, Cal., has been granted a franchise in Shasta County The company proposes to begin work at once on the extension of its transmission lines to Castella, which, eventually, will be extended further south The company supplies electrical service in Klamath Falls and Ashland, Ore. on the north, and Sisson and Dunsmuir, on the south. Jesse W Churchill, of Yreka, is president and manager

SAN BERNARDINO, CAL.—The City Council has awarded the contract for street lighting to the Pacific Light & Power Company at the rate of $3.75 per lamp per month. A new street-lighting system will be installed, equipped with magnetite arc lamps.

SAN FRANCISCO, CAL.—Bonds to the amount of $1,000,000 have recently been sold by the Northern California Power Company, the proceeds of which will be utilized for improvements and extensions to its system.

SAN FRANCISCO, CAL.—The Spring Valley Water Company and the Pacific Gas & Electric Company have entered into a contract under which the latter will supply electricity to be used in connection with building the Calveras dam in Alameda County. Preparations are being made for the erection of a transmission line from Sunol to the Calveras dam site, a distance of 10 miles. The contract will amount to about $100,000.

SAN FRANCISCO, CAL.—The Northern California Power Company, which operates in the northern part of the State, is building a tunnel 6000 ft. long in connection with its Dry Burney Creek conservation and irrigation project. It is proposed to build a dam on Dry Burney Creek, which will form a reservoir of 1540 acres and provide sufficient power to generate 6000 hp. The tunnel is to be dug through a divide to convey water from Dry Burney Creek basin to Cera Creek basin. The water will be carried down to Cow Creek to Kilare, where the company has a 4000-hp plant, which will be increased to 7000 hp, now that more water is available. It is understood that additional machinery for the plant has been ordered. In addition, a secondary plant will be built down Cow Creek, using the water a second time and generating 3000 hp more. After passing through the last plant the water will be used for irrigating purposes.

YUCAIPA, CAL.—The installation of an electric-light system in Yucaipa is under consideration. The Edison Electric Company is contemplating extending its transmission line from the Mill Creek power house to this town. It has also been suggested that the water power in Burch Canyon be utilized to generate electricity to supply the service. It is estimated that sufficient power could be developed to supply electricity for residential lighting and to operate the pumps of the water system in Yucaipa.

AULT, COL.—The question of establishing an electric-light plant in Ault is reported to be under consideration.

COS COB, CONN.—Plans are being prepared by the New York, New Haven & Hartford Railroad Company for enlarging its power plant at Cos Cob. The present equipment of the plant includes four 3000-kw generators. An extension will be added to the plant providing for four 4000-kw generators, of which three will be installed immediately. The plant when completed will not only supply energy for operating the main line between New York and Stamford, but also for the Harlem division, the Stamford railway system, the New York, Westchester & Boston, of which a portion will be in operation next summer, the Mamaroneck, White Plains & Tarrytown line.

EAST HARTFORD, CONN.—The question of extending the street-lighting system to Hockanum is under consideration by the municipal committee. The Hartford Electric Light Company, of Hartford, Conn., supplies street lighting and electrical service in East Hartford.

FT. PIERCE, FLA.—Plans are being considered for installing water-works, electric-light and sewerage systems in Ft. Pierce. A bond issue amounting to $85,000 to pay for same will probably be submitted to the voters. F. M. Tyler is clerk.

JACKSONVILLE, FLA.—The Board of Bond Trustees has awarded the contract for driving piling foundations for the new electric-power plant to the Merrill-Stevens Company. The greater part of the work will be done by the board under the supervision of the Schofield Engineering Company, of Philadelphia, Pa.

AUGUSTA, GA.—It is reported that plans are being made for improvements and extensions to the local street-railway system, which will involve an expenditure of about $1,000,000. Among the improvements contemplated is increasing the output of the power plant by 3000 hp.

AUGUSTA, GA.—The Augusta & Aiken Railway Company is making arrangements to place its wires under ground on the principal streets in this city, work on which will soon begin. The American Telegraph & Telephone Company and the Postal Telegraph Companies will also put their wires under ground in the same district.

CLAXTON, GA.—A proposition has been submitted to the Mayor and City Council for the installation of an electric-light plant and water-works system in Claxton.

SANDPOINT, IDAHO.—Plans are being considered by the Northern Idaho & Montana Power Company for the extension of its transmission lines from Sandpoint to Hope, East Hope and Clark Fork.

WALLACE, IDAHO.—E. C. Meiklejohn, who is interested in the mining operations in the Coeur d'Alene, is endeavoring to secure the extension of an electric-transmission line to the Coeur d'Alene Nellie mine in the Osborn district and to the Mineral Point properties.

FORT SHERIDAN, ILL.—Sealed proposals will be received at the office of the Chief Quartermaster, Federal Building, Chicago, Ill., until June 16 for furnishing and installing a central power and heating plant at Fort Sheridan, Ill. Plans and specifications will be furnished on application to the above office. A deposit of $10 will be required for plans and specifications, which will be refunded upon return of same. Lt. Col. Thomas Cruse is chief quartermaster.

GIBSON CITY, ILL.—The Gibson Electric Light & Power Company has entered into a contract to supply electricity for operating the plants of the Gibson Iron Works and the McIntyre-Haight Canning Machinery Company.

MANITO, ILL.—The erection of a new power station for the municipal electric-light plant is reported to be under consideration.

PARIS, ILL.—It is reported that an election will soon be held to submit the proposition to issue $15,000 in bonds, the proceeds to be used for the improvements to the municipal electric light plant.

ROCK ISLAND, ILL.—Bids will be received at the office of the Commanding Officer, Rock Island Arsenal, Rock Island, Ill., until June 6, under circular 302, for furnishing an induction motor, polar-wound, slip-ring type.

KENDALLVILLE, IND.—Arrangements are being made to enlarge the municipal electric-light plant, the cost of which is estimated at about $25,000. The Council has authorized the superintendent of the plant to advertise for bids for a 400-kw generator.

SOUTH BEND, IND.—Preparations are being made by the Central Union Telephone Company for improvements and extensions to its system in South Bend, involving an expenditure of about $20,000. The work will include an addition to the switchboard capacity of the central exchange and the erection of new aerial cable.

TERRE HAUTE, IND.—The contract for the plant of the Trebert Gas Engine Company has been awarded to Roehm Brothers. The building will be 50 ft. x 156 ft. Considerable electrical apparatus will be installed. The company is moving its plant from Butler, Ind., to Terre Haute.

BELLE PLAIN, IA.—Plans are being considered to install electroliers in the business district of the city.

HAMPTON, IA.—The plant of the Hampton Electric Light & Power Company is reported to have been destroyed by fire, causing a loss of about $40,000. James J. Roe is president and manager of the company.

MASON CITY, IA.—Arrangements are being made by the Western Electric Telephone Company to rebuild its telephone line extending from Mason City to Charles City, and also the local service, the cost of which is estimated at about $25,000.

NEW LONDON, IA.—The City Council has decided to erect a new electric-light plant on the site of the present municipal plant. Contracts will be awarded for construction of the building as soon as plans are prepared.

STATE CENTER, IA.—Preparations are being made by the Town Council to rebuild the municipal electric-light plant, which was recently destroyed by fire. Contract for construction of power house will be let at once and bids will be called for new machinery. It is expected to have the plant completed and in operation within sixty days.

VILLISCA, IA.—The installation of a municipal electric-light plant in Villisca is reported to be under consideration.

WAUBEEK, IA.—It is reported that K. S. Tasker is contemplating the construction of a power plant on the Wapsipinicon River.

KENTWOOD, LA.—It is reported that surveys are being made for location of an electric-light plant and water-works system.

NEW ORLEANS, LA.—The Southwestern Traction & Power Company has awarded contract for the construction of the first division of its proposed railway from Spanish Lake through Iberia to Jeanerette, a distance of 17 miles. The railway when completed will be 65 miles in length and will connect Lafayette and Morgan City and intervening towns The power station and car barns will be located in New Iberia. The company will also supply electricity for lamps. F. W. Crosby, Tenegre Building, New Orleans, La., is president, and H. A. Mentz, engineer.

OLD ORCHARD, MAINE.—At a town meeting held recently the citizens voted to authorize the Selectmen to contract with the York Light & Heat Company, of Biddeford, Maine, to supply electricity for lighting the town for a term of five years. Under the terms of the contract the company is to supply eighty-six or more 60-cp incandescent lamps at $25 per lamp per year.

READFIELD, MAINE.—Preparations are being made by the Readfield Light & Power Company for extending its transmission line to the Readfield depot. A number of additional street lamps will be erected in Readfield.

WISCASSET, MAINE.—Negotiations are under way between the Wiscasset Electric Light & Power Company and the Portland Power & Development Company to supply electricity in Wiscasset.

ANNAPOLIS, MD.—Sealed proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until May 31 to furnish at the Naval Academy, Annapolis, Md., a quantity of electrical conductor material, arc-lamp posts, steel conduit, outlet and switch boxes, vitrobestos, pipe covering, steel or wrought-iron pipe, gate valves and cast-iron tees. Applications for proposals should refer to schedule No. 3581. Blank forms furnished on application to navy pay office, Baltimore, Md., or to bureau. T. J. Cowle is paymaster general, U. S. N.

BALTIMORE, MD.—The Independent Ice Company is reported to have purchased the plant of the Atlantic Ice Company, Frederick Street. A 250-hp electric motor will be installed in the plant. It is said that another unit of about the same rating will be installed early next year, which will give the plant an output of about 175 tons per day.

CATONSVILLE, MD.—Arrangements have been completed by the Baltimore County Water & Electric Company for the installation of new arc and incandescent lamps for street lighting in Catonsville. It is understood that the street lamps now in use will be transferred to Highlandtown. The cost of the new lamps is estimated at $5,000.

BOSTON, MASS.—Louis K. Rourke, Commissioner of Public Works, has awarded a contract to the Edison Electric Illuminating Company for the installation of 2000 tungsten lamps to replace gas lamps in the underground section of the city, extending from Roxbury Crossing to the water front. The electric lamps will cost $22.31 each per year, which is $1.27 less per year than paid for gas lamps under the present contract.

GREENFIELD, MASS.—Preliminary plans have been filed by Chace & Harriman for the construction of two dams on the Deerfield River, east of the Gardner Falls power plant of the Greenfield Electric Light & Power Company. The plans call for the construction of two concrete dams, one to be located about 1 mile east of the Gardner Falls dam and the other west of Dragon Brook.

WESTBORO, MASS.—The Selectmen have granted the Westboro Gas & Electric Company permission to erect transmission lines on Milk, Ruggles, Charles, Cross, High and Willow streets in Westboro.

KALAMAZOO, MICH.—It is expected that the proposition to install a municipal electric-light plant will be submitted to a vote at special election in connection with the charter revision.

MIDDLETON, MICH.—It is reported that a new electric street-lighting system will be erected in Middleton. J. A. Garrison is said to be interested in the project.

DULUTH, MINN.—The Duluth & Northern Traction Company, recently organized, is reported to be preparing plans for the construction of an interurban electric railway to extend from Hardy Street to the Tischer Road, 4½ miles in length. Charles P. Craig and J. G. Williams are interested in the project.

ROCHESTER, MINN.—Plans are being prepared by Earle D. Jackson, of St. Paul, Minn., engineer, for the installation of a new street-lighting system in Rochester.

WILLMAR, MINN.—Sealed proposals will be received by the State Board of Control, State Capitol Building, St. Paul, Minn., until May 29, for the erection of an administration building, men's and women's wards buildings, service buildings and connecting corridors, superintendent's house, power plant, laundry building and connecting tunnels, including the general contract work, plumbing work, heating and ventilating and electrical work, in accordance with plans and specifications, which are on file at the office of Architect Clarence H. Johnston, 715 Capital Bank Building, St. Paul, Minn. Plans and specifications are on file at the Builders' Exchange, St. Paul, Minn.; the Builders' Exchange, Minneapolis, Minn.; the State Bank of Willmar, Willmar, Minn., and at the office of the State Board of Control, St. Paul. Copies of the above plans and specifications may be obtained from the architect on payment of cost of duplication. Bids will be received collectively or separately.

TUPELO, MISS.—The City Council is reported to have engaged R. C. Houston, of Memphis, Tenn., to take charge of the construction of the proposed municipal electric-light plant, to cost approximately $20,000.

ANDERSON, MO.—Harry V. Forest, of Kansas City, Mo., is reported to be interested in the construction of an electric-light plant in Anderson.

MOBERLY, MO.—The citizens have voted to grant a gas and electric franchise to T. F. Fulkerson, of Trenton, Mo., for a term of twenty years, and a five-year contract for street lighting.

QUEEN CITY, MO.—Preparations are being made by the City Council to construct a municipal electric-light plant to cost $5,000. Proposals for equipment are now being received by W. M. Saxbury, Mayor.

ST. LOUIS, MO.—The City Lighting Department is preparing ordinances providing for adding 133 blocks to the underground wiring district in the city.

ST. LOUIS, MO.—The Dixon-Smith Engineering Company, Wright Building, St. Louis, Mo., consulting engineers, has been engaged by the Arcadia Country Club, of St. Louis, Mo., to prepare plans for the construction of a hydroelectric plant, to cost approximately $50,000. The proposed work includes the construction of a concrete dam and a 50-kw, three-phase, alternating-current electric plant, bids for which will be received until July 15.

GREAT FALLS, MONT.—The Great Falls Townsite & Power Company has filed a mortgage in favor of the Bankers' Trust Company, of New York, N. Y., to secure a bond issue of $15,000,000, of which $4,000,000 will be used to cover bonds issued for the development of the Rainbow Falls power site, now in operation, and $4,000,000 for the construction of a power plant at Great Falls. The proceeds of the remaining $7,000,000 will be used to equip the St. Paul railroad from Lewiston to Great Falls, a distance of 120 miles, for electrical operation. It is said that if the Lewiston-Great Falls line is operated successfully the entire St. Paul system will be equipped for electrical operation.

MEREDITH, N. H.—The Meredith Electric Light Company is reported to have offered to sell its electric plant to the town for $12,000.

BLOOMFIELD, N. J.—Action has been taken by the Board of Trade looking to the installation of a municipal electric-light plant. The board will recommend to the Mayor and Council that plans and estimates be obtained at once for installing an electric plant.

HADDONFIELD, N. J.—The installation of a municipal electric-light plant to cost about $40,000 is reported to be under consideration.

JERSEY CITY, N. J.—An agreement has been ratified between the Street and Water Board and the Public Service Corporation of New Jersey whereby the company will place its wires underground. Under the new agreement the company guarantees to place at least 2500 ft. of its electric-light wires in underground conduits on streets as designated by the board. The Street and Water Board reserves the right to order a second 2500 ft. annually, making a total of 5000 ft.

MOUNT TABER, N. J.—The rates for electricity for lamps have been reduced. The price, which was 20 cents per kw-hour, has been reduced to 17 cents per kw-hour for residential lighting and 15 cents per kw-hour for commercial lighting. The Eastern Pennsylvania Power Company, of Easton, has taken over the property of the Rockaway Electric Light & Improvement Company, which supplies electrical service in Mount Taber.

SEASIDE PARK, N. J.—The Borough Council, it is reported, is contemplating improvements to the electric light, water and sewer systems, involving an expenditure of about $35,000.

TUCUMCARI, N. M.—The electric plant of the Tucumcari Water, Ice & Power Company is reported to have been purchased by I. LaFite, of Denver, Col., for $22,000. It is understood that Mr. LaFite will take charge of the plant. It is expected that improvements will be made to the plant, a day service established and several miles of transmission line erected. About $10,000 will be expended on the system.

ALBANY, N. Y.—The Board of Contract and Supply has awarded a new contract to the Municipal Gas Company to furnish electricity to light the streets of the city for a period of five years, beginning June 21, under the terms of which the company is to supply the service from overhead wires at the rate of 22½ cents per arc lamp per night and from wires in underground conduits at 24½ cents, and 5½ cents for incandescent lamps. The Municipal Gas Company agrees to begin work of placing its wires underground before June 1, and to install magnetite arc lamps without expense to the city, and to install ornamental lamp standards, and also to make improvements and extensions to its plant, so as to insure an adequate supply of electricity for all purposes. Under the new contract the city will save $16.42 per lamp per year, or about $14,000 per annum on the 900 lamps used. The improvements to the electric plant and lighting system contemplated by the company will involve an expenditure of about $62,000.

BUFFALO, N. Y.—The American Agricultural Chemical Company, it is reported, is planning to erect a storage warehouse and power plant at its plant on Babcock and Lyman Streets and Erie Railroad, to cost approximately $50,000.

DELHI, N. Y.—The Delaware County Electric Light & Power Company has been authorized by the Public Service Commission, Second District, to execute a mortgage on all its property to secure an issue of $200,000 in bonds, of which $25,000 is to be sold at once at not less than par. The company is also authorized to issue $100,000 in capital stock. Of the proceeds of the $25,000 in bonds and $10,000 in capital stock, the sum of $2,000 is to be reserved for the purchase of additional electric equipment, $1,500 is to be used for the erection of a transmission line to the county house, and the balance is to be used for rebuilding the electric plant and distributing system formerly owned by the Delhi Electric Company, located in Delhi, Delaware County.

JOHNSTOWN, N. Y.—The Fulton County Gas & Electric Company has received authority from the Public Service Commission, Second District, to issue bonds to the amount of $92,000, the proceeds to be used for extensions and improvements to its plant and system, amounting to $95,322, the remaining $3,322 to be paid from the balance of the proceeds of the sale of $99,000 in notes, authorized by the commission March 31, 1910.

PORT JEFFERSON, N. Y.—The Public Service Commission, Second District, has authorized the Port Jefferson Electric Light & Power Company to issue bonds to the amount of $30,000. The proceeds of $8,800 to be used for the purchase of new equipment; $2,700 for expenses incurred in improving the plant, and $18,500 in payment of bills and accounts incurred for capital purposes.

ROCHESTER, N. Y.—The Rochester Railway & Light Company, it is reported, is contemplating the installation of Mazda incandescent lamps from Genesee Street through Elmwood Avenue past Mount Hope Cemetery and the State buildings in South Avenue through Highland Park to South Goodman Street.

UTICA, N. Y.—Sealed proposals will be received by the Board of Contract and Supply until May 24 for construction and extension of electric subways in Utica, N. Y. The work will include about 150,000 duct ft. of tile and appurtenances. Plans and specifications may be obtained from Stuart F. Day, secretary of Board of Contract and Supply.

CHARLOTTE, N. C.—The Piedmont & Northern Railway Company has placed a contract with the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for ten 500-kw motor-generator sets. It is understood that the company will order additional equipment in the near future.

FAYETTEVILLE, N. C.—The Town Council has granted the Fayetteville Traction & Power Company permission to extend its lines through Haymount along Hay Street.

TARBORO, N. C.—Sealed proposals will be received by the Mayor and Board of Commissioners of the town of Tarboro, N. C., until June 15, for water-works improvement, including the construction of a 500,000-gal. concrete filter plant, electric-driven turbine pumps and a 260,000-gal. concrete storage reservoir and auxiliary electric pumping station and 1 mile of 10-in. cast-iron pipe. Plans and specifications are on file at the office of the town clerk, Tarboro, N. C., and at the office of Gilbert C. White, engineer, Durham, N. C. Copies of specifications and proposal form, etc., may be obtained from the engineer. W. O. Howard is Mayor.

BOWBELLS, N. D.—The National Briquetting Company, of Kenmare, N. D., is reported to have applied to the Council for a franchise to install and operate an electric-light system in Bowbells.

FORMAN, N. D.—The contract for installing electric-light equipment for the new court house has been awarded to the McQuay Company for $1,550.

GLEN ULLIN, N. D.—Application has been made to the Council by C. E. V. Draper, of Mandan, N. D., for a franchise to install an electric-light plant at Glen Ullin.

GRAND FORKS, N. D.—It is reported that the construction of a dam in the Red River is under consideration.

COLUMBUS, OHIO.—Proposals will be received by the Board of County Commissioners until June 2 for the construction of a power house at the Franklin County Infirmary Farm. Howard & Marion are architects.

COLUMBUS, OHIO.—Bids will be received by H. S. Holton, Director of Public Service, for furnishing equipment for the municipal electric light plant as follows: 28,000 ft. No. 2, 204,000 ft. No. 4 and 60,000 ft. No. 6 triple-braided, weatherproof wire; remodeling switchboard, two 750-kva transformers, two 150-kva transformers, 7-in. top cedar poles as follows: 390, 40 ft.; 75, 45 ft.; 50, 50 ft.; 25, 55 ft.; 25, 60 ft.; 12, 65 ft., and 6, 70 ft.

GREENSPRING, OHIO.—The Village Council has granted a franchise to D. M. Scott to construct and operate an electric-light and power plant in Greenspring.

LIMA, OHIO.—The Western Ohio Electric Railway Company is contemplating the purchase of coal-handling machinery for its power house in the near future. F. D. Carpenter is general manager.

TOLEDO, OHIO.—The Board of Education has awarded contracts for electric wiring of the new high schools, known as the Morrison R. Waite High School and the Jessup W. Scott High School, to the Bailey Electric Company, of Cincinnati, Ohio, for $31,700.

EUGENE, ORE.—The City Water Board has asked the City Council to submit the proposition to issue $57,000 in bonds, the proceeds to be used for extensions of the municipal electric plant, to a vote of the people. It is proposed to install a complete distributing system to supply electricity for commercial lighting and for motors, and also the rehabilitation of the hydroelectric plant at Walterville.

NEWBERG, ORE.—The Yamhill Electric Company is said to be planning to enlarge its power plant within a few months. It is understood that the output of the plant will be doubled. C. J. Edwards is president and manager.

PAISLEY, ORE.—Arrangements are being made by local business men for the installation of an electric plant on the Withers Mill site on Summer Lake during the summer, to supply electricity for lamps and motors in Paisley. It is proposed to incorporate a company to operate the system.

ROSEBURG, ORE.—The local electric-generating plant, owned by J. L. & S. A. Kendall, which was recently destroyed by fire, will be rebuilt. The loss is estimated at about $50,000.

PANAMA.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until June 15, for furnishing line material, including insulators, copper wire, copper sleeves, cross-arms and pins, etc., as per circular No. 633. Blanks and general information relating to the above circular may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing officer.

CLAYSVILLE, PA.—The City Council has granted the Claysville Electric Light, Heat & Power Company a franchise to construct an electric plant in Claysville. The company has two sites under consideration, one in the borough and the other just outside. It is proposed to operate an ice plant in connection with the proposed plant, and possibly a laundry. A. C. Whitaker, of Wheeling, and M. G. Hertzog, of Claysville, are interested in the project.

PHILADELPHIA, PA.—The Pennsylvania Railroad Company, it is reported, is contemplating improvements to its Broad Street terminal, which will include equipping the suburban lines for electrical operation. Plans are now being prepared for the proposed work.

PITTSBURGH, PA.—The Duquesne Light Company has increased its capital stock from $500,000 to $3,000,000.

PITTSBURGH, PA.—The question of improving the street-lighting system in the downtown district is under consideration.

COLUMBIA, S. C.—The stockholders of the Columbia Railway, Light & Power Company have voted to adopt the resolution of the directors to increase the capital stock of the company from $1,600,000 to $3,000,000, the proceeds to be used for extensions and improvements to the system. The stockholders also voted to change the name of the company to the Columbia Railway, Gas & Electric Company.

EDGEFIELD, S. C.—At a special election held May 18 the citizens voted to issue bonds to the amount of $18,000, the proceeds to be used for the construction of a municipal electric-light plant. A. T. Padgett, L. T. May and B. F. Zimmerman were elected Commissioners of Public Works, and will have charge of construction and operation of the proposed plant.

HONEA PATH, S. C.—At an election held recently the citizens voted to issue bonds to the amount of $11,000, the proceeds to be used for the installation of a municipal electric-light plant. P. W. Sullivan is superintendent pro tem.

CHAMBERLAIN, S. D.—Preparations are being made by the Chamberlain Light & Power Company for enlarging its plant, which will involve an expenditure of about $12,000. The company proposes to establish a day service and make a number of extensions to its transmission lines during the coming year. It is understood that equipment for the proposed extension has been purchased.

FLANDREAU, S. D.—The installation of an electric-light plant in Flandreau is reported to be under consideration. The cost of the proposed plant is estimated at about $20,000. Mr. Shaver, of St. Paul, Minn., is said to be interested in the project.

KNOXVILLE, TENN.—The Knight-Weller Company, which owns coal, iron, copper and other mineral lands in Tennessee, Virginia, West Virginia, North Carolina and South Carolina, and timber lands in Tennessee and North Carolina, is developing some of its timber land under contract, and others will be used by the company for charcoal in electric smelting of ores. The company is contemplating developing its water powers, bids for which have already been asked. One will develop from 5000 to 10,000 hp, which will be used for mining and smelting purposes. The main office of the company is located in the District Bank Building, Washington, D. C., and the local office in the Empire Building, Knoxville, Tenn.

LIVINGSTON, TENN.—Plans are being considered by the Livingston Light & Power Company for the installation of electric equipment. W. W. Hendrix, of Cookeville, Tenn., is reported to be interested in the project.

McKENZIE, TENN.—Bonds to the amount of $40,000 have been voted, the proceeds to be used for extensions to the electric-light and water-works systems and street improvements.

AUSTIN, TEX.—It is reported that W. P. Carmichael, of the Carmichael Construction Company, of St. Louis, Mo., will submit a proposition to the City Commission for the reconstruction of the dam across the Colorado River in Austin and the installation of a hydroelectric plant. Grant Hornaday, president of the Midland Construction Company, of Fort Scott, Kan., is also negotiating with the City Commission with the same object in view.

LONGVIEW, TEX.—It is reported that bids will be received about the middle of June for the installation of an electric-light system, and for sewers and paving, for which bonds to the amount of $90,000 were recently voted. P. E. Green, of Chicago, Ill., is consulting engineer.

McALLEN, TEX.—A. L. Strang, who was recently granted a franchise to install and operate an electric system in McCall, is planning to install a plant to cost about $10,000.

NEW BRAUNFELS, TEX.—The City Council has adopted preliminary plans prepared by the W. K. Palmer Company, of Kansas City, Mo., for the construction of a large reinforced concrete dam across the Guadalupe River, near New Braunfels. The proposed dam will supply power for operating a large hydroelectric plant which the city proposes to install.

PALESTINE, TEX.—Tucker Royall and associates are reported to be promoting the construction of an electric street-railway system in Palestine.

ROSENBERG, TEX.—The City Council is reported to have accepted the proposition submitted by a Houston engineering company to install an electric-light plant in Rosenberg.

OGDEN, UTAH.—The Merchants' Light & Power Company, of Ogden, Utah, has awarded the Falkenau Electrical Construction Company, of Chicago, Ill., the general contract for the complete construction and installation of its system. Plans and specifications were prepared by H. A. Straus, of Chicago, Ill., consulting engineer. The Merchants' Light & Power Company was recently awarded the contract for street lighting in Ogden.

SALT LAKE, UTAH.—The City Council has appointed a committee, consisting of the engineering committee and the Mayor and City Engineer, for the purpose of investigating the offer of C. W. Earl to sell the city a site in the American Fork Canyon for a municipal electric-light plant. The site is located at the junction of the American Fork River, the Deer Creek and Silver Creek, about 30 miles from Salt Lake City. It is estimated that from 2500 hp to 3000 hp could be developed. If the site is purchased it is not expected that any immediate steps will be taken by the city toward the construction of a plant.

MONTPELIER, VT.—Arrangements have been made by the Consolidated Lighting Company to extend its service to the town of Washington. It is proposed to extend the transmission line from East Barre, a distance of about four miles. The company is also making investigations in the town of Orange with a view of extending its lines to supply electricity for lamps and motors in that place.

WATERBURY, VT.—Moody & Almon, of Montpelier, Vt., are contemplating extending a transmission line from their plant at Moretown to Waterbury to supply electricity for lamps and motors in that village.

DANVILLE, VA.—At an election to be held June 27 the proposition to issue $150,000 in bonds, the proceeds to be used for improvements to the municipal electric-light plant and paving will be submitted to a vote of the people.

DARBYVILLE, VA.—Arrangements are being made by the Darby Coal Company for the installation of electrical power to operate the machinery in its mines. Orders have been placed with the General Electric Company for five 6-ton locomotives. Electric haulage and chain coal-cutting machines will be installed. Electricity for operating the machinery will be usupplied by the company's own plant.

RADFORD, VA.—A new charter has been obtained by the Virginia Power Company under the name of the Dominion Power Company. Extensive water-power developments are contemplated by the company on different rivers. About 100,000 hp will be developed, of which 30,000 hp is for local distribution. About 500 miles of transmission lines will be erected. The first plant will develop about 10,000 hp. The entire project will involve an expenditure of about $12,000,000. J. J. Mott, of East Radford, Va., is president, and Robert A. Schott, of Radford, is chief engineer.

ROCKY MOUNT, VA.—The capital stock of the Franklin County Telephone Company has been increased from $7,000 to $12,000.

BREMERTON, WASH.—The Puget Sound & Southern Railway Company is reported to have applied to the Council for a franchise to supply electricity for lamps and motors in Bremerton. The company proposes to construct an electric railway between Bremerton and Charleston, 4 miles distant, which, it is understood, will ultimately be extended to Port Orchard, Union City, Shelton, and into the Gray's Harbor district.

ECHO, WASH.—The Snow Creek Water Company, recently incorporated, is reported to have applied to the Council for a franchise to supply electricity in Echo.

LEAVENWORTH, WASH.—The Tumwater Light & Water Company is reported to have been granted an electric-light franchise in Leavenworth for a term of forty-three years.

LYLE, WASH.—The Pacific Power & Light Company is reported to have purchased a power plant, located 25 miles east of the town. It is understood that the company will enlarge the plant.

BARABOO, WIS.—A special committee has been appointed to look into the matter of installing a municipal electric-light plant, for which bonds to the amount of $45,000 were recently voted. J. S. Worthman is city clerk.

MERRILL, WIS.—The Merrill Railway & Lighting Company expects to purchase thirty lamp standards, each carrying a single lamp. E. S. King is secretary and manager.

OCONOMOWOC, WIS.—The contract for the construction of the new concrete dam and power plant to be erected on the Okauchee Lake property of Henry Schoelkopf, of Milwaukee, Wis., has been awarded to J. Nelson & Company. The cost of the dam is estimated at $25,000.

RHINELANDER, WIS.—The Wisconsin Valley Improvement Company is reported to be contemplating the construction of a large dam at Bardley, on the Tomahawk River, for power and mill purposes.

SUPERIOR, WIS.—Preparations are being made for extensive improvements and extensions to the system of the Superior Light & Power Company, which will involve an expenditure of about $100,000 and include the installation of new transformers, remodeling and enlarging the pumping station and installation of a new pump having a capacity of 5,000,000 gal. daily, and the construction of two new reservoirs near the pumping station. Thomas B. Scott is president of the company.

WAUKESHA, WIS.—The Waukesha Gas & Electric Company is installing a 650-kva turbine in its new station, and is also making extensive changes in its switching equipment. H. M. Buck is manager.

WAUSAU, WIS.—The Wausau Street Railway Company, it is reported, is planning to make improvements to its system involving an expenditure of about $50,000. The extension of the Third Avenue and Sixth Street lines is included among the proposed improvements.

WEST BEND, WIS.—Preparations are being made for the construction of building for county home, bids for which will be received until May 29. The plans include the installation of a power plant The cost of the work is estimated at about $41,000. J. E. Hennen, of Fond du Lac, Wis., is architect and Anton Thielmann is county clerk.

CALGARY, ALTA., CAN.—It is understood that a recommendation will be made to the City Council to the effect that those who wish ornamental street lamps in front of their property will be required to pay half of the cost of maintenance.

WINNIPEG, MAN., CAN.—Bids will be received by the Chairman of Board of Control, Winnipeg, Man., until July 3 for furnishing material and installing police patrol telegraph system. F. A. Cambridge is city electrician and M. Peterson city secretary.

BERLIN, ONT., CAN.—A by-law to appropriate $20,000 for improvements to the municipal electric-light plant will be submitted to the ratepayers on May 31, also a by-law appropriating $7,900 for a street railway.

GUELPH, ONT., CAN.—The People's Railway Company is reported to have awarded contracts for the construction of its proposed electric railway from Guelph to London, via Berlin and Woodstock, to the Acme Construction Company, of Toronto, Ont. Several of the municipalities through which the railway will pass have subscribed to preferred stock of the company to the amount of $295,000, and individual have taken $150,000. W. A. Bugg is managing director of the company.

HAMILTON, ONT., CAN.—Arrangements are being made by the Dominion Power & Transmission Company for the construction of an electric railway from Hamilton to Galt. It is proposed to use the track of the Brantford & Hamilton Street Railway Company to Brantford, and from there to cut across the country to Galt. The company also intends, if the railway which John Patterson is endeavoring to build is constructed in a direct line from Hamilton to Waterloo and Guelph, to build a line to connect with it, which will give Hamilton direct service connection with Galt, Berlin and Guelph. The Dominion Power & Transmission Company is enlarging its generating plant at Power Glen, increasing the output from 45,000 hp to about 60,000 hp, so as to be able to supply electricity to operate the above interurban railway and for other extensions to its present railway system. William C. Hawkins is general manager.

PENETANGUISHENE, ONT., CAN.—The by-law appropriating $27,000 for installing the municipal hydroelectric power system was carried. Of this amount $10,500 will be utilized for extensions and improvements.

MONTREAL, QUE., CAN.—The Board of Control is reported to be considering the question of calling bids for enlarging the present aqueduct, which is nearly completed. It is proposed to double the capacity of the aqueduct so as to provide sufficient water to generate electricity to light the entire city of Montreal. Specifications are now being prepared for the proposed work.

PRINCE ALBERT, SASK., CAN.—Tenders will be received by the City Commissioners, Prince Albert, Sask., until May 31, for extensions to water and sewerage systems, including the construction of concrete sewage pumping station No. 2, and supplying and installing two electrically driven centrifugal sewage pumps and motors. Plans and specifications for Sections A and B may be seen at the office of F. V. Creighton, city engineer, Prince Albert, Sask., and Section C will be forwarded on application to the city engineer. Andrew Holmes is Mayor.

PRINCE ALBERT, SASK., CAN.—Sealed tenders will be received by the city of Prince Albert, Sask., Can., until June 26 for equipment for the La Colle Falls power station, as follows: Three 1300-hp vertical turbines, two 250-hp vertical turbines and five governors for above; three 937½-kva generators, two 150-kw exciters, two 1850-kva transformers, switching apparatus, lightning arresters and voltage regulator. Plans and specifications will be on file after June 1 at the City Hall, Prince Albert, or at the offices of C. H. & P. H. Mitchell, engineers, Traders' Bank Building, Toronto, Ont., Can. Andrew Holmes is Mayor.

ROULEAU, SASK., CAN.—Bids will be received by W. H. Stewart, secretary and treasurer, until May 29, for construction of power house in Rouleau, in connection with water-works system. J. Darlington Whitmore, MacKenzie & Brown Block, Regina, Sask.

SOUTH QU'APPELE, SASK., CAN.—It is reported that the local electric light company is contemplating erecting a new power house and using gasoline for motive power. L. G. Bell is secretary and treasurer of Board of Trade.

New Industrial Companies.

THE ELECTRIC HEATING COMPANY, of Boston, Mass., has been incorporated with a capital stock of $25,000 by Henry J. Cushing, Nelson E. Mann and Harold A. Mann.

THE ELECTRIC WELDING COMANY, of Pittsburgh, Pa., has been granted a charter, with a capital stock of $5,000. The directors are: R. A. Cummings, Stanton Avenue, Pittsburgh, Pa., treasurer; E. Cummings, and J. E. MacCloskey, Jr., both of Pittsburgh, Pa.

THE LANGDON & HUGHES ELECTRIC COMANY, of Utica, N. Y., has been incorporated with a capital stock of $5,000 by Walter T. Langdon, Dennis A. Hughes and George S. Langdon. The company proposes to conduct an electrical contracting business.

THE REBUILT TELEPHONE EQUIPMENT COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $2,500 by Frank T Sollivan, Phillip L. Sollivan, William J. Maber and Edward C. Stoeffhass.

New Incorporations.

SAN FRANCISCO, CAL.—A company has been organized under the title of The St. George Corporation to conduct a light and power business in Del Norte County, and also to furnish power of all kinds, to operate ferries and to run tugboats and other business. The company is captalized at $1,000,000, and the incorporators are: George M. Warren, of Warrenton, Ore.; Francis E. Rowell, of Hillsboro, Ore.; H. S. Wooley, Charles M. Lanning and Charles R. Wilson, of Wooleyport, Del Norte County, Cal., and Taggart Aston, of San Francisco, Cal.

DOVER, DEL.—Articles of incorporation have been filed for the Frederick Water, Light & Power Company with a capital stock of $25,000.

The incorporators are: H. A. Elwell, H. T. Downing and J. S. Hoy, of Philadelphia, Pa.

ALBION, ILL.—The Albion Electric Light & Gas Company has been incorporated, with a capital stock of $20,000, by W. A. Achock, H. M. Knipe and W. H. Broaran. The company proposes to operate an electric light and gas plant.

CHICAGO, ILL.—The Chicago, Waukegan & Woodstock Traction Company has filed articles of incorporation, with a capital stock of $50,000. The company proposes to construct an electric railway from Waukegan, in Lake County, to Woodstock, in McHenry County. The directors are: Charles A. Spenny, of Columbus, Ohio; Irving D. Stevens, W. P. McCracken, Peter B. Olsen and H. S. Hedberg, all of Chicago, Ill.

BOONE, IA.—The Central Iowa Light & Power Company has filed articles of incorporation with a capital stock of $5,000 for the purpose of supplying electricity for lamps and motors.

HUMBOLDT, IA.—Articles of incorporation have been filed for the Northern Iowa Power Company by N. T. Guernsey, F. A. Brown, A. G. Ripley, F. W. Lehmann, Jr., and C. F. Maxwell, all of Des Moines, Ia. The company is capitalized at $1,000,000 and proposes to operate a light, heat and power plant.

MAXWELL, IA.—The Maxwell Light & Heat Company has been incorporated with a capital stock of $5,000 by J. G. Wells, Charles Ollinger, N. W. Dickson, H. J. Garlock and A. J. Fawcett.

BOSTON, MASS.—The Hixton Electric Company has been incorporated with a capital stock of $30,000 by Alfred J. Hixon, Clifford J. Titus and Nathan L. Bennock.

EXCELSIOR, MO.—Articles of incorporation have been filed for the Excelsior Water, Gas & Electric Company with a capital stock of $500,000 by H. T. Henderson, S. W. Henderson and W. H. Pratt.

ST. LOUIS, MO.—The Zwalle Light, Ice & Power Company has been chartered with a capital stock of $25,000 by William D. Stock, John W. Stock and James A. Steele.

CANONSBURG, PA.—The Union Township Electric Company has been granted a charter with a capital stock of $5,000. The directors are: J. S. Tannehill, of Canonsburg, Pa.; Earl Beach, N. S., Pittsburgh, Pa., and C. R. Turton, of Aspinwall, Pa.

ERIE, PA.—The Erie Lighting Company has been incorporated with a capital stock of $50,000. The directors are: E. D. Carter, of Erie, Pa., treasurer; Louis Streuber, Paul Mueller, M. J. Fogarty and John Maahs, all of Erie, Pa.

MADISON, WIS.—The Peninsula Power Company has been incorporated by D. H. Otis and C. A. W. Tresler, members of the faculty of the University of Wisconsin, and Henry J. Hunt. The company is capitalized at $750,000 and proposes to utilize one of the water powers of the northern peninsula of Michigan and build an electric plant.

Personal.

PROF. D. C. JACKSON has been appointed temporary chairman of the committee on public utilities of the Boston Chamber of Commerce to serve during the absence of Chairman Henry Howard.

MR. WILLIAM McCARROLL, Public Service Commissioner, First District, New York, was married May 16 to Mrs. Grace J. Johnston, widow of the late Mr. W. J. Johnston, formerly publisher of the *Electrical World*.

PROF. HENRY S. CARHART, who retired some time ago from his chair at the University of Michigan, has been a guest for some months at the Bureau of Standards, in Washington, where he has been carrying on some special investigations.

MR. A. H. ARMSTRONG, who was recently elected mayor of Lincoln, Neb., by the largest majority ever received for that office, has severed his connection as head of the Lincoln Gas & Electric Company, to be succeeded by Mr. Frank W. Frueauff.

MR. S. W. GREENLAND, for four years secretary-treasurer and general manager of the Columbus (Miss.) Railway, Light & Power Company, has tendered his resignation to become purchasing agent for the Ft. Wayne & Northern Indiana Traction Company.

MR. H. M. BYLLESBY, of Chicago, delivered recently an able and carefully thought-out address on "Securities of Water-Power Companies as Investments" before the Wharton School of Finance and Commerce of the University of Pennsylvania. The address has been published in pamphlet form.

MR. O. B. COLDWELL, general superintendent of the light and power department of the Portland (Ore.) Railway, Light & Power Company, is making a tour of the Middle and Eastern States for the purpose of inspecting the notable hydroelectric developments in this part of the country. Mr. Coldwell, who was instrumental in the promotion of the Portland Section of the American Institute of Electrical Engineers and served as its first chairman, is a graduate of Stanford University and Cornell University.

HON. ADAM BECK, chairman of the Hydroelectric Commission of Ontario, sailed from Quebec on May 20 for Europe, where he will be joined by Chief Engineer P. W. Sothman and W. B. Roadhouse, private secretary of the Minister of Agriculture. In company with Mr. Beck, these two will continue their investigation of the application of electric power for farm work and rural use generally. During the absence of Mr. Beck Hon. J. S. Hendrie and Mr. W. K. McNaught, M. P. P., the other two members of the commission, will transact the business of the commission.

MR. WILLIAM H. COUGHLIN, for twenty-seven years superintendent of the Worcester (Mass.) Electric Light Company, has sent in his resignation to the board of directors. Mr. Coughlin is one of the best known central station managers of the East, and has been closely identified with the development of the Worcester plants and system since 1883, when he came to Worcester from Groton to accept the superintendency of the company. Under his administration the company has grown from the standards of a small belted station with overhead distribution to those of a modern turbine plant with an unusually large installation of underground service, and from an organization of insignificant commercial position to one of the most substantial and prosperous central stations of New England. It is stated that he will continue to maintain consulting relations with the company for an indefinite period.

DR. SVANTE ARRHENIUS, of Stockholm, Sweden, lectured at the City College of New York on the afternoon of May 17. The subject was "The Passage of Micro-Organisms Through Inter-Stellar Space; a Theory Bearing on the Origin of Life on a Planet." This subject was chosen instead of "Electrolytic Dissociation," as previously stated in these columns. In the evening of the same day Dr. Arrhenius was a guest of honor at a dinner given by the Chemists' Club. On this occasion he was elected an honorary member of the club and spoke on the subject of "Electrolytic Dissociation." He referred to the time when his theories were first published, telling how he traveled around the world to introduce the theories and how they were received by scientists such as Oswald, Van't Hoff, Planck and Nernst. On May 18 he delivered a lecture at the Columbia University, the subject treated being "Adsorption." On the following days Dr. Arrhenius was entertained by his countrymen and on May 22 he returned to Sweden.

MR. FRED H. SMITH has been appointed general manager of the Worcester (Mass.) Electric Light Company, succeeding Mr. W. H. Coughlin. Mr. Smith is a native of Bangor, Me., and devoted the first years of his electrical service to the work of trouble expert for the Thomson-Houston interests at Lynn, Mass., later becoming attached to the Boston office of the General Electric Company as assistant engineer with Mr. A. R. Bush. In 1896 he joined the staff of the Worcester Company as its electrical engineer, being placed in immediate charge of the distribution system and supervising a large part of the underground conduit construction following his advent. About a year ago he was appointed assistant superintendent and has since borne increasing responsibilities in connection with the construction and established service of the company's new Webster Street turbine station, the development of an active commercial policy, and in particular, the extension of the power load and cultivation of closer personal relations between the company and its patrons.

Obituary.

MR. ROBERT D. FERGUSON, whose death was noted in this column last week, was buried in Boston a few days ago. Mr. Ferguson lost his life in a boating accident on the Ohio River at Evansville, Ind., and it was feared that his body would not be recovered. The remains were found after several days, however, and were taken to Boston for burial.

MR. HENRY HUTCHINS SYKES, general manager of the Southern New England Telephone Company, died in New Haven, Conn., on May 18. He was born in Suffield, Conn., in 1867. He was graduated from the Yale Scientific School in 1889 and from the Massachusetts Institute of Technology in 1891. Immediately afterward he became connected with the American Telephone and Telegraph Company, remaining with that company until 1895. In that year he was appointed chief engineer of the Bell Telephone Company of Missouri, and went to live in St. Louis. In 1902 he went to New Haven as general superintendent of the Southern New England Company, and in January, 1907, was made general manager. Mr. Sykes was an associate of the American Institute of Electrical Engineers, a member of the Quinnipiack, Union League and Graduate clubs of New Haven and of the Yale Club of New York.

Trade Publications.

CURVE-DRAWING AMMETERS AND VOLTMETERS.—The General Electric Company has issued Bulletin No. 4820, which supersedes its previous bulletin on recording ammeters and voltmeters.

BALL-BEARING GREASE.—The Hess-Bright Manufacturing Company, 2020 Fairmount Avenue, Philadelphia, has issued a descriptive sheet, with price list, of Hess-Bright ball-bearing grease, which has been compounded specially to suit the lubricating conditions of ball bearings.

FOUNDRY MACHINERY.—The Mumford Molding Machine Company, of Plainfield, N. J., has just issued a loose-leaf sheet catalogue illustrating its line of molding machines for foundry work, and including jolt ramming machines, split-pattern machines, power squeezers and pneumatic vibrators.

SWITCHBOARD INSTRUMENTS.—The Weston Electrical Instrument Company, Newark, N. J., has issued an illustrated folder devoted to its complete line of switchboard indicating instruments, including wattmeters, synchroscopes, power-factor meters, frequency meters, voltmeters and ammeters.

CRANES AND MACHINE TOOLS.—The Q. M. S. Company, Plainfield, N. J., has just issued loose-leaf catalogs illustrating its line of metal sawing machines, hand-power traveling cranes, jib cranes, I-beam trolleys, pneumatic hoists, power hack saws, car-wheel grinding machines, Stanwood car steps and pneumatic pit jacks.

TELEPHONE SWITCHBOARDS.—In its Bulletin No. 1003 the Western Electric Company describes magneto, convertible, non-multiple switchboards with self-restoring line signals. These switchboards are so designed that they can be used originally for magneto service, and can be converted at will for central-battery operation.

WIRING MATERIAL.—The H. T. Paiste Company, Philadelphia, Pa., has issued a condensed catalog and price list of standardized wiring material. In this catalog, which is designated as No. 18, careful distinction is made between fittings which have and fittings which have not been approved by the National Board of Fire Underwriters.

POLE-LINE SPECIALTIES.—W. N. Matthews & Brother, St. Louis, Mo., have issued the third edition of their telephone-line construction book, dealing with the erection of poles from the boring of the hole in the ground to the placing of the insulators on the cross-arm pins. The present edition contains 240 pages, covering an unusually large amount of usable data.

MOTOR-DRIVEN FIRE PUMPS.—Bulletin No. 1622 of the Allis-Chalmers Company, Milwaukee, Wis., contains a well-prepared article descriptive of the high-pressure fire-service system in use in lower New York. The descriptive matter covers the complete equipment of two fire stations, each of which contains five five-stage centrifugal pumps driven by induction motors.

CHARGING ELECTRIC VEHICLES.—The General Electric Company has issued an attractive pamphlet entitled "Charging the Electric at Home." This pamphlet describes briefly the mercury-arc rectifier as used for charging the batteries for electric runabouts. The publication should prove of interest to owners of such vehicles, since it describes a method of overcoming the difficulties which usually attend the charging of the batteries.

AMMONIA CONDENSER.—Catalog No. 401 of the Griscom-Spencer Company, 90 West Street, New York, describes an evaporative ammonia condenser which is said to require only 4 per cent of the amount of water generally used in pipe condensers. The condenser illustrated is arranged for motor operation, and is designed with particular reference for use in refrigerating and ice-making plants where condensing water is not plentiful.

WIRE SPECIALTIES.—The Fancleve Specialty Company, Jamaica Plain Station, Boston, Mass., has issued a well-illustrated catalog of twenty-six pages devoted to fittings for use with interior wiring construction. Among the new features are fittings for use with metal moldings and others for use with flexible conduits and armored cables, which employ the clamp type of connector for fastening and grounding rather than the set screw type.

DIRECT-CURRENT MOTORS.—The importance of direct-current motors is now well established in practically every industry. The selection of the right kind of motor has consequently become a matter of very great importance. Bulletin No. 132 published by the Crocker-Wheeler Company, of Ampere, N. J., contains information regarding the design of one line of these machines that should be of interest to all users of motor-driven machinery.

CRANE AND HOIST MOTORS.—Bulletin No. 129 printed on the subject of crane motors by the Crocker-Wheeler Company at Ampere, N. J., has much in it that should be of interest to anyone who is in any way responsible for the installation or operation of electric cranes. This pamphlet is handsomely illustrated with halftone engravings which show many interesting applications of electric motors to cranes and hoists under widely different conditions.

ELECTRIC FANS.—The General Electric Company has issued a very attractive bulletin which illustrates and describes its electric fans for the coming season. These fans are made for either alternating current or direct current, and in various styles and sizes to meet various conditions. The publication lists fans suitable for the home, office and restaurant, and fans which can be placed on desk or table or fastened to the wall or ceiling. The bulletin, which is No. 4806, lists also various small motors.

RAILWAY MOTORS.—Bulletin No. 4822 of the General Electric Company, illustrates and describes its GE-98 railway motor which was designed to meet the demands of heavy city and suburban service, and is suitable for either two or four-motor equipments. The motor is rated at 50 hp. The publication contains dimension diagrams, characteristic curves, a table of schedule speeds and a form for a prospective customer to fill out and forward to the company when desiring further information on this motor.

LUBRICATOR PUMP.—The Phenix lubricator oil pump, square and round types, is the subject of an attractive 16-page catalog recently issued by the Richardson-Phenix Company, of Milwaukee. Besides pointing out the special applications and advantages of the Phenix force feed lubricator for cylinder lubrication, data concerning different types of power plants are given showing that the rubbing surface and also the power consumption of auxiliaries bear a rather high ratio to the total power ouput of the plant. The pamphlet then points out that it is [illegible] to spend a lot of money in proper lubrication of main units without devoting some attention to the auxiliaries.

BUSINESS NOTES.

MR. F. C. FINKLE has moved his consulting engineering offices from 628 South Spring Street, to the I. W. Hellman Building, Los Angeles, Cal.

J. R. DEANE & COMPANY, of Chicago, announce their removal from the Isabella Building to 332 South Michigan Avenue (McCormick Building). The firm has the agency for Peerless motors and dynamo and Colonial fans.

THE GENERAL ELECTRIC COMPANY has lately shipped to the Southern Power Company a 12-000-amp, triple-pole, 650-volt alternating current circuit-breaker, to be used in controlling the current from the 600-volt side of an 11,000 600 volt, 60 40-cycle, 6600-kw frequency-changer set. This is stated to be the largest capacity of alternating-current circuit-breaker that has ever been manufactured.

PARTRICK, CARTER & WILKINS COMPANY, Philadelphia, suffered from a fire in its factory building on the night of May 16, which caused considerable damage and a temporary shutdown. The loss is being adjusted and arrangements made for an early resumption of work. The firm asks its friends in the trade to be patient in case of any delays in filling orders, as it expects soon to have the factory in operation.

MR. H. J. BREWER has severed his connection with the Connecticut Dynamo & Motor Company, of which he has been president for several years, and has become associated with the Ideal Electric & Manufacturing Company, of Mansfield, Ohio, as manager of its New York office. Mr. Brewer has been in the electrical manufacturing business for the past fifteen years, and has an unusually large circle of acquaintances throughout the United States.

THE J. FAESSLER MANUFACTURING COMPANY, Moberly, Mo., maker of Boss and Universal flue expanders, flue cutters and other boiler tools, has reorganized its sales department and placed Mr. Chas. F. Palmer in charge as sales manager, with office at 8[illegible]0 Olive Street, St. Louis. Mr. Palmer is well qualified for this position through previous experience in selling Faessler tools and as representative of the Frank E. Palmer Supply Company, of St. Louis.

THE NORTHWEST ELECTRICAL EQUIPMENT COMPANY has opened offices at 530 Lumber Exchange, Portland, Ore., as manufacturers' agent and is preparing to take care of the trade for the American Electric Fuse Company, Hygrade Incandescent Lamp Company and several other specialties, such as overhead material for electric railways and steel transmission towers, besides electric hammers and tools. Mr. W. H. Banes, formerly of the J. C. English Company, is president and general manager of the new concern.

THE FRED LEE COMPANY, 40 East Twentieth Street, New York, has taken over the assets of the T. Fred Lee Company, which had been doing business for several years at 514 Atlantic Avenue, Boston, and 302 Asylum Street, Hartford, Conn., as Eastern distributor for the Shelby Electric Company, of Shelby, Ohio, incandescent lamp manufacturer. The Fred Lee Company, however, is distributor of electrical illuminating appliances; that is, Eastern incandescent lamps, reflectors and fixtures. The firm will not repair electrical machinery, as erroneously stated in these columns, but do business as manufacturer and jobber of electrical illuminating appliances.

THE CHICAGO ARMATURE & MOTOR COMPANY, of 552 West Harrison Street, Chicago, is a new organization. Mr. Leonard C. Jones is president and Mr. Gustav Jost superintendent. The concern will do repairing of motors and generators, making a specialty of alternating-current work. Mr. Jones was formerly connected with the Westinghouse works at Pittsburgh, being foreman of the transformer department when he left. Later he was employed for four years in the Chicago repair shop of the General Electric Company. Mr. Jost has been foreman in the electrical repair department of the Northwestern Electric Company, Chicago. He has also been connected with the General Electric repair shops, Chicago.

HODENPYL, HARDY & COMPANY.—Messrs. Anton G. Hodenpyl, George E. Hardy and John C. Weadcock, of the firm of Hodenpyl, Hardy & Company, the formation of which was noted in our issue for May 4, have been associated with the management and financing of public service and other corporations for a number of years. Mr. Bernard C. Cobb, who is associated with the new firm, has been closely identified with the management of gas, electric and street railway companies in Michigan, Illinois and Wisconsin, and particularly with the gas companies in Grand Rapids, Detroit, Saginaw and Bay City, Mich. William H. Barthold, who is also associated with Messrs. Hodenpyl, Hardy & Company, has for many years served the companies which will be managed by the new firm as consulting engineer. Messrs. William M. Eaton and E. J. Bechtel are connected with the new firm in executive and engineering capacities. Mr. Eaton has occupied important administrative positions in connection with gas and electric properties at Jackson and Grand Rapids, Mich., and Rochester, N. Y., and for some time has been giving his attention to the development of water powers and to the electric-lighting and motor-service interests of the firm in Michigan. Mr. Bechtel will serve as consulting engineer, and will also discharge executive as well as engineering duties in connection with the various properties controlled by the firm.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 16, 1911.
[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

992,165. TELEPHONE SYSTEM; H. P. Clausen, Chicago, Ill. App. filed March 17, 1902. Bimetallic, central energy system with a pair of supervisory relays controlling a supervisory signal and a line relay shunted by one of the supervisory relays to control the line signal.

992,174. TROLLEY GUIDE; E. De Planque, Philadelphia, Pa. App. filed Sept. 22, 1910. The harp is provided with upward and outward guide fingers to receive and guide the wheel to the wire.

992,201. SYSTEM OF ELECTRIC MOTOR CONTROL; H. D. James, Pittsburgh, Pa. App. filed June 8, 1907. A plurality of independently operated switches for governing the acceleration with alternating motors with means for delaying the closing of the last switch. The system includes a voltage reducing transformer with switches for controlling the transformer circuit.

992,202. SYSTEM OF ELECTRIC MOTOR CONTROL; H. D. James, Pittsburgh, Pa., and E. Lehr, Wilkinsburg, Pa. App. filed Sept. 3, 1907. For starting polyphase induction motors by means of electrically operated switches having a plurality of actuating magnets whose windings carry currents of different phases with automatic means for delaying the introduction of the secondary resistance in the controlled circuit, the switches being initially actuated from a single-phase source and their coils connected in polyphase relation when the switches close.

992,205. TUNNEL AND PLATE-HOLDER SLIDE FOR X-RAY PICTURES; J. R. Kelley, Cincinnati, O. App. filed April 20, 1909. For exchanging plates in a plate holder to locate the object. Details.

992,214. ELECTROPNEUMATIC BRAKE; L. A. Lariviere, Paris, France. App. filed June 13, 1910. Electropneumatic valve doing away with the train pipe. The valve is placed under each carriage and actuated from a rheostat by the engine driver, admitting air from the reservoir to the brake.

992,217. UNIT SWITCH CONTROL SYSTEM FOR ELECTRIC MOTORS; E. Lehr, Wilkinsburg, Pa. App. filed June 8, 1907. A plurality of control switches which close in a certain order with a series relay switch, and intermediate relay switches which alternately delay the action of the successive control switches to permit the series relay switch to act after each control switch is closed.

992,280. POLYPHASE MOTOR; S. Sparrow, St. Louis, Mo. App. filed April 30, 1910. Induction motor with distributed winding. Increase torque at starting. A number of the elements of the winding are permanently short-circuited and the rest may be when desired.

992,281. ELECTRIC FURNACE; E. C. Speiden, Niagara Falls, N. Y. App. filed Jan. 31, 1911. By arranging the electrodes at an angle, the heat developed by the electrode terminals is intercepted and reflected upon the molten bath by the upper portions of the electrodes.

992,289. MULTIPLE VOLTAGE CONTROLLER; E. W. Stull & G. B. Schiey, Milwaukee, Wis. App. filed Sept. 30, 1909. The motor armature is changed from one set of mains to the other of different voltage without breaking the circuit by means of a drum controller and by throwing in a variable resistance which is cut out when the change is made from the higher voltage mains to the lower.

992,294. MOTOR STARTER OR ELECTRIC CIRCUIT CONTROLLER; G. G. Thompson, Muskegon, Mich. App. filed Dec. 31, 1910. A pair of resistance elements consisting of columns of disks to which the pressure is applied by an equalizer bar operated by a lever and link connection.

992,300. ELECTROMAGNETIC APPARATUS; M. Walker, Manchester, England. App. filed Dec. 16, 1905. The cores are magnetized by alternating currents in such a way as to obtain constant polarity. A continuous conductor surrounds the core and includes two paths of unequal resistance responsive to alternating current to give the constant field. A pair of brushes are rotated with relation to the conductor.

992,302. ELECTRIC MACHINE FOR THERAPEUTIC PURPOSES; R. H. Wappler, New York, N. Y. App. filed Oct. 11, 1910. An alternating generator supplies a step-up transformer whose secondary is connected to a rectifier which rotates in synchronism with the generator, giving unidirectional current.

992,333. ELECTRIC EXCHANGE SYSTEM; A. T. Brown, Syracuse, N. Y. App. filed May 28, 1895. Automatic exchange system with an automatically operating controlling device for controlling the selecting switch by governing the passage of the current through the conductors to the controlled mechanism.

992,360. TROLLEY POLE CONTROLLING MECHANISM; M. Kearn, Chicago, Ill. App. filed Aug. 23, 1909. Combines in one mechanism the pole spring and the trolley catcher, with means for preventing lateral swaying of the trolley pole. Details in the construction of the mounting for the trolley pole.

992,372. COMMUTATOR; E. Mattman, Milwaukee, Wis. App. filed Aug. 6, 1909. A plurality of bars supported by a spider and a member having slots secured to the spider to prevent dust from reaching the bars.

992,397. INSULATOR; M. E. Anderson, Louisville, Ky. App. filed Aug. 18, 1910. An insulator in two sections, one having grooves. The wire is clamped between the sections without twisting.

992,417. ELECTRIC TOASTER AND GRIDDLE; H. B. Gale, Natick, Mass. App. filed Nov. 16, 1909. For hotel use. Includes a horizontal, electrically-heated table on which the bread is placed with an electrically-heated plate for toasting the top, the plate being hinged and raised by a spring-pressed arm.

992,427. MEANS FOR CONVERTING ELECTRICAL ENERGY INTO MECHANICAL MOVEMENT; W. Jandus, Cleveland, O. App. filed Nov. 24, 1902. An electrically-heated hot wire is used in a measuring instrument. A multiplicity of the wires in series is suspended between and secured to the base member; two clamps and two inner insulators are provided to which the wires are directly secured.

992,462. INSULATOR; W. Weicker, Hermsdorf, Germany. App. filed May 11, 1907. Discharges the drops of water by electrostatic action. A metallic roof is in electrical connection with the wire which forms an electrostatic field.

992,468. SIGN FLASHER; O. D. Ziegler, Chicago, Ill. App. filed Oct. 13, 1910. A rotating shaft which operates a number of double-pole knife switches.

992,477. AUTOMATIC FIRE ALARM; H. Becker, Newport, Ky. App. filed Oct. 21, 1910. Thermostat, including a glass container which holds the mercury. Details.

992,478. ELECTRIC SWITCH AND CUT-OUT DEVICE; R. Birnn, New York, N. Y. App. filed Mar. 24, 1910. For molding strips used in wiring buildings, the switch and the cut-out being specially proportioned and designed to fit into the molding strip.

992,479. ARC LAMP; A. Blondel, Paris, France. App. filed Jan. 15, 1906. Inclosed lamp with conduit for the gases which are returned to the point below the arc. The circulation is produced either by natural draft or by means of a fan driven by a motor.

992,539. TEST SWITCH FOR RECORDING WATTMETERS; H. G. Blokusewski, Weehawken, N. J. App. filed June 25, 1909. Three conducting blocks arranged in a circle, two of them in the work circuit and three similar blocks opposite the first, all in the circuit, and two additional blocks within the circle, with a movable lever co-operating therewith.

992,541. THERMOSTAT; M. J. Briggs, Philadelphia, Pa. App. filed June 8, 1908. Protects the thermostat from moisture and gases by inclosing it in an elongated tube. The expanding member consists of the zinc tube, and the base carries a pivoted lever whose short arm engages the tube, and the long arm acted upon by a spring closes the circuit.

992,542. THERMOSTAT; M. J. Briggs, Philadelphia, Pa. App. filed Oct. 22, 1908. The expansible member consists of an elongated tube inclosing the contacts, one end of the tube being connected to the short arm of a contact-closing lever.

992,548. FIELD-MAGNET STRUCTURE; W. P. Dandliker, West Allis, Wis. App. filed April 19, 1909. A pair of clamping plates with conversion faces engaged by a spreading block to spread the plates and force them into engagement with the coils.

992,570. INSULATOR; H. R. Markel, Columbus, O. App. filed July 1, 1910. A two-part insulating block whose sections are grooved to grasp the wire between them.

992,583. POWER SYSTEM; A. H. Olmsted, Havre, France. App. filed Sept. 26, 1910. The generator is driven by a gas engine and supplies current to an electric motor for driving the vehicle. The control gear can be operated from any point in the train.

992,595. INSULATOR LINE ATTACHING DEVICE; L. W. Ridenour, Gratis, O. App. filed July 23, 1910. A wire split tie to be fastened to an insulator and through which the line wire passes.

992,600. PROCESS OF TREATING ALUMINUM ARTICLES FOR THE FORMATION OF GALVANIC METALLIC COATINGS; C. Rumpler, Schoenberg, near Berlin, Germany. App. filed Oct. 6, 1910. Treats the article in an electrolytic bath, comprising a solution of two or more metallic double cyanids and a sulphite to prevent oxidation.

992,628. ELECTRICAL DISTANCE CONTROL; A. Aichele, Baden, Switzerland. App. filed Sept. 24, 1909. Multiple-unit control system for trains having a sectional transformer, a master controller, a switch or arm and a motor operator for the switch arm.

992,633. BREAK-GLASS FIRE ALARM; C. Auth, New York, N. Y. App. filed June 11, 1910. A window having two positions and controlling contact mechanism with a bolt mounted upon the window and constituting a latch and a lock, including a locking ring engaging the bolt for holding the window in its normal position.

992,682. MEANS FOR OPERATING ELECTRIC MOTORS DRIVING MOTOR TRAINS; W. A. T. Muller, Berlin-Steglitz, Germany. App. filed Mar. 1, 1911. Supplies current from different sources to the armature winding and field winding of each electric motor of the train, so that the motors may be run forward or backward and electrically braked from the driving car without requiring switches on the other cars.

992,698. METHOD FOR THE PRODUCTION OF DENSE COMPACTED SILICON CARBID; F. J. Tone, Niagara Falls, N. Y. App. filed July 28, 1910. Forms similarly shaped pieces from a mixture of silicon carbid and carbon and heats the pieces near a silicon containing material so as to cause it to combine with the carbon.

992,715. ELECTRIC HEATER; C. S. Hawley, Albany, N. Y. App. filed Jan. 23, 1911. A heating resistance with two casing walls separated by air spaces perforated so that the openings in one wall are opposite the solid portions of the other wall.

992,728. ELECTRIC HEATER; J. F. McElroy, Albany, N. Y. App. filed Jan. 23, 1911. The heating resistance with the casing therefor and an internal deflector in line between the openings in the wall and the resistance.

992,735. ACTUATING MECHANISM FOR STATION INDICATORS OR THE LIKE; O. E. Kellum and T. P. Wilson, Los Angeles, Cal. App. filed Jan. 31, 1910. The wheel engages a member near the rail and closes the circuit to the indicator.

992,738. LINEMAN'S PROTECTOR; H. E. Marshall, Detroit, Mich. App. filed June 20, 1910. A split tubular protecting device with rings of hard rubber engaging the split tube, the tubes being placed over the wires at the cross arms.

992,744. LIGHTNING ARRESTER; E. E. F. Creighton, Schenectady, N. Y. App. filed Feb. 7, 1907. The path to ground includes a spark gap and an automatic switch with an electrolytic condenser, a second path to ground therefor and a larger spark gap.

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WELFARE WORK AND PUBLIC POLICY.

It is significant of the success with which the National Electric Light Association clearly distinguishes the great public movements of the times that the public policy committee devoted its entire report this year to the single topic of welfare work. Standing by itself and without the distracting influences which a consideration of a number of other subjects would have involved, the study of this topic assumes a prominence that could have been given to it in no other way. It is a concise, masterly treatment of a feature of corporation management which deserves careful consideration and introduction wherever practicable in the united interest of all who are concerned. It is at once broad in its recognition of a right public policy and exact in its definition of the restrictions and limitations with which reasonable systems of welfare work should be safeguarded. The committee recognizes with wisdom that the question of wages and the question of welfare work are separate and distinct. The question of wages is a business one; the issue involved in welfare relations between company and employee should be a better thing than a gift from one to the other. Great emphasis is given to the recommendations in the report by the influence of the names of the members of the committee by which it is issued. But it is connected still more closely with the public thought of the times and with the electrical industry by reason of its presentation with the support of the thoughtful address of Mr. Insull and the commendatory message of the Secretary of the Department of Commerce and Labor. It is the pride of the electrical industry that it has been in advance of the times and never a laggard in development. With good reason the association may point to the result of the year's consideration of questions of public relation as a commendable document, but it rests with the individual member companies to go further and make the recommendations effective. If, as Mr. Insull indicates, the real test of welfare work is to come when the companies include the cost in the rates of service, the issue is one that it is not best to postpone too long.

THE CONVENTION.

So much business of importance was considered at the great and enthusiastic New York convention of the National Electric Light Association now closing that it is rather difficult, while the atmosphere is still electric with the enthusiasm, the fellowship and the joyous excitement of the whole affair, to summarize results. One event, however, is of outstanding importance, and that is the public-policy report presented at the New Theatre on Wednesday evening. This report on welfare work for employees is not only of the highest importance as indicating a very advanced position taken in reference to the wellbeing of employees of member companies, but it cannot be overlooked that its official adoption reveals a public-spirited attitude on the part of the association which can hardly fail to affect favorably relations with communities in which the employees live. Thus the influence of this official welfare recommendation should be widespread.

The attendance at the convention was amazingly large, reaching a total of about 5150, almost exactly double the figure attained at the St. Louis convention of 1910, which held the record up to this year. This tremendous gathering was partly due to the fact that the meeting was held in New York and to the great attendance of company section members, but in large part is to be attributed to the continued growth of the industry, which, as Mr. C. A. Coffin said in his speech, is, or should be, an inspiration to every man engaged in it. Perhaps the greatest figure in the industry, Mr. Edison, attended the convention, and thereby added to its prestige in the eyes of the general public, while giving the convention attendants an appreciated opportunity to render a tribute of admiration.

In the space and time available it is impossible to review or even to mention all the committee reports and papers presented and discussed at the convention. Many of them are of distinct value, and individual reference is made to the principal features of this character elsewhere in the general report of the convention and the sections giving abstracts of the papers and discussions. It may serve to indicate the amount of business considered to say that the stenographic transcript of the discussions alone makes more than 1000 typewritten pages. The concomitant features of the convention, as the presentation of cups, meetings "on the side," dinners, luncheons, etc., were numerous and interesting. The arrangements for the convention were most complete; the entertainment features were on an unparalleled scale, the New Yorkers showing every courtesy to the visitors, and in every respect the convention has been, beyond all question, the greatest in the history of the association.

THE VENTILATION OF TURBO-GENERATORS.

In view of the fact that the permissible output rating of alternating-current generators is set almost wholly by a limiting temperature beyond which it is considered unwise to operate the machine, it needs no argument to show that one of the most important problems confronting the designer of the apparatus is that relating to the means for dissipating the heat produced within the machines as unavoidable losses. The thermal problems become more difficult of solution as the ratio of loss to unit mass of material increases, and reaches the extreme in this direction in the very high-speed steam turbo-generators, in which the ratio of the loss to the volume of the material throughout which the temperature is affected is greatest. Under conditions now met in generating-station practice, where low inherent regulation is of minor importance, it may safely be stated that the permissible output of any chosen alternating-current generator varies directly with the effectiveness of the facilities which are provided for cooling the machine.

A good idea of the magnitude of the thermal problems encountered by the designer of a turbo-generator was given in a N. E. L. A. convention paper by Mr. R. B. Williamson, abstracted in this issue. The author shows that, in the very limited passages that can be provided within the generator, approximately as great a weight of air must be passed as the weight of steam consumed by the steam turbine. The prejudice which formerly existed against the use of so-called artificial means of ventilating generators is slowly disappearing as the users of electrical apparatus are educated to appreciate the important relation between ventilation and cost of equipment. The centrifugal ventilating fan is now a well-recognized adjunct to the turbo-generator, and even at the present time not all of the fans are hidden from view within the generator casing. Probably there exist frequently conditions under which separately driven fans would prove more convenient and effective than the self-contained ventilating equipments. The time seems now to have arrived when such an auxiliary cooling installation for a turbo-generator unit can be looked upon just as is the similar installation for cooling transformers, and not as indicating poor design and construction, as would have been assumed to be the case in earlier years.

THE DIELECTRIC CONSTANT FOR ICE.

If we consider a rectangular slab of insulating material, assumed initially as a perfect non-conductor, then we know that if there be a varying difference of electric potential across the slab electricity will pass across the slab and that the rate of flow at any instant will be proportional to the rate of change in the impressed potential-difference. For slabs of different material of the same dimensions, and for given rates of change of impressed potential-difference, the electric current through the slabs is materially different. The least current of all is found with a slab of vacuous space, or what may be called a slab of free ether. Slabs of gases at ordinary temperatures and pressures carry but little more current than slabs of vacuous space. Solids always carry more, and much more. The ratio of the current through a slab of given uniform insulating material to that through a slab of vacuous space is called the dielectric constant of the material. When, as frequently happens, appreciable conductive leakage of electricity occurs through the slab, in addition to the dielectric transfer, a deduction has to be made for the leakage. In magnetics a somewhat similar phenomenon occurs. When a slab of material has a difference of magnetic potential applied across it, a magnetic current passes through it. With slabs of different materials, however, the magnetic current is always nearly the same as for a slab of vacuous space, unless we use a slab of a magnetic metal, such as iron, nickel or cobalt, when the magnetic current is commonly increased. In these cases the increase is due to the generation of molecular magnetic sources within the structure of the magnetic metal.

In the case of dielectrics we usually consider that the dielectric constant indicates a greater electrostatic conduction in the substance than exists in air or in vacuo. We do not attribute this to an e.m.f. evoked structurally in the material. It is as though a storage battery were allowed to discharge in succession through a number of different wires, all of the same dimensions, but of different substances. Those wires which received the largest currents would be regarded as possessing the greatest conductivities. But it would be conceivable for the wires all to possess the same conductivity and to have a structure of molecular sources of e.m.f. capable of being oriented and connected in series to assist the passage of current flow from the storage battery. The distinction between the effects of structural e.m.f. and those of difference of conductivity would be looked for in the persistence or non-persistence of current flow. In the one case there would be a residual current flow analogous to residual magnetism in a steel ring. In the other case there could be none. The dielectric constant of water and of ice is large compared with the dielectric constant of most substances. The constant of solids commonly varies between 2 and 8, but in the case of ice it has been observed to be as much as 95. Much depends upon the frequency used and on the method of measurement in such cases. An experimental research by Mr. Phillips Thomas, published recently in the *Physical Review*, made the constant for ice from 94 to 96, at temperatures from — 2 deg. C. to — 18 deg. C. and frequencies from 40 cycles to 70 cycles. It is to be hoped that the measurements will be extended up to high frequencies and down to low temperatures.

MORE CHICAGO ENTERPRISE.

The Commonwealth Edison Company of Chicago has already made an extraordinary record for successful activity and remarkable energy in building up new business and providing station equipment in ample time to take care of it. So far as we can remember this company has never allowed its needs to get ahead of its resources, and it has gone ahead with a wonderful breadth of perspective to enter upon new fields and exemplify in every respect the largest view of central station business. The notable Northwest station described in our columns this issue is an admirable example of the way in which the big policies of the Commonwealth company have been carried out. It is perhaps the largest steam-driven power station now under construction, and when completed, if completion is not too long delayed, will in all probability hold the record as the largest steam-driven station in existence. Mere bigness, however, does not count in central-station design so much as wise arrangement and skilful adjustment to the needs of the situation. The Northwest station embodies all of this.

In the first place, its construction carries out the policy of the Commonwealth company of not putting all its eggs in one basket, for the engineers evidently realize fully that there is a maximum size of station beyond which mere increase of size does not pay. Instead of trying to unify the supply for the whole territory served, they have followed the wise theory that when generating stations of immense size have to be erected they may just as well be located in advantageous positions with respect to the whole problem of generation and distribution as collected under one colossal roof to satisfy a crude desire for aggregation. Hence the Northwest station has been carefully located eight miles from the present chief station in a position where there is ample room for growth and a good opportunity for fuel and water supply. More than this, the new plant really consists of two independent units, each of which when completed will have 120,000 kw of generating rating. The present beginning contemplates the immediate installation of two 20,000-kw turbines out of the six assigned to one-half of the completed design. These turbines will be operated at higher pressure and hence at even greater economy than those now in use, which, we believe, hold the present record for cheap generation of energy.

A glance at the station plan shows the arrangement as it has been at present developed, and it is indeed illuminating as regards the existing situation in prime movers. The huge 20,000-kw turbines are spaced more closely than the 12,000-kw units now in use, giving a material gain in floor space, even although in the situation occupied by the station this is of itself not essential. It is very clear that at the present moment the prime mover has outrun the steam-generating equipment in development. Twenty boiler units are required to feed with steam the two great turbo-generators of the station. The turbine-room seems a mere annex to the boiler-room, and in fact the transformer house and the switch house between them take up more space than the turbine-room. One cannot help wondering when the boilermakers will rise to the occasion and build units more nearly adequate for the steam supply of the great generators now in use. Practice abroad is already tending toward an increase in the size of boiler units, and a glance at the floor plan of this Northwest station emphasizes the need and arouses a feeling of wonder that the builders of generators have been allowed to get so far ahead of the game. The usual excuse is that it is not "feasible," or "practicable," or "economical," or "conservative," or something else of the same kind, to produce larger boiler units than the "standard" ones now in use. A decade hence, however, engineers will grin at the remembrance of our present practice. They may also smile indulgently at our present intricate methods of switching.

This reference to switching is not offered in criticism of the admirable work of the engineers of the Commonwealth Edison Company in the design of this station, but merely in hope that some day a larger view of the whole problem may be acquired to which the art of construction may grow. From a practical standpoint the present great elaboration of switching mechanism brings a new danger in station operation, the risk of crippling the cable connections that lie between the generator and the distributing house. More than one big station has in the last year or two been put out of business with disastrous results, not by failure of the generating apparatus, but by the wholesale destruction of its connections But, taking apparatus and methods as they are, the Northwest station is an admirable example of design. Some of its most valuable and ingenious features are found in the boiler room, where the coal-handling equipment is of a most perfect and complete kind. The coal cars run into the basement of the boiler-room and are discharged by automatic machinery, which takes care of the coal from its reception to its combustion with a minimum of hand labor. Even the ashes are carried away by ash cars run under the furnaces for their reception. No more complete plant for economical and efficient handling of fuel has ever been devised. The fuel is brought to the station on an electric elevated road, and besides the large storage capacity provided in the boiler-house bunkers provision is made for immense storage capacity in the yards. Not the least commendable feature of the great plant is the systematic effort that has been made to relieve it of the grimy utilitarian appearance only too common and to make it as dignified and ornamental as possible This is but the part of the larger conception of central station responsibility for which the Commonwealth company has been conspicuous. Altogether the new plant is a remarkable example of skill and foresight as applied to electrical supply.

A. I. E. E. Convention.

Arrangements have been completed for the annual convention of the American Institute of Electrical Engineers, to be held in Chicago at the Hotel Sherman from June 26 to 30. Among the entertainment features will be a reception and dance at the hotel on Monday evening, June 26. On Tuesday afternoon visits will be made to the factory of the Western Electric Company and to the generating stations of the Commonwealth Edison Company. On Wednesday afternoon there will be a reception for the ladies at the South Shore Country Club. On Wednesday evening there will be a boat excursion on Lake Michigan. On Thursday afternoon a visit of inspection will be made to the Indiana Steel Company's plant at Gary. There will be additional entertainments provided for the ladies, including automobile trips, details of which have not yet been decided upon.

A partial list of the papers to be presented was given in our issue of May 4. The complete technical program is as follows:

POWER-STATION SESSION, TUESDAY MORNING.

The opening session will be held at 10 o'clock on Tuesday morning, the first item on the program being the presidential address by Prof. Dugald C. Jackson, of the Massachusetts Institute of Technology, Boston. This will be followed by the address of President-elect Gano Dunn, of the Crocker-Wheeler Company. Dr. C. P. Steinmetz, General Electric Company, will present a paper entitled *Development of the Modern Central Station*. A paper entitled *Tests of Oil Circuit-Breakers* will be presented by Mr. E. B. Merriam, of the General Electric Company. *The Use of Reactance Coils in Large Central-Station Systems* is the title of a paper which will be presented by Messrs. R. F. Schuchardt and E. O. Schweitzer, of the Commonwealth Edison Company.

ELECTRIC-LIGHTING SESSION, TUESDAY EVENING.

At a session to be held at 8:30 on Tuesday evening the following two papers will be presented: *Depreciation as Related to Electrical Properties*, by Mr. Henry Floy, of New York, and *Important Features Entering Into the Making of Appraisals*, by Mr. H. M. Byllesby, of Chicago.

RAILWAY SESSION, WEDNESDAY MORNING.

The following papers will be presented at a session to be held at 10 o'clock on Wednesday: *Some Data from the Operation of the Electrified Portion of the West Jersey & Seashore Railroad*, by Mr. B. F. Wood, of the Pennsylvania Railroad; *Analysis of Electrification*, by Mr. W. S. Murray, of the New York, New Haven & Hartford Railroad; *Solution of Problems in Sags and Spans*, by Mr. W. L. R. Robertson, of the Philadelphia Electric Company, and *Induction Machines for Heavy Single-Phase Motor Service*, by Mr. E. F. W. Alexanderson, of the General Electric Company.

INDUSTRIAL POWER SESSION, WEDNESDAY AFTERNOON.

At 2:30 Wednesday afternoon the following papers devoted to the application of motors in industrial service will be presented: *Automatic Motor Control for Direct-Current Motors*, by Mr. Arthur C. Eastwood, of the Electric Controller & Supply Company; *Some Limitations of Rheostat Control*, by Mr. T. E. Barnum, of the Cutler-Hammer Company; *Control of High-Speed Electric Elevators*, by Mr. L. I. Tatum, of the Cutler-Hammer Company; *Electrically Driven Reversing Rolling Mills*, by Mr. Wilfred Sykes, of the Westinghouse Electric & Manufacturing Company.

TELEGRAPHY AND TELEPHONY SESSION, WEDNESDAY AFTERNOON.

Simultaneously with the holding of the industrial power session there will be held a session devoted to telegraph and telephone subjects, at which the following papers will be presented: *Multiplex Telephony and Telegraphy by Means of Electric Waves Guided by Wires*, by Major George O. Squier, U. S. A.; *Telegraph Transmission*, by Mr. F. F. Fowle, of Chicago; *Commercial Loading of Telephone Circuits in the Bell System*, by Mr. Bancroft Gherardi, of the American Telephone & Telegraph Company.

HIGH-TENSION TRANSMISSION SESSIONS, THURSDAY AND FRIDAY.

The following papers relating to high-tension transmission problems will be presented on Thursday and Friday. *The Law of Corona and the Dielectric Strength of Air*, by Mr. F. W. Peak, Jr., of the General Electric Company; *Mechanical and Electrical Characteristics of Transmission Lines*, by Dr. Harold Pender and Mr. H. F. Thomson, of the Massachusetts Institute of Technology; *Dielectric Strength of Air*, by Prof. J. B. Whitehead, of Johns Hopkins University; *Sag Calculations of Suspended Wires*, by Mr. P. H. Thomas, of New York; *Transmission System of the Great Western Power Company*, by Mr. J. P. Jollyman, San Francisco; *Transmission System of the Southern Power Company*, by Mr. W. S. Lee, Charlotte, N. C.; *Transmission System of the Great Falls Power Company*, by Mr. Max Hebgen, of Butte, Mont.; *The High-Efficiency Suspension Insulator*, by Mr. A. O. Austin, of the Ohio Insulator Company, and *Electric Line Oscillations*, by Mr. G. Faccioli, of the General Electric Company.

CONFERENCE OF SECTION DELEGATES, FRIDAY EVENING.

A conference of Institute officers and section delegates will be held under the auspices of the sections committee at 8:30 on Friday evening.

GENERAL SESSION, FRIDAY MORNING.

The following papers on general electrical engineering subjects will be presented at a session to be held at 10 o'clock on Friday: *The Economical Design of Direct-Current Electromagnets*, by Mr. R. Wikander, of Pittsburgh; *Electrolytic Corrosion in Reinforced Concrete*, by Prof. C. E. Magnusson and Mr. G. H. Smith, of the University of Washington; *Wave Shape of Currents in an Individual Rotor Conductor*, by Mr. Hans Weichsel, of the Wagner Electric Manufacturing Company; *The Choice of Rotor Diameter and Performance of Polyphase Induction Motors*, by Mr. Theodore Hoock, of the Westinghouse Electric & Manufacturing Company; *The Application of Current Transformers in Three-Phase Circuits*, by Mr. J. R. Craighead, of the General Electric Company, and *The Cost of Transformer Losses*, by Messrs. R. W. Atkinson and E. C. Stone, of the Standard Underground Cable Company.

EDUCATIONAL SESSION, FRIDAY AFTERNOON.

At 2:30 on Friday afternoon the following papers on educational subjects will be presented: *Tentative Scheme of Organization and Administration of a State University*, by Mr. Ralph D. Marshon, of New York.

Report of Central-Station Load-Factor at Turin International Electrical Congress.

Prof. G. Sartori has been invited to prepare a report on the problem of increasing the load-factor in central stations for presentation before the International Electrical Congress in Turin in September. Professor Sartori, whose address is 727 Via Michelangelo, Trieste, Austria, will be very glad to receive from American central-station men communications on the subject.

Pittsburgh Meeting of A. S. M. E.

The spring meeting of the American Society of Mechanical Engineers convened at Pittsburgh on Tuesday, May 30, the headquarters being at the Hotel Schenley, with an attendance of about 600. The opening day was devoted to registration and a reunion of the members and their friends. A meeting of the council of the society was held in the afternoon, Col. E. D. Meier, president of the society, presiding. In the evening an informal reception was held at the hotel, the officers of the society being assisted in receiving by several prominent citizens of Pittsburgh.

Wednesday morning was devoted to the cement session, at which there were papers and discussions of the cement-making industry. In the afternoon a special train was run to Universal, Pa., where an inspection was made of the plant of the Universal Portland Cement Company. On the return trip the party was taken through the works of the Westinghouse industries at East Pittsburgh.

ENERGY RELATIONS IN STEAM TURBINES.

On Thursday morning at the miscellaneous session Prof. Forest E. Cardullo, of the department of mechanical engineering of the Agricultural and Mechanical College of Vermont, read a paper on the calculations of the distribution of energy and pressure drop among the stages of an impulse turbine. Professor Cardullo stated that there are three general methods open to the designer for determining the properties of steam during its passage through the turbine: First, empirical equations giving the relation between heat content, entropy and temperature or pressure of expanding steam; second, by use of Mollier's total heat-energy diagram giving the relation between the total heat, entropy, pressure and quality of steam; and third, making use of a table showing the relation between the temperature, entropy, total heat, quality and specific volume of steam, similar to the one given by Prof. C. H. Peabody before the Society of Naval Architects and Marine Engineers at the Detroit convention in 1909. The author suggested as a substitute for the last mentioned a method which he believes to be simpler and more exact. Professor Cardullo stated that there is no known reason why this method should give correct results, but experience shows that it does.

It is customary to design multi-stage impulse turbines on the assumption that the entropy of the steam remains constant, but the effect of the friction of the steam is to increase the total heat and the entropy of the steam. It also increases the proportion of the power developed in the later stages. The author proposed an empirical formula for estimating the power developed in each stage, and this formula can also be used in the determination of the proper pressure drop of each stage.

The author gave a graphical solution of the problem in connection with Mollier's total heat-entropy diagram. This method he recommended when the amounts of power developed by the different stages are unequal, as is sometimes the case.

THE PURCHASE OF COAL.

Mr. Dwight T. Randall, of Boston, formerly employed by the government in research work, but now engaged in consulting engineering work, at the Thursday morning session read a paper on the purchase of coal. He stated that most boiler-rooms are now able to effect economies in two ways, namely, by burning the coal in the most approved manner and by carefully selecting the coal best suited to the conditions—that is, the one that would give the most heat units per dollar expended.

Coals purchased in the open market differ widely in quality, though sold under the same trade name. An intimate knowledge, therefore, should be had of the coals to be selected from and also of the combustion operation. If coals are suited for the furnaces in which they are to be used the output is proportional to their heating value. In some cases it has been found economical to alter the furnace in order to utilize a low grade of coal. A great deal depends on the knowledge the operating department has of the boiler-room and reasons for variations in economy obtained, and low efficiencies charged to poor coal are often due to lack of this knowledge.

It is very generally conceded now that the proper method of buying coal is by analysis, with a guarantee as to its quality, with some provision for variations from the guarantee. A great deal depends on the sample, and extreme care should be used in selecting this, taking it from all portions of the car or barge. Very different results can be obtained from samples from the same vessel, and it is therefore incumbent to select an average sample.

The method of burning coal after the proper kind has been selected should also be carefully studied. Poor combustion operation will nullify the advantage gained in having obtained the correct coal.

Electric Vehicle Club Meeting at Boston.

At the regular meeting of the Electric Vehicle Club of Boston on May 24 Secretary L. D. Gibbs called attention to the far-reaching influence of the Boston Edison company's electric-vehicle publicity work, citing favorable comments upon it from England. He announced that the Boston Edison company is ready to send letters to lists of prospective customers, casting the weight of its influence for electric vehicles. This circularization is not permitted in connection with the company's bills, but will be handled in a strictly confidential way without displaying any partiality between different makers.

The committee on the electric-commercial vehicle parade for May 30 announced that the owners of sixty-two trucks have expressed their willingness to enter, and a striking comparison with the horse-drawn vehicles of the annual work-horse parade was anticipated. The committee on parking stated that an effort is to be made to secure rights on Charles Street, between Boston Common and the Public Garden. Negotiations on behalf ot Hamilton Place, nearer the business center, had been unavailing. Mr. J. Allen Smith, president of the National Battery Company, Buffalo, N. Y., emphasized the importance of securing parking space and said that electric pleasure vehicle proggress in Boston depended to no small extent upon liberal treatment of automobile owners by the public authorities.

Mr. E. S. Mansfield said that the Massachusetts automobile register showed that on May 20 there were 1274 commercial automobile trucks and vehicles operating in the State. Of these 123 are of the electric type and sixty-one are in the Edison district. About 108 new electric machines of all types have been sold in Boston this year. The meeting closed with a somewhat protracted discussion of the evils of demonstrating cars and the importance of properly caring for batteries in order to secure the life guaranteed.

Water-Power and Conservation.

At the noon luncheon of the Chicago Electric Club May 24 Mr. I. E. Brooke, of the W. H. Rosecrans Engineering Company, presented a paper on the subject of "Water-Power and Conservation," which, in his absence, was read by Mr. C. E. Freeman. Mr. Brooke's paper directed attention to the enormous fuel costs which must now be paid owing to the non-development of existing water-power. In addition to the coal actually used for fuel purposes, the author pointed out that for each ton of coal hauled across the continent approximately another ton must be burned under the boiler of a locomotive. In this country alone there are 33,000,000 hp of waterfalls not yet utilized, the development of which would mean a saving of $200,000,000 in fuel costs annually. With proper storage facilities the above undeveloped water-power could be made capable of producing 150,000,000 hp, which would be equivalent to 50 per cent more than an average year's coal consumption at the present rate. At the present time about 5,000,000 hp is being developed by about 5000 different waterwheels in this country.

The influence of forests on stream flow and annual run-off was also discussed by Mr. Brooke, who enumerated the various popular arguments which friends of the forestry movement have put forward tending to show that forests conserve uniform stream flows. These statements the author characterized as fallacies and showed that in many instances where timbered land had been cut off the stream conditions remained practically unchanged. He also declared that the influence of forests, if any, must be very small and totally disproportionate to effect any storage of the scale required. While under average flow conditions, the speaker admitted, the forests might be expected to conserve and regulate run-off to a small extent, they could have practically no effect on the extreme flood conditions, some of the most severe of which are encountered in regions thickly covered with timber.

Mr. Brooke called attention to the use of combination irrigation and power-development plants and suggested that such developments should be undertaken by engineers familiar with the combined problems of power generation and water supply so that neither one of these important phases would be overlooked in sites available for the double purpose. The improper construction of one plant or the other often results in prohibiting any future developments of the other undertaking. Mr. Brooke spoke of the increasing stability and value of water-power securities, and suggested methods by which these values might be increased by government supervision and regulation. The author then referred to water-power control in France and Italy. The laws of the latter, he declared, are most admirable in their completeness and thoroughly fix the conditions of diversion, use, quantity and restoration, and the sanitary conditions surrounding the development. Water-powers are leased to operating companies at 55 cents per hp-year on a thirty-year term, which is renewable for a second thirty-year term, although further renewals are optional with the government. If the power company cannot show a development of all of the power allotted the lease is revocable. The Italian government considers the difference between a generating plant supplying service within a closely settled community and one where transmission of the power developed is necessary. For all transmissions above 10 km in length it allows a reduction in the 3-franc rate per hp-year proportional to a number equivalent to the square of the kilometers of transmission distance multiplied by one-thousandth, the rental in no case, however, being less than ½ franc, which applies to all transmissions above 50 km in length. In France all water-powers above 200 hp are regarded as municipal or public-service plants, while those below this rating are regarded as private plants and are supervised as such. In Switzerland the limit is 100 hp for public-service plants.

Proposals have been made by those taking suggestions from the government's construction of irrigation plants to have water-powers built by the government and leased to private parties for operation. Mr. Brooke declared that this course would not be satisfactory on account of the higher cost at which government plants are constructed as well as the incident formality of government control, which might repel investors. On the other hand, the presence of the government in the undertaking would no doubt lend stability to the character of the investment. Mr. Brooke advocated extending the right of eminent domain to water-power and transmission companies, as is done in the case of railroad companies, to bring about the greatest benefit to the greatest number. He also pointed out that the proposed tax upon water-power is about forty times that provided in the coal lands, which the government is selling at an estimate of 0.1 cent per ton of coal.

The Electric Club of Chicago has voted to tender a complimentary luncheon to the members of the American Institute of Electrical Engineers during the latter's convention at Chicago in July.

Expansion of Electric Vehicle Business at Boston.

As a result of the vigorous campaign inaugurated about three months ago by the Edison Electric Illuminating Company of Boston in co-operation with nearly a score of representatives of manufacturers the demand for the electric commercial and pleasure vehicle is rapidly increasing in the company's territory. In the publicity work fostered by the Electric Vehicle Club larger advertising space is continually being taken in the Boston press by dealers in electric vehicles and accessories, and a more favorable attitude is being displayed by newspaper managements toward this type of equipment. Space is being given to articles of electric vehicle interest as a feature of issues in which competitive makes are advertised together, and a vigorous effort is being made to show the public that the gasoline car has no monopoly in the territory. Among the recent decisions favorable to the electric vehicle is one by the publishing house of Ginn & Company, Boston, which has concluded after exhaustive service tests of three delivery wagons to dispense entirely with horses and to install a private garage for charging and maintenance by the company's own staff. The George W. Gale Lumber Company, Cambridge, Mass., will shortly place three tractor trucks in service, replacing all the horses required to handle twelve lumber wagons. The Carpenter Garage & Motor Company, Brookline, Mass., has recently installed charging equipment capable of handling twenty-five machines simultaneously, including a switchboard permitting the taking of readings on individual batteries and thus obviating troubles which have sometimes hampered the older garages.

Meeting of New England Section, Electric Vehicle Association.

The regular monthly meeting of the New England Section of the Electric Vehicle Association of America was held at the Edison Building, Boston, Mass., on the evening of May 26, with President E. S. Mansfield in the chair. Before the address of the evening, which was by Mr. L. D. Gibbs, superintendent of advertising, Boston Edison company, on "Advertising in Relation to the Electric Vehicle," a short business meeting was held. Mr. Day Baker stated that the committee on parking had been successful in obtaining permission from the Boston Police Commissioner for the use of the portions of Tremont, Park and Beacon Streets fronting on Boston Common by owners of electric vehicles desiring to keep their cars standing downtown on shopping excursions. The authorities have informed the committee that the police will co-operate with owners in every way, and cars will be permitted to stand in one position for an hour without objection. Much satisfaction was expressed with the report, since it was generally recognized that the provision of adequate parking spaces in the business district of a city is one of the most important points to secure in the development of the electric pleasure vehicle industry.

President Mansfield gave the results of a recent canvass of electric pleasure vehicles as follows: Indianapolis, 200; Buffalo, 450; St. Louis, 450; Cleveland, 1800; Chicago, 2400; Boston district, 144; Massachusetts, 370. In the last-named State there are now 24,946 gasoline pleasure cars. The possibilities of expansion are thus large. The committee on insurance submitted blanks for distribution to electric-vehicle owners, giving space for the recording of service, accident, damage and fire-loss statistics. Two of the largest insurance companies have informed Chairman Baker of the committee that if the claims of electric-vehicle advocates regarding safety and freedom from fire hazard are properly supported reductions in rates will be effected. There is no question that the electric-vehicle owner is now paying a share of the cost of insuring the gasoline car.

ADVERTISING IN RELATION TO THE ELECTRIC VEHICLE.

Mr. Gibbs discussed the fundamental principles of effective publicity and advertising writing in a trenchant manner, pointing out the importance of compelling attention in limited space, securing directness of appeal, forcefulness, originality and simplicity. He criticised repetition as weakening the influence of the argument, and laid considerable stress upon the value of suggestion. In advertising the electric pleasure vehicle the use of illustrations showing a handsomely dressed and attractive lady operating her own car is far more convincing than a bald admonition to use such a vehicle. Such a picture at once conveys a notion of comfort, luxury, cleanliness, elegance and that indefinable element denominated "class." Similarly, a view of an electric truck plowing through a snowdrift or moving steadily through the street laden with a burden which at once suggests the difficulty of handling such a tonnage successfully and economically by horses is more effective than mere generalities of expression. If tactfully used, the element of command may be effectively employed, as in the phrase: "Let the electric truck cut your delivery costs in two." In selling electric vehicles the advertiser must not forget that he is addressing a busy man, and must avoid trying to tell the whole story in a single space reservation. The facts must be told simply, and the "peaks" emphasized. The employment of the advertising agency for specialized services was highly commended, and a wider use of the experience of newspaper advertising solicitors was advised.

The speaker said that the chief reason why the electric vehicle has not yet come into its own is the ignorance of the public regarding its reliability and economy. There are thousands of people who can afford to operate an electric vehicle if the apparent mystery of its service details is eliminated. The practice of the best garages more and more takes these details off the hands of the owner. Social emulation is an important factor in the selection of electric pleasure vehicles. The points which appear to tell most with the public are the features of cleanliness, healthfulness and scientific construction; by the latter meaning the care with which the vehicle has been put together.

In the discussion following Mr. Gibb's address the value of reading notices in papers printing vehicle advertisements was emphasized. The notice and the advertisement co-operate, but the notice must have human interest in order to be acceptable. Mr. Day Baker cited co-operative publicity which he had handled, even writing articles illustrating the machines of his competitors in order to promote the growth of the industry as a whole. Mr. J. F. McNalley, of the *Boston Herald*, urged the preparation of reading notices having genuine news interest, without the exploitation of individual makers' products. He emphasized the value of the non-cranking feature of the electric vehicle and pointed out the benefits of aggressive advertising. It was announced that, through the courtesy of Mr. Thomas A. Edison, moving-picture films were to be taken of the electric-vehicle parade to be held in Boston on May 30 in contrast with the work-horse parade. Closing, Mr. Gibbs spoke in disfavor of the comparative advertisement, with the exception of that which shows the limitations of the horse. It divides attention and tends to dignify the competitor too much. The policy of the Boston Edison Company has been to avoid any references to gas in its publicity work, in the belief that the day is coming when electricity will be in possession of the entire field of illumination.

New York Commission News.

Next week the Red Hook Light, Heat & Power Company and the Albany Southern Railroad Company will be heard on the applications for authority which will allow them to exercise franchises in Greenport, Columbia County. The Red Hook company seeks the assignment of a franchise which the town granted June 4, 1907, to Mr. Jonathan T. Rider, which has not been exercised. The company, which has a distributing plant at Red Hook, Dutchess County, and now serves Red Hook, Germantown, Livingston and Clermont with electricity, asks authority of the commission to enter Greenport. For some time past the Albany Southern Railroad Company has been furnishing electric energy for light, heat and motor purposes to residents of various towns along its railroad between Albany and Hudson. The franchise which it seeks to exercise was granted by the town board of Greenport on May 20, 1911. The terms of both franchises are practically identical in that they grant authority to the holders to construct necessary poles, lay pipes or install other fixtures for the conveying of electricity for public and private use for compensation.

The Red Hook company also asks authority to exercise a franchise granted to Mr. Jonathan T. Rider by the town of Claverack, Columbia County, for necessary construction for the furnishing of electricity for light, heat and motors in that town. It also seeks to enter the territory of the Albany Southern Railroad Company in the city of Hudson, and now has an application before the Hudson Common Council for a franchise to furnish electricity.

The Public Service Commission, Second District, has authorized the Syracuse Lighting Company to issue extension and improvement mortgage 6 per cent ten-year gold bonds to the aggregate amount of $456,000, the bonds to be sold at not less than 98. The proceeds of the bonds are to be used for general extensions and improvements in its gas and electric-lighting service in the city of Syracuse.

The Federal Telephone & Telegraph Company has been authorized to issue $578,000 of 5 per cent bonds upon the security of its mortgage dated March 24, 1909. Bonds to the amount of $364,800 par value may be issued from time to time for the purchase of the entire outstanding issue of bonds of the Niagara Home Telephone Company, amounting to $456,000, upon the express condition that for each and every bond of the Niagara Home Telephone Company so purchased and acquired there will be issued bonds of the Federal Telephone & Telegraph Company to the amount of 80 per cent only of the par value of the Niagara Home Telephone Company bonds, and upon the further condition that there shall be acquired presently from the Niagara company bonds to the amount of $275,000 par value. Bonds to the amount of $64,000 are allowed to be issued for the acquisition and purchase of the entire issued and outstanding capital stock of the Dunkirk Home Telephone Company, the exchange of bonds for stock to be par for par on the condition that there shall be acquired presently of this stock shares to the amount, par value, of $39,000. One hundred and fifty thousand dollars of bonds are to be issued for the purchase and acquisition of the property of the Independent Union Telephone Company, a long-distance line west of the city of Syracuse, including all property and rights of this company in the State of Pennsylvania. This latter purchase is authorized upon the express condition that at the time of the purchase and organization of the properties of the Independent Union Telephone Company and the issue of bonds therefor the Independent Union property shall be free and clear of all liens and incumbrances, etc., and that an absolute and unqualified title in fee be given to the Federal company.

The application of the Oneonta Light & Power Company and the Electric Water Power Company, of Oneonta, for permission to merge the latter company into the Oneonta Light & Power Company has been approved. The Electric Water Power Company was organized for the purpose of generating and distributing electricity, but afterward transferred all its property to the Oneonta Light & Power Company, which is the only company now operating for such service in the city of Oneonta.

The Public Service Commission, Second District, has closed upon its records the complaint of residents of Kingsbridge, Spuyten Duyvil and Riverside against the New York Telephone Company as to toll charges in the Kingsbridge and Marble Hill exchange territory in New York. The commission received a petition signed by practically all of the compainants indicating their satisfaction with an arrangement which had been made with the company and asking that the case be closed.

Wisconsin Commission News.

In the matter of the application of the Brooklyn Telephone Company for authority to increase its rates the Wisconsin Commission has decided that the present rates are adequate for the service now being rendered. The applicant, however, was empowered to put into effect the rates petitioned for at such time as it shall furnish continuous service to its patrons. The principal rates in force at present are as follows: Business telephones, $18 per year; residence telephones, $12 per year. The reasons stated for requesting an increase in rates are that the present rates do not produce sufficient revenue to furnish a depreciation fund, and that the furnishing of a continuous service, as contemplated in the future, will result in an increase of operating expenses. The testimony in the case shows that it has been the policy of the company to set aside a fund for depreciation and to utilize this fund for the purpose of making additions to the property. Furthermore, the company has been able to declare a 6 per cent dividend upon its capital stock practically ever since the company was organized. The commission usually allows a telephone company 7 per cent for interest and from 6.5 per cent to 7 per cent for depreciation. However, in the present case the commission was of the opinion that a substantial increase in rates is not justifiable as conditions are at present, but that the following schedule would be authorized at such time as the company offers continuous service: Business 'phones, $21 per year; residence 'phones, $15 per year.

The commission has authorized the Baraboo Gas & Electric Company to issue 1000 shares of stock of the par value of $100 each and $98,000 par value of bonds. The total issue is to be made to Messrs. Frank R. Glover, T. H. Durst and William Clancy on the completion of the organization of the Baraboo Gas & Electric Company to take all the property, rights and privileges of the Baraboo Electric Company which were acquired through a foreclosure sale. The total outstanding indebtedness of the latter company at the time of the foreclosure sale was $198,000. All of the outstanding bonds were owned by the incorporators of the Baraboo Gas & Electric Company. The commission has made no valuation, as the matter is one of reorganization only.

The Manitowoc Gas Company has been authorized to issue $2,500 par value of 5 per cent bonds for the purpose of paying 80 per cent of the cost of the enlargements and extensions of the company's property, for which payment the bonds are applicable under the terms of the trust deed, held by the Merchants' Loan & Trust Company of Chicago. The bonds are to be sold for money only and for not less than 75 per cent of the par value.

Testimony has been taken in the matter of the rates and practices of the Southern Wisconsin Power Company. This investigation has been carried on at the commission's own motion and concerns primarily the maximum loads which the company has arbitrarily assigned to the various cities and villages taking power from its transmission lines between Kilbourne City and Milwaukee. These arbitrary maximum loads constitute the basis upon which the demand charge is fixed, and there appears to be a doubt in the minds of the commission as to their equitableness.

Maryland Commission News.

The Maryland Public Service Commission has entered an order authorizing the Consolidated Gas, Electric Light & Power Company to issue 4½ per cent bonds to the amount of $844,000. Under the terms of the order the minimum price of the bonds is fixed at 92. The money to be derived from the sale of the securities will be used for the acquisition of new property and to discharge certain outstanding obligations of the company. The petition filed by the company states that $82,263 is needed for the Westport electric plant. Other large amounts are needed for substations, among them $79,565 for Arlington, while $60,000 will be used to refund bonds of the Brush and Edison companies that the present concern has bought out. The company also proposes to pay $262,000 of its floating debt out of the bond issue.

The Peters Wagon Works Company has filed a second complaint, asserting that the Consolidated company has demanded that the wagon company shall substitute direct for alternating current and remove its alternating-current motors at its own expense. The alternating current now in use is, it is claimed, especially well adapted to the business, and was substituted for the direct-current system which had been used until ten months ago. Willingness is expressed to have the direct-current system replaced, provided the Consolidated does the work at its own expense. The commission is requested to investigate the matter and order the lighting company either to supply the wagon works with new service or continue to furnish direct current.

Ohio Public Utility Bill.

The conference committee of the two houses of the Ohio Legislature has been hard at work during the recess on the preparation of a public utilities bill that will be acceptable to both, and early in the week the indications were that it will be ready for consideration when the session is resumed for the closing business.

In the agreement upon a basis for fixing rates the Wisconsin law was followed closely. Instead of the market value of the stocks and bonds being taken into consideration the actual property value will be taken as a basis, due regard being given to the necessity for the establishment of surplus, depreciation and contingency funds. Natural-gas and some other companies objected to this method and urged that companies should have a wide range in fixing rates, so that they might continue to do as they have in the past on the expiration of franchises.

In order to forestall the possibility of entering into contracts at a high rate for service that will be continuous because of their terms, the bill provides that the Public Utilities Commission may have power to terminate any contracts which are of themselves terminable. This, it is believed, will place all utilities entirely under the control of the commission in this respect.

Trouble was encountered in complying with the home-rule idea in making rates for utilities. Many of the cities have insisted that the Legislature must not take out of their hands the privilege of making contracts as to rates. In order to cooperate with the municipalities a majority of the members of the committee are in favor of leaving the matter with them, subject to an appeal to the commission by either party.

The bill will declare telephone companies common carriers, and all consolidations will be placed under the control of the commission, which will be absolute in the matter of agreements, contracts, leases and other forms of combination. Physical connections must be made between localities, but not within municipalities, except for long-distance purposes. This provision is so formed because of the belief that each municipality will have but one exchange within a short time after the law goes into effect.

The commission will have power to require joint use of poles, wires, tracks and other equipment within a municipality when necessary to the public convenience, on condition that such requirement does not work an irreparable injury to the company upon which such demand is made.

Companies furnishing a continuous service may establish a minimum rate. This provision is especially applicable to gas and electric-light companies, and was inserted as a kind of compromise with the gas companies, which had insisted upon many things they did not get. Members believe that some charge should be made for being in position at all times to furnish a service, even if the service is not used for certain periods or is used to such a slight extent that the rate will not cover the expense of maintaining the equipment.

Massachusetts Legislative News.

The committees on railroads and metropolitan affairs, sitting jointly, have reported a bill in favor of the Boston & Eastern Electric Railroad Company, declaring that public necessity and convenience require the construction of the road. The act also provides that it shall become void unless the company files a bond for $100,000 within thirty days, and within 160 days the Railroad Commission must be petitioned to fix the detailed route. An alternative is provided that within sixty days the company shall file a bond for $400,000 with the State so conditioned that upon the beginning of the work at least 10 per cent of the capital stock shall be expended. In case of the default of the company the bonds will be forfeited to the State. Upon meeting the conditions of either of the bonds the directors may be reimbursed by certification of the Railroad Commission.

New Hampshire Public-Utilities Law.

The new public-utilities law of New Hampshire, which was approved by Governor Bass on April 15, contains a number of unusual provisions.

No person who owns stock in any railroad in the State or elsewhere, or in any utility in the State, or who is employed by any such company, or otherwise pecuniarily interested therein, shall be appointed upon the Public Service Commission. If any commissioner shall become voluntarily interested pecuniarily in any such company he shall be removed as for malfeasance in office, and if he shall become so interested otherwise than voluntarily and shall not within a reasonable time divest himself of such interest he shall be so removed. The Governor and Council may remove any commissioner for inefficiency, neglect of duty or malfeasance in office after a hearing.

No commissioner shall render any professional service for any railroad in New Hampshire or any other state, or for any public utility in the State, or act as attorney, or render professional services against any such company, or be a member of a firm rendering any such service, nor shall he be a party to any contract with any such company, except for the transportation of telephone or telegraph messages, or passengers or property, or the purchase of water, gas or electricity, or other similar service. No commissioner shall hold any national or other State office of profit except the office of justice of the peace or notary public.

Witnesses summoned before the commission shall be paid on the same basis as witnesses summoned before the Superior Court. Any witness who refuses or neglects to appear, or refuses to testify, may be compelled to do so and for that purpose the commission may apply to any justice of the Superior Court for an order returnable in not more than five days directing the person to show cause why he should not be committed as for contempt. If the justice shall determine that the person refused without reasonable cause or legal excuse he may commit the offender as for contempt, so to remain until he submits to do the act which he was required to do or is discharged according to law. No person shall be excused from testifying or producing any book or paper when ordered to do so by the commission upon the ground that his act would incriminate him or subject him to penalty or forfeiture, but no person shall be prosecuted for any act concerning which, after claiming his privilege, he shall by order of the commission have testified or produced evidence. It is provided, however, that no person shall be exempt from prosecution or punishment for perjury in testimony.

The new commission assumed charge on June 1, 1911, of the powers and duties of the present Board of Railroad Commissioners. The commission is to have general supervision of all utilities so far as necessary to carry into effect the provisions of the act. It is to have power to investigate and ascertain from time to time the methods employed in manufacturing or supplying electricity for light, heat and power, and after notice and hearing to order all just and reasonable improvements and extensions in service or methods.

Whenever it deems it advisable the commission may establish a system of accounts and records for public utilities, and prescribe the manner in which the accounts shall be kept. Every utility shall file and print and keep open for public inspection schedules of rates in such places, form and detail as the commission may order. Unless the commission orders otherwise, no change shall be made in rates except after thirty days' notice to the commission and such notice to the public as the commission shall direct. Whenever any schedule of higher rates shall be filed the commission may investigate the reasonableness of the proposed changes, and pending such investigation may suspend the schedule for such period not to exceed six months as in its judgment may be necessary.

If any utility neglects to file a report within the time specified by the commission or to make specific answer to any question lawfully asked $100 shall be forfeited for each day of default. The commission of its own motion may investigate any act done or omitted to be done by any utility, and shall make such inquiry in regard to any act done or omitted to be done in violation of any provision of the law or order of the commission.

No utility shall transfer or lease its franchise, works or system, or any part thereof, to any other person or corporation, or contract for the operation of its works and system, until the commission shall give its assent thereto by order. No utility shall directly or indirectly acquire the stock or bonds of any other corporation incorporated in or doing business in the State, and engaged or preparing to engage in the same or similar business, unless so authorized by the commission. Nothing in the act shall prevent a utility which is the owner at the time of the passage of the act of the majority of the stock of any other utility or is licensed to operate such other utility from acquiring the balance or all of the outstanding stock of the other utility. Every contract for transfer of any stock in violation of this section shall be void.

Whenever it is necessary to construct a line, extension, etc., over the land of any other person or corporation, or it is necessary for a utility to acquire land for a necessary extension, and an agreement cannot be reached with the owners as to the necessity or the price to be paid, the utility may petition the commission for rights and easements or permission to take such lands as may be needed, and the commission thereupon shall determine the necessity and the compensation and shall render judgment accordingly. Any person aggrieved by an order of the commission awarding damages may file a petition in the Superior Court and have the damages assessed by a jury.

No utility shall issue stock, bonds, notes or other evidences of indebtedness payable in more than twelve months after date without first procuring an order of the commission. The commission upon petition shall determine the amount of stock or bonds reasonably requisite for the purpose. No utility shall apply the proceeds of such issue to any other purposes than those specified in the order. Accounts showing in such detail as the commission requires the disposition of the proceeds shall be filed.

Whenever a utility shall increase its stock it shall offer the new shares proportionately to its stockholders at such price, not less than par, as shall have been determined in the vote for the issue. The determination by the commission of the amount of stock reasonably requisite shall be based upon the price at which the stock is offered to stockholders. The commission shall refuse to authorize any particular issue if in its opinion the price fixed is so low as to be inconsistent with the public interests. When an increase in stock does not exceed 4 per cent of the existing stock the directors, without first offering it to the shareholders, may sell the new shares by public auction at not less than par for cash.

Whenever the commission shall be of the opinion that a utility is failing to do or is about to fail to do anything required by law or by order of the commission, it shall have authority to lay the facts before the Attorney General and to direct him immediately to begin action in the name of the State praying for relief by mandamus or injunction or otherwise.

Any order of the Superior Court suspending an order of the commission reducing rates shall provide that the utility affected shall keep such accounts as shall show the amount collected in excess of that amount which it would have received if the order had not been suspended, and that any such excess shall be impounded within the State or paid into court. Whenever there is occasion after final decision for the distribution of said excess, any violation of the order of the court providing for the repayment of the excess may be punished as a contempt of court. In all trials, actions and proceedings growing out of the authority granted to the commission the burden of proof shall be upon the party adverse to the commission or seeking to set aside its determination or order to show by clear and satisfactory evidence that the order is unreasonable or unlawful.

REPORT OF THE NEW YORK CONVENTION OF THE N. E. L. A.

President Freeman's N. E. L. A. Address.

In his address before the National Electric Light convention President W. W. Freeman reviewed in detail the work of that body during the past year. During that period 3500 members were added, making the present total membership more than 8500, and President Freeman stated his belief that there is nothing to prevent continued growth at a rapid rate for several years to a membership of perhaps 25,000. He pointed out that as the complexion of the organization changes new methods of procedure must necessarily follow. Opinions differ as to the urgency or desirability of radical changes, but all agree that in the natural evolution of the organization there may arise an imperative need for changes which it is not too soon to anticipate and carefully consider. With individual membership added in blocks of thousands, each having a direct interest in all that the association does, the problem of meeting *en masse* annually increases. Unquestionably there is inspiration in a large meeting, but there is a certain disadvantage in the loss of individuality and free discussion such as is possible only in smaller meetings. The holding of frequent parallel sessions between general sessions offers some solution for the time being, but these meetings, in turn may become unwieldy. As the geographical sections multiply in number and in activity it is probable that the conventions of these sections can cover satisfactorily much of the important educational work now being performed by the national organization and at less inconvenience and expense to the local companies. It has been seriously suggested that ultimately, and perhaps shortly, the national convention should be limited to a given number of representatives of the member companies to discuss particular questions of policy and issues of common interest without reference to details of engineering and commercial practice, which subjects could then be treated in the conventions of the geographical or other sections. On the other hand, the policy of national special sections has been urged for the standardization and exchange of principles and experiences concerning special lines of work, such as the present Commercial and Power Transmission Sections, it being pointed out that geographical sections are generally too restricted to furnish comparative experiences to both the large and small companies.

It is probable, President Freeman stated, that neither the one nor the other plan would alone meet the situation fully, and, under the authorization of the constitution, both ideas are in operation and working toward an ultimate solution of the problem. Referring to company sections President Freeman said that experience has shown that the company-section idea has proved sound and successful wherever it has been given a fair trial, and the great growth of membership in such sections has clearly demonstrated their desirability and permanent usefulness. The provision for geographical sections is also steadily growing in favor. The division of membership into geographical sections is the logical method of sub-organization for much of the work of the association. The existence of separate state associations is an evidence of the need for territorial organization, but since many if not practically all the member companies of such associations are already members of the national body the separate organizations generally involve additional and unnecessary effort and expense. The plan is to consolidate effort in the one general organization, having such subdivision as may be necessary or wise, and thereby meet all needs, whether local, geographical or national, at a minimum of expense and effort and with a maximum of efficiency and influence.

Reference is made to the national special sections of the association now organized, namely, the Commercial Section and the Power Transmission Section. The latter, President Freeman stated, has made its influence felt in the discussion of public questions of special importance to the central-station industry, notably in the public conference held in New York on April 8. There is reason to believe that the national administration and Congress will welcome reliable information bearing upon the proper utilization of water-powers, and President Freeman believes it to be the duty of the association to facilitate in any proper way the adoption by the national government of a policy of conservation which shall be reasonable and economically sound.

Referring to the report of the public-policy committee, President Freeman said that its group of welfare policies will place the association in the forefront of modern industrial advance. In addition to preparing its report, the committee, he said, had given attention to numerous matters of policy which have arisen during the year.

In referring to the work of the accounting committee, its classification of accounts was praised. President Freeman said that the value of the system of accounting which it had formulated had been recognized through its adoption not only by many central-station companies, but by certain of the public-service commissions. The member companies were urged to take full advantage of the standard system which had been devised, especially since the general adoption of such a standard by the lighting companies will continue to be influential in obtaining its adoption by commissions and regulating bodies throughout the country.

In conclusion President Freeman said that probably no other industry has equaled that of electric lighting in attracting so many men of talent and enterprise, and in imbuing them with the conviction that theirs is the best business in the world and holds out the largest opportunities for advancement and reward. Great as has been the history of the first quarter century of the business, he believes that the industry has only been started and that past achievements are but the promise of future accomplishments. The business is one of action and growth, and the man who stands still in it is certain to be left behind as the procession moves, whereas the man who studies and works and advances can find new roads to success and ample help on the way.

RELATIONS OF CENTRAL-STATION COMPANIES WITH THEIR EMPLOYEES.

REPORT OF THE N. E. L. A POLICY COMMITTEE AND ITS DISCUSSION

To say that the presentation of the report of the public-policy commission of the National Electric Light Association and its discussion at a special meeting in the New Theater on Wednesday evening constituted the leading event of the New York convention does not imply any lack of strength in the other entries on the program of the week. The program of the meeting was, in fact, better balanced and the papers, on the whole, of greater intrinsic worth than at any previous convention in the history of the body. But the report of the committee on policy dealing with relations of central-station companies with their employees exhibited such breadth of view and liberality of spirit as to constitute it a document of national importance which promises to have an influence extending far beyond the industry to which its recommendations directly relate.

The committee which prepared the report consisted of the following members of the association: Mr. Charles I. Edgar, president of the Boston Edison Company, chairman; Mr. Arthur Williams, general inspector of the New York Edison Company, secretary, and Messrs. Nicholas Brady, vice-president New York Edison Company; Everett W. Burdett, counsel Boston Edison Company; H. M. Byllesby, H. M. Byllesby & Company, Chicago; Henry L. Doherty, H. L. Doherty & Company, New York; W. W. Freeman, president National Electric Light Association and vice-president Brooklyn Edison Company; Gen. George H. Harries, vice-president Washington Railway & Electric Company; Samuel Insull, president Chicago Commonwealth Edison Company; Joseph B. McCall, president Philadelphia Electric Company; Samuel Scovil, president Cleveland Electric Illuminating Company; Charles A. Stone, Stone & Webster, Boston. At the special request of the committee, the following gentlemen attended and assisted at the meetings of the committee: Messrs. H. W. Blood, Jr., Stone & Webster, Boston (representing Mr. Charles A. Stone); R. S. Hale, Boston, Edison Company; Thomas E. Murray, president Association of Edison Illuminating Companies and second vice-president New York Edison Company.

Following is given the report, slightly condensed, and a report of its discussion at the special meeting in the New Theater before an audience of more than 3000.

In opening its report the committee says that undoubtedly modern industry on a large scale depends upon three factors, namely, capital, direction—executive and administrative—and labor. All combined and working in harmony are so essential that a partial or dwarfed interest in any one factor would invite absolute failure, or at best make possible only partial success. However, neither the interest of capital nor that of direction has been considered by the committee, excepting in so far as either is conserved by an equitable interest in the welfare of labor. Nor has it been attempted to pass upon the question of wages, other than to express the belief that in the same locality they should be fully equal to those paid by any other employer engaged in similar work. Wages are a local and independent question and in this respect, so far as the committee's knowledge goes, the employees of the industry are treated very generously. The work of the committee has rather dealt with questions such as follow:

(*a*) Are employees, individually or collectively, receiving all of the results of their labor to which they may be properly entitled?

(*b*) Are they adequately compensated in the event of industrial sickness or accident? Do we appreciate and fairly assume the responsibility—moral if not technical—sometimes resting upon us to restore an injured employee to health, or in the event of a fatal accident to provide adequately for his dependents?

(*c*) Do we take sufficient interest in the welfare of our employees when, owing to conditions beyond their control, such as serious sickness, they are in distress and possibly subject to want and deprivation?

(*d*) Are there any available means other than those now employed by which the efficiency of labor can be fairly increased?

(*e*) Can the differences between labor and capital be lessened or removed without decreasing the efficiency of labor?

ECONOMY AND HUMANITY.

Believing that anything accomplished in the solution of these questions possesses elements of sound economy as well as of humanity, the committee realized that its conclusions may not apply with equal appropriateness to all members. It is mindful that differences may exist in different communities, not alone regarding financial resources and the personality of the employees, but in public sentiment. What one may find practicable and profitable, another—equally anxious to accord fairest treatment, and no less mindful of public interest—may find impracticable or impossible of accomplishment.

Upon these questions wide differences of opinion naturally exist. This was originally true in the committee, but consultation with various authorities, consideration of available statistics and the experience of others have enabled it to reach a common and unanimous conclusion. The adoption of the suggestions of the report thus must depend upon the judgment of members individually.

SERVICE ANNUITY

By unanimous vote the term "pension," as being inadequate or subject to wrong interpretation, has been eliminated and the term "service annuity" recommended as a substitute The opinion of the committee is that the latter is to be paid as a form of compensation for a definite service that cannot be rightly included within ordinary wages. It is compensation for continuous service over a period of several years and is to be paid upon carefully prearranged and understood conditions.

WAGES.

As employed in the report the term "wages" is inclusive of both wages and salaries, for in the last analysis the latter is also a wage for a given service. Wages are the sum paid for a given work and should be the same in a corporation whose relations with its employees go far beyond any legal requirements, or with one which does nothing more than meet its technical obligations, or with a private employer. Any contribution for the improvement of an employee's surroundings or of himself should not be construed as affecting his wage in the slightest degree.

NEITHER CHARITY NOR PHILANTHROPY.

The committee felt it important that all suggestion of charity or philanthropy should be entirely eliminated in the establishment of relations between employees and their employers. It is urged that these several forms of relationship be adopted in the sense that the employees are to get only that which they earn, that what they receive is the result of rendering service as well as of performing work—oftentimes two entirely different phases of industrial employment.

Were a word of explanation needed it might be pointed out that an employee performs his technical task for a definite wage; in addition he can, and often does, render his employer service by working continuously and in exercising a degree of devotion which affects not only his own work, but that of all other employees associated with him. Thus in continuous service, with other advantages, we have enhanced efficiency: with increased devotion to his employer "soldiering" becomes lessened or eliminated: in a more careful utilization of tools and materials still other economies and efficiency may be expected.

It is to secure this added service that the committee has endeavored to find a form of compensation reasonable and mutually satisfactory. This it believes has been accomplished in the recommendations of its report. Further, that in this (*a*) there will be inevitably larger resultant efficiency and economy, though not necessarily apparent statistically, and (*b*) that expenditures devoted to these purposes are justified as elements in the cost of service, and would be so considered by legislative authorities, public-service commissions or others passing authoritatively upon the subject.

The suggested forms of relationship include (1) accident insurance, (2) sickness insurance and death benefits, (3) service annuities, (4) profit sharing, (5) employees' savings and investment funds, and (6) life insurance.

ACCIDENT INSURANCE.

The committee believes that the cost of all accidents inherent to the industry which it represents should fall, not upon the individual employe or his dependents, but upon the industry as a whole. It, therefore, recommends:

(*a*) That when an accident occurs which is clearly without deliberate misconduct, gross carelessness or reckless disregard of consequences on the part of the employee, the entire cost should be borne by his employer, who should assume full responsibility for restoring the injured employee to health as rapidly as possible.

(*b*) That full wages should be continued during illness and convalescence for a period of six months, and at the expiration of six months the wages should be continued at one-half the full wages for life or during disability, unless the "service annuity" to which the employee would be entitled in case of retirement should exceed one-half the wages, in which case the employee would be entitled to the "service annuity."

(*c*) That in the event of partial disability proportional payments should be made to compensate, either wholly or partly, for the employee's decreased earning capacity, if there be any.

(*d*) That in the event of death from accident within the service, the payment to which the employee would be entitled in the event of total disability shall be continued: (1) To his dependents, should there be any, during the employee's expectation of life, under the assumptions of the "American Experience Table of Mortality," or (2) until a widow should again marry, or dependent children reach the age of sixteen years, or to other dependents, such as a father or mother, while they live, with such other provisions as may be applicable in individual cases, but in no event to exceed the deceased's expectation of life under the experience table.

SICKNESS INSURANCE AND DEATH BENEFITS.

This is a kind of relationship which has no connection with industrial accidents or industrial sickness; of the latter, however, there is practically none in the central-station industry. Many members have established associations of this character, and where such organizations do not exist the committee believes it desirable:

(*a*) To organize and, subject to local conditions, to contribute where necessary to employees' co-operative benefit associations.

(*b*) To encourage their harmonious and successful development in every practical way.

(*c*) It is estimated that, assisted by the employing company, co-operative associations can contribute approximately 50 per cent of the employee's wages when sick at a cost of approximately 1 per cent of his wages. Likewise, that a death benefit of from $300 to $500 can be paid with a weekly contribution ranging from 10 cents to 15 cents.

In this the committee omits all detail, realizing that members have had a great deal of experience and believing that it is better for these associations to be organized and conducted, so far as practicable, by the employees in co-operation with the company and the policy that guides its affairs.

SERVICE ANNUITIES.

The committee is of the opinion that member companies should provide a "service annuity" for every permanent male employee who reaches the age of sixty-five years, and for every female employee of sixty years having a continuous and satisfactory record of ten years of service. In this connection the following recommendations are offered:

(*a*) That the entire cost of "service annuity" should be contributed by the company as part of the annual cost of labor.

(*b*) That this is to be the compensation to which the employe is entitled, in addition to his wages, for rendering continuous and satisfactory service throughout his term of employment.

(*c*) Should the continuity of the term be broken by the employee of his own volition the obligation to pay the "service annuity" would cease. The term, both in reference to the minimum period at which the "service annuity" can begin and the percentage upon which the amount shall be based, must then begin with renewed or reinstated service.

(*d*) The possible exception to this rule is where employees are laid off temporarily through no fault of their own. The committee suggests that if this is done by the company an employee's service, when not less than nine months yearly, shall be treated additively in determining the "service annuity." Likewise it is suggested that if employees are temporarily laid off because, say, of the destruction of the power plant or for similar cause, this should not be considered as an interruption in the continuity of service. The point is emphasized that the service of the employee is discontinued through no fault of his own, but for economic reasons within the company.

(*e*) That any employee having a minimum record of ten years of continuous and satisfactory service, and who in the opinion of the company has become unfitted for duty, may be retired at any age and given a service annuity; that any such employee may make application for retirement or that the recommendation may be made by his employing officer.

(*f*) The suggested basis of service annuities is from 1 per cent to 2 per cent of the yearly wages, as may be adopted by the company, for each year of continuous service, based upon the employee's wages during the highest ten consecutive years of employment.

PROFIT SHARING.

The adoption of the principle of profit sharing by members insures a means for establishing closer, more efficient and more satisfactory relations with employees. The following suggestions are offered:

(*a*) That the justification for profit sharing is to secure and pay for service of fidelity and efficiency.

(*b*) That the object is to secure partner instead of employee service, to have our fellow workers partners instead of employees in the accepted sense of the term.

(*c*) That the compensation paid to employees in the form of profit sharing should be considered no part of the ordinary wage schedule.

(*d*) That ordinarily profit sharing should preferably not be paid immediately in cash. Local conditions may control this general rule, and at times special reasons may make payments in cash desirable, as, for example: (1) The purchase of a home. (2) Special circumstances which, in the judgment of those in control of the matter, justify cash payments.

(*e*) That preferably the profits of the employee should reach him in the securities of the company, or, in the case of a subordinate company, the securities of the parent company.

(*f*) That securities for distribution in other than special instances should be secured at the best terms and wherever obtainable. Employee security holders would necessarily bear any reduction and receive the benefit of any advance in values or the rate of income paid.

(*g*) That dividends upon securities acquired through profit sharing should be paid in cash in the manner customary to other security holders and available for any purpose desired by the recipient.

(*h*) The committee emphasizes that one object of profit sharing is to have every employee also an owner. If he does not receive securities this ownership interest may not follow, or if after receiving the securities he sells them his lasting interest is not secured.

(*i*) The committee recognizes that this feature of its plan calls for the largest contribution required in this movement; on the other hand, the economic results promise to be most important and satisfactory in (1) more efficient and permanent service; (2) a tendency greatly to improve the relations between the companies and their employees; (3) the creation of a large number of security holders from the body of employees who will thus have a double interest in the welfare and success of the property.

(*j*) In the distribution of the results of profit sharing the committee desires impartially to suggest two plans, leaving the adoption of either to the judgment of the individual member: (1) Restricting the sharing of profits to employees who, in the judgment of those to whom they are subordinate, render specially efficient service. This means that those who are to become participants in profit sharing must be carefully selected from year to year from the employee forces. (2) Sharing profits alike with all employees having a minimum period of service, say of one or two full calendar years, excepting under very special circumstances.

(*k*) Some favor giving at once the maximum amount to all who are entitled to it, others favor increasing the amount with the service, giving the maximum only after several years have elapsed. The latter method places an added premium upon long service, but between the two methods the committee makes no recommendation, believing that this is a local matter.

(*l*) The committee believes that in sharing profits with employees a dividend should be declared annually which bears a fair relation to the income paid to the security holders, and also that there should be definite relation between the securities and the labor dividend.

EMPLOYEES' SAVINGS AND INVESTMENT FUNDS.

It is evident to the committee that in view of the experience of some of the member companies a material benefit can be obtained by establishing employees' savings and investment funds. Possibly this should be divided into two classes. The first would be simply a savings fund to encourage thrift among employees, under which the deposits would be guaranteed by the company and more than the ordinary savings-bank rates of interest could usually be paid.

SAVING FUNDS.

For savings funds the committee makes the following recommendations:

(*a*) That the security and safe return of the funds be guaranteed by the company.

(*b*) That every convenience be afforded employees to make their deposits.

(*c*) That deposits be made directly by the employee rather than that the company, under other than special conditions, take them from his wages.

(*d*) That to encourage thrift where deposits are permitted to remain for a definite period the company might guarantee something more than the savings-bank rate of interest; that where left for less than a definite period they may be withdrawn under substantially the conditions that apply to savings-bank deposits.

INVESTMENT FUNDS.

The second suggestion is that an investment fund for the employees might be organized with the understanding that the funds shall be invested only in the company's securities. This might be combined with profit sharing and the two work very satisfactorily together. For an employees' investment fund the recommendations are as follows:

(*a*) That the company should assume full responsibility for receiving and accounting for the funds.

(*b*) That the responsibility for the investment of these funds should rest solely upon the trustees and members of the investment fund.

(*c*) That the securities of the fund should be purchased at the best prices obtainable.

(*d*) That the members should understand that the result of their investment might be either a profit or a loss, exactly as these possibilities rest upon every other investor in public-service securities.

(*e*) That every convenience should be afforded for receiving the deposits of the members of the investment fund. The committee thinks it undesirable for the company to make deductions from its employees' wages, excepting under other than very special circumstances; rather should the money be paid directly by the employee to the accredited fiscal officer of the investment fund.

LIFE INSURANCE.

It is suggested that members take the initiative in providing their employees with all possible information in connection with safe low-cost life insurance, but that such insurance should be at the sole cost of the employees.

IN CONCLUSION.

The committee in concluding recommends that any plan adopted for improving the relations between employees and member companies shall include every employee and officer from the office boy to the president, inclusive. It is added that several of the members of the association have already adopted some of the recommendations of the report, and that should any information be desired upon the methods followed or the results accomplished, the secretary of the association will be glad, upon request, to furnish any information in his possession.

PRESENTATION OF THE REPORT.

The report of the public-policy committee was considered in executive session by the association on Wednesday and adopted. It was formally presented to a notable gathering at the New Theater on the evening of that day and was received with evident great interest as a manifestation of that spirit of progress which has made the association and the industry famous.

The circumstances under which the report was given its public expression were in complete accord with the importance and the strength of the recommendations advanced. It was to an audience that was representative of the power of the industry that President W. W. Freeman introduced the subject as the first spokesman of the association. A number of people were present at the beginning of the musical program which preceded the business of the evening, and the seats were filled rapidly until, as Mr. Freeman said, it was a question whether so large an assemblage composed entirely of the membership of the association had been seen before.

In his pleasing introduction Mr. Freeman, speaking for the members of the committee and other leaders of the industry who were on the platform, said that it was very gratifying to greet so large an audience under the inclement weather conditions of the evening. The attendance indicated a keen appreciation of the importance of the subject as well as of the distinction of the speakers of the evening. The subject is presented from the viewpoint of the industry and from the larger point of view of the national welfare. This association does not hesitate to express its views on all questions relating to its employees and the public. It is proud of the business in which it is engaged and proud of its past record. It proposes to put itself on record in a way that shall be commensurate with the record of the past and that shall point to corresponding responsibilities and growth in the future.

The means of communication of the views of the association on these subjects is through the public-policy committee, which is composed of men known throughout the industry and the country and who have the entire allegiance of the membership. The committee has done continuous and invaluable work during the year. It is composed of men who know how to do big things and have the courage of their convictions. This year the committee determined to undertake to do but one thing, and to do that thoroughly. Mr. Freeman added that he was sure that the members of the association would agree that the committee had succeeded in its task. The meetings held by the committee during the year were numerous and extensive in time.

The question may be asked, Mr. Freeman continued, why busy men are willing to devote so much time to matters that are of more interest to the general public than to themselves. The answer is that the industry should take a prominent part in any movement that tends to advance the public welfare. The committee gathered all the information that it could secure upon general welfare work. Its members obtained data and compared results and the committee was prepared to submit detailed and unanimous recommendations which, if followed, should and would place the industry in advance of all others in the country in carrying out reasonable and definite welfare work. The chairman of the committee, Mr. Charles L. Edgar, is abroad on a well-earned vacation, and Mr. Arthur Williams the vice-chairman, secured the consent of a member of the committee to present the report; a member, said Mr. Freeman, who was greatly interested in the association and in the progress of the work during the year, and whose name would be an introduction to the audience—Mr. Samuel Insull.

Mr. Insull read the report in full, as published elsewhere in these columns. He then supplemented the report by a personal positive recommendation for the adoption of the measures advanced by the committee, showing most skilfully and successfully the intimate connection between the text of the report and other problems of the day. Mr. Insull's remarks are published substantially in full below.

When Mr. Insull concluded Mr. Freeman stated that the report had the added influence of formal adoption by the association. It is now given to the public, therefore, as the expression of the association.

Mr. Freeman announced that he and General Harries discussed these questions recently with President Taft, who showed much sympathetic interest in the subject. President Taft was invited to honor the convention with his presence. The extra session of Congress made it impossible for the President to accept, but the Hon. Charles Nagel, Secretary of the Department of Commerce and Labor, was present at considerable personal sacrifice. Mr. Freeman congratulated the audience upon the presence of Hon. George B. Cortelyou, and then introduced Secretary Nagel. Upon the conclusion of Secretary Nagel's address, which is published elsewhere in these columns, President Freeman stated that the recommendations of the committee had been determined by experience to be practical and that every company ought to make at least a start in a welfare policy.

The meeting was then closed.

REMARKS OF MR. INSULL UPON THE PUBLIC-POLICY REPORT.

The only discussion upon the report of the public-policy committee of the National Electric Light Association was contained in the remarks with which Mr. Samuel Insull gave additional emphasis to the recommendations and in the introductory and supplemental remarks of President Freeman.

After concluding his presentation of the report of the committee, Mr. Insull said that, while a number of the members of the association have done considerable in the direction of welfare work, it is perfectly natural that in a business which has grown in a little less than three decades to the enormous proportions which the electric light and power business of to-day shows attention should have been devoted for a number of years more especially to matters of new invention, improvements in efficiency of apparatus, and improvements in the method of conducting our business. But notwithstanding all of the effort that has been bestowed on these various subjects, the financial results, that is to say, the dollars and cents, have really gone to the consumers of electricity throughout the country, to the extent of probably between 90 and 95 per cent of the money that it has been possible to save by these improvements.

The questions of relations to the public and to the communities served and the view taken of the companies by their customers are subjects to which a great deal of attention has been given in the past, and will be given in the future, but Mr. Insull said he knows of no subject that will bring a greater money return than attention to the welfare of employees. Those in the room appreciated the fact that one of the greatest pleasures that can possibly be afforded to men who have the responsibility of directing large enterprises is not the pleasure afforded by the money which they can make for their stockholders, but the pleasure that is afforded to them to do good to their fellows, and to try to leave the world a little better off than when they came into it.

While the sentimental side of this work is very inviting, there is another side of it which has to be considered. As the business is one of monopoly, it has to be operated economically to meet the best interests of the users of service, and such methods must be adopted as will enable them to get the service rendered for the least possible price. If the business is to be operated with due regard to a safe return on capital, it must be run as a monopoly business. In welfare work with employees, consideration must be given to the fact that as the business is a monopoly business companies are subject to regulation of rates. That regulation may come in the shape of action by the Board of Aldermen, or by a State commission, or from legislators having the power to deal with such matters, or in the shape of an appeal to the courts on a charge of the unreasonableness of rates; and the real, final test of this welfare work will come when it is proposed to include all or most of the matters treated in the report in the cost of service. The cost of the selling price to customers will have to be passed upon by whatever regulating bodies may have jurisdiction.

Continuing, Mr. Insull said he knows of no business where continuity of service is of such great importance as in the central-station industry. It is a business of very great capitalization, in proportion to the yearly turnover. It is impossible to run it satisfactorily so as to turn over the cash capital more than once in five years. There are very few instances on either side of the Atlantic Ocean where such a result has been obtained. The consequence is that the interest and the depreciation accounts are of far greater importance than the wage account, and what is needed, in order to keep down the interest and depreciation accounts, is absolute continuous and faithful service. That can only be obtained by the offer of some incentive beyond the mere wage to which every laborer and every man who works with his hands or brain is entitled.

The subjects with which the report deals are not exclusively association subjects. The industry is not alone in this work. Most of the great industrial corporations in this country are giving a great deal of thought and attention to these matters to-day, and as a result aid very substantially in the welfare work in connection with their business, largely for the reason set forth in this report, and the reasons stated in these remarks. In other countries, a great deal is being done in the direction of governmental assistance and legislative action. Take, for instance, the drastic employees' liability law passed in England, or the old-age pension bills passed in England and Germany, or the compulsory insurance measure with all its complex details as proposed by the British Chancellor of the Exchequer. These are examples of a species of governmental paternalism, certainly with relation to the old-age pensions and compulsory insurance, which could hardly find any favor in this country. It appears to the public-policy committee that it is far better that that work in this country should be done voluntarily, based upon the mutual interests alike of the consumer, the employee and the capital invested. That is the work that it is hoped to start among those who have not taken up the subject. It is not necessary in every case to carry out all the plans suggested in this report. That is not a possibility in a great many cases. It is possible for every one, although it is not possible for all to try all of these schemes, to apply to his own case one of these schemes, or some other scheme. If this is done it will improve relations with the employees. Mr. Insull concluded by saying that he was confident that this would improve relations with the public, and would add to the stability of the securities of the business.

ADDRESS OF SECRETARY NAGEL ON THE PUBLIC-POLICY REPORT.

Secretary Nagel stated that after listening to the report of the public policy committee he accepted the invitation to speak as a double compliment. He represents a department with a very long name—commerce and labor. He is disposed to lay particular stress upon the word "and" in that title, because he believes that the more closely commerce and labor can be associated and made of mutual advantage, the better off this country will be. He is the beneficiary of the work that was done by Mr. Cortelyou in laying a foundation for that department. There is not a day in which he does not find the results of Mr. Cortelyou's labors when that foundation was laid, and he is doing the best he can to pursue it in that spirit and to develop the vast interests represented by it harmoniously with each other.

The national government sustains no immediate relation to the question under consideration, certainly not so immediate a relation as some may suppose. The department has to do largely with the making of investigations and with reports, in the hope that the knowledge which is thus distributed may be gradually accepted by the states to shape legislation and their course and may be accepted, indeed, by private and quasi-public organizations for their guidance.

After listening to the report Secretary Nagel said he was encouraged to believe that in many respects it will be possible to do without the co-operation of the state authorities and to rely upon the best motive power for any community, namely, private initiative and enterprise, for mutual well-being.

The country has been tardy in recognizing the dangers that have lurked in the situation with which the association now has to deal. We have permitted ourselves to believe that everything must come to us and that we need not grapple with the social and economic problems that have disturbed other countries. We permitted the old doctrines to rule and rejoiced in our prosperity until a condition of things arose that no fair-minded man could tolerate. Take any one of the subjects to which reference has been had and it will be recognized at once that the positions are not acceptable to an enlightened man. Take the mere case of accident. Every business man, every honest lawyer, knows that we have permitted old rules to prevail that did not meet enlightened modern standards. Our courts were crowded with damage suits and we were wrestling and fighting with antiquated doctrines to the injustice and the injury of men who deserved a better protection.

Secretary Nagel added that he did not believe in over-legislation, but he believed that when there is complaint the best way to cure it is to take the sting out of it. Too tardy recognition of demand for normal improvement had been the greatest breeder of radical legislation. There were men who recognized this; there were interests that recognized this; there were large employers who were making changes; there were large concerns that never had damage suits. For twelve or fifteen years, one that employed from 3000 to 4000 men never had a damage suit, and made money for the employees and for itself. That stood to reason. There were larger concerns that were adopting modern methods, based upon the mutual interest of employer and employees. But they were not noticed. The courts were crowded with the old litigation, according to the old crude forms, and that was the feature that attracted attention. Much was heard about publicity; but the trouble about publicity is that it gives a distorted picture. We are not half so bad as we are made out to be. The Secretary believes in being sanguine and hopeful, and thinks that we are a pretty good people as we are. But vice is apt to find notoriety and virtue is not a good advertiser.

So with all the changes that were coming over us, with all the improvements that men were making; the demand for the modification of our laws was becoming more and more evident. We changed the law in some states as to contributory negligence. We changed the law in other states as to co-employees, and so we went forward, to increase the measure of damages, to fix it in some places, and finally there came the law that in case of accident the employer shall pay absolutely a fixed amount.

That was the first direct response to a condition which had become intolerable.

One cannot live on sentiment, and the employee cannot accept charity and retain his self-respect and his independence as a citizen. Therefore the plan must be built up soundly upon the theory that a man who is well taken care of is better than a man who is neglected.

A good man will do more work in eleven months than in twelve. A man who knows that those who are dear to him have reasonable security will work with a better heart and more fidelity than a man who does not; and that argument can be extended without limit. Secretary Nagel added that he believed in the initiative of the individual citizen, in the avoidance of protection from the state wherever it can be done. A railroad that is able to report that for a whole year, by reason of its own diligence, vigilance and care, it had not a single accident has accomplished more for the community than if it has made the lowest rate that was ever offered as a result of an order from the Interstate Commerce Commission.

These gentlemen had gone very far, although the speaker suspected that there had been progress of one kind or another made in this country that will respond very promptly to the fullness of their claims. Of course they will be asked if they have not undertaken so much that it will be impossible to stop the progress. That, of course, is always the danger in any new, broad scheme. John Stuart Mill said that the greatest results of new legislation are usually those that no one has thought of, and there may be some such experience here.

The Secretary said he was not a radical in the difference of opinion about that at all. As to the constitutionality of the new laws he should be tempted to say that, in his judgment, such laws might be sustained. When the courts decided that the law of contributory negligence can be changed without injustice to the employer, when the courts held that the rule concerning employees can be changed without constitutional injustice to the employer, he, for his part, did not quite see why that same legislature could not, as a matter of constitutional law, say that in case of accident without wilful neglect on the part of the employee the damage of that accident shall be charged to the business in which it happened. That would be his off-hand view, but he regarded that as of minor importance, because ultimately the constitution will not control these questions. If the constitution is strained too long it will yield, either by amendment or by the action of judges who will obey the public will, be that enforced by recall or not. If you strain the constitution too long and demand that it stand for too much, ultimately the popular will in our government will control. So it is a question not of constitutional law so much as it is a question of sound policy—what ought to be done in our country as a matter of law. Some say that we should have no difficulty in adopting principles of this kind as a matter of state legislation, because these things have been done in England and in Germany. In his opinion, that analogy was dangerous. We must not forget that in those countries the subject is approached from the standpoint of centralized power, whereas in our country it is approached from the standpoint of a free republican form of government, and when the state, as a state, undertakes to say arbitrarily that in a matter of contract between two citizens in the event of accident one shall pay without question, in his judgment it extends a protection to one citizen at the cost of another that ultimately will mean more than appears upon the face of that statute. It is a question of policy. When it comes to state mandate, Secretary Nagel would be afraid of it; but for that very reason he hails and congratulates the committee as the representatives of large private enterprises in bringing forward a suggestion and a plan that will solve this great question voluntarily and not by the mandate of state law.

The provisions for payment in case of innocent accident, the provision for sick insurance, death benefit, and service annuity must appeal to every observing citizen.

He did not believe that it is pure altruism but hoped not because if it is to be successful it must be, from a business standpoint, correct.

Edmund Burke said that Lafayette was the strongest man he knew in starting a revolution and the poorest one in stopping it, and these gentlemen may be charged with the same criticisms; but these gentlemen have not started a revolution, but they have taken a long stride toward stopping one.

This country is threatened with a lot of unripe legislation Why mince matters? Every one knows it. We have got to cure our mania. We think everything can be done by law. That is our danger. Some of the laws that we now have upon our statute books and that we cannot repeal because they have become a necessity are as drastic as they are because industry and commerce had permitted conditions to drift until the aggressive and drastic power of the government's arm became absolutely essential.

People wonder at the extent of railroad control. But why wonder, when you reflect what the conditions were that had to be cured? The fact is that conditions have come to such a pass that no shipper, however big, and no railroad, however well equipped, could stand up against the system that had been inaugurated. It had got past the stage of correction or reform by any private power. The rules of the game were false and wrong, and it became necessary for the government to interpose for the introduction of rules of the game that every one would have to mind.

Who can measure the consequence of such a plan?

It would be easy to point to other legislation. We have the Sherman act upon the books, and have been some twelve or fifteen years trying to find out what it means. We think we know now. Four weeks ago there was not a concern engaged in interstate commerce in the United States that knew whether it was guilty or innocent. To-day some of them may not quite know, but they have a way of finding out; and they have just as safe a guide for finding out as any one has in finding out about his own private conduct. There is just one safe rule—when in doubt, decide for the right. Conditions were permitted to drift until the strong arm of the law had to interfere, and it is retarded recognition of a normal demand for improvement that has been the greatest breeder of hasty legislation in this country.

And in contemplating the possibilities of such a situation we must bear in mind that we have to deal not with one government, but with a federal government, and with forty-six or forty-eight individual states, every one of them experimenting at the expense of the situation.

Talk about fair competition! How can two concerns in this country compete fairly, if one of them gets its charter from New Jersey and the other one gets its charter from Kansas? Do they start fair? And that situation might easily be elaborated.

Those are the possibilities and those are the invitations for hasty interference on the part of authorities. The plan outlined, the boldness of it, the clearness of it, the strong backing that it has, is of infinite significance, not only to this industry, but as an example of what may be done and what should be accomplished throughout this country wherever similar conditions exist.

Commerce has been called the pioneer of civilization. That phrase was employed in the early days by one in possession of some valuable charter who went forth to conquer new domains. He put in the entering wedge to get a footing in some foreign country in the hope that ultimately his interests might become large enough to justify his government in backing him with a new territory and thus giving him his first footing to spread the civilization of the home country.

Commerce is the finger of civilization. It has a much larger part to play in its domestic relations, and in that sense this report is of peculiar value in pointing the way to show what can be done, and to demonstrate that the plan is economically true. If this is so no organization can be better fitted to furnish the current, a new light, not only throughout this country, but throughout the world.

ADDRESS BY MR C. A. COFFIN

At a special session on Thursday afternoon, Mr. C. A. Coffin, president of the General Electric Company, was proposed by unanimous vote of the executive committee for honorary membership in the National Electric Light Association, and elected unanimously to that grade by a rising vote. In acknowledging the compliment, Mr. Coffin said:

"The next greatest honor to me would be regular membership in the society, a society which has had my admiration, my confidence, has been my support and help in all times of trouble, in all seasons of business depression, in all times when there seemed to be a halt in the march of electrical progress, as sometimes happens. In such periods of stress, suddenly one of our engineers, or one of our official staff, would get an inspiration from you, the skies would brighten, and we would go on to further work, and effort, and with your help, to a measurable victory. We have appreciated the vast encouragement we have received from you, the inspiration and the constant upbearing, the comradeship, communionship that we have had with all of you."

Continuing, Mr. Coffin said that he had especially one message from the busy and happy, fruitful years, in which his organization has been in such close touch with the Association—namely, that he had often been impressed by the fact that the workers in its field are happy in and satisfied with their particular calling in life. "More than that, you should be proud of it, and above both of these, you should be devoted to it." He said that he often has occasion to compare in his mind the most interesting, fascinating work in which the members of the Association are engaged, with the work in what may be called for want of a better name, the old industries—the regular, the standard industries, and he often thinks that if the question were asked, "Would you exchange the work to which you have put your hand for any of these?" that the answer would come promptly that he would not. "Problems in the electrical field have," he said, "the fascinating charm of chance, the great and supreme inspiration of possibility, and the great satisfaction of extraordinary accomplishment in respect to adopting means to ends, in contributing wonderfully, not only to the comfort, but to that which appeals more to the imagination of mankind, to the luxuries and conveniences of every day life. Particularly can it be said of your calling, your art, that there is nothing in it of the element of hundrum, nothing the history of which was old yesterday, or which will become old tomorrow, or next year. There is a human touch with the household, with the cuisine, with cheerful illumination, with that which appeals to the imagination, especially of the fair sex." He referred to the electrical advertising sign, as a marvel, particularly to visiting foreigner, and said that to Mr. Insull and Mr. Gilchrist and his associates a great debt of gratitude was due for the extraordinary work they have done in that art, which is not confined to the conspicuous element of it, but extends to the practical element in that the electric sign educates the public eye to a much higher degree of illumination, accustoms the eye to greater brilliancy, so that what previously seemed a well-lighted office or home, now requires more illumination.

Transportation, he said, has become the great field of industry in modern civilization, but were a friend to consult him about leaving the field of the Association's work to enter that of transportation, he would say, no. For he would miss the personal touch, the co-operation with every individual citizen, that recompense for struggle and work and achievement, that incident to service rendered to a satisfied, responsive community, "in which every citizen whose home is lighted feels that his, and her, and their children's comfort is augmented, their convenience increased, their health preserved, and contentment with life in the city, suburbs or farm, greatly deepened and strengthened. Thus from every point of view members of the National Electric Light Association have occasion to be gratified, profoundly so, with its work, to be proud of it and devoted to it."

In conclusion, Mr. Coffin said that he felt an inspiration in standing before such an assemblage, each member of which represents in his own community the greatest expression of American civilization—there is no luxury greater, no convenience handier, nothing that meets more fully the wants in the everyday life of any community than that afforded in all the various applications of electricity already made, and still others yet to come. "I want to congratulate you all, and I never forget to congratulate myself and my associates, that we have in the members of the Association the support which has been a source of strength for so many years, who are carrying in a way our banner, doing our work, are achieving sometimes triumphs the credit for which unjustly comes to us; and I want you never to forget, and I have said it in your presence before, that we fully appreciate the duty that we owe you, for the work you are doing in our behalf, the problems you solve for us, and the suggestions and improvements which you are quicker to make than are we."

General Report of the Convention.

THE convention of the National Electrical Light Association, held in New York City, was phenomenal in many respects. It was certainly the most successful ever conducted by the organization, and in point of attendance surpassed the convention held last year in St. Louis by over 2500, the total registration being 5149.

During the year the association has enjoyed most unprecedented growth, the gross gain in new members during the year being 3919, and the total membership at the present time being in excess of 8800. Five geographic sections affiliated during the year and company sections were formed in five cities. In point of numbers the company sections represent over 62 per cent of the entire organization.

There were over eighty entries listed on the program, necessitating three simultaneous meetings. The sessions were held in the main auditorium, north assembly room and south assembly room of the Engineering Societies Building on West Thirty-ninth Street. This structure is the finest of its kind in the world. The main auditorium has seats for approximately 1200 persons, and the other meeting rooms were ample for the purpose. Never before have sessions of the association been held under such ideal conditions.

The registration of members and distribution of badges and papers followed a carefully arranged plan. The entire east side of the lobby was occupied by a counter subdivided into sections for this purpose. On the north side of the lobby were the headquarters of the membership committee, stenographer, transportation committee and the public telephone stations. Beyond the telephone room were three elevators, providing rapid service to the main auditorium and gallery and to the two meeting rooms on the fifth floor, one having accommodations for 600 and the other for 450. A check room was located on the second floor. The offices of the association are located on the eighth floor of the building, and on the sixth floor there was a catalog display of the exhibition committee. The headquarters sub-committee on theater tickets was also located on the sixth floor, and in an assembly room on this floor were the headquarters of the New England, Pennsylvania and Eastern New York Sections and also of the Sons of Jove. Through the courtesy of the New York Telephone Company local telephonic communication was provided gratis to members wearing the badge of the association.

Entertainment features in abundance were provided for the guests and members, as noted elsewhere in this report. The public policy meeting at the New Theatre on Wednesday evening brought out a most enthusiastic crowd, as befitted the presentation of a report considered to be the most thoroughgoing and far-reaching effort yet made by any large body of employers in this country to reduce friction with employees, and to inspire the devoted service which springs from good feeling. Mr. John F. Gilchrist was elected president of the association at the closing session on Friday afternoon.

FIRST GENERAL SESSION.

The convention was called to order at 10:20 a. m., after which President Freeman introduced Hon. John Purroy Mitchel, president of the New York City Board of Aldermen. Mr. Mitchel said that the City of New York seldom had the opportunity of welcoming the delegates to a convention so truly national in scope. He referred to the electrical industries as factors in municipal comfort, wealth and progress, but said that the progressive economic principles and enlightened social ideals toward which the body is striving lent most interest to the event. The convention, he said, promised to be epoch-making in the electrical industry, owing to the probable adoption of plans calculated to place the business represented in the forefront of civilization and economic progress.

After responding in proper terms to the welcoming address of Mr. Mitchel, President Freeman presented his annual address, an abstract of which is printed elsewhere.

Vice-President John F. Gilchrist, of the Commonwealth Edison Company, Chicago, in the chair, appointed a committee to consider the president's address, consisting of Mr. H. M. Byllesby, of Chicago; Mr. A. A. Dion, of Ottawa, Can., and General George H. Harries, of Washington.

Mr. Arthur Williams, chairman of the entertainment committee, then reported the arrangements made for entertainment during the convention. President Freeman referred in high terms to the work of the entertainment committee, after which Mr. H. H. Scott presented the report of the committee on membership, which showed a total membership of 8665 and a net gain of 3143 since the last convention. Mr. T. C. Martin then presented his report as secretary, which, with the report of Mr. Scott, is abstracted elsewhere.

Mr. W. H. Blood, Jr., then presented his report as insurance expert, which showed that, as the result of action taken by the association last year, reductions in fire insurance had been obtained by many companies.

OVERHEAD-LINE CONSTRUCTION.

The preliminary report of the committee on overhead-line construction was then presented by Mr. Farley Osgood, of the Public Service Electric Company, Newark, chairman. Mr. Osgood referred to the great labor in securing harmony with respect to specifications for overhead crossings, but finally the various conflicting interests were brought to agreement. One thousand copies of the complete report had been sent out for criticism, but the replies brought up very few questions that had not been discussed in meetings of the committee; consequently the report was in condition to be offered for final adoption. An abstract of the report and its discussion is printed elsewhere.

Mr. John L. Bailey, of the Baltimore Consolidated Gas & Electric Company, presented, as chairman, a preliminary report of the committee on uniform accounting. The full report was considered at a later meeting of the accounting section, an account of which appears elsewhere. Mr. T. C. Martin presented his report on progress, an abstract of which is given elsewhere, which was followed by the paper of Mr. Paul Lupke, of the Public Service Electric Company, Trenton, N. J., on "Master and Man," abstracted elsewhere. After the presentation of Mr. Lupke's paper President Freeman stated that the subject which it dealt with would be discussed at a meeting of the public-policy committee at the New Theatre on Wednesday night.

PRESENTATION OF PORTRAIT OF MISS BILLINGS.

Mr. W. C. L. Eglin, of the Philadelphia Electric Company, then presented, on behalf of Mr. H. L. Doherty, a portrait of Miss Harriet Billings, assistant secretary and treasurer of the association. In his remarks Mr. Eglin asked the association to look back for a moment at the time when it was very much younger. About twenty years ago all of its work was practically carried on by two persons, namely, Miss Billings and the president, and the great bulk fell to the former. Miss Billings in addition engaged actively in all of the work of the committees and edited the *Transactions*, which stand as the best record of the work of the association, while their editing is one of the best records that could be left by any person. Miss Billings also had the faculty of inspiring confidence and enthusiasm in the work of the association on the part of its members, and her many sacrifices and her unselfish work should always receive the heartiest appreciation. With her portrait in the headquarters of the association, there will always be something to remind one of his duties to the association and encourage him to give his best when working for it.

In accepting the portrait, President Freeman regretted that Miss Billings was not present, which was due to an apprehension that the strain of meeting so many old friends would be unwise for her to bear. Upon motion of Mr. Paul Doty, seconded by Mr. Samuel Insull, a telegram was sent to Miss Billings on behalf of the association expressing its high appreciation of her work. The general session then adjourned.

THE QUESTION BOX.

At the opening of the second general session on Tuesday afternoon Mr. M. S. Seelman, Jr., of the Brooklyn Edison Company, presented his report as editor of the Question Box. Mr. Seelman strongly recommended that, instead of having the work on the Question Box done by a member company through one of its employees, provision should be made for carrying it on in the office of the association by a thoroughly competent man.

A report then followed of the committee on Question Box revision, Mr. Alexander J. Campbell, New London Gas & Electric Company, chairman. Mr. Campbell stated that the material is now in the hands of the printer, and the book will soon be issued. Owing to the fact that in the revision the editors were limited to the questions and answers in the past issues of the Question Box, the work is not as adequate as it otherwise might have been; they felt, however, that the revision is merely the first step toward the issue by the association of a comprehensive handbook covering all phases of engineering and operation connected with central-station work. The committee joined in the recommendation of the editor of the Question Box, that the association should engage the services of a competent man to issue the *Bulletin,* including the Question Box.

LIBRARY COMMITTEE.

Mr. Arthur Williams then presented the report of the library committee, which included a recommendation that the association shall make an annual appropriation for the purpose of adding to the library of the Engineering Societies in the same building books of value to the association, which otherwise would not be found in the library. He thought it would be better to do this than for the association to build up a complete library of its own.

HANDBOOK COMMITTEE.

The report of the committee on the "Electrical Solicitors' Handbook" was submitted by Mr. Arthur Williams, chairman. It was stated that the new edition has been considerably expanded, particularly in sections relating to illuminating engineering, with many additions to sections on the electric vehicles, and on load and diversity factors.

After presenting his report Mr. Williams stated that the New York Edison Company is planning an educational course, one of the important features of which will be to make solicitors familiar with the handbook, for it is believed that any one who thoroughly understands the handbook becomes from that very fact a competent solicitor. He objected to having the handbook increased in size, in which he was supported by Mr. C. N. Duffy, of Milwaukee. Secretary Martin suggested the issue from time to time of supplements to the handbook in order to keep it up to date without a revision requiring reprinting. This gave rise to some discussion, some members approving and others disapproving of the idea, and the matter was finally submitted to the committee for consideration.

Mr. E. A. Edkins, of Chicago, presented a paper on "Company Sections and Company Section Bulletins." After sketching the history of the bulletin idea, he gave an account of the various central-station bulletins that have been published in the past and are now being issued, and pointed out the great benefit in the publication of bulletins by company sections.

AWARD OF DOHERTY GOLD MEDAL.

Mr. W. C. L. Eglin, of Philadelphia, chairman of the Doherty gold medal committee, then made his report of award of the medal offered by Mr. Henry L. Doherty about a year ago for the best paper presented at a company section meeting. Mr. Eglin stated that twenty-nine papers were received from various company sections, from which three were selected as of highest merit, and upon further examination the committee was unanimous in reporting in favor of a paper by Mr. Charles J. Russell, of the Philadelphia Electric Company, having for its subject "Load and Diversity Factors." President Freeman then presented the medal to Mr. Russell, who in appropriate terms acknowledged the honor conferred upon him. Mr. Russell said that when the paper was prepared there was no though of submitting it for an award, and, in fact, at the time the medal had not yet been offered. The sole object of preparing the paper was to stimulate discussion and the study of subjects of high economic importance to every central-station man. In reply to an inquiry, President Freeman stated that Mr. Doherty desires to make a similar offer of a medal annually.

Following the presentation of the Doherty medal there was a general discussion on company sections and company section bulletins, in which subjects the greatest interest was manifested. An abstract of the discussion will be found elsewhere in this issue.

FIRST TECHNICAL SESSION, TUESDAY AFTERNOON.

At the first technical session, held on Tuesday afternoon, two reports of committees were submitted for discussion and three papers were read. Mr. F. M. Tait, of Dayton, presided.

METER COMMITTEE REPORT.

The meter committee, of which Mr. G. A. Sawin, Newark, N. J., was chairman, submitted a report divided into two distinct parts. In the first part were recorded the practices of various operating companies and the improvements in constructive details introduced by various manufacturing companies. The second part was devoted to the meter code, which was recommended for adoption by the member companies.

The paper was discussed by Messrs. H. H. Lyon, Buffalo; Alfred Herz, Chicago; S. G. Rhodes, New York; L. F. Mowry, Providence; A. G. Strickrott, Schenectady, and G. A. Sawin. Mr. Mowry claimed that for use in meters having an unbalanced retarding torque giving a side thrust on the bearing sapphire rings can advantageously be employed with the cupped diamond bearing. Mr. Rhodes remarked that the friction with this arrangement might be quite as great as with the deeply cupped diamond bearing. Mr. Sawin stated that some companies follow the practice of re-cupping the bearings at each inspection in order to avoid excessive friction.

REPORT ON GROUNDING SECONDARIES.

Mr. W. H. Blood, Jr., Boston, as chairman of the committee on the grounding of secondaries, submitted a report in which attention was called to the present unanimity of opinion as to the advisability of grounding secondary alternating-current circuits, the only difference of opinion now existing being with reference to the limiting voltage beyond which grounding should not be carried. The committee recorded its unanimous opinion that it is unwise to ground circuits operating at an emf in excess of 150 volts.

The discussion was participated in by Messrs. Farley Osgood, Newark; H. L. Wallau, Cleveland; H. A. Holdrege, Omaha; Alfred Herz, Chicago; P. M. Lincoln, Pittsburgh; C. H. Stevens, Brooklyn; L. F. Mowry, Providence; Paul Spencer, Philadelphia, and W. H. Blood, Jr. Mr. Osgood explained that the fire underwriters have not made the grounding of circuits mandatory because the fire risk is not lessened by grounding, and expressed the hope that the committee of the American Institute of Electrical Engineers, which recommends grounding all circuits having voltages below 250, and the committee of the association, placing the limit at 150 volts, could find a common limit satisfactory to all persons.

PROTECTION OBTAINED BY GROUNDING.

In a paper entitled "Grounding of Low-Tension Circuits as a Protective Measure," Mr. Paul M. Lincoln, Pittsburgh, discussed the conditions under which comparatively high-voltage strains may appear between the low-tension windings and core of a transformer.

The discussion on this paper assumed the form of an oral Question Box. In reply to a question by Mr. J. W. Brown, Brooklyn, Mr. P. M. Lincoln said that the current produced by the condenser relations when the secondary circuit is grounded is very small, as may be appreciated from the fact that the effective impedance of the condenser circuit is many megohms. Mr. Brown claimed that since the current is negligible the effect upon a person who might touch the circuit should not prove fatal and seldom should be disagreeable.

SINGLE-PHASE MOTOR IMPROVEMENTS.

Mr. W. A. Layman, St. Louis, read a paper in which were given outline descriptions of the fundamental principles of operation of two new types of single-phase motors, one being of the constant-speed and the other of the adjustable-speed type.

The characteristics of the motors described were well shown by means of a practical demonstration upon motors of the two types operated under service conditions. The demonstration proved that the constant-speed motor consumes a considerable component of leading wattless current at no load and at a power-factor of 0.96 at full load, and that the adjustable-speed motor can deliver any desired speeds by equipping it with the proper controller. The paper was discussed by Messrs. John C. Parker, Rochester; P. M. Lincoln, Pittsburgh, and the author. Mr. Parker remarked that there are many applications for the adjustable-speed alternating-current motor and expressed the hope that American manufacturers will soon respond to the demand for adjustable-speed polyphase motors, such as are now being made in Europe.

STATION EQUIPMENT FOR MODERN LOAD CONDITIONS.

In a paper entitled "Relation of Modern Load to Station Equipment" Mr. F. D. Newbury, East Pittsburgh, outlined the load conditions which affect the selection of generating equipment for an alternating-current station. He stated that the average operating power-factor of such a station is about 80 per cent. An improvement in power-factor means a lessened kva rating to the generators. Synchronous motors are advantageous in giving control of the power-factor of the system.

In the discussion, which was participated in by Messrs. H. L. Wallau, Cleveland; P. M. Lincoln, Pittsburgh, and F. D. Newbury, the disadvantages of electric spot welding as a station load were pointed out. Mr. Lincoln said that the welding energy should be furnished by a generator driven by an induction motor equipped with a flywheel to minimize the excessive fluctuations in the demands upon the generator as they are transmitted to the supply system.

FIRST ACCOUNTING SESSION.

The accounting sessions of the 1911 convention proved to be one of the most successful features of the business meetings. The attendance was much larger than at any previous sectional meetings, and the success of the papers and the extended discussion which they aroused was gratifying to the officials of the association and the members of the accounting committee. The character of the sessions was indicated by President W. W. Freeman when he stated at the last meeting over which he presided as chairman that the accounting section had the distinction of beginning its meetings first and ending them last.

The first session on May 30 was called to order by Mr. John F. Gilchrist, of Chicago, Ill., at 2:30 p. m. Before the formal business on the program was begun Mr. E. J. Allegaert, Newark, N. J., and Mr. C. N. Jelliffe, New York, were appointed a committee to draft resolutions regarding the recent death of Mr. R. D. Ruhright, of Brooklyn. At a subsequent session a resolution expressing the regret of the association was passed.

UNIFORM SYSTEM OF ACCOUNTING.

The report of the committee on a uniform system of accounting was presented by the chairman, Mr. John L. Bailey, of Baltimore, Md. The committee is endeavoring to interest more members in the standard classification, and will make several efforts to secure its adoption by companies and State commissions. Already the Maryland Public Service Commission has formally adopted the system. The committee also recommends the establishment of a statistical bureau and the adoption of standard forms Discussion upon the report was opened by Mr. H. M. Edwards, of New York, who stated that the statistical information would be of the greatest value to both large and small companies. This can be interchanged in such a way that names of individual companies can be given by mutual agreement, if desired Mr. Frank J. Baker, Chicago, Ill., spoke of the approval of the standard classification by companies in the Illinois Electric Association.

CUSTOMERS' ORDERS.

Mr. R. F. Bonsall, Baltimore, Md., was unable to be present, and his paper on the subject "Handling Customers' Orders" was read by Mr. Douglass Burnett, Baltimore. This emphasized the impression upon customers of the agreements and forms presented for signature when service is desired. In the ensuing discussion particular emphasis was laid upon the advisability of avoiding disappointment to customers because of delay in furnishing service. Mr. Burnett showed that a form of order can take care at one writing of all of the necessary details. Mr. E. M. Podeyn, of Brooklyn, N. Y., said that a customers' bureau has been organized on geographical lines. Mr. W. A. Cox, of Newark, N. J., has a card record of all unfinished work. Mr. R. S. Hale, of Boston, described a special form for customers, similar to a time table, showing the limits within which work may be expected to be completed. Mr. W. H. Rogers, of Paterson, N. J., requires forty-eight hours' notice in the event of removal by some customers, and a deposit in other cases. Others who discussed the report were Messrs. John F. Gilchrist, Chicago; H. E. Neisz, Chicago, and L. A. Coleman, New York.

COLLECTIONS.

Mr. E. J. Bowers, Kansas City, Mo., then presented his paper on the "Collection of Bills." He favors a cash discount for prompt payment. Mr. Daniel Goss, of Boston, believes in net bills with a systematic follow-up policy in charge of collectors. Mr. Geo. E. Burns, of Chicago, has found a discount advantageous in effecting the prompt collection of money. Mr. J. C. VanDuyn, New York, emphasized the fact that the business status of customers may change. Mr. E. J. Allegaert, of Newark, N. J., thought that if a discount was desired 2 per cent or 3 per cent would be ample. Mr. Herman N. Spoehrer, St. Louis, Mo., had found it effective to bond the troublemen. Mr. Frank W. Smith, of New York, said that collectors had been effective in getting into close personal touch with customers and revealing causes of complaints. Others who discussed the report were Messrs. L. A. Coleman, New York; John F. Gilchrist, Chicago; H. M. Edwards, New York; W. H. T. Jones, New York; W. H. Rogers, Paterson, N. J.; Leon H. Scherck, Newburgh, N. Y.; Louis H. Egan, Kansas City, Mo., and W. E. Freeman, New York.

ELECTRIC VEHICLE ACCOUNTS.

Mr. Herman N. Spoehrer of St. Louis, Mo., then read his paper on "Electric Vehicle Accounts as Applied to a Department of a Central-Station Plant." This described the garages of the company, the rates for service and the classification of accounts employed in this department. Mr. J. H. Scobell, of Cleveland, said that business in Cleveland is largely with pleasure vehicles. Mr. W. H. Blood, Jr., was particularly interested in the classification of accounts, and said that the standardization committee of the Electric Vehicle Association is at work upon various matters, including a uniform charging plug for electric vehicles. Mr. Douglass Burnett, of Baltimore, said that the company in that city has established a garage for commercial vehicles. Others who discussed the report were Messrs. E. W. Goedgen, Chicago, and J. W. Brennan, Detroit, Mich.

SECOND ACCOUNTING SESSION.

Mr. F. M. Tait, Dayton, Ohio, called the meeting to order on May 31 and acted as chairman.

TRACING STORE-ROOM MATERIAL.

Mr. John T. Brady, of Denver, read his paper on the subject, "Tracing Store Room Material." He emphasized the importance of the store-room and said that no material should be given out to any official without a requisition. The various points of the paper were discussed in much detail. Mr. E. S. Brock, of Newark, N. J., recommended the bound ledger Mr H. M. Edwards, of New York, asked whether store-room wagons should be under the charge of store-keepers. Mr. F L. Leitner, of Brooklyn, N. Y., said that the substitution of one class of material for another was a great cause of discrepancies. Mr. W. H. Bogart, of New York, described the system of the New York Edison Company. Mr. E. J. Allegaert, of Newark, N. J., had found it advantageous to segregate the appliances and supplies from the regular materials. Mr. J. C. Campbell, of Detroit, Mich., found the card system more flexible and involving less labor than a book system. Mr. W. E. Freeman, of New York, recommended the appointment of a stores inspector to report to the auditor. Mr. C. F. Bryant, Mt. Vernon, N. Y., said that materials could be transferred from one district to another. Mr. J. H. Gulick, of Chicago, Ill., has various calls for material checked at unexpected times. Others who discussed the report were Messrs. William Schmidt, Jr., Baltimore; H. F. Frasse, Brooklyn, and John F. Bailey, Baltimore.

PURCHASING DEPARTMENT.

Mr. T. W. Buxton, of Brooklyn, N. Y., in his paper on the "Purchasing Department" strongly advocated the complete control of purchase and orders by the purchasing department. In the discussion the best means of avoiding double payment of bills were discussed. It was recommended that goods be ordered in the regular way through the purchasing department and that some method of control over the original invoice be held. Mr. J. C. Collins and Mr. E. C. Scobell, of Rochester, N. Y., recommended the uniform bill system. Those who took part in the discussion were Messrs. John L. Bailey, of Baltimore; John T. Brady, of Denver; W. E. Freeman, New York; E. A. Barrows, Providence, R. I.; William Schmidt, Jr., Baltimore; C. F. Bryant, Mt. Vernon, N. Y.; E. J. Allegaert, Newark, N. J.; F. L. Leitner, Brooklyn, N. Y.; J. W. Brennan, Detroit.

JOB COST SYSTEM.

In his paper on "Advantages of a Job Cost System" Mr. A. L. Holme, of New York, described the system of the New York Edison Company. It was agreed in the discussion that the system provides an accurate record of costs, tends to keep the expense within the estimate, and acts as a check on expenditures generally. Those who took part in the discussion were Mr. John L. Bailey, Baltimore; William Schmidt, Jr., Baltimore; J. W. Brennan, Detroit; Paul R. Jones, New York; J. W. Flower, Brooklyn, N. Y.; E. J. Bowers, Kansas City, Mo.; H. M. Edwards, New York; Hermann Spoehrer, St. Louis, Mo.; W. E. Freeman, New York; F. L. Leitner, Brooklyn, N. Y., and J. C. Collins, Rochester, N. Y.

SECOND TECHNICAL SESSION

Although the second technical session was not scheduled to require more than the morning of Wednesday, the discussion on the first report presented was so interesting and prolonged that an afternoon session was required to complete the program. Fortunately the condition of the weather precluded the possibility of carrying out the entertainment program for the afternoon, so that the second part of the session did not conflict with any other arrangements. Mr. W. C. L. Eglin presided.

OVERHEAD LINE CONSTRUCTION.

The report of this committee, of which Mr. Farley Osgood, Newark, N. J., is chairman, contained 195 pages, and was presented in abstract. The work represents three years of labor. The work of previous years has been revised and to it has been added a section covering specifications for overhead crossings of electric wires over railroad right-of-way, tracks or lines of wires, which specifications further apply to electric wires carrying over 5000-volt constant-potential energy crossing or constructed over telephone, telegraph or other similar lines. With so many conflicting interests the report of necessity represents a compromise and is offered by the commitee as embodying the American standard of overhead line construction. It is divided into four sections, the first of which comprises specifications covering methods of overhead line construction for 2300-volt distribution and for street lighting circuits, together with specifications for material. The second section contains specifications covering methods of overhead line construction for secondary circuits, including pole wiring for street lighting work. The third section is made up of an inter-company agreement form and specifications for the joint use of poles by central-station and telephone companies. The fourth section is in reality a joint report of the committee on overhead line construction of the National Electric Light Association, the high-tension transmission committee of the American Institute of Electrical Engineers, the committee on power distribution of the American Electric Railway Association, the committee on high-tension wire crossings of the Association of Railway Telegraph Superintendents, and the sub-committee on electricity of the American Railway Engineering and Maintenance-of-Way Association. This part of the report covers nine pages with eighteen pages of appendices; one on wind and ice load; the second comprising tables and curves of conductor sags; the third embodying specification for galvanizing for iron and steel; the fourth being made up of pole formulæ, and the final appendix showing drawings of typical crossings. It was hoped by the committee, in view of the agreement reached among the conflicting interests, that no changes would be made, but that the report will be accepted as printed. This suggestion of the chairman of the committee was also indorsed by Messrs. B. F. Pearson, Los Angeles, Cal.; W. K. Vanderpoel, Newark, N. J.; W. C. L. Eglin, Philadelphia, Pa.; W. W. Freeman, Brooklyn, N. Y.; Paul Spencer, Philadelphia, Pa., and P. H. Thomas, New York. There were others, however, who spoke in opposition to the indorsement without modification. Messrs. E. H. Davis and G. E. Wendle, of Williamsport, Pa., doubted whether the specifications were sufficiently in accord with standard practice and whether some of the provisions were not too drastic. While they appreciated the work of the committee, they could not subscribe to the fourth section of its report, since this condemns all existing types of crossings that are not in accordance with the standard therein contained. Mr. Davis cited court-findings which were at variance with the recommendation for clearances given in the report.

Mr. A. S. Miller, St. Louis, Mo., felt that in view of the fact that the report stands as a precedent and yet was only available to the members when they registered at the convention it was too important to adopt without more study being allotted to it. Prof. A. S. Richey, Worcester, Mass., speaking as the representative of the American Electric Railway Engineering Association, asked the N. E. L. A. not to adopt the specifications for the joint use of poles until the American Electric Railway Association had an opportunity to meet the National Electric Light Association in joint committee for a full discussion of the matter. There were a number of matters in the section which were not in accord with standard electric railway practice and were not just, he said, to electric railway interests. This part of the report was practically the verbatim specifications of the American Telegraph & Telephone Company, he maintained, and the railway association objects to some of the methods of telephone construction covered in the report. Mr. W. C. L. Eglin said that it was impossible to obtain agreement on matters of this kind and that it was necessary for the association to adopt a standard on important questions and that definite action at the present time was vitally necessary. Mr. A. S. Ives, of Poughkeepsie, N. Y., drew attention to various parts of the report which were at variance with the practice of his company and felt that some modifications were advisable. Others joining in the discussion were Messrs. G. H. Lukes, Chicago, Ill.; William Brophy, Boston, Mass.; G. H. Whitfield, Richmond, Va.; I. E. Moultrop, Boston, Mass., and L. A. Ferguson, Chicago, Ill. In conformity with a suggestion made by President Freeman and indorsed by Past-president Ferguson the sense of the meeting was expressed in the form of a motion that the members of the technical section recommend to the executive committee of the association that the report be adopted. This motion was carried.

PRESERVATIVE TREATMENT OF POLES.

The report of the committee on preservative treatment of poles and cross-arms, of which Mr. W. K. Vanderpoel, Newark, N. J., is chairman, was divided into two parts, dealing respectively with preservatives and treatments. The report on preservatives was confined to creosote oil and methods for its introduction into line timber, the committee's attitude being that evidence that other processes can be as successfully applied as creosote are lacking. The high pressure, atmospheric pressure and brush treatments were discussed in detail, and for the purpose of assisting the buyer in obtaining the best service from companies engaged in this work specifications for high pressure treatment were given in detail. General directions were incorporated in the report for applying the atmospheric pressure treatment, and suggestions were offered as to the application of the brush treatment, which is the least effective, but cheapest, of the three processes. The report was discussed by Messrs. R. D. Coombs, Newark, N. J.; F. B. H. Paine, Buffalo, N. Y.; Paul Spencer, Philadelphia, Pa.; H. A. Holdrege, Omaha, Neb.; W. L. Abbott, Chicago, Ill.; B. F. Pearson, Los Angeles, Cal.; A. Eisenhauer, New York, and Dr. G. Alleman, New York. Mr. Paine compared wooden poles and towers for 60,000-volt transmission lines with reference to the question of narrow rights-of-way, the wooden line being more flexible and convenient than any possible tower line. The only possible objection to the wooden pole line, he said, would be based on its life, but with preservative methods he felt this objection might be brushed aside. Mr. Holdrege said that southern pine poles treated by the high-pressure process showed no deterioration after five years of service. The conductivity of the pole, however, due to its preservative impregnation, renders it necessary to dispense with the creosoted pole where transformers are hung and at crossovers and corners. Mr. Pearson related his experiences with the open hot tank treatment followed by cold immersion and also with the creosote and carbolineum processes. Dr. Alleman, who is a member of the committee, answered numerous questions which arose in the course of the discussion relative to the preservatives and their effects on the wood. He cautioned members against the frauds possible in the creosoting business and suggested rigid inspection of all creosoting work done by contract.

UNDERGROUND CONSTRUCTION.

The report of the committee on underground construction presented by Mr. W. L. Abbott, of Chicago, its chairman, recorded the results of investigations relating to conduit construction, cables, the installation of cables, auxiliary subway equipment and operation. The chief features of the report were specifications for cable joints, comparisons of various conduit materials, hints as to the prevention of electrolysis and the protection and separation of cables in manholes, outline of methods for quickly locating and repairing cable breaks and a description of selected devices for indicating the lowering of cable insulation. The report was discussed by Messrs. Farley Osgood, Newark, N. J.; W. K. Vanderpoel, Newark, N. J.; S. B. Way, St. Louis, Mo.; Philip Torchio, New York; G. E. Brown, Brooklyn, N. Y.; W. N. Ryerson, Duluth, Minn.; F. B. H. Paine, Buffalo, N. Y., and W. C. L. Eglin, Philadelphia, Pa. In answer to a question by Mr. Osgood, relative to the use of concrete conduits, Mr. Way said that the system first used in St. Louis, Mo., has been tried in Joliet, under unfavorable circumstances, only to be abandoned. Mr. Paine called attention to the use of lead-covered cable laid directly in the ground without conduit in Germany, and said that this construction was well suited for use in streets not paved. Mr. Torchio said armored cables were used in Central Park, New York, in connection with tungsten-lamp installations. Replying to a question by Mr. Vanderpoel, Mr. Eglin said an effective method of ridding a manhole of gas is to employ a false air-tight manhole cover, and drive out the gas by means of compressed air.

LOAD REPORTS.

In a paper by Mr. A. S. Loizeaux, Baltimore, Md., were shown sample load reports of an electric system, including daily output summary, special day load curves, daily load curves of large customers, monthly reports of energy generated, energy purchased, energy delivered to commercial lines, monthly load statements, graphic load record, maximum peak and maximum output, yearly tabulation of energy statistics, peak loads, load factors, etc. The report was discussed by Messrs. W. C. L. Eglin, Philadelphia, Pa.; Farley Osgood, Newark, N. J.; N. J. Neall, Boston, Mass., and Douglass Burnett, Baltimore, Md., who presented the paper in the absence of the author. Mr. Neall accentuated the importance of keeping records such as those described by the author, especially since the formation of commissions in the various states. Mr. Eglin, as the presiding officer, expressed the sense of the meeting as favorable to the standardization of the form of load reports and characteristic load curves of central stations.

FIRST COMMERCIAL SESSION.

The first Commercial Session convened on Wednesday with Mr. J. F. Gilchrist, of Chicago, in the chair.

Mr. George Williams, of New York, chairman of the Commercial Session, in his address at the opening of the session drew attention to the fact that the section has already a membership as large as that of the entire association six years ago. He felt that there is no association work having a commercial side to it which cannot be best developed through the Commercial Section. The latter affords opportunities for commercial men to acquaint manufacturers with consumers' wants and for manufacturers to educate the commercial men. He suggested the affiliation of the committee on the "Solicitors' Handbook" with the Commercial Section and felt that with the sources of information available that section could supply a genuine all-the-year-round service such as has never been given in any commercial association. Mr. C. N. Duffy, of Milwaukee, Wis., asked whether it would be feasible to carry out the latter suggestion of the chairman of the section and was told that the matter would be taken up in executive session.

REPORT OF POWER COMMITTEE.

The report of this committee, presented by its chairman, Mr. E. W. Lloyd, of Chicago, embodied much data relative to the motor development of the various industries, the maximum demand and energy consumption, in addition to tabulated data on horse-power required to drive various machines, including refrigerating machines. The committee felt that the hard work done in the last few years by commercial departments has had its effect and that the growth of motor loads should increase at a much more rapid rate in the future. For soliciting this class of business the committee recommended engaging young men from technical schools whose training rendered them competent to make analyses of all the conditions entering into the cost of making electricity in private plants. In its compilation of data relative to the horse-power required to drive different types of machinery the committee has not duplicated data already covered in the "Solicitors' Handbook." Valuable information on the average consumption of energy per ton of ice delivered on the loading platform was incorporated in the report. It is pointed out that this should not exceed 60 kw-hours per ton and that the result might be accomplished at not less than 50 kw-hours. Mr. C. E. Graves, of Brooklyn, expressed the hope that in future years the responses to letters from this committee would be more liberal. Confidence in the information is bred with the volume of replies received, numerous instances carrying more weight than one or two. Mr. M. O. Dell Plain, of Syracuse, N. Y., suggested that in its future work the committee make use of graphic wattmeter tests of motor installations, noting all of the conditions on the back of the record. Mr. H. J. Gille, of Minneapolis, Minn., suggested that the committee also endeavor to ascertain the approximate kw-hours per unit of manufactured product. Mr. R. L. Lloyd, of Philadelphia, Pa., spoke on automatic refrigerating machines.

ELECTRICITY IN RURAL DISTRICTS.

In its report to the convention the committee headed by Mr. John G. Learned, of Chicago, showed that the possible income from rural industries other than farming was such as to make the matter worth careful study and investigation. The report is divided into several sections, each treated by itself and also with reference to the whole; the object being to reflect the situation as it exists from the viewpoint of the central station and the interurban electric railway. The committee points out that unless reasonable rates for this service are offered recourse will be had to other means such as gasoline engines for motive power and acetylene and pressure-oil systems for illumination, all of which were being constantly offered to the inhabitants of rural districts. It suggested also that the business be encouraged by such inducements as instalment payment for utensils or motors, cost prices on wiring, etc. The committee touched in a general way on numerous rural industries such as stone quarries, brick yards, lumber yards, grist mills, cement mills, etc., which it would be most practical and profitable to reach. The report concludes with a list of articles germane to the subject of electricity in rural districts which appeared in the technical press and other publications. Mr. S. M. Kennedy, Los Angeles, Cal., discussing the report, gave information on the lines operated by his company in southern California. The highest standard of line construction, he maintained, is necessary and the average cost of extending lines, he stated, depends on the voltage and the territory served, ranging from $600 to $1200 a mile. Where low rates prevail in typical rural districts the consumer should pay for the transformer, but where the rates are fairly high the company should furnish this equipment. Mr. J. C. Parker, Rochester, N. Y., dwelt on the possibilities offered in reclamation and irrigation work, stating that the reactive effect on the country itself would usually justify running the extensions. Mr. E. P. Edwards, Schenectady, N. Y., suggested that members digest the information given in a bulletin issued by the United States Department of Agriculture entitled "The Cost of Producing Minnesota Farm Products." This gives in detail the cost of animal and manual labor on the farm and would indicate how far a company would have to go in order to compete successfully with this labor by the substitution of the electric motor. Messrs. H. J. Gille, Minneapolis, Minn.; E. L. Callahan, Chicago, Ill.; H. K. Mohr, Philadelphia, Pa.; L. H. Scherck, Newburgh, N. Y., and J. F. Gilchrist, Chicago, Ill., also joined in the discussion on this paper

ORNAMENTAL STREET LIGHTING.

The arc, festoon or arch, and the post systems of ornamental street lighting are described in detail in the report submitted by the committee on this subject, of which Mr. W. R. Collier, of Atlanta, Ga., is chairman. A list of cities possessing each of the respective systems of lighting is given and the advantages and disadvantages of the various systems are pointed out. The festoon or arch system the committee feels has served its purpose and the trend should be toward a more permanent and more simple system. On its commercial side the committee strongly urges companies to make contracts with cities or with merchants' associations rather than with individuals, the unit of payment being based on the front foot, and this also should be made the unit of installation cost. A number of specimen contracts were appended for the benefit of companies desiring to engage in this work. Mr. V. R. Lansingh, New York, disagreed with the committee in its statement that whether the lamps are placed upright or hang pendent is not of great importance. From tests in his possession he said lamps hanging pendent, all other conditions remaining the same, showed a gain of 35 per cent in light distribution over lamps placed vertically. Mr. T. I. Jones, Brooklyn, N. Y., said that the beauty of the post and its advertising value were of more significance than the type of glassware used. The merchant who bore the cost of the installation wanted his place advertised and the best effect artistically is produced with dense glassware showing a ball of light rather than with globes giving a point of light. Mr. C. N. Duffy, Milwaukee, Wis., was also of the opinion that the scientific side of the question was not of much interest to commercial men and oftentimes marred results. Mr. W. H. Gardner, Lincoln, Neb., felt that inasmuch as more revenue could be produced from signs, outline and window lighting than with ornamental street lighting the latter should not be encouraged at the expense of the former. Mr. S. M. Kennedy, Los Angeles, Cal., showed how the income of his company was more or less curtailed owing to the ornamental lamp-posts in Los Angeles and the inability of his company, because of these, to install sign and outline lighting. He nevertheless felt it a gain to the community and expressed pride at the artistic lighting effects on the streets of his city. Mr. A. S. Ives, of Poughkeepsie, N. Y., urged companies to enlist the municipality in work of this kind because whatever helped the municipalities helped the taxpayer and also redounded to the credit of the central station. Mr. L. H. Scherck, of Newburgh, N. Y., stated that as a result of cooperation wooden trolley poles were displaced, by ornamental iron poles in Poughkeepsie holding four lamps; and Mr. Ives vouchsafed the information that the life of tungsten lamps was not impaired by being affixed to trolley poles. Others joining in the discussion were Messrs. H. K. Mohr, of Philadelphia, Pa.; L. Fitzgerald, Gary, Ind., and E. Creed, New York.

EXECUTIVE SESSION.

At the conclusion of the first commercial session on Wednesday noon the association went into executive session. Mr. Arthur Williams, vice-chairman of the public policy committee, touched briefly upon the report of the committee scheduled for presentation that evening at the New Theatre. Mr. Samuel Insull, of Chicago, expressed high appreciation of Mr. Williams' work, and the report of the committee was unanimously accepted.

CONSTRUCTIONAL AMENDMENTS.

Mr. F. W. Frueauff read the report of the committee on form of section organization, in which various recommendations for amendments to the constitution and suggested forms for a constitution for a state or geographic section and for a company section were embodied. A committee consisting of Messrs. F. W. Frueauff, J. F. Gilchrist, F. M. Tait, J. D. Israel, George Williams and D. B. Rushmore was named and instructed to report its findings at the executive session Friday afternoon.

TREASURERS' REPORT.

Gen. George H. Harries, Washington, D. C., treasurer, submitted a detailed statement of receipts and expenditures for the year, showing that the association at that time had total assets of $21,548 with no liabilities except current bills. The total receipts during the year were $62,177, plus cash on hand at the beginning of the year of $7,564, giving a total of $69,741. Disbursements of $51,241 left a cash balance of $18,500. The report was accepted by unanimous vote.

NOMINATING COMMITTEE.

In accordance with the provisions of the constitution the following nominating committee was elected to report its recommendations at the executive session Friday afternoon: Messrs. John W. Lieb, Jr., New York; Charles R. Huntley, Buffalo; R. F. Pack, Toronto; E. H. Davis, Williamsport; M. S. Hart, New Orleans.

FIRST POWER TRANSMISSION SECTION.

The meeting of the first session of the Power Transmission Section was opened by the presentation by Dr. A. S. McAllister of a report of the public conference on water-powers and their governmental control, held under the auspices of the N. E. L. A. Power Section in New York on April 8. The report gives a verbatim account of the proceedings, including the able and opportune address by Secretary of Interior W. L. Fisher.

CENTRAL SUPPLY OF ELECTRICAL ENERGY.

Mr. Fred Darlington, East Pittsburgh, submitted a paper entitled "Central Power Plants and Electrical Supply for Trunk-Line Railroads," in which he presented arguments in favor of a common source of supply of energy for electric lighting, industrial power and railway motors, and railroad electrical terminal service. He believed that railways in particular should not combine electrical generation with traffic operation.

Mr. F. B. H. Paine, of the Niagara, Lockport & Ontario Power Company, Buffalo, agreed with the author of the paper as to the desirability of a central source for the supply of energy for all electrical industries within a given district, and also favored generation for the many small central stations within a given district at a large central plant. An interesting account was given of the far-reaching service of the company with which he is connected. Mr. R. F. Schuchardt, of the Commonwealth Edison Company, Chicago, considered that the paper of Mr. Darlington was one of prime importance at the present stage of central-station progress, and thoroughly agreed as to the feasibility and efficiency of the supply of electric energy to street railways and to the terminal lines of railroads by existing central-station organizations.

PROTECTION FROM LIGHTNING.

Mr. B. E. Morrow, Albany, presented, as chairman, the report of the committee on protection from lightning. Among its recommendations were that the overhead ground wire should be used, choke coils placed on every independent circuit leaving the generating station and improved types of insulation used for transformers subject to damage from lightning. The use was also recommended of the electrolytic type of arrester on all transmission lines not now equipped with the multi-gap or horn-type of arrester.

An interesting discussion of the report was opened by Dr. C. P. Steinmetz, who said that almost absolute protection from lightning can now be obtained if necessary, although in some cases it may be more economical to take some risk of trouble from lightning than to expend the money necessary to provide perfect protection. In some cases it may be found best to confine protection to apparatus connected with the system.

Prof. E. E. F. Creighton, Schenectady, suggested the use of an ammeter in series with aluminum cells. Messrs. R. P. Jackson, of Pittsburgh, and P. H. Thomas, of New York, thought that it was more desirable to increase the insulation of line and apparatus rather than to set arresters to discharge at a moderate rise of voltage. Mr. P. M. Lincoln pointed out that, in addition to the use of arresters, protection against lightning might be obtained by suspension insulators, overhead ground wire and grounded neutral points.

SECOND COMMERCIAL SECTION, THURSDAY.

Practically the entire time of the Second Commercial Session on Thursday morning under Chairman F. M. Tait was devoted to a discussion of electric vehicle developments.

ELECTRIC VEHICLES.

The report of the committee on electric vehicles was presented by Mr. H. W. Peck, of Rochester, N. Y., in the absence of Mr. J. C. Hutchins, chairman. The report pointed out several important fields of usefulness in central-station work which justified its adoption by operating companies. Not the least important advantage of the electric vehicle is its advertising power in the communities served. There is room for a large amount of additional publicity work to be accomplished in acquainting the public with the possibilities of this type of transportation equipment. The committee emphasized the importance of taking all items of expense into account in estimating the cost of operation of electric vehicle service, and it called attention to the necessity of proper tire selection in order to secure the guaranteed mileage per battery charge. The justice of the lower insurance rates for electric vehicles was also mentioned and the committee pointed out that early difficulties in the operation of batteries, and particularly in their maintenance, are now things of the past.

A long discussion followed the reading of the committee's report. Central-station men from all parts of the country participated, showing the keenest interest in the problems reviewed. Mr. P. D. Wagoner, Long Island City, urged the vital importance of assembling adequate data. He felt that nothing was more important than this in the exploitation of electric-vehicle service. Mr. J. Baker, Boston, called attention to a disposition on the part of insurance companies to lower their rates on electric vehicles when provided with adequate information showing that the fire and accident hazards are as low as are claimed by their advocates. Mr. W. H. Blood, Jr., Boston, called attention to the off-peak value of the electric-vehicle load, and urged the elimination of the gasoline car in central-station service wherever the electric vehicle can do the work to greater advantage. Mr Wagoner stated that in February, 1911, the sales of his company were greater than in the entire year 1908 or 1909.

Mr. F. W. Frueauff, Denver, said that a central station solicitor should feel as responsible for the purchase of a gasoline vehicle in his territory as he would for the establishment of a gas-engine plant within the radius of his company's circuits. Mr. H. S. Knowlton, Boston, outlined the work of the Boston Edison Company in connection with its electric vehicle campaign, and Mr. C. F. Smith, Boston, referred briefly to the appearance of sixty-two electric trucks in a competitive procession at the time of the annual Work-Horse Parade.

Mr. G. H. Whitfield, Richmond, Va., pointed out that the offer of the local central station companies to garage private vehicles resulted in a great stimulus in sales in that locality, although it has never been necessary to establish the garage. Mr. M. S. Seelman, Jr., Brooklyn, emphasized the value of the publicity game in a road run fostered by one of the New York newspapers. A long discussion took place regarding the question of rates for charging, which appeared to run from about 3 to 8 cents per kw-hour. The participants were R. W. Rollins, Hartford; S. M. Kennedy, Los Angeles; E. L. Callahan, Chicago; H. L. Parker, Baltimore, and T. I. Jones, Brooklyn. At Oklahoma City the revenue from electric-vehicle charging increased in one year from practically nothing to $600 per month, the present income being about $1,000 per month. Mr. E. W. Lloyd, Chicago, advocated placing electric vehicles in local delivery service in connection with the outlying distribution centers of department stores. Mr. Arthur Williams, New York, said that the question of rates for electric-vehicle charging energy is subordinate to other advantages of this equipment. Mr. D. R. Stetson, of New Bedford, Mass., gave an interesting sketch of development of the electric-vehicle service by the New Bedford Gas & Edison Light Company.

EXECUTIVE COMMERCIAL SESSION.

Before the opening of the Executive Session Chairman Tait called attention to the co-operative advertising exhibit which had been placed on the front of the rostrum, consisting of a sample page from the Cleveland *Plain Dealer*, illustrating new electrical devices and containing both advertisements and descriptive articles designed to show the public the trend of electrical progress. Mr. P. S. Dodd, Cleveland, outlined the development of this plan of publicity which has by some authorities been considered about five times as valuable as ordinary newspaper paid advertising. The plan originated with Mr. Turner of the Cleveland Electric Illuminating Company and has been in successful use for two years.

THIRD ACCOUNTING SESSION.

The third and concluding session was called to order by President Freeman, who presided as chairman, on the morning of June 1. Mr. Freeman expressed his interest in the work of the session and stated that the large attendance showed the appreciation of the work of the committee and of the subjects of the papers.

GENERAL OFFICE ACCOUNTING.

Mr. Franklyn Heydecke, of Newark, N. J., then read his paper on "General Office Accounting." He said that in the compilation of monthly statements of operation and profit and loss it is best to furnish the general facts first and follow with the details. Mr. Hermann Spoehrer, of St Louis, Mo., said that the paper was of special interest to companies which operate several central-station systems. Mr. Frank Birch, of Philadelphia, Pa., stated that the most satisfactory system is one which furnishes not only general data but also details. Mr. W. E. Freeman, of New York, said that the subject of scientific accounting is receiving general attention, with the result of improved efficiency in administration and operation. Dr. Fenner H. Peckham, Providence, R. I., and Mr. E. J. Allegaert, Newark, N. J., also discussed the paper.

ACCOUNTING FOR DEPRECIATION.

Mr. H. M. Edwards, of New York, presented his paper on the subject "Accounting for Depreciation," which described the practice of the New York Edison Company. Mr. Edwards favors a general charge for depreciation rather than a charge based upon a specific calculation of lives of apparatus that cannot be determined satisfactorily.

Mr. N. J. Neall, of Boston, said that examination of the returns made to the New York Public Service Commission, Second District, showed that a very small proportion of the companies make any allowance for depreciation. Mr. E. J. Allegaert, of Newark, N. J., said that as the purpose of accounting is to determine how much has been made or lost depreciation accounts are a necessary element. Mr. C. N. Duffy, of Milwaukee, Wis., agreed with the advisability of the adoption of the general rather than the specific method. Mr. P. S. Young, of Newark, N. J., said that a company cannot spend enough in maintenance to take care of the waste. Mr. W. H. Gardiner, of New York, suggested the adoption of the general method with some flexibility to permit addition or reduction as conditions warrant. Mr. E. A. Barrows, of Providence, R. I., described the interesting practice of the Narragansett Electric Light Company. Mr. William B. Jackson, Chicago, Ill., felt that the best parts of both the general and specific methods should be adopted and an intelligent approximation made which can be altered as experience shows necessary. Mr. J. H. Gulick, of Chicago, said that the system of the Commonwealth Edison Company is similar to that of the New York Edison Company. Dr. Fenner H. Peckham, of Providence, R. I., said that a unanimous agreement as to the proper rate to be charged should be reached. Mr. J. H. Donlan, of Brooklyn, N. Y., referred to the consideration of depreciation by courts in decisions affecting utility companies.

TABULATING MACHINES IN ACCOUNTING WORK.

Mr. William Schmidt, Jr., of Baltimore, read his paper on the subject, "The Extent to Which a Tabulating Machine Can Be Used in Accounting Work." Mr. Paul R. Jones, of New York, described the uses to which this machine has been put in Denver. Mr. H. C. Schlegel, of New York, stated that mechanical devices made it possible to meet the greatly enlarged demand for statistics and other information. Mr. John L. Bailey, of Baltimore, and Mr. W. H. T. Jones, of New York, also discussed the paper.

As this closed the formal program, Mr. Freeman before adjournment complimented the session upon the conduct of the meetings and the great interest which was shown. Mr. Bailey expressed the thorough appreciation of the committee for the attendance and general interest manifested in the program.

SPECIAL EXECUTIVE SESSION IN HONOR OF THOMAS A. EDISON AND MR. CHARLES A. COFFIN.

President Freeman at 2:30 p. m. called to order a special executive session for the reception of Mr. Thomas A. Edison and for the election of Mr. C. A. Coffin to honorary membership. Mr. Thomas A. Edison was escorted to the Auditorium and took a seat upon the platform amid loud applause, upon the cessation of which President Freeman said it is safe to say that if the attendants at the convention were asked who, above all others, they would most like to see on this platform the unanimous answer would be Thomas A. Edison. Mr. Edison, he said, does not intend to speak, because his deeds speak for him, but he would therefore call on his former associate and very intimate friend, Mr. Samuel Insull, for some remarks.

Mr. Insull said, that of all the honors that it has been his good fortune to receive at the hands of the industry in which all present are engaged there is none so great to his mind as that of rising to give thanks for the cordial reception accorded to his chief, Mr. Thomas A. Edison. Mr. Edison never attempts to address an assemblage, but he desired the speaker to express his heartfelt thanks for the handsome way in which he was received, and wish all the greatest success that can possibly be achieved in the business in which they are engaged. If there is one thing more than another which pleases him it is to be informed that the same old enthusiasm which existed in the electrical field thirty years ago exists among the generation that is now rising identified with the business.

President Freeman then announced that the representatives of the Class A companies would be asked to vote at this session upon a unanimous recommendation of the executive committee as to the election of an honorary member. The association, he said, has on its list of honorary members at the present time twenty-five men of distinction and prominence; and in this, its twenty-sixth year, if the recommendation of the executive committee is accepted, a twenty-sixth honorary member will be added in the person of Mr. Charles A. Coffin. Upon motion of Mr. W. H. Blood, Jr., Mr. Coffin was unanimously elected by a rising vote. In announcing the result, President Freeman said the gentleman just elected to honorary membership represents probably as no other one does the combination of interest in the manufacturing and central-station branches of our industry. While perhaps he is best known as the executive head and guiding genius of a large manufacturing company his personal interests in central-station work are probably as much as they are in manufacturing work.

THIRD COMMERCIAL SESSION.

RESIDENCE BUSINESS.

Following the ovation to Mr. Edison and the election of Mr. C. A. Coffin, of the General Electric Company, as an honorary member, the third commercial section began with the presentation of a committee report on residence business, of which Mr. Clare M. Stannard, of Denver, Col., is chairman. The committee devoted itself only to a general consideration of the subject, making what might be termed a progress report. It concedes the desirability of this class of load provided the distribution costs are reasonable. For this class of service sidewalk and backyard systems of distribution appear to be preferred. Three general methods for getting residence business are outlined and two designs of houses electrically equipped after modern practice form part of the report. The average revenue received per customer is $25 per annum and the average revenue per kilowatt connected is $21 per annum. Mr. H. J. Gille, of Minneapolis, Minn., called attention to the central station's obligation to the community and Mr. P. H. Kemble, of Toronto, Ont., showed the defects of the methods pursued in compiling data by correspondence rather than by personal interviews. Mr. R. M. Searle, of Rochester, N. Y., contributed interesting information on some new and important uses of electric fans in the household and Mr. E. F. McCabe, of Lewistown, Pa., told of increased business secured by his company despite natural-gas competition by means of a flat-rate type of meter. Messrs. D. Burnett, Baltimore, Md., A. S. Ives, Poughkeepsie, N. Y., L. H. Scherck, Newburgh, N. Y. and M. S. Seelman, of Brooklyn, N. Y., contributed to the discussion.

ELECTRIC HEATING AND REFRIGERATION.

The report of this committee was read by Mr. F. H. Gale, of Schenectady, N. Y., its chairman. Four sub-committees each devoted itself to a particular phase of the subject. Apparently consumers have embraced the opportunity of utilizing many of the numerous household electrical devices due to the lesser cost of lighting since the advent of the tungsten lamp. The committee finds much to encourage and stimulate development in this direction. The advantages possessed by a particular electrical device over other standard devices on the market are pointed out. Investigation has not been confined entirely to domestic apparatus; but covers the whole range of devices for industrial service, concerning which much information of value was given. Although the report indicates that electrical refrigeration is confined to a few large cities, hope is held out for interest and development in small refrigerating systems operative from central-station service. A motion picture thrown on the screen after the reading of the report described more eloquently than words could the advantages of electricity in the household. The report itself, however, was not discussed.

WIRING AND EQUIPMENT.

This was the subject of the committee report presented by Mr. M. C. Rypinski of New York. The committee sought to obtain information looking toward the improvement, standardization and, if possible, cheapening of wiring practice, and with this in view sent out numerous forms, only about 20 per cent of which were returned, however. Apparently very few central-station companies are endeavoring to further the campaign for wiring old and new houses by rendering financial aid to the consumer in the shape of permitting monthly instalment payments for wiring work. There also is a lack of definite knowledge as to what extent the present cost of installations retards wiring of houses. Such suggestions as were received looking to the development of cheaper forms of wiring referred to foreign practice at present not permitted in this country. The National Electric Light Association, National Electric Lamp Association and the National Electric Contractors' Association will issue jointly a wiring handbook suitable alike for the solicitor and the electrical contractor. The report elicited no discussion.

INDUSTRIAL LIGHTING.

This committee, of which Mr. M. S. Sloan, of Birmingham, Ala., is chairman, attempted no analysis of particular systems now in vogue and confined its report to descriptions of what it considered to be model installations. It suggested that its work be continued so that the various methods of lighting might be classified or at any rate data compiled which when placed in condensed form would be helpful to central station men and even to the customer. Mr. N. Macbeth, of Bloomfield, N. J., spoke at some length on the cash value of good illumination in industrial work, lamenting the fact that the importance of industrial lighting as a revenue producer is often overlooked by central-station managers. Mr. M. O. Dell Plain, Syracuse, N. Y., told of the perceptible flicker on 25-cycle energy where radially corrugated reflectors were used with tungsten lamps. This flicker is not noticeable with reflectors having a smooth surface. Mr. C. E. Clewell, of Pittsburgh, Pa., offered an explanation of the phenomenon attributing the defect to light surfaces rather than to particular types of reflectors. Messrs. S. Ashe, Harrison, N. J., F. J. Leitner, Brooklyn, N. Y., S. E. Doane, Cleveland, Ohio, W. D. A. Ryan, Schenectady, N. Y., F. N. Willcox, Harrison, N. J., and H. L. Parker, Baltimore, Md., joined in the discussion, which centered chiefly on the examples given in the report.

THIRD TECHNICAL SESSION.

INCANDESCENT-LAMP REPORT.

Mr. W. F. Wells, of Brooklyn, presented, as chairman, the report of the Incandescent Lamp Committee, which described developments during the year in the methods of manufacturing tungsten lamps, standardization of lamp sizes and ratings, and referred to the increase in the use of 400 and 500-watt units. In reply to inquiries, Mr. Wells stated that it would not at present be practicable to renew tungsten lamps absolutely free, and that customers cannot be required to purchase tungsten lamps exclusively from central stations.

PRIME MOVERS.

Mr. I. E. Moultrop, of Boston, submitted, as chairman, the report of the Prime Motive Powers Committee, which includes much valuable practical data of a wide range collected during the year. Mr. E. E. Gilbert, Schenectady, N. Y., said that it was a decided step in the right direction to insist upon clean air for ventilating generators. Mr. John C. Parker, Rochester, said that the increasing use of accumulators in connection with the governors of hydraulic turbines is a good thing. He said that a strong point could have been made of the advantage of the bleeder type of turbine if used in connection with exhaust steam heating. He referred to a new European type of gas engine of very high efficiency, and which should be a valuable adjunct to a hydraulic plant, displacing the steam engine auxiliary. Mr. R. D. De Wolf, of Rochester, referred to the importance of exhaust steam heating in connection with electric-power generation, and particularly to the use for this purpose of the bleeder-type of steam turbine, which promises to come largely into use. Mr. Moultrop stated that 10,000-hp gas engines are now being built in Germany and France.

ELECTRICAL APPARATUS.

Mr. G. L. Knight, of the Brooklyn Edison Company, read the report of the Committee on Electrical Apparatus, in the absence of the chairman, Mr. L. L. Elden, of Boston. The report gives the results of tests of 12,000-kw turbogenerators. The insertion is advised of reaction in generator-leads as affording protection to the generator when the circuit breaker is open. Mention was also made of the use of auto transformers for the same purpose.

In the discussion, Mr. W. F. Wells, chairman, suggested the placing of fuses over the top of air-cooled transformers, so that as soon as a flame commences to come out the blower would be automatically shut down. Mr. F. D. Newbury, Pittsburgh, said that generators can be built with sufficient internal reactance to avoid the use of external reactance. Referring to high and low-speed machinery, he said that the former can be made equally quiet in operation, provided the apparatus is properly enclosed. Mr. R. F. Schuchardt, Chicago, said that a series of tests had resulted in a very much increased confidence in oil switches.

Mr. E. M. Hewlett, Schenectady, referred to the changes in the bellows type relay to make it more selective. Mr. Moultrop stated that while the present form of relay is selective for grounds it is not selective for short-circuits.

VENTILATION OF TURBO-GENERATORS.

Mr. R. B. Williamson, Milwaukee, presented a paper which dwelt upon the advantages of the thorough ventilation of turbo-generators and described the methods of ventilation found effective. The weight of ventilating air often equals that of the steam passing through the turbo units, and this air can be used for heating factory buildings. He pointed out the great desirability of using clean air, as a slight percentage of dirt may cause trouble. In a discussion of the paper, Mr. H. L. Wallau, of Cleveland, suggested the use of a vacuum cleaner to remove dirt from the generators, and Mr. Schuchardt said that such a vacuum system is being installed in a Chicago central station.

TRANSFORMER DEVELOPMENT.

Mr. H. O. Troy, Schenectady, presented a paper entitled "Recent Developments in Self-Cooled Transformers," which included a historical account of the development of this type. A method of cooling is described employing a boiler iron tank equipped with external tubes, and it is stated that transformer tanks having similar characteristics are now being built with compound corrugation. The brief discussion of the paper was confined to the proper definition of the term "radiation"

FINAL POWER TRANSMISSION SESSION.

At the final Power-Transmission session held on Friday morning there was a topical discussion on the operation of transmission system which was preceded by the presentation of a paper by Mr. H. A. Wagner, Baltimore, entitled, "Increasing the Flexibility and Reducing the Cost of Operation of Steam Boiler Plants by the Use of Fuel Oil," and a paper by Mr. George H. Walbridge, Denver, entitled, "Determining the Cost of Production in Steam Properties Under Varying Conditions."

BOILER FUEL OIL.

The paper by Mr. Wagner contained a description in outline of a boiler furnace arranged for combined oil and coal fuel.

Tests showed a gain in output of 66 2-3 per cent by the added use of oil, or a saving of 40 per cent in the cost of boiler equipment for a given output. This paper was discussed by Mr. M. C. Kennedy, Syracuse, who submitted a written communication, and Mr. W. L. Abbott, Chicago. Mr. Kennedy described the use by the Syracuse Lighting Company of oil for fuel in boilers held in reserve in case the supply of transmitted energy is interrupted. Mr. Abbott said that probably one ton of coal per day could be saved by using oil for banking fuel for a 500-kw boiler.

COST OF ENERGY FROM STEAM.

Messrs. Walbridge and Gilbert described certain charts for showing the factors which control the cost of steam energy, including size of plant, cost of labor, cost of fuel, evaporative efficiency of boilers and type of engine. There was no discussion relating specifically to this paper.

OPERATION OF TRANSMISSION SYSTEMS.

Written communications to the topical discussion were received from Messrs. Max. Hebgen, Butte; J. P. Jollyman, San Francisco, and R. S. Kelsch, Montreal. Mr. Hebgen outlined the features which tend to insure continuity of service, the most important of which he stated to be high insulation, great mechanical strength, good general arrangement and proper operation. He advocated the suspension type of insulator for all voltages above 20,000.

Mr. Jollyman described the ideal arrangement for generating apparatus, transmission line and substation equipments in order to minimize the number of interruptions and the length of time consumed in restoring service after each interruption.

Mr. Kelsch claimed that the insulation factor of safety in many systems now in operation should be increased by at least 200 per cent.

The discussion was continued by Messrs. W. N. Ryerson, Duluth; F. B. H. Paine, Buffalo; B. F. Pearson, Los Angeles; R. J. McClelland, New York; J. R. McKee, New York; G. H. Walbridge, Denver; E. L. West, Denver; R. G. Black, Toronto; P. H. Thomas, New York; N. J. Neall, Boston, and D. B. Rushmore, Schenectady.

Mr. Pearson called attention to the remarkable fact that in Southern California the inner petticoats of pin type insulators develop cracks, probably on account of the high temperature to which they are subjected. Trouble has also arisen from birds short circuiting the line to the steel cross-arms upon which they alight. Mr. West stated that the velocity of the wind at the highest altitude reached by the lines of the Central Colorado Power Company has been observed to be 165 miles per hour. Mr. Black said that during nine months the Niagara-Toronto 90-mile line operated without a single interruption to service; last month there were three attributed to lightning.

FOURTH COMMERCIAL SESSION.

The fourth commercial session was called to order in the main auditorium by Chairman John F. Gilchrist at 10.10 o'clock Friday morning. A large and enthusiastic audience was early on hand, and so much interest was displayed that the session was prolonged until 1.30 p. m.

ELECTRIC SIGNS.

The report of the committee on electric signs was presented by Mr. E. L. Callahan, Chicago, who announced that a bulletin on electric signs would be presented to each member of the session during the morning. Taking up the report he emphasized the importance of paying more consideration to the mechanical and artistic features of such signs, particularly to avoid trouble with the municipal authorities. A model sign ordinance was submitted. The committee advocated operating signs until at least 10 o'clock p. m. daily. No central station should supply energy to any sign presenting a serious fire risk. Electrical advertising to meet permanent success must be conducted on a dignified basis, avoiding the methods of the tinsmith. A suggestion was made that moving pictures be taken of animated signs for display at the next convention. The possibility of securing business from national advertisers were reviewed, and as a result of the work of the committee one large sign equipped with over 2000 lamps is to be placed in twenty-five cities.

The report was discussed by Messrs. E. A. Mills, New York; Frank Hammond, Birmingham; T. K. Jackson, Mobile; J. F. Gilchrist, Chicago; H. L. Parker, Baltimore; C. A. Littlefield, New York; and W. A. Johnson, Pittsburgh. Among the points brought out in the discussion were the facts that in New York an ordinance limiting the height of signs has been declared unconstitutional; and that sketches of prospective signs should be made and carried into effect under strict supervision, preferably by a responsible municipal officer. Diplomacy is needed in this work. Mr. Gilchrist favored paying a rental to cover the cost of inspection against accidents, which do the sign business great injury. The importance of securing lower freight rates on electric signs through appropriate action of the association was also mentioned. Mr. Littlefield cited the co-operation of the New York Edison Company with artistic organizations to the extent of even refusing to solicit sign customers on a particular street. Mr. Johnson pointed out that about 75,000 tungsten lamps are in service in Pittsburgh sign work.

COMPETITIVE ILLUMINANTS.

Chairman H. J. Gille presented the report of the committee on competitive illuminants, which was replete with valuable data for the lighting solicitor. The report constitutes one of the most exhaustive collections of anti-gas arguments which has ever been assembled, including comparative costs and a thorough discussion of service, inefficiencies and disadvantages. Considerable attention was given to the cost of operating pilot flames in connection with mantle lamps, it being shown that the gas consumption is increased about 30 per cent thereby. An inverted gas burner emits nearly 10 times as much heat as a 60-watt tungsten lamp. A very serious defect of the gas mantel lamp is its rapid depreciation of candle-power. A special section of the report dealt at length with the serious drawbacks and dangers of gasoline lighting installations.

The report was discussed by Messrs. S. W. Ashe, Harrison, N. J.; Norman Macbeth, Bloomfield, N. J.; L. H. Scherck, Newburgh, N. Y.; E. L. Callahan, Chicago; George S. Barrows, Philadelphia; Mr. Klumpf, Chicago; J. S. Codman, Boston; Thomas Hawkins, Rockland, Maine; George A. Sawin, Newark, N. J.; E. J. McCabe, New York, and Mr. Wagner, Brooklyn.

A wide difference of opinion appeared in the discussion concerning the report's accuracy. Messrs. Macbeth, Scherck and Barrows defended gas illumination, while Messrs. Callahan and Sawin spoke vigorously in behalf of the fidelity of the report to service conditions. In closing, Mr. Gille said that the values represent average practice and may be used with safety by the employees of commercial electric lighting departments.

ADVERTISING.

Mr. F. C. Lee presented the report of the committee on advertising, which furnishes an interesting exhibit of modern central-station publicity selected from all sections of the country. Over $2,000,000 per year is now being spent on central-station advertising, and it is probable that this will be increased at least 50 per cent within the next twelve months. Recent campaigns in Baltimore, Brooklyn, Philadelphia, Chicago, Mobile, Rochester, Milwaukee, Duluth, and other cities are included in the exhibits. Considerable attention has been paid in the report to advertising by public utility syndicates. The best opinion is that matters should be given a strong local tinge when distributed by a syndicate in different sections of the country. Adult thought and human interest, telling the reader something that is new to him, are vitally necessary. A feature of the report was the inclusion of several advertisements dealing with questions of corporate policy.

The report was discussed by Messrs. H. K. Mohr, Philadelphia; M. S. Seelman, Jr., Brooklyn; F. H. Gale, Schenectady; Douglas Burnett, Baltimore; J. Robert Crouse, Cleveland, and Vice-chairman George Williams. The principal points brought out by the discussion were a plan outlined by Mr. Gale, by which, upon central stations sending the names of people contemplating the erection of buildings to manufacturing companies, the latter will in turn send such parties special and general literature, describing electrical apparatus which may be profitably used by them; and the importance of closer daily co-operation between advertising and sales departments.

Vice-chairman announced at this point that the winner of the Crouse silver cup is Mr. Arthur S. Huey, Chicago, the victor having secured the largest number of new members for the commercial section.

FUNCTIONS OF A SALES DEPARTMENT.

The report of the committee on the functions of a sales department was presented by Mr. T. I. Jones, Brooklyn. It discusses selling-force organization, credit in relation to new business, department bureaus and the compensation of salesmen. The partial-payment plan of wiring old houses was given high praise. The report advised selling apparatus at a profit. Power engineering questions were also taken up in considerable detail. The committee favored abandoning the plan of requiring deposits to be made in connection with new business. It was found that most companies are paying solicitors straight salaries. Salesmen should not be measured entirely by the volume of business secured. Where instalment wiring is required a commission for the salesman appears desirable.

The report was discussed by Messrs. B. W. Mendenhall, Salt Lake City; William H. Gardner, Lincoln, Neb.; S. M. Kennedy, Los Angeles; C. Duffy, Milwaukee; Douglas Burnett, Baltimore; E. W. Lloyd, Chicago; C. A. Littlefield, New York, and J. D. Israel, Philadelphia. In general, the persons taking part in the discussion favored the abandonment of the term "16-cp equivalents." The payment of straight salaries was also favored, although the combination of a salary and a commission was given some praise. Mr. Jones laid special stress upon the importance of paying good salaries to few men, rather than small salaries to many, and urged the merits of promotion from within the ranks. The importance of shortening the time elapsing between the signing of a contract and the turning on of the lights was also emphasized.

NOMINATIONS.

Mr. E. W. Lloyd, as chairman of the nominating committee, presented the following list of nominations for the ensuing year, which was unanimously accepted, after which the meeting adjourned:

Chairman, Mr. H. J. Gille, Minneapolis; vice-president, Mr. S. M. Kennedy, Los Angeles; secretary, Mr. F. B. Rae, New York. Executive committee, Messrs. Geo. Williams, New York; F. H. Gale, Schenectady; J. Robert Crouse, Cleveland; E. L. Callahan, Chicago; D. Campbell, Scranton; A. B. Rypinski, New York; E. W. Lloyd, Chicago; T. I. Jones, Brooklyn; Mr. Winter, Seattle; H. K. Mohr, Philadelphia; C. W. Lee, New York, and J. F. Becker, New York.

CLOSING GENERAL SESSION.

As chairman of the committee on the president's address, Mr. H. M. Byllesby, of Chicago, opened the third general session held in the Auditorium, Friday afternoon, and reported the thorough approval and appreciation felt by his committee in Mr. Freeman's official remarks.

PUBLIC UTILITY APPRAISALS.

Mr. Byllesby then presented his own paper, "Breadth of Vision in Public Utility Appraisals," in which, after remarking the obvious relation between appraised value and rates, he pointed out the difficulty of arriving at a fair estimate of actual plant values, reminding his audience that practically all structures or engineering undertakings invariably exceed the original allowances made by experienced builders and engineers. Such fixing of plant valuation requires the most conscientious application, he said, and as the difficult problems and complexities of electric service are better realized, Mr. Byllesby said he believed higher values would be allowed. The speaker also referred to the evident unjustness and lack of wisdom of reducing rates and income which might result in the restriction of future extensions. The principle of setting aside capital reserve against lean years, he said, has already been admitted and is, in fact, necessary to establish stable credit, insure fair employee's wages, and a proper reward for loyal workers.

Mr. Byllesby was followed by Mr. Insull, who urged plant managers to learn the actual values of their own properties, calling in outside expert assistance for this purpose. Such expert appraisals, said Mr. Insull, will usually result in divulging far higher values than previously suspected, and may be of the greatest importance in dealing with regulative bodies.

PLANT AND PROPERTY VALUATIONS.

A paper on "Elements Affecting the Fair Valuation of Plant and Property" was next presented by its author, Mr. W. F. Wells, who enumerated some of the factors to be considered in approximating original cost and reproduction values of actual property represented by fixed capital accounts. Mr. Henry Floy, of New York, referred to the confusion of terms of "wearing" and "service" values, and sought to distinguish between "theoretical" and "actual" depreciation. Mr. F. H. Peckham, of Providence, R. I., spoke of the difference in rates of depreciation under differing conditions. Mr. J. W. Lieb, Jr., referred to obsolescence and radical changes in types of machinery as affecting rates. Mr. Alten S. Miller, of St. Louis, said that certain regulative commissions have recognized the right of a company to earn a reasonable return while building up its business. He also advised the substitution of the term "non-inventory" property for "intangible" property in discussions before bodies unfamiliar with corporate accounting terms. Mr. H. C. Abell, of San Antonio, Texas, said that good management is often virtually penalized by public-service commissions in their efforts to determine reasonable returns. Mr. J. F. Klump, of Philadelphia, dwelt on the significance of going value, and referred to the principles adopted by the American Waterworks Association in which the physical plant is first assumed completely installed, and the cost of securing the business is then computed.

RATE RESEARCH COMMITTEE.

Mr. J. F. Gilchrist then submitted the report of the rate research committee, which advocated, so far as possible, the general establishment of more uniform rates throughout the country. While the committee was not unanimous as to the desirability of establishing a differential rate for residence use, it recommended the floor-area method as being the fairest, cheapest and most practical, easily understandable method of determining such a differential. A feature of the committee's report was an exhibit of models based on the three dimensions of kilowatt demand, kilowatt-hour consumption, and customer's bill, illustrating the rate schedules used in various cities. The use and development of this ingenious application of descriptive geometry was explained by the originator of the scheme, Mr. H. E. Eisenmenger, of Cleveland.

VARIABLE RATES

"Some Reasons for Difference in Price for Different Services" was the title of a paper by Mr. Norman T. Wilcox, which, after a contrast of the difference between residence and commercial conditions, pointed out that here are certain natural discounts depending upon the size of the installation, cost of the equipment required, and hours' use of the service. The wide difference in basic cost is exemplified, for instance, in the possibility of selling 800 to 1000-kw-hours to residence service with an investment of $350 to $440 per kw of generator capacity, while with large motor service taking 3000 to 7000-kw-hours only an investment of $175 to $100, or even less, is required.

STANDARDIZING ELECTRIC SALES.

On account of the lateness of the hour, Mr. Douglass Burnett presented his paper on "Standarizing Electrical Sales" in abstract. Mr. Burnett advocated full publicity for central-station rates, suggesting that they be prepared in printed form and placed in the company's office so as to be equally accessible as the time-tables in a railroad office. He also proposed methods of figuring house-wiring, signs, etc., on a unit basis, so that immediate estimates might be quoted in reply to inquiries, without recourse to a contractor's inspection of the prospective job.

Mr. F. W. Smith, of New York, approved the idea of complete accessibility of rate schedules to the public, and declared that many persons now regarded such rates as obscure and difficult to understand.

SCIENTIFIC MANAGEMENT.

"The Possibilities for Economy in the Operation of Light and Power Companies by Scientific Time Study" were discussed by Mr. L. B. Webster, who presented his paper in abstract. Mr. Webster proposed and exhibited charts for comparing the output of certain classes of labor, and referred to the saving which can be made by giving proper instructions to employees. The author showed how a certain gang of supposedly hard-working firemen under full-load conditions at the plant were found to be actually only 47 per cent occupied. In other instances, highly-paid men were found hiding their idleness by doing the work of cheaper labor. The engine-room, boiler-room and outside-plant department, said Mr. Webster, offer equal opportunities for improving the time-efficiency of the employees, in which the remainder of the crews should benefit from the elimination of the useless men employed in the gang.

In discussing the paper, Mr. H. Fitzjohn Porter, a professional efficiency engineer, said that while study has already been made of such operations as coal shoveling, as regards simple transfer of material, the procedure of firing a boiler to secure steaming efficiency involves so many variables that all conditions must be held constant, or misleading and worse-than-useless results will be obtained. Mr. Porter also pointed out that in making tests of labor possibilities, there is danger of carrying output to the point of over-fatigue, although the workmen might be unconscious of such effort.

NECROLOGY.

The report of the committee on memorials, which was presented by Secretary Martin, disclosed the loss of fourteen association members during the last year. The names of the following, with brief characterizations of their individual careers, were presented in the committee's necrology:

Stephen R. Bradley, Nyack, N. Y.; Rutherford D. Rubright, Brooklyn, N. Y.; Edward L. Brewster, Chicago, Ill.; Wallace G. Webber, Wareham, Mass.; Alex Henderson, New York; Albert Spies, Jersey City, N. J.; Theodore P. Bailey, Mount Airy, Philadelphia, Pa.; William H. Browne, Brooklyn, N. Y.; William C. Woodward, Providence, R. I.; Charles A. Vergin, Owatonna, Minn.; E. A. Beck, Los Angeles, Cal.; Frank S. Gorton, Chicago, Ill.; Robert D. Ferguson, Evansville, Ind., and L. J. Forget, Montreal, Can.

COMMITTEE ON RESOLUTIONS.

The report of the committee on resolutions was next presented jointly by its members, Messrs. Arthur Williams and T. C. Martin.

Resolutions of hearty thanks were expressed to the chairmen and members of the various committees who contributed to the success of the convention, including Mr. Arthur Williams, general chairman of the entertainment committee; Mr. F. W. Smith, hotel sub-committee; Mr. T. I. Jones, boat-ride sub-committee; Mr. H. E. McGowan, baseball sub-committee; Mr. C. G. M. Thomas, theatre sub-committee; Mr. Dudley Farrand, musicale and tea sub-committee; Mr. F. C. Bates, automobile sub-committee; Mr. J. W. Lieb, power-house visits sub-committee; Mr. J. E. Phillips, pumping-station sub-committee; Mr. H. M. Edwards, golf sub-committee; Mr. C. L. Law, secretary, and Mr. Walter Neumuller, treasurer of the entertainment committee.

The association also placed on record its appreciation of the courtesies and hospitalities received at the hands of the several member companies in the vicinity of the convention city—Flatbush Gas Company, New York and Queens Electric Light and Power Company, Northern Westchester Lighting Company, Peekskill Lighting and Railroad Company, Queens Borough Gas and Electric Company, Richmond Light and Railroad Company, the Bronx Gas and Electric Company, the New York Edison Company, the United Electric Light and Power Company, Westchester Lighting Company and the Yonkers Electric Light and Power Company, the Brooklyn Edison Company, and the Public Service Company of New Jersey.

To the Brooklyn Edison Company, the United Electric Light and Power Company and the New York Edison Company, the association's thanks were tendered for the services of employees, placed at the disposal of the secretary of the association to assist during convention week in the registration bureau, the distribution of advance copies of papers and the operating of the meeting rooms during the various sessions.

Other resolutions of thanks were passed as follows:

To President Freeman, Vice-presidents Gilchrist and Tait, and Treasurer Harries for their work of the year, with cordial compliments upon the condition of the association as it now enters upon its second quarter of a century.

To the secretary, Mr. T. C. Martin, and his loyal and efficient staff for the manner in which it has been sought to place promptly and efficiently at the disposal of every member the resources of the association in regard to the furnishing of data and information, the prompt handling of correspondence and the assistance to all the committees in their work.

To the association's sister engineering societies occupying the United Engineering Societies Building, which were most considerate and thoughtful, extending generous hospitality in every way.

To the superintendent of the Engineering Societies Building, Mr. Lambden, and his staff for their unremitting efforts in planning and carrying out arrangements which enhanced the success of the convention.

To the McGraw Publishing Company and to the entire editorial staff of the *Electrical World* for the *Convention Daily* issued during the week, the association placing on record its appreciation alike of the generosity and efficiency with which this service was rendered.

To the technical press for its loyal and efficient co-operation, and for the work and publicity which did much to make the convention so successful.

To the respective New York daily papers for generous and appreciative comment, and assistance to the association in its work and aims.

To Mr. J. C. McQuiston, chairman of the exhibition committee; to its secretary, Mr. Walter Neumuller, and to the individual members of the committee for the valuable and interesting collection of literature of Class D manufacturing companies, adding greatly to the educational value of the convention.

To Mr. Charles H. Hodskinson, master of transportation, for the efficient manner in which the important duties of his office were discharged.

To the Hotel Astor for the co-operation which made a success of the reception on Monday evening, May 29; the Hotel Waldorf-Astoria for the entertainment of the ladies on Thursday morning, and the Hotel Plaza for the tea and reception on Friday afternoon.

To President Brown, of the New York Central Railroad, for the use of its pier for the steamboat ride on Tuesday morning, and to President Bishop, of the Iron Steamboat Company, for the use of the Steeplechase pier for the sail on Tuesday night.

CONSTITUTIONAL AMENDMENTS.

Mr. Frank W. Frueauff, chairman of the constitutional amendment committee, presented his report outlining several skeleton plans of constitutions for company branches, technical and commercial sections, etc., and also proposing certain constitutional amendments, already submitted to the association during the executive session on Wednesday. On motion of Mr. Arthur Williams this report was accepted.

The report of the committee on overhead-line construction was also received by the association and matters in it pertaining to public policy referred to the executive committee. On motion of Mr. E. H. Davis, the subject of creating a bureau for receiving and dispensing information was referred to the executive committee.

ELECTION OF OFFICERS.

The nominating committee, comprising Messrs. J. W. Lieb, Jr., chairman; H. H. Davis, W. S. Hart, C. R. Huntley and R. F. Peck, then presented its report, embodying recommendations for officers as follows during the ensuing year:

President, Mr. John F. Gilchrist, Chicago.

First Vice-president, Mr. Frank M. Tait, Dayton, Ohio.

Second Vice-president, Mr. Arthur S. Huey, Oklahoma City, Okla.

Secretary, Mr. T. C. Martin, New York.

Treasurer, Gen. George H. Harries, Washington, D. C.

Members of the executive committee, Messrs. W. W. Freeman, Charles L. Edgar, Arthur Williams and H. H. Scott.

The report of the nominating committee was unanimously accepted and the convention cast a unanimous ballot for the officers above named.

When the newly elected president, Mr. Gilchrist, was escorted to the platform he received a rousing ovation from the floor of the convention, and President Freeman in conferring upon his successor the gold badge of the president's office predicted that Mr. Gilchrist's administration would mark, to date, the crowning success of the National Electric Light Association.

In accepting the honor of his election to the presidency Mr. Gilchrist graciously rejoined that he only hoped he might serve the association with some measure of the efficiency rendered by his predecessors in office.

There being no further business, President Freeman then declared the thirty-fourth annual convention of the National Electric Light Association adjourned.

THE PRESIDENT-ELECT.

Mr. John Foster Gilchrist, the president-elect, is assistant to the president of the Commonwealth Edison Company, Chicago. He is a native of Chicago, having been born there March 14, 1868. Mr. Gilchrist obtained his secondary education in the Chicago High Schools and later in the law department of Lake Forest University. He entered the service of the Chicago Edison Company as an office boy in 1887, and has been connected continuously with the company from that time. From 1894 to 1896 he was assistant to the manager of electrical sales, and in the year last named was made contract agent for the company. In 1906 he was promoted to be assistant to the president, a position he still occupies. Mr. Gilchrist has, however, other business interests, being secretary of the Economy Light & Power Company, of Joliet, Ill.; treasurer of the Federal Electric Company and the Federal Sign System, and second vice-president of the Illinois Valley Gas & Electric Copany. Mr. Gilchrist is an associate of the American Institute of Electrical Engineers and a member of the Illuminating Engineering Society, of which he has served as a director, and has read papers before technical societies on several occasions. He is also a member of the Union League, Chicago Athletic, Chicago Yacht, Homewood Golf and South Shore Country clubs in Chicago and the Industrial and Engineers' clubs in New York.

John F. Gilchrist, President-Elect.

ENTERTAINMENT FEATURES.

There was probably a wider variety of entertainment provided for the delegates to the 1911 convention than at any other in the history of the National Electric Light Association.

The social features of the week began on Monday evening, May 29, with a reception to President and Mrs. W. W. Freeman, at the Hotel Astor. The many ladies and gentlemen present enjoyed an excellent musical program, which included an organ recital, orchestral music, and a promenade concert on the roof garden. Simultaneously there was dancing in the grand ballroom, interrupted for a collation served in the Orangerie of the hotel.

On Tuesday morning, there was a steamboat trip on the Hudson River as far as Tarrytown for the ladies exclusively. The day being a most clear and delightful one, the beautiful scenery on each side of the river was viewed at best advantage, the rugged Palisades, the well-kept estates, and the great stretches of woodland which greeted the eye fully sustaining the appellation, "The Rhine of America," so often applied to the Hudson. On Tuesday evening, members and their ladies were the guests of the Edison Electric Illuminating Company of Brooklyn for a steamboat trip down the East River to Steeplechase Park, at Coney Island. Over 1200 of those attending the convention took advantage of the opportunity to view the harbor at night, and found much pleasure in viewing the illumination of the three great bridges, in the picture presented by the flashing of a searchlight from the boat upon old Castle Williams, nestled amid the shadows of the army post on Governor's Island, the Statue of Liberty with its lighted torch in the Lower Harbor, and in Forts Hancock and Wadsworth at the Narrows. Here appeared in full view the magnificent illumination of Coney Island, in which was a great gap, filled hitherto by the brilliantly lighted "Dreamland," destroyed by fire on the night of Friday, May 26. Many in the party disembarked at Steeplechase Park to view the numerous attractions, after which the boat returned to New York with those who preferred the water to the rail route.

Heavy rain made it necessary to cancel the ball game between teams from the Brooklyn and the Philadelphia companies which was to have been held on Wednesday afternoon, and owing to the necessity to adhere to the schedule it proved impossible to find other time for this popular event. The contest was to have been the first for a cup donated by the Westinghouse Electric & Manufacturing Company.

On Thursday morning there was a costume musicale for the ladies at the Waldorf-Astoria, and in the evening members and their guests attended the theatre as guests of the association. The choice lay between "Everywoman," at the Lyric Theatre; "The Henpecks," with Lew Fields, at the Broadway and a variety show at the Winter Garden. This was one of the most successful events at the convention and the large audiences were most enthusiastic over the performances and the many quips and jests on the electrical industry which were interspersed among the regular lines.

The entertainment provided for Friday included an automobile for the ladies throughout the upper sections of the city. There were over forty automobiles in line, each decorated with flags bearing the insignia of the association. The ride lasted nearly three hours and covered many places of interest in the residential districts and in the parks. In the afternoon there was a tea at the Hotel Plaza for the ladies, and at 6 o'clock in the evening the Sons of Jove held a dinner and rejuvenation at Reisenweber's Casino, Coney Island.

The concluding event of the week was a boat trip on Saturday at which the members and ladies were the guests of the New York Edison Company. Visits were made at the generating stations of the company, at those of the Interborough Rapid Transit Company, and at the works of the Consolidated Gas Company. Luncheon was served aboard, and a concert was given throughout the trip by an excellent orchestra.

Provision was made during the week for members who desired to play golf, and in addition to the interesting events on the program, the visiting ladies enjoyed many shopping and sightseeing trips in company with an official chaperon.

The work of the members of the entertainment committees was most efficient in every detail. Credit is due them in a large measure for their part in making a success of the 1911 convention. Members and their guests were entertained in a most comprehensive manner, and the excellence of trips arranged afforded opportunity for both out of town delegates and those from New York and vicinity to gain a lasting impression of the magnitude of New York City and its environs.

Convention Notes.

One of the pleasant features of the convention was the presentation of a portrait of Miss Harriet Billings, assistant secretary and treasurer of the association. The portrait was presented by Mr. W. C. L. Eglin in the name of Mr. H. L. Doherty, who had intrusted the commission for the portrait to Miss Peterson, a well-known artist. In presenting the portrait, Mr. Eglin referred to the great service of Miss Billings to the association, which dated from 1891. During the greater part of the period Miss Billings was practically in charge of all the routine work of the body, and in addition was editor of the *Transactions*. She also greatly assisted the work of the committees, and performed much executive work of various natures. The labor of editing the *Transactions* alone was very great, as it was the ambition of Miss Billings to leave the record in a literary form that would compare favorably with the *Transactions* of professional societies. Mr. Eglin referred to the faculty of Miss Billings of inspiring confidence and enthusiasm among the members in the work of the association. Her many sacrifices and unselfish work should, he said, always be remembered with the deepest gratitude and appreciation. Mr. Samuel Insull, in seconding a motion to appoint a committee to send to Miss Billings an expression of the high appreciation of the members of the association for her activities in the past, said that any one who has been president of the association in its early days knows full well the great service rendered by Miss Billings, and added that it was a pleasant thought on the part of Mr. Doherty to present to the association the portrait of one who had labored so faithfully in its interest.

Portrait of Miss Billings.

NEW YORK EDISON BAEDEKER.

A New York Baedeker ("Glimpses of New York"), distributed at the convention by the New York Edison Company, was not only highly appreciated by all for the useful information it conveys, but by book-lovers among the attendants who were fortunate in obtaining a copy will be valued and preserved as a beautiful specimen of the book-making art. In general design, binding, paper, typography, and illustration, the little volume of about 150 pages is certainly unique as a production for ephemeral use. The numerous artistic illustrations, which include several excellent etchings, have their full value brought out by the manner in which they are printed and by the character of the type page. The little book well deserves preservation in permanent binding as a most tasteful production of the book-designer and printing press.

BULLETIN BOARDS.

The arrangements provided for keeping members in touch with proceedings at parallel sessions and for notifying members who were wanted on the telephone left nothing to be desired. The auditoriums were equipped with telephone and bulletin board service, by means of which the name and subject of each speaker were continuously displayed at the front of the hall. The bulletin was changed as rapidly as the papers and committee reports were altered in any particular session so that a person so desiring could leave one session to attend another, at which some paper in which he was interested was about to be presented. Persons desired on the telephone were apprised of this fact by having their names flashed on the wall by a stereopticon.

ELECTRIC VEHICLE LUNCHEON

At the close of the second commercial session on Thursday afternoon electric vehicle manufacturers and their agents were tendered a luncheon at the New Grand Central Palace by Mr. Arthur Williams, of the New York Edison Company. A number of vehicle men were present at the convention, and embraced the opportunity for an informal talk after the report of the committee on electric vehicles. A secondary purpose of the meeting, as explained by Mr. Williams, was to give the manufacturers an opportunity to inspect New York's latest and largest show place. About forty gentlemen were present at the luncheon, which was prepared entirely by electric heat.

EXCURSION TO POWER PLANTS.

As the concluding feature of the convention the New York Edison Company arranged a steamboat ride on the Hudson and East rivers Saturday, with stops at the Astoria plant of the Consolidated Gas Company and the Interborough Rapid Transit Company's station on West Fifty-ninth Street. The party was scheduled to leave Waterside Station No. 2 on the steamer *Majestic* at 11 o'clock. Luncheon was to be provided and an orchestra to entertain the ladies who did not wish to embark and go through the fatigue of inspecting the power houses.

REJUVENATION OF THE SONS OF JOVE.

About 500 members of the Sons of Jove held an annual rejuvenation and dinner at Reisenweber's Casino at Coney Island Friday night, initiating 125 novices. The dinner began at 6 o'clock, the members arriving by boat, train and special automobiles. Mr. T. I. Jones presided at the dinner, at which Messrs. W. W. Freeman and J. F. Gilchrist were guests of honor. Mr. J. F. Dostal, of Denver, the reigning Jupiter of the order, presided at the exercises, which were scheduled to begin at 8 o'clock. The original arrangements for the dinner and rejuvenation were made for Dreamland, Coney Island, but the destruction of the famous park by fire necessitated a change at the last minute. The Sons of Jove has a membership of almost 8000.

SPECIAL TRAINS.

Special trains bearing members and the guests to the convention arrived in New York Sunday afternoon and Monday. The largest trainload came from Chicago Monday morning with 134 persons aboard. It ran as a second section of the New York Central's Twentieth Century Limited, leaving Chicago at 2:40 p. m. Sunday and arriving in New York at 10:50 the following morning. A special car was added to the train at Cleveland and a stop of twenty minutes was made at Elkhart, Ind., to enable a group photograph to be taken. The arrangements for the train were in charge of G. A. Freeman, of the Commonwealth Edison Company, who acted as assistant master of transportation. The longest special trip was that made by the St. Louis party, who occupied a couple of special cars attached to the Pennsylvania Railroad twenty-four hour New York. The party left Union Station, St. Louis, at 12:20 p. m.

Saturday, reaching New York at precisely 1:20 p. m. Sunday. Several convention delegates from Illinois and Indiana points joined the party en route. The arrangements of the train were in charge of Mr. F. N. Jewett, of St. Louis, who acted as assistant master of transportation. A number of Bostonians journeyed to New York Sunday evening by boat, coming on the *Commonwealth* of the Fall River line, which, touching at Providence, took on several local electrical men, thus bringing in a party of forty. Another New England contingent of thirty followed Monday morning on the Bay State, Limited, from Boston.

BASEBALL TROPHY.

A very handsome three-handled silver loving cup lined with gold and standing nearly 12 in. high was presented to the association by the Westinghouse Electric & Manufacturing Company as a baseball trophy to be contested for by amateur company teams each year during the annual conventions. The design is by Tiffany. Engraved on the exterior of the cut is the following inscription: "Westinghouse Cup, presented by the Westinghouse Electric & Manufacturing Company to the National Electric Light Association (here follows the association symbol), to be competed for at annual conventions by baseball teams composed of members of the association and to be held in trust at association headquarters. MCMXI." The teams of the Brooklyn Edison and Philadelphia Electric companies were to compete for this trophy at the baseball grounds in Brooklyn on Wednesday afternoon, but owing to rain the game was abandoned, so that the first contest for the cup must be held at some future date.

Silver Baseball Trophy.

COMMERCIAL SESSION BANQUET.

One minute before midnight on Thursday a banquet was given at the Hotel Martinique to the officers, committee chairmen and committee members of the company section of the N. E. L. A. The masters of ceremonies were Messrs. J. R. Crouse and George Williams. Speeches were made by Messrs. Freeman, Gilchrist, Tait, Martin and others. The event of the evening was the announcement of the award in the membership contest, a silver loving cup having been donated by Mr. Crouse to the person who obtained the largest number of new members. The cup was won by Mr. A. S. Huey, of H. M. Byllesby & Company, Chicago, who had obtained 107 new members. Mr. George Williams, of H. L. Doherty & Company, made a close second with 106 new names. The cup was presented by President Freeman, and Mr. Huey, who was detained at home because of illness, was represented by Mr. E. S. Callahan.

ANNUAL MEETING OF CLASS D MEMBERS.

At 12:30 Thursday afternoon about fifty Class D members held a meeting in the summer garden arranged in the passageway east of the lobby. Mr. J. C. McQuiston presided, and Mr. Walter Neumuller, secretary-treasurer, read the minutes of the last meeting and presented his report. Mr. McQuiston referring to the convention in Seattle next year called upon Messrs. C. Blizzard, W. M. S. Miller, F. H. Gale and H. M. Wilson for a discussion as to the advisability of holding an exhibit on the Pacific Coast in 1912. Mr. McQuiston stated that there were excellent facilities for this purpose available in Seattle and those who spoke on the subject felt that the convention offered an opportunity of introducing many manufacturers to a new circle of friends and purchasers in the extreme Northwest. Messrs. F. H. Gale, C. W. Price and H. W. Young were appointed as a committee on nomination for members of the exhibition committee to succeed Messrs. J. I. Ayer, C. Blizzard and H. G. McConnoughy. The nominating committee recommended that the terms of the outgoing members of the committee be extended, and this recommendation met with unanimous approval.

CONVENTION DAILY.

One of the features of the convention was the *Convention Daily*, issued for the National Electric Light Association by courtesy of the *Electrical World* on Tuesday, Wednesday, Thursday, Friday and Saturday of the convention week. The entire staff of the *Electrical World* was placed at the disposal of the association, which was relieved of the entire expense and work incident to the issuance of a publication of this kind. The proceedings and incidents of each day were chronicled in the issue appearing the following morning at 6 o'clock. The paper was distributed to members registered at hotels and to all others attending the convention. The smallest issue contained twenty-eight pages the size of that of the *Electrical World*, and the largest issue contained thirty-six pages.

CURRENT NEWS AND NOTES.

Ceremonious Opening of Electric-Lighting Offices.—Elaborate preparations were made for the exercises connected with the opening of the brilliantly lighted offices of the Bristol (Tenn.) Gas & Electric Company on May 18. The company held a reception which is said to have been the most effective affair of the kind ever held in Bristol. The building was outlined with electric lamps forming a flaming sign that will be retained as a permanent feature of the illumination. The president of the company is Mr. H. L. Doherty; the general manager and chief engineer is Mr. S. M. Vance.

Reputed Fire Extinguisher Itself Inflammable.—Carbon tetrachloride, which has been recommended as a valuable fire extinguisher for use in telephone exchanges, power houses and other electrical installations on account of its non-conducting properties, is declared by chemists familiar with the material to be itself inflammable, assisting rather than retarding combustion. Carbon tetrachloride is said to decompose at 550 deg Fahr., burning with a blue flame and liberating pure chlorine gas, which is very poisonous. In a closed room this gas would probably suffocate any one attempting to use the tetrachloride before the fire could be extinguished.

Concrete Houser Lake Dam in Service.—As described in our issue for April 25 and May 23, 1908, the iron framework of the Houser Lake dam on the Missouri River near Helena, Mont., was destroyed by a flood on April 14. The iron dam has now been replaced by a reinforced-concrete structure 600 ft. in length by 130 ft. in maximum height, 110 ft. in maximum width at the bottom and 20 ft. in width at the top: the foundation is laid 65 ft below the bed of the river. The dam, which is being placed in service during the present month, is the property of the United Missouri River Power Company, Helena, Mont., which has taken over the Helena Power Transmission Company, for which the iron dam was constructed The president is Mr. S. T. Hauser and the general manager Mr. H. M. Gerry.

University of Nevada.—The Nevada State Legislature has appropriated $40,000 to purchase additional electrical equipment for the University of Nevada at Reno, the purpose being to make the electrical course there one of the strongest in the West. Prof. J. G. Scrugham is in charge of the electrical engineering department.

Free Telephone Service Illegal in Pennsylvania.—The Pennsylvania State Railroad Commission, which has jurisdiction over telephone companies, declared illegal and unlawfully discriminatory the practice of giving certain periods of free telephone service in consideration of contracts for a longer period of service at the standard rate.

Canadian 100,000-Volt Transmission System.—The Shawinigan Water & Power Company, which operates an 80-mile, 30-cycle system transmitting energy at 50,000 volts into Montreal, has begun work on a duplicate three-phase steel-tower line from Shawinigan Falls to Montreal to be operated at 100,000 volts. The new line will parallel the old line at a distance of about 10 miles.

Electrical Engineering at Clemson College.—It has been decided to discontinue the electrical engineering course at the University of South Carolina, Columbia, and those desiring to take up the study of that branch will be referred to Clemson College, which will be the only state institution conducting a professional electrical course. There have been fifty-eight graduates from the university's electrical engineering course.

To Investigate Corona Losses in Transmission Lines.—Experimental sections of high-tension transmission lines are being constructed on Stuart Field at Purdue University, Lafayette, Ind., to study the corona losses occurring under conditions of high potential. A steel and a wooden pole line are being erected, the latter arranged with movable insulator pins so that the distance between wires may be varied. These transmission lines will be excited from the 300,000-volt transformer in the electrical-engineering laboratory at Purdue.

Railway Signal Association.—The summer meeting of the Railway Signal Association will be held at the Hotel Astor, New York, June 13-14. Reports will be submitted by twelve standing committees and several special committees. Among the papers to be presented is one by Messrs. W. K. Ferguson, R. E. Russell and E. E. Kimball on "Apparatus for Charging Storage Batteries." An important matter to be considered at the meeting will be the subject of signal symbols. Mr. C. C. Rosenberg, consulting signal engineer, Bethlehem, Pa., is the secretary.

Underground Conduits for Montreal.—A commission has been appointed to determine details of the municipal electrical circuit conduits to be constructed by Montreal in accordance with a charter amendment which authorizes the construction, administration and maintenance of a system of underground conduits to carry all electrical circuits. The commissioners appointed are: Mr. R. S. Kelsch, consulting hydroelectric engineer, representing various electrical companies operating in Montreal; Mr. Beandry Leman, manager of the Canadian General Development Company, representing the city of Montreal, and Prof. Louis A. Herdt, of McGill University, representing the Quebec Public Utilities Commission.

A. I. E. E. Visit to McCall's Ferry Plant.— On Sunday, May 21, members of the Washington and Baltimore Sections of the American Institute of Electrical Engineers, the Washington Society of Engineers and the Engineers' Club of Baltimore, aggregating more than 190 men, were carried on a special train to Holtwood, Pa., where they inspected the large hydroelectric plant of the Pennsylvania Water & Power Company. Four units, three of 7500-kw and one unit of 10,000-kw rating, have been placed in operation, and the fifth unit is now being installed. Mr. John Abbet Walls, chief engineer of the company, assisted by a number of other officials and employees, took the excursionists over the plant and explained in detail its numerous interesting features.

Merger of Chicago Elevated Roads.—The elevated railway companies of Chicago, through their directors, have agreed to the terms offered by Mr. Henry A. Blair for the merging of the overhead routes, and the consolidation of the roads will follow as soon as the stockholders ratify the action of their directors, which is confidently expected. The South Side Elevated Company has accepted the offer of $75 a share for its stock, allowing dividends of cash on hand above liabilities to be returned to its stockholders. The merger terms have also been accepted by the Metropolitan West Side Elevated and the Northwestern Elevated companies, the latter of which controls the Chicago & Oak Park Elevated Railway and also owns the Union Elevated Loop. June 15 has been set as the date of the transfer. After the plans of the elevated-lines merger have been worked out and are in effect, it is expected that the pending merger of the surface lines with the elevated routes will also be consummated. This deal will involve a total of $271,000,000 of existing securities of Chicago transportation properties.

Minneapolis Electric Show for 1912.—Plans have already been formulated for the Minneapolis Electric Show to be held March 16 to 23, 1912. In addition to the Electric Show proper a mechanical and industrial exposition is to be given, a feature of which will be a special exhibition of commercial and pleasure electric vehicles. The 1912 Minneapolis show will be given under the auspices of the Northwestern Electric Show Association, the officers of which are: President, Mr. Fred G. Dustin; vice-president, Mr. H. J. Gille; secretary, Mr. Walter Stevenson, and treasurer, Mr. A. W. Leonard. The directors are Messrs. George Cadwell, C. D. Wilkinson and Theodore Hayes. Mr. Robert W. Clark has been again chosen as general manager of the exposition. The meeting of the Minnesota Electrical Association will be held in Minneapolis at the time of the Electric Show, and there are also to be other important electrical sessions, among which will be the Northwestern meeting of the American Institute of Electrical Engineers under the auspices of the local branch. Realizing the educational advantages of the show, the Minneapolis Commercial Club has arranged to award prizes for electrical apparatus made by students.

Ithaca A. I. E. E. Annual Dinner.—The Ithaca Section of the American Institute of Electrical Engineers held its fourth annual dinner Wednesday evening, May 24, at which over 100 members were present. Prof. E. L. Nichols, head of the department of physics, was toastmaster. The guest of honor was Mr. P. M. Lincoln, chairman of the sections committee of the A. I. E. E. Mr. Lincoln gave a short address, taking as his subject "Looking Forward." Prof. Vladimir Karapetoff, who gave a talk in behalf of the unsuccessful student, caused much amusement by his witty remarks. Mr. W. M. Alexander, of the General Electric Company, who happened to arrive in Ithaca that evening, made a few remarks on the relation that should exist between the colleges and manufacturers in the education of young engineers. Several novel features were introduced during the evening. Among them an electrical "stunt" was very successful. As the guests entered they were forced to pass between two small cedar trees placed so that they brushed against them. The trees were connected to the terminals of a 30,000-volt static machine operated by a small motor. No wires were required on the trees since the fresh wood made a sufficiently good conductor. The shock was not heavy enough to be unpleasant, but caused some surprise and gave amusement to the guests who had previously passed through.

NORTHWEST STATION, CHICAGO.

Commonwealth Edison Company's Generating Plant, with 20,000-kw Units, Now Building.

In his annual report dated Sept. 30, 1910, the president of the Commonwealth Edison Company, Chicago, made this brief statement: "In order to take care of the company's continued increase in business your directors have acquired 112 acres of land on the North Branch of the Chicago River, north of Belmont Avenue, for the purpose of building thereon a central power plant which will have an ultimate capacity of 360,000 hp. Work on the first section of this plant is now in progress, and it is expected that 60,000 hp of machinery will be installed and in operation by next autumn."

This official announcement by Mr. Samuel Insull refers to perhaps the largest electric generating station now under construction, which has several features of particular interest and significance. The *Electrical World* of March 17, 1910, contained the anouncement of the building of this station, with a general forecast of the manner in which it would be constructed. The plans have been changed to some extent since that time, but the map of Chicago and vicinity then given, showing the relative location of the new station, may be consulted in connection with the present article, which is intended to give a brief outline description of the plant at a time when the work is well advanced toward completion.

Unceasing growth is a characteristic, of course, of successful electric-service companies. It is interesting to recall that at the time of the Chicago convention of the National Electric Light Association in 1903 the Fisk Street station of the Commonwealth Edison Company (or Commonwealth Electric Company, as it was then) was under construction. Five years later, when the association met again in Chicago, the later Quarry Street station, near neighbor to "Fisk Street," was building, and now, after a lapse of three years, the association is meeting at a time when a greater station than either is under construction in Chicago—a station to have when completed twice the rating of the famous Fisk Street plant.

The present generating rating of the Commonwealth company is about 240,000 kw, divided as follows: Fisk Street, 120,000 kw; Quarry Street, 84,000 kw; miscellaneous plants and storage batteries, 36,000 kw. At the new Northwest site there will be ultimately two stations of 120,000 kw rating each, making a total of 240,000 kw on this site, or 480,000 kw in all. Fig. 1 is an architect's perspective of the twin Northwest stations as they will appear when completed. The remarkable growth of the company's business is indicated by the figures given. The demand for electricity increases steadily with the growth of Chicago, improved engineering to reduce the cost of the output and modern methods of merchandising to demonstrate the logic of central-station service for all classes of electrical demand. The total maximum demand on the stations last winter was 184,000 kw, which, compared with the maximum rating of 240,000 kw (including storage batteries), shows that, to preserve the margin of safety, the need of further extensions with the constant growth of the company is a real one.

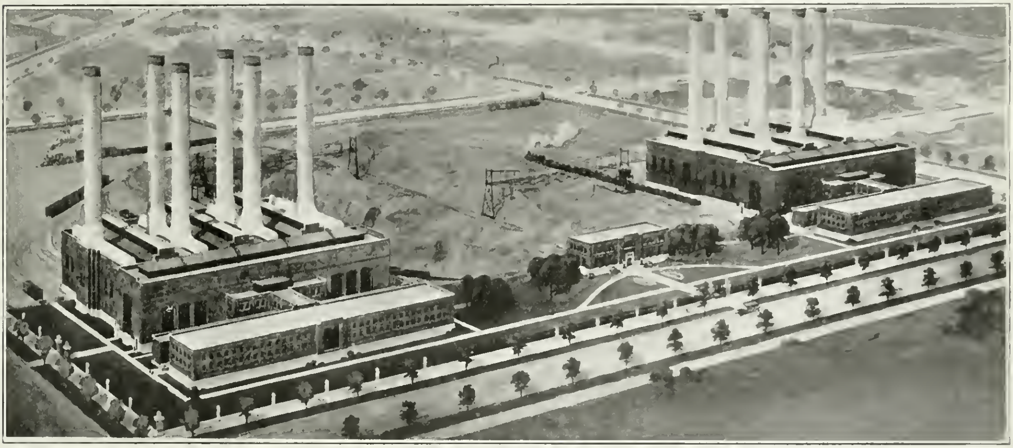


Fig. 1—Northwestern Station, Chicago, Showing Twin Power Houses as They Will Appear When Completed.

GENERAL ARRANGEMENT AND METHODS.

Work has been under way for over a year on the site of the new stations. Only a portion of one of the twin plants is under construction at the present time, but, as shown by Fig. 2, the initial station equipment is itself very large. The station now under way will contain ultimately six 20,000-kw turbo-generators. The initial-equipment installation will consist of two of these units, or one-third of the ultimate equipment of the station. In order to effect economy in construction, however, more than one-third of the completed station is being built at the present time. For instance, the turbine-room is provided with an operating gallery forming a bay at one side of the room and equidistant from the ends of the completed room, as shown in the general-arrangement plan, Fig. 3. The portion of the turbine-room now building will include this bay for the operating gallery complete, so that about two-thirds of this particular portion of the plant is under construction at the present time. It may be said, perhaps, that nearly one-half of the ultimate first station is now under construction, although the initial rating will only be one-third of the completed station.

As stated by Mr. Insull in his annual report, the site of the new Northwest station embraces 112 acres of land. This site consists of two large portions, with a wide connecting strip. One of these borders on the North Branch of the Chicago River and in general terms is bounded by West Addison Street on the north, the river on the east, West Roscoe Street on the South and North Sacramento Avenue, North Whipple Street and Elston Avenue on the west. This portion of the site contains fifty-three acres, and is the actual site of the new generating station. West of it is another large area, bounded by West Addison Street on the north, North Kedzie Avenue on the east, West Roscoe Street on the south and North Kimball Avenue on the west. This is contiguous to the Chicago & Northwestern Railroad tracks, and may ultimately be used in part for switch tracks and coal storage. Connecting these two portions is a strip of land 150 ft. wide, and on this strip has been built a two-track elevated railway to be electrically operated, forming a spur line connecting the Chicago & Northwestern Railroad tracks with the station. Coal will be delivered over this elevated railway. Fig. 8 is a map of the property showing elevated railway.

The cable distance from the new Northwest station to the center of the downtown district will be about 6 miles, which is substantially the distance in an air line. The cable distance between the Northwest station and the Fisk Street station will be about 8 miles. Northwest station, like other large generating stations, is essentially a great manufacturing plant: Coal is brought from the west over the company's own elevated railway, and water is brought from the North Branch of the Chicago River at the east, a much shorter distance to the generating station. From these raw materials electricity is manufactured and distributed. The handling of the coal is a very important item in a large modern steam central station, and careful attention has been paid to it at this new location.

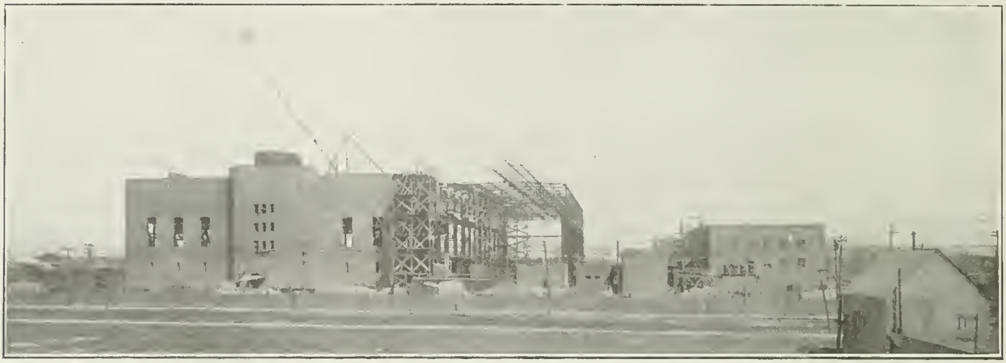


Fig. 2—Northwest Station, Chicago, at the Present Time Under Construction.

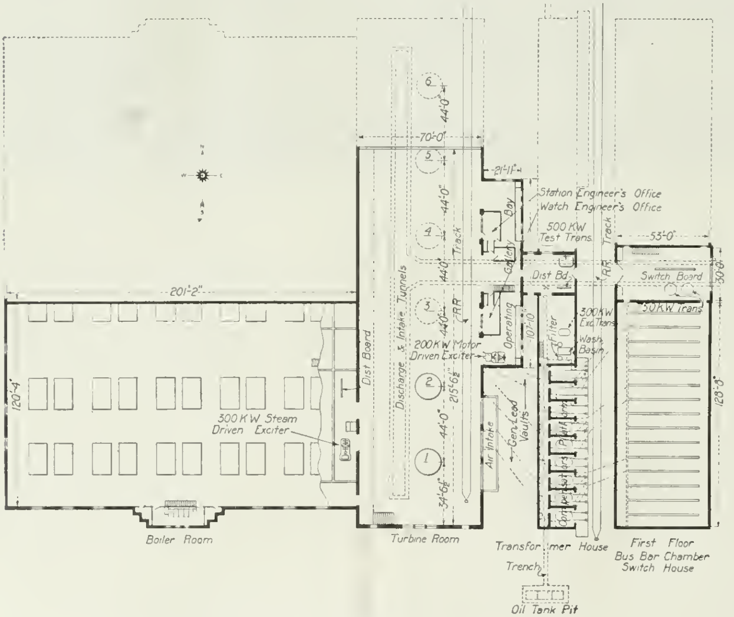


Fig. 3—General Arrangement Plan of First Floor.

THE ELEVATED RAILWAY AND THE EMBELLISHMENT FEATURES.

The territory in which the Northwest station is built is thickly settled only in spots, but the company is making every effort to make the new institution not only a great addition to the neighborhood in an industrial sense, but also, in many ways, an improvement in esthetic conditions. The elevated railway, which is about 4000 ft. long, is very thoroughly built, and is provided at five street crossings with substantial yet attractive steel bridges.

As shown in Fig. 8, the railway is laid out in switchback fashion west of the two power houses, as they will exist eventually. This portion of the railway, inside the eastern grounds of the company, is at grade. The switchback is arranged to provide a smooth and easy descent for the loaded coal cars coming from the elevated portion and also permit of the taking off of switch tracks in an advantageous manner. Including the switchback, there will be over 3 miles of track on this railway. It is owned and operated by the Commonwealth Edison Company, using, eventually, 600-volt direct current. The third-rail system will be used to supply energy to electric locomotives which will haul the coal cars.

An important feature of the Northwest station is the care taken to make it attractive. The company is going to considerable expense to make the institution something of which the people living in the neighborhood will be proud. On the railway right-of-way houses have been moved, and in relocating them the company has also repaired and improved them. The sides of the elevated structure will be sodded, and all about the plant when completed there will be attractive fences and ornamental lighting systems.

Particularly elaborate is the beautification proceeding at the corner of Elston Avenue and West Roscoe Street. Here two frame houses that existed on the property have been remodeled for the company's uses, one serving for offices and the other as a restaurant, and the grounds about them are being sodded and set out with flowers, shrubbery, etc., and provided with winding cement walks. When completed the appearance of this corner of the property will be no doubt the most attractive, park-like feature of the neighborhood, and the pains the company is taking in this matter in-

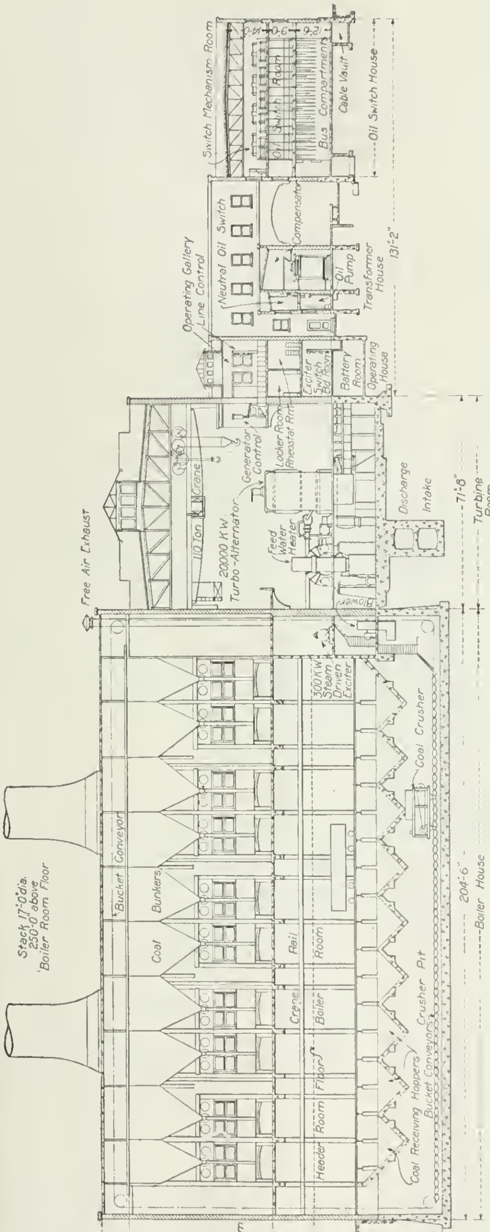


Fig. 4—Sectional Elevation of Northwest Station, Looking North from Unit No. 2.

dicate forcibly a comparatively new conception of what a central-station company owes to its neighbors in beautifying its property. It is hoped that people living in the vicinity will look on the new station as no undesirable intruder

STATION CHARACTERISTICS AND DIMENSIONS.

As indicated in Fig. 3, Northwest station consists essentially of four parts in three distinct buildings, yet so connected as to form a compact and conveniently arranged whole. Referring to the general arrangement plan and sectional elevation it will be seen that the four portions of the plant are the boiler house, the turbine-room, the transformer house and the switch house. The station now under construction is near the corner of West Roscoe Street and North California Avenue, and the greater dimension of the station is from east to west, or parallel with West Roscoe Street. The station group is 411 ft. long—that is, from east to west—and when completed will be 294 ft. 5 in. wide—that is, from north to south. The turbine-room, transformer house and switch house have their major axes from north to south, but the rows of boilers in the boiler house will extend at right angles to the turbine-room or from east to west. The inside dimensions on the four sections of the plant, from east to west, are as follows: Boiler-room, 201 ft.; turbine-room, 70 ft. (operating gallery of turbine-room, 22 ft.); transformer house, 20 ft.; switch house, 53 ft. North and south the turbine-room is being built now for a length of 218 ft. As previously explained, the other parts of the station are not being extended as far as this at the present time. The north wall of the present station is of a temporary nature, to be taken out as extensions are made.

The buildings are of steel-frame construction, with outer walls of hard-burnt red paving brick. The foundations, basement walls, coal-receiving hoppers, cribs and tunnels are made of reinforced concrete. The architectural design of the building exteriors is simple and massive, but is relieved by a number of panel designs in courses of brick.

COAL-HANDLING AND BOILER-HOUSE DESIGN.

Considering first the boiler house at the west, and referring to Figs. 4 and 5, it will be seen that a large proportion of the coal is handled under the boiler-room floor. This makes for greater ease and convenience in handling and does not require such heavy steel construction for overhead hoppers. There is no train shed, as is the case at Fisk and Quarry Streets, the basement of the boiler house answering that purpose. Four railroad tracks enter this basement at present, two being used for the delivery of coal and two for the removal of ashes. As there are four boiler-house railroad tracks for each pair of generating units, there will be twelve in the completed station.

The coal-handling arrangement is notably simple and effective. The coal is brought into the basement by electric locomotives hauling the coal cars in which it is delivered. It is there dumped directly into coal-receiving hoppers or handled by an overhead coal crane in case of cars without hopper bottoms. From these receiving hoppers the lump coal is run through a traveling coal crusher which is provided with a by-pass for the fine coal. The crushing machinery is in a deep pit, as shown in Fig. 5, while the boiler-room floor, as shown in the longitudinal section, Fig. 4, is on a comparatively high level, being, in fact, on the same level as a gallery in the turbine-room, enabling the boiler-room operating engineers to obtain a survey of the entire turbine-room from this somewhat elevated position.

From the coal crusher the fuel is discharged into a coal conveyor which takes it to overhead bunkers over the firing space, whence it is spouted into the mechanical stokers of the boiler furnaces. The removal of ashes is accomplished simply by dumping the ashes from the furnaces directly into cars placed on the ash-removal tracks beneath the ash pits of the furnaces. Coal-storage space is provided in the yards to the extent of 150,000 tons for each station. Spanning each of these coal piles will be an electrically operated gantry crane with 265-ft. span. In addition, the storage capacity of the receiving hoppers beneath the boilers is 74 tons for each boiler, while the capacity of the overhead bunkers is 63 tons for each boiler.

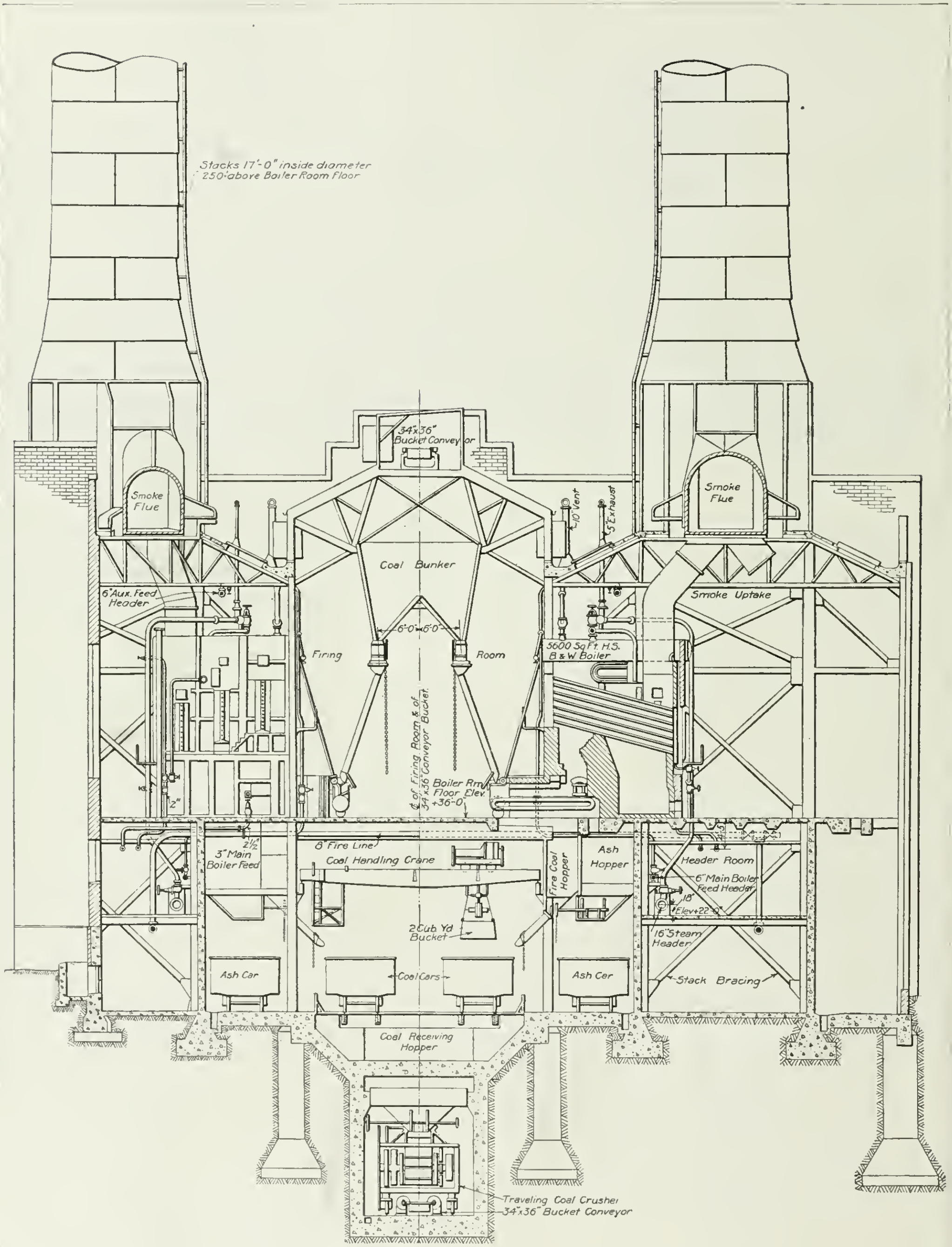


Fig. 5—Cross-Section of Boiler-Room of Northwest Station, Chicago, Looking West.

Ten boilers are provided for each 20,000-kw unit, the boiler lanes running east and west and at right angles to the major axis of the turbine-room, which is north and south. Each boiler has 5600 sq. ft. of heating surface and is inclosed in a sheet-steel casing. The boilers are equipped with chain-grate stokers and the ten boilers for each unit are placed in a row. The working steam pressure will be 250 lb. per square inch, which is from 25 lb. to 50 lb. greater than the usual steam pressure in generating stations. For the completed station there will be six chimney stacks, and three of these will be erected for the portion now under construction. These stacks are circular in section and constructed of steel lined with fire-brick. They are 17 ft. in inside diameter and extend 250 ft. above the boiler-room floor. The basement of the boiler house also contains the machinery for the oiling system for the station.

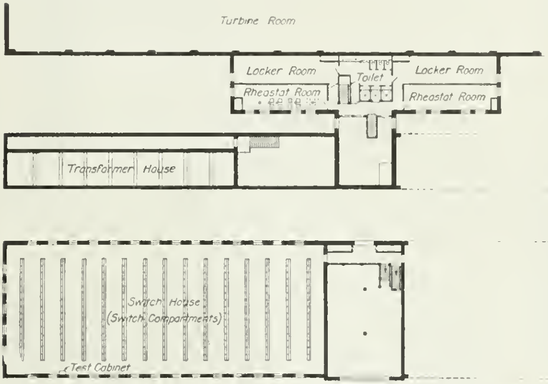


Fig. 6—Second Floor of Operating-Gallery Bay and Switch House.

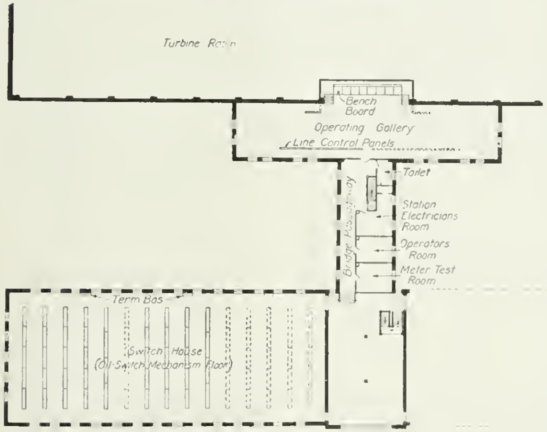


Fig. 7—Third Floor of Operating-Gallery Bay and Switch House.

TURBINE-ROOM EQUIPMENT.

The turbine-room, directly east of the boiler house, will contain when completed a row of six 20,000-kw turbo-generator units. Two of these will constitute the initial installation These units will be the largest electric generators ever built, and the first two will consist of 4500-volt, 25-cycle, three-phase, alternating-current generators vertically mounted on steam turbines provided with condensers in the base and below the turbine-room floor. Some of the future units will no doubt be built for a frequency of 60 cycles. Ventilating ducts leading to the tops of these units will be provided, as in the case of the units at the Quarry Street station.

Aside from the condensers, the other steam auxiliaries will be placed on the turbine-room floor. They will be arranged on the unit system, somewhat similar to the plan followed at Fisk Street. All of these auxiliaries will be steam-driven. In the completed station there will be four exciters, two, rated at 300 kw each, driven by steam turbines, and two, rated at 200 kw each, driven by electric motors. There will also be a storage battery for excitation and another storage battery for operating switches and for emergency lighting.

The turbine-room is 55 ft. high from the floor to the bottom of the roof girders. It is finished in white enameled brick and is spanned by a 110-ton overhead traveling crane. The generating units are 27 ft. high from the floor to the top of the governor, and are 15.5 ft. in largest diameter. Each one is provided with a 16-in. steam header. It is an interesting fact that these great 20,000-kw units are spaced on 44 ft. centers, whereas the 12,000-kw units at Fisk Street are spaced on 42-ft. centers. A notable increase of output per square foot of turbine-room area is thus secured by the larger units. The turbine-driven exciters are placed in an alcove under the boiler-room floor, while the motor-driven exciters are in an alcove under the operating gallery. The illumination of the turbine-room will be furnished by flaming-arc lamps placed on the ceiling girders. There will be no bracket lamps and thus no direct light in the operators' eyes. A railroad track extends the entire length of the turbine-room near the east wall.

INTAKE AND DISCHARGE TUNNELS.

Condensing water will be obtained from the North Branch of the Chicago River. A crib is being built at the river's edge at a point equidistant from the present station and the second station, and from it an intake tunnel will lead to the turbine-room of each station. The second station will be built north of the present station, and is planned to be a duplicate of it. In the case of the present station the intake tunnel will be about 1200 ft. long. It will be approximately rectangular in shape and about 90 sq. ft. in section. The discharge tunnel will be over the intake tunnel and follow the same route for the greater part of the length of the intake tunnel, departing from it, however, to discharge directly into the river. The path of these tunnels is shown on Fig. 8. Where one tunnel is thus superimposed above the other they are built together in the form of one reinforced-concrete structure.

OPERATING GALLERY.

As shown in Fig. 3, the operating gallery is in a bay on the east side of the turbine-room. This operating-gallery bay consists of three floors. A new feature is a separate rheostat-room (shown in Fig. 6), on the second floor of this bay, in which are placed all generator rheostats. The two storage batteries previously mentioned are in the basement of the operating-gallery bay. The operating gallery proper is on the third floor of this bay and is connected with the switch house by a covered passageway leading over the transformer house, as shown in Figs. 4 and 7. The operating gallery proper projects into the turbine-room in such a manner that the switchboard operators have a full view of all generating units and accessories on the turbine-room floor. The generators are controlled from benchboards located here, while the line-control switches and instruments are placed on vertical panels.

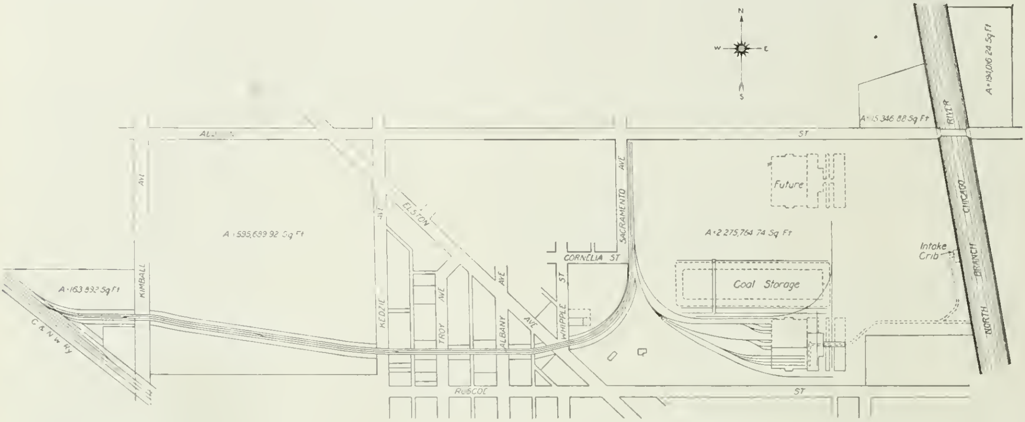
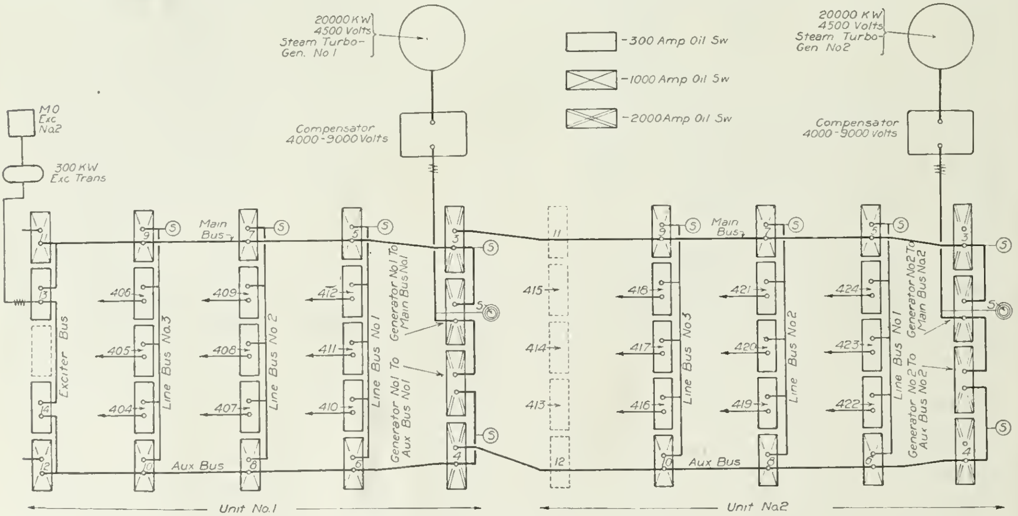


Fig. 8—Map of Northwest Station Property, Chicago, Showing Elevated Railway for Coal Delivery.

BUILDING FOR TRANSFORMERS

Lead-covered cable leads pass from the generators to the transformer house, which is in a separate one-story building directly east of the turbine-room, and like it, having its major axis north and south. In this transformer house there are three 3333-kva auto-transformers for each unit, raising the generator potential from 4500 volts to 9000 volts. These transformers are oil-insulated and water-cooled. Each stands in a separate fireproof compartment and is placed on a truck which can be moved out to an unloading platform and transferred directly to repair shops on a railroad track. The oil-pump room, the neutral oil-switch room and the neutral busbars are also placed in the transformer house. South of the structure is an oil-tank pit, with a reservoir serving to drain oil from the transformers in emergency.


20000 KW 4500 Volts Steam Turbo-Gen. No 1
20000 KW 4500 Volts Steam Turbo-Gen No 2
-300 Amp Oil Sw
-1000 Amp Oil Sw
-2000 Amp Oil Sw
MO Exc No 2
300 KW Exc Trans
Compensator 4000-9000 Volts
Compensator 4000-9000 volts
Main Bus
Aux Bus
Exciter Bus
Line Bus No 3
Line Bus No 2
Line Bus No 1
Generator No 1 To Main Bus No 1
Generator No 1 To Aux Bus No 1
Generator No 2 To Main Bus No 2
Generator No 2 To Aux Bus No 2
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424
Unit No. 1
Unit No 2

Fig 9—Diagram of Electrical Connections.

SWITCH HOUSE AND SWITCH GEAR.

East of the transformer house is a switch house forming a separate structure, and the most eastern of the group. The 9000-volt leads from the auto-transformers to the switch house are covered with double-braided varnished-cambric insulation, and are supported in a special vault, in a manner similar to the high-tension buses. The switch house has three floors. On the first floor are the high-tension buses, the instrument transformers and the bells of the outgoing transmission lines, of which there are nine for each unit, with an arrangement to take care of twelve ultimately for each unit. On the first floor the line and generator buses run east and west, while the main and auxiliary buses run north and south. Fig. 9 is a plan of the buses and the line connections, showing this simple and convenient arrangement.

The second floor of the switch house is the oil-switch room. There are nineteen oil switches for each unit. Of these nine are line switches, eight group and tie switches and two generator switches. Only the oil pots and disconnecting switches are on this second floor. A special feature is that the oil pots are arranged in single rows rather than in double lines. Thus there are provided four rows of oil pots for each unit, space being left for a fifth row. The single-row arrangement simplifies materially the busbar connections. Each phase will have a lengthwise compartment of two oil pots arranged longitudinally rather than transversely. This arrangement also insures greater safety, because the longitudinal arrangement permits protection for each line of oil pots by a solid wall without sacrificing ease of inspection and cleaning.

The third floor of the switch house will contain all the operating mechanisms for the oil switches, entirely separate from the parts carrying high-tension currents. The operating mechanisms are raised only slightly from the floor, with the exception of the generator and tie switches, which will have part of the oil-switch compartments above the floor. Figs. 3, 6 and 7 show the general arrangement of the three floors of the switch house.

In the basement of the switch house there will be two cable vaults running north and south, one placed next to the east wall of the building and one next to the west wall. These are for the outgoing transmission lines and are connected by means of ducts in such a way that several distinct routes of cable runs to various parts of the city may be established. The main bus walls in the switch house are of concrete, while all barriers and switchboard compartments are made of "elecrete" slabs. Of course, the whole station is made as nearly fireproof as human ingenuity can devise.

STATION LIGHTING, HEATING AND MOTOR SERVICE.

All the lamps and motors on the premises will be supplied with energy from 60-cycle, 115-230-volt circuits. Two 750-kw, three-phase transformers in the switch house will supply this energy, at first receiving 12,000-volt, 60-cycle energy from the Quarry Street station and reducing the emf to 230 volts. Ultimately, however, 60-cycle energy will be generated at Northwest station. All motors used within the plant, including crane motors, will be of the induction type exclusively. The motor load will be about 900 hp connected rating, while about 2100 incandescent lamps and fifty arc lamps will be required.

Three distribution boards for local lighting will be placed about the premises—one in the switch house, one in the transformer house and one in the boiler-room. Direct-current incandescent lighting will be provided in the watch engineer's office, in the exciter switchboard rooms in the operating-gallery bay, and in the operating gallery itself. These circuits will be connected to a storage battery so that they cannot fail in any conceivable emergency.

For testing generators and connections and transmission lines a 500-kva, 20,000-40,000-60,000-volt transformer will be placed in the transformer house. The primary winding of this transformer will be actuated by 25-cycle, 300-volt energy supplied from a motor-generator set.

A passageway will connect the basement of the operating gallery of the turbine house with the basement of the transformer house and the basement under the central portion of the switch house. This passage will contain steam-heating mains and ventilating ducts. The operating gallery and the switch house will have an indirect-heating system, warm air being supplied from heating coils in the switch-house basement. Steam for these coils will come from the boiler house through the passage mentioned, and warm air will be forced into the different rooms by ducts. A ventilating system will also be provided.

CONCLUSION.

It is expected that the first of the generating units will be in operation by September next. During construction an extensive use of electrical energy is made in operating hoists, concrete mixers, etc. For this construction service, including also temporary lighting, a bank of three 50-kw transformers has been erected.

The list of architects, engineers and principal contractors engaged on this large and extremely interesting plant is as follows: Architects, Holabird & Roche; consulting engineers, Sargent & Lundy; electrical engineers, engineering department of Commonwealth Edison Company; general contractor, George A. Fuller Company; structural steel and elevated-railway bridges, George W. Jackson, Inc.; docks, tunnels and track construction, James O. Heyworth; boilers and furnaces, Babcock & Wilcox Company; generating units, exciters, oil switches and electrical equipment, General Electric Company; condensers, Henry R. Worthington; turbine-room crane, Morgan Engineering Company; coal conveyors, Mead-Morrison Manufacturing Company; coal-handling crane, Whiting Foundry Equipment Company.

MUNICIPAL WATER-POWER PLANT AT BLACK RIVER FALLS, WIS.

WITH the great leaps and bounds by which the use of electricity is advancing for uncounted purposes the design of any generating station, whatever its present size, must take into consideration extensions of equipment to serve the growing demands of the next few years. The accompanying illustrations show how the future has been provided for in the construction of a small municipal water-power station in Wisconsin, the design having been carefully worked out so that an increase in generating capacity of 300 per cent can be made with a minimum of expense when the changes are to be effected.

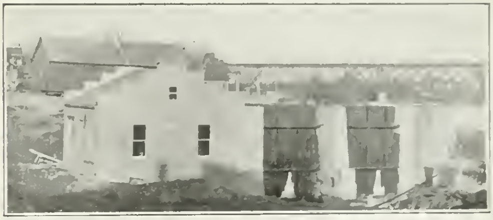


Fig. 1—Exterior of Power House, Showing Provision for Extra Water Wheel Unit.

The plant is that of the City of Black River Falls, in south central Wisconsin, and utilizes an 18-ft. head in the Black River which passes through the town and gives it its name. The local plant enjoys the advantage of being about twelve miles below the extensive water-power developments of the La Cross Water Power Company, at Hatfield, and gains the benefit of the great season-storage reservoirs impounded behind the dams of this company on the headwaters of the Black River. A highly uniform stream flow is thus assured to the municipal plant throughout the year.

The first installation made in the Black River Falls plant, which was only recently completed, consists of a single 400-hp pair of Leffel waterwheels direct-connected to a 400-kw, 2300-volt, 60-cycle, three-phase Fort Wayne alternator. The present waterwheel unit is installed in the first bay of the waterwheel chambers, seen next to the power house in the illustration, and

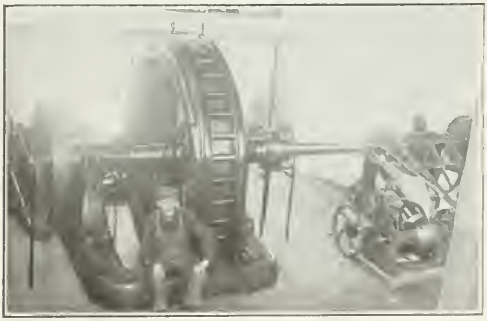


Fig. 2—Interior of Municipal Water Power Plant at Black River Falls, Wis.

though rated at only 400 hp is large enough to carry the present station demand on the 400-kw generator. To operate this machine at full load, of course, about 700 hp will be required, and when the load conditions reach this point the second 400-hp pair of waterwheels will be mounted on the same shaft, which extends through the middle concrete wall and into the second wheel pit, shown at the right. Later, it is expected that the use of electricity in the town will exceed even the full-load rating of the 400-kw machine, and then a second similar unit will be installed in the partially completed wheelpit toward the foreground of the picture, the shaft openings for the future wheels being shown in the illustration. The bulkhead wall of the present wheel pits is formed of heavy wooden planking supported by steel beams, and when the second unit is installed it will be necessary only to move these bulkheads a few feet down stream to the new sockets provided for them. The planking was used for making this closure in preference to a permanent concrete wall, which would have been expensive to tear out and rebuild in the downstream position. However, the back penstock wall shown will be moved down and made of reinforced concrete.

The governor of the present waterwheel unit is of the Woodward mechanical type and the exciter generator is belt-driven from the main shaft. The foundations and walls of the power-house structure are all of concrete, being made water-tight up to the sill of the entrance door as a protection against backwater from the tail-race in case of flood. Mr. Theodore Mason is chief electrician of the Black River Falls municipal lighting plant, which was designed and installed under the direction of Messrs. A. L. Bogart and J. W. Schuman, of the Power Engineering Company, consulting and contracting engineers, Minneapolis, Minn.

COMBINATION WATER-WORKS AND ELECTRIC PLANT AT WINNETKA, ILL.

WINNETKA, Ill., a residential suburb containing 3600 mostly well-to-do people, on the shore of Lake Michigan, 17 miles north of Chicago, has finished reconstructing its municipal water-works and electric-lighting plant, including the addition of new machinery. The plant is on the lake shore at the foot of a 70-ft. clay bluff, on the top of which is the village. In exterior finish the station, together with the water tower on the plateau above, is a really ornamental addition to its attractive neighborhood. The building, 125 ft. x 54 ft., exclusive of its hillside coal bunkers, is of red pressed brick, with green wooden trimmings and a tile roof. Since the plant was started on a small scale eleven years ago all additional buildings and equipment, including the repayment of the first investment and the setting aside of a $7,000 fund, have been paid out of the actual plant earnings. The present plant, including distribution, cost about $80,000.

Fig. 2—Exterior View of Station.

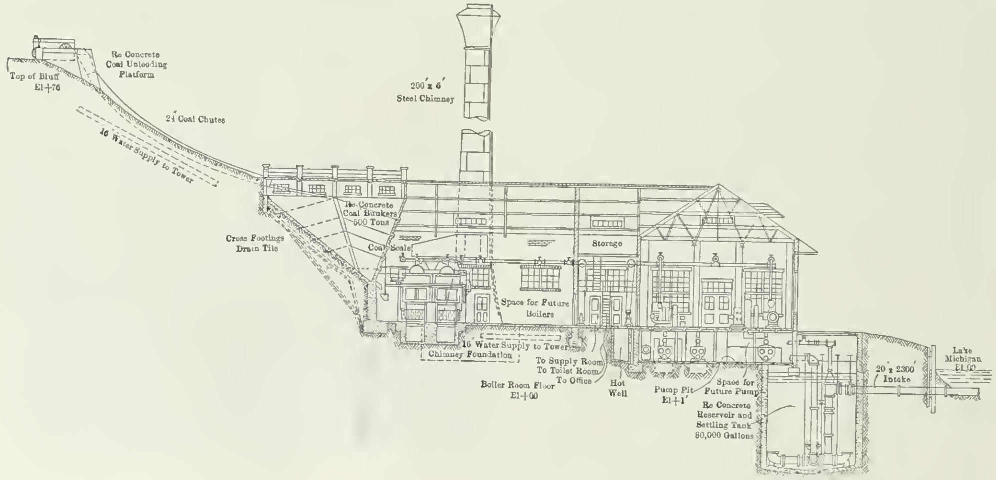


Fig. 1—Longitudinal Section of Combined Water-Works and Electric Plant at Winnetka, Ill.

The hillside arrangement of the station has made it possible to adopt several ingenious expedients for conveying coal down to the plant. Wagons loaded with coal are backed up to and dumped into the concrete coal hopper at the top of the bluff. From this hopper lead two 24-in. concrete tubular chutes to the bins below. By means of a gate in the hopper the coal can be sent down either chute as desired. At the lower end of each chute is a similar steel gate, which can be thrown to deliver coal into either of the pair of bunkers to which the chute delivers. In this way by proper setting of the gates the coal wagon, 60 ft. above, dumps directly into any one of the four bins desired. The four bunkers will hold 600 tons of coal. The entire construction is of reinforced concrete, and the weight of the mass is sustained by a 6-ft. x 3-ft. x 54-ft. concrete truss bedded on the clay bottom.

From the sloping bottom of the bins four valves open into the boiler-room, and can be used to fill a 600-lb. trolley bucket running on an overhead track past the bunker valves and the three boiler units. The two 200-hp Heine boilers are equipped with Illinois chain-grate stokers, and the third, 80-hp, boiler, which is held in reserve, is fitted with an American mechanically operated underfeed stoker. The flue gases from the furnaces are led to a 200-ft. self-supporting steel stack, foundationed outside the building. This stack is 16 ft. in diameter at its base and tapers upward to a diameter of 6 ft. at the top. All coal fed to the furnaces is weighed in the hopper bucket on a section of the overhead track, which is supported by a scale beam.

Between the boiler-room and the engine-room is an intermediate 15-ft. x 54-ft. space fitted up as a machine shop with lathes, drill press, shaper, etc. A skilled machinist is employed as operating engineer, and practically all the plant repairs are made in the station. The engineer consequently spends much of his time in the machine shop, and as this room is fitted with large glass windows opening into both the boiler and engine-rooms, he is in immediate supervision of the entire plant at all times, although engaged usefully in repair work. One end of the machine shop is inclosed for an oil-storage-room. and adjoining it is a modern toilet and bathroom. Over these is the plant office, and on the floor above is a general supplies storage space. The location of the machine shop between the engine and boiler-rooms also prevents smoke and dirt reaching the machines, which was a partial reason for this design.

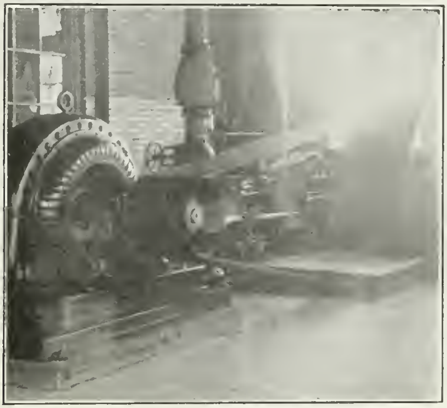


Fig. 3—Engine-Driven Alternator in Winnetka Plant.

The engine-room is 40 ft. x 54 ft. in floor dimensions with clear head room of 22 ft. to the underside of the 13-ft. roof trusses. It contains one 300-hp Erie City tandem-compound, four-valve engine belted to drive a Western Electric 2300-volt, 60-cycle, two-phase alternator at 900 r.p.m. The exciter is belt-driven. The other and smaller generating unit comprises a 200-hp Erie City simple engine driving a 115-kw Bullock alternator with exciter on the generator shaft. Both of these machines, including the steam pumps in the basement, are operated condensing, exhausting into Deane jet-type condensers.

Supplies for the plant, oil, machinery, etc., can be lowered down the bluff by a small car which runs on a track out of the plant and thence onto the steel sidepieces of the iron stairway up the bluff. One of the hollow handrails is continuous throughout the length of the stair, and through this will be run a cable from a winch in the power house below. At the top of the railing will be a folding, ornamental pulley beam which can be placed across the passage, serving as a block by which the car can be hoisted up the incline by the winch.

The steam pumps for the water-works are located in the open basement at a level 8 ft. below the generator-room floor and about 16 in. above the mean height of Lake Michigan. There are two 635-gal. pumps and one larger pump delivering 2,000,000 gal. per twenty-four hours. The steam cylinders of these pumps operate expansively, exhausting into the condenser line, on which a vacuum of 26 in. is carried. The intake pipe extends 8000 ft. under Lake Michigan, tapping the pure water off shore. The land end of this line opens into a circular concrete well, 23 ft. in diameter and 26 ft. deep. This well, with walls 18 in. thick, was constructed by building first a ring section with sharpened bottom, then adding successive concrete rings as the first section sank into the sand. In this way a solid, water-tight well, 26 ft. deep, was formed. The 20-in. suction pipe from the intake well is provided with connections for installing in all four pumps with 12-in. suction lines. The delivering header from the pumps ascends 79 ft. from the pump-room level to the base of the 120-ft. water tower on the bluff level. The 50,000-gal. tank in this tower provides water pressure sufficient to throw a fire stream over any house in Winnetka. The extreme lift of the pumps from the lake level to the 30-ft. tower tank is 200 ft.

Lighting service is distributed single-phase from the plant switchboard at 2200 volts, 60 cycles, being stepped down by transformers at distribution points in the village. There are now 760 electric customers, some of whom use day motor service, taking advantage of the twenty-four-hour operation inaugurated in the plant eighteen months ago. Most of the consumers are householders whose business is in Chicago and the electric bills in these comfortable homes range above the average. The average income per customer is about $48 a year at the straight rate charged, 12.5 cents per kw-hour, regardless of use. Energy for motors is furnished at 10 cents per kw-hour. The minimum bill in any case is 50 cents a month. The principal business of the plant is, of course, lighting, the daily peak for this service reaching more than 200 kw. In addition to the commercial lighting, 248 series incandescent street lamps are furnished at an annual rate of $25 a lamp.

The Winnetka plant was originally started by the village government as a water-works, the cost of apparatus being defrayed by special assessment. In 1900 the general fund had accumulated enough earnings to withstand a loan of $8,000 to the electric fund for starting an electric plant. Time warrants were also issued for $10,000 and later for $5,000. Two years ago reconstruction of the combined plant was started, and these changes and additions have just been completed at a cost of $35,000. All of this amount, besides the repayment of the original loan and the time warrants, has been paid out of the electric-plant earnings, leaving to the credit of the electric fund a balance of $7,000, besides $25,000 in street-lighting charges during the eleven years. The successful results

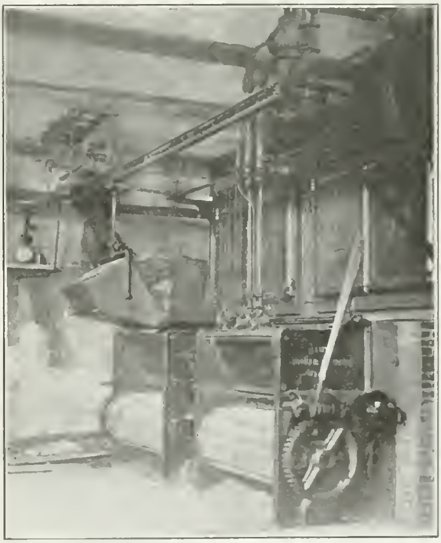


Fig. 4—Coal-Bunker Valves, Trolley Bucket and Mechanically Stoked Boilers.

attained in the case of the Winnetka plant have come from an application of business principles to the station affairs and the entire removal of all plant matters from local politics. The residential character of the suburb fortunately places on a high plane matters of local government, and the relatively large incomes from the individual consumers have made possible results in Winnetka that might not be equaled under other conditions. During the eleven years of successful operation of the combined water and electric properties they have been in charge of Mr. F. E. Herdman, manager and engineer, who also designed the operating features of the new station.

PRODUCER-GAS ENGINE ELECTRIC PLANT AT PORTLAND, ILL.

An attractive municipal electric-light plant has been put into operation recently in Portland, Ill. It is small in size, but modern in design and housed in its own building of rather neat appearance. Two 35-hp gas engines, made by the International Harvester Company, are belted to two Fort Wayne 25-kw, revolving-field, 2300-volt, three-phase alternators connected in single phase. Ultimately the waterworks will be operated in connection, the pumps being driven by gas engines.

Gas is obtained from two 35-hp producers made by the Smith Gas Power Company. These producers are of interest on account of the simplicity and effectiveness of the scrubbing apparatus and also owing to the small floor space occupied. The ordinary tower scrubbers are dispensed with and a special form of baffle scrubber of small size, but apparently very efficient, is used instead. This not only reduces the floor space, but adds materially to the safety of the plant, since the amount of gas contained in the scrubber and piping is so small that even if mixed with air and ignited the resulting explosion could do little damage. The producers are arranged to operate continuously twenty-four hours a day and are provided with a large magazine space, making it possible to run for ten to twelve hours on one charging. The attention required consists in cleaning and charging daily on ten-hour operation, or in cleaning and charging every six hours on twenty-four-hour service. The two producers are connected in such a manner that either one may operate either engine. The "mustard-seed" size of anthracite coal is burned in the producers.

For the purpose of placing the two alternators in parallel most conveniently use is made of an air-core synchronizing reactance coil as described on page 991 of our issue for April 20. When the two machines are to be joined together the reactance is placed in circuit between them without any regard to the relative time-phase positions of the alternators. The reactance limits the current to a permissible value and gives it such a time-phase position as to tend to accelerate the slow machine and retard the fast one, thereby bringing them into exact synchronism and correct time-phase position. The reactance is then short-circuited and the engine governors are adjusted to divide the load between the machines as desired.

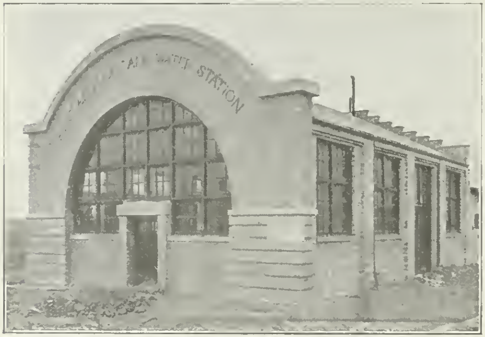


Fig. 1—Exterior View of Portland (Ill.) Municipal Plant.

The generators are three-phase machines, but they are operated as single-phase alternators. The plant supplies electrical energy for 104 100-watt series tungsten lamps used for the street lighting of Portland. These lamps are operated on 4 amp. The regulating transformer is rated at 16 kw, which will allow a 33 per cent increase in the present street-lighting installation. Commercial lighting is also supplied to the merchants in the town, the emf being transformed down to 110 volts for this purpose. A two-panel switchboard is part of the station equipment. There is no motor load at the present time.

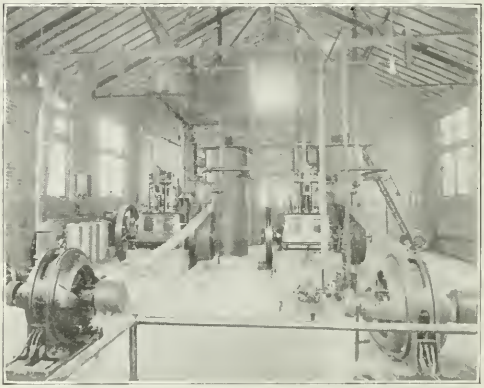


Fig. 2—Interior of Portland (Ill.) Municipal Plant.

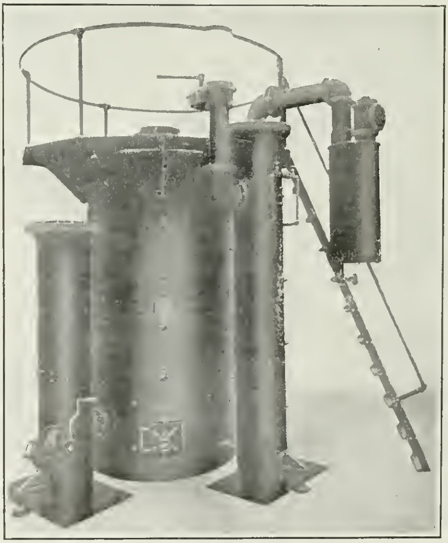


Fig. 3—Gas Producer Used in Portland (Ill.) Municipal Plant.

Three 100-watt lamps are placed at each street intersection and there is one lamp between corners. Mr. B. E. Avey, of the engineering department of the International Harvester Company of America, designed this attractive little plant.

DISCUSSION ON COAL AT NEBRASKA CONVENTION.

Mr. R. E. Burger, general manager of the Fremont Gas & Electric Light Company, gave at the Nebraska Electrical Association convention in April a paper on "Coals Available for Nebraska Power Plants" which contained information of value to central stations in all parts of the country. Of several coals having a similar composition the one that has the least moisture and the least ash will generate the most steam when burned under a boiler. In the coals available in Nebraska the proportion of ash may range from 4 per cent to 30 per cent. Coals containing small percentages of ash are the most valuable, not only because of their correspondingly high heating value, but because they offer less resistance to the free and uniform distribution of air through the bed of coal in the furnace. The labor and cost of managing fires and handling ashes are also correspondingly less, and are items to be considered in the choice of coal. Of two coals of different character the one that contains the highest proportion of fixed carbon is most easily burned, so as to give the maximum efficiency. However, the coal containing the higher volatile matter if properly burned in a suitably designed furnace may be made equally efficient. The size of the coal influences the capacity of any given equipment, owing to its effect on the draft. With a poor draft fine coal cannot be burned in sufficient quantities to maintain the rated capacity. If thin fires are resorted to the efficiency is usually lowered as a result of an excessive supply of air through holes in the fire. Dust or fine coal may either check the flow of air or be taken up by the draft. In general it may be said the coal obtainable at the lowest price is the most economical, provided the furnace equipment is suitable. If the furnace is not so designed as to use the cheaper size it should be changed. If in the purchasing of coal it is found that all other conditions are equal coals of similar composition are of value in proportion to the number of heat units contained per pound. Nebraska obtains its coal mainly from the surrounding States of Iowa, Missouri, Kansas, South Dakota, Wyoming and Colorado. The author gave the analysis of a number of different kinds of coal from these States, and concluded that the coal produced from the Kansas field shows a marked superiority over any of the other coal. He presented results of some tests carried on in the steam plant of a brewery at Fremont, Neb., by Mr. W. B. Stark. One test was made of Weir City (Kan.) slack coal under a Kenny water-tube boiler, and another of Weir City nut coal under the same type of boiler. With the slack coal 7.52 lb. of water was evaporated from and at 212 deg. per pound of coal, and in a second test, 7.61 lb. The gain by the use of nut coal was 1.2 per cent. He also gave the results of some United States government Bureau of Mines tests on washed coal and gave it as his opinion that the increase in price on washed coal is very much out of proportion with the increase in value.

DISCUSSION.

Mr. L. J. Schwingel, of Holdrege, Neb., said that tests in his plant showed that they were able to save about 4 mills per kw-hour by using Weir City (Kan.) slack as compared with Iowa, Wyoming or Missouri coals. Slack coal costs about $4 per ton. It is burned wet.

Mr. F. H. Brooks, superintendent of the Lincoln Traction Company, said that coal results depend almost altogether on the furnace design. Certain tests made with hand-firing showed that the best efficiency was obtained with nut coal. By changing to finer grates and using forced draft the conditions were reversed and nut coal was made the most expensive. The use of Jones underfeed stokers improved the efficiency and made most economical the lowest grades of coal.

The question then came up of storing large quantities of coal under water. Mr. Burger told of a 10,000-hp plant at Joplin, Mo., where a coal storage of 10,000 tons capacity had been built, consisting of a tank 100 ft. x 80 ft. x 20 ft. deep made of concrete. A traveling crane and grab bucket over the tank provides for the removal of the coal.

Mr. H. A. Holdrege, general manager of the Omaha Electric Light & Power Company, said that his company was building a concrete tank to store coal 100 ft. x 100 ft. x 20 ft. deep, the cost to be about $39,000 for the tank and $10,000 for the crane. The crane, however, would be in a position to serve an additional tank should one be built. The tank would be much cheaper but for the fact that it was built on quicksand and much piling foundation had to be put in. He brought up the point, in regard to the burning of low-heat-unit coal, that it is impossible to obtain as high boiler capacity as with coal containing more heat units per pound. By the use of low-grade fuel the capacity of the boilers and the temperature of the furnaces are reduced and consequently the efficiency is reduced.

Mr. F. H. Brooks said that with proper furnace design and a grate area large enough cheap fuels can be burned with better economy than higher grade fuels. If the furnace is not large enough to get the capacity out of the boiler with low-grade fuel it should be enlarged.

Mr. Charles Smalley, of the Lincoln Gas & Electric Light Company, discouraged the use of mine-run coal because of the holes it is likely to leave on the grates as it burns down. For this reason slack is better because of the even bed of fuel it produces. In his experience at Lincoln he had found no nut coal equal to Weir City slack.

COAL PER KW-HOUR IN SEVERAL PLANTS.

The discussion then took the form of an experience meeting, in which representatives of a number of plants gave the average pounds of coal per kw-hour consumed under actual running conditions.

Mr. L. J. Schwingel, of Holdrege, Neb., operating a small plant with high-speed engines and 3 lb. to 5 lb. back pressure, in connection with an exhaust steam absorption ice machine, reported 11 lb. per kw-hour.

Mr. Bell, of David City, operating a simple Corliss engine half the night, reported 7 lb. per kw-hour.

Mr. H. A. Holdrege, general manager of the Omaha Electric Light & Power Company, operating a steam turbine plant condensing, reported 3.1 lb. per kw-hour.

Mr. F. H. Brooks, superintendent of the Lincoln Traction Company, operating engines condensing part of the time and part of the time against back pressure on a steam-heating system, reported 5 lb. per kw-hour condensing and 9 lb. per kw-hour under extreme back-presssure conditions.

Mr. T. O. Kennedy, of the Lincoln Gas & Electric Light Company, operating a plant with steam turbines and compound condensing engines, using Kansas slack, reported 7 lb. per kw-hour.

Mr. Bell, of David City, reported that, inasmuch as his plant had a boiler capacity considerably more than needed for light loads, the plan had been adopted of building an 18-in. firebrick partition across the middle of the grate and banking the fires on one side of this partition during light loads.

OIL AS A BOILER FUEL.

Mr. T. O. Kennedy, superintendent of the Lincoln Gas & Electric Light Company, presented a paper on "Oil as a Boiler Fuel" at the convention of the Nebraska Electrical Association at Lincoln in April. He took up the questions of furnace design and comparative heat value of oil and coal.

He first laid down the fundamental principle that to burn any fuel efficiently the furnace must be designed especially for that fuel. Although the physical properties of oils used as fuel in the United States differ widely, their heating values may usually be taken as a constant quantity. This constant is approximately 19.000 heat units per pound. The fuel most available in Nebraska is known as a reduced oil, being crude petroleum from which the lighter and more volatile oils have been distilled. This has more heat units per gallon than the crude oil because of its higher specific gravity.

Storage tanks for oil should be isolated from the boiler-room as a safety precaution. A plant equipped for burning oil exclusively should have storage capacity for at least thirty days' requirement. For the same heating value oil occupies half the space and weighs 35 per cent as much as coal. The arrangement now generally accepted as being the best practice is to draw oil from the storage tank by a constant-speed pump and force it through the burners.

The burner principally used in this country is of the inside mixer type in which the oil enters under pressure and is vaporized by the action of air or steam jets. Most plants find it more economical to use steam jets because of the expense of maintaining a supply of compressed air. A good oil burner must thoroughly atomize the oil and be simple in design so as not to be easily clogged. After the correct proportion of oil and steam is adjusted the burner should be arranged to increase or decrease the flame by the opening or closing of one valve governing both the oil and steam.

Mr. Kennedy uses in Lincoln an oil pressure of 30 lb. and a steam pressure of 35 lb. Steam is partly superheated by running the steam pipe through the boiler setting near the back. It is also well to have the oil heated almost to volatilization when it enters the burner. However, with either the steam or oil too hot, carbon will be deposited and clog up the burner. The most important detail of an efficient oil-burning installation is the design of the furnace into which the atomized fuel is blown. This furnace must conform to the requirements of perfect combustion, which briefly stated are that every particle of fuel shall come in contact with no more or no less air than it theoretically needs for its complete combustion and that it shall come in contact with this air before it reaches a part of the furnace which is below the temperature of ignition.

There are then three ways in which the furnace may be wasteful. First, it may supply more air than is needed to burn the fuel. Second, it may supply less air than is needed, allowing some fuel to go up the stack unconsumed. Third, the temperature in parts of the furnace where the air and fuel come together may be below the temperature of ignition, which means that the fuel will not be consumed. The last two conditions are indicated by a smoky stack. The first condition is indicated by a clear stack. The air supply and distribution should be such that the stack is continually just on the point of smoking but does not smoke. It is necessary either to admit more air at the furnace than is needed or to admit small quantities at different points in the furnace for the combustion of any unconsumed fuel. With the latter method it is possible to cut down the excess air to a very small quantity.

In order to insure plenty of time for the air and fuel to mix before reaching the cooler portions of the furnace, it is necessary to have a very large volume of flame and a combustion chamber where the flame can be confined until the chemical action of combustion is complete. Failure to observe this point means that unconsumed fuel will strike the boiler surface and in addition to causing waste of fuel will also result in blistered tubes. This is the foundation for the popular belief that fuel oil increases the expense of boiler repairs. With a properly designed furnace the repair account is decreased rather than increased by changing from coal to oil as fuel. The available air supply must be large enough to take care of the largest overloads and the combustion chamber must also be large enough to accommodate the largest flame used. It is necessary in some settings to lower the ash-pit level and to install the burners almost at the bottom of the regular ash-pit doors.

Usually, however, the following construction will suffice for a tubular boiler. A burner is placed in a hole drilled through each fire door. These burners are set so as to direct the oil flame against a firebrick incline built from the bridge wall toward the front. Air is supplied to each burner through openings in the ash-pit door. As the flame passes over the bridge wall more air is admitted through an opening communicating from the rear of the setting. Behind the bridge wall all along the bottom of the chamber are a large number of very small openings through which additional air may be admitted. All these different sets of openings are equipped with dampers so that the distribution as well as the amount of air supplied is under the control of the fireman. Peepholes are provided in order that the fireman may judge the condition of the furnace, changing the dampers until the entire combustion chamber reaches a uniform temperature and is very bright red in color.

In the case of a water-tube boiler it is not so easy to provide a long combustion chamber. Extra precautions must be taken to insure perfect combustion before the flame reaches the tubes. This is accomplished by means of a firebrick arch built just in front of the bridge wall, which causes the flame to return on itself before it has a chance to be chilled by the water surface of the boiler. In order to secure as large a combustion chamber as possible, the burners are placed one in each ash-pit door, the fire doors being closed slightly. Air is admitted through six passageways under a false firebrick bottom laid in the fire box. Small openings are left in this false bottom so that the air can come up at points all over the furnace. One passageway leads directly to an opening at the top of the firebrick arch and considerable air is admitted at the point where the flame is deflected back toward the front of the boiler. In order to insure the advantages of a longer combustion chamber some installations include a "Dutch oven" built out in front of the boilers, which allows the burners to be located several feet in front of the boiler front. For permanent installations there is no doubt that this is a good arrangement.

Given a properly designed furnace it still requires great care in operation to insure good efficiency. This is probably more true than in the case of a coal furnace, the reason being that, because of the nature of the fire bed, coal tends to limit the passage of air through the furnace. With oil there is nothing to obstruct the draft except the dampers, which must be adjusted by the fireman. It is not safe to be satisfied with a clear stack for reasons before mentioned. With a perfect air supply the flue-gas analysis would show 15 per cent of CO_2. With 10 per cent CO_2 the theoretical furnace efficiency is 70 per cent. It is not at all impossible to operate regularly a fuel-oil furnace at an actual efficiency of 80 per cent to 85 per cent. The coal furnace that shows an efficiency of 70 per cent is much above the average.

Comparing fuel oil with 19,000 thermal units per pound and Kansas coal with 11,000 heat units per pound, one short ton of coal equals 143 gal. of oil. As a matter of fact one ton of coal is equal to only about 130 gal. of oil, because of an increase of about 10 per cent in furnace efficiency when oil is substituted for coal. This increased efficiency is really nearer 15 per cent, but 4 per cent of the steam generated is required to operate the burners and oil pump. In most plants in Nebraska Mr. Kennedy considered it safe to say that the boiler-room labor for handling and firing coal amounted to 50 cents per ton. In any boiler-room requiring more than one fireman per shift for coal burning the labor cost could be reduced at least 50 per cent by the use of oil fuel. Other advantages of oil are increase of boiler capacity, 30 per cent to 40 per cent, because of higher furnace temperature, lessened liability of labor trouble due to fewer men employed, possibility of larger storage due to smaller bulk and weight of fuel. With the coal situation as it is in Nebraska, the ideal arrangement would be to have half the boiler capacity equipped for oil burning and arranged so that were cheap coal available the oil burners could be disconnected and grates put in. With a week's supply of non-depreciating fuel always on hand the central-station man would enjoy many a good night's sleep that he would not get were he dependent on coal shipments to keep his plant running.

DISCUSSION.

Mr. F. H. Brooks, superintendent of the Lincoln Traction Company, said that his company had installed oil burners partly to be in a measure independent of troubles in coal supply. With one kind of fuel the company is too much dependent on shippers and dealers. Under special tests in his plant, 13 lb. of water had been evaporated per pound of oil. With coal 7.3 lb. of water had been evaporated per pound of coal. He cautioned prospective users that unatomized oil striking boiler tubes would blister or burn them.

HOT-WATER RECEIVERS.

By Charles T. Baird.

While hot-water receivers are frequently used to catch the hot water resulting from heating mills, shops and factories in the winter, they are also employed in connection with dry kilns in both winter and summer. When placed on a cast-iron base plate which also carries a good duplex pump, the combination is the best-known device for returning this hot water to the boilers without releasing it from presssure. They can also be used to drain the receivers of compound and triple-expansion engines to good advantage. As these receivers are not all alike, a discussion of some prominent points in their design cannot fail to benefit both owners and users.

Fig. 1 shows a very compact form of the device, as the pump is located directly under the receiver, thus occupying no more floor space than the receiver alone requires. This is a decided advantage where it is necessary to economize space, but the water valve cannot be removed conveniently nor their seats cleaned and repaired to the best advantage because the water cap is so near the receiver. There will always be a good head of water above the valves so long as there is any left in the receiver, thus making it possible to run the pump at a high rate without causing it to pound on account of partially filled water cylinders at every double stroke, because this head of water secures a full supply.

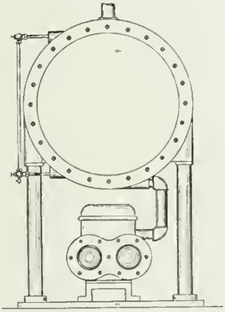


Fig. 1—Compact Form of Hot-Water Receiver.

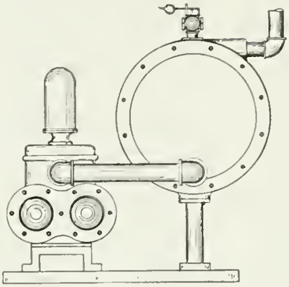


Fig. 2—Preventing Sediment from Going Into the Pump.

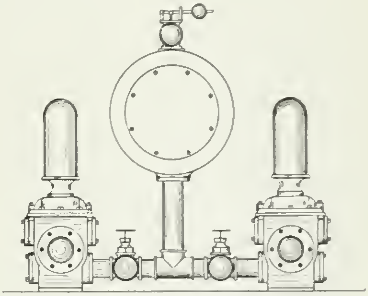


Fig. 3—Two Pumps for One Receiver.

All water will drain to the pump when it is desired to empty the receiver, but sediment which so frequently collects in these receivers when used in connection with heating systems will also gravitate to the water cylinders and may cause trouble there. One advantage of fibrous-packed pistons in this connection is that grit and sediment are less liable to cut the cylinders than when metal pistons with rings of the same material are used, as this foreign matter works in between the hard surfaces and causes trouble. On the other hand, fibrous rings at least make it possible for some of this matter to become embedded in the comparatively soft material, and it is thus rendered less harmful.

A glass gage is provided which shows the water level in the tank, provided the lower connection is not filled with mud. It is possible to keep this connection clear, but when located so low it requires frequent attention. As such a receiver is generally placed at the bottom of a pit, and owing to the lack of means for keeping it dry this pit contains water from 1 in. to 12 in. deep, no effort is made to keep the glass gage in good order, partly because it is seldom seen and partly owing to the fact that it is an unpleasant job. If the lower connection on all of these receivers was placed higher on the device it would be an improvement because sediment would not drift into it. As it is only needed to show when the water level is high, indicating that the pump is not doing satisfactory work, raising it would do no harm.

Fig. 2 is a good design because water is taken out through the head several inches above the bottom of the cylinder, and, therefore, sediment will not pass to the pump until a considerable amount has collected. The inlet appears to be nearly over the outlet, but a side view would show that it is located at the other end, thus preventing the incoming water from keeping the sediment agitated, as it must flow slowly along from one to the other.

When repairs are necessary or the plant is shut down for other reasons the water cap on this pump can easily be removed, uncovering all of the valves, and as there is nothing to prevent access to them there is no excuse for neglecting to keep them in good order. This point is more important than appears when the matter is first presented, for the following reasons: Pumps installed for this service must be ready for use at all times during cool weather, for, as a general rule, there is but one pump in a plant that can be used for this purpose. The exception, or the plant with duplicate pumping machinery of this kind, is rarely found. In some of these plants there are three machines for feeding the boilers, hence one of them at least is always in good order, but this forethought is not extended to the pump and receiver needed for removing the returning hot water and sending it into the boilers.

The only remedy that the operating engineer can apply to this defective condition is to give his one outfit special care, and, of course, this should be done whether the parts are easily accesssible or not. In some plants it is customary to allow all such matters to wait until failure of the pump to work well or perhaps its refusal to deliver water at all demands immediate attention. Especially is this true of jobs that are disagreeable and call for more work than would be required under better conditions.

Fig. 3 illustrates the exception mentioned, as it has two separate pumps taking hot water from one receiver. During cold weather when steam condenses rapidly and the resulting hot water must be pumped accordingly, both pumps are used, but when only a comparatively small quantity is coming into the receiver one of them may be shut down. Under this condition it is not necessary to shut the suction valve shown, but if the pump valves are to be taken out, or the pistons or the rods require packing this valve will be very convenient, for by shutting it hot water cannot rush down from the receiver and flood the pump. Both of these pumps are fitted with one steam and one water cylinder, hence are properly known as single pumps, although both are double-acting. As duplex pumps are used more than others in this service on account of their reliability in action even when the parts are badly worn, it seems odd to find the single type used, but, owing to the duplicate feature, one may be operated while the other is repaired thus insuring continuous service.

In some plants the combined pump and receiver is taken apart as soon as cold weather gives place to the opening of spring, cleaned, inspected and repaired if necessary, then put together again ready for use, although it may not be wanted for several months. However, undue haste ought to be avoided, for another cold day may come before summer appears, when those employed to operate machinery, exclusive of the engine-room force, will call for heat and feel badly disappointed if they cannot have it. This makes it necessary to start the pump and consequently have the work of "laying it up" to do over again or else admit that a part of the machinery is not ready for use when all of it ought to be available.

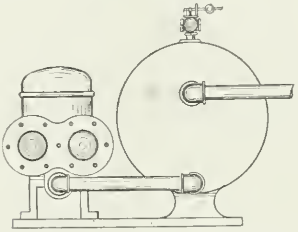


Fig. 4—Receiver Placed Lower Than Pump.

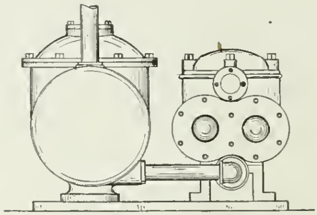


Fig. 6—Easily Accessible Receiver.

In contrast to this there are plants where no attention is paid to these details, as the hot-water receiver and pump is run as long as required, then the throttle valve is closed and nothing more is done until it is wanted again the next fall or winter. This is wrong, because sediment has probably collected in the receiver and the pump needs new packing. Even if the machine worked well the last day it was used it ought to be thoroughly overhauled before the approach of winter warns the engineer that it will soon be wanted again.

Fig. 4 illustrates a receiver the bottom of which is set lower than the pump cylinders, but the water level is above them because the receiver is large in proportion to the pump. Hot water is discharged through the upper part of this head and taken out through the lower part of the same head. This apparently is better than taking it through the bottom, but the arrangement is defective because the incoming water containing more or less sediment drops directly in front of the outlet; hence there is no chance for it to settle, as this action keeps it agitated as long as the system is in operation. There is a manhole in the opposite head which enables a man to go inside and clean it thoroughly. This large receiver is made of boiler iron, hence hot water standing in it causes the plates to become pitted. To overcome this objectionable feature they are scraped and painted with graphite.

Fig. 5 shows a smaller receiver located higher above the pump, thus giving head enough to overcome the tension of springs which hold the valves to their seats. If the suction pipe is continued, as shown by dotted lines, it will prevent sediment from being washed down into the pump. It will also retain water in the receiver when the machine is to be laid up for the summer, but a ¾-in. drip pipe can be tapped into the lowest part to draw off this water.

Fig. 6 illustrates a peculiar receiver which is set low in comparison with the duplex pump used. Water is drawn from the bottom of this receiver into a suction chamber below the water cylinders, therefore this pump is not of the submerged-piston type. This style gives more direct water passages and the pistons draw the water satisfactorily because there is but a very low lift. For a high lift the submerged-piston pump is preferred. This receiver is of cast iron, made in what appears like two parts, although they are cast together. The front part is circular, while the rear is enlarged, as shown. This has a flat top covered by a cap made in two pieces. The upper carries the mechanism by which the pump is operated, while the lower is to be removed for cleaning the inside.

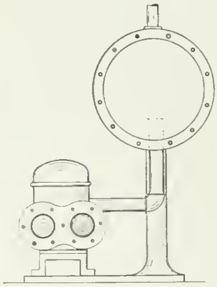


Fig. 5—Elevated Receiver.

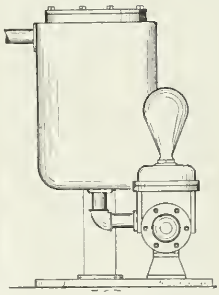


Fig. 7—Vertical Receiver.

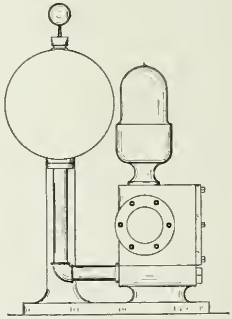


Fig. 8—Small Receiver with Single Pump.

Fig. 7 is a vertical receiver that is partially supported by a single pump to the frame of which it is bolted. It also rests on a cast-iron post which stands on the baseplate common to both pump and receiver. When the upper head is removed the entire inner surface is exposed to view, thus rendering it easy to clean. This is one of the very few combinations of this kind that include but one single pump. If that fails to work the whole heating system must be shut down until repairs are completed. This demonstrates beyond dispute that the manufacturers of this pump believe that it will go and pump water whenever steam is turned into the steam chest at reasonable pressure. All makers of single pumps claim that, owing to their improved valve gear, the pump will run very slowly without stopping and when it is stopped it will start again readily from any point in the stroke. This claim is made with the expectation that the pump will be located in some boiler-room where it will be under the direct care of the fireman, hence if it does stop occasionally he can move some part of the valve gear by hand with little trouble and water will be supplied. When the same firms are given a chance to locate a pump and receiver in the bottom of a pit where it will seldom be seen and never taken care of properly they usually supply a duplex pump. Fig. 7 is an exception to the general rule, for the firm that makes it has no other kind of pump to sell except the single type and therefore its use in connection with a receiver shows that they believe in it fully. This pump is designed with a direct connection between the piston rod and the steam valve.

Fig. 8 is another receiver that is used in connection with a single pump. It is not large in diameter nor long, but is elevated above the pump. It is fitted with a dead-weight safety valve. This is practicable because only a light pressure is allowed and a leverage on the valve is not required. The valve gear of this pump has no direct outside connection with the piston rod, yet the makers install these machines wherever heating systems require them.

ABSTRACT OF N. E. L. A. CONVENTION PAPERS AND DISCUSSIONS

ABSTRACTS are given below of all the papers and committee reports presented at the annual convention of the National Electric Light Association held this week in the Engineering Societies Building, New York City, with the exception of those presented at the sessions of the accounting section, which will appear in a later issue. When a paper or report was discussed a résumé of the remarks follows the abstracts. The abstracts are grouped so far as possible according to subject without regard to the order of presentation. The running report of the convention, printed elsewhere, presents the events in the order of their occurrence, and includes some subjects not taken account of in this section, such as special addresses, social features and other matters not associated with the presentation and discussion of formal papers and reports.

Association Affairs.

THE LIBRARY.

Mr. Arthur Williams, general inspector of the New York Edison Company, in his report as chairman of the library committee, stated that the library is in constant receipt of reports and documents of great value for reference, which applies particularly to the reports of kindred or affiliated societies and to the publications issued by the various public service commissions. As these commissions become more numerous it will be necessary to give closer attention to their records, and also to the general literature pertaining to public-utility regulation. Taking up the question as to how far the N. E. L. A. shall go in building up a library of its own, it is pointed out that there is already in the Engineering Societies Building the finest engineering library in the world. This library is peculiarly weak in the literature of social economics as related to utilities, and the committee suggested that such societies as the N. E. L. A. should contribute a small sum, possibly $250 a year, which should be devoted by the Engineering Library to the purchase of literature dealing with public-utility industries and their public relationships. In this way there would be built up a new and valuable section. The Engineering Societies do not feel justified in creating it, as their funds are already too limited for purchasing all that is of a strictly engineering nature. Over this section there might be some little control, and incidentally it might give the National Electric Light Association an influence with regard to the library which it does not now possess merely as a tenant in the Engineering Societies Building.

WATER-POWERS AND THEIR GOVERNMENTAL CONTROL.

The report of the conference called by the Power Transmission Section, and held in New York April 8, was presented at the convention in the form of a pamphlet of ninety-six pages, and consists of a verbatim transcription of the addresses by the various speakers at the conference and of the discussions which followed.

SECRETARY'S REPORT.

In his report, Mr. T. Commerford Martin stated that last year not less than 7000 copies of the *Transactions* in two volumes of the 1910 *Proceedings* were distributed. Editions of the *Bulletin* now run about 10,000 copies monthly, and single issues have contained over 100 pages. the large size being largely due to the increased matter contributed to the Question Box. The revision of the Question Box has been completed and put in type, and will be issued immediately after the close of the convention. Standard classification accounts have been put in book form and issued free to Class A members in leather binding. A large number of extra copies in cloth have been sold at about cost to all applicants, with the object of familiarizing the entire art with the classification. Three thousand copies of the revised edition of the Electrical Solicitors' Handbook were issued during the year, nearly all of which have been distributed. The secretary announced that the executive committee of the Northwestern Electric Light and Power Association has voted in favor of affiliation with the N. E. L. A. It is pointed out that owing to the increase of work the association, like its three sister national engineering bodies in the same building, will at no distant date require practically the whole of the floor on which it is now located.

REPORT OF MEMBERSHIP COMMITTEE.

The report of the membership committee, H. H. Scott, Doherty Operating Company, chairman, showed that the total membership on May 30, 1911, was 8665, a net gain of 3243 members during the year, or a gross gain of 3919. The membership is distributed as follows: Company members (Class A), 958; company individual members (Class B), 6654; Class C members, 19; Class D members (manufacturers and dealers), 226; Class E members (Class D individual members), 808. Of Class B members 5440 out of 6654 belong to company sections. On May 25 there were 39 company sections, including all of the sub-sections of the New York Edison and associated companies. There are now seven geographical sections, namely, Georgia, Mississippi, Nebraska, New England, Pennsylvania, Canada and Eastern New York, having a total membership of 2524. The commercial section has a membership of about 1000, and the power transmission section a membership of 17. The membership committee suggests the advisability of changing its name to the "committee on the organization of the industry."

QUESTION BOX REVISION.

The committee on Question Box revision, Mr. Alexander J. Campbell, chairman, in submitting its report said that the work of revision of the Question Box had been done by twenty-six associate editors. Owing to the revision being limited to consideration of questions and answers in past issues of the Question Box, the book will not be as complete as would otherwise have been possible. Critics were reminded that the editors consider that the issue of the present revision is merely the first step toward the issue by the association of a comprehensive handbook covering all phases of engineering and operation connected with central-station work. While there are many engineering handbooks available, very few cover operation at all adequately, and the editors have felt that no men in the country were better able to supply the deficiency than members of the association. The committee joined in the recommendation of the editor of the Question Box, that the association should engage the services of a competent man to issue the *Bulletin*, including the Question Box. but would add the further recommendation that he shall have the title of editor of the association publications, and that his work shall include the second revision of the Question Box.

DISCUSSION.

In reply to a question, Mr. Campbell stated that the size of Question Box revision would be that of the *Bulletin*. Mr. Pen Dell, Chicago, suggested that it would be well to make all publications of the association of the size of the *Bulletin*. as he has found that the Solicitors Handbook. which is of small size, is rarely carried in the pocket. as they do not wish to let the customers know that they are referring to a handbook for information. In reply to a question. Secretary Martin stated that the revision would cover about 400 pages. In late discussions much opposition was manifested against the suggestion to enlarge the size of page of the handbook.

THE QUESTION BOX.

In his report as editor of the Question Box, Mr. M. S. Seelman, Brooklyn Edison company, recommends that the association shall engage an assistant to the secretary, who shall attend to all correspondence relating to that feature of the *Bulletin* and gather, compile, arrange, edit and issue the *Bulletin,* including the Question Box. He does not consider it reasonable or necessary for the association to impose, as at present, on a member company the expense and responsibility of the work. Aside from the expense to a member company the conduct of the Question Box involves too much labor for any one man to assume in addition to his regular work as an employee of the company.

ELECTRICAL SOLICITORS' HANDBOOK

Mr. Arthur Williams, general inspector of the New York Edison Company, reported, as chairman of the "Solicitors' Handbook" committee, the features of the new edition of the "Handbook." The sections on the electric vehicle and illumination were thoroughly revised and considerably extended, and much new data introduced in the sections on load and diversity factors. A number of tables are included giving the ratings, specific consumption and other operating characteristics of incandescent and arc lamps and gas lamps. Thus far 10,500 copies of the "Handbook" have been distributed. The price of the new edition is $1 to members who have a copy of the first edition; to other members a copy will be mailed free.

COMPANY AND SECTIONAL BULLETINS

The report of the committee on company and sectional bulletins, Mr. E. A. Edkins, Commonwealth Edison Company, Chicago, chairman, gives an interesting account of the origin and growth of the bulletin idea. More than 500 house organs are now issued in this country at an expenditure of more than $2,000,000 per year. As examples of circulation it is stated that the Metropolitan Insurance Company distributes 5,000,000 copies of its organ each month, while the John Deere Plow Company distributes more than 1,000,000 copies of *The Furrow* every quarter. The first publication in the central-station field was the *Edison Monthly,* the first issue of which appeared in January, 1902; this has a circulation of about 25,000 copies monthly, though special editions may reach 50,000 copies. The next publication of the kind to be founded was the *Electric City Magazine,* the first number of which appeared in April, 1903, under the name of *Chicago, The Electric City.* This publication was first printed and circulated in the interest of the Chicago central stations, but at present the publication is supplied, with local matter substituted for that appearing in the Chicago edition, to central stations in thirty-seven cities and towns. Central-station bulletins under various names are now published in New York, Louisville and Chicago, and in the past have been published in Brooklyn, Portland, Ore.; Cleveland, Newark, Dayton and Buffalo. In addition, there are bulletins published for the benefit of central-station employees in Brooklyn, Boston, Seattle, San Francisco, Philadelphia, Denver, Toronto and Chicago, in some cases under the auspices of a company N. E. L. A. section. Mr. Edkins expressed the opinion that every N. E. L. A. sectional organization, however small, should be represented by a bulletin, than which there is no better agency for the upbuilding of membership in the association. He recommended that the association should do everything in its power officially to encourage the smaller member companies to follow the example of the larger bodies and establish bulletins, as this will not only make for the growth of the association, but will confer many substantial benefits upon the companies and their employees.

COMPANY SECTIONS.

Following the presentation to Mr. C. T. Russell of the Doherty gold medal at the second general session on Tuesday afternoon, there was a discussion on the work of company sections. Mr. Joseph D. Israel, of Philadelphia, thought that good results could be secured in section work by having a prominent man outside the company ranks deliver lectures at the section general meetings. He considered it wise to divide the membership into departmental branches, each of which would have a regular monthly meeting, at which men within the company would deliver lectures accompanied, where possible, with experiments. Good results might also be secured by having exhibits at the general meetings, with demonstrations of the latest devices, some of which might be those sold by the commercial department, and others consist of engineering devices used in the operating stations or on the lines. The plan of a large membership committee divided into sub-committees to canvass for members had given very good results in Philadelphia. Another successful plan was to reward the members for suggestions or ideas to improve the company's service.

Mr. Ernest F. Smith, of the Commonwealth Edison Company, Chicago, sketched the lines of activity of the Commonwealth Company section. Outside of regular monthly meetings the time is equally divided between serious educational work and entertainment of a good order, all of which is furnished by company employees. There is a glee club of twenty members, and recently the presentation and discussion of several short papers was followed by a minstrel show, which not only furnished a great deal of entertainment, but resulted in substantial increases in membership. The most elaborate entertainment of the past season was in the form of a comic opera with ninety members in the cast, following which refreshments were served and ending with a dance in an adjoining ball-room. While the members pay their own dues, the company contributes generously to the support and development of the section in a number of ways that show its appreciation.

Mr. R. F. Pack, of Toronto, gave an account of the work of the company section in that city. At first men were urged to write papers on the work of their departments, but this plan did not work out well. The idea was then carried into effect of having a course of lectures on more or less general subjects, beginning with one by a doctor on "First Aid to the Injured," and subsequent lectures were given by prominent men on subjects of broad general interest. The result has been that the men now realize that the company is not trying to work them, but endeavoring to benefit them, with the consequence that they increase in loyalty to the company section and to the company itself. In referring to experience in publishing bulletins he advised every company, no matter how small, to start a bulletin, adding that it would be better to have a two-page monthly than a larger one quarterly. He remarked that two men are attending the convention at the expense of the Toronto Electric Light Company, one for sending in to the bulletin the greatest number of good suggestions and ideas, and the other because he contributed an excellent article on company management vs. municipal ownership. The bulletin also serves the purpose of enabling the company from time to time to give out announcements of its policy in such a manner that the rank and file of the employees assimilate the ideas and get into their minds the general policy of the company.

Mr. George W. Baily, of the Brooklyn Edison company, stated that since last year the membership of the Brooklyn company section has been increased 64 per cent. After several trials the policy was adopted of having a combined business and social meeting every month. It is the aim to have a speaker from the outside at the meetings, either a leader in the electrical fraternity, a man high up in city government or some representative citizen to deliver an address, which is usually followed by a paper on a commercial and another on a technical subject, after which there is some entertainment with refreshments. The result of this plan was that the attendance has varied from 75 per cent on stormy nights to almost 100 per cent on other nights. One feature looked forward to with much interest is the annual convention held at one of the seaside resorts immediately after the national convention, at which there are two sessions, one in the afternoon devoted to business, and the other in the evening at which there is an address.

Mr. Pen Dell, of Chicago, stated that while the Commonwealth Edison branch had more than 1000 members, the North Shore branch, owing to its limited opportunities, had but 130, yet he felt that it was much better to have the two separate bodies instead of a combined body. At first the policy was to have all papers prepared by outsiders, but at present all papers are contributed by members. There are occasional musical entertainments.

Mr. Parker H. Kemble, of Toronto, formerly editor of the Brooklyn Company bulletin, spoke of the value of such publications, partly owing to bringing the work of each department before all the others, by means of which the organization is welded together. He believed it desirable to provide something in a lighter vein at meetings, in addition to the more serious features, and that getting some prominent man from outside to speak on a broad subject is one of the most successful methods of brightening up the men and spurring on their work. There is a tendency of sticking too closely to the technical or educational part in direct connection with company work. The idea should be to enlist some man of prominence to take a man's mind away from the little rut of everyday procedure.

Mr. F. C. Hendershott, of the New York Edison Company, gave an account of the New York company sections. He described the great success of the New York Edison section, which now has a membership of 1500, largely to the executive ability of Mr. Arthur Williams and to a very active membership committee which meets monthly and includes a representative from each of the associated companies and partly to securing good speakers at the regular meetings. The adoption of a section bulletin has been of great advantage, as have also the social features.

Mr. Joseph D. Israel, of the Philadelphia Electric Company, said that through the liberality of his company, and its president, Mr. McCall, there are fifty members of the company's section present at the convention at the company's expense, who were selected on the score of their attendance at section meetings. This was not held out as a reward, as the men did not know of the matter until last week.

Mr. Martin J. Healy, of the Buffalo General Electric Company, gave an account of the experience of the Buffalo section. He said the greatest difficulty was to get linemen to talk, those who attend the meetings in the greatest number being members of the meter, contracting and auditing departments. The attendance is very much larger when there is a banquet or similar entertainment. In reply to a question Mr. Arthur Williams stated that the dues of all the branches are $5 a year, which entitled a member to all advantages of membership in the national association. He favored the idea of a company advancing the association membership dues, the employees repaying the same on the installment plan.

President Freeman referred to an inquiry made regarding the admission of other than company employees into company sections. It had been suggested that it would be valuable to have a sort of relationship between electrical contractors and company employees, but at present there is no provision in the constitution to allow this. He said, however, that he understood an amendment was under consideration.

Mr. M. S. Seelman, Jr., of the Brooklyn Edison Company, called attention to the fact that the New York company section was formed too late to enter into the medal competition. Referring to the size of bulletins he said he thoroughly believed it better to confine matter to a brief than to a large space, and he believed in reducing the size of bulletins, so far as possible, in order to secure the largest number of readers. He spoke of the value of company sections through affording a means of contact between the men and those who control and direct. He suggested that at section meetings queries and answers from the Question Box might with benefit be discussed. He said that there is a volume of live matter on every phase of central station activity within the covers of the Question Box.

Mr. Farley Osgood, of the Public Service Electric Company, Newark, stated that his company section had about 130 members. The reason why it is not larger is that the men are distributed from Jersey City as far south as Camden, and therefore they cannot easily get together at meetings. The company donates $500 to the company section so that it is necessary for the men to pay only $2.50 for annual dues. The experience with linemen has been the same as at Buffalo, but the plan for the future is to have papers that will interest outside construction men in order to attract them. The reason why meter men and commercial men are more regular in attendance is because they are accustomed to talk through meeting the public, and thus are not timid about speaking at meetings.

Mr. Bayard W. Mendenhall, Utah Light & Railway Company, said that Salt Lake City had met the same difficulty as that referred to by Mr. Healy, of Buffalo, and Mr. Osgood of Newark. The method was then adopted of distributing many questions from the N. E. L. A. bulletin, and then calling on them for answers at meetings, which had proved successful.

Mr. Samuel Insull said that the company sections had rendered a great service, not only to the association, but to the companies and to the industry. Personally he considers that the company section has been one of the most desirable factors brought into the central-station business. Nothing contributes more to the esprit de corps, that results in a close feeling of relationship and loyalty to the organization, than the establishment of company sections. That the greater part of company-section membership is among the larger companies is to be regretted, for this class of work can be extended right down to the smallest organization that has membership in the N. E. L. A. If the association is to maintain its virility it will have to look to the company sections, and some scheme should be devised to obtain representation of such sections at the national convention. He doubted if it would be desirable to admit to section membership employees of electrical contractors or allied industries. The aim should be to bind together the employer and employee, and there is no method of bringing about that result more certain than so to educate the foreman or lineman as to enable him to occupy an executive position. This has been done in the steam-railroad business very extensively, and to-day a great number of the trunk lines of the country have as executive heads men who have worked in section gangs, and there is no reason why similar results should not be brought about in the central-station business. No way of doing this is better than through the encouragement of company sections, and he believes that the main effort of next year's administration should be in this direction.

It was difficult, he said, to get men together in the evening who have worked hard all day, unless some form of entertainment was provided. A fair estimate of the number of employees of central-station companies is 100,000, and if, following the experience of Brooklyn, New York, Chicago and Philadelphia 40 per cent of these were to become members of company sections spread over the country, the effect in molding public opinion would be very great. Subjects relating to generating and selling price, relations of capital and labor, relations of the community to the business, the serious effect upon companies of adverse relations—all these matters could be discussed in the company branches, either by men inside or outside of the organization.

In conclusion Mr. Insull said that he believed it to be of vital importance, alike to the National Electric Light Association, its company members and its employees, vigorously to encourage the formation of company sections in all parts of the country.

Apparatus, Electrical and Steam.

LOAD FACTOR AND CENTRAL-STATION EQUIPMENT.

In a paper entitled "The Relation of the Modern Load to the Station Equipment," Mr. F. D. Newbury, Westinghouse Electric & Manufacturing Company, considers the effect of loads of various kinds on the station equipment, and discusses the adaptation of station equipment to meet the requirements imposed by such loads. The paper contains data giving the approximate power-factor of various loads, ranging from incandescent lamps connected with small transformers, through induction motors, rotary converters, synchronous motors, to arc and induction furnaces and electric-welding transformers. Of all the apparatus the only kind which affords any control over the power-factor is the synchronous motor. In case of low power-factor such motors have been installed running without energy load, in which case they act as condensers, causing a leading current to circulate. It is, however, more economical to utilize a synchronous motor for energy load as well as for regulating purposes. Examples are given to illustrate the method of determining the proper size of synchronous motor to effect a certain improvement in the power-factor.

The effect of instantaneous current demand on station capacity is treated, and cases are pointed out where it would be undesirable for a central station to take on certain loads unless adding also motor-generator sets or separate feeders. In treating of arc-lamp load, it is shown that the power-factor of a direct-current open arc, the machine being driven by an induction motor, is 90 per cent; of the alternating-current inclosed-arc lamp with current transformer, 75 per cent, and of the direct-current metallic-arc lamp with rectifier, 65 per cent. In considering combined lighting and railway loads the author concludes that in a great majority of cases the rotary converter can be used to greater advantage than a motor-generator set, particularly in view of recent improvements in the former involving fewer poles, permitting a wide range of brush position without sparking and flashing, and with higher commutator peripheral speed, permitting more commutator bars per pole. Discussing the station equipment to meet the requirements of its specific load, stress is laid upon the importance, in alternating-current generators having plenty of margin in excitation voltage, of enabling the generator to hold up in voltage under unusual load conditions. To secure uniformity of voltage two classes of regulators have been adopted, one being used to hold a constant voltage at the terminals of the generator and the other—a single-phase feeder regulator—to hold a constant voltage at the ends of the respective feeders that may be supplied by a single generator. It is stated that the use of the latter, which is compact in design and requires very little floor space, has been increasing by leaps and bounds during the past two years.

Modern generators suitable for operation with automatic regulators, and which will safely withstand accidental short-circuits, require proportions antagonistic to a low percentage inherent regulation, the desideratum being a generator designed with sufficient leeway in exciting voltage to hold up voltage safely under all conditions of load and power-factor that will be met in operation. In modern generators the instantaneous short-circuit current may vary from fifteen to fifty times the normal current, and since the forces acting between conductors vary with the square of the current the armature-rupturing forces under short-circuit are tremendous, which explains the very rigid bracing required by the larger turbine-driven generators and also explains failures in such generators under extreme conditions or when adequate coil bracing has not been provided. Additional external apparatus, such as auto-transformers or choke coils, have been proposed for protecting large generators from the destructive effects of short-circuits, but their use is only advisable when it is impossible so to construct the generators that they will in themselves stand the service requirements. It has been found by experience that all ordinary generators, if designed with comparatively high-armature self-induction and an adequate system of coil bracing, will safely withstand even the enormous shocks of short-circuits, and it is only with generators of extreme size, or in cases of frequent or severe short-circuits, such as are encountered in power stations having grounded alternating-current railway systems, that external safeguards have been found necessary.

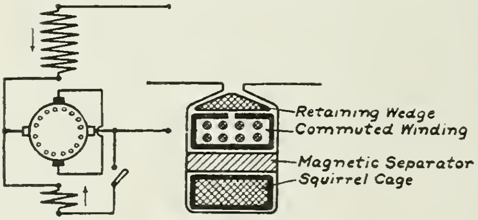
DISCUSSION.

Mr. H. L. Wallau, Cleveland, cited a welding installation supplied by motor-generating set rated at 400 kva at 50 per cent power-factor. The motor was a 210-hp synchronous machine. The average load was about 60 kw, but the peak demands were so great that the circuit-breaker on the low-tension side of the machine would open at 1600 amp. When the breakers were set higher the motor was pulled out of synchronism. Mr. Newbury confirmed this statement and suggested that the only satisfactory way to take care of welding loads is by separate motor-generator sets. Mr. P. M. Lincoln also concurred with the foregoing statement, and suggested that probably better results could be secured by driving the generator in question by an induction motor with possibly some flywheel effect on the outfit.

RECENT IMPROVEMENTS IN SINGLE-PHASE MOTORS.

In a paper with the above title Mr. W. A. Layman, vice-president of the Wagner Electric Manufacturing Company, gave descriptions, accompanied with illustrations, of a new form of constant-speed, single-phase motor with an improved power-factor, and of a high-power-factor, adjustable-speed, single-phase motor comparable with the well-known adjustable-speed, shunt-wound, direct-current motor. The stator or field and the rotor of the new constant-speed motor have each two windings. The main stator winding produces the initial magnetism, as heretofore, while an auxiliary winding controls the power-factor and compensates the motor. Of the two windings of the rotor one is of the usual squirrel-cage type and occupies the bottom of the rotor slots, the second, or auxiliary, winding is connected to a standard form of horizontal commutator and occupies the upper portion of the rotor slots. Between the two rotor windings is placed a magnetic separator in the form of a rolled-steel bar.

Two sets of brushes are provided, of which the main pair is placed in the axis of the main stator winding and is short-circuited, an auxiliary pair being placed at right angles to the axis of the main stator winding and connected in series with it at starting. The auxiliary stator winding is permanently connected to one auxiliary brush and is adapted to be connected to the other auxiliary brush by means of a switch. The purpose of the peculiar rotor construction and of the brush arrangement and connections is to accentuate at starting the effect of the squirrel-cage winding along the axis of the main stator winding while suppressing it, so far as possible, along the axis at right angles thereto. The magnetic separator tends to suppress the effect of the squirrel-cage winding along all axes by making it less responsive to outside inductive effects. The influence of the separator is, however, nullified along the axis of the main stator winding by the presence of the short-circuited brushes, while no means are provided for nullifying its effect along the axis at right angles to the main stator winding. As a result, the main stator winding will be able to



Figs. 1 and 2—Circuit Diagram and Windings of Motor.

induce heavy currents in both rotor windings, because of the short-circuited brushes and in spite of the magnetic separator, while the rotor winding connected in series with it will not be able to produce heavy currents in the squirrel-cage winding along the axis because of the magnetic separator, which shunts or side-tracks the intensified magnetic flux. The accompanying illustrations illustrate the above details.

The speed-torque curve of the motor is mainly composed of two torques, one of which is due to the interaction of the commutated and squirrel-cage windings in the main axis, with the commutated winding in the auxiliary axis; this torque is large at starting and diminishes with increasing speed. The other is due to the interaction of the main stator winding and squirrel-cage winding, which torque is zero at starting and increases very rapidly beyond a certain speed. The net result is a speed-torque curve which in the main is a rising one, reaching a maximum just below synchronous speed and becoming nil or nearly so just above synchronism. The paper discusses in detail the events in going from no-speed to full-speed and enumerates a number of features of the motor having relation to durability and reliability. Under tests the motor shows a remarkable constant speed at all loads.

The adjustable-speed, single-phase motor, to which the esecond portion of the paper is devoted, has been brought to a successful commercial stage by Mr. Val A. Fynn, of England; Prof. E. Arnold, of Germany, and Mr. J. L. la Cour, of Sweden, the object in view being to produce an alternating-current motor which fulfills every condition now met by the direct-current adjustable-speed motor. With a rated 3-hp motor of this type an adjustment of speed can be secured between the limits of 750 r.p.m. and 2250 r.p.m., yielding from 2 hp at lowest speed up to 5 hp at highest speed. The number of positive steps of control may be as many as desired within reasonable limits. The small percentage of slip between no-load and maximum load, on each step, is stated to be one of the very interesting features of the performance of this motor, and the very high power-factor under all operating conditions is especially noteworthy. The efficiency is fairly constant for all speeds within the working range of the machine. In conclusion the paper points out that both types of motors described impose upon a central-station system a load of substantially unity power-factor.

DISCUSSION.

Replying to questions, Mr. Layman said that at all loads the motor will take less current from the circuit than any motor with lagging power-factor. The starting torque is lower than at a high speed, the acceleration being less rapid, but the power-factor is higher at starting and the effect on the circuit is improved. The motor can be designed for a considerable variation of starting torque, depending on the exact ratio of the windings in the rotor slot and the magnetic characteristics.

Mr. John C. Parker, Rochester, congratulated the industry upon the possession of an adjustable-speed alternating-current motor of the type shown. The field of application is very large, notably in machine-tool work, where there is a large demand for high power-factor, high-efficiency, adjustable-speed alternating-current motors for the operation of air compressors and refrigerators under variable loads, particularly where the maximum-demand system is used. These characteristics are required in refrigerating and air-compressor service. There is also a demand for such motors in connection with centrifugal-pump and rotary-fan operation, where high efficiency of the driving apparatus demands that the pressure be secured at the desirable point of speed regulation. In conclusion Mr. Parker emphasized the importance of striving to accomplish satisfactory polyphase speed adjustment combined with high efficiency or a tolerable power-factor. Much is being done in this direction in Europe. It is admitted that commutation characteristics are bad in the larger sizes of adjustable-speed alternating motors, but this does not appear to have discouraged our European friends.

Mr. Layman closed the discussion by stating that this type of motor has been developed up to the 15-hp size. He felt that performances will be accepted abroad which will not be accepted here, and brought out the point that many new devices in Europe are sold by the manufacturers to themselves for trial in a separate corporation. He had seen large polyphase commutator motors operating in Europe, but the results were not those required in this country.

PRIME MOVERS.

The report of the prime motive power committee, Mr. I. E. Moultrop, of the Boston Edison Company, chairman, devotes attention largely to standard apparatus in use by the various member companies. As in the case of previous reports, the present one contains information of high practical value, presented in a well-digested form. It is stated that the stream turbine is rapidly reaching a standard which leaves very little room for criticism in the way of economy of operation or reliability of service. No new development has been found in gas-power apparatus and, as in the case of steam power, the general tendency has been toward the perfection of the apparatus. In steam-turbine work it has been found that the auxiliaries are subject to some criticism, and suggestions pertaining to the construction of steam turbines were submitted to several manufacturers in this country, replies from which are included in the report. It was found that there has been considerable trouble with condenser tubes, such as splitting, breaking, creeping endwise, etc., and an appendix contains statements from a number of tube manufacturers relating to condenser-tube troubles. There is also an appendix relating to the troubles connected with the circulation of water in surface condensers. Numerous other points are considered relating to the details of steam-power operation.

A paper by Mr. James E. Klumpp is included which contains information on the present status of gas producers, gas and oil engines, and gives a list of gas-engine installations compiled since the 1910 report. Another paper by Mr. W. N. Ryerson relates to water-power apparatus. Replies were received from 153 member companies using water-power from which information is abstracted relating to difficulties met with in operation, etc. A final appendix gives a description of a system for the ventilation of turbo generators. As in the case of former reports on motive power, the present report contains information of much value in a well-digested form.

DISCUSSION.

Mr. E. E. Gilbert, Schenectady, emphasized the necessity of clean air for the ventilation of generators.

Mr. John C. Parker, Rochester, approved of the increasing use of oil accumulators in connection with the governors of hydraulic turbines. Referring to the bleeder type of turbine, he said that there should be an increasing demand for this type not only for the supply of electrical energy, but in connection with the use of exhaust steam for heating purposes. Mr. Parker referred to a new type of gas engine which is now passing into use in Europe, and having an efficiency at least 10 per cent above the ordinary gas engine. Units of this type have been designed in size as high as 1600 hp. and it is said that it can be built cheaply. A considerable portion of the discussion was devoted to the consideration of the matter of erosion of steam turbines, which was largely ascribed to impurities carried over in the steam. Attention was directed to the desirability of rendering more rapid the dismantling for repair of turbines and auxiliaries.

Mr. R. D. DeWolf, Rochester, referred to the bleeder type of turbine and said that the bleeder turbine furnishes a solution of the problem of carrying properly the electric load and furnishing steam for exhaust heating.

Mr. Moultrop, in closing the discussion, said that attention should be called to the fact that in Germany and France gas engines are being built in ratings as high as 10,000 hp.

VENTILATION OF TURBO-GENERATORS.

In a paper by Mr. R. B. Williamson, of the Allis-Chalmers Company, Milwaukee, Wis., much interesting information was given concerning recent developments in the forced ventilation of turbo-generators. On the basis of the specific heat and weight of air and the permissible temperature rise, the author showed that about 125 cu. ft. of air per minute is required for each kilowatt of loss. He stated that in many cases the weight of air required for ventilation of the generator is even greater than the weight of steam consumed by the turbine during a corresponding period of time.

The heat units in the discharged air represent from 3 per cent to 6 per cent of the total station output, and economy would dictate utilizing these units for some useful purpose, such as preheating the air supplied to the boilers or maintaining a comfortable temperature in a factory. Arrangements are being made to accomplish the latter purpose in a large glass factory now being erected. The generating station is located alongside of the factory and the generators are arranged so that the air can be discharged either upward or downward, as described later. In summer the air can be discharged upward by removing a cover plate on top of the generator. In winter the outlet at the top of the generator can be closed and the air discharged downward into a large duct from which it can flow into the factory. The plant will ultimately have four 2500-kva units, so that between 400 kw and 500 kw stored in the air will be available for heating. This plant will run continuously at full load, so that a steady supply of warm air will be available.

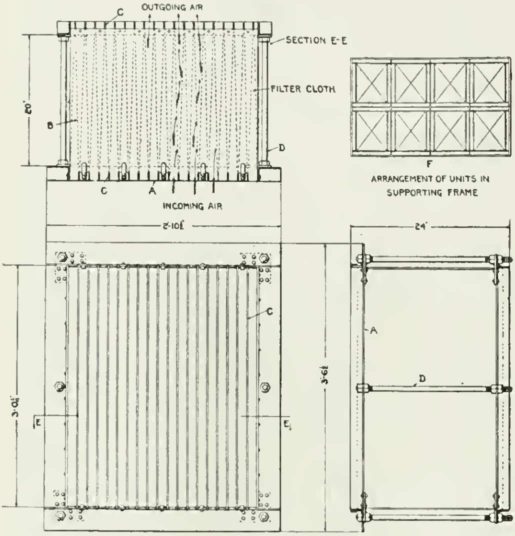


Fig. 1—Filtering Arrangement.

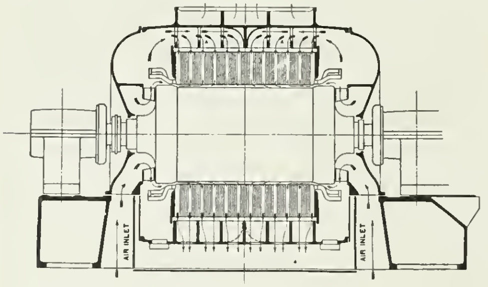


Fig. 2—Ventilating Arrangement.

On account of the large quantity of air required for ventilating a turbo-generator even a small percentage of dust soon results in a large amount of dirt within the machine. Numerous forms of air filter have been devised for cleaning the air. Fig. 1 shows a filter that can easily be made by stretching cheese cloth, cotton or thin flannel between two frames. The cloth *B* is passed around flat strips of galvanized iron *C* and is pulled taut by the nuts on the threaded studs *D* at each corner. The cloth is threaded back and forth, as shown, so that the air entering at *A* must pass through a large surface of cloth. The velocity of the air through the cloth is, therefore, very low and filter unit approxmiately 3 ft. wide, 3 ft. high and 2 ft. deep can pass 2000 cu. ft. of air per minute with an air velocity through the cloth not exceeding 10 ft. per minute. With this low velocity the filter does not throttle the flow of air to any great extent, and with the large area thus obtained the cloth will not become clogged up rapidly.

Many different plans have been used for passing the required amount of air through the limited passages within the machines, but the usual practice is to set up the air circulation by means of centrifugal fans at the ends of the rotating field structure. In some cases the air has been supplied by separate centrifugal blowers in the same manner that is customary for an air-blast transformer. This arrangement is advantageous in that the fan can be designed for the highest possible efficiency and the flow of air through the generator can be controlled at will, but is slightly disadvantageous in increasing the number of station auxiliaries.

The major portion of the heat to be dissipated is produced in or at the stationary armature core. According to a method of ventilation extensively used in both this country and Europe air enters intakes in each of the end housings and after passing through the fans flows into a chamber at the bottom of the stator yoke, whence it is forced through the ducts in the stator core and out at the top. The air divides into two streams, one-half passing up through the core on each side of the machine. With a generator of large diameter the paths for the air become long and the temperature rise correspondingly high.

For large, high-speed units a better method is the one illustrated in Fig. 2. Instead of passing all of the air up through the machine according to the two-path plan it is introduced behind the core through a number of inlets distributed around the whole periphery and after passing through the ducts is discharged into adjacent chambers. Several advantages are claimed for the multi-path method of ventilation for large machines. One-half of the outside circumference of the stator punchings is exposed directly to air from the fans and the stator is not dependent for its cooling on hot air that has already passed over the rotor before reaching it. The use of a number of short paths in parallel through the core greatly reduces the resistance offered to the flow of air, thus, for a given pressure, allowing a much larger quantity of air to be passed through the machine, or, on the other hand, allowing the use of lower pressure for a given flow.

DISCUSSION.

Mr. H. L. Wallau, Cleveland, referred to the necessity of purified air for ventilation, and suggested the use of a vacuum cleaner for removing the dirt from generators. Mr. R. F. Schuchardt, of Chicago, said that this plan is being carried out in a Chicago central station.

OIL-COOLED TRANSFORMERS.

A paper by Mr. H. O. Troy, of the General Electric Company, entitled "Recent Developments in Self-Cooled Transformers," opens with a review of the development of the transformer, particularly with relation to its cooling. Illustrations of various types of transformers are included, together with curves relating to efficiency and regulation. The present state of the art is then sketched, and it is pointed out that the recent increase in the range and capacity for which self-cooled transformers are now built is due in part to the demand for such transformers and in part to improvements in transformer steel and methods of mechanical construction which have made new forms of tanks practicable. These advances in the art have extended almost indefinitely the range of capacity for which self-cooled transformers can be built. In summarizing his paper the author states that the development of the self-cooled transformer in recent years is not inherently different from the development of the water-cooled transformer except in the development of a cooling system. The thermal problem involved in water-cooled transformers so far as case and coil structure are concerned has been solved up to almost any capacities required and the insulation problem solved up to any voltage which can be successfully transmitted. Actual transformers up to 14,000 kva have been developed, and the voltages they actually transmit up to 140,000. The only additional problem involved in the self-cooled transformer, namely, the cooling system, may be said to have advanced as far as at present required by the demand for large capacities. If the demand of the future required even greater capacities than those now under consideration it can no doubt be met by the further development of some of the cooling systems illustrated in the paper, or possibly by some form of cooling system which places a portion of the radiating surface external to the building in which the transformers are housed.

DISCUSSION.

The brief discussion on this paper was confined to a definition as to what constitutes radiating surface.

DEVELOPMENTS IN ELECTRIC APPARATUS.

In the report of the committee on electrical apparatus, of which Mr. L. L. Elden, of the Edison Electric Illuminating Company, was chairman, brief discussions were given of the newer types of generating and auxiliary equipments, including relays, instrument transformers, polyphase transformers, auto-transformers, motor-generators, storage batteries, feeder regulators, mercury-arc rectifiers and lightning arresters.

Much attention was paid to the use of reactors to limit the current produced by generators on short-circuit. In the case of the 20,000-kw units for the Commonwealth Edison Company the series reactance limits the short-circuit current to from twelve to fifteen times the normal full-load current. The reactance is formed largely in auto-transformers used to increase the generator emf of 4500 volts to the busbar emf of 9000 volts. By use of a 4500-volt generator in the auto-transformers rather than a 9000-volt machine without transformers the normal efficiency is not lowered, while performance under abnormal conditions is much improved.

As a result of short-circuit tests made upon certain 12,000-kw generators the committee recommended that the use of reactance to limit the short-circuit current be given the most careful consideration. Reactance should be inserted in series with the armature of low-reactance turbo-generators, while all new equipment should be purchased with as high reactance as is compatible with good design.

DISCUSSION.

Referring to fires from transformer oil, Mr. W. F. Wells, of Brooklyn, said that a plan might be devised whereby in case oil accumulates in concrete floors they can be flooded with water, a drain being provided to carry off the mixture of oil and water. In case of air-cooled transformers he suggested placing fuses over the top, so that as soon as the flame commences to come out the fuse is melted and the ventilating motor automatically shut down.

Mr. F. D. Newbury, Pittsburgh, said that turbo-generators can be built with sufficient internal reactance to avoid the use of external reactance. As to coil bracing, with good reactance the damage can be limited by the use of effective bracing. As to low-speed versus high-speed machinery the latter is the cheaper, but he believed that quiet operation is as possible with the high-speed machine, provided the apparatus is properly inclosed.

Mr. Schuchardt said that a recent long series of tests in Chicago had given rise to a greatly increased confidence in oil switches.

Mr. E. M. Hewlett, Schenectady, stated that changes are being introduced in the bellows-type relay in order to render it more selective. Mr. Moultrop stated that the present form of relay is selective for grounds, but not for short-circuits.

Mr. H. L. Wallau, of Cleveland, agreed with Mr. Moultrop in stating that in the case of grounds there is selective action, but not in the case of short-circuits.

Power House Design and Operation.

COST OF ENERGY FROM STEAM.

A paper by Messrs. G. H. Walbridge and E. M. Gilbert entitled "Method of Determining the Cost of Steam Power Under Various Conditions" was presented by Mr. Walbridge, of the Central Colorado Power Company, Denver, Colo. The paper was devoted to the description of curves devised for showing the factors which control the cost of steam energy in the various parts of the territory covered by the circuits of the transmission company in Colorado. Curves were plotted to show the relation between the pounds of coal per kw-hour and the cost of coal in mills per kw-hour for different types and sizes of engines. There was also shown the cost of boiler room labor in dollars per kw-year as affected by the pounds of coal required per kw-hour. In a separate set of curves was shown the cost of banking in mills per kw-hour as affected by the cost of coal in dollars ped kw-year; there was also shown the relation between the cost of engine room labor in mills per kw-hour as affected by the kw rating of the station. The opinion was expressed by the authors that the curves should prove useful for rapid and rough approximations in cases where an engineer is not well supplied with other data.

This paper was not specifically discussed, although the facts mentioned in the paper were covered indirectly in a general discussion on the operation of transmission systems which followed.

FUEL OIL FOR STEAM BOILERS.

Mr. Herbert A. Wagner, Baltimore, described the system employed by the Consolidated Gas, Electric Light & Power Company in its Westport station for using coal and oil simultaneously for fuel for its boilers. The space under the boiler back of the usual coal grate is made into a large combustion chamber with the oil burners at the extreme rear end. This chamber is separated from the boiler tubes above it by tiling and from the coal grate by a low bridge wall. The coal grates are 14 ft. wide and 8 ft. long. Each furnace is provided with four oil burners. Oil is delivered to the boilers under 20 lb. of pressure per square inch and is atomized in each boiler by means of a steam jet.

Under actual operating conditions the maximum boiler outputs obtained during seven hour runs have been as follows: With coal used alone, 1188-hp.; with oil alone, 702-hp.; with coal and oil together, 1445-hp. It was found that a 2000-kw station load can be carried by each boiler when using coal and oil together with as much ease and certainty as 1200-kw per boiler can be carried when coal is used alone. The results indicate a gain in output of 66 2-3 per cent by the use of the oil or a saving of 40 per cent in the cost of the boiler equipment for a given output.

The cost of oil for producing a certain amount of steam is about 33 per cent more than that of coal. In spite of this difference in cost of fuel, the actual cost of banking is less with oil than with coal for the reason that the oil is burned efficiently while the coal is necessarily burned very inefficiently. The author stated that a saving in investment and in labor for peak load can be effected by the use of oil. Fuel oil shows its advantages as compared with coal most markedly when used as fuel for operating steam plants in connection with long transmission lines receiving energy from hyrdo-electric stations.

The paper contained considerable data relating to the use of fuel oil as compared with coal. From this data it was shown that the cost per month for fuel and labor for boilers to keep 10,000 kw in reserve at full steam pressure and ready to take the load equals $1,600 with oil and $3,126 with coal.

DISCUSSION.

A written communication was received from Mr. M. G. Kennedy, of the Syracuse Lighting Company, Syracuse, N. Y. Mr. Kennedy outlined the conditions in Syracuse, where the lighting company operates under a contract with the transmission company to receive nominally 6000-hp with penalty for a peak load exceeding 7400-hp. The company possesses a 4950-kw steam relay sub-station; the steam is used only for peak load and for an average of six hours per day. However, during off-peak hours, two 1500-kw turbo-generators are kept floating on the system in readiness to assume the load in case the transmission supply is interrupted. The generators are over-excited to act as condensers. Reverse power relays are used to prevent the transfer of energy from the steam station to the transmission line in case of interruption to the transmission supply.

The steaming equipment consists of twenty-two 330-hp Heine water-tube boilers, nine of which are equipped with fuel oil burners, the others being arranged for coal fuel. The oil fuel boilers are kept only for emergency conditions, but are maintained hot at all times by means of live steam introduced from the other boilers. Each standby boiler is equipped with one oil burner at the end of which a gas pilot flame is kept burning at all times. When the transmission service fails, the oil burners are placed in service at once without any interruption to the local distribution of energy. Mr. Kennedy stated that the scheme of operation employed is not ideal, but it has prevented discouraging interruptions to the service and, on the whole, the result has been more successful than was expected.

Mr. W. L. Abbott, of the Commonwealth Edison Company, Chicago, endorsed the suggestion of the author concerning the use of oil fuel for carrying peak loads and for banking purposes. He expressed the opinion that when used for banking the result should be a saving of, say, one ton of coal per day on a 500-hp boiler.

SCIENTIFIC MANAGEMENT.

Mr. L. D. Webster, of the Marion Light & Heating Company, presented a paper entitled "The Posibilities for Economy in the Operation of Light and Power Companies Offered by Scientific Time Study," which gives the result of a study in the scientific management of power houses based upon the records of a public-service corporation operating a number of electric-light and power companies in cities of from 5000 to 150,000 in the Middle West. Charts accompany the paper illustrating the method of handling the data secured. The case was cited of a plant having eighteen firemen working in three shifts firing boilers which during the peak load were driven at from 100 per cent to 150 per cent above the normal rating. One man fired 600 hp of boilers, and notwithstanding the handicap of overloaded boilers and poor fuel the eighteen firemen were found, upon tabulation of the observations, to have worked on an average of only 47½ per cent of the time. This result was largely due to lack of proper instructions and neglect of working details, such as proper tools and the style of fire-doors. In another plant an examination of operating records disclosed the fact that the output of useful work for firemen had fallen off from an average of 477 tons of coal per man in January, 1909, to 334 tons in January, 1911. Here it was found that the prevailing sentiment among the men was that they considered they were doing as much work as a man should be asked to do, and that they could not get any better results in economy if they worked harder. This is cited as a practical illustration of the natural tendency of the laboring man to give a diminishing return for his wages when the supervision over him is relaxed ever so slightly.

Experiments were made in connection with economy tests on the boilers of this plant to find out just how much work was necessary to fire the boilers when driven at various ratings, and the results are submitted in tabulated form. These show that an increase of over 50 per cent in the quantity of coal fired was made, with an increase of only about 25 per cent in that portion of the fireman's time spent in work. Curves are given showing that a very considerable part of the fireman's working time is spent in opening and closing furnace doors, picking up and laying down tools, leveling fires, etc. Any action taken by the management of a plant toward increasing the ease of operation of doors, etc., the placing of coal and tools where they can be reached with the least possible effort, together with the offer of a premium or bonus when the rate of driving is kept at the most economical standard will not only result in an increase in economy of the boiler plant, but a decrease in the labor cost per ton of fuel handled. An account is given of a similar examination of the work of an engine-room force which showed that not only were the high-priced men on a shift idle a large percentage of the time, but that in order to keep busy they were doing a good share of the work properly belonging to the cheaper men under them. In one plant 32 per cent of the engineer's time was spent on his own work, 25 per cent on cheap men's work and 39 per cent in doing no work; in another case these figures were respectively 8 per cent, 24 per cent and 57 per cent.

Investigation showed that the field for scientific time study was even greater in the distribution department than in the power house. Data and curves were given relating to the disposition and amount of time spent in fastening cross-arms and iron-top brackets on new poles, which indicate a low efficiency of labor. In conclusion the author said that in the reorganization of power-house and line forces, and the bringing of the work of a man up to as near 100 per cent efficiency as possible, it is wise in order to avoid a discontented working force with possibility of strikes, after eliminating such men as were found from observation to be unnecessary, to give the remaining men a percentage of the saving effected.

DISCUSSION.

Mr. H. Fitzjohn Porter, efficiency engineer, said there were ample data on the time required to shovel coal as regards the mere transfer of material. But when it is necessary to fire this coal under boilers with an idea toward high steaming efficiency, so many variables may enter into the problem that the efficiency of demand is difficult to obtain. Unless these variables can be held constant, the data will be deceptive and so worse than useless. In making test experiments to determine the productiveness of certain classes of labor, care should be taken not to over-fatigue the men to a point at which they cease to be continually productive, although the men themselves may be unconscious of this overwork.

POWER HOUSE LOAD REPORTS.

Mr. A. S. Loizeaux, of the Consolidated Gas, Electric Light & Power Company of Baltimore, presented a paper entitled "Load Reports of an Electric System," which describes the system of station-load reports employed by the company with which the author is connected. Numerous forms accompany the report. The subject is treated under the heads of log sheets, record books and reports. Of the latter there are described and illustrated forms for daily-output summary, special day-load curves and large customers' monthly reports for kw-hours generated and purchased, kw-hours sent to commercial lines, load statement, graphic load record, daily maximum peak and maximum output yearly report of kilowatt statistics, peak loads, load-factors and continuous reports. Information is given as to the method of keeping the log sheets and record book.

DISCUSSION.

In the absence of the author, the above paper was presented by Mr. Douglass Burnett, of the Consolidated Gas, Electric Light & Power Company, of Baltimore. Mr. N. J. Neall, Boston, said that the curves of load on central stations become of greater and greater importance, and will be especially valuable when in the future the utilization of water-powers becomes necessary and curves are called for to determine whether the operations of an electric company are compatible with old-time practice. He stated that load curves and other data should be collected by the proper committees of the Association, with the idea of obtaining characteristic curves in order that members at large may have an authoritative reference file indicating the present status of electrical operations, and also the various kinds of service constituting different load-factors, etc. Chairman W. C. L. Eglin, Philadelphia, remarked that to carry out this suggestion of Mr. Neall would involve an expenditure of many thousands of dollars, but he expressed the opinion that it might be well for the Association to attempt to obtain a standard form of load sheets.

Mr. Farley Osgood, Newark, suggested that some suitable person should present at the next convention of the Association a paper relating to the general characteristics of load curves which would contain the information requested by Mr. Neall. The chairman expressed the sense of the meeting as a desire for the Association to endeavor to prepare standard forms of load reports and also indicate characteristic load curves.

CENTRAL-STATION ENERGY SUPPLY FOR RAILROADS

Mr. Fred Darlington, of the Westinghouse Electric & Manufacturing Company, presented a paper entitled "Central Power Plants and Electricity Supply for Trunk-Line Railroads" in which arguments were presented to show that energy generation and railroading should be conducted as independent undertakings, and that electrical energy for all purposes, including manufacturing, lighting and railroading, should be supplied from the same central stations. The author's arguments were based on decrease in cost per kw-hour with increase in size of generating station and improvement in load-factor by diversity of requirements for energy. He claimed that the largest and best steam locomotives are merely relatively poor portable steam-engine plants limited in service output. By means of multiple-unit operation the output of electric locomotives is practically unlimited and concentrated generation of the energy and transmission where needed is the best solution of the problem of the operation of the electric units. The author contended that central-station men should co-operate with the railroads to furnish them with electrical energy for operating their trains.

DISCUSSION

After reading his paper, Mr. Darlington pointed out that when the time comes to deliver energy in large quantities for railway work, much more substantial transmission lines will be required than with present practice.

Mr. F. B. H. Paine, of the Niagara, Lockport & Ontario Power Company, Buffalo, advocated the federation of smaller organizations, and the supply from a single generating station of lighting and railway power over any considerable districts. He spoke of a case where there were in two counties about a dozen separate central stations, aggregating in rating about 500-kw, which were purchased by one interest and supplied with electrical energy from a single source. It is expected that within five years between 4000 and 5000 kilowatts will thus be distributed throughout these two counties.

Mr. R. F. Schuchardt, of Chicago, said that a single decade ago the paper by Mr. Darlington would have seemed visionary, but that it is now in actual accord with conditions being rapidly developed. The centralization of electrical supply, he said, is one of the most important movements in the electrical field. In regard to the electrification of terminals, he said that if in Chicago all the passenger trains were electrically operated for a distance of from twelve to fifteen miles from the center of the city, the maximum load demand would be less than the total output of two units being placed in the Chicago and Northwestern generating plant.

Transmission.

OPERATION OF TRANSMISSION SYSTEMS.

In a written communication to a topical discussion on operating transmission systems Mr. Max Hebgen, Butte, Mont., said that the most important factors in securing uninterrupted service on transmission systems were stated to be insulation, mechanical strength, general design of system and operation. He claimed that the factor of safety in the insulation of transmission systems as now employed is too low. For a 100,000-volt system the safety factor should be not less than three, for 50,000 volts it should be four, and for 20,000 volts it should be five. He stated his belief that for all electromotive forces above 20,000 volts the suspension type of insulator is far preferable to the pin type. When the suspension type is employed no difficulty is encountered in obtaining the factors of safety mentioned above.

Mr. Hebgen claimed that too much attention cannot be paid to the mechanical strength of a transmission line where continuity of service is essential. He stated that any wire larger than No. 6 gage should be stranded; the 6-wire stranded conductor with a hemp center exposes more surface to wind and ice than does a 7-strand conductor of equal conductivity, so that the advantage of having all the wires subjected to the same stress is more than counterbalanced, and the 7-wire strand is altogether preferable. He said that the clamps for suspension insulators should be connected to the insulator by a hinge joint so that there will be little tendency to bend the wire when the insulator pulls in a direction other than perpendicular to the wire.

Transmission lines feeding energy to an important load center should be in duplicate or triplicate. They should preferably follow different routes, but where this is impracticable the different lines should at least be mounted on separate poles spaced far enough apart to prevent the possibility of one line interfering with another. All lines should be sectionalized by means of out-door air-break switches, with a cross-over switching station at the middle of the line equipped with switches so arranged that one-half of either line may be cut out and the remaining section continue in operation. In any case where two or more lines supply energy to the same point, the incoming lines should be controlled by reverse-power relays. Troubles from lightning can be guarded against by high insulation, the installation of one or more overhead grounded wires and the use of electrolytic arresters. Continuity of service depends equally as much on good operators as on good apparatus. In large systems all operations should be controlled by one man who has the position of load dispatcher. The importance of systematic patrolling of the line should not be overlooked.

A written communication was received from Mr. J. P. Jollyman of the Western Power Company, San Francisco, Cal., who claimed that in order to eliminate interruptions to service the power houses should be built on the unit system, only such cross-connections being used as are absolutely necessary for proper flexibility. It is especially essential that all apparatus which may need immediate attention in the event of trouble should be within the reach of every man. Relays should be used sparingly, if at all, because the power-house circuits must not be disarranged by any ordinary disturbances which may come in from the transmission system. The transmission line should preferably be constructed in duplicate on separate poles. In case only one pole line can be erected the arrangements should be such that one circuit may be kept in operation while the other is undergoing repairs. In order that trouble originating on one distributing line may not interfere with other feeders, fuses or relays are necessary on the distribution circuits radiating from substations.

A written communication was also received from Mr. R. S. Kelsch, Montreal, who claimed that the most successful method of obtaining continuity of service from the high-voltage transmission line is to use the same factor of safety on the line as is now employed in the power house with its reserve generators, duplicate busbars, extra exciters, spare transformers, etc. A high factor of safety in the insulation is of the greatest important. Too much economy has been practised in the purchasing of insulators in the past; there are numerous transmission lines in operation to-day that should have a factor of safety in the insulators three times as great as at present.

Mr. W. N. Ryerson of the Great Northern Power Company, Duluth, Minn., expressed the opinion that too much insulation may prove disadvantageous in low-voltage work. Mr. F. B. H. Paine of the Niagara, Lockport & Ontario Power Company, Buffalo, N. Y., remarked that troubles on transmission lines are frequently hard to locate although easy to correct after being discovered. He mentioned the fact that certain line patrolmen now make use of automobile or bicycle head-lamps in patrolling the line at night.

Mr. B. F. Pearson of the Southern California Edison Company, Los Angeles, Cal., stated that it had been found necessary to subdivide the 118-mile 75,000-volt transmission line in order to continue operation in case of failure to any one part of a circuit. He called attention to a peculiar faulting of pin-type insulators upon which cracks develop on the interior petticoat, attributable probably to excessive temperature. Difficulty has been encountered with the pin type of insulator construction on account of birds standing on the steel cross-arms and stretching their wings to reach the live circuit above. This trouble can be overcome by the use of the suspension type of insulators. In replying to the question of Mr. R. J. McClelland of the Electric Bond & Safe Company of New York, Mr. Pearson stated that the interruptions to the Kern River transmission line totaled 160 in a year, most of which occurred during the spring season when the birds were more inclined to stand upon the transmission lines.

Mr. J. R. McKee called attention to the fact that the limit of increase in voltage to a transmission system is set by the corona loss rather than by the amount of insulation employed. Experience would seem to indicate that at the high altitudes in Colorado, 100,000 volts is about the limit; in Michigan, where a 110,000-volt system is operating without lighting arresters or overhead ground wires, no trouble is experienced from interruptions, probably on account of the excess of corona loss accompanying any abnormal increase in the voltage.

Mr. G. H. Walbridge, of Denver, said that most of the troubles encountered on the system of the Central Colorado Power Company have proved to be mechanical rather than electrical. Considerable trouble has been caused by the excessive wind velocities at the high altitude of 13,500 ft., at which a certain part of the transmission line is erected. Mr. E. L. West, of the Central Colorado Power Company, remarked that, on account of the condenser effect, when an electromotive force of 100,000 volts is applied on the 190-mile transmission system, an electromotive force of 150,000 volts is obtained at the far end. The clearance between wires has proved to be too small for the high altitudes encountered. He said that, by actual measurements made by government officials, the wind velocity has been found to reach 165 miles per hour at the highest point of the transmission line. In order to prevent breakage of the transmission line, due to kinking, use is now being made of a flexible saddle for connecting the insulator to the line.

Mr. West said that the hemp-core, six-wire cable has proved satisfactory during the three years it has been in operation. Mr. Ryerson remarked that hemp-center cable used by the Great Northern Power Company has been found in good condition after five years of service. Mr. R. G. Black, of the Toronto Electric Light Company, stated that the six-wire, hemp-core cable employed between Niagara and Toronto has given no trouble during the five years of service; the only interruptions to the 90-mile 60,000-volt transmission system has been those attributable to lightning. In May there were three interruptions, but in the previous nine months there was none.

Mr. P. H. Thomas, of New York, stated that the enormous currents produced on short circuit could be minimized by the use of series impedance combined with some automatic means of sectionalizing the system. Mr. Pearson remarked that a scheme similar to that described by Mr. Thomas is being used in Southern California. It has been found that the synchronous apparatus is not thrown out of step during short circuits.

Mr. N. J. Neall, Boston, called attention to the conditions of operation in a certain manufacturing plant receiving energy from one stream and three hydroelectric stations. In this system there are no automatic circuit breakers, the operator being depended upon to open switches by hand in case trouble develops.

Mr. D. B. Rushmore, of the General Electric Company, Schenectady, remarked that a transmission system must be designed for both normal and emergency conditions. In order to minimize troubles, it is necessary to employ high-class apparatus, and engineers should learn to distinguish between apparatus of this type, which is costly to produce, and the cheaper grades of apparatus found upon the market.

PROTECTION FROM LIGHTNING.

The committee on protection from lightning, Mr. B. E. Morrow, Hudson River Electric Power Company, Albany, N. Y., chairman, obtained the data for its present report, not by sending out a list of questions to each member company of the association, but by selecting some twenty companies which have considered the effects from lightning disturbances as constituting an important factor in the success of their business, and have therefore gone into the matter very thoroughly. It states that with improvements in the art of insulation and of lightning arresters failure of apparatus from lightning is becoming very much less frequent. The results obtained from the use of the electrolytic type of arrester have been very satisfactory. Arresters of the horn type are in common use, but in a great many cases are being rapidly replaced by those of the electrolytic type. On the other hand, an objection to the electrolytic arrester is its high first cost and the necessity of frequent charging and attention; indeed, in a station of minor importance it has been considered cheaper to replace an occasional damaged transformer. Transmission lines having overhead ground wires appear to have suffered the least damage. The use of a grounded metal ring for each insulator is reported as being effective for the elimination of line disturbances, but is no protection against a direct stroke and is expensive. In some cases a grounded spark gap has been provided for each insulator, and still another form is that of installing a grounded wire on each pole, carrying it well above the top. A special device, known as an arc suppressor, is now being experimented with for the relief of transmission line troubles due to an arc around the insulator, the device being used at the busbars of the principal station to take care of the entire system.

In its recommendations the committee states that where all lines leading into a station are operated separately each of them should be provided with an arrester installed on the line side of all apparatus. In other cases experience justifies installing one arrester on the common busbar. The installation is recommended of choke coils in every circuit leading to the generating station, advantage also being taken of the newer and improved types of insulation for transformers and other classes of apparatus connected with a high-tension system that are especially susceptible to damage from lightning or surges. In the case of stations where no arresters are being used the electrolytic type is recommended; if, however, arresters of the multi-gap or horn type are in use and giving satisfactory service there is no need for a change. The committee unqualifiedly recommends the use of the overhead ground wire, which should be grounded at every supporting structure, either pole or tower. A lightning rod carried above the ground wire is also recommended. The results of investigations have shown that a lightning arrester does not protect any apparatus on a distributing system more than 400 ft. or 500 ft. away. A calculation is given showing that it would not pay to increase the number of arresters beyond one for each $500 worth of transformers. The company repeats its recommendation as to the inspection of arresters, as well as to the importance of detailed records.

DISCUSSION.

Dr. C. P. Steinmetz said that, ten years ago, electric circuits were practically helpless against lightning, whereas at present they can be almost completely protected against all forms of lightning; the problem of lightning protection has thus become essentially an economic one, as to how far the cost of protective apparatus is balanced by probable damage to apparatus. A protective device should be close to the apparatus to be protected, and it is a question whether we should not abandon altogether the attempt to protect distribution circuits and confine attention to the apparatus connected to these circuits, installing the devices near them. In other words, it is becoming more economical from year to year to connect the arresters to the device to be protected, and not distribute them along the line. Dr. Steinmetz described the manner in which the various troubles relating to lighting disturbances and abnormal voltages may be scientifically determined.

Prof. E. E. F. Creighton recommended, as a means for determining the condition of an aluminum lightning arrester, connecting an ammeter in series with it when it is being charged. The details of the method, however, were not elaborated. The valuable quality of an aluminum arrester is, he said, its capability of discharging heavy currents at abnormal voltages, but it cannot economically be built to discharge the main generator current.

Mr. R. P. Jackson, of Pittsburgh, emphasized the importance of good insulation of apparatus. He did not believe in the indiscriminate use of lightning arresters that discharge freely, when they should be set to a higher voltage and the additional stress taken by the insulation of the apparatus. Some of the money that has been spent in protective apparatus might well be spent in better insulation and on improving the transmission lines.

Mr. H. B. Gear, of Chicago, said that data are lacking on the subject of the proper spacing of arresters. Referring to an economic study of the question, he said that the matter of interruption must be taken into consideration.

Mr. Farley Osgood, of Newark, said that there is a possibility in some cases of which he knows that the number of lightning arresters now in use may be decreased; but that the lightning protection problem is one for individual study, as local conditions may influence the number of arresters to be used. Grounding the secondary will enable a reduction to be made in the number of lightning arresters. In conclusion, Mr. Osgood advocated a careful study of the subject of protection from lightning, rather than increasing the number of lightning arresters.

Mr. Percy H. Thomas, of New York, agreed with Mr. Jackson as to setting lightning arresters at low voltage, as it is a menace every time an arrester discharges, the system being strained each time. A trouble to be expected with the electrolytic lightning arrester is that when the discharge passes over the horn-gap the potential of the line is momentarily reduced, and the apparatus subjected to a severe shock. The electrolytic arrester has the disadvantage over the multi-gap series arrester of discharging frequently. Numerous advantages of the multi-gap type of arrester were pointed out. Mr. Thomas said that the new schemes for shunting out an arcing ground on a transmission line seemed to have made progress. The idea of the type of device referred to is to close a circuit automatically in shunt at the power house as soon as the arc is established. This takes the potential off that portion of the line, which then is automatically restored.

Mr. Paul M. Lincoln, of Pittsburgh, said that there are several means besides lightning arresters for taking care of lightning disturbances. One is the use of the suspension insulator, which has a grounded portion above the line to be protected; the second is the use of a ground wire above the transmission line, and the third is the grounding of the secondary distribution and primary transmission circuit. These three methods of construction will, he believes, secure a greater reduction in damage from lighting disturbances than the use of arresters.

Prof. Creighton considered some of the comparisons made between the aluminum and multi-gap arrester. The former, he said, was designed specifically to take care of continuous surges for a considerable length of time, which the former cannot possibly do, because of the heavy current that flows and the great amount of voltage expended in the resistance rods. When the neutral is grounded the difficulty is transferred from potential to current troubles. In many cases, however, it is advisable to ground the neutral, especially in the operation of a railway system.

Mr. E. J. Richards, Pittsburgh, said that very good results have been obtained during the past two years from the use of aluminum-cell arresters on high-tension lines and feeders. He directed attention to the inspection and care required in the operation of aluminum-cell arresters. There has been only one interruption due to insulator failure on the lines referred to during the past two years, and this was caused by a direct stroke of lightning.

Mr. Farley Osgood said that he could not agree with the statement that multi-gap arresters require no attention, because dirt will collect on them and cause trouble if not removed.

Mr. H. L. Wills, of Savannah, said that in the case of a 6600-volt system good results had been obtained by connecting one side of the lightning arresters to the line and the other side to the ground wire; the next line is connected to a lightning arrester, but not connected to the same ground wire, etc. By connecting one lightning arrester to one line at one pole, and the next lightning arrester to the other line at another pole, there is a much easier discharge.

Distribution.

GROUNDING AS A PROTECTIVE MEASURE.

In a paper with the title "Grounding of Low-Tension Circuits as a Protective Measure," Mr. Paul M. Lincoln, of the Westinghouse Electric & Manufacturing Company, pointed out how under certain conditions comparatively high-voltage strains may appear between low-tension windings of transformers and ground when these transformers are connected to a relatively high-tension transmission system. The fundamental cause, he stated, why break-downs so often occur on low-tension circuits simultaneously with disturbances on the high-tension side is that transformers act to a very considerable extent as condensers as well as transformers. A method is given whereby, knowing the construction of a transformer, its static capacity as a condenser can be determined with a fair degree of accuracy. It was shown that the greatest danger to the low-tension windings of transformers from disturbances on the high-tension side will take place when the low-tension windings are entirely disconnected from all other circuits. Moreover, any attempt to overcome the difficulty by increasing the insulation of low-tension winding is a step in the wrong direction. Examples are given showing the amount of static potential induced by the high-tension winding upon the low-tension winding of a transformer, which may be as high as 27 per cent of the voltage impressed across the high-tension winding, and in an abnormal case even as high as 115 per cent. A remedy for this condition is to ground the low-tension windings and thereby afford a path by which the condenser current may be taken off. The ground connection should be a sturdy one, not only on account of the fact that quite an appreciable current may be passed by the condenser, consisting of the high-tension winding as one plate and the low-tension as the other, but also to insure that the ground connection is not such a flimsy one that it would be destroyed at the slightest provocation. In conclusion, Mr. Lincoln stated that the reasons set forth make a very good argument for grounding low-tension circuits when obtained from a high-tension system. This is, however, by no means the only argument for the grounding of low-tension circuits, and he suggested that the slogan "Ground your low-tension circuits" would not be a bad one for the N. E. L. A. to adopt.

DISCUSSION.

Replying to a question, Mr. Lincoln said that in general the greater the voltage the higher will be the amount of insulation on the high-tension winding, resulting in reduced static capacity of high tension against low tension. The actual ratio does not make any large difference in the ratio of the two static potentials which govern this difference of potential upon the secondary winding.

Mr. G. E. Brown, Brooklyn, inquired whether grounding should be practised in the case of two 250-volt, three-wire power services and also whether it is possible to get 700 volts to ground from the secondary of the ordinary commercial pole-line transformer in case a primary 2400-volt circuit is grounded.

Mr. T. W. Varley, New York, asked how much current will flow from a secondary to ground under normal conditions. Mr. Lincoln replied that the worst condition is where the secondary of the transformer is entirely isolated from all of the circuits, in which case with a ground on the high-tension windings one may get on the secondary from 20 per cent to 30 per cent of the terminal voltage of the high-tension circuit. The amount of current which can be passed under ordinary conditions is very small. As the frequency goes up the current goes up in the same ratio, but extreme conditions obtain only when the static discharge, the direct ground or the lightning charge is present. The worst conditions arise from the isolation of the secondaries.

WIRING AND EQUIPMENT STANDARDS.

The report of the committee on improved wiring and equipment standards, Mr. M. C. Rypinski, of the Westinghouse Electric & Manufacturing Company, chairman, gives a résumé of answers to eight questions on a form sent out to member companies. In reply to a question as to whether the company has a system for aiding a customer financially in wiring his home, 80 of 160 central stations replied that they had no such system; all the others have some method of taking care of the consumer, the most common being to charge the wiring to the customer at cost, or cost plus a small profit, allowing him to pay the charge by monthly instalments varying anywhere from two to three months up to twenty-four. A number of replies are quoted which give details of the practice of some of the companies.

Of 160 central stations, 125 replied that they had no system for laying out the wiring of houses. A few replies are quoted in which such a system is in use. In reply to an inquiry as to whether there is a system of co-operation with contractors, forty-eight negative replies were received, and several replies are printed giving information as to methods of co-operation. In reply to an inquiry as to a campaign of education among architects, 105 negative replies were received, and several were quoted from those who co-operated with architects.

As to the extent to which present costs retard the wiring of houses, fifty-five central stations disclaimed any knowledge along that line, forty-two stated that wiring was not retarded at all by present costs, and sixty-three felt that present costs had retarded wiring, particularly of old houses—the majority of these believing that this consideration affected about 50 per cent of prospective business. The general opinion was that the cost of wiring new houses did not need as much reduction as the cost of wiring old houses.

In conclusion, the committee stated that it had been asked to assist in the compilation of a handbook on wiring, to be issued jointly by the National Electric Contractors' Association, the National Electric Lamp Association and the Commercial Section of the National Electric Light Association. It is intended that the handbook shall be placed in the hands of the central-station solicitor, contractor and, where necessary, the consumer. It will contain, among other things, model plans for the various classes of houses, with illustrations of proper wiring outlets, and including details as to equipment varying from the most simple to the most complete. The handbook will be sold to company members of the association at a price very little in excess, if any, of its actual cost.

No discussion followed the presentation of this report.

UNDERGROUND CONSTRUCTION.

The report of the committee on underground construction, Mr. W. L. Abbott, chief operating engineer Commonwealth Edison Company, Chicago, chairman, gives the results of investigations undertaken by the committee bearing on conduit construction, cables and their installation, auxiliary subway equipment and operation. It is pointed out that the cost to the larger companies of subsurface structures amounts to about one-fourth of their entire investment. The committee stated that the use of fiber duct is increasing, the reasons given being that it does not injure the cable sheath, offers little resistance to pulling in and out of a duct, and protects the cable sheaths from electrolysis. Complete instructions are given for making joints in lead-covered cables, the details being taken from the specifications used by four different companies which had independently adopted almost identical specifications for such joints.

Although it proved impossible to ascertain definitely the influence of the duct material as affecting electrolytic action, two companies stated their preference for fiber conduits over any other material for ducts. Some of the companies attempt to keep the cables practically insulated from the ground, except at the station ends. However, in all cases where the electric-lighting companies are in any way allied to the electric-railway interests the sheaths of the electric-lighting cables are frequently connected to the rails and to the negative return circuits in the proximity of railway stations.

Among the auxiliary devices for a subway system, manhole transformers, junction boxes and disconnective switches were briefly discussed. Descriptions were given of the Marz system of cable protection and the Torchio-Varley selector ground-detector system. The former depends upon the effect of the unbalanced currents in the series transformers at the two ends of the system when current passes to earth at some point between the ends. The latter system depends upon the unbalance in the electrostatic conditions when one conductor of a three-phase system is brought to earth potential by a ground along the line.

DISCUSSION.

In reply to a question by Mr. Farley Osgood, Newark, N. J., as to the use of concrete conduit such as is employed in St. Louis, Mr. S. B. Way, of the Union Electric Light & Power Company, St. Louis, Mo., stated that this conduit was installed under adverse conditions in Joliet, where it did not prove successful, but its use is being extended in St. Louis with very satisfactory results. The cost of this construction is about equal to that of a single duct surrounded by a 3-in. wall of concrete. The conduit possesses the advantages of being absolutely fireproof and of uniform quality. It is disadvantageous in that its installation requires good warm weather. Where concrete conduits have been substituted for Edison tubes that have rotted away and required replacing they have proved quite satisfactory.

Mr. F. B. H. Paine, Buffalo, called attention to the fact that in semi-rural communities in a large part of Germany the practice is to lay cables directly in the earth alongside of the road and to do away completely with ducts. The cost is found to be approximately 50 per cent greater than that of overhead line construction. Mr. Philip Torchio, New York Edison Company, said that well-insulated lead-covered conductor, wrapped with jute and armored with steel, should last indefinitely, provided it is not necessary to alter its location after being placed in the ground. The armored cable construction has proved advantageous in certain sections of New York City, notably Central Park. This type of construction seems well suited for sparsely settled districts, though not applicable in congested city streets. In reply to a question by Mr. W. K. Vanderpoel, Newark, Mr. W. C. L. Elgin, of the Philadelphia Electric Company, Philadelphia, Pa., stated that there is only one effective method to rid a manhole of gas, and that is to place a false cover over the manhole and force the gas back into the pipe from which it has escaped.

GROUNDING SECONDARIES.

The report of the committee on grounding secondaries, Mr. William H. Blood, Jr., Stone & Webster, Boston, chairman, reiterates its position that it would be unwise to carry the grounding of secondary circuits above 150 volts. It admits, however, that such good authority as a committee of the American Institute of Electrical Engineers wishes to carry the limit to 250 volts. While it may be safe to ground between 150 volts and 250 volts, the N. E. L. A. committee does not, however, feel warranted in suggesting that a rule be made mandatory covering these potentials. On the contrary, it believes that a voltage of 150 volts to ground is about as high as it would be safe to handle at all times, and if this were raised to 250 volts accidents and fatalities are likely to occur.

The committee believes it much more necessary to protect the lighting than the motor circuits, owing to the large proportion of lighting customers and to the large number of people who handle electric lights who, unlike those who handle motors, are not expert in electrical matters, and because the lighting circuits are less carefully installed than motor circuits, and often so located as to render the getting of a shock an easy matter. Referring to means of grounding, it is stated that metallic piping systems give the best grounds, and that plates and other devices are at best makeshifts. Regret is expressed that certain grounding devices are now on the market which in fact do not make good ground connections. The report quotes the resolution adopted at the annual meeting this year of the Underwriters which, after stating that there is difference of opinion as to whether the grounding of circuits having a normal difference of potential of under 150 volts induces hazards due to such grounding, urges that municipal departments shall make the grounding of secondary circuits up to 150 volts mandatory; that underwriters' inspection departments recommend at all times such grounding as a proper and desirable precaution which induces no fire hazard; that the National Electric Light Association be urged to see that all of its member companies be brought to realize the necessity of such grounding for the protection of their customers. and that the American Institute of Electrical Engineers be urged to use its best endeavors to harmonize the present difference of opinion as to the limit of voltage at which grounding ceases to be desirable, by determining the limit which shall meet with general approval.

In conclusion the committee, in view of the above resolutions, urges upon every member company the desirability of taking steps to see that its circuits up to and including 150 volts be effectively and permanently grounded.

DISCUSSION.

Mr. Farley Osgood, Newark, said that he was in accord with Mr. Blood's report, but he felt that grounding should be done up to 250 volts. He recommended that all operating men should give special attention to the subject, giving their ideas as to the proper voltage limit. Mr. Osgood said that the underwriters will not at present make grounding the secondary mandatory. It reduces the life hazard, but does not usually decrease the fire hazard to a sufficient extent to justify raising the fire rate in cases where secondaries are not grounded. The speaker advocated testing 200 or 300 grounds at intervals of six months, or a year, preferably making the second test under different weather conditions from the first. He said in conclusion that the committee would be greatly helped if every operating company would send to it a report of a number of ground tests.

Mr. H. L. Wallau, Cleveland, said that in operating a Y-connected system with a grounded neutral two 2½-in. pipes driven 20 ft. into the ground were installed at one station. Direct-current tests showed that the resistance of the two pipes were substantially the same, showing a desirable uniformity in the ground conditions. In some cases complaints have been received from customers on whose premises circuits from 115-volt potential have been grounded. In one case the company was requested to remove the ground where the maximum ground through a combination of transformers was 220 volts, and this was changed to a maximum of 115 volts. Mr. Holdrege mentioned a new form of ground plates consisting of a series of disks of molded cement which are placed at the proper wire. The cement is impregnated with a metallic salt, the outfit being cheap and easily installed. Mr. Osgood said that his practice is to use a series-pipe ground where water systems are not available. He considered this superior to any cone type of ground. Mr. Hertz said that his experience was that the ground resistance of the cone type of apparatus was too high, the trouble being probably with the size of the cone. He favored the grounding of 150-volt circuits with the object of making no point of greater potential after a circuit is grounded.

Mr. P. T. Davies, Montreal, stated that 250 tests on ground pipes showed that 90 per cent were short-circuited when 110 volts were applied across the conductor to ground. Cones showed a better ground than ordinary pipe, and he did not consider pipes satisfactory when set in rocky soil. Mr. Blood said that most of the grounding devices on the market do not give sufficient contact with the earth. The character of the soil is probably the controlling feature in a good ground. In seaport towns, like Boston and New Orleans, a good ground may be made by driving a pipe of small size into old dark mud, but in rocky areas like Arizona many pipes would have to be driven to considerable depths to get a reliable ground. Ordinary soil seems to vary in different lays, requiring driving to depths from 5 ft. to 20 ft., according to local conditions. The grounding section is also affected by the season of the year.

Mr. Paul M. Lincoln, Pittsburgh, said he was favorably impressed with the scheme of a ground made by driving a pipe into the earth and pouring concentrated brine in and around it. The fundamental point is the area of conductor in contact with the earth. Mr. H. W. Stevens, Boston, said that the practice of his company is to employ a 350,000-circ. mil cable about 5 ft. long, spinning it out to a depth of about 5 ft. or 6 ft. and filling the hole with rock salt. The connection to the cable and transformers is made with a No. 0000 wire. Mr. Holdrege found that the use of brine destroyed the ground pipe at the end of a year.

Mr. Mowbray favored not exceeding 150 volts in grounding secondaries, contending that the effects of a 250-volt shock are extremely unpleasant, not to say dangerous. Mr. Paul Spencer, Philadelphia, agreed with the foregoing speaker, citing two fatal accidents from 250-volt circuits in one of the companies with which he is connected. He felt that Mr. Blood in his recommendation limiting grounds to 150 volts had taken a correct and conservative stand.

METER REPORT.

The meter committee, Mr. George A. Sawin, Public Service Electric Company, Newark, N. J., chairman, submits its report with the title "Necessity for Maintained Accuracy." A table is given showing a great improvement in accuracy between the years 902 and 1910. During this period the light-load accuracy has increased from 84.4 per cent to 95.9 per cent and the heavy-load accuracy from 92 per cent to 98.4 per cent. Another table gives the percentage of accuracy of several types of meters as follows: Induction meters, heavy load, 97 per cent; light load, 92 per cent; commutating meters, 110-200 volts, direct current, heavy load, 92 per cent; light load, 74.5 per cent; commutating 500-volt meters, direct current, heavy load, 78.5 per cent; light load, 63.5 per cent. A considerable section of the report is devoted to descriptions, with illustrations, of new meters recently placed on the market A section is devoted to meter testing and to meter-testing tools and appliances, with illustrations. The practice in reading meters is given for the Union Electric Light & Power Company, St. Louis, and for the United Electric Light & Power Company, of New York City. The section on records of costs details the cost data which each meter department should keep, and suggestions as to the methods of keeping these costs are given. Several pages are devoted to flat rates, in which reports are given from a number of towns and cities which, in part, have adopted flat-rate systems. A digest is given of laws having a bearing on the electric-meter department which during the last year have been passed in New York, Wisconsin, North Carolina, New Jersey, Maryland and South Carolina. Half of the report of seventy-two pages is taken up by a continuation of the meter code, the present portion (Section IX) dealing with maintenance methods. This is an elaborate treatise on the subject of maintenance, including an analysis of all the various causes of inaccuracy, with instructions for their correction. Many illustrations are included and also an excellent index.

DISCUSSION.

Mr. H. H. Lyon, Buffalo, inquired what the practice of the committee was with respect to ball-bearing meters, and Mr. Sawin stated that the recommendation is the same for both pivot bearings or ball bearings. Mr. A. Hertz, New York, stated that the New York Edison Company had concluded not to oil bearings of meters. Trouble had been experienced from caking. In reply to a question Mr. Sawin said that the Public Service Corporation of New Jersey had also encountered caking. Careful speculation and testing of the oil are highly desirable. Mr. S. G. Rhodes, New York, called attention to the thorough investigations of oil made by meter manufacturers, and advised consulting with them to secure the addresses of concerns manufacturing reliable lubricants.

Mr. M. J. Mowbray, Providence, stated that the Narragansett Electric Lighting Company uses a meter with a heavy moving element, with two drags on the same side of the disk. All meters are equipped with the cup diamond jewels. Trouble has been experienced from the running off of the pivot with resultant cutting into the brass, producing a metallic dust in the bearing which nearly stops the meter. The company is now using a form of bearing with the cup diamond jewels removed and fitted with sapphire ring stones. This has greatly improved the situation. Mr. A. G. Strickrott, Schenectady Illuminating Company, said that his greatest item of expense in meter maintenance is with the sapphire jewel. Mr. H. A. Holdrege, Omaha, asked for a definite recommendation as to the frequency with which meter tests would be advantageous. He finds 95 per cent of his single-phase induction type meters accurate within 2 per cent when tested once a year, but felt that other types of meter should be tested more frequently. Mr. Mowbray called attention to the fact that on high speed, where the pivot goes into the brass, it is restrained by the sapphire. He further stated that a deeper cut diamond would aid the drag on the ordinary meter. Mr. Rhodes felt that further tests should be made before adopting a recommendation to change from the cup-diamond type of bearing to the sapphire type.

Mr. Sawin said that some of the large companies make a practice in direct-current meters of removing every jewel for periodical tests, invariably repolishing the jewels. Other companies have had difficulty in re-cupping sapphires. It was his opinion that re-polishing pays. The desirable frequency of tests has been covered in the Meter Code.

OVERHEAD LINE CONSTRUCTION

The report of the committee on overhead line construction, Mr. Farley Osgood, of the Public Service Electric Company, comprises in printed form 195 pages, divided into four sections as follows: Specifications covering methods of overhead line construction for 2300-volt distribution and for street-lighting circuits, with specifications for material; specifications covering methods of overhead line construction for secondary voltages, including pole wiring for street-lighting circuits inter-company agreement forms and specifications for the joint use of poles by lighting and telephone companies, and specifications for overhead crossings of electric-light and power lines. The last-mentioned is a joint report of the National Electric Light committee, A. I. E. E. high-tension transmission committee, committee on power distribution of the American Electric Railway Association, committee on high-tension wire crossings of the Association of Railway Telegraph Superintendents, committee on electricity of the American Railway Engineering & Maintentance of Way Association. The specifications have been formally aprpoved by the Postal Telegraph Cable Company, Western Union Telegraph Company, American Telephone & Telegraph Company and the New York, New Haven & Hartford Railroad Company. The publication is well illustrated and constitutes a complete engineering handbook of the subject which it covers.

DISCUSSION.

Discussion on the report was opened by Mr. Ernest H. Davis, of the Lycoming Edison Company, of Williamsport, Pa., who expressed his opposition to the section of the report relating to clearance, which he stated in effect condemns all existing types of crossings that are not in accord with the standard adopted. He objected specifically to the specified clearance of 30 ft. above the track, claiming that such a distance is not absolutely necessary for safety, and if specified as a minimum distance it will undoubtedly be held to in the future. The specifications call for extra construction at railroad crossings. Mr. Davis claimed that lives of citizens walking along the streets of a city are equally as important as the lives of the railroad passengers, and if a certain construction is required for railroad crossings an equally good construction should be required along the city streets.

Mr. Benjamin F. Pearson, of the Southern California Edison Company, Los Angeles, Cal., remarked that although the specifications proposed are not acceptable in detail to all engineers they are applicable to conditions of the Southern California Edison Company, which operates over territories covering eight big counties, with line voltages ranging up to 100,000 volts. He expressed his belief that the report should be adopted as a whole.

Mr. W. K. Vanderpoel, of the Public Service Corporation, Newark, N. J., expressed his pleasure at the excellent standardization of rulings relating to poles and cross-arms. Mr. A. S. Miller, of the Union Electric Light & Power Company, St. Louis, expressed the opinion that in view of the predominating importance of the report its adoption should not be considered until after the members have had sufficient time to study it in detail. In reply to Mr. Miller, Chairman Eglin stated that the matter relating to the specifications has been before the association for three years and that all of the member companies have been in actual correspondence with the committee during the entire past year. Mr. Pearson added that the adoption of the report by the convention would not necessarily carry with it a mandatory obligation to carry out the regulations. To this Mr. Miller replied that in case of a damage suit the specifications would be looked upon as a standard of good construction, and any damage caused by a construction not in accord with the specifications would place the company at a disadvantage. He held that, while the report is not a legal document, it represents a very important precedent and should be carefully considered before it is passed.

Prof. A. S. Richey, of the Worcester Polytechnic Institute, Worcester, Mass., as representative of the power distribution Committee of the American Electric Railway Engineering Association, requested that the specifications for the joint use of poles be not passed by the National Electric Light Association until an opportunity has been afforded for consultation with the proper committees of the American Electric Railway Association. He stated that there were several matters in this section which were not in accord with the standard of electric railway practice and were unjust to electric railway interests. He stated that the objections raised by the railway people related more largely to telephone circuits than to electric circuits, and the Railway Association does not wish the National Electric Light Association to adopt a specification which would prove a great leverage with the telephone interest.

Mr. George H. Lukes, of the North Shore Electric Company, Chicago, Ill., suggested that the report be accepted as one of progress. President W. W. Freeman stated that it is necessary for the association to adopt a standard on important questions. He suggested that in the event of disagreement concerning the adoption of the report the entire matter be referred by both sides to the executive committee of the association. The executive committee will then put itself into communication with any who wish to communicate their wishes and will try to reach the correct conclusion on the subject.

Mr. George E. Wendle, of the Lycoming Electric Company, Williamsport, Pa., claimed that a clearance of 24 in. between circuits occupying joint poles is known to be safe, and thought it unnecessary to specify 48 in. as the minimum clearance. Mr. Arthur S. Ives, of the Central Hudson Gas & Electric Company, Poughkeepsie, called attention to the fact that the spacing between pins on an eight-pin cross-arm is less than on a four-pin cross-arm, and remarked that any spacing which is safe for the former should be equally safe for the latter. He stated that between wires on a joint pole the clearance could well be at least 6 ft. so as to prevent the men standing on the cross-arms in order to work on the transmission wires.

Mr. Paul Spencer, of the United Gas Improvement Company, Philadelphia, expressed the opinion that the entire report could safely be adopted; but if the members could not agree upon the absolute adoption of the report, such action should be taken as would lead to the adoption of the report after such conference as may be necessary to get the full consent of other bodies interested. Capt. William Brophy, of the Boston Edison Company, expressed the belief that the report can be adopted without prejudice to any company in case of a lawsuit. A universal practice is recognized to be as binding as law, and the specifications seek only to harmonize the general practice. He commended the work of the committee, stating that the report itself is a fitting monument to it and suggested that the members dedicate it by adopting it.

Upon motion by Mr. Louis A. Ferguson, of the Commonwealth Edison Company, Chicago, which was carried, the technical session recommended to the executive committee the adoption of the report as a whole.

PRESERVATIVE TREATMENT OF POLES AND CROSS ARMS.

The report of the committee on the preservative treatment of poles and cross-arms of last year treated the subject more or less generally, while the present report takes up the subject in specific detail. Mr. W. K. Vanderpoel, of the Public Service Electric Company, Newark, was chairman of the committee, with Mr. C. C. Tutwiler, chairman of a sub-committee on preservatives, and Mr. Martin Schreiber, chairman of a sub-committee on treatments. The section on preservatives is confined to a report on creosote oils and the methods for the introduction of such oils into timber. The committee recommends, as the result of its investigations, that this class of preservative be used for the treatment of line poles. Three specifications for creosote are included in the report. The various processes are considered under the heads of brush and dipping, open tank and pressure treatments. The report, which comprises 122 pages, includes numerous illustrations relating to processes, etc. There is a number of appendices, dealing with the following principal subjects: European method of treating telephone and telegraph poles, by Dr. Herman von Schrenk; the open-tank treatment of poles with creosote, by Mr. Howard F. Weiss; report of an operating company giving its experience with a creosoting plant; damage to poles by wood-boring insects; U. S. statistics of poles sold during the years 1907-09; discussion of the 1910 report of the committee, by Dr. Herman von Schrenk.

DISCUSSION.

The discussion of this report was opened by Mr. R. V. Coombs, of the Public Service Electric Corporation, Newark, who asked a number of questions relating to the size of flasks, method of taking samples of impregnating material, the size of auger to be employed in boring holes in the pole and the permissible size of knots in cross-arms. He claimed that a cross-arm containing a large knot should not be accepted for line construction.

Mr. F. D. H. Paine, of the Niagara, Lockport & Ontario Power Company, Buffalo, remarked that the principal element in the cost of transmission, aside from the interest on the investment, is the maintenance of the lines, which means the avoidance of trouble whenever it occurs. If preservatives can be used in poles in order to increase the length of life, the maintenance will be correspondingly reduced, and troubles resulting from the necessity of replacing structures will similarly be reduced. He expressed the opinion that steel has been adopted for transmission towers almost wholly on account of the permanence obtained. As a matter of fact, there are many features of a wooden pole line which render it preferable to a steel pole line. The only real disadvantage of the wooden pole is its short life, hence the importance of preservative treatments to transmission companies can easily be appreciated.

H. A. Holdredge, of the Omaha Electric Light & Power Company, Omaha, stated that of several thousand southern pine poles treated with concrete by the pressure process, which have been in the ground for five years, not one shows evidence of decay at the present time. However, the conductivity of the poles is a disadvantageous feature. The creosoted pole acts at all times as does an untreated pole after a long soaking rain. The wires held by these poles can be handled by men only when they use rubber gloves.

W. L. Abbott, of the Commonwealth Edison Company, Chicago, expressed the opinion that it would be feasible to treat a pole already erected in the ground with creosote by inclosing that section of the pole in some kind of a cylinder which could be rendered watertight, pressure then being put upon it at that point.

B. F. Pearson, Los Angeles, stated that the Department of Forestry of the United States has co-operated with the transmission companies in southern California in the erection of a plant in which about 400 poles have been treated and planted in all kinds of soils and examined every year. The open hot tank treatment with subsequent cold immersion afterwards has been found the best. The companies have adopted the policy of treating all poles thoroughly before putting them into the ground for any purpose, whether for transmission or distribution.

Dr. G. Alleman stated that he knew of no business which is as productive of frauds as the creosoting business. He claimed that it is absolutely necessary to have conscientious and rigid inspection in case the creosoted material is to possess the characteritics intended. In certain cases where the specifications called for an impregnation of 12 lb. per cubic foot tests have shown that the actual impregnation did not exceed 8 lb. In a certain case where poles were ordered for the U. S. Army according to a specification calling for 20 lb. of creosote per cubic foot about 9 lb. was found to be the maximum and 3 lb. the minimum in the poles delivered.

Lamps and Illumination.

ILLUMINATION FOR INDUSTRIAL PLANTS.

The report of the committee on industrial lighting, Mr. M. S. Sloan, Birmingham (Ala.) Light & Power Company, chairman, consists of a number of monographs, including descriptions of actual lighting installations or plans for the same. The first paper is by Mr. D'A. Ryan, of the General Electric Company, which, under the title of "Industrial Lighting," lays down the fundamental principles applying The conclusions are as follows: 1. Large units for high-studded rooms, small units for low-studded rooms. 2. Lamps should be above the cranes and always as high as conditions permit, using in every case suitable reflectors. 3. The largest lamps should be selected consistent with sufficiently good disposition for the particular purpose. 4. Where the floor space is large and the work rough there should be a moderate general illumination with local lights at the tools. General illumination should be used where there is a great number of small machines in a relatively small space. For presses or machines turning out particularly fine work individual lights will probably be required. 5. Employees should be protected as much as possible from direct rays of light, the intrinsic brilliancy being cut down and good diffusion secured. 6. Local lights should range from 2 cp to 8 cp and be completely covered by reflectors so ventilated that stray light cannot enter the eyes of the operators from the top and with the light field being free from streaks or spots. In the two following papers Mr. Ryan describes, with many illustrations, the illumination of a clothing factory and the illumination of a building of the General Electric Company at Schenectady.

Mr. C. E. Clewell, of the Westinghouse Electric & Manufacturing Company, contributes to the report a paper prepared by the illuminating engineering department of the Westinghouse company describing, with many illustrations, the manner of installing over 7000 tungsten-filament lamps for lighting about 10 acres of floor space in the Westinghouse plant at East Pittsburgh. The considerations are given which led to the disposition chosen for each class of lighting. At 25 cycles no flicker was detected in the 250-watt lamps, and this was scarcely appreciable in the 100-watt and 60-watt lamps. Slight flicker was noticed in 40-watt lamps, but not sufficient to impair the illumination for ordinary purposes. The maintenance cost of the tungsten system described on a percentage basis was found to be 75 per cent for renewals, 3 per cent for broken reflectors, 16 per cent for making renewals and changing reflectors for washing, 2 per cent for washing reflectors, and 4 per cent for additional indirect charges, the total being 100 per cent. It has been found that one man can inspect 3000 tungsten-filament lamps in about two hours' time. Experience showed that if reflectors are not cleaned at fairly short intervals they may lose as high as 40 per cent of their reflecting efficiency. This report forms an excellent contribution to the planning and maintenance of a large industrial illuminating system employing tungsten lamps.

Mr. H. J. Tait, of the Holophane Company, contributed a paper on reflector maintenance, giving practical instructions. Mr. J. S. Codman contributed a communication from the National Electric Lamp Association entitled "Industrial-Plant Lighting," which lays down the fundamental principles concerned and includes a number of illustrations of lighting in factories and shops.

DISCUSSION.

Following the presentation of the above report there was a rather extended discussion bearing chiefly on the installations described in the report rather than on the committee's suggestions themselves. Mr. Sidney Ashe, of Harrison, N. J., asked a number of questions, some of which were answered by Mr. Clewell, one of whose articles was embodied in the report.

Mr. Norman Macbeth, of Bloomfield, N. J., spoke at some length on the cash value of good illumination and suggested that central station managers view the problem of industrial lighting in the light of the larger returns which such business affords. Too often the large returns obtainable from the lighting of industrial establishments is not appreciated as fully as it might be. Speaking of actual installations, he said that for factories having low ceilings the maximum unit was a 100-watt lamp, while a 60-watt lamp probably would give the best service. He was very much pleased that the committee had not attempted to standardize lighting installations.

Mr. M. O. Dell Plain, of Syracuse, N. Y., stated that in installations fed from his company's services with 25-cycle energy the flicker was very noticeable if reflectors having radial corrugations were employed with tungsten lamps. Where smooth surface reflectors are used this flicker is not noticeable.

Mr. C. E. Clewell, of Pittsburgh, Pa., commenting on the foregoing statement, said that the phenomon might be due to light surfaces such as would be offered by a sheet of white paper on a desk. In factory installations where the lamps are located near belts Mr. Clewell stated that a satin-finished reflector shows more rapid deterioration than the plain-glass reflector.

Mr. H. L. Parker, of Baltimore, Md., voiced the need of having specially trained men for soliciting industrial work.

Messrs. F. J. Leitner, of Brooklyn, N. Y.; S. E. Doane, of Cleveland, Ohio; W. D'A. Ryan, of Schenectady, N. Y., and F. N. Willcox, of Harrison, N. J., also took part in the discussion.

COMPETITIVE ILLUMINANTS.

The report of the committee on competitive illuminants, Mr. H. J. Gille, of the Minneapolis General Electric Company, forms a valuable contribution to the subject, owing to the data contained as to candle-power and operating costs of gas lighting units and gasoline installations. The nature of the report does not, however, admit of satisfactory full abstract. It is stated that 85 per cent of the gas used for illumination is consumed in open-flame burners, and that the cost for such illumination is double that of the electric light from either tungsten, Nernst or Cooper Hewitt lamps. About 55,000,000 gas mantles are manufactured annually in this country, as compared with approximately 100,000,000 incandescent electric lamps. Comparing the heating effect of gas and electric lamps, it is stated that an inverted mantle gas burner gives off approximately 2250 lb.-Fahr. thermal units per hour, whereas a 60-watt tungsten lamp, which has a higher illumination value than has the inverted burner, gives off only about 200 thermal units in the same period. Referring to the color of incandescent lamp mantles, it is stated that those which give off a light of good quality have a low efficiency and short life. For this reason the "white light" mantle is very rarely used and the new amber light has a lower efficiency than the ordinary gas mantle. Not more than 60 per cent to 70 per cent of the initial laboratory rating of the gas-mantle lamp can be obtained under good service conditions.

A table is given of the comparative operating costs of gas and tungsten units, gas being assumed at $1 per 1000 cu. ft. and electricity at 10 cents per kw-hour, and in every instance the cost of the electric units is shown to be less. For example, the cost for the Welsbach, Jr., for 1000 hours is $5.50, as compared with $3.91 for the tungsten; for the standard Welsbach, $9.36, as compared with $6.19 for the tungsten; $6 for the open-flame gas, as compared with $2.77 for the tungsten, and $21.17 for the two-mantle "upright gas arc," as compared with $12.38 for the tungsten.

The final portion of the report is devoted to gasoline lighting, the several systems in use being described. The results of tests are given which show that with gasoline at 18 cents per gallon the fuel cost to operate single-mantle units will vary from ½ cent to 1 cent per hour, while with electrical energy at 10 cents per kw-hour a 100-watt tungsten can be operated at an expenditure for energy of 1 cent per hour. If to the energy cost the maintenance expense and fixed charges for the gasoline outfit are added, it will be found that the total operating cost for tungsten lighting is much less than that for gasoline; and that in any event the saving in favor of gasoline will never compensate for its many disadvantages and inconveniences.

DISCUSSION.

Mr. S. W. Ashe, Harrison, N. J., commended the report of the committee, but regretted that data were not given on mercury vapor lamps. He thought that the average c.p. of a lamp during its life should be used as a basis of all engineering service comparisons. Increased life has been obtained by the use of the wiredrawn filament, but at the sacrifice of candle-power to a slight extent. Recent tests on a mercury vapor tube showed that a direct-current equipment maintained 61 per cent of its initial candle-power during its life, an average candle-power of 75 per cent being obtained in an alternating-current lamp of the same type. Inverted and upright gas arcs with pilot flames are more expensive to operate than tungsten lamps. He gave various figures showing the gas consumption of illuminants under service conditions, and said that an average performance of from 60 to 70 per cent of the initial candle-power rating appears conservative. In general, a three-mantle upright gas-arc can be comfortably replaced by a 150-watt tungsten lamp.

Mr. Norman Macbeth, Philadelphia, severely criticised the report on the ground that it was unfair to the gas interests. He contended that electricity could not compete with gasoline lighting on the ground of first cost, and also argued that inverted burners can be successfully operated on pressures as high as 2 in. The main consideration in dealing with prospective lighting installation is what the actual requirements are, and he felt that electricity had been given more weight as a general solvent of lighting problems than was warranted by the circumstances.

Mr. L. H. Scherck, Newburgh, N. Y., contended that the report would not stand the criticism of competent gas men. Mr. E. L. Callahan, Chicago, commended the report with a hearty indorsement, saying that it is the best compilation of data which he has ever seen, being a combination of laboratory and field results of the highest practical value. Mr. George S. Barrows, Philadelphia, supported Mr. Macbeth and Mr. Scherck. Mr. George A. Sawin, Newark, made a vigorous speech in behalf of the report, stating that the figures represent average service conditions and not those of a secluded laboratory. A motion to refer the report to a committee before sending it broadcast over the country was lost.

Mr. Gille closed the discussion by pointing out the fact that the values given in the report are precisely those that will be found under the stress and strain of service conditions. The committee's single object was to assemble approximate data which would be of practical service in central-station commercial departments. The figures have been checked from the operating field. Mr. Gille said that in view of the opposition by the gas interests to the report the committees would be continued during the forthcoming year.

ORNAMENTAL STREET LIGHTING.

Mr. William Rawson Collier, Georgia Railway & Electric Company, as chairman of the committee on ornamental street lighting, submitted a report discussing briefly the advantages and disadvantages of the different systems in common use, including the arc-lamp system, the festoon system and the post system using tungsten lamps. The arc-lamp system is expensive, but probably within a few years such systems will be installed in a number of cities, especially as the flame-arc lamp has been much improved recently. The festoon system, although attractive at night, has the appearance of being temporary and detracts from the beauty of the street during the day. Moreover, the equipment begins to rust within a few years and becomes dangerous unless overhauled frequently at considerable cost. The ornamental-post system is by far the most popular at present. Its advantages are permanence, beauty by day and night, even distribution of light, comparatively low installation and maintenance cost and great advertising value.

DISCUSSION.

Mr. V. R. Lansingh, of New York, commenting on the statement of the committee that, whether the lamps are placed upright, or hang pendant, is not of great importance since the light of tungsten lamps burned in either position is now about the same, said that there is a large difference between the illumination on the street with the one and with the other. Tests made with lamps placed in similar glassware and at the same height from the street surface showed a difference of 35 per cent in useful flux on the street with the lamp pendant as compared with the lamp in the upright position. He maintained that the success of ornamental street lighting schemes will depend on their economy of operation and in this connection pointed to the vast discrepancy between the different systems. Mr. Lansingh gave data on various shaped reflectors and shades indicating that it is necessary to bestow as much study in the question of ornamental street lighting as in the question of arc lighting.

Mr. T. I. Jones, of Brooklyn, N. Y., said the point at issue in ornamental street lighting glassware is the beauty which the globe gives and its advertising value. If flux of light were all that were wanted it would be an easy matter to put a reflector on a lamp to obtain this result. However, merchants wish their places advertised and desire to have the beauty of the system commented on; and where the ornamental post is for the use of the customer and where he pays for it, the type best adapted is that which shows a ball of fire rather than a point of light; so that considered from this viewpoint, the question of flux of light or reflector is of no significance.

Mr. C. N. Duffy, of Milwaukee, Wis., also was of the opinion that commercial men are not particularly interested in the technical side of the question, but rather in the value of the system as ornamentation, and electric advertising. Where the distribution question is allowed to interfere there is no uniformity, one section of the city having posts with the lamps pendant and another section having posts with the lamps arranged vertically. In Milwauke his company installs ornamental posts on a flat rate, including the installation of the posts, at $9 a month on a two-year contract. The cost on a front-foot basis approximates 25 cents. Where the consumer buys the post a flat rate of $6.30 a month is charged, with the lamp burning from dusk until midnight. He called attention to the difficulties often experienced in collecting money from individual consumers and stated that in the city of Racine an arrangement has been effected with the municipality by which the cost becomes a tax against the property.

Mr. W. H. Gardner, of Lincoln, Neb., felt that central stations in this matter have let their aesthetic enthusiasm befog their sense of business. Looked at from the viewpoint of net earnings per foot of street, ornamental street lighting does not begin to yield the returns obtained from window, sign and outline lighting. He said that excessive street lighting hurts window displays and that more emphasis should be placed on sign, outline and window lighting, since these were of more benefit to the merchant; gave more revenue to the central station and also illuminated the street.

Mr. S. M. Kennedy, Los Angeles, Cal., stated that his company had not been required to do any soliciting for ornamental street lighting in Los Angeles or in adjacent cities. This business came to it so fast that in many cases it was necessary to discourage it. His company has found that the miles of ornamental street lighting in Los Angeles are very artistic and very much admired for their decorative appearance not only in the daytime but also at night. This has brought about a highly desirable condition in the artistic education it has given the community. A municipal league in the city will not permit the passage of a sign ordinance since projecting signs would spoil the decorative effect of the posts. The decorative lighting therefore has not only restricted sign lighting but also outdoor and window lighting. Despite the knowledge that the decorative lighting deprives the company of considerable revenue. Mr. Kennedy said he is proud of the decorative effect and of the appearance of the Los Angeles streets.

Mr. A. S. Ives, of Poughhkeepsie, N. Y., urged companies to induce the municipality to pay for the decorative street lighting since every taxpayer is interested in anything that advertises and benefits the city, and everything that benefits the city benefits the central stations. The ornamental street lighting installed in Poughkeepsie last year has been increased materially this year and has brought the name of the city into prominence.

Mr. L. H. Scherck, of Newburgh, N. Y., supplementing Mr. Ives' statement, said that in Poughkeepsie by co-operating with the railway company and with the city a mile of wooden trolley poles were replaced by ornamental iron poles bearing four lamps. Mr Ives stated in this connection that tungsten lamps mounted on trolley poles suffered no impairment in life.

Messrs. H. K. Mohr, of Philadelphia, Pa.; L. Fitzgerald, Gary, Ind., and E. Creed, New York, also participated in the discussion.

LAMP COMMITTEE REPORT.

The report of the lamp committee, Mr. W. F Wells, Brooklyn, chairman, mentions several improvements in the method of manufacturing tungsten lamps, and some advances in the standardization of lamp sizes and ratings. It was stated that tungsten units rated at 400 watts and 500 watts have come into very general use during the past year. In reply to questions Mr. Wells said that he did not think central stations at present could give free tungsten-lamp renewals, and that consumers could not be prevented from buying lamps from contractors and others.

Miscellaneous.

PUBLIC UTILITY APPRAISALS.

In an address on the subject "Breadth of View in Public-Utility Appraisals" Mr. H. M. Byllesby, Chicago, called attention to certain general observations on the subject which can be applied to any method or any detail procedure which from time to time or eventually may be adopted. He expressed the opinion that greatly increased values will be allowed to the properties and going business of all classes of public service corporations in the future as compared with the tendency of either the past or present.

The speaker said that the almost unvarying experience has been that in installing a public-utility equipment the completed cost has largely outrun the estimated cost; this occurs even when the party making the estimates has charge of the construction and the work is done under his supervision and with everything in his favor. It is unfair, therefore, to allow this same procedure to be applied to appraising the cost of a property the construction of which is extended over a period of from a few to twenty years and the history of which construction is not available to the appraiser. In every case the appraiser should give the finished property the benefit of his own personal equation of under-estimating as well as the benefit of any expensive surrounding conditions existing at the time the construction under consideration was installed. Such a procedure would have a pronounced bearing upon the percentage allowances in fixing the value of public-service properties.

In addition to the above a suitable allowance should be made for the going value of the property, which represents its established business which costs more to build up than is generally understood, its large development account and a fair and reasonable dealing with the cost which in some form or another every public service corporation has gone through with in developing the art and experimenting with new systems, methods and apparatus and in learning the business.

Mr. Byllesby expressed the belief that the time will come when there will be a condition of better mutual understanding between the lawmakers and the public-service companies than has existed in the past. If the companies are properly protected they will do their part and continue the developments with the enterprise which has characterized their work in the past.

DISCUSSION.

Mr. Insull, taking the viewpoint of the financier, he said, rather than that of the engineer, declared that plant managers often fail to place a proper value on their own physical properties. He advised operators to take stock of their properties from time to time, securing the services of an outside expert for this purpose, rather than depending upon company engineers and auditors. Mr. Insull cited the case of a company with a yearly income of $160,000, whose manager believed that his actual plant value was far below that represented by his securities, although Mr. Insull declared that no business with an income of $160,000 per annum could be operated with a capital materially less than $600,000 to $800,000, and insisted that in some form or other this value actually existed in the property. The valuation which unbiased appraisal may disclose, often surprises plant operators who heretofore believed themselves to be familiar with their properties. In dealing with regulative bodies, suggested Mr. Insull, the information disclosed in such a report may often prove valuable.

ELECTRICITY IN RURAL DISTRICTS.

Mr. John G. Learned, of the North Shore Electric Company, Chicago, chairman of the committee on electricity in rural districts, submitted a report which deals with the subject in its commercial form alone, not going into any of the technical features—the object being to present a view of the situation from the standpoint of the central station and interurban electric railway, and to stimulate interest in the subject among the members of the association. The report is accompanied by seventy-eight illustrations giving views of the application of electricity on farms and for power purposes in rural districts. The report includes a tabulation of the returns received from a circular sent out by the committee asking for data relative to central-station business in rural districts. It is stated that the basis of development of rural electrical supply rests upon the extension of the lines of central stations in country towns, on connecting with interurban transmission systems and with the transmission distributing lines of interurban railways. In many cases it has been found advisable for a company to bear the expense of bringing the service to the rural customer, although this is not the general practice at present. The rural electric motor load is usually off the peak, and this is very often true with respect to the lighting load. It is believed that a great many rural customers can be secured consuming enough energy to pay the central station for the effort to reach them. If, however, an increased rate is charged for rural service the farmer will not favor its adoption and will turn to other means now continually offered, such as gasoline engines, gasoline-engine-driven dynamos, etc. Business should be encouraged also by means of instalment payments, cost price on wiring and similar inducements.

DISCUSSION.

Mr. H. J. Gille, of Minneapolis, Minn., desired information with regard to the cost of extensions in rural districts and Mr. Learned replied that although his committee had made no attempt to gather such information local conditions would necessarily have to govern. In few cases construction inferior to standard was used.

Mr. S. M. Kennedy, of Los Angeles, Cal., gave information on the lines operated by his company in southern California The highest standard of construction is necessary owing to liability of interrupting the service. The average cost of the extensions depends on the voltage of the lines and the nature of the territory, ranging from $600.00 to $1200.00 per mile. As a rule his company will make extensions to any distance upon the basis of 50 per cent of the first year's income, the presumption being that in future years the percentage will be considerably increased by the addition of other business. On a 26-mile extension the consumer had to pay one-third the cost of the line. In many instances the consumer owns the transformer, but where the rates are higher and the returns smaller the company usually supplies the transformer.

Mr. J. C. Parker, of Rochester, N. Y., spoke of the very advantageous loads offered in reclamation and irrigation work, and in reclamation work especially the reactive effect on the character of the country itself often justifies line extensions. Whatever can be done to increase the density of population in the country makes line extensions there possible. By means of electricity the value of marsh land and also of arid land is materially increased so that eventually the distribution question in rural districts becomes comparable with the present distribution question in urban districts.

Mr. E. L. Callahan, of Chicago, Ill., questioned the profitableness of some rural business and asked whether oftentimes the transformer losses would not more than offset the revenue received. Mr. Parker in replying said he believed that the fundamental and social character of people in rural districts would prolong the lighting load materially if electricity is introduced, and that much other business could be obtained from the operation of farm machinery. If short-hour business prevails the supply company could advantageously group customers on one transformer, ignoring the efficiency and making a considerable reduction in fixed cost.

Mr. L. H. Scherck, of Newburgh, N. Y., suggested that the committee embody in its recommendations a proviso that the data collected might also be issued in pamphlet form for distribution by the central-station companies to their respective consumers in rural districts.

Mr. E. P. Edwards, of Schenectady, N. Y., commenting on the need of specific data on the subject in hand, said it was hard to get information from the farmer and that it would be part of the duty of the expert recommended by the committee to compile this information. He stated that the U. S. Department of Agriculture had published a pamphlet entitled "The Cost of Producing Minnesota Farm Products" which contains accurate and detailed information on the cost of producing every form of farm produce. The bulletin gives the average cost of animal labor and of manual labor; the average cost of animal labor per horse-power ranging about eight cents. With information such as this bulletin contains the solicitor will soon discover where to go in order successfully to compete with animal and manual labor. Specific information is what the farmer needs and as an instance of the interest manifested in the subject he stated that his company had published 10,000 folders on "Electricity on the Farm" which were exhausted in three weeks.

Mr. J. F. Gilchrist spoke of the great headway made in the application of electricity to farming abroad, the farmers there being more advanced than the average farmer in this country.

REPORT ON PROGRESS.

The report of the committee on progress, Mr. T. C. Martin, executive secretary National Electric Light Association, chairman, forms a pamphlet containing ninety-eight pages, in which every phase of central-station development is considered under appropriate heads. The first part of the report treats of the general growth of the industry and its future. Statistics for the past year are given, followed by an account of conditions abroad with data. Sections are devoted to the federal corporation tax, federal lamp suit, electric transmission, right-of-way, physical valuation, rates and public-service commissions. The subject of conservation and water-powers is next treated, after which there is a section on valuation, rates and charges, with particular reference to St. Louis, Los Angeles, Toledo and Montreal. A number of notable new plants and hydroelectric developments are then described, after which steam-power and fuel questions are taken up. The question of illumination is treated under a number of heads, following which is a section on recent central-station methods and conditions, including improved meter reading and house wiring. The final pages of the report deal with events of the year in regard to matters of general public interest affecting central stations.

PUBLIC POLICY.

Questions relating to the environment of the working classes constitute the subject of the report of the public policy committee, Mr. Arthur Williams, vice-chairman. Modern industry depends upon three factors: Capital; direction, executive and administrative, and labor. The harmony of all is essential. The question of wages is a local one, but in the same locality wages should be fully equal to those paid by other employers engaged in similar work. The term "service annuity" is adopted rather than pension as compensation for continuous service over a period of several years. Wages is inclusive of both wages and salaries. Any contribution for the improvement of an employee's surroundings or of himself should not be construed as affecting his wage or as either charity or philanthropy. It is to secure the added service of enhanced efficiency, increased devotion to the employer and more careful utilization of time, tools and materials that the committee has directed its efforts to find a form of compensation reasonable and mutually satisfactory. The suggested forms of relationship between employer and employee include, in brief, accident insurance, sickness insurance and death benefits, service annuities, profit sharing, employees' savings and investment funds and life insurance.

A full account of the report of the committee and the discussion thereon will be found elsewhere in this issue.

MASTER AND MAN.

Mr. Paul Lupke, whose paper has become one of the features of the annual convention, took this year for his subject the relations between employers and employees. The leading note is that in such relations the human sentiment cannot be eliminated as a factor. Though rational welfare plans may make us all friends, and extensive profit-sharing schemes may make us all partners, still masters and men always must be and always will be, and wherever difficulties exist they are largely due to the fact that we have allowed the distance between the two to grow in proportion to the expansion of our business. The result is that the real masters are apt not to know their men, and the real men just as often not to know their masters. Launching an elaborate welfare plan, he said, without any attempt to educate the men up to its appreciation is like sowing good seed in an unplowed field—the crop is bound to be meagre. In the work of preparation nothing is so effective as personal presentation; this our commercial departments learned long ago—they have solicitors. Let him whose mind has conceived a plan try earnestly to imbue those next around him with his own enthusiasm and charge them solemnly to pass it down the line undiminished, step by step, to the last man, and when that is done, and not until then, introduce the formal features. Referring to profit-sharing schemes, he said that it is well to remember that benefits thrust upon one are apt to be considered with suspicion. If one can manage to convince men that not every dollar they can call their own must necessarily be in the vest pocket they are ripe for a profit-sharing plan, as they will then be about ready to ask for it, and that is the psychological moment for its promulgation.

ELECTRIC HEATING, REFRIGERATION, ETC.

In view of the broad scope of the work of the committee on electric heating, refrigeration and kindred appliances, Mr. F. H. Gale, of the General Electric Company, chairman, four subcommittees were formed, of which the chairmen were respectively: Messrs. C. J. Russell, Philadelphia Electric Company; E. L. Callahan, of H. M. Byllesby & Company, Chicago; G. B. Johnson, Commonwealth Edison Company, Chicago; L. R. Wallace, Boston Edison Company. The subjects were considered under the heads of domestic and commercial heating appliances, domestic and commercial cooking appliances, domestic lighting appliances, comprising novelty lamps, portable, fancy lamps, etc., and domestic and small power appliances, comprising domestic refrigeration, ventilation, vacuum cleaning and miscellaneous small motor applications.

It is stated that the flatiron is the greatest electric heating revenue producer singly, the average income being about 65 cents per month. It is estimated that last year 250,000 flatirons were sold in the United States and Canada, or one to every four residence electrical customers. The heating pad is second in popularity, and air heaters and luminous radiators are steadily growing in favor. Encouraging reports were received as to the industrial use of electrically heated tools and appliances, some member companies receiving an income of from $20,000 to $50,000 per year from customers of this class.

The report considers in detail the situation in various industries with respect to electric heat and power, in many cases giving interesting data. The use of domestic cooking appliances was found to be increasing. Details are given concerning a special type of electric cooking range designed for the Cleveland Illuminating Company, which is a combination of a storage heating oven having cooking plates and the radiant broiler of an ordinary electric range. About thirty of these outfits have been installed, and the average monthly bill per person for the last quarter, at the rate of 5 cents per kw-hour, varies from $4.13 for a family of two down to 81 cents for a family of eleven; a family of eight averages $1.41, and the average of four families of five persons each was a monthly bill of $2.54 per person. Answers are given to sixteen questions sent out to central-station companies relating to electric cooking. Two stations report their cooking rates to be 5½ cents per kw-hour; nineteen, 5 cents; one, 4½ cents; one, 4 cents; five, 3 cents, and two, 2.4 cents. All stations answering questions as to the minimum charge said that this was $1 per customer. There are cooking installations in hotels, restaurants, clubs, factories, etc., in Los Angeles (twenty), Chicago (fifteen), also in Brooklyn and Atlanta, Ga. The possibilities of commercial electric cooking are reported to be encouraging.

In a report on home refrigeration it is stated that one manufacturing company has sold in the vicinity of New York City and New Jersey 170 one-quarter-ton outfits, which are economical for any household which uses 40 lb. or more of ice per day. The use of ozone generators is said to be extending, and this apparatus promises a use of electric current that will grow in this country as it has done in Germany and other European countries. The electric vacuum cleaner is becoming very popular, and where placed in service invariably gives satisfaction.

DISCUSSION.

At the conclusion of the reading of the report and in lieu of any discussion, motion pictures were thrown on the screen showing the application of electricity to the servant problem. The films, which were loaned by the Commonwealth Edison Company, depicted scenes in a household bereft of any electrical conveniences; the purchase of the latter in the Edison Shop and the happy domestic changes resulting from their installation.

CENTRAL-STATION INSURANCE

In his report as insurance expert of the association Mr. W. H. Blood, Jr., of Stone & Webster, recalled that at the meeting last year figures were presented showing that the fire-insurance premium rates on electric-light and power plants were on an average about twice as high as the losses warranted, and that resolutions were passed calling the matter to the attention of the Underwriters and asking for such reduction in rates as the facts justified. The effects of these resolutions, Mr. Blood states, have been beneficial, although the matter has not received the full attention which its importance warrants. In some cases the effect was almost instantaneous and reductions as high as 50 per cent have been reported. Letters from underwriters were quoted, which indicate that the insurance people, as a rule, do not know whether central-station business is particularly profitable or not. While in certain geographical localities it is probable that no injustice exists, yet in certain other places scientific rating has received little, if any, attention. The Central Traction Lighting Bureau last year formulated a schedule with a basic rate of 8 cents in place of rates running from 25 cents to $1.25, each rating bureau having previously established its own basis. A few of the Underwriters' bureaus have adopted the new schedule, and where it has gone into effect there has been a reduction of approximately 35 per cent in premiums. Referring to the Underwriters' wiring rules, it is stated that there is a constant tendency to increase the requirements unnecessarily. It is recommended that member companies give more attention to seeing that new wiring installations to which they connect are in accordance with the National Code and that old installations are safe, as there will then be little demand made by the inspectors for something better. While it is imperative that the association shall stand unequivocally for safe wiring, it must also do all that it can to see that the cost is kept as low as possible.

VALUATION OF PLANT AND PROPERTY.

Mr. W. F. Wells, general superintendent Edison Electric Illuminating Company of Brooklyn, presented a paper on the subject of "Elements Affecting the Fair Valuation of Plant and Property," several member companies having requested information for use in the preparation of evidence in connection with rate cases, sale of property, additional capitalization, etc. The paper considers two of the factors, the approximate original cost and the reproduction value of that part of the property which is represented ordinarily by the fixed capital accounts. To obtain such estimates it is suggested that exhibits be prepared as follows:

1. Net cost of property to date, consisting of original cost with betterments, additions, improvements, withdrawals and renewals as made during a term of years. 2. Reproduction value. 3. Allowance for accrued depreciation or deferred maintenance. 4. Increment value of real estate and other property. Either the standard classification of accounts of the association or the classification prescribed by the New York Public Service Commission, First District, is suggested for use in the preparation of exhibits.

Exhibit 1 should be prepared from books and records, but the costs should be distributed, where possible, in accordance with the classification. Where charges have not been so segregated and evidences of cost of individual items are unavailable the distribution may be estimated. This should show the credits to fixed capital accounts for property withdrawn and charged against surplus or reserve accounts. It should show accumulated reserves, and should indicate whether it has been the practice of the company to make betterments and replacements out of earnings and to charge the cost thereof directly to operating expense accounts each month. The same treatment should be given to administration, engineering and general expenses and costs of developing the business which were met from earnings and thereby diminished the net return on the capital investment. Profits that were earned and not distributed, but were reinvested in the property, are justly part of the total cost.

Exhibit 2 should consist of a complete inventory of tangible and intangible property properly chargeable to capital as a part of the unimpaired investment. The cost of reproduction may be determined by present unit cost of labor and material delivered, except where prices are affected abnormally by temporary market conditions. These figures would represent the cost to a sub-contractor; overhead charges for contractor's profit, administration, engineering, incidentals and extra expenses incurred in construction which are not apparent in the finished work should be added. Proper allowance should be made for the term of years during which the work was actually done. The existence of intangible property is recognized by all courts, and several methods are in general use for the determination of the fair value.

If the accrued depreciation of any part of the property resulting from normal service or accidents has not been made good by proper repairs and renewals through charges to operating expenses, an allowance should be made for deferred maintenance, but if normal repairs have been made, and the original usefulness or earning ability of the property is unimpaired, no allowance should be made for normal wear or tear. Property inventoried and permanently withdrawn from service, but not yet sold, should be subject to an allowance for depreciation representing the difference between the reproduction cost and the sale value.

For the following reasons it is erroneous and illogical to assume that the reproduction value of the property is decreasing as the result of depreciation: On this basis, if a company had operated for a number of years its property taken as a whole, excepting real estate, might have depreciated 50 per cent of its service value, because one-half of the estimated physical life thereof had passed, even though the property had been kept in good repair and its original utility was unimpaired. A company managed in accordance with this theory would have a surplus or depreciation reserve equal to nearly one-half of its outstanding securities, and if these funds were reinvested in property of the company the earnng power would be enhanced correspondingly. If a company should accumulate a depreciation reserve fund upon this basis, its rates during the early period of operation would have to be so high that the business could not be developed.

Any so-called depreciation which does not affect utility should not be considered as impairment of capital, but rather as unaccrued expenses, as the replacement or withdrawal of the property in this case would be charged to operating expenses when the earning capacity actually ceases. Even though depreciated property is replaced from earnings, it is sound business policy for a company to maintain a sufficient amortization reserve to provide for any reasonable depreciation that may accrue during the following year, in addition to a surplus sufficient to meet dividend requirements for a year in case of adverse business conditions. No company, however, should be required to maintain a fund for all future unaccrued depreciation, any more than for interest of future years. Unaccrued depreciation will be offset by unaccrued earnings.

Exhibit 3 should show only such deductions as are to be made from the reproduction values in exhibit 2 on account of (1) obsolete or inadequate property withdrawn from service, but not yet sold or charged off, and (2) property whose utility is impaired because of deferred maintenance or repairs, accidents or other causes.

Exhibit 4 should show the increases in value in some parts of the property, the aggregate of which may more than offset accrued depreciation of deferred maintenance. Increment value of real estate may be shown by the difference in assessed values. Increment value of subway ducts or other sub-surface structures is shown by the difference between original and reproduction costs. It is also possible that there may be an increment value in buildings, due to increased costs of material and labor and shorter working days.

DISCUSSION.

Mr. Henry Floy, of New York, opened the discussion with a reference to the confusion which incompletely defined terms may cause. He discusses the various meanings of "service value," "wearing value," "salvage value" and "junk value," and distinguished between absolute or sensible depreciation and theoretical depreciation, by which he characterized the writing off of value on equipment yet rendering full service. Mr. Floy also spoke of the lack of definite data on the life of outside-line materials and equipment. Mr. F. H. Peckham, Providence, R. I., referred to the differing rates of depreciation encountered, and suggested the appointment of a committee to investigate the subject. Mr. J. W. Lieb, Jr., New York, declared that a saving of both time and money might be expected to result from the employment of outside appraisal experts, even though such service proved expensive and the company might have within its own organization men capable of doing the work. He also referred to the importance of obsolescence and changes in apparatus types in affecting service rates to customers. In closing Mr. Lieb urged the necessitty for making allowance for depreciation on the books of the company, pointing out that in case of a contest on the subject of rates the advantage of such a fund on the books would be obvious, although it would not be possbile to introduce it after the contest was in progress. Mr. Alten S. Miller spoke of the importance of capitalizing the cost of building up the business and said that certain progressive commissions, among them that of Wisconsin, allow the company a right to a reasonable return during the time of building up the business. In discussions before persons or bodies unfamiliar with corporation accounting terms, Mr. Miller advised the use of the expression non-inventory property instead of non-tangible property. Mr. H. C. Abell, San Antonio, pointed out how good management of a plant may often be penalized by commissions which seek to make proper allowances for earnings and depreciation. Mr. J. F. Klump, of Philadelphia, dwelt on the importance of going value. In 1908 he said the American Waterworks Association adopted a scheme for computing this intangible quantity, which he believed applied to the electric light situation. According to this scheme it was the plan first to consider the plant completed, but with no developed business. The cost of developing this service was then estimated and proved to be a very actual value. Mr. Wells, the author of the paper, acknowledged his difficulty in selection of words to express the ideas which he had in mind, and declared for this reason he had undertaken to define the expressions used.

THE ELECTRIC VEHICLE.

The report of the committee on electric vehicles, Mr. J. T. Hutchings, general manager, Rochester Railway & Light Company, chairman, discusses the use of the electric vehicle in central-station work under the following heads: General hauling of all kinds; hauling of heavy materials, such as transformers, reels of cables, etc., in which the electric winch is indispensable; application of electric vehicle in construction of aerial lines; use of electric vehicle in underground work; the electric-tower wagon, and the adaptability of the electric vehicle as an advertising medium. The committee very strongly emphasizes the desirability of every central station using the electric vehicle in its own work, first, on account of the saving and economy; second, as an encouragement to the manufacturers, and, third, as an encouragement to those in the community who could use electric vehicles with economy and satisfaction. It is pointed out that a number of up-to-date organizations are using electrically illuminated vehicles for the advertising of their wares after dark and that central stations might make a similar use of them to great advantage. As a moving power plant, through it all sorts of devices can be shown in operation during the evening hours, and many companies have found that the lighting of lawns for lawn fêtes, fairs, etc., can be accomplished cheaply by the use of storage batteries of vehicles.

From returns received from various manufacturers it appears that 4513 electric-pleasure vehicles were sold last year. Referring to competition between the electric and gasoline trucks, it is stated that manufacturers of the former are handicapped for the reason that they are unable to put out enough vehicles to reduce the selling price to an equality with that of the gasoline truck. Moreover, up to the present time there are no reliable data as to cost of operation, the result being that the electric vehicle is not receiving the attention at present which it deserves. The report urges strongly the compilation of operative data, stating that the electric vehicle cannot be effectively exploited among merchants if the central stations have no reliable information as to cost of operation.

From reliable data carefully compiled over a period of three years the report gives the following data applying to 1½-ton wagons: Average days in service per month, 24½; average miles per day, 29½; average kw-hours per mile, 0.491; oil and other supplies per mile, 0.6 cent; general repairs per mile, 1.4 cents; electric energy at 4 cents per kw-hour, per mile, 2 cents; tires per mile, 1.62 cents; batteries per mile 1.7 cents—making an operating cost of 7.32 cents per mile. For total operating expenses there should be added the salaries of drivers, cost of washing and minor repairs, and garage expenses. The committee has found that there is a difference of from 30 per cent to 70 per cent against the heavy gasoline type of tire as regularly sold in favor of the best special electric tire on the market. This means that the latter will give nearly double the mileage and double the life of the tire, if the vehicle is given proper attention otherwise. This question of tire efficiency will often account for the increase in electric bills and complaints from consumers having pleasure vehicles

Owing to the slower speed, more perfect control and lack of complexity of the electric vehicle liability-insurance companies are beginning to realize the greater safety of the latter and to make a material rate difference in its favor Fire-insurance companies recognize the lower hazard of the electric trucks and allow it on wharves and in sheds and warehouses where the gasoline truck is prohibited. Where electric garages can be satisfactorily fitted with a sprinkler system a very low rate of insurance can be obtained. Central stations intending to inaugurate an electric-vehicle campaign are advised to send a man from their organization for a month or six weeks to the various manufactories where electric vehicles are being built and assembled or to make arrangements with a station at present handling the vehicle situation satisfactorily to take [illegible] their man and give him a thorough insight into the practical part of electric-vehicle maintenance. Every central station should decide for itself immediately whether it will confine itself to co-operating with all electric-vehicle manufacturers and dealers, or whether it will sell electric vehicles directly; in the latter case the station should co-operate with the dealers in so far as possible. An abstract of the report relating to electric-vehicle accounting appears under the head of "Miscellaneous."

DISCUSSION.

Mr. P. D. Wagoner, Long Island City, brought out the importance of keeping accurate cost records. Examination of many so-called records of horse, gasoline and electric-vehicle equipment demonstrated no uniformity in method. The results have, therefore, not been comparable, and in some cases the vehicle owners have entirely overlooked the question of fixed charges. He felt that there was nothing more important from the central-station standpoint in the extension of electric-vehicle applications than comparable results giving the cost of operation of the three types of transportation. Referring to tires, Mr. Wagoner said that he remembered a test where the energy consumption was 75 per cent above what was considered the standard. It is of the greatest importance for every user of commercial vehicles to obtain tires which will give the proper consumption results, otherwise his mileage per charge will be very unsatisfactory.

Mr. Day Baker, Boston, called attention to the fact that the insurance of electric vehicles is certain to be reduced if the proper statistics can be placed before the insurance companies. The Electric Vehicle Association has the assurance already from two of the largest companies to the effect that they will reduce the insurance on electric vehicles if given something to work upon in the way of data. Blanks are being sent to all central stations and to all known users of electric vehicles, and the co-operation of every one was asked in filling out the forms. In Boston the fire underwriters permit the electric vehicles to be stored in the center of the city, whereas gasoline cars cannot be garaged in the business district.

Mr. W. H. Blood, Jr., Boston, said that, in his opinion, many managers do not realize the importance of the electric-vehicle load. Probably 90 per cent of it comes off the station peak. He felt that there was nothing in sight so easily handled without additions to capital and stations as the charging of vehicle batteries. It is desirable for central stations to give up using gasoline cars where they could better use electric vehicles, although it is inadvisable to advocate the use of electric vehicles for every service. The electric vehicle is not intended for touring purposes, but it has a legitimate field of its own in the trucking business, carrying heavy loads at low rates of speed and with limited mileage.

Mr. R. L. Lloyd, Philadelphia, stated that two manufacturers have received more orders to date this year for commercial vehicles than during the entire year 1910. Mr. Wagoner stated that the sales of his company for the month of February, 1911, were considerably more than the sales of the total year of 1908 and about the same as 1909.

Mr. Frank W. Frueauff, Denver, emphasized the need of greater activity in connection with electric vehicles. On his system a careful canvass has been made of all the users of gasoline vehicles and the advantages of the electric machine are being placed before them. He stated that a solicitor should feel as much responsibility for a man who purchases a gasoline car as he would for a merchant who establishes a gas-engine plant in the central-station territory.

Mr. H. S. Knowlton, Boston, spoke briefly in regard to the benefits of the electric-vehicle weekly luncheons which the Edison Electric Illuminating Company of Boston has lately been giving. Each Wednesday noon all representatives of electric-vehicle manufacturers located in the Boston district gather at the Edison Building for a pleasant social hour, after which, under the oversight of the chairman elected each week, a large number of imparted topics in connection with the development of electric vehicles in the district are discussed. It is inspiring to see these competitive interests putting their shoulders to the wheel with the single object of advancing the industry. Reference was also made to the recent decision of the Boston Edison company to replace all its gasoline and horse-drawn vehicles by electrically driven machines. On Memorial Day an electric-vehicle parade occurred in Boston in contrast to the annual work-horse procession, sixty-two electric vehicles being in line. Through the courtesy of Mr. Thomas A. Edison arrangements were made to have a moving picture taken of the parade and these moving pictures will be used by Mr. Baker in some of his lectures upon electric-vehicle transportation in the New England territory.

Mr. C. F. Smith, Boston, stated that the Edison company had sixteen trucks in line on Memorial Day. He brought up the point that in keeping records he had been confronted with serious difficulty on account of the use of auxiliary motors in some of the vehicles. The company's records are kept on a mileage basis and consequently it has been exceedingly difficult in many cases to determine the efficiency of the vehicles from the electrical standpoint. Frequently a truck will run less than a mile, consuming not a little energy in auxiliary service, and he asked if any of the members could advise a good method of properly crediting the value of the work which it does.

Mr. George H. Whitfield, of Richmond, Va., stated that his company had been careful not to enter into competition with local dealers. The policy is to do everything possible to assist local dealers in recommending cars, but the garages were smaller and irresponsible. Business was poor in the line of car sales on account of the lack of reliable garages. The central-station company finally announced that it would take care of the cars if anyone would find satisfactory facilities, and the immediate result was the increase in the sale of electric vehicles. The company has not been obliged to take care of a single car as yet, the mere announcement of its willingness to perform garage service being sufficient.

Mr. J. W. Brennan, Detroit, suggested that the problem of keeping records of vehicles with auxiliary motors could be handled either by two meters, one on the drive circuit and the other on the auxiliary wire, or by an amp-hour meter, the later being read when the vehicle comes to rest. Mr. Brennan stated that in spite of the fact that Detroit has the reputation of being the banner gasoline town in the country there have been sold there in the past six months about fifty electric commercial vehicles, and when one considers the handicap of competition existing there, both through loads and sometimes through price-cutting, such a record is remarkable and emphasizes the fact that the gasoline truck in a great many cases is unsatisfactory and that the users of transportation are on the lookout for the best equipment for a given service.

Mr. M. S. Seelman, Jr., Brooklyn, called attention to the road run recently initiated by a New York news company with a very large circulation. The publicity which this affair received was of great value to the electric vehicle, many central stations, manufacturers, owners and operators entering the contest. The newspaper that promoted this plan gave a great deal of space to the affair, and the electric vehicle came in for its full share of publicity. Many commercial vehicles have been purchased in Brooklyn within the past few months. Two of the largest department stores have announced the discontinuance of their horses for deliveries, and about half of their total of 150 delivery wagons have already been replaced by electric vehicles. The Brooklyn Edison company is also a very large user of electric vehicles and proposes to do everything that it can with this type of automobile.

Mr. Egbert Douglass, Milwaukee, emphasized the importance of the quality and extent of pavement upon the analysis of results in different cities of the same population. The large mileage of asphalt streets in Buffalo tended to make it a comparatively easy city in which to exploit electric vehicles.

Mr. Day Baker referred to a 5-ton truck which was six years old on the day of the electric-truck parade in Boston. For four years this machine has been operating over unpaved streets in the outskirts and it is apparently good for six years more. It appeared almost a duplicate of a new machine which made its initial appearance on the same day. A life of twelve years should easily be realized even under adverse conditions.

Mr. R. W. Rollins, Hartford, Conn., stated that the cost of energy for runabouts in his companys service figured about 1 cent per kw-hour, or was about 50 cents per week each. On the same basis 1000-lb. vehicles cost about $1 a week. The company feels that the business will have to be pushed pretty hard in order to amount to much in the way of selling energy.

Mr. S. M. Kennedy, Los Angeles, emphasized the importance of getting rid of gasoline cars at present used in central-station service. It was his opinion that in the present high state of efficiency of electric trucks and vehicles central stations should rely for their delivery service upon electric runabouts only. He had never seen an electric-lighting company's office illuminated by gas, or vice versa, and was of the opinion that the central station must set a good example if it is to induce consumers to put money into such equipment. It is a very difficult thing to ask a man to buy an electric truck for his business when the electric company has gasoline cars running around town.

Mr. E. F. McCabe, Titusville, Pa., inquired about the use of flat rates in selling energy for electric-pleasure vehicle service. His company has about a dozen runabouts and pleasure vehicles, selling energy at the rate of $60 a year per machine. A revenue of about 8 cents per kw-hour is the result of this arrangement. Mr. J. R. Brennan said that the practice in Detroit is not a flat rate, the company's plan being to make a low energy rate of about 4 cents per kw-hour, installing a separate meter for commercial-vehicle service.

Mr. E. L. Callahan, Chicago, stated that in Oklahoma City the company has five electric wagons and one runabout. The runabout has paid for itself in connection with the new-business department's work already. The town is growing so fast that it is almost impossible to anticipate the demands of manufacturers and save a great deal of business thereby. In one year the revenue from energy sold for charging purposes grew from practically nothing to $600 per month, and at present the revenue from this source is about $1,000 a month. There are about 350 electric vehicles in the city of Oklahoma. He did not agree that the business is not going to be very lucrative, but emphasized the importance of selling energy at considerably above 1 cent per kw-hour.

Mr. Rollins said that the Hartford company had no intention of selling energy for charging vehicles at any such price.

Mr. H. L. Parker, Baltimore, stated that his company has a flat-rate proposition of $25 per month for maintaining and charging 1000-lb. trucks. A large milk dealer which the company had in prospect was discouraged about the use of electric trucks on account of the cobblestone pavements. The company loaded a 3½-ton truck to about 57 per cent of its capacity and hauled milk for this dealer very satisfactorily for three days over the roughest part of the city.

Mr. T. I. Jones, Brooklyn, contended that the price charged for energy is a point vital to the sale of electric vehicles. He felt that if the electric vehicle is going to be pushed at all it must be along economic lines. He advocated compiling the results which have been obtained from certain rates by various companies in the development of the sale of electric vehicles, including rates which are not remunerative as well as those which are profitable.

Mr. E. W. Lloyd, Chicago, reviewed the practice of the Commonwealth Edison Company in pushing electric vehicles, stating that about forty vehicles are in use in the transportation department alone. The contract department has decided to use electric vehicles for transportation rather than gasoline. The company employs a battery expert who is doing a part of the work of an educational character among private-vehicle owners and garages. The company's energy charge for vehicle service is 4 cents per kw-hour maximum. In some of the larger garages the rate goes as low as 3 cents. To-day there are not more than half a dozen isolated plants in Chicago garages. The department store of Marshall Field & Company is buying additional electric vehicles from time to time. The speaker believed that the small commercial electric vehicle has a wide field for local delivery. In larger cities department stores have outlying distribution centers from which deliveries take place, and there is an admirable opportunity in this direction for expansion. The prospects will be better if the people in these stores are educated to use local delivery wagons, gradually working up to the larger sizes. The heavy truck is economical, but in connection with store business the use of the small vehicle should be strongly urged.

Mr. Arthur Williams, New York, said that there is a tendency to place too much emphasis on the rate for electric energy and advocated the use of electric vehicles. Assuming in any event that the rate payable for energy seems high, it stands to reason that anyone requiring service of that character cannot afford to use electric energy if he is going to place emphasis on its price. Whatever the energy rate may be, it is competitive, either with the horse on one hand or with gasoline on the other. Emphasis should be placed on the other services rather than on the energy because the latter is an incidental matter. The electric vehicle men are far too modest in the service claims for their equipment. The controlling considerations are cheapness, simplicity, economy and longevity. The only vehicle that can stand the strain and bear all comparison in the delivery service of large cities is the electric. In one department the speaker found that one truck would replace thirteen horses, and in still another that the ordinary 2000-lb. wagon would replace eight horses. Mr. Williams held that all that has to be done is to show the superiority of the service, the simplicity of the management and the low cost of delivery; if we can show this it will make a very serious encroachment on the pleasure field which is now largely occupied by the gasoline machine

Mr. Peck closed the discussion by thanking Mr. Smith for calling attention to the importance of keeping records of auxiliary apparatus, and Mr. Brennen for his suggestion as to the methods of keeping such records. In neglect of the records of energy and cost it would make the performance of these particular vehicles much worse than as though no record were taken whatever. Mr. Brennen's suggestion of having two meters appeared to be the best. Mr. Peck questioned the practicability of using the ampere-hour meter before and after the use of the auxiliary motor, on account of the unreliability of readings taken by drivers. He did not think that the flat-rate system could be satisfactorily applied to vehicle charging unless it is combined with the garage maintenance at a figure which would be particularly profitable to the central station through a period of years.

Mr. George R. Stetson, New Bedford, Mass., reviewed his experiences in purchasing electric vehicles for service on the system of his company. He started with a 1000 truck used in taking care of meter service. The first expense incurred in two years has been a set of wheels at a cost of $158. This truck has been run over 2000 miles, and has accomplished the work of two horses and four men during the two years of its service Snowstorms have not interefered with its operation, and in one instance a second truck of one-ton rating has very largely repaid its initial cost. Four trucks are now in service at New Bedford, the largest being a 3½-ton outfit. The latter is used for the distribution of coke and the handling of the supplies for the gas department. The first piece of work it performed was to haul a 35-ft. pole 8 miles, with a body of men to erect the pole, and the cost of handling the work by the usual method of trucking the pole with a horse and sending the men with a team would easily keep the truck running for several days.

Commercial.

ADDRESS OF CHAIRMAN OF COMMERCIAL SECTION

In his address at the opening of the Commercial sessions, Mr. George Williams, of New York, chairman of the Commercial Section, called attention to the fact that the latter has already enlisted a membership as large as that of the entire association six years ago. He stated that there is no association work with a commercial side to it that cannot best be developed through the Commercial Section. In public-utility work there must be harmony among customers, central-station men and supply men if the right kind of service is to be obtained. The Commercial Section affords opportunities for commercial men to acquaint manufacturers with the wants of consumers and for the manufacturers to educate the commercial men. The greater this amalgamation the more rapid the results. The process of simplifying and popularizing things that are intricate or technical demands the co-operation of scientific and commercial men. The author foresaw the time when the work of the Commercial Section would reach a point of specialization to warrant 50 special committees. He called attention to the fact that the reports compiled do not embody one-man opinions or clerical compilations, but the findings of groups of men of broad experience. He suggested the affiliation of the committee on the "Electrical Solicitors' Handbook" with the Commercial Section, and said that the section, although well established, will find its greatest usefulness is yet to come.

DISCUSSION.

Mr. C. N. Duffy, of Milwaukee, Wis., inquired if it would be feasible to bring about the amalgamation of the Electrical Solicitors' Handbook Committee and the committee of the section. The chairman suggested deferring the answer to this question until the second commercial session.

STANDARDIZING ELECTRIC SALES

With the above title, Mr. Douglass Burnett, of the Consolidated Gas, Electric Light & Power Company, of Baltimore, presented a paper advocating that the selling program of central stations should be on a strictly business basis, capable of tabulation and specification. The things that are sold and their prices should be clearly outlined and described for the purpose of instructing solicitors, making explanations to prospective customers and to complaining customers, and for meeting most effectively all demands for service and for equipment. A campaign for the sale of central-station output cannot effectively be conducted until rates are clearly set forth in pamphlets obtainable without the necessity of verbal inquiry, and until the details of equipment to be sold have been thoroughly worked out and a complete price list formulated. The author gives the practice of his company with respect to forms of schedules, its selling organization, prices for equipment, etc. There are eight schedules covering various classes of service, which include provision for extension of the mains for establishing service connections, both overhead and underground, etc., the prices being quoted on an easily understood basis. The selling organization of the company is described and complete details given as to prices fixed for various kinds of work. Lighting installations are charged for at a uniform price per watt. For a minimum order of 240 watts the price for the complete wiring and equipment of a store is 8 cents per watt or 5 cents per watt if wiring and switches are already installed; in the latter case any outlets requiring more than 5 linear ft. of molding and wire are charged for at the rate of 8 cents per watt. These prices include any of six styles of fixtures. Terms for work are cash in twelve monthly payments. For house wiring the charge in the case of a two-story, six-room house, or one-story bungalow, is 6 cents per watt for an average of 50 watts to 55 watts per outlet, less 0.6 cent for each watt over 55 watts, except that 4 cents per watt is charged for every 75 watts per outlet. For residences having one or more floors above the first floor, and two-story, three-story or four-story houses built in rows, or two-story or three-story semi-detached or cottage-type houses, 7 cents per watt is charged for an average of 50 watts to 55 watts at the outlet, less 0.6 cent for each watt over 55, except that 4½ cents per watt is charged for an average of over 80 watts per outlet. For a still better class of residences the charge is 8 cents and 5½ cents per watt instead of 7 cents and 4½ cents as in the preceding case. The paper gives many other details as to charges for various kinds of lighting installations and information is also given regarding the conduct of advertising campaigns and the work of solicitors.

RATE RESEARCH.

The report of the rate research committee, Mr. John F. Gilchrist, of the Commonwealth Edison Company, Chicago, chairman, confined its recommendations this year to rates for residence business, believing it wise to defer the consideration of general schedules until after some progress has been made in establishing uniform rates for residence lighting. A considerable portion of the report is taken up by the description of a graphical three-dimensional method for the study of electric rates, of which the mathematical theory is given in an appendix. An examination of schedules received from member companies indicated in most instances a surprising similarity. In the case of companies which have given study to the subject the rate curves are not only strikingly alike, but there is only slight variation in the actual cost to the consumer, these remarks applying where conditions are approximately the same for the business which forms the bulk of the company's income. In a comparison of the rates of companies where the elements of operating cost were approximately the same, the net charges per kw-hour were found to be very similar; however, in rates applying to the class of service where a maximum rate is generally charged, and which affords the smallest income to the company, there was very little uniformity either in schedules or net cost to the consumer.

The committee strongly recommends a campaign toward establishing among central station, so far as practicable, a uniform system of rates. Then each company could point out to its customers that its system of rates was in general use throughout the country. This would be particularly desirable in the case of customers dealing with more than one lighting company, which class is yearly growing greater in number and importance. With such a uniform system of rates new companies would be deterred from establishing schedules of unreasonably low rates, which frequently happens under present conditions, and as such low rates are always widely advertised they reflect discredit upon the reasonable and proper rates charged by other companies for similar service.

The committee believes that a campaign for national uniform rates could best be started by establishing, first, a schedule for residence customers. With this in view the committee makes the following recommendations as to residence rates:

The committee is of the unanimous opinion that the charges as a whole should be no more than sufficient to pay expenses, plus a profit high enough to attract capital into the central-station business. This, however, does not mean that each customer should necessarily pay the same profit or give the same return on his portion of investment as every other customer, so that a so-called maximum rate, with the customary minima for meter rent, break-down service, etc., will be entirely proper, especially when demanded by public opinion, even if some particular customers are an apparent loss.

The committee is by no means unanimous as to whether any rate should include a minimum charge per month or per year. It is not unanimous as to whether a differential for residence business is desirable, but is unanimous that, if adopted, either a wholesale or a differential based on hours' use of maximum or its equivalent is the best.

The committee recommends that floor space is the simplest, fairest, cheapest and most practical, constant and easily understood method of determining such a differential, although it has no recommendations to make as to whether this should be used directly or reduced to the number of rooms.

CENTRAL-STATION ADVERTISING AND PUBLICITY

The report of the committee on advertising and publicity, Mr. C. W. Lee, of the C. W. Lee Company, chairman, is divided into two sections, one of which considers regular central-station advertising and the other the use of newspaper advertising pages by central stations in setting forth its status as a public utility in case of hostile attack. Numerous illustrations are given of effective advertisements and of publicity "talks" bearing on rates, regulations, franchises, etc. Twenty central stations serving cities with a population from 20,000 to 50,000 reported an average of $1,500 expenditure per annum for advertising. The average for seventeen companies in cities from 50,000 to 100,000 population was $2,500 per annum; three companies in cities between 100,000 and 200,000 population expended an average of $6,300, and the average for fourteen companies in cities over 200,000 population was $31,660. The replies indicated that over $2,000,000 per annum is being expended annually for central-station advertising. The report includes accounts of advertising campaigns in various cities and of advertising assistance rendered to central stations by manufacturing companies.

DISCUSSION.

Mr. H. K. Moore, Philadelphia, pointed out the opportunity afforded by accidents for the preaching of service reliability. Considerable success had attended publicity put forth in Philadelphia recently in the newspapers in connection with an accident at the station, the company laying special stress upon the rapidity with which service was re-established. Mr. Moore felt that the committee can be made of greater value to the smaller companies, if the latter will send in accounts of special problems in publicity work which may oppress them from time to time, and he stated that the committee may frequently be in possession of information of decided value to such companies. Mr. M. S. Seelman, Jr., Brooklyn, agreed with this and spoke at length upon the importance of regular and close association between the advertising and commercial departments of the company. Not a day should be allowed to pass without the advertising department getting the benefit of the changing conditions and the opportunities for special publicity which are constantly apparent in the experience of those in contact with the great public outside.

Mr. F. H. Gale, Schenectady, outlined a plan by which central-stations will send to electrical manufacturing companies the names and addresses of prospective builders of houses, apartments, office buildings, factories and other structures in which electricity can profitably be used. The latter manufacturers will then in turn send to such people special and general publicity matter describing electrical apparatus of interest. Mr. Douglass Burnett, Baltimore, pointed out that such information can also be obtained from many additional sources. Mr. J. Robert Crouse, Cleveland, called attention to the "People's Electrical Page" which has been run in a prominent newspaper of Cleveland for about two years. Great success has been obtained by the use of this method of advertising, in which both paid publicity matter and reading notices are placed side by side on a single page. A person cannot run through a metropolitan daily having a page devoted exclusively to electricity without obtaining some new ideas which often result in the purchase of current-consuming apparatus. Vice-Chairman Williams cited a sale of a residence electric elevator solely through catalogue sent to people of means, and he also stated that in one medium-sized city seven such elevators have been placed in service largely on account of the social distinction conveyed by the installation of the first machine. He felt that the committee's report is the most useful and interesting of its kind thus far presented. Closing, Mr. Lee urged giving greater attention to the publicity needs of smaller central-stations, especially in connection with supplying them with the complete publicity data of a specific campaign. He re-read a letter from Printers' Ink commending the work the central-stations are doing in the advertising field.

ELECTRICAL ADVERTISING

The report of the committee on electrical advertising, Mr. E. L. Callahan, of H. M. Byllesby & Company, Chicago, chairman, refers to a bulletin on electrical advertising, consisting of reproductions of successful electrical displays now being operated in various parts of the country, a copy of which has been given to each member of the Commercial Section. The engineering data in the bulletin will, it is believed, be of much assistance in preparing specifications for electrical displays. The committee has investigated a large number of sign ordinances and submits in its report a model sign ordinance, consisting of seventeen sections, as a suggestion to central stations which desire to take up the subject with a city government. An investigation on the subject of the character of electric signs has brought to light many cases of signs so crudely designed and constructed as to have little or no value. Central-station companies are advised to prevent sketches and specifications for signs from being placed with incompetent persons for their execution. It is pointed out that at present electric advertising is a high type of the art, and its dignity should not be endangered through inferior design and workmanship and improper installation of electric signs.

DISCUSSION

Mr. E. A. Mills, New York, emphasized the importance of preparing sign legislation with great care. An ordinance in New York City limiting the height of signs has been declared unconstitutional. The New York Edison Company has an expert designer of signs who co-operates with the consumer, and before any installation is made submits sketches to him. These sketches and specifications are then sent to competitive sign manufacturers. Mr. Frank Hammond, Birmingham, outlined the favorable conditions under which his company operates, with particular reference to sign ordinances. Plans for prospective signs are submitted to manufacturers without discrimination. Some trouble has been experienced by the company from the burning out of five-watt tungsten lamps in alternating-current service. No difficulties have been noted with similar lamps operated by direct current. Mr. T. K. Jackson, Mobile, contended that liberal sign ordinances are likely to lead to abuses. on account of the freedom with which irresponsible structures can be erected. He was greatly in favor of placing the control of sign installation under the supervision of some single municipal authority qualified to pass upon the vital factors involved.

Mr. J. F. Gilchrist, Chicago, spoke in high terms of the committee's report. He pointed out the need of exercising a large amount of diplomacy in connection with the sign problem. He felt that any sign which is in a sense an obstacle should serve some purpose which justified the inconvenience of its position. Under proper conditions there is no question that signs are of great benefit to a municipality. The speaker thought that the situation in many cities was the payment of a rental to the municipality to cover the cost of inspection. Accidents are very serious in their effect upon the development of new-sign business. The business is sufficiently profitable to enable the central-station companies to pursue a liberal and tactful policy. The member companies themselves should do everything possible to exercise a closer surveillance of sign practice in their respective territories. As a rule, agitation comes from the installation of signs in the face of public opinion, particularly such examples as are flagrant violations of good taste or of safe construction. The policy of patronizing local sign-makers is a good one where the work can be done on a thoroughly sound mechanical and artistic basis. But preeminently a business should be given to concerns doing the best work. Mr. Gilchrist also pointed out the need of united action by the association in regard to freight rates on electric signs. The best which can be done at present is a rate of practically double the first-class tariff, and there is little doubt that if the association takes up the matter properly some reduction will be in order.

Mr. H. L. Parker, Baltimore, pointed out the adverse influence of a sign accident which occurred in Philadelphia some time since, at a period when the Baltimore company was inaugurating a campaign of publicity on behalf of a wider application of electric signs. Six weeks of double advertising were required to overcome the handicap, and as the sign which fell in Philadelphia was not of the electric type the circumstances indicated the importance of endeavoring to keep some sort of supervision of every kind of sign used within a company's territory Mr. Parker felt that a rate per lamp for electric sign service is preferable to a kilowatt-hour charge. Mr. C. A. Littlefield, New York, favored strict municipal ordinances, and also advocated the use of a flat rate. The object of the sign business is to cultivate long-hour service and this cannot be done by a kilowatt-hour charge as ordinarily instituted.

Mr. C. A. Littlefield, New York, pointed out how the New York Edison Company is co-operating with artistic organizations against excessive advertising by the electric sign method in certain localities. In deference to the wishes of such an organization the company has refrained from soliciting sign customers on a particular avenue and has as a result secured the co-operation of the society in other matters. The speaker favored rigid ordinance.

Mr. W. A. Johnson, Pittsburgh, said that his company had received many compliments from influential business men on account of the illumination of the streets by electric signs. About 75,000 4-c.p. tungsten lamps are in service. He criticised the custom of putting small signs in front of large ones, and urged the importance of inspection and careful installation.

In closing, Mr. Callahan said that a rigid ordinance provides the best plan of action. He also favored the use of a flat rate on account of its benefit in securing long-hour service.

ELECTRIC POWER DATA.

The report of the power committee, Mr. E. W. Lloyd, of the Commonwealth Edison Company, Chicago, chairman, consists very largely of tabulations of electric power data, which are of high value owing to their great completeness and authoritative character. One table, occupying twenty-four pages, consists of data collected from central-station companies relating to industrial installations of every class in which electric power is employed. The heads under which the data are given are as follows: Group or individual drive, number of motors, horsepower installed, running hours of factory per week, maximum demand in kilowatts, kw-hours consumed per annum. The second section, which occupies twenty pages, gives the horsepower required to drive more than 800 machines, covering almost every industrial use of machinery. These latter data are an addition to and not a duplication of similar data published in the N. E. L. A. handbook.

A final section gives information as to the power required for the making of artificial ice. The report states that it is safe to say that, under average conditions, using reasonably efficient apparatus, the consumption of electric power in ice-making should not exceed 60 kw-hours per ton, and the result might be accomplished at not more than 50 kw-hours. The data secured indicate that the annual load-factor of the ice auxiliary in a latitude above that of New York is about 65 per cent, and that the maximum demand per ton capacity, where the machinery is of 75 tons capacity or greater, is about 2.3 kw per ton, or, in other words, the maximum demand of a 100-ton plant would be about 230 kw, which includes the power for operating compressors, all auxiliary apparatus and electric lights for the plant.

DISCUSSION.

Mr. C. A. Graves, Brooklyn, said that he hoped that in future the responses to letters sent out would be more liberal. Information received from only one or two installations tends to create a lack of confidence. It has been his experience that many men whose work had been confined to motor service do not realize the essential information that they should have. Inquiries must be of a detailed character.

Mr. Dell Plain, Syracuse, cited the difficulty of tabulating the horse-power requirements of different machines, on account of the variation in conditions in individual cases. In Syracuse a graphic wattmeter test is made for every motor installation. The peculiar feature of this instrument is a variable speed in the paper feed, running from 3 inches per hour to 12 inches per minute. In addition to this record, full data are marked on the chart or on an accompanying card. In dealing with air-compressors, for example, it is necessary to know the pressure requirements, the speed, and the speed of the guiding fly-wheel. Great difficulty has been found in securing the horse-power data of blowers. The speaker did not know of any particular class of machine giving so much trouble as air-handling apparatus. The lack of authentic information regarding steam heating was also brought out by Mr. Dell Plain.

Mr. H. J. Gille, of Minneapolis, Minn., suggested that in future work the committee endeavor to ascertain the approximate number of kw-hours consumed per unit of manufactured product.

Mr. R. L. Lloyd, of Philadelphia, Pa., commenting on the refrigeration returns embodied in the report, pointed to the lesser energy consumption of the automatic machines due to their better regulation.

THE FUNCTIONS OF A SALES DEPARTMENT.

The report of the committee on the functions of a sales department, Mr. T. I. Jones, of the Brooklyn Edison Company, chairman, treats the organization of a sales department in great detail under four heads, namely: General organization of the selling force and the duties naturally pertaining to it; principal reports to be made by the sales department as a whole by its bureaus and by the salesmen; credit as it affects the getting and retaining of business; the compensation of salesmen. The selling-force organization is treated under the heads of advertising bureau, new-installation bureau, appliance bureau and power-engineering bureau. Under sales department the matter of reports is discussed in detail, and forms of reports are reproduced. Compensation of salesmen is discussed under the heads of straight salary, small salary and commission and straight commission. An appendix gives a schedule for solicitors' commissions as used by the Commonwealth Edison Company of Chicago, which has an added interest on account of enumerations in detail of the various classes of electrical business. A schedule is also given of the Denver system of compensation based upon salary and commission.

DISCUSSION

Mr. B. W. Mendenhall, Salt Lake City, favored solicitors' reports expressed directly in terms of watts and kilowatts instead of 16-c.p. equivalents, and Mr. William H. Gardner, Lincoln, Neb., took the same ground, also emphasizing his opinion that comparisons of results between different cities should not be made on the basis of absolute figures only, but should take into account the local conditions. It had been his experience that the plan of making a prospective customer put down a deposit before being connected with the company's service is a policy which tends to throttle sales and discourages the growth of new installation. Business can be properly handled as a rule on the strength of references to or from the tradesmen with whom the new consumer deals.

The payment of straight salary to solicitors was advocated by Mr. S. M. Kennedy, Los Angeles, except in connection with the sale of domestic electric appliances, in which instance a combined salary and commission was divided. Mr. C. Duffy, Milwaukee, favored the use of a kilowatt designation. In his company a daily estimate of the yearly revenue per kilowatt is submitted by the individual salesman. He also favored solicitors' commissions, uniform reports and terms, especially advocating the use of the words "sales department," 'salesmen," rather than "commercial department" or "solicitors." Mr. Burnett favored commissions for salesmen.

Mr. E. W. Lloyd, Chicago, said that his company could not afford to eliminate the commission, which is particularly well adapted to stimulate the growth of business through the enterprise of the employee. Mr. C. A. Littlefield, New York, concurred with Mr. Gardner regarding the inadvisability of making snap judgments upon surface figures. Mr. J. D. Israel, Philadelphia, believed that the deposit is an incidental necessary in dealing with all classes of people. It is as important to hold business once gained as to secure a new revenue.

Mr. Jones closed the discussion by a vigorous speech emphasizing the value of the 50-watt equivalent as a satisfactory unit of comparison. He pointed out the advisability of paying good salaries to few men rather than small salaries to many, and urged the importance of encouraging promotion from within the ranks. He did not agree with the other speakers concerning the interpretation of comparative figures, urging that human nature is the same everywhere and that figures are the only means of comparing results in anything but a fragmentary way. He felt that giving a customer a prompt connection after he signs a contract is the most important question confronting the commercial department of a modern lighting company.

RATES FOR DIFFERENT CLASSES OF SERVICE.

In a paper entitled "Some Reasons for Difference in Price for Different Services" Mr. Norman T. Wilcox, of the Lowell (Mass.) Electric Light Corporation, gives the result of an analysis of various classes of electrical service in towns of from 5000 to 100,000 inhabitants. In dealing with the data an average diversity factor of 2 was assumed as practically correct between the transformer and generating station; a diversity factor of 1.5 was assumed for the small customer on a single-phase service, and 1.2 for the large motor customer. It was found that the total annual investment per kilowatt of generator for small residences was $350 to $375, with an annual supply of 800 kw-hours to 1000 kw-hours per kilowatt of generator capacity; for commercial work (50 kw), $225, with 1500 kw-hours per annum per kilowatt of generator; for single-phase (1-kw motor), $285 to $290, with 3000 kw-hours or more per annum per kilowatt of generator rating; for three-phase (1000 kw), $175, with 3000 kw-hours or more per kilowatt per annum, though this figure may fall to $100 or even less per kilowatt. Some authorities give the cost of residence-lighting investment as high as $440 per kilowatt of generator rating, so that while in residence service with an investment of $350 to $440 only 800 kw-hours to 1000 kw-hours per kilowatt of generator are sold annually, with large motor service, involving a total investment of $175 down to $100 or less, 3000 kw-hours, or possibly 6000 kw-hours or 7000 kw-hours, per annum are sold for each kilowatt of generator rating. For residence work often 2 kw-hours must be generated for every kw-hour sold, while, on the other hand, only 1.1 kw-hours are generally required for large motor use. The attendant losses are much less for the larger customer, so that with a 50-kw customer the complete investment per unit may be not more than one-half or two-thirds that required for a small customer. In this case again the larger customer so uses the station equipment as to enable the service company to sell him possibly 1500 kw-hours per annum instead of the 800 kw-hours to 1000 kw-hours sold to the residence customer, thus distributing the total cost over more units with resulting lower kw-hour rate.

RESIDENCE BUSINESS

The report of the committee on residence business, Mr. Clare N. Stannard, of the Denver Gas & Electric Company, chairman, considers the subject under the heads of desirability of residence business, means of getting such business and the results that had been obtained in securing residence lighting. As to the first question the reply is that there is no doubt that residence business is desirable, the point to be decided being how desirable. As the result of an inquiry among member companies the consensus of opinion is practically unanimous that apartment business is very desirable. As to the other classes, whether it is desirable depends upon the saturation of the lines in the residence districts and whether the construction is overhead or underground. Nevertheless, the educational or advertising value is in many cases sufficient to warrant taking on residence business regardless of whether it is profitable or not. For suburban territory the advantages between street overhead, sidewalk and backyard construction of distribution lines is in favor of the latter as being on the whole least expensive. It is stated the greatest difference of opinion exists as to the advisability of companies rendering any financial assistance to a prospective customer in installing or equipping his installation. The practice varies from free wiring, with a nominal charge for fixtures, to no assistance whatever. Competitive companies usually render some assistance to the customer. As to the advisability of companies going into the fixture and wiring business, the great weight of opinion is toward the protection of the contractor by employing him as the agent of the company to do the work, the company paying the contractor and collecting from the customer

A valuable feature of the report consists of a number of plans for wiring relating to two model houses, one of the bungalow type, costing $3,000 complete, and the other of two stories and basement, costing $8,000 complete. All circuits and outlets are indicated on the plans, and schedules given of the material required and of all appliances that it will be desirable to have the customer install. As to prepayment meters, it is stated that the answers received from member companies show that this device has not yet been developed to such a state as would warrant its widespread installation. Where installed the tendency is to require a guarantee of at least $1 per month from the customer. Opinion, however, is against its use in residences. An inquiry among the member companies showed that the requirements for extensions vary from a minimum that the revenues shall show over 10 per cent of the overhead charges after the actual cost of delivering the energy shall have been paid to a maximum that the revenue for the first year shall equal the whole cost of the extension. The opinion seemed pretty well established that where the revenue for the first year promises to equal 70 per cent of the cost of the extension the latter should be run free of cost to the consumer. Where the estimated revenue is less than this it is a good policy to return to the customer a part of the cost, this being credited to him as a certain percentage of his monthly bills.

In conclusion, the committee states that the results reported in securing residence business have been most encouraging, showing increases of from 20 per cent to 40 per cent in residence business over the previous year. As to the revenue secured there is a great difference, the amount varying from $18 to $40 per year, a fair average being $25 per customer. The figure for kilowatts connected varies from $18 to $22, the average being $21 per annum.

DISCUSSION.

In the discussion following the reading of the report Mr. Douglas Burnett, of Baltimore, questioned the advisability of charging the customer for the service wires from the building to the pole lines where competitive electric, independent gas and electric or a combination gas and electric company exists. He felt that in a combination company the matter should be decided on its merits and that there should be no service charge to the consumer.

Mr. A. S. Ives, of Poughkeepsie, N. Y., drew attention to the fact that in making extensions, plant investment as well as line investment should be considered and that the revenue should be about 10 per cent over the actual cost of the energy, divided between interest and investment charges.

Mr. H. J. Gille, of Minneapolis, Minn., felt that residence business was most desirable and that oftentimes central station companies forget that they owe obligations to the public. From an analysis of 4000 residences in his city, flats consumed on an average of 23.7 kw-hours per month during the year and residences 26.5 kw-hours.

Mr. L. H. Scherck, of Newburgh, N. Y., wished to know if the committee had obtained any information on controlled systems, and Mr. E. F. McCabe, of Lewistown, Pa., vouchsafed the information that despite competition from natural gas selling at 28 cents per thousand cubic feet his company had by means of the excess indicator secured in three months five times as many residence customers at it did in the whole year previous.

Mr. P. H. Kemble, of Toronto, Ont., pointed out serious defects in the present method employed by the association in obtaining information of value. He had come to the conclusion that circular letters were of little or no avail and that if best results were desired personal interviews should obtain.

Mr. R. M. Searle, of Rochester, N. Y., enlivened the discussion with some experiences from Rochester. While regretting the fact that his company was somewhat backward in canvassing for residence business, he nevertheless showed it possessed a lively appreciation of its obligations to the public and to the community.

LETTERS ON PRACTICAL SUBJECTS

ADJUSTING INTERPOLE FIELDS OF GENERATOR

The following method of adjusting the interpole fields of generators may be of interest to those operating this class of apparatus. First set the brushes on no load neutral by taking voltage readings with the armature rotating clockwise and then counter-clockwise. The brushes will be on the neutral point when the two voltage readings are the same. Then throw the rated load on the generator and adjust the interpole field strength until the neutral point is brought back to the no-load neutral position, this being determined by taking voltage readings with the generator rotating in both directions. The interpole field strength is now properly adjusted for all loads up to the saturation of the interpoles and a permanent shunt of german silver should be made up for the interpole field winding.

Pittsburgh, Pa. H. M. Nichols.

BLUEPRINTING FROM TYPEWRITTEN FIGURES.

To obtain strong, clear and contrasting blueprints from typewritten letters and figures a sheet of carbon copy paper, reversed, should be placed behind the original sheet, so that the characters will be offset on the back of the page as well as printed on its front. This double printing prevents the diffusion of the light through the paper, which otherwise causes the dull and ragged appearance usually obtained when attempts are made to blueprint typewritten figures. A little trouble taken to place the reversed carbon behind the paper or cloth original will result in clear, distinct figures, as sharp and often better formed than hand-lettering.

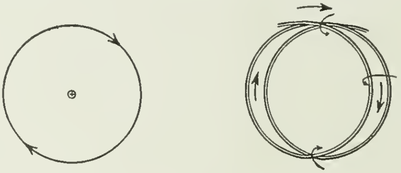
Chicago, Ill. L. S. Dennis.

THE CORKSCREW VS. FLEMING'S RULE FOR RELATION BETWEEN DIRECTION OF CURRENT AND FLUX.

There is a definite relationship in the direction of the current through a conductor and the flux which this current tends to set up. This interrelation is absolutely fixed and unchangeable, no matter whether the conductor be a wire in a motor or generator or a disk rotating between the poles of a permanent magnet. There are two methods of determining the direction of the magnetic flux when the current polarity is known and vice versa, namely, Ampere's rule, the first to be set forth, and the corkscrew rule. Both are well known and their use seems to be fairly equally divided, but the latter appears to be by far the better of the two. To apply Ampere's rule requires a distinct effort of the memory; thus, it is necessary to know whether to swim with or against the current, whether to have face or back to the needle, and, hardest of all to remember, whether the needle will point toward the right or the left hand. On the contrary, anyone who is familiar with a corkscrew will have nothing with which to burden his memory. The latter rule states that if current is flowing along a corkscrew the lines of flux go around it, as though traveling along the helix; or, equally true, if current is flowing circumferentially, as if in the helix, the lines of force advance axially in the direction in which a corkscrew would go.

In Fig. 1 we have a wire in which the current is going into the paper (shown by the tail of the arrow), and consequently the flux lines must go around to the right, as shown. If the current were coming out of the paper it would be the unscrewing action, to the left. Fig. 2 shows a coil in which the current is supposed to be going around right-handed. This motion of a corkscrew would make it go in, and that is precisely what would happen to a north pole placed in the coil—that is, the distant end of the helix is of north polarity. If the current had the unscrewing motion, the lines would come out. Thus it is seen that it is even unnecessary to remember whether by this convention it is the flux which rotates and the current which progresses, or the reverse; they are perfectly interchangeable in this rule.

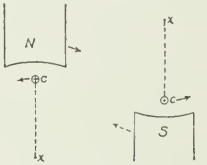
The above rule is widely known, and is so simple and so easily applied that it is in wide use. When we come to dynamo-electric machinery, however, conditions are quite different.



Figs. 1 and 2—Relation Between Direction of Current and Flux.

Here the only rule of current direction at all well known is that due to Fleming, and the person who is not using it frequently will find that this rule cannot be accurately remembered. For one must recall which of three fingers represents respectively the direction of motion, flux or current; and then the left hand must be used in some instances and the right hand in others.

But if our corkscrew rule really expresses a fundamental relationship, as was stated, it ought to be able to solve all such cases, and, indeed, this it will do. In Fig. 3 suppose *c* is a conductor carrying current into the paper, as is indicated by the cross. If this conductor is fixed, and *N* is a north pole free to rotate around the axis *x*, what will be the direction of its motion? A corkscrew going in would turn to the right, and so would *N*, as the arrow indicates. Now let us fix *N* and leave *a* free to rotate about the same axis; then, since the relative motion of the two must be the same, the conductor will move to the left. This principle will solve all motor problems. Take the case of Fig. 4; here we have a fixed south pole *S* and an axis *x* about which the conductor *c* is free to rotate. The current is coming out of the paper, and a corkscrew would turn as shown. A south pole, which travels not with, but against, the lines of magnetic flux, would go clockwise around *c* (dotted arrow); and to preserve the relative motion the conductor moves to the right.



Figs. 3 and 4—Motor Action.

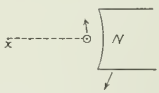


Fig. 5—Generator Action.

In the case of a generator it will be remembered that the magnetic effect of the armature current tends to oppose the motion. Thus, in Fig. 5 we have a conductor rotating upward, as shown. That means that the *N* pole is turning clockwise about the current; opposing this would be unscrewing the corkscrew, which would move outward, as indicated by the arrow tip. The application of the rule to other cases is equally simple.

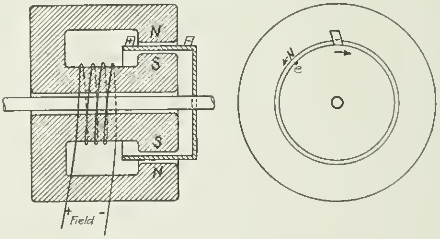


Fig. 6—Homopolar Generator.

This method of solution is especially good for unusual problems. Let us investigate the direction of the current in the homopolar or acyclic generator represented in Fig. 6. Here we have a field winding in which the current, as seen from the right, is circulating in the clockwise direction, thus causing the lines of force to go in toward the left. Referring to the end view, take an element of the cylinder *e* which is rotating clockwise, giving the *N* pole a relative counterclockwise motion. As this is a generator, the current tends to oppose this motion, turning right-handed, and thus going in. This is, therefore, the negative end, as shown.

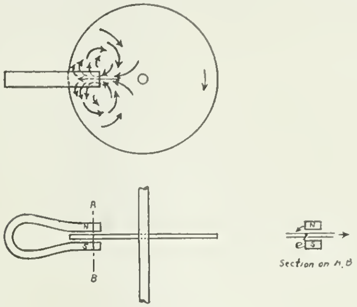


Fig. 7—Eddy Currents in Rotating Disk.

The case of eddy currents in a brake disk, Fig. 7, is similarly solved. Referring to the section on *A-B*, we have relative rotation of the *N* pole about the element *e* to the left. The current opposing this would send the lines of flux around to the right, or the corkscrew would go in. The path of the eddy currents is shown.

Wilkinsburg, Pa. HORACE V. S. TAYLOR.

ACTION OF INTERPOLE MOTORS.

Referring to the article by Mr. R. W. Abraham in the first issue for April exception is taken to that part of his statement relative to position of brushes of an interpole motor necessary to cause the motor to reverse its direction of rotation if the main field should become so weak that it would be demagnetized by the field of the armature and a field set up in the field poles in an opposite direction. It is not understood just how the armature field could, with a forward lead of the brushes, demagnetize the main field and set up a field in the opposite direction. By an examination of the cut it will be found that if the brushes are placed on the line *a*, a_1, and the field excitation reduced to zero the armature will stop, since the attractive force exerted at this instant is the result of the action of the armature field on the pole-pieces—that is, the armature field N_2 induces a magnetic field in the pole tips nearest to it of unlike sign S_2S_3, which would be equal and opposite in direction, thereby preventing rotation. If the brushes are moved ahead (in the direction of rotation) on the line *b*, b_1 and the exciting current reduced to zero or to a point at which the armature field would become stronger than the main field, demagnetize it and induce a field in the pole-pieces, the armature would continue to rotate in the same direction, provided the load was very small, and would not reverse its direction of rotation as stated in the article referred to above. By moving the brushes ahead the N_2 pole of the armature is moved ahead through the same angle, thereby bringing it nearer to the S_1 than the N_1 pole-pieces, which will cause the attraction due to the fields induced in the pole tips S_2, S_3 by the armature field toward the S_1 to be greater than toward the N_1 pole-pieces; this will result in the rotation of the armature in the same direction as when the field was excited. But should the brushes be set back (against rotation) on the line *c*, c_1 and the field excitation be reduced until the field of the armature was the stronger, if the armature was then carrying a very small load, it would reverse its direction of rotation. By moving the brushes from *a* to *c* the N_2 pole of the armature is moved through a corresponding angle, which brings it nearer the N_1 than the S_1 pole-pieces, and since the action of the armature N_2 pole is to induce an unlike, or S_3, pole in pole-piece N_1, also to induce an unlike pole S_2 in S_1 the attraction is greater toward the N_1 pole, which has now become a south pole, consequently the direction of rotation will be reversed. The action of the interpoles in the above-cited experiments was only to add torque to the motor in either direction of rotation. It was necessary in all of the above tests to have sufficient resistance in the armature circuit to keep the current within the limits of the maximum allowed for the line and machine. Actual experiments have been made which prove the above statements to be true.

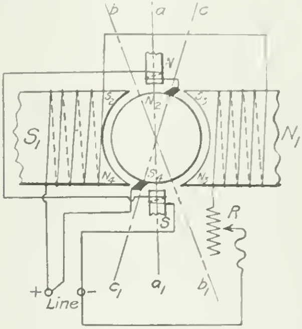


Diagram of Interpole Motor.

Ft. Monroe, Va. WILLIAM M. CLINE.

DRYING OUT ELECTRICAL APPARATUS.

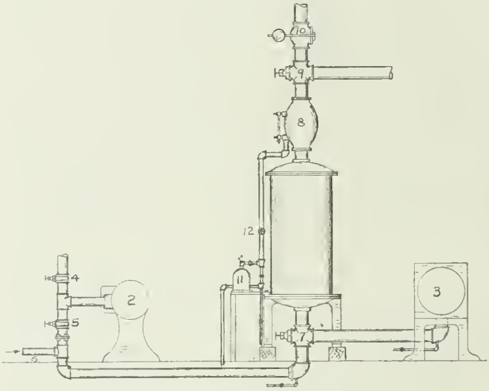
For several years past a number of dredges have been employed deepening and extending the Los Angeles Harbor at Long Beach and San Pedro, Cal. As the material to be removed is sand and silt and fairly soft, these dredges are for the most part of the pump type, and all machinery is electrically driven, the energy being supplied from the lines of the Southern California Edison Company, which cover that district. A cutter blade similar to a propeller is driven by a motor and forced against the ground to be removed, while just back of this cutter is the suction pipe of a large centrifugal pump. It is readily seen that the sand, etc., loosened by the cutter will be picked up by the stream of water flowing into the pump and from there it discharges through a pipe carried on pontoons to the land to be built up for warehouse and factory sites, this area of "made" land being first outlined by a dike thrown up by a clam-shell dredge so that the water runs off, leaving the solid matter from the harbor bottom behind. Some of the dredges are quite large and expensive, and in addition to the machinery mentioned above carry a number of motors for their control and guidance while working. Not long ago a valve in the discharge pipe inside the hull of one of them gave way and the water in the discharge pipe, together with that thrown by the pump before it could be shut down, was sufficient to sink the dredge, and it remained on the bottom about ten days before being raised, towed to the dock and pumped out. The power company was requested to take charge of the work of drying out the electrical equipment and getting it back in service, and it was a sorry, bedraggled looking lot of apparatus that was found upon arrival. The dredge is supplied with energy at 2200 volts through a submarine cable and large motors are wound for this voltage, while a pair of 37½-kw transformers step it down to 440 volts and 220 volts for the smaller motors, lamps, etc. The pump motor was a 600-kw synchronous machine, so that a variable-speed starting motor and an exciter were required As ten days' immersion in sea water is rather rough treatment for 2200-volt apparatus the method used in getting the machinery back in running condition may be of interest. First, the whole lot was gone over with a hose and stream of fresh water to wash off the sand and silt with which the machines were covered; then the hose was connected with a boiler on the dock and water nearly boiling hot was used to wash out as much of the salt as possible. Next, the machines were covered with a tarpaulin one at a time and hot air from an electric heater was forced through them by means of fans until it was thought they would stand enough voltage to give a little over full-load current with the rotors blocked. The machines were run this way for several days and then the rotors were allowed to revolve, as it was found that the fanning action of the rotor was as good as heat in drying out the windings. As soon as one motor was in shape to run it was belted to the synchronous machine and this was kept running with the field coils short-circuited and 440 volts on the armature windings. This large machine had been reconnected from 6600 volts and the connections taped with varnished muslin and friction tape. It was found that the salt had worked in here and could not be washed out, so that all this tape was taken off and new put on after the drying was completed. To show the penetration of the salt water it may be said that with 400 volts on this machine it was dangerous to touch any of the coils or rubber-covered cables leading to it while standing on the steel hull of the dredge. The synchronous machine was run this way for about ten days, and then the voltage was built up on it to 2800 and it was pronounced sound. The two transformers were short-circuited on the secondary side and 110 volts applied to the primary for a time and then the low-voltage motors were connected to the secondary and the primary voltage raised from day to day until they were finally put on the line at normal voltage. Of the entire equipment only one motor had to be rewound, this being a 440-volt, variable-speed machine having partially inclosed slots, so that the coils were not protected by the insulation as was the case with the form-wound coils placed in open slots. Some of the low-voltage motors had this closed slot and yet were saved, but all the big machines had the open slot and it would seem that this is much to be preferred on machines subject to such severe treatment as this, for instance, where the salt fog and spray are always more or less present. The direct-current exciter ran satisfactorily for a while, but the heat seemed to drive the moisture in the field coils to the surface, where the tape and insulation prevented its escape, so that they were also rewound. They could possibly have been saved, but as time was a great factor it was considered cheaper to rewind them. With the above two exceptions and the several switchboard instruments the entire electrical equipment was saved, even to the watt-hour meter, which checked up closely after drying out, cleaning and replacing a rusted shaft. The total rating of the apparatus was approximately 1200 hp and the cost of drying out but a small fraction of what the replacement or rewinding cost would have been. The dredge has now been in regular service something over a month without showing a sign of trouble, which speaks well for the methods of drying used, as well as for the electrical machinery which will withstand such abuse and live to tell the tale.

Los Angeles, Cal. C. A. Howell.

IMPROVING A STEAM PLANT.

A certain steam plant had been operated under conditions which will be understood by examining the illustration in connection with the following description. A high-speed engine of about 25 hp is shown at 2. Formerly it exhausted into a feed-water heater, and from there the steam passed freely into the atmosphere. A moderate-speed engine of about 60 hp is illustrated at 3. The exhaust steam from this engine passed into the large heater and then was conducted through the roof into the outer air. There was not a valve in either of these pipes. A steam-driven air compressor and two direct-acting boiler-feed pumps also exhausted through separate pipes which extended above the roof. Live steam was used for heating the shop, as the engineer who designed this plant did not believe that exhaust steam was valuable for any purpose.

The method of operation was as follows: The small engine 2 was used every day, and a suitable steam pump forced water through the heater and supplied the boiler for this service. The larger engine 3 was required three or four days per week. When it was used another steam pump was started to supply the additional water required. It forced water through the large heater shown by means of a separate system of piping. This method is not only wasteful, but if anything happened to one pump or the connecting pipes it was not possible to use the other to supply the deficiency, as both were separate.



Improving a Steam Plant.

It was decided to remodel this part of the plant, and the following changes were made. The small heater was discarded and a free-exhaust pipe carried out through the roof. This is for use in an emergency which makes it necessary to shut off exhaust steam from the other pipes shown in the illustration. A gate valve 4 was provided, but it is closed under ordinary working conditions. Another gate valve 5 is open allowing steam from this engine to pass to the large heater, as indicated by the arrow. The inlet 6 receives exhaust steam from the pumps and air compressor.

The larger engine 3 exhausts through the cross-valve 7 into the heater, and by this arrangement all of the exhaust steam is utilized instead of blowing into the air. Under former conditions the roof was partly covered with grease, caused by exhausting the remains of cylinder oil from the engines and pumps, but this is all taken out by the separator 8 and sent to the sewer. This location of separator above the heater is criticised by some engineers, but the reason for it is as follows: If located below the heater it would leave only pure exhaust steam for use in heating the feed water, which process always produces more or less water resulting from the condensation of steam, which can be returned to the boiler, thus saving water and heat. With the arrangement shown this water is wasted, but the main object is to remove the harmful cylinder oil, preventing it from going into the boiler and this is done more effectually when drops of water are mingled with the steam. The heater supplies these drops and the desired result is secured. In this particular case the separator could not be placed below the heater as there is no cellar under the engine-room.

The cross-valve 7 is closed when 3 is shut down in order to prevent steam from backing up into the cylinder and causing the parts to rust and corrode. The drip pipe in the ell under this valve is a necessary feature, as the exhaust pipe must be kept free from water. Another drip pipe is shown under 3, which is also necessary for use when 7 is closed.

A cross-valve at 9 was included in the original plans to shut steam off from the heating system, but it could not be secured promptly as it was not carried in stock by the manufacturers, hence a tee was substituted and a globe valve put in the pipe extending toward the right hand. The back-pressure valve 10 is opened when steam is not wanted for useful purposes, but is closed when the shop requires heat. The small trap 11 allows all water and oil to go into the sewer, but prevents waste of steam. Equally good results cannot be secured by use of a valve in the pipe, as shown at 12, because it must always be nearly closed, whereas the trap opens wide when a large quantity of water comes into it and closes automatically if the steam is nearly dry. With the trap in use 12 should always be wide open.

This exhaust steam which was wasted under former conditions is sufficient to heat the shop in ordinary cold weather and only a small quantity of live steam is required when the thermometer indicates zero temperature.

The water resulting from condensation of steam in heating the shop goes into a receiver and is automatically returned to the boiler. This pump is large enough to supply water for both engines, and can be run slow enough for one only. This improvement not only saves a large part of former bills for water, but reduces the consumption of coal about 25 per cent, thus proving a very good investment.

New Haven, Conn. W. H. Wakeman.

FOUNDATIONS FOR ELECTRICAL MACHINES.

After reviewing and carefully digesting the several able articles and letters which have recently appeared regarding machinery foundation, it seems as if foundations were often designed and constructed with a very indefinite realization of what a foundation is to accomplish. Briefly stated, the office of a machine foundation is threefold: First, to support the machine by distributing its weight over sufficient soil to carry it; secondly, to absorb vibrations of the running machine, and, third, to withstand any tendency to topple sideways through pull of belts or settling of any local soft spot in the soil beneath the foundation. These three points are little regarded by the majority of engineers when building a foundation for electrical or other machinery. The usual procedure is to locate the top of the foundation where convenience demands and then locate the bottom wherever solid soil may be found. The two planes thus selected are filled in between with solid masonry or concrete with no regard to the mass of masonry actually required to give stability and smooth running to the machine thus supported. Usually, even where there is solid earth close to the plane of the foundation top, an excavation will be made from 4 ft. to 8 ft. deep and a mass of masonry or concrete placed therein. It is to induce constructors to study the actual requirements of machines as regards foundations, with a view of saving some material now evidently wasted in foundations, that these lines are written. That there can be a saving made in most foundations is the belief of the writer, and engineers and constructors are requested to study and carry out the following considerations before putting yards and yards of good building material beneath comparatively small machines for foundation purposes. The first point to be considered is the weight which a given foundation will support when placed upon ordinary soil. The engineers carefully calculate the footings of building walls to carry from 1½ tons to 6 tons per square foot, according as the soil ranges between soft, wet sand and hardpan. In the following deductions let it be assumed that the soil will safely carry a vibrating machinery load of 1 ton per square foot of area and that the foundation material weighs 150 lb. to the cubic foot. Right here is a suggestive point against high or deep foundations. Without footings a wall or pier will barely sustain its own weight on 1-ton soil when 13 ft. 4 in. high. Of course, footings may be extended to enable almost any load to be carried, but the fact that a foundation 13 ft. or 14 ft. high is the limit for a machine foundation on poor soil may set a train of thought going in a direction new to some constructors. Next comes the size of foundation necessary to support a machine (and its foundation) upon the soil. Assume that a certain generator weighs 5000 lb. and occupies a floor space 4 ft. x 7 ft., or 28 sq. ft., to carry a load of 5000 lb., which is about 185 lb. to the square foot. Of what use is a foundation 5 ft. or 6 ft. deep under this machine, with footings extending on all sides from 1 ft. to 2 ft. beyond the foundation? Such an arrangement would give 54 sq. ft. of soil-bearing surface and the machine load would be only about 92 lb. per square foot. The 4-ft. x 7-ft. foundation need be only deep enough to hold itself together or to absorb the vibrations of the running machine. In case of a steam engine this amounts to something, but in case of an electric generator vibration drops out of the question entirely, hence the foundation has nothing to do except to keep the generator out of the dirt. But the pull of the belt is something to be directly opposed by the foundation. There is a 10-in. belt and it is supposedly put on the pulley with a strain of 40 lb. to the inch of width. This is 400 lb. for the 10 in. of belt width, and, allowing an equal strain in the other fold of the belt, there will be the modest pull of 800 lb. on the generator belt. When the machine is running it is evident that the tension slacks in one fold of the belt and increases in the other fold. This may increase until the excess tension in the working fold is 60 lb. and the tension of the slack fold is 20 lb. This gives the working pull 40 lb. to the inch of belt width as before. Belts work better and last longer when thus tensioned than they do when the working strain is made 88 lb. per inch, as given in some belt catalogs. But the slight sidewise belt pull of 800 lb. is nothing for a 5000-lb. generator. That strain could never move it in the least, therefore no attention need be given to the belt pull or resistance thereto. The next point to be considered is the side strain of the machine due to the columnar effect of a load upon a foundation of a given height. It may be stated that until the height of a foundation exceeds its least thickness, width or length there can be no columnar effect and the calculations are the same as if the foundation were a cube. Therefore, until the height of any foundation exceeds either the width or length no attention need be given to the columnar effect, which is that of a weight supported by a post or column. In every point considered above it has been shown that the less depth given to a machine foundation the better. Therefore, should great depth be required in order to support the machine at a considerable distance above bedrock or firm soil, it will be better to put in a system of pillars or arches to carry a low, flat foundation to which the machine shall be attached, the posts, columns or arches to be calculated independent of the fact that a machine foundation is to be supported. The calculations should be made exactly as if the arches were to carry a certain load in an architectural structure. The last point to be considered is the use of the foundation to lessen vibrations of a machine. In electric generators vibration is, as stated, not a factor in the problem. In steam engines and other reciprocating machines foundation mass is sometimes made use of to lessen vibrations, but it is not a mechanical method. The place to lessen or cure vibration is in the vibrating machine itself, not by adding concrete masonry to the vibrating mass. When it is considered necessary to use a foundation to keep a machine in the home county, then the owner should look around for a machine which "will stand without hitching." Don't add to the wear caused by vibration by adding a still greater load to the efforts of natural laws to follow the line of least resistance In the case of heavy hammers or similar machinery the mass of foundation should bear a direct ratio to the permissible movement caused by vibration For instance, should a 4000-lb. machine be found to vibrate 1/8 in. the addition of another 4000 lb. in the shape of a firmly attached foundation will reduce the vibration to 1/16 in. Then 8000 lb. more in the foundation will reduce the vibration to 1/32 in., and so on. But as it is impossible to attach the foundation mass to the center of gravity of the machine, the result of the added weight in a horizontal reciprocating machine will be that the machine will rock to and fro in an arc, the center of which is a point in the bottom of the foundation.

South Bend, Ind. James F. Hobart.

QUESTIONS AND ANSWERS

I have a 2-hp, 60-cycle, 110-volt, self-starting, single-phase motor operating at 1200 r.p.m. At starting the motor pulls 30 amp, and when the brushes are released the motor takes from 40 amp. to 45 amp. The motor was recently rewound and it may be that the work was not properly done. J. A. R.

Assuming that you have properly rewound the motor, it is very probable that the brushes do not occupy the correct position along the commutator. A very slight movement of the brushes makes a great difference in the current taken by the machine, both at starting and when the brush mechanism releases. However, it has no effect upon the running speed or the current taken by the machine when operating at full speed.

Kindly inform me what the voltage and other data on the energy supply of the principal cities of this country are, both for light and railway service. C. A. G.

Both alternating and direct current and many different voltages are used in this country. However, the standard emf for lighting circuits is 110 volts. In large cities the direct-current system with 110 volts at lamps is commonly employed. In the smaller towns 60-cycle alternating current is usually employed, with 110 volts at the lamps. When motors are used on the same circuits with the lamps the arrangement is usually such as to provide 220 volts for the motors. The standard electric railway system of this country employs 600-volt direct current. There are in existence a few 1200-volt direct-current railway systems, and also a few alternating-current railway systems with emfs ranging from 3000 volts to 11,000 volts.

Is there any metal or substance which varies its electrical resistance in accordance with the amount of light it receives? That is, is there a substance that will allow more electricity to pass through it in sunlight than in shade? Is the change instantaneous in effect or due to the added heat? H. D. W.

Of the substances the electrical resistance of which is varied according to light falling thereupon the one best known and most commonly used is selenium. Selenium in pencils for making cells may be procured from Eimer & Amend, Third Avenue and Eighteenth Street, New York. We do not know of any firm that keeps the cells in stock, but doubtless Queen & Company, Philadelphia, would accept an order for importation.

We have recently changed our system from single-phase to three-phase. Our transformers are connected up to feed a three-wire secondary, 110-220-volt lighting load, with the neutral grounded. If the transformers are connected so as to balance the load on each phase, the neutrals being grounded, will it cause a cross-current to flow from one transformer to another, on a different phase through the grounded neutral? Can I connect three transformers in delta, giving 220-volt, three-phase energy for motor circuit work, and then use a fourth wire connected to the neutral of each transformer, so as to obtain 110-volt energy between that wire and any of the other three? C. H. C.

The method of employing common neutrals for the three transformers of a delta-connected three-phase system will prove disastrous. When the transformers are connected in delta there exists between the middle points of the different transformers an emf 86.6 per cent as large as the emf between the terminals of each individual transformer. If these so-called neutral points are joined to a common wire this emf will produce an enormous current in the transformer circuits. It is permissible to connect the middle point of any one transformer to the ground, but when this is done the middle point of the other delta-connected transformers should not be so connected. The only permissible way of using a common neutral when employing three-wire distributing circuits from a three-phase source is to use separate main leads from each transformer circuit. That is to say, any one point of the secondary of any one transformer can be connected to any one point of the secondary of another transformer, but after one point is connected it is not permissible to connect any other point. If the middle points of the three transformers are jointed together, then the terminal points must not be joined, and six separate leads must be taken from the three transformers.

Is it proper to refer to well-known instrument transformers used on switchboards as current transformers and potential transformers? W. F.

While the terms would be understood by operating men they are not correct. What is commonly referred to as a current transformer is a series transformer, and a potential transformer is a shunt transformer. "Series" and "shunt" are preferable to "current" and "potential."

Are there any other services that an electric fan can be made to perform in addition to its usual functions of keeping one cool; keeping frost and vapor from windows; increasing the circulation in a hot-air furnace and increasing the amount of heat liberated from a radiator? K. J. C.

Circulation of air causes rapid evaporation, resulting in cooling and drying and also condensation. Wherever any of these is required an electric fan can be used to advantage. Wherever just a movement of air is desired the electric fan is also applicable. One use for the electric fan not widely known is its ability to keep rooms or areas free from flying insects and pests, such as house flies, mosquitoes, etc. It would be impossible to enumerate all the uses to which an electric fan is put. One so minded could use an electric fan all the year round for different purposes to advantage.

I have read much about the undesirability of residence customers, the argument being that a residence load is unprofitable. We do not find it so, and wonder if ours is an exceptional experience. G. T.

Inasmuch as for years the only business available to central-station companies was and even now is in the majority of places residence business, and since such companies did not then become nor are they now bankrupt, the contention that the load is unprofitable is untenable. The load is not as profitable as business having a greater load-factor, and hence is not in a sense as desirable. We doubt, however, if any company not already possessing an overloaded station would refuse such business.

Given a 100-kw, three-phase, 2300-volt generator, 25.13 amp per phase, what is the formula for obtaining the kw rating? If the ammeters indicate 15 amp per phase does not this signify three-fifths of the total output? Is the hp obtained by calculations on one phase, or are the phases added together and the result multiplied by the number of volts to get the kw? What is a safe number of 54-watt lamps to connect to a 100-kw, 2300-volt, three-phase generator? J. A.

Assuming that you are familiar with the method of calculating loads on single-phase apparatus, it can safely be stated that in dealing with three-phase quantities it is best to reduce the three-phase quantities to single-phase equivalents. On this basis the equivalent single-phase voltage is the value measured between wires on the three-phase system, while the equivalent single-phase current is the value measured in one wire multiplied by a constant equal to about 1.7. Thus if the ammeters indicate 15 amp in each wire the equivalent single-phase current is $15 \times 1.7 = 25.5$ amp. You will note that it differs only slightly from the value stated by you—that is, 5/3 of the indicated current. If, as assumed, a three-phase, 2300-volt generator carries 25.13 amp in each wire, the equivalent single-phase current is equal to about 44 amp. The value of the volt-amperes is $44 \times 2300 = 101.200$. It cannot be stated just what the value of kilowatts would be from the known value of volt-amperes because the latter value must be multiplied by the power-factor in order to obtain the kilowatts. If the power-factor is equal to 1, the kilowatts would be 101, while if the power-factor is 50 per cent the kilowatts would be 50.5. A 100-kw generator could safely feed energy to $100,000 \div 54 = 1852$ lamps, each of which consumes 54 watts.

Central Station
Management, Policies and Commercial Methods

FREE FLATIRON REPAIRS.

The Union Electric Light & Power Company, St. Louis, is advertising in the daily newspapers to announce that it will make repairs on electric flatirons free of cost, provided the irons are obtained from the company. If such an electric iron is not in working condition, it is necessary only to notify the company and the necessary repairs will be made without charge. Furthermore, the company offers to deliver a household-type electric flatiron for thirty days' free trial. If the customer finds the iron satisfactory he is to agree to pay $4.25 for it in five monthly payments, four of which will be $1 each.

A TINY TEXAS CENTRAL STATION.

Mr. C. W. Faulk, of Skidmore, Tex., is installing a 10-kw gasoline-engine-driven generator set which will make central-station lighting service available for a local community of 600 inhabitants. The transmission system into which the 2300-volt alternator delivers its energy comprises a total of about 3 miles of line, which is equipped with several 2-kw transformers for house service. The generator set will be operated nine hours each night, its cost of output at the switchboard being 3 cents per kw-hour at full load, and 5 cents per kw-hour at half load. The customers' service is to be operated on a flat-rate basis—90 cents per month for each 25-watt lamp. Under these conditions Mr. Faulk is assured a net income of several hundred dollars per month, as a number of local citizens have expressed their intention to use the electric light.

FREE CLEANING AND OILING OF CUSTOMERS FANS AT SEASON'S OPENING.

With the opening of the fan season in Louisville, Ky., the Kentucky Electric Company, supplying central-station service in that city, has dispatched a corps of ten men to visit all fan customers, cleaning and oiling their fans free of charge. This free cleaning and oiling service reaches every customer on the company's circuits, including the outlying residences with one or more fans, as well as the large downtown consumers, some of whom have many fans installed. The company takes the precaution to see that all these fans are in good running order at the beginning of the season, finding that this inspection insures the use of the fans all summer long, so that the expense of sending out representatives is well justified. Before starting its men on their rounds, the company addressed a letter to all its customers explaining to them that it proposed to clean and oil the fans gratis and offering to make repairs at cost.

WIRED-HOUSE RATIO AT DALLAS, TEXAS.

With a population of 92,000 in Dallas, Tex., the Dallas Electric Light & Power Company has 12,400 electric customers, of whom at least 8000 are residence users. Excluding the humble homes of Dallas' negro population, it is probable that over 90 per cent of the residences of the city are wired and using electricity, according to Mr. J. C. Woodsome, who, until his appointment as manager of the Tampa (Fla.) Electric Company April 1, was superintendent of the Dallas Electric Light & Power Company. This large ratio of customers to population, which places Dallas among the first cities in the country in this regard, has been in part due to the low rates for service, 9 cents net per kw-hour for residence lighting customers. All wiring is done by contractors, and the demand for central-station service in residence sections has even resulted in the company being importuned to extend its lines to new customers where sometimes such business is not advantageous on account of construction cost.

ELECTRIC RATES AT LOS ANGELES.

The Board of Public Utilities of Los Angeles has fixed the schedule for the sale of electricity for lighting and motor service for the ensuing fiscal year of 1911, these rates to go into effect July 1. In general the electric-lighting rates are reduced, and the present minimum monthly bill of $1 has been abandoned in favor of a monthly service charge of $0.35 per connection, in addition to which the customer is required to pay for the electricity actually registered by his meter. The new schedule decreases the cost per kw-hour for the first 250 kw-hours from 7 cents to 6.5 cents. Consumers using less than 11 kw-hours per month will profit by this change, while those using from 11 kw-hours to 70 kw-hours will be required to pay slightly more than before. Consumers using more than 70 hours will effect a saving from the operation of the new rates. In cases where the consumer is given the choice between direct-current and alternating-current motor service and chooses to use the direct-current supply he will be required to pay 15 per cent above the regular motor service rates specified. Where he is given no choice between direct current and alternating current the rates for both classes of service are the same.

ELECTRIC FANS VERSUS SCREEN DOORS.

A number of electric ceiling fans are being installed over the doorways of business houses in Mobile, Ala., to keep flies from entering the storerooms, the former annoying and uninviting screen doors being meawhile dispensed with. The draft created by the fans effectually prevents flies from passing through the wide-open doorways and also discourages them from alighting on and soiling display windows near by. The use of the fans eliminates the need for the unpleasant screen doors, which, as merchants know, detract from the appearance of their shops and admit flies when opened. One of the first of these outside ceiling fans in Mobile was placed in the entrance to a store near a restaurant, the flies from which were most persistent and annoying in getting past the screen doors and in soiling the show windows. Since the fan has been installed not a fly is to be found in the storeroom, although the 6-ft. doorway is wide open and customers are continually passing in and out. The presence of the fan has also cut down the necessity for cleaning the show windows where the flies were formerly wont to foregather, and customers coming in off the hot street stop and cool themselves in the pleasant breeze which the fan affords.

HOUSE-WIRING RESULTS FROM A NEWSPAPER ADVERTISING CARD.

During the last sixty days the Nashville (Tenn.) Railway & Light Company has run a small advertising card in the local papers offering to wire six-room houses for six outlets at $14.75 per house, the customer paying one-fourth or one-fifth down and the remainder at $1 per month. The work was done by a local contractor who was paid $14.75 per house by the electric company upon the completion of his job, the company being later reimbursed by the customer as above stated. Besides the newspaper advertising, no other special effort was made to get this house-wiring business, all inquiries being handled as they came in by the regular solicitors. As a result of the advertising campaign, continuing for sixty days, 100 houses were wired. The advertising cost approximated $300, according to Mr. James E. Carnes, contract agent for the company. If each of the 100 new customers pays only his minimum charge bill of $1.25 per month or $15 yearly, the company is thus assured an annual increased gross income of $1,500 a year from the $300 outlay. The same dollar-per-month payment proposition was offered on any house-wiring cost up to $25 where the owner desired to take advantage of the instalment plan of payment.

COST FIGURES OF A SUCCESSFUL HOUSE-WIRING CAMPAIGN.

During the recent forty-five-day house-wiring campaign conducted by the Mobile (Ala.) Electric Company 662 new contracts were closed. Mobile is a city of 51,000 population, about 40 per cent of which is colored, and the electric company now has 5642 consumers, all of whom, with the exception of twenty or thirty, are white. Considering only the white population served, this represents an average of one meter to every 5.5 persons. Such a figure, however, is not strictly fair for comparison with other cities, for, while the large negro population is not itself a consumer of electricity, its presence nevertheless supports some central-station business in stores, shops, etc., which would not otherwise exist.

In the course of the forty-five-day campaign, which actually comprised only thirty-nine working days, spread advertisements in the local papers described three house-wiring equipments which the company offered to have a contractor install at cost, the customer paying one-third or one-fourth down and the balance within from sixty to ninety days. These installations were estimated at the lowest possible rates and the company paid the contractor's bonus of from $1.50 to $2.50 per house, depending on the proposition A, B or C accepted. For the 563 houses actually wired the contractor thus received $965.50. Although 662 contracts were taken, ninety-nine were not actually completed, in ninety of these cases credit being withheld from the applicant, while in the nine other instances the parties moved away from their houses. As the result of the campaign it is estimated that at least 100 other prospective customers were stirred to the point of applying for service later, and the effects of the campaign were thus felt for some time after it closed, although the wiring-at-cost proposition was withdrawn promptly at the end of the forty-five-day period.

Three salesmen were employed continuously during the forty-five days, and a fourth man was used for one week. The salary cost of these men was $393.50. For each 100 contracts closed by a salesman a cash prize of $25 was offered the men, and the results of the campaign cost the company $175 in prizes. About 1675 column-inches of advertising was used in the local newspapers, including several full-page announcement displays and smaller spaces. This newspaper advertising cost $586.67. Just before these announcements were printed the company had extra copies run off to be distributed by boys from house to house. The boys were instructed to deliver a copy to all houses not reached by electric-light wires. Lantern slides relating to house wiring were also prepared and thrown on the screens at the moving-picture theaters. The dodger-sheet and slide publicity cost $17. The 662 contracts closed thus cost $2,137.67, or an average of $3.22 each.

At a conservative estimate, it is believed that the new business secured through this campaign will result in increasing the company's gross income about $10,500, as follows:

Twenty customers at $24 per year	$480
220 customers at $18 per year	3,960
422 customers at $14.50 per year	6,119
	$10,559

The above estimate is based on the assumption that only twenty of the new customers will average $2 monthly, one-third of the remainder will average $1.50 per month and the remaining two-thirds will average about $1.20 per month, the chances being, however, that these figures will be exceeded. The house-wiring campaign of the Mobile Electric Company was in charge of Mr. R. E. Flower, new-business manager. Mr. T. K. Jackson is general manager of the company.

HEATING APPLIANCES ON CONTROLLED FLAT-RATE CIRCUITS.

In the case of flat-rate systems using demand controllers heating appliances, such as electric irons, etc., are usually operated on a fixed flat rate per month, being connected in on the street side of the controller so as not to affect the latter's setting for the lamps in circuit.

A Texas central-station operator making use of a number of flat-rate controllers has tried with success the scheme of employing in residence installations a double-throw switch with the heating circuits on one side and the lamp circuits in series with the controller on the other pair of contacts. This insures, of course, that the heating circuit demand cannot be thrown on while the lighting demand is in use. As the heating load in the city mentioned is made up chiefly of irons, practically no hardship is worked on the customers. From the central-station standpoint, of course, the arrangement avoids any superimposing the heating and lighting demands.

The presence of an uncontrolled heating circuit in some cases offered temptations to attach lamps to these wires. Where such misuse was suspected a 2-to-1 auto-transformer was inserted in the lighting lines and instead of 110-volt 55-volt tungsten lamps were used. These gave the advantage of larger, sturdier filaments with increased life when properly operated. A single trial usually made clear to the customer that the 55-volt lamps could not be operated on the 110-volt heating circuit.

FREE LAMP RENEWALS IN CHICAGO.

While discussing "Maintenance of Service" in a paper read at a recent meeting of the Commonwealth Edison Branch of the National Electric Light Association Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company, Chicago, gave some interesting information about free-lamp renewals by his company. The practice of exchanging good carbon-filament incandescent lamps for burned-out or defective lamps, without cost, was begun by this company in 1895. At first customers had to call at the downtown office to renew their lamps, but later outlying depots were established, and now the lamps—new lamps for old—are delivered at the customer's door on request.

With the growth of the company the cost of this free-renewal service has assumed large proportions, and it now amounts to 32 per cent of the total distributing cost, the free lamp renewals costing the company about $500,000 a year. A bureau of the operating department is in charge of this work and twelve telephone lines are needed to handle the incoming calls of customers to this lamp-renewal bureau. Seven horse-drawn wagons and five electric wagons are used in delivering lamps to customers. Both classes of vehicles for this service present an attractive appearance. Tungsten lamps, which are not renewed free, are delivered by boys traveling on street cars, each boy carrying about fifty lamps. Carbon lamps are carried in trays, and both in the delivery wagons and in the stockroom the position of the lamps in these trays indicates the character of the lamps. New lamps are placed in the trays with bases up, the old lamps being placed with tips up. By this simple method there is no trouble in distinguishing the good lamps from the bad ones.

Lamps returned by customers are carefully tested. In the year 1910 it was found that about half the lamps returned were burned out. From 15 per cent to 30 per cent of the remainder were broken, and from 15 per cent to 30 per cent were found to be good after testing and were returned to service, many of them being used by the company itself in substations and elsewhere. It has been found that by handling the returned lamps carefully the percentage of serviceable lamps has been increased to a noticeable extent.

BOOMING ELECTRIC COOKING IN MONTANA.

The Billings & Eastern Montana Power Company, Billings, Mont., has just closed a very successful demonstration of electric cooking, which was commenced on May 10 in a large hall. On May 15 a dinner was served to the Chamber of Commerce and the city officials, the Mayor of the city presiding, at which 100 guests were entertained. The dinner was entirely prepared by electricity and was such a decided success that electric cooking received the hearty indorsement of every business man present, which naturally favorably impressed the public at large. Following is a list of foods cooked and baked for the dinner: Baked, twenty-two loaves of bread and twenty cakes; roasted, 26 lb. of beef; stewed, 20 lb. of potatoes and twelve cans of June peas; 8 gal. of coffee were made. The bread and cakes were kneaded and the coffee ground by electric power, all at a cost of less than $1 for the entire meal for 100 guests.

During the demonstration, which lasted a week, the sales included twenty-five stoves, three vacuum cleaners, four electric washing machines, one 14-qt. coffee urn, one dozen electric irons, coffee percolators, etc., the total value being $2,500. Over sixty electric stoves are now installed in the city, which has a population of but 10,000. There has been no complaint about any stove, and, in general, the people are enthusiastic on the subject of electric cooking. It is expected that the demonstration will be the means of selling over 100 electric stoves, which will mean an increase in revenue of at least $400 per month. In fact, with the approach of warm weather there may be difficulty in supplying the demand. We are indebted to Mr. J. F. Roche, manager of the Billings & Eastern Montana Power Company, for the above information.

MOISTURE CONDITIONS PREVENT GROUNDING OF SECONDARIES AT GALVESTON, TEX.

The salt, wet air encountered at Galveston, Tex., so thoroughly permeates all buildings with conducting moisture that it is impossible to ground the secondaries of transformers on account of the painful shocks given from brass socket shells or other metal parts which make contact with the ungrounded side of the line. Buildings of wood, brick or concrete become so conducting after brief exposure to the climate of this semitropical island that even when standing on carpeted floors on upper stories one finds it impossible to touch any live conductor at ordinary lighting voltages. The capacity leakage effect from even ungrounded secondaries in many cases proves unpleasant. Being an advocate of grounded secondaries elsewhere, when Mr. Fred M. Lege, Jr., the present manager of the Brush Electric Lighting & Power Company, first came to Galveston several years ago he immediately took precautions to see that his own house service was properly grounded. Painful shocks at once became manifest from various sockets and switches, and members of the family and servants soon grew so fearful of all outlets that the ground had to be removed. The model lighting installation at Ft. Crockett, the government post at Galveston, is equipped with grounded secondaries which have given rise to much lightning and fuse trouble, making it also impossible to replace fuses without removing voltage from the lines. The climatic conditions at Galveston also make it necessary to use porcelain instead of wooden strain insulators, besides other modifications of standard construction practice.

MOVING-PICTURE DRAMA TO DEMONSTRATE CENTRAL-STATION SERVICE.

The adventures of a young married couple with a smoky cook-stove and an impudent servant who leaves without warning, the wife's unproductive efforts in the old-fashioned kitchen, the husband to the rescue with a complete set of electric cooking and household appliances, and the comfort and satisfaction which thereafter ensue are shown in the form of a connected and interesting moving-picture drama now being exhibited nightly to crowds in the Commonwealth Edison exhibit hall at the White City amusement park, Chicago. The charm and interest of the present display, unlike previous mere-demonstrating pictures that have been shown, lies in the continued thread of plot which permits the electrical devices to be brought in without effort, and though these electrical details are given a prominent part, the story contains sufficient of human interest to hold the attention of every spectator until the 1500 ft. of film have been run off.

The little drama opens with a kitchen interior, showing a fat and untidy hired girl, who furnishes the comedy for the piece, in her efforts to build a fire in the smoking coal stove. While she divides her time between emptying the ashes and getting food ready for cooking it grows late, breakfast is delayed, and at last the head of the house takes part in a stormy interview in the kitchen. The hired girl determines to leave, collects her wages, and departs, while the young wife attempts to complete the breakfast arrangements. Unequal to the task with the old-fashioned utensils provided, her husband insists that she give up the attempt, and he goes to his club for breakfast. There, while discussing the evils of the servant problem with his friends, one of them shows him a newspaper advertisement of the Commonwealth Edison Company, "the servant problem solved by electricity—cooking, washing, ironing, cleaning."

The next picture shows the man of the performance swinging down Michigan Boulevard coming from his club. After a few glances about he notes the location of the Electric Shop, enters, and explains his needs to a gentlemanly attendant, who escorts him through the exhibit rooms demonstrating toasters, flatirons, chafing dishes, electric ranges, sewing machines, etc. After a number of interior views on the main floor the pair enter the push-controlled electric elevator and descend to the demonstration rooms below. This is said by moving-picture men to be the first time an elevator has been successfully shown in a film.

Other demonstrations of vacuum cleaners, washing machines, etc., follow; meanwhile the attendant has been noting down orders as each successive appliance strikes the fancy of the customer. A busy street scene in Michigan Boulevard shows the appliances being loaded into one of the Commonwealth company's electric trucks for delivery to the house. There they are quickly set into place, making a completely equipped electric kitchen and laundry. The wife is, of course, delighted, and with a pretty show of enthusiasm tries each device in turn, not forgetting to express her appreciation to the head of the house. Another servant girl is secured, this time a neat, trim maid, who goes busily about her electric cooking, washing, ironing and housecleaning wearing the starchiest and whitest of aprons. A model electric meal is served, and at its close the dishes are swept from the table in a twinkling—the one bit of legerdemain in the film—which closes with a series of character studies in facial expressions of the man of the house, his cigar and his electric cigar-lighter. No expense was spared by the Commonwealth Edison Company in staging the film. Experienced motion-picture actors were employed to take the parts, and while special scenery was prepared for some of the views, the Electric Shop and Chicago street scene provide the loci for most of the action. The film is of unusual length, 1500 ft., and the details and idea of the playlet, which is entitled "Solving the Servant Problem," are due to Mr. Charles F. Stark, of the advertising department of the Commonwealth Edison Company.

PURCHASING COAL ON A HEAT-UNIT BASIS.

The Birmingham (Ala.) Railway, Light & Power Company purchases its coal under a contract with the mine by which payment is made entirely on the basis of the quality of the fuel furnished, as shown by chemical test. These tests, which are made on a 100-lb. sample taken from each shipment, include a determination of the heat-unit fuel value of the coal and the quantities of sulphur, moisture and ash material present.

According to the six-year contract which the company has entered into with the coal dealer it agrees to pay $1.55 per ton for the coal, on a basis of 13,000 lb.-Fahrenheit units per pound. For all deviations shown by the test results from this 13,000 heat-unit standard the coal company is paid proportionately, receiving a premium when the fuel content runs above the base value and sustaining a proportionate reduction when it falls below 13,000 heat units.

Further premiums and deductions are granted the dealer with regard to the ash content of the fuel as follows:

7 to 8 per cent ash, 9 cents per ton premium.
8 to 9 per cent ash, 6 cents per ton premium.
9 to 10 per cent ash, 3 cents per ton premium.
10 to 12 per cent ash, no correction.
12 to 13 per cent ash, 3 cents per ton deduction.
13 to 14 per cent ash, 6 cents per ton deduction.
14 to 15 per cent ash, 9 cents per ton deduction.
15 to 16 per cent ash, 12 cents per ton deduction.
16 to 17 per cent ash, 15 cents per ton deduction.
17 to 18 per cent ash, 18 cents per ton deduction.
18 to 20 per cent ash, coal rejected.

Part of the sample is also subjected to a drying temperature and its loss in weight noted as the moisture is driven out. Three per cent moisture content by weight is allowed, but for all water present above this amount proportionate correction is made in the car-load weights of the coal.

As long as the sulphur content of the coal remains below 1 per cent no deduction is made for the presence of this material, but for sulphur in excess of this amount penalties as follows are subtracted from the purchase price of the coal per ton:

1 to 1¼ per cent sulphur, 5 cents
1¼ to 1½ per cent sulphur, 10 cents
1½ to 1¾ per cent sulphur, 15 cents
1¾ to 2 per cent sulphur, 20 cents
Above 2 per cent. sulphur, coal rejected.

The contract stipulates the delivery of the coal in drop-bottom cars, and provides for a deduction of 5 cents per ton from the price of all coal not delivered in such cars. In case the specifications for the thermal units, ash, sulphur or moisture in the coal are continually infracted to a degree that may be deemed injurious to the plant equipment, the company reserves the right to cancel the entire contract. The price of the coal contracted for is based upon a certain wage payment to the miners, and if during the life of the contract this wage scale is raised the electric company agrees to pay the coal company proportionately. The Birmingham company is now burning from 300 tons to 500 tons of coal a day at its main generating station, from which the local lighting, power and street-railway services are supplied.

Mr. F. V. Underwood, electrical superintendent for the company, declares that after two years' experience with the thermal-unit basis of purchasing fuel he has found the results of the arrangement mutually and highly satisfactory to both the mine and the plant interests. The scheme insures that the electric company gets the best output of the mine. The mine is paid at a higher rate for this superior product and the electric company profits by its better combustive properties. The analytical-test results of the 100-lb. samples from each shipment, which include both lumps and fine coal, are prepared in triplicate, one copy being retained by the chemist, one going to the superintendent's office, and the third being sent to the coal company, providing it with the data from which its bill is prepared. When desired a chemist representing the coal company checks the work done by the electric company's analyst. In case of dispute it is provided that the issue be submitted to an impartial laboratory for retest of a sample from the same shipment.

PURCHASING COAL ON A MINE-RUN BASIS.

At the third annual convention of the International Railway Fuel Association held at Chattanooga, Tenn., May 15 to 18, a number of papers were presented on locomotive fuel subjects. Two of general power-plant interest were those by Dr. J. A. Holmes, director of the United States Bureau of Mines, "Fuel Investigations," and by Prof. A. A. Steel, of the University of Arkansas, entitled "Some Results of Buying Coal Upon a Mine-Run Basis."

Professor Steel recounted how formerly in the purchase of coal only the lump material was valued and paid for until changing conditions and the reduction in the price of blasting powder resulted in less careful mining, producing a larger proportion of slack. As soon as this slack coal became a marketable commodity the cost of mining and the sale of the coal came to be figured on a run-of-mine basis and the miners were paid on this scale, although, of course, a ton of coal largely made up of slack was more easily mined and handled than a ton of the superior lump material. In some states coal purchasers are thus required to pay full price for all sizes of coal and slack as well as for whatever slate is mixed in the material. Lately the miners have learned to reduce the number of shots by increasing the power per shot, so that even the tight masses of coal are converted into little better than slack. The heavy shots also often cause masses of slate to fall from the roof, lowering the quality of the coal. The miners gain by these larger shots since they have fewer holes to drill, require but little more powder per hole and remove much larger quantities of coal.

Professor Steel spoke of the difficulties in introducing mining machines owing to the miners' prejudice, since it is easier to shovel up slack than to break up and load machine-cut lumps. As long as the mine-run basis persists, declared the speaker, this condition will continue. The only way to be sure of good-quality coal is to buy it upon a lump basis, or at least to pay more for lump coal than for slack. Jaw crushers equipped with long pick points on one jaw and with a bar screen on the other break up the lumps with the production of the least fine slack, but such equipment is expensive for the small mines to install.

GAS ENGINE PLANT ADDITIONS AT SAPULPA OKLA.

A 400-kw twin-tandem, horizontal Allis-Chalmers gas-engine-driven alternator set is being added to the new power-house equipment of the Sapulpa (Okla.) Electric Company, the first 250-kw single tandem-cylinder gas-engine set of which has been in operation since last May. With the rapid growth of Sapulpa this initial unit was soon loaded to a point where it was considered unwise to solicit more business until additional capacity could be secured. The new engine will shortly be ready to run, and an active new-business campaign has been formulated, including house-wiring and business-section lighting. Sapulpa is in the midst of the world's greatest oil field, and as natural gas sells locally at from 25 cents for lighting down to 4 cents for power purposes, the electric-motor business challenges sharp competition.

To advertise Sapulpa the local central-station company has offered to the municipality to install free of charge a 32-ft. x 20-ft. tungsten sign, on posts 40 ft. apart, spanning a principal street, the sign reading: "Sapulpa, the Oil City of the Southwest." Around the word "oil" colored lamps and a flasher will simulate the effect of flames. The sign will contain 675 low-voltage tungsten lamps. The company has offered to erect this sign free of charge to the city provided that it shall have a ten-year contract for lighting the sign from dusk to midnight for $75 a month.

The Sapulpa Electric Company is operated by H. M. Byllesby & Company, Chicago, Mr. Harry B. Wales being local manager at Sapulpa.

ESTIMATING THE COST OF ENERGY.

In leading a discussion before the Toledo Section of the American Institute of Electric Engineers on April 7 Mr. Marvin W. Hansen stated that if the local company is losing money on energy furnished certain classes of consumers, the system of computing cost of production is all wrong. Mr. Hansen argued that the question is not so much one of production as it is of non-consumption. Under the present system, he said, the large consumer pays the fixed charges against the small consumer.

The three fundamental principles in fixing charges for service, Mr. Hansen stated, are as follows: First, a fixed load for each consumer; second, a fixed charge per year for this load; third, a fixed low rate for the amount of energy used. For the residence consumer he thought that the fixed load should be determined as one-half the possible demand. To arrive at the possible demand circuit interrupters should be used and the consumer would be able to ascertain at any time whether he was using energy at too rapid a rate or not.

Mr. Hansen estimated the cost of energy for residences of average size as follows: Cooking, $1.80 per month; ironing, 10 cents; washing, 20 cents; electric fans, ten hours per day, 15 cents; heating room 16 ft. x 20 ft., $3; house cleaning with vacuum cleaner, 10 cents.

On this basis, he said, as nearly as he could determine, the highest cost per kilowatt installed is $60, which, plus an equal amount for distribution, would make $120 the fixed cost to the company for each consumer having a load of 1 kw.

* * *

COST OF MAGNETITE-ARC LIGHTING IN WORCESTER.

Exhaustive figures bearing upon the cost of magnetite-arc lighting were presented by the Worcester (Mass.) Electric Light Company at a recent hearing before the Massachusetts Gas and Electric Light Commission on the petition of Mayor James Logan for a reduction in the prices charged the city for the illumination of its thoroughfares. At former hearings the petitioner introduced testimony to show that a fair price for the service would be about $65 per lamp per year. The company's figures showed that under present conditions the cost is $96.28 per lamp, including a 6 per cent interest charge. The 4-amp magnetite lamp of General Electric manufacture is used in Worcester and an all-night and every-night service is rendered at a price of $91.25 per lamp per year.

TABLE I.—INVESTMENT IN MUNICIPAL ARC SERVICE (900 4-AMP MAGNETITE LAMPS). PRESENT VALUE.

Apparatus.	City's Figures.	Company's Figures.
Lamps, machinery, poles and appurtenances	$48,500(b)	$42,716 (d)
Steam plant	15,000	10,465
Buildings and real estate	5,000	7,349
1,279,971 ft. No. 6 B & S copper wire (a)	11,500 poles 50,000 wires (c)	31,386 (e) 129,871 (f)
100 miles single duct (g)	160,000	214,804
Totals	$290,000	$436,591

The following tables show in detail the company's methods of determining the cost of the service. The analysis is one of the most complete thus far made in the practice of moderate-sized central stations and is particularly suggestive for the reason that practically the entire service of the city was rendered by a single type of arc lamp. The Worcester company was one of the earliest in the country to adopt the magnetite system. No other plant in Massachusetts outside the Boston Edison company has so much underground conduit installed.

In Table I item (a) is the amount in use June 30, 1909. Item (b) includes a part of the generator plant. Item (c) is based upon a valuation by the city's expert of about 4 cents per foot, or a depreciation of more than 75 per cent from the initial value of the wire. The company contends that the city's value is absurd since the initial cost of the wire is 18.5 cents per foot. The company's estimate of the value of the wire at present is about 12 cents per foot, although the wire is as efficient as when first installed six years ago. If the company maintained a higher value, which might be legitimately done, the depreciation would be larger and the cost greater per lamp. Item (d) is made up of generator plant, $3,429; station equipment, $20,093, and arc lamps, $19,194, the total being $42,716. Item (e) includes the following at the book values given against each:

Lamp poles	$10,438.00
Fixtures	15,443.50
Arresters	967.50
Line poles (municipal arc portion)	15,000.00
Total	$41,849.00
Estimated depreciation 25 per cent	10,463.00
Present value	$31,386.00

Except some line poles this is all about five years old. Depreciation is taken at 10 per cent for an average of two and one-half years.

Item (f) is made up as follows, the figures being as of June 30, 1910:

1,022,012 ft. No. 6 B & S underground lead-covered copper wire at 12 cents	$122,461
32,968 lb. No. 6 weatherproof copper wire at 12 cents	3,943
38,864 ft. No. 6 rubber-covered wire at 10 cents	3,287
Present value, total	$129,871

These valuations were given as a matter of expert opinion, but were verified by the following statement of costs and estimate of depreciation:

1,022,012 ft. No. 6 wire as above, initial cost 18½ cents	$189,072
32,968 lb. No. 6 wire as above at 15 cents	4,945
32,864 ft. rubber-covered wire as above, at 15 cents	4,929
Total initial cost	$198,946

Average age six years. Average depreciation on underground wire taken at 6 per cent per year and on other wire at 10 per cent per year.

36 per cent of $189,072	$68,065
60 per cent of $4,945	2,967
60 per cent of $4,929	2,957
Total depreciation	$73,989

Deducting this depreciation from the initial cost leaves a present value of $124,957, or within $5,000 of the preceding estimate.

The lengths and values of the different classes of ducts are as shown in the first table on the following page.

The original cost of ducts to June 30, 1910, was $666,538, and the total length of ducts to June 30, 1910, was 1,731,141 ft. The average cost of construction at Worcester per foot of duct is $0.385 and the average age of ducts seven years.

Depreciation on ducts, including obsolescence, has been charged at 3.5 per cent per year, giving a total depreciation of 24.5 per cent in seven years. The original cost of ducts was 38.5 cents per foot and the depreciation 9.5 cents, hence the present value of ducts is 29 cents per foot.

I. REVENUE DUCTS.		
Municipal arc ducts, at 29 cents	430,000 ft	$124,700
Commercial arc ducts	47,000 ft.	13,630
Incandescent ducts	430,000 ft.	124,700
Power ducts	100,000 ft.	29,000
Totals	1,007,000 ft.	$292,030
II. NON-REVENUE DUCTS.		
Vacant ducts	372,141 ft.	107,920
Totals	1,379,141 ft.	$399,950
FREE CITY DUCTS	352,000 ft.	102,080
Totals	1,731,141 ft.	$502,030

The company points out that this depreciation is very high. If taken at only 2 per cent the present value would be 38.5 cents less 14 per cent, or 33 cents instead of 29 cents. The latter figure was, however, allowed to stand by the company, particular emphasis being laid upon the fact that the allowance of such high depreciation charges means a serious scaling down of the present value of the investment in arc-lighting equipment and consequently favors the city.

The proportion of municipal arc ducts to all ducts except the free city duct is 31.2 per cent. The proportion of vacant ducts to all except the free city ducts is 27 per cent. Interest and depreciation on the free city ducts, such ducts being now and perpetually non-revenue-producing and practically a special tax or exaction for the privilege of laying the other ducts, must be carried by the other ducts in the proportion that each class of ducts bears to all the ducts except the free city ducts.

Value of municipal arc ducts as above	$124,700
31.2 per cent of value of free city ducts ($102,080)	31,849
	$156,549
Value of vacant ducts as above	$107,920
27 per cent of value of free city ducts ($102,080)	27,561
	$135,481

But these non-revenue-producing ducts must also be carried by the revenue-producing ducts until they become self-sustaining, so that to the augmented value of the municipal arc ducts above ($156,549) a sum ($58,256) must be added on the following basis:

Ratio of municipal arc ducts to all revenue ducts, 43 per cent	$156,549
43 per cent of corrected value of all vacant ducts ($135,481) is	58,256
Total corrected investment in municipal arc ducts	$214,805

RECAPITULATION.

Total investment	$436,591
Depreciation, 5 per cent	21,829
Interest or profit, 6 per cent	26,195
Charges For 900 lamps, or $53.58 each.	$48.024

Taking 5 per cent average depreciation and 6 per cent as a reasonable profit, the investment cost per lamp is as given above.

The total operating expenses for 900 lamps are $28,680.42, or $31.87 per lamp.

The city's expert, Mr. W. D. Marks, of New York, allowed $29.81 for operating expenses, but included no allowances for patrolmen or general expenses. These amount to $4.27 and $1.74 per lamp per year respectively, and when included bring the operating cost as estimated by the petitioner to $35.82 per lamp per year.

TABLE II.—DEPRECIATION, ITEMIZED.

LAMPS, MACHINERY, POLES AND APPURTENANCES.	
Electrical plant, $23,523 @ 10%, $2,352	
Arc lamps, $19,194 @ 10%, $1,919	
Poles and fixtures, $31,387 @ 10%, $3,139	$7,410
STEAM EQUIPMENT.	
Steam plant, $10,465 @ 7%	723
LAND AND BUILDINGS.	
Land, $1,831, no depreciation	
Buildings, $5,518 @ 2½%	138
WIRES.	
Underground, $122,641 @ 7%, $8,585	
Overhead, $7,230 @ 10%, $723	9,308
DUCTS.	
$214,804 at 2%	4,296
Total	$21,874

(An average depreciation of 5 per cent on the municipal arc investment is $21,829.)

TABLE III.—TAXES AND INSURANCE.

Total investment of company June 30, 1910	$1,459,483
Present value of equipment in municipal arc department	436,591
Ratio of latter to former	29%
TAXES (total).	
(a) On real estate	$2,885
Machinery, etc	19,188
State tax	8,947
Commission tax	373
	$31,393
29 per cent attributable to municipal arc department	9,104
(b) U. S. income tax, total	$1,041
Income from municipal arcs is 20 per cent of total, or	78,791
20 per cent of income tax is	208
COST OF INSURANCE, TOTAL OF COMPANY	$7,127
Municipal arc equipment is 8.6 per cent of total equipment, so 8.6 per cent of the total insurance is	641
Total insurance and taxes municipal arcs	9,953
Taxes and insurance per lamp	11.06

TABLE IV.—OPERATING EXPENSES OF MAGNETITE SYSTEM.

Item	Total Expense.		Fixed Charge.	Output Charge.
Engineers' wages	$460.64	8.6 % of total	$460.64	....
Firemen's wages	468.52		468.52	....
Dynamo tenders' wages	887.88		887.88	....
Fuel	9,281.64	proportioned on station output.	....	$9,281.64
Oil, water, waste	480.00		....	480.00
Station expense	3.32	8.6 % of total on output	3.32	....
Repairs, building	46.30		46.30	....
Repairs, steam plant	860.82		430.41	430.41
Repairs, electrical plant	177.98		....	177.98
Rectifier tubes	1,920.00	actual cost	......	1,920.00
Patrolmen	3,847.60	" "	.....	3,847.60
Trimmers	909.40	" "	.....	909.40
Repairs, poles, lines	1,828.12	" "	914.06	914.06
Repairs, underground	957.76	" "	478.88	478.88
Repairs, arc lamps	2,105.94	" "	....	2,105.94
Globes	387.00	" "	......	387.00
Carbons	1,068.00	" "	....	1,068.00
Sundries	1,423.08	" "	711.54	711.54
General expense	1,566.42	8.6% of total	1,566.42	....
Total	$28.680.42		$5,967.97	$22,712.45

The total energy output for street-lighting service in Worcester in the year ended June 30, 1910, was 1,326,104 kw-hours and the connected load of the street-lighting service is about 360 kw.

In the preliminary cross-examination of Mr. Smith the above data were unshaken by the petitioner's counsel. The additional points were brought out that the magnetite installation necessitated the purchase of a new rectifier board at a cost of $23.500. which the company can use for nothing else but arc or series incandescent street lighting. Station reconstruction included a concrete floor, $1,224; special wiring, $1,046; labor, $1,420; crane, $1,800, and arc-distributing board, $4,499. Twenty-three tub transformers are in service in the Worcester installation, and the average initial cost of the arc lamps is $25 each. The hearing was continued.

TABLE V.—GRAND TOTALS OF ACTUAL ANNUAL COSTS.

Items.	For 900 Lamps.	Per Lamp
Interest on investment at 6 per cent (Table I)	$26,195	$29.10
Depreciation @ 5 per cent (Table II)	21,829	24.25
Taxes and insurance (Table III)	9,953	11.06
Operating expenses (Table IV)	28,680	31.87
Total yearly cost	$86,657	$96 28

Wiring and Illumination

CREOSOTED POLES IN BIRMINGHAM, ALA.

Poles of Southern pine impregnated with creosote to the amount of 12 lb. per cubic foot of wood have been adopted by the Birmingham Railway, Light & Power Company as its standard line construction. Mr. F. V. Underwood, electrical superintendent for the company, expects poles thus treated to show lives of at least twenty-five years, basing his conclusions on observations of creosoted poles that have been in use in Birmingham over a long period.

Following the vacuum treatment of the entire pole, the creosote preservative is driven into the pores of the wood under a pressure of 125 lb. per square inch, insuring that each cubic foot of wood receives about 12 lb. of creosote. After the pole has been in the ground for some time it is found that the creosote material works down from the top of the pole toward the butt, increasing the density of impregnation at the ground line, where the pole is most subject to deterioration. Some of the creosote also penetrates out into the surrounding earth as a gummy tar, forming a water shed about the pole base.

Poles thus treated, delivered to the electric company, cost about twice as much as ordinary untreated wood, but the life of such creosoted poles is declared to be indefinite, outlasting several wood poles at least. Examination of creosoted poles taken up after five years in the ground disclosed no deterioration whatever in the structure of the wood. Besides the saving in pole cost resulting from the longer life of the doubly expensive creosoted pole, there are important additional economics in the labor costs of setting new poles, replacing cross-arms, maintenance, etc., and all of these must be considered. The creosoted poles cost the Birmingham Electric Company as follows:

30-ft. poles, 8-in. tops, $6.95.
35-ft. poles, 8-in. tops, 7.85.
30-ft. poles, 10-in. tops, 8.30.
30-ft. poles, 13-in. tops, 11.35.
35-ft. poles, 10-in. tops, 9.90.

A disadvantage offered by the creosoted poles is the damage they sometimes do, when new, by soiling the clothes of persons who brush against them. In the hot sun some of the creosote is distilled out to the surface of the pole where it adheres as a sticky black tar. The Birmingham company has had to settle several damage accounts of this kind, but after the pole has been exposed to the elements for a short time it becomes as innocuous as any painted surface.

FIREPROOF WIRING IN TELEPHONE BUILDINGS.

As a result of an investigation into conditions of internal fire hazards and external exposures of its telephone exchanges, the Colorado Telephone Company is making arrangements to systematically eliminate these hazards to the greatest possible extent. The plans will entail the adoption of conduit wiring for all lamps and motor circuits, fireproof inclosures for all fuses on these circuits excepting in fireproof buildings, metallic inclosures for all motors except in fireproof buildings and special arrangements for drop cords, movable lamps and the like. Exposures will be removed by the use of metal frames and wired-glass windows and by roller fire shutters for exposed door openings. Heating devices will be all standardized and the present interior protection devices supplemented.

The American District Telegraph Company, of Denver, Col., of which Mr. E. B. Field, Jr., is president, is now engaged in moving its entire central-station equipment from a basement room in the eight-story fireproof building of the Colorado Telephone Company to a small one-story unexposed building about a block distant, to be occupied solely by the A. D. T. central station.

ADEQUATE ILLUMINATION FROM THE CIVIC STANDPOINT.

The St. Louis *Times* editorially presents its readers with something to think about on the subject of ample street and shop-window lighting in its issue of May 18. "To-day," remarks its editorial paragrapher, "the progressive merchant has as many lamps as he can use effectively, and he permits them to burn as long as there are people abroad on the streets. The storekeeper who has a pretty window realizes that a flood of light in that window is more eloquent than the best salesman. Moreover, he knows that by contributing his share of the bright light to the streets he is helping to advertise his city.

"An expert recently declared that Broadway, St. Louis, is the best-lighted street in the world. Can any one estimate the value of that advertisement to St. Louis? Would it not bring a certain return in dollars and cents if every street in St. Louis was as well illuminated as Broadway? Would not the footpad give way to the delighted visitor who might carry the praises of the city abroad?"

ELECTRIC-LIGHTED CROSS ON CHURCH STEEPLE.

Attention has been attracted by a cross outlined in electric lamps on the steeple of St. Mel's Catholic Church, at Forty-third Avenue and Washington Boulevard, Chicago. The cross is 9 ft. high and 6 ft. wide. Each side of it is outlined by thirty 4-cp carbon lamps, the total installation consuming 1.16 kw. The specific consumption of the lamps used is 47 watts per candle. This cross can be seen very distinctly at night for a distance of twenty-five city blocks in a direction at right angles to the arms of the cross. Rev. Father McDonald, who is in charge of the church, expresses himself as well pleased with the results obtained by the use of electricity for lighting this church emblem.

The change will also include the entire standardization of all central-station equipment, the use of conduit for all wiring, of slate, glass and iron for all register tables, switchboards and protection panels, and the necessary open connections will be all flame-proofed. Independent storage battery and two motor-generator sets will be provided in the basement cut off from the remaining apparatus by concrete floor slab with no communication. One motor-generator will receive energy from the 220-volt alternating-current secondaries of the Denver Gas & Electric Company and the other from the 500-volt trolley supply of the Denver City Tramway or from the 440-volt direct-current motor circuits of the Denver Gas & Electric Company. The battery will be in duplicate, each portion capable of serving the central station for thirty hours continuously. In this watch service system some 85 per cent of all the lines are in underground cables of the Colorado Telephone Company, using No. 19 wire in cables, and the pairs being made available for the watch service upon requisition from the telephone company.

In connection with this isolation of the watch service from the telephone central station, the rewiring in conduit of all customers' installations is rapidly proceeding, and there have been developed new registers and signal boxes showing very pronounced advantages over older types.

STREET LIGHTING IN PUEBLA, MEXICO.

By Roscoe Scott.

Perhaps the title "Great White Way" could be applied with greater aptness to a well-lighted Mexican street than to most of the Broadways and Main Streets which have laid claim to that distinction in the United States. The most common color for exteriors of buildings in the tropical republic is, roughly speaking, white, and this, of course, tends toward efficiency in street lighting since reflection aids materially in brightening the roadway. The reflecting value of a white building is well illustrated in Fig. 1, a view of the Kioska substation of the Puebla Tramway, Light & Power Company. The structure is outlined with 5-watt, 12-volt sign lamps.

Puebla boasts the first installation of tungsten-filament series lamps on poles in the Republic of Mexico—an installation which for decorative beauty compares most favorably with many of its Northern prototypes. Before describing this system, however, it may be of interest to present a few salient facts about the city itself.

Puebla, as American cities go, is very old. All the records of the municipality, dating back to the year of its foundation, 1521—a century before the Pilgrims landed—are preserved in its archives. The 1910 census indicated a population of about 102,000. Puebla the state—of which Puebla the city is the capital—is the richest agricultural state in the Mexican Republic. The city, which is about 85 miles east of Mexico City, is a great cotton-factory center and on this account is often spoken of as the "Manchester of Mexico."

Puebla is also famous for its old-established ornamental ironwork industry. The finest ornamental tiles made in the Republic of Mexico are the product of Puebla factories, where very good reproductions of the old Talavera ware may also be purchased. As the city is close to the famous onyx quarries, naturally, a specialty is made of the cutting and polishing of this beautiful decorative material, which in such a mild climate can be used even for exterior work. Recently a complete modern drainage system and an excellent water-supply system have been installed, the latter including a reinforced-concrete reservoir and two electric pumping stations of the most modern type, using centrifugal pumps. A duplicate of both pump and motor installation exists in each pump house. All the city streets have been repaved within the past three years, the central thoroughfares being provided with asphalt pavement and the outlying streets, macadam finished with crude oil.

Electricity for the power and lighting lines of the Puebla Tramway, Light & Power Company is generated by three water plants within 15 miles of the city, with an aggregate capacity of about 10,000 hp. The high-tension distributing system comprises about 120 miles of line for supplying power, in addition to that delivered in the city of Puebla, to the following towns or districts: Atlixco, Cholula, Panzacola, Santo Domingo, Santa Ana, San Pablo, Santa Cruz, San Manuel, San Geronimo, San Felipe, Apizaco and San Rafael. Arrangements are being made to develop a fourth fall situated about 60 miles from the city of Puebla, which will bring an additional generating capacity of about 35,000 hp, making an aggregate of 45,000 hp.

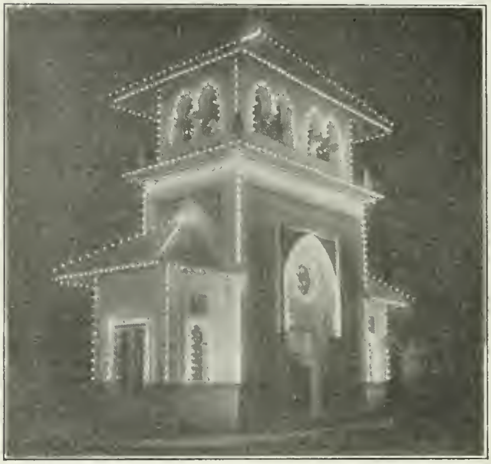


Fig. 1—Substation of Light and Power Company, Puebla.

The new street-lighting system employs lamps of the metal-filament 100-watt "street-series" type, with clear bulbs. These were supplied by the Buckeye Electric Lamp Company, of the City of Mexico. They are installed five in series on constant-potential circuits. The standard lamp-post which has been adopted consists of an artistically designed cast-iron upright having four arms at the top. Each arm is equipped with a spherical globe, 13 1/16 in. in diameter, of special diffusing glass, containing a single 100-watt lamp, while a fifth lamp and globe surmount the entire fixture. The standards were designed

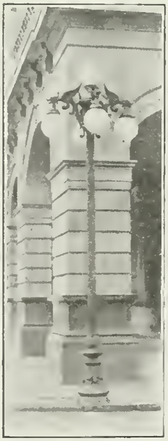


Fig. 2—Ordinary Street Standard.

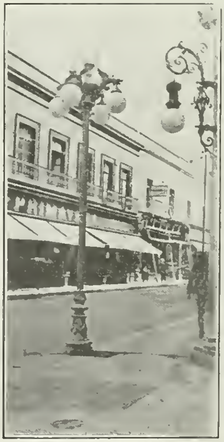


Fig. 3—Fixture at Street Corner.

and executed in the city of Puebla by Landa Hnos. The conception of a winged dragon or gargoyle is used for the arms at the top of each post. The lowest part of the pole is of elaborate design in all cases, while the central portion is plain for most of the standards, but is very elaborately designed in the case of some of the units which occupy prominent positions on the Zocalo, or public park of the city.

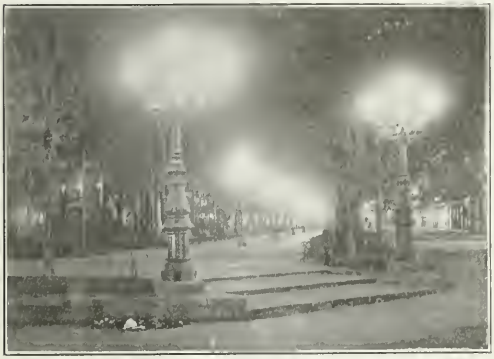


Fig. 4—Elaborate Standards on the Zocalo.

The best lighted part of Puebla is the Zocalo. The broad poles which encircle this are illuminated, as seen in Fig. 4, by central rows of units spaced about 15 m apart. The main business section of the city surrounds the Zocalo and the streets are to be illuminated by units staggered normally about 30 m apart on a side. When the entire city has been lighted in this way, as is the present intention, there will be approximately 1000 lamps in service. The average illumination at the street level is estimated by the engineers in charge to be nearly 0.5 ft.-candle.

The efforts of the management of the Puebla Tramway, Light & Power Company to introduce series tungsten lighting have been appreciated and seconded by the progressive mayors of the city and the no less progressive governors of the state. Preliminary negotiations for the installation were conducted while Señor Francisco de Velasco was Mayor and during the period in which he served all details were fully discussed by the Council and approved. The contract was signed by the present Mayor, Señor Antonio Perez Marin, who enthusiastically supported the project. Señor J. Rafael Isunza, Governor of the state, without whose approval no such contract may be made by any municipality, being thoroughly aware of the undoubted benefits which would accrue to the city from this system of lighting, saw his way clear to approve the contract, and the greater part of the installation was finished by May 5.

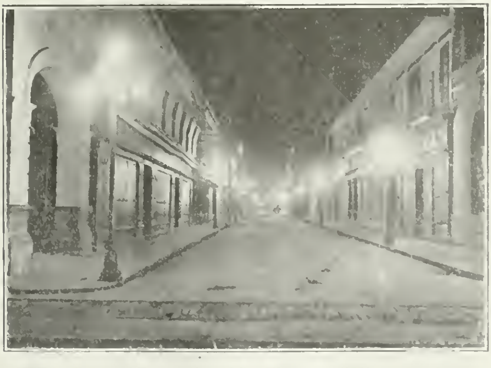


Fig. 5—Street Lighting, Showing Staggering of Units.

Good street lighting, as has been found out in the United States, is contagious, and cities show a disposition to emulate each other. It will be interesting to see how long Puebla, which has for years been one of the best lighted and is now said to be the very best lighted city in Mexico, succeeds in maintaining its reputation.

LIFE OF SERIES TUNGSTEN LAMPS AT CEDAR FALLS, IOWA.

Mr. J. P. Jones, superintendent of the Citizens' Gas & Electric Company's substation at Cedar Falls, Ia., gave some valuable figures before the Iowa Electrical Association convention at Davenport, April 20, on the life of series tungsten lamps in use for street lighting at Cedar Falls. The record is for two years seven and a half months, from July 15, 1908, to April 1, 1911. There are 248 lamps still in service which have not burned out. The average hours these have burned is 2708. Six and five-tenths per cent have burned an average of 330.8 hours; 5.3 per cent have burned an average of 706.5 hours; 25.8 per cent have burned an average of 1444 hours; 17.7 per cent have burned an average of 2498 hours; 16.5 per cent have averaged 3432 hours; 19.3 per cent have averaged 4409 hours, while 8.9 per cent have averaged 5484 hours. Of the lamps which have burned out in service there are 407 with an average life of 1213 hours. This low average, compared with the lamps still in service, is accounted for by the improvement in life of lamps purchased and installed the latter part of the period. Of the lamps burned out 32.9 per cent averaged 192 hours; 20.1 per cent averaged 734.4 hours; 25.1 per cent averaged 1399 hours; 12 per cent averaged 2398 hours; 6.2 per cent averaged 3372 hours; 3.7 per cent averaged 4254 hours. Of the total number of lamps which have been used, including those still in use and those burned out, there were 655, the average life of which was 1838 hours. The present number in service is 253. The sizes of lamps in use are the 40-watt, 6.6-ampere and the 40-watt, 3-ampere. Cost of lamp-maintenance material only was $248.27 for 1910, with an average of about 230 tungsten lamps in service.

LETTER TO THE EDITOR.

Library of the Engineering Societies, New York.

To the Editor of Electrical World:

SIR:—I desire to call your especial attention to the facilities offered by the library of the Engineering Societies, at 29 West Thirty-ninth Street, New York City. The library is formed from the combined libraries of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the American Institute of Mining Engineers, and contains over 40,000 volumes on engineering subjects. It is open for reference to the general public, without charge, every day and evening, except Sundays The library is supplied with all the published indexes, has most complete sets of periodicals, both domestic and foreign, and a well-trained reference staff.

Students residing in New York City and vicinity are especially invited to utilize the library in their researches on technological subjects. The library is on the top floor of the United Engineering Society Building, is quiet, well-lighted and ventilated. Those who are prevented from visiting the library by distance or business engagements may nevertheless receive assistance. The library is prepared to furnish references on engineering subjects to persons at a distance, and also to furnish transcripts, translations and photographic reproductions of diagrams and maps. For such work, if extensive, a moderate charge is made. Correspondence is welcomed, telegraphic and telephonic inquiries will receive especial attention.

New York. W. P. CUTTER, *Librarian.*

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Maximum Current in Secondary of Transformer.—J. S. Stone.—A paper on the conditions of the maximum current in the secondary of an alternating-current transformer. The author considers particularly the condition in which the amplitude of the secondary current has its greatest value. In practice this condition is in general attained by the adjustment of the capacities, inductances and mutual inductance of the primary and secondary circuits. The author considers the frequency as constant and the reactances of the primary and secondary circuits as well as the mutual reactance as the independent variables. He gives the formula which must be fulfilled so that the condition of the greatest maximum value of the current in the secondary circuit may be attained.—*Phys. Review,* April.

Induction Generators.—P. Bunet.—In the second part of his long article on synchronous and non-synchronous alternators the author discusses the induction alternator and shows that it overcomes various inconveniences in the use of synchronous alternators. He thinks that the use of induction alternators will largely increase, but that the development will be somewhat delayed by the great development which the synchronous alternators have already undergone in spite of their inconveniences.—*L'Industrie Elec.,* April 10.

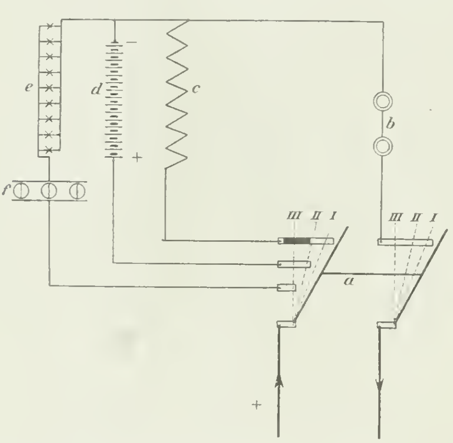


Fig. 1—Arrangement Showing Arc Lamp and Incandescent Lamps on Same Circuit.

Damping Noises of Machines.—W. Gerb.—An illustrated article in which the author describes a method of damping the disturbing noises of revolving machines by attaching to the base of the machine an oscillating system in which the vibrations are absorbed in columns of elastic plates.—*Elek. Zeit.,* April 27.

Lamps and Lighting.

Arc Lamps in Series with Incandescent Lamps. —W. Schaeffer.—A paper read before the Berlin Electrical Society (Verein). The author discusses the possibility of substituting incandescent lamps for the series resistors usually employed with arc lamps and the possibility of employing a single arc lamp together with incandescent lamps on 110-volt circuits or less than four arc lamps with incandescent lamps on 220-volt circuits. To be successful any such arrangement must fulfil the following conditions: The voltage and current for the arc lamps must be variable; the incandescent lamps must get constant current and constant voltage; finally, any disturbances in the arc lamps must not reach the incandescent lamps. The author shows that this is practically fulfilled in the arrangement shown in Fig. 1, in which two arc lamps *b* are connected to a 220-volt circuit; *c* is a resistor; the polarization cells *d* consist simply of lead plates without active mass in dilute sulphuric acid with specific gravity 1.8. The action of these polarization cells is similar to that of a storage battery, but they are not able to give any appreciable current for any length of time. *e* indicates several incandescent lamps and *f* "variators" (like the ballast used with the Nernst lamp—that is, iron-wire resistors in a hydrogen atmosphere). In connecting the lamps to the circuits the switch is first brought to position I, when the arc lamps are supplied with current and are in series with the resistor *c* just as in the ordinary operation of arc lamps. The switch is then turned over to position II, in which the polarization cells *d* are connected in parallel with the resistor *c*. Finally the switch is turned to position III, in which the system of incandescent lamps *e* together with their variators *f* is now in parallel with the polarization cells *d* and this system of parallel-connected circuits is in series with the arc lamps *b*. The resistor *c* is now disconnected from the circuit. Results of tests are given. The paper is to be concluded.—*Elek. Zeit.,* April 27.

Ratio of Light to Illumination.—H. T. Harrison.—A paper presented before the (British) Illuminating Engineering Society. The author considers light as that which causes illumination, whether that illumination is visible or not. He agrees with Trotter's definition of illumination as depending simply on the quantity of light falling upon a surface and that it has nothing to do with the color or reflecting value of that surface. Therefore, it would be, strictly speaking, inaccurate to state that an instrument such as the lumeter indicates the illumination except when it is pointed at a white screen of similar material to the screen in the instrument itself. To demonstrate his point the author has carried out the following experiments with his "universal" photometer. By replacing the standard comparison screen in the instrument by various tinted wall papers, the increased illumination necessary in order that the rays reflected from such wall papers should have the same effect on the eye as when a white paper of similar surface to the photometer screen is used can be ascertained very accurately. The results are as follows:

Color.	Increased Illumination Necessary (Times).
Bright red	3.5
Dull cardinal red	6.5
Medium blue	4.8
Light blue	3.2
Dark green	7.0
Light green	2.2

Another interesting point that these tests prove is that the angle of incidence of the light rays closely follows the cosine law over the greater part of the angular movement, despite the fact that the surfaces of these wall papers were far from plain. The next experiment was to ascertain the value of the light reflected from the area of these papers compared with that from white blotting paper, and, though these tests were made under very different conditions and very roughly, they corroborated the figures given above, thus proving that an instrument of the lumeter class measures correctly the irregular reflecting value of a surface. The author further deals with terminology of lighting, and suggests the following definitions: "Light" = the emanations from a light source. "Illumination" = the extent to which anything is illuminated; foot-candles. "Brilliancy" refers to a primary light source and is candle-power divided by area. "Intrinsic brilliancy" = candle-power per unit surface (square centimeter). "Brightness" and "intrinsic brightness," same as brilliancy. "Luminosity" or "luminous intensity," same as brilliancy, but applied to secondary sources of light. The author finally discusses the use of reflectors with lamps, but emphasizes that shadowless illumination is always depressing, just as a day when the sun is obscured by clouds is depressing. He claims that it would be wise to deliberate carefully before any system of shadowless illumination is adopted, and to remember that the object of all illumination is to produce an effect by which the outlines of objects are easily seen, which result is greatly assisted by the contrast of light and shade.—Lond. *Electrician*, May 5.

Visibility of Radiation.—P. G. Nutting.—Radiation of wave-length 0.61μ (orange red) must be twice as intense as radiation of wave-length 0.54μ (in the green) to produce the same luminous impression. Similarly radiation in the red at 0.65μ or in the blue at 0.47μ must be ten times as intense to produce the same illumination as in the green. By determining the intensities of radiation necessary to produce equal luminous sensations for a number of wave-lengths a complete curve may be obtained having a single maximum in the green and sloping off toward the extreme red and violet. This curve gives the visibility of radiation of the various wave-lengths. König investigated the visibility of radiation for his own eye, a normal trichomat, for nine different luminous intensities ranging from the threshold of vision up to about 600 meter-candles per square millimeter of pupil opening. The author has recalculated König's data on visibility, making a certain correction which had not formerly been applied.—*Bull. Bur. of Standards*, May 15.

Long Waves from Quartz Mercury Lamps.—H. Rubens and O. von Baeyer.—An account of an experimental investigation in which the authors prove the presence of extremely long waves from quartz mercury lamps. Heat rays of a wave-length of about 0.3 mm may be extracted from the radiation of the mercury lamp in sufficient force to permit an investigation of their qualities. The infra-red spectrum thereby sustains another enlargement of one and one-half octaves. This long-waved radiation is not emitted by the quartz walls, and it is highly probable that it originates in the luminous mercury vapor.—*Phil. Mag.*, May.

Binocular Photometer.—H. Kruess has arranged the well-known photometer of Lummer and Brodhun for use as a binocular instrument. According to tests of Steigler the percentage error when one eye only is used for a photometric test is generally more than 2 per cent, while with the use of both eyes the error decreases below 1.5 per cent.—*Zeit. f. Instrumentenkunde*, Vol. 30, 1910, page 329; abstracted in *Elek. Zeit.*, April 20.

Generation, Transmission and Distribution.

Three-Phase Autotransformer.—P. Girault.—The three coils, P_1, P_2 and P_3, of a three-phase autotransformer are connected in delta, as shown in Fig. 2, the three points 1, 2 and 3 of the triangle being connected to the three conductors of the three-phase supply line with the effective voltage of u. The points m_1, m_2 and m_3 are the centers of the three phases. This arrangement gives three systems of supplying three-phase currents at ½ u volts, namely, first, $m_2\,1\,m_3$; second, $m_3\,2\,m_1$, and, third, $m_1\,3\,m_2$. The author considers in detail the phase relations of the currents and voltages and the transformation of energy in three cases, namely, if the three systems just mentioned are all loaded or only two are loaded or only one is loaded. The article is illustrated by numerous diagrams and the fundamental formulas are given.—*L'Industrie Elec.*, April 10.

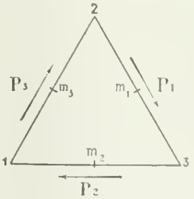


Fig. 2—Three-Phase Autotransformer.

Cranes.—R. Boyle.—A paper read before the Institute of Engineers and Shipbuilders in Scotland on large motor-driven cranes, with special reference to electric revolving cantilever cranes. The high efficiency of the modern cantilever crane is largely due to the use of electric motors. The introduction of the electric motor has made it a success, which steam and hydraulic motors could never have done. The various units in the driving system may now be quite separate and disconnected, and may be placed in the position of greatest advantage. The problem of electric braking is discussed and a summary is given of the typical equipment of 150-ton to 200-ton cranes.—Lond. *Electrician*, April 28.

Northeast Coast of England.—The fifth of an illustrated serial on electric-power developments on the northeast coast of England. The present article deals with substations. There are several hundred of them, and the principal typical forms are described and illustrated.—Lond. *Eng'ing*, May 5.

Installations, Systems and Appliances.

Electrical Industry in Italy.—The depression in many industries, especially in the cotton industry, prevailing in Italy has had a bad effect on electric-supply systems. For the first time since it was founded the Societa Lombarda, in Milan, has not increased its connections. The company will not increase its present plant and it seems certain that if hydroelectric plants continue to be built at the present rate in northern Italy there will soon be an overproduction of electrical energy in Lombardy. There will soon be available in this district not less than 350,000 hp of hydraulic plants, and it is not yet known what to do with more than 100,000 hp which is now being developed. The tendency of the large generating companies is at present not to sell the energy directly to their customers, but to found subsidiary companies which distribute energy over smaller districts. For instance, the Societa Elettrica Riviera di Ponente has seven subsidiary companies all along the Riviera coast. The Conti Company has twenty subsidiary companies. A greater increase in the use of electricity seems to be imminent in central and southern Italy, especially in Sicily, where quite an unexpected demand for electric light has arisen and electric motors will be used in the sulphur mines. In nothern Italy the hopes of the electrical companies are based on the extension of electric traction on main roads, but this development is getting along slowly. Moreover, competition is very active and prices are very low.—*Elek. Zeit.*, April 27.

Day Load for Central Stations.—J. B. C. Kershaw.—The first of a series of articles in which the author intends to suggest new sources of day loads for electric-service stations. In the present article he deals with the recovery of iron from the waste metals in brass and iron foundries by means of electromagnetic separators, a few simple types of which are sketched in general. This method will pay only in those foundries where the value of iron recovered (or of the waste material free from iron) is greater than the running and fixed charges of the installation. Cupola slag and ashes contain on the average 10 per cent of iron; molding sand contains 6 per cent. Taking these percentages as the basis of calculation, it is a simple matter to estimate what will be the total value of the recovered iron for any particular foundry, and what expenditure might be safely incurred upon an electromagnetic machine for dealing with the products containing iron. In brass foundries the problem is different, for here the value of such a method lies chiefly in the ease and completeness with which brass filings, borings and turnings, etc., may be freed from the admixture of iron which sometimes greatly reduces their value. In the majority of cases it will, therefore, pay to install such machines in brass foundries without any regard to the price to be obtained for the recovered iron.—Lond. *Elec. Review*, May 12.

Electrophysics and Magnetism.

Pressure Shift of Arc and Spark Lines.—H. G. Hale and

W. S. Adams.—An abstract of a paper read before the American Physical Society. In examining the spectrum of the sun's limb Adams has found that the enhanced lines (lines stronger in the spark than in the arc) are shifted toward the red, presumably by pressure, markedly more than the arc lines. The authors' present investigation was undertaken to see whether or not laboratory plates would show a greater pressure shift for the enhanced lines than for the arc lines. Many photographs of a powerful spark under pressures varying up to 300 lb. were taken. These were compared with photographs of the arc of titanium under pressure. Differences in the displacement of the arc lines and the spark lines with pressure were established. The authors suggest a hypothesis of the variation of pressure displacements with temperature.—*Phys. Review*, April.

Electrification of Air Near Water Falls.—W. A. D. Rudge.—An account of measurements of the electrification of the air near the Zambesi Falls in South Africa. The potential gradient in volts per meter was measured at different distances from the falls. At a distance of 1000 paces it was 1700 volts per meter, at a distance of 900 paces 2400, at a distance of 700 paces 3500, and at a distance of 500 paces 5000. At the edge of the falls the potential gradient, if it increased at the same rate, would have been enormous, but no doubt in the cloud itself there would be some conduction going on (certainly convection). From the rate at which the electroscope leaves diverged to a maximum, the charge at the falls would be twenty-five times as great as that at a distance of 1100 paces, namely, 25,000 volts per meter.—*Phil. Mag.*, May.

Polarization of Roentgen Rays.—F. C. Miller.—Ham has formerly investigated the polarization of Roentgen rays from an anti-cathode of lead. The present author has studied them from an anti-cathode of silver and the results show that practically no difference exists in the polarization of Roentgen rays from a lead target and a silver target.—*Jour. Frank. Inst.*, May.

Electrochemistry and Batteries.

Structure of the Atom.—E. Rutherford.—The well-known fact that the alpha and beta particles suffer deflection from their rectilinear paths by encounters with atoms of matter is used by the author to study closely the nature of these deflections and to derive therefrom some idea of the constitution of the atom to produce the effects observed. He considers an atom which contains a charge $\pm Ne$ at its center surrounded by a sphere of electrification containing a charge $\mp Ne$ supposed uniformly distributed throughout a sphere of radius R. e is the fundamental unit of charge, which is taken as 4.65×10^{-10} e. s. unit. It is further supposed that for distances less than 10^{-12} cm the central charge and also the charge on the alpha particle may be supposed to be concentrated at a point. On this basis he gives the theory of the deflection of alpha particles and compares the theory with experimental results. The general data available indicate that the value of the central charge of Ne for different atoms is approximately proportional to their atomic weight, at any rate for atoms heavier than aluminum. The deductions from the theory so far considered are independent of the sign of the central charge, and it has not so far been found possible to obtain definite evidence to determine whether it be positive or negative.—*Phil. Mag.*, May.

Units, Measurements and Instruments.

Measuring Susceptibility.—C. E. Mendenhall and W. F. Lent.—An abstract of a new method for measuring the susceptibility of weakly magnetic substances. The principle of the method is to balance the torque produced by the action of a non-uniform magnetic field upon two symmetrically placed specimens of the substance under test by the torque due to the action of the same field upon coils immediately surrounding the specimens, the current in which can be measured. The general arrangement of the apparatus is shown in Fig. 3, where N, S are the poles of the magnet producing the testing field; S_1 S_2 the small cylinders of the metal under test; c_1 c_2 the cylindrical coils accurately surrounding the test specimens through which the balancing current is passed, and w_1 w_2 the suspending wires, which also serve to carry the current to and from the coils c. The method is applied to a study of the susceptibility of alloys of bismuth with tellurium and thallium with the following results: The mean value for the susceptibility $k = 14.32$ is obtained for pure bismuth. Preliminary results of the effect of heat-treatment (crystal structure) on the susceptibility of bismuth are given. The curves connecting k and percentage composition for the series of Bi-Te alloys is given, showing no peculiar magnetic properties for the compound Bi_2Te_3. The corresponding curve for Bi-Th alloys is also determined and does show peculiar magnetic properties for the compound Bi_5Tl_3.—*Phys. Review*, April.

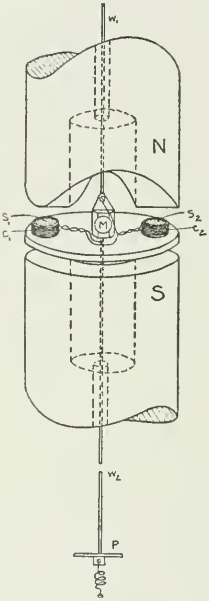


Fig. 3—Arrangement of Apparatus for Measuring Susceptibility.

American Testing and Research Laboratories.—F. Laporte.—An abstract of his report on his visit to various electrical laboratories in the United States, where the laboratory is stated to be the faithful auxiliary of the industry and to develop with it. First, the Bureau of Standards is mentioned and its equipment described. The generosity of the government in providing funds is pointed out. A comparison is made as to the number of tests and the prices charged for them between the Bureau of Standards and the Central Laboratory of Electricity in Paris. In the two sections of electricity and photometry 4389 tests were made in 1910 at a cost of $7,254 at the Bureau of Standards in Washington, while in the same year at the Central Laboratory of Electricity in Paris 1170 tests were made at a cost of $11,800. The equipment of the Electrical Testing Laboratories of New York is next described and the attention paid there to ventilation is especially pointed out. From the research laboratory of the General Electric Company in Schenectady the author got the impression of a certain scantiness (exiguité) of installation, but at the same time one of extraordinary activity. Reference is made to the use of wooden buildings in spite of the presence of electric furnaces. With respect to the laboratory of the National Electric Lamp Association in Cleveland the automatic feature of the manufacture and test of tungsten lamps "with an activity worthy of note" is pointed out.—*Bull. Soc. Internat. des Elec.*, March; abstracted in *La Lumière Elec.*, April 29.

Electric Resistance Thermometer.—C. F. Marvin.—A paper read before the Franklin Institute in which the author describes exact methods by which manufacturers of electric instruments can construct resistance thermometers so as to indicate temperatures on the gas scale directly and thus avoid the necessity of the trouble of the conversion tables commonly employed. The method consists in a combination of a resistance thermometer with a Wheatstone bridge, four different arrangements being shown. By exercising a proper choice in the manner of connecting up the bridge and of the resistance in the arms, the bridge scale can be fitted to almost any kind of resistance thermometer, whether its resistance changes with temperature by a linear law or according to some curve, convex either upward or downward. The general formulas are given and some numerical examples are added.—*Jour. Frank. Inst.*, May.

Measuring the Insulation Resistance of a Bundle of Insulated Conductors.—R. Lautré.—The author points out that there is a certain difference between the usual tests of the insulation resistance of bundles of insulated conductors and the specification for insulation resistance. That is, the insulation resistance measured is not exactly the one referred to in the specifications. To overcome this difference the author describes a number of simple measurements and recommends that in the specifications it should be exactly stated what test should be made.—*La Lumière Elec.*, April 29.

Induction Meter.—An official communication of the Reichanstalt by which a single-phase induction meter for two-wire and three-wire networks at 100 volts to 250 volts with currents from 3 amp to 75 amp made by Keiser & Schmidt is admitted for calibration. The construction is described and illustrated and the method of calibration discussed.—*Elek. Zeit.*, April 20.

Meters.—W. Lubach.—An English translation of his recent German paper on developments in the last years in the manufacture of electric meters.—Lond. *Electrician*, April 21.

Telegraphy, Telephony and Signals.

Measurement of Electric Oscillation in Receiving Antenna.—L. W. Austin.—The perikon detector can be standardized by comparing it with a thermo-element in a circuit to which it is coupled. If the thermo-element is calibrated so that the numerical value of the oscillating currents in the second circuit is known, then for the given conditions of frequency and coupling the perikon may be used for quantitative measurement of very small currents in the circuit to which it is coupled. This method has been developed for use in determining the numerical value of the currents in a wireless antenna when signals are being received. The arrangement of the apparatus is described and results of tests are given.—*Bull. Bur. of Standards,* May 15.

Miscellaneous.

Removing of Electric Charges in Textile Mills.—Paillet, F. Ducretet and E. Roger.—An abstract of a French Academy paper. In the different phases of the manufacture of textile materials like wool, silk, cotton, etc., electrostatic charges due to friction often cause considerable trouble. For instance, in spinning wool the charged threads will diverge and a considerable portion will detach from the principal mesh. There is, therefore, a considerable loss. To overcome this trouble the air is usually artificially loaded with moisture, but this is a bad remedy from the standpoint of sanitation, since all ventilation is impossible, double windows are used, and the shops are overheated. In experiments made at Fournies in the factory of Paillet it was found that the electric charge could be neutralized simply by using high-frequency, high-tension currents such as have been used in electrotherapeutics according to the method of D'Arsonval and more recently in wireless telegraphy. Since the use of these currents is not offensive, it is possible to use a large amount of energy without any danger for the workingmen. In the process which they employ and which has been in regular operation since May of 1910, use is made of the oscillating discharge of condensers which are supplied with an alternating current, the voltage of which is raised by means of a transformer. The arrangement which has given the best results is known under the name of "Oudin resonator" in wireless telegraphy. The aerial wires or antennas are stretched along the frames near the textile matter under treatment. The results obtained have been officially confirmed. The elasticity of the product has been raised by 19 per cent. The waste has been decreased from 23 per cent to 28 per cent. The windows of the factory are now open and the shops well ventilated.—*L'Industrie Elec.*, April 10.

American Plants.—A. Gerard.—Brief descriptions of the Schenectady works of the General Electric Company, of the Westinghouse Works in Pittsburgh, and some notes on a few electrochemical plants at Niagara Falls from the observations of the author during a trip through this country.—*La Lumiere Elec.*, April 29.

Book Reviews.

Die Normalen Eigenschaften Elektrischer Maschinen. By Rudolf Goldschmidt. Berlin: Julius Springer. 68 pages, 34 illus. Price, 3 marks.

A tabular and diagrammatic critical analysis is here given of the properties and limitations of electrical machinery. It is clearly and simply drawn up for engineers and students of machinery. It employs practically no algebra and depends upon tables and curves to present the facts. The book is divided into nine chapters on the following subjects: Direct-current machines, converters, synchronous alternating-current machines, asynchronous motors, single-phase commutator-motors, transformers, efficiencies of electrical machines at underloads and overloads, power-factor of induction motors at underloads and overloads, intermittent service loads. The book will be useful to electrical engineers who desire to compare standard German construction with United States construction in electrical machinery. It is evidently not intended to delimit the possibilities of construction in special machines.

Manuale dell' Ingegnere Elettricista. By Ing. A. Marro. Milan: Uirico Hoepli. 862 pages, 254 illus. Price, 8½ lire.

This is the second revised and enlarged edition of an excellent manual for the electrical engineer. The book is divided into eighteen principal sections on the following topics: Elementary principles, units of measures, electric and magnetic constants, methods and instruments of measure, generators, storage batteries, transformer motors, lamps, distribution systems, conductors, central stations, transmission lines, operating rules, legislation, electric traction, special applications. Although somewhat heavy for a pocket book, the manual is conveniently arranged for reference. It contains many important formulas and diagrams of connections. Arithmetical tables are appended at the end. The book will be useful to electrical engineers and students familiar with Italian.

Smoley's Tables. By Constantine Smoley, C.E. New York: The Engineering News Publishing Company. 171 pages. Price, $3.50.

This is the sixth edition of a handy set of municipal tables particularly useful to architects, artisans and artificers. Its purpose is largely connected with overcoming the difficultes of the English system of lengths as given in feet, inches and sixteenths of an inch. In the metric system the book would to a large extent be rendered unnecessary, so that it constitutes a monument to the metrological inefficiency of the English-speaking peoples. Nevertheless, the utility of the book as a ready reckoner in the swamps and quagmires of our English measures is indisputable. The type is well selected, the tables are well arranged, and excellent examples are offered with each to show their method of application. The tables will be of particular use to foremen builders.

Electrician's Operating and Testing Manual. By H. C. Horstman and V. H. Tousley. Chicago: F. J. Drake & Company. 360 pages, 211 illus. Price, $1.50.

This manual for the practical electrician, written by practical men of wide electrical experience, one of whom is chief inspector for the city of Chicago, contains information useful to those installing, testing and repairing the more common kinds of electrical apparatus. While this practical material shows excellent selection in the subjects treated, the arrangement and discussion is not always most clearly or simply presented. Loose use of terms and units is also indulged in to an extent that may prove confusing to one seeking a correct understanding of electrical quantities. The workman, to whom the book is addressed, however, will be sure to find much of an instructive nature in the illustrations and diagrams with which the manual is profusely furnished.

Notions Fondamentales sur la Télégraphie. By Albert Turpain. Paris: Gauthier-Villars. 180 pages, 122 illus. Price, 5 francs.

The book is addressed to elementary students of telegraph engineering. It describes in a direct and simple way the apparatus and processes employed in ordinary land telegraphy, especially in France. An introduction of fifteen pages is devoted to a brief history of the telegraph. The book is then divided into three sections. The first relates to simple telegraphy, the second to multiple and multiplex telegraphy and the third to the future probable development of the art. An elementary physical theory is outlined along the lines of Lord Kelvin's original treatment of a single signal.

The work will be of interest to electrical engineers desiring to acquaint themselves with French telegraph apparatus and systems.

La Théorie des Courants Alternatifs. By Alexander Russell. Paris: Gauthier-Villars. Vols. I and II. 1010 pages, 342 illus. Price, 33 francs.

This work has been translated into French from the original English by M. G. Séligmann-Lui. The translation is in itself an excellent piece of work, because in style and language the book reads very largely as though it had been thought out in French. Aside from the matter of translation, the book must be considered as an English original. As such it is probably the best work on alternating-current theory that England has yet produced. Books on that subject equally masterful in style have been written by other writers in the past, but at a date when alternating currents had received but little practical development.

It is strange, considering the many technical questions discussed mathematically in this textbook, that so little use should be made therein of vector methods explicitly. Corresponding discussions in this country would be dealt with by the use of complex quantities to a considerable extent at least. In this respect the book is well adapted to the needs of French engineering students, who, as a rule, do not lay much stress on vector methods of demonstration. The work will be of great value to advanced students of alternating-current electrical engineering, either in the French or in the original. Volume I deals mainly with the principles of alternating currents and their properties, while Volume II treats of alternating-current machinery and energy transmission.

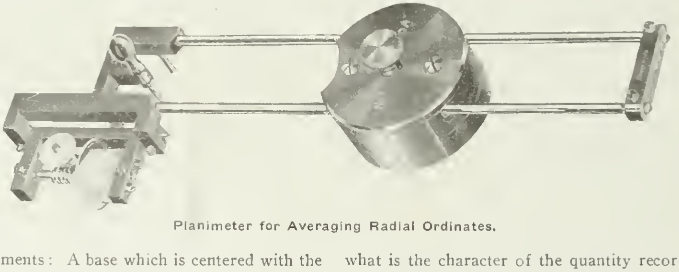
Elektrizitat aus Kehricht. By Etienne de Fodor. Budapest: Julius Benko. 224 pages, 169 illus.

In this work Mr. Etienne de Fodor, general manager of the Budapest General Electric Company, deals in a most interesting way with the subject of refuse destruction as related to central stations. Mr. de Fodor has given this subject much attention for some years, studying nearly all of the most important plants that exist or are under construction. The work contains not only valuable data for the engineer, but also abundant general information for all interested in the subject of refuse destruction. From the many original illustrations contained it is readily apparent that the development of power from refuse destruction is making much progress abroad. The erection of plants was at first principally confined to England, where nearly all of the pioneer work has been done, and where most of the existing plants are located. Germany, however, has of late years taken up the manufacture and erection of such plants. After English concerns had erected plants at Hamburg, Brussels and Zürich, brisk competition from Germans developed, but, owing to improvements in construction, English manufacturers are again in the front and lead as formerly.

The book, which includes numerous illustrations, is divided into twelve chapters treating the following subjects: I. The disposal of refuse. II. Refuse destruction. III. Development in refuse destruction. IV. Refuse-destruction development on the Continent V. Refuse-destruction furnaces as generators of energy. VI. Assorting and refuse-destruction combinations. VII. Further developments in refuse destruction. VIII. The mechanical feeding of refuse furnaces. IX. Steam generation from refuse. X. Utilization of by-products. XI. Refuse transportation to destructor plant. XII. The location of destructor plants

New Apparatus and Appliances

PLANIMETER FOR AVERAGING RADIAL ORDINATES.



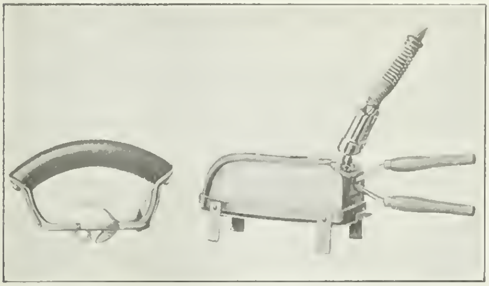
Planimeter for Averaging Radial Ordinates.

The accompanying illustration shows a type of planimeter designed to give the mean value of ordinates in the circular diagram—a feat impossible with the ordinary form of planimeter, which gives the mean square of the ordinates rather than the mean ordinates. The instrument shown embodies the following geometrical elements: A base which is centered with the diagram or chart to be averaged and carrying a pair of parallel guide slots; a pair of rods working in the slots of the base and carrying at their end a frame to which is attached a tracing point and a pivoted carriage for the integrating wheel, and the integrating wheel for measuring the record. The line joining the tracing point with the center of the base determines the radius vector at any one instant. The axis of the integrating wheel is parallel with this line and the record counted on the wheel is proportional to the product of the average radius vector multiplied by the angle through which the radius vector is carried. Hence, by dividing the reading by the angle the mean radius is obtained. The instrument is graduated to give the mean ordinate in linear inches, so that by applying the appropriate scale factor it may be used for all diagrams, no matter what is the character of the quantity recorded. The limits for the movement of the tracing point are from a circle of 1.5 in. in diameter as a minimum to a circle of 10.5 in. in diameter as a maximum. The instrument above described is made by the well-known Swiss firm of Amsler, Laffre & Company, the pioneers in the manufacture of planimeters, and was designed by

Prof. W. F. Durand, Leland Stanford, Jr., University, Palo Alto, Cal.

THE TRAVELER'S ELECTRIC IRON.

Often the traveler has occasion to do light pressing in his or her room. Creases in garments that come from packing must be eliminated, the effects of damp weather must be removed and often dainty linen must be pressed. An electric iron is invaluable for these services, but, for the traveler, an iron should be so designed that it can be packed readily and it must be thoroughly reliable. The iron shown herewith is arranged so that the handle can be removed, and hence a minimum of packing space is necessary. The heating element is inclosed under enormous pressure between the bottom ironing face and a top casting which constitutes a heat reservoir and which is thermally insulated from the sheet-metal cover by an air space. This construction prevents oxidization of the element, hence it will last indefinitely. No breakable material enters into the construction of the iron. Neither porcelain, lava nor molded asbestors, all of which are brittle, is used in this iron or in its plugs. All insulation is of sheet mica and the connecting plug is composed wholly of metal and sheet mica. In the end of the iron there is a hole in which a curling iron can be heated. This iron is made by the Westinghouse Electric & Manufacturing company.



Traveler's Electric Iron with Handle Removed.

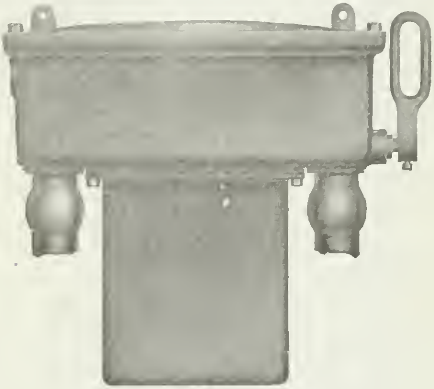
OIL-BREAK SWITCH FOR MANHOLE SERVICE.

It is oftentimes desirable to install an oil-break switch in a manhole or other location where obviously the ordinary type of oil-break switch is not adapted owing to danger of flooding. To meet this end the General Electric Company has developed a water-tight oil-break switch substantial in construction and suited to operation on circuits up to 7500 volts, in which the normal current rating is 200 amp or less.

These switches are made in non-automatic form, single-pole, double-pole and triple-pole, single-throw. The frame cover and oil vessel are of cast iron and all joints are made water-tight by means of gaskets. The frame is provided with a large vent hole to which a pipe may be connected and extended above the water line to prevent undue strain on the gaskets, due to gases generated when the switches are opened under load. The operating handle is outside the frame and can be operated by hand or by a hook. The shaft to which the handle is attached passes through the frame in a water-tight stuffing box. The leads are carried to and from the switch through the bottom of the frame, water-tight bushings being provided for this purpose on the frame.

The double-pole and triple-pole switches are so arranged that each lead may pass through a separate outlet, or one outlet may be used in each end of the frame for double or triple conductor cable.

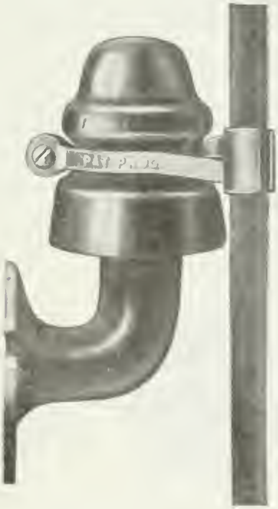
The stationary contacts consist of flared fingers of drop-forged copper supported from the contact blocks of the current-carrying copper studs by heavy flat steel springs. The studs are supported and insulated from the frame by poreclain insulators. The movable contacts are wedge-shaped copper blades actuated by specially treated wooden rods connected to the cross-head, which in turn is operated by the handle and actuating mechanism. The construction of the stationary and movable contacts is such that the arc is ruptured between the flared portion of the stationary and the upper extremity of the movable contacts protecting the actual contact surfaces. This form of construction insures clean contact surfaces, uniform contact under pressure and does not retard the opening of the switch.



Oil-Break Switch for Manhole Service.

CLAMPS FOR VERTICAL WIRES.

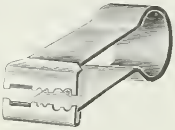
The clamp shown in the accompanying illustration has been developed for tying vertical wires to the ordinary type of line insulator. The arrangement of the device is self-evident from the illustration. The clamp can be put on the insulator and placed around the wire without removing the bolt, so that the minimum of time is consumed in erection. It readily adjusts itself to various sizes of wires and cable up to and including duplex-arc cable 1.25 in. in diameter. This clamping device has been put on the market by Henry J. Blakeslee, 603 South Crouse Avenue, Syracuse, N. Y.



Clamp with Vertical Wire in Place.

WIRE-SKINNING TOOL.

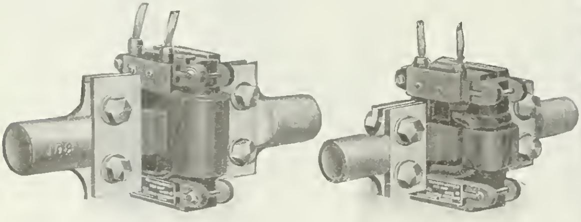
To remove insulation from a wire by the use of a knife is slow and tedious and often endangers the operator or work by the knife's slipping and cutting the hand or nicking the wire so that the latter may break at some important connection. A tool recently marketed by Mathias Klein & Sons, 562 West Van Buren Street, Chicago, is illustrated in the accompanying sketch and consists of a steel-spring handle with specially constructed cutting edges for separating duplex wire, splitting insulation and scraping wire. The largest pair of twin cuts is used for splitting duplex wires. The small teeth at the center of the tool may be used for splitting the insulation on a single wire without damaging the copper within. By means of the parallel scraping jaws the insulation may then be drawn off and the copper scraped clean, ready for soldering. The tool can also be used for stripping the braid insulation from lamp cord with a single pull. For this purpose the small or middle teeth are used without injuring any of the strands of the cord. The tool is made of tempered steel, nickel-plated and is practically indestructible. It measures 3½ in. long x 1½ in. wide, so that it is adapted to be carried in the pocket.


Wire-Skinning Tool.

SERIES INSTRUMENT TRANSFORMERS

As the usefulness of the series transformer is more generally appreciated its application is steadily increasing, especially for service in conjunction with measuring instruments, as it permits a range of measurement that cannot be secured with self-contained instruments. Aside from the flexibility of measurement, the series transformer also secures a factor of insulation impossible with self-contained instruments and this fact alone is of sufficient importance to warrant its more general application.

The requirements of modern metering necessitate the use of series transformers having an accurate ratio of transformation, as otherwise it would be useless to employ a meter having high accuracy and then impair the reading or registration by using a series transformer of such characteristics that it had a poor ratio curve. The type of series transformers illustrated herewith is such that the transformer can be conveniently mounted on the switchboard or other support without entailing expensive busbar construction and the appearance conforms to other high-grade switchboard appliances. The coils closely fit the iron core, which is held in position by locking clamps, thus securing a construction which is permanent. In the larger sizes the busbar itself forms the primary, the secondary winding in all sizes being wound for 5 amp.


Series Instrument Transformers.

Heavy clamping contacts are provided of sufficient area to carry full load continuously without heating and heavy intermittent loads without damage. The 5-amp leads are brought through porcelain bushings. The various elements are arranged so that a permanently high insulation value will be maintained under both normal and abnormal conditions. The electrical design is such that the ratio is said to be very accurate on a wide range, thus insuring correct measurements at both light and heavy loads. These transformers are made by the Sangamo Electric Company, Springfield, Ill.

ARTIFICIAL PRODUCTION OF COMMERCIAL LOAD.

Indicating instruments for use on commercial circuits when new and tested under laboratory conditions often show a high degree of accuracy and yet in actual service become unreliable and quite inaccurate. Therefore, in judging the fitness of such instruments it is necessary to have some means of observing their behavior under actual service conditions.

Load fluctuations produce changes in current, emf and frequency and thus they may introduce serious errors in the indications of the instruments. Fluctuations of the current through an instrument cause corresponding changes in the torque, and unless the movable system is sensitive to quick changes it will be sluggish in following a change in load, and if not well damped it will overswing and oscillate about its true position, thus rendering reading difficult.

In connection with an exhibit of Weston alternating-current switchboard instruments now being held in New York City provision has been made for the artificial reproduction of the severe conditions encountered in commercial service. The exhibit includes a full line of indicating instruments for alternating-current switchboards mounted on instrument panels and connected for operation; the individual parts and movements of all these instruments are displayed in showcases, together with a line of portable alternating-current instruments for testing and field purposes.

The connections of the operating equipment are shown in Fig. 3. The power plant consists of two 120-volt, 0.6-kw Eck motor-generator sets. The motors are provided with two rheostats in each field circuit, one for coarse steps and the other for fine adjustment. By this means the speed can be quickly and nicely adjusted over a range corresponding to an adjustment of frequency from 50 cycles to 70 cycles per second and the fineness of the adjustment permits accurate synchronization of the machines. The emf of the system may be varied from 50 volts to 150 volts by means of rheostats in the field circuits of the generators.

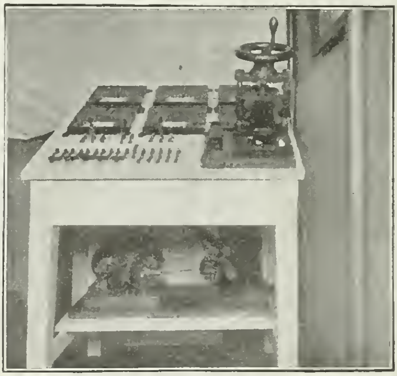


Fig. 1—Bench Board for Control.

The load circuit is made up of a reactor and a group of resistors connected in series. The reactor consists of a coil wound on one leg of an [-shaped core, the bridging leg being mounted on a screw so as to permit adjustment of the air-gap. By means of this adjustment the power-factor may be varied from 0.50 lag to 1.00, where the reactor is short-circuited by a switch. The entire control apparatus, switches, rheostats, etc., are mounted on a benchboard located in front and to one side of the instrument board, as may be seen in the accompanying general view.

Lamp banks were used as resistors because of the small space required in proportion to the power dissipated. Four are connected in multiple, two being joined in series with a home-made flasher, the purpose of which is to cause the load to fluctuate in a non-periodic and irregular fashion. The flasher is operated by an Eck 0.1-hp motor, illustrated in Fig. 5. The flasher consists of a rotating contact cylinder and an oscillating brush. The cylinder is made of wood and is partly enveloped with a triangular sheet of brass connected conductively to the axle, against which bears a spring contact. The brush is fitted with a platinum contact and is mounted on a long arm pivoted near one end and arranged to be swung back and forth over the surface of the cylinder by the combined action of a cam and a spring.

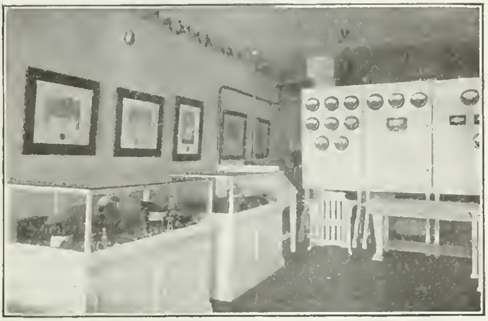


Fig. 2—General View of Exhibit.

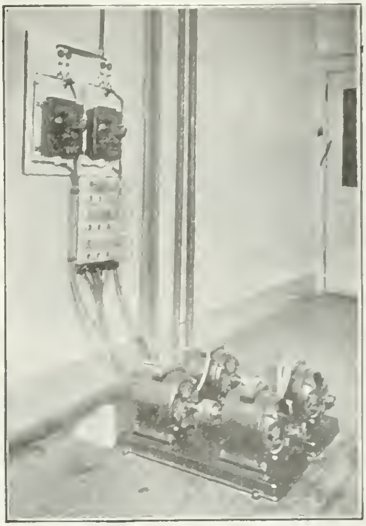


Fig. 5—Power Plant.

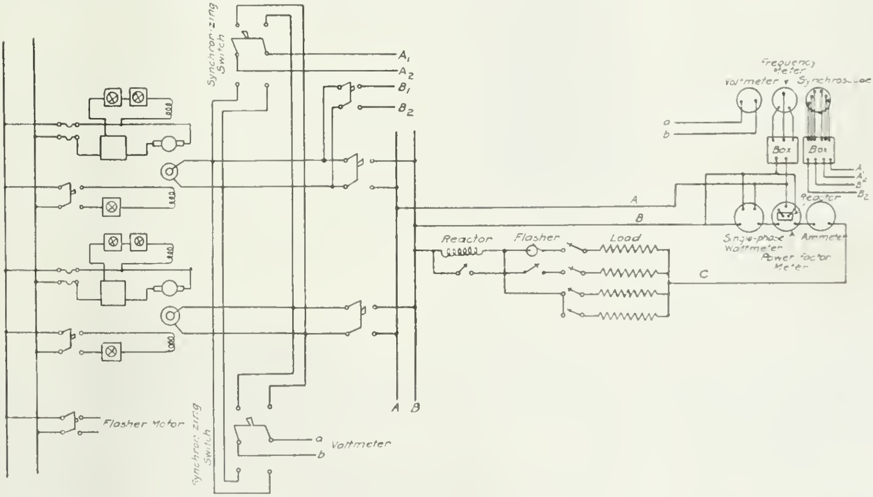


Fig. 3—Diagram Showing Connections of Operating Equipment.

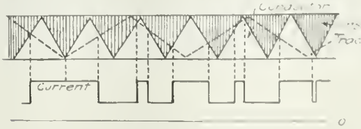


Fig. 4—Load Curve.

The length of time the total load is on the circuit varies continuously and irregularly, due to the combined motion of the cylinder and the brush. Fig. 4 shows the developed path of the brush over the alternate conducting and insulating surfaces of the cylinder; the load curve is constructed from the trace of the brush.

The series coils of the wattmeters and power-factor meters and the ammeter are connected in series with the load reactor and resistors, and the same voltage is impressed across all shunt or potential coils; therefore, the readings of the various instruments should be comparable with each other. For instance, the wattmeter reading should equal the product of the readings of the voltmeter, ammeter and power-factor meter. The synchronizing connections are the same as usual and need no explanation other than that afforded by the wiring diagram, Fig. 3.

DRAWN-WIRE, HIGH-EFFICIENCY LAMP FILAMENTS.

A majority of the incandescent-lamp companies of this country are now using drawn-wire filaments for practically their entire output of high-efficiency lamps, the new construction having been generally adopted for all regular sizes and types, except for the lower wattages in the high voltages (200 volts to 500 volts, 45 watts and 60 watts). That is to say, miniature, train-lighting, low-volt, street-series, compensator and automobile lamps, as well as the regular 100-volt to 125-volt type, may now be obtained with drawn-wire filaments.

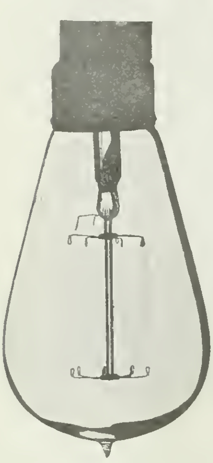


Fig. 1—Tungsten Lamp with Filament Knotted.

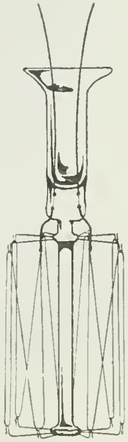


Fig. 2—Mount with Drawn-Wire Filament Before Sealing In.

While the new construction does not give a non-breakable lamp it greatly reduces fragility. Metal-filament lamps should still be handled with care both in shipment and in service, as the filament after burning loses some of its mechanical strength.

While this recent advance in lamp manufacture is an important one, the research laboratories are as busy as ever, and there is good reason to suppose that the drawn-wire lamp is the forerunner of even better lamps in the future, although what the next important development will be, and when it will occur, can only be conjectured. It should be added that the new construction does not involve greater ease in the manufacture of metal-filament lamps, since the process of drawing the densest kind of wire down to almost microscopic dimensions, especially when that wire must pass most exacting tests for quality and uniformity, involves a long, costly series of operations and is beset with many disturbing factors, all of which must be watched with great care.

To the public the new method of lamp construction means that the same general methods of filament mounting that have been found so successful in the tantalum lamp have now been made practical for its more efficient rival, and this has been accomplished without entailing the mediocrity of performance on alternating current which was characteristic of the tantalum filament. To the lamp manufacturers the new development signalizes a triumph of invention and research. The metal, which less than a dozen years ago was known in its pure form only as a dense, infusible black powder, is to-day drawn into wires of half the diameter of a human hair. The manufacturer now has a high-efficiency filament material possessing all the desired flexibility and strength when put into a lamp, although, as above intimated, the completed lamps will not withstand football tactics, as burning tends to make them less rugged.

The accompanying picture shows a freak lamp with a large number of loops and knots in the filament, showing how easily it can be bent before mounting. Like many other inventions, the drawn-wire filament has meant and will mean the abandonment of much costly and highly specialized machinery. More than that, it has meant that employees who had become specially skilled in the performance of operations connected with the manufacture and inspection of pressed filaments must now be trained to do entirely different operations, since their skill in the old kind of work has lost its market value. The scrapping of many tens of thousands of dollars' worth of machinery and materials in this departure is an example of the way in which the modern manufacturer tears down in order to progress.

To the electrical jobbers, dealers and contractors all over the country the new lamp will mean less breakage in shipment and in stock. It will be an easier lamp to sell and it will bring a large amount of electrical construction work in residences and other buildings where its introduction will mean the introduction of electric light itself. More fixtures, more reflectors and more of the hundred and one accessories and current-consuming devices will be used.

From the central-station's standpoint the new lamp is sure to have the effect of increasing the number of high-efficiency lamps on the circuits and thus of increasing the average efficiency of all the lamps in service. Thus it brings the high-efficiency lamp problem once more forcibly before the attention of the central-station manager and shows him the necessity for such a public policy as regards rates, publicity, etc., as will enable the central station to share with the consumer the advantages of the saving made possible by the high-efficiency lamps. It will be an effective instrument in the hands of new-business men. To many central stations it will mean that whereas they have not hitherto found it advisable to carry metal-filament lamps in stock or to supply them to their customers, the policy in this respect will be reversed. Its coming means another reduction in the cost of light, another extension of the field in which high-efficiency incandescents are advantageous.

ELECTRIC FIRELESS COOKER.

In the stove illustrated herewith the well-known principle of the fireless cooker is applied in a highly efficient and effective manner. The heat is applied electrically for such a length of time as is required to produce the proper temperature and then the supply of energy is cut off. The stove is thermally well insulated and hence retains the stored energy for cooking the food. It is not necessary to preheat or partially cook the food before it is placed in the stove, and there are no plates to be taken out and heated artificially. The stove is conveniently arranged, compact and self-contained. However, the electric heater of each stove element can be removed at will for frying, toasting or general use separate from the fireless cooker.

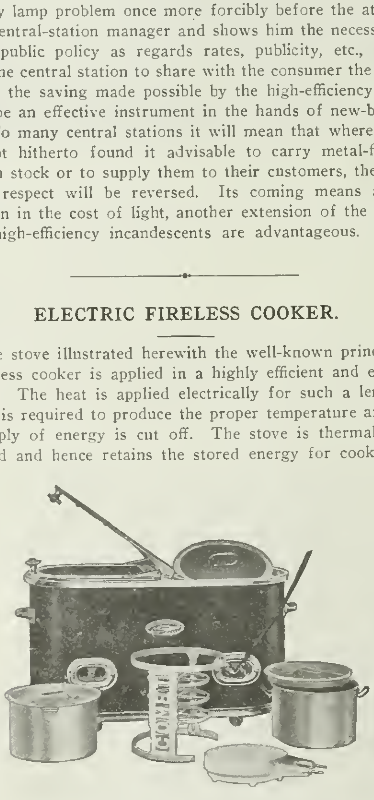


Fig. 1—Outfit for Two-Oven Stove.

The body of the cooker is made of black Russia iron, while the top and bottom trimmings are nickel-plated. The inner lining is of copper. Between the outer wall of the stove and the inner lining is packed the thermal insulating material, which renders it possible to retain the heat for many hours. The stove is made in the one-oven, two-oven and three-oven styles. The assembly parts of the two-oven stove are shown in Fig. 1, while a view of the baking rack in service is given in Fig. 2. These cookers are made by the Comet Electric Stove Company, 280 Eighteenth Street, Detroit, Mich.

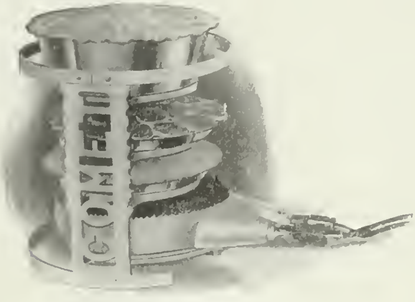


Fig. 2—Baking Rack as It Appears in Use in Oven.

THERMO RAIL-BONDING PROCESS.

The Ohio Brass Company, Mansfield, Ohio, has devised a method by means of which the terminals of rail bonds can be soldered to the rails after being compressed in the ordinary way. The process consists of heating the bond terminal after compression and the adjacent web of the rail practically instantaneously by a chemical reaction. The resultant heat is so concentrated that while the terminal and adjacent web are quickly brought to a soldering temperature, the ball of the rail remains cold. The solder enters under the shoulder of the terminal and unites the entire shoulder to the web of the rail, forming a fillet which seals the joint against the entrance of moisture between the head of the bond and the web of the rail and uniting the compressed portion of the terminal to the annular walls of the hole in the rail. The bonding process is covered by patents and its use is strictly limited by the company to the application of rail bonds furnished by it. The illustrations show the application of the bonding process. A clamp spans the rail and holds the thermo cup in position against the head of the bond. In the cup is placed the necessary amount of compound, on top of which is placed the ignition powder. The resultant chemical reaction of the firing of the charge is accompanied by great heat, enabling the solder to be applied from a spool in the usual manner after the application of a suitable flux.

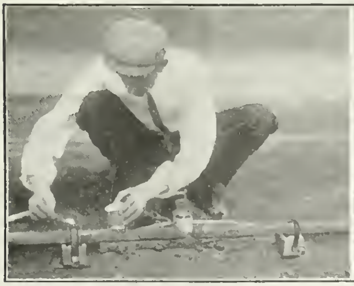


Fig. 1—Ready for Ignition.

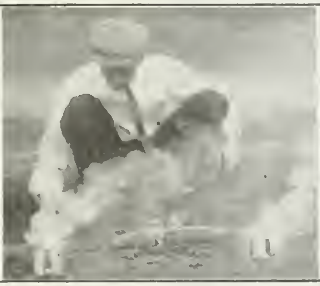


Fig. 2—During Reaction.

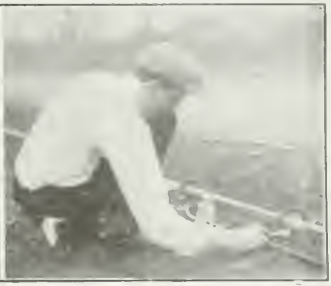


Fig. 3—Applying the Solder.

END-BELLS FOR ALTERNATING-CURRENT GENERATORS.

The sheet-steel end-bell of the Westinghouse alternating-current generator has met with much appreciation for several reasons. Its neat and uniform construction gives a generously rounded, complete and distinctive appearance to a machine not so well accomplished by the more clumsy and heavy castings. Castings, moreover, are liable to be more or less warped and difficult, if not impossible, to fit nicely with a reasonable amount of work. More important than this reason for changing from cast to sheet material was the constant breakage of the castings in shipment and erection. The necessary number of different designs made it costly to carry large numbers of cast end-bells in stock to avoid delay in manufacture.

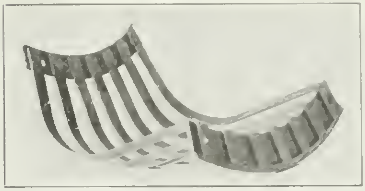


Fig. 1—Detail of End-Bell.

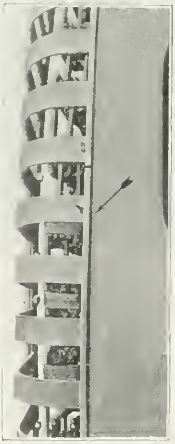


Fig. 2—Application of End-Bell.

Cast end-bells, in order to present a pleasing appearance and avoid interference with development, have to be made in shapes rather delicate for the rough handling they receive. The sheet-steel end-bell, with its ability to withstand mechanical injury, provides an admirable solution of the breakage difficulty It is securely bolted to the frame at one end and bound together in a continuous circle on the other end. Sheet-steel bells greatly improve the appearance of a machine because the bells are just alike and the material is smooth and uniform, indicating successful design for a specific purpose. The bending strap is of angle iron with one very short flange, just long enough to cover the ends of the ribs. This Westinghouse end-bell is undoubtedly very practical, and it will be found by those using it to be a well-designed device for its purpose in connection with alternating-current generators

HANDLING COAL IN A MODERN BOILER-ROOM.

An ideal system for handling coal in feeding boilers would enable the coal to be dropped into the bunkers direct from the car or lighter and fed to the grates without rehandling. This is impossible in any modern city building, or, indeed, in any but a few boiler-rooms enjoying an exceptionally favorable situation. Although boiler-room excavations are carried to greater and greater depth in our cities, there are but few instances in which the coal can be fed to the boiler-room or into the automatic stokers by gravity.

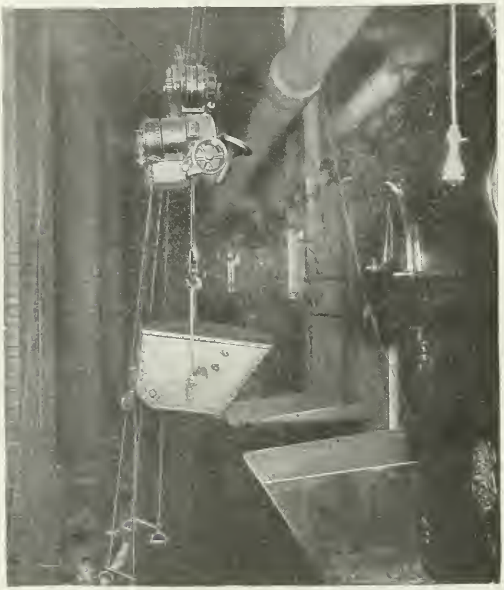


Fig. 1—Coal-Bucket, Hoist and Carriage.

An interesting solution of the coal-handling problems is found in the new Fifth Avenue Building, at the corner of Twenty-third Street and Broadway, in New York City. The boiler-room is located three stories below the street level and the coal supply is carried in bunkers, which are as favorably located in relation to the boiler-room as the general conditions will permit. There are 21,000 hp of boilers equipped with automatic stokers, and the coal-handling problem is, therefore, reduced to the simplest basis. Yet the transfer of the coal from the bunkers to the hoppers of the stokers presents some problems of interest to every engineer. The coal is handled in iron buckets holding about 600 lb. These buckets are attached to and hung on the hook of a Yale & Towne electric hoist, which in its turn is built into a trolley running on an overhead track leading from the bunkers to the hoppers of the various stokers. In operation the buckets are lowered to a point opposite the mouth of the bunker chute to permit the coal to flow into them by gravity from the bunkers. A pull on the switch then starts the electric hoists and the bucket is soon lifted high enough to enable it to start on its journey to the hoppers of the stokers.

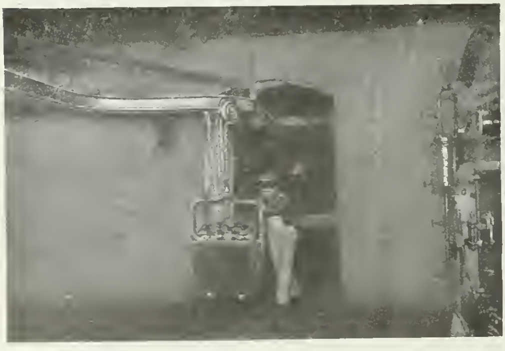


Fig. 2—Bucket Suspended from Carriage on Overhead Track.

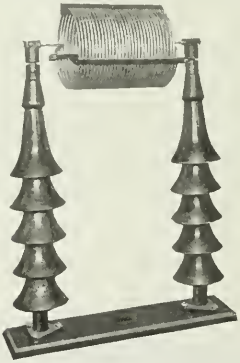
This journey, accomplished by means of a smaller motor which is geared to and drives the trolley wheels, is made in a few seconds, and the coal is then discharged by dumping into the hoppers of the stokers. A simple switch in the overhead track enables the hoist to be run to a point where it can pick up the ash cans, and these are all handled as swiftly and cheaply as is the coal.

The installation at the Fifth Avenue Building and a number of others of the same character are made by the Yale & Towne Manufacturing Company, New York, N. Y.

AIR-COOLED CHOKE COILS.

It is sometimes convenient to mount choke coils on ceilings so that the insulating-coil supports hang pendent, and at other times it is preferable to arrange them so that the coil rests on the supports. This shows a new Westinghouse coil that can be mounted either way, because the insulating columns can be removed and inverted by taking out four bolts.

An aluminum rod, bent into a helix of about 15-in. diameter and containing about thirty turns, forms the coil proper. Bracing clamps are provided to give mechanical strength to the helix. The aluminum rod used is of sufficient diameter safely to carry 200 amp. Each coil is supported on two insulating columns made up of porcelain insulators, which, except for the end pieces, are interchangeable.



Choke Coil Mounted on Supports.

This type of coil can be mounted in any position convenient for the wiring, on the floor, wall or ceiling. For floor mounting the parts are arranged as shown in Fig. 1 and for inverted mounting the insulator columns are inverted and the base attached to the ceiling. The insulating columns are supported on substantial cast-iron blocks fixed on wooden bases. These choke coils are intended principally for the protection of transformers and should not be used for generators. Where greater reactance than is afforded by a single coil is desired for the higher voltage circuits two or more coils may be connected in series.

WIRE GRIP WITH LOCKING FEATURE.

The Western Electric Company has recently placed on the market a "Buffalo grip" with a special locking feature. In Fig. 1 the grip is shown with the jaw held open by the locking device. A turn of the handle locks the jaw in any position and enables the lineman to insert the wire in the grip easily and quickly. When the handle is pushed down, as shown in Fig. 2, the wire is held in a tight grip. The grip is made in various sizes for both bare and insulated wire, and can be supplied both with and without pulleys.

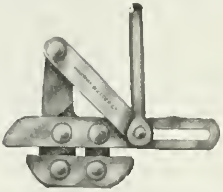


Fig. 1—Grip with Jaw Held Open.

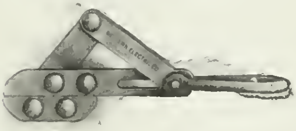


Fig. 2—Grip Closed.

Convention Echoes

As is well known, there were no official exhibits connected with the convention just closed, Class D associate members having voted to forego the usual collective display this year. Several manufacturing companies, however, rented quarters in the immediate vicinity of the Engineering Societies Building where exhibitions of their wares were made during the week. Among these were the General Electric Company, the Weston Electrical Instrument Company, the Holophane Company and Gudeman & Company. Other companies, such as the Westinghouse Electric & Manufacturing Company, the Wagner Electric Manufacturing Company, etc., maintained headquarters in many of the hotels near by. There was, however, a host of other manufacturers or their agents in evidence during the week, the following brief references by no means covering the whole or giving any indication of their number.

H. H. Cudmore was ably assisted by W. C. Wing in keeping Brilliant lamps well to the front.

The Pittsburgh Transformer Company was represented by Mr. R. V. Bingay and Mr. H. G. Steel.

Mr. A. S. King, New York representative of the Sterling Varnish Company, represented that company.

George Hearn, of the Ricker Manufacturing Company, Rochester, was on hand as usual and followed the various sessions closely.

The Speer Carbon Company, of St. Marys, Pa., was represented as usual by Mr. John S. Speer, who was accompanied by Mrs. Speer and the two little Speers.

W. K. Archbold, of the Archbold-Brady Company, Syracuse, was very much in evidence among the manufacturers and engineers who attended the convention.

Mr. L. P. Sawyer, of the Buckeye Electric Company, Cleveland, was accompanied by Mrs. Sawyer, and as usual was the genial host at a number of pleasant little informal gatherings.

N. L. Norris and "Banner Betterness" are synonymous. It is hardly necessary to record the fact that their home is in Youngstown, Ohio, and that both have been in New York this week.

The Electric Storage Battery Company, of Philadelphia, was represented by Mr. Herbert Lloyd, president, and Mr. Charles Blizard, vice-president and general sales manager. Mr. Blizard was accompanied by Mrs. Blizard.

The Tungstolier Company.—No convention is complete without Mr. E. J. Kulas, of the Tungstolier Company. Mr. Kulas still hails from Cleveland, though his general offices have been moved to the plant at Conneaut, Ohio.

Wm. Coale, of the Sterling Electrical Manufacturing Company, has been willing to tell you at any time all about the complete Mazda unit street-lighting system which Warren, Ohio, is going to turn on for the first time next week.

Mr. C. L. Bundy, of the Philadelphia Electrical Manufacturing Company, represented his line at the convention. Mr. Bundy has been quite sick for some time past. His many friends are glad to see him looking so well and quite like himself again.

Triumph Electric Company.—One of the well-known visitors at convention headquarters was Mr. W. H. Jacob, the genial representative of the Triumph Electric Company, Cincinnati, who was warmly greeted by his many friends in the electrical fraternity.

The National Carbon Company, Cleveland, was ably represented by Mr. J. F. Kerlin and Mr. C. W. Wilkins. In addition to its personal representatives catalogs and literature describing the various products of the company were on file in the catalog exhibit.

Mr. Harry Curtis Rice, of the General Incandescent Lamp Company, Cleveland, was present and everybody is glad that he brought Mrs. Rice to the convention. This is the first opportunity which many have had to offer personal congratulations on their wedding, which occurred in February.

Mr. C. L. Eshleman, sales manager of the Adams-Bagnall Electric Company, Cleveland, was in attendance all the week and was particularly enthusiastic about "Abolites," which are the most recent addition to the A-B line and are being put onto the market in both commercial and industrial types.

H. W. Johns-Manville Company, New York, was represented by the following staff: Messrs. J. W. Perry, New York; G. A. Saylor, Milwaukee; H. M. Frantz, Chicago; W. E. Rapp, St. Louis; Daniel Fitts, Boston; E. C. Cameron, Boston; S. G. Meek, New York; J. R. McLain, New York; H. M. Slauson, New York; A. D. Miles, New York; E. B. Hatch, president Johns-Pratt Company; R. C. Cole, the Johns-Pratt Company.

Live Lamp Delegation.—Strongly in evidence among the wearers of the dark-brown badges were the delegates from the National Electric Lamp Association, and from its member companies in various cities. The following gentlemen were from the association's headquarters and engineering department in Cleveland, Ohio: Mr. F. S. Terry, Mr. B. G. Tremaine, Mr. H. A. Tremaine, Mr. J. Robert Crouse, Mr. H. M. Vanswoll, Mr. E. S. Doane, Mr. Philip S. Dodd, Dr. Edward P. Hyde, Mr. Glenn G. Webster, Mr. W. M. Skiff, Mr. G. S. Merrill, Mr. Paul F. Bauder, Mr. N. H. Boynton, Mr. Roscoe Scott, Mr. Ralph Beman, Mr. R. E. Campbell, Mr. M. D. Cooper, Mr. Hugo E. Eisenmenger, Mr. Ward Harrison and Mr. J. G. Henninger. Among the officials and representatives of individual member companies of the National Electric Lamp Association who registered at the convention were the following: Mr. M. L. Norris, the Banner Electric Company; Messrs. E. H. Haughton and G. G. Lockwood, the Bryan-Marsh Company; Messrs. H. H. Cudmore and W. C. Wing, the Brilliant Electric Company; Mr. L. P. Sawyer, the Buckeye Electric Company; Messrs. C. Leonard and J. S. Lehman, the Columbia Incandescent Lamp Company; Mr. L. Lobenthal, the Economical Electric Lamp Company; Mr. H. C. Rice, the General Incandescent Lamp Company; Mr. C. R. Tuck, the Munder Electric Company; Mr. William Coate, the Sterling Electrical Manufacturing Company, and Mr. C. O. Brandel, the Warren Electric & Specialty Company.

Industrial and Commercial News

The Week in Trade.

OPTIMISM for the future is evidenced in many sections of the country, and while the increase in new business each week is small, with the totals well under those for this period in recent years, a gradual improvement is being made in general business in volume as well as in tone. There is not, on the other hand, the marked increase which many hoped would follow the Standard Oil decision. The Supreme Court handed down its decision on Monday in the case of the American Tobacco Company, holding that the corporation is a combination in restraint of trade in violation of the Sherman antitrust law, and ordering the dissolution of the combine. In spite of announcement of both of these rulings, there naturally remains some hesitancy to become involved to a serious extent before prices become more settled, both as to levels and time, for with the present tendency to shade, as shown during the week, when the Republic Iron & Steel Company, in accordance with a more aggressive sales policy, lowered its price on bars, followed by similar action by other steel companies, there arises a doubt as to the wisdom of commitment at such a time. Increase in business for the week has been most marked in retail trade, as was natural with the continuation of warm weather. This, to some extent, has benefited jobbing and wholesale lines, but buying remains on a narrow scale, and apparently for current uses. Demand for cotton goods has increased and a fair business has been done in dry goods. The reduction in steel prices is one of the most important features of the week, and the results in the iron and steel trades will be reflected to a considerable extent upon trade as a whole. Collections continue to be reported slow to fair. Business failures for the week ended May 25, as reported by *Bradstreet's*, were 236, as compared with 235 for last week, 200 for the same week in 1910, 205 in 1909, 263 in 1908 and 142 in 1907.

The Copper Market.

SALES to domestic interests have been in the small volume of those of the previous week, but export business is reported slightly improved. The tone of the market throughout the week has been rather firm and prices in this country are practically unchanged. In London slight gains were registered. Rumors of the likelihood of a consolidation between the large producing interests continue in abundance, but none is well sustained and nothing definite is offered at this time. Greater stability as regards prices would tend to encourage sales, inasmuch as buyers at present show no desire to commit themselves to a large extent, having no certainty that prices are well settled or have reached the bottom. There is every reason to believe that merging of the great producing interests will be effected ultimately, but the present situation is not benefited by this probability and will undoubtedly be little bettered until drastic changes are made in the present system of operation as regards output. Each week shows the existence of hand-to-mouth proceedings in the copper trade, and the sooner curtailment is made in output in keeping with the demand the sooner improvement may be expected. The widespread rumors of merging were, to some extent, at the bottom of the foreign purchases, and contracts placed for electrolytic were made at advanced prices. This movement was reflected in the domestic market in higher prices asked by producers of electrolytic. There was little response from domestic consumers and sales continued in small volume throughout the week. Exports for the month, including May 29, were 23,926 tons. The daily call on the Metal Exchange May 29 quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.70	12.00	.....
May	11.70	12.00	11.85
June	11.70	12.00	11.85
July	11.70	12.00	11.85
August	11.70	12.00	11.85

The London market, May 29, was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	55	0	0	55	0	0
Standard copper, futures	55	11	3	55	12	6

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.30c	11.57½c
London, spot	£56 15 0	£53 7 6
London, futures	57 12 6	54 0 0
Best selected	60 5 0	57 5 0

Industrial and Commercial Notes.

Westinghouse Railway Orders.—The Westinghouse Electric & Manufacturing Company has received orders from the Philadelphia & Easton Electric Railway Company, of Doylestown, Pa., for two quadruple equipments of No. 101 B2 motors, with type K 28 control; from the Asheville & East Tennessee Railway Company, Asheville, N. C., for a quadruple equipment of No. 307 motors, with type K 35-G control, and from the Wausau Street Railroad Company, of Wausau, Wis., for a quadruple equipment of No. 307 motors, with type K 35 control. The Toledo Railway & Light Company has ordered 100 box-frame, interpole street-railway motors; New York, New Haven & Hartford Railroad, four quadruple equipments of alternating-current railway motors with unit-switch control; Guelph Radial Railway Company, of Ontario, one 27-ton locomotive, having four railway motors, with control. Recent street-railway motor business includes orders from the Hummelstown & Campbellstown Street Railway, Hershey, Pa.; Nashville Railway & Light Company, of Nashville, Tenn.; Cumberland Electric Railway Company, Cumberland, Md.; Frederick Railway Company, Frederick, Md., and Connecticut Company, of New Haven, Conn. Among foreign business lately secured was an order from the Takasaki Water Power Electric Company, of Japan, for two double equipments of street-railway motors with controllers. The order was placed through Takata & Company, the Westinghouse Company's representatives in Japan.

Sprague Electric Company Becomes Sprague Electric Works.—On June 1, 1911, the Sprague Electric Company will be merged with the General Electric Company, of Schenectady, N. Y. Its business will be conducted under the name Sprague Electric Works of General Electric Company. The manufacture and sale of the lines of apparatus and supplies heretofore exploited by the Sprague Electric Company will be continued by the Sprague Electric Works of General Electric Company under the same organization, with D. C. Durland in responsible charge as general manager. All correspondence will be with the Sprague Electric Works at the same address as in the past. Bills and statements will be rendered from, and remittances made to, the Sprague Electric Works, 527 West Thirty-fourth Street, New York, N. Y. The offices of the Sprague Electric Works will be continued as heretofore, with main offices at 527-531 West Thirty-fourth Street, New York, N. Y., and branch offices in principal cities.

H. M. Byllesby in New Company.—The Appalachian Power Company, of Richmond, with an authorized capital of $25,000,000, has been chartered. The new company is promoted by New York and Chicago interests and will operate in southwestern Virginia, with rights to enter any city. This will touch the Pocahontas coal fields and include the towns of Bramwell, Graham, Bluefield, Pocahontas and Princeton. The officers of the company are: H. M. Byllesby, president; C. M. Wells, New York, vice-president; Elmer Dover, Chicago, secretary, and R. J. Graff, Chicago, treasurer. Messrs. Viele, Blackwell and Buck, of New York, who are back of the New River developments, are interested in the proposition.

Cutler-Hammer Company.—Announcement is made by the Cutler-Hammer Company of the establishment of a new department to be devoted exclusively to the design and manufacture of electrical appliances for industrial heating. The thoroughly equipped New York factory of the company, 144th Street and Southern Boulevard, will be devoted principally to the manufacture of this class of apparatus, under the direction and supervision of W. S. Hadaway, Jr., the well-known electric-heating engineer.

General Electric Sales.—An order from the Pacific Electric Railway Company, of Los Angeles, includes the following equipment: Four motor-generator sets, each consisting of an 1120-kw, 2200-volt, three-phase synchronous motor directly connected to a 100-kw, 600-volt direct-current generator, for operation at 500 r.p.m.; three motor-generator sets, each consisting of one 900-hp, 2200-volt, three-phase induction motor directly connected to a 600-kw, 600-volt direct-current generator for operation at 750 r.p.m.; fifty quadruple, 500-volt railway equipments and controllers; nine 450 transformers and nine 300-kw transformers, all of which are designed for 15,000 volts primary and 2250 volts secondary. The Omaha & Council Bluffs Street Railway Company, Omaha, Neb., has ordered the following apparatus from the General Electric Company: Three 1000-kw, 600-volt rotary converters; two 1050-kw, three-phase transformers; three 350-kw, single-phase transformers; one 75-kw turbo-driven exciter; one blower set, one air compressor, one switchboard, twenty double-motor GE-80 car equipments, five double-motor GE-20 one-car equipments, five straight air-brake equipments with CP-27 compressors. Two of the 1000 kw rotary-converter equipments will be installed in the new South Omaha substation, while the third is for installation in the power station. The car equipments are for new cars, which will be supplied by the American Car Company. The Wilmington & Philadelphia Traction Company has purchased from the General Electric Company a 4000-kw turbo-generator, a 100-kw turbo-exciter and two 1000-kw, 250-volt motor-generator sets, which will be used on the three-wire lighting system. The General Electric Company has also sold one 300-kw, 2300-600-volt rotary converter to the Tri-State Electric Railway Company, at Wellsburg, W. Va. This and the foregoing apparatus were sold through J. G. White & Company. The Mercer County Traction Company, of Trenton, N. J., has purchased ten double railway equipments from the General Electric Company.

Important Movement to Forward American Export Trade.—Through the co-operation of a number of large manufacturers and with the support of one of the largest financial institutions in the country, the Allied Machinery Company of America has been organized for the purpose of systematically forwarding American export trade. To this end there will be established in each foreign country where there is a prospect of increasing the demand for American manufactures a bureau in charge of a specialist in the line of promotion work to be carried on. An important feature of the plan is to provide for extending to purchasers time credits such as they are accustomed to receive in their own country, or from other than American exporters. One of the greatest handicaps to American export trade has been the refusal or inability of our manufacturers to extend the credits customary in foreign countries. Captain Godfrey L. Carden, who is well known in manufacturing circles in this country and abroad for his investigations as agent of the Bureau of Commerce of export conditions in Europe, is one of the vice-presidents of the organization, and sailed this week for Europe to commence the establishment there of bureaus in the several important countries.

Electric Storage Battery Company.—A contract for the battery equipment of the thirty-five new storage-battery cars for the Dry Dock, East Broadway & Battery Railroad Company, of New York City, which are to be placed in service on its lines during the early summer, has been awarded to the Electric Storage Battery Company, of Philadelphia. These new cars have been specially designed by the Third Avenue Railroad Company to give the necessary strength with minimum weight. Each car is equipped with two motors and the batteries are installed under the longitudinal seats. The cars will give a maximum speed of 15 miles per hour on level track with a scheduled speed of 7 to 8 miles an hour including stops. They are of the open-platform single-truck type, with 18-ft. car bodies. The battery equipment of each car consists of fifty-eight oxide cells. Cells of this type have been operated in street-car service in New York for about a year with marked success.

Copper Wire for Boise Project.—At 2 p. m. May 17 bids were opened at the Department of the Interior, United States Reclamation Service, Los Angeles, Cal., on the following lines for the Boise Project, Idaho: (1) 43,000 lb. No. 3 B. & S. 7-wire, hard-drawn copper strand; (2) 500 lb. No. 6 B. & S. soft copper wire; (3) 38,000 lb. No. 3 B. & S. 7-wire, hard-drawn copper strand; (4) 350 lb. No. 6 B. & S. soft copper wire. Three bids were received as follows: Standard Underground Cable Company, San Francisco, Cal.—(1) 0.1425 cent per pound; (2) 0.14 cent per pound. American Steel & Wire Company, Los Angeles, Cal.—(1) 0.1475 cent per pound; (2) 0.1425 cent per pound. John A. Roebling's Sons Company, Trenton, N. J.—(1) 0.1475 cent per pound; (2) 0.1425 cent per pound; (3) 0.1475 cent per pound; (4) 0.1425 cent per pound.

Appeal Granted in Telephone Suit.—Judge Colt, of the United States Circuit Court, has allowed an appeal to the United States Circuit Court of Appeals in the suit of the Western Union Telegraph Company against the American Bell Telephone Company. The Circuit Court last April, after ten years of litigation based on patent rights, awarded $3,141,529 to the Western Union Telegraph Company. Certain shares of stock in subsidiary companies of the American Bell Telephone Company were also awarded to the Western Union Company, based upon agreement between the parties. The American Bell Telephone Company has filed a bond of $7,500,000 with the court to secure the appeal. The American Telephone & Telegraph Company is given as security.

Large Canadian Developments.—It is reported that the Diamond Mills Company and the Dominion Securities Company have purchased a large tract near Revelstoke, B. C., on which they plan the construction of a large water-power and paper pulp plant. The total first cost is estimated as close to $20,000,000. Work is to be pushed, with a view of completing the water-power plant by next year, and the total construction within three years. Plans include the building of a trolley line and 50 miles of railroad for connecting the mills with the town. Charles A. Barnum, of Chicago; F. C. Adams, of Duluth, and Charles E. Stone, of St. Paul, are mentioned as being interested in the project.

Porcelain Companies Merged.—The General Porcelain Company, which was recently incorporated in New Jersey, has taken over the Ohio Porcelain Company, the George F. Brunt Porcelain Company, the Anderson Porcelain Company and the Electric Company, all of East Liverpool, Ohio. It is considered likely that the United States Porcelain Company, of New Cumberland, W. Va., and Findlay, Ohio, and three pottery concerns in New Jersey will enter into the combination. J. N. Parker, of Boston, one of the largest dealers in porcelain for electrical uses, is mentioned as the probable president of the new combination.

Canadian Power Company Enlarges.—Report of the purchase of the Central Heat, Light & Power Company, of Montreal, by the Canadian Light & Power Company is confirmed by E. A. Roberts, vice-president of the latter company. This acquisition will afford a means for the Canadian Light & Power Company to distribute energy in the central section of Montreal. The price paid for the Central company is said to be in the neighborhood of $500,000.

Ends Investigation of New York Commission.—John N. Carlisle, who was appointed by Governor Dix to look into the affairs of the Public Service Commission for the First District of New York, has presented his report to the Governor. Mr. Carlisle states, in part, that any change at this time in the personnel of the commission would mean further delay in settling the subway question, and is considered unwise for this reason.

Street Lighting in Winnipeg.—The city of Winnipeg, Manitoba, proposes that its two main streets, which are 132 feet wide and 96 feet from curb to curb, shall be the most effectively and efficiently lighted thoroughfares in the world. A study is now being made of street-lighting systems prior to deciding on details. Mr. J. G. Rossman, manager of the Hydroelectric Power Department of the city, has charge of the matter.

Soreng & Beedle.—The firm of Soreng & Beedle, recently organized in Danville, Ky., for carrying on a general consulting engineering business, will specialize in the promotion and construction of small and medium sized electric-lighting plants for rural communities. They desire to receive catalogs and price and discount lists from manufacturers and jobbers.

General Vehicle Company Buys Land.—Fifty lots near Long Island City have been purchased by the General Vehicle Company, the price being in the neighborhood of $100,000. It is believed that the site will be used for the erection of a branch plant.

Prize for Safety Lamp.—A report from London states that a coal-mine owner has offered, through Winston Churchill, the Home Secretary, a prize of $5,000 for an efficient electric safety lamp

Financial.

The Week in Wall Street.

At the close of the week few signs remained of the boom which revived the Stock Exchange immediately after the Standard Oil decision. The volume of transactions has steadily decreased, and totals for the week reach only 2,530,758, as compared with 3,653,630 for the week preceding. Prices have not suffered materially, despite the irregularity of the week, and the majority of advances reached in the recent flurry are maintained. The bond market has been active since last report, and total sales of some $140,000,000 of securities are registered by local financial interests. This is regarded as an outcome of the decision and held to be part of the funds reported some time ago as being reserved for conservative investment pending the results of the Standard Oil case. Among the larger transactions of interest during the week were the financing of the Chicago elevated merger and the taking of several of the long-term issues of several of the railroads. The price cutting in the steel trade was followed by slight reaction in the stock market, and the dullness continued throughout the rest of the week and through Monday, pending the American Tobacco decision. Naturally, less interest was shown early in the week in the possibility of receiving the American Tobacco decision than in the case of the first ruling, and the transactions of the market were not greatly influenced by the prospect of its anouncement before the recess. The stock market will respond more readily than will general trade to slight improvements throughout the country, and although the volume of business registered for the year is small as yet, and the summer season is not likely, at best, to encourage briskness, it is felt that the end of the year will see much better results than have been made to date. The crops are still to be heard from, and with the satisfactory yield now predicted and further readjustment possible now that the decisions are known, confidence should be restored and rapid progress made. Money markets are still on an easy basis. Rates May 29 were: Call, 2@2¼ per cent; ninety days, 2½@3 per cent. The quotations in the tables are those of the close of May 29.

NEW YORK.

	May 22.	May 29.	Shares Sold.		May 22.	May 29.	Shares Sold.
All. Ch.	8¼	9¼	500	Int. Met, pf.	53	52⅛	5,100
All. Ch., pf.	31	33	1,400	Mackay Cos.	92¾*	90*	700
Amal. Cop.	67⅛	67¾	72,420	Mackay C., pf.	76½	76¼*	200
Am. D. T.	20½*	20½*	———	Man. Elev.	137¾	136⅝	100
Am. Loco.	43	41¼*	3,600	Met. St. Ry.	15*	15*	...
Am. Loco., pf.	108	108¼*	700	N.Y.&N.J.Tel.	139½*	139½*	...
Am. Tel. & C.	82½*	82*	67	Steel, com.	80⅝	78⅜	672,244
Am. T. & T.	148⅞	148¾	9,000	Steel, pfd.	120¼	118⅝	5,220
B. R. T.	80⅝	80	18,735	W. U. T.	79¼	82⅛	81,648
Gen. Elec.	160½	167½	16,000	West'h, com.	74	78½	29,600
Int. Met.	18¾	18⅞*	5,300	West'h, pfd.	117	118	300

PHILADELPHIA.

	May 22.	May 29.		May 22.	May 29.
Am. Rys.	44	44½	Phila. Elec.	16⅞	16⅜
El. Co. of A.	12*	12*	Phila. R. T.	18⅛	17¾
Elec. St. B'ty.	54	54	Phila. Trac.	83½*	82½*
Elec. St. B'ty., pfd.	30*	30*	Union Trac.	46½	46¼

CHICAGO.

	May 22.	May 29.		May 22.	May 29.
Chi. City Ry.	186*	186*	Chi. Tel Co.	123	123
Chi. Rs., Ser. 1.	80*	80*	Met. El. Co.	24¾	26*
Chi. Rs., Ser. 2.	21*	22½*	Met. El., pfd.	71	72¾*
Com. Edison	128½	129⅛	Nat'l Car	120*	120*
Chi. Subways	4¾*	4⅛*	Nat'l Car, pfd.	120*	120*

BOSTON.

	May 22.	May 29.		May 22.	May 29.
Am. T. & T.	149	148⅞	Mex. Tel.	4*	4*
Cum. Tel.	153¼*	157½	Mex. Tel., pfd.	6½	6½*
Edison E., Ill.	287	286¾	N. E. Tel.	146	146*
Gen. Elec.	161¼	167¾	W. T. & T.	19	19⅝
Mass. E. Ry.	20	21¼	W. T. & T., pfd.	96	96
Mass. E. Ry., pf.	89½	89½			

*Last price quoted.
Shares sold for week May 22 to May 29.

Financial Notes.

Montreal Light, Heat & Power Company.—The report of the Montreal Light, Heat & Power Company for the year ended April 30, 1911, compares favorably with that for the year preceding. Gross earnings increased $163,180, amounting to $4,404,126, and operating expenses and maintenance decreased $21,092, amounting to $1,827,786, leaving net earnings of $2,576,340, which represents an increase for the year of $184,272. Deducting fixed charges of $472,051, which were $8,816 under last year's figures, left a balance of $2,104,289 available for dividends, this being $193,088 in excess of the balance of the previous year. Dividends amounted to $1,275,000, and, after $476,011 was deducted for depreciation, renewals, etc., from the $829,289 remaining, there was left a surplus for the year of $353,278. This was $32,077 more than the previous surplus and made a total profit and loss surplus of $2,395,839. In addition to the allowance for depreciation and renewals included above, $373,528 was also charged to the same item. H. S. Holt, president of the company, states that the policy of the company is to provide against all possible contingencies and that the depreciation item, in accordance with this, is naturally large in keeping with the rapid growth of the company's business. The report states that during the year there were redeemed for cancellation, in accordance with the mortgages securing the respective issues, $70,000 of the mortgage debt of the company; that various additions at the gas and hydraulic plant of the company at Lachine Rapids have been completed and are in operation; that extensions to the underground conduit system are being considered, together with appropriations for extending both gas and electric distributing systems to meet the rapid growth of business. As a result of the reduction in gas and electric rates, May 1, 1910, customers' discounts during the year amounted to $559,944, against $332,598 for the previous year.

Chicago Telephone to Issue More Bonds.—About $5,000,000 additional first mortgage 5 per cent bonds will be issued next fall by the Chicago Telephone Company. This will be the first financing by the company since the marketing of the present outstanding $5,000,000 bonds, in 1909. The mortgage permits the issuing of $50,000,000 at a rate not exceeding $5,000,000 annually, and not exceeding 50 per cent of the total assets. In connection with the financing, President Sunny is quoted as follows: "Chicago Telephone bonds to be issued are for new construction in Chicago and the ten counties covered by our operations. The extension is not extraordinary, but in line with our regular growth of 38,000 telephones, which will equal this year's record. Gross revenues show steady growth, but larger payrolls and other operating expenses absorb full proportion, leaving the net about the same as last year." Work is to be started immediately on the new sixteen-story building for the Chicago Telephone Company, which is to cost about $1,500,000.

Columbus Railway Company Stock.—A special meeting of the stockholders of the Columbus Railway Company will be held June 26 to authorize a $3,000,000 increase in capital. This is to be issued to reimburse the Columbus Railway & Light Company for financing improvements upon the system of the Columbus Railway Company. The additional capital will be divided equally into preferred and common stock, which will make the total authorized common stock amount to $5,000,000 and the preferred to $4,500,000. The terms of the lease to the Columbus Railway & Light Company provide that the latter shall be reimbursed for permanent betterments or equipment either in cash or in securities of the Columbus Railway Company at par. There is a balance of some $113,000 now due the leasing company, the Columbus Railway & Light Company having received about $1,483,000 to date in cash and stock, in accordance with the agreement.

Niagara Falls Power Company.—The combined statement of the Niagara Falls Power Company and the Canadian Niagara Power Company for the quarter ended March 31, 1911, gives a total operating revenue of $544,171; expenses and taxes, $158,023; net operating revenue, $386,149, to which is added other income of $16,891, making a total income of $403,040. Charges are given as $272,057, leaving a surplus of $130,982. The additional capital stock of the Niagara Falls Power Company, recently listed on the New York Stock Exchange, amounting to $1,560,200, will be used to retire at par all of the Canadian collateral debentures of the company, now outstanding, and to acquire, share for share, 491 shares of the Tonawanda Power Company, not yet held by the Niagara Falls Company, as outlined in the *Electrical World,* April 27 The total amount of Niagara Falls Power Company stock now listed is given as $5,757,000.

United Railways & Electric Bond Payments.—The board of directors of the United Railways & Electric Company, of Baltimore, has approved the ruling of the executive committee to pay the United Railway's income bonds in cash June 1. Payment of all outstanding dividends on the preferred stock of the company will also be made at this time.

Washington, Baltimore & Annapolis Earnings.—The report of earnings of the Washington, Baltimore & Annapolis Electric Railway Company for the month of March shows a decrease in both gross and net revenues, as compared with the corresponding period of 1910. The gross income of the property for the month was $48,048, as against $54,426 for last year, making a decrease of $6,377 for March of this year. Operating expenses were $30,055, as compared with $27,981 for the same month of the preceding year, or a gain of $2,074 for the current year. The net revenues of the property were $17,993, as against $26,244 for 1910, the loss for March, 1911, being $8,251. The business of the company for March was not as bad as it might first appear, in view of the fact that March of 1910 was one of the best months in the history of the road. The Legislature was in session and travel between Baltimore and Annapolis was heavy. As a result of this heavy passenger traffic, the income for March, 1910, showed a large gain over that for the same month of 1909. For the nine months of the fiscal year ended March 30 the Washington, Baltimore & Annapolis made an excellent record, both gross and net income showing a satisfactory increase over the corresponding period of the preceding fiscal year. Gross income for the nine months totaled $499,685, as against $450,067 for 1910, the gain for 1911 being $49,618, while operating expenses were $262,410, as compared with $275,977, showing a decrease of $13,567. The net income for the period mentioned was $237,274, as compared with $183,089 for last year, making a gain of $54,185 for the nine months of the present fiscal year.

Kansas City Railway & Light Dividend.—The passing of the preferred dividend of the Kansas City Railway & Light Company, which is payable June 1, as mentioned in the issue of May 25, is the first since 1903. The common stock has never paid a dividend. The quarterly dividend of 1¼ per cent on the $9,500,000 preferred stock amounts to $119,000. R. J. Dunham, chairman of the board, has made the following comment: "It is thought that the ultimate interests of the stockholders will be best subserved by this course for these reasons: The company's $5,500,000 6 per cent notes mature Sept. 1, 1912, when some arrangement must be made to meet or refund them. Meanwhile, it is impossible to obtain new money for extensions and additions without giving security upon the new property acquired therewith. This security can only be given with the consent of the city, which apparently cannot be obtained. All resources must at the present time be conserved so that the present franchise requirements may, as far as possible, be met from the earnings without any increase of the floating indebtedness. The Kansas City bankers will not increase that indebtedness but insist upon its reduction. The interests of stockholders are, of course, subordinate to the demands of creditors and rights of the public." Gross earnings for the year ended May 31, 1911, were in excess of $7,000,000, as compared with $6,633,620 for the preceding year.

United Railways of St. Louis Bonds.—Announcement is made that arrangements have been completed by the United Railways of St. Louis for the refunding of the $1,500,000 5 per cent underlying bonds of the Lindell Railway Company. These mature Aug. 1, 1911, and will be replaced by an equal amount of 4½ per cent ten year securities, sale of which has been made. The controlling interest in the traction companies of St. Louis is held by the North American Company, which owns some 75 per cent of the $24,913,800 common stock. Another suit has been filed by the city of St. Louis toward collection of the passenger tax, over which litigation has been held for some time. The city now asks $1,023,617 on this basis. The point is made by the United Railways of St. Louis that the tax is unconstitutional, being excessive and a double taxation, the contention of the city being that the tax is justifiable on the grounds that it is a license tax and cannot be classed as a property tax.

Independence Electric Company Changes Ownership.—The Kansas Gas & Electric Company has acquired the properties and franchises of the Independence Electric Company, of Independence, Kan. The company has franchises extending to 1926, and its properties are free from bonded indebtedness. The Kansas Gas & Electric Company, which was incorporated 1909 to acquire by consolidation the United Gas Company, the Edison Light & Power Company, the Gas & Electrical Appliance Company, of Wichita, Kan., and the Home Light, Heat & Power Company, of Pittsburgh and Frontenac, Kan., is controlled by the American Power & Light Company, which is controlled in turn by the Electric Bond & Share Company and affiliated interests.

Long Acre Electric Light & Power Company.—A development arose this week in the case of the Long Acre Electric Light & Power Company, which has been endeavoring for some time to obtain permission from the Public Service Commission for the First District, New York, to float a large stock issue and mortgage, as mentioned in these columns during the year. Announcement was made that the commission would act upon the application of the company by proceeding to consider the amount of stocks and bonds which the company should be allowed to issue and the terms under which these securities might be approved. Hearings will be given shortly upon this point.

Federal Telephone & Telegraph Company.—The Public Service Commission for the Second District of New York, has authorized the Federal Telephone & Telegraph Company to issue $578,000 5 per cent bonds, on security of its mortgage of March 24, 1909. The proceeds are to be utilized for acquiring the securities of the Niagara Home Telephone Company, the Dunkirk Home Telephone Company and the Independent Union Telegraph Company.

Georgia Power Company Bonds.—The Georgia Power Company has received permission from the Georgia Railroad Commission to issue $20,000,000 stocks and bonds. Description of the plants now in course of construction by the company has been given from time to time in the *Electrical World*

DIVIDENDS.

American Telegraph & Cable Company, quarterly, 1½ per cent, payable July 1.

Chicago City Railway Company, quarterly, 2½ per cent, payable June 30.

Mackay Companies, quarterly, common, 1 per cent, preferred, 1¼ per cent; payable July 1.

Westinghouse Electric & Manufacturing Company, quarterly, preferred, 1¼ per cent, payable July 15.

Winnipeg Electric Company, quarterly, $3 per share, payable July 1.

REPORTS OF EARNINGS.

Period.		Gross Earnings.	Operating Expenses	Net Earnings.	Fixed Charges	Net Surplus.
ELECTRICAL PROPERTIES COMPANY.						
Yr., Apr.,	1911	$251,841	$62,101	$189,740	.....	......
" "	1910	239,053	54,062	184,991	....	......
INTERBOROUGH RAPID TRANSIT COMPANY.						
April,	1911	$2,658,586	$1,071,177	$1,446,408	$888,031	$558,377
"	1910	2,564,775	937,047	1,500,755	878,356	622,399
MONTREAL LIGHT, HEAT & POWER COMPANY.						
Yr., Apr.,	1911	$4,404,126	$1,827,786	$2,576,340	$472,051	$2,104,289
" "	1910	4,240,945	1,848,878	2,392,067	480,866	1,911,200
MONTREAL STREET RAILWAY.						
April,	1911	$372,309	$200,718	$171,591	$50,337	$121,254
"	1910	344,766	190,842	153,924	44,584	109,340
NASHVILLE RAILWAY & LIGHT COMPANY						
April	1911	$161,228	$94,554	$66,674	$38,262	$28,412
"	1910	147,519	87,993	59,526	38,[illegible]	21,434
PHILADELPHIA COMPANY.						
April	1911	$1,817,713	$983,791	$833,922	....	.....
"	1910	1,699,996	892,692	807,304	...	...
PORTLAND RAILWAY, LIGHT & POWER COMPANY						
Year,	1910	$6,064,795	$2,870,077	$3,194,717	$1,678,228	$1,516,489
"	1909	5,190,567	2,569,04[illegible]	2,621,526	1,4[illegible]	1,128,487
SAO PAULO TRAMWAYS, LIGHT & POWER COMPANY						
April	1911	$284,038	$104,278	$[illegible]760	....	.
"	1910	231,5[illegible]	82,624	148,89[illegible]	.....	.....
RIO DE JANEIRO TRAMWAYS, LIGHT & POWER COMPANY.						
April,	1911	$1,030,111	$511,324	$518,787	.	....
"	1910	825,236	427,812	397,424	..	....
TWIN CITY RAPID TRANSIT COMPANY						
April	1911	$620,672	$319,939	$300,732	$[illegible]	$160,653
"	1910	584,378	268,045	316,333	[illegible]	176,103
TRI-CITY RAILWAY & LIGHT COMPANY						
April,	1911	$210,755	$124,877	$85,878	$47,[illegible]	$38,692
"	1910	190,053	117,754	72,289	43,[illegible]	28,582
UNITED TRACTION COMPANY OF ALBANY						
Qtr., Mar.,	1911	$537,234	$364,521	$187,665	$102,860	$84,804
" "	1910	487,144	331,879	173,580	95,863	77,716
UNITED RAILROADS OF SAN FRANCISCO.						
April,	1911	$652,866	$363,030	$289,836	....	......
"	1910	648,015	366,427	281,588		.....

General News

Construction News.

ONEONTA, ALA.—The installation of an electric-light plant to cost approximately $6,000, in Oneonta, is reported to be under consideration. D. M. Farson & Company, of Chicago, Ill., it is said, are interested in the project.

SYLACAUGA, ALA.—Electricity for operating the municipal electric system is received from the hydroelectric plant located on Hatchett Creek, 16 miles south of the city. The plant, which was recently completed, is equipped with one pair of horizontal twin turbines, developing 375 hp under a 19-ft. head, manufactured by the Trump Manufacturing Company, of Springfield, Ohio.

FAYETTEVILLE, ARK.—The Fayetteville Electric Light & Power Company, it is reported, is contemplating making extensions and improvements to its plant, including the installation of additional machinery, to cost approximately $20,000.

MAMMOTH SPRINGS, ARK.—The Mammoth Springs Electric Light & Power Company, it is reported, is contemplating extending its transmission lines to West Plains, Mo., to supply electricity for lamps and motors in that town.

BAKERSFIELD, CAL.—A new telephone company is being formed by local capitalists. The new company has no connection with the Home Telephone Company. Application will soon be made to the City Trustees and the County Supervisors for franchises to operate in the city and county. J. W. Kelly is interested in the project.

BERKELEY, CAL.—The City Council has fixed the rate for electricity for lamps in Berkeley for the next fiscal year as follows: Arc lamps with moonlight schedule, $4.50 each per month; all-night service, $6 each per month; 16-cp incandescent lamps, all-night service, 50 cents per lamp per month; electroliers, $1.75 each per month; meter rate, 3 cents per kw-hour; for motors, 2½ cents per kw-hour.

FRESNO, CAL.—Arrangements are being made by the San Joaquin Light & Power Company to invade the West Side by the extension of its transmission lines from Madera to Los Banos, Gustine, Dos Palos, Mendota and Firebaugh, work on which will begin about July 1, at which time it is expected that the transmission line now being erected from Copper Mine, near Clovis, to the Bakersfield country will be completed. The company is now extending its transmission lines from Merced to La Grand and Planada on the Santa Fe Railroad, which will supply electricity to the two towns and also to operate pumping plants in the surrounding territory. Another line is to be erected from Corcoran to Angiola, Salida and Stohl, and Corcoran to Buena Vista. Substations are also being erected at the Copper Mine, Caruthers and at Henrietta. A temporary plant is also being installed by the company on the Tule River to supply power for the construction of 3¼ miles of tunnels, of which about 2 miles has been completed. When the lines which are now being erected are completed all the plants of the company will be connected with the main plant at Crane Valley.

LOS ANGELES, CAL.—Plans have been completed by the Los Angeles & San Fernando Electric Railway Company for the construction of an independent electric railway to extend from Los Angeles to San Fernando. The new electric railway will be linked with the new railway now being built by the Los Angeles-Pacific Company to Van Nuys and the road now under construction by the Los Angeles Homes Company to Owensmouth The officers of the Los Angeles & San Fernando Electric Railway Company are: L. C. Brand, president; W. G. Kerckhoff, vice-president, and J. F. Sartori, secretary and treasurer.

LOS ANGELES, CAL.—A substantial reduction will be made in the prices for electricity in Los Angeles under the schedule fixed by the Board of Utility, which will become effective July 1. Under the new schedule the minimum charge will be reduced from $1 per month to 35 cents per month, but in addition the consumer pays for the amount of electricity used. The price has been reduced from 7 cents to 6½ cents per kw-hour for the first 250 kw used. From 250 kw to 500 kw the rate is 6 cents per kw-hour; from 500 kw to 1000 kw, 5 cents per kw-hour; from 1000 kw to 2000 kw, 4 cents, which is the same as last year, for all used from 2000 kw to 4000 kw, 3 cents per kw-hour, and for all in excess of 4000 kw, 2¾ cents per kw-hour. Under the present schedule the rate is 3 cents per kw-hour for all energy consumed above 2000 kw. Under the new charter the board fixes the rates for motors as well as for lamps. The new rates for motors are as follows: For electricity furnished at less than 15,000 volts; first 100 kw, 7 cents per kw-hour; 100 kw to 500 kw, 6 cents; 500 kw to 1000 kw, 5 cents; 1000 kw to 1500 kw, 4 cents; 1500 kw to 2000 kw, 3 cents; and all above 2000 kw 2 cents. In addition to the charge for the energy used the companies are allowed to charge 50 cents per month for each horse-power furnished, the minimum charge to be $1 per month.

PASADENA, CAL.—The City Council has awarded a contract for the construction of underground conduits along part of Orange Grove Avenue and certain other streets to G. M. Gest for $45,000. Herman Dyer is city clerk.

PASADENA, CAL.—Bids will be received by the Mayor and City Council of Pasadena, at the office of the city clerk, City Hall, Pasadena, Cal., until June 6 for furnishing and installing one turbo-generator set with Terrill regulator and exciter, together with condenser, pumps and auxiliaries with a rating of from 1500 kw to 1650 kw or 1250 kw or 1000 kw. Herman Dyer is city clerk.

SAN FRANCISCO, CAL.—The Northern California Power Company has signed a contract to supply electricity to operate the pumps for irrigating the Carson Colony No. 2, a tract of 1160 acres, situated near Butte City, Glenn County.

SAN FRANCISCO, CAL.—The Board of Supervisors has adopted a resolution authorizing the clerk of the board to advertise for proposals for lighting the streets and outlying districts, and for lighting the public buildings of the city and county for the fiscal year beginning July 1, 1911.

TULARE, CAL.—The Tulare County Power Company has applied to the City Council for a franchise to erect and maintain an electric plant and distributing system in Tulare. C. H. Holly is manager.

WALNUT CREEK, CAL.—The Pacific Gas & Electric Company is reported to be making preparations to extend its transmission lines to Danville to supply electricity for lamps and motors in that town. It is also proposed to supply electrical service to the residents and ranchers along the route of the line.

DANIELSON, CONN.—Arrangements are being made by the Connecticut Mills Company to equip its No. 2 mill for electrical operation and to install additional lamps.

PLAINFIELD, CONN.—Preparations are being made by the Plainfield Mills Corporation for the construction of a new mill, which will be erected near the present mill of the Lawton Company. A new power plant will also be installed. John Porteous is vice-president and general manager.

WASHINGTON, D. C.—Sealed proposals will be received until June 12 for wiring and extension of electric-lighting system in the buildings of Howard University, Washington, D. C., in accordance with plans and specifications, copies of which may be obtained upon application to the chief clerk of the department. Carmi A. Thompson is assistant secretary.

HASTINGS, FLA.—The establishment of an electric-light plant in Hastings is reported to be under consideration.

HAVANA, FLA.—It is reported that a franchise has been granted to a company, recently organized, to install an electric-light plant and ice plant in Havana. James Cheatham and others are said to be interested in the project.

TALLAHASSEE, FLA.—Bids will be received by the city of Tallahassee for $15,000 in bonds, the proceeds to be used for improvements and extensions to the electric and gas plants and water-works system. A. H. Williams is city clerk.

BLACKSHEAR, GA.—The installation of an electric-light plant in Blackshear is reported to be under consideration.

CHICAGO, ILL.—The Chicago Telephone Company, it is said, will issue about $5,000,000 in bonds next fall, the proceeds to be used for new construction in Chicago and the ten counties which its system covers.

CHICAGO, ILL.—Sealed proposals will be received at the office of William Carroll, city electrician, Room 618, City Hall, Chicago, Ill., until June 5, for furnishing the Department of Electricity, city of Chicago, Ill., with 25,000 ft., more or less, of No. 6 B. & S. gage, rubber-covered, lead-incased electric-light cable, in accordance with specifications on file in the office of the city electrician.

FT. WAYNE, IND.—It is reported that surveys are being made of the St. Joseph River under the supervision of Engineer Barnes with a view of locating power sites and building dams.

LAPORTE, IND.—The Laporte Telephone Company has increased its capital stock from $100,000 to $500,000.

NOBLESVILLE, IND.—Harry Sheridan, referee in bankruptcy, has appointed Elmer Wetzell, of Indianapolis, Ind., trustee for the White River Light & Power Company. The trustee was instructed not to make any effort to dispose of the property until the question of turning the property over to the bondholders was decided. The White River Light & Power Company began the construction of a hydroelectric plant on the White River, 2 miles above Noblesville, nearly three years ago. After expending about $50,000 on the plant, work was suspended on account of lack of funds. According to the report of the receiver, the indebtedness of the company exceeds $100,000. The plant has never been operated.

WEBSTER CITY, IA.—Sealed proposals will be received at the office of P. M. Banks, city clerk, Webster City, Ia., for furnishing and installing equipment for the municipal electric-light and power plant as follows: (1) Three 72-in. x 18-ft. return tubular boilers. (2) One 20-in x 36-in.

right-hand, simple non-condensing Corliss engine, 120 r.p.m., 150 lb. working pressure for direct connection to a 300-kva alternator. (3) One 16-in. x 36-in., left-hand, simple non-condensing Corliss engine, 120 r.p.m., 150 lb. working pressure for direct connection to a 200-kva alternator. (4) One No. 77, 500-hp Hoppes Standard feed-water heater with outside float box; all necessary pipe and fittings to connect engines and boilers, boiler feed pumps and heater. (5) One 300-kva, 60-cycle, 2300-volt, 120 r.p.m. alternator with exciter. (6) One 200-kva, 60-cycle, 2300-volt, 120 r.p.m. alternator with exciter, for parallel operation. (7) Switchboard for above apparatus. H. M. Sparboe is Mayor.

HUTCHINSON, KAN.—The United Water, Gas & Electric Company is reported to be negotiating with the towns of Nickerson, Partridge and Arlington with a view of extending its transmission lines to those places to supply electricity for lamps and motors.

INDEPENDENCE, KAN.—The plant and holdings of the Independence Electric Company, of Independence, Kan., have been purchased by the Kansas Gas & Electric Company, which is a subsidiary of the American Power & Light Company.

NICKERSON, KAN.—It is reported that a committee has been appointed to make investigations in connection with the proposition of securing electricity from the plant of the United Water, Gas & Electric Company, of Hutchinson, Kan., to operate a municipal lighting system in Nickerson.

LAFAYETTE, KY.—The Lafayette Ice & Electric Company, which is operating an ice plant in Lafayette, is reported to be installing an electric-light plant. The company is capitalized at $7,500. Samuel Bumpus is general manager.

SHELBYVILLE, KY.—Charles E. Collins, Drexel Building, Philadelphia, Pa., is reported to be preparing plans for the construction of a concrete dam for the Shelbyville Water & Light Company, of Shelbyville, Ky.

LAFAYETTE, LA.—W. L. Eryes, superintendent of the municipal electric-light plant, recommends improvements to the electric-light plant involving an expenditure of about $40,000, including the installation of new machinery and changing the system from direct current to alternating current.

BANGOR, MAINE.—The property of the Bodwell Water Power Company at Milford, Maine, was sold at a foreclosure sale May 19 to Attorney Verrill, who, it is said, represented the bondholders. The price paid for the property was $500,000.

WISCASSET, MAINE.—Arrangements have been made by the Wiscasset Electric Light & Power Company to secure electricity from the plant of the Portland Power & Development Company, located at Damariscotta Mills, 12 miles distant. The Portland company already supplies electrical energy in the villages of Damariscotta, Damariscotta Mills, Noblesville, Newcastle, Boothbay Harbor, East Boothbay, Bayville and the Isle of Springs.

BALTIMORE, MD.—The Public Service Commission has authorized the Consolidated Gas, Electric Light & Power Company to issue bonds to the amount of $844,000, to be sold at not less than 92, the proceeds to be used to take up outstanding obligations and for improvements and extensions to its system. The petition filed by the company states that $82,263 is needed for the Westport electric plant; for the Arlington substation $79,565 is required; extensions will be made to other substations, and $60,000 will be used to refund bonds of the Brush and Edison companies, which have been taken over by the Consolidated company. It is also proposed to pay $262,000 of the floating indebtedness out of the bond issue.

FREDERICK, MD.—The Frederick Railroad Company has applied to the Public Service Commission for authority to issue $156,000 in bonds, the proceeds to be used for improvements and extensions to its system.

GLOUCESTER, MASS.—The Gloucester Electric Company has applied to the State Board of Gas and Electric Light Commissioners for authority to issue capital stock to the amount of $75,000, the proceeds to be used for placing its wires underground, for recent additions to its plant and for extending its transmission lines to the town of Essex.

NORTHAMPTON, MASS.—The City Council has refused to accept the new contract submitted by the Northampton Electric Lighting Company for street lighting for a term of five years. Under the new contract the company offers to supply forty-six arc lamp with all-night service at $86 and $90 each per year; fourteen incandescent lamps with all-night service at $24 and $28 per lamp per year; 63 arc lamps with midnight service at $71.50 and $75.56 each per year; 374 incandescent lamps with midnight service at $18 and $20.51 per lamp per year. Under the terms of the new contract the city would save $1,433 per year.

PITTSFIELD, MASS.—The State Board of Gas and Electric Light Commissioners has granted the Pittsfield Electric Company permission to issue 1500 additional shares of capital stock at $135 per share. The board directs that the proceeds of 1400 shares be applied to the payment of an equal amount of outstanding notes of the company and the remainder for the cancellation of indebtedness incurred for additions to its plant.

WORCESTER, MASS.—The State Board of Gas and Electric Light Commissioners has handed down a decision against Alfred S. Lowell, of Worcester, in his case against the Worcester Electric Light Company. Mr. Lowell, who owns a large department store in Worcester, was granted permission by the Mayor and Aldermen to construct and operate an electric-light plant and to build a [illegible] across Main Street from his plant to the store. The Worcester Electric Light Company held that this was an infringement on its franchise, which has been upheld by the commission.

DETROIT, MICH.—Schwanbeck Brothers are reported to have purchased a tract of twelve acres on Westminster Avenue, between Russell Street and the Grand Trunk Railroad tracks, on which they propose to erect a plant for manufacturing showcases. A separate power plant will be erected. The equipment will consist of a 300-hp Corliss engine and generator. Part of the machinery will be equipped for electrical operation.

ESCANABA, MICH.—The Escanaba Traction Company is reported to be contemplating the construction of a second power dam on the Escanaba River. About 2000 hp will be developed.

MUSKEGON, MICH.—Owing to a disagreement between the City Council and the Muskegon Traction & Lighting Company, it is expected that the city will be without street-lighting service after June 1 until the new municipal lighting plant is completed. As yet the bonds have not been issued. The Council demands a reduction in the prices for street lamps, which the company refuses to make unless given a new contract for a term of five years.

RED LAKE FALLS, MINN.—The Red River Power Company is reported to be considering a proposition to supply the farmers in this vicinity with electricity for lamps and motors.

WAYZATA, MINN.—The Village Council has engaged W. D. Lovell, of Minneapolis, Minn., consulting engineer, to make investigations and prepare estimates as to the probable cost of installing a municipal electric-light plant and water-works system in Wayzata.

BELTON, MO.—The citizens are reported to have voted to install an electric-light system in Belton.

COLUMBIA, MO.—The City Council has awarded the contract for extensions to the municipal electric-light plant and water-works system to the John W. Danforth Company, of St. Louis, Mo., for $66,000. Shaw & Humphrey, Chemical Building, St. Louis, Mo., are consulting engineers.

BUTTE, MONT.—The City Council has authorized an extension to the curb cluster lamp-lighting system, to cost approximately $12,000.

LIBBY, MONT.—The Libby Water Works, Electric Light & Power Company, it is reported, is planning to install an electric-light plant in Libby, Mont.

KIMBALL, NEB.—The installation of an electric-light plant in Kimball is reported to be under consideration.

WYMORE, NEB.—The contract for the construction of the municipal power plant and office building is reported to have been awarded to Sidney Cornell, of Pawnee City, Neb.

RENO, NEV.—The Truckee River General Electric Company has commenced a suit against the farmers in the Truckee Valley for condemnation of rights of way over their lands for a high-voltage transmission line from the new power plant under construction at Verdi to Wabusha.

BLOOMFIELD, N. J.—The Town Council is reported to have engaged Runyon & Carey, engineers, of Newark, N. J., to make investigations and report on the feasibility of establishing a municipal electric-light plant in Bloomfield.

PHILLIPSBURG, N. J.—The Town Council has awarded a contract to the Easton Gas & Electric Company, of Easton, Pa., for lighting the streets of the town for a term of ten years.

TRENTON, N. J.—The Board of Public Utility Commissioners has given its approval of a proposed bond issue by the Riverside Traction of $137,125.

BINGHAMTON, N. Y.—Sealed proposals will be received at the office of the Supervising Architect, Washington, D. C., until June 19, for installing a conduit and wiring system and extension of the present gas-piping system at the United States post office and courthouse in Binghamton, N. Y., in accordance with plans and specifications, copies of which may be obtained at the above office or at the office of the custodian of the building, Binghamton, N. Y. James Knox Taylor is Supervising Architect.

BUFFALO, N. Y.—The Public Service Commission, Second District, has authorized the Federal Telephone & Telegraph Company, of Buffalo, N. Y., to issue bonds to the amount of $578,000, the proceeds to be used for the purchase of the properties of the Niagara Home Telephone, the Dunkirk Home Telephone and the Independent Union Telephone Companies.

CATSKILL, N. Y.—The Catskill Illuminating & Power Company, of Catskill, and the Schoharie Light & Power Company have consolidated under the name of the Upper Hudson Electric & Railroad Company.

CORNING, N. Y.—The Corning & Painted Post Street Railway Company is reported to be preparing plans for an extension of its railway from Corning to North Corning. It is also proposed to double-track the Main Street line in Corning. The cost of the proposed improvements is estimated at about $40,000.

CORNING, N. Y.—The Corning Gas & Electric Company has submitted propositions to the Council to enter into a contract with the city for street lighting for a term of ten years, under the terms of which a saving of $7,000 will be effected and the efficiency of the street-lighting system greatly increased. The company also offers to furnish arc lamps of the same type as those now in use under a five-year contract for $75 per lamp per year, or $72.50 for a ten-year contract. The price for incandescent lamps is to be reduced to $28 and $27.50 respectively. The city now pays $80 each per year for arc lamps. The company has also offered to install new luminous arc lamps under a ten-year contract at the rate of $75 each per year, and to furnish 75-watt incandescent lamps, for which the city now pays $30 per year, at $25 per lamp per year, and to supply a new-style lamp of 125 watts at the rate of $27.50 each per year.

NEW BRIGHTON, S. I., N. Y.—The contract for furnishing and placing lamp-posts on Jay and South Streets, retaining walls and curb lamp-posts on South, Jay and Hyatt Streets has been awarded to the Vulcan Railway Construction Company, 175 North Ninth Street, Brooklyn, N. Y., for $24,057.

NEW YORK, N. Y.—The Manhattan Bridge Service Company has applied to the Board of Estimate for a franchise to construct an electric street railway from the Bowery and Canal Street, along Canal Street to the Manhattan Bridge and thence to Flatbush Avenue and Fulton Street, Brooklyn, N. Y.

NEW YORK, N. Y.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until June 12, for installation of electrically driven pumps in the United States post office and courthouse building at New York, N. Y. Plans and specifications may be obtained at the above office or at the office of the chief engineer and superintendent of repairs. James Knox Taylor is Supervising Architect.

NEW YORK, N. Y.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until June 12 for the installation complete of four new electric elevators in the United States post office and courthouse in accordance with plans and specifications, copies of which may be obtained at the above office or at the office of the chief engineer and superintendent of repairs of the building. James Knox Taylor is Supervising Architect.

NEW YORK, N. Y.—Frederick W. Whitridge, receiver of the Union Railway Company, has been authorized by Judge Lacombe, of the United States Circuit Court, to enter into a contract with the city for operating cars across the Madison Avenue bridge, to connect with the company's lines between East 136th and 138th Streets. A contract was also authorized for a double-track extension along Broadway, between 225th and 230th Streets, to connect the system of the Union Railway Company with the Kingsbridge Railway Company.

NEW YORK, N. Y.—Sealed bids will be received by C. B. J. Snyder, superintendent of school buildings, until June 12 for repairs, alterations and additions to the electric equipment in schools 2, 7, 34, 43 and 160, 6, 57, 58 and 74, Borough of Manhattan.

PLATTSBURG, N. Y.—The Plattsburg Gas & Electric Company has received authority from the Public Service Commission, Second District, to issue bonds to the amount of $10,000, to be sold at not less than 92, the proceeds to be used for extensions and improvements to its plant.

SCHENECTADY, N. Y.—Proposals will be received by the Board of Supervisors of Schenectady Countil until June 6 for furnishing and installing complete pneumatic water system, consisting of one electrically driven pump having a capacity of 200 gal. per hour, one electric motor, automatic starting device and pressure regulator and two 1500-gal. tanks.

SILVER CREEK, N. Y.—The question of purchasing the electric plant of the People's Electric Light & Power Company, to be owned and operated by the village, is reported to be under consideration.

SYRACUSE, N. Y.—The Board of Contract and Supply has awarded the contract for installing a central fire-alarm system in the Gamewell Fire Alarm Telegraph Company at $23,875. Work will be started at once on installation of the system.

SYRACUSE, N. Y.—The Public Service Commission, Second District, has authorized the Syracuse Lighting Company to issue $456,000 in bonds, of which the proceeds of $85,000 will be used for extensions and improvements to its electric system. Among the improvements contemplated is the erection of a new transformer station at East Syracuse, extension of a transmission line to Jamesville and the construction of a new station at Liverpool. James C. DeLong is general manager.

SYRACUSE, N. Y.—The Syracuse, Watertown & St. Lawrence River Railroad Company has applied to the Public Service Commission, Second District, for permission to construct a railway from a connection with the Syracuse & South Bay Electric Railroad in the town of Cicero to the village of Brewerton, a distance of 6 1-3 miles. The cost of the road is estimated at about $300,000. C. D. Beebe and William Nottingham, of Syracuse, N. Y., are interested in the company.

UTICA, N. Y.—The Board of Contract and Supply has awarded the contract for furnishing about 150,000 duct feet of tile and appurtenances for an extension of the electric subways in the city to the Safety Insulated Wire & Cable Company, of New York, N. Y., for $29,906. Stuart F. Day is secretary of board.

WHITE PLAINS, N. Y.—The Public Service Commission, Second District, has given the Hudson River Eastern Traction Company permission to build an electric railway in the village of Sherman Park, through the towns of Mount Pleasant and North Castle and into the village of White Plains, and to exercise its local franchises in these places. The company now has authority to construct an electric railway from Ossining to White Plains.

WOLCOTT, N. Y.—The Public Service Commission, Second District, has authorized the Northern Wayne Electric Light & Power Company to purchase the plant and holdings of the Wolcott Electric Light & Power Company in Wolcott for $33,000, and to issue capital stock to the amount of $75,000, the proceeds to be applied to the purchase of the property and to the erection of transmission lines authorized under its various franchises.

RALEIGH, N. C.—The Carolina Power & Light Company is reported to have secured the controlling interest of the Standard Gas & Electric Company, of Raleigh. Charles E. Johnson, of Raleigh, N. C., is president of the Carolina Power & Light Company.

WELDON, N. C.—The Virginia & Carolina Power Company, recently organized, it is reported, will take over and develop the water-power on Roanoke River, near Weldon, where it is estimated that about 25,000 hp can be developed. Electricity generated at this plant will be transmitted to Weldon and other North Carolina cities, to Petersburg, Va., 50 miles distant, and to Norfolk, Va., a distance of 70 miles. This development is connected with the consolidation of the Virginia Railway & Power Company, of Richmond, Va., and the Norfolk & Portsmouth Traction Company, of Norfolk and Portsmouth, Va. William C. Whitner will be president of the Virginia & Carolina Power Company.

NEW ENGLAND, N. D.—Preparations are being made by the North Dakota Independent Telephone Company to install a telephone exchange in New England.

CAMBRIDGE, OHIO.—The Midland Power & Traction Company, it is reported, is contemplating extending its lines to Pleasant City in the near future. W. A. Gibbs, of Cambridge, Ohio, is general manager.

FINDLAY, OHIO.—The farmers in the southern part of Hancock County have organized a company to build an independent telephone system connecting about forty towns. Christian Hilty is president, J. W. Shilling vice-president, and Noah O. Blossom treasurer.

CUSTER, OKLA.—The Western Engineering Company, of Oklahoma City, Okla., it is reported, is preparing plans for the installation of an electric-light plant and water-works system in Custer, to cost approximately $40,000.

PANAMA.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until June 22, for furnishing cargo-handling and locomotive cranes, gasoline-engine-driven passenger car, rock skips, caplets, electric cable and cable terminals as per Circular No. 634. Blanks and general information relating to the above circular may be obtained from this office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing officer.

MOUNT UNION, PA.—The capital stock of the Mount Union Light & Power Company has been increased from $25,000 to $60,000.

PHILADELPHIA, PA.—Bids will be received at the office of the Commanding Officer, Frankford Arsenal, Philadelphia, Pa., until June 5, for furnishing and installing a one-ton electric traveling crane in the scrap storehouse at Frankford Arsenal, Philadelphia, Pa.

PHILADELPHIA, PA.—Contracts have been awarded by the Cumberland Valley Railroad Company for equipping its signal system with electric lamps on 43 miles of double track. Alternating-current, 3300-volt, 25-cycle, three-phase system will be used. It is proposed to carry sufficient current in the signal mains to supply electricity to light all of the stations.

PHILADELPHIA, PA.—The Philadelphia Railways Company, recently incorporated, will take over the property of the Southwestern Street Railway Company, which was sold under foreclosure sale on April 21. The new owners, it is said, will re-equip the railway, enlarge the power plant and generally rehabilitate the entire system. The motor cars will be increased to twenty-five. The company is capitalized at $400,000. Isaac H. Silverman is president and Alvin H. From secretary. The offices of the company are located at 605 Land Title Building, Philadelphia, Pa.

PUNXSUTAWNEY, PA.—The Jefferson Electric Light, Heat & Power Company has increased its capital stock from $25,000 to $100,000.

ESTELLINE, S. D.—The Council is reported to have granted a franchise for the installation of an electric-light plant in Estelline, S. D.

FAITH, R. F. D. LEMMONVILLE, S. D.—It is reported that Mills & Harrington are contemplating the installation of a 100-kw electric-light and power plant, to cost approximately $10,000. M. E. Bookman, of Eagle Butte, S. D., is engineer.

MOBRIDGE, S. D.—Plans are being considered by the Chicago, Milwaukee & Puget Sound Railway Company to install a telephone system for dispatching trains between Mobridge, S. D., and Deer Lodge, Mont., a distance of 775 miles.

PIERRE, S. D.—The contract for installing conduits for electric-light wires in the State Capitol grounds has been awarded to Nimis & Nimis, of St. Paul, Minn., for $1,440. H. B. Anderson is State Auditor.

DYERSBURG, TENN.—Sealed proposals will be received by the City Water and Light Department, Dyersburg, Tenn., until June 13, for equipment for extensions to the municipal electric-light plant, including engines, boilers, generators and switchboard equipment. Specifications may be obtained upon application to the City Light and Water Department, or to M. W. Ewell, Mayor.

GREENVILLE, TENN.—At an election to be held June 5 the proposition to issue $65,000 in bonds, the proceeds to be used for the construction of an electric-light plant and water-works system, will be submitted to a vote of the people.

McKENZIE, TENN.—The city of McKenzie, Tenn., it is said, will ask for bids about July 1 for the construction of an electric light plant. Bonds to the amount of $40,000 were recently voted, the proceeds to be used for construction of an electric-light plant, water-works system and street improvements. C. H. Jenks, of St. Louis, Mo., is engineer.

BROWNWOOD, TEX.—Dr. M. M. Scott, who recently purchased the town site of Owens, near here, is reported to be contemplating extensive improvements, including the installation of public utility plants.

CUERO, TEX.—The Cuero Light & Power Company, it is reported, is contemplating the installation of a 1200-hp water-wheel and electrical equipment, which will double the output of its plant. E. J. Hayes Company, of Houston, Tex., has the contract for the work.

EL PASO, TEX.—Permits have been secured by the El Paso Electric Railway Company for the erection of an addition to its power house in El Paso, the cost of which is estimated at $83,290.

TERRELL, TEX.—Plans are being made by the city for the construction of a municipal electric-light plant, for which, it is said, bids have been received.

MAYFIELD, UTAH.—The Gunnison Valley Power Company, of Gunnison, Utah, has been granted a franchise to supply electricity in Mayfield.

RICHFIELD, UTAH.—The Telluride Power Company, of Provo, Utah, has purchased the plant and holdings of the Richfield Electric Light & Power Company. The Telluride company will take over the entire system, including the steam plant, water system and water power at Glenwood and distributing system in both cities.

FT. ETHAN ALLEN, VT.—Bids will be received at the office of the Quartermaster, Ft. Ethan Allen, Vt., until June 21 for building addition to pump house, installing electrically operated pumping machinery, building concrete reservoir and remodeling electric-lighting system. Captain R. J. Fleming is quartermaster.

BEDFORD CITY, VA.—Plans are being considered by the city for the installation of a 1200-hp hydroelectric power plant to supply electricity for small manufacturing plants.

RICHMOND, VA.—The contract for wiring the United States post office in Richmond, Va., is reported to have been awarded to the Atlantic Electric Company, of Norfolk, Va., at $7,924. James Knox Taylor is supervising architect.

RICHMOND, VA.—It is reported that the city is contemplating the installation of electric pumps at the old pumping station, to be connected with the standpipe service. The cost is estimated at $16,000. Charles E. Bolling is city engineer.

SEATTLE, WASH.—Proposals will be received at the office of the Constructing Quartermaster, 482 Arcade Annex, Seattle, Wash., until June 15, for the construction of an electric lighting system at Ft. Flagler, Wash. Plans and specifications may be obtained on application to Captain E. C. Long, Constructing Quartermaster. A deposit of $10 will be required which will be refunded on return of the plans.

SPOKANE, WASH.—Plans are being considered by the Washington Water Power Company to complete its Little Falls power plant, the extension of many of its distributing lines in Spokane, the installation of storage batteries, extensions to its underground conduit system and the completion of its transmission line from Post Falls to Newport.

HUNTINGTON, W. VA.—It is reported that arrangements have been completed by the American Railways Company, of Philadelphia, Pa., for taking possession of the properties of the Ohio Valley Electric Railway Company. Bonds to the amount of $2,000,000 will be issued by the American Railways Company, of which $1,700,000 will be given in exchange for the stock of the Ohio Valley Electric Company, and $300,000 will be held for extensions and improvements to the new lines.

MARTINSBURG, W. VA.—It is reported that arrangements are being made by the Martinsburg Power Company for the installation of a 1500-hp steam turbine. H. B. Shoemaker is manager.

BARABOO, WIS.—The Baraboo Gas & Electric Company has been authorized by the State Railroad Commission to issue $100,000 in capital stock and bonds to the amount of $98,000. The total issue is to be made to Frank R. Glover, T. H. Durst and William Clancy on completion of the organization of the Baraboo Gas & Electric Company to take over the property, franchises, etc., of the Baraboo Lighting Company, which were acquired through a foreclosure sale. The total outstanding indebtedness of the latter company at the time of the sale was said to be $198,000.

FOND DU LAC, WIS.—Plans are being made by the business men to install ornamental lamps on Main Street from Division to Fourth Street, for which subscriptions are now being taken.

BASSANO, ALTA., CAN.—It is reported that the town of Bassano, located midway between Calgary and Medicine Hat, will be supplied with electricity from the hydroelectric plant of the Canadian Irrigation Company, which is building a large dam, for irrigation purposes, at a cost of about $7,000,000. Turbines capable of generating 28,000 hp are now being installed.

CALGARY, ALTA., CAN.—Arrangements are being made by the Alberta Electric Railway Company for the construction of its proposed electric railway to extend from Medicine Hat to Banff, work on which will begin at once. The proposed railway will be 79 miles [illegible] headquarters of the company will be located in Calgary. The company is capitalized at $10,000,000.

STETTLER, ALTA., CAN.—The ratepayers have voted in favor of the by-law to install an electric-light and power plant in Stettler. A plant with sufficient output to provide for 2500 lamps of 16 cp will be erected, work on which will begin at once.

NELSON, B. C., CAN.—It is reported that application will be made on June 16 for permission to use 6300 cu. ft. of water per second from the Kootenay River at Granite, 4 miles below Nelson, to be utilized for power purposes. The proposed work will include construction of dam, canal and power house. A. L. McCulloch, of Nelson, mining engineer, and W. F. Teetzel, water commissioner for the district, are said to be interested in the project.

REVELSTOKE, B. C., CAN.—It is reported that the Diamond Mills Company and the Dominion Securities Company have purchased a large tract of standing timber near Revelstoke, B. C., and will begin immediately the development of a large water-power development and a large paper and pulp mill a few miles from Revelstoke. The project will involve an expenditure of about $20,000,000 and include the construction of an electric railway connecting the mills with the town. Charles A. Barnum, of Chicago, Ill.; F. C. Adams, of Duluth, Minn., and Charles E. Stone, of St. Paul, Minn., are interested in the project.

VICTORIA, B. C., CAN.—It is reported that the City Council is asking bids for 300 electric-lamp standards for street-lighting purposes.

HALIFAX, N. S., CAN.—The City Council has adopted a resolution authorizing plans and specifications prepared for the construction of an incinerating plant, to cost about $40,000. It is proposed to generate power at the plant to operate a stone crusher and other small machines.

NICTAUX FALLS, N. S., CAN.—The Canada Iron Corporation, of Montreal, Que., Can., it is reported, is building a hydroelectric power plant, at a cost of $70,000, in connection with its iron mines, and also a washing plant, to cost $75,000. E. M. Archibald, [illegible] engineer.

FT. WILLIAM, ONT., CAN.—Tenders will be received by the City Clerk, addressed to the chairman of the utilities [illegible], Ft. William, Ont., Can., until July 1, for the sale of equipment of the municipal pumping and electrical generating plant, which has been thrown out of use by the hydroelectric power and gravity water system, and would be suitable for a town with a population of 5[illegible]00. The equipment includes two duplex compound pumps having a capacity of 6[illegible] gal. per minute; one tandem compound engine; one engine with countershafting, pulleys and belting complete; one Westinghouse revolving-field [illegible]-kw., two-phase, 60-cycle, 2400-volt generator with exciter, switchboard, etc.; one Royal Electric 180-kw, 133-cycle, 2400-volt generator with exciter, switchboard, etc. Machinery can be inspected any time at the municipal power house, Ft. William, Ont. John Wilson is city engineer.

GALT, ONT., CAN.—A by-law authorizing an expenditure of $25,000 for the extension of the hydroelectric power system in Galt was passed by the ratepayers at an election held May 26. It is proposed to extend the residential lighting service, provide equipment for service to manufacturing and industrial plants and for extensions to the street-lighting system.

GODERICH, ONT., CAN.—Representatives from the town of Goderich and other villages in this vicinity have submitted a proposition to the Hydroelectric Power Commission to build a dam on the Maitland River near Goderich to supply power to generate electricity for Goderich and surrounding territory. The cost of the work is estimated at about $300,000. It is proposed that the municipalities of Goderich and Huron develop the power and distribute it on the same basis as the Hydroelectric Power Commission.

LONDON, ONT., CAN.—The City Council is reported to be considering the question of installing 200 additional street lamps.

OTTAWA, ONT., CAN.—It is reported that the Grand Trunk Railway Company is planning [illegible] shops, to cost about $15,000. Electrical power will be used.

JONQUIERE, QUE., CAN.—It is reported that the Price Brothers Company will be in the market for machinery and equipment for its new pulp mills to be erected in Jonquiere, consisting of water wheels, generators, penstocks, etc. The cost of the equipment is estimated at about $300,000. R. S. Kelsch is consulting engineer.

MAGOG, QUE., CAN.—Plans are being made for the construction of a new power plant to be built jointly by the town and the Dominion Textile Company. The proposed plant will supply electricity for lamps and motors for the town, and the surplus will be used at the mills of the Dominion Textile Company. R. S. Kelsch, Power Building, Montreal, Que., has been engaged as consulting engineer by the company. T. Pringle & Son will represent the town.

MONTREAL, QUE.—It is reported that a new power house and laundry will be erected for the Windsor Hotel. The power house will have an output of about 800 hp. R. S. Kelsch is consulting engineer.

MONTREAL, QUE., CAN.—The Canadian Light & Power Company has purchased the plant and holdings of the Central Light, Heat & Power Company, of Montreal, Que. The price paid for the property is said to be about $500,000. The plant of the Central company will give the Canadian Light & Power Company means to supply and distribute electricity in the city of Montreal immediately.

MONTREAL, QUE., CAN.—Tenders will be received by the Board of Commissioners of the city of Montreal, Que., until June 29 for furnishing and installing pumping machinery, rotary blower and cranes in and about one proposed low-lift pumping station of the filtration plant, consisting of fourteen centrifugal pumps, direct-connected to electric motors as follows: Four pumps having a capacity of 17,500 imperial gal. per minute each, 18 ft. lift; two pumps having a capacity of 11,600 imperial gal. per minute each, 18 ft. lift; two pumps having a capacity of 58000 imperial gal, per minute each, 18 ft. lift; two pumps having a capacity of 1500 gal. per minute each, 46 ft. lift; two pumps having a capacity of 330 imperial gal. per minute each, 15 ft. lift; two pumps having a capacity of 150 imperial gal. per minute each, 15 ft. lift; one rotary blower, direct-connected to an electric motor, having a capacity of 5000 ft. of air against 5 lb. per square inch pressure, and two 6-ton hand-operated traveling cranes. Plans and specifications are on file at the office of the Chief Engineer of Public Works, Montreal, and at the office of Hering & Fuller, 170 Broadway, New York, N. Y. L. N. Senecal is secretary of Board of Commissioners.

New Industrial Companies.

THE AUTOMATIC ELECTRIC LIGHT & POWER COMPANY, of Chicago, Ill., has been granted a charter, with a capital stock of $250,000, for the purpose of manufacturing electrical and other appliances. The incorporators are: M. W. Zabel, O. M. Wermich and H. Jones.

THE CENTURY RAILWAY EQUIPMENT COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $160,000, to do a general contracting business and to deal in railroad equipment.

THE ELECTRIC SMELTING & REFINING COMPANY OF MEXICO has filed articles of incorporation under the laws of the State of New Jersey, with a capital stock of $500,000. The company proposes carrying on the business of smelting and refining metals, etc. The incorporators are: J. H. Reid, L. P. Adams and C. H. Slease, all of Newark, N. J.

THE ELECTRIC SPIRITS AGING COMPANY, of Chicago, Ill., has been incorporated by M. C. Olson, C. W. Howe and B. Levering. The company is capitalized at $50,000 and proposes to carry on a business of aging and coloring liquors and spirits by an electrical process.

THE ELECTRIC WEIGHING COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $50,000, by E. H. Messiter, J. A. Byrne and H. G. Pierce, of New York, N. Y. The company proposes to manufacture electric weighing apparatus.

THE FRANCO-AMERICAN ELECTRIC NOVELTY COMPANY, of New York, N. Y., has been incorporated by John Smith, 318 East Thirty-first Street; Samuel I. Posen, 1130 Union Avenue, and Mordych L. Kaplan, of 1130 Union Avenue, all of Buffalo, N. Y. The company is capitalized at $40,000 and proposes to manufacture electrical novelties and supplies.

THE GRAFTON ELECTRICAL CONSTRUCTION COMPANY has been organized, with a capital stock of $5,000, by William Ile and others. The company proposes to do a general electrical contracting business.

THE LEE MACHINE COMPANY, of New Haven, Conn., has been incorporated with a capital stock of $150,000 by Henry B. Lee, of New London, Conn.; Winthrop G. Bushnell and Samuel C. Morehouse, of New Haven, Conn. The company proposes to manufacture the Lee steam turbine.

THE MOTOR EQUIPMENT MANUFACTURING COMPANY, of Kansas City, Mo., has been chartered, with a capital stock of $10,000, for the purpose of manufacturing motor equipment. The incorporators are: George B. Maegly, P. R. Toll, L. L. Seibel and others.

THE MURPHY EQUIPMENT COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $100,000, and proposes to manufacture and sell railway equipment, etc. The incorporators are: Albert C. Murphy, 600 West 142d Street; John H. Allen, 523 143d Street, New York, N. Y., and Franklin M. Patterson, 1124 Avenue C., Bayonne, N. J.

THE NATIONAL COMBUSTION COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $30,000, for the purpose of manufacturing boilers, furnaces, factory and foundry supplies. The incorporators are C. M. Gilpin, J. J. McKenna and J. M. Wright, all of New York, N. Y.

THE ST. LOUIS AUTOMOBILE & ENGINE COMPANY, of St. Louis, Mo., has been incorporated, with a capital stock of $50,000, by W. D. Williams, Charles F. Keene and Frank H. Braden. The company proposes to manufacture a patented rotary engine for automobiles and other purposes.

New Incorporations.

MANSFIELD, ARK.—Articles of incorporation have been filed for the Modern Electric Light & Power Company with a capital stock of $100,000. The officers of the company are: C. E. Brice, president; N. Hudson, vice-president; G. E. Gilmore, secretary, and J. C. Wheeler, treasurer.

EL MONTE, CAL.—The El Monte Light & Water Company has been chartered, with a capital stock of $25,000, by A. F. Snell, I. T. Baker, G. H. Coffin, S. Shirpser and M. Kauffman.

SACRAMENTO, CAL.—The Sacramento-Folsom Electric Railway Company has filed articles of incorporation with a capital stock of $1,000,000 to build an electric railway from Sacramento to Folsom, a distance of 22 miles, and a branch line, 4 miles in length, out from the Fair Oaks bridge. The incorporators are: Francis V. Keesling, Herman H. Grau, Ernest L. Brune, J. W. Cook and Otto Grau.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Sacramento-Sierra Power & Water Company with a capital stock of $2,000,000 by C. C. Chapman, C. L. Barsotti, John Muldoon, Dudley Smith and C. J. Lancaster.

MOODUS, CONN.—The Moodus & East Hampton Electric Railroad Company has been incorporated for the purpose of building an electric railway to connect Moodus, East Hampton and Marlboro Mills. E. W. Crocker, of Moodus, is interested in the project.

HAZLETON, IND.—Articles of incorporation have been filed for the Consolidated Light & Power Company with a capital stock of $15,000. The company proposes to supply electricity for lamps and motors in the towns of Hazleton and Potaka. The incorporators are: Ethelbert Curtner, Jesse D. Doty and James F. Breithaupt.

ELLISVILLE, MISS.—The Jones County Rural Telephone Company has been incorporated with a capital stock of $10,000 by W. N. Montgomery, J. O. Freeman and others.

MOBERLY, MO.—The Randolph County Gas & Electric Company has filed articles of incorporation with a capital stock of $100,000 by Thomas F. Fulkerson, Walter C. Duncan and James T. Menefee.

RALEIGH, N. C.—The North State Hydro-Electric Company has been incorporated with a capital stock of $300,000 by A. C. Wykoff, H. L. Parker and F. H. Briggs The company proposes to erect a hydroelectric power plant and transmission system.

TOWNSVILLE, N. C.—The Northwestern Telephone & Telegraph Company has been incorporated, with a capital stock of $10,000, by G. W. Morrow, J. J. White and W. B. Chapin.

FRANCIS, OKLA.—Articles of incorporation have been filed for the Francis Light & Power Company, with a capital stock of $10,000, by W. P. Chism, Albert Goetter, W. L. Shaffer and others.

CANBY, ORE.—The Willamette & Mollala Valley Railway Company has been chartered with a capital stock of $250,000 to build an electric railway from the Willamette River up the Mollala Valley to Canby, a distance of 12.5 miles. W. J. Lee, of Canby, Ore., is manager.

AVIS, PA.—The Avis Light, Heat & Power Company has been chartered with a capital stock of $5,000. The directors are: W. Harry Baker, of Harrisburg, Pa., treasurer; Charles E. Covert, of Harrisburg, Pa.; Thomas R. Harter, of Loganton, Pa.; Luther M. Patterson, C. Fred Kreamer, James M. Miller and W. H. Klapp, all of Lock Haven, Pa.

EPHRATA, PA.—The Denver & Ephrata Telephone & Telegraph Company has been chartered with a capital stock of $35,000 and the following directors: C. J. Martin, of Martindale, Pa., treasurer: A. N. Landis, Ephrata, Pa.; W. F. Brossman, Stevens, Pa., and others.

HARBOR CREEK, PA.—The Harbor Creek Township Electric Company has been granted a charter, with a capital stock of $10,000. The directors are: R. W. Mott, 2031 East Chelten Avenue, Philadelphia, Pa., treasurer; George Gray, Jr., of Wilmington, Del.; G. W. Wallace, and J. J. Hope, of Philadelphia, Pa.

HARRISBURG, PA.—The Willistown Electric Company has been incorporated, with a capital stock of $5,000, and the following directors: George V. Smith, 2029 Pine Street, Philadelphia, Pa., treasurer; John Eliason and Howard Kirk, all of Philadelphia, Pa.

HARRISBURG, PA.—The Northeast Borough Lighting Company has been chartered with a capital stock of $10,000. The directors are: R. W. Mott, 2031 East Chelten Avenue, Philadelphia, Pa., treasurer; W. Marriott Canby and G. W. Wallace, of Philadelphia, Pa.

HARRISBURG, PA.—A charter has been granted to the Bucks County Light Company, with a capital stock of $5,000. The directors are: Harry W. Stoll, Cape May Court House, N. J., treasurer; John F. Lederach, of Lederach, Pa., and Fred H. Souder, of Lansdale, Pa.

HARRISBURG, PA.—The Northeast Township Company has filed articles of incorporation, with a capital stock of $10,000. The directors are: R. W. Mott, 2031 East Chelten Avenue, Philadelphia, Pa., treasurer; W. Marriott Canby, F. C. McCown, Jr., of Germantown, Philadelphia, Pa., and E. C. Batchelor, Mount Airy, Philadelphia, Pa.

HARRISBURG, PA.—Articles of incorporation have been filed with the Secretary of State for the Waldameer Electric Light Company, with a capital stock of $10,000. The directors are: R. W. Mott, 2031 East Chelten Avenue, Philadelphia, Pa, treasurer; William R. Wenstrom, of Philadelphia, Pa., and Joseph E. Mager, of Haddonfield, N. J.

HARRISBURG, PA.—Charters have been granted by the Secretary of State to the East Goshen Electric Company; the East Whiteland Electric Company, and the West Whiteland Electric Company. Each company is capitalized at $5,000 and the directors are: George V. Smith, 2029 Pine Street, Philadelphia, Pa., treasurer; Howard Kirk and John Eliason, all of Philadelphia, Pa.

HARRISBURG, PA.—Charters have been granted by the Secretary of

State to the Clinton Light Heat & Power Company, the Patterson-Scootac Light, Heat & Power Company, the Susquehanna Light, Heat & Power Company and the West Branch Light, Heat & Power Company. Each company is capitalized at $5,000 and the directors are: W. Harry Baker, of Harrisburg, Pa., treasurer; Charles E. Covert, of Harrisburg, Pa.; Thomas R. Harter, of Loganton, Pa.; Luther M. Patterson, C. Fred. Kreamer, James M. Miller and W. H. Klapp, all of Lock Haven, Pa.

HARRISBURG, PA.—Charters have been granted by the Secretary of State to the following companies: The Warwick Township Electric Company; the Warminster Township Electric Company; the Whitpain Township Electric Company; the Upper Dublin Township Electric Company; the Southampton Township Electric Company, and the Horsham Township Electric Company. Each company is capitalized at $5,000, and the directors are: W. T. Robinson, of Philadelphia, Pa., treasurer; M. W. Stroud, of Philadelphia, Pa., and R. R. Van Horn, of Plymouth, Pa.

HARRISBURG, PA.—Charters have been granted by the Secretary of State to the following companies: The West Wyoming Electric Company; the Warrior Run Electric Company; the Union Township Electric Company; the Shickshinny Electric Company; the Pringle Township Electric Company; the Larksville Electric Company; the Lehman Township Electric Company; the Lake Township Electric Company; the Jackson Township Electric Company; the Hunlock Township Electric Company, and the Gas Company of the West Side. Each company is capitalized at $5,000 and the directors are: W. T. Robinson, of Philadelphia, Pa., treasurer; M. W. Stroud, of Philadelphia, Pa., and W. C. Anderson, of Kingston, Pa.

HARRISBURG, PA.—Charters have been granted by the Secretary of State to the following electric companies: The Albion Electric Company, the Beechwood Electric Company, the Diamond Electric Company, of Washington Township, Pa.; East Allen Electric Company; Excelsior Electric Company, of Plainfield Township; Equitable Electric Company, of Whitehall Township; Greenwood Electric Company; Hazard Electric Company; Lower Mount Bethel Electric Company; Lehigh Navigation Electric Company; Moore Township Electric Company; Newquehoning Electric Company; North Whitehall Electric Company; Oakdale Electric Company; Orchard Electric Company; Panther Creek Electric Company; Primrose Electric Company; Standard Electric Company, of Washington Township; Skidmore Electric Company; Star Electric Company; South Whitehall Electric Company; Upper Nazareth Electric Company; Upper Mount Bethel Electric Company; Upper Macungie Electric Company, and Upper Milford Electric Company. Each company is capitalized at $10,000 and the directors are: H. F. Baker, of Germantown, Pa., treasurer; W. A. Lathrop, of Dorrance, Pa., and R. H. Wilbur, of St. Davids, Pa.

HOMESTEAD, PA.—The Mahan Electric Company has filed articles of incorporation with the Secretary of State with a capital stock of $5,000. The directors are: F. J. Taylor, of Homestead, Pa., treasurer; A. E. DuBois, of Pittsburgh, Pa., and A. L. Davis, of Oakland, Pa.

McKEESPORT, PA.—Articles of incorporation have been filed for the Penn Borough Electric Company with a capital stock of $5,000. The directors are: H. C. Miller, of McKeesport, Pa., treasurer; C. W. Scheck, of Mount Lebanon, Pa.; and F. J. Taylor, of Homestead, Pa.

MOUNTAIN, PA.—The Mountain Electric Light, Heat & Power Company has been chartered with a capital stock of $10,000. The directors are: Walter W. Perkins, of Philadelphia, Pa., treasurer; Scott S. Crane, of Altoona, Pa.; C. L. S. Tingley, of St. Davids, Pa.; Frank T. Pryor, Jr., and Joseph M. Walsh, of Philadelphia, Pa.

MOUNT CARMEL, PA.—The Mount Carmel Light, Heat & Power Company has been incorporated with a capital stock of $50,000. The directors are: B. F. Christ, of Mount Carmel, Pa., treasurer; J. E. Nastress, C. H. Robins, C. L. Cleaver and C. A. Goldschmidt, all of Mount Carmel.

NORRISTOWN, PA.—The Tredyffrin Electric Company has been chartered with a capital stock of $5,000. The directors are: Herbert H. Ganser, of Norristown, Pa., treasurer; Daniel A. Bertolette and Montgomery Evans, of Norristown, Pa.

PITTSBURGH, PA.—The Beaver Northern Street Railway Company has been chartered with a capital stock of $30,000. The directors are: J. S. Herron, of Pittsburgh, Pa., president; E. A. Morton, of Dravosburg, Pa.; F. J. Lobert, John F. Hayes and Charles Pederson, all of Pittsburgh, Pa.

SHAMOKIN, PA.—The Black Diamond Electric Company has filed articles of incorporation with the Secretary of State with a capital stock of $5,000.

SMITHTON, PA.—The Smithton Light, Heat & Power Company has been incorporated with a capital stock of $20,000. The directors are: Van A. Reed, Jr., of Elizabeth, Pa., treasurer; Joseph Boyes, of Smithton, Pa.; Thomas H. Verner, of McKeesport, Pa.; George M. Keefer, of Pittsburgh, Pa., and David E. Brown, of Cresson, Pa.

STEELTON, PA.—The Swatara Electric Light Company has been granted a charter with a capital stock of $5,000. It is understood that the company proposes to erect a plant in Steelton. The incorporators are: J. W. Carpenter, W. T. Reynolds and Fred E. Scott, all of Scranton. The office of the company is located in Scranton.

WARREN, PA.—Articles of incorporation have been filed for the Warren Light & Power Company with a capital stock of $10,000. The directors are: C. T. Conarro, of Warren, Pa., treasurer; R. G. Chapel, F. B. Jackson and C. B. Ayers, all of Warren, Pa.

Personal.

MR. C. A. TUPPER, of Milwaukee, Wis., has returned home from a lengthy trip abroad, during which he visited North Africa and all of Europe west of Russia, except the Scandinavian [illegible].

MR. HENRY FLOY delivered an illustrated lecture on May 25 before the Cornell University Club, New York, on the subject of the Panama Canal, which he recently visited with the party of members of the American Society of Civil Engineers.

MR. DONALD MURRAY is the author of a paper entitled "Practical Aspects of Printing Telegraphy," presented at the May meeting of the British Institution of Electrical Engineers. The paper contains a complete exposition of the latest type of the Murray printing telegraph.

MR. EVAN PARRY, who has been associated with Dr. H. F. Parshall during the past eighteen years, has been appointed electrical adviser to the New Zealand government. On May 6 a farewell dinner was tendered to Mr. Parry in London, at which eighty of [illegible] men of Great Britain were present.

PROF. RICHARD MULLER, head of the department of electrical engineering at the University of Quito, has been appointed by the government of the Republic of Ecuador as its delegate to the Turin International Electrical Congress. Prof. Muller, who also acts as consulting engineer to the government, sailed from Guayaquil May 29 for New York, where he will embark, after a short stay, for Italy.

MR. L. H. NEUBERT manager of the Redwood district of the Pacific Gas & Electric Company, will on June 1 take charge of the company's new-appliance department, with headquarters at San Francisco. To fill the vacancy caused by his appointment, E. W. Florence, district manager of the Pacific Gas & Electric Corporation at Fresno, has been transferred to the Redwood district. W. H. Henderson, manager of the Colusa district, has been transferred to Fresno.

MR. ALTEN S. MILLER has tendered his resignation as president and general manager of the Union Electric Light & Power Company, of St. Louis, to rejoin Dr. Alex C. Humphreys, of Hoboken, N. J., with whom he was associated a number of years ago. Mr. Miller's resignation is to take effect July 1, after a service of two years with the Union company. A farewell banquet will be given in his honor at the Southern Hotel, St. Louis, June 27, by the St. Louis League of Electrical Interests and the local branch of the National Electric Light Association.

MR. C. H. ANDREWS has been appointed manager in charge of the North Carolina Public Service Company's properties at Greensboro and High Point, N. C., furnishing electric-lighting, gas and street-railway service in these cities. Mr. Andrews was graduated from Purdue University in 1908, and entered the employ of the North Carolina company two years ago as a meter reader and tester. Since then he has been successively placed in charge of the electric-lighting, commercial and gas departments, finally succeeding Mr. E. C. Deal as local manager, following the latter's transfer to Atlanta, Ga.

MR. ROBERT T. LINCOLN, first vice-president of the Commonwealth Edison Company and a director in the Chicago Telephone Company, on May 18 presented his resignation as president of the Pullman Company, a position which he has held since 1897. Following the acceptance of his resignation, Mr. Lincoln was elected chairman of the board of directors of the company. Mr. Lincoln, who is now sixty-eight years of age, is a son of Abraham Lincoln and was born at Springfield, Ill., August 1, 1843. During the civil war he served as captain under General Grant. He was admitted to the Chicago bar in 1867. From 1881 to 1885 he was Secretary of War, and from 1889 to 1893 served as United States Minister to Great Britain.

MR. GEORGE R. FIELD, assistant general manager of the Great Western Power Company, has resigned his position, to take effect July 1. This follows the resignation of H. R. Sinclair as general manager of the same company, announced recently, Mr. Field having decided on his action at the same time. Mr. Sinclair and Mr. Field will retain a connection with the company in its construction work contemplated on the Feather River, as the plans for this work were [illegible] and it is the desire of the officials of the company that the actual work be done under their direction. In addition to his other duties, Mr. Field has had general direction of the construction work of the company for the past two years, including the large concrete dam at Big Bend, Feather River, finished last November.

MR. G. H. STICKNEY has been placed in charge of illuminating engineering work at the incandescent lamp sales office of the General Electric Company at Harrison, N. J. Mr. Stickney graduated from the electrical engineering course at Cornell University in 1896, and immediately thereafter entered the student course offered by the General Electric Company at Schenectady, N. Y. In February, 1898, he was transferred to the Lynn (Mass.) factory of the company. As a result of some suggestions tending to simplify and improve the photometric work, Mr. Stickney was placed in charge of the photometric tests under Mr. W. D. A. Ryan and has devoted his time to the solution of problems relating to both arc and incandescent lighting. He has assisted Mr. Ryan in the design of light-measuring instruments as well as diffusers and reflectors and was responsible for the introduction of the radial reflector for street lighting. For the past three years a large part of his time has been devoted to consulting illuminating engineering.

MR. GEORGE BELL, formerly with the Westinghouse Electric & Manufacturing Company, has become associated with the Duncan Electric Manufacturing Company, of Lafayette, Ind., as sales manager. Mr. Bell prepared for college at Mercersburg Academy at Mercersburg, Pa., and took the electrical engineering course at Lafayette College, at Easton, Pa. Upon leaving college he entered the apprenticeship course of the Westinghouse Electric & Manufacturing Company, and after spending a year and a half in its shops entered the sales department, spending some time in the offices at East Pittsburgh, and later joined the sales force in the Atlanta office. After spending eight months there he was transferred to the Cincinnati office. In the fall of 1906 Mr. Bell was sent to Indianapolis to build up his company's business in Indiana, and the following spring opened the Indianapolis office, where he remained in charge until he resigned his position in October, 1910, to get some experience in central-station work. Mr. Bell has acquired an interest in the Duncan Electric Manufacturing Company.

Obituary.

MR. JAMES RUTHERFORD GORDON died from heart disease May 16 at Savannah, Ga. Mr. Gordon was born in Canada fifty years ago and was connected with the sales department of the Westinghouse Electric & Manufacturing Company for a period of twenty-five years, acting as district manager for the Southeastern States with headquarters in Atlanta for twelve years. In 1908 he resigned to take charge of the power apparatus department of the Western Electric Company in the Southern territory, acting as power apparatus manager. After a year and a half with this company, he resigned to take up hydroelectric development work. He is survived by his wife and a son, John H. Gordon. The interment took place at McKeesport, Pa., May 21.

Trade Publications.

OIL-BREAK SWITCHES FOR MANHOLE SERVICE.—The General Electric Company in Bulletin No. 4831 describes briefly a type of oil switch suitable for installing in manholes. These switches are made single, double or triple-pole, single-throw, and are for use on circuits on voltages up to 7500. The normal current rating is 200 amp.

FLOW METERS.—Bulletin Nos. 4826 and 4827, just issued by the General Electric Company, describe that company's water and air-flow meters, respectively. The water-flow meter provides a means of obtaining accurate information which will show the amount of water pumped, consumed or distributed, while the air-flow meter provides accurate information to be obtained as to the exact amount of air compressed or distributed.

SWITCHBOARD INSTRUMENTS.—The General Electric Company has recently issued Bulletin No. 4825, which illustrates and describes a line of compact, accurate and moderate-priced instruments for use on alternating-current and direct-current switchboards. The bulletin contains dimension diagrams and also illustrations showing the actual size of the meter scales. These illustrations will enable a prospective customer to see at a glance the ease with which readings may be made.

DRAWN-WIRE FILAMENT MUTIPLE LAMPS.—Bulletin 13 A of the engineering department of the National Lamp Association has for subject "Mazda" multiple-filament lamps with drawn-wire filaments, which are made for 100 volts, 125 volts and 200 volts, 25 watts to 500 watts. The various forms of bulbs are shown in good illustrations, and curves are given showing relation of life to candle-power, candle-power to voltage, and comparing the new lamp to older types. Information is also contained relating to the use of the burner in illumination calculations.

PULSOMETERS.—"The Pulsometer" is the title of an attractive handbook recently issued by the Pulsometer Steam Pump Company, of 17 Battery Place, New York City. The book is illustrated with numerous recent photographs showing the pulsometer employed for different kinds of work, and explains fully the operation and construction of the appparatus. Paragraphs explain the special adaptability of the Pulsometer for a variety of uses and the tables on pipe sizes, loss of head due to friction in pipes and other data on the flow and pumping of water should interest engineers.

ALTERNATING-CURRENT SWITCHBOARD PANELS.—The General Electric Company has just issued Bulletin No. 4819, which is devoted to the subject of alternating-current switchboard panels. The panels described are equipped with oil switches and are suitable for general use in central stations and isolated plants. They are designed for use with one set of busbars, to which all generators and feeders are connected by means of single-throw oil switches, and suitable provision is made for parallel operation. They are for use on three-phase three-wire circuits of 480 volts and 600 volts and 25 cycles to 60 cycles.

ELECTRICAL SUPPLIES AND APPLIANCES.—The Electric Shop, Michigan Avenue and Jackson Boulevard, Chicago, has just issued a handsome 9-in x 12-in., seventy-five-page mail-order catalog of its stock of electrical appliances, devices, fixtures, lamps, etc., for the benefit of patrons living at a distance from Chicago who may wish to order goods. The catalog is very complete and is profusely illustrated, enabling purchasers to select articles with almost the same judgment as by a personal visit to the Electric Shop's own lavish display. In formulating arrangements for mail-order service it has been the aim of the Electric Shop management to provide out-of-town electrical consumers with facilities for selection from an ample stock, at the same time relieving local central stations of the expense and annoyance of carrying their own electric-appliance displays. Copies of the new mail-order catalog have been mailed to a selected list of electrical consumers in a number of the larger cities of the country.

BUSINESS NOTES.

THE REYNOLDS ELECTRIC FLASHER MANUFACTURING COMPANY has moved its Chicago office to 617 West Jackson Boulevard.

NEUHAUSEN & COMPANY.—The firm name of McGrath & Neuhausen Company, dealer in electrical securities, Portland, Ore., has been changed to Neuhausen & Company.

MR. H. A. HUNT has been appointed Eastern sales agent of the Edgar Allen American Manganese Steel Company, with headquarters at New Castle, Del., which appointment was made to fill a vacancy caused by the resignation of Mr. V. W. Mason, Jr.

THE RIGGS & SHERMAN COMPANY has been retained by the city of Grand Haven, Mich., to make an appraisal of the municipal water and light plant. The same company has been engaged by the village of Dresden, Ohio, as engineer for the proposed street improvement.

THE WILLARD STORAGE BATTERY COMPANY has moved its Detroit branch from 227 Jefferson Avenue to 1191 Woodward Avenue, where a salesroom and fully equipped battery repair department will be ready for business after May 15. This branch is in charge of Mr. Max G. Hilman.

THE BAIRD-OSTERHOUT COMPANY, Philadelphia, announces the removal of its offices from 36 South Sixteenth Street to the Stafford Building, 1112 Chestnut Street, Philadelphia. This company represents in the Philadelphia district the Banner Electric Company, Sprague Electric Company, Semet-Solvay Company, and Williams Gauge Company.

AGENS & HOPPER.— The corporation of Agens & Hopper has been formed under the laws of New Jersey to carry on the business formerly conducted by the Electric Motor & Equipment Company. The president is S. H. M. Agens, formerly connected with the Electric Motor & Equipment Company, and Mr. Roland I. Hopper is treasurer. The new company will act as jobber of lighting, power and signaling supplies, with offices at 219 Market street, Newark, N. J.

THE PAGE & HILL COMPANY, dealer in cedar posts and poles, Minneapolis, Minn., has completed the installation of a cedar pole-treating plant in its Minnesota transfer yard. Remarkable savings in the yearly cost of pole-line maintenance may be made by proper treatment of poles, it having been demonstrated that suitable preservation will extend the effective life of the pole by two or three times. The demand for treated poles is increasing, and to meet these requirements the Minnesota yard plant has been established.

BURGOON-MATTHEWS ELECTRIC COMPANY.—C. E. Burgoon and H. W. Matthews have formed the Burgoon-Matthews Electric Company with headquarters at Atlanta, Ga. The company will conduct a general wholesale and retail electrical supply business, and will represent a number of manufacturers of power-station equipment. Mr. Burgoon was formerly chief engineer of the Federal Building, Chicago, Ill. Mr. Matthews was formerly associated with the Westinghouse Electric & Manufacturing Company as an electrical engineer.

WOODMANSEE, DAVIDSON & SESSIONS, engineers, Chicago, have been incorporated to do general consulting work in electrical and mechanical engineering. The offices of the company, commencing June 1, will be at 1048 First National Bank Building. The members of the firm are Mr. Fay Woodmansee, for nine years in charge of electrical work for Sargent & Lundy; Mr. C. J. Davidson, for thirteen years chief engineer of the Milwaukee Electric Railway & Light Company; and Mr. E. O. Sessions, who has been connected with the General Electric Company and subsidiary companies for the past twenty years.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Geo. S. Emery, 11 N. Royal St., Mobile, Ala. Annual convention in November.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next semi-annual meeting at Toronto, Canada, September or October, 1911.

American Electro-Therapeutic Association. Secretary, Dr. J. Willard Travell, 27 East 11th St., New York. Next meeting at Philadelphia, Pa., Sept. 5, 6 and 7, 1911.

American Institute of Consulting Engineers. Secretary-Treasurer, Eugene W. Stern, 103 Park Ave., New York City. The Council meets the first Friday of every month.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September. Annual convention, Chicago, June 26-30, 1911.

American Electric Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia. Annual convention, Atlantic City, N. J., October 9-13, 19[illegible]

American Electric Railway Engineering Association. Secretary, Norman Litchfield, Interborough Rapid Transit Company, New York. Annual convention, Atlantic City, N. J., Oct. 9-13, 1911.

American Electric Railway Association. Secretary, H. C. Donecker, Engineering Societies Building, 29 West 39th St., New York. Annual convention, Atlantic City, N. J., Oct. 9-13, 1911.

American Physical Society. Secretary, Ernst Merritt, Cornell University, Ithaca, N. Y.

Arkansas Association of Public Utility Operators. Secretary, W. J. Thorpe, Little Rock, Ark.

Association of Iron and Steel Electrical Engineers. Secretary, James Farrington, Steubenville, Ohio.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, 135 Adams St., Chicago. Next meeting, Boston, Mass., June, 1911.

Association of Railway Electrical Engineers. Secretary, J. Andreucetti, Chicago & Northwestern Railway, Chicago. Next annual meeting (Hotel La Salle, Chicago), November 6 to 10, 1911. Semi-annual meeting, Washington, 1911.

Association of Edison Illuminating Companies. Secretary, N. T. Wilcox, Lowell, Mass.

Canadian Electrical Association. Secretary, T. S. Young, 220 King St. West, Toronto, Can.

Colorado Electric Light, Power & Railway Association. Secretary, F. D. Morris, 323 Hagerman Building, Colorado Springs, Col. Annual convention, Glenwood Springs, Col., September 13-15, 1911.

Electric Vehicle Association of America. Secretary, Harvey Robinson, 124 West 42d St., New York. Meetings, fourth Tuesday of each month.

Electric Club, Chicago. Secretary, N. F. Obright, 1500 American Trust Bldg., Chicago. Meets every Wednesday noon, 303 Wabash Ave., Chicago.

Electrical Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York. Annual meeting at Buffalo, N. Y., June 20, 1911.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursday of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Ernest S. Cowie, 1413 Grand Ave., Kansas City, Mo. Next meeting in Kansas City, Saturday, June 10, 1911.

Electrical Salesmen's Association. Secretary, Francis Raymond, 125 Michigan Ave., Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Credit Association of Chicago. Secretary, Frederic P. Vose, Marquette Building, Chicago. Annual meeting Chicago, November 2, 1911.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Credit Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of directors meets second Thursday of each month.

Empire State Gas and Electric Association. Secretary, Charles H. B. Chapin, Engineering Societies Building, 29 West 39th St., New York.

Florida Electric Light & Power Association. Secretary, H. C. Adams, West Palm Beach, Fla.

Illinois State Electrical Association. Secretary H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, Engineering Societies Building, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago. Annual convention, Chicago, 1911.

Independent Electrical Contractors' Association of Greater New York. Secretary, L. H. Woods, 2355 Jerome Ave., New York.

Indiana Electric Light Association. Secretary, J. V. Zartman, Indianapolis, Ind. Annual meeting, August 23 and 24, 1911.

Internal Combustion Engine Association. Secretary, Chas. Kratch, 416 W. Indiana St., Chicago. Meetings, second Friday of each month.

International Association of Municipal Electricians. Secretary, C. R. George, Houston, Tex. Next convention at Ryan Hotel, St. Paul, Minn., Sept. 12-15, 1911.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

Iowa Electrical Association. Secretary, W. N. Keiser, Dubuque, Ia.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Independence, Kan., Sept. 21 and 22, 1911.

Maine Electrical Association. Secretary, Walter S. Hyman, Waterville, Maine.

Massachusetts Street R[illegible]. Secretary, C[illegible] S. Clark, 70 Kilby St., Boston, Ma[illegible]. Meets [illegible] Wednesday of each month, except July and August.

Michigan Electric Association. Secretary, Herbert Silvester, 18 Washington Boulevard, Detroit, Mich. Annual convention on board the S.S. Minnesota, June 19-22, 1911.

Minnesota Electrical Association. Secretary, T. C. Gordon, Little Falls, Minn.

Mississippi Electric Association. Secretary, A. H. Jones, McComb City Light and Power Co., McComb City, Miss. Annual convention, Gulfport, Miss., June 20-21, 1911.

Missouri Electric, Gas, Street Railway & Water Association. Secretary, N. J. Cunningham, Springfield Gas & Electric [illegible], Springfield, Mo.

National Arm, Pin & Bracket Association. Secretary, [illegible] B. Magers, Madison, Ind.

National District Heating Association. Secretary, D. L. Gaskill, Greenville, Ohio. Third convention, Fort Pitt Hotel, Pittsburgh, June 6-8, 1911.

National Electric Contractors' Association of the United States. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Niagara Falls, July 19, 1911.

National Electric Light Association. Executive Secretary, T. C. Martin, Engineering Societies Building, 33 West 39th St., New York.

National Electric Light Association, New England Section. Secretary, Miss O. A. Bursiel, 39 Boylston St., Boston, Mass.

National Electric Light Association, Pennsylvania Section. Secretary-Treasurer, Van Dusen Rickert, Pottsville, Pa.

National Electric Light Association, Nebraska Section. Secretary-Treasurer, S. J. Bell, David City, Neb.

National Electric Light Association, Georgia Section. Secretary-Treasurer, H. M. Corse, Columbus Railroad Company, Columbus, Ga.

National Electric Light Association, Baltimore Section. Secretary, A. W. Hawkes, Jr., Continental Building, Baltimore, Md.

National Electrical Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

National Electrical Credit Association. Secretary, Frederic P. Vose, 343 Marquette Bldg., Chicago.

National Fire Protection Association. Secretary, R. Sweetland,, 141 Milk St., Boston, Mass. Next biennial meeting, March, 1913.

National Independent Telephone Association. Secretary, Joseph B. Ware, Grand Rapids, Mich.

Nebraska Electrical Association. Secretary, J. Bell, David City, Neb.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New Orleans Electrical Contractors' Association. Secretary, L. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

New York Electrical Society. Secretary, G. H. Guy, Engineering Societies Building, 33 West 39th St., New York.

Northwest Electric Light & Power Association. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July 25-28, 1911.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, Prof. I. E. Sanborn, Ohio State University, of Columbus, Ohio.

Order of Rejuvenated Sons of Jove. Mercury (Secretary), R. M. Van Vleet, 1157 Monadnock Bldg., Chicago, Ill. Annual meeting, Denver, Col., Oct. 16-18, 1911.

Pittsburgh Electric Booster Club. Recording Wattmeter, O. R. Rombach, 919 Liberty Ave., Pittsburgh, Pa. Meetings, fourth Monday of each month.

Society for the Promotion of Engineering Education. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y. Annual meeting at Pittsburgh, June 27, 28 and 29, 1911.

Society of Wireless Telegraph Engineers. Secretary F. B. M[illegible]e, 39 Trinity Place, Boston, Mass. Monthly meeting, first Saturday of each month, at the Massachusetts Institute of Technology, Boston.

Southwestern Electrical & Gas Association. Secretary, D. G. Fisher, 1316 Commerce St., Dallas, Tex.

Street Railway Association of the State of New York. Secretary, C. G. Reel, Kingston, N. Y. Annual meeting at Cooperstown, June 27 and 28, 1911.

Vermont Electrical Association. Secretary-Treasurer, A. B. Marsden, Manchester, Vt.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 145 Monroe St., Chicago, Ill.

Western Society of Engineers. E[illegible] S[illegible], f[illegible] Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Wireless Institute. Secretary, Alfred N. Goldsmith, College of the City of New York, New York.

Wisconsin Electrical Association. Secretary, George Allison, Stephenson Building, Milwaukee, Wis. Next annual meeting, Milwaukee, January, 1912.

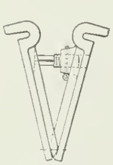
Weekly Record of Electrical Patents

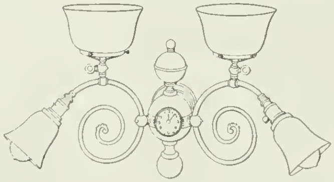
UNITED STATES PATENTS ISSUED MAY 23, 1911.
[Conducted by W. F. Bissing, Patent Law, 2 Rector St., New York City.]

13,244. AUTOMATIC PLAYING APPARATUS FOR MUSICAL INSTRUMENTS; T. B. Powers, New York, N. Y., and M. R. Jewell, Chicago, Ill. App. filed March 1, 1908. Electromagnets operate the keys and are controlled by a music sheet arranged in a box on the table near the instrument.

992,768. ELECTRIC METER; J. Harris, Rensselaer, N. Y. App. filed Sept. 24, 1906. Permanent magnet type of meter with movable armature coil and scale and pointer with a closed conductor member to constitute a dampening device.

992,791. WIRELESS TELEGRAPHY; J. F. McElroy, Albany, N. Y. App. filed Oct. 4, 1905. Sending and receiving conductors with two or more aerials separated a wave length and electrically connected and another series of aerials separated a wave length and arranged alternately with the first series and station apparatus in circuit with both series, so as to superpose the waves.


992,846 — Field Magnet Structure.


992,992.—Combined Lamp Support and Automatic Timing Mechanism.

992,817. METHOD OF AMPLIFYING ELECTRIC CURRENTS; L. W. Southgate, Worcester, Mass. App. filed July 10, 1908. An alternating-current polyphase generator to the field of which a generating current is applied, a disk rotating with the armature of said generator, coils arranged circularly around said disk and connected electrically to the coils of the armature so that a rotating magnetic field will be produced which will rotate in opposition to the rotation of the disk, and a coil held stationary and placed in said field.

992,836. PARTY-LINE RINGING SYSTEM; C. S. Winslow, Chicago, Ill. App. filed Sept. 16, 1908. Ringing-key circuit with a plurality of ringing-key contacts associated with the ringing key, but excluded from the talking circuit during conversation.

992,846. FIELD-MAGNET STRUCTURE; A. J. Brown, Milwaukee, Wis. App. filed April 19, 1909. For counteracting centrifugal force by means of bracing plates between adjacent poles, which are braced against the coils to support them.

992,851. CONTROLLING DEVICE; H. W. Cheney, Milwaukee, Wis. App. filed Sept. 13, 1909. Avoids the necessity of moving the rheostat arm over the entire set of contacts by providing a variable resistance and a switch to change the line connection from one end of the resistance to the other, thus cutting it out or in as desired, the reverse movement of the arm repeating the action.

992,852. MOTOR-CONTROL SYSTEM; H. W. Cheney, Milwaukee, Wis. App. filed April 15, 1910. Liquid rheostat having a casing containing electrodes with means for pumping a liquid into it and a vertically adjustable overflow weir for determining the height of the liquid, together with means for varying the height of the electrodes with relation to the liquid level.

992,870. CENTRIFUGAL SWITCH; C. B. Hanright, Cambridge, Mass. App. filed June 14, 1909. For single-phase induction motors for cutting auxiliary windings in and out at speed, consisting of a pair of contacts on a rotary shaft controlled by pivoted weighted arms.

992,875. METHOD OF TREATING REFRACTORY ELECTRIC-FURNACE PRODUCTS G. N. Jeppson, Worcester, Mass. App. filed Aug. 21, 1909. For treating carborundum by roasting it under oxidizing conditions and separating the impurities.

992,883. DYNAMO-ELECTRIC MACHINE; A. F. Kwis, Cleveland, Ohio. App. filed May 13, 1909. A housing with spaced ribs so that the dynamo is cooled by air forced through the stator core.

992,943. DYNAMO-ELECTRIC MACHINE; W. A. Dick, Pittsburgh, Pa. App. filed Dec. 31, 1908. An armature with two sets of collector rings and conductors between them, each comprising two offset parts, and flexible connections between the parts, so as not to interfere with the expansion and contraction of the rods.

992,951. PROCESS FOR THE MANUFACTURE OF DUCTILE ELECTROLYTIC IRON; F. Fischer, Berlin, Germany. App. filed Oct. 23, 1909. Precipitates the iron from the electrolyte by electrolysis at a temperature over 70 deg. C. and adds calcium chloride, a hygroscopic salt.

992,952. PROCESS FOR THE MANUFACTURE OF DUCTILE ELECTROLYTIC IRON; F. Fischer, Charlottenburg, Germany. App. filed Aug. 29, 1910. Adds to the electrolyte the salts of sodium chloride so as to produce a hygroscopic double salt of sodium and iron.

992,965. DYNAMO-ELECTRIC MACHINE; A. Kingsbury, Pittsburgh, Pa. App. filed Jan. 11, 1909. The collector rings are mounted upon resilient seats to provide for their expansion.

992,980. OZONE-PRODUCING APPARATUS; O. Patin, Paris, France. App. filed Sept. 29, 1910. Two concentrically positioned tubes with an annular space between, an electrode within the inner tube and a second electrode or coil of wire spirally wound about the outer tube, water flowing through the inner tube, which is ozonized.

992,992. COMBINED LAMP-SUPPORT AND AUTOMATIC TIMING MECHANISM; G. H. Rupley, Schenectady, N. Y. App. filed Aug. 10, 1906. The clock is driven by an electric motor and a rotary contactor is driven by the clock mechanism to close the motor circuit at intervals for winding.

992,993. WEATHERPROOF ELECTRICAL RECEPTACLES; F. J. Russell, New York, N. Y. App. filed March 18, 1908. For cut-out and connecting plugs, with a spiral plug holder lying within the chambered body and having both ends seated on the body and serving as supports for the holder and a line wire terminal mounted on the body and retaining the holder in place.

993,024. COHERER; E. J. Burke, New York, N. Y. App. filed Oct. 29, 1906. The cohering material is fed through a funnel to a vertical tube, passing a plurality of electrodes.

993,034. MEANS AND METHOD OF DEMAGNETIZING PAPER; F. R. Craig, Hamilton, Ohio. App. filed Jan. 9, 1908. For discharging static electricity from the paper by means of a gas burner on a reciprocating carriage, which carriage delivers the sheet. The paper is thus subjected to heat on its delivery from the press.

993,046. SYSTEM OF TRANSMITTING SIGNALS ELECTRICALLY THROUGH CONDUCTORS; F. Fisher, New York, N. Y. App. filed Feb. 3, 1910. For relieving the receiving coil from inductive disturbances, the receiver being connected with the ground and the line on opposite sides of the receiver being connected with the ground through shunt circuits, including a resistance and condenser coupled in series.

993,062. ELECTROSTATIC VOLTMETER; H. E. Heath, Hartford, Conn. App. filed July 6, 1908. A pair of terminal plates with elastic insulating material between them and extending beyond the edges and an indicator operated by the movement of the elastic material.

993,076. COLLECTOR RING FOR DYNAMO-ELECTRIC MACHINES; A. Kingsbury, Pittsburgh, Pa. App. filed Sept. 6, 1910. The collector ring is divided into inner and outer rings, with an interposed resilient spacing means.

993,098. SERVICE TERMINAL BLOCK; G. E. Palmer, Boston, Mass., and W. E. McCoy, New York, N. Y. App. filed Jan. 22, 1910. A service terminal block with a fuse, a switch and a current-measuring device, through which the line and load circuit is established with a by-pass around the fuse and measuring device so that either device may be removed without interrupting the service connection.

993,099. METER-CONNECTION BLOCK; G. E. Palmer, Hartford, Conn. App. filed Oct. 14, 1910. Combined fuse and test connection block for use with either two-wire or three-wire meters, its construction being such that the connections used for test purposes on two-wire meters are also used for testing three-wire meters.

993,105. ELECTRIC SMELTING AND REFINING APPARATUS; J. H. Reid, Newark, N. J. App. filed Aug. 18, 1910. Vertical furnace with inclined arc-producing electrodes and means for dropping the material upon the arc, from which it passes in smelted condition to a lower chamber.

993,123. METER AND OUTLET BOX; J. G. Swallow and W. E. McCoy, New York, N. Y. App. filed Feb. 6, 1909. The box carries the meter and incloses the connection block to prevent tampering, the cover being supported on parallel links.

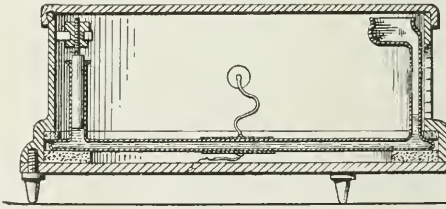
993,157. COMPOSITION FOR TREATING MOLDS USED IN THE ELECTROTYPING ART; G. E. Dunton, New York, N. Y. App. filed Sept. 6, 1910. For treating wax electrotype molds by a solution of soda, potash, black lead and glycerine.

993,168. TEMPERATURE INDICATOR OR ALARM; M. L. Huberman, Los Angeles, Cal. App. filed Dec. 17, 1908. Thermostatic alarm, consisting of diaphragm walled chamber which expands and contracts under heat and cold and controls circuit connections to ring a bell.

993,204. BRUSH HOLDER FOR ELECTRIC METERS; G. A. Scheeffer, Indianapolis, Ind. App. filed Jan. 14, 1910. For removing and replacing the brushes of the meter without changing adjustment by mounting them upon a rocker arm between adjustable stops.

993,266. TRAIN-CONTROLLING SYSTEM; W. O. Medford, Spokane, Wash. App. filed March 14, 1910. Applies the brakes when a train enters and occupies block, the first train setting a trip and the control being effected by circuit closers actuated by a wheel of the train.

993,310. ELECTRIC MOTOR METER; P. May, Charlottenburg, Germany. App. filed March 10, 1908. Motor meter with permanent magnet and rotating coil armature in which the friction is avoided and compensated. A rotatable armature in the magnetic field is in series with the load and has a sectional commutator with brushes for connecting them with the circuit arranged on a lever which is turned under the influence of the strength of the current flowing in the circuit. A greater proportional torque is thus afforded when the load is low.


993,062.—Electrostatic Voltmeter.

993,311. CONNECTION BLOCK; W. E. McCoy, New York, N. Y. App. filed Aug. 24, 1909. For connecting and testing meters. The block has an insulating base, a long terminal strap, two meter terminal straps, an additional terminal strap, a removable fuse and a removable connector between the meter terminal strap and the extended terminal strap.

993,316. METER FOR ELECTROMAGNETIC WAVE COMMUNICATION; G. W. Pickard, Amesbury, Mass. App. filed July 1, 1907. For measuring wave energy by operating a receiver alternately by a local source of energy which can be measured and by the energy of the source of the waves.

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AN UNUSUAL STATION CONSIDERATION.

The power station of the Northern Heating & Electric Company, of St. Paul, is a curious and interesting example of the adaptation of station design to topographical necessities, which incidentally conveys some very useful lessons. The plant is situated on the side of a cliff, its base being against the river bank, while the sixth story, which contains the general offices of the company, is at the level of the city street. The result of the necessities of this situation has been a curious, but convenient and practical, up-and-down design for the station. The advent of the steam turbine has made it possible to adopt in the interior arrangement of stations methods quite out of the question with reciprocating engines. The turbine when properly constructed and installed spins so steadily and smoothly that it imposes very slight strains on the foundations other than those due to its mere weight. In several stations advantage has been taken of this fact to place the turbines directly above the boilers so as to bring the amount of steam piping to a minimum and give the maximum of output for the ground space occupied. This arrangement has been highly successful and ought to be used in the interest of economy far oftener than it is. The St. Paul station utilizes something very like this principle of construction in virtue of the peculiar topography of the station site.

On the ground floor at the base of the cliff are the boilers with a coal crusher and conveyer in the basement under the spur track that brings the coal to the station. The cliff being cut away leaves room for the main front of the building into which the boiler-room opens on the lowest floor, providing room for the feed-water tanks and exhaust steam piping. On the second floor, above this extension of the boiler-room, are located the turbo-generators, and still above these is the floor containing a machine shop which brings the building front at last up to the level of the city street. In a still further excavation of the cliff, and under the sidewalk in front of the general offices, space is provided for the transformer room and all the switching apparatus. Above the general offices on the street floor are rooms for the engineering staff and for storage. The rear of the building above the boilers and the economizers, which latter are on the same floor with the turbines, is a huge space occupied for coal-storage bunkers. These bunkers will hold 1500 tons of coal in each of the three bins, and each bin supplies the pair of boilers beneath it. The furnaces are automatically stoked and are worked with induced draft, so that the short smokestack rises but a short distance over the roof of the building. The compactness of design is very extraordinary and the convenience in operation resulting from it is advantageous to no small degree.

Almost equally unusual is the construction of the distributing tunnels for the underground service from this station. The main distribution is at the generator pressure of 2300 volts.

although one of the substations is fed at 6600. The rock formation under St. Paul is peculiar. Under a shallow layer of soil lie about 25 ft. of extremely hard blue limestone, very difficult to excavate. Below this lies a layer of soapstone and hard sandstone and under this again a very soft sandstone, which is easily cut. Almost from necessity, therefore, the public utilities of various kinds are forced into deep tunnels and the geological situation has been taken advantage of in the fullest manner by the Northern Heating & Electric Company. Its tunnel system in this soft sand rock, 25 ft. to 40 ft. below the surface of the street, is some 8000 ft. in length. The tunnel is 6 ft. high and 3 ft. wide, giving room for electric cables and some steam-heating mains. The distributing transformers are located in chambers cut out alongside the tunnels, and the cables leaving the transformers rise through shafts drilled in the hard rock above into the service connections or into the cellars of buildings served. These drill holes are 4 in. to 6 in. in diameter and are consequently made with comparative ease. Through the same tunnels are served some 275 steam-heating customers, the heating service being measured by means of condensation meters. The plant is not a large one as modern plants go, containing at present only 4300 kw in equipment; but both as regards the design of station and nature of the distribution it is certainly a most interesting example of clever adaptation of methods to circumstances.

POWER-FACTORS AND LOAD-FACTORS.

So far as concerns the required increase in kilovolt-ampere rating of generators a load-factor of a certain low percentage is equally disadvantageous with a power-factor of the same percentage. However, in their effects upon other parts of the system a low power-factor is essentially different from a low load-factor. For example, with an average load of 100 kw at unity power factor, a load-factor of 80 per cent would require a complete installation of boilers, engines, generators, transmission circuits, etc., for 125 kw; with an average load of 100 kw at unity load-factor, a power-factor of 80 per cent would require an equipment for only 100 kw in boilers and engines, but would necessitate 125 kva in generators, transmission circuits, etc., while the voltage regulation would be much less satisfactory than under the conditions of unity power-factor and 80 per cent load-factor. A load-factor of 80 per cent, combined with a power-factor of 80 per cent, necessitates an increase in the boiler and engine equipment of 25 per cent, with an increase in generating and transmitting equipment of 56.25 per cent, and results in very poor voltage regulation. It will be appreciated, therefore, that designing and operating engineers are vitally interested in the character of the load upon supply systems as well as in its average value.

Much information relating to the character of load found upon alternating-current systems was given in a paper read by Mr. F. D. Newbury at the New York convention of the National Electric Light Association, as abstracted elsewhere in this issue. Although dealing largely with the power-factors of the various types of consuming apparatus, yet some idea is given of the maximum demand as shown by the consumption of the different motors under starting conditions. The highest power-factor is attributed to incandescent lighting loads and the lowest to electric welding loads, if an exception be made of synchronous apparatus, the power-factor of which can be adjusted at will. It would seem that from all points of view the welding load is the most disadvantageous, in that its power-factor is extremely low and its load-factor very poor.

The power-factor of the induction motor varies from a low value at no-load to a satisfactorily high value at full-load. The high value under load does not, however, mean an improvement in conditions over those existing at no load; the lagging wattless component of the kilowatt-amperes, to which the low power-factor at no load is attributed, not only does not decrease but actually increases with increase of load. To a large extent the effects that are usually attributed to a low power-factor are caused by and vary almost directly with the wattless component of the kilovolt-amperes, such as the demagnetization of the generators and the reduction in the delivered emf. While the magnetization of an induction motor requires a certain amount of wattless kilovolt-amperes, quite independent of what other machines upon the system are consuming or furnishing, yet it is not necessary for this amount to come from the generator; a portion, all, or even an excess, may be produced locally by means of machines of the synchronous type operated with over-excited magnetic circuits. Such machines consume leading wattless kilovolt-amperes which may be used to neutralize an equal amount of lagging wattless kilovolt-amperes taken by the induction motors.

With the appreciation of the disadvantages of the lagging wattless kilovolt-amperes of the induction motor has come a realization of the advantages of the synchronous motor in permitting the value of the wattless component of its kilovolt-amperes to be changed from lagging through zero to leading; so that at the present time the so-called synchronous condenser is a familiar auxiliary to the alternating-current supply system. It is not too much to expect a rapid introduction of alternating-current motors possessing simultaneously in a single unit the desirable characteristics of the induction motor and the synchronous condenser.

THE N. E. L. A. ACCOUNTANTS' PROGRAM.

That the accountants interested in the National Electric Light Association have put their separate sessions to good use was proved sufficiently by their attendance at and participation in the meetings last week. The subjects of the papers were diversified, and in nearly every case the discussion which followed the presentation of the paper brought out differences of practice or arguments that added substantially to the value of the proceedings. As is shown by the abstracts of papers and discussions published elsewhere in this issue, the range of topics covered several matters that concern the executive and operating departments, and thus the general policies as well as the internal affairs of the company. The accounting activities of the association are under the direct charge of one committee, whose title indicates no more than its duties with regard to the uniform accounting system. That has been no bar to a marked increase in enthusiasm at the meetings, and the subjects that may be taken up with profit will probably continue to be greater in number rather than less. Adequate provision for this enlargement of activities might be made by the appointment of new standing committees or committees to take up suggested subjects from year to year, or by the enlargement of the scope and membership of the present committee. The adoption of the latter alternative would permit the appointment of sub-committees to take up specific topics assigned by the general committee, and would afford a means for occasional meetings of a number of those actively engaged in the work. This plan was followed by the committee last year in the consideration of one or two matters, but the work might with benefit be further broadened.

Certainly no one will question that the need for a correct understanding of sound accounting principles is urgent. One of the first issues raised by the new Public Service Commissions was that of the classification of accounts. If there is substantial uniformity of practice among the companies of the country, the possibilities of uniformity in the systems prescribed by the commissions will be strengthened materially. Since the association has approved the standard classification of its committee it remains for the companies individually to incorporate the system in their policies, unless they have objections that are too strong to be overcome. If such objections relate to the text of the classification, it is important that they be placed in the hands of the committee for consideration. We have no authority to speak for the committee in any way, but realize that its principal work lies in the formation of a classification which has the official sanction of the association. The plans of the committee, subject to approval by the executive committee of the association, provide for the creation of a statistical bureau. It is apparent at once that data of the nature which it is proposed to exchange derive their value largely from the fact that they are determined by uniform methods. Like results cannot be obtained by unlike methods. It is important that standardization in accounts be effected, and if this end is not attainable with the present system, such changes should be made as will adapt the classification to the needs of the largest possible number of companies. A system of accounts, like any other feature of the business, requires revision as conditions change. It should be analyzed carefully and periodically with this fact in mind. Undoubtedly companies that have experimented with the classification will be willing before the end of another year to relate their experience and thus afford a starting point from which many others may determine the applicability of the accounts to their regular operations.

ORGANIZATION PROBLEMS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Over 5000 persons were registered at the New York convention of the National Electric Light Association last week. It is probable that not all of that number were present at the various functions of the association on any one day, for no doubt there were some registered in advance who were unable to attend at all, while others went away before the convention was over. But if a deduction as high as 20 per cent be made for this discrepancy between registered and actual attendance, the figure of 4000 remaining is still very large. And, indeed, everyone present must have been impressed by the sheer bigness of the gathering. Notwithstanding the very admirable advance preparations and all the resources of the Engineering Societies Building, it was almost impossible for any one person to keep in touch with the various activities of the convention. To some extent the unparalleled registration was due to the fact that the convention was held in New York, with its large population of persons interested in electrical pursuits, but it also reflects the remarkable increase in membership of the association itself, for the N. E. L. A. has now nearly 9000 members of all classes.

The growth in size both of the organization itself and of the annual convention foreshadows new and important problems of organization. In his annual address the retiring president, Mr. W. W. Freeman, said that there is nothing to prevent the total membership from reaching perhaps 25,000. Obviously, as Mr. Freeman points out, new methods of procedure must also follow changes in the complexion of the organization. One plan suggested is to intrust to the geographic sections, as they increase in number and in facilities for practical accomplishment, much of the important educational work now performed by the national organization. This procedure would entail less inconvenience and expense to the local companies than the plan now followed, and has for a precedent the successful sectional distribution of work by the Illuminating Engineering Society. Mr. Freeman said that it has been suggested seriously that the national convention, ultimately and perhaps shortly, should be limited to a given number of representatives of member companies, to discuss broad questions of policy and issues of common interest. Details of engineering and commercial practice may then be left to geographic and other sections. An alternative plan is to organize national special sections for the promotion of special lines of work, as illustrated by the present Commercial and Power Transmission Sections.

Mr. Freeman's conclusion is that probably neither plan would alone meet the situation fully. Both ideas are in operation to some extent and are working toward an ultimate solution of the problem. Whatever this ultimate solution may be, as a matter of common prudence the policy of the association will be to proceed with caution in striving to reach a correct determination. At the New York convention several amendments to the constitution were adopted to broaden the scope of the company, geographic and national special sections. Provision has been made for the admission of persons "interested in advancing the central-station industry" on recommendation of Class A or company members. Other amendments are intended to fix more definitely the status of the sections, while at all times retaining the control of the present association, and hence of all sections, in the hands of Class A members.

Many persons will view with reluctance the possibility of giving up a big, rousing general convention for all hands, but with the growth of the industry and of the association the likelihood of a delegated general convention becomes increasingly probable as an apparently necessary method of preventing the annual convention from becoming too bulky to accomplish useful work under practical conditions. However, the step is one not to be taken lightly, for the smaller Class A members may look upon it with some apprehension. It is a good subject for a general and thorough discussion, and at any rate is still some distance in the future. The Seattle convention of next year, at least, will be one of the old-fashioned—we have no doubt many will say the good old-fashioned—kind. By that time the combined wisdom of those who take an active interest in the association may result in a practicable working plan to meet the needs of the future.

The Mississippi Convention.

For the third annual convention of the Mississippi Electric Association to be held in Gulfport, Miss., June 20, 21 and 22, unusually elaborate preparations have been made. A handsome souvenir program has been printed, and it shows that both meetings and entertainments have been carefully planned. On the opening day there will be an address of welcome by Judge J. H. Neville, followed by President Greenland's annual address. Papers to be presented thereafter include the following: *Relation of Employees to Company and Public,* by Mr. A. B. Patterson; *Modern Street Lighting,* by Mr. J. N. Eley; *Electrically Heated Appliances,* by Mr. L. Callender; *Economy of 750-kw Engine,* by Mr. D. R. Tomlinson; *Steam Turbines,* by Mr. Edmund Dreyus; *Necessity of Commercial Department,* by Mr. A. H. Jones; *Economical Care and Maintenance of Street Cars,* by Mr. Jack Abbott. In addition there will be a Question Box and a general assembly on Thursday morning, June 22, especially for Class B members.

Entertainment features include sight-seeing and shopping in Gulfport for the ladies and a reception and dance on Tuesday evening. On Wednesday afternoon there will be a trip to Beauvoir and Biloxi on the interurban railway, while in the evening there will be a banquet, Judge Neville being toastmaster. On Thursday morning, after the general assembly, there will be an excursion to Ship Island by boat, and some special features are promised for this trip.

The Mississippi Electric Association, which is affiliated with the National Electric Light Association, has these officers: President, Mr. S. W. Greenland, Columbus; vice-president, Mr. Jack Abbott, Jackson; secretary and treasurer, Mr. A. H. Jones, McComb. Other members of the executive committee are: Messrs. A. B. Patterson, of Meridian; H. Crittenden, of Greenville; F. J. Duffy, of Natchez, and S. M. Jones, of Laurel.

Finale of the New York Convention.

The concluding feature of the New York convention of the National Electric Light Association of last week was commensurate in every respect with the remarkable gathering of which it formed the appropriate finale. It consisted of a combined inspection of riverside power plants and an excursion on the East and Hudson rivers on Saturday. The weather was threatening all day, with dashes of rain, but notwithstanding, 960 convention delegates and visitors, including many ladies, made the trip. Assembling at Waterside No. 2 station of the New York Edison Company, the party inspected first the turbine-room and next the boiler-rooms of that imposing demonstration of the dignity and magnitude of the electric service in the greatest of American cities. Courteous guides were in attendance and all features were carefully explained. The Waterside No. 1 station was not open for inspection, owing to the installation of the 20,000-kw units at the present time.

Next, the party embarked on the steamboat *Majestic,* chartered for the occasion by the New York Edison Company. To each visitor was presented a booklet giving information on the electric power houses of New York, with an itinerary of the trip, and a most acceptable map. Copies of the *Convention Daily* of Saturday were distributed, and with these and the booklets, and watching the extremely interesting coal-handling operations of the Waterside stations, the early arrivals on the boat passed the time until the lines were cast off.

Leaving the foot of East Fortieth Street, the boat proceeded north on the East River to the Astoria (L. I.) plant of the Consolidated Gas Company, which was inspected. Here, too, the arrangements were most complete in every detail, the plan of rallying groups of visitors at guide stations being particularly ingenious and effective in handling so large a party. This great gas-making plant is electrically operated throughout, and the scientific methods exemplified were most interesting to the visitors.

Returning to the boat, each visitor was handed a box of luncheon, with the compliments of the New York Edison Company. While the boat retraced its course down the East River this appetizing luncheon was discussed at hundreds of impromptu but merry luncheon parties of ladies and gentlemen. Non-alcoholic drinks were served before and during the luncheon, and at its conclusion there was ice-cream, while Edison men followed with packets containing cigars, cigarettes and matches, all cleverly done up in wrappings displaying the well-known "At your service" manikin of the New York Company. The arrangements for the luncheon were happily conceived and carefully carried out.

Meanwhile, the *Majestic* was proceeding south on the East River, rounding the Battery and going north on the Hudson to the foot of West Fiftieth Street. This gave the visitors a fine view of the East River bridges and New York's waterfront and was greatly appreciated by the out-of-town visitors, who drank in the scene with delight.

At the power house of the Interborough Rapid Transit Company on Fifty-ninth Street near the Hudson a stop was made to view this large, modern and unusually interesting station, with its double-ended boilers, combined vertical and horizontal engines and exhaust-steam turbines. Following this, most of the members of the party re-embarked and took a farther trip up the Hudson, landing at West Forty-third Street about 5:30 p. m.

The courtesy of the New York Edison Company in giving this delightful trip to convention visitors was highly appreciated. It is safe to say that every guest was pleased and grateful. Mr. Freeman, the retiring president of the N. E. L. A., and Mr. Gilchrist, the new president, were both present and "took in" the sights together. The sub-committee of the entertainment committee in charge consisted of Mr. J. W. Lieb, Jr., chairman, and Messrs. W. R. Addicks, Clarence L. Law, Frank W. Smith, H. G. Stott, Henry Stephenson and W. F. Wells.

Operating Organizations at the Convention.

Coincident with last week's convention of the National Electric Light Association, or at about the same time, several of the large electric-service operating organizations of the country gathered their clans in New York. Thus the Doherty Operating Company held a convention at its New York offices on May 26 and 27, just before the convention. Dr. John Wesley Hill addressed the meeting on the first day, his subject being "Brains and Business," and on Saturday night, May 27, the gentlemen in attendance, to the number of nearly 100, were the guests of the management at a beefsteak dinner at Healy's restaurant. Mr. H. L. Doherty was not present, as he is taking a well-earned vacation in Europe. Nearly all the Doherty men remained for "the big show."

On Monday night, May 29, J. G. White & Company, Inc., gave a dinner in the Yacht Room, Hotel Astor, to about fifty gentlemen connected with that organization. This organization is the operating manager of about twenty-two public-service companies in Maine, Connecticut, Pennsylvania, Delaware, Georgia, Michigan, Illinois, Iowa, Nebraska, Oklahoma, Montana and the Philippine Islands. Mr. J. G. White made an address at the dinner, and among others present were Messrs. F. H. Reed, J. H. Pardee, R. B. Marchant, H. S. Collette, T. W. Moffat, L. H. Conklin, S. D. Sprong, E. R. Welles, W. R. W. Griffen, W. B. Rockwell and J. A. Fleet.

H. M. Byllesby & Company were represented by a delegation including Mr. Byllesby himself, who read a paper before the convention on Friday, June 2. Mr. A. S. Huey, of this organization, was elected second vice-president of the N. E. L. A. and was awarded the Crouse loving cup for bringing in the largest number of members to the Commercial Section. This organization operates in ninety-three municipalities in thirteen states of the West and South. On Thursday evening, June 1, Mr. Byllesby gave a dinner at the Metropolitan Club. Among the guests were Messrs. C. A. Coffin, Samuel Insull, S. Z. Mitchell, F. C. Walcott, J. J. O'Brien, T. K. Jackson, Harold Almert, E. L. Callahan, Samuel Kahn, H. C. Hoagland and William H. Hodge.

The Stone & Webster interests were represented by about fifty delegates, headed by Mr. W. H. Blood, Jr., past-president of the N. E. L. A. Included in this number were Messrs. H. J. Gille, N. T. Wilcox, C. F. Wallace, F. J. Hovey, R. W. Child, J. S. Bleecker, W. J. Grambs and C. C. Curtis. Messrs. Blood, Gille and Wilcox presented papers or reports before the convention. At the close of the convention the Stone & Webster men proceeded to Boston, where an informal meeting was held on June 5 under the direction of the home office.

* * *

Electrical Development in the Philippines.

By Louis R. Freeman

The Philippine Islands, with their great mountain area and enormous rainfall, have great hydroelectric possibilities, and it is hardly an exaggeration to say that there is not a single town in the whole archipelago which is not within transmitting distance of water-powers. The time is particularly ripe for hydroelectric development to supply Manila and several other points in Luzon, but nothing thus far has been done owing to the failure to enlist capital.

The largest electrically operated plant is, of course, that of Manila, owned by the Manila Light & Railway Company. The generating and railway plant of this company was built by the J. G. White Company, and at present consists of two 750-kw, one 1500-kw and one 2000-kw Westinghouse three-phase turbo-generator. The current is generated at 360 volts, that portion required for railway service being converted into direct current by rotary converters.

Mr. C. B. Graves, vice-president and general manager of the Manila Light & Railroad Company, informed the writer that the Japanese coal which his company uses is comparatively high-priced and of but fair quality, making the generation of electricity from steam power considerably more expensive than in the United States. Borneo coal is not of good quality and, although much is hoped from them, little has yet been done with any of the coal prospects in the Philippines themselves. The demand for electricity is increasing at an encouraging rate, both through its increasing use in the large tobacco factories and small manufacturing plants of the island capital and through a realization on the part of the natives—who do a great deal of their work by night—of its safety and economy as a lighting medium in their highly inflammable houses. The general use of electricity by the natives, however, cannot be expected until energy is furnished at a considerably lower figure—the price is now 20 cents, gold, per kw-hour—than at present, a consummation Mr. Graves does not believe practicable until the installation of hydroelectric plants in the vicinity of Manila reduces the cost of production to the company. The steady extension of the street-car lines into the suburbs will also demand more power for operation than can be furnished by the present steam plant, and this Mr. Graves expressed himself as being hopeful of developing from water-power. This company has had several hydroelectric power-plant sites, all within easy transmitting distance, under observation for some time.

Lighting bills, Mr. Graves said, will always be higher in Manila than in America. The larger rooms and numerous windows necessitate the use of more light than is common in the United States, where the rooms are smaller and the larger amount of wall space increases the reflective power of the light. It is also true that the fixed charges are higher than at home, while deterioration is heavier. Besides that there is a purely local problem in the high peak between 6 and 9 in the evening, and the comparatively small amount of energy used in manufacturing does not give the distribution of cost that companies operating in America and elsewhere enjoy.

Concerning hydroelectric conditions, rainfall is very heavy, averaging about 100 in., but 90 per cent of the precipitation is between the months of May and October inclusive. Over 85 per cent of the area of the islands consists of mountains, and this makes for heavy gradients and many storage possibilities. Were a market available hundreds of thousands of horse-power could be economically utilized. The industrial conditions at the present time are at such a feeble state of incipiency that it is doubtful if more than 25,000 hp or 30,000 hp could be utilized in the archipelago at even very cheap rates.

As to market, the Manila Electric Light & Railroad Company uses about 5000 hp for its peak load, while tobacco factories, machine shops, mills, etc., may total 10,000 more. Outside of Manila the city of Baguio and its surrounding gold-mine prospects might utilize 2000 hp, while the cities of Iloilo, Cebu, Zamboanga and Vigan might utilize up to 1000 hp each. The Mindoro Development Company, which has taken up some 60,000 acres of sugar land on the island of Mindoro and intends to construct a modern mill, may offer a market for a large project on that island. The company has its own engineering staff and what data it may have gathered in the hydroelectric line have not been made public.

The Manila Railroad Company has a franchise to construct, and is now constructing, a steam line to the north of the town of San Fernando, Union Province. The northwest coastal plain, extending north from San Fernando to the town of Laoag, Ilocos Norte, some 150 miles north, may in time offer inducements for an electric line. The coastal plain, varying in width from 5 miles to 10 miles, is thickly settled, and the locality is one of the most prosperous in the Philippines. The greatest drawback in building a line in this territory would be the excessive cost of bridge construction, as the line would cross quite a number of good-sized rivers. Economical hydroelectric power could be cheaply developed at any one of a dozen points along this line.

Owing to the climate, and especially the heavy typhoons, transmission lines have to be of a very strong and permanent type. Considering the available markets it is not believed that energy could be economically transmitted over 50 miles. Within that radius of Manila are four feasible projects which would each probably develop from 3000 hp to 5000 hp, at an installation cost of less than $100 per horse-power. There are the Gumain River at a point about 45 miles northeast of Manila, the Angat River at a point about 40 miles north of Manila, the Carigara River at a point about 40 miles southeast of Manila, and the San Juan River at a point about 30 miles southwest of Manila.

Within a radius of 20 miles of Baguio and the mining district in that vicinity are perhaps a dozen streams on which could be developed many thousands of horse-power were there a market for it. The largest of these projects would be on the Agno River at a point about 12 miles east of Baguio. It is estimated that 40,000 hp could be developed at this point.

The head office of the irrigation division is at Baguio, and as fast as the field data are received they are recorded and filed in standard forms for public use. Rating curves, hydrographs, run-off tables, etc., are being prepared as rapidly as possible for all permanent gaging stations. It is the intention of the engineers in charge to extend this investigation until all perennial streams of the islands are under investigation.

* * *

Evolution of the Electric Railway.

In the course of an address upon the occasion of the presentation to Mr. Frank J. Sprague of the Edison medal at the recent annual meeting of the American Institute of Electrical Engineers, Mr. W. B. Potter, of the General Electric Company, gave an interesting account of the evolution of the electric railway, of which the following is an abstract:

Referring to the early experiments of Davenport, the Vermont blacksmith, in 1834, the work of Davidson in Scotland in

1838, of Professor Farmer at Dover in 1847, Professor Page of the Smithsonian Institute in 1851, of Hall in Boston in 1851 and 1860, it was pointed out that while successful so far as they demonstrated that a vehicle could be propelled electrically, they bore no real fruit in the art of transportation as the primary battery was the only source of power they possessed. The practical railway had to wait for the development of the electric generator, and the first electric railway which resembled the final type in that it received its energy from an electric generator was installed by Siemens at the Berlin exposition in the year 1879.

From this date the progress of the art was continuous and effective, the work of Edison and Field following close on that of Siemens. In 1880 Edison built and operated an electric locomotive at Menlo Park, this being the first practical development of electric traction in this country. The first application of the electric railway to public service was made by Siemens at Lichterfeld, in Germany, in 1881, and during the two years following the commercial development seems to have been mainly in Europe, Siemens installing a road at Portrush, Ireland, which was opened in 1883.

The work which led more especially to the commercial development of the electric railway in this country began in 1883. An electric locomotive was built by Field and Eickemeyer and exhibited at the Chicago Railway Exposition. It was during this year that Van Depoele began his experiments with an electric car in Chicago. His advent deserves special mention, as Van Depoele thereafter, by reason of his foresight and inventive ability, contributed largely to the development of the electric railway. During the same year Draft, who will ever hold a prominent place, sharing honors with Van Depoele, operated at Saratoga an electric locomotive hauling a passenger car.

In 1884 the Sprague Electric Railway & Motor Company was organized by Mr. Sprague. Bentley & Knight appeared during this year and contributed to the development by operating in public service at Cleveland, Ohio, an electric car taking energy from electrical conductors in an underground conduit. This was the first demonstration of the conduit system as afterward installed in New York City and Washington, D. C.

In 1885 Daft built an electric locomotive for the Ninth Avenue line of the Manhattan Elevated, which in appearance and arrangement was not unlike the electric locomotive as built today. He also installed in Baltimore a surface road using an electric locomotive with a third-rail as the principal conductor, but with an overhead conductor and under-running contact at road crossings, a combination of electrical conductors to meet special conditions which has been in use since that time.

During the same year Van Depoele equipped an electric railway at Toronto, the first road in Canada, which, as it had an overhead-trolley wire throughout its length with an underrunning contact at the end of a trolley pole, was the forerunner of our modern trolley. Henry, in Kansas City, and Short, in Denver, also begain their electric-railway experiments about this time.

Sprague, whose name has been so prominently associated with electric-railway development, built his first car equipment in 1885. His motor was really the prototype of the modern single-reduction railway motor. It was supported at one end by bearings on the car axle and at the other end was flexibly attached to the car truck. This method of supporting the motor, commonly known as nose suspension, is now in almost universal use. The motors were shunt-wound and a regenerative method of control was used, energy being returned to the line when reducing the speed of the car. The arrangement of the motor field winding was also such as to produce a commutating-pole effect to improve commutation. These motors were undoubtedly the first to use a fixed brush holder and the same brush for running in either direction. A demonstration of this equipment was given by Sprague at the Durant Sugar Refinery, Brooklyn, and a more important public demonstration on the Thirty-fourth Street branch of the Manhattan Elevated early in 1886.

In 1887 Sprague secured the contract for the electrical equipment of the Union Passenger Railway, Richmond, Va., and the road was opened for traffic in 1888. The large number of equipments and the severity of the service conditions made the fulfilment of this contract the most notable achievement in the development of electric-trolley lines up to that time; indeed, it was the first effective demonstration of the trolley system as a practical commercial enterprise.

Considerable progress was made by others during 1888. Beltley and Knight equipped the Observatory Hill line in Allegheny, Pa., and the Thomson-Houston Company, which had absorbed the Van Depoele interests, made its first demonstration at Revere Beach, Mass.

Eickemeyer, to whom the industry is indebted for the idea of form-wound coils for armatures, put into operaton at Long Island City electric cars driven by a combination of side rods and gearing. Steinmetz was associated with Eickemeyer during has later development of the side-rod drive without gears. It was about this time that Van Depoele applied the carbon brush to the railway motor, seemingly a simple thing to do, but a detail of improvement found to be essential to the operation of all high-voltage commutating machines whether running as motors or generators. To this all will bear witness who were in the field early enough to have had sad experience with metal brushes.

Shortly after this the Bentley-Knight interests were absorbed by the Thomson-Houston company. In 1890 the Sprague Electric Railway & Motor Company was absorbed by the Edison General Electric Company, and during the same year the Westinghouse Electric & Manufacturing Company began its electric-railway development.

Limitations imposed by the characteristics of the early motors had led to a general use of double-reduction gearing which was recognized to be a disadvantage on account of both its inefficiency and the noise. In 1890 Parshall, then with the Wenstrom Company, designed a motor which by reason of its more powerful and slower speed armature made the use of single-reduction gearing practicable. Following this, in 1891, all of the manufacturing companies discontinued building double-reduction motors and brought out motors with single-gear reduction, which has been the standard-type gearing since that date.

The series-parallel controller, which effected a material reduction in the energy required by the car, and also the inclosed-frame railway motor, an improvement in the mechanical design of motors, were developed by the Thomson-Houston Company in 1892. It was during this year that the Thomson-Houston Company and the Edison General Electric Company were merged into the General Electric Company.

The pioneer work with the trolley car had been accomplished and electric railways were now accepted as a new and better mode of transportation. Some idea of the tremendous growth in America in practically a single decade can be gathered from the fact that while in 1888 there were only 172 electrically propelled cars on 86 miles of road, in 1899 there were over 41,000 electric cars operating on upward of 14,500 miles of road.

The next development of importance was the multiple-unit control devised by Sprague in 1897 and installed by him during that year on the South Side Elevated Railway, Chicago. The multiple-unit control, as its name implies, provides with equal facility for the control of one or a number of motor-cars in a train. Train service had previously been accomplished with trail cars hauled by an electric locomotive or by a single motor-car equivalent to a locomotive. It would be difficult, if not impossible, to meet the requirements in many instances of our present-day train service with a single motive-power unit. High tractive power and the elimination of switching at terminals is essential to high schedule speeds and close headway between trains, conditions which are fulfilled to an admirable degree by the multiple-unit arrangement. As an illustration of the powerful motor equipment which is little in evidence on a multiple-unit train it was pointed out that an electric locomotive even of the weight and power of those used by the New

York Central Railroad would be incapable of handling an express train of the subway at the present schedule.

During the last ten years much has been accomplished in the development of methods and apparatus extending the scope of electric railways and leading up to the more general electrification of railroads now operated by steam. The single-phase system and the adoption of higher direct-current voltages made possible by the addition of commutating pole to railway motors, improvements in methods of generating power and in trolley and third-rail construction cover, in brief, the nature of the work. It is also during this period that the three-phase system first found a commercial application in America, although it had been previously used in Europe to a considerable extent.

Norwegian Hydroelectric Developments.

At the May meeting of the Faraday Society Mr. A. Scott-Hansen, C. E., of Christiania, Norway, read a paper on "Hydroelectric Plants in Norway and Their Application to Electrochemical Industry," from which the following details are abstracted:

The physical configuration of Norway is remarkably favorable for the utilization of the large number of waterfalls to be found on the seaboard of the mountain chains which almost cover the country, and through whose valleys the enormous quantity of water precipitated from the western and southeastern sea breezes finds its way as rivers flowing down to the sea. In the winter the rainfall takes the form of snow, so that the volume of water brought down by the rivers is at its greatest from May to July, when the snows melt on the mountains. To make use of the water-power storage is therefore necessary, and for this the country is from its nature peculiarly adapted, it being covered with lakes that have very contracted outlets and which can be easily converted by damming into storage reservoirs. Thus in the watershed of Skien the natural water-power of 50,000 hp has been increased to an available horse-power of 375,000, while the Mösvand reservoir has increased the water-power of the Rjukan factories from 30,000 hp to 250,000 hp with a capital outlay of only some $425,000. (*Electrical World*, Dec. 9, 1909.)

The total water-power in Norway has been estimated at from 5,000,000 hp to 7,000,000 hp, but as much of the country has not been hydrographically surveyed, this is probably too low an estimate. The power stations can supply power at from $5.50 to $11 per annual electrical horse-power, and in some cases even for less, and as the quantities available are as high as from 50,000 hp to 100,000 hp for a single fall, the conditions are ideal for the development of electrochemical and electrometallurgical industries. Many such industries have already reached an advanced stage of development. Thus nearly 180,000 hp will be utilized this year in the manufacture of nitrates of lime, soda and ammonia from the air by the Birkeland-Eyde process and the Badische Analin und Sodafabrik Company's process (*Electrical World*, April 27, 1911); about 60,000 hp are employed in the manufacture of calcium carbide, and other electrochemical and electrometallurgical industries absorb at present some 20,000 hp. Now that a suitable electric furnace—the Grönwall—has been designed for the smelting of iron ore, a furnace that has yielded excellent results on a practical scale, electric iron and steel smelting is likely to develop largely in the near future, for Norway possesses extensive deposits of iron ore. Three plants, aggregating 16,000 hp, with provision for increasing to nearly 60,000 hp, are now being erected at Hardanger, Arendal and Tinfoss. Other ores, notably copper, nickel and zinc, will also possibly be electrically smelted at no distant date.

On the Glommen River, in the east, three falls are utilized. The uppermost, Kykkelsrud, yields about 40,000 hp, of which 10,000 kw is transmitted at 60,000 volts (three-phase, 50 periods) to Christiania, 31 miles away, and the remainder to Sarpsborg. At Sarpsborg occurs the lowest fall of the Glommen, and here there are two power stations—Hafslund, supplying 24,000 hp to calcium-carbide works and for zinc smelting, and Borregaard, whose output of 26,000 hp is utilized by the Kellner Partington Paper Pulp Company, Limited, owning the largest works in Norway. The intermediate fall on the Glommen is at Vamma, where a dam is now in course of construction under considerable difficulties. This dam will have a height of 90 ft. and will be one of the largest in Europe. The power station will be in the center of the river bed below the dam and will yield some 70,000 hp to 80,000 hp.

A large number of the minor power stations in the south supply the towns with light and power. Among the smaller electrochemical works are the electro-iron and steel works of Arendal, the experimental nitrate works of the Badische company at Christiansand, and nickel and aluminum factories near the same town. The nickel works refine nickel matte and turn out about 400 tons of the pure metal per annum. At Gjössingfjord is Mr. Albert Hiorth's small experimental electro-steel works. At Vadheim, on the west coast, is a sodium factory, and at Trondhjem, in the north, carbide, ferrochrome and ferrosilicon are manufactured.

Another great power center is in the Telemarken district in the southeast of Norway. The Svaelgfoss power station supplies 40,000 hp to the nitrate factory at Notodden at a voltage of 10,000, delivered without transformation. The four 10,000-hp machines—capable of developing 13,000 hp—are among the largest in the world. A power station now being constructed at Lienfoss will be able to furnish Notodden with a further 20,000 hp. The Tinfoss Works, also at Notodden, are intended to generate 15,000 hp, to be used mainly for iron and steel smelting.

The third of the great Norwegian falls is the celebrated Rjukanfoss waterfall on the Maaneely River. The Mösvand dam, above this fall, provides a reservoir of about 840,000,000 cu. m (tons) of water, and 5 miles below is another dam, forming the intake for the power station situated 1000 ft. below. A lower fall of about 1000 ft. provides the power for a second station. Both of these power stations—the largest in Europe—will yield 140,000 hp, there being in each ten units of 14,000 hp. The turbines, on account of the great height of the falls, are Pelton wheels. The construction of the dams, flumes and power stations at Rjukanfoss was attended with great engineering difficulties, which are described in the paper. The power from these stations is transmitted through sixty copper and aluminum cables to Saaheim, where factories for the manufacture of nitrogenous products to employ from 2000 to 3000 persons are in course of erection.

The power plant at the Tysse falls consists of seven units, each of 4500 hp, from which electric energy is transmitted at 12,000 volts to Odda, where it is used for the manufacture of calcium carbide and of cyanamide. Here again, on account of the steep, mountainous character of the country, great difficulties presented themselves, particularly in the drilling of tunnels 1320 ft. above the fjord and in fixing the flumes, some against a smooth precipice with an inclination of 60 deg. The Tysse power station will eventually yield in the neighborhood of 100,000 hp.

In the discussion it was brought out that in some instances the cost of Norwegian water-power is as low as $3.75 or $4 per year.

New Telephone Rates in Greater New York.

In the New York City interborough telephone rate case the Public Service Commission of the Second District has ordered a reduction of interborough telephone rates from the Borough of Manhattan below 110th Street to the Borough of Brooklyn (except Coney Island and Bath Beach), and from the Borough of Manhattan below 110th Street to the central-station districts of Astoria and Newtown on Long Island. The reduction in this case is from 10 cents to 5 cents. Reductions of from 15 cents to 10 cents are made in the service from Manhattan below

110th Street to the central-station districts of Flushing, Richmond Hill and Jamaica on Long Island. These reductions are ordered as the result of an inquiry conducted by the commission on its own motion to determine whether certain toll rates charged by the New York Telephone Company are just and reasonable.

In explaining its reasons for arriving at these conclusions the commission notes the magnitude of the subject matter involved. In the city of New York, with an area of 326 sq. miles and a population by the last census of 4,767,883, the New York Telephone Company has more than 400,000 telephone stations used by subscribers, and in addition a large number of public pay stations. During the year ended Nov. 1, 1910, a total of 30,132,330 toll messages were transmitted, for which the gross earnings were $3,114,345.

The opinion of the commission was rendered by Chairman Stevens. The opinion points out that in the determination of this case the commission had in mind the total investment of the company, its investment in the city of New York, the general cost of operation, the necessity of making reservation out of income for surplus and contingencies, returns actually received by the company from its operations in the city of New York, the rates established for long-distance service elsewhere, the length of call from zone to zone, the rates established from each zone to every other zone, the varying density of traffic, the probable relative cost of service from zone to zone and a number of other factors.

From the financial statement furnished by the company it is said that the total investment of the company in the city of New York is $110,582,897, and the net earnings from the property $10,757,000. It is understood that these net earnings are reached after deducting from gross earnings the operating expenses, taxes and a proper depreciation reserve, so that the 9.7 per cent of net earnings to investment is all available for dividends.

In the financial statement there is an item of $30,000,000 as the value of special franchises. Another value given among the intangible assets is that mentioned under the head of "going concern" and placed at at least $10,000,000. The commission points out that the reduction in revenue by the new rates would reduce net earnings from 9.7 per cent to 6.8 per cent on the showing of the company. However, if the $30,000,000 claimed as value of franchises be eliminated the percentage of net earnings to investment will be 11.8 per cent, and if there be further elimination of the $10,000,000 mentioned as the value of "going concern," the percentage of net earnings to investment will be 13.5 per cent. The commission also calls attention to the fact that the figures do not take into account any increase of business which would be caused by the reduction of rates.

Bearing in mind these considerations the commission remarks that there is a demand for toll service in the city of New York which is not satisfied because the cost now exceeds the value. In other words, there is a large demand for service for which the consumer can afford to pay 5 cents, but for which he cannot afford to pay 10 cents. It is the duty of the company to meet this unsatisfied demand if it can be done with due regard to financial results.

The new rates apply for a connection of five minutes or less. For overtime each five minutes, or fraction thereof, may be charged as another call. A large increase in the telephonic service, because of the reduced rates, will require additions to the plant and equipment of the company in order to enable it to perform the service efficiently, and for this reason the company should be allowed a reasonable time in which to make the necessary additions to its plant. It is the judgment of the commission that the months of June and July will be reasonably sufficient for this purpose, and the company will not be required to charge the reduced rates until Aug. 1, 1911. It is understood that the company has expressed its acceptance of the decision of the commission, although perhaps further time will be asked than the period which is mentioned in the decision.

Ohio Public Utility Bill.

The public utility bill, as prepared by a conference committee, was passed by both houses of the Ohio Legislature last week and is now before Governor Harmon. This committee restored many of the amendments that were eliminated by the Senate and provided for closer supervision of public utilities.

The bill places interurban railway, water transportation and express companies under the laws governing steam railroads, and also applies generally to electric light and power, telegraph, telephone, artificial-gas, natural-gas, gas and oil pipeline, waterworks, heating or cooling, messenger, and signaling companies. Telegraph and telephone companies are considered common carriers and are to be treated as such.

The commission is given power to examine officers of companies as witnesses and to require officers and employees to produce books, papers and documents for examination. Disobedience or refusal to appear in answer to a summons subjects the offender to contempt proceedings before a court of common pleas. The commissioners and duly authorized employees and examiners shall have access to the books of public utility companies whenever it is deemed necessary.

The commissioners and examiners and employees shall have access to the offices and plants of public utilities at all times, for the purpose of making such investigations as are considered necessary for the protection, convenience or safety of the public or the safety of employees, to ascertain whether the operation is in compliance with the laws and the rules of the commission and to secure data. Each public utility must, when required, file a copy of contracts with other public utilities with the commission. The commission may devise a system of accounts for utilities or may divide them into classes and establish a system for each. Companies may be required to keep no other records except those provided by the laws of the United States and the State, if deemed advisable.

Every utility shall furnish just and reasonable service, and the charges shall be just and reasonable and not more than is allowed by law or by orders of the commission. Charges shall be uniform, and no free service for the purpose of destroying competition shall be rendered. Within ninety days after the act goes into effect each company shall file a printed schedule with the commission, showing all rates. The commission may prescribe the form for such schedules, which must be open for public inspection.

Companies are not prohibited from entering into arrangements with customers for a distribution of the profits or from providing a sliding scale or a minimum charge for service, unless such minimum charge is prohibited by the franchise. Subject to the approval of the commission, rates may be graded upon the basis of the quantity used, and other arrangements may be made for the benefit of customers so long as they are reasonable and just and all are treated alike under similar conditions. Rebate or refund of a portion of the charges is prohibited.

Contracts made before the passage of the act may stand unchanged except where they provide for termination on notice. Then the commission may terminate such contracts by order, if it chooses.

A utility must give the commission thirty days' notice of its intention to make any change in rates. Upon complaint of unjust or unreasonable rates, insufficient service or anything else of the kind, the commisson must notify the company and set a date for a hearing. The company has a right to make complaint and to be heard in the same manner. If the commission shall consider the rate too high or low, it shall, with due regard to the value of all the property used for the public convenience, exclusive of any franchise value with the exception of such sums as may have been paid for the franchise, and exclusive of any value derived from a monopoly of service or through mergers, fix a rate that seems just and reasonable, or substitute a schedule; thereafter no change shall be made unless on order of the commission. The commission may give a rehearing, rescind former orders or take such other steps as may be made necessary by further knowledge in any case of the kind mentioned. The same conditions apply as to the character of service given, the equipment of plants and the conveniences furnished the public.

The commission shall have authority to appraise the properties of all public utility companies, but before a final decision is reached shall give a hearing, if requested, and summon witnesses and follow the same methods as in any other hearing. Properties may be revalued at any time.

The commission may direct that extensions and repairs be made to a plant in order that proper and adequate service may be rendered, after a hearing is had, to show that such repairs or extensions are actually needed for the service and convenience of the public.

Every public utility company having equipment on, above or under streets shall, for a reasonable compensation, permit such equipment to be used by other companies, when found necessary and when joint use does not work irreparable damage to the owners. In case of disagreement, the compensation or conditions shall be fixed by the commission.

Rates may be suspended temporarily by the commission in cases of emergency.

Units of service shall be determined where this is possible and companies shall furnish a complete report of their business in such units in order that the cost may be known. Certain standards of service may be fixed, and certain rules for examination and testing of the service or product may be established by the commission. Tests of apparatus for measuring service may be made, and any consumer may have his apparatus so tested by the payment of a fee.

No person may be excused from testifying before the commission or from producing such books or documents as are requested, but all persons are immune from prosecution because of any incriminating evidence that may be so given.

In case of disagreement between the interested companies on a joint rate the commission may investigate and apportion such rate.

Where steam, interurban or suburban railroad companies' tracks intersect, cross or connect, such connections may be required as will permit interchange of business. The expenses shall be apportioned between them, and they shall give proper service for passengers or freight.

In cases where municipalities fix the rate of a public utility company for a future period, within one year before the old ordinance expires, an appeal to the commission may be taken within sixty days after the passage of the ordinance. Should the conclusion be that the rate is too low or too high, the commission may substitute another rate, with due regard to the value of the property actually in use for the service of the public. This does not apply to street-railway franchises granted under the general code.

Every public utility company shall carry a proper depreciation fund whenever the commission decides that such a fund can be reasonably required. The commission must decide upon the amount that should be charged to cover the necessities of the company. Such funds shall be used for repairs, renewals and extensions that will maintain the property in adequate condition to give reasonable service.

Before a telephone company can establish an exchange on a permit or franchise granted before this act was passed, but not yet exercised, or on any permit or franchise granted in the future in a municipality that already has service, it must secure from the commission a certificate that the plant is necessary to the public convenience. The object of the section appears to be to control the installation of a dual service.

A public utility or a railroad or electric railroad may, upon order of the commission, issue stocks, bonds, notes and other evidences of indebtedness, payable at more than twelve months after date, when necessary for the acquisition of property, the construction, completion, extension or improvement of facilities, the improvement or maintenance of service, the reorganization or readjustment of indebtedness or capitalization, the discharge or lawful refunding of obligations, or the reimbursement of moneys actually expended from income or from other money in the treasury not secured from the issue of stocks, bonds, notes or other evidences of indebtedness within five years next prior to the filing of the application therefor. The commission must set out clearly in its order the kind of securities, the purpose for which the funds are to be used, the terms for which they are to run and the rate of interest.

In case of the organization of a new company or companies to acquire a property in the hands of a receiver at the time this act goes into effect, the requirements do not apply, except to the extent of limiting the securities, exclusive of those issued for additional capital, to an amount not to exceed the aggregate evidences of indebtedness of the old company.

No company shall declare any stock, bond or scrip dividend or divide the proceeds of the sale of any such securities among stockholders without consent of the commission. Capitalization of franchise value, except such money as shall have been paid a political subdivision for the franchise, shall not be authorized by the commission, nor shall the capital stock of consolidated companies exceed the combined capital stock of the original companies at par, except for such amounts as are actually paid in addition to such combined capital stocks; neither shall contracts of consolidation be capitalized nor bonds be issued against such contracts.

With the consent of the commission, but not otherwise, any two or more public utilities furnishing a like service in the same municipality or locality, or any two or more public utilities whose lines intersect or parallel, may enter into contracts to operate their lines or plants in connection with each other. Any public utility may purchase, lease or sell its property, plant or business to any other such public utility. Any such public utility may purchase the stock of any other such utility. The commission must be satisfied that such consolidations will benefit the public and that a better service at just and reasonable rates will be furnished thereby.

One section, which provides for the consolidation of telephone companies, is based upon a point which was the subject of extended discussion throughout the session of the Legislature. Two or more companies whose properties lie within or partly within the State, when they shall have complied with the orders of the commission and the requirements of this act, may consolidate. Such companies must file a joint petition in which all the details of the terms must be set forth. If, after a hearing, the commission is satisfied that consolidation will be of public advantage and convenience and that adequate service will be furnished at reasonable rates, it shall make an order of consolidation. No consolidation shall be valid until after the commission has ascertained the value of the properties concerned, and upon this valuation all charges must be based.

Telephone companies may be required to connect their lines in order to give a continuous service between localities. Joint use of equipment may be required to accomplish this purpose, but at all times the tolls for joint service must be reasonable, and the commission shall have power to apportion charges among the companies.

Neglect or refusal to obey the orders of the commission or disobedience of the requirements of this act subjects companies to a fine not to exceed $1,000 for each offense and officers or employees may be punished by a fine of not less than $100 nor more than $1,000 for each offense, or imprisonment not to exceed two years, or both. Each day's continuance shall constitute a separate offense. Action to recover in such cases shall be brought in the name of the State. In addition, the company shall be liable to any person, firm or corporation injured through disobedience of the orders of the commission or the laws, in treble the amount of damages actually sustained.

Any company dissatisfied with an order of the commission relating to rates, service or anything else of the kind may commence proceedings in the Common Pleas Court of Franklin County or the county wherein the principal office is located, to set aside the order as unreasonable and unjust. The order of the commission shall continue through such proceedings, however, unless the company shall elect to operate under the rates or rules in force for the period next preceding the issue of new rates or orders, when bond shall be given for the protection of patrons in case the commission is sustained by the court.

Utility companies may grant free service to the United States, the State of Ohio or any political subdivision in the State, or for charitable purposes, fairs and expositions, or to employees and their families.

No permit, franchise or right to own, operate or manage any public utility, known in this act as an electric light company, gas company, waterworks company or heating and cooling company, shall hereafter be transferred to any corporation not duly incorporated under the laws of Ohio. Companies formed for this purpose, though they may not have acquired any property, are to be subject to this act.

The bill appropriates $75,000 per year for the support of the commission, but fees may be charged for copies of papers and other services. When complaint is filed against a corporation and the commission conducts a hearing on the complaint, the expenses shall be paid by the corporation in case the finding is against it.

Under the act the Railroad Commission shall become the Public Utilities Commission. The act is to be in force from June 30, 1911, if signed by Governor Harmon.

There is general speculation as to the effect of the passage of the public utilities bill on telephone service. The first move toward consolidation will probably be made in one of the larger cities, as Cleveland, Toledo, Columbus or Dayton. Cincinnati has never had but one system. Bonds of the Cuyahoga Telephone Company have advanced from 83 to 89 on the Cleveland Stock Exchange since the passage of the public utilities bill.

Wisconsin Commission News.

The Railroad Commission of Wisconsin has authorized the Peninsular Power Company to issue 7500 shares of stock of the par value of $100 each, for money only and at not less than par. The stock is to be issued for the purpose of supplying the company with funds for purchasing certain designated properties in Dickinson County, Michigan, and Florence County, Wisconsin; for the purchase of all rights, powers and privileges incident to the construction and maintenance of a dam across the Menominee River, near Iron Mountain, Michigan; for paying organization expenses; for acquiring overflow lands and other property necessary for the purposes of the company; for constructing and equipping an electric power plant. The company proposes to install a 3000-kw hydroelectric plant and to increase the total output to 4000 kw by means of steam auxiliaries.

The commission has received a complaint from citizens of Lodi, Wis., in which it is alleged that the municipal plant of Lodi is charging unreasonable and excessive rates for electric energy for lighting; that discrimination is being practised in the application of the meter-rental provision of the schedule. The hearing has been set for the latter part of June. The Village Board of Park Falls has complained informally that the rate charged by the Park Falls Water, Light & Power Company for street lighting is excessive.

A bill has recently been before the lower house of the Legislature which provides that physical connection between competing telephone systems be made compulsory and that no duplication of systems in cities be permitted. The advocates of the bill regard the telephone business as a natural monopoly, and as such competition can be permitted only after the commission has investigated the conditions and has concluded that public convenience and necessity require more than one system, all questions pertaining to the administration of the bill, should it become a law, are left to the Railroad Commission.

New York Commission News.

After investigating the New York Public Service Commission, First District, at the request of Governor Dix, Mr. John N. Carlisle submitted a report in which he commends the commission from every viewpoint, based upon the work accomplished by the commission since its inception in 1907. In commenting on the subway problem, which will probably be settled definitely during the present week, Mr. Carlisle said:

"Undoubtedly the question as to the route is a very important one in connection with an operating company, but my own opinion is that the public officials, in order to give to the people of New York a comprehensive and adequate subway system, should themselves determine where such a system should be built and should require the operating company to comply with the routes laid out by them, and not permit the operating company to fix the routes itself. Similar delays will always result in connection with subway construction unless the public officials take the bull by the horns, lay out the routes which they believe are best suited to the people of New York, commence construction promptly, and then procure operators.

"The view that no operator can be procured is in my opinion absurd. The great congestion of population in New York will make any subway operation very profitable upon any kind of fair terms. The only fair criticism that can be laid against the commission in connection with the delay is that after they had laid out the Triborough route they were apparently willing to postpone action and negotiate for a change of route to suit the demands of proposed operators."

The Public Service Commission, Second District, has granted authority to the Long Island Lighting Company, recently organized for the purpose of taking over several companies on Long Island, to issue a first mortgage upon all its property and franchises, conditioned to secure the payment of its 5 per cent bonds payable twenty-five years from date to the aggregate amount of $6,000,000. The company is authorized to issue its capital stock to the amount of $300,000 at not less than the par value thereof. The company is also authorized to issue bonds upon the security of its mortgage to the aggregate amount of $295,000. Bonds are to be sold at such a price as will produce to the company, after paying all commissions, expenses and discounts, not less than 85. The proceeds of the stock and bonds are to be used for the purchase of the capital stock and outstanding bonds of the Northport Electric Light Company, Amityville Electric Light Company, Sayville Electric Company, Islip Electric Light Company; for new construction from Northport to Commack, Commack to Islip, Islip to Sayville, and Islip to Babylon; for a low-tension line from Brentwood to Central Islip and Sayville to Ronkonkoma, and also for general improvements in apparatus and overhead construction throughout the entire territory which it covers. The company is also authorized to commence construction of the new transmission lines and other parts of its improved system whenever it shall have acquired all the stock and bonds of the Northport, Amityville, Sayville and Islip companies.

The Syracuse Lighting Company has been authorized to exercise rights and privileges under franchises granted by the town of Manlius, Onondaga County, giving the company permission to construct and operate an electric transmission line in that town.

The Marion Power Company has been authorized to issue 6 per cent bonds to the amount of $9,500, the bonds to be sold at not less than par and the proceeds used for the construction of a plant of the company in Marion, Wayne County.

The commission has approved of the sale, transfer and assignment to the Federal Telephone & Telegraph Company of the franchises held by the Warner Telephone Company, Penn Yan Telephone Company, Wayland Independent Telephone Company, Clifton Springs Telephone Company, Livingston County Telephone Company, Salamanca Telephone & Telegraph Company, which companies operate in the villages of

Gowanda, Lima, Dansville, Livonia, Genesee, Honeoye Falls, Penn Yan and Wayland.

Maryland Commission News.

The Maryland Public Service Commission last week concluded the consideration of complaints that the service furnished by the Easton Light & Fuel Company was not satisfactory. The commission went to Easton to make inquiry and Chief Engineer Phelps also made an investigation. In a report to the board the latter recommended extensive improvements to the plant of the company in order to remedy the defects complained of. In an order signed last week the commission directs the company in detail as to what must be done and requires that it shall submit plans for doing the work within ten days.

City Solicitor Poe has conferred with President Aldred, of the Consolidated Gas, Electric Light & Power Company, relative to an adjustment whereby Baltimore consumers would be furnished gas for 80 cents per 1000 cu. ft. Mr. Poe is quoted as saying that if the price of gas and electricity is not voluntarily reduced before Oct. 1 the city will petition the Public Service Commission. Mr. Aldred has promised to take up the question when he returns from abroad, which will be some time during the present month. As the result of an investigation recently made, Dr. C. E. Munroe, of Washington, reported that gas could be manufactured in Baltimore for 55 cents per 1000 cu. ft., leaving a profit of 35 cents on each 1000 cu. ft. The commission sent to the Consolidated company on March 9 a letter asking, on behalf of the city solicitor, information as to the cost of producing and distributing gas. While this information was refused, Commissioner Laird said that he did not feel called upon to demand the information since the city's case was not at that time up for consideration by the commission. The letter expressed a hope that the gas and electric rate problems could be solved without the necessity of further controversy. In his reply President Aldred said that by reason of the recent reduction in the price of gas from $1 to 90 cents per 1000 cu. ft. the consumers of Baltimore saved $300,000.

New Jersey Public Utility Commissioners on Competitive Franchises.

On Sept. 15, 1910, the Atlantic Highlands Gas Company filed a petition seeking to obtain a franchise in order to supply gas to the inhabitants of Shrewsbury Township, Monmouth County, N. J. About two months later a fifty-year franchise was granted by the township committee and accepted by the company. However, it appears that the Consolidated Gas Company of New Jersey had been previously granted a franchise for Shrewsbury Township. This franchise was granted in 1895, and for a number of years the Consolidated company has supplied gas through pipes laid in Shrewsbury Township. Furthermore, it was shown that the Consolidated company is now laying pipes to supply gas to much the same section of the township as the Atlantic Highlands Gas Company desires to serve.

The conflict was referred to the Board of Public Utility Commissioners of New Jersey, and in a decision handed down May 31, 1911, the board announced that it withheld its approval from the franchise granted to the Atlantic Highlands Gas Company. It was stated that the commissioners could not find that the franchise conferred by the recent ordinance is "necessary and proper for the public convenience" nor that it "properly conserves the public interests."

In its opinion accompanying this decision the board says that the creation of various boards and commissions with supervisory powers over public utilities demonstrates that the illusive doctrine of competition in the field of public utilities is being superseded by an experimental régime of strictly regulated monopoly. Often the competition in the end results in increased prices to consumers. There appeared to be no exceptional circumstances in the Shrewsbury case, and the addition of a competing company with permit to supply like service in the same general region would involve sanctioning the general idea of competition.

However, the board does not by its refusal of a competing franchise express itself as approving the price for gas now set by the Consolidated Gas Company. This price is $1.50 per 1000 cu. ft. On its own initiative, the Board of Public Utility Commissioners has called a hearing for the purpose of determining whether this rate is just and reasonable. This hearing will be held at 11 a. m. on June 13, in the State House in Trenton.

Among other business recently transacted, the New Jersey board has ordered an exhaustive inquiry into the recent accident on the Belvidere division of the Pennsylvania Railroad at Martins Creek, which resulted in the death of twelve persons and injuries to many others.

Among recent complaints has been one from the borough of Haworth and others against the New York Telephone Company in relation to the alleged failure of the company to supply service.

CURRENT NEWS AND NOTES.

Canton Meeting of Ohio Society of Engineers.—Canton, at which the Ohio Society of Mechanical, Electrical and Steam Engineers was organized ten years ago, has been chosen as the next meeting place for the convention to be held on June 17 and 18, 1912.

Seattle Convention of N. E. L. A.—As announced in our issue for May 18, Seattle has been selected as the National Electric Light Association convention city for 1912. The executive committee has as yet not chosen the exact date for the Pacific Coast convention, but it will probably be held during the first week in June.

New York Meeting I. E. S.—At a meeting of the New York Section of the Illuminating Engineering Society, to be held in the Engineering Societies Building on June 8, Dr. Sydney W. Ashe will present two papers, entitled "Comparison of Illuminants" and "A Graduate Course in Illuminating Engineering."

M. I. T. Bequests.—Gen. T. C. DuPont has given $500,000 to the Massachusetts Institute of Technology, to be applied to the purchase of a new site. The institute will receive nearly $500,000 from the bequest of Mrs. Emma Rogers, widow of Dr. William B. Rogers, the first president of the institute, and somewhat more than this amount from the fund created by Mr. Francis B. Green. Combined with the aggregate gift of $1,000,000 from the State, these amounts will be sufficient to purchase the proposed new site and erect the necessary buildings.

Animated Electric Sign for Circus.—A large circus now touring the West sends a huge spectacular electric sign along with its advance agent to the larger cities which it visits. The sign shows a bareback rider, with horse and equestrienne in natural and rapid motion. Tungsten sign lamps are used exclusively in the display, the circuits making up the loping positions being arranged on the secondaries of two sets of low-voltage transformers, controlled from flashers on their primary sides. The sign is erected on roof tops in the larger cities where the circus remains more than a day and where electricity is available. As a publicity measure this sign is considered one of the best investments of the circus' advertising department.

No Wisconsin Summer Convention This Year.—Mr. George B. Wheeler, of Eau Claire, Wis., president of the Wisconsin Electrical Association, announces that there will be no summer convention of that association this year. The annual convention of the association is held in Milwaukee beginning on the third Wednesday in January.

Damage Caused by Snow Slides Repaired.—Last March the power plant of the Pacific Hydroelectric Power Company at Mono Lake, near Bodie, Cal., was destroyed by snow slides, which tore away the station and a portion of the transmission lines, causing death or injury to several people. This plant, which supplies electrical energy to several cities and mining camps in southern Nevada, has now been completely restored.

British Columbia 15,000-hp Hydroelectric Development.—The Prince Rupert Hydroelectric Company has been incorporated with a capital of $5,500,000 to develop 15,000 hp on the Okeena River, British Columbia, and branches, for transmission to Prince Rupert, about 42 miles distant. Work will be begun at once on a provisional 1500-hp plant. The company has been organized by interests connected with the Western Canada Power Company, of British Columbia, and includes among its incorporators Mr. R. F. Hayward, general manager of the latter company, and Prof. L. A. Herdt, of McGill University.

Reconstruction of Colorado River Dam at Austin, Tex.—Two propositions for the reconstruction of the large dam across the Colorado River at Austin, Tex., are under consideration by the City Council of that city. One is from the J. F. Cogan Company, of New York, and the other was submitted by the Hydraulic Properties Company, of the same city. The water-power is to be utilized to generate electrical energy. In one case all of the energy is to belong to the city; in the other about 25 per cent is to go to the city, the remainder to be sold by the company for a term of twenty-six years. The proposition accepted tentatively by the City Council will be submitted to popular vote.

Hydroelectric Project Near Santa Rosalia, Mexico.—Contrary to recent reports, the Mexico Northern Power Company has not abandoned its plan for the construction of a hydroelectric development on the Conchas River at a point about 18 miles from Santa Rosalia, in the State of Chihuahua. While the work of building the dam was interfered with to some extent on account of recent revolutionary troubles, the force of laborers will be increased at once with a view of making up for lost time. From the generating plant transmission lines will be construction to the cities of Chihuahua, Parral, Jimenez, Santa Rosalia and a number of the larger mining camps. The initial cost of the enterprise will be about $5,000,000 in gold, it is said. It is reported that mines and other industrial concerns have already contracted for the use of about 50,000 hp in electrical energy. The company is composed of a small group of Canadian capitalists.

Texas Attorney-General Investigating Alleged Electrical Trust.—The joint resolution adopted by the Legislature of Texas at its recent session calling on the Attorney-General to investigate the so-called electrical trust that is alleged to be doing business in Texas and to institute prosecutions against its members, should he find that the reports of its existence are well founded, is now being observed by Attorney-General J. P. Lightfoot. In company with Assistant Attorney-General John W. Brady, Mr. Lightfoot is visiting a number of cities for the purpose of investigating different companies that are doing business in Texas. The resolution requires that he shall investigate the books and affairs of the Bell Telephone Company, the Southwestern Telegraph & Telephone Company, the United States Electric Company, the General Electric Company, the Western Union Telegraph Company, the Postal Telegraph Cable Company, the Stone & Webster syndicate and the various subsidiary concerns of these respective corporations.

Central-Station Development.—With the title "The Commercial Development of the Electric Light and Power Industry," the Electric Bond & Share Company has issued an interesting pamphlet prepared by Mr. Edward B. Lee, statistician of the company. The greater portion of the text consists of a comparison and discussion of statistics from the United States central-station census reports for 1902 and 1907. An estimate is given of the outstanding bonds and stock of central-station companies in 1911, the total being $1,788,075,452, an increase of 284.9 per cent over the census figures of 1902. A partial list is given of transmission companies operating 100 miles or over of high-tenson lines. Twenty-one companies are mentioned, of which five operate at 100,000 volts and one (Commonwealth Power Company, Michigan) at 110,000 volts. One of the companies (Pacific Gas & Electric Company) has now approximately 1000 miles of high-tension line.

Opening of New Northwestern Railroad Station, Chicago.—The new Chicago Passenger Terminal of the Chicago & Northwestern Railroad, just completed at a cost of $24,000,000, was thrown open to the public Sunday, June 3. A very full preliminary illustrated account of the electrical features of this station was given in the *Electrical World* July 8, 1909. The building is a monumental structure of granite and marble, 320 ft. x 218 ft. in plan, and contains ten acres of floor space. The exterior is designed in the Italian Renaissance style of architecture, with a Doric portico of six 60-ft. granite columns. The terminal has its own lighting and power plant, with cross-compound engines exhausting into low-pressure steam turbines. This equipment furnishes energy for twenty-four elevators for passengers, baggage, mail, etc.; a pneumatic tube system, ventilating blowers, belt conveyors, station lighting, yard lighting, curb-post illumination, etc. A total of 780 hp in motors is installed in the building. The switching of trains in the thirty-acre yards is controlled by a complete system of electric interlocking signals. Nearly 75,000 cp in incandescent lamps is said to be employed in the indirect illumination of the main waiting-room.

Cincinnati Accident Causes Picturesque Reporting.—Lightning struck a portion of the Plum Street plant of the Union Gas & Electric Company in Cincinnati on May 30 and did considerable damage. The opportunity for some rather sensational writing was not overlooked by the Cincinnati reporters. Thus we are told that "Fire that no water could extinguish burned into the very vitals of the plant, fried and roasted the thick insulations of the giant feed wire, and in a few moments the entire city, along with West Cincinnati, was shrouded in Stygian darkness." There are references to "wiring from a thread size to diameters similar to sewer piping," to "machinery growling under the heat," and so forth, to the extent of a column and a half. It is also neatly stated that, in ordinary course, the lightning would have been "quickly absorbed by superior electric power." In the same article Mr. Rollin W. White, acting president of the company, was interviewed, and, if correctly reported, gave the facts as follows: "This is one of the most remarkable accidents that have ever happened to the Cincinnati plant, and it is also a very rare one. A bolt of lightning struck the building and made its way to one of the big transformer tubs. It fractured the transformer casing, allowing the oil to run over the floor. The oil ignited and burned out two cable leads, as well as throwing the whole plant into confusion. As soon as the fire was quenched repairs were begun. The damage was very slight so far as machinery and plant are concerned, being confined to the transformer and the burned cable, and will hardly run over $500. The accident threw the whole plant out of service for half an hour or more."

A CLIFFSIDE STEAM-TURBINE PLANT.

Northern Heating & Electric Company's Station in St. Paul, and Its Sand-Rock Distributing Tunnels.

NATURAL conditions often make it necessary to depart from the commonly accepted ground-plan arrangement of the various operating elements in power plants. Stations built on hillsides may secure certain advantageous vertical positioning of parts not possible or advisable under the limits of a flat foundation.

A plant embodying the vertical idea of arrangement to a unique degree is the 4300-kw steam-turbine station of the Northern Heating & Electric Company, at St. Paul, Minn. This is virtually an eight-story building standing on the river shore against a high cliff, so that its sixth story, on which the company offices are located, is at the level of the city sidewalks.

Beginning at the bottom, below the level of the tracks outside is the coal-receiving apparatus. Above this are the boilers. The turbine-room occupies the third and fourth-floor levels, its switchboard being at the fourth story. A machine shop is on the fifth, the general offices on the sixth, the engineering offices on the seventh and a storeroom on the eighth. As shown by the sectional elevation, Fig. 2, however, the major part of the building's interior, from the third to the eighth stories, is occupied by the economizer chambers and by the huge coal bunkers.

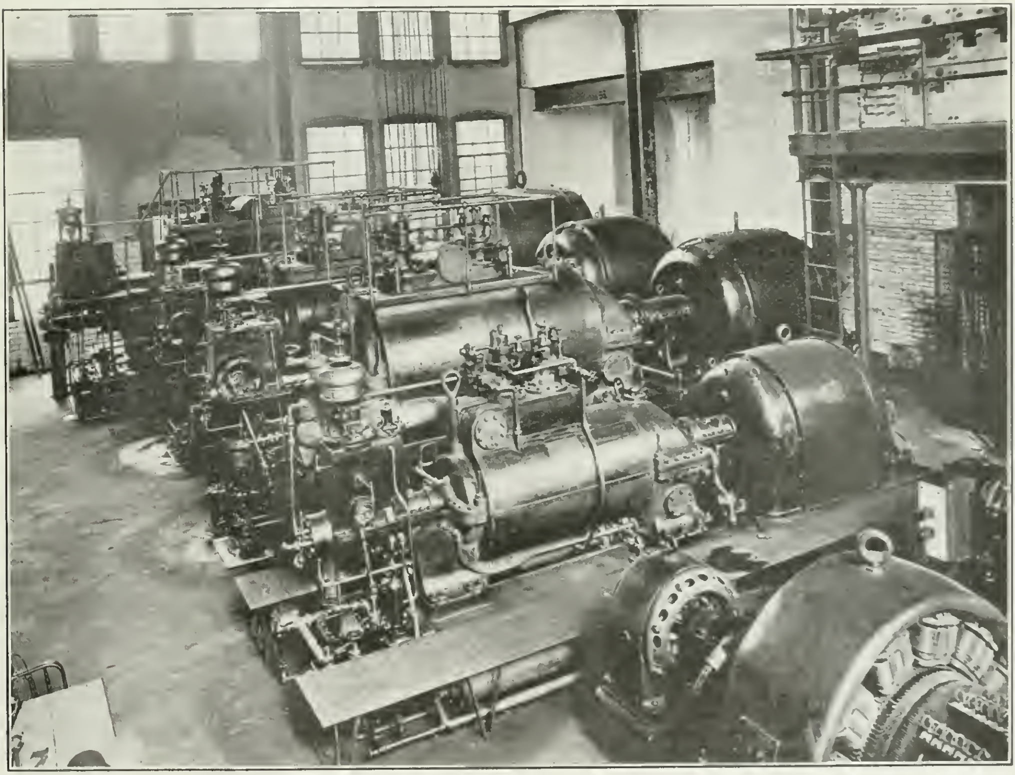


Fig. 1—Turbo-Generator Room of Northern Electric & Heating Company, St. Paul.

The building, a steel-frame structure with brick walls, measures 143 ft. x 75 ft. in floor plan and has an extreme height of 145 ft. from the foundation of the coal-crusher room to the eaves of the roof. To the main building a 37-ft. x 30-ft. boiler extension, seen in Fig. 3, has just been added. The three-story portion of the front of the plant which extends above the upper street level is faced with red brick and bears the general appearance of a prosperous business building, giving no suggestion of the complex mechanical and electrical equipment within. As the main furnaces are worked with induced draft, even the short smokestack is hardly noticeable above the roof of the building.

STEAM EQUIPMENT.

Coal is brought into the plant on a spur track at the river level from the lines of the principal railroads entering St. Paul, all of which pass the station. From the cars it is dumped into a track hopper, Fig. 2, and passed through a crusher driven by a 15-hp, 220-volt alternating-current motor. From this a drag conveyor, operated by a 5.5-hp motor, raises and dumps the coal into the main bucket conveyor, which in turn elevates it to the bunkers 120 ft. overhead. This Peck carrier is made up of 182 24-in. buckets 18 in. wide and is driven by a 15-hp motor. After raising the coal 120 ft. to the overhead horizontal run the buckets strike a tipple, which can be set to discharge them into any of the three great coal-storage bins.

The overhead coal bunkers are 84 ft. long, 58 ft. wide and 62 ft. deep, and altogether are capable of holding 4500 tons at one time. The sides are of arched steel plates, while the ends and inclined surfaces are of heavy reinforced concrete supported by steel framing. The bunkers are divided into three bins by steel partitions, each bin feeding a pair of boilers beneath it, while No. 3 bin supplies, in addition, the new pair of 500-hp boilers in the newly erected boiler-room extension. The coal used in this plant is Youghiogheny and Hocking screenings, costing $3.15 per ton delivered in car-load lots. In case of fire in the bunkers, or if for any other reason it becomes necessary to transfer coal from one bin to another, telescope chutes are provided from the bunkers, discharging through manholes in the boiler-room floor to the conveyor buckets beneath.

Beneath the coal bunkers are six 600-hp Edge Moor water-tube boilers, and in the new addition at the west of the building are two 500-hp boilers of the same type. Five of the original battery of 600-hp boilers are equipped with Murphy automatic stokers, the sixth boiler having a Model stoker. The new 1000-hp battery is equipped with Green chain grates and Foster superheaters. All coal fed into the furnaces is first weighed or measured in overhead hoppers. In this way a close record is kept of the coal burned. The ashes dropped from the furnaces are collected in hoppers in the basement and discharged into the Peck conveyor already mentioned. This elevates the ashes to the 120-ft. level, as in the case of the coal, dumping them by means of an adjustable tipple into a cylindrical steel ash bin. The bin has a capacity of two carloads and extends downward through the lower floors of the building, discharging into the cars on the track below.

From the furnaces of the six older boilers the flue gases pass upward through asbestos-covered uptakes (conducing to a low temperature in the boiler-room) to the economizer chambers on the floor above. Here the gases give up a large part of their heat, being reduced in temperature to about 350 deg. Fahr. to 380 deg. Fahr. The draft on these boilers is induced mechanically by two 16-ft. x 5-ft. fans driven at 100 r.p.m. by Ball engines. The draft over the grates averages a pressure equal to 0.3 in. of water column. From the fans the flue gases are discharged into the atmosphere by a 9-ft. 6-in. steel stack, 101 ft. in height over the boilers and extending a few feet above the roof of the building. The fan engines are lubricated by a forced-feed oiling system, the necessary pressure being supplied by a water column tapped from the condensate of a steam line. One man is charged with filling the oil reservoir weekly, although the tank holds a two weeks' supply, insuring that the engines shall be always well lubricated. The bearings of the flue-gas fans are lubricated with a solid oil which is forced into the heated bearings by home-made but effective screw-thread syringe arrangements, to the handles of which is given a half-turn every few hours.

Feed water for the boilers is diverted into a tank in the basement from the jet-condenser discharge line, water from the nearby Mississippi River being used for condenser cooling purposes. From the basement tank the feed water passes through the Green economizers, each set comprising 280 4-in. tubes 10 ft. in length. Tests made on these boiler units with the water in the tank at 40 deg. Fahr. have shown the water leaving the economizers to be at from 125 deg. to 150 deg., the flue-gas temperature having been meanwhile reduced to about 350 deg. A pressure of 185 lb. per square inch is carried on the boilers, and the tests already cited have shown that under ordinary operating conditions the boilers evaporate about 7.1 lb. of water per pound of coal. Drain valves from the water columns on the boilers over the Dutch ovens are mounted within reaching distance from the floor, so that the columns can be drawn off easily every hour. The boilers are blown off once in each eight-hour watch. On the boiler-room floor are a Knowles boiler-feed pump, a Worthington low-service pump and a Blake pump. In the basement below are a Smith-Vaille boiler-feed pump, a Smith-Vaille low-service pump and a Dean pump.

All of these boiler-feed pumps are arranged with double-pipe inlet and discharge piping, one inlet pipe coming from the heater and the other from the cold-water tank. In case the feed water becomes overheated in the economizers, producing steam vapor which the feed pumps will not handle, a little cold water has only to be turned into the inlet by adjusting one of the two valves. The lines are also duplicated from the pumps to the boilers. The steam taken from the old boilers is led through ten dry pipes in each, effectually drying and superheating it. The large headers from the boiler-room to the turbines over-

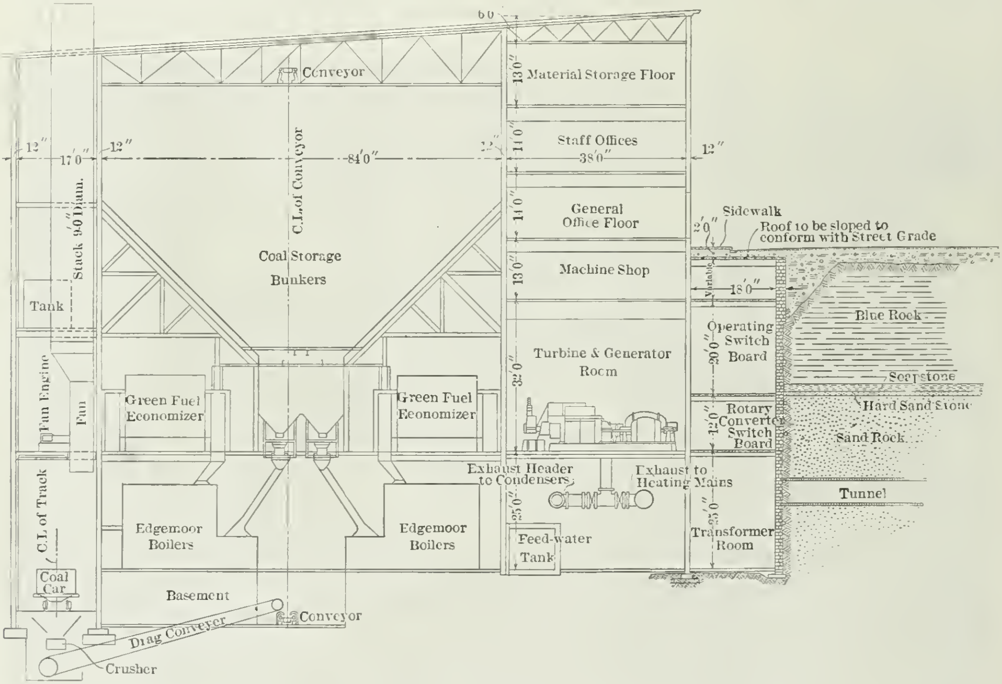


Fig. 2—Sectional Elevation of Power House, Showing Cliff and Sand-Rock Tunnels.

head are arranged for sectionalizing so that any boiler or boilers can be cut out for cleaning or repair.

The new boiler equipment installed in the west addition will enable the six main boilers to be shut down during the three summer months when there is no steam-heating load to be carried. As before noted, the new pair of 500-hp boilers are equipped with Foster superheaters. The flues open into a 6-ft. 6-in. steel stack, 150 ft. high above the boilers, and providing its own natural draft. Together with this new boiler equipment there has also been installed a 700-hp Stillwell open feed-water heater, utilizing the exhausts from the plant auxiliaries and the drains from the main steam lines. The new feed-water heater will be used in conjunction with all eight boilers, the flue-gas economizers being employed to raise the feed-water temperature even higher than that at which it leaves the heater.

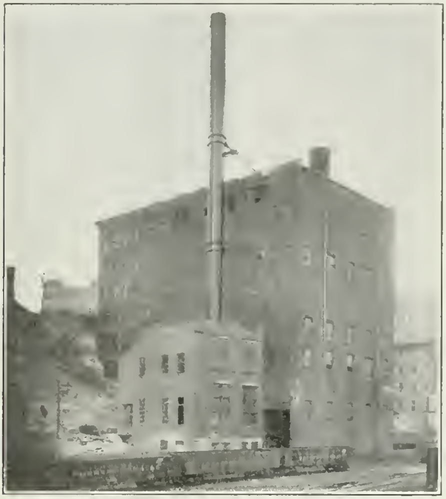


Fig. 3—Generating Station of Northern Electric & Heating Company, St. Paul.

ELECTRICAL GENERATING APPARATUS.

The turbine-room, Fig. 1, on the floor level above the boiler-room contains 4300 kw in horizontal, high-pressure steam turbines driving Westinghouse 2300-volt, 60-cycle, three-phase alternators. There is one 2000-kw unit, two of 1000-kw rating each and one of 300-kw rating. The excitation of these alternators can be furnished from either a 40-kw or 25-kw, 2300-volt motor-generator set or for starting by a 30-kw direct-connected steam-engine unit in the basement. In addition to the prime movers on the generator-room floor there are also a 300-kw and a 150-kw rotary converter delivering 220-volt direct current for the use of direct-current customers near the plant. Across the leads of these machines a 7.5-kw balancer set can be operated, giving a neutral point from which to bring out the middle wire of the 220-110-volt three-wire circuit used.

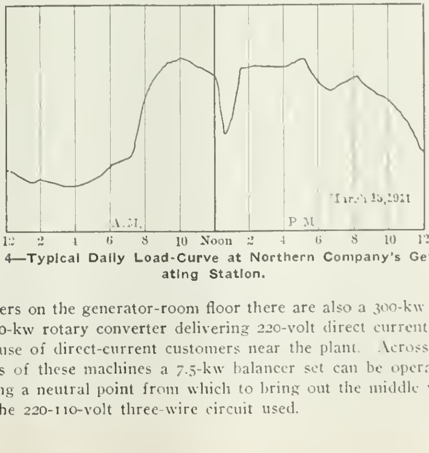


Fig. 4—Typical Daily Load-Curve at Northern Company's Generating Station.

The huge exhaust lines from the steam turbines are arranged with valves so that any unit can be connected to exhaust into either the condensers or the low-pressure steam-heating system which serves the business district of the city in the neighborhood of the plant. The condensers are of the Baragwanath barometric jet type and are supplied with cooling water from the Mississippi River by two 50-hp motor-driven centrifugal pumps, each capable of delivering 2200 gal. per minute against a head of 40 ft. These pumping units in addition to a spare unit supplied for emergency are installed in a pump house at the brink of the river near the plant. As has been already noted, the boiler-feed water supply is taken from the discharge of the condensers.

The steam-heating system into which the turbines are exhausted eight months in the year presents a normal back-pressure of from 4 lb. to 8 lb. per square inch at the station end of the mains. From June 15 to Sept. 1 only are these turbines run condensing, and during this time they gain the thermal efficiency of exhausting into a vacuum equal to 25 in. of mercury column. Running as a purely electrical plant during the summer season the coal consumption per kw-hour has been as low as 4 lb., but, as explained, during the major part of the year, on account of the Northern climate, the greatest part of the coal burned in the boilers is for the supply of the steam-heating consumers. The electrical load on the station, which is to a large extent commercial-motor business, continues nearly constant during the year. A sample load curve is shown in Fig. 4. During an average winter month from 4000 tons to 5200 tons of coal is burned, while the summer consumption barely reaches 1500 tons per month. The difference between these figures gives some estimate of the water evaporated purely

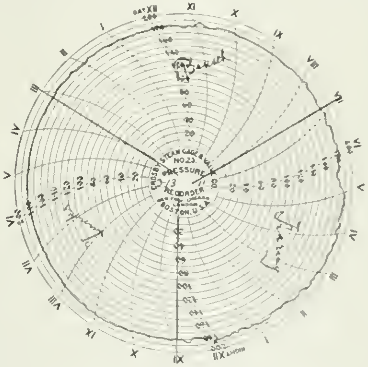


Fig. 5—Steam-Pressure Record Chart Marked by Shifts for Bonus Award.

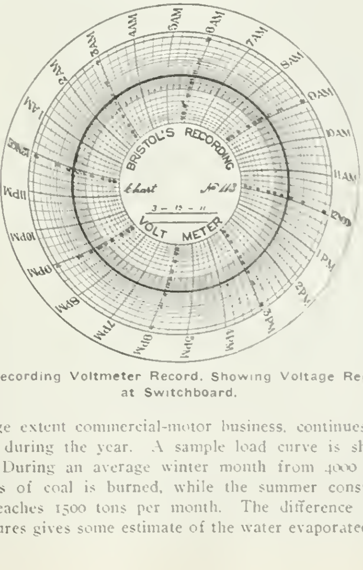


Fig. 6—Recording Voltmeter Record, Showing Voltage Regulation at Switchboard.

for steam-heating purposes. This during certain months has reached 60,000,000,000 lb.

The personnel of a plant force and the treatment which is accorded employees are not small factors in the successful operation of a station. Three eight-hour shifts are now employed in the Northern company's station. The men appreciate the reduced strain thus placed upon them, and are in better condition for working the shorter hours. A system of bonus awards is also in effect among the firemen, which conduces to keeping a nearly perfect steam curve. The cards taken from the recording-pressure gage are divided into three eight-hour segments, as shown in Fig. 5, corresponding to the three shifts of firemen employed. The fireman having the best pressure line during the preceding two weeks gets a bonus or cash prize of $5. Penalties are, of course, adjudged for allowing water to come over, for holes in the fire, etc., and a carbon-dioxide recorder is to be attached to the stack, making it possible to detect irregularities in the firing at any time. The comfort of the men in the fireroom is also enhanced by the asbestos insulation of the flue uptakes, the provision of draw-off pipes from the water columns and other minor details, mentioned in the foregoing.

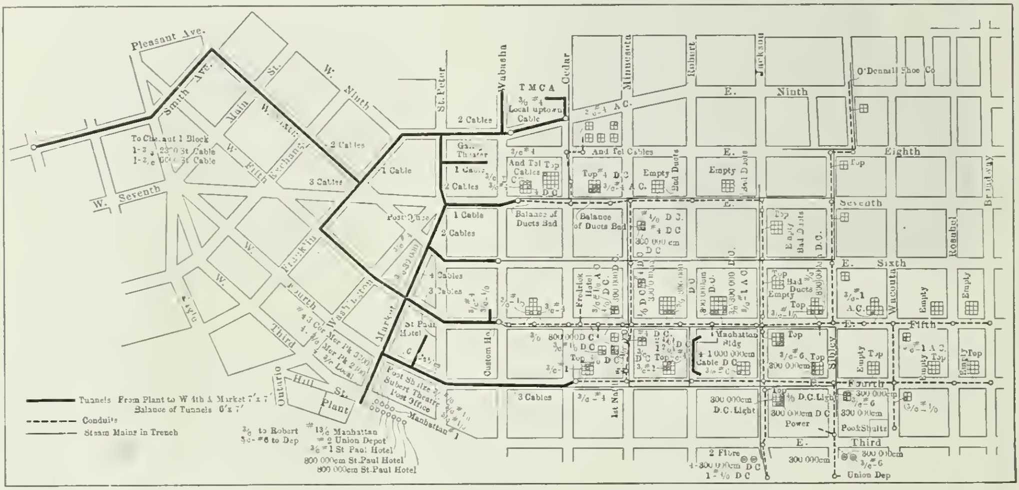


Fig. 7—Map of Northern Electric Company's Sand-Rock Tunnels, Conduits and Steam Lines Under Business Section of St. Paul.

The operation of the electrical equipment is controlled from a switchboard gallery, 36 ft. x 10 ft., mounted to overlook the turbine-room. Besides the standard machine panels and instruments with which the gray marble board is equipped there are also a Tirrill voltage regulator, a Bristol recording voltmeter, a Westinghouse recording wattmeter, static ground detectors, power-factor meters, totalizing watthour meter and a synchroscope Oil switches are provided for controlling the various feeders which go out of the station. A sample voltage regulation chart is shown in Fig. 6, illustrating the close regulation obtained.

DISTRIBUTION LINES AND SAND-ROCK TUNNELS.

The principal part of the station output is transmitted at the generator pressure, 2300 volts. As before explained, however, there is 450 kw of transformers and rotary converters, the 110-220-volt direct-current output of which is used in the district near the plant. There is also a 6600-volt transmission from the generating station to the Merriam Park substation, seven miles distant, duplicate lines being provided. One follows the river bank on pole-line construction; the other goes underground through the tunnels, emerging at a distant point and then taking to overhead construction.

Before describing the underground distribution system something should be said of the peculiar geological formation on which the business part of St. Paul is situated. The surface material, after cutting below a foot or two of soil, is of a flinty "blue rock" or limestone, which is nearly as difficult to excavate as the hardest granite or gneiss. This extremely hard rock extends down for a depth of 25 ft., although varying, of course, in different parts of the city. But at approximately this depth, as shown in Fig. 2, the formation undergoes a sudden change, and, below comparatively thin strata of soapstone and hard sandstone, there is a soft sand rock through which tunneling is easy. The formations described belong to the Silurian period of the earth's geological history, and the varying materials passed in order represent changes that occurred during forgotten ages in the ocean currents and conditions along the old sea bottoms which formed the present rocks of Ramsey County.

Advantage has been taken of the presence of the soft sandstone substratum to construct great galleries of underground tunnels for the use of the various public utilities of St. Paul, including the electric companies, telephone companies, waterworks and sewers. The tunnel system of the Northern Electric & Heating Company, which branches from the main raceway leading from the plant, comprises a total of about 8000 lin. ft. of tunnel, 6 ft. high and 3 ft. wide, through which electric cables and steam-heating mains are carried. Fig. 7 shows a map of these tunnels. At distribution points in the underground system transformers are mounted in chambers hollowed out of the sand rock at the side of the tunnels, and from these points the low-tension and the 2300-volt cables rise, through shaft holes drilled in the upper blue rock, to the surface or to the cellars of the buildings served. The sand-rock tunnels of the Northern company average in depth 25 ft. to 40 ft. below the surface. The sandstone is quite hard when first exposed and has to be excavated with pick and shovel, one man being able to advance a 6-ft. x 3-ft. heading about 2 ft. per day. The drill holes leading from the tunnels to the surface are 4 in. to 6 in. in diameter.

Through the main tunnel, shown in Fig. 8, are carried ten three-conductor alternating-current cables, one pair of single-conductor direct-current cables, a 20-in. and a 16-in. low-pressure steam-heating main, and a 5-in. live-steam pipe, the latter carrying steam for cooking in the Hotel St. Paul kitchens, several blocks from the plant.

All service to this splendid modern hotel, including lighting, power, heating and steam for cooking, is furnished by the Northern company. The 800,000-circ. mil, 220-volt direct-current circuit above mentioned operates the electric elevators in the St. Paul Hotel, besides serving the 130-kw lighting and motor load of the federal buildings near by. Alternating-current energy for lighting and motor purposes in the hotel is delivered at 2300 volts to three 125-kw transformers in a concrete compartment in the hotel basement and there reduced to 110 volts. The transformer chamber is force-ventilated by special pipes from the open air to the floor of the vault, and the transformers are equipped with switches so arranged that in case of breakdown any one can be removed from circuit and the remaining two operated on open-delta. A complete distribution switchboard is mounted in the sub-basement, outside the transformer cell. The connected load of the hotel represents 200 kw in incandescent lamps, the majority of which are tungstens, and 272 hp in motors. The latter are used to operate the elevators, hoists, a fifteen-ton ice machine, circulating pumps, vacuum cleaner, ice crusher, dish-washers, silver polishers, electric irons and laundry washers and mangles, all being alternating-current service except the elevators. The West Publishing Company, whose plant is near the station, also has a direct-current load amounting to 188 hp, which is supplied from the rotary converters in the main station.

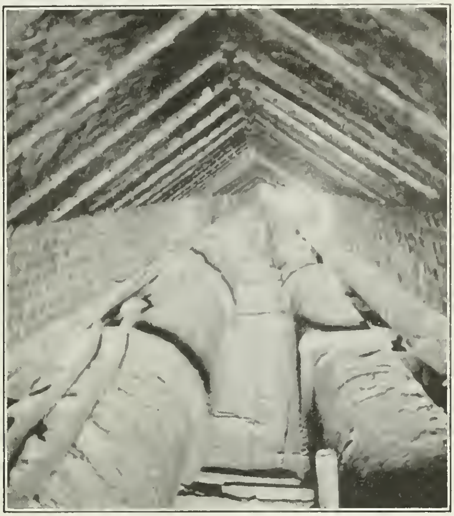


Fig. 8—Main Sand-Rock Tunnel, Showing Steam Pipes and Cable Brackets.

In the main tunnel the cables are carried on A-frame brackets mounted overhead as shown. Three of the alternating-current, three-conductor cables are made up of No. 0 cross-section, the remainder being of No. 4 copper. Three of these cables feed the Manhattan substation, at Robert and Fifth Streets, where are installed two 400-kw motor-generators, producing 110-220-volt direct current for the district bounded by Wabasha, Seventh, Wacuta and Second Streets. A 6600-volt cable, which also traverses the tunnel, is used as an auxiliary line to the 6600-volt overhead pole-line construction leading northwest along the river bank to the Merriam Park transformer substation, seven and one-half miles distant, which serves a residence section. Lightning arresters are provided on the next poles, where the overhead lines enter the tunnels at the borders of the underground district.

There is also a 6600-volt line leading across the river, a distance of eight miles, to a substation in South St. Paul. This substation serves a capacity of about 500 kw in street and commercial lights and power.

Besides those above mentioned other large consumers of the Northern Electric Company are the Central Warehouse Lumber Company, with 235 hp; Foot-Schulze Shoe Company, 153 hp; Shubert Theater, 100 kw; Union Station, 100 kw; Y. M. C. A.; Auditorium; Farwell, Ozman, Kirk & Company; Raudenbush Piano Company, and the Frederick and McGee hotels.

The 331,000 sq. ft. of radiation of the 225 steam heating customers are served by a total of 20,000 ft., or nearly four miles, of low-pressure steam mains. All heating service is measured by condensation meters, the rate being $0.50 to $0.80 per 1000 lb.

The Northern Heating & Electric Company is operated by H. M. Byllesby & Company, Chicago, Mr. Eugene Holcomb being general manager at St. Paul. Mr. J. L. Lawrence is chief engineer of the power plant.

THE COLORADO RIVER POWER COMPANY.

At Marble Falls on the Colorado River, in central Texas, there is approaching completion the first hydroelectric development of the Colorado River Power Company, whose future plants at Cummins and Smithwick Falls will ultimately make up a 20,000-hp system which is to transmit energy at 66,000 volts to Austin, Temple, Waco, San Antonio and other points in the central part of the State.

The Marble Falls dam, which will be the first to be completed, comprises an immediate development of 1650 hp—later to be increased to 9650 hp—utilizing a 70-ft. head in the Colorado River. With the storage area of 116,000 acre-ft. impounded by an 80-ft. dam across the San Saba River, 90 miles above the Marble Falls dam, a minimum constant flow of 740 cu. ft. per second is assured. The power dam is of the concrete compartment type, and measures over all 748 ft. at the top and 700 ft. along the base, which rests on a shelf of hard limestone. The masonry spillway section rises to a height of 65 ft., above which is 5 ft. of mechanically operated flashboard extending the full width of the spillway, 400 ft. This movable crest is built in 10-ft. sections, the frames being made of structural steel covered with 3-in. lumber and secured by heavy hinges. All joints are made watertight by strips of heavy six-ply rubber belting.

The buttresses of the spillway section are spaced at 10-ft. distances and those in the power-house section 14.5 ft. apart. The thirty-five sluice gates, each 7½ ft. x 8 ft., are built up of 9-in. channels reinforced by I-beams and covered with ⅜-in. steel plate. The gates are operated, one at a time, by a hydraulic cylinder mounted on a car on a transfer track extend-

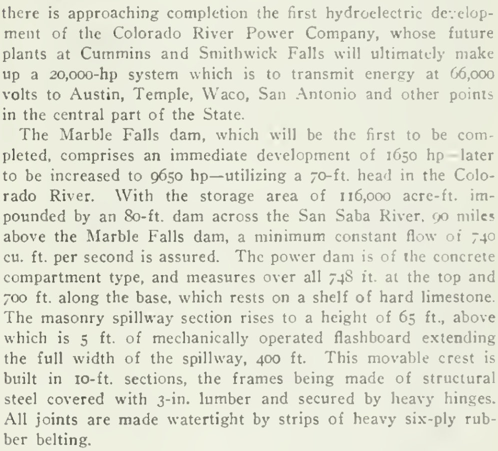


Fig. 1—Vertical Section Through Power House.

ing the full length of the sluice-gate section. This cylinder is supplied with water pressure to manipulate the gate by an electrically driven triplex pump delivering 2000-lb. pressure per square inch. In case of flood the sluicegates will first be operated and then any part, or all, of the movable crest can be lowered. The maximum flood recorded in the river has been 200,000 cu. ft. per second. Each of the 7.5-ft. x 8-ft. gates can discharge 5000 cu. ft. per second, so that the quantity remaining to be spilled over the crest is small.

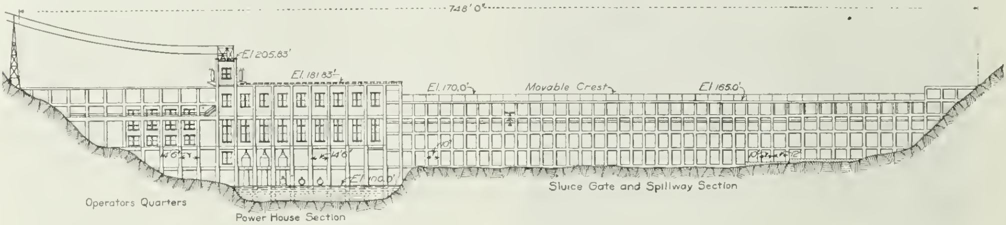


Fig. 2—General View of Marble Falls Dam from Downstream Side.

The power-house section of the dam structure is built to a height above any possible high water, the maximum height from the foundations to the top of the transmission-entry tower being 115 ft. The generating equipment to be installed at once comprises three 550-hp Victor vertical waterwheels direct-connected to 350-kw Westinghouse 2300-volt, 60-cycle, three-phase alternators. Each waterwheel unit will be equipped with a Lombard A6 oil governor. The present units occupy three of the nine compartments making up the power house, the other bays, except one, providing for the installation of future 2200-hp units. The ninth bay or compartment will contain the high-tension transformers and switching apparatus, the energy being raised for transmission to 66,000 volts. The present plans contemplate using wooden-pole line construction, eventually installing duplicate lines to the Round Rock junction and switching point.

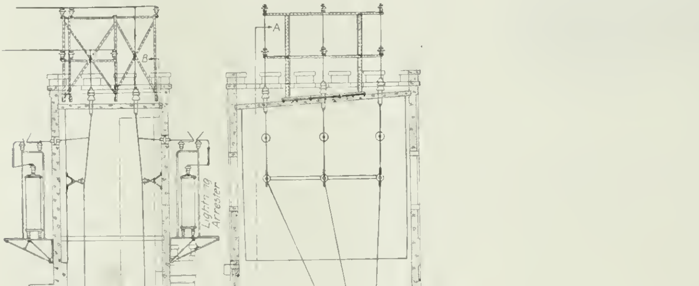


Fig. 3—Section Through Line Entry Tower and Transformer Bay.

A unique feature in the construction of the Marble Falls dam is the "dry-dock" provision of a concrete cofferdam extending along the crest of the natural fall for the purpose of diverting the flow of the river through the sluicegates during construction as well as later when making repairs or inspection of the power-plant section of the dam. Three 48-in. steel tubes extend through this permanent cofferdam toward the power-house section and through the concrete bulkhead, terminating in the discharge pits at an elevation slightly above tailwater. Swivel gate valves in these pipes make it possible, after drawing the water down in the pond, to divert the entire ordinary flow of the river through the tubes, so lowering the water in the pond as to expose the gate section of the dam. The space between the cofferdam and the power house can also be drained, exposing the upstream side of the power-house bulkhead and foundations. Through tailgates water can be pumped from any compartment, enabling any of the foundations of the structure exposed to be easily repaired or inspected.

The largest part of the power developed by the Colorado River system of hydroelectric developments will probably be sold at wholesale to large consumers, a part having already been contracted for. On account of the high cost of fuel in the district reached by the water-power lines, it is expected to find a good market for secondary power to consumers now having steam plants, a reciprocal agreement being made with these plant owners by which their surplus steam power may be absorbed by the water-power system in case of low water. Besides the power transmitted to the larger centers like Waco, Austin and San Antonio, some power will be used locally at Marble Falls and at points on the route of the transmission line.

The San Sabe 80-ft. storage dam, 90 miles above the Marble Falls dam, will be arranged for the installation of future power units. The Cummins dam, 10 miles above the Marble Falls site, is now marked by a 7-ft. dam, which will be replaced by a reinforced-concrete dam similar to that at the lower site and creating a 47-ft. head. The Smithwick Falls site, 12 miles below the present site, will produce a 50-ft. head when built.

From the group of water-power plants a transmission line will be taken 40 miles southeast-by-east to a switching station near Austin, from which point runs a 110-mile line northeasterly to Waco, and an 80-mile line southwest to Austin. The Marble Falls plant will thus be required to transmit over a maximum distance of 130 miles in transmitting energy to Waco.

Mr. C. H. Alexander, of Dallas, Tex., is president of the Colorado River Power Company. The W. H. Zimmerman Company, engineer and constructor, Chicago, has acted as engineer for the Marble Falls development during its design and construction.

POWER-FACTORS AND STARTING CURRENTS.

In a paper presented by Mr. F. D. Newbury at the recent N. E. L. A. convention a table was given of the power-factors of various kinds of central-station loads and another of alternating-current starting currents, both of which are reprinted below.

Incandescent lighting with small lowering transformers.—Power-factor, 90 per cent to 95 per cent.

Alternating-current inclosed-arc lamps with constant-current transformers.—Power-factor, from 60 per cent to 75 per cent, depending upon whether the transformers are carrying their rated number of lamps. An average figure would be 70 per cent.

Direct-current metallic-arc lamps with rectifiers.—Power-factor, from 55 per cent to 70 per cent, depending upon whether the rectifiers are carrying their rated number of lamps. An average figure would be 65 per cent.

Single-phase induction motor, squirrel-cage rotor, 1/20 hp to 1 hp.—Power-factor, 55 per cent to 75 per cent, average 68 per cent, at rated load.

Single-phase induction motors, squirrel-cage rotor, 1 hp to 10 hp.—Power-factor, 75 per cent to 86 per cent, average 82 per cent, at rated load.

Polyphase induction motors, squirrel-cage rotor, 1 hp to 10 hp.—Power-factor, 75 per cent to 91 per cent, average 85 per cent, at rated load.

Polyphase induction motors, squirrel-cage rotor, 10 hp to 50 hp.—Power-factor, 85 per cent to 92 per cent, average 89 per cent, at rated load.

Polyphase induction motors, phase-wound rotors, 5 hp to 20 hp.—Power-factor, 80 per cent to 89 per cent, average 86 per cent, at rated load.

Polyphase induction motors, phase-wound rotors, 20 hp to 100 hp.—Power-factor, 82 per cent to 90 per cent, average 87 per cent, at rated load.

Induction motor loads in general.—Power-factor, from 60 per cent to 85 per cent, depending on whether motors are carrying their rated loads.

Rotary converters, compound wound.—Power-factor, at full load can be adjusted to practically 100 per cent. At light loads it will be lagging, and at overloads slightly leading.

Rotary converters, shunt wound.—The power factor can be adjusted to any desired value, and will be fairly constant at all loads with the same field rheostat adjustment. Rotary converters, however, should not be operated below 95 per cent power-factor leading or lagging at full load or overload.

Small heating apparatus.—This load has the same characteristics as an incandescent-lighting load. The power-factor of the load unit is practically unity, but the distributing transformers will lower it to some extent.

Arc furnaces.—Power-factor, 80 per cent to 90 per cent

Induction furnaces.—Power-factor, 60 per cent to 70 per cent.

Electric-welding transformers.—Power-factor, 50 per cent to 70 per cent.

Synchronous motors.—Adjustment between practically zero power-factor leading to zero power-factor lagging.

The author made the following general statements regarding probable power-factors (1) Operating power-factors above 95 per cent will be obtained only when practically all of the load is synchronous motors or converters which may be operated at practically unity power-factor. Even with this character of load the generators should be capable of operating satisfactorily at 93 per cent power-factor to provide for unforeseen contingencies. (2) Power-factors of 90 per cent to 95 per cent can be safely predicted only when the load is entirely incandescent lighting or heating, or if a large non-inductive load, such as synchronous motors or converters, is used with a smaller proportion of inductive motor load. (3) For the average central-station load, consisting of lighting and motor service, a power-factor of 80 per cent should be assumed. (4) A power-factor of 70 per cent should be assumed for a plant having a large proportion of induction motors, arc lighting, electric furnaces or electric welding load.

In what follows the starting torque is expressed in terms of the full-load torque, and the starting current in terms of the full-load current. The smaller values given for synchronous motors cover the requirements of motor-generator sets and air compressors and pumps when the apparatus can be started without load. The larger values refer to motors for driving pumps and fans, which must be started under practically full-load conditions. The wide variation in the starting current comes from differences in construction of the motor or differences in the proportions of the motor, since, by increasing the size and cost of synchronous motors, the starting performances can be materially improved.

Single-phase induction motors, with clutch, split-phase starter.—Starting torque, 1 to 1¼, starting current, 4½ to 6.

Single-phase induction motors, without clutch, split-phase starter.—Starting torque, 2; starting current, 3½ to 4½.

Polyphase induction motors, cage-wound type, auto-transformer starter.—Starting torque, 2; starting current, 7 to 8.

Polyphase induction motors, wound-rotor type, step-by-step resistance starter.—Starting torque, 1; starting current, 1¼. Starting torque, 2; starting current, 2½.

Synchronous motors, auto-transformer starter.—Starting torque, 0.3 to 0.5; starting current, 1½ to 2½. Starting torque, 0.7 to 1; starting current, 4 to 8.

Rotary converters, auto-transformer starter.—Starting torque, 0.2; starting current, 1½. Starting torque, sufficient to start itself.

REASONS FOR COOLING TOWERS ON ISLAND POWER HOUSES.

Engineers visiting Galveston, Tex., often express surprise to find cooling towers in use on local power plants, although Galveston is situated on an island in the Gulf of Mexico with plenty of circulating water available on all sides. The Brush Electric Light & Power Company of Galveston has probably the largest cooling tower in the South, an open, wooden-tray structure, 30 ft. wide, 150 ft. long and 28 ft high. The tower is situated over two large reservoirs, and was designed to require the minimum pumping lift for the water. A vacuum of 26½ in. to 28 in. of mercury is maintained on the 4300-kw turbine plant, which the tower serves, the water being cooled from 120 deg. down to 80 deg to 90 deg. Fahr in its passage through the trays.

Attempts to use ocean water with surface condensers have failed at Galveston on account of the activity of submarine life in the waters of the Gulf of Mexico. In spite of any straining devices that could be employed eggs and germs of barnacles and shellfish were admitted to the intake pipes and, adhering to the pipe walls, soon grew to a point where they actually choked up the pipes. Before this action was understood a number of ocean-water intakes were installed leading down to the bay, but these, some even 14 in. in diameter, were soon entirely closed by the growth of animal and vegetable life so that they are useless, and cooling of the condenser water by atmospheric evaporation has had to be resorted to.

Abstracts of the N. E. L. A. Accounting Papers and Discussions.

SUPPLEMENTING the detailed report of the general, commercial and technical sessions contained in last week's issue, there is published herewith an account of the papers presented before the accounting sessions at last week's annual convention of the National Electric Light Association and the discussion thereon. A running report of the successful meetings of this section was published in connection with the general report of the convention in last week's issue, which also contained abstracts of papers of interest to accountants that were presented before other sessions. A number of those who attended the accounting sessions prepared discussions of the papers in advance, and these contributions to the program lengthened the proceedings and suggested more points for comparison of ideas, with the result that discussion was stimulated to a greater extent than at any of the previous meetings.

UNIFORM SYSTEM OF ACCOUNTING.

Mr. John L. Bailey, treasurer Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., presented as chairman the report of the committee on a uniform system of accounting. The committee devoted its time during the year to the work of interesting members in the standard classification of accounts. In this work 800 circulars and bound volumes of the classifications were used, resulting in ready responses from fifty-six companies. The efforts of the committee were directed to the end of placing the accounting system in an acceptable position so that wherever commissions are formed they will realize that the classification is standard and use it. This will tend to prevent the adoption of different systems in different States. The committee recommends that action be taken looking to the general adoption within a limited time of the standard system. In one or two States the companies cannot conform to the system, but it is desirable to make the accounts standard so that all of the commissions will be glad to accept them. The Maryland Public Service Commission has adopted the system for electrical companies under its jurisdiction.

In response to a circular letter of the committee, fifty-six companies stated that they would use the uniform system of accounts, fifty-three said they would not do so, and seven did not answer this question. Seventy-one companies approved the organization of a statistical department by the association, thirty-seven disapproved and eight did not answer this question. Twenty-six companies agreed if such a department should be organized to furnish regular reports thereto, while forty-six were unwilling to do so and forty-four did not answer this question. Thirteen companies were agreeable to the use of their names in the distribution of reports to member companies, while ninety-two raised objections to this suggestion and eleven did not answer the question. Thirty-seven preferred to have the name of the company omitted and only the State given, while eleven disapproved this alternative and sixty-eight did not answer the question. Fifty-five companies were willing, to share the incidental expenses of the development of such data for reference, while forty-eight companies were unwilling to do so and thirteen did not answer this question. There were 684 companies that did not reply in any way to the suggestion for the organization of a statistical department.

The number of approvals is considered sufficient by the committee to warrant a recommendation for the establishment of a statistical bureau. The committee believes that the advantage derived from the interchange of figures would be sufficient to warrant the payment by the companies of the slight expense of maintenance of the bureau, but does not make any definite recommendation with regard to this feature of the proposed work. The committee therefore recommends the establishment of a statistical bureau without disclosure of the name of the company when information is given to an inquiring member, and that a sub-committee of the accounting committee be appointed to work out a suitable plan for the collection and dissemination of the information, as well as an equitable basis in the allotment of expenses if the executive committee should decide that the participating companies should bear such expenses. It is also recommended that a canvass be made during the convention in order to increase materially the number of companies submitting figures to a statistical bureau.

It is believed by the committee that it will not be possible to devise a set of standard forms suitable for all the varying conditions of member companies and acceptable to them. As such forms, however, would be a distinct benefit to a number of companies, it is recommended that the association authorize the committee to prepare and distribute a set of forms to each company.

DISCUSSION

After presenting the report, Mr. Bailey emphasized again the importance of adoption of the classification by member companies.

Mr. H. M. Edwards, New York Edison Company, wondered whether the companies realized what an advantage they would secure from the exchange of statistical information. This information was of the greatest value to the large companies and he could not see why it should not be equally useful to the smaller properties. If names of companies are not to be given generally, arrangements can be made by which names could be interchanged by agreement. Sooner or later every state would have to meet the requirements of a public service commission. The accounting system had been designed after years of study and any commission should be glad to avail itself of this help in the introduction of a uniform system. If the system had previously been adopted by companies their argument for its acceptance by a commission would be helped materially.

Mr. Bailey thought that ultimately the executive committee would decide that the cost of a statistical bureau should be met by the association.

Mr. Frank J. Baker, North Shore Electric Company, Chicago, Ill., said that, while the National Electric Light Association classification had been approved by the Illinois Electric Association last year, scarcely any of the companies throughout the State had adopted the system. The reason with the smaller companies appeared to be the lack of forms. If the association could prepare forms for distribution 90 per cent of the smaller properties would adopt the system. Forms could be prepared and adapted for uniform application at moderate cost.

GENERAL OFFICE ACCOUNTING.

Mr. Franklyn Heydecke, of the Public Service Electric Company, Newark, N. J., said that the first thing to consider is the monthly statement of operations and the profit and loss statement. It is better to furnish the executive and operating officials with the general facts first and then follow with the details than to delay the statement for compilation of the details. Analyses of accounts can be made later when necessary. If an account shows the same amount as the same period of the previous year or a slight increase it does not require analysis. It is only when charges are unusually heavy or the reverse that analysis is required. Accounting on authorizations, both for improvements and repairs, is very interesting work. If enough of this work is done to justify the use of a separate ledger it should be provided. The books should be ruled especially for authorization accounting and should have the following columns on both the debit and credit sides: Date, name, material, amount and remarks. It is very important that sound judgment be used to distinguish between improvement and repair. The plant and property accounts should not be charged unfairly simply to make a good showing in improvements and in low operating expenses. When in doubt it is good policy to lean strongly toward charges to operating expenses.

If there are several underlying companies it is well to have the construction accounts separated so that the amounts expended for construction, extension and improvement on each underlying property can be shown separately. At some future time the lease of the underlying company might terminate and the property return to the former management, when the controlling company would be entitled to compensation for betterments and improvements made.

DISCUSSION

Mr. Hermann Spoehrer, United Electric Light & Power Company, of St. Louis, stated that the paper is of special interest to companies that operate several central-station systems. The system described by Mr. Heydecke is similar to that of the St. Louis company.

Mr. Frank Birch, Philadelphia Electric Company, said that a system that yields not only general data, but also details, is the most satisfactory one.

Mr. W. F. Freeman, New York Edison Company, said that scientific accounting is receiving the attention of the leading associations and governmental authorities, with the result of improved efficiency in administration and operation by all corporations. In general the staff auditor should keep or cause to be kept detailed books of account, as distinguished from the general books of account kept by the treasurer, showing specifically each operating revenue, operating expense and capital outlay by the company; and all books of operating or other accounts kept by the several departments or at the suboffices or stations should be under his direction and control. He should inspect and audit all such accounts, distribute the items of revenue, expense and outlay among the several accounts and prepare an abstract of such distribution and of the results of the company's business whenever required by the executive of the company.

The paper was also discussed by Dr. Fenner H. Peckham, Narragansett Electric Light Company, of Providence, R. I., and Mr. E. J. Allegaert, Public Service Electric Company, of Newark, N. J.

TRACING STOREROOM MATERIAL.

Mr. John T. Brady, treasurer of the Denver Gas & Electric Light Company, said that the development of the industry rendered it imperative to store an extensive supply of material. This made it necessary to devise plans for the proper care and handling of material, and a system of records to show correctly the receipts, disbursements and material on hand. Where stock is handled carelessly the fault is not so much in the system employed as in the failure to follow the regulations. One of the first rules upon which the success of the storeroom depends is that no material shall be given out without a requisition. The first violation of the rule usually leads to a repetition, which begets the habit and destroys efficiency. The storekeeper must be exacting. As the result of experience the Denver company has permitted few changes in the position of storekeeper, keeping the salary advanced as the service demanded and retaining men who have been in charge of this work for a period of years and who are so exacting that the general manager must accompany a request for material by his signature and a requisition.

Not enough importance is attached to the feature of storeroom facility. In crowded quarters confusion results invariably. Thousands of dollars may be spent or wasted if great care is not exercised in keeping supplies up to requirements. A system of records should be provided for the entry of all material received and disbursed. The use of a card record is usually advocated, but the loose-leaf ledger was preferred by the Denver company. Stock records are kept at the stockroom. A foreman's weekly balance sheet is used to show the name of the foreman, the number of the wagon, amount and description of articles drawn, balance on hand, materials used and the account to be charged. The material drawn is charged at the beginning of each week to the foreman, who is given credit at the end of the week for material used, as shown by the work orders, and is held responsible personally for material carried as balance on hand. The job-record figures submitted by the foreman are checked by the superintendent of construction and engineering department. The incandescent-lamp stock is received with the various other supplies at the warehouse. The electric-fan stock is also kept at the warehouse. An inventory is taken each month of a portion of the goods on hand. This affords an opportunity to take an inventory of each particular class of stock every six months. If losses occur or there is the slightest irregularity the difference can be adjusted and accounted for more rapidly and satisfactorily than under the old custom of making an inventory once a year.

DISCUSSION

Mr. F. M. Tait, of Dayton, Ohio, said that it was very important to account properly for material returned to the storeroom.

Mr. E. S. Brock, Public Service Electric Company, Newark, N. J., said that after experience with a loose-leaf ledger he had concluded that no record was as satisfactory as that in a bound ledger. Loose leaves are liable to be lost after removal. It has been found impossible in Newark to introduce the weekly system of foreman's balance sheets, and materials are checked daily.

Mr. William Schmidt, Jr., Consolidated Gas, Electric Light & Power Company of Baltimore, said that he believed it would be more satisfactory to have the storekeeper in charge of wagons.

Mr. F. L. Leitner, Edison Electric Illuminating Company of Brooklyn, said that district or operating departments are more efficient in sorting out returned material which can be used than the storeroom department. The substitution of one class of material for another is one great cause of discrepancies.

Mr. W. H. Bogart, New York Edison Company, said that that company has seven district storerooms which are supplied from the general storeroom. Material is given out on the order of the foreman and is checked twice before it is delivered. The wagon should be under the direction of the storeroom. Sometimes foremen use material charged to one job for another job. To overcome this difficulty checkers are employed. All moving supplies are checked twice a week. An inventory squad checks up the various storerooms. There is a similar squad which inventories the lamp stock.

Mr. E. J. Allegaert, Public Service Electric Company of Newark, N. J., said that it had been found desirable to segregate appliances and supplies from regular materials. Separate records are kept for each.

Mr. K. C. Campbell, Peninsular Electric Light Company, of Detroit, thought that the responsibility of the storekeeper should cease when material left his control unless he had a competent representative on each wagon.

Mr. W. F. Freeman, New York Edison Company, said that all stores of the company should be under the charge of the storekeeper. Records in quantity should be kept in the general storeroom, but they should be supervised by the accounting department. He advocated the appointment of a store's inspector to report to the auditor and make inventories at stated periods.

Mr. H. M. Edwards, New York Edison Company, said that every corporation owes it to its men to surround them with every safeguard against temptation.

Mr. Brock said that on rainy days linemen sort scrap wire and place it on reels. The same practice is followed with other appliances, which are repaired when necessary.

Mr. J. H. Gulick, Commonwealth Edison Company, of Chicago, said that a record of quantities, not values, is kept on a card system by a man under the direction of the storekeeper. No periodical inspection is made and the storekeeper never knows when he may be checked up on any class of material. The storekeeper also charges out merchandise. Material used on different jobs is cheked at the place of work.

Mr. Leitner said that one of the greatest problems is that of obsolete material. Past experience is sometimes a false guide to the amount of stock and materials that should be kept on hand.

Mr. Bailey said that nowadays the storekeeper is not permitted to determine the materials to be bought.

Mr. Brady in closing the discussion said that the purchasing agent advises with the storekeeper regarding the price to be placed on material that is to be returned to stock. When the price of any material is low requisitions are referred to the superintendents. If they feel that it is an opportune time to purchase a larger amount than is really needed the requisition may be increased. The subject is often referred to the general manager.

Others who discussed the paper were Messrs. H. F. Fraase, Edison Electric Illuminating Company of Brooklyn, and C. F. Bryant, Westchester Lighting Company.

ELECTRIC VEHICLE ACCOUNTS.

Mr. Hermann Spoehrer, secretary and treasurer of the Union Electric Light & Power Company, of St. Louis, Mo., in a paper entitled "Electric-Vehicle Accounts as Applied to a Department of a Central-Station Plant" described the electric-vehicle business of his company and the system of accounting designed to analyze its various features. The company operates a garage in the residential section exclusively for electric-passenger cars and one for electric-power wagons exclusively near the commercial center. The company also sells electric-passenger cars and power wagons.

The classification of accounts for the electric-automobile department is divided into two general headings, entitled sales and garaging. The principal accounts under sales are passenger-car sales, power-wagon sales and fixed charges. Both passenger-car sales and power-wagon sales are subdivided into cost of machine, labor, material, advertising, office expenses and receipts. The account fixed charges is subdivided into two accounts, one for interest and depreciation and the other for taxes, insurance and rent. The general account garaging is divided into passenger-car garaging, power-wagon garaging and fixed charges. The two former accounts are subdivided into advertising, office expenses, general garaging, labor, material and electricity, repairs, labor, material and receipts. The separate accounts for labor and material in these sub-accounts are reported separately for charge on work-order sheets. Fixed charges are subdivided into interest and depreciation and taxes, insurance and rent.

The cost of a machine under the general heading passenger-car sales represents the cash cost f.o.b. at the company's garage, including freight. Labor represents the salesman's time, a portion of the time of the manager of the auto department and the cost of labor applied at the garage prior to the sale of the car. It also includes a flat monthly charge for the garage expenses of demonstrating cars. Material includes the expense of maintenance and repair of demonstrating cars and in connection with the salesroom. A depreciation charge is made against this account for cars used for demonstration purposes. Advertising includes charges for billboard and newspaper advertising, pamphlets, etc., and current supplied to auto signs of the company. Office expenses include the portion of light, heat, telephones and miscellaneous supplies properly chargeable to the sale of pleasure vehicles. Fixed charges include interest and depreciation on the garage-equipment investment, taxes, insurance and rent, which are apportioned between the sales and garaging accounts.

General garaging includes labor incident to ordinary garage service, a portion of the time of the auto-department manager, clerical help, etc. To cover repairs a standing work order is issued for each car. The items not chargeable to routine garage expense or which are of a special nature are charged to this account and entered upon the work-order sheet and billed to the customer with his regular monthly charge. The work-order sheets are written in triplicate. One copy is held by the billing department of the company, one copy goes to the purchasing department and the original is sent to the garage storekeeper and timekeeper, who enters all the material passing through his hands for use and the time spent on the various jobs. He then sends the sheet to the purchasing department for pricing. A general sheet is also used to carry the charges for all material used for general expenses of the garage not chargeable to any particular job, and for labor and material for jobs so small that an individual work-order sheet has not been issued. The expense of maintaining the vehicles of the company is kept separately and a daily charge made against the department using the vehicles. A standard work order is issued for each vehicle and is subdivided into labor and material. All expenses are charged directly to this order, and no operating or maintenance charges to the controlling account are accepted by the accounting department.

Careful and accurate data are indispensable in the settlement of disputes arising from alleged improper handling of customers' cars. A general sheet is kept to show the actual charging rate and voltage on every battery on charge in the garage during the twenty-four hours. Readings are taken every thirty minutes night and day. A second record is kept of the condition of each cell in every battery in the garage every ten days. A third record is in use for battery discharges, when made necessary by conditions. A fourth record shows the time each car in the garage leaves and returns, and other incidental information, including any special items, such as a broken lamp, fender, etc. Another record gives details regarding the tires. A regular printed form is used for instructions by the foreman for special repairs on any machine. No contracts are used in connection with the garage service, as it has been found to be poor practice to try to force the owner of a car to continue when he wants to leave.

DISCUSSION.

Mr. J. C. Scobell, Cleveland Electric Illuminating Company, said that the manufacturers of automobiles have made a successful campaign in Cleveland in the sale of pleasure vehicles and the business is largely of that nature.

Mr. W. H. Blood, Jr., president Electric Vehicle Association, was particularly interested in the classification of accounts, and believed that if this was followed it would give the information which is wanted.

Mr. Douglass Burnett, Consolidated Gas, Electric Light & Power Company, of Baltimore, said that that company felt that conditions warranted the development of electric commercial vehicle business and that it had established a garage for that purpose.

Mr. E. W. Goedjen, Commonwealth Edison Company, of Chicago, said that an effort should be made to induce manufacturers to establish a uniform plug.

Mr. Blood said that the standardization committee of the Electric Vehicle Association had been at work on various matters. One of the first matters taken up was that of standardization of the charging plug. The committee had been working with the pleasure-vehicle manufacturers and thought that within a short time uniformity would be attained. It is also working for uniformity of the charging plug for commercial vehicles, which appears to be a more difficult matter. The work of the committee is to go very much further.

Mr. J. W. Brennan, of Detroit, also discussed the paper.

In closing Mr. Spoehrer said that the garage is charged 1½ cents per kw-hour for energy. No distinction is made on account of different batteries on vehicles.

ELECTRIC-VEHICLE ACCOUNTING.

The report of the committee on electric vehicles, Mr. J. T. Hutchings, general manager of the Rochester Railway & Light Company, chairman, which was in part abstracted under the head of "Miscellaneous" in the *Electrical World* of June 1, contains a section that deals with accounting. The following classification of costs of operation is recommended: (1) General expenses—covering supervision, garage rent, wheel tax and State license. (2) Operating expenses—including the cost of oil and other supplies, general repairs, cost of electric energy, cost of repairs on tires and batteries, drivers' salaries, washing, oiling, minor repairs and garage expenses. (3) Fixed charges—interest, taxes, insurance and depreciation. The committee in an average-cost table gives the following items of operating expense as common to all who are operating under average conditions: Oil and other supplies, general repairs, electric energy, tires and batteries. To find the total operating expense, however, there should be added the salaries of drivers, cost of washing and minor repairs and garage expenses. The latter items vary with local conditions. In the calculation of total costs fixed charges should be taken into account, and it is recommended that they be made on the following basis: Interest, taxes and insurance on the total cost of vehicles, and depreciation on the total cost of vehicles less the cost of batteries and tires.

ACCOUNTING FOR DEPRECIATION.

Mr. H. M. Edwards, auditor New York Edison Company, assumed in his paper on this subject that every company recognizes that its tangible assets are disappearing with use or with the march of improvement and realizes that some provision must be made in the accounts to provide for the replacement of worn-out or superseded apparatus. How should the amount to be reserved for depreciation be determined, and how should the reserve be treated in the accounts?

The Public Service Commissions of New York permit the capitalization of the new expenditure but require that the thing replaced shall be credited at its cost to property account and charged against the reserve, or, in the absence of a reserve, to surplus account. It is not proposed to argue the question whether this theory is correct and the fair one to apply in all instances, although there is much to be said against the absolute acceptance of the theory. Let it be agreed that the purpose of the fund is to maintain the efficiency of the property, as shown by the books, reinvesting the fund as the apparatus is replaced or retaining in the fund the cash equivalent.

Two methods of determining the amount to be reserved suggest themselves, the specific method and the general method. A company adopting the specific method would undoubtedly inventory its physical properties, noting in adjoining columns the original cost, scrap recovery value, life, etc. Assuming that the books have been properly kept, it would not be difficult to inventory the plant and list the costs. The life table would present a real difficulty, for, as the life of the apparatus determines largely the amount of the reserve, it must be reasonably accurate. The life of any piece of apparatus is affected by repairs and other conditions. The scrap recovery value also presents a difficulty. This value, it must be conceded, is largely conjecture, and at the same time may affect materially the amount of the reserve. One of the objections to the specific method is that it endeavors to treat with exactness what in the very nature of things is inexact and to the last degree approximate. The second objection is that the specific method takes no account of the factor of supersessionary depreciation.

Under the general method a reserve may be built up by a stated percentage of the inventory value of the property, by a percentage of the gross earnings, by a rate applied to the electric energy generated and sold, or by a definite amount appropriated from surplus earnings. A reserve created by any of these means is frankly approximate and its sufficiency can only be determined with the lapse of years. In this respect the method is in accord with the fact, for any reserve created to provide for the cost of replacement occasioned by use or supersession, and especially the latter, must be the result of approximation, and this approximation should not be in detail, but should be applied to the property as a whole.

The New York Edison Company started its depreciation reserve fund on the date of its incorporation, May 1, 1901. Generally speaking, depreciation is the result of kw-hours produced. A percentage of the book value did not include the element of work done and a percentage of the gross earnings did not bear equally on the product because of the rate schedules. The company finally adopted a rate of 1 cent per kw-hour sold to general customers. The selection of kw-hours sold rather than kw-hours generated was the result of local conditions and the fact that because of relations to affiliated companies a considerable portion of the energy generated did not circulate through its entire system, including transmission and distribution apparatus and devices. The company has been able to accumulate an adequate reserve which has provided for all its depreciation to date, with ample provision for the future.

Depreciation, whether from wear and tear or supersession, is a cost and must be recovered in the price of the product sold. The gross earnings, less the expenses of operations including depreciation, taxes and bad debts, would represent the net earnings from the business which bear a direct relation to the amount of capital invested. It is apparent, therefore, that the theoretical price for the product would be a sum derived from adding together operating expenses, depreciation, taxes, bad debts, cost of money invested and a profit on the money invested, and this sum total divided by the kw-hours sold gives the average rate per kw hour which the company should charge.

It is customary to show the net earnings as applicable to the returns on the capital invested. It would not be consistent or logical to claim that depreciation is a part of the cost of the product and then provide for it through an appropriation from the surplus belonging to the owners of the property.

The Public Service Commissions of New York recognize that depreciation or amortization is an operating expense and their treatment of it is consistent and logical, for to permit a company to recover the cost of depreciation as a part of operating expenses necessarily implies that depreciation shall occupy an appropriate position in the schedule of operating expenses.

If reserves are accumulated separately for the production plant, the transmission plant, the distribution plant and the miscellaneous plant, a number of reserves will be established, and, although the sum total may be adequate for the company's purpose, yet individual reserves may be insufficient or excessive and transfers from one to the other would throw the entire system out of gear. The plan of the Public Service Commissions of New York simplifies all the transactions and treats the subject of depreciation in one item, the reserve accumulated being available for all the replacements which may be necessary.

If a company has accumulated a reserve for depreciation, it is not necessary to charge off at annual intervals a proportionate amount of the cost of the tangible assets; rather, the property should be carried in property account at its original cost until finally retired from service. This simplifies the accounting problem involved and enables an exhibit to be made of the status of the reserve fund, showing the unexpended balance remaining therein, and also identifies the cost of the actual apparatus retired and charged to the reserve.

There remains for consideration the status of a company which has not created a depreciation reserve fund, and upon this point it may be well to refer again to the rule of the Public Service Commissions of New York. The amortization rule in relation to fixed capital on Dec. 31, 1908, means that a company which has not heretofore established a reserve fund will only be allowed to charge against the fund after it is created that part of the depreciation of a thing which occurred after the fund was started, the balance being charged to surplus account. This is a very drastic rule, and it is not unreasonable to expect that a strict adherence to its provisions might require a company having no reserve to make charges to its surplus fund sufficient in amount to prevent the payment of dividends for years to come.

The following recommendations seem to be justified:

First—In view of the fact that depreciation in electric lighting plants is to an extraordinary extent the result of supersession rather than of wear and tear, the reserve should be determined by the general rather than the specific method.

Second—Considering the nature of the business, and because of the fact that the entire product consists of electric energy expressed in kw-hours, the most feasible way of determining the amount of the reserve is by a rate per kw-hour generated or sold, according as local conditions apply.

Third—In view of the fact that depreciation is a definite item in the cost of operation the reserve should be built up through operating expense and not as an appropriation from surplus.

Fourth and Finally—Any member company which has not as yet provided for a depreciation reserve fund should do so at once as otherwise the day of reckoning will soon arrive and delay may seriously affect its financial stability.

DISCUSSION.

Mr. N. J. Neall, of Boston, said that he had been examining returns of companies in the Second District, New York Public Service Commission, and found that only a comparatively small percentage of the total companies made any allowance for amortization. It would be highly desirable if some life tables should be furnished at a future convention to guide the members, even though the percentage basis should be adopted. The specific method appears almost necessary with some companies whose business is of such a character that it could not be considered as perpetual. Commissions like that in Wisconsin have given very serious consideration to the life of materials.

Mr. E. J. Allegaert, Public Service Electric Company, of Newark, said that replacements cannot properly be charged to plant account, unless the thing replaced is first written off at cost. The depreciation reserve is more or less incidental to proper accounting for depreciation. The very purpose of accounting in a business conducted for profit is to ascertain how much is actually made or lost. This information cannot be obtained unless all elements of the cost of conducting the business are taken into consideration. A plant, or a large part of it, is consumed eventually in the process of manufacture, and this extinction is an element of the true cost of conducting the business.

Mr. C. N. Duffy, Milwaukee Electric Railway & Light Company, agreed regarding the advantage of the general method as oposed to the specific method. The Milwaukee company has had this question before it. Since 1897 this company has set aside in a reserve for all depreciation charges 10 per cent of the gross earnings, and charges against the reserve every replacement, renewal and substitution. The life of any 100 cars varies with numberless conditions that cannot be covered in the accounts. To undertake to set aside funds on a sinking-fund basis on a life table would be absolutely impracticable. The companies in New York are to be congratulated that the commissions recommended the general method.

Mr. P. S. Young, Public Service Electric Company, of Newark, said that the general plan was the feasible one. It is a fallacy to say that it is not necessary to take care of depreciation if the property is kept up. It is impossible to spend enough in maintenance to take care of the waste.

Mr. W. H. Gardiner, Doherty Operating Company, suggested the propriety, as well as the expediency, of not only adhering to the general method, but of avoiding a definite method of application of a fixed rate from month to month, or year to year. Owing to conditions over which companies have no control earnings fluctuate, and while an average rate might be maintained, it could be varied from time to time.

Mr. E. A. Barrows, Narragansett Electric Light Company, Providence, R. I., said that Mr. Edwards emphasized the fact that the earnings remained after depreciation had been deducted. The Narragansett company has set aside a reserve for about the entire twenty-five years of its operation. The amount set aside was charged to plant account a number of times. It is now carried in a reserve fund. In the earlier years the depreciation reservation was the amount left after provision for dividends. That is not now the case. The directors vote the first of the year to set aside the estimated amount of the depreciation for the year. For the last seven or eight years the amount has been determined through the use of all the information available by the directors. It is very difficult to determine the proper amount, and any method which assists should be taken into consideration. The depreciation reservation is between 11 per cent and 12 per cent of the gross earnings, and slightly over 1 cent per kw-hour sold.

Mr. William B. Jackson, Chicago, Ill., believed that Mr. Edwards was fixing an iron-bound rule in one direction, while possibly some are fixing an iron-bound rule in another direction. The best man will take the best from both plans; neither one is a cure-all. When the facts are considered the matter of kw-hours output has nothing to do with the actual depreciation from wear or tear or obsolescence. The depreciation is the same whether the plant has a 20 per cent or a 40 per cent load-factor. There are two kinds of approximation: One is a guess and the other is an intelligent estimate, based on past experience and subject to revision, as necessity may indicate. The only way to revise this estimate is through the acquisition of additional information as to the life of property. The sufficiency of the amount set aside can be proved by an investigation of the plant step by step, and the addition of a little for some items and the reduction of a little in other items, yielding a final intelligent approximation.

Mr. Duffy said that analysis of balance sheets shows that adequate care of depreciation is not being taken.

Mr. J. H. Donlan, Edison Electric Illuminating Company of Brooklyn, N. Y., said that allowance for depreciation is made in court decisions. If the company bases its return on the capital expended its rates will conflict with those that would be determined upon a valuation which took into account the necessity for depreciation.

Mr. J. H. Gulick, Commonwealth Edison Company, of Chicago, said that the practice of that company is similar to that of the New York Edison Company. A monthly charge is made, and at the end of the year the various charges are placed against this sum and the balance is charged against the cost of plant.

Dr. Fenner H. Peckham, Narragansett Electric Light Company, said that it is important that there should be a practically unanimous agreement as to the amount that should be charged for depreciation. If those who are engaged in the business cannot agree upon the allowance that should be made it is illogical to expect others to do so.

Mr. Edwards said that when the New York Public Service Commissions' classification of accounts was under consideration one of the greatest questions which had to be determined was that of the treatment of depreciation. Those who represented the companies wanted to have the question left open because no data existed that would justify definite rates. A general method was finally selected. It was, as the paper stated, frankly approximate. If depreciation was designed to cover wear and tear only, the problem would be relatively simple. The problem is to provide for the supersessionary depreciation. Nothing is stationary. Every company has seen its investment swept away, not because it was worn out, but because new conditions made it absolutely necessary to scrap good machinery. Is anyone prepared to say that apparatus today is permanent? Any life table is inadequate, because it cannot take into account the development features of the business. The rate stated in the paper is the New York Edison Company's guess, the sufficiency of which can be determined only after a lapse of years. The balance sheet discloses a healthy state of affairs.

PURCHASING DEPARTMENT ACCOUNTING.

Mr. Thurlow W. Buxton, of the Edison Electric Illuminating Company of Brooklyn, described in his paper the purchasing department of that company and the important details in the methods of accounting for its three divisions—order, invoice and transportation. The storeroom and stationary departments are under the jurisdiction of the purchasing agent, and the lamp bureau reports to the storekeeper. The objects of distinctive accounting for the purchasing department are as follows: 1. To close the purchase properly. 2. To verify receipt of the purchase. 3. To verify the resulting expenditure with a minimum of dispute or delay. 4. To care for special and miscellaneous matters. 5. To provide particular statistics and ready information. 6. To handle the sale of certain materials.

The order and the contract form the foundation of the system. Descriptions of material in the order should be exact, and prices should be noted, together with details as to the point of sale, terms of payment, shipping or routing instructions, etc. It is undesirable to permit any other department to purchase, obtain quotations or order material directly. When material is received the purchasing department secures reports from the departments involved, and, if the conditions have been met and the purchase is satisfactory, reports are issued at once. These reports are the principal authority for the passing of the invoice, which facilitates the passage of the bill for payment. In the case of contracts or large orders the terms of payment may call for instalments as specified portions of the work are performed and special estimates are prepared as the basis for payment.

All the invoices, manifests and bills of lading are received first by the transportation division. Certain special invoices deserve more attention than is given to ordinary transactions. The most important of these are the bills for coal and telephone service. A special record providing permanent statistics is kept of the coal. There are constant returns of material for various reasons, and it is necessary to have a permanent record of these as a basis for adjustment. Records of prices and quotations for comparison and constant reference must be maintained and be easy of access. A card system is used with a separate card for each item. All correspondence of every character is filed, when possible, with the contracts or orders concerned, which are given consecutive numbers.

Despite all efforts a number of bills remain unadjusted at the close of each month. A detailed list of these is prepared, giving the reasons for the delay. A statement termed "outstanding obligations" is prepared for the benefit of the fiscal department. It includes current obligations and an estimate of the amounts taken from the orders placed, which it is expected will be certified for payment on the tenth day of the following month. Freight and express bills, while handled mainly in the same manner as other invoices, are checked with established tariffs, rates and weights when possible, and in case of discrepancies are held until adjusted or claims are entered for overcharges. The purchasing department exercises direct supervision over the sales of all scrap material and discarded machinery or apparatus. Accommodation sales are made at prices fixed by the purchasing department, and sales of electric appliances are handled directly by the sales department. Cash is exacted for sales of scrap or discarded apparatus. When the exact tonnage of scrap is not known the buyer makes a cash deposit more than sufficient to cover the amount.

DISCUSSION.

Mr. John L. Bailey, Consolidated Gas, Electric Light & Power Company, of Baltimore, suggested that methods of avoidance of double payment of the bill be discussed.

Mr. John T. Brady, Denver Gas & Electric Light Company, said that double payment might happen if goods are not ordered in the regular way through the purchasing department. If goods are needed in a hurry a telephone message may be sent to the office and the purchase made immediately. This prevents irregularity.

Mr. W. E. Freeman, New York Edison Company, said that it is advisable to have the auditor retain the invoice and to have regular reports of goods received. If bills are referred to the heads of departments they may be lost.

Mr. E. A. Barrows, Narragansett Electric Lighting Company, Providence, R. I., uses a bill register on which all bills are entered. Any unusual delay is called to the attention of the proper official. This register is checked at the end of each month or at stated periods. It is important to see that advantage is taken of all bills on which discounts are allowed for prompt payment and that the machinery of the office does not delay accounts of this nature.

Mr. E. C. Scobell, Rochester Railway & Light Company, said that an invoice is sent with each order. Invoices are supplied to manufacturing companies with which much business is done.

Mr. J. C. Collins, Rochester Railway & Light Company, said that the uniform bill system had been in use for several years. It provides the information that the company wants and is a material aid to the general manager in passing bills.

Mr. Scobell, of Rochester, said that the policy of secrecy about prices had been abandoned by that company. It is now made the business of everybody to know the cost of materials. If these costs are known there are many cases in which less expensive material can be used on certain jobs.

Mr. Buxton in closing the discussion said that there is no reason why the rule to confine purchases to the purchasing department should not be followed to the letter. It is desirable to have shippers send a memorandum of shipment on the day the shipment is made.

Others who discussed the paper were Messrs. C. F. Bryant, Westchester Lighting Company; E. J. Allegaert, Public Service Electric Company, of Newark; F. L. Leitner, Edison Electric Illuminating Company, of Brooklyn; J. W. Brennan, of Detroit, Mich., and William Schmidt, Jr., Consolidated Gas, Electric Light & Power Company, of Baltimore.

ADVANTAGE OF A JOB COST SYSTEM.

Mr. A. L. Holme, of the New York Edison Company, said that one of the reasons for the gradual development of the job-order system for all construction, and to a varying extent for repair work also, is that the executives of the company desire to be consulted before expenditures are made and to be assured that such expenditures, if authorized, will be made within the limitations approved. The system provides a requisition with sufficient description of proposed expenditures and an estimate of cost which, when approved, can be given an identifying number so that all costs may be assembled thereunder and after completion a comparison of actual and estimated cost be made. This feature alone is sufficient to warrant the use of the system. Cost data obtained gradually through the use of job orders will make estimates much simpler and more reliable in the future. Greater care will be exercised in the preparation of estimates because of the knowledge that comparisons will be made with actual costs after the work is completed. The advantages of such a system to the accounting department are also worthy of consideration. If expenditures are authorized simply with instructions to charge certain permanent accounts there is no assurance that instructions have been followed, and the auditor is without the means of determining whether the charges have been made correctly. The usual result of the policy of permitting officials or others to charge expenditures directly to accounts instead of job orders is that the construction accounts are made to carry more than their share.

Most companies favor the plan of charging all expenditures on job orders to a weekly account, transferring those chargeable to repairs monthly and to construction only upon completion of the work. When transferred to the permanent property account the completed job orders form a full inventory of construction. It is difficult to make any positive statement as to the extent to which job orders should be used to cover each piece of work. This is influenced by the organization of the company and the functions of its various departments, as well as the extent to which expenditures are charged to capital accounts. It is a fairly general practice to insist on approved job orders to cover all expenditures on capital accounts, but even the definition of capital expenditures will not be uniform. The objections to the introduction of a comprehensive job-order system are based on its cost. This objection is warranted where the system is kept solely as an auxiliary to the regular accounting system. Where introduced as a part of the accounting system and all unnecessary duplications are avoided it will be found, so far as the job-order system applies to the record of cost, that there is practically no added expense, for items of expenditure must necessarily be assembled in some way. The real expense will be confined, therefore, to the extent to which additional details of cost or descriptions are carried on the cost sheets in order to supply information readily. That expense can be avoided by suitable arrangements for filing data. In the New York Edison company practice all station construction or reconstruction work is performed by or under the supervision of the construction department. The work in the streets, whether construction or repair, is performed by the distribution department. Both of these departments do their work entirely on job orders. To take care of the regular maintenance work of the distribution department standing job orders are issued to cover the various classes of operating expenses as well as so-called emergency repairs within certain limitations of cost. An annual budget of estimated construction is prepared early in the year, and the bulk of the work of the construction department is done thereunder.

When labor details are checked with the estimate investigations are caused occasionally which develop that the work cannot be done in accordance with the estimate. A supplementary estimate is then prepared and submitted to the construction committee for approval.

DISCUSSION.

Mr. J. W. Brennan, of Detroit, said that the system tends to confine the cost of work to the estimate, and also avoids occasional clerical errors. The same system is followed in all shop work, including switchboard construction.

Mr. Paul R. Jones, Doherty Operating Company, said that no work of investment or operation is conducted as a rule without a job order. This keeps an accurate cost of all work and of the men. In some cases the superintendents or foremen will employ more men than are necessary if there is no check of this nature. A proper record cannot be made without the job order system.

Mr. T. W. Flowers, Edison Electric Illuminating Company of Brooklyn, said that a series of numbers is kept for service orders and another series for construction work. The company is trying to create an index for construction orders. In reconstruction work the original cost of the line is ascertained or an estimate is prepared by the engineers. The net depreciation is charged to the amortization account.

Mr. H. M. Edwards, New York Edison Company, said that the advantages of this system had been described before the association for many years. Ordinary operating transactions can be gaged on the basis of kw-hour costs, but there is no way of checking construction and repair jobs unless work orders are used. The system is used by companies in New York, Chicago, Brooklyn, Philadelphia, Boston and other cities. It is of particular advantage in connection with the accounting system of the Public Service Commission, which in capital expenditures wants to know how the money is used and sends an inspector to identify the physical elements. By the use of this system work that was almost thirty years old was identified. Nothing helps a company so much with a regulating commission as to be able to show by its books what has been done. He would not recommend any system that is not used as part of the accounting system. This enables the construction committee, which meets about an hour once a week, to keep in touch with all projected work. As the system is part of the accounting system no cost is involved that would not exist otherwise.

Mr. Hermann Spoehrer, Union Electric Light & Power Company, of St. Louis, said that the work order system is of inestimable value in inventories.

Mr. J. C. Collins, Rochester Railway & Light Company, said that the job order system has been in successful use by that company for several years.

The paper was also discussed by Messrs. John L. Bailey, Consolidated Gas, Electric Light & Power Company of Baltimore; E. J. Bowers, Kansas City Electric Light Company; W. E. Freeman, New York Edison Company; F. L. Leitner, Edison Electric Illuminating Company of Brooklyn, and William Schmidt, Jr., Consolidated Gas, Electric Light & Power Company, of Baltimore.

HANDLING OF CUSTOMERS' ORDERS.

The paper on this subject by Mr. R. F. Bonsall, of the Consolidated Gas, Electric Light & Power Company, of Baltimore, was read in his absence by Mr. Douglass Burnett. Each order form should be part of a system. The entire system should be planned in detail from the time the unsigned forms are placed in the hands of the salesman until service is connected and the account is opened on the ledgers. All order forms should meet the requirements of the various departments concerned before they are adopted. The general public gains its first impression of a central-station company when it is asked to sign an order for service. The necessary forms of agreement can be made either a source of annoyance to the customer because of the number presented for signature or, because of their brevity, the means of a satisfactory introduction. Orders should be so drawn as to embody all the work of a certain class under one agreement.

All forms should be of a standard size convenient for filing and printed on papers of different colors to signify different classes of work. The most efficient form will permit the necessary number of carbon copies to be made at one time. The application for new service should contain the printed schedule of rates for the particular service desired as well as the general terms and conditions under which service is supplied. In taking an application for lighting service salesmen should try to secure also an order for the necessary equipment of lamps. The experience of the Baltimore company shows that meters should be allowed to remain on the premises for three months after service has been discontinued.

Unless a valid reason is advanced by the operating department, all orders not executed within the usual time limit should be brought to the attention of the head of the department. In cities where a municipal or underwriters' certificate of approval of wiring is required it will aid in the prompt handling of orders if a complete record of certificates is kept on the cards.

DISCUSSION.

After reading the paper, Mr. Burnett emphasized the advantages of a form that should cover at one writing the many details concerned.

Mr. John F. Gilchrist, Commonwealth Edison Company, Chicago, Ill., said that the paper covered operations of the greatest importance in the proper handling and management of the business.

Mr. E. M. Podeyn, Edison Electric Illuminating Company of Brooklyn, said that it has been found necessary in the work of that company to organize a customers' bureau upon geographical lines.

Mr. W. A. Cox, Public Service Electric Company, Newark, N. J., said that a card record is kept of all unfinished work. It is not good practice to furnish service without the signature of a new customer unless he is well known. It is essential to warn customers against going to any expense for wiring until rights-of-way for lines are secured.

Mr. R. S. Hale, Edison Electric Illuminating Company of Boston, Mass., said that in a case of doubt as to the necessity for securing right-of-way the agent takes an application from a customer with a warning that it may not be possible to secure the necessary permits. A special form is used similar to a timetable, calling attention to the time ordinarily required to install different classes of service. This shows the probable limits within which the service will be completed, and the customer is requested to notify the company if the desired work is not completed within the time specified. If after investigation it is found in ordinary cases that rights-of-way have to be secured, immediate notice is sent to the customer.

Mr. W. H. Rogers, Public Service Company, of Paterson,

N. J., said customers are divided into two classes—the responsible and those who are not responsible. Some are required to give forty-eight hours' advance notice of removal and others are required to make a deposit.

The report was also discussed by Mr. L. A. Coleman, United Electric Light & Power Company, of New York, and Mr. H. E. Neisz, Cosmopolitan Electric Company, of Chicago.

Mr. Burnett in closing the discussion said that all concerns that do electric wiring in Baltimore operate under State licenses. Daily lists of certificates issued are secured, together with applications from contractors. It has been found that discussion of the details with the customers facilitates the work of the office. To prevent outstanding orders from accumulating in an unnecessary degree solicitors are requested to withhold applications until a definite time limit for completion can be fixed. Inspection is effective in many cases in revealing the existence of defective work which might not be discovered promptly otherwise.

COLLECTION OF BILLS.

In a paper entitled "The Collection of Bills" Mr. Edward J. Bowers said that the Kansas City Electric Light Company did not employ banks, express companies or drug stores as collection agencies for the reason that a large percentage of the remittances received are in checks. When a company becomes of such size that it has to maintain a collection bureau separate from its billing and bookkeeping department the question is raised as to how the collections shall be made. Such companies are in a position to offer a reasonable discount for the prompt payment of bills due them, and are justified in enforcing rules. The discount must necessarily be much larger than that offered by mercantile institutions. It should be simple and easy to figure and sufficiently attractive to customers to induce them to pay during the discount period. It must also be taken into consideration in rate-making. The object of such a discount is to decrease collection expenses and reserves for bad debts, and to a certain extent increase the revenue of the company through discounts forfeited. Court decisions have upheld the reasonableness and justice of rules concerning discounts allowed, penalties exacted and deposits required in advance.

All contracts for credit are based upon the approval of references, the reports of Bradstreet's and Dun and the amount of property in the possession of the applicant. Applications for service in cases where bills were unpaid at the former homes are not passed until the old account is met. A cash deposit sufficient to cover three months' service or a guarantee of real-estate owners is required in the case of pool halls, picture shows, saloons, restaurants, barber shops, etc., where there is risk of loss in collection. A card is kept for each delinquent account. These cards are arranged by districts corresponding with the customers' ledgers and handed to the collection department. A first notice is written to the consumer requesting a remittance by a certain date of a delinquent account. The card is then advanced to this date, approximately five days, in the follow-up system. If a reply is not received a second notice is sent stating that service will be discontinued unless settlement is made by a certain date. The card is then advanced to the second date. If the account is still not paid at the expiration of that time a cut-off list is made out and sent to the trouble department. This department sends a man, together with a representative of the collection department, to the premises of the customer and service is discontinued unless the collector is paid at that time. After a reasonable length of time the meter is removed and the account placed in the hands of an attorney for collection. Ninety per cent of the delinquent customers paid their accounts as soon as they were told that service would be discontinued. The practice of sending delinquent notices through the mails is apparently the quickest and least expensive. Payments received after the discount date for less than the full amount are returned to customers with a letter. In these cases the envelopes in which the remittances are received are held by the cash department.

DISCUSSION.

Mr. Daniel Goss, Edison Electric Illuminating Company of Boston, said that all bills are rendered net by that company. At one time the introduction of a discount system was considered and questions were sent to thirty companies asking for information regarding their experience. No reply showed as large a percentage of payments as the Boston company was receiving by rendering net bills. It was then decided to make no change and consideration was given to a follow-up system designed to assure the prompt payment of accounts, and also a check on collectors. A plan of changing collectors was tried, but discontinued. Collectors are given a certain ledger, or a portion thereof, and the entire responsibility for the collection of the accounts is placed under their jurisdiction. With the old system the company averaged from 1800 to 2000 accounts per collector, but now has an average of 3300 to 3500. One man located in the country has 4500 accounts and covers his district in an automobile. The system expedites the prompt payment of bills and eliminates complaints, because it applies equally to all customers, large or small.

Mr. George E. Burns, Commonwealth Edison Company of Chicago, said that that company has a system of allowance of a discount for payment in ten days. This is advantageous in attracting the prompt payment of bills.

Mr. John F. Gilchrist, Commonwealth Edison Company of Chicago, said that all retail customers receive a discount of 1 cent per kw-hour.

Mr. J. C. Van Duyn, New York Edison Company, said that weekly accounts are required from some classes of customers. Payments are made at various branch offices of the company. Frequently the business status of a customer may change. It is important to show the customers doing certain classes of business that they can have about the same amount of credit that they would receive from merchants with whom they do business.

Mr. E. J. Allegaert, Public Service Electric Company, of Newark, N. J., said that a comparison of two offices showed that the collection expense was much less in the flat-rate office than in the discount office. The percentage of bad debts was also less. The allowance of a discount as great as 10 per cent, or 1 cent per kw-hour, cannot be justified. If a discount is wanted 2 per cent or 3 per cent is ample. A reasonable business chance should be assumed in the extension of credit.

Mr. Hermann Spoehrer, Union Electric Light & Power Company, of St. Louis, said he had found it effective to bend the trouble man and let him collect the bill.

Mr. H. M. Edwards, New York Edison Company, said that where public-service commissions have jurisdiction bad debts have been decided to be operating expenses.

Mr. W. H. Rogers, Public Service Electric Company, Paterson, N. J., said that a weekly bill enables certain classes of customers and small business men to know each week where they stand.

Mr. Louis H. Egan, Kansas City Electric Light Company, said that that company has no competition in electric lighting and practically none with the gas company on account of the low price of gas.

Mr. Frank W. Smith, United Electric Light & Power Company, of New York, said that six months ago the company began to present its bills to customers and the expense is about the same as with the old method. The experience was very satisfactory because it led to personal touch with customers.

The paper was also discussed by Messrs. W. H. T. Jones, of New York; L. A. Coleman, United Electric Light & Power Company, of New York; Leon H. Scherck, of Newburgh, N. Y.; J. H. Gulick, Commonwealth Edison Company of Chicago, and W. E. Freeman, New York Edison Company

THE USE OF TABULATING MACHINES.

Mr. William Schmidt, Jr., Consolidated Gas, Electric Light & Power Company, of Baltimore, in his paper on "The Extent to Which the Tabulating Machine Can Be Used in Accounting

Work" said that it has been possible to secure information at a very small expense through the adoption of various mechanical office and accounting devices. These devices have not only permitted the calculation of more statistical information but they have also helped in the compilation of reports more promptly and with greater accuracy and less expense than before.

The machine that has been of the greatest help to the electrical companies is the tabulating machine which made its first appearance in the Census Bureau at Washington. This has been used as a general rule only for statistical information, but it is equally useful in general and commercial office work. The outfit for this system consists of cards, the key punch, the gang punch, sorter and tabulator. Mr. Schmidt said that in his company the machine is used for tabulation of the monthly electric sales. A monthly bill can be checked very quickly and at less expense by the use of this machine than by other methods. The tabulating system is also used for a daily analysis of the incandescent lamps, tungsten lamps, shades, etc., issued from lamp renewal rooms. This analysis show the class of issue, such as free renewals, charge renewals, cash renewals, etc. If this analysis had to be made on tabulated sheets, the expense would be almost prohibitive. Information has also been compiled as to the meters, indicators, transformers and arc lamps in service and as to the number of poles and apparatus attached. Arrangements are now being made to take care of the voucher distribution by use of the machine instead of with the present sheets. It is also planned to use the machine in connection with the payrolls, stores, accounting and a job-order system.

The adding and listing machine can be used for many classes of work. Where the coupon system has been adopted in billing this machine can be used in listing coupons received each day. It is also used in the compilation of the total daily credits for each individual ledger and for taking off the unpaid accounts at the end of each month, as well as by the collectors and in the storeroom. It has been found that it pays to keep at least one adding machine in each department where there is any adding or listing to be done. The machines are electrically driven and are believed to be one-third more efficient than the hand-driven machines.

The calculating machine is invaluable in the calculation of costs and cost statements. Two billing typewriters are used. Another machine which plays an important part is the addressing machine. This can be used in the opening of new ledgers. The machine can also be used on the payrolls and employees' service cards. An electrically driven printing outfit is used for form letters. In conjunction with the printing machine, various duplicating devices are used for copies of statements and other papers. Rubber stamps are used in the gas division to show the gross amount, discount and net amount. A change-making machine enables the receiving teller to attend more promptly to customers. A somewhat similar machine can be used in connection with the payroll. A receipting machine can be had by the receiving teller. An electric envelope sealer helps to reduce the office-boy expense. Numbering machines may also be mentioned among the devices used in modern offices.

Mr. Schmidt said he would like to see the association maintain a bureau to collect information concerning mechanical devices designed to effect economy and accuracy and to increase facility.

Central Station
Management, Policies and Commercial Methods

ELECTRIC INCUBATOR LOAD AT NEW ORLEANS.

Many people in New Orleans have taken up with enthusiasm the raising of chickens at home, and as a result of this interest the New Orleans Railway & Light Company has acquired a number of electric-incubator customers. About forty such incubators are now in use, ranging from the small seventy-egg domestic size to a large machine in use by a commission merchant which is arranged for 3000 eggs. The electric incubator load is a steady, long-hour demand during the three-week period of hatching, after which electric brooders extend the use of central-station service for another month. The incubators used in New Orleans, which, according to Mr. W. E. Clement, contract agent for the electric company, are giving entire satisfaction to their users, are the product of a local maker, the Electric Manufacturing Company. The feature of their construction is the bridging of the thermostat contact points by a small lamp, which prevents arcing destructive to the points and also serves as a visible indication of the thermostat's operation enabling the adjustment screw to be set quickly for the desired hatching temperature, which averages 103 deg. Fahr. The seventy-egg incubator has a 45-watt heater, but takes only 7 watts when the thermostat is open, and the consumption averages 20 watts with ordinary outside temperatures. The 120-egg machine takes a maximum of 55 watts, minimum 8 watts, and average 23 watts; 200-egg, maximum 70 watts, minimum 9 watts, average 35 watts; 300-egg, maximum 140 watts, minimum 18 watts, average 50 watts. In New Orleans these domestic installations are operated on the regular rate of 10 cents per kw-hour. The electric brooders take continuously about 20 watts per seventy-five chicks. The large 3000-egg commercial incubator, mentioned above, is made up of twenty 150-egg compartments, each with its separate thermostatically controlled heater, these averaging 30 watts, so that any part or all of the incubator can be used as desired. According to Mr. Clement, these electric incubators at New Orleans have reached the point where they constitute a characteristic central-station load, and one which, on account of its long-hour demand, is desirable business on residence lines where the machines are principally in use.

CENTRAL-STATION VERSUS MUNICIPAL-SERVICE AT GALVESTON, TEX.

The city of Galveston, Tex., for which Mr. W. D. Masterson is electrical superintendent, has entered into a contract with the Brush Electric Light & Power Company, which has a 4300-kw turbine-driven central station, to supply the energy for its 350 magnetite street arc lamps, shutting down for the present at least the city's new 200-kw steam-turbine plant. The immediate cause of this change is the 10-cent excess premium imposed on all insured property in the city of Galveston as the result of the city lighting plant's being housed in the same engine-room as the high-pressure waterworks pumps. The rectifier-transformers will accordingly be transferred to another part of the building and central-station energy to operate them will be purchased at 2.5 cents per kw-hour, practically the same figure as has been the cost of operating the municipal turbine plant using oil as fuel. The good load-factor of the city lighting load, however, has made it possible for the central station to supply this service satisfactorily at this low figure. Electric pumping for the city of Galveston is also contemplated. The water supply for the island comes from a group of artesian wells at Alta Loma, 20 miles inland on the mainland, from which point the supply is piped to Galveston. The plans for electrifying the water supply contemplate installing three 75-hp motor-driven pumps at both the Alta Loma wells station and the Galveston pumping plant, all receiving energy from the Galveston central station.

CENTRAL-STATION SERVICE TO TELEPHONE COMPANY'S MANHOLES.

Through a spare duct of its conduits in the underground section of Muskogee, Okla., the Pioneer Telephone & Telegraph Company, which is the local Bell concern, has carried a pair of No. 12 110-volt duplex conductors in Greenfield armored conduit for operating electric soldering irons, fans and lamps in the forty-seven manholes of its sub-surface system. The electric-service pair was installed by the telephone company's employees in one of the spare lower ducts of the tile conduit at the time of pulling in the other cables, and in each manhole it is led to an outlet box inclosing an Edison-base socket into which any desired cord extension can be plugged. Use is made of the electric service thus available for operating electric soldering irons and also for lamps where the hole is dark or work has to be done after night. An especially useful purpose of the wires, however, is the operation of electric fans. During the warm summer weather in Muskogee these fans are genuinely appreciated by telephone employees who have tedious jobs of cable splicing and wiping to do in the hot manholes. The supply of energy for the underground-manhole system is from the lines of the Muskogee central-station company, the wires entering the conduit through a separate meter in the telephone company's basement. Last summer, when a good deal of new construction work was being done in the underground manholes, an average monthly consumption of 100 kw-hours was registered by this meter.

A STEAM-LAUNDRY CENTRAL-STATION AUXILIARY.

Frequently when the central-station solicitor approaches the local steam-laundry manager on the subject of motor drive and electric heating for his washing and ironing machinery the argument is advanced that, since exhaust steam and hot water are needed anyway, the boiler and engine plant may as well be operated to furnish power for the machines. When this attitude is taken the laundry is a difficult customer to get.

If, however, the central station is operating non-condensing and perhaps serving an exhaust-steam heating load in winter, it can sometimes be pointed out to the laundry manager that he can profitably shut down his steam plant and move his whole laundry equipment to new quarters near the electric plant, purchasing from it exhaust steam for water heating, electricity for irons, and perhaps a small amount of live steam for the mangles. The laundry is thus spared the nuisance and expense of keeping up isolated boiler equipment, while the central station gets a good year-round customer for part of its exhaust steam, besides landing an excellent daylight electric motor and heating load otherwise unobtainable.

In a Minnesota city of 4500 inhabitants where the central station has 175 kw in generating equipment driven by Corliss engines, and does a steam-heating business during the winter, summer use for its exhaust steam is provided by heating water for a steam laundry, three hotels, three barber shops and two apartment buildings. As the plant is operated with a back pressure of from 2 lb. to 3.5 lb. per square inch, winter and summer, this water-heating business is found of great service in helping to carry the plant over the light-load summer period.

Of course, the steam laundry is the best user of exhaust steam during the summer period. The laundry is located adjacent to the electric plant and is supplied with exhaust steam for water heating through a 3-in. lagged pipe line, and with live steam for its large mangle through a 1 in. high-pressure steam line. The large mangle, two washing machines and a centrifugal drier are all driven by electric motors, and electric heat is used for the flatirons and collar machine. The electricity consumed for heating purposes and for motors has averaged about 615 kw-hours per month. Steam is sold by meter at an average rate of 70 cents per 1000 lb. of condensation. The income for the steam used by the drier, mangle, water heater and several small machines has averaged $22.75 per month. The exhaust steam utilized by the steam laundry is about one-fourth the quantity passed through the steam engines of the electric plant during the summer period of operation.

The heating of water for barber shops, flat buildings and hotels near the plant has also been found to be a profitable adjunct of the regular summer service in the case of this central station.

DISCUSSION ON ELECTRICAL VEHICLES IN IOWA.

Mr. F. H. Golding, general manager of the Rockford Electric Company, appeared before the Iowa Electrical Association convention at Davenport on April 1 with a paper on electric vehicles which gave principally the experience at Rockford. He said that ten years ago the construction of electric vehicles was such that they were confined to cities with level and well-paved streets. Now on account of the improvement in batteries, tires and vehicles there are but few cities where the electric vehicle is impracticable. Rockford has 165 electric vehicles. There are seventy-seven private charging stations. The rate is 6 cents per kw-hour for private users and 4 cents to public garages, which retail it at 6 cents. This is on an "off-peak" contract whereby the vehicle users agree to keep off the lines at the time of the central-station peak. The average revenue is $60 per car per year. He gave the usual cost of electric-vehicle operation per year as $180.

For a number of years the company employed a battery man who maintained vehicle batteries for consumers. More recently garages have taken up this work. One garage handles electric vehicles exclusively, and another about half electric and half gasoline. Mr. Golding thinks the electric vehicle with its present possibilities will become a formidable competitor of the gasoline car.

DISCUSSION.

Mr. Thomas Crawford, of Clinton, compared Rockford development with that at Clinton, which has only forty-five vehicles and is about one-half the size of Rockford.

Mr. Golding, in answer to a question as to how the electric compares to the gasoline vehicle in hill climbing, said that he had a runabout which climbs 6 per cent and 7 per cent grades in bad weather without trouble and, in fact, the electric vehicle is about the only one which does not have trouble in bad weather on grades. He also told of a case last fall when a football game was held 2 miles north of the city with a long stretch of soft road between. He went out and returned with his electric car, passing several gasoline cars stuck on the way. The mileage obtainable on one charge under favorable conditions is about 100 for a lead battery and 160 for the nickel battery. The majority of gasoline garages in Rockford do not handle electric vehicles at all. His company still does some work on minor troubles and inspection

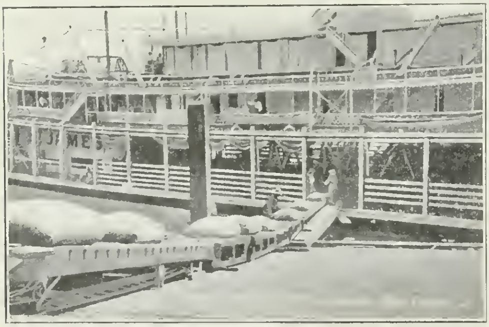
Mr. H. C. Blackwell, of Davenport, told of a 2000-lb. truck which his company has been operating for fourteen months for the delivery of material and men in its gas and electric departments. Repairs so far had been $14 a year, or a trifle over $1 per month. The batttery is divided into four sections. A fifth reserve section was also purchased so that one section could be taken out for repairs. This truck takes 6 kw-hours per mile. He could not estimate the saving over old methods because the most important saving of all was in the time of men who are ready to be moved from one job to another, and this cannot be measured accurately. Two more electric trucks have been ordered, one for delivering freight from depots in Rock Island and Davenport, and the other for miscellaneous purposes, delivering meters, etc

Mr. P. B. Sawyer, of Des Moines, said that he had determined that a certain gang of men now does 2.5 times the work with one electric truck at its service that it did before, when it had to wait for transfer teams. The cost was 18.6 cents per truck-mile, including 12.5 per cent depreciation. Mr. Golding said that the electric passenger vehicle is suited for business and professional men for driving around town where frequent stops make the cranking of a gasoline car objectionable. The electric is also suitable for ladies. Closed electric vehicles now outnumber the open runabouts five to one. Mr. Gus Lundgren, of Cherokee, asked about the possibility of competing with light gasoline grocery wagons. As near as he could find out such a wagon in his town was out of service about half the time. Mr. Golding thought the electric delivery wagon would be able to compete with this from reports he had from gasoline delivery wagons in use by central-station companies at Auburn, N. Y., Canton, Ohio, and Scranton, Pa. The manager at Canton stated that they could keep the wagon going by overhauling it once a week, while at Auburn and Scranton the comments of the managers on the performance of the wagon were anything but complimentary.

Mr. H. C. Blackwell, of Davenport, expressed the opinion that if electric trucks were to be introduced in his neighborhood the central-station company must start a maintenance bureau to look after the trucks of customers.

UNIT MOTOR-DRIVEN CONVEYORS FOR UNLOADING MISSISSIPPI RIVER STEAMBOATS.

Bags of rice, coffee, cotton seed, meal cakes and bales of cotton are unloaded from steamboats plying the lower Mississippi River and adjacent waters by means of unit motor-driven belt conveyors which carry the packages from the vessel's deck and up the levee slope to the warehouse floor, as seen in the accompanying illustration. This shows a group of five such 25-ft. unit sections conveying 190-lb. bags of rice from the boat deck up a 20-deg. grade at a speed of 200 ft. per minute. The portable units of which the conveyor is made up consist of self-contained 25-ft. lengths of 20-in. conveyor belts running on pulleys and idler rollers, each unit being driven by its own motor of 2-hp to 5-hp rating. The ends of the conveyor sections are provided with connection plugs and sockets, so that any number of units can be operated, clamped together in line, as desired. The bags are delivered to the warehouse faster than a single set of men can handle them, so by means of a trip they are dumped into three separate piles from the end of the conveyor. Stacking machines are also in use employing a sort of inclined conveyor which lifts the bags to the level of the piles being worked. These unique conveying devices were designed by Mr. Edward Hanak, of New Orleans, and are protected by a number of patents which he holds. All of the units are easily portable, and can be hauled aboard the boat for use at any loading point. The conveyor motors are arranged for 110 volts, the standard pressure of the steamboat lighting plants from which the conveyors are operated at landings where central-station service is not available. The conveyors handle packages weighing up to 400 lb., and any object larger than 12 in. x 12 in. will bridge the gap between adjacent belts with safety. The conveyor system illustrated delivers 1200 bags per hour from boat to warehouse.



Unloading Rice by Electric Conveyor at New Orleans, La.

CONTRACTORS' USE OF CENTRAL-STATION ENERGY ON GALVESTON CAUSEWAY AND REGRADES.

The city of Galveston, Tex., occupies a low, sandy island in the Gulf of Mexico, 2 miles from the mainland. Following the calamity of 1900 a 17-ft. concrete seawall was built protecting 4½ miles of the ocean front, and behind this wall the grade of the city was raised 17 ft. by steam dredges pumping sand onto the low surfaces.

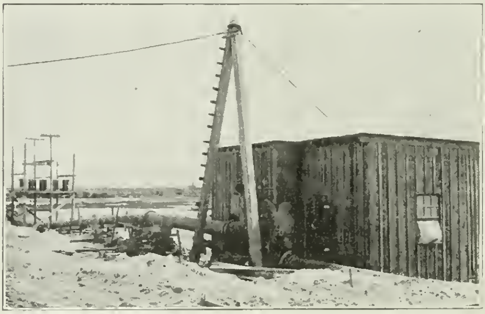


Fig. 1—Motor-Driven Booster Pump for Filling Galveston Causeway.

Since the completion of this original work of protecting the city from the waves, two other large and important undertakings have been in progress during the last year, involving the transfer of more than 2,500,000 cu. yd. of material, all of which was accomplished by motor-driven sand pumps using central-station energy. The first of these works, just completed, involved the construction of a sand crowning, 500 ft. wide and 5 ft. thick at its crest, along the entire length of the sea-wall filling, providing the base for a splendid ocean boulevard. Altogether 1,198,331 cu. yd. of sand was applied in this fashion, using in general the same methods employed in the undertaking now in progress, the building of the Galveston causeway from the island to the mainland.

This causeway is 10,642 ft. long, being made up of about 2000 ft. of unprotected roadway approach across the flat wastes of the island; 6200 ft. of concrete-protected roadway, and a bridge section 2400 ft. in length for accommodating tidal flow. This bridge section, near the middle of the work, comprises twenty-eight concrete spans and a 100-ft. steel rolling-lift bridge for passing commerce through the bay. The causeway level is 16 ft. above mean tide, and the roadway section is 119 ft. wide and the bridge section 66 ft. wide. It is designed to carry two rail-

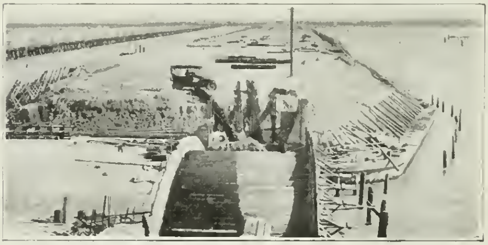


Fig. 2—Completed Fill on Galveston End of Causeway.

road tracks, two electric-railway tracks and a country road. The completed causeway will cost $1,500,000.

The protected portion of the causeway is being constructed by placing in position two rows of concrete sheet piling tied together by steel members. Then into the space between these concrete walls sand is discharged from dredge lines. The unprotected approach roadway on Galveston Island is also being formed by means of sand applied from the dredge. The unprotected roadway will require about 600,000 cu. yd. of sand, and the two protected sections of the causeway proper will take nearly the same amount.

The steam dredge with its suction line is located in a bayou on the island near the causeway. This dredge is capable of conveying about 150,000 cu. yd. per month through its 20-in. discharge line, but cannot satisfactorily deliver at distances above 3000 ft. For conveying the sand and water out onto the causeway when one pipe line reaches a length of 12,000 ft. booster pumps are required at 3000-ft. intervals. These pumps, similar to that on the dredge, are chain-driven by 250-hp, 2300-volt, 60-cycle, two-phase motors supplied through transformers from the 11,000-volt transmission line from the generating plant of the Brush Electric Light & Power Company, of Galveston, 5 miles distant. As the work progresses from the island shore additional booster pumping units are addded every 3000 ft. When one pump was in use 5500-volt transmission was employed and this was raised to 8800 volts and then to 11,000 volts as the second and third pumps were put into service, the transformer ratio being suitably changed to give 2300 volts at the secondaries. The present pipe line, used for filling the mainland end, is carried from the dredge in the bayou, through two booster pumping stations on the south end of the causeway, through an inverted siphon at the drawbridge channel and up again to a third pump on the mainland end, where the discharge is now located. The sand is being pumped onto the filling for a height of about 15 ft. above the edge of the piling, after which it will be faced with concrete.

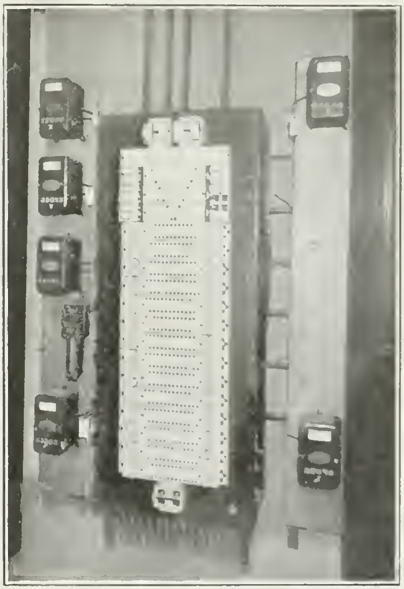
The present sand-pumping load has been almost continuously on the central-station company's lines during the last year, when the boulevard crowning was begun. The booster load continues twenty-four hours a day from ten to twenty days at a time, following which a day is taken to shut down, overhaul and move the machinery if necessary. The pump impellers last only one or two months under the severe service required of them in pumping the sand. At present three 250-hp booster units are in service, and the energy consumption of the North American Dredging Company of Texas, which is doing the work, has reached 365,000 kw-hours in a single month. For this service a comparatively low rate is granted, as the proposal to use central-station drive for the booster units had to compete with some very efficient isolated-plant installations. The income obtained from the dredging load, however, according to Mr. F. M. Lege, manager of the central-station company, is very satisfactory from his standpoint in view of the high load-factor of the demand, and has been of considerable advantage in improving the load conditions of his 4300-kva turbine generating station.

ELECTRICITY IN THE PEOPLE'S GAS BUILDING, CHICAGO.

The new office building of the People's Gas & Coke Company at the corner of Michigan Avenue and Adams Street, Chicago, is a monumental structure of granite, steel, concrete and tile twenty stories high and occupying a ground area 190 ft. x 170 ft. The main floor is used by the gas company as its business office, a corner room being leased to a banking company. The floors up to the sixteenth are occupied by office tenants, while the stories from the sixteenth to the twentieth are used by the gas company for its general and executive offices, employees' restaurant, etc.

While the building is architecturally and structurally one of the most modern and imposing erected in Chicago, the fact of its ownership by the gas company has resulted in the use of gas for illuminating purposes wherever possible. The business offices of the gas company are lighted entirely by gas, the office-building corridors are equipped with inverted incandescent-mantle fixtures, and the tenants offices are arranged with combination fixtures combining gas outlets for indirect illumination and direct electric lighting. Although efforts were primarily made to have the tenants rely on gas for illumination, it is significant that three-fourths of these offices are now lighted entirely by electricity.

The fixtures for the People's Gas Building were all of special design and from a gas standpoint incorporate a number of new ideas. The fixtures in the offices comprise three upright-mantle gas burners shaded by a reflector and projecting their light flux upward onto a porcelain ceiling plate, from which the room is lighted indirectly. This ceiling plate performs the double function of reflecting the light rays and also providing a surface, easily cleaned by wiping, designed to collect the soot and dust carried in the heated-air columns rising from the burners. Even with the ceiling plates, however, the plaster suffers noticeable discoloration at the margins of the porcelain. The lower sides of the indirect-lighting reflectors are of amber-colored art glass, combining a limited amount of direct lighting with the indirect. These indirect-lighting fixtures were provided to avoid the necessity for desk-lamp hose connections in case gas was generally used for illumination. Pending from the reflector of each ceiling fixture is a cluster of three lamp sockets. As above noted, the majority of the tenants now use electricity for lighting. The entire building is completely wired for electricity, including the concealed outlets in the gas company's own offices, where fixtures have not been installed. The distribution boards employed on the office floors, four to each story, are of the New York type with porcelain-covered fuses and represent the first installation made of this kind of board in Chicago. The main fuses are shown at the top of the board. Below them are the connections to the vertical meter buses, while each branch circuit is fed from transverse-threaded buses which by means of special screws inserted through the holes shown can be connected to the meter bus desired. The entire bus structure is covered with porcelain and all fuses are porce-


Meter Panel Installed in the People's Gas Building, Chicago.

lain-inclosed. These meter panels were built by the Metropolitan Engineering Company.

The corridor lighting is done by specially designed mantle fixtures in which all openings and vents for the primary and secondary air and for the discharge of the products of combustion are concealed. These lamps are equipped with pilot flames and pneumatic valves controlled through double tubing from junction boxes. To light or extinguish the lamps the attendant inserts a little pocket pump into the "on" or "off" tube terminal, operating the valves at the jets as desired. In case of injury to one of the tubes the system can still be worked by exhausting and compressing the air in the remaining tube.

Altogether there are 6840 pilot flames burning continuously in the building. The outages have averaged only about two a month according to Mr. C. A. Luther, illuminating engineer for the gas company. Mr. Luther designed a number of the gas fixtures in the building, and on May 18 read a paper describing its lighting before the Chicago Section of the Illuminating Engineering Society following an inspection of the building by members.

The main office of the gas company on the first floor is finished in red and white Grecian marbles and as a business interior is probably unsurpassed in size or beauty by any banking room in the country. The principal lighting is done by twenty-two high-pressure single-mantle gas units ranged about the border of the room. These chain-suspended fixtures are of unusual beauty and are made of solid brass, each weighing 500 lb. The burners are suspended 18 ft. above the floor and 12 ft. below the ceiling, and are placed at 15-ft. intervals. The center of the room is lighted by 11-ft. vertical bronze candelabra, each carrying four low-pressure mantle burners. All of the tellers' cages, offices, etc., are equipped with individual inverted lamps. An attempt was made to use gas lamps in the vaults of the gas-company's office, but after an earnest effort the gas units were abandoned and electric lamps substituted. The office is completely wired for electricity, but all outlets are concealed and no use is made of electric lighting except in the instance mentioned.

Between the huge granite columns along the Michigan Avenue and Adams Street fronts of the building are twenty-two high-pressure single-mantle units similar to those in the main office. The gas pressure for these forty-four lamps is raised from the city-main pressure, 3.5 oz., to 2 lb. per square inch by a pair of 4-hp motor-driven blowers installed in the building. One blower is ordinarily in use, but the connections of the second are so arranged that in case of interruption to the first unit the second blower will automatically start up. The high-pressure gas lamps are arranged with thermostat valves which admit the gas slowly to the burner as it warms up, full brilliancy being reached about one minute after the gas is turned on. This partial admission of the gas supply prevents the noise and miniature explosions which would injure the mantle in case the high pressure were turned on full at once. The high-pressure burners show a light-producing efficiency two or three times that of the low-pressure burners, and give 67 cp-hours per cubic foot of gas per hour.

The People's Gas Building is equipped with fourteen electrically operated elevators, and motor drive is used for many auxiliary purposes in the building, including water pumping, refrigeration, etc. No gas engines are used in the building, the original plan to install a gas-operated isolated electric plant having been abandoned in favor of the purchase of electrical energy from the Commonwealth Edison Company.

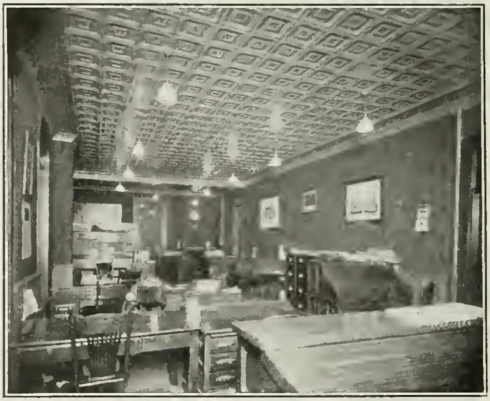
CENTRAL-STATION DEEP-WELL PUMPING FOR SMALL-TOWN SUPPLY.

The water supply for the town of Coalgate, Okla., 4000 population, is lifted from 250-ft. wells by one 50-hp motor-driven compressor supplying air-lift pumps, and one 15-hp deep-well pump. The reservoir level is maintained by a 25-hp centrifugal pump capable of delivering 300 gal. per minute. Tests made by Mr. H. L. Reager, manager of the local central station company, show that about 1.25 watt-hours are required by the deep-well pump for every gallon lifted. As this means a considerable saving over the air-lifts, the town has decided to replace the latter by deep-well pumps. The pumping station is 5 miles from the town and the power house, and the attendant who takes care of the pumps augments his income by farming. All of the motors are 2300-volt machines. Ordinarily the pumps are operated from 3 p. m. to 5 p. m. and for several hours in the early morning beginning at 12 midnight. The town pays 4 cents per kw-hour for its pumping service, from which the central station derives an income of about $500 a month.

Wiring and Illumination

UNIT LIGHTING SYSTEM IN A SMALL OFFICE.

The illuminating engineer who recommends the overhead, so-called "unit lighting" system to replace local desk lighting in an office is often met with the justifiable objection that the owner does not want the entire installation burning when only one desk is in use.. The accompanying illustration shows a factory office, 50 by 20 ft. floor space, in which the lamps on the right side of the room over the individual desks are under separate switches, while the row at the left is divided into alternate groups of two and three lamps, which serve to light the tables beneath, which are in almost continuous use.


Overhead Unit Lighting of an Office.

It was first proposed to light this room by a cluster of four 60-watt tungsten lamps at the center of the ceiling, together with 12 50-watt carbon lamps, one on each desk, totaling, with a 250-watt cluster in the entrance aisle, 1200 watts. This factory office is in St. Louis, where the Union Electric Light & Power Company tenders its customers the expert advice of its illuminating engineer, Mr. John F. McGlensey. Mr. McGlensey advised against the desk-lamp installation, and suggested that shown, which was carried out with a connected load of only 720 watts in tungsten lamps, and at a cost for wiring less than for the desk-lamp outlets. Twelve 60-watt tungsten lamps were installed 10 ft. above the floor, in intensive reflectors, as shown. The lamps are approximately 5 ft. or quarter way out from the walls, with 10 ft. between lamps. The intensity at the working plane is designed to be 3.5 ft. candles.

The desks on the right-hand side of the room belong to individuals who are absent much of the time, and each of the lamps in the row is controlled by a switch in the group at the far corner, so that any lamp can be switched off by its user as he leaves the door at the right. The seven wires required for these six lamps were easily carried in the 1-in. conduit concealed under the metal ceiling. The tables at the left are in use almost continuously. The alternate lamps on this side are accordingly arranged in two groups, so that either or both can be switched on, depending on the general illumination required in the room. Both the owner and his employees are well pleased with the uniform illumination afforded by the overhead system. The uniform quality of this lighting is shown in the illustration, which was made from a night photograph of the room. The actual watts expended in the room also represents a saving of about 40 per cent over the amount required for carbon desk lamps.

ERECTION OF METAL MOLDING.

By A. G. Tonstead.

Right-angle turns in metal molding runs are ordinarily made with metal-molding elbow fittings, as shown in Fig. 1. A more sightly turn can be made, without elbow fittings, as suggested in Fig. 2, by mitering the capping and base in much the same way as wooden molding would be mitered. The miter is cut with a hack-saw. A miter-box can be used to guide the saw or the cut can be made quite satisfactorily by laying off a distance, *W*, Fig. 3, equal to the width of the capping or brace, as the case may be, along its side and indicating it with a pencil mark. The saw cut should be made connecting the corner of the molding with the pencil mark. After a wireman has done a little mitering he can judge, with his eye, the angle that the cut should take and can dispense with the miter-box and the marking. Metal molding is flexible enough to let it be bent to meet at mitered corners if the cutting is a little inaccurate.

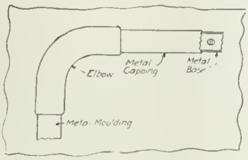


Fig. 1—Turn Made with Elbow.

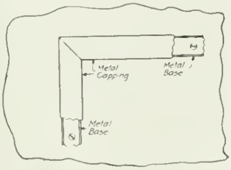


Fig. 2—Turn Made by Mitering.

In somewhat the same way that turns are made elbows can be formed. Fig. 4 shows the usual method where fittings are used and Fig. 5 how it can be done by mitering. It is required by the National Electrical Code (Rule 25 A d) that metal molding be so installed that adjacent lengths of molding will be mechanically and electrically secured at all points.

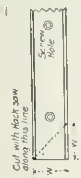


Fig. 3—Method of Laying Out a Miter Cut.

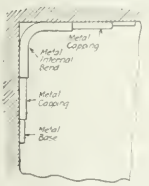


Fig. 4—Elbow Formed with Fittings.

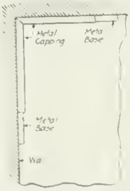


Fig. 5—Elbow Formed by Mitering.

Where work is subject to Underwriters' inspection connecting pieces, cut from scraps of molding, can be inserted as outlined in Fig. 6, to join electrically and mechanically adjacent lengths together. Where molding is being erected on a wooden surface flat-head wood screws can be used for supporting it and for effecting the connection between the conducting piece and the base pieces. (It is required by the code [Rule 25 A c] that the heads of any bolts or nuts used must lie flush with the interior face of the base, after they have been inserted.) On concrete surfaces screws, turning into expansion anchors, or stove bolts can be used and toggle bolts or stove bolts can be used on tile fireproofing. Where stove bolts are utilized small cavities must be chipped in the supporting surface to accommodate the nuts, but it is often more convenient to chip these holes than to drill for an expansion anchor or a toggle bolt.

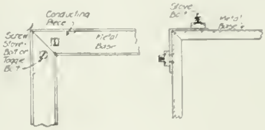


Fig. 6—Application of Conducting Pieces.

Toggle bolts, of the form detailed in Fig. 7, are well adapted for fastening metal molding to tile fireproofing. The bolt itself is threaded its entire length. The toggle is pivoted eccentrically and the long end tends to lie close to the bolt, while it is being inserted, as shown in Fig. 8. After the toggle is through the hole it can be thrown into a horizontal position by twirling the bolt or by jiggling it up and down. Two sizes of toggle bolts are used for supporting molding. The ¼-in., that shown, is very satisfactory. The other size, 3/16 in., is a trifle light for all around work. A length of 4 in., as suggested in Fig. 7, is about right for the average condition.

All holes drilled for supporting screws or bolts in metal molding base should be countersunk. A special bit for this work, having a square shank which fits the ordinary brace, is available. It is a combination drill and countersink, in that it drills and countersinks at one operation, and is a convenient tool. The base is usually drilled and countersunk by its manufacturers to accommodate No. 8 wood screws. These have a diameter of a trifle over 5/32 in., about No. 6 B & S. gage.

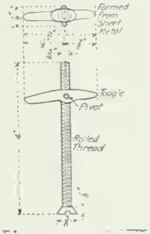


Fig. 7—Toggle Bolt for Metal Molding.

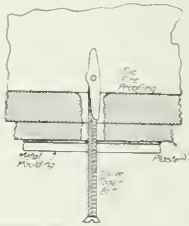


Fig. 8—Toggle Bolt Being Inserted.

RECENT TELEPHONE PATENTS.

SUPERVISORY SYSTEM.

With two-wire common-battery switchboards it is customary to use four supervisory relays to effect a complete system of supervision. The usual arrangement splits the cord pair as to answering and calling, but includes a condenser in each cord strand. The battery can thus be supplied to each cord independently. In a system just patented by Mr. N. C. Schellenger, of Chicago, however, the battery is supplied through the four relays, one relay being associated with each strand of each cord. When the hook is up at a station to which the cord is connected, both relays are in circuit, one being operated to close the circuit of the supervisory lamp, while the other opens this circuit, so that the lamp is not lighted. If now the hook be depressed, the circuit-closing relay has its operating current maintained through the grounded bell at the station. But the circuit-opening relay is de-energized because its circuit is broken at the hook switch. Thus the supervisory lamp circuit is closed and the lamp lights. The patent is assigned to the Stromberg-Carlson Telephone Manufacturing Company.

REPEATER SYSTEM.

A repeater system employing mechanical rotation as the source of the relaying energy, through the use of a unipolar dynamo, has been patented by Mr. C. G. Ashley, of Chicago. The patentee arranges his dynamo with an exciting winding, preferably supplied with a uniform current from a battery. This field is then modified by an auxiliary winding which carries the received telephone current. The cup-shaped armature traveling in the field has generated in it a reinforced duplicate of the telephone current, the regenerated current being delivered through a step-up transformer to the telephone line.

TELEPHONE RECEIVER HOLDER.

Mr. C. L. Williams, of Parkersburg, W. Va., has obtained a patent for a receiver-supporting device, which takes the form of a "lazy-tongs" or multiple pantograph, with a receiver clamp at its outer end. Switch springs are arranged so that the circuits are changed as required as the arm is extended or shut. If desired, a counterbalance may be arranged opposite the receiver so that the telephone set will not be overbalanced.

IMPROVEMENTS IN REPEATERS.

Some five years ago it was first realized that the mercury-vapor arc could be utilized as a telephone repeating apparatus. The received current was led through an electromagnet, the feed of which cut the arc. This varied the arc resistance correspondingly and the arc thus became impressed with a counterpart of the received current. Mr. Peter Cooper Hewitt, of New York City, at that time obtained a patent for such an arrangement.

Now he has discovered a second means of utilizing the vapor arc as a means of repeating, and he has recently obtained a patent for this invention.

It is well known that the surface of the positive electrode of such an arc is continually broken or disturbed by one or more protuberances. Mr. Hewitt has found that these protuberances present an interference to the positive current flow, and that their effect in this regard may be varied by the action of a magnetic field. It is thus evident that variations of current flow may be impressed upon the arc circuit, corresponding to the field variations of the disturbing magnet. This patent is assigned to the Cooper Hewitt Electric Company.

Mr. C. A. Kruckow, of Germany, has also obtained a patent relating to repeaters. Here the object is to associate two repeating instruments with a single two-way line in a manner such that a two-way conversation may be carried on. The repeaters must, of course, be so arranged as to be mutually non-responsive, and this is accomplished by the use of four triple-wound induction coils with windings so arranged that the receiving part of each repeater is in a neutral position with respect to the reinforced currents from the other.

EXCHANGE SYSTEMS.

Mr. H. P. Claussen, of Chicago, has obtained a patent for a circuit system for common-battery exchanges which requires a three-wire plug and cord and a three-wire jack. The line relay is connected between tip and ring at the jack, while the supervisory relay is similarly connected in the cord. The line relay is of high resistance and is shunted out by the low-resistance supervisory relay.

An automatic exchange system forms the subject of a patent recently issued to Mr. A. T. Brown, of Syracuse, N. Y. He makes use of a motor-driven connecting device having thirty movable contacts arranged upon a moving carriage. These contacts are uniformly spaced with a center-to-center distance, the same as that of thirty groups of stationary contacts. A single step of the rack puts the thirty movable contacts over No. 1 stationary contact of the corresponding group. At will any movable contact may in this way be selected and brought into operative position. Sixty impulses on the line will thus give direct selection of any one of 900 lines.

NEW APPARATUS.

An improved plug seat is the subject of a patent granted to Messrs. J. J. Taylor and L. K. Hoss, of Cherryville, Kan. The usual plug seat comprises a small brass plate with a perforation which will admit the switchboard cord, but not the attached plug. Therefore, the whole length of cord must be drawn through the seat in installing or replacing it. According to the present invention, a small metal sleeve, too small to admit the plug, is mounted loosely upon the cord, and a notched strip of metal is arranged at the base of the plug socket to receive, support and retain this sleeve. The plug socket must, of course, be widened at its base to permit the cord to be thrown out of line sufficiently so that the sleeve can be seated above the notched strip of metal.

The patent of Mr. S. A. Koltonski, of Boston, describes a transmitter. The face of the instrument is removable, exposing a frame which carries the diaphragm and bridge. A clamp ring fits into the face of this frame in such a manner as to clamp a moisture-proof celluloid diaphragm in front of the operating diaphragm.

LETTERS TO THE EDITOR.

Indirect Lighting vs. Gas.

To the Editor of Electrical World:

Sir:—In reading Mr. Norman Macbeth's reply of April 20 to my article in your issue of March 30, it seemed to me as if the overstatements in it were sufficient to make any rebuttal on my part unnecessary. However, several other journals have since taken up the matter, referring to Mr. Macbeth's impressions of what I said, instead of going back to my original article, hence attention should be called to the difference.

Thus, my reporting the reasons why the indirect-lighting equipments actually tried by an enterprising manufacturer had not proved a success, and my referring to these reasons as present shortcomings, is quoted as a conclusion "that gas cannot be used for indirect lighting." Moreover, I am blamed for referring to the vitiation of air by gas, although no reference whatever had been made to it in my article.

That manufacturers of gas equipment have not the time to devote to indirect-lighting systems is an easily made excuse, it being generally customary for manufacturers to be "too busy" when asked to figure on work on which they know they would be outclassed. I was long in the manufacturing business myself. The fact that my article was based on the comments of a "manufacturer of lighting fixtures eager to cater to the large gas interests" should answer that point. Personally, I presume that some day this same manufacturer may be able to adapt his fixtures to gas, for I am an optimist. However, my article was based on the present situation, the present handicaps; hence any one taking Mr. Macbeth's letter seriously should read what I actually said.

Chicago, Ill. Albert Scheible.

Visual Acuity.

To the Editor of Electrical World:

Sir:—In the account given in your issue of May 11 by Dr. Louis Bell of the results of a highly instructive research on the subject of "Chromatic Aberration and Visual Acuity" he substantiates the findings which were presented by the writer in an article in your issue of Feb. 25, 1909. In this latter article were given the results of a very careful research on the subject of "Physiological Optiques," extending over a considerable period, during which time the subjects of "Glare," "Visual Acuity," "The Validity of the Flicker Photometer" and many other subjects which have recently been under discussion were investigated.

In the article by Dr. Bell he notes that the acuity increases with the shorter wave lengths, which he attributes to chromatic aberration of the eye. In this connection the writer would like to call attention to a paper presented by him before the Boston Section of the Illuminating Engineering Society in May, 1909, on "The Physiological Effects of Illumination." It was noted that with the shorter wave lengths, such as produced by the mercury-vapor tube (pages 417, 418 and 419), a sharp contraction of the pupil was produced, which effect has been also noted by MM. Broca and Laporte in their very interesting research report in the *Bulletin* of the Société Internationale des Electriciens, June, 1908. This fact may also be readily noted by any one who may stand near the mercury-vapor tube, allowing another to gaze at the pupil of his eye. A sharp contraction will be noted.

In the published results of the writer's observations the conclusion was drawn that this sharp contraction probably accounts for the high acuity which is produced by the short wave lengths, the pupil of the eye acting as a diaphragm to a camera, in which, if we desire to obtain a sharp, clearly defined negative, we always use a small stop in taking a photograph. Why the pupil should contract to such a marked degree under the mercury-vapor tube it is difficult to explain It is certain, however, that in so doing nature is exercising some protective agency to the retina of the eye. Whether this is due to the deleterious effects attributed to the shorter wave lengths of the mercury-vapor tube it is hard to say, but the fact remains that nature does cause a much sharper contraction of the pupil for a given intensity of mercury-vapor lighting than it would for the same intensity from light sources giving a more normal spectrum.

Harrison, N. J. SYDNEY W. ASHE.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Free Oscillations of Synchronous Alternators.—L. DREYFUS.—In the investigation of the phenomenon of the surging of alternators the so-called "forced" oscillations have been chiefly considered in the past. There may also be free ("self-exciting") oscillations. These are produced when the frequency is low, when the excitation of the machine is high and when the ohmic resistance of the magnet winding, together with that of the series regulator, is high. The author investigates this phenomenon mathematically and shows first that an ideal synchronous machine which has no stray fluxes and in which the ohmic resistance of the phases is negligible is incapable of producing such self-excited free oscillations. In the main part of the paper the author, therefore, takes into consideration the ohmic resistance of the windings and partly also the stray fluxes. He shows that the "synchronizing force" of the machine when running without surging at a low frequency is considerably influenced by the ohmic resistance of the phases and the value of the direct-current excitation. The author discusses especially how the limit of stability of running depends on the degree of over-excitation. He also shows that the law of damping of a synchronous machine at low frequency is quite different from the law usually assumed and that the damping effect of the ohmic resistance of the windings becomes of more importance the higher the over-excitation. The free self-excited oscillations can be best suppressed by means of a short-circuit winding of as ample dimensions as possible, arranged in the axis of the "cross flux" (synchronous machine with cross-flux dampings). The effectiveness of this remedy has been proved by experiments and its theory is given at some length.—*Elek. u. Masch.* (Vienna), April 16 and 23.

Voltage Between Commutator Segments.—T. HOOCK.—An English translation of his recent German paper in which he shows that the maximum voltage between commutator segments depends on the saturation of the magnetic circuit and points out how it increases in the case of a motor when the speed is raised by shunt regulation.—Lond. *Electrician*, May 5.

Unipolar Dynamos.—An abstract of a recent thesis of B. von Ugrimoff. The author considers the contact made between a rotating disk and mercury. A long series of experiments was made with different arrangements of this liquid contact at very high peripheral speed. It is only when water cooling is resorted to, however, that a practical solution can be found. The author built an 80-kw, 40-volt unipolar machine running at 8000 r.p.m. The conclusions of the author are as follows: A unipolar machine with nickel-steel disk armature and good liquid contacts can be made to yield pressures sufficient for incandescent lamps. The water-cooled liquid contact has proved satisfactory for collecting current at peripheral speeds which range up to 270 m per second.—Lond. *Electrician*, May 5.

Aluminum Wire for Field Coils.—M. A. MARIAGE.—A report to the International Congress of Tramways and Light Railways held in Brussels last year on the use of aluminum wire for the field coils of electric-traction motors, with special reference to the experience of the General Omnibus Company in Paris. The advantages which aluminum has over copper are pointed out.—*La Lumière Elec.*, April 29.

Circular Diagram.—R. MOSER.—A communication in which the author gives a simple graphical proof of the exact circular diagram of the three-phase induction motor.—*Elek. Zeit.*, April 27.

Lamps and Lighting.

Effect of Wall Papers on Illumination.—P. J. WALDRAM.—A paper read before the (British) Illuminating Engineering Society. Up to the present it has been customary to neglect more or less the wall and ceiling illumination and to consider the working plane illumination as being a criterion of the whole. This is not only wrong, but is injudicious. The walls are what practically every one unconsciously judges by. According as they are bright or dull, warm in tint or cold, so, rightly or wrongly, the illumination of the room is popularly classed. The light reflected by the walls and ceilings has a psychological effect. Commercially, too, the reflected light from the walls and ceilings is important. The author emphasizes that it would be important to establish standards of surface brightness which would be satisfactory for different classes of interiors. The author suggests that reflection coefficients for paper of any color or texture can be ascertained with sufficient accuracy for all practical purposes by measuring its apparent surface brightness in a direction normal to its surface, as compared with that of white blotting paper, a holophane lumeter standard card, or any other suitable standard under the same illumination. He emphasizes the importance of the use of candle-power curves of lamps and shades, and suggests the following method: To one end of a light wood lath is fixed a vertical bent plate of tin blackened and marked in degrees and carrying a plumb bob so that the angle with the horizon at which the rod is being held can be read off at once. Part of the tin plate is bent at right angles to the direction of the lath, and a plate of known whiteness—white blotting paper of a lumeter test plate—is attached by means of a rubber band. A blackened brown-paper screen is held or hung behind the lamp and shade to be tested; the lath is held with the point just touching the lamp. The illumination in foot-candles produced on the test-plate is then read with the lath held at different angles. This illumination (except in the blackened room) is produced partly by the lamp and partly by reflection from surroundings or even by other lamps. The rays coming from the lamp alone are isolated from the extraneous light as follows: A small black screen of such a size as just to screen all the rays from the lamp and shade, but nothing else, is held in a notch in the lath and a reading taken under these conditions represents the extraneous light only. The difference between the two represents the direct rays from the lamp and shade only. The net foot-candle readings divided by the square of the length of the lath used give the required candle-power at various angles. The method gives curves which approximate very closely to those obtained in the laboratory, and it also enables curves to be measured for gas mantles, oil lamps, wax candles, etc., which are very difficult to obtain in any other way. The author refers to the exhaustive series of tests on the increase in flux due to reflection carried out by Sharp and Millar and emphasizes that it would be good to make more numerous if less detailed tests of a similar nature in a number of rooms of different sizes with different schemes of color and with varying proportions of light thrown upon walls, ceilings and floor respectively by means of light units at varying heights with various shades. The author is making a number of such tests of different rooms. The method adopted is to divide the floor, walls and ceiling into a number of equal rectangles. The candle-power distribution curves of the lamps having been measured as before described by means of a photometer, readings were then taken of the illumination received by a detached test-plate in the center of each rectangle. Then another series of readings was taken with a small black screen placed about halfway between the test-plate and each lamp so as just to cut out the direct lamp rays while obliterating as little as possible of the light reflected from the ceiling. This second test of readings isolates the increase due to all reflections and counter-reflections, and the difference between the sets of readings should equal the direct flux as calculated from the candle-power curves. —Lond. *Electrician*, May 5.

Spectral Luminosity Curves Obtained by the Equality of Brightness and Flicker Photometers.—H. E. Ives.—An abstract of an American Physical Society paper. The photometry of lights of different colors is complicated by physiological and psychological factors. These enter to different degrees in the various methods of photometry which have been employed for such comparisons. The most accurate methods available are those of equality-of-brightness and flicker photometry. In the latter the psychological element of estimation is eliminated, but ignorance of behavior of the flicker photometer under various conditions has delayed its general use. The present investigation consists of a comparison of the two methods of photometry under a wide range of conditions. Special luminosity curves have been obtained by comparing the brightness of the prism face of a spectrometer with the illumination of a white sector illuminated by a standard incandescent lamp. The sector in rotation forms the flicker photometer. Curves have been obtained for a large range of illuminations and three sizes of photometric field. It has been found that the sensibility and reproducibility of the flicker method are much greater than the method by equality of brightness. With decrease of illumination the maximum of luminosity shifts toward the blue with the method of equality of brightness (Purkinje effect); toward the red with the flicker method. With decreased size of field the maximum of luminosity shifts toward the red for the equality-of-brightness method (yellow spot effect); toward the blue for the flicker method. At low illuminations the two methods give results considerably different, but at high illuminations the special luminosity curves closely approach each other. Measurements made at two illuminations (high and low) by five different observers of normal color vision show marked differences in the position of both kinds of curves; all show the opposite shift of luminosity maximum by the two methods with change of illumination; different relative positions of the two curves at high illuminations are found with each observer, but the mean high illumination curves by each method closely agree, thereby supporting the conclusion that the methods approach equivalence at high illuminations for an average eye. A mean luminosity curve is obtained and reduced to a normal spectrum. Its maximum lies at 0.545μ. Conclusions are drawn that the standard condition for heterochromatic photometry should be a high illumination, thus permitting the use of the more accurate flicker photometer. Further investigations on problems arising in this connection are mentioned.—*Phys. Review*, April.

Metallic-Filament Lamps.—A note on a recent British patent (8984, May 4, 1911) of the British Thomson-Houston Company and J. Gray. Filaments drawn from an alloy of tungsten with another metal are strung on the carriers or spiders before the latter metal is driven out by volatilization. In order to permit of the contraction of the filament during the volatilization it is previously corrugated or crinkled.—Lond. *Elec. Eng'ing*, May 11.

Selective Radiation.—W. W. Coblentz.—A continuation of his extended researches on the selective radiation from various substances. In the present paper the author describes the apparatus and methods used by him, and then deals especially with the radiation from acetylene flame and the Welsbach mantle. Finally data are given on the problem of color match versus spectral-intensity match.—*Bull. Bur. of Standards*, May 15.

Generation, Transmission and Distribution.

Electromechanical Transmission Gear.—An illustrated description of the Thomas electromechanical transmission system for automobiles. This system differs from other systems devised to give a wide speed variation by means of electrical machines in that there are two distinct paths of power between the engine and the load shaft—one mechanical and the other electrical. This arrangement is obtained by means of planetary gear in conjunction with two small electrical machines. These units are so arranged that the greater proportion of the engine power is directly transmitted mechanically. Fig. 1 shows the arrangement. The casing D forms the flywheel of the engine and is directly coupled to it. Inside this casing are two planet pinions P and P_1 of different diameters keyed to the same spindle. This spindle is supported in the sides of the casing and is free to rotate about its own axis. The planet pinions P and P_1 mesh with the two sun pinions W and W_1, which are rigidly connected to the independent shafts H and K. On the shaft K is mounted the armature B of an electrical machine and on the shaft H (which is the load shaft) is mounted the second electrical machine CC_1. In these two machines, BB_1 and CC_1, the field windings are in series with the armatures and are connected in series by the operation of the controller. There are thus two paths of power between the engine and the road wheels—the first a direct mechanical path from W along the shaft H and the second an electrical path from W_1 through two electrical machines to the shaft H. If W is larger than W_1, then for a certain rotation of the casing W_1 will tend to rotate backward and W forward at speeds depending upon their relative resistances to motion. It will be seen that if the speed of the casing D is constant the speed of H will vary with the speed of K, and since the speed of K depends on its resistance to motion (and, therefore, on the load

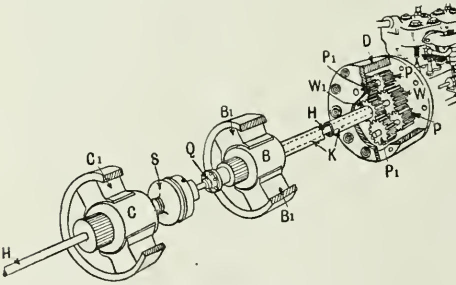


Fig. 1—Electromechanical Transmission Gear.

on the machine BB_1), the speed of H can be varied by changing the amount of power transmitted electrically.—Lond. *Electrician*, May 5.

Colorado Water-Powers.—W. B. Freeman and E. O. Christiansen.—A paper giving a large number of statistical data on the water-power available in Colorado. The estimated total minimum or primary horse-power of river systems in Colorado is 828,400, of which 586,300, or 70 per cent, is on the western slope. The minimum for the six high months is 1,673,100, of which 70 per cent is on the western slope, and the horse-power from storage during the six months' period is 2,560,200, of which 72 per cent is on the western slope. A list of different power plants installed in Colorado is given.—*Jour. Eng'ing.* Univ. of Colo., No. 7.

Traction.

1200-Volt Trolley Line.—A fully illustrated description of the 1200-volt equipment of the Shore Line Electric Railway, which follows the Connecticut shore of Long Island Sound for a considerable portion of its length. Three-phase 11,000-volt energy is transmitted at 11,000 volts to two substations in which the emf is reduced to 370 volts and then the current is converted to direct current at 1200 volts, which latter pressure is used on the trolley. Each car is equipped with four 50-hp interpole motors wound for both 600-volt and 1200-volt operation. The cars operate at 600 volts in New Haven and at 1200 volts on the interurban section.—*Elec. Ry. Jour.*, May 20.

Single-Phase Traction.—An illustrated article on the single-phase electrification of the London, Brighton & South Coast Railway.—*Elec. Ry. Jour.*, May 6.

Installations, Systems and Appliances.

Statistics of Swiss Electrical Industry.—Extracts from statistics prepared by the Swiss Electric Society and the Association of Swiss Central Stations for 1909. The statistics refer to 675 stations which sell electrical energy. Two hundred and twenty-eight stations have their own generating plant, sixty-four stations buy part of their energy from other stations, while 383 stations buy the whole energy from others. Of these stations which have their own generating plants complete data are available from only 176 stations. Of these, ninety stations are pure water-power plants with a rating of 11,426 kw, or 40.5 per cent of the total. Sixty-six are combined water-power and steam stations with a rating of 156,612 kw, or 57 per cent of the total. Five stations are operated by steam only with a rating of 1012 kw (0.4 per cent). Thirteen stations have internal combustion engines (1280 kw) and two stations have steam and combustion engines (4500 kw). The largest rating of a station is 31,380 kw. There are fifty-eight stations from 100 kw to 500 kw and sixty-one stations with ratings below 100 kw. Seventy per cent of the total equipment rating is installed in plants with more than 5000 kw. The first cost for sixty-one stations with ratings below 100 kw was, on the average, $599 per kilowatt, while the average for the stations above 1000 kw was only $240 (the figures in the latter case varying between $168 and $334). Compared with respect to the type of prime movers the first cost per kilowatt was $191 for water-power plants, $279 for combined water and steam plants, $480 for pure steam plants and $595 for gas-engine plants. Nineteen and three-tenths per cent of the plants generate direct current only, 66 per cent single-phase or polyphase currents, 15 per cent both direct current and alternating current. Fifty-three per cent of all long-distance lines are on the three-phase system, 4 per cent on the two-phase system, 32 per cent on the single-phase system and 12 per cent carry direct current. The maximum emf for long-distance lines is 50,000 volts (Brusio) for alternating-current transmission and 25,000 volts (St. Maurice to Lausanne) for direct-current transmission systems.—*Elek. u Masch.* (Vienna), April 16.

Battery Economics.—An account of the discussion which followed the paper of Taylor recently abstracted in the Digest. B. M. Jenkin thought one of the most interesting points was the comparison made beween the ordinary battery booster and the author's suggested arrangement. That method of working might be carried still further, since the chief object of the battery was to give the maximum possible discharge when it was most needed. So long as the booster was used to assist the battery to discharge, some energy would be used in the booster when it was of most value for the load. He suggested that the absence of the booster during discharge was the point to be aimed at, especially if the battery was to be regarded as a standby. The speaker suggested the use of regulating cells on a battery with a sufficient number of cells to take the discharge. He outlined the following arrangement: The booster was placed in parallel with the regulating switch circuit, as indicated in Fig. 2. During charge the whole of the cells were equally charged through the booster. The regulating switch was adjusted to suit the busbar volts, and the booster voltage was adjusted to give the required charge and at the same time keep the current through the regulating switch circuit at zero. During normal discharge the same method was followed, so that all the cells were equally discharged. During the beginning of the discharge the booster was run inverted and the motor delivered energy to the busbars. At the end of the discharge the switch was on the end cell and the booster shut down. In emergency the heavy discharge was taken through the regulating switch circuit and the booster was automatically cut out as the switch was moved to the end cell. The regulating switch circuit was available for emergency discharges at all times, and was not affected by the booster connections, which might be set with armatures in series or in parallel, charging or discharging. C. E. C. Shawfield said he had formerly believed a booster to be the best and most economical means of charging and discharging a battery. But in Continental Europe the opposite opinion is held. He found switches in the Berlin Electricity Works which were "really wonderful in their simplicity and certainty of operation." He saw one move over several contacts when carrying 4000 amp and, although that particular switch had been in service seven or eight years, the contacts appeared absolutely new. He was assured that they had not required any repairing or renewals during that period. In regard to the cost of regulating switches, it did not appear to be any higher than the cost of the boosters. He thinks that the efficiency to be obtained by the use of regulating cells is very much higher than is possible with boosters. The rating of the batteries installed in the Berlin Electricity Works was 35,000 kw on the two-hour rate, and in case of breakdown they were capable of maintaining the whole supply of the city for a period of two hours. It was considered necessary to make such a large provision in the way of batteries because they result in considerable economy in coal, which is expensive in Berlin. Further, the supply company is under very heavy penalties to the local tramways, to the underground railways and to the municipality in the event of any failure of supply. The batteries installed afford insurance against the heavy liability for breakdowns. Such a state of affairs, however, does not exist in England. S. L. Pearce gave data on the large batteries installed at Manchester. He said that it is not true that the coal bill has been reduced by some 25 per cent. It was true in three months in the summer of last year, but the average for the completed twelve months is only 13 per cent. The long reply of Taylor is also given.—Lond. *Electrician* May 5.

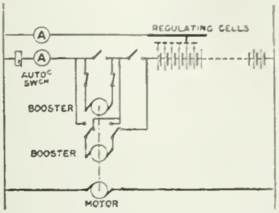


Fig. 2—Battery Booster Connection.

Triple Harmonics in Transformers.—W. W. Lewis.—A paper illustrated by diagrams in which the author explains some of the facts accompanying the presence of triple harmonics in transformers and draws some practical conclusions therefrom. No-load conditions only are considered. He reaches the conclusions that to produce proper conditions in operation a three-phase transformer or a bank of three single-phase transformers should always be operated with a closed delta in either the primary or the secondary, or if operated with both sides star-connected the neutral of the side receiving the energy should be connected either metallically or through ground to the neutral of the source of energy. He also concludes that transformers will operate safely in open delta as far as magnetizing is concerned.—*Journ. of Eng'ing,* Univ. of Colo., No. 7.

Wires, Wiring and Conduits.

Resistance of Copper Wires.—F. H. Millard and H. K. Humphrey.—The authors suggest the following simple method for determining with a slide rule the resistances of copper wires when in the absence of suitable tables approximate resistances of wires in ohms per 1000 ft. are desired. To find the resistance subtract ten from its number (B. & S.) and divide by ten. Regard the result as the logarithm of the required resistance, which may be found by taking the antilogarithm on a slide rule. The error of this rule is said to be less than 2 per cent for wires larger than No. 20.—*Jour. of Eng'ing,* Univ. of Colo., No. 7.

Insulated Aluminum Cables.—Although aluminum is now being used extensively for overhead conductors, it has so far been little employed for underground mains, partly on account of the increased size of cable necessary (which is, however, to some extent offset by the reduction of weight) and also because of the difficulty of making satisfactory joints in such cables. However, methods of manufacture have been improved and the reduction in the price of aluminum has changed the situation considerably, so that aluminum cables, according to the London manufacturer, can compete with paper-insulated, lead-covered copper cables. Fig. 3 has been prepared to illustrate the saving which, it is claimed, can be effected by the use of lead-covered, paper-insulated aluminum cables as compared with copper cables of equal carrying capacity. The saving is based on a cost of raw copper at $300 per ton and of aluminum wire at $466.66 per ton.—Lond. *Electrician,* May 5.

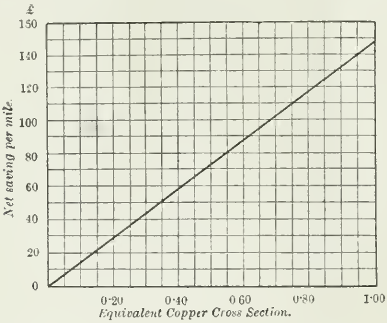


Fig. 3—Diagram Showing Saving by Using Aluminum Cables.

Electrophysics and Magnetism.

Effect of Pressure on Electric-Furnace Spectra.—A. S. King.—An abstract of an American Physical Society paper. An electric-resistance furnace was used to observe the effect of pressure upon spectra. A graphite resistance tube of 0.5 in. inside diameter and 12 in. long, 9 in. being heated, contained the metal to be vaporized. The compressed gas was carbon dioxide at pressure ranging from 6 atmospheres to 15 atmospheres. The furnace has proved very efficient in showing the shift of spectrum lines, which are of good quality for measurement. The shifts are toward the red and of very different magnitude for different lines. The relative displacement of lines in the iron spectrum follows very closely that observed for the arc under pressure. The magnitude of the displacement, however, is much larger for the furnace than for the arc under the same pressure. It was found possible to obtain different shifts of furnace lines for the same pressure by varying the conditions of the luminous vapor. These changes, as well as the general differences between the furnace and the arc, have not as yet been traced either to difference of temperature or of vapor density, although an increase of temperature was found to bring the shifts nearer those of the arc. The luminous vapor in the furnace appears to offer less resistance to the displacing influence of pressure than is offered by the vapor in the arc. A fundamental difference in the two sources is found in the fact that in the furnace the compressed gas is heated to the same temperature as the particles of radiating metallic vapor, which cannot be true to the same degree for the discharge conditions of the arc.—*Phys. Review,* April.

Fundamental Principles of Physics.—W. Nernst.—A translation of a discussion of certain fundamental principles of modern physics under the following headings: Experiment and generalization by hypothesis, sphere of the validity of the laws of nature, system of measurements, indestructibility of matter, transformation of matter, transformation of energy, molecular hypothesis, atoms and molecules, classification of natural phenomena.—*Jour. Frank. Inst.,* May.

Electrochemistry and Batteries.

Primary Battery.—A note on a recent British patent (207, May 4, 1911) of A. Heil. Instead of using dioxide a depolarizer in the form of a dark-brown hydrated oxide of manganese mixed with graphite is employed, the whole being placed in a porous cell with solid carbon and with zinc for the other electrodes, which dip into a solution of ammonium-nitrate or ammonium chloride.—Lond. *Elec. Eng'ing,* May 11.

Units, Measurements and Instruments.

Determination of Melting Points.—C. W. Kanolt.—An abstract of a paper read before the American Physical Society. The melting points of a number of very refractory substances, including magnesia and alumina, have been determined by means of heating curves or cooling curves obtained with the Holborn-Kurlbaum optical pyrometer. The substances were heated in an Arsem graphite resistance furnace, usually in a vacuum. A pyrometer was sighted through a glass window in the top of the furnace. A correction was applied for the reflection and absorption of the glass. This correction was small and could be determined accurately. The substance to be melted was placed in a crucible of graphite, tungsten, platinum, magnesia or kaolin, with a cover provided with a hole about 3 mm in diameter. The pyrometer was sighted into the inside of the crucible through this hole, thus obtaining black-body conditions. In case the substance was likely to be contaminated by the carbon or other substances in the furnace it was placed within a tube of magnesia or kaolin, which was connected by a nearly air-tight joint to the top of the furnace in such a way that the pyrometer could be sighted down the tube. Sometimes two concentric tubes were used. In case it was necessary to avoid any trace of the carbon monoxide produced from the graphite heater a feeble current of air was admitted to the magnesia or kaolin tube and allowed to pass out through the porous walls of the tube into the furnace, the pressure in the furnace being kept down to 2 mm or 3 mm of mercury by running the vacuum pump continually. Usually about 5 grams of material was employed, although good results have been obtained with ½ gram. Successive determinations upon the same substance usually agreed within 5 deg. As a check the method has been applied to a number of those substances whose melting points are most accurately known, and the results obtained are in close agreement with the generally accepted values.—*Phys. Review,* April.

Exploring Interior Composition of the Earth.—H. Lowy.—An illustrated article in which a brief description is given of a method of investigating the interior of the earth due to experimental researches by the author and G. Leimbach. This is based on the use of electric waves, whose course will depend upon the character of the rocks in the strata traversed. That such a method has not been used previously is probably due to the idea that the earth is too good a conductor to give measurable results.—Lond. *Electrician,* May 5.

High-Tension Condenser.—A note on a recent British patent (15,873, May 4, 1911) of W. & R. Bullimore and A. C. Crosser. This is a method for the prevention of sparking from the inner to the outer conductor, as is usual in condensers where thin dielectrics are employed. It consists of a septum, with a central aperture, preferably of the same material as the dielectric, being placed in a suitably shaped vessel closed at one end, at a point so that the inner conductor terminates near the central aperture of the spectrum, while the outer conductor is carried up past the septum, thus separating the conductors sufficiently to prevent sparking. Instead of the septum inside a flange outside can be used, when the inner coating would be extended beyond the flange.—Lond. *Elec. Eng'ing,* May 11.

Telegraphy, Telephony and Signals.

Coupled High-Frequency Circuits.—L. W. Austin.—A paper describing some experiments with coupled high-frequency circuits. The results obtained by the author have a practical bearing as they show that for the greatest efficiency in working the apparatus must be so arranged that the amount of energy withdrawn from the antenna may be varied until the point of maximum effect is obtained. If the detector is connected in shunt across an inductance the number of turns contained between the detector terminals should be variable and independent of the number of turns of the inductance which are used for tuning purposes. If the detector is connected around a condenser it should have in series with it a small variable condenser which can be used to regulate the amount of energy flowing into the detector. By far the simplest and best method, however, is the inductive coupling of the untuned detector circuit to the antenna or to an intermediate tuned circuit, the coupling coils being arranged so as to be easily moved toward or away from each other by means of a rack and pinion or some similar device.—*Bull. Bur. of Standards,* May 15.

Miscellaneous.

Engineering Education.—J. A. Ewing.—While empiricism was predominant the system of training, both in medicine and engineering, was a system of apprenticeship and nothing more. But now it is understood that the ideal training is one which comprises, in addition to means of getting experience, a properly organized course of study in the relevant sciences taught with reference to their practical application. These "applied sciences" may be broadly described as the theory of engineering. A striking feature of the engineering schools is their general likeness—the substantial uniformity in methods which has now been evolved. The most conspicuous difference as regards organization is that in some schools the division of engineering into branches is carried further than in others, specialization begins earlier and is more pronounced. Premature specialization means narrowness, and it is the business of the university to save the young man from that by laying foundations that are broad and deep on which the superstructure of professional knowledge will afterwards be built. In those British universities which first took up the teaching of engineering the ideal aimed at was to lay a general foundation. No attempt was made to give detailed information on professional subjects. From this ideal there has been in some instances a considerable departure; the American and Continental methods, in which professional detail occupies a large place, are now more closely approached in several British schools. The differentiation of professorships tends toward this. It allows of and practically compels a more thorough treatment of each branch, but it has serious drawbacks. There is apt to be a lack of co-ordination and balance between the various parts of the engineering school and the student who wishes a general course is not well provided for. The fundamental subjects to be taught are mathematics of the practical sort, applied mathematics, strength of materials and theory of structures, prime movers and applied electricity, mechanical drawing, surveying and experimental work in the engineering laboratory. The use of tools could be taught in a college workshop in such a way as to have solid professional value. The ordinary student of engineering must, however, look to getting his workshop experience either before or after his collegiate education. There is much to be said in favor of both plans. On the whole the advantages incline to have the practical training follow rather than precede the other mainly because the mental equipment given by the college course will make such a stage of practical training enormously more full of meaning than it can be when the pupil attacks it without preliminary knowledge of the rationale of what he has to do or sees done.—Lond. *Electrician,* May 5.

Book Reviews.

Die Wechselstromtechnik. By Dr. E. Arnold. Berlin: Julius Springer. 592 pages, 307 illus. and 10 plates. Price, 18 marks.

This fifth volume of Dr. Arnold's well-known series of textbooks on dynamoelectric machinery is devoted to induction machines. The chapters relate to the following subjects: An introduction; slip and torque; equations and constants of the polyphase induction machine; analytical theory; graphical theory of the polyphase induction machine; the load diagram of the polyphase induction motor, and its determination from the light-load and short-circuit tests; theory and load diagram of the single-phase induction motor; influence of harmonic fields and currents on the behavior of an induction motor; losses and efficiency of an induction motor; heating of an induction motor; starting and speed regulation of the polyphase induction motor; starting and speed regulation of the single-phase induction motor; the experimental testing of an induction motor; the design of an induction motor; examples of design; the construction of an induction machine; the applications of induction motors; the induction generator; cascade connection of two induction machines; cascade connection of an induction machine and a synchronous machine; the motor-converter; several applications of the induction machine.

The book has been prepared with great care and is well illustrated and developed. It will be of value to advanced alternating-current engineering students acquainted with the German language and interested in the theory and prnciples of induction machines.

Building for Profit. By Reginald Pelham Bolton. New York: The De Vinne Press. 124 pages, illus. Price, $2.

This book is mainly directed to an economical discussion of the values of buildings as affected by land values and by depreciation, particularly on Manhattan Island. The principal item which enters into the economical question is that of depreciation and longevity in a building as a whole and in different parts of the same. Much attention is devoted to this topic. On the whole, the book tends to show that the cost of modern buildings in New York, including equipment, maintenance and especially depreciation, is considerably greater than is generally estimated. Whatever exception may be taken to the figures and percentages set down, the general reasoning must be admitted. The book will be of interest to investors, constructors, builders and building engineers.

High-Efficiency Electrical Illuminants and Illumination. By Rollin W. Hutchinson, Jr. New York: John Wiley & Sons. 278 pages, 147 illus. Price, $2.50.

An elementary descriptive treatise of modern electric light-sources, including their mode of manufacture, photometry, installation and maintenance. The chapters relate to the following topics: Light and color, photometry, metallic-filament and electrolytic incandescent lamps, arc lamps, vapor lamps, fundamental principles involved in efficient and economic interior illumination, notes on street illumination. The book is written in simple untechnical language and well illustrated It does not indulge in arithmetical relations and still less in algebra. It will be of interest to the general public and to architects, builders or engineers not directly connected with illuminating.

Téléphonie. By Albert Turpain. Paris: Gauthier-Villars. 186 pages, 123 illus. Price, 5 francs.

An elementary description and an explanation of the apparatus and processes used in France for telephony are given in this book, which is divided into sixteen chapters, the abbreviated titles of which are as follows: Invention, the Bell telephone, the method of telephonic operation, telephone installations, military telephony, telephone networks, the telephone switchboard, multiple telephony, central battery switchboards, prepayment instruments, party lines, extension of networks, automatic switchboards, applications, long-distance telephony, conclusions. The book is intended more for the educated public than for specialists. Nevertheless, the descriptions are clear and will be useful to an elementary student of electrotechnics. It relates more especially to the telephonic service of Paris and neighboring French towns.

New Apparatus and Appliances

HIGH-VOLTAGE AIR-BREAK SWITCH.

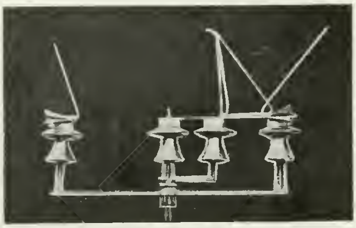


Fig. 1—Switch Closed.

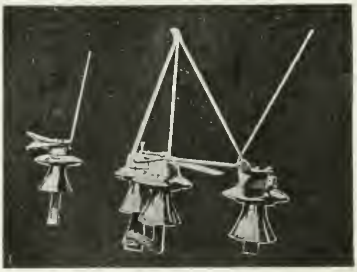


Fig. 2—Switch Opening.

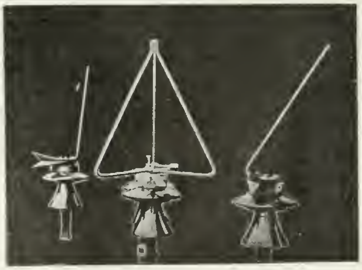


Fig. 3—Switch Open.

The Railway & Industrial Engineering Company, Pittsburgh, Pa., has placed in the market the Burke high-voltage air-brake switch, whose operation is based on the fact that an arc can be extinguished on a pair of diverting horns. It is claimed that the switches will open a loaded circuit without the slightest difficulty or without causing any voltage disturbance in the system other than the normal disturbance occurring from the change of current. The switches, moreover, are so constructed that their operation will not be affected by a heavy coating of ice and sleet which might be encountered in cold weather. Fig. 1 shows a single-pole, double-throw, 25,000-volt, 200-amp switch in the closed position. It will be noted that the circuit entering the middle of the switch is carried jointly by means of a heavy blade and the diverting horns to the switch jaws and thus to the outgoing line. The shunted horns are so arranged that when the switch is closed there is considerable torsion in the center horns; thus when the switch is opened the switch blade leaves the jaws while the horns are in contact. This is shown in Fig. 2. When the switch is further opened the arc starts and extinguishes itself, due to the widening of the gap brought about by the joint action of the arc rising on the diverting horns and the switch opening. The switches are manufactured in single-pole units, each consisting of a stationary and a movable casting, as shown in Fig. 1. The stationary casting is provided with a brass bearing and the movable casting has an extended stem, part of which is accurately machined to fit this bearing, the remainder being squared off to receive a bell-crank or sheave wheel. A curved brass washer is placed between the two castings to prevent the entrance of water into the bearing. On the extended arms of each of the castings a high-voltage porcelain insulator is cemented. A sherardized iron cup of special design is placed on top of the insulators and attached thereto by special means, enabling it to be readily removed if necessary. The switch blades, horns, jaws, etc., are bolted to these cups. In order to prevent corrosion, all the screws and bolts used in the construction are sherardized. By means of bell-cranks or sheave wheels any number of these units can be connected together so as to be operated simultaneously. Between the operating handle and interconnected to these switches is placed a connecting rod by means of which the switch is safely operated from the ground, the control apparatus being properly grounded to protect the operator from danger. The switches are built in three styles for voltages ranging from 6600 to 60,000.

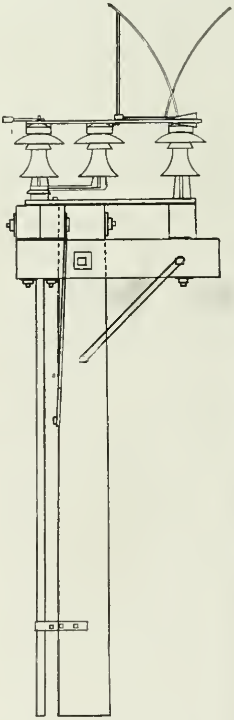
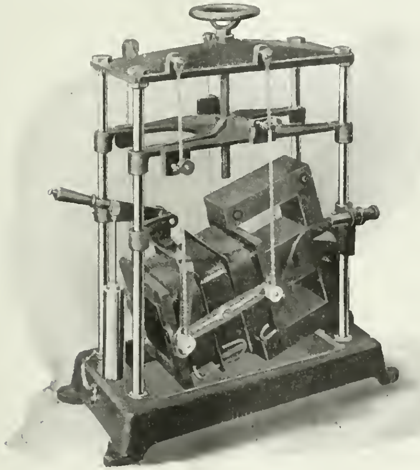


Fig. 4—Switch Mounting.

REGULATOR FOR SERIES ALTERNATING-CURRENT LIGHTING CIRCUITS.

Where a resistor is employed to effect the regulation of the current in a series tungsten lighting system the efficiency is reduced because of the constant loss of energy which results; but if a reactance is depended upon for regulation nothing worse than a lowering of the power factor results. Realizing the importance of high-power factor and close regulation, the Moloney Electric Company, St. Louis, Mo., has brought out the automatic regulating device shown herewith. The principle upon which it is based is that when a coil carrying alternating current is brought near an iron plunger it is drawn toward the plunger and as the latter enters the coil a counter emf is introduced into the circuit passing through the coil, which increases with the depth of penetration by the plunger. By applying a proper mechanical force to the coil in opposition to the force supplied to it by magnetic attraction, it is possible to adjust the counter emf so that constant current may be obtained.

As shown, the regulator rests on a cast-iron base, with four upright posts supporting a top frame and a movable plate with adjusting screw, together with a laminated core and a movable coil. Attached to guides is a lever with dashpots. The coil is wound on a shell made of hard rubber and mica, and the reactance is sufficient to maintain the current at normal value, if all or none of the lamps are burning. In operation the lever is pushed down and secured by a ring on the end of a chain before the circuit is closed; the coil is then in the position of minimum current. The chain is next disengaged and the lever permitted to rise under the action of the dashpot, the coil automatically taking the position necessary to permit the predetermined current to pass through it. The object of the movable plate is to change the length of the supporting chains, as the shorter they are the more pull is required to bring the coil on the core. By means of the screw and hand wheel a variation of the current can be effected of from 0.5 amp below normal to 0.5 amp above normal. The manufacturer draws attention to the fact that there are no delicate knife edges to wear and no weights for adjustment. The binding posts are covered with hard-rubber sleeves so as to eliminate danger of accident to attendants. The regulator and transformers are suitable for use on 60-cycle or 133-cycle circuits and are also built for 25-cycle circuits. The transformers are of the oil type, the primary winding being designed for 2200 volts.



Regulator for Series Alternating-Current Lighting Circuits.

NURSERY MILK WARMER.

With the electric nursery milk warmer shown in the accompanying illustration and made by the Westinghouse Electric & Manufacturing Company a bottle full of infants' food will be heated to the right temperature for the baby in three minutes after the switch is turned on. Although intended primarily for heating infants' food, the milk warmer, without the bottle, can be used for heating or boiling any liquid and is convenient for heating water for the sick-room, for shaving and for similar purposes. The water vessel holds about a pint, and this quantity of water can be raised to the boiling point in about six minutes. A heater of the immersion type is used, and as this is wholly submerged in the water to be heated all of the heat developed in the heater must be transmitted to the water. The heating element (resistor) is hermetically sealed within the walls of the copper jacket forming the heater and is thus effectually protected against oxidation. The heater has an indefinite length of life if operated on normal voltage.

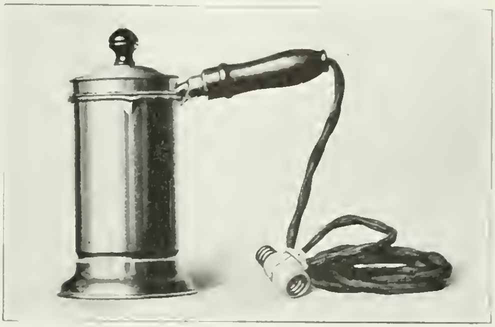


Fig. 1—Nursery Milk Warmer.

By merely turning it to a position where a slot in the rim permits of its being taken out the heater can be removed from the water vessel. All parts are accessible for easy cleaning, as indicated in Fig. 2. A nursery bottle and nipple of Hygeia manufacture are supplied with each warmer. While being heated the bottle sits in a water bath and in the cylindrical heater, which, in turn, rests in the water vessel. The water bath is an important feature of the heater, as infants' food should not be burned and thereby rendered indigestible. A current tap attachment plug is furnished with each milk-warmer outfit, which screws into any Edison base lamp socket and into a socket to accommodate the plug on the milk-warmer cord. By using it the warmer and an incandescent lamp can be operated from the same outlet. The warmer takes 500 watts and operates with either alternating current or direct current.

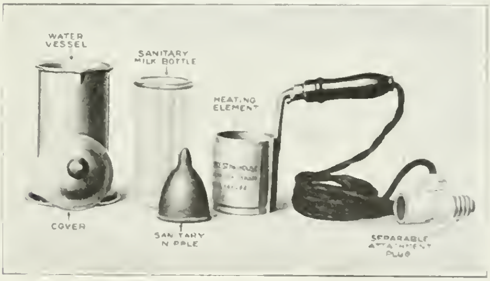


Fig. 2—Showing Parts of Milk Warmer.

Industrial and Commercial News

The Week in Trade.

THERE are fresh signs each week of the gradual increase in new business and of the establishment of confidence in the future. This is borne out in a large measure by the increased financing which is being done each week, and by the formulation of plans for new projects. Significant of the tone in general trade is the growth of new companies during the month of May. Charters taken out during the month by companies having a capital of $100,000 and over represented $326,144,000, as compared with $146,864,000 this April and $224,447,800 for May, 1910. These gains are due, to some extent, to the results of the Supreme Court decisions and represent a portion of the funds which were held in reserve until the necessary trend of corporate policy could be determined. With further understanding of the requirements of the recent decisions, there can be no doubt that capital will be readily attracted to new enterprises and to the development of existing industries and aid the progress of the revival movement. Results of the past week have shown a slight improvement in tone, although the actual increase in new business is not as large as had been hoped for. The continuance of warm weather has given further assistance to the retail trade, and wholesale and jobbing interests have benefited thereby. The sentiment, while cheerful, is one of reserve for future commitments. Price shading is one of the dominant factors of hesitancy, and is most notable at this time in the iron and steel trades. The reductions of the past few weeks in these have not resulted in a large volume of sales, and the outcome is somewhat uncertain. The majority of industries report sales only for immediate needs. There are continued evidences of abundant harvests, and the outlook is considered decidedly hopeful. Collections remain from slow to fair. Business failures for the week ended June 1, as reported by *Bradstreet's,* were 168, as compared with 236 for the previous week, 160 for the same week in 1910, 191 in 1909, 225 in 1908 and 155 in 1907.

The Copper Market.

DEMAND for electrolytic copper was rather better during the week than has been the case for some weeks past, and a brighter tone is reported throughout the trade. Interest has been chiefly in July and August shipments. Activity abroad continues to increase, and a fair amount of copper is being taken for use in foreign industries. Such business as has been done in this country during the week has been in small amounts and largely through second hands. Prices still hold between 12¼ cents and 12⅜ cents, delivered, thirty days. There is a general belief in the copper trade that business of the country will be revived within a short time, and that the activity will see a movement toward higher copper prices. There is further talk of a merger between producing interests, and the rumors of pending negotiations grow stronger each week. There is, further, a decided feeling that such action would be most beneficial to the copper trade and to the producers concerned. Interests in the copper trade hold that copper consolidation would be one of the most reasonable mergers possible, inasmuch as the smaller companies, which have been unable to meet competition with the larger interests by reason of higher costs of production, etc., would be able to operate at a profitable return. Provided a merger can be effected which will be in full compliance with the Sherman anti-trust law, it is thought that it will be only a matter of time until this will meet the full approval of the trade. Exports for the month, including June 5, aggregate 2921 tons. The daily call on the Metal Exchange June 5 quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.85	12.05	....
June	11.85	12.05	11.95
July	11.85	12.05	11.95
August	11.85	12.05	11.95
September	11.85	12.05	11.95

The London market, June 2, was as follows:

	Noon. Highest. £ s d	Closing. £ s d
Standard copper, spot	55 7 6	55 2 6
Standard copper, futures	55 17 6	55 15 0

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	12.30c	11.57½c
London, spot	£56 15 0	£53 7 6
London, futures	57 12 6	54 0 0
Best selected	60 5 0	57 5 0

Industrial and Commercial Notes.

Westinghouse Equipment Sales.—Among recent orders received by the Westinghouse Electric Company, Pittsburgh, Pa., are the following: For the Cosmopolitan Construction Company, Chicago, two 1500-kw synchronous motor-generator sets; for the San Francisco Gas & Electric Company, two 1000-kw synchronous motor-generator sets, and for the Edison Electric Illuminating Company of Boston, one 1000-kw generator set. The Seattle-Everett Traction Company, of Bellingham, Wash., has ordered from the Westinghouse Company a quadruple equipment of No. 304 railway motors with new non-automatic unit switch control. The Great Falls & Old Dominion Railway Company, of Washington, D. C., has purchased three quadruple equipments of No. 93-A2 railway motors with the above type of control, arranged for both rail and overhead return with special change-over switches. The St. Joseph Railway Light & Power Company, St. Joseph, Mo., has awarded a contract to the Westinghouse Company for ten single equipments of No. 307 split-frame, interpole railway motors. The Toledo & Indiana Traction Company, Toledo, Ohio, has recently ordered one Baldwin-Westinghouse locomotive furnished with a quadruple equipment of No. 304-A interpole railway motors and type L4 control. Among other recent orders for railway motor business secured by the Westinghouse Company is one from the Pittsburgh Railways Company, Pittsburgh, Pa., for fifty-three quadruple equipments of No. 306 C.D., box frame railway motors, type K 43-G control, and an additional order for 1160 single equipments of the same type of motor. The San Antonio Traction Company, San Antonio, Texas, has placed an order with the Westinghouse Company for twenty double equipments of No. 92-A interpole railway motors, type K-28 control.

Transformers for Reclamation Service.—The United States Reclamation Service invites sealed proposals at its office, in Los Angeles, Cal., for 36 single-phase, 25-cycle transformers and 41 single-phase and two to three-phase, 60-cycle transformers as follows: Four 50-kw, four 25-kw and four 10-kw transformers wound for a primary voltage of 11,000 and a secondary potential of 2300 volts; four 10-kw and four 5-kw transformers with primary winding designed for 2300 volts and secondary for 110-220 volts; four 10-kw and four 5-kw transformers with 11,000-volt primary and 110-220-volt secondary windings; four 50-kw and four 25-kw transformers Y-connected for 23,000-40,000 volts primary and 11,000 volts secondary. All the above are to be 25-cycle, single-phase transformers. The 60-cycle apparatus comprises the following: Fourteen 50-kw and three 20-kw single-phase transformers with primary wound for 2200 volts and secondary for 244-488 volts; three 25-kw, nine 10-kw and six 5-kw single-phase transformers for stepping down from 2200 to 110-220 volts; one 50-kw and one 35-kw, three-phase, 2200 to 110-220 transformer, and six 200-kw, 20,000-volt delta-connected transformers having a secondary potential of 2200 volts. The proposals will be received until 2 p. m. June 23.

Northern Electric Company of Sacramento.—In connection with the question as to the legality of franchises granted to the Northern Electric Company, in Sacramento, an ordinance has been passed by the city trustees re-enacting all grants to the traction company. The Northern Electric Company did not build its track within the time limit of the original franchises and an extension of time was granted by the city board. The question then came up as to the legality of these extensions, and in order to cover any possible legal defects the trustees were requested by the Northern Electric Company to re-enact all ordinances.

Chicago Elevated Merger Terms.—With further reference to the financing of the Chicago elevated merger reported from time to time in these columns, it is understood that the offer of purchase to be sent to the stockholders, with a request that they deposit their holdings before July 1, contains the following purchase terms: For each share of the $10,231,400, par value, outstanding stock of the South Side Elevated Railroad Co., $75; for each share of the $8,707,900, par value, outstanding preferred stock of the Metropolitan West Side Elevated Railway Company, $75; for each share of the $7,464,100, par value, outstanding common stock of the Metropolitan West Side Elevated Railway Company, $27.50; for each share of the $4,944,400, par value, outstanding preferred stock of the Northwestern Elevated Railroad Company, $70; for each share of the $4,947,100, par value, outstanding common stock of the Northwestern Elevated Railroad Company, $30. The plan further provides that all the stock required under the offer is to be transferred to a corporation which will have authority to issue participation shares. The initial issues of these will be 410,000, each with a par value of $100, 160,000 shares of these being 6 per cent cumulative preferred shares and 250,000 of common. Each depositor is to have the right to take, in place of 30 per cent of the cash payable, preferred and common shares of the new corporation on the basis that they will receive for each 100 of the 30 per cent, one preferred share and four-fifths of a common share. It has been arranged to take the stock trust certificates of the Northwestern Elevated which were issued under a voting trust agreement in 1900 as equivalent of the number of shares of preferred and common stock which are represented by these certificates.

Denver Public Utilities Reorganization.—All the companies in Denver controlled by Henry L. Doherty, through the Cities Service Company, are to be consolidated at a meeting called for July 11, under the title of the Denver Gas & Electric Light Company, with a capitalization of $10,000,000 and an authorized bonded indebtedness of $25,000,000. The purpose of the merger, as explained by William J. Barker, vice-president of the Denver Gas & Electric Company, is to retire the underlying bonds of the various concerns and to provide for future extensions. A most important phase of the consolidation, so far as the general public is concerned, is provision for the immediate renewal of the thirty-year-old mains of the Denver Steam Heating Company—which company is included in the deal—at a cost of $400,000. In addition, it is the intention to construct a new plant capable of furnishing steam heat, which, without further extensions, will meet all demands for the next twenty years, in spite of the city's growth. Plans are being drawn for this steam plant, which will cost in the neighborhod of $750,000 before it goes into commission. The consolidation is the consummation of plans made by Mr. Doherty more than a year ago. The companies to be taken into the new corporation, with their outstanding bonds, are: The Lacombe Electric, with about $900,000; the Denver Steam Heating Company, with about $400,000, and the Denver Gas & Electric Company. The latter has outstanding $6,000,000 of its own bonds and $2,500,000 three-year notes.

Hydroelectric Development in British Columbia.—The Prince Rupert Hydroelectric Company, Limited, has been incorporated and organized by interests controlling the Western Canada Power Company of British Columbia, including Charles H. Cahan, K. C., H. A. Lovett, K. C., of Montreal; R. F. Hayward, general manager of the Western Canada Power Company; Prof. L. A. Herdt, of Montreal, and R. Brutinel, of British Columbia. The capital stock to be issued is $3,000,000 with $2,500,000 of bonds. The latter are being issued at 92½, carrying a bonus of ordinary shares equal to 40 per cent. of the par value of the bonds issued. The company has acquired control of the Timpsean Light & Power Company, the Continental Power Company, and the water rights on the Khtada and Falls Rivers, branches of the Skeena River. The water-powers are located about 42 miles from Prince Rupert and are said to be capable of developing at least 25,000 hp. The company proposes to develop 1500 hp at once by means of a provisional power plant to supply the immediate demands of Prince Rupert and to proceed to the construction of a permanent installation capable of supplying 15,000 hp, to be completed within three years or as soon as the Grand Trunk Pacific Railway shall be completed to the Pacific Coast. A gas-producing plant will also be installed at Prince Rupert with a capacity of 75,000,000 cubic feet of gas per annum.

Long Acre Electric Light & Power Company.—Following the decision of the Public Service Commission of the First District in New York to consider the amounts of securities which the Long Acre Electric Light & Power Company will be permitted to issue, as mentioned in the *Electrical World,* June 1, 1911, the company is preparing to extend its lines to distribute energy throughout Manhattan and the Bronx This case has been before the Public Service Commission for some little time. The company has a perpetual franchise for supplying electricity in the two boroughs mentioned above. This franchise originally covered Forty-second Street, New York, and the immediate vicinity. Following an order of the city compelling the removal of wires from poles a few years ago, the American Illuminating Company, which operated in the lower section of Manhattan, retired from business and its franchise was acquired by the Long Acre Company. The Long Acre Company now has a small generating station at Forty-second Street and Second Avenue, with underground wires from Forty-second Street, supplying energy to several customers in the theatrical district, including the Criterion Theater. It is planned to extend these lines both north and south from Forty-second Street as soon as all details are perfected

Fair Dealing Between Public-Service Corporations and the Public.—At the last session of the recent New York convention of the National Electric Light Association, H. M. Byllesby, of Chicago, read a paper, not down on the program, entitled "Breadth of View in Public Utility Appraisals." He made a plea for a better mutual understanding between public utility companies and the public they serve, stating that there should be a strict accountability in all corporate matters, but if this is conceded by the companies, they should receive adequate and proper protection. With a better mutual understanding there will be an increasing improvement in the service, and in general a continual lowering of rates, although, of course, the lowering of charges cannot go on indefinitely. Mr. Byllesby urged that great care be exercised in making appraisals of public utility plants for rate-making purposes, and pointed out that the estimates of engineers for new enterprises are usually below the actual cost of the work. He contended that if engineers err in their estimates prior to construction, they may make mistakes also in estimating the cost of completed work.

Independent Telephone Company Plans Extension.—Receivers for the Interstate Independent Telephone & Telegraph Company have received permission from Judge Kohlsaat, of the United States Circuit Court, to borrow $190,000 for improvement of the service and lines of the company. In April last the court approved an agreement between the telephone company and the Illinois Tunnel Company making it possible for the Interstate company to furnish service to Chicago subscribers. The present plan includes the extending of 4100 miles of new wire into Aurora, Bellowington, Joliet, Peoria, Decatur, Ill.; Clinton, Ia., and St. Johnston, Ind., and two lines to Springfield. The cost of extending this part of the system is close to $175,000. The loan is to be protected by a general mortgage through the Chicago Title & Trust Company.

Electrical Construction.—Among the items printed under Construction News in the present issue are announcements of proposed new plants or considerable extensions to present plants at Colorado Springs, Col.; Mishicot, Wis.: Greenville, Cal.; Downington, Pa.; Sebewaing, Mich.; McKenzie, Tenn.: Gadsden, Ala.; Motley, Minn.; Chamberlain, S. D : Sacramento, Cal.; Des Moines, Ia.; New Orleans, La.; Washington, Ga.; Vancouver, B. C., Can.; Elwood, Ind.; Marion, N. Y.: Amityville, N. Y.; Madison, Wis.; Stettler, Alta., Can.; San Francisco, Cal.; Washington, D. C.; Hot Springs, Ark.; Prince Rupert, Sask., Can., and Tupelo, Miss.

Fort Wayne Electric Works Becomes General Electric Branch.—On June 1 the Fort Wayne Electric Works, which was capitalized at $2,000,000, gave up its charter as a State corporation and is to be known hereafter as the General Electric Company, Fort Wayne Branch. The control of the company has been vested in the General Electric Company for a considerable length of time. Changes are expected to follow in the local board of directors.

Electric Boat Company of New York.—The Chilian government has awarded a contract for two submarine boats to the Electric Boat Company, of New York. The total cost of these boats will be about $1,000,000. They are to be built at Seattle, and they will be sent to Chili under their own power.

Financial.

The Week in Wall Street.

STOCK transactions and prices have been irregular during the past week, with total sales reaching 2,946,879 shares, as compared with 2,530,758 for the last report. Prices declined sharply upon receipt of the decision in the American Tobacco case, but recovered during the middle of the week and were maintained until this Monday, when a decline was again registered. In the bond markets the same strength which has given a buoyant tone to the market in the past month continues to be shown, and in the week just past was effected one of the largest single transactions in railroad bonds ever made on the Stock Exchange. This was a sale of $1,000,000 Atchison convertible 4's of the issue of 1960, the price being 105. One feature of the week was the announcement of the Great Northern Railway's $600,000,000 mortgage. The influence of the American Tobacco case is still felt in financial circles, and the price-cutting in the steel trade adds perplexity to the general situation. The many incidents accompanying each of these factors are the source of widespread comment. Events are occurring in a decidedly spasmodic manner and are giving an equally irregular tone to the stock markets. The rapid response of the market to varied reports is added proof of the uncertainty which still attends the situation. In spite of the growing understanding of the Standard Oil and American Tobacco decisions there are several questions of moment which must be solved before the outlook in the stock markets will become greatly improved. The Canadian reciprocity agreement is still in an unsettled condition, the trouble in Mexico does not seem to be clearing up as rapidly as might be desired, and the prospects of government regulation of corporate enterprise is a matter of concern. Interest in the speculative markets is increasing, but it is yet too soon to look for a revival of briskness. Money is becoming a trifle firmer. Rates, June 5, were: Call, 2¼@2½ per cent; ninety days, 3@3¼ per cent. The quotations in the table are those at the close of June 5.

NEW YORK.

	May 29.	June 5.	Shares Sold.		May 29.	June 5.	Shares Sold.
All. Ch......	9¼	9	3,925	Int. Met., pf.	52⅛	53½	6,400
All. Ch., pf..	33	33	3,300	Mackay Cos..	90*	90⅛	100
Amal. Cop...	67¾	67¼	78,760	Mackay C.,pf.	76¼*	75¼*	100
Am. D. T...	20½*	20½*	———	Man. Elev...	136⅝	138	120
Am. Loco....	41¼*	41½	1,100	Met. St. Ry..	15*	15*	———
Am. Loco., pf.	108¼*	108¾*	100	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	82*	82*	100	Steel, com...	78⅜	77¾	560,210
Am. T. & T..	148¾	149¾	17,492	Steel, pfd...	118⅝	119	7,625
B. R. T......	80	85⅝	24,910	W. U. T.....	82⅛	81½	13,950
Gen. Elec....	167½	165	24,227	West'h. com..	78½	77	32,300
Int. Met.....	18⅞*	19½	1,900	West'h. pfd..	118	118	290

PHILADELPHIA.

	May 29.	June 5.		May 29.	June 5.
Am. Rys..........	44½	44*	Phila. R. T.........	17¾	19⅛
El. Co. of A.......	12*	11⅞*	Phila. Elec.........	16⅜	16½
Elec. St. B'ty......	54	54	Phila. Trac........	82½*	83¼
Elec. St. B'ty., pfd..	30*	30*	Union Trac........	46¼	48½

CHICAGO.

	May 29.	June 5.		May 29.	June 5.
Chi. City Ry......	186*	186*	Chi. Tel. Co........	123	14*
Chi. Rs., Ser. 1....	80*	80*	Met. El. Co........	26*	25*
Chi. Rs., Ser. 2....	22½*	22½*	Met. El., pfd......	72¾*	72½
Com. Edison........	129⅛	129½*	Nat'l Car..........	120*	120*
Chi. Subways.......	4⅛*	4¼*	Nat'l Car, pfd......	120*	119*

BOSTON.

	May 29.	June 5.		May 29.	June 5.
Am. T. & T........	148⅞	149¾	Mex. Tel..........	4*	4*
Cum. Tel...........	157½	157½*	Mex. Tel., pfd......	6½*	6*
Edison E., Ill......	286¾	287*	N. E. Tel..........	146*	146¾
Gen. Elec	167¾	165½	W. T. & T.........	19⅝	19
Mass. E. Ry........	21¼	23¼	W. T. & T., pfd....	96	97*
Mass. E. Ry., pf....	89½	90⅞			

*Last price quoted.
Shares sold for week May 29 to June 3.

Financial Notes.

Portland Railway, Light & Power Company.—The Portland Railway, Light & Power Company since 1906 has owned all of the stock, properties and franchises of the Oregon Water Power & Railway Company, the Portland Railway Company and the Portland General Electric Company, $7,486,000 of whose first mortgage 5 per cent bonds were recently listed on the New York Stock Exchange. The financial interests of these companies are closely allied, and the earning statements of the Portland Railway, Light & Power Company include those of its three subsidiaries. Up to Jan. 1, 1911, the Portland Railway, Light & Power Company had $5,000,000 cumulative preferred and $10,000,000 common stock. The preferred stock was retired on that date at 105 and the capital stock increased to $25,000,000, of which 65 per cent was paid. In effecting this financing, the holder of each share of common stock received the privilege of surrendering his share and paying $62.50 in cash and receiving in return two and one-half shares of the new stock, 65 per cent paid. If the earnings continue for the rest of the year on the scale shown during the first four months, the company will earn in 1911 more than 10 per cent on this $16,250,000 stock. The earnings on this basis were 9.3 per cent in 1910 and 7 per cent in 1909. The company's surplus at present totals $1,500,000, and, while its working capital is small, the company had on April 30 of this year about $500,000 cash on hand. The Portland Railway, Light & Power Company operates and owns 131 miles of single track in Portland, Ore., 12 miles of line in Salem and 61 miles of suburban road connecting Portland, Oregon City, Cazadero and Troutdale, making a total of single-track mileage of 226. In addition to its traction interests it owns and operates electric-light and power stations in Portland, Salem, Silverton, Woodburne, Oregon City and Vancouver, Wash., and also a gas plant in Salem.

Independent Telephone Companies to Merge.—Plans are being made for merging all the independent telephone companies of New York State with the New York (Bell) Telephone Company. In connection with this consolidation Theodore M. Brush, one of the directors of the Home Telephone Company, is quoted as follows: "Large financial interests believe that the proper handling of the telephone and telegraph business can be more economically and satisfactorily taken care of by the merging under one organization, and the public appears to acquiesce in that solution, provided all wire companies are put more or less under commission control. The independent companies affiliated with the Home Telephone Company are getting matters into such shape that they can be handled on these lines if it seems wise." The majority of the independent telephone companies west of Utica, N. Y., have already been acquired by the Bell interests, and it is expected that the Commercial Company of Troy will shortly be taken over.

Tri-City Railway & Light Company.—The earnings of the Tri-City Railway & Light Company for April show a substantial increase over those for the corresponding period of last year. The gains are most marked in the electric department of the company, in which a gain of more than 16½ per cent is registered for this period. The earnings of the railway department also increased in a substantial manner, and the gross earnings from all sources increased 45½ per cent. The gain in net earnings is approximately 18¾ per cent; the balance for dividends increased 35.37 per cent, and the surplus after deduction of preferred stock dividends shows an increase of very nearly 70 per cent. For the twelve months ended April 30 the company earned a surplus over preferred stock dividends of $366,976, as against $249,142 in 1909. This represents 4.07 per cent on the $9,000,000 outstanding capital stock, comparing favorably with 2.76 per cent in 1910.

Yonkers Lighting Company Shares Sold.—The New York Edison Company has obtained permission from the Public Service Commission of the First District, New York, to purchase ninety-five shares of the stock of the Yonkers Electric Light & Power Company, the price of which is not to exceed $7,125. There are 2000 shares of the Yonkers Lighting Company stock, of which the New York Edison Company has acquired 1905 shares from time to time. Commissioner Maltbie, who conducted the hearings in this matter, is quoted as saying that the purchase of this stock has no bearing on the possible merger of the companies, and that the acquisition of the stock will not change the relations existing between them.

Parkersburg & Ohio Electric Company.—C. L. Williams, of Parkersburg, W. Va., has been appointed receiver of the Parkersburg & Ohio Valley Electric Railway Company. This concern was formed with a view of building an electric road from Parkersburg, W. Va., to the Pennsylvania line. The receivership was made upon motion of J. M. Jackson, of Pennsylvania, who owns $52,000 of first-mortgage bonds on the road.

Annual Report of J. G. White & Company, Inc.—Under date of May 24, Mr. J. G. White, president of J. G. White & Company, Inc., submits the eighth annual report to the stockholders. This report is for the year ended Feb. 28, 1911, and shows an increase in the surplus for the year from $391,394 to $485,529. Nearly all the properties in which the company is interested have shown satisfactory increases in earnings during the year, and some of them have also increased their rates of dividends. Mr. White says that while in general there is not great activity in engineering and construction lines, he is able to report that the company has secured recently a considerable amount of new work, and has fair prospects of securing additional new work in the near future. The balance sheet shows a total of $4,629,963 in assets. The largest item is $2,317,959 in securities owned and syndicated participations. This shows an increase from the $1,765,816 of a year ago. The good will, purchase of business, plant, tools, instruments, etc., are valued at $1,499,037, while deferred charges and plant, tools and equipment, less depreciation, are valued at $148,902. The latter account shows a decrease from the $331,160 of a year ago. Accounts receivable amount to $344,447 and cash in banks and on hand is $266,389. The liabilities include $3,500,000 for capital issued, $530,855 for bills payable, the surplus before mentioned and two smaller items. Mr. White is president of the company and F. H. Reed, L. N. Farnum and J. H. Pardee are respectively first, second and fourth vice-presidents. R. B. Marchant is treasurer of the company and H. S. Collette is secretary. The authorized capital stock of the company is $5,000,000, divided into $2,000,000 of common stock and $3,000,000 of 6 per cent preferred stock.

Public Utility Offerings.—New York banking houses are offering $1,871,000 Kentucky Traction & Terminal Company 5 per cent first and refunding mortgage gold bonds, due February 1, 1951. The Kentucky Traction & Terminal Company owns and operates electric street and interurban railways in and between the cities of Lexington, Frankfort, Georgetown, Nicholasville and Winchester, Ky., and adjacent territory. The proceeds of $800,000 of this issue will be expended in the construction of a new power plant and other improvements, and the remaining $1,071,000 were issued to refund underlying bonds. The issue is a first lien on forty-eight miles of electric lines and is additionally secured by pledge of the stock of the company controlling the gas, electric-light and ice business of Lexington, Ky. The major portion of the issue has been disposed of, and the unsold balance is offered at 94 and interest to yield about 5.35 per cent.

Long Island Lighting Company.—The Public Service Commission for the Second District of New York has authorized the Long Island Lighting Company to issue a first mortgage on all its property and franchises, conditioned to secure the payment of its 5 per cent bonds payable twenty-five years from date, to the amount of $6,000,000. This company was recently organized for the purpose of taking over several companies on Long Island and is authorized to issue capital stock to the amount of $300,000 at not less than par. In addition, the company is authorized to issue bonds to the value of $295,000, to be offered at a price not less than $85, on security of its mortgage.

Kansas Traction in Hands of Receivers.—Judge Hook, of the United States Circuit Court of Appeals, has named Ford F. Harvey, of Kansas City, and R. J. Dunham, of Chicago, chairman of the Metropolitan board of directors, as receivers of the Metropolitan Street Railway Company of Kansas City. The company was placed in the hands of receivers upon application of John M. Egan, president of the Metropolitan company. J. Ogden Armour, of Chicago, is a large stockholder in the company and is said to have a controlling interest.

Public Utility Earnings Increase.—The gross earnings of the Boston Suburban Electric Companies for May were in the neighborhood of $10,000, which represents an increase of 14 per cent over those of May of the previous year. The gross earnings of the Philadelphia Rapid Transit Company for the month of May were $175,000 in excess of those in the same month last year. The gross earnings of the Massachusetts Electric Companies were $86,500, or 15 per cent larger during May, 1911, than in May, 1910.

New Orleans Railway & Light Company.—When the time for deposit, under the agreement, of the preferred and common stock of the New Orleans Railway & Light Company held in the United States expired on May 31, more than two-thirds of the amount required had been deposited. In view of the fact that the time for deposit of the stock abroad does not expire until June 15, an extension until June 7 for deposit without penalty, of the New Orleans Railway & Light Company's stock held in America, was approved.

Hudson River Electric Company.—George W. Dunn, receiver of the Hudson River Electric Company and its seven allied companies, which are mortgaged to secure a payment of $11,000,000, announces through George B. Curtis, United States Attorney, his representative, that these properties will be sold before passing into the hands of the receiver. Application is to be made June 14 before United States Judge Rae for foreclosure of this mortgage.

Massachusetts Companies Merge.—At special meetings of the Old Colony and Boston Northern Street Railway companies, held June 2, it was unanimously voted to merge the two companies. Provision was made to increase the capital of the Boston & Northern Street Railway Company by 7767 shares of preferred stock and 80,041 shares of common stock at par value to exchange for preferred and common stock respectively of the Old Colony Street Railway Company, the additional capitalization not to exceed $8,780,000.

Lynchburg Traction Bonds.—The Lynchburg Traction & Light Company, which is owned by the American Railways Company, has filed a mortgage at Lynchburg, Va., to the Real Estate Title Insurance & Trust Company, of Philadelphia. This is for securing a loan of $1,750,000 twenty-year 5 per cent bonds. It is understood that the loan is to retire outstanding 6 per cent bonds and for improvements and betterments to the street-railway system.

Chicago Company to Redeem Bonds.—The Chicago Suburban Light & Power Company, the successor of the Chicago Water & Light Company, will redeem the outstanding 5 per cent mortgage bonds of the latter company August 1, at its office, or at the office of the International Trust Company in Boston. These bonds are due in 1949 and are redeemable at 102½ and interest.

Hall Signal Company.—Notice has been given to the stockholders of the Hall Signal Company, the affairs of which have been before the public during the past month, that the time for depositing their stock in the Empire Trust Company has been extended to June 12. On June 1, the date first set for this purpose, about two-thirds of the stock had been deposited.

DIVIDENDS.

Butte Electric Light & Power Company, quarterly, 1¾ per cent, payable July 1.

Chicago Telephone Company, quarterly, 2 per cent, payable June 30.

Massachusetts Electric Companies, semi-annual, preferred, $2 per share, payable July 5.

Muskogee Gas & Electric Company, preferred, 1¾ per cent, payable June 15.

Oklahoma Gas & Electric Company, quarterly, 2 per cent, payable June 15.

San Diego Consolidated Gas & Electric Company, quarterly, 1¾ per cent, payable June 15.

Seattle Electric Company, quarterly, $1.75 per share, payable July 5.

Standard Gas & Electric Company, quarterly, 1¾ per cent, payable July 15.

REPORT OF EARNINGS.

Period.	Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
CUMBERLAND TELEPHONE & TELEGRAPH COMPANY.					
April, 1911....	$604,632	$366,895	$237,736	$51,846	$185,890
April, 1910.....	565,054	321,239	243,815	48,731	195,084
4 m., April, '11..	2,383,309	1,403,810	979,498	206,682	772,816
4 m., April, '10..	2,230,652	1,274,096	956,556	191,594	764,961
ECONOMY LIGHT & POWER COMPANY					
Yr., April, '11..	$430,375	$216,232	$214,143	$79,813	$134,330
Yr., April, '10..	406,746	217,654	189,092	75,743	113,349
FAIRMONT & CLARKSBURG TRACTION COMPANY.					
April, 1911....	$53,185	$18,889	$34,296	$16,942	$17,354
April, 1910.....	44,518	17,296	27,122	12,609	14,513
LAKE SHORE ELECTRIC COMPANY.					
April, 1911....	$91,958	$53,207	$38,751	$34,614	$4,137
April, 1910....	86,915	48,513	38,402	34,962	3,500
4 m., April, '11.	339,314	200,517	138,797	138,814	*17
4 m., April, '10.	322,770	193,470	129,300	138,923	*9,523

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*Deficit.

General News

Construction News.

GADSDEN, ALA.—E. R. LeFevre and associates, who were recently granted a franchise by the City Council to supply electricity in Gadsden, are planning to build a hydroelectric power plant capable of developing 20,000 hp for transmission by electricity.

TUCSON, ARIZ.—The Great Western Power Company has commenced preliminary work on the installation of a large hydroelectric plant near Tucson. A large dam 360 ft. high will be built and form a storage reservoir to supply water for operating the plant.

BLYTHEVILLE, ARK.—It is reported that Hollipeter & Jontz, owners of the local electric-light plant, are contemplating the installation of a cold-storage plant.

CAMDEN, ARK.—Proposals will be received at the office of the Supervising Officer, Treasury Department, Washington, D. C., until July 3 for installing a conduit and wiring system, gas-piping system and lighting fixtures at the United States post office at Camden, Ark., specifications for which may be obtained at the above office or at the office of the custodian, Camden, Ark. James Knox Taylor is Supervising Architect.

HELENA, ARK.—The Helena Gas & Electric Company, it is reported, has decided to make extensive improvements to its plant involving an expenditure of about $200,000. The new machinery will include four 300-hp boilers, three 500-kw, 2300-volt turbines, three 200-kw rotaries, for which it is understood that bids are being received by the Scofield Engineering Company, Arcade Building, Philadelphia, Pa.

ENGLAND, ARK.—Bids will be received by the City Council for a thirty-year franchise for an electric-light plant. H. Galloway is recorder.

HOT SPRINGS, ARK.—Bids will be received until June 12 for construction of addition to power house at the Army and Navy General Hospital in Hot Springs, Ark. Further information will be furnished on application to Major G. D. Deshon, quartermaster.

BODIE, CAL.—The power plant of the Pacific Hydroelectric Power Company at Mono Lake has been rebuilt and put into commission, and is now supplying electricity in cities in Southern Nevada. The plant also supplies electrical energy to Bodie, Lucky Boy, Aurora, Rawhide, Fairview and other camps in Nevada. The plant was destroyed by snowslides last March.

FRESNO, CAL.—The Fresno, Hanford & Summit Lake Interurban Railway Company is contemplating the construction of an extension of its railway from Fresno to Calwa.

GRANGEVILLE, CAL.—The Grangeville Light & Power Company is reported to be making arrangements to extend its transmission lines into the Ten-Mile mining district.

GREENVILLE, CAL.—The Indian Valley Light & Power Company has acquired the Dunn water rights on the Feather River, near Seneca, where it is estimated that about 25,000 hp can be developed. Preparations are being made by the company to enlarge its plant, for which surveys are now being made for a ditch and transmission line. The capital stock of the company has been increased to $500,000. S. P. Dunn, who controlled the water right for seven years, is interested in the Indian Valley Light & Power Company.

LOS ANGELES, CAL.—Plans have been prepared by the Pacific Electric Railway Company for building an extension from Horrewood and Redondo, a distance of about 6 miles. Another extension from Santa Ana to Anaheim will also be built.

LOS ANGELES, CAL.—The contract for installing all electrical apparatus, except turbo-generators, in the new power house of the Southern California Edison Company, at Long Beach, Cal., was awarded to J. C. Farrar & Company, San Fernando Building, Los Angeles, Cal., for $18,000.

LOS ANGELES, CAL.—Sealed bids will be received at the office of the United States Reclamation Service, Federal Building, Los Angeles, Cal., until June 23 for furnishing transformers for the United States Reclamation Service. For further information address the above office or the United States Reclamation Service, Department of the Interior, Washington, D. C. F. H. Newell is director.

LOS ANGELES, CAL.—The Secretary of the Interior has awarded contracts for the steam-power plant in connection with the Elephant Butte dam of the Rio Grande irrigation project, New Mexico, as follows: To the General Electric Company, of Schenectady, N. Y., for generators, exciters and switchboard, etc., for $31,371, and to W. E. Anderson, El Paso, Tex., for condensers, boilers, etc., at $44,258.

LOS ANGELES, CAL.—The Board of County Supervisors has ordered the franchise for electric-pole line applied for by the Pacific Light & Power Company advertised for sale. The franchise applied for extends east to the county limits, south to a line extending directly east of Redondo, also embracing territory south of Redondo, and the west line runs due north from Redondo. On the north the limit is approximately the line of the national forest.

MANTON, CAL.—Chadwick & Sykes, who had the contract for building the Coleman ditch for the Northern California Power Company, have given it up and turned the work back to the company. A. H. Clough, civil engineer for the company, will take charge of the work. The Colma power house is completed and all the machinery installed. The ditch will not be completed before the first of the year.

MARTINEZ, CAL.—The Pacific Gas & Electric Company is contemplating extending its transmission line to Danville to supply electricity for lamps and motors in that district.

MARYSVILLE, CAL.—Plans are being considered for the construction of an electric railway in Marysville, 3 miles in length. It is said that the railway will eventually encircle Marysville. G. W. Hall, of Marysville, is interested in the project.

SACRAMENTO, CAL.—The Sacramento Electric, Gas & Railway Company has purchased a site consisting of five acres on the bank of the Sacramento River, on which it proposes to erect a new power house.

SAN FRANCISCO, CAL.—The United Properties Company of California is reported to have purchased the property and holdings of the Northern California Power Company. The price paid for property is said to be about $8,000,000.

SAN FRANCISCO, CAL.—Plans are being prepared by Willis Polk, architect, for the construction of a reinforced concrete power house for the San Francisco Gas & Electric Company to be erected on Bush Street, near Larkin Street, to cost about $15,000. The building will be used as a substation in connection with the distributing system.

SONORA, CAL.—Notice of appropriation of two reservoir and dam sites on Clavey and Coffin Hollow creeks has been filed by T. M. McGovern and others. It is understood that the locations have been made for the Tuolumne River Power & Irrigation Company. Each dam is to be 150 ft. in height.

WATSONVILLE, CAL.—The Watsonville Railway & Navigation Company, it is reported, will soon award contracts for the construction of an extension from Watsonville to Rowes Corners, thence to Corralitos, and along the Santa Cruz road, returning to Watsonville. Another line is to be built along the San Juan road, Driscoll's lane and Salsipuedes road to a connection with the main line at Rowes Corners, and a branch may also be constructed to Pajaro and the Werner district. Concrete docks will be built at Port Watsonville. F. E. Snowden, 311 California Street, San Francisco, Cal., is president.

COLORADO SPRINGS, COL.—Extensive improvements are contemplated by the Colorado Light, Heat & Power Company to its system, which will involve an expenditure of about $50,000.

WESTBROOK, CONN.—The Essex Light & Power Company, of Essex, Conn., is planning to erect electric-light wires for the purpose of supplying electricity for lamps in Westbrook.

WILMINGTON, DEL.—The Wilmington & Philadelphia Traction Company has placed a contract with the General Electric Company, through J. G. White & Company, of New York, N. Y., for one 4000-kw turbo-generator set, one 100-kw turbo-exciter and two 1000-kw, 250-volt motor-generating sets, which will be used on its three-wire lighting system.

WASHINGTON, D. C.—Bids will be received by the office of the disbursing clerk, Department of Agriculture, Washington, D. C., until June 9 for furnishing the Forest Service with approximately 385 miles of insulated copper telephone wire, according to specifications, which will be furnished on application to the disbursing clerk. James Wilson is Secretary of Agriculture.

WASHINGTON, D. C.—One of the commercial agents of the Department of Commerce and Labor reports that an old-established house of Turkey, with branches in the commercial centers of the empire, would like to receive communications from builders of elevators for office buildings, hotels, apartment houses, of steel construction and latest construction; also dynamos and other machinery required for installation and operation of same. For further information address the Bureau of Manufacturers, No. 6793, Department of Commerce, Washington, D. C.

WASHINGTON, D. C.—Bids will be received at the office of the Chief Signal Officer, War Department, Washington, D. C., until June 17 under proposal 533 as follows: For furnishing 39,600 ft. of cable, type 213; 31,690 ft. of cable, type 214; 5000 ft. of cable, type 215; 5000 ft. of cable, type 216; 13,000 ft. of cable, type 217; 4000 ft. of cable, type 128; 24,500 ft. of cable, type 401; 14,000 ft. of cable, type 403; 18,000 ft. of cable, type 405; 1000 ft. of cable, type 406; 3000 ft. of cable, type 407, and ½ mile of cable, type 55; 2000 ft. of cable, type 321; 5000 ft. of cable, type 322; 20,000 ft. of cable, type 325; 2000 ft. of cable, type 327; 4000 ft. of cable, type 305; 75,000 ft. of cable, type 53; 35,000 ft. of cable, type 55; 20,000 ft. of cable, inside twisted pair wire, No. 18; 500 ft. of brass wire, No. 12; 10 spools buzzer wire, 3000 ft. stranded wire, 75 miles insulated wire, No. 9; 400 miles of pothead wire; 5100 ft. of submarine cable and two terminal bells. Captain A. S. Cowan is disbursing officer.

JACKSONVILLE, FLA.—The Board of Bond Trustees has awarded a contract to the James N. Bruin Company for building certain portions of the new electric-light station, to be erected on Talleyrand Avenue. The Scofield Engineering Company, of Philadelphia, Pa., has charge of the engineering work.

JACKSONVILLE, FLA.—A permit has been secured by the Jacksonville Traction Company for the erection of a new power plant 133 ft. long, 98 ft. wide and three stories high, of concrete, brick and corrugated galvanized iron. The equipment will include two 57-in. barometric condensers, three 600-hp water-tube boilers and two 1200-kw generators, feed and vacuum pumps, etc. The station will have an output of about 2400 kw and will cost about $500,000.

DALTON, GA.—The East Tennessee Power Company, it is said, will apply to the City Council for permission to bring its transmission lines into Dalton to supply electricity in this town. The company is erecting a transmission line from its plant on the Ocoee River to Rome.

PERRY, GA.—The City Council, it is said, has decided to call an election on July 1 to vote on the proposition to issue bonds to the amount of $6,000 for the installation of a municipal electric-light plant in Perry.

ROME, GA.—The City Council has granted franchises to the East Tennessee Power Company and the Georgia Power Company to supply electricity in Rome. The franchises are for a period of twenty years and each company was charged $250 for the franchise. The plant of the Georgia Power Company is located at Tallulah, and the plant of the East Tennessee Power Company near Chattanooga, Tenn.

STILLMORE, GA.—F. P. Bryant and W. A. Brinson, Jr., are reported to be interested in the construction of an electric-light plant in Stillmore. It is understood that machinery has already been purchased.

WASHINGTON, GA.—Plans are being considered for extensions and improvments to the municipal electric-lighting system and power plant. The work includes extensions and improvements to power plant to cost $10,700; repairs to distributing system, $8,000; installation of electric pump at pumping station and erection of transmission line to pumping station, to cost $6,300. It is proposed to issue bonds to the amount of $30,000 to pay for the work.

HONOLULU, HAWAII.—The contract for the construction of pump house, plumbing and electric wiring at Ft. Ruger, Hawaii, has been awarded to the Lord-Young Engineering Company, of Honolulu, for $1,982, also the contract for furnishing and installing two triplex pumps, direct-connected to 40-hp motors, for $4,830. The Honolulu Construction & Draying Company, of Honolulu, was awarded the contract for construction of pipe line, pipe in tunnel, etc., for $20,707.

BOISE, IDAHO.—The Secretary of the Interior has awarded a contract to the Allis-Chalmers Company, of Milwaukee, Wis., for furnishing hydraulic turbines for use in connection with the Boise irrigation project, Idaho, at a cost of about $17,310. The equipment will be installed at the Arrow Rock dam.

BOISE, IDAHO.—Contracts have been awarded by the Secretary of the Interior for apparatus for the Arrow Rock dam in connection with the Boise irrigation project as follows: To the Allis-Chalmers Company, of Milwaukee, Wis., three alternators, four auxiliary transformers and air compressors, at $19,450; for three air-blast transformers and two blowers to the Westinghouse Electric & Manufacturing Company, for $5,880, and to the General Electric Company, of Schenectady, N. Y., for switchboard, twenty-four disk switches, six electric circuit-breakers, supplies and two lightning arresters, at $6,096.

HOPE, IDAHO.—The Council is reported to have granted the Northern Idaho & Montana Power Company a franchise to supply electricity for lamps and motors in Hope. Work will soon begin on the erection of a transmission line, 14 miles in length.

CHICAGO, ILL.—Judge Kohlsaat in the United States Circuit Court has authorized the receivers of the Interstate Independent Telephone Company to borrow $190,000 for improvements to its lines and service. The company proposes to erect 4100 miles of new wire to Aurora, Bellowinton, Joliet, Peoria, Decatur, Clinton, Ia., and St. Johnston, Ind., and two lines to Springfield, at a cost of about $175,000.

COLCHESTER, ILL.—The electric plant of the Colchester Electric Light & Power Company is reported to have been destroyed recently by fire.

LEAMAN, ILL.—The Fulton County Coal & Power Company, recently incorporated, proposes to carry on a mining business and operate an electric-light plant. The company is capitalized at $200,000. The incorporators are: C. J. Buman, J. Loughrey and T. H. Dimon.

LENA, ILL.—Extensive improvements and extensions are being made by the Lena Electric Light & Power Company, which will include the installation of new boilers, generators and engine. When improvements are completed the company will supply electricity to operate the factory of the Lena Casket & Supply Company.

MOUNDS, ILL.—A. J. Dougherty, of Mound City, Ill., has submitted a proposition to the City Council offering to install a water-works system and to supply electricity for lighting the city for a term of twenty-five years.

MOUND CITY, ILL.—Plans are being considered by A. J. Dougherty, of Mound City, Ill., for the installation of an electric-light power plant and water works system in Mound City. Mr. Dougherty will soon apply to the City Council for a twenty-five-year franchise [illegible] the systems.

WHITEHALL, ILL.—The Alton, Jacksonville & Peoria Railway Company has awarded a contract for the construction of an extension from Godfrey, Ill., northwest to Jerseyville and extending into Calhoun County to Grommett & Johnson.

ELWOOD, IND.—The Bacon-Olds Company, it is reported, is planning to make extensive improvements to the plant of the Citizens' Light, Heat & Power Company, involving an expenditure of $1[illegible]0,000 and including the installation of new machinery and equipment.

GARY, IND.—The Gary & Southern Interurban Railroad Company, which is now building an electric railway from Gary to Crown Point it is said, will extend the line to Cedar Lake and Lowell next year and thence to Kankakee, Ill

KOKOMO, IND.—The Kokomo, Marion & Western Traction Company is asking for bids for the construction of its proposed railway from Kokomo to Terre Haute. George J. Marott, of Indianapolis, Ind., is president.

MARTINSVILLE, IND.—It is reported that the City Council is contemplating making improvements to the municipal electric-light plant, including the installation of new equipment. H. K. Johnson is city engineer.

BONAPARTE, IA.—The installation of an electric-light plant in Bonaparte is said to be under consideration. J. A. Johnson and associates are interested in the project.

CHARLES CITY, IA.—It is reported that the Western Electric Company is contemplating extensive improvements to its local system, which will involve an expenditure of $50,000 during the coming year.

CORNING, IA.—C. K. Munns, owner of the local electric-light plant, has submitted a proposition to the City Council offering to sell the plant to the city for $18,000. If the price is not satisfactory he proposes to select a committee of three, Mr. Munns to select one member and the Council the other and the two members to choose the third, to determine upon a fair valuation of the plant on which the basis of the sale shall be made. At present the city is paying $1,600 per year for street lighting. The franchise of the light company expires in June, 1913.

DALLAS CENTER, IA.—The citizens have voted to grant the Adel Mill Company a franchise to install and operate a lighting system in Dallas Center.

DES MOINES, IA.—Preparations are being made by the Des Moines City Railway Company to build an addition to its power house during the coming year. The company has awarded a contract to the General Electric Company, of Schenectady, N. Y., for the installation of 4000-hp generating equipment.

DEXTER, IA.—Arrangements are being made for the construction of a municipal light plant, for which bids have already been received.

FAIRFIELD, IA.—It is reported that Paul & Adams, of Centerville, Ia., have been awarded the contract for improvements to the municipal electric-light plant.

FT. DODGE, IA.—The Northern Iowa Power Company has awarded the contract for the construction of a hydroelectric power plant to Butler Brothers, of St. Paul, Minn., for $178,000. The project includes the construction of an 18-ft. dam, an auxiliary steam plant and electric generating machinery. It is expected that the dam will be completed by Feb. 1, 1912.

MONTICELLO, IA.—The City Council is considering the question of installing an electrically-driven pump in connection with watre works system to cost approximately $1,500.

NEVADA, IA.—The Nevada Electric Company, it is reported, is planning to extend its transmission lines to Roland, McCallsburg and Zearing to supply electricity for lamps.

NEWTON, IA.—The Council is reported to have decided to build a new municipal electric-light plant to replace the one recently burned.

PLEASANTVILLE, IA.—Plans are being made by the Knoxville Electric Company for extensive improvements to the local telephone system, including the construction of a new exchange.

SPRING HILL, KAN.—The question of installing an electric-lighting system in Spring Hill is reported to be under consideration. It is expected that the proposition will soon be submitted to a vote of the people.

NEW ORLEANS, LA.—Plans are being considered by the Southwestern Traction & Power Company for the erection of a new power house. F. W. Crosby, Tenegre Building, New Orleans, La., is interested in the company.

LEWISTON, MAINE.—Plans are being considered by the Lewiston, Augusta & Waterville Railway Company for the construction of an extension from Bath to Popham Beach, 12 miles in length.

WATERVILLE, MAINE.—The Central Maine Company is making arrangements to extend its transmission lines to Solon and Bingham to supply electricity for lighting those villages.

CAMBRIDGE, MASS.—The City Council has appointed a committee of five, consisting of Aldermen O'Neil and Sullivan and Councilmen Delaney, Tweedle and Toomey, to look into the matter of establishing a municipal lighting plant in Cambridge.

SALISBURY, MASS.—The Wilkinson Company, of New Bedford, Mass., electrical contractor, has secured a contract for extensive improvements at Salisbury Beach. The contract includes the installation of an electric-light plant with sufficient output to supply more than 10,000 lamps, the wiring of all the cottages for electric lamps, etc.

STERLING, MASS.—The contract for furnishing and installing equipment for the municipal plant, which is to supply electricity for street lighting and for lighting municipal buildings, has been awarded to the Western Electric Company, for $3,963. The transformer station is to be erected by the town.

BATTLE CREEK, MICH.—The Battle Creek, Coldwater & Southern Railway Company is negotiating for the sale of $120,000 in bonds, the proceeds to be used for the construction of its proposed electric railway to connect Battle Creek and Coldwater, a distance of 28 miles. Fred Warren is interested in the project.

HILLSDALE, MICH.—The Board of Public Works has awarded a contract to the Allis-Chalmers Company, of Milwaukee, Wis., for equipment for the municipal electric-light plant, including a new 300-kw turbogenerator set, for $9,000.

IRON MOUNTAIN, MICH.—The Peninsular Power Company has awarded the contract for the construction of its large concrete dam at Twin Falls, on the Menominee River, a few miles above Iron Mountain, Mich , to the Newton Engineering Compay, of Milwaukee, Wis. Magnus Swenson is interested in the company.

LUDINGTON, MICH.—The Stearns Lighting & Power Company, Ludington, has purchased the property of the Interurban Light & Power Company in this city. It is understood that the Stearns Lighting & Power Company proposes to supply the Oceana County towns with electrical service from a central plant. The village of Hart is making arrangements to secure electricity for operating the municipal electric system from the company and close down its generating plant. Ludington, Scottville, Pentwater and Shelby will also be served by the Stearns company.

MARQUETTE, MICH.—The contract for the construction of a dam on the Dead River is reported to have been awarded to Powell & Mitchell, to cost approximately $57,000. Wahlman & Trebilcock, of Ishpeming, Mich., are reported to have secured the contract for building the Silver Lake dam, to cost about $15,000.

NEWBERRY, MICH.—The proposition to issue bonds to the amount of $11,500, the proceeds to be used for the construction of a municipal electric-light plant, is under consideration.

SEBEWAING, MICH.—At a special election held recently the citizens voted to install a municipal electric-light plant. Work on construction of the plant will begin as soon as arrangements can be made for issuing bonds and awarding contract.

ANOKA, MINN.—The residents of Anoka have subscribed to $30,000 in capital stock of the Minneapolis & Northern Railway Company, which proposes to build an electric railway to connect Anoka, Onaway and Fridley with Minneapolis, Minn. W. J. Whitcom, of Minneapolis, Minn., is president of the railway company. It is expected to have the road completed to Anoka by Aug. 1.

BRAHAM, MINN.—The Village Council has granted the Eastern Minnesota Power Company a franchise to install an electric-light plant in Braham.

BRAINERD, MINN.—The Board of Water and Light Commissioners has awarded the contract for equipment for street-lighting system to the Northwestern Electric Equipment Company, of St. Paul, Minn., for $3,080.

DULUTH, MINN.—It is reported that the Minnesota Canal & Power Company is preparing plans for the development of a hydroelectric power plant.

EXCELSIOR, MINN—The Belleplaine Electric Light & Power Company, of Belleplaine, Minn., has been granted a franchise to construct and operate an electric-light plant in Excelsior. It is proposed to erect a plant to cost about $12,000.

FERGUS FALLS, MINN.—The question of submitting the proposition to issue bonds for extensions and improvements to the municipal electric-light plant is under consideration.

MOTLEY, MINN.—C. Thompson, representing St. Paul and Brainerd capitalists, is contemplating the construction of a power dam on the Crow River to supply electricity for lamps and motors to the towns on the Cuyana range.

OLIVIA, MINN.—Plans are being considered by the Montevideo Electric Light & Power Company, of Montevideo, Minn., to extend its transmission lines from its plant at Minnesota Falls to Olivia, Renville and Danube to supply electricity in those places.

PRINCETON, MINN.—The Village Council has granted the Eastern Minnesota Power Company a franchise to install and operate an electric-light plant in Princeton.

ST. PAUL, MINN.—Mayor Keller has authorized Oscar Claussen, city engineer, to prepare specifications for street lighting, on which bids will be advertised for. An appropriation of $75,000 has been made for the purchase of street-lighting equipment. If satisfactory bids for street lighting are received it is thought that no effort will be made to provide municipal street-lighting equipment this year.

WINONA, MINN.—The City Council has granted the Minnesota-Wisconsin Power Company a franchise to supply electricity for lamps and motors in Winona.

TUPELO, MISS.—Sealed proposals will be received by the Mayor and Board of Aldermen of the city of Tupelo, Miss., until June 16 for furnishing machinery and equipment for municipal electric-light plant as follows: Two cross-compound condensing, 4-valve or Corliss-type engines, for direct connection; two 250-kva, three-phase, 60-cycle, 2400-volt, 200-r.p.m. revolving-field-engine-type generators, complete with field rheostat; one motor-driven exciter and one steam-driven exciter to excite above generators and running in parallel at 80 per cent factor; one generator voltage regulator; a street-lighting system providing for 125 tungsten lamps, and 15 metallic-flame arc lamps complete with rectifier; one 60-hp, 2200-volt, three-phase, 60-cycle, 690-r.p.m. squirrel-cage induction motor with chain drive; one 5-hp, 220-volt, three-phase, 60-cycle, 1720-r.p.m. induction motor, direct connected to centrifugal pump of sufficient capacity to deliver 350 gal. of water per minute against 15-lb. pressure; seven 2½-kw transformers, thirteen 5-kw transformers, seven 7½-kw transformers, eight 10-kw transformers, marble switchboard, consisting of eight panels. Bids will also be received for materials for overhead pole-line construction. Plans and specifications are on file at the office of C. E. Goodlet, city clerk, and at the office of R. C. Huston, 1634 Exchange Building, Memphis, Tenn., consulting engineer.

BELTON, MO.—At an election held recently the citizens voted to issue bonds for the installation of an electric-light system in Belton, Mo.

COLUMBIA, MO.—The contract for construction of power plant complete has been awarded to the John W. Danforth Company, of Buffalo, N. Y., for $84,882. Henry H. Humphrey, 1505 Chemical Building, St. Louis, Mo., is consulting engineer.

INDEPENDENCE, MO.—The installation of an additional boiler in the municipal electric-light plant, to cost $2,900, has been recommended to the City Council by the light committee and A. L. Nichols, superintendent of the plant.

ST. LOUIS, MO.—Plans are being considered by the Springfield & Central Illinois Traction Company for the construction of an interurban railway from Springfield to Southern Illinois with a branch from Greenville to Edwardsville to connect with other lines for St. Louis. The proposed railway will be 320 miles in length. The cost of the road is estimated at $16,000 per mile. The company is capitalized at $5,000,000.

SPRINGFIELD, MO.—Preliminary surveys have been made by the Springfield & Western Railroad Company for its proposed electric railway to connect Springfield and Joplin and intervening towns, 90 miles in length. H. D. Mackay, of Springfield, Mo., is president, and J. P. McCammon secretary and superintendent.

SPRINGFIELD, MO.—It is reported that improvements are contemplated to the system of the Springfield Gas & Electric Company and the Springfield Traction Company, which will involve an expenditure of about $300,000. W. A. Bixby is general manager.

KALISPELL, MONT.—The construction of an electric railway from Kalispell to Polson is reported to be under consideration. David R. McGinnis is said to be interested in the project.

SHERIDAN, MONT.—The Madison Power Company, it is reported, is planning to supply electricity in Sheridan, Alder and Laurin.

HOAG, NEB.—Dr. C. B. Fall and others are said to be contemplating the construction of a dam on the Blue River. It is proposed to develop 500 hp to supply electricity in Beatrice and other towns.

LIBERTY, NEB.—The proposition to issue bonds for the installation of a municipal light plant, it is reported, will soon be submitted to a vote of the people.

OMAHA, NEB.—Orders have been placed by the Omaha & Council Bluffs Street Railway Company with the General Electric Company, of Schenectady, N. Y., for three 1000-kw, 600-volt rotary converters; four 1050-kw, three-phase transformers; three 350-kw, single-phase transformers; one 75-kw turbo-driven exciter, one blower set, one air-compressor and one switchboard. Two of the 1000-kw converters will be installed in the new South Omaha substation and the third will be placed in the power house in Omaha.

VERDI, NEV.—The Truckee River General Electric Company is making rapid progress on its new generating plant in Verdi. Water is to be taken from the Truckee River at Verdi and carried to a point 2 miles below the town through a ditch 36 ft. wide and 8 ft. deep. The water will be dropped 85 ft. through a penstock 2100 ft. long to the turbines. The plant will develop about 3200 hp, which will be transmitted to Mason, Nev., and the surrounding country for lamps and motors. It is expected to have the plant completed by Sept. 1.

CONCORD, N. H.—Arrangements have been made between the Concord Electric Company and the Manchester Traction, Light & Power Company, whereby the former will supply electricity at the power station of the Manchester Traction, Light & Power Company at Garvin's Falls as soon as the power plant of the Boston & Maine Railroad Company, at Eastman's Falls, in Franklin, is completed. Work on the erection of a transmission line between Sewall's Falls in Concord and Garvin's Falls in Bow will begin at once. The Concord Electric Company now supplies power to the Boston & Maine Railroad Company to operate the Concord & Manchester electric branch. When the new arrangement goes into effect it is understood that the Manchester Traction, Light & Power Company will discontinue the use of its steam-generating plant.

KEYPORT, N. J.—The Jersey Central Traction Company, of Keyport, N. J., which operates an electric railway between Keyport and Red Bank, it is reported, is contemplating extending the railway to Long Branch, via Little Silver, Port-au-Peck and Branchport.

SILVER CITY, N. M.—The Gilla River Development Company, which is contemplating a hydroelectric development, has engaged H. von Schon, of Detroit, Mich., as consulting engineer. The company proposes to develop a 500-ft. fall.

AMITYVILLE, N. Y.—The Public Service Commission, Second District, has granted the Long Island Lighting Company, recently organized, permission to issue a first-mortgage on its property and franchises to secure an issue of $6,000,000 in bonds. The company is also authorized to issue capital stock to the amount of $300,000 at not less than par, and to issue bonds to the amount of $295,000, to be sold to net not less than 85. The proceeds of the stocks and bonds are to be used for the purchase of the capital stock and outstanding bonds of the Northport Electric Light Company, of Northport, N. Y.; the Amityville Electric Light Company, of Amityville, N. Y.; the Sayville Electric Company, of Sayville, N. Y., and the Islip Electric Light Company, of Islip, N. Y.; also for improvements to the system throughout the entire territory covered, including the erection of a low-tension transmission line from Brentwood to Central Islip and Sayville to Ronkonkoma.

AUBURN, N. Y.—The Auburn Light, Heat & Power Company has awarded the New England Electric Construction Company the contract for supplying 135 ornamental lamp posts to be used in the inner-lighting district.

MARION, N. Y.—The Marion Power Company has received authority from the Public Service Commission to issue $9,500 in bonds, the proceeds to be used for the construction of an electric-light plant in Marion.

NEW YORK, N. Y.—The contract for the construction of the electric-light system at Gouverneur Hospital has been awarded to Anderson Martin, 1 Madison Avenue, New York, N. Y., for $6,320.

NEW YORK, N. Y.—The contract for installation of complete feeder system for lighting and power service of section No. 1, including spur line and service connection to Catholic church and service connection to new laundry building, in electric subway and conduit system at the New York City Home, Blackwell's Island, was awarded to Phillips Manufacturing Company, 60 Wall Street, New York, N. Y., for $1,638.

ROCKVILLE CENTER, N. Y.—The contract for installing a new boiler in the municipal electric plant has been awarded to the Springfield Machine & Boiler Company, Springfield, Ill., for $8,237.

SYRACUSE, N. Y.—The Public Service Commission, Second District, has authorized the Syracuse Lighting Company to exercise its rights and privileges under franchises granted by the town of Manlius to erect a transmission line in that town.

TROY, N. Y.—Negotiations are under way for the sale of the property of the Commercial Telephone & Telegraph Company and its subsidiary branches to interests believed to represent the American Telephone & Telegraph Company. The purchase of the plants of the Rensselaer Telephone Company and the United Message Corporation are also included in the negotiations. It is also proposed to absorb companies in Rensselaer, Albany, Saratoga, Washington and Warren Counties.

GRAND FORKS, N. D.—Arrangements are being made by the Grand Forks Street Railway Company to build an extension of its railway into East Grand Forks and to make other improvements to its system.

MINOT, N. D.—The Consumers' Power Company is reported to be contemplating rebuilding its power plant.

WAHPETON, N. D.—The installation of a new street-lighting system on Dakota Avenue is under consideration by the Commercial Club.

CINCINNATI, OHIO.—The City Council has passed an ordinance extending the district which may be lighted by the boulevard system.

COLUMBUS, OHIO.—Part of the recent appropriation of $75,000 for extension of the municipal electric-light plant and relief of water needs of North Columbus, will be used for the erection of a water and electric light boosting station in the vicinty of Eleventh or Twelfth Avenue. It is proposed to arrange to have the electric plant supply electricity to operate two emergency pumps having a rating of 250 hp each to provide for the increase in consumption of water during the summer months.

DAYTON, OHIO.—The Secretary of State has granted the Dayton Power & Light Company, recently incorporated, permission to increase its capital stock to $20,000,000. It is reported that it is proposed to consolidate the street-railway and lighting companies in Dayton.

EAST LIVERPOOL, OHIO.—The Tri-State Railway & Electric Company has placed an order with the General Electric Company, of Schenectady, N. Y., for a 300-kw, 2300-600-volt rotary converter.

STEUBENVILLE, OHIO.—The Steubenville & East Liverpool Railway & Light Company has purchased the electric-light plant owned by Erwin & Robinson, which supplies electricity for lighting a number of business houses on Fourth Street.

BARTLESVILLE, OKLA.—Judge Ralph Campbell, of the United States District Court, has ordered the property and holdings of the Bartlesville Light & Power Company to be sold at receiver's sale. E. L. Orr, of Tulsa, Okla., is receiver. The State Corporation Commission ordered the receiver to make repairs and improvements to the water system, costing $60,000, which the bondholders agreed to.

CHICKASHA, OKLA.—Judge Campbell, of the Federal Court at Muskogee, Okla., has appointed C. G. Johnson as receiver of the Chickasha Heat, Light & Power Company, of Chickasha. In the petition presented by the Central Trust Company of Illinois and the bondholders it is alleged the company has been badly mismanaged and has been unable to pay the interest on its bonds.

COMANCHE, OKLA.—It is reported that bonds have been voted for the installation of an electric-light plant in Comanche.

TALIHINA, OKLA.—The Talibina Light & Power Company has awarded the contract for construction of its electric-light plant to the Mullergren Engineering Company, of Poteau, Okla. The cost of the machinery is estimated at $10,000. O. P. Mullergren is president of the Telihina Light & Power Company.

BAKER CITY, ORE.—Plans are being formulated by the Commerical Club of Baker City, it is reported, for the construction of an interurban railway from this city into the Powder River Valley.

MEDFORD, ORE.—The Siskiyou Light & Power Company, of Yreka, Cal., it is reported, is contemplating extending its transmission line from the Fall Creek plant to Ashland and distributing electricity in the Rogue River Valley in connection with the Condor Power Company, for which surveys are now being made. The line will be of wooden construction, ten towers to the mile, and will carry current at 60,000 volts. The cost of the line is estimated at approximately $75,000. When completed it will tie into five different plants operated by subsidiary companies. The line will be connected with the plant of the Ashland Electric Light & Power Company in Ashland in the fall.

BUTLER, PA.—The Allegheny & Northwestern Street Railway Company has filed a mortgage for $700,000 in favor of the Guarantee Title & Trust Company, of Pittsburgh, Pa., to secure a bond issue of the same amount. The company proposes to construct and operate an electric railway cross country from Evans City to a point near Harmarville, where it will connect with the Allegheny Valley Traction Company's line, a distance of 21 miles. A contract for grading the line has been let.

DOWNINGTON, PA.—The Chester Valley Electric Light, Heat & Power Company has purchased about 2½ acres of land along the east branch of Brandywine Creek. The company is said to be planning to erect a power house to cost about $75,000.

HOMESTEAD, PA.—Arrangements are being made by the P. & A. Telephone Company to replace its present equipment in Homestead with a common-battery system, at a cost of $15,000.

MIDDLETOWN, PA.—The Middletown & Elizabethport Railway Company has filed a mortgage for $350,000 to secure funds to build an electric railway, 7 miles in length, that will complete the chain of railways that will unite Carlisle and Harrisburg with Lancaster and Philadelphia.

WASHINGTON, PA.—The Washington Electric Power Company of Pennsylvania, recently incorporated, will on July 1 take over the electric light and power plants in Washington, Canonsburg, McDonald, Oakdale and Waynesburg, Pa. It is understood that the company will supply electrical service to the towns mentioned from a large central power plant, and will erect transmission lines from Washington to Waynesburg and other points at once.

WASHINGTON, PA.—Notice has been given that application will be made to the Governor of Pennsylvania on June 22 for charters for electric-light and power companies in seventeen different boroughs and townships in Washington County, as follows: Washington, East Washington, Canonsburg, Houston, Burgettstown, Cecil, North Strabane, Chartiers, Canton, South Franklin, Mount Pleasant, Smith, Robinson, North Robinson, North Franklin, Amwell, South Strabane and Morris. The incorporators are: Charles H. Kennedy, E. S. Wheeler and H. P. Carr. It is proposed to supply electricity for lamps, heat and power in the places named.

PROVIDENCE, R. I.—The Rhode Island Company, which is controlled by the New York, New Haven & Hartford Railroad Company, has leased the Providence & Danielson Railway Company and the Seaview Street Railway Company properties for a term of 999 years. The first-named company operates 35 miles of street railways and the latter 20 miles.

PROVIDENCE, R. I.—The New York, New Haven & Hartford Railroad Company has secured the control of the Narragansett Pier Railroad Company, which extends from Narragansett Pier to West Kingston, a steam railroad 8½ miles in length. The railroad has been leased to the Rhode Island Company, of Providence, R. I., for a term of 999 years. The Narragansett Railroad will be equipped for electrical operation by the Rhode Island Company and operated in connection with the Seaview line.

WESTERLY, R. I.—The Westerly Light & Power Company, it is reported, is planning to extend its transmission line to Pleasant View to supply electricity for lamps in that place.

WOONSOCKET, R. I.—Preparations are being made by the Woonsocket Electric Machine & Power Company to build a large concrete dam at Bernon pond at a point between the present wooden dam and the Bernon Street bridge.

CHAMBERLAIN, S. D.—A company has been organized by local capitalists to install a new electric plant in Chamberlain. An election will soon be called to vote on the proposition to grant the company a franchise to operate an electric system. The street-lighting contract will expire July 1, 1911. The company is capitalized at $50,000. W. Hall Irens is president and J. H. Kennedy treasurer.

ESTELLINE, S. D.—The Estelline Telephone Company has been granted a franchise by the Council to construct and operate an electric light plant in Estelline. The Battery Power Company, of Milwaukee, Wis., has charge of the engineering work.

FT. PIERRE, S. D.—The installation of an electric-light plant with twenty-four-hour service in Ft. Pierre is reported to be under consideration.

CHATTANOOGA, TENN.—It is reported that C. E. James, of the Chattanooga Estates Company, has closed a deal whereby Chicago capitalists will construct a cement plant with a daily output of 9000 barrels of cement. The plant will be operated by electricity supplied by the plant of the Chattanooga-Tennessee River Power Company.

McKENZIE, TENN.—Bids will be received about July 1 for extensions to the municipal electric-light and water-works systems, for which bonds to the amount of $40,000 were recently voted. C. H. Jenks, of McKenzie, Tenn., is engineer in charge.

BISHOP, TEX.—Arrangements are being made to enlarge the local electric-light plant, owned by F. Z. Bishop. The installation of an ice plant is also under consideration. Bishop has not a post office.

CANYON CITY, TEX.—The Canyon City Power Company, recently organized, proposes to operate a lighting and power business in connection with an ice plant.

LULING, TEX.—The Luling Electric Light & Power Company is contemplating making extensions and improvements to its plant in Luling.

SHERMAN, TEX.—Preliminary arrangements are being made for the construction of an electric interurban railway between Sherman and Paris, Tex., a distance of 65 miles. John C. Wall, Mayor of Sherman and others are interested in the project.

WACO, TEX.—Announcement has been made of the sale of the properties of the Waco Gas & Electric Company and the Citizens' Street Railway Company to the Southern Traction Company, of Dallas. Steps have been taken by the Southern Traction Company for the construction of an electric interurban railway between Dallas and Waco. The plan includes the construction of street lines in East Waco and building a bridge across the Brazos River.

WAXAHACHIE, TEX.—The Commercial Club of Waxahachie, Tex., is reported to have signed a contract with the Stone & Webster Engineering Corporation, of Boston, Mass., for the construction of an electric interurban railway between Dallas and Waxahachie.

LYNCHBURG, VA.—The Lynchburg Traction & Light Company has filed a mortgage in favor of the Real Estate Title Insurance & Trust Company, of Philadelphia, Pa., to secure an issue of bonds to the amount of $1,750,000. It is said that the proceeds of the bonds will be used to retire outstanding bonds and for extensions and improvements to the local street-railway system.

RICHMOND, VA.—Bids will be received by the city of Richmond until June 14 for furnishing and erecting two centrifugal pumps, piping and water meters, two 200-hp electric motors, switchboard and wiring. E. E. Davis is superintendent of water department.

STAUNTON, VA.—Plans are being prepared for the construction of an electric railway from Staunton to Waynesboro. J. F. Cassell is engineer.

NORTH YAKIMA, WASH.—The Yakima Valley Transportation Company has commenced work on construction of an electric suburban line to Moxee City.

NORTH YAKIMA, WASH.—The City Council has awarded a contract to the Pacific Power & Light Company for the installation of an ornamental lighting system on Naches Avenue to cost about $6,000. Lamps will be erected on ornamental posts, four to each block.

TACOMA, WASH.—Plans are being considered by the Municipal Commission to extend the electric-light service to the Narrows, at a cost of $2,500 to $3,000.

TACOMA, WASH.—The Municipal Commission is reported to have awarded the contract for supplying incandescent lamps to the city for one year to the Home Electric Company, Tacoma, Wash., for $25,000.

TACOMA, WASH.—The contract for installing a power plant in the Rhodes Brothers' new department store is reported to have been awarded to the Caldwell Brothers Company, 1746 Pacific Avenue, Tacoma, Wash.

PANTHER, W. VA.—The Lathrop Coal Company, recently incorporated, is planning to develop coal mines covering about 500 acres, with a daily output of about 1000 tons. Electrical machinery will be installed. W. A. Lathrop is president, and William Leckie vice-president and manager.

PARKERSBURG, W. VA.—The West Virginia Western Telephone Company has been authorized to issue $15,000 in receivers' certificates, of which $10,000 will be used for improvements to its system and the remainder to pay off indebtedness.

CHIPPEWA FALLS, WIS.—It is reported that the Twin City Rapid Transit Company is securing flowage rights at Eagle Rapids, 8 miles from Chippewa Falls, with a view of developing same. It is estimated that 20,000 hp can be developed.

MADISON, WIS.—The Peninsula Power Company has received authority from the Railroad Commission of Wisconsin to issue 7500 shares of capital stock having a par value of $100, to be issued for money only and at not less than par. The proceeds will be used to purchase certain properties in Dickinson County, Mich., and Florence County, Wis., and for the rights and privileges incident to the construction and maintenance of a dam across the Menominee River, near Iron Mountain. The company proposes to install a 3000-kw hydroelectric plant, and to increase the total output to 4000 kw by means of steam auxiliary plants.

MILWAUKEE, WIS.—The Milwaukee-Western Electric Railway Company, it is reported, is planning to extend its electric railway to Beaver Dam, Wis.

MILWAUKEE, WIS.—Sealed proposals will be received at the office of the Board of Trustees of Public Museum until June 14 for furnishing material and installing plumbing and gas fittings, steam-heating apparatus, electric wiring, telephone and clock system, vacuum cleaning and light and power plant in the Public Museum Building on Eighth Street.

MISHICOT, WIS.—Negotiations are under way between Ira Beyer and Peter Rowlier and the Acker Electric Company, of Sheboygan, Wis., whereby the latter is to install an electric-light plant and water-works system in Mishicot. Power for operating the system is to be secured from a dam in the Mishicot River.

SPOONER, WIS.—The contract for improvements to the municipal electric-light plant has been awarded to the Power Engineering Company, of Minneapolis, Minn.

STETTLER, ALTA., CAN.—Plans are being considered by the town of Stettler for the construction of a municipal electric-light plant to cost about $17,000. The Galt Engineering Company, of Calgary, Alta., has charge of the engineering work.

PRINCE RUPERT, B. C., CAN.—The Prince Rupert Hydroelectric Company has acquired control of the Timpsean Light & Power Company and the Continental Power Company, Ltd., and the water rights on the Khtada and Fells Rivers, branches of the Skeena River. These waters, which are about 42 miles from Prince Rupert, it is said are capable of developing at least from 25,000 to 30,000 hp of electric energy. The company proposes to install a temporary plant to develop about 1500 hp to supply the immediate demands of the city of Prince Rupert, and to proceed with the work of construction of a permanent plant with an output of 15,000 hp. The company will also control the gas works in the city of Prince Rupert and install a gas-producing plant having a capacity of 75,000,000 cu. ft. per year. The directors are Charles H. Cahan, H. A. Lovett, R. F. Hayward, R. Brutinel and L. A. Herdt.

VANCOUVER, B. C., CAN.—Proposals will be received until June 26 by the Canadian Colleries (Dunsmuir), Ltd., for furnishing and installing two direct-connected hydroelectric units in the power house of the company, near Comox Harbor, Vancouver Island, B. C. Specifications may be obtained from W. L. Coulson, general manager, Victoria, B. C., or from H. K. Ownes, Central Building, Seattle, Wash., consulting engineer. Each unit is to develop 3750 kva at switchboard and include complete hydraulic and electric equipment.

MINNEDOSA, MAN., CAN.—Tenders will be received by the Minnedosa Power Company, Minnedosa, Man., until June 15 for the construction of power-station foundations and penstock, and the spillway and intake structures for the Minnedosa Power Company at Minnedosa. Plans and specifications may be seen at the office of H. F. Maulson, secretary, Minnedosa, and at the office of Andrews, Andrews & Company, Portage la Prairie, Man

GUELPH, ONT., CAN.—The contract for the construction of the municipal radial railway extension in St. Patrick's ward has been awarded to P. H. Secord & Sons.

TORONTO, ONT, CAN.—The Eastern Power Company, Ltd., recently incorporated with a capital stock of $500,000, it is reported, is planning to construct a power plant on the Trent River. Thomson, Tilley & Johnston are said to be interested in the company.

TORONTO, ONT., CAN.—C. H. Rust, city engineer, has submitted estimates to the Board of Control of Toronto on the cost of building the proposed street railway on St. Clair Avenue and on Gerrard Street East. The construction of St. Clair Avenue line from Avenue Road to the Grand Trunk Railroad tracks, 2.65 miles, including rail construction, overhead construction, car bars and repair shops, passenger and operating equipment, transformer station and feeder wires and general engineering and other expenses, is estimated at $280,928. The cost of the construction of the Gerrard Street East line, from Greenwood Avenue to Main Street, 1.85 miles, is estimated at $225,780.

WINDSOR, ONT., CAN.—The Sandwich, Windsor & Ambersthurg Railway Company has submitted a proposition to the City Council offering to supply electricity for operating the street-lighting system at the rate of $35 per hp per year.

New Industrial Companies.

THE AMERICAN ELECTRIC WATER-PURIFYING MACHINE COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $500,000 to manufacture water-purifying apparatus, etc. The incorporators are W. A. Guthrie, E. A. Pfeffer and E. R. Sanford, all of New York, N. Y.

THE ELECTRIC CARRIER COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $100,000. The incorporators are F. R. Hansell, of Philadelphia, Pa.; G. H. Martin and S. C. Seymour, of Camden, N. Y.

THE HUGHES UNIVERSAL ARC LAMP COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $200,000. The incorporators are C. C. Hughes, of Philadelphia, Pa.; T. J. Rigby, of Pasadena, Cal., and W. H. Rigby, of Chester, Pa.

THE PATTERSON HYDRO-POSITIVE TRANSMISSION COMPANY, of Camden, N. J., has been chartered with a capital stock of $200,000 by T. S. Patterson, W. F. Eidell and J. A. MacPeak, of Camden, N. J. The company proposes to do a general electrical and mechanical engineering business, etc.

THE UNIVERSAL TROLLEY WHEEL COMPANY, of Springfield, Mass., has been incorporated with a capital stock of $300,000 to manufacture trolley wheels. L. J. Tetlow is president of the company and J. W. Steele treasurer, both of Springfield, Mass.

New Incorporations.

CHICAGO, ILL.—The Chicago Muncipal Subway Company has been incorporated with a capital stock of $25,000 by W. S. Jackson, C. M. Harlan and S. W. Cookins.

GRANVILLE, ILL.—Articles of incorporation have been filed for the Granville Water Company with a capital stock of $2,000 by J. F. Cole, George A. Harrop and George W. Hunt. The company proposes to construct and operate water works and electric-light systems.

EVANSVILLE, IND.—Articles of incorporation have been filed for the Evansville Independent Telephone Company with a capital stock of $25,000 by E. B. Oslage, H. G. Cooper and E. Q. Lockyear. The company recently applied for a franchise in Evansville.

GOULD, MONT.—The Landers Power Company has filed articles of incorporation with a capital stock of $100,000. The directors are Owen Byrnes, O. M. Lanstrum, F. B. Linderman, W. W. Patterson and F. M. Hall.

FRANCIS, OKLA.—The Francis Light & Power Company has been incorporated with a capital stock of $10,000. The directors are A. L. Mullergren, W. J. Donathan, of Potheau, Okla.; W. P. Chism. Albert Goetten and W. L. Shaffer, all of Francis, Okla.

SHAMOKIN, PA.—The Black Diamond Light, Heat & Power Company has been incorporated with a capital stock of $5,000. The directors are: William W. Ryan, of Shamokin, Pa., treasurer; N. J. Cox and W. A Coulston, all of Shamokin, Pa.

WARWICK, PA.—The Warwick Township Electric Company has been incorporated with a capital stock of $5,000. The directors are: W. T. Robinson, of Philadelphia, Pa., treasurer; M. W. Stroud, W. T. Robinson, of Philadelphia, Pa., and W. C. Anderson, of Kingston, Pa.

WILLIAMSPORT, PA.—The Clinton Electric Company has been incorporated with a capital stock of $5,000. The incorporators are: Ernest H. Davis, of Williamsport, Pa., treasurer; Charles Cochran and Allen P. Perley, both of Williamsport, Pa.

WOODFORD, S. C.—The Woodford Ginning & Light Company has been granted a charter, with a capital stock of $40,000. The incorporators are: H. B. Knotts, G. W. Whetstone, J. S. Ulmer and W. E. Ulmer.

MANCHESTER, TENN.—The Duck River Power Company has been organized with a capital stock of $10,000 to construct and operate a hydroelectric-power plant.

MEMPHIS, TENN.—Articles of incorporation have been filed for the Lytle Electric Company by P. W. Lytle, H. P. Woods, W. C. Tupper. W. M. Waters, Sr., and H. H. Barker. The company is capitalized at $5,000.

PETERSBURG, TENN.—The Petersburg Electric Light & Power Company has been granted a charter with a capital stock of $2,100. The incorporators are A. C. Davis, George McAdams, J. A. Montgomery, J. C. McRady and O. F. Gill. The company proposes to supply electricity for lamps and motors in Petersburg, Tenn.

ALLEN, TEX.—The Allen Light & Power Company has been incorporated with a capital stock of $2,000 by J. N Bush, S. P. Bush, G. I. Wilcox and J. B. Preston.

CHELAN, WASH.—Articles of incorporation have been filed for the Rubin Electric Power & Lumber Company with a capital stock of $500,000. William H. Schokel, of St. Paul, Minn., is interested in the company. Charles Rubin, of Chelan, Wash., is manager.

Personal.

MR. P. T. HANSCOM, formerly engineer of the Central Colorado Power Company, Denver, has been appointed general superintendent of the Great Western Power Company, San Francisco.

MR. W. F. HINE, a graduate of the Wisconsin University school of electrical engineering in 1907, has been appointed chief gas expert on the technical staff of the Public Service Commission of the First New York district, which comprises the city of New York.

MR. J. D. MOONEY has resigned his position with the Westinghouse bureau of publicity, where he was in charge of technical press matter, to join the editorial staff of the Hill Publishing Company, New York. On May 26 Mr. Mooney's associates at East Pittsburgh tendered him a farewell dinner at the Hotel Henry, Pittsburgh, a feature of which was a humorously conceived souvenir menu card.

DR. ROY W. MOORE, of the research department of the General Electric Company, Schenectady, will spend two months of the present summer in Berlin, Germany, investigating the processes of preparing tungsten for incandescent lamps. Dr. Moore graduated from the Worcester Polytechnic Institute in 1901 and from the University of Bonn, Germany, two years later. He has been engaged in research work at Schenectady for the past six years.

PROF. V. KARAPETOFF, who has been with the department of electrical engineering at Cornell University for seven years, will spend his sabbatical year vacation in the engineering department of J. G. White & Company, with headquarters in New York. During the present week Prof. Karapetoff will deliver an address before the Sigma Xi Society at the Worcester Polytechnic Institute, his subject being "Engineering Calculations Relating to Electromagnetic and Electrostatic Circuits."

MR. SAMUEL KAHN, formerly secretary and manager of the Union Light, Heat & Power Company, of Fargo, N. D., has been appointed manager of the Appalachian Power Company, with offices at Bluefield, W. Va. The Appalachian company, which was taken over by the Byllesby company June 1, supplies energy for the operation of a number of coal mines in the Bluefield and Pocahontas section. A 6000-kw steam-turbine plant is now in operation, and two water-power developments on the New River are to be added.

Trade Publication.

DIRECT-CURRENT INTERPOLE GENERATORS.—Circular 1194, recently issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has for its subject engine-driven direct-current interpole generators, type Q. The circular is well illustrated and contains information on the advantages of interpole construction and an entirely new line of standard direct-current generators just placed on the market.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 30, 1911.

13,247. ADJUSTABLE CASING FOR LAMP SOCKET; E. H. Freeman, Trenton, N. J. App. filed Aug. 9, 1910. Constructive details of a lamp socket of the bayonet slotted type.

13,248. SELF-ANSWERING SIGNAL SYSTEM; E. R. Gill, Yonkers, N. Y. App. filed Dec. 13, 1910. A local signal and a line are so arranged that upon closing the circuit through the local signal answering-back impulses are inductively impressed upon the line, such impulses audibly affecting the receiver in the sending station.

993,352. ELECTRIC DRILL; W. O. Duntley, Chicago, Ill. App. filed Jan. 20, 1905. An inclosed portable electric drill, comprising a tool shaft, a plurality of electric motors arranged annularly to the axial line of the shaft and operatively connected therewith.

993,359. ALTERNATING-CURRENT MOTOR; V. A. Flynn, Blackheath, England. App. filed March 2, 1908. The motor is provided with a neutralizing winding, a field winding displaced therefrom and connected in series relation therewith. A revolving member is connected in series with the neutralizing winding along one axis, and in series relation with the field winding along another axis. Means are provded for producing an alternating flux along an axis approximately coinciding with that of the neutralizing winding.

993,378. SWITCH; I. W. Jepson, Depew, and W. F. Boucne, Buffalo, N. Y. App. filed June 10, 1910. The two members of the switch mechanism are rotatable in opposite directions, and the device is pivoted eccentrically on the main switch member, and weighted so as to assume different positions thereon, depending upon the direction of rotation of its member.

993,391. METHOD FOR REDUCING METALS; R. J. McNitt, Niagara Falls, N. Y. App. filed Oct. 8, 1909. The metal is dissolved, alloyed or chemically combined with another metal volatile only at different temperatures and pressures than that at which the metal sought to be produced gives off its vapor. The solution, alloy or compound being maintained at a suitable temperature and an inert gas being passed through it.

993,414. ELECTRIC FURNACE; F. Sartori, Monteponi, Italy. App. filed Aug. 19, 1910. An electric furnace for the distillation of zinc and its ores or by-products.

993,417. ELECTRICAL CONTROL APPARATUS; W. M. Scott, Philadelphia, Pa. App. filed Jan. 6, 1910. An electric motor is arranged for operating a plurality of switches or circuit-breakers, mechanical means being provided for connecting and disconnecting the motor and each switch.

993,434. MULTIPLE SWITCH STARTER; F. R. Bacon, Milwaukee, Wis. App. filed Aug. 2, 1909. Automatic means are provided for checking the closure of a plurality of separately actuated manual switches normally free to be closed but tending to stand in open position.

993,442. TELEGRAPHY; J. A. Esslinger, Washington, D. C. App. filed May 23, 1910. An interacting relay shunts the induced and main line currents through its break points, to operate a reciprocating electromagnetic inductive sounder, which in turn operates a diaphragm receiver.

993,447. OSTEOPATH'S ELECTRIC OPERATING TABLE; C. W. Hotchkiss, Sandwich, Ill. App. filed Dec. 3, 1909. Constructive details.

993,459. ELECTRIC MOTOR; H. A. Rhodes, Denver, Col. App. filed July 20, 1909. Both members of a motor are arranged to rotate, a third member being provided to utilize the differential speed of the two members.

993,460. ELECTRICAL ALARM DEVICE; A. J. Rice, Lawrenceburg, Ky. App. filed April 27, 1910. Details of a self-contained alarm device mounted upon an insulating base.

993,475. ELECTRIC CURRENT CONTROLLER; G. G. Thompson, Muskegon, Mich. App. filed Jan. 5, 1911. The controller is provided with both starting and running fuses, so arranged that the starting fuse is automatically opened when the control lever is in its closed position, and automatically closed when the control lever is in its open position.

993,526. ELECTRIC SWITCH; A. J. Horton, White Plains, N. Y. App. filed Sept. 14, 1908. A movable contact of the switch is adapted to be held magnetically in engagement when the switch is moved in one direction. Means are provided for causing the contact to break engagement with the switch upon reaching a certain position.

993,561. APPARATUS FOR TRANSFORMING ELECTRICAL ENERGY INTO MECHANICAL ENERGY; H. B. Smith, Worcester, Mass. App. filed May 14, 1908. A revolving electrostatic field motor, the rotating field being produced by impressing displaced alternating emfs upon a number of circularly arranged plates.

993,610. SYNCHRONIZING DEVICE; F. E. A. Mathelot and H. G. Gentilhomme, Paris, France. App. filed April 23, 1908. Mounted opposite each other on separate shafts are two wheels, one having on its opposite face contacting sectors separated from the wheel and from each other by insulating material. The other wheel carries a flexible brush contacting when the wheels are in unison with the insulation between the sectors. The wheels are actuated by electromagnets, cams being mounted on the driving shafts of the device to be synchronized to make at predetermined intervals electric contacts with the terminals of the electromagnets.

993,611. ELECTROMAGNETIC POWER VELOCITY RATIO DEVICE, PARTICULARLY APPLICABLE FOR DRIVING AUTOMOBILES; A. H. Midgley, Forest Gate, and C. A. Vandervell, Acton Vale, England. App. filed May 7, 1909. A combination generator and motor having a common field magnet system is mounted so that the motor armature remains fixed, while the generator armature and the field magnets are adapted to move relatively to one another and to the motor armature, means being provided for exciting the field magnets and for conveying the energy generated by one armature to the other armature.

993,637. CIRCUIT-BREAKER; C. C. Badeau, Bethlehem, Pa. App. filed Feb. 19, 1908. One contact of a circuit-breaker is in the form of a carbon cylinder and the other in the form of a metal block. The block is provided with a curved notch on the side which engages with the carbon cylinder, the notch being circular in shape and having the same diameter as the cylinder.

993,638. PROPULSION OF VESSELS IN WATER; J. N. Bailey, Stratford, England. App. filed May 17, 1909. The equipment consists of a steam turbine driving an electric generator supplying energy to a motor on the propeller shaft. A controller is provided for governing the supply of steam to the turbine, and for affecting a reversal of the connections leading from the generator to the motor, and to cut off automatically the supply of steam from the turbine.

993,688. BURGLAR AND FIRE-ALARM SYSTEM; J. M. Johnson, Belleville, Kan. App. filed Oct. 12, 1909. A portion of the electrical signal circuit consists of a fuse held in tension by means of a rotatable drum. When the fuse is opened by excess temperature the drum revolves and thereby actuates the signal circuit.

993,727. ELECTRIC TOY; E. Sollmann, Hoboken, N. J. App. filed March 4, 1910. Details of a miniature electric railway, consisting of two running rails and a third contact rail.

993,756. SWITCH; F. C. Chlan, Baltimore, Md. App. filed Aug. 6, 1910. Details of a wall-type push-button switch, the head of which is provided with an approximately W-shaped engaging face pivotally connected with the supporting structure.

993,776. MANUFACTURE OF SILVERED GLASS MIRRORS; E. Hoorick, Brussels, Belgium. App. filed May 30, 1911. An apparatus for electroplating mirrors in which use is made of a central conductor and a number of spaced means carried by the conductor for electrically connecting the conductor with the edges of the mirror to be electroplated, the means extending at right angles with the conductor.

993,792. TROLLEY HARP; J. L. Perkins and C. W. Putnam, Holyoke, Mass. App. filed Jan. 28, 1910. Details relating to the mounting of a harp upon a trolley pole.

993,804. AUTOMATIC SWITCH; A. B. Strohm, Columbus, Ohio. App. filed Dec. 15, 1910. The switch mechanism is operated mechanically by means of a diaphragm responding to a pressure produced by the machinery which the switch is intended to control.

993,814. MOTIVE-POWER-CONTROLLING DEVICE; T. E. Barnum, Milwaukee, Wis. App. filed July 1, 1907. Device comprises a pair of moving members actuated by solenoids.

993,843. HIGH-VOLTAGE MERCURY-ARC RECTIFIER; O. O. Kruh, Schenectady, N. Y. App. filed Sept. 20, 1907. The tube is surrounded by a shield placed at the anode, and connected therewith in such a way as to equalize the potential between the anode and the shield.

993,870. FIRE ALARM; H. G. Perkins and G. H. Elliott, Topeka, Kan. App. filed Dec. 17, 1910. Constructive details.

993,872. MERCURY METER; W. H. Pratt, Lynn, Mass. App. filed April 9, 1908. The meter is provided with a cup-shaped armature revolvable in mercury between the poles of the magnet, the magnetic member substantially filling the interior of the armature. Conductors lead current to diametrically opposite edges of the armature; a retaining member, rigidly attached to the magnetic member and the conductors, is revolvably adjustable about the armature axis.

993,888. METHOD OF SEPARATING SUBSTANCE IN SUSPENSION; B. Schwerin, Frankfort-on-the-Main, Germany. App. filed Feb. 8, 1911. Covers a method of electro-osmotically separating substances suspended in a solution, which consists in adding to the solution an electrolyte which is capable of neutralizing the iron normally liberated at the electrode through which the substance tends to migrate.

993,899. VAPOR RECTIFIER SYSTEM; C. P. Steinmetz, Schenectady, N. Y. App. filed June 21, 1907. Between the source of supply and the rectifier are connected two reactive devices mounted upon the same core, and so arranged that the core is continuously magnetized in the same direction for current to either anode.

993,913. SILICON-OXYGEN PRODUCT; F. J. Tone, Niagara Falls, N. Y. App. filed Jan. 18, 1907. The product is condensed from gases produced by electrically heating a mixture of carbon and silica, which when treated with hydrochloric acid yields a residue of amorphous silicon.

993,944. ELECTRIC MOTOR ATTACHMENT FOR SEWING MACHINES; H. S. Baldwin, Lynn, Mass. App. filed Oct. 14, 1909. A motor-supporting bracket is hinged on an axis transverse to the shaft of the sewing machine, and a countershaft is joined in the bracket with its axis normally parallel with that of the machine.

993,961. ELECTROLYTIC LIGHTNING ARRESTER; E. E. F. Creighton, Schenectady, N. Y. App. filed Oct. 11, 1907. In series with an aluminum cell lightning arrester is placed a spark gap shunted by a device operated by a time-limit relay, responsive only to a continuous discharge of current through the arrester circuit.

993,968. SNAP SWITCH WITH INCLOSED FUSE; F. C. De Reamer, Schenectady, N. Y. App. filed April 22, 1905. A carrier is pivoted on one of the two terminal clips, and the inclosed fuse is provided with blades projecting axially from the ends thereof, one of the blades being removably secured in the carrier and the other blade being adapted to enter the other clip.

993,973. THREE-WIRE GENERATOR; H. F. T. Erben and J. L. Burnham, Schenectady, N. Y. App. filed June 21, 1907. The generator is provided with three leads, two of which are connected to the main armature winding. There is also a continuous auxiliary winding closed upon itself, and generating a different emf from the main winding, and having different points connected to the main winding and to the third lead to maintain a constant difference of potential between the third lead and the other two.

993,975. TELEPHONE SUPPORT; Charles E. Flynn, Vale, Ore. App. filed Feb. 25, 1911. A slidable grip is mounted on the handle of the telephone, and means are provided on the grip for connecting with the receiver fork of the telephone in order to raise and lower the latter.

993,977. PRESSURE-OPERATED CIRCUIT CONTROLLER; F. J. Frasier, Minneapolis, Minn. App. filed April 19, 1910. A pressure-operated diaphragm is arranged to close contacts when the pressure exceeds a predetermined value.

994,010. METHOD OF AND APPARATUS FOR PRODUCING EXHAUSTED VESSELS; I. Langmuir, Schenectady, N. Y. App. filed Oct. 22, 1910. The method consists in heating an incandescent lamp during exhaustion to a temperature between 460 deg. C. and 520 deg. C. and shielding the walls of the lamp during exhaustion from pressure great enough to distort them by surrounding the lamp with a medium at substantially the same pressure as the medium inside the lamp.

994,011. SNAP SWITCH; I. Larsen, Schenectady, N. Y. App. filed Oct. 2, 1907. Constructive details.

994,022. PROCESS OF DISTILLATION; R. J. McNitt, Niagara Falls, N. Y. App. filed Sept. 18, 1909. Electrical heat produced by transformer action is employed for distilling substances which cannot be distilled by the application of external heat on account of the destructive effect of such heat upon the walls of the distilling vessels.

994,026. THERMAL ELECTRIC FIRE ALARM; J. W. Mowbray, Gleichen, Alberta, Canada. App. filed July 18, 1910. To the face of the device is secured a contacting post and supported thereto is a turnable shaft. A helical coil of contacting material is secured at one end to the post and at the opposite end to the turnable shaft.

994,030. TROLLEY-POLE ATTACHMENT; W. A. Peffer, Louisville, Ky. App. filed Oct. 24, 1910. The pole is provided with an extra arm carrying a second trolley wheel, intended for removing any undesired matter from the trolley wire.

994,039. TROLLEY HEAD AND HARP; J. Siragusa and R. E. Wood, Chicago, Ill. App. filed March 4, 1910. The wheel shaft is equipped with arms extending above the wheel and spanning the wire.

994,040. PUSH-BUTTON SWITCH; M. H. Spielman, New York, N. Y. App. filed Sept. 8, 1910. The switch is provided with a barrel having an interior annular groove and with contact devices, including a movable member and a ring-like pivot for this member sprung into and seated in the groove.

994,046. PROTECTIVE MEANS FOR SAFES; W. Weikel, dec'd, by E. E. Weikel, Middletown, Ohio. App. filed Dec. 14, 1910. An electric circuit which is closed upon attempted forcible entry to the safe is arranged to fuse a device containing material which poisons the air surrounding the safe.

994,058. ARMATURE; J. Coates, Lynn, Mass. App. filed March 27, 1907. The armature is of the spherical type intended fo use on commutator type watt-hour meters. A supporting shell for the coils crossing at the ends of the armature is formed of two approximately hemispherical parts having raised portions adapted to raise a coil above the coil immediately below it at the crossing point of the coils.

994,060. RAILWAY SIGNAL; J. P. Coleman, New York, N. Y. App. filed Dec. 27, 1910. Constructive details relating to a railway signal depending upon gravity for assuming its position of indication.

994,067. BATTERY WELL; F. L. Dyer, Montclair, N. J. App. filed Nov. 8, 1910. A battery well is provided with double walls of fibrous material indurated with an infusible, insoluble final phenolic condensation product, and having an air space between the walls.

994,079. TELEGRAPH TRANSMITTER; B. P. Hayes, Topeka, Kan. App. filed May 17, 1910. Constructive details relating to a mechanical telegraph transmitter arranged to operate an automatic keyboard machine by the use of which messages in the Morse code may be sent at substantial speed without nervous effort on the part of the operator.

994,080. MOTOR CONTROLLER; C. T. Henderson, Milwaukee, Wis. App. filed Oct. 17, 1908. The controller is arranged to change series-wound motors from series to parallel connection by means of the minimum number of switches.

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ELECTROLYSIS OF PIPES.

It is, of course, well known that the large and increasing use of the earth as an auxiliary conductor in electric-railway practice has brought with it some very grave problems regarding the protection of buried pipes from the incidental attacks of the return current. The general questions of responsibility and of remedies have not yet been fully answered. It is well known that in many cities the water and gas pipes have been and are being seriously attacked by electrolysis due to return railway currents, and in numerous instances the matter has in one form or another been brought before the courts, like the similar but by no means identical questions regarding the common use of the earth by electric companies for return circuit which appeared in the very early history of the electric railway by reason of grounded telephone circuits. This latter problem has solved itself because of the fact that metallic circuits for telephones have been found desirable and have been generally introduced for reasons quite apart from interference by railway current. Water and gas-pipe systems, however, cannot be put upon poles, and in the former case at least there are questions of public safety involved much more serious than any considerations which apply to the telephone case. As the action is cumulative, the time is soon likely to come when the whole matter will have to be threshed out thoroughly before the courts. So far the more general issues have not been thoroughly settled. Meanwhile remedial and preventive measures are acquiring greater and greater importance.

An article in one of our foreign contemporaries gives an interesting account of work carried on in Karlsruhe, Germany, directed toward the prevention of electrolytic action. The insulation of danger spots in the pipe system by means of asphalt and other materials was thoroughly tried and found wanting. The spots insulated were, it is true, protected, but the scene of electrolytic activity was merely transferred to another point. Failing in this endeavor, attention was next directed toward an electrical remedy constituted on the good old hair-of-the-dog-that-bit-you plan. The scheme, which has not infrequently been suggested, but has seldom been properly tried, was exceedingly simple inasmuch as danger from electrolysis to pipes comes only when the vagabond currents are leaving them. Means were taken to block this exit and, what is more, to make the pipe cathode instead of anode with respect to all currents affecting it. By so doing the pipe is even protected, rather than exposed to injury. To this end auxiliary electrodes were placed in the earth either as continuous lines or as plates connected and buried at intervals. These were connected with the positive pole of a low-tension source, while the pipes were connected with the negative pole. The effect was to reverse the difference of potential which otherwise would have tended to lead currents away from the pipe, if they had entered it, and to transfer the scene of any electrolysis that might exist from the pipe to the buried conductor in Karlsruhe. This latter was chiefly an old pipe line improved as a conductor by making the joints with lead. Under this régime the protected pipe became the cathode with respect to any stray current flowing and was consequently protected instead of attacked. The interesting part of the matter is less in the system, which merely carried out suggestions made long since, than in the workmanlike way in which the plan of protection was carried out and in its apparently complete success as a preventive measure. After fifteen months of trial no trace of deterioration was found in the protected pipe, while the same system had been very serously injured in a period of ten months prior to the installation of the preventive measures. The energy required for suitable protection appears to be very slight, since the difference of potential to be reversed amounts to only a few volts and the current flow along the pipe is small. In the Karlsruhe experiments the power involved was only 110 watts for the protection of a couple of hundred yards of pipe, and even this small quantity gives an average which would probably be greatly reduced when working out such protection on a fairly large scale.

TRANSMISSION-LINE COMPUTATIONS.

In another column Mr. J. A. Viehe gives a very pretty method of graphical solution of some of the problems involved in figuring the long spans now commonly used on transmission lines. The general employment of the tower construction on such circuits has brought with it the necessity for a refinement of calculation entirely unfamiliar in building ordinary pole lines. The distances between the towers are so great as to require a large sag of the conductors to keep the stresses within conservative limits, and, as Mr. Viehe points out, this large sag makes it necessary to consider the topography of the ground intervening between towers. The point of nearest approach to the ground in passing over rough country is not at all necessary at the mid-point between towers. Mr. Viehe's method is particularly addressed to the convenient solution of the problem thus introduced. It is essentially graphical, consisting in the construction of sag templets which can be applied directly to a profile to determine the characteristics of the proposed span. Graphical methods are always convenient, and when precise enough often afford the most convenient means of getting practical solutions of problems otherwise complicated. In this particular case such methods are undoubtedly sufficient since a great enough factor of safety has to be allowed in planning the span to take account of the most dubious quantities among the data.

There is a rather conspicuous lack of definite information regarding the coefficient of expansion of line wires under heavy initial stress. The subject should be investigated more carefully than it yet has been in order better to meet the requirements of long-span construction. Enough is known about it, however, to make safe construction fairly easy, so that a process like that shown by Mr. Viehe can be safely and conveniently employed in the design. When more is known about the question of expansion, it may be desirable on some of the very long spans now used to take account of the fact that the actual curve of the suspended wire is not the parabola generally assumed, but a catenary. If the time should come for introducing this refinement, however, the templet method here suggested will apply equally well to the new condition of rigorous curve of the catenary, which can easily be constructed by the help of a table of hyperbolic functions and the necessary templets readily prepared. It is worth noting, indeed, that the ordinary equation of the catenary, involving as it does the distance to an origin below the lowest point of the curve, lends itself more readily than is generally realized to long-span calculations. At all events Mr. Viehe's method seems to be a very general and satisfactory one which can be made exceedingly useful in the design of long spans.

RESISTIVITY OF COPPER-NICKEL ALLOY.

Interesting information relative to the resistivity of a certain copper-nickel alloy is contained in an article by Mr. A. A. Somerville in this issue. The alloy, which is that used in the 5-cent coin known as the "nickel," is said to contain 75 per cent of copper and 25 per cent nickel. When drawn into a wire about 70 circ. mil in area and 1.15 ft. in length, the resistance was found to be in excess of 3.3 ohms at normal temperature. A wire of the same size made wholly of nickel would have a resistance of about 1.0 ohm, while about 0.18 ohm would be the resistance of one made wholly of copper. Similar extra-ratio relations were found concerning the resistivity-temperature coefficient of the alloy. The increase in resistivity of the alloy for a change of temperature from zero to 900 deg. C. was 18 per cent, thus indicating an increase of 0.02 per cent per degree. The increase per degree for copper would have been of the order of 0.4 per cent, and for nickel about 0.6 per cent. The author calls particular attention to the effect of heat treatment upon the resistivity of the alloy as measured at zero deg. C. He reports a gradual decrease in the resistivity as annealing was continued, and a smaller final resistivity in each case with increase of the temperature at which annealing took place, the resistivity being about 2 per cent less for annealing at 300 deg. rather than at 100 deg. It would seem that annealing must be continued for considerably more than an hour before the electrical properties—and probably the mechanical properties also—become stable. To what extent the mechanical changes can be judged from the observed electrical changes it is not safe to say, but the annealing of the alloy seems to be as thorough when accomplished at 300 deg. as at 700 deg.

THE REFLECTING POWER OF METALS.

A valuable contribution to our knowledge of this subject from Dr. Coblentz, of the Bureau of Standards, is noted in the Digest. This is a study of the reflecting powers of various pure elements for visible and infra-red radiations. On its face an investigation of this kind is principally of theoretical value, but since it is well known that the emissivity of substances used as radiators is an inverse function of the reflectivity, and that upon the emissivity depends in a considerable measure the efficiency of the material as a light radiator, the practical bearing of such investigations on incandescent-lamp manufacture appears at once. Unfortunately, the reflecting powers of most pure metals are near enough alike somewhat to discourage the seeker after materials of extraordinary selective radiating power. Moreover, there is not, so far as is yet known, any metal sufficiently refractory to be of much service for lighting by incandescence which has at the same time the freakish reflectivity demanded for highly efficient selective radiation. Some metals are better than others, but none depart widely enough from the general average to be highly desirable. The substances investigated by Dr. Coblentz were tungsten, molybdenum, graphite, tantalum, antimony, rhodium, iridium, iron, magnesium, chromium, vanadium, tellurium and silicon. The ideal substance for a lamp filament must stand a high operating temperature and have low reflectivity in the visible spectrum and, conversely, high reflectivity in the infra-red. Most pure metals meet the latter part of the specification moderately well, but are less satisfactory in their properties in the visible spectrum. Of the metals investigated by Dr. Coblentz, tungsten and molybdenum seem on the whole to have the best balanced reflectivity curves for use as lamp filaments. Some known metallic substances, like silicon, have very favorable reflectivity in the visible spectrum, but rather unfavorable in the infra-red.

It certainly looks as though the physical properties of refractory elements have now been investigated sufficiently well to give a pretty good line on their probable value as radiators, tungsten and molybdenum being certainly the most promising on the list. Any further improvements in selective radiation will have to be sought among known metallic substances or among alloys. The former are apt to be mechanically troublesome, but still deserve further investigation. The latter field is as yet almost untouched. If the alloys of the highly refractory metals have been to any extent investigated, the results are buried in the research laboratories of the electrical manufacturers. It is possible, thought not probable, that an alloyed filament of high radiating power, able to stand a reasonably high temperature, may be obtained. One may, in fact, perhaps gain more in emissivity than he loses in absolute temperature available. It must be admitted, however, that we are at present working pretty near the temperature limit available with any pure metal and inferentially available with any alloy, since there is no case in which a metallic alloy has a higher melting point than either of its constituents. It is to emissivity, therefore, that we must look for increased efficiency of solid illuminants, hence the direct value of such researches as that before us. One further consideration leads one to look to alloys for help. It is the general rule that alloys are worse conductors than either constituent, or at least conspicuously worse than chief constituents; so that even if no alloys should be found of which the emissivity is conspicuously advantageous, it yet is quite likely that one may be evolved of which the mechanical properties and electrical resistance are so favorable as to give a filament of much more durable and reliable character than any we now have, even if of no higher efficiency.

A NEW METHOD FOR THE ABSOLUTE MEASUREMENT OF ELECTRIC QUANTITY.

At the present time the abstract unit of electric current in the magnetic system of units is the absolute ampere, which is exactly 10 abstract amperes, or 10 amperes theoretically. The concrete unit of electric current as adopted by international agreement is the current which in one mean solar second will deposit 1.118 milligrams of silver in a silver voltameter of prescribed character. This concrete unit of electric current is called the international ampere. Thanks to the work of the various national laboratories, we possess in electrical engineering laboratories apparatus for measuring current in terms of the international ampere which possesses satisfactory precision, and is in international accord well within the limits that engineering demands. The question of the international ampere is, therefore, at present closed from the standpoint of applied science. All engineers refer to the same standard of current when they specify the international ampere.

But the abstract question of the ampere is naturally never closed. From the standpoint of pure science the absolute ampere, or so called absampere, maintains perennial interest. The theoretical unit is always capable of being investigated to a higher degree of precision than that already attained. The era that witnesses absolute disinterest in the determination of the c.g.s. unit of current would mark the era of scientific decadence. The international ampere purports to be a deci-absampere, just as the international meter purports to be the deci-microquadrant of the earth. The international meter we already know is short of its theoretical value by about one-fiftieth of 1 per cent; nevertheless we do not alter the meter to conform more nearly with its latest estimate of true value. An error is no error when it is known. We all use the international meter, and even the United States foot is defined by law in terms of it, without regard to the discrepancy between the absolute meter and the international meter. So the international ampere may turn out in time to be distinctly off the tenth part of the true absampere, as the latter becomes better known, but there will probably be no necessity to alter the international ampere in consequence. The determination of the absampere has always been a difficult undertaking for the physicist. It is possible, theoretically, to weigh the mechanical force produced electromagnetically by a current between two active coils and deduce the strength of the current in absolute measure from the dimensions and mechanics of the system, but practically the measurement offers great difficulties in the direction of high precision.

A new method has recently been suggested in the *Bulletin* of the Bureau of Standards and in a paper by Dr. Burton McCullum. It consists essentially in swinging a movable coil inside a coaxial fixed coil and in measuring the swing-frequency with current both on and off the system. With the current on the swing-frequency will naturally be greater than with the current off. By careful measurements of the coil dimensions, of the moment of inertia of the moving system, and of the two swing-frequencies the value of the steady exciting current supplied to the coils becomes computable in absolute measure If the same current also passes through a silver voltameter for a measured period of time, the value of the accepted electrochemical equivalent of silver can be checked The paper discusses the various sources of error that are likely to arise in the measurement and their possible magnitude. It makes out a good case for the new method as compared with existing methods, and it seems desirable that the method should be tried. One of the principal difficulties will evidently lie in the precise determination of the moment of inertia of the swinging system, including the swinging entangled air. Fortunately this moment of inertia appears under a radical sign in the final formula for the current strength, so that a given percentage of error in estimating the moment of inertia would produce only half that percentage of error in estimating the deduced current

Westinghouse Annual Report.

The report of the Westinghouse Electric & Manufacturing Company for the year ended March 31, 1911, is of exceptional interest owing to the account in detail given of the European affiliated companies. A résumé of the purely financial portion of the report will be found in the department of "Industrial and Commercial News."

The gross earnings during the year were $38,119,312, an increase of almost $9,000,000 over the previous year, the net manufacturing profit being $5,608,765, or an increase of about $2,000,000 during the same period. The interest charges were $1,585,487, a decrease of about $103,000, and the net surplus, $4,881,105, an increase of $1,821,000.

The assets reported aggregate $82,395,570, the principal items being as follows: Property and plant, $17,692,145; patents, charters and franchises, $6,074,485; working and trading assets (raw material, work in progress, goods on consignment, etc.), $14,321,474; investments (including stock, bonds, notes, etc., of affiliated and subsidiary companies), $24,034,365; cash, $6,634,677; notes receivable, $2,946,551; accounts receivable, $9,494,731.

The report points out that the year's business, both in gross earnings and net income, is the largest in the history of the company; and, as the past year was a period of somewhat less than normal activity in other lines of industry, the showing affords a sound basis for continued hope in the future of the electrical manufacturing industry, and in the maintenance by the company of its position in that field. On the other hand, the volume of business now offering is on a diminishing scale, the volume of unfilled orders as of March 31, 1910, being $11,256,196, as compared with $7,616,058 as of March 31, 1911. The results of last year are thus no certain indication of a continuance for the future of gross earnings and profits such as the past twelve months have produced.

The statement is made that the patent agreement entered into with the General Electric Company March 31, 1896, expired by limitation on April 30, 1911, and that no renewal is contemplated. Patent license agreements with other manufacturers under which the company has been working for some years have recently been canceled, on the suggestion that they might be questioned as being in violation of the federal anti-trust laws, notwithstanding that they were originally made and have been maintained under the advice of counsel that assured the company of their validity.

In order to strengthen the company's position the directors have authorized a considerable increase in the expenditures of the selling organization in order to increase the number of salesmen in the field, for remuneration to representatives adequate to secure the best efforts on their part, for the extension of advertising and to provide for proper warehouse facilities for carrying stocks at distributing points. While this has added considerable to the aggregate selling expenses, the action has been justified in increased volume of business. The report states that it is a matter of simple computation, on the basis of the operations for the past two years, to ascertain the point at which the volume of gross business fails to provide a surplus over operating expenses and fixed charges, and it is vital that the business shall not drop to that point.

With the same purpose in view fairly large expenditures have been authorized for the work of new development and for improvements in types of apparatus, such as the redesigning of direct-current motors, alternating-current and direct-current mill and crane motors, small power motors, high-speed turbo-generators, circuit-breakers, railway equipment and heating and cooking apparatus. The cost of new development and redesigning is charged monthly as a part of the current cost.

Reference is made to the Newark plant which now owns practically all of the city square on which the factory is located. An extension now being built will increase the floor space about 30 per cent. Additions have also been made to the Bridgeport (Conn.) and the R. D. Nuttall plants. In anticipation of the termination of the lease on premises in which the present iron foundry is located, and also because the plant is poorly adapted to the company's needs, plans have been completed for the erection of a new foundry at Trafford City, about 6 miles east of East Pittsburgh, where approximately 63 acres of land have been acquired for this and other possible purposes. For the purpose of insuring communication between the proposed new foundry and the East Pittsburgh plant, 60 per cent of the capital stock of the Interworks Railway Company has been acquired. The proposed foundry and pattern plant at Trafford City will cost approximately $1,250,000.

During the past year a complete inventory and appraisal was made of the buildings, machinery and equipment of all the company's plant, and also of the real estate owned by the company. The appraisal of the buildings, machinery and equipment was made to ascertain, first, the cost to reproduce the same as new and, second, the present sound values, after charging against reproductive cost the depreciation of machinery, buildings and equipment.

After a thorough discussion in detail of the assets and liabilities of the company, and taking into account the elements of uncertainty as to the immediate future of the company's business, the need for cash for new foundry facilities, for the extension of the Newark plant and other factory improvements and the necessity of making wide provision for shortly maturing obligations, it is stated that the directors have felt that it is not wise at the present time to weaken the company's position by diverting its surplus earnings, even in part, to the payment of dividends on the assenting stock. Whenever changed conditions shall allow the directors to feel that a change of attitude can safely be assumed, the question will be reconsidered and determined in the light of such a change.

The report discusses in detail the various items of the balance sheet and in particular gives full details concerning the investments in affiliated and subsidiary companies.

The subsidiary companies consist of the Westinghouse Lamp Company, the Bryant Electric Company (the Perkins Electric Switch Manufacturing Company), the R. D. Nuttall Company and the Westinghouse Electric & Manufacturing Company. The ownership by the Bryant Electric Company of all the capital stock ($125,000) of the Perkins Electric Switch Manufacturing Company is carried on the books of the Bryant Electric Company at $2,000,000; this item is included in the consolidated balance sheet, after deducting the par amount of the outstanding capital stock, at $1,875,000, which item, it is said, can be considered as having value only as goodwill.

The first foreign Westinghouse company, organized July 11, 1889, was the Westinghouse Electric Company, Limited, a corporation of Great Britain. The entire issue of capital stock of this company was carried as an investment on the books of the American company at an aggregate value of $1,773,084, this representing the expenses incurred from 1889 to 1906 in the efforts to establish the manufacture and sale of the company's products in foreign countries. On March 31, 1910, the assets of the company consisted of practically the patents owned by it in various European countries and of certain licenses granted by it under some of its patents. The income had long been insufficient to pay the expenses of the operation of the company and the up-keep of its patents. During the year ended March 31, 1910, the directors wrote off from the book value of this item $773,084, and during the fiscal year just ended an additional $500,000, leaving the present book value $500,000. It is added that further depreciation of this item must be contemplated.

The next foreign company, organized July 10, 1899, was the Westinghouse Electric & Manufacturing Company, Limited, a corporation of Great Britain, which constructed and equipped immense works for the manufacture of electrical apparatus, steam turbines and gas engines at Trafford Park, near Manchester, England. The preference shares and mortgage debenture stock were sold for cash at substantially par, and the aggregate of the face value, or $18,145,562, represents approximately the amount of money spent in producing the facilities of the British company and in paying the losses incurred in its operation prior to 1907. Its operations, it is stated, have been quite uniformly unprofitable. Several reductions have been made in the capital of the company, and a further reduction seems to be forecast by the necessity for providing for the payment of an award against it, aggregating with costs about $485,000, in an arbitration proceeding recently decided between the British company and the London Underground Railway. The American company owns preference shares of the British company to the face value of $2,600,143; ordinary shares, $922,615, and mortgage debenture stock, $3,273,750. Of these, the ordinary shares do not appear on the books of the company as an investment of any value. The preference shares, having a par value of $2,600,143, were carried as an investment until 1910 at a book value representing the original cost of acquisition, or $4,458,083. On March 31, 1910, there was written off as depreciation of this item the sum of $3,564,563, leaving the present book value $893,520. This corresponds to the present market value of the shares on the London Stock Exchange. The debenture stock, having a par value of $3,273,750, is carried on the books as an investment at the cost of acquisition, $3,137,104. This yields a return of 4 per cent on par. Recent sales on the London Stock Exchange have been at the price of 62 per cent of par.

On Nov. 28, 1901, the Société Anonyme Westinghouse, of Paris, was organized, which company operates a factory at Havre, where it manufactures a general line of electrical apparatus and certain condensing apparatus for steam engines and turbines. It also has a factory at Freinville, near Paris, for the manufacture of Westinghouse air brakes. Its territory includes France, Belgium, Holland, Switzerland, Spain and Portugal. The operations of the company are stated to have been steadily unprofitable, and, while it earns and pays interest on its debentures, it was only in the year 1908 that it paid dividends on its preference shares. Of the outstanding capital of the French company the American company owns preference shares to the par value of $893,348; ordinary shares, $556,563, and 5 per cent debentures, $1,447,500. During the receivership of the American company the court authorized the receivers to advance money to the French company, and in 1909 preference shares to the value of $671,398 were purchased at par. The debentures of the French company are now carried on the books as an investment at cost, aggregating $1,430,730. The preference shares are likewise carried at cost, aggregating $896,536. Prior to March 31, 1910, the ordinary shares were carried as an investment at cost, $494,032; during the year ended March 31, 1910, there was written off for depreciation of this item $275,057, and during the last fiscal year a further sum of $218,974, leaving the book value of the ordinary shares at $1. It is believed that with careful management the debenture and preference shares of the French company may be made worth their face value.

On March 11, 1907, the Societa Italiana Westinghouse was organized. It constructed a factory at Vado, Italy, for the primary purpose of executing important contracts for the electrification of certain of the Italian street railways. Delay by the Italian government in carrying out its program for the improvement of its railway lines has temporarily disappointed the expectations with which this company was organized and its plant created, so that it is now looking to the general market for orders for electrical apparatus to keep its works in operation. The amounts advanced by the American company appear in the balance sheet under the items notes and accounts receivable at $289,746. For the purpose of capitalizing certain advances recently made to it by the French company and the American company the Italian company is about to create an issue of $772,000 of 5 per cent debentures, of which approximately $289,500 will be received by the French company and $482,500 by the American company. In 1908 the net surplus of the Italian company was $32,953; in 1909, $45,782, and in 1910 there was a loss of $32,940.

In July, 1906, the Société Electrique Westinghouse de Russie was organized, primarily to execute a contract amounting to over $5,150,000 for the electrification of St. Petersburg tramways. Upon the organization of the Russian company the American company advanced to it sums aggregating $895,888, of which there remains due $290,000. The American company purchased from the Russian company 5 per cent debentures at a cost aggregating $2,243,243, and subscribed for its shares an aggregate of $696,322. Of the "apport" shares the American company owns $198,962. The Russian company owes the American company on open account for material, $32,355, and unpaid interest on debentures aggregating $324,324. The total investment in and accounts due by the Russian company at the close of the last fiscal year, therefore, amount in the aggregate to $3,785,207.

As of March 31, 1910, the investment in the cash and "apport" shares was written off to $1 for each class of shares, leaving the book value of this investment $2,243,245, a further depreciation of which may be required. Other items carried against the Russian company are, accounts receivable, $32,355, and notes receivable, $290,000. The execution of the St. Petersburg contract resulted in a loss of approximately $1,030,000, and in its other operations the losses to the Russian company have aggregated $815,978, the aggregate to date being, therefore, in excess of $1,800,000. There are other losses not yet definitely ascertained, due to the difference between the actual value of the Moscow plant and the price paid for it, and to depreciations occurring since the property was acquired not entered on the books. The city of St. Petersburg is withholding from the amount due by it to the Russian company an aggregate of over $360,500, by way of fines imposed for alleged delays in the performance of the contract, and the company is urging a large claim for extras. It is said that there is reason to hope that the fines may be substantially remitted, but until these disputes are adjusted and payment is made it is impossible to predict how much of the investment in the Russian company can be realized. To maintain the company as a going concern advances approximating $110,322 to March 31 were made, being secured by mortgage. During the past year improvement in the operation and increase of the business of the Moscow plant have encouraged the hope that it may at least earn its operating expenses.

On Sept. 6, 1906, an Austrian company, the Westinghouse Metallfaden-Gluhlampen-Fabrik Gesellschaft, was organized, which operates a factory for the manufacture of tungsten lamps near Vienna. Of the outstanding capital stock of the company, $324,800, the American company owns $249,690, which is carried among investments at the cost of acquisition, aggregating $250,626. The shares of this company are stated to be safely considered worth their par value.

At the same time the Austrian lamp company was organized the Westinghouse Metal Filament Lamp Company, Limited, was organized in Great Britain with a capitalization of $48,500, 80 per cent of which is owned by the Westinghouse Lamp Company and carried on the books at $38,800. This company was organized to control the patents covering the tungsten-lamp manufacturing processes for the territory outside of that of the Austrian lamp company, and it is believed that the book value of the investment will be realized.

The Canadian Westinghouse Company, Limited, has issued $4,376,600 of capital shares, of which the American company owns $1,710,000; of this $500,000 was acquired in consideration of the transfer of patent rights and manufacturing information for Canada, and $1,210,000 for cash. The shares are carried on the books as an investment at par, $1,710,000. The Canadian company has been uniformly and increasingly successful and has paid dividends regularly since 1903 at the rate of 6 per cent per annum, with an extra 1 per cent for 1910 The shares may therefore be considered worth in excess of their book value.

Of the capital stock of the Westinghouse Machine Company the electric company acquired $250,000 par value as part consideration of adjustment of relations. These shares were taken on the books at the time of the acquisition at a value of $218,538, and they are now carried on the books at a value of $125,000.

The company holds $500,000 of 5 per cent mortgage bonds of the Nernst Lamp Company, which comprises in part money advanced and materials furnished to that company, and in part an unpaid balance on the sale to it of a factory building. These bonds are carried on the books at par. All of the capital stock of the Nernst Lamp Company is owned by the Westinghouse Machine Company.

In 1901 the Traction & Power Securities Company, Limited, was organized in Great Britain as a securities-holding company and has an outstanding capital of $4,142,385 in ordinary shares. Its assets consist of $3,007,000 par value 4 per cent prior-lien debentures of the Mersey electric railway, which earns a small surplus over and above the interest on its debentures, the market value of which is 81, and $1,670,679 par value ordinary shares of the Clyde Valley Electrical Power Company, which owns and operates two power plants on the Clyde River, near Glasgow, Scotland. Work under way will involve a further expenditure by the latter of $970,000, secured by mortgage to the Traction & Power Securities Company. The receivers of the American company acquired at par $820,377 of the capital stock of the Traction & Power Securities Company, the value of which depends upon the receipts of the Mersey Railway and the Clyde Valley Electrical Power Company. It is believed that eventually the stock may be worth substantially par, and it is carried on the books at a value of $820,135.

The Westinghouse company owns $912,000 par value of the first-mortgage 5 per cent bonds and $1,000,000 par value of the 5 per cent coupon notes of the Niagara, Lockport & Ontario Power Company, and owns or controls substantially 55 per cent of the outstanding capital stock of that company. The bonds are carried on the books at a value of $912,000, the notes at a value of $907,219, and the stock at a value of $2. The Niagara company is earning and paying interest on its notes and its bonds, and its business shows a continuous growth. It would seem, therefore, that the book value of the investment that has been made in the securities of this company should eventually be realized.

On Oct. 1, 1907, the company acquired $400,000 of the capital stock of the Atlanta Water & Electric Power Company, which is carried on the books at cost. This company, which operates a hydroelectric plant near Atlanta, Ga., earns a surplus over and above the 4 per cent dividend paid on its stock, and the book value of this should eventually be realized, although there is at present no market for the shares.

On various dates in 1904 and 1908 the company acquired at par bonds of the Lackawanna & Wyoming Valley Rapid Transit Company of an aggregate face value of $6,174,000. On March 31, 1911, $2,000,000 was written off, thus making the present book value $4,147,042, at which value it is hoped that the investment may eventually be liquidated. The company also owns $4,885,600 of the capital stock of the traction company, which is carried on the books at a value of $1. The company's net earnings have never been sufficient to pay the entire interest on its outstanding bonds.

The report states that the only item on the liabilities side of the balance sheet that calls for any comment is that of collateral notes, of which $4,000,000 are now outsanding. A description of the securities comprising the collateral for these notes is given, followed by the statement that, with the possible exception of the shares of the assenting capital stock of the American Westinghouse Company ($950,000), the collateral securing these notes is not readily salable. The company therefore must contemplate the necessity, as these notes mature, either of extending them with the same collateral or providing other means of meeting them than through the sale of the collateral. There can, it is added, be but two such other sources, namely, first, through the issuance of additional capital securities, by way of bonds secured by stock, or, second, through the use of the company's earnings.

Cleveland Federal Incandesent Lamp Suit.

The twenty-six companies made defendants in the action brought by the government authorities some time ago for the purpose of dissolving an alleged trust have filed answers in the United States Circuit Court at Cleveland, Ohio, which deny every allegation charging them with being parties to a combine in restraint of trade. No date for a hearing has been set.

Convention of National Electrical Contractors' Association.

The eleventh annual meeting of the National Electrical Contractors' Association will be held in Niagara Falls, N. Y., on July 19, 20 and 21, with headquarters at the International Hotel. It is expected that the convention will be the largest in the history of the organization, as the membership of the association has increased more than 80 per cent in the last twelve months.

A number of outside speakers will address the open sessions to be held on June 19 and 20. Among these will be Mr. F. E. Cabot, of Boston, who will speak on the work of the National Fire Protection Association; Mr. Arthur Williams, of New York, who will speak for the National Electric Light Association: Mr. Franz Neilson, of New York, who will speak on the subject of "Credit Protection for Electrical Contractors," and Mr. E. E. Whitehorne, of New York, who will speak on "Business Getting for the Contractor."

There will be visits to the Niagara Falls power house and the Catholic College grounds, a trip upon the Gorge electric railway, a baseball game and other entertainment features.

Electrical Operation of Drawbridges.

There are thirty-one electrically operated drawbridges in Chicago, nearly all of them spanning the Chicago River and its branches. These bridges are operated by 550-volt direct-current motors, and as the Commonwealth Edison Company has not supplied 550-volt direct current since 1904 it is necessary to obtain electrical energy for the bridges from some other source. The supply has been and is obtained from the surface electric railway companies of the city, which purchase alternating current at wholesale rates from the Commonwealth company and convert it into 550-volt direct current for car operation. The railway companies are paid a flat rate of $50 a month for the operation of each bridge. In a recent cummunication to the City Council Mr. Thomas G. Pihlfeldt, engineer in charge of bridges, gave a table showing the consumption of electrical energy at the bridges and concluded that the flat rate of $50 a month is a reasonable one, as it compares favorably with the cost of steam operation, which averages about $63 a month for swing bridges in Chicago.

Postal Telegraph Company Enters Telephone Field.

The Postal Telegraph Company has announced that as the result of experiments on some of its far Western trunk lines with simultaneous telegraphy and telephony it will enter the telephone field, employing its trunk telegraph lines to transmit also telephone messages. It is stated that Salt Lake City is to get the new telephone service first, which later will be extended through the great Northwest by way of San Francisco, Spokane, Billings and Great Falls, Mont. A business rate of from $48 to $60, and a residence rate of from $15 to $30 a year, will, it is said, be charged for this service, which will be operated with automatic instruments. The Postal has put into operation between Salt Lake City and San Francisco two new lines which cost $2,000,000.

Medina Valley (Mexico) Hydroelectric Plant.

The project inaugurated by Dr. F. S. Pearson, of New York, and associates for the purpose of irrigating about 60,000 acres of land in the Medina Valley and the installation of a hydroelectric plant is now in course of execution. The holding company is the San Antonio Land & Irrigation Company, recently organized, and stock to the amount of $6,000,000 has been taken in Canada and England, the shareholders being practically the same men who are largely interested with Dr. Pearson in the large Necaxa hydroelectric project near the City of Mexico and in the ownership of the Mexico Northwestern Railroad and very large timber and lumber mill interests in Mexico. The subsidiary operating company is the Medina Irrigation Company, which has just been organized with headquarters in San Antonio. The directors of the subsidiary company are Mr. C. H. Kearny, chief engineer of the Pearson interests in Mexico; Messrs. T. B. Palfrey, C. C. Cresson, Franz Groos and William Aubrey, all of San Antonio. Mr. A. W. K. Billings, of New York, is on the ground as engineer in charge, and has general supervision of the engineering and construction work. Preliminary work looking to the construction of a dam across Box Canyon of the Medina River at a point 26 miles north of Dunlay has been in progress for about eight months. The company is now constructing a railroad from Dunlay to the site of the dam. This 26-mile line will connect with the Southern Pacific Railroad at that place and it will be finished early in July. An army of men is already employed in clearing the land, surveying the lines for the canals and ditches and in other preparatory work.

The dam across Box Canyon, which will be 160 ft. high, will be of stone and reinforced-concrete construction. It is estimated that the cost of equipment that will be necessary for the construction of the dam will be more than $200,000. Two cableways will be strung across the canyon, each capable of depositing 10-ton stones and loads of smaller stone and concrete at any part of the dam. Ten large derricks will supplement this equipment. Running down the sides of the canyon will be two inclined railways for delivering material. A rock-crushing plant capable of producing 200 tons of crushed stone per hour and a large crushing plant for the purpose of making artificial sand will be installed. A concrete-mixing plant with a capacity of 150 cu. yd. of concrete per hour will also be placed at the dam site. The machinery for the different plants and equipment will be operated by a steam-power plant. A temporary electric-light plant for affording light for the construction camp and for carrying on night labor at the dam will also be installed. It is estimated that 200,000 bbl. of cement will be required for the works.

Preparations are being made for opening up a large rock quarry near the site of the dam. The company will equip this quarry with two locomotive cranes for loading the 10-ton blocks of stone on cars. In some places the canals will have to be carried long distances through concrete flumes. The main dam will be supplemented by a diversion dam, 4 miles below. This second dam will be 60 ft. high and 800 ft. wide The main reservoir will cover a surface of 5000 acres. The company expects to develop a large amount of electric power, which will be transmitted to San Antonio and other towns, but this feature of the enterprise is as yet in a preliminary stage

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Progress on Boston Elevated Power Extensions.

Active work is being pushed upon the large turbine plant which is being built for the Boston Elevated Railway Company at South Boston, Mass., under the direction of the Stone & Webster Engineering Corporation, of the same city The initial capacity of the plant will be three 15,000-kva turbo units, generating electricity at 13,200 volts, three-phase, 25 cycles, for transmission to numerous substations in Boston and its suburban districts. The foundations of the plant have been carried forward sufficiently far to permit the erection of a portion of the steel frame, and the first generator is nearly ready for shipment from the factory of the General Electric Company, which has secured the contract for this apparatus. Auto-transformers will be used in connection with the generators to minimize the effects of short-circuits. The plant will be provided with coal stored in a field of probably over 100,000 tons capacity, located on tidewater with ample facilities for the most efficient handling. In connection with the distribution of power to substations the company has recently placed an order with the American Steel & Wire Company, of Worcester, Mass., for what is probably the largest amount of cable ever purchased on a single specification, nearly 67 miles of No. 0000 copper cable of the paper-insulated, lead-covered type being selected. The Boston Elevated Railway Company has recently added a third 1000-kw rotary converter to its Egleston Square substation, now receiving power from a converter turbo-generator in its Dorchester station. In connection with the new O Street station in South Boston underground trunk line conduits will be run to substations located at Egleston Square, capacity 5000 kw; Roslindale, 2000 kw; Coolidge Corner, 4000 kw; Kendall Square, Cambridge, 2000 kw; Arlington, 2000 kw; Malden, 4000 kw, and East Boston, 2000 kw. Power will be supplied in part from the Kendall Square substation to the new subway now being built in Cambridge by the railway company; from Malden to the extension of the elevated railway service from Sullivan Square northeast, and from Egleston Square to the Forest Hills elevated extension, now in operation. A very considerable rearrangement of the feeder system will be required, and the adoption of the service from the new station will initiate a complete change in the system of power generation in Boston, which has for many years been supplied with energy for street and elevated-railway service from scattered direct-current generating stations located at important load centers, with tide-water coal-handling facilities in the majority of cases.

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June Meeting of the New York Section of the Illuminating Engineering Society.

At a meeting of the New York Section of the Illuminating Engineering Society on June 8 two papers were presented by Mr. Sydney W. Ashe. In one paper was described the course in illuminating engineering provided by the General Electric Company for forty-three college graduates who are employed in the Harrison lamp works of the company. The other paper related to the comparative performance of various illuminants, including gas lamps, mercury-vapor lamps, arc lamps and incandescent lamps. An abstract of this paper is given elsewhere in this issue.

The discussion was participated in by Messrs. W. A. Evans, Cooper Hewitt Electric Company, Hoboken, N. J., P. S. Millar, Electrical Testing Laboratories, New York; B. F. Fisher, Westinghouse Lamp Company, Bloomfield, N. J.; Norman Macbeth, Westinghouse Lamp Company, Bloomfield, N. J.; H. T. Owens, *American Gas Journal*, New York, G. H. Stickney, General Electric Company, Harrison, N. J.; S. G. Rhodes, New York Edison Company, N. Y., and S. L. F. Rose, General Electric Company, Schenectady, N. Y.

Mr. Evans remarked that the particular mercury-vapor lamps tested by the author were seven years old and did not represent modern practice. He claimed that there is no "smashing point" for mercury-vapor tubes, and cited the case of one tube that has been in use for 56,000 hours.

Mr. Millar said that the only satisfactory method of eliminating commercial bias from the comparison of the light output from lamps is to rate the lamps on the total lumens basis and employ certain utilization factors for determining the relative amount of light delivered on the working plane.

Mr. Macbeth explained that the 70 per cent factor relating to gas lamps is in reality a utilization factor as defined by Mr.

Millar and not a time reduction-in-light factor as implied by the author.

Mr. Stickney called attention to the fact that an arc lamp may deliver an increased amount of light after being in service for a few hours by reason of the change in position of the arc as the electrodes are consumed.

Mr. Rhodes stated that the life of the arc-lamp electrodes specified by the author is the theoretical value and not the length observed in operating installations.

The following section officers were elected: Mr. Bassett Jones, Jr., chairman; Mr. A. J. Marshall, secretary; Dr. H. H. Seabrook and Mr. H. T. Owens, managers.

Meeting of Electric Vehicle Club at Boston.

Regular weekly meetings of the Electric Vehicle Club of Boston were resumed on June 7, following a brief interim due to the recent convention of the National Electric Light Association. Mr. P. E. Whiting, of the S. R. Bailey Company, presided, and after the usual luncheon Secretary Gibbs exhibited advertisements which the Boston Edison company is publishing in forty-six suburban newspapers in the Boston district, featuring the electric vehicle and emphasizing the company's sponsorship of it. A large sign will be installed at Mattapan, on the famous Blue Hill automobile and electric car route, and another in Chelsea, in full view of the Revere Beach Boulevard. The work is being carried forward under the direction of the company's construction bureau, for the reason that special consideration is to be given to mechanical and electrical details. It was also announced that the company is prepared to expend from $2,500 to $10,000 upon a moving sign advertising electric pleasure and commercial vehicles.

The committee on parades reported that fifty-seven electric trucks and pleasure vehicles were operated in the Memorial Day procession in Boston. Successful moving pictures were taken of the machines in the Copley Square district and extended use is to be made of these later in furthering the development. Mr. Day Baker announced that in March, 1912, the Commercial Truck Dealers' Association of Boston is to hold a show, and it is planned to establish an extensive electric truck department in connection with this. Mr. W. H. Atkins, Boston Edison company, said that in the near future a tent equipped with electrically driven farming implements is to be fitted up and exhibited for fortnightly periods throughout the company's territory of nearly 600 square miles. The equipment and tent fittings will be transported from place to place by electric trucks, and electric delivery wagons will form a part of the exhibit.

Mr. E. S. Mansfield urged the importance of dealers' sending in lists of prospective customers for electric vehicles so that the Edison company may add the weight of its recommendations on behalf of this type of transportation. Secretary Gibbs then announced that a supply of pennants 20 in. wide by 10 in. long, marked "Use Electric Vehicles—Business and Pleasure," will shortly be ready for distribution in Boston for service on dealers' and company cars. The committee on co-operation with the Boston Edison company sent in a report advocating the liberal extension of lines without guarantee or deposit where a reasonable amount of electric-vehicle-charging business is in sight. It was announced that the company is prepared to lease charging sets of the mercury-arc rectifier type to persons trying out electric vehicles, for the nominal price of $5 per month, the money to be credited in case the party later purchases the equipment. The person using the rectifier pays the cost of installation. The assistance of the sales department is offered to facilitate the determination of exact cost of charging vehicles under specific conditions, expressed on a kw-hour basis.

Mr. Fred H. Smith, manager of the Worcester Electric Light Company, described the conversion of a portion of an old boiler-room into a garage, and stated that active preparations are being made to push this class of service. The committee on rates reported that there are now about 150 charging points within easy reach of Boston. The rates vary from 2 cents to 12 cents per kw-hour, the smallest charge being in a water-power plant and the average being 9 cents to 10 cents. Emphasis was laid upon the importance of assembling complete charging station data for New England and the co-operation of the New England Section Information Bureau of the National Electric Light Association was assured, the headquarters being in the Edison Building, Boston. Mr. Day Baker, Boston, outlined the interest shown in the electric vehicle at the recent N. E. L. A. convention. He had recently had an interview with Mr. Thomas A. Edison, who expressed great interest in the work of the Electric Vehicle Club. Mr. R. S. Hale, Boston Edison company, cited the increasing use of electrical equipment in the fire departments of Hanover and Berlin, as has been noted in these columns. Remarkable economies in operation have been shown in comparison with the cost of horse traction for fire-department service, including the handling of the apparatus more rapidly and effectively in times of emergency. In Berlin a saving of about $20,000 per year will shortly be effected by the use of twenty electromobile units of four pieces of apparatus each. Mr. Baker cited the successful use of an extension-ladder truck and chemical engine of the electric type in the Springfield (Mass.) fire department, notwithstanding early opposition in the town before the apparatus was purchased. Energy is supplied by the United Electric Light Company at a rate of 4 cents per kw-hour. The grades found in the town do not prove serious.

Meeting of Boston Edison Section, N. E. L. A.

A meeting of the Boston Edison Company Section of the National Electric Light Association was held in Boston on June 8, with Chairman R. E. Curtis presiding, "Trouble on Overhead and Underground Lines" being discussed from the outside standpoint by Mr. James A. Vahey and from the point of view of the station by Mr. Pierce Kent, chief operator of the alternating-current system. The practical character of the discussion aroused much interest.

LINE TROUBLES FROM THE MAINTENANCE STANDPOINT.

Mr. Vahey pointed out that the maintenance of lines department in Boston has at all hours in all parts of the territory men specially trained in hunting down line troubles. Reports of defects occurring can be transmitted at any hour to every man who is responsible for the clearing of trouble, usually by telephone. The closest co-operation is practised between the generating department and the employees of the maintenance department. The company serves an area of nearly 600 sq. miles. Pressure wires are run from all substations on the Edison direct-current system to the terminal boxes under the streets, so that the operator may at any time know the pressure delivered at the farther end of the feeder. Trouble on the three-wire, direct-current system is shown by an abnormal load on either or both outside legs, the neutral being operated grounded at all times. The feeder at fault is first determined by opening the switch in the substation or generating plant. Copper catches are provided in the terminal boxes to facilitate tests of voltage. A trouble on the mains can be traced by testing at the different services between boxes. If the fault lies between the box and the station, it becomes necessary to dig down to the tube and cut it open, making tests on both sides of the cut, and continuing this method until the fault is located.

LOW-TENSION DIRECT-CURRENT SYSTEM.

Much the same method is pursued in case of trouble on the pressure wires. Sometimes a pressure wire has a loose or slipped connection which is remedied by using a current-consuming device, such as a bank of lamps, which will cause the loose connection to weld solid and perhaps burn open. In case a feeder feeds back pressure, but will not carry a load, by cutting into the tube between the terminal box and the station and using test lamps, it can be determined by the difference in voltage on which side of the cut the fault lies. Although the pressure is low, and is not considered dangerous, there is no little danger from the flash in lifting the catcher on a heavy short-circuit. A knowledge of the soil is helpful. Electrolysis is the chief enemy of the tube system.

STREET-LIGHTING SYSTEM.

Trouble in the street-lighting system consists of opens, grounds, short-circuits and crosses with other live wires. A daily test is made of the insulation resistance of all circuits supplied directly from the main generating plant in South Boston. During the day a direct-current generator in the station delivering 500 volts with a small current output is used in the location of faults, a single spark showing in proving a loop or testing to ground. The operator makes any connections which are designated by the troubleman. At night, if the trouble is overhead, grounds and short-circuits can be traced by patrolling. For the location of faults in underground cables the use of interrupted current has long been in vogue, for both alive and dead circuits. The interrupted current is applied at regular intervals by hand between the grounded cable and earth, the cable being explored with coil and telephone receiver. On account of the incasement of the Edison direct-current tubes in interconnected iron pipe, the results of this method of testing proved so inaccurate in the direct-current service that it has been abandoned.

TRANSMISSION TROUBLES.

Transmission-line troubles are the most serious on account of the large amount of energy involved, the high voltage employed and the commercial importance of continuous service. With circuits of 2300 volts and 4000 volts potential it is possible by the use of a separate bus and one-to-one transformation to continue a grounded circuit in operation, while any trouble on a 6900-volt or 13,800-volt line means that the line is out of commission until the fault is repaired. If the line is overhead and underground in its makeup, it is determined as soon as possible in which section the fault lies. To facilitate this the company has recently installed high-tension sectionalizing oil-switches directly on the lines, where the circuits have taps to different substations, and in one long circuit an oil switch is installed at the midway point in a manhole. The switches on the overhead lines are mounted within easy reach of the linemen and can be operated alive in emergencies. They save a great deal of time in localizing trouble and in cutting down hours of patrolling. Having discovered the section in which the fault occurs, the rest of the line is placed in service and the fault located by inspection of terminals, potheads, manholes or overhead services. If a heavy current is forced through a fault danger exists of burning out other cables near the affected one or of destroying by combustion the conducting path through the insulating medium. When all other methods fail recourse must be had to the cut-and-try method, which consists of opening the cable and testing from the station end. The magneto is used to some extent on street-lighting circuits in suburban districts, but is very unreliable where there is a great deal of underground cable in the circuit. The speaker exhibited an exploring coil and telephone-receiver equipment which he had devised which can be used with either alternating current or direct current on short-circuits, grounds and opens, on overhead or underground lines, on live lines or dead, and also to pick out the different legs of a circuit without opening them.

INSPECTION.

Special attention is given in Boston to the prevention of troubles on the distributing and transmission circuits. Transmission lines are rigidly inspected and patrolled. On the low-tension direct-current service the catch boxes are regularly examined, cleaned and sealed. Manholes are regularly inspected and the water is removed, and all overhead sections of the transmission lines are inspected daily. Transformer oil is tested periodically for moisture.

LINE TROUBLES FROM THE STATION VIEWPOINT.

Mr. Kent stated that there are forty-six series-arc circuits supplied from the South Boston station, operating at potentials varying from 3000 volts to 8000 volts. About 75 volts per lamp are allowed. Three tests are made daily while circuits are out of service, one being with a voltmeter to see if there are any direct-current crosses, another with a 50-watt, 2300-volt to 110-volt transformer, with a lamp in the secondary to determine if any alternating-current crosses exist, and a third with 500-volt direct current supplied from a small motor-generator set to determine whether circuits are open or not, and for the purpose of locating any grounded circuit.

ARC-CIRCUIT TESTS.

After all circuits are started in the evening a voltage test is made to see if each line has the proper number of lamps burning, and a voltage test is also made by connecting the positive side of the line to ground through the voltmeter and then the negative side and noting by the voltage readings the number of lamps in service. If the sum of these readings is equal to the total reading on the circuit it is reported to the proper parties as grounded and the trouble located. Two grounds on the circuit are indicated by the shifting of the brushes and a change in the position of the contact arm on the field rheostat. A swinging short-circuit or intermittent double ground causes flashings at the brushes and their continual shifting. A cross with an alternating-current or direct-current line is indicated by violent flashing at the brushes or the possible breaking down of insulating bushings on various parts of the dynamo, a burn-out of an armature bobbin or the grounding of it on the core. This usually requires cutting out of service, and tests are made with the transformer and then with the voltmeter. The arc circuits at South Boston are protected by static dischargers.

ALTERNATING-CURRENT LINE TROUBLES.

Four 2300-volt distributing circuits and eleven interstation lines are supplied from the main plant, the bus being equipped with electrostatic ground detectors. Grounds are located by transferring each distributing circuit separately to an auxiliary bus, which is supplied from the regular bus through a bank of transformers of 2300 volts to 2300 volts winding. If the ground is located on one of these services it is allowed to remain on the auxiliary bus and a report is made to the proper parties. Otherwise the interstation lines are cleared one at a time, the load being transferred in the process. When a ground appears it is indicated on the ammeters of some single service by their rapid fluctuations. A short-circuit due to two grounds or a cross is immediately indicated by the opening of the circuit-breaker. When this trouble occcurs the line is again tried on the auxiliary bus through the transformers, and if the breaker opens it is reported. Ten interstation lines are operated at 6900 volts. The troubles are similar to those on the 2300-volt service. Besides the electrostatic detectors each line is equipped with the Torchio type of ground detector, which indicates the line on which the ground exists. The principal parts are a specially designed series transformer mounted on the standard three-conductor cable at the end bell, and an ordinary telephone relay and drop. The relay winding is connected to the secondary of the series transformer, and the number of the line on which the transformer is mounted is painted on the drop. Under normal conditions, when no ground exists no current flows in the end sheath of the cable, and the relay remains inactive. The moment a ground develops current flows in the lead sheath, the relay is energized by the secondary current from the transformer and the drop falls. The best results are obtained when two or more lines are operated in multiple from the same bus. On this class of service when a single ground develops another quickly follows, causing a short-circuit, the line then being automatically cut clear of the system. In that case a test with separate generator is made to determine on what section the trouble exists, provided some section switch in a substation has not already opened.

The 13,800-volt service is supplied by four lines from South Boston, the troubles being similar to those on the 6000-volt lines, but more violent. Each line is equipped with the Torchio detector. Since this service was installed there have been but two cases where a single ground developed where the section in which it existed was located and cut out before a short-circuit occurred. Three of the substations supplied from 6900-volt and all from the 13,200-volt service are equipped with aluminum-cell lightning arresters. After troubles are remedied a test is made on a separate generator at maximum running voltage from five to thirty minutes before the line is placed in service. The company also numbers the phases of all lines, taking the station bus as a basis, checking to correspond in the substations, so that corresponding conductors can be found and placed in the proper phase when connecting back into service.

Electrical Growth in Boston.

The recently published report of Wire Commissioner James E. Cole, of Boston, shows that substantial gains are being made in the electric-service facilities of the city from year to year. On Jan. 31, 1911, the total rating of steam boilers in Boston electric power plants was 150,515 hp, compared with 147,846 hp in 1910; the rating of engines, including steam turbines and gas engines, was 226,189 hp, as against 223,504 hp the year before, and the rating of electric motors in service was 342,188 hp, compared with 331,763 hp in 1910. The number of electric motors increased in the year from 19,658 to 20,904, and the average size of electric motors decreased from 17.4 hp to 16.3 hp, showing that the smaller user is tending to avail himself more and more of electric service. Practically all the increase in total motor horse-power utilized was effected in central-station and isolated-plant service, the total rating of the motors of the Boston Elevated Railway Company being nearly identical in both years, or 271,545 hp. The use of central-station power increased much more rapidly in the year than the application of motors to isolated-plant service. The Edison Electric Illuminating Company gained about 8500 hp in motors, the isolated-plant gain being about 1300 hp. The present rating of motors in Edison service is 52,147 hp, the isolated-plant motors figuring 15,984 hp. The Edison company maintains the largest generating rating in the city, its prime movers being rated at 99,200 hp, with the Boston Elevated Railway Company second with 74,950 hp, and isolated plants third with 50,672 hp. The average rating of the railway motors used in Boston is about 42 hp and the average rating of each motor used on Edison service is 4.3 hp. The isolated-plant motors have an average rating of 9.2 hp each.

District Heating Association at Pittsburgh.

The third annual convention of the National District Heating Association at Pittsburgh, Pa., was opened on Tuesday afternoon, June 6, with the official address of its president, Mr. George W. Wright, of Baltimore. Mr. Wright called attention to the widening field opening before the district-heating industry, and referred to the new problems in administration, operation, rates, meters, etc., which managers are now required to solve. The president congratulated the three-year-old association upon its rapid growth into an important position and declared his hope that the present session of the organization might be the most memorable within its annals.

The convention was then welcomed to Pittsburgh by Mr. Robert Garland, vice-president of the Chamber of Commerce, and by Mr. H. M. Irons, assistant city solicitor, who spoke on behalf of Mayor Magee. The Pittsburgh men referred with pride to the pre-eminent position of the city as an iron, steel and electrical manufacturing center, and Mr. Irons cited the statement, of interest to the heating men, that 75 per cent of the pipe used in this country is made in Pittsburgh.

The report of the secretary-treasurer, Mr. D. L. Gaskill, of Greenville, Ohio, next presented, showed the financial and business affairs of the association to be in a flourishing condition, and he was accorded a vote of thanks.

The report of the committee on data, of which Mr. E. J. Kiefer, of Easton, Pa., is chairman, was then read by Mr. A. D. Spencer, of Detroit. Therein the committee presented a number of card and record exhibits the purpose of which is to attain a more uniform system of accounting among member companies so that operating data, costs, income, etc., may be intelligently compared and considered. The exhibits included service-connection cards, meter-test cards, main and pipe records, customer-record cards, etc., all accompanied by explanatory notes. The report concluded with a review of the conditions of fuel costs, distance of transmission, temperature range, prevailing humidity and winds, and length of season which affect heating rates. At the suggestion of Secretary Gaskill the data committee was continued until the following convention, and asked to submit its completed report for the association's approval at that time.

A paper by Mr. J. B. Holbrook, of New York, on "The Heating and Ventilating Equipment of the City Investing Building, New York," was next read by Secretary Gaskill in Mr. Holbrook's absence. The paper included a general description of the mechanical and electrical plant of this thirty-three-story structure, the largest office building in the world. As the structure rises 470 ft. above Broadway, some unusual but necessary departures were required in laying out the equipment. The building has its own isolated plant and is equipped throughout in the most modern manner. It is heated on the two-pipe up-feed, vacuum-return system, with direct radiation of the exhaust steam from the power-plant apparatus. Adequate ventilation is accomplished by motor-driven blower fans of both the exhaust and supply types.

The next paper, by Mr. George W. Wright, of Baltimore, Md., on the subject of "Handling Customers," pointed out the necessity of keeping present steam-heating customers satisfied with their service. Discontinuances mean severe revenue losses, for prospective users are limited to the territory covered by existing steam lines. Mr. Wright gave a number of pointed items of advice on the subject of educating new and old customers to use steam heat properly, frequent reading of meters, estimates of cost, handling of complaints and sources of revenue loss. His paper, which will be presented in abstract with full discussion in a future issue of *Electrical World*, was discussed by Messrs. Cadwallader Evans, of Pittsburgh; J. A. Donnelly, of New York; A. S. Armguac, of New York; R. D. De Wolf, of Rochester, N. Y.; W. H. Schott, of Chicago; Warren Partridge, of Springfield, Ill.; A. C. Rogers, of Toledo Ohio, and S. C. Garner, of Hazleton, Pa.

On Wednesday morning a paper on "Heating Franchises," by Mr. C. A. Gillham, of Chicago, was read by Mr. W. H. Schott in the author's absence. Mr. Gillham outlined those salient features and vital points which, he said, should be guarded in preparing such a franchise, and enumerated among the subjects to be considered those of legality, use of streets and alleys, extensions to lines, rates, method of estimating radiation, service guarantee, franchise terms, city protection, franchise tax and franchise forfeiture. Plants which have been required to make extensions without adequate return have suffered loss and injury to their service, so that Mr. Gillham suggested the introduction of a clause guaranteeing a given amount of radiation for each foot of main extension. The author also advised permitting the statement of only maximum and flat rates in the franchise, leaving further rate detail to the company's discretion. In closing, typical franchise clauses were submitted with the paper. Mr. P. Mueller, of Erie, Pa., referred to his own required payment of a police tax per foot of main in addition to his franchise tax, and Mr. G. W. Wright said that in Baltimore an easement tax has been substituted for the franchise charge. Mr. J. L. Hecht, of Chicago, suggested the value of a clause making a railroad company liable for damages and expense sustained by public-utility corporations incident to the elevation or change of the former's tracks. Mr. W. H. Schott, of Chicago, referred to franchise conditions at Indianapolis, Ind.

Prof. John R. Allen, of the University of Michigan, Ann Arbor, next presented a highly interesting paper giving the results of some original investigations on the transmission of heat through radiating surfaces conducted at the university. These tests showed that while under average room and steam temperatures the transmission coefficient remains practically constant, the coefficient is varied with the difference of temperatures and the presence of cold surfaces, such as glass windows, etc. Humidity also slightly affects the coefficient in an unexpected manner, reducing rather than increasing the coefficient as the moisture contents approaches 100 per cent saturation. Tests on painting radiators with enamels, bronzes, lead pigments, etc., showed that the bronzes reduce the transmission as much as 25 per cent below that of the unpainted radiator, while the enamels and lead and zinc paints show practically no loss in transmission. A light terra-cotta enamel actually increased the heating efficiency 4 per cent beyond the unpainted surface. These results show that the heating action is, in fact, a surface effect which depends very little upon the material of the radiator. Professor Allen also appended tables giving coefficients for fan-coil radiators, condenser-tube interchange, etc., showing the effect of velocity of flow on the results.

In the discussion Mr. A. C. Rogers, of Toledo, confirmed Professor Allen's results with a citation of tests made by paint manufacturers, and said that in Toledo he is prosecuting a campaign of education which has already resulted in a number of radiators being changed from bronze to enamel. Mr. Rogers also referred to the presence of humidity as affecting the sensible temperature, stating that while 76 deg. is often necessary for comfort with dry air, 70 deg. may be found ample with higher humidity. Mr. Warren Partridge, of Springfield, Ill., observed with a smile that the aluminum-bronze paint so universally employed for coating radiators might be better used as an insulator for lagging steam pipes, and asked whether any simple paint material is available for insulating such pipes. Mr. J. A. Donnelly, of New York, insisted that radiation data of actual value should be determined from commercial-scale installations under practical conditions of inattention and neglect. Mr. R. D. DeWolf, of Rochester, observed that the personal element of the attendant will always be involved in such tests. Mr. J. L. Hecht, of Chicago, in discussing condenser-heat exchange, said that with a velocity of 4 ft. per second 300 heat units per square foot of surface per degree difference in temperature is obtained, and that increasing the velocity to 7 ft. per second improves the transmission by about 17 per cent, beyond which point no higher values are obtained, whatever may be the velocity.

Mr. F. C. Chambers, of Springfield, Ill., next read a paper giving some results of measuring the station load of the Springfield Light, Heat & Power Company's plant with Venturi and General Electric flow meters. Following a description of the mechanical and electrical features of the installation, the author gave the results, in quantity of steam, of hourly readings of the steam-flow meters as well as the water circulated in the hot-water system as measured by Venturi meters. Tests of individual customers' installations were also appended.

The meeting on Thursday morning was opened by Mr. R. D. DeWolf, of Rochester, N. Y., with his paper "The Preparation of a Rational Rate System." For steam-heating service Mr. DeWolf recommended three-rate systems of charging each made up of a customer charge, a maximum-demand charge and a quantity or consumption charge. He presented some examples of such rates as developed for live-steam, exhaust-steam and combined heating-and-power service. In the latter combination service some especially interesting relations were worked out, assigning proportionate steam and electrical charges for the respective services delivered by the plant. The algebraic expressions for these rates, as proposed by Mr. DeWolf, will be given in another number of the *Electrical World*. Mr. Warren Partridge reviewed the elements of a rational system of rates, and Mr. A. D. Spencer, while admitting the scientific accuracy of the schedule proposed by Mr. DeWolf, observed that frequently simplifications have to be made on account of customers and legislative rulings.

A paper on "Superheated Steam" was next presented by Mr. W. E. Dowd, of Philadelphia, in which he drew attention to the economics in transmission and consumption of steam heated above its normal temperature corresponding to its pressure. In the case of steam-engine consumption this saving, he said, ranges from 1 per cent to 3 per cent per 100 deg. of superheat. For process or heating service, as in kettles, driers, stills, etc., superheated steam, heated in a separately fired superheater, has the advantage of husbanding the valuable latent heat present and often effects savings of 25 per cent. Temperatures up to 1000 deg. Fahr. have been reached in commercial use. A representative of the Edison Illuminating Company of Detroit told of an experience in superheating the steam from the 2200-hp boilers in the Del Ray station, and cited the results of the honeycombing it produced in cast-iron fittings. These effects, said Mr. Dowd, are attributable to temperature variations which strain the metal, although steel withstands such action without injury. Mr. Dowd also added that superheated exhaust steam is practicable for process purposes up to 150 deg., beyond which some auxiliary use of the latent heat should be made to secure an efficient installation. Sometimes such applications are required, however, for insurance reasons. In answer to Mr. A. C. Rogers' reference to large and rapid temperature variations obtained from superheaters Mr. Dowd declared that the guarantees of good equipment are limited to 15 deg. variation from 90 per cent boiler load up to extreme overload. Replying to Mr. Evans' suggestion the author declared that in special cases exhaust steam from prime movers can be superheated to advantage before being distributed for heating purposes. Mr. R. D. DeWolf, of Rochester, pointed out that with present condensation methods of heating-service measurement customers receiving superheated steam might obtain more than their share of heat for the same cost.

Mr. W. J. Kline, of Lockport, N. Y., opened the afternoon session with a paper describing the atmospheric system of house piping, which employs the hot-water type of radiation. Steam is admitted to the top of the radiators and the water which collects below in the coils serves as an economizer in removing the sensible heat remaining in the condensation. A graduated valve installed at the top of the radiator enables the amount of steam in the radiator to be controlled with nicety. The advantages offered by this type of radiation, as enumerated by Mr. Kline, are: Low operating pressure without mechanical circulating means, ease of regulation by graduated valve, elimination of noise by bringing steam into top of radiators, control of heat, and elimination of vents and possible odors.

Mr. Kline's paper was followed by one by Mr. A. C. Rogers, of Toledo, Ohio, in which were illustrated and described various types of hot-water-heating systems and the method of connecting them to a district-heating plant. The schemes outlined included a single-belt, one-pipe series underfeed gravity system, a similar but two-belt system, a two-pipe system with parallel mains, a similar system with parallel but opposed mains a pressure-gravity system, a series-coil pressure system, etc. Mr. Rogers pointed out that a general supervision of house installations is entailed upon the engineering department of the heating company, and observed that many owners will be satisfied with results from their private plants which they would not tolerate from a district-heating system. In closing the author recommended overfeed systems, especially of the multiple, gravity or pressure type, for buildings more than three stories high having attic room to accommodate the mains.

The report of the committee on radiation, which was read by Mr. DeWolf, recounted the trials and difficulties of the committee in attempting to secure uniform data or constants in use by member companies. Blueprints of a small dwelling were furnished to members by mail, with the request that the radiation required be computed, and the results, together with an estimation of the way in which they were obtained, be returned to the committee. Of the fourteen replies received ten gave the data asked for, but each correspondent was found to have used a different formula with results varying widely. The committee, therefore, tendered its regrets that better results had not been accomplished by it, and was continued over to the following convention session.

On Thursday morning, following the adoption of a new constitution, which was approved after a number of amendments, the convention elected officers as follows: President, Mr. A. D. Spencer, Detroit, Mich.; first vice-president, Mr. Warren Partridge, Springfield, Ill.; second vice-president, Mr. R. D. DeWolf, Rochester, N. Y.; third vice-president, Mr. Cadwallader Evans, Pittsburgh; secretary-treasurer, Mr. D. L. Gaskill, Greenville, Ohio; members of the executive committee: Messrs. E. J. Kiefer, Easton, Pa.; J. L. Hecht, Chicago, and G. W. Wright, Baltimore, Md., past-president.

A feature of the Pittsburgh meeting was the enjoyable entertainment program arranged by the local committee, headed by Mr. G. R. Folds. A theater party was provided for Tuesday evening, and on Wednesday afternoon the convention became the guests of the Westinghouse Electric & Manufacturing Company on an inspection trip through the works of the Westinghouse interests at East Pittsburgh. Returning to the city, the party was taken to the Pittsburgh Natatorium, where a refreshing swim was enjoyed. On Wednesday evening the association smoker and reception was held on the roof-garden of the twenty-four-story Oliver Building, overlooking the lights of the city. Entertainment was furnished by the Westinghouse orchestra in addition to professional talent. On Friday morning the delegates visited the plant of the National Tube Company, at McKeesport. During the sessions of the convention the ladies were entertained by automobile trips to points of interest about Pittsburgh.

A Problem of the Trolley Return Circuit.

In a recent Franklin Institute paper Dr. C. P. Steinmetz said that the electric railway presents an unexplored phenomenon of every-day occurrence. Referring to the case of a 500-volt direct-current system, he said that while the car passes along the track the current flows from the wheels down into the rails, and then in the rails to the station, as shown diagrammatically in Fig. 1. At the point A_0 the current enters the rail from the wheel. To the left of this point it flows toward the left, as indicated by the arrow a. To the right of A_0 it is supposed to flow toward the right, as indicated by b, and at the point A_0 the current in the rail thus is supposed to reverse. However, the current cannot instantly reverse in the entire rail section, but the same screening effect of the magnetic field in the conductor which causes unequal current distribution with an alternating current makes it impossible for the current inside of the conductor to reverse instantly; and in the first moment, the reverse current b thus flows only on the very top surface of the conductor, and only gradually penetrates deeper into the conductor, and before the current flows uniformly throughout the entire rail section in the new direction b, the car has moved hundreds or even thousands of feet. Thus, the current distribution in the rail behind the moving car, in the successive sections A_1, A_2 . . ., is as indicated approximately in Fig. 2, where the black or shaded portion of the rail shows the section in which the current has already reversed, the unshaded portion the unreversed part; that is, that part in which the current still flows in opposition to the resultant current flow is running forward instead of backward. The obvious result is an increase of the effective resistance of the rail return, which immediately, behind a high-speed car, may be very considerable. Nevertheless, this phenomenon, which occurs hourly all over the country, has never been investigated, and its existence has not even been recognized.

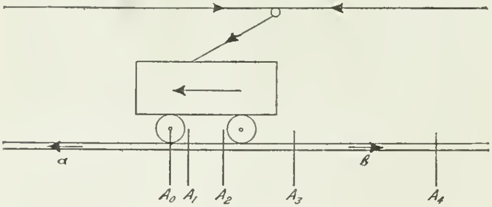

Fig. 1—Typical Trolley Circuit.

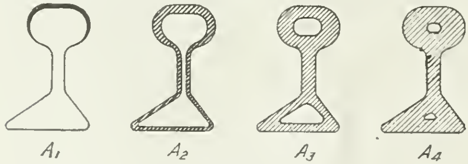

Fig. 2—Current Distribution in Rail Behind Moving Car.

German Technical Universities.

Vol. XVIII of the *Proceedings* of the Society for the Promotion of Engineering Education contains an interesting paper by Prof. George H. Shepard, of Syracuse University, entitled "Notes on German Technical Universities." There are nine of these institutions, or "technische hochschule," located respectively at Hanover, Charlottenburg, Dresden, Munich, Karlsruhe, Aachen, Brunswick, Stuttgart and Darmstadt. Professor Shepard says that the difference between the methods of the German technical schools and our own arises fundamentally from three causes, as follows: The German student has had a more advanced entrance preparation than the American, is older and more mature while taking the technical course, and the German system is designed to develop the best men to the utmost with little regard to what becomes of the rest. On the other hand, the American system is intended to make industrially valuable engineers out of as much as possible of the raw material that comes to it. Before being admitted to a German technical school as a candidate for its first degree the applicant must present the final diploma of a German secondary school or its equivalent. The course in the secondary schools is nine years, and to some extent corresponds to the curriculum of our regular college courses. Electrical engineers must have at least one year of practical experience before obtaining a degree, which may be obtained prior to entering the electrical course; otherwise half of it may be obtained during summer vacations. German universities also admit students who are not qualified to pass the regular entrance requirements. There are two classes of these, namely, "hearers," who receive an academic certificate for their work, and "visitors," who follow only a single course and who do not receive any academic certificate. The age of a German electrical or mechanical engineer on beginning his professional career is twenty-five years, the corresponding age of the American engineer being twenty-four years. Professor Shepard states that the military service the Germans must undergo is of more value to a student than Americans commonly suppose, as the life of a soldier builds up the student's health, teaches him to be orderly, neat and systematic, while, more important, in a military service he may learn organization, discipline, administration and the handling of men.

Referring to the American system of daily markings, examinations and the general oversight of students, Professor Shepard says that the Germans claim that this system makes a student dependent and morally weak, and that their system develops men more strongly self-reliant. Professor Shepard says that doubtless it does so in the case of those who survive it, but it seems to him very much like the Indian method of building a strong physical constitution, under which any Indian who could not stand everything could not possibly live to grow up. While the course offered to the German student is purely elective, the requirements as to passing examinations on certain subjects and limiting alternatives to some others restrict the instruction practically to a prescribed course, as in this country.

The German claim for special thoroughness in educational methods is based upon the student being placed on his honor and given complete freedom, and on the extensive use of practical examples, both in the laboratory and in the drafting-room, and of problem work. Commenting upon this Professor Shepard says that the first cause doubtless produces the desired effect in the work of those students who are earnest and conscientious in the face of abundant opportunity to be otherwise On the other hand, he says, our method of education compensates by getting something out of students who would go all to pieces under the German system. In German technical universities after a problem has been assigned the student is left pretty much to himself in its solution, it being held that the student develops more independence by being thus let alone and that the faculty is too much occupied otherwise to give him much attention. In addition to the first degree the German technical universities award the degree of Doctor-Engineer, which is awarded to any graduate who presents an official certificate of good character and a scientific dissertation which shows the ability of the candidate as an independent technical scientific worker. To prepare an acceptable dissertation requires from one to two years.

In a written communication on Professor Shepard's paper Dr. Franz Erich Junge-Hermsdorf, in referring to a query of Professor Shepard as to why American technical colleges in four years equip students substantially as well as Germans do their better-prepared students in five years, said that the question is not one of superior method of equipment, but of superior facilities or conditions which engineers in this country encounter. The mere fact, he said, that German engineers coming to America, often with little, if any, knowledge of the country, its institutions and its language, are able to fit themselves in a comparatively short time to the new surroundings and get along well is proof both of the ease of conditions here and the excellence of the technical training they receive at home. He said that Americans must not lose sight of the fundamental truth that it is much easier, industrially speaking, to support 90,000,000 of people on an enormously vast and exceedingly rich territory like the United States than it is to support 65,000,000 people on a small, meager territory like Germany, four-fifths the size of Texas. The big cake is very easily so divided that every hungry mouth in the family has a sufficiency, while with the small cake there are required more ingenuity, more system and more restraint on the part of the possessor to make everybody satisfied. The potentiality, he said, of the United States rests chiefly on the abundance of natural resources, both mineral and agricultural, and of staples and similar commodities of a lower order which are easily obtained and quickly sold in all markets without much additional industrial improvement. American capital is importing by the score high-class talented foreigners possessing just those finer qualities which American engineering demands and which American environment cannot impart. He asked that one look around in the engineering, designing and drafting departments of the large industrial establishments of the United States and count the number of "Dutchmen" employed there, and add the number of Swedes, Danes, Norwegians and other Europeans who have received their technical training in Germany. Industrial conditions of Germany, he said, require a combination of Spartan principles and Prussian drill, which forces the selection of the fittest of the race for protection from decay and fierce competition. "This calls for a thrice-tempered armor of skill or discipline and an enlightened leadership, forming a closed phalanx of physical, mental and moral forces. It affords the only peaceful way to supply new means of subsistence to an intelligent population which increases by 900,000 each year."

Worcester Street-Lighting Case.

The Massachusetts Gas & Electric Light Commission gave continued hearings on May 23 and 24 at Worcester upon the petition of Mayor Logan for a reduction in the prices charged by the Worcester Electric Light Company for street-lighting service. The full board was present. The petitioners were represented by Messrs. Thayer, Anderson and Vaughan, of the city law department, and the company by Everett W. Burdett, Esq., of Boston. Interest centered upon a protracted direct and cross-examination of Mr. Fred H. Smith, general manager, and, upon the second day, on testimony given by President George T. Dewey, of the company. The company's estimates of cost were printed in the issue of June 1.

Mr. Smith stated that the company figures depreciation on balances left yearly after previous depreciation is deducted. He pointed out that the evidence of the petitioners regarding No. 6 wire purchased by the Hartford Electric Light Company was misleading, for the reason that the quoted rate of 9.1 cents per foot applied to paper-insulated wire, while the wire used at Worcester is insulated with rubber to a thickness of 7/32 in., costing about 18 cents per foot new installed, with an estimated present value of about 12 cents. The point was brought out that there is at Worcester an additional cost of 3½ cents to 4 cents per foot above the first cost of the installed wire, due to the expense of tagging the wires in the conduits, racking them in the manholes and getting them ready for cutting into circuit. From two to four men are required in tagging and racking the cables, and clerical labor also has to be expended in getting the cables into shape on the books. The cost of installing the cable ran at about 3 cents per foot.

The company has noted very little depreciation on ducts, although some of the cement-lined ducts first installed have given trouble. Mr. Burdett emphasized the point that the life of the most indestructible duct may be limited to fifty years on account of the growth of the art. The company installs from 25 per cent to 75 per cent more ducts than it needs for the moment to save the trouble and cost of re-excavation. The cost of drawing out cables is about 2 cents per foot, not including damage that may be done to the cables in the process. The point was also brought out that the municipal arc service demands a new duct for every fifty lamps installed, whereas large extensions can be made to the commercial lighting and motor load without increasing the duct allowance or drawing in new circuits. Mr. Smith said that the company is greatly desirous of installing lamps on a spacing of about 250 ft. in the underground district instead of on the present spacing of from 250 ft. to 600 ft., the opinion being that the city is insufficiently lighted on the present basis of installation. The point was also brought out that the total cost of the arc-lamp service to the city produced a revenue for the company of 6 cents per kw-hour sold for street lighting, including 6 per cent interest on the investment used in municipal lighting.

President Dewey stated that the company has been to large expense to determine the cost of doing business in its different departments so far as practicable, with the object of charging for service somewhat closely in relation to its cost, after allowing a fair return of, say, 6 per cent on the investment. He conceded that the central-station business is not uncertain in character, but contended that there are changes sometimes coming rapidly and unexpectedly which must be faced. In twenty-seven years the company has accumulated a surplus of $370,000, which has not been paid out to stockholders. The proper depreciation has been charged off the plant for many years, and yet the company has found it necessary to build a large and expensive plant within the past year and practically to abandon its old plant so far as the production of electricity is concerned. If this plant should be abandoned and wiped off the books it would nearly destroy the surplus which has been accumulated for twenty-seven years. The company has never paid a dividend on its surplus. The point was brought out that although Worcester has had a lower price for gas than almost all other cities in Massachusetts the electric lighting company has made as low or lower prices on incandescent lighting than other cities correspondingly situated.

Continuing, Mr. Dewey pointed out that there are certain reasons which make the cost of municipal lighting larger than in other cities, as indicated in the following table:

STREET LIGHTING DATA, 1909.

	Number of Lamps.	Investment in Distribution System.	Real Estate, Steam and Electric Plants.	Total Assets.
Worcester	852	$881,837	$337,908	$1,472,000
Springfield	1079	749,459	967,023	2,405,870
Fall River	823	267,980	645,543	1,141,727
Lynn	340 arc 1820 incan.	579,308	652,534	....

These figures reflect the facts that the Worcester company has had to invest a larger amount in underground conduits and wires than other companies, and that this is in the nature of a dead investment, rather than a productive investment like the power plant. The other companies have a much larger proportion of their investment in power plant. More than half the assets of the Worcester company are tied up beneath the ground.

Mr. Dewey said that the limitations of the coal and water supply at the old Faraday Street station, the lack of space for boiler-room expansion and the location of the plant outside the business center had held back the development of electric power business prior to the establishment of the new plant on Webster Street. He pointed out that in Worcester the city has the free use of ducts costing $135,520, whereas in Springfield and Fall River no free city ducts are in service. The taxes of the Worcester company are larger in proportion to its size than for any other company in the State. The State tax amounts to nearly 10 per cent of the gross business of the company. Five years ago the price of arc lamps was reduced from $103.50 to $91.25 per lamp per year, the company being able to make the reduction by using the magnetite lamp. It is expected that the additional business in sight will not for the present offset the effect of increased cost due to the building of the new station. Mr. Burdett brought out the point that the company has had no contract with the city for five years and that such a condition of uncertainty justifies the fixing of a still higher price by the board than where a contract can be effected.

The further point was made that Worcester's length of wires in conduits is 3,122,494 ft., compared with 1,312,435 ft. in Springfield, 322,388 ft. in Fall River and 452,640 ft. in Lynn. The company contended that there is no other city in the country having so large a proportion of underground conduit in relation to its size. Mr. Dewey emphasized the fact that the cost of the single item of a cable connection between the new and the old plants was $220,000. This investment was absolutely necessary, otherwise the company would have been obliged to change its distribution center to the new plant and thereby incur a great expense for a new system of feeders, entirely rearranged, and necessitating the abandonment of a very large part of the existing investment. Mr. Dewey stated that if any reduction in rates is to be made it should be in the field of incandescent lighting, since the company's residence and commercial lighting service is growing with considerable rapidity. Illustrating the effect of depreciation, Mr. Dewey said that the electric lighting and power business is practically a new industry, being not much over twenty-five years old, and it lacks the data bearing upon depreciation which an old industry like cotton manufacture possesses. The arc lamps in use five years ago were sold at $1 apiece, and it is impossible to state how soon the present types of lamp may not have to be disposed of as a result of the progress of the art. The hearing was continued.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission has made public its twenty-sixth annual report, covering the year 1910. The report contains 211 pages of text and 350 pages of appendix devoted to the usual abstracts of returns filed by private and public-utility organizations for the year ended June 30, 1910. These returns have been made by seventy-two incorporated gas companies, fifty-eight electric-light companies and twenty-three persons, associations or manufacturing corporations engaged in making or selling gas or electricity for light or heat. Returns for the same period have been made by twenty-nine municipal lighting plants, twenty-five of which supply electricity only.

A new feature of the report is a brief discussion of the jurisdiction of the commission over the smoke problem, in which the board points out that since the appointment of its smoke inspector all complaints have been promptly investigated and observations made as required by the law. The smoke inspector has investigated twenty-eight complaints and has made a thorough examination of the territory in the Boston district covered by the act. Placards displaying the essential features of the law have been widely posted over the district and freely distributed for the use of fireroom employees. The co-operation of owners of plants has generally been accorded. No prosecutions have as yet been necessary.

The results of the year's operations have already been noted in these columns. The report shows that the electric central stations of the State had a total income of $11,206,004 for 1910, compared with $10,558.070 the preceding year, the expenses of operation being $6,738,093 in 1910 and $6,279,046 in 1909. Dividends were $2,411,202 last year, compared with $2,144,202 in 1909. The gross profits from electric lighting of all the companies increased $188,887 during the year. The sales of energy for light increased about $550,000 and for motor service $370,000 during the year. The aggregate valuation of all the electric-light companies is now $35,176,630, and the total amount of taxes paid during the year, including State supervision and the amounts paid by the gas companies on account of their electric plants, was $963,766. Nineteen companies paid no dividends, the other thirty-nine paying an average rate of 10 per cent on their capital stock. Eleven companies reduced the maximum net price of electricity during the year, the lowest prices being given by the Edison Electric Illuminating Company of Boston and the Charlestown Gas & Electric Company, each of which charges 11 cents per kw-hour, maximum. The usual statistical data of operation are included for both private and municipal plants. No municipalities of importance have taken steps on behalf of municipal ownership during the year, although an investigation was authorized in Revere. Brief reference is made to the municipal-ownership campaign in Haverhill, which resulted in an overwhelming defeat by a vote of 4780 to 1328 of the proposition to establish a public-lighting system. A résumé of 1910 legislation of interest to electric- and gas-lighting companies is included, and a valuable feature of the report is the tabulation of all population data on the basis of the census of 1910, permitting the deduction of per capita statistics which have been uncertain for the past two or three years. At the time of the report's completion there were twenty-one cases pending before the board, four of these dealing with questions of price and eleven with capitalization.

Ohio Commission News.

A question has been submitted to Attorney General Hogan of Ohio as to how the $75,000 for the support of the Public Utilities Commission is to be collected from the corporations affected. This expense is to be assessed upon the corporations on the basis of their resources and under the terms of the law the assessment must be made in August. However, the returns of the companies showing earnings and resources are not made until September and the members of the State Railroad Commission see no way of apportioning the expense in August. The question presented to Attorney General Hogan is whether the apportionment shall be made on the basis of the reports filed last year or whether it will have to go over for a year, thus leaving the commission without funds upon which to operate.

Mr. Frank Binkley, manager of the Home Telephone Company, which operates lines in Butler and Montgomery Counties, states that under the public utilities bill the independent companies will now have access to Cincinnati, a city to which they have never been able to gain entrance. The bill, he says, provides for an interchange of business between telephone companies and that all companies doing an interstate business must exchange service under the dual connection clause in the bill.

Maryland Commission News.

The Maryland Public Utilities Commission last week ordered the Easton Light & Fuel Company forthwith to make numerous repairs and additions to its plant. The company was further ordered to report to the commission promptly if it has complied with its order. This action is the result of a visit to Easton by the commission's expert to investigate complaints of the service of the company and indicates the policy with respect to public utilities in general. The order designates the following additions and repairs: (a) The installation of a dry scrubber to improve the quality of the gas. (b) The covering of the steam pipes and the introduction of a steam separator at the point of connection with the generator. (c) Installation of an oil meter to register the flow of oil admitted to the carburetor. (d) Installation of capital tillar cocks for making stain test on top of superheater and outlet of wet scrubber. (e) Syphon gage for indicating blast pressure. (f) Calibrated steam cock for controlling and regulating the admission of steam into the generator, together with a steam gage located near it to register actual steam pressure at the cock. (g) Provision for calibrating the jet photometer. (h) Facilities for making stains and other continuous tests of gas when and as it is manufactured. (i) Installation of a suitable pump for pumping tar and condensation from the drip pot in the main system, together with a suitable receptacle for receiving the pumpage from the drip pot. The company is required within ten days after the receipt of the order to notify the commission in writing whether the above terms are accepted and will be obeyed. In the event of acceptance an inspector of the commission will be directed to be present and superintend the making of the additions and repairs. It is further ordered that said company shall as soon as practicable and not more than thirty days after the date of the order install on the gas main leaving the holder a suitable drip pot for collecting the tar and condensation from the pipes, and that this drip pot, together with others now connected to the piping system, be pumped out at intervals of not more than two weeks until it may be determined what are the proper intervals for pumping required at each particular location where there is a drip pot or where one may be required. The company is also required to submit to the commission a comprehensive plan covering adequate repairs necessary to put the gas-making machine now in use in condition for the proper manufacture of gas.

Mr. William Cabell Bruce, chief counsel of the commission, rendered an opinion last week that the commission has power to compel the United Railways & Electric Company to keep in order the paving between and 2 ft. on each side of its tracks in Baltimore. The question arose on the complaint of Mr. George C. Brauer, who asked the commission to investigate the condition of the paving on Baltimore Street between Pulaski and Garrison Avenues. In his opinion Mr. Bruce refers to the space between and 2 ft. on each side of the car tracks which the company's charter requires it to keep in order. Mr. Bruce says the power of the commission is clear, but recommends that no action be taken unless the city engineer, after his attention has been called to it, fails to do his duty.

Canadian Hydroelectric Commission News.

On June 3 the Toronto Hydroelectric Commission published the rates for motor and lighting service for consumers in Toronto for Niagara energy distributed by the municipal distributing plant.

The following rates have gone into effect:

For residence service a monthly service charge of 4 cents per 100 sq. ft. of floor area, plus an energy charge of 3 cents per kw-hour. Subject to a discount of 10 per cent for prompt payment.

For commercial lighting, alternating current, 115-230 volts, 8 cents per kw-hour for the first thirty hours' monthly use of the maximum demand. All excess at 3 cents per kw-hour. Ten per cent discount for prompt payment under one-year agreement, 15 per cent discount for prompt payment under three-year agreement and 20 per cent discount for prompt payment under five-year agreement. Minimum monthly bill, $1 net for each kilowatt of maximum demand.

For industrial motor service, three-phase, 25 cycles, 550 volts, a service charge of $1.35 per month per horse-power of maximum demand for the first 10 hp. All excess at $1 per horse-power of maximum demand, plus an energy charge of 1½ cents per kw-hour for the first fifty hours' monthly use of the maximum demand, with 1 cent per kw-hour for the next succeeding fifty hours' use and ½ cent per kw-hour for all excess. Ten per cent discount for prompt payment under one-year agreement. 15 per cent discount for prompt payment under three-year agreement and 20 per cent discount for prompt payment under five-year agreement.

In certain confined limits direct current will be furnished at a potential of 120-240 volts under the following rates: Ten cents per kw-hour for the first thirty hours' monthly use of the maximum demand. All excess at 4 cents per kw-hour. Ten per cent discount for prompt payment under one-year agreement, 15 per cent discount for prompt payment under three-year agreement and 20 per cent discount for prompt payment under five-year agreement. Minimum monthly bill, $1 net for each kilowatt of maximum demand.

For direct-current motors a service charge of $1.35 per month per horse-power of maximum demand for the first 10 hp. All excess at $1 per horse-power of maximum demand, plus an energy charge of 2½ cents per kw-hour for the first fifty hours' monthly use of the maximum demand, 1½ cents per kw-hour for the next succeeding fifty hours' use and ¾ cent per kw-hour for all in excess. Where direct current is supplied a storage battery is used as a stand-by, insuring continuity of service.

The prices at present charged by the Toronto Electric Light Company are as follows:

House-lighting rates, 8 cents per kw-hour net (20 cents, subject to discount of 60 per cent for prompt payment).

Store-lighting rates, net rate of 8 cents per kw-hour on five-year contract, 12 cents on one year.

Motor rates, for alternating current, 8 cents per kw-hour, with $1 per month minimum.

Discounts to motor users vary according to quantity used. Those whose bills reach $25 per month pay 6 cents per kw-hour; if the bills reach $50 per month the rate is 4 cents, after that there are special rates to large consumers. One very large consumer, it was stated, received his energy at ⅔ cent per kw-hour.

The Toronto Electric Light Company charges no meter rental unless an extra meter is installed at the request of the customer. In that case the rental is 25 cents per month for a lamp meter and 50 cents per month for a motor meter.

It is understood that the Toronto Electric Light management has under consideration a reduction in its rates in order to meet the cut made by the city electrical system.

Massachusetts Legislative News.

The committee on street railways has voted to report the so-called omnibus bill of the Boston Elevated Railway Company extending the leases of the various subway and tunnel lines in Boston, providing for subways to Dorchester and under Boylston Street, in the Back Bay, with a possible extension of the East Boston tunnel, and an extension of the present lease of the West End Street Railway to the Boston Elevated. The bill provides in general for a twenty-five-year extension of the subway leases and a determination in 1936 of the length of time the leases shall further run by an arbitration board, upon the basis of the time required to pay off the indebtedness incurred in subway and tunnel construction.

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Wisconsin Commission News.

The case of the city of Neenah vs. the Wisconsin Traction, Light, Heat & Power Company and the Wisconsin Electric Railway Company has been before the commission again in the form of an application for a rehearing by the Wisconsin Traction, Light, Heat & Power Company. The general trend of the testimony offered at the hearing was to show the inconvenience and impracticability involved in putting into effect the previous order of the commission establishing a joint fare applicable to travel within the city of Neenah. The chief objection, apparently, was due to the fear that there would be opened up an opportunity for dishonest passengers to ride beyond the present single-fare limit. It was also contended that, as the cities of Neenah and Menasha form practically a single community and are treated as such in the matter of fares established by the two railway companies, it would be necessary to have the joint rate apply to both cities, which, it was claimed, would result in compelling the applicant company to carry passengers a distance of more than three miles for a portion of a present single fare.

In this connection it was pointed out by the commission that if both companies had been under the same management the fare within the limits of the two cities would have been but 5 cents. Furthermore, inasmuch as the former petitioner, the city of Neenah, asked for a joint fare within its corporate limits only, the original order was limited to the result prayed for, and the question of extending the operation of the joint fare to both cities was left voluntary with the two companies. When two companies operate within a single municipality under street-railway franchises and are obliged to furnish street-railway service within the municipality, public convenience requires that they be operated in conjunction with each other in rendering such service. If the compensation to each company for the portion of the joint service rendered by it is reasonably adequate, the commission is of the opinion that no just complaint can be made because of a requirement that an arrangement for a joint fare be entered into. After reviewing all the testimony offered on both hearings and all the circumstances involved, the commission was unable to find any valid reason for revoking or in any way altering the previous order.

The question of the apportionment of the joint fares was left for the commission to determine inasmuch as the two companies could not come to a satisfactory agreement as to a proper basis of apportionment. While recognizing the different bases upon which such an apportionment could be made, the commission did not consider it advisable at the present time to make an apportionment other than that the two companies should divide the joint fare equally or upon any basis that they could agree upon.

The Ripon Light & Water Company is making preparations to give day service, and has submitted a tentative schedule for power service. The net rates range from 9 cents per kw-hour for the first 100 kw-hours per month to 3.6 cents for all over 1000 kw-hours. The minimum bill is to be $2 per month for motors of 2 hp or less, nominal rated capacity, and $1 per month for each additional horse-power or fraction thereof.

The Hayward Electric Light & Power Company has submitted a revised schedule of rates for electric lighting, but, as the new rates are higher than the present rates for certain classes of service, a formal application and a hearing will be necessary before the present schedule can be changed.

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CURRENT NEWS AND NOTES.

Explosion of Gasoline Lighting Machine.—A drug store at 843 Larimer Street, Denver, Col., was wrecked June 4 by an explosion of the gasoline lighting plant, resulting in a loss of about $2,000. The proprietor of the store attempted to fill the lighting machine from a 5-gal. tank of gasoline, when the latter exploded, and besides spreading the flames all over the room slightly burned a clerk.

Convention of Pennsylvania Engineers.—The third annual convention of the Engineers' Society of Pennsylvania, which was to have been held at State College on June 7-10, has been postponed until October at a date to be set later. It is hoped that all engineers of the State will co-operate in the movement, and the later date has been selected in order to afford time for complete organization before the convention.

Lighting of South Park System, Chicago, by Sanitary District.—The Sanitary District of Chicago and the South Park Commissioners of the same city have arrived at an agreement by which the former will supply electrical energy from the Chicago Drainage Canal hydroelectric plant for lighting the South Side parks and boulevards. The contract provides for the furnishing of electricity at 0.75 cent per kw-hour for a term of five years from June 26, 1911. The existing steam generating plant in Washington Park will be shut down and held as a reserve.

Franchise Taxation in California.—The California Supreme Court has reversed the decision of a lower court enjoining the county of Los Angeles from collecting a franchise tax from the Western Union and Postal-Telegraph companies. The Supreme Court held that when the telegraph companies accepted the franchises to use the highways for their purpose they became subject to such taxation of the franchises as should legally be imposed. The claim that such taxation is in any way taxation of a federal franchise was rejected, the court declaring that the tax is solely on valuable property within the State—the right to the permanent and exclusive use of portions of the public streets of Los Angeles, free of compensation, "a tax differing in no material way from one levied on its poles and wires located within such city."

Stone & Webster Outing at Boston.—About seventy-five employees of Stone & Webster, including fifty representatives of companies outside the home office, were entertained at an outing in Boston on June 5. The gathering took place at Pemberton Inn, on the outer shore of Boston Harbor, and a varied program was enjoyed, including a baseball game, dinner and informal interchange of greetings among members of the organization from widely separated parts of the country. In the evening a banquet was held, Mr. Edwin S. Webster being toastmaster. Many reminiscences of the early days of the organization were brought out, and at a late hour the party returned to Boston on a specially chartered steamboat. The affair was an outcome of the attendance of many Stone & Webster men at the recent N. E. L. A. convention in New York City, and was under the general direction of Mr. W. H. Blood, Jr.

Examination for Electrical Engineer.—The New York State Civil Service Commission will hold an examination at Albany on July 8 to fill the position of electrical engineer in the office of the State architect. The salary is $1,800 to $2,100 per annum.

Outing of Independent Contractors of New York.—The seventh annual outing of the Independent Electrical Contractors' Association of Greater New York will be held on Saturday, July 15, at Queens Avenue Hotel and Park, Queens Avenue and Twentieth Street, Flushing, L. I. Mr. A. Whiteley is president of the association and Mr. C. A. Christensen, 121 West Eighty-third Street, is chairman of the program committee.

The 1912 Boston Electric Show.—The 1912 Boston Electric Show has issued an attractive pamphlet containing diagrams, rules and regulations and space application blank. This show will occupy the whole of Mechanics' Building, Boston, with over 100,000 sq. ft. of exhibit area, and will be held from Sept. 28 to Oct. 26, 1912. Great preparations are under way for this exhibition, which is under the auspices of the Edison Electric Illuminating Company of Boston. Mr. H. W. Moses, 39 Boylston Street, Boston, is manager.

The Highest Power Chimney.—What is probably the highest chimney ever utilized to produce natural draft on power-plant boilers is that of the thirty-three-story City Investing Building, New York, which also handles the smoke from the boilers in the adjoining 612-ft. Singer Building. The Singer chimney is carried up only fourteen stories, and to prevent its discharging its contents against the windows of the City Investing Building it has been connected into the latter's flue passage at this level. The City Investing chimney, which serves 2000 hp in hand-fired water-tube boilers in the subbasement of its own building, is approximately 50 sq. ft. in cross-sectional area and is 500 ft. high.

Unexplored Magnetic Phenomena.—In a recent paper presented before the Franklin Institute on "Unexplored Fields in Electrical Engineering" Dr. C. P. Steinmetz referred to several unexplored phenomena of magnetism. One relates to permanent magnetism and involves an answer to the question, What is permanent in the permanent magnet—the magnetic flux, the mmf, the flux density or distribution, or the magnetic energy? Again, there is no satisfactory explanation of hysteresis—that is, of the loss of energy by a cyclic change of magnetism. Finally, the Heussler and other similar alloys have introduced problems that require elucidation, and the magnetic characteristics of oxygen should be studied.

Engineering English.—In a recent discussion on the use —or misuse—of the English language by engineers, one of those who took part and who is a professor of engineering said that the paper discussed "serves to prove what has been again and again surmised, that the man who takes to engineering is more apt than not *not* to take to composition. The two kinds of activity," he said, "appeal to different types of men," adding that "it seems probable that we can effect only a moderate measure of improvement over present conditions, and that improvement only by one of the old-fashioned standard methods and not by any special process." The other teachers taking part in the discussion strongly advocated more attention to imparting to engineering students facility in the use of the English language.

Safety of Electric Transportation at Boston.—According to figures recently filed with the Massachusetts Railroad Commission by the Boston Elevated Railway Company, the total number of persons using the stations of the elevated and subway lines in Boston since they were first thrown open to the public has been 1,364,956,732. Only fifteen persons have received serious injury at pits or in the stations, which indicates that there is but one chance in 100,000,000 of accident to a passenger entering or leaving a station on the Boston rapid transit system. A report has been made by the commission to the Legislature stating that in its opinion the introduction of guard railings at stations is unnecessary in the interests of safety in the light of present investigations. The elevated-railway service in Boston has been in operation ten years.

Gas Rates in Chicago.—Mr. E. W. Bemis has been named by the committee on gas, oil and electric light of the recently elected City Council of Chicago to review the report of Mr. W. J. Hagenah, appointed by the old municipal administration, who, as an expert, after an exhaustive investigation, gave it as his opinion that the rate for gas in Chicago could be reduced from 85 cents per 1000 cu. ft. to 77 cents. The present administration wishes to obtain possession of the books and papers on which Mr. Hagenah based his report. The documents were provided by the People's Gas Light & Coke Company, and are now in its possession. The present administration thinks tnat 77 cents is not a sufficient reduction, but has declared for a 70-cent rate, Mayor Harrison having, indeed, been elected largely on that issue.

Lawyers' English.—Mr. John J. Clark, dean of the faculty of the International Correspondence Schools, gives in a paper printed in the current issue (Vol. XVIII) of the *Proceedings* of the Society for the Promotion of Engineering Education a number of examples of engineering English, and the following specimen of lawyers' English: "Dear Sir: Your letter received, and I will write to Mr. ——— with regard to the copyright question. The only thing it strikes me that when the Instruction Papers are copyrighted they are protected, but when they are bound in Bound Volume form and a title page is added it protects the whole set. The question in my mind is whether or not there should be a title page filed with the first Instruction papers, or what will be the title page of the I. C. S. Reference Library. As soon as I get word from Mr. ——— I will advise you."

Electricity in a Boston Church.—Electricity performs effective lighting and motor service at the new Mission Church in the Roxbury district of Boston, which is one of the largest Roman Catholic institutions in the city. The interior of the church proper is equipped with many hundreds of incandescent lamps, energy being supplied for both lighting and motor service from a plant of 120-kw generating capacity located in an adjoining boiler house. The double towers of the church are both capped by large crosses which face the cardinal points of the compass. At night the crosses are outlined by 136 tungsten lamps of 60 watts individual rating, seventeen being installed on each cross. Automatic time switches installed in the towers control the electrical supply, so that the crosses are maintained in a luminous condition from dark to 11 p. m. daily. In the vicinity of the church the effect of these luminous crosses is most impressive, the lamps being located at a height of about 153 ft. above the level of the street. Another electrical feature of interest is the use of a solenoid lever to cut in and out of service one of the most beautiful sets of chimes in New England. These are employed to strike quarter hours from 7 a. m. to 9 p. m. The solenoid equipment is controlled by a manually operated switch located in the church. Besides the use of electric power for organ blowing in the shape of a 5-hp motor for the main instrument and a 1-hp motor for the basement chapel, a 7½-hp motor is used to operate an elevator in the adjoining rectory, and another motor of the same size is used to operate a ventilating and heating fan system in connection with St. Alphonsus Hall, seating 1200 persons. A 5-hp motor and a 1-hp motor are used to operate an extensive printing plant on the premises, which turns out a large yearly volume of prayer books, circulars, programs, leaflets, pledge cards, etc. Father James Hayes is rector and Mr. T. E. Cusick chief engineer of the Mission Church.

Fan-Motor Weather.—Warm weather prevailing over a large area of the country for the last week or so has caused a very heavy demand for fan motors. In some cities, as in Chicago, for instance, dealers have had great difficulty in meeting the calls for fans, and in some instances have been unable to supply the demand for certain sizes and types.

Worcester Polytechnic Institute Commencement.—The Worcester Polytechnic Institute awarded at the annual commencement exercises twenty-five degrees in electrical engineering and four advanced degrees for graduate work, including theses, to Mr. R. D. Whitmore, Sunderland, Mass., on "The Design of a Small Hydroelectric Power Plant"; Mr. Ray M. Taber, New Bedford, Mass., on "Power Vectors in Transformer and Induction Motor Diagrams," and to Mr. Howard G. Parker, Pawtucket, R. I., on "Commutation of Direct-Current Machinery."

Proposed New York State Department of Electricity.—Favorable action has been taken by the finance committee of the New York Senate upon Senator Duhamel's bill providing for the creation of a State department of electricity. The measure gives the proposed commission sweeping supervision of electrical and kindred corporations. It provides for a single-headed commission, the commissioner to be appointed by the Governor and removable at his pleasure, the salary being $5,000; also for the appointment of a chief electrical engineer and chief inspector at salaries not exceeding $3,000 and $2,500 respectively.

Wireless Between Norway and Spitzbergen.—On May 3 the Norwegian Storthing authorized an expenditure of $80,400 for establishing a station for wireless telegraph on Spitzbergen Island in conjunction with a similar station at the town of Hammerfest in northern Norway. The station at Spitzbergen will be erected on the peninsula between Green Harbor and the sea west of Spitzbergen. Large portions ot the ground around Green Harbor are held by Americans, and it is believed that in the course of time they will build a telephone line from Green Harbor to Advent Bay, where valuable coal mines are located, thus placing the mines in touch with Europe via Hammerfest, and thence with the rest of the world.

Annual Meeting of the New York Electrical Society.—At a meeting of the New York Electrical Society to be held on June 15 the following names will be submitted in nomination for the offices indicated: Mr. John Bottomley, president; Messrs. E. A. Sperry, J. C. Hartzel and Emil Henel, vice-presidents; Mr. George H. Guy, secretary; Mr. Kingsley G. Martin, treasurer. After the election of officers an illustrated lecture will be delivered by Mr. T. I. Jones on "Electrical Development at Coney Island." The meeting, which will be held in the Brighton Beach Casino, will be preceded by an informal dinner beginning at 6:45 p. m. Following the lecture a visit will be paid to the Coney Island substation of the Edison Electric Illuminating Company of Brooklyn

Experts in Public Utility Cases.—In an address at the dedication of the new engineering laboratories of the University of Nebraska Prof. M. E. Cooley, of the University of Michigan, in discussing the subject of the public and public-service corporations said that those best trained to bring out facts in case of public-utility controversy or litigation are men who at some time or other have been employed by such corporations, and then related an incident that occurred while the late Judge Tayler was hearing testimony on the street-railway arbitration in the city of Cleveland. A very well-known expert had testified on the costs of reconstruction of a street railroad, and on cross-examination was asked if he had not sometimes been employed by the street-railway companies, the object of the question being to discredit his testimony by implying that it was biased. Judge Tayler interrupted, saying he would hear no more questions of that sort; that no one could be qualified to testify on that subject who had not been employed by a street-railroad company—that it was that fact which qualified him to testify at all.

Commencement at Boston "Tech."—Commencement exercises were held by the Massachusetts Institute of Technology at Boston on June 6, there being 253 degrees granted at the hands of President Richard C. Maclaurin. Two persons received the degrees of doctor of philosophy and doctor of engineering respectively, and in the department of electrical engineering forty-nine degrees of bachelor of science were conferred. Among the electrical theses discussed at the exercises were the following: "Steel-Making by Electric Furnaces," by Mr. M. A. Grossman, Youngstown, Ohio; "Losses of Power Through Coronal Discharges," by Mr. Otto R. Schurig, Zwickau, Germany, and "Fusion of Different Materials Under High Electrical Temperatures," by Mr. Irving W. Wilson, Bloomington, Ill.

Tungsten in Nova Scotia.—In the fall of 1907 tungsten-bearing veins were discovered at Scheelite, on the Moose River, in Nova Scotia. They have since been continuously operated with a force of about forty men. Nine shafts have been sunk, averaging in depth from 30 ft. to 120 ft. From this work, roughly, 75 tons of ore have been recovered, which has not yet been treated. Development work has not reached a stage where definite conclusions as to the extent or value of the ore can be arrived at. However, enough has been done to show that the deposit is an important one. New veins have recently been uncovered and the owners believe it to be the richest tungsten mine in the world. A new company, called the Scheelite Mines, Limited, with a capital of $3,000,000, has just received a charter to work these mines.

A Problem in Conductor Resistance.—In a recent Franklin Institute paper Dr. C. P. Steinmetz said that there is apparently no better known phenomenon than the resistance of a conductor. A conductor has a definite resistance which varies with the temperature, etc. With the alternating current the resistance apparently increases in large conductors, because the current flowing in the conductor is not uniform throughout the entire section, but, by the screening effect of the magnetic field inside the conductor, the current density inside of the conductor is less than it is on the outside. One can calculate the phenomena of the lack of uniformity of the current density in the conductor for the case where the current density is not yet very un-uniform, as if in the center of the conductor the current density is only from 5 per cent to 10 per cent lower than on its periphery. An approximation can be got which is satisfactory for all purposes of electrical engineering and shows how large a conductor can be used without serious waste of conductor material. Then there is the other extreme where the current density in the middle of the conductor is practically zero, and the current is limited to a thin shell on the outer surface, as in the rail return of the single-phase railway, or in ordinary conductors at very high frequencies, as with lightning discharges. This case one can calculate, determining the current distribution in the conductor, the apparent penetration and the effective resistance of the conductor, with an approximation as close as knowledge of the constants of the material, the conductivity and permeability permits. But when one comes to the intermediate and probably most interesting case, where there is current even in the center of the conductor, but a material difference in the current density between the outside and the center of the conductor, one finds as solution an infinite series, which in this case converges so slowly as to be practically useless, and Dr. Steinmetz said that this case is still practically unexplored. An interesting study of one phase of the subject was recently presented in these columns (Feb. 23) in an article by Mr. Frank F. Fowle entitled "A Method for Studying the Internal Inductance of Linear Conductors."

ELECTRICAL GENERATION AT NEW ORLEANS.

Main Power Station and System of the New Orleans Railway & Lighting Company.

THE central-power station of the New Orleans Railway & Lighting Company develops energy for the company's lighting service besides a large portion of the power required by its street-railway department, the remainder of which is generated at the Claiborne and St. Charles stations. The new main station adjoins the sites of the old municipal plant and railway generating station between the bank of the Mississippi River and Tschoupitoulas Avenue, resting on a site reclaimed by driving numerous wooden piles, which are capped by a coating of concrete. The new building is a steel-frame structure with brick walls, the engine-room measuring 94 ft. x 108 ft. and the boiler-room 110 ft. x 153 ft. The engine-driven units are all 575-volt railway machines, while the turbines produce 60-cycle energy at 6600 volts and 2300 volts, which is utilized as alternating current for lighting or can be converted by motor-generator sets for augmenting the railway output when needed. From the main generating station 6600-volt transmission lines extend to the Valence, Magazine, Bourbon, Canal and Edison substations, as shown in the accompanying diagram, Fig. 3. The town of Algiers, across the Mississippi River from New Orleans, is supplied directly from the main station. The Edison, Magazine and Bourbon substations convert part or all of their alternating-current input into 250-volt direct current, which is fed into the Edison underground system in the downtown or business section of the city.

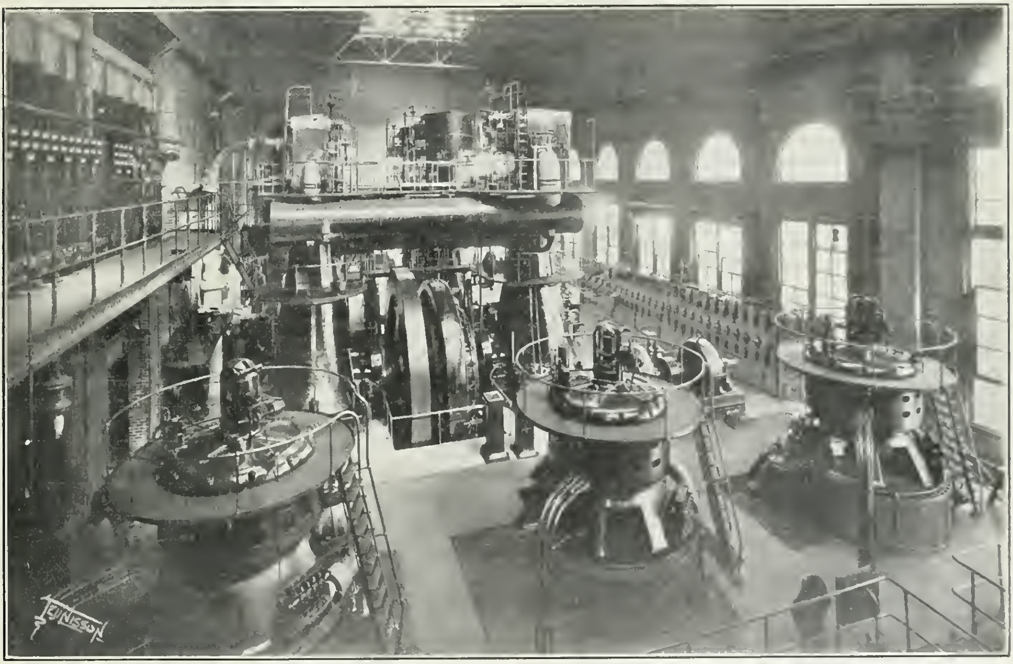


Fig. 1—Interior of Main Generating Station of New Orleans Railway & Lighting Company.

When the present plans for coal handling at the main power plant are completely realized several unique and unusual features will be represented in the method of storing and delivering the fuel to the boiler-room. At present the station receives its coal by rail over the tracks which skirt the river levee at this point, but the hoist shown in Fig. 4 has been provided for unloading coal from barges in the river. The grab bucket on the overhanging boom dips down into the barge hull and delivers its coal into a hopper inclosed in the cabin on the structure. Here the coal will be weighed and then dropped into 2-ton cars running on a narrow-gage track along the lower chord of the trusses 22 ft. above the ground. At present only 200 ft. of this trackway have been finished, but when completed the small coal cars will run by gravity over the projected coal-storage yard, which will be capable of containing 40,000 tons of coal, dumping onto the piles from the overhead tracks. A number of switch spurs will also be arranged so that by gravity the cars can be run to any part of the coal yard to discharge their load. Beneath the coal piles in the storage yard will be concrete tunnels containing narrow-gage track on which similar coal cars will be operated. Valves in the tunnel roof will enable these cars to be filled quickly from the coal piles above and then the cars will be transferred to the boiler-room with their loads. The handling of the coal from the waterside to the plant will thus be accomplished entirely by gravity, utilizing the energy of the first hoist to effect all subsequent transfers. The coal hoist as now built is 68 ft. high over all and is supported on concreted timber footings out to the line of the new wharf.

As already noted, coal is now delivered to the station by drop-bottom freight cars which discharge their loads into a track hopper below which is a coal crusher capable of handling 80 tons per hour. A section of the railroad track approaching the hopper is provided with a scale, so that all coal can be weighed as delivered. From the crusher a Heyl & Patterson bucket conveyor lifts the coal 110 ft. to the level of the overhead bunkers. The coal crusher and conveyor are each driven by 50-hp motors. The coal bunkers are of reinforced concrete and hold 2000 tons.

The twelve 900-hp Babcock & Wilcox boilers are arranged on two decks of six each, provision being made for eight boilers on each deck. The furnaces are equipped with Murphy stokers for mechanical firing of the coal, but are also arranged for burning oil in case this becomes desirable. The stoker

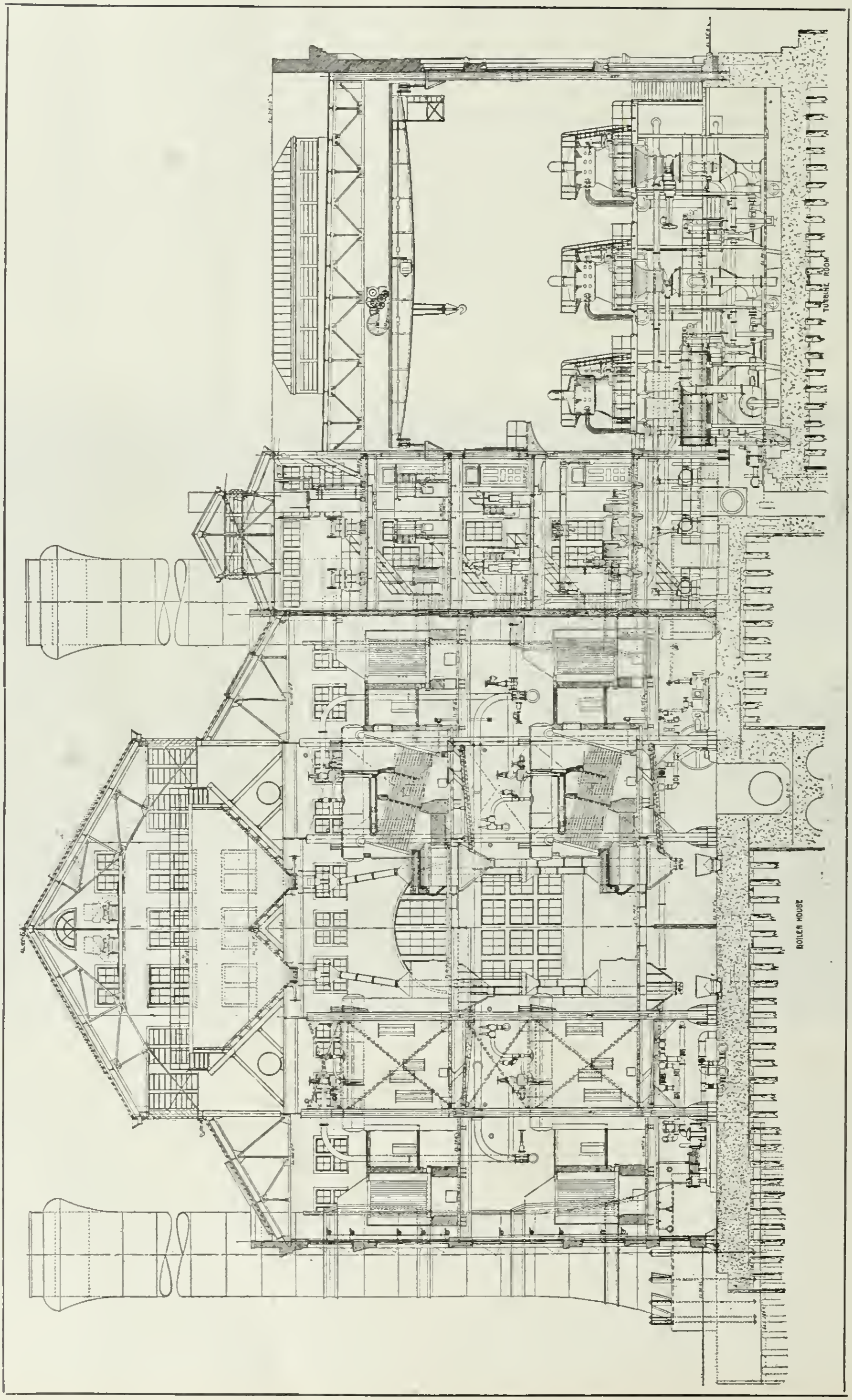


Fig. 2—Sectional Elevation of Main Power Station.

engines exhaust into the 3-in. asbestos-covered pipe shown extending the length of the boilers in Fig. 5. From this pipe lines are taken off supplying the steam nozzles under the grates for keeping the bars cool and free from clinkers. In case it is desired to convert the furnaces to oil burning, valves are provided for cutting off the engine exhaust and nozzle sprays from the 3-in pipe line. Into this pipe line steam from the boilers is then turned, and valves from the laterals are opened, supplying the steam pressure to the oil burners, two of which are provided for each drum. In this way the steam pipe noted serves a double use and is available for either coal or oil burning. The fuel-oil supply for the plant is derived from four cylindrical tanks, 60 ft. long and 12 ft. in diameter, buried underground near the station. A 6-in. oil pipe-line extends along the levee front, passing the station, and is available for filling the tanks and replenishing the oil supply at any time.

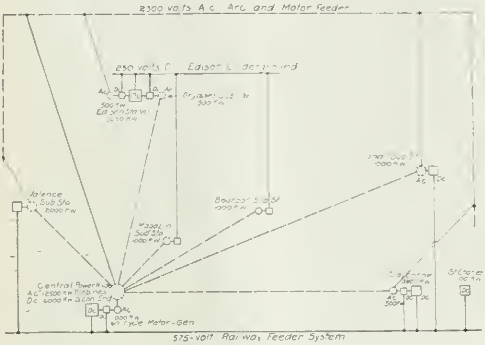


Fig. 3—Diagram Showing Distribution System of New Orleans Railway & Lighting Company.

The stack gases from the furnaces are first led through Sturtevant economizers, extracting surplus heat which is used to warm the feed water. The stacks, one serving each double-decked side of boilers, are of steel, 268 ft. high and 15 ft. in diameter, lined with brick throughout the lower 60 ft. of their height. The ashes from the furnaces are discharged into push cars running on narrow-gage tracks in the basement. These cars are dumped into a huge hoist bucket and the ashes lifted overhead to an ash tank from which they can be discharged into freight cars on the coal track below.

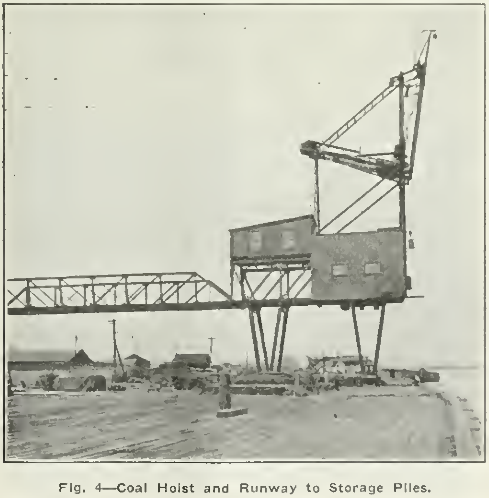


Fig. 4—Coal Hoist and Runway to Storage Piles.

Feed water for the boilers is derived from a 900-ft. well, in which the water now comes within 100 ft. of the surface, although this well was formerly of the self-flowing artesian type. The upper lift is now accomplished by compressed air supplied by a Buckeye engine driving an Ingersoll-Rand compressor which furnishes air to the storage-reservoir tanks at 80 lb. per square inch.

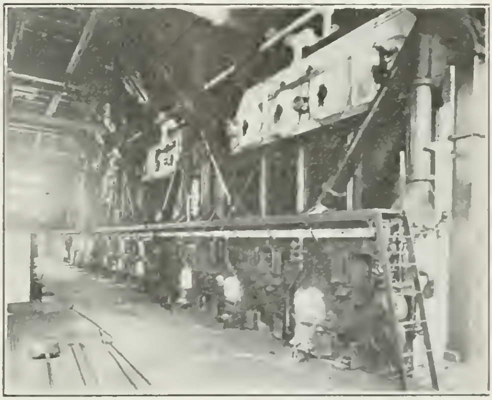


Fig. 5—Boiler-Room, Showing Furnaces Arranged for Coal or Oil Burning.

Three reciprocating boiler-feed pumps are now held in reserve, but for regular duty a turbine-driven centrifugal pump, Fig. 6, has been operated twenty hours daily during the last three years. This unit comprises a Terry steam turbine running at 1675 r.p.m., direct-connected to a D'Olier five-stage, 8-in. centrifugal pump capable of delivering 1000 gal. per minute against a head of 500 ft. The boiler pressure carried is normally 175 lb., but the friction and static heads due to the elevation of the boilers increase the pressure actually withstood by the pump to 235 lb. per square inch. The operation of this turbine-driven boiler-feed pump is declared to have effected a saving of $300 a month, gained by the avoidance of packing, decrease in steam consumption, lessening of racking on pipes

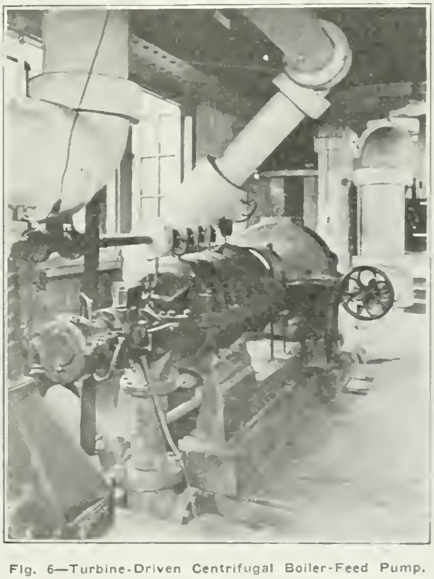


Fig. 6—Turbine-Driven Centrifugal Boiler-Feed Pump.

due to uniform pressure developed, etc. In case the discharge line becomes obstructed the turbine pump cannot raise the pressure to a dangerous point, since at pressures above that which it is designed to deliver its impeller simply churns the water. The pump has been run continuously except four hours daily during three years, and in this time the cost of packing is said to have been less than $10. The boiler-feed pump takes its supply from a 60-ft. tank, 12 ft. in diameter, just outside the building. The blow-off valves from the boilers open into tanks leading to 72-in. mains into which the condensers discharge.

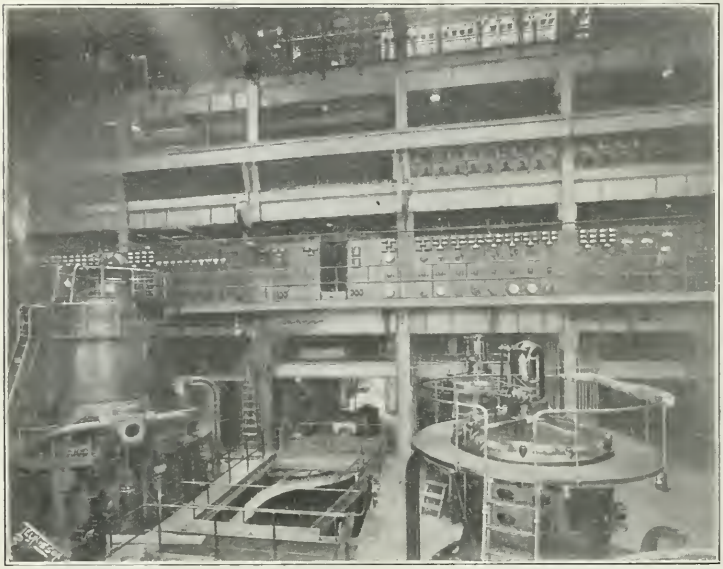


Fig. 7—Turbine-Room and Switchboard Galleries.

A feature of the New Orleans central station is the application of motor-operated valves for controlling all of the principal steam lines as well as the exhausts into the jet-type condensers. A small switchboard in the engine-room, shown in Fig. 8, controls fourteen motor-driven high-pressure Chapman steam valves inserted in the various main headers, cross-overs and steam lines. The largest high-pressure steam valves thus controlled are in 16-in. main headers. The valve-control board comprises a group of double-throw, double-pole switches which are thrown up to open and down to close. As long as these contacts are made the motors continue to operate until the valves have moved to full position, after which the motors are automatically cut off. The operation of these motor-operated valves is tested regularly once a week, and the presence of the remote-controlled cut-offs has several times proved a safeguard to the plant by enabling the engine-room attendant to shut off the steam to some disabled unit in a fraction of the time that the boiler-room valves could have been reached for hand-closing. Each of the steam turbines exhausting into jet condensers is also equipped with a motor-driven exhaust valve, one of which is shown in Fig. 10. The largest of these motor-driven exhaust valves, which are controlled from the turbine-room floor near the base of the respective turbine served, are 42 in. in diameter. Direct current at 110 volts is used for the valve-control lines.

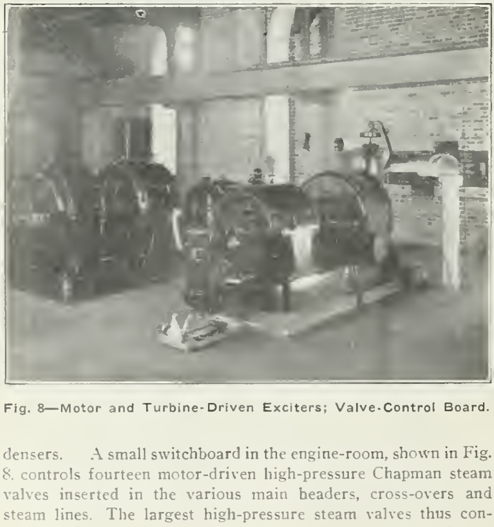


Fig. 8—Motor and Turbine-Driven Exciters; Valve-Control Board.

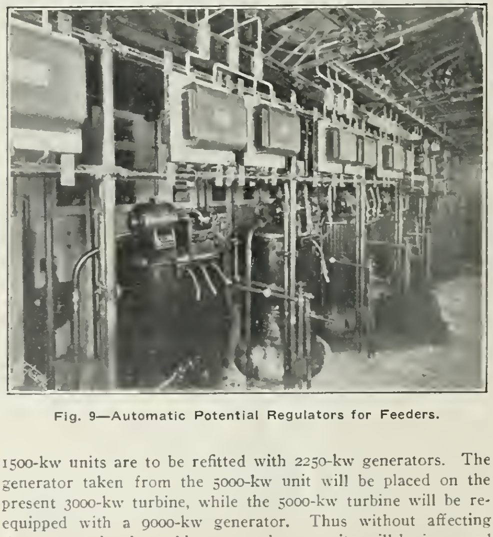


Fig. 9—Automatic Potential Regulators for Feeders.

The steam-turbine equipment is all of the General Electric-Curtis vertical type, generating 60-cycle, three-phase energy. There are three 1500-kw, 2300-volt units running at 900 r.p.m.; one 3000-kw, 6600-volt set running at 720 r.p.m., and one 5000-kw, 6600-volt set which also runs at 720 r.p.m. Tests made of the steam elements of these turbine units have shown that at full load on the electrical elements hardly half of the automatic steam valves are open, owing to the generous safety factor allowed on the turbine ratings. In order, therefore, to increase the plant generating capacity without extending the station or replacing existing prime movers at present it has been decided to re-equip the present turbines with larger generators, which they are easily capable of driving. The 1500-kw units are to be refitted with 2250-kw generators. The generator taken from the 5000-kw unit will be placed on the present 3000-kw turbine, while the 5000-kw turbine will be re-equipped with a 9000-kw generator. Thus without affecting the steam units the turbine generating capacity will be increased from 12,500 kw to 20,750 kw, a gain of nearly 70 per cent. The present 3000-kw turbine set and two of the 1500-kw units exhaust into Alberger jet-type condensers, while the third 1500-kw turbine and the 5000-kw machine are arranged with Wheeler surface-type condensers. These condensers are supplied with cooling water through 72-in. intake tunnels from the Mississippi River.

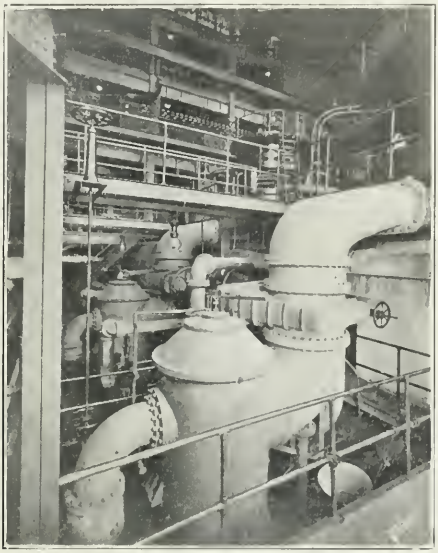


Fig. 10—Jet Condensers for Turbines, and Motor-Operated Valves.

The three vertical compound engine-driven sets installed in the New Orleans power house develop 550-volt direct current for the street-railway system. Two of these units are composed of 2200-kw Allis-Chalmers engines driving Westinghouse generators, and the third comprises a 1500-kw Allis-Chalmers engine driving a General Electric generator. The railway direct-current switchboard is located on the main floor opposite the engine-driven units. There is also an additional block of 2250 kw in 550-volt belt-driven railway generators installed in the old railway station adjoining the new plant and soon to be dismantled.

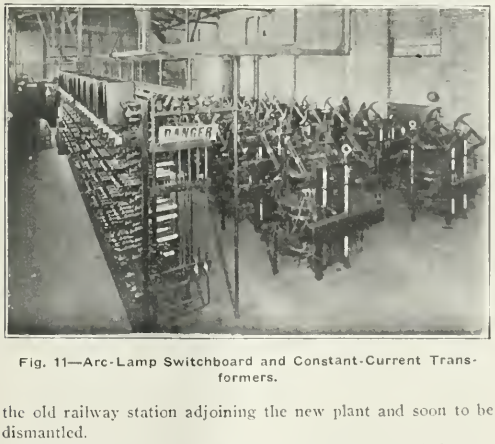


Fig. 11—Arc-Lamp Switchboard and Constant-Current Transformers.

The excitation equipment for the turbine portion of the station comprises an 80-kw induction-motor-driven 125-volt generator, one 75-kw and one 25-kw Curtis-turbine-driven generators, and a 75-kw marine-engine-driven set. These machines, shown in Fig. 10, are located on the main turbine-room floor beneath the switchboard gallery. In the same space are also installed two 500-kw, 550-volt railway generators driven by 2300-volt synchronous motors, permitting an interchange of power when needed between the 2300-volt alternating-current and 550-volt direct-current buses. The motor-generator and auxiliary-room is served by a 10-ton motor-operated crane, while a 50-ton crane is mounted to span the main engine-room.

On the gallery level above the auxiliary-room is the main alternating-current operating switchboard divided into 2300-volt and 6600-volt sections opposite the respective machines delivering these pressures. Besides the usual complement of switchboard instruments the panels are provided with curve-drawing voltmeters and wattmeters and a station synchroscope with 3-ft. scale suspended across the gallery and visible from any point along the switchboard.

From the station seven 2300-volt feeders pass under the river in submarine cables to light Algiers, the suburb across the Mississippi from New Orleans. Transformers are also provided for interconnecting the 2300-volt and 6600-volt buses.

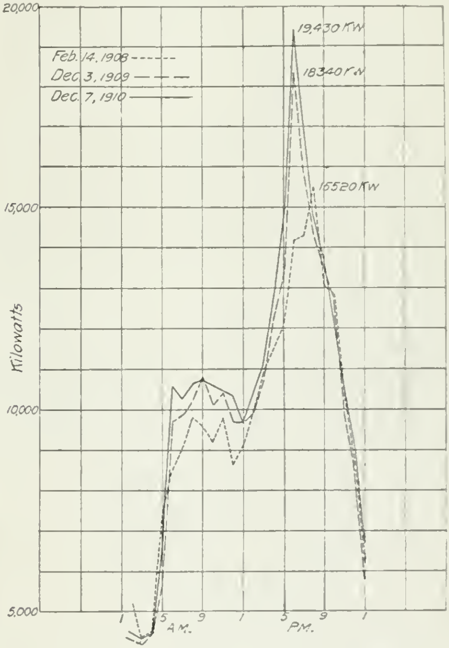


Fig. 12—Typical Daily Load Curve, Showing Two Years' Growth.

Nine 6600-volt feeders leave the main station for the various substations, Valence, Edison, Magazine, Bourbon, Canal and Claiborne, where the output is stepped down to the 2300-volt distributing pressure or is converted into direct current at 250 volts or 550 volts, as shown by the diagram of the system in Fig. 3. On the second and third gallery levels are the motor-operated oil switches for the generators and feeders, all of which are remote-controlled from the switchboard. On the third floor are seven 38-kw Westinghouse automatic potential regulators, Fig. 9, controlling the 2300-volt feeders to Algiers. The arc-lighting equipment for the 1170 7.5-amp series street arcs is on the fourth gallery, as shown in Fig. 11. Twelve constant-current transformers are provided, two circuits being supplied from each transformer.

Mr. Hugh McCloskey is president of the New Orleans Railway & Lighting Company; Mr. J. J. Gannon is first vice-president; Col. J. H. De Grange is second vice-president and secretary, and Mr. H. A. Ferrandon is treasurer. Mr. R. E. Slade is general manager of the gas and electric departments; Mr. E. B. McKinney is superintendent of power, and has direct supervision of all generating stations and equipment, and Mr. A. L. Black is electrical engineer.

TRANSMISSION-LINE SUPPORTS AT DIFFERENT ELEVATIONS.

By J. S. Viehe.

In working over transmission-line profiles for locating towers the writer has observed that the lowest point of the wire is not always the closest point to the ground, and has found that it is necessary to sketch in the curve in which the wire will hang, both when it is hot and when it is cold. The following method has been found convenient:

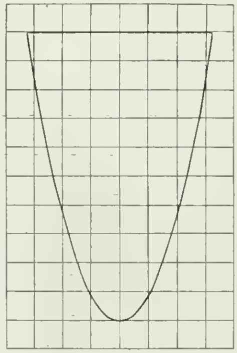


Fig. 1—Curve Showing Position of Wire.

With calculations for the line made assume, for example, a 600-ft. span with a sag of 12.5 ft. when the wire is hot and 10.4 ft. when it is cold for supports at the same elevation. From these values, assuming that the tension is the same in all spans, one can easily determine the sag for different lengths of span, since the sag is proportional to the square of the span. The table in the next column was obtained in this way.

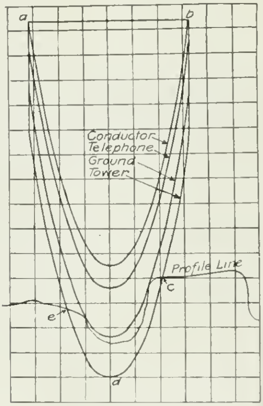


Fig. 2—Positions of Conductor, Telephone Line and Tower.

As the greatest sag occurs when the wire is at high temperature it is important to locate the towers and adjust the length of spans in such a manner as to insure sufficient clearance between ground and wire at all points of the transmission line. Fig. 1 represents the curve in which the wire will hang, the scale, of course, being exaggerated. This curve was plotted from the values in the above table, using half the length of span as abscissa and the sag, when wire is hot, as ordinate, the scale of plotting being the same as that on the profile under consideration, which is here 250 ft. to the square for the horizontal scale and 10 ft. to the square for the vertical scale.

Length of Span in Feet.	Sag in Feet.	
	Hot.	Cold.
300	3.1	2.6
500	8.7	7.2
600	12.5	10.4
800	22.3	18.5
1000	34.9	29.0
1200	50.1	41.5
1500	78.3	65.0

This curve was then transferred to celluloid four times, as shown in Fig. 2, *a b c d e* being the celluloid card. The vertical distance between these curves is as follows: Between "conductor" and "telephone" the distance is the separation of these wires at the towers, in this case 9 ft.; between "telephone" and "ground" the distance is the allowable clearance between telephone wire and ground at points in the span, in this case 20 ft.; between "conductor" and "tower" is the height of the tower from ground to lowest transmission conductor, in this case 45 ft. The celluloid was then trimmed along the line marked "tower." The card is used by keeping the axis vertical and sliding it around until the curve marked "ground" just touches the profile line, in which position the intersection of the curve marked "tower" with the profile line gives the locations of the two towers. In the illustration the towers would be located at the points *e* and *c*. The towers can now be drawn in and the celluloid card moved up until the curve marked "tower" touches the two points of support, in which position the curve can be drawn in. If one of the towers has been previously located the card can be used in a similar manner except that the point of support must be in contact with the curve "conductor" when the curve "ground" touches the profile line. A curve similar to Fig. 1, plotted from the values of the sag when the wire is cold, can also be used on the profile to insure that no insulators will have an upward strain on them under this condition. It should be noted that the card in Fig. 2 can be used without regard to length of span or difference in elevation of supports.

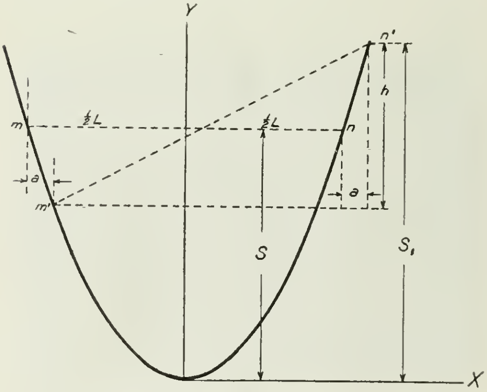


Fig. 3—Symbols Used in Determining Wire Sag.

This method of locating the curves is based on the usual assumption in regard to spans and, of course, gives the same position of low point of the wire. The method of obtaining the co-ordinates of the low point of a span with supports at *h* ft.

difference in elevation in terms of the sag of a span of equal length but supports at same elevation is as follows:

Referring to Fig. 3, assume the span *mn* to have the length L and sag S; the problem is to locate the low point of the span *m'n'* having the same length but with a difference h in elevation of supports.

The equation of the parabola is

$$x^2 = ky$$

But when $y = S$, $x = \frac{1}{2}L$, so that $k = \dfrac{L^2}{4S}$

Therefore,
$$x^2 = \frac{L^2}{4S}y \qquad (1)$$

When $y = S, \quad x = \frac{1}{2}L + a$

When $y = S_1 - h, \quad x = -\frac{1}{2}L + a$

Substituting in (1)
$$\left(\tfrac{1}{2}L + a\right)^2 = \frac{L^2}{4S}S \qquad (2)$$

$$\left(-\tfrac{1}{2}L + a\right)^2 = \frac{L^2}{4S}(S_1 - h) \qquad (3)$$

From equations (2) and (3), eliminating L and a, there is obtained

$$S_1 = S\left(1 + \frac{h}{4S}\right)^2$$

which gives the amount of sag below the high support. The distance of the low point from the high support can easily be shown to be

$$\frac{L}{2}\left(1 + \frac{h}{4S}\right)$$

These two values locate the low point.

As noted above, the writer has found this method convenient, and in some cases has found that the minimum distance between ground and wire did not occur at the low point of the sag.

THE SAND-ROCK TUNNELS OF THE ST. PAUL EDISON COMPANY.

IN the issue dated June 8 appeared a description of the distributing tunnels of the Northern Heating & Electric Company of St. Paul, Minn. The present article gives a short account of the underground system of the St. Paul Edison Company.

Nature has favored the public-service companies having underground distribution systems in the city of St. Paul by providing, 25 ft. below the hard surface rock, a relatively soft sandstone which lends itself to tunneling. To make these bores even more convenient of access she seems, through a series of later processes, to have kindly opened up a whole side of the sand-rock formation and arranged a shelf alongside them on which to build power plants whose switchboard galleries open directly into the cable tunnels referred to.

A good many million years back, in the days of the steaming old Silurian seas—whose most highly developed trilobites would likely be disowned by their modern descendants, our intelligent horseshoe crabs—there was deposited on the ocean floor later to become Minnesota the sea ooze which forms the buff-colored limestone which underlies St. Paul at a depth of 100 ft. or more. Then, due to forgotten causes, ocean currents changed, the Hennepin country perhaps became a bay into which an unnamed river emptied, and for a few ages this arm of the sea went on filling up with fine sand which later compacted into a solid rock-like formation. Again conditions changed, and for a century or two a fine ocean mud was deposited on top of the sand, forming the soapstone which lies there to-day. Another tremendous event took place, this time probably a subsidence, and the earlier processes of limestone building by sea ooze again went on uninterrupted, producing after the lapse of geologic time the extremely hard "blue rock" on which the city of St. Paul is built. This old ocean floor then rose above the sea level, and for uncounted ages the processes of erosion and weathering were at work attacking the formations thus exposed. A great river flowed near by. But on a geologic yesterday, when the great glacial ice sheets came down from the north, a quantity of boulders and detritus was dumped into the old channels, closing them up and forcing the rivers to make new beds. The Mississippi's new course lay alongside the future city of St Paul, and here, centuries before even a western continent was dreamed of, the "Father of Waters" began cutting away first the hard limestone and then the softer sand-rock cliffs through which the extensive underground structures are to-day most conveniently entered.

Practically all of the public utilities of St. Paul take advantage of this underlying soft sandstone stratum to avoid the expensive excavation of the extremely hard "blue-rock" surface limestone. The Edison Light & Power Company, which is the electrical department of the St. Paul Gas Light Company; the Northern Heating & Electric Company, the two telephone companies, and the city water-works and sewer systems each have their independent systems of tunnels in the sand-rock formation which underlies most of the business district, but the most extensive of these systems are probably those of the Edison company, which lie lowest next to those of the sewer system.

In all, the St. Paul Gas Light Company, as the Edison company is better known locally, has 15,450 ft. of these tunnels, 3000 ft. being steam-pipe bores and 12,450 ft. exclusively for electric cables. On account of the danger of leaks no gas mains are laid in any of these tunnels. The standard tunnel section is about 6 ft. 6 in. high and 3 ft. wide, with vertical walls, arched roof and slightly ditched floor.

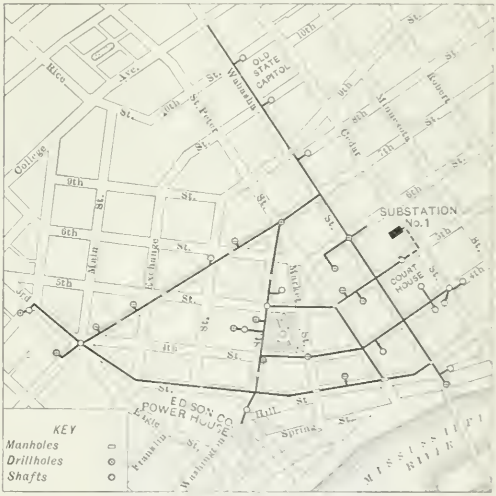


Fig. 1—Map of Downtown St. Paul, Showing Sand-Rock Tunnels of Edison Company.

When first reached this sand rock is very hard and has to be picked down in advancing the headings. One workman is enabled to make about 8 ft. of progress per day. The cost of excavating the tunnels has averaged about $1.75 per running foot. After the tunnel is finished, smoothed and shaped, the cables it is to contain are disposed on vertical brackets along the side walls. A place for countersinking the bracket is first picked into the sand wall and a hole, 18 in. deep, is then bored into the native sand rock. Into this hole a wooden plug is driven and to this the bracket is bolted. The cables carried are the direct-current Edison system circuits and the 2300-volt, two-phase, four-conductor distribution and tie lines between the steam-power plant and water-power substation. The tunnels follow the streets overhead, as shown in the accompanying map, and are well lighted by incandescent lamps every 35 ft. The pervious character of the sand rock takes care of all drainage. From the tunnels the cables ascend at various points through shafts drilled through the hard blue rock and enter the basements of buildings which serve as distribution centers. The Edison tunnel system lies from 25 ft. to 50 ft. below the street surface, and communicates with the surface above through ventilating shafts, manholes provided for quick entry to the interior and drill holes through which the cables ascend. The location of these is shown on the map. The tunnels are high enough for a tall man to walk upright, and a trip through the well-lighted corridors can be made with ease.

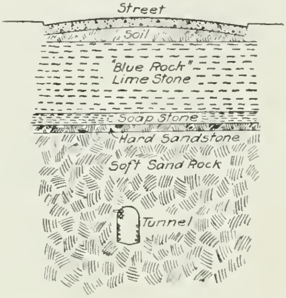


Fig. 2—Cross-Sectional View of Earth Strata at St. Paul, Showing Location of Tunnel.

Another interesting feature of the St. Paul company's underground plant is the three miles of 25,000-volt cable duct, through which the transmission circuits from the 5000-hp Apple River water-power plant, twenty-seven miles from St. Paul, reach the transforming substation in the heart of the city. Although several other companies are now using similar potentials underground, the St. Paul company was the pioneer in installing its one paper-insulated and one rubber-insulated three-conductor No. 2 cable ten years ago. During this time a number of burnouts have occurred, due to breakdowns and other causes, but in the last year the operation of both cables has been without a single such instance. The major part of the three-mile distance is in four-hole McRoy duct. As the substation is approached this is increased to larger conduit to accommodate returning distribution feeders, but one row of holes is left empty surrounding the high-tension cables. The incoming aerial lines enter the lightning arrester station at Atlantic Avenue and traverse the choke coils, which are 10-in. helices of rubber-covered wire, 7 in. in diameter and mounted on insulators before being tapped to the lightning arresters. The potheads where the lines enter the underground cable, as shown in Fig. 4, are filled with paraffine. Simple knife disconnect switches are arranged so that either or both of the aerial circuits can be connected to either or both of the cables in case of accident to any part of the line. Little difference is noticed in the operation of the rubber and the paper-insulated cable, although the latter is, of course, more sensitive to the entrance of moisture if its sheath becomes injured. The 25,000-volt cable ducts are laid in the usual way under the street surface. There are no sand-rock tunnels in the portion of the city traversed by the duct lines, as the sand formation is not accessible at this point. Mr. F. R. Cutcheon is electrical superintendent for the St. Paul Gas Light Company.

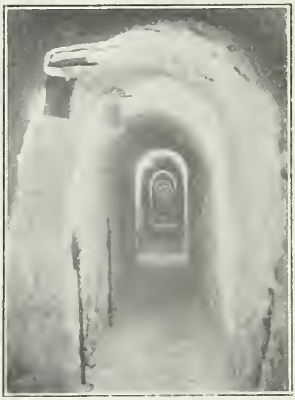


Fig. 3—A Corridor in the Sand-Rock Tunnels Underneath the City of St. Paul.

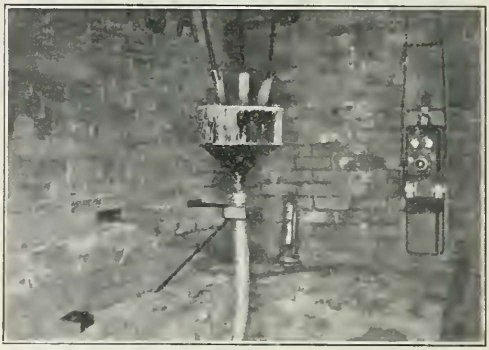


Fig. 4—Pothead Entry of 25,000-Volt Transmission Line Into Rubber-Covered Underground Cable.

* * *

ELECTRICAL RESISTANCE AS A FUNCTION OF THERMAL AND MECHANICAL CHANGE.

By Albert Alexander Somerville.

For some time the author has been investigating the temperature coefficients of electrical resistance, carrying the temperatures to a higher range than has heretofore been done in this work. Excellent facilities have been available for doing the work, such as furnaces, electrical power, thermometers and temperature recorders, bridges and a nitrogen plant equipped with pump and motor. About forty different mate-

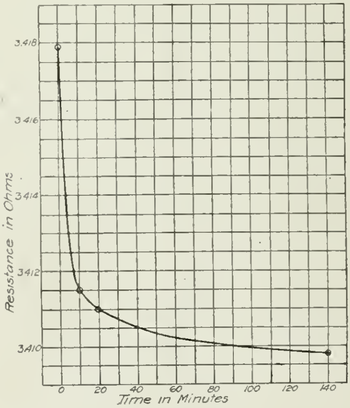


Fig. 1—Resistance at Zero Deg. Cent. When Annealed at 100 Deg. Cent.

rials have been tested during three years' time and in some of the more common ones the results obtained at ordinary temperatures have not agreed very well with results reported by other investigators. These differences, however, can readily be explained by the different conditions under which people have worked. The condition of a body depends much on the treatment that body has received. Three things that will affect it are rolling, cold drawing and annealing. The effects of the first two may be completely removed by the last. In order to get a material in shape to measure its resistance it is commonly put through a set of draw-plates to produce wire that will have a certain specific resistance and temperature coefficient; if it were rolled instead the constants might be different and if it were annealed they would be almost sure to change. No one who has ever used a platinum resistance thermometer would think of trying to calibrate it until it has been thoroughly annealed at a temperature as high as or higher than that at which it would subsequently be used.

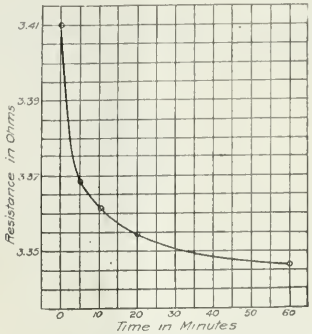


Fig. 2—Resistance at Zero Deg. Cent. When Annealed at 300 Deg. Cent.

The time required for annealing and the temperature at which it is accomplished are not well known as yet, and in order to acquire a little information on this subject the work here described was performed. In electrical work copper is the most common metal used. Nickel has the most peculiar electrical properties and it does not readily oxidize at high temperatures. It was thought that an alloy of these two materials might prove interesting, and for this purpose use was made of a 5-cent coin, which contains 75 per cent copper and 25 per cent nickel, according to the superintendent of the Mint at Philadelphia. The author has no information concerning the purity of the elements used.

Use was made of a 1910 coin first rolled into a sheet 12 cm long and 0.027 cm thick. This sheet was cut into narrow strips and one of these strips put through sapphire draw-plates until a wire was obtained which was 35.5 cm long and 0.021 cm in diameter. This was wound on a quartz tube and copper-lead wires were attached by fusing in a small arc made by using lead pencils as electrodes. The specimen, together with dummy lead wires insulated by quartz tubes, was then placed in a porcelain tube and sealed in with plaster-of-paris so that the oxygen in the tube could be forced out by pumping nitrogen into the tube in order to prevent oxidation.

It was then alternated between ice and steam baths, or it was annealed at 100 deg. C. and the resistance at zero deg. C. was measured at stated intervals. Fig. 1 shows the results. The X axis indicates the net time in the steam bath, the time for cooling to zero deg. C. and making the measurements being subtracted from the whole. This curve shows that most of the annealing done at 100 deg. C. is accomplished during the first ten minutes and after two hours the change is nearly complete.

When the specimen was placed for a short time in an electrical furnace at approximately 300 deg. C. it was found that the annealing process was only begun and that a temperature of 100 deg. C. was not sufficient to anneal such an alloy. Fig. 2 shows the added effect of annealing at 300 deg. C. Fig. 3 shows the comparative effects produced at 100 deg. C. and 300 deg. C.

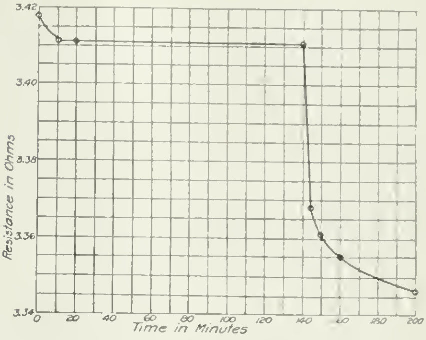


Fig. 3—Resistance at Zero Deg. Cent. When Annealed at First 100 Deg. and Then 300 Deg. Cent.

Further heating at 700 deg. C. produced very little effect on the resistance at zero deg. C., and hence it was concluded that annealing was almost completed at 300 deg. C. It is known that some materials cannot be completely annealed at this temperature. A platinum thermometer is not "aged" until it has been used for some months. The one with which this work was done has been used about three years in the same room. Only slight repairs have been required in that time. During the first year it was necessary to calibrate it frequently. It has been heated to approximately 1000 deg. C. probably 500 or 600 times, and during the last half year no change whatever in its resistance at zero temperature or its fundamental interval could be detected.

The results obtained, then, in the case of the alloy of nickel and copper used are that the specific resistance is changed from 0.0000330 when rolled and cold drawn to 0.0000331 when annealed thoroughly. Moreover, the temperature coefficient is changed from 0.00016 in the first case to 0.00019 in the latter case.

The resistance was also determined over the range of temperature from zero to 900 deg. C., as shown in Fig. 4. As plotted it appears to be represented by two nearly straight lines, the slope of each being small as compared to that of the pure metals.

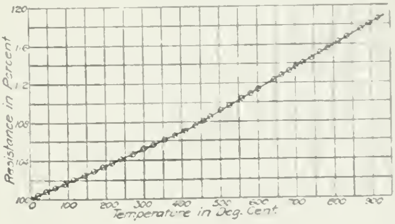


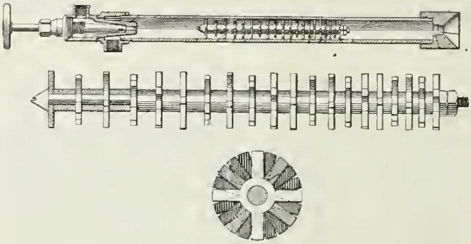
Fig. 4—Resistance at Temperature from Zero to 900 Deg. Cent.

Various metals behave differently and each one should be separately investigated. Results now at hand can hardly be compared unless previous conditions of treatment are also considered.

BURNER FOR CRUDE OIL.

By the use of an improved crude-oil burner of his own invention, Mr. E. J. Owin, chief engineer of the Galveston (Tex.) municipal pumping station, which also furnishes the street lighting for the city, reports he has been able to effect a saving of 22 per cent in the quantity of oil burned. At the present time 42,000 gal. of oil are consumed monthly under 800 hp in boilers, the steam developed being used to pump 2,500,000 gal. of water daily and to operate steam turbines supplying the 350 magnetite street lamps.

The burner shown in the accompanying sketch consists of a long hollow tube into which the oil and steam at 50 lb. pressure are sprayed through a needle valve. In the center of the burner tube are a number of four-fingered baffles mounted on a clamping rod and so staggered that to the fuel and steam passing there is imparted a whirling motion. The burner nozzle is in the form of a circular beveled opening, unlike the flattened fishtail-producing flame usually employed. The spacing between the adjacent baffles is diminished in the direction of the fuel's flow, so that the speed of rotation of the fuel is constantly increased at each point. A United States patent was recently granted Mr. Owin on the features of novelty of this burner.



Details of Crude-Oil Burner.

Central Station
Management, Policies and Commercial Methods

SEPARATE DRIVE FOR PLANER SPINDLES.

The matter of individual motor drive of wood-working tools is now being carried a step past even the unit stage, experiments being under way to apply separate motor drive to each of the cutter spindles on planers. As much as 30 per cent of the full-load power is often absorbed by the friction of belts and speed-changing devices in these machines, and by directly connecting the motors to their spindle shafts it is expected to save much of this waste.

IRRIGATION PUMPING LOAD AT LAREDO, TEX.

Laredo, Tex., a city on the Mexican border, with 15,000 inhabitants, the majority of whom are of Mexican and Spanish descent, lies in the center of a great onion-growing territory, irrigation of which has become one of the principal loads of the local central station. Mr. F. E. Scovill, manager of the Laredo company, reports that due to this pumping the day load on his company's lines exceeds the night lighting peak by about three times, but the long-hour business afforded by the pumping demand is very satisfactory and profitable from a central-station viewpoint.

HOLDING THE HOUSEWIFE'S ATTENTION.

To insure that one of its little booklets on the use of household electrical appliances shall have the attention of the housewife for more than a brief inspection the Commonwealth Edison Company, Chicago, has incorporated into the last pages sheets of gummed labels, "Cherries," "Peaches," "Strawberries," etc., for use in canning fruit. The fruits named on the labels have been so chosen as to span nearly the entire canning season, insuring that the booklet will be held and prized during this period at least. Beneath the name of the fruit each label bears in small type the words "Commonwealth Edison Company," so that when the fruit is opened another reminder of the company is presented.

BREWERIES AS CENTRAL STATION CUSTOMERS.

On account of their long-hour use of energy, operating practically twenty-four hours per day, the New Orleans Railway & Light Company has found serving its brewery customers a very desirable class of business from a central-station standpoint. The electric company now has several of the largest breweries in the city as its customers, using motor drive to operate bran mashers, agitators, pumps, conveyors, elevators, etc. For one large brewery it furnishes energy for a total connected rating of 200 hp in motors, supplying all power used in the plant except that for a 75-hp steam-driven refrigerating machine, which has not yet been converted to electric drive. In each of these breweries the electric installation has grown a step at a time, increasing from initial motor services of from 10 hp to 15 hp to the present almost complete operation of the plants, as the convenience and economy of central-station service was demonstrated.

MOTOR-DRIVE REDUCES COST OF COTTON GINNING.

Throughout the South and Southwest cotton gins are not generally considered desirable central-station loads on account of the heavy demand and the few months of autumn operation of the gin load. In the case, however, of a 65-hp cotton gin at Coalgate, Okla., motor-driven by the local central station, not only does the electric company consider this consumption good business, but the gin, though in the midst of a coal-mining section, has been able to reduce its total operating expenses from 50 cents down to 30 cents per bale, with energy at 4 cents per kw-hour. This gin has a capacity of about one bale each ten minutes when running continuously. With electric drive the heavy boiler operating and up-keep costs have been eliminated, together with the boiler-room force, leaving only one gin-stand man and one packer to operate the plant. The gin usually begins operation Aug. 15 and runs until about the first of the year. The heaviest cotton-ginning season is near the middle of this period, when the gin is sometimes run twenty-four hours per day. At other times the ginning load by agreement is kept off the peak period of the lighting plant, being operated principally during daylight hours. Mr. H. L. Reager, manager of the Coalgate Light & Ice Company, declares that in his estimation such a cotton-ginning load is desirable business for a small central station, asserting that in his own plant the gin has been a profitable customer.

MINIMUM SIZES OF SERVICE AND LINE WIRES.

In a discussion at the recent Iowa Electrical Association convention at Davenport several speakers compared notes as to practice in minimum sizes of line and service wires used.

Mr. Austin Burt, of Waterloo, said that for a number of years his company installed nothing smaller than No. 6 wire for consumers' services, no matter how small the load. Recently wire as small as No. 8 and even No. 10 has been installed for services in some cases.

Mr. A. L. Dodd, of Charles City, said his company's practice was to use nothing smaller than No. 6 on primary and arc circuits.

Mr. H. B. Gear, of the Commonwealth Edison Company, Chicago, who has charge of its overhead work, said that Chicago practice had been to adopt a few standard sizes for different purposes to avoid having a large number of sizes of wires. The largest overhead primary feeder wire used is No. 0. If more power is needed than can be transmitted at a reasonable line loss with the No. 0 feeder, additional feeders are installed, because more than this amount of power cannot be distributed from the ends of feeders on No. 6 mains and maintain the line loss at a reasonable figure. No. 6 wire is the standard for primary mains and branches. The city of Chicago allows no consumers' service wire less than No. 8. For most services No. 6 is used. For very small consumers and short spans No. 8 is used, although in former years some No. 10 was used.

RECOGNITION OF ELECTRICITY AS BOOSTER OF PROPERTY VALUES.

"The lessee hereby expressly agrees to erect and maintain during the life of this lease a bright electric sign having lamps on the outside, to be lighted each and every night until at least 10 p. m., and he further agrees to burn bright window lights until 10 p. m."

The preceding quotation is from the form of lease under which ten storerooms, each renting at $200 a month, have been let in a newly renovated business building at Muskogee, Okla. The landlord has no interest, direct or implied, in the local electric company and his action was entirely unsolicited. He realized, however, that nothing would do as much to enhance the value of his property as brilliant electric lighting after nightfall. This particular building, though on a prominent corner, was formerly dark and gloomy after night, so that it was avoided by the evening crowds. It was with the idea that the sidewalk should again be made attractive that this peculiar clause was incorporated in the lease.

To do his own share toward this result the landlord has ordered 500 low-voltage tungsten sign lamps installed to outline the building, and will also erect a large sign to advertise the hotel which will occupy the upper floors. Indeed, so pleased was he at the prospect of having his new building amply illuminated that with the order for the above display he handed Mr. Norman B. Hickox, new-business manager of the Muskogee Gas & Electric Company, a check covering the cost of the construction and two years' operation of the lamps.

THE COTTON GIN AS A CENTRAL-STATION LOAD.

The electrical operation of cotton gins as desirable central-station loads came up for discussion during the recent convention of the Southwestern Electrical Association at Houston, Tex. In general, electric companies in the South and Southwest have chosen to avoid cotton-ginning loads on account of their comparatively heavy demand during only a few months in the year, overlapping the winter lighting season. The cotton-ginning season usually begins in August or September and lasts through December, running much of this period twenty-four hours a day, the latter part coming at a time, however, when the capacity of generators is needed for the evening lighting peaks.

Mr. J. A. Walker cited a case where the cost of energy for ginning was 50 cents a bale, 10 kw-hours to 15 kw-hours at the low rate of 4 cents to 5 cents per kw-hour being required for each bale. In re-equipping a steam-driven gin for electric drive he advised that the gin apparatus be practically reconstructed, since with the long mechanical transmission in the engine-operated plant the friction losses are very high, reaching as much as 75 per cent of the full-load input. He also mentioned the successful operation of a set of seven seventy-saw gins driven by a pair of 50-hp motors supplied on a meter basis. This service is considered a satisfactory central-station load.

Mr. E. D. Kelly, of Terrell, Tex., declared that the large investment and overhead charges required by the gin load during the short period of its operation, conflicting with the lighting peak, make it poor central-station business. Mr. C. H. Cushman, of San Antonio, Tex., referred to the high cost of ginning single bales of cotton under the intermittent conditions obtaining in many gin plants, where the machines have to be started up to gin a few bales at a time as farmers bring these to the mill. Under such circumstances the labor and fuel costs may amount to $1 or more per bale. Mr. C. W. Kellogg, of Dallas, pointed out that the small central station has comparatively high labor and fixed costs, while its coal cost may be actually the least of its charges. On the other hand, the fuel charge is often one of the most important factors that go to make up the cost of a kw-hour in a large generating plant where machinery and labor have been reduced to the minimum possible with big units. This difference in the make up of generating costs in large and small plants should be considered, declared Mr. Kellogg, in determining upon the desirability of long-hour and short-hour business under such plant conditions.

PHENOMENAL CENTRAL-STATION GROWTH AT OKLAHOMA CITY.

Oklahoma City, with a population of 75,000, has 17,000 consumers of gas and electricity, 80 per cent of whom are residence customers. During the past seven years the generating capacity of the local power plant has been increased seven times, the last addition being a 3000-kw engine-driven set, which brings the station rating up to 8600 kw. On preceding occasions each power-house addition was designed and expected to meet the growth of the system during the next two or three years, but the capacity provided has invariably been taxed in each case within six months or less of the completion of the new equipment. Connected to the central-station lines there are now nearly 1000 motors, aggregating about 6000 hp in rating.

Oklahoma City has 150 electric vehicles, including ten trucks. The minimum monthly charge for a private-garage rectifier set is only $1 and the equivalent rate for vehicle charging is 3.5 cents to 4 cents per kw-hour. The average yearly income per vehicle is estimated to be $60 in Oklahoma City. The present excellent showing of the electric car in the city is largely due to the unremitting publicity given these vehicles by the central-station company, aided by the local representatives of the manufacturers.

The company does no wiring, delegating all such construction work, sale of supplies, etc., to local contractors and dealers. The percentage of houses wired in Oklahoma is very high. Contractors do the wiring, billing the customer at cost and collecting from the central-station company a fixed profit, which is figured at a fair percentage of the gross amount. The house-wiring and sales campaigns of the Oklahoma Gas & Electric Company were inaugurated only last September following the establishment of a department in charge of Mr. A. Larney, new-business manager. The company transacts its business rather like that of a banking institution and maintains no display in connection with its handsome offices. Recently to inaugurate a domestic-appliance campaign several windows in a leading department store were secured, fitted up as room interiors and equipped with all kinds of heating appliances. Two demonstrators in the windows manipulated the apparatus, which was fully labeled by explanatory cards, while outside on the sidewalk a representative of the company explained to the crowd the functions of the various devices. Good work has been done in this way and through local newspaper advertising. Following the opening of the new-business department the first efforts were made to gain the confidence and satisfaction of local merchants and residents, who were shown in many cases how to improve their installations without additional expenditure. In this way the local standard of illumination was raised rapidly, and the streets of the city now present an attractive appearance after nightfall, due to signs and window lighting. Sixty-two signs have been erected in four months, and a "white way" of tungsten curb posts has been installed.

The Oklahoma Gas & Electric Company is controlled and operated by H. M. Byllesby & Company, Chicago, Mr. F. H. Tidnam being local manager at Oklahoma City.

LOW OFF-PEAK RATE FOR LARGE CONSUMERS AT NASHVILLE, TENN.

The Nashville (Tenn.) Railway & Light Company has been very successful in acquiring large motor-load business on a low-rate off-peak proposition wherein the customer guarantees a monthly minimum of $100. Under this class of service the consumer is required to stay off the lines from 4:30 to 7:30 p. m. For all energy used, as shown by his meter, he pays 2 cents per kw-hour, guaranteeing, however, a minimum bill of $100 a month. In the case of new business motor installations are made on trial by the central-station company without charge, the customer having thirty to ninety days' use of the electric service at only the cost of the electricity used. At the end of this time he is usually pleased with the savings recorded and retains the motor drive, paying 10 per cent of the cost of the installation down and the remainder in instalments as agreed upon. As the result of this proposition the Nashville company has been able to place about 10,000 hp in motors during the last four years. A number of these installations are large consumers, several having 300 hp and above in connected load. The especially valuable feature of this low-rate proposal has been the trial installation of motors without cost to the company, as it has been demonstrated that after motor drive is once installed users are loath to return to the old ways of isolated plants.

A SCHEDULE OF RATES INVOLVING THE INVESTMENT COST OF REACHING THE CONSUMER.

By J. C. Lawler.

Due to the many changes in electrical apparatus and the various conditions under which electrical energy is supplied, it is difficult to form a comprehensive idea or set of definite rules governing the sale price of electricity by a central station. It is well known that a straight rate of so many cents per kw-hour consumed is not fair to either the consumer or the central station, except for very small consumers. Electrical energy can be supplied in large quantities at a lower unit cost, of course, than in small quantities. The time of day, or possibly the season of the year, as well as the distance of transmission, will also affect the costs. The consumer with a large demand and a low consumption of energy should pay a higher rate than one with a low demand and a good load-factor. The consumer who uses service during the peak-load period should pay a higher rate than one who does not operate on the peak and saves the company the expense of maintaining reserve capacity for him. The consumer who requires a special extension of the station's lines for his sole benefit should pay a higher rate than a like consumer who shares a line with other consumers.

With these conditions in mind it appears that a fixed charge plus an energy charge would be a just method for determining a proper rate for electric service.

The fixed charge would be made up of two components:

1. The cost to the central station of installing and maintaining lines, transforming devices, etc., to supply service to the consumer.

2. The cost to the central station of installing and maintaining generating equipment for the consumer.

These fixed charges will vary according to the class of business to be supplied. The cost of extending lines, installing transforming devices, etc., would be the same no matter whether they were to supply motors or lamps of equal demand, while the second item would vary with the time of day when the current is to be supplied.

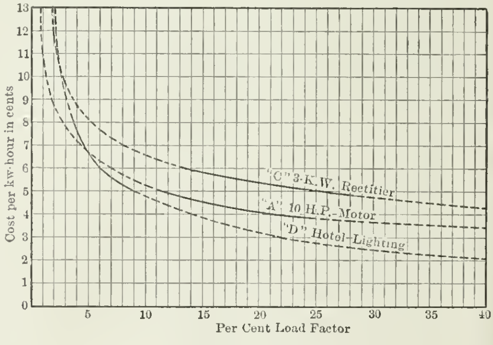
Electrical energy for lighting purposes (leaving out investment costs, which are taken care of in the fixed charges) does not cost any more than a like amount of electrical energy for motor purposes and consequently the kw-hour cost should be the same to the two classes of consumers when sold in the same quantity and during the same period of time. The price should vary, however, with the amount of energy sold, the larger consumer receiving a lower unit rate. The lesser expense of manufacture in large amounts is very apparent, for distribution is facilitated by requiring fewer pole lines, the larger transforming devices are more efficient and clerical work is decreased when supplying one large consumer whose consumption is equivalent to that of several small consumers.

We should then supply electrical energy to all classes of business at the same rate when furnished in equal quantities, but the unit price should be lower when served in large quantities.

The next step would be in determining a method of making the charges in a systematic way, one in which the commercial representatives of the company could at once give the prospective consumer a definite cost figure, without having to refer to a large volume or consulting the head of his department or other authorities. It should not matter whether the prospective consumer desires energy for a 1-hp motor or lighting for a ten-story hotel, for unless the representative can furnish the information immediately he is likely to be rated as an office boy or an inefficient clerk who must ask the proprietor the price of each parcel he sells.

The writer has formulated a plan whereby he believes the company's rates for consumers having monthly bills of $4 or more can be determined monthly from a single typewritten sheet. This would cover all classes of business service, and the commercial representative need have only a general idea as to the cost of the construction required and be able to calculate the maximum demand required.

The method proposed is based upon a fixed charge varied according to the cost of construction and demand, plus a charge for the kw-hours consumed as indicated by a meter. The unit cost per kw-hour is the same for all classes of business, but varies according to the quantity consumed, and while the unit cost grows less as the quantity consumed increases, there is no sudden drop, the decrease presenting a smooth curve, which prohibits a consumer from lowering his bill by using a few additional kw-hours.



Curves Showing Equivalent Costs of Energy at Various Load Factors.

The figures herein given are those that have been determined for practical purposes for a station in the West obtaining its output from both steam and hydraulic plants. While the ultimate results may not be suitable for all distributing plants, it would appear that the same general plan with different values applied would give equally good results.

There are three classes of fixed charges, herein known as the "D," "DN" and "N" rates.

The "D" rate is secured by consumers who operate during the off-peak hours, and is $2 per month for each $100 of the construction costs expended by the company in carrying service to the consumer.

The "DN" rate is given to consumers who operate during the day and night and may use service during the peak period. The fixed charge is $1.80 per month per $100 of cost of construction, plus $0.40 per kilowatt of demand (during the peak load) per month.

The "N" rate is obtained by consumers who operate entirely or principally during the peak load. The fixed charge is $1.80 per month per $100 of cost of construction, plus $0.80 per kilowatt of demand (during peak load) per month.

Without going into detail the fixed charge of $2 in the "D" rate includes the interest, maintenance, etc., of the construction required and also a slight portion of the transmission line and plant expense.

The $1.80 charge in the "DN" rate includes the local construction work, and the 40-cent charge covers a large part of the plant and transmission charges.

The $1.80 charge in the "N" rate is the same as in the "DN" rate, and the 80-cent part covers the expense of maintenance, etc., and the cost of transmission and plant capacity, covering the "readiness-to-serve" charge.

The consumer on the "D" rate should pay only a small portion for plant capacity, as this capacity is installed for the "DN" and "N" rate consumers. The "DN" consumer receives some benefit on account of his longer hours and resultant load-factor.

The company usually allows a 10 per cent discount on the total fixed charge if the bill is paid on or before the tenth of the month. The meter rate is net. The small discount is probably just as much of an inducement to the consumer to pay his bills promptly as is a large discount and leaves a less quantity to argue over in case of a dispute with the consumer regarding the discount. The fixed charges, however, could be increased and a larger discount given if desired.

For small installations up to 20 hp the construction amounts to approximately $25 per kilowatt and this figure is generally used for the construction cost when the installation is located on present lines. In other words, when a 10-kw motor is to be connected on the company's present lines the cost of service, transformer, etc., amounts to approximately $250. In direct-current systems the cost remains about the same, due to the larger copper and transforming devices located in the plant. When short pole-line extensions are required approximately $25 per pole may be added to the construction expense, increasing the fixed charge proportionally.

The demand of a single motor is usually its rated capacity. On a group of motors this demand would have to be determined by measurement to be accurate, but as the construction work must be completed before such demand test can be made the fixed charge can be calculated from the construction work actually done.

The demand loads can generally be very clearly estimated. A motor may at times be overloaded, but as the company's devices are capable of the same overload the consumer can receive the advantage of the rate. Lighting installations will never be overloaded, the ordinary demand being only approximately 80 per cent of the connected load for business houses and 25 per cent for residences, so that the construction costs for lighting installations could in most cases be less than those for the equivalent connected power load, assigning the overload rating of the equipment to take care of the full connected load if required.

It might first appear that a definite contract could not be made intelligently until all the construction work was finished and the demand tests made, but this is hardly the case. The construction engineer must estimate the demand before the construction work can take place, and even should the exact cost be improperly estimated it would require at least a $100

COMPLETE SCHEDULE OF RATES FOR ELECTRICAL ENERGY

Fixed charges:

"D" rate is $2.00 per month per $100 of cost of construction
"DN" rate is $1 80 per month per $100 of cost of construction plus $0 40 per month per kilowatt demand during peak
"N" rate is $1.80 per month per $100 of cost of construction plus $0 80 per month per kilowatt demand during peak.

The fixed charge cannot be less than $2.50, and is subject to discount of 10 per cent if paid on or before the tenth of the month.

The peak-load period is taken to be from 5:30 to 10 p m

The consumer agrees to pay the fixed charge, plus that for the amount of energy consumed for the month, as follows:—

Energy charges:

7.0 cents per kw-hour for the first 25 kw-hours, or $1 75 for the first 25 kw hours and
6 0 cents per kw-hour for each additional kw hour above 25 to 50, or $3 25 for the first 50 kw-hours, and
5.4 cents per kw-hour for each additional kw hour above 50 to 100, or $5 95 for the first 100 kw-hours, and
5.1 cents per kw-hour for each additional kw hour above 100 to 300, or $16 15 for the first 300 kw-hours, and
3.7 cents per kw-hour for each additional kw hour above 300 to 500, or $23 55 for the first 500 kw-hours, and
3.0 cents per kw-hour for each additional kw hour above 500 to 750, or $31 05 for the first 750 kw-hours, and
2.8 cents per kw-hour for each additional kw hour above 750 to 1500, or $52.05 for the first 1500 kw-hours, and
2.6 cents per kw-hour for each additional kw hour above 1500 to 2500, or $78.05 for the first 2500 kw-hours, and
1 8 cents per kw-hour for each additional kw-hour above 2500 to 3500, or $96.05 for the first 3500 kw-hours, and
1 1 cents per kw-hour for each additional kw-hour above 3500 to 5000, or $112.55 for the first 5000 kw-hours, and
0 9 cent per kw-hour for each additional kw hour above 5000 to 15,000, or $202 55 for the first 15,000 kw-hours, and
0 85 cent per kw-hour for each additional kw hour above 15,000 to 50,000, or $500 05 for the first 50,000 kw-hours, and
0.8 cent per kw-hour for each additional kw hour above 50,000 to 100,000, or $900.05 for the first 100,000 kw hours, and
0.77 cent per kw-hour for each additional kw hour above 100,000

The rates as per meter are net.

SUMMARY AND RECAPITULATION OF EXAMPLES EMPLOYING SUGGESTED RATE.

Example.	Supplying.	When Operating	Construction Cost	Kind of Rate	Load-Factor per Cent.	Kw Hours Consumed	Total Paid.	Average Rate per Kw-Hour
A	10-hp motor on present lines	Day only	$187.50	D $3 75	16.7	900	$38 63	$0.0429
A	10-hp motor on pole-line extension .	Day only	400.00	D 8.00	16 7	900	42 45	.0471
A	10-hp motor on present lines	Day only	187.50	D 3.75	13 0	700	32 93	.047
B	15-kw elevator on present lines	Day and night	375.00	DN 12 75	8 3	900	46 73	.0519
C	3-kw rectifier on present lines.	Day and night	75.00	DN 2 55	74.0	1600	56 95	.0356
C	3-kw rectifier on present lines	Day and night	75.00	DN 2.55	16 6	358	20 59	.0575
C	3-kw rectifier on present lines...........	Day and night	75.00	DN 2.55	21 5	465	24 55	.0528
D	Hotel, 30 kw in lamps on present lines	Night only	675.00	N 36 15	16 7	3600	120 6[illegible]	.0336
E	Sanitarium, 20 kw in lamps on pole-line extension........................	Night only	2,500.00	N 61 00	8 3	1200	98 55	.0821
F	Store, 2 kw in lamps on present lines......	Night only	50.00	N 2 50	4 2	60	6 [illegible]4	[illegible]
F	Store, 2 kw in lamps on present lines... .	Night only	50 00	N 2 50	2 1	30	4 30	.1433
F	Store, 2 kw in lamps on present lines	Night only	50.00	N 2 50	8 3	120	9 22	.0768
G	Store, 8 kw in lamps on present lines.. ...	Night only	200 00	N 10.00	6 9	400	28 85	.0721
G	Store, 8 kw in lamps on present lines. ...	Night only	200 00	N 10 00	10 4	600	35 55	.0592
H	Sawmill, 37 kw in motors on pole-line extension......	Day only	975 00	D 19.50	16 9	4500	124 6[illegible]	.0277
H	Sawmill, 37 kw in motors on pole-line extension.....	Day only	975.00	D 19 50	22 5	6000	139 1[illegible]	.0232

error to make a difference of $2 in the bill on the "DN" rate.

In practical use with this schedule it is usual to designate a consumer's contract by specifying the letter and the amount of his fixed charge. Thus, if informed that a certain consumer had a "D-$14.50 rate" one would know that the consumer was operating on the off-peak schedule and that his fixed charge was $14.50 per month, subject to a 10 per cent discount, his kw-hour rate being the same as that of any other consumer as given herein. The schedule printed on the preceding page shows the complete plan.

Following are some typical examples of customers' bills computed according to this schedule:

Consumer A has a 10-hp motor in a machine shop on existing distribution lines. He does not run during the peak-load period and therefore is entitled to a "D" rate. From estimates it is found that the necessary construction costs amount to $187.50. The fixed charge on this rate is $2 per $100, so that this customer's monthly charge would be $3.75. If he consumed 900 kw-hours his bill for the month would be as follows:

Fixed charge	$3.75
750 kw-hours	31.05
150 kw-hours at $0.028	4.20
Total....900 kw-hours	$39.00
Less 10 per cent on fixed charge if paid before the 10th	.37
	$38.63

or an average net rate of $0.0429 per kw-hour. If an extension had been required, making the necessary construction cost, say, $400, then the fixed charge would have been $8, and if the consumption was the same the bill would have been:

Fixed charge	$8.00
750 kw-hours	31.05
150 kw-hours at $0.028	4.20
Total....900 kw-hours	$43.25
Less 10 per cent on fixed charge	.80
	$42.45

or an average of $0.0471 per kw-hour, showing the consumer paying the extra expense required.

Taking the first case, assuming that the consumer used 700 kw-hours, the bill would have been as follows:

Fixed charge	$3.75
500 kw-hours	23.55
200 kw-hours at $0.03	6.00
Total....700 kw-hours	$33.30
Less 10 per cent on fixed charge	.37
	$32 93

or an average of $0.047 per kw-hour as compared to $0.0429, showing how the better load-factor lowers the total unit cost. See curve *A* in the accompanying diagram, which shows the equivalent rate per kw-hour for the energy taken by this installation at various load-factors. The solid portion of the curve shows the practical limits between which the motor is likely to be operated.

Consumer B installs a 15-kw elevator to be operated all day until 8 p. m. He is entitled to a "DN" rate, and as the company's construction costs amount to $375 his fixed charge would be $1.80 per $100 of cost of construction, plus 40 cents per kilowatt of demand, or

$1.80 x 3.75	$6.75
.40 x 15	6.00
Total fixed charge	$12.75

Hence a "DN-$12.75" rate is given.

If he consumed 900 kw-hours his bill would be $46.73, as shown by the figures that follow, or an average of $0.0519. This is the same consumption as Consumer A had in the first example, but due to the lower load-factor which an elevator necessarily has, and due to its operating on the peak load, this energy costs nearly 1 cent more per kw-hour.

Fixed charge	$12.75
750 kw-hours	31.05
150 kw-hours at $0.028	4 20
Total...900 kw-hours	48.00
Less 10 per cent on fixed charge	1.27
	$46.73

Consumer C installs a battery-charging rectifier of 3-kw capacity and charges his electric car in the evening and morning. He is given a "DN" rate, the construction cost being $75.

$1.80 x 0.75	$1.35
.40 x 3	1.20
Total fixed charge	$2.55

If he consumed 1600 kw-hours his bill would be:

Fixed charge	$2.55
1500 kw-hours	52.05
100 kw-hours at $0.026	2.60
Total....1600 kw-hours	$57.20
Less 10 per cent on fixed charge	.25
	$56.95

or an average of $0.0355 per kw-hour.

This case serves to illustrate that even though the consumer operates on the peak load he is a very desirable consumer, due to the excellent load-factor. A consumer with a 3-kw demand, consuming 1600 kw (74 per cent load-factor), operating on the peak, is, in the writer's mind, entitled to a better unit rate than the consumer with a 7.5-kw demand consuming 900 kw-hours (16.6 per cent load-factor) off the peak. If the rectifier customer had used 358 kw-hours, or 16.6 per cent load-factor, his bill would have been:

Fixed charge	$2.55
300 kw-hours	16.15
58 kw-hours at $0.037	2.14
Total....358 kw-hours	$20.84
Less 10 per cent on fixed charge	.25
	$20.59

or an average of $0.0575 per kw-hour. The unit rates would be about the same if the rectifier customer had consumed 465 kw-hours at 21.5 per cent load-factor. See curve *C* in the accompanying diagram.

Consumer D has a hotel, whose demand is 30 kw. The estimated construction cost is $675, while, due to the general conditions, the principal demand will occur during the peak load, so that this installation obtains the "N" rate. The fixed charge is determined in the same manner as for the "DN" rate, except that $0.80 per kilowatt of demand during peak is added.

$1.80 x 6.75	$12.15
.80 x 30	24.00
Total fixed charge "N"	$36.15

If the month's consumption reaches 3600 kw-hours the bill becomes:

Fixed charge	$36.15
3500 kw-hours	96.05
100 kw-hours at $0.009	.90
Total....3600 kw-hours	$133.10
Less 10 per cent on fixed charge	3.61
	$129.49

or an average of $0.0359 per kw-hour. Similarly, of course, a higher consumption, involving a better load-factor, would give a lower unit rate, as is shown in curve *D* of the accompanying diagram.

Consumer E having a sanitarium some distance from the company's lines desires light, his demand being 20 kw. The cost of construction, including the pole-line extension, amounts to $2,500. The fixed charge would be:

$1.80 x 25	$15.00
.80 x 20	16.00
Total fixed charge	$61.00

If the monthly consumption was 1200 kw-hours the bill would be:

Fixed charge	$61 00
750 kw-hours	31 05
450 kw-hours at $0.028	12 60
Total....1200 kw-hours	$104 65
Less 10 per cent on fixed charge	6 10
	$98 55

or an average of $0.0821 per kw-hour. At first thought this may appear high for this large consumption, but in consideration of the $2,500 invested and the peak-load business, it compares favorably with the other examples given. Should other business develop on this extension the sanitarium fixed charge could be proportionally reduced at the expiration of the first contract.

Consumer F has a small clothing store, the demand of which is 2 kw. The store being on the present lines the construction cost is estimated to be $50, and the nature of the installation demands an "N" rate, as he operates on the peak load. His monthly fixed charge would be:

$1.80 x 0.50	$0.90
.80 x 2	1.60
Fixed charge	$2.50

If he consumes 60 kw-hours during the month his bill would be:

Fixed charge	$2.50
50 kw-hours	3.25
10 kw-hours at $0.054	.54
Total....60 kw-hours	$6.29
Less 10 per cent on fixed charge	.25
	$6.04

or an average of 10.06 cents per kw-hour. If the consumption had been 30 kw-hours in place of 60 kw-hours the average unit rate would have been 14.33 cents. If the consumption had been 120 kw-hours the average rate would have been $0.077, nearly.

Consumer G has a store on the existing lines with 8-kw demand. The estimated construction cost is $200 and with an "N" rate his fixed charge is:

$1.80 x 2	$3.60
.80 x 8	6 40
Fixed charge	$10.00

If he consumes 400 kw-hours his month's bill would be:

Fixed charge	$10.00
300 kw-hours	16.15
100 kw-hours at $0.037	3.70
Total....400 kw-hours	$29 85
Less 10 per cent on fixed charge	1 00
	$28.85

or an average rate of $0.0721. If the consumption were 600 kw-hours the bill would have figured out at the rate of $0.0592.

Consumer H has a motor-driven planing mill equipped with one 20-hp, two 10 hp, one 7.5-hp, two 5-hp and three 1-hp motors, a total of 60.5 hp, or 45.13 kw connected load. From experience it is estimated that 37 kw would be the maximum load and a four-pole extension is required to reach him. The nature of his business demands a "D" rate. The estimated cost of construction for 37-kw demand is $875, and the four-pole extension amounts to $100 additional, so that the fixed charge is based on a total of $975.

The fixed charge is $2 × 9.75, or $19 50. If this customer consumed 4500 kw-hours his bill would be:

Fixed charge	$19 50
3500 kw-hours	96 05
1000 kw-hours at $0 011	11 00
Total ..4500 kw-hours	$126 55
Less 10 per cent on fixed charge	1 95
	$124 60

or an average of $0.0277 per kw-hour. If 6000 kw-hours had been consumed the equivalent rate would have been $0.0235 per kw-hour.

In most cases it is customary to require a minimum monthly guarantee of $1 per connected horse-power. Due to the fixed charge this affects only consumers operating on exceedingly low load-factors.

The power-factor of a motor installation is at times an important matter. To large power customers, who are generally three-phase consumers, it appears that an extra charge could be made when the average monthly power-factor falls below a certain point, the average monthly power-factor being determined by the ratio of the amounts recorded on two single-phase wattmeters. The amount of extra charge would depend upon extra losses incurred on the transmission line, generating equipment, etc. This charge could be added to the regular statement without interfering with the rate system as outlined.

The writer has endeavored to show in the foregoing examples how the load-factor, expense in obtaining business and the character of business all affect the rates, resulting in a just rate to both the consumer and the central station. In addition, it is believed that the method of taking care of the various factors is comparatively simple and automatically eliminates some of the difficult points encountered in contract making.

Wiring and Illumination

LUMINOUS EFFICIENCY.

By Herbert E. Ives.

The *Electrical World* for Jan. 19 contains a report of a discussion in Chicago upon the writer's paper on "Luminous Efficiency," which appeared in the *Transactions* of the Illuminating Engineering Society for February, 1910. There is given therein a table of values of possible efficiencies of light production, taken from that paper. It may be of interest to record some values more recently obtained for these quantities.

One of the principal objects of the paper was to emphasize the fact that the "luminous efficiency" frequently determined by physicists and engineers, namely, the ratio of the "visible" to the total energy, is a quantity of small significance, because the "visible" energy has no useful relationship to "light" as photometrically determined. On the other hand, "lumens per watt" is an exact and satisfactory measure of the relation desired. It becomes of interest scientifically from this point of view to know what values in lumens per watt are theoretically attainable, and the quoted table contains such values.

The only corrections to the original paper which time has developed apply not to the point of view there emphasized, but to the values given for the theoretically possible lumens per watt. That these values might be changed as a result of future investigation was noted in the paper. New data have been collected during the past year from two sources. First, progress has been made in the problem of the measurement of lights of different colors, whereby it has been possible to fix more accurately the luminosity values of the spectrum and incidentally to determine the wave-length of maximum efficiency. Secondly, additional data have been gathered on the question of the radiated power corresponding to luminous flux in the black body and in incandescent lamps. The combination of these data by the method developed in the paper of last year, and as described below, gives confirmation of the order of magnitude found for the quantities in question and probably yields substantially more accurate values for the highest possible efficiency of light production.

In the paper of last year the luminosity values of the spectral colors were obtained from the work of Koenig, as reduced by Nutting. This indicated the maximum brightness of the spectrum at 0.565 μ. The more recent work of the writer, described in the November issue of the *Transactions* of the Illuminating Engineering Society, places this maximum further toward the blue, at wave-length 0.545 μ. A careful search through Koenig's work shows that his value is actually in close agreement with this, the apparent difference arising from the fact that the correction necessary for the dispersion of his prism was not considered by him or by Nutting. The data on the Hefner, incandescent lamps, etc., have been recalculated, using the more correct luminosity values, with the following results:

	Spherical Candles per Watt.	Lumens per Watt.	Reduced Luminous Efficiency per Cent.
Yellow-green light wave-length 0.545 μ....	65	800	100
Black body at 6000 deg..........	10	125	15
Most efficient white light. (Black body at 6000 deg., radiation between 0.4 μ and 0.7 μ)....	26	330	40

It is of interest to note that the most efficient monochromatic radiation corresponds almost exactly with the green mercury line (0.546 μ). This suggests a possible ideal standard of luminous intensity, namely, *1 watt radiated in the most efficient way possible*, to be achieved practically by the use of the mercury arc.

In regard to new data to be given below it should be recalled that there are two methods of measuring radiated power. One, the direct method, by means of a bolometer; the other, by assuming, in the special case of radiators in evacuated bulbs, that the power output as radiated is practically equal to the power input, as measured by a wattmeter. Data from each kind of measurement have been obtained which give weight to the above figures.

For the theoretical black body, which has been practically realized by the construction of electric furnaces with a small aperture for the escape and observation of the radiation, the bolometric method alone is available. Nernst[1] has made measurements on the candle-power of a black body of 1 sq. mm aperture at various temperatures. Kurlbaum[2] has determined bolometrically the constant a in the equation

$$W = aT^4$$

where W is the radiated power and T the absolute temperature. By combining the work of Nernst and of Kurlbaum the candles per watt of a black body at various temperatures can be calculated. Combining these values with the luminosity values of the spectrum—that is, determining the power radiated, the candle-power and the "reduced luminous efficiency" for a certain temperature—values are obtained for the quantities of the table above. This has been done and the result is, for the highest specific output of the black body, 10.5 candles per watt, or about 900 lumens per watt, for the highest possible monochromatic specific output: a very satisfactory agreement with the average value given above.

A modification of the general method employed with the black body may be applied to the incandescent lamp. Knowing the law connecting power input with light output one can extrapolate beyond the temperatures at which it is practicable to operate a lamp, and thereby obtain a figure for the highest efficiency it would attain if it continued to radiate according to the same law. With a carbon filament, which appears from various lines of work to be not very different in radiating properties from a black body, the value for its highest specific output may be expected to lie not far from the figure of the table for a black body—that is, about 125 lumens per watt. A somewhat lower value is to be expected because of the conduction and convection losses, but, on the other hand, the fact that carbon is somewhat selective will tend to give a larger value.

Lummer describes the experiment of burning out a lamp and calculating its efficiency at the point of failure from the relation $\left(\frac{cp_2}{cp_1}\right) = \left(\frac{T_2}{T_1}\right)^x$, estimating T and taking x as 12, confessedly only an approximate relation. Fery and Cheneveau[3] have more recently proposed the equation

$$cp = Ae^{-\frac{B}{\sqrt[x]{W}}}$$

to represent the candle-power—watts relation in the incandescent lamp. This is simply the Wien equation for the black body for monochromatic radiation, $\sqrt[x]{W}$ being substituted for T on the assumption that the radiated power varies as the xth power of the absolute temperature. The assumption that the total candle-power closely follows the laws for monochromatic radiation for considerable range was made by Crova, and has more recently been studied by the writer.[4] Fery and Cheneveau take the value 4 for x for carbon lamps partly by analogy with the black body and partly as the result of optical pyrometer measurements and solve for several lamps for the constants A and B. Using this equation and the constants obtained by them I have by extrapolation obtained efficiency-watts values for the carbon lamp. These rise and pass through a maximum as the watts increase. The maximum, corrected for the fact that the monochromatic radiation equivalent to candle-power changes with rise in temperature (a correction of 10 per cent) and that the values given by Fery and Cheneveau relate to the horizontal candle-power, comes out 110 lumens per watt.

Criticism on several grounds may be made of the equation given by Fery, and use of the equation should be made only upon thorough understanding of its significance. In the first place, it may be questioned whether, except in the case of the black body, the total radiation varies as a simple power of the temperature. The total power is the integral of the monochromatic radiations, in the case of the black body $W = \int c_1\lambda^{-5}e^{\frac{-c_2}{\lambda T}} = aT^4$. In the case of other bodies which have a reflecting power varying with wave-length Kirchhof's law calls for an emissivity varying with wave-length—that is, for C_1 must be substituted $C_1 f(\lambda)$. If $f(\lambda)$ is a simple power of λ, say λ^{-b}, the integral becomes $W = aT^{4+b}$—that is, a power of the temperature. If the emissivity is any other function of the wave-length than a simple power this latter equation will not be true. Study of the reflection curves obtained by Coblentz shows that the emissivity, $C_1(1 - \text{reflecting power})$, is, in the case of carbon, probably approximately represented by a power of λ. One can then conclude that the total radiated power over ordinary operating ranges varies as a power of the temperature to a close approximation. Extrapolation from the equation above merely assumes the possibility of a substance whose emissivity varies with wave-length exactly in accordance with the simple law to which carbon approximates.

The second exception that may be taken is that the value 4 is probably too low, since the work of Coblentz on the value of the radiation constant α indicates higher values, near 4.7. As a matter of fact, any value near 4 may be used in the Fery equation and good agreement with observed values obtained after solving for the other constants. Probably the only satisfactory way to determine what value is most nearly correct is to make simultaneous measurements of total power and temperature. Meanwhile, it is interesting to note that the value of x

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[1] *Physikalische Zeitschrift*, Vol. 7, p. 380; 1906.

[2] *Annalen der Physik*, Vol. 65, p. 746; 1898.

[3] *Bull. de la Soc. Int. des Elec.*, 1909, p. 655.

[4] To appear shortly in the *Physical Review*.

DATA ON ARC LAMPS.

Type of Lamp.	Miniature Carbon, 110 Volts, 4 Amp, Direct Current.	Standard Multiple Carbon, 110 Volts, 5 Amp, Direct Current.	Standard Multiple Carbon, 110 Volts, 6½ Amp, Direct Current.	Intensified Arc, 110 Volts, 5 Amp, Direct Current.	Standard Multiple Carbon, 110 Volts, 6 Amp, 60-Cycle, Alternating Current.	Standard Multiple Carbon, 110 Volts, 7½ Amp, 60-Cycle, Alternating Current.	Twin Carbon Multiple 220 Volts, 3½ Amp, Direct Current	Standard Carbon, 220 Volts, 3½ Amp, Direct Current
Volts at terminal....	110 volts	110 volts	110 volts	110 volts	110 volts	110 volts	220 volts	220 volts
Volts at arc........	83 volts	80 volts	80 volts	80 volts	72 volts	72 volts	2 arcs, each 80 volts	150 volts
Current..................	4.1 amp, direct current	5 amp, direct current	6½ amp, direct current	5 amp, direct current	6 amp, 60 cycle alternating current	7½ amp, 60 cycle, alternating current	3½ amp, direct current.	3½ amp direct current
Watts..................	451	550	715	550	430	540	715	715
Power factor	....	....	....	....	65%	65%	....	....
Reflectors and glassware..	White porcelain reflector, opal inner, no outer globe	Porcelain reflectors, light opal inner, no outer globe	Porcelain reflectors, light opal inner, no outer globe	Porcelain reflector, opal inner, no outer globe	Porcelain reflector, opal inner, no outer globe	Porcelain reflector light opal inner no outer globe	Porcelain reflectors, light opal inner no outer globe	Porcelain reflectors, light opal inner, no outer globe
Electrodes..............	½-in. carbon	½-in. carbon	½-in. carbon	Two ½-in. upper ⅜-in. lower carbons	½ in. carbon	½ in. carbon	(2 pairs) ½ in carbon	½ in. carbon
Life of electrodes........	50 hours	150 hours	100 hours	75 hours	125 hours	100 hours	150 hours	150 hours
Maximum candle-power at angle below horizontal...................	440 at 60 deg.	400 at 30 deg.	580 at 30 deg.	600 at 55 deg.	230 at 30 deg.	310 at 30 deg.	280 at 30 deg.	240 at 20 deg.
Mean spherical candle-power...............	218	215	318	225	160	215	195	160
Watts per m. s. candle-power...............	2.06	2.56	2.25	2.44	2.63	2.51	3.75	4.44
Mean hemispherical candle-power............	332	379	559	414	276	371	240	215
Watts per m.h.s. candle-power...............	1.36	1.45	1.28	1.33	1.56	1.45	3.05	3.43

Type of Lamp.	Series Direct Current Open Carbon Arc, 50 Volts, 6.6 Amp.	Series Direct Current Open Carbon Arc, 50 Volts, 9.6 Amp.	Series Direct Current Enclosed Carbon Arc, 75 Volts, 6.6 Amp.	Series Alternating Current Enclosed Carbon, 77 Volts, 6.6 Amp.	Series Alternating Current Enclosed Carbon, 77 Volts, 7½ Amp, 60 Cycles.	Flaming Arc, 55 Volts, 12 Amp, Direct Current	Flaming Arc, 55 Volts, 12 Amp, Alternating Current, 60 Cycles	Multiple Vertical Carbon Flame Arc, 110 Volts, 6.5 Amp, Direct Current.
Volts at terminal........	50 volts	50 volts	75 volts	77 volts	77 volts	55 volts	55 volts	110 volts
Volts at arc............	48 volts	48 volts	73 volts	72 volts	72 volts	45 volts	45 volts	75 volts
Current................	6.6 amp.	9.6 amp.	6.6 amp.	6.6 amp.	7½ amp, alternating current, 60 cycles	12 amp.	12 amp.	6.5 amp.
Watts....	330	480	495	425	480	660	500	715
Power factor...........	....	....	....	(Lamps only) 84%	(Lamps only) 84%	....	75%	....
Reflectors and glassware.	Clear outer	Clear outer	Porcelain enameled iron reflectors, clear inner and outer globes	Porcelain enameled iron reflectors, clear inner and outer globes	Porcelain enameled iron reflector, clear inner and outer globes	Light opal globe	Light opal globe	40-in. inverted diffuser alba globe
Electrodes.............	1-in. carbon (2 pairs)	⅝-in. carbon (2 pairs)	½-in. carbon	½-in. carbon	½ in. carbon	Yellow ½-in.	Yellow ½ in.	Upper ½-in. carbon, lower only mineralized
Life of electrodes........	18 hours	18 hours	125 hours	125 hours	100 hours	17 hours	17 hours	20 hours
Maximum candle-power at angle below horizontal..................	720 at 45 deg.	1250 at 45 deg.	530 at 30 deg.	250 at 20 deg.	305 at 20 deg.	2150 at 90 deg.	1350 at 90 deg.	2425 at 30 deg.
Mean spherical candle-power...............	265	460	290	144	173	1460	875	1129
Watts per m.s. candle-power	1.25	1.02	1.71	2.95	2.77	0.45	0.52	0.63
Mean hemispherical candle-power............	395	690	479	232	291	1890	1170	2058
Watts per m.h.s. candle-power...............	.82	0.71	1 03	1.83	1.65	0.32	0.39	0.35

Type of Lamp.	Multiple Flame 110 Volts, 5.5 Amp, Direct Current.	Multiple Flame 110 Volts, 7 Amp, Alternating Current, 60 Cycles.	Series Vertical Carbon Flame Arc, 78 Volts, 6.6 Amp, Direct Current.	Series Flaming Arc, 50 Volts, 12 Amp, Alternating Current, 60 Cycles.	Series Luminous Arc, 78 Volts, 4 Amp, Direct Current	Series Luminous Arc, 78 Volts, 6.6 Amp Direct Current	Multiple Luminous Arc, 110 Volts 6.5 Amp, Direct Current.
Volts at terminal.........	110 volts	110 volts	78 volts	50 volts	78 volts	78 volts	110 volts
Volts at arc...........	70 volts	70 volts	75 volts	45 volts	75 volts	75 volts	75 volts
Current................	5.5 amp, direct current	7 amp, alternating current, 60 cycles	6.5 amp, direct current	12 amp.	4 amp, direct current	6 6 amp, direct current	6.5 amp, direct current
Watts.................	605	525	510	440	310	510	715
Power factor...........	....	68%	....	75%	....		..
Reflectors and glassware..	Clear inner, opal outer porcelain enameled reflector	Porcelain enameled reflector, clear inner, opal outer globe	26 in. inverted diffuser alba globe	Opal outer	Clear outer	Clear outer	Clear globe
Electrodes...............	⅜-in. upper carbon, ⅜-in. miner. lower	⅜ in. upper carbon, ⅜-in. miner lower	Upper ½-in carbon lower only mineralized.	Yellow	Upper copper slag, lower ½ in magnetite	Upper copper slab lower 11-16-in. magnetite	Upper copper slab, lower ½ in. magnetite
Life of electrodes..	60 hours	50 hours	20 hours	12 hours	175 hours	125 hours	80 hours
Maximum candle-power at angle below horizontal..........	1500 at 30 deg.	1250 at 30 deg.	2350 at 30 deg.	1350 at 90 deg.	700 at 10 deg.	1650 at 10 deg	1650 at 10 deg.
Mean spherical candle-power............. ...	706	583	1.23	875	285	720	720
Watts per m.s. candle-power	0.80	0.90	0.42	0.50	112	0 71	0.99
Mean hemispherical candle-power............	1210	875	2051	1170	545	1340	1340
Watts per m.h.s. candle-power................	0.50	0.60	0.25	0.37	0.57	0 38	0 53

may be determined directly from lamp data by considering the equation as one of three undetermined constants and solving for x as well as A and B. The performance curves for the treated carbon lamp as determined by one of the incandescent lamp companies furnished data for obtaining these constants in this way. The modified form of Fery and Cheneveau's equation,

$$\log \frac{cp}{cp_0} = 5.475 \left(1 - \sqrt[4.65]{\frac{w_0}{w}} \right)$$

was derived, where cp_0 and w_0 are the (mean horizontal) candle-power and watts at a specific consumption of 3.5 watts per candle. This equation, in which x is 4.65 instead of 4, as used by Fery, represents the performance of the carbon lamp to within the errors of reading the curves.

The maximum of specific output given by use of this equation (with the correction noted above) is 88 lumens per watt. In other words, the carbon incandescent lamp, if it continued to radiate according to the laws which hold at its condition of normal operation, would attain the above value, which is of the same order of magnitude as the figures obtained from the other methods of attack.

It appears, therefore, to the writer that there is pretty good evidence for believing the highest possible specific output of the black body to be from 90 to 140 lumens per watt, corresponding to from 600 to 900 lumens per watt for the highest possible monochromatic specific output, with a probability of 800, or the value in the table above.

These values are very much larger than those obtained by Drysdale and by Nutting through direct power and light measurements on yellow-green light. It is, therefore, of some interest to find the further confirming evidence here presented as to the order of magnitude of ideal light efficiency.

COMPARISON OF ILLUMINANTS.

In a paper presented by Mr. Sydney W. Ashe before the New York Section of the Illuminating Engineering Society on June 8 much information relating to the comparative performance of various illuminants was given. A considerable portion of the paper was devoted to a discussion of the variation in candle-power during life of the several illuminants compared. The author claimed that the only fair basis for comparison is the average candle-power performance during life. He assigned the accompanying values to the average candle-power in per cent of the initial for six different classes of illuminants:

Illuminant.	Per Cent. of Initial Candle-Power (Average.)
Gas mantle (high grade)	70
Mercury-vapor tube, alternating current	75
Mercury-vapor tube, direct current	61
Inclosed carbon arc	78
Magnetite arc (6.6-amp)	90
Drawn-wire tungsten-filament incandescent (1,000 hours), 60-watt and 100-watt, 100-volt (consumption, 1.18 watts per cp.)	94

Accompanying the paper was a table of data, compiled by Mr. Henry Schroeder from central-station sources, relating to the operating characteristics of various types of arc lamps. This table is reproduced in full on the preceding page.

RECENT TELEPHONE PATENTS

AUTOMATIC EXCHANGE APPARATUS

An automatic exchange system has been invented and patented by Mr. V. Alexeeff, of Enseli, Persia. The stations are divided into groups with subcenter switching devices. The talking connections are established through the action of electromagnets upon operating rods. The act of calling energizes a magnet to actuate the rod of the calling line and thus cut that line into talking relation. The selecting currents cause an arm to carry a connecting magnet to proximity to the bar of the desired line, whereupon the energizing of this magnet draws the bar into the talking position for that line.

PARTY-LINE RINGING SYSTEM.

Accepted operating practice has for a long time required that when a called station is being rung, the calling station must be so associated with the circuits as to escape the ringing current. This involves a cut-off feature in the ringing key, which therefore usually introduces one or more contacts in the talking circuit. With the advent of selective ringing, the most obvious arrangement to meet its requirements was a set of ringing keys in series, requiring one key and thus one set of contacts for each different kind of current. The number of contacts in series soon proved to be a source of trouble, and many arrangements have been devised to do away with them. One such arrangement is that described in a patent recently granted to Mr. C. S. Winston, of Chicago, and assigned to the Kellogg Switchboard & Supply Company. This is shown in Fig. 1. The tip or ringing side of the line is open at the contacts of the supervisory relay, until this has operated. Furthermore, this cannot by any possibility be operated during the ringing period, as its circuit is opened by the ringing key on the battery side. Although the operator must talk through the contacts in series, the contacts are entirely removed from the through talking connection.

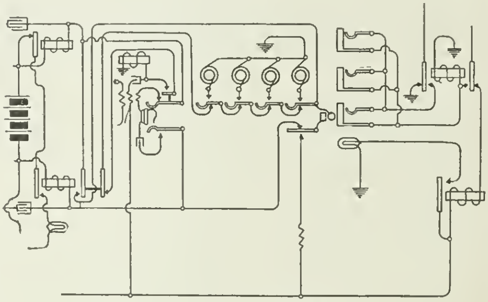


Fig. 1—Party-Line Ringing System.

NEW APPARATUS

The modern method of using aerial cables often involves the introduction of more than one terminal for each cable pair, rendering the pair available for use at more than one point. If protective devices are to be used, the cost will be run up, due to an idle protector at each unused tap. To overcome this expense, Mr. F. B. Cook provides a terminal with removable fuse mounts. The protector element is built up of metal strips and insulating blocks, and carries a fuse and carbon blocks. The cable pairs are soldered to binding posts which project through the face plate, and the protector element is engaged by these and by hooks upon the face plate, as shown in Fig. 2.

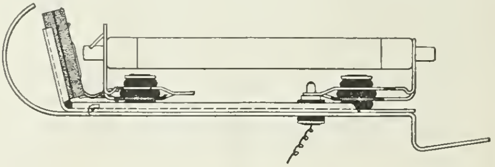


Fig. 2—Individual Protector Unit.

A semaphore signal for attachment to a telephone instrument is patented by Mr. K. W. Gale, of Los Angeles. The semaphore is released by a trip magnet in series with the ringer, and is restored by a link from the hook lever. The purpose of the semaphore is to identify the instrument corresponding to an unidentified ring.

A recent invention by Mr. F. W. Coole is a muffler for preventing the overhearing of telephone conversations. The muffler takes the form of a collapsible auxiliary mouthpiece which will conform to the features of the user and prevent the escape of sound.

Letter to the Editor.

Chromatic Aberration and Visual Acuity.

To the Editor of Electrical World:

Sir:—I have read with interest Mr. Ashe's comment on my paper on "Chromatic Aberration and Visual Acuity," of May 11.

With respect to the possible effect of pupillary contraction in the results which I obtained it is only necessary to say that this effect was completely eliminated by the method which I employed, inasmuch as the eye was always under simultaneous stimulus from both the lights under investigation and, consequently, whatever the pupillary aperture it was the same in the observation of both sides of the acuity target. Moreover, the phenomena remained the same when using a diaphragm less in diameter than the pupil. It is safe to say, therefore, that there was no effect which was due to the cause which Mr. Ashe suggests.

With respect to the other question, that regarding the possible gain in acuity merely from employing the shorter wave-lengths, some gain is to be expected, as I showed in considering Lord Rayleigh's work on resolving power. But this gain for the range of wave-lengths investigated is probably quite negligible compared with the differences due to chromatic aberration. I do not think that the tungsten lamp should be assigned an effective wave-length materially, if at all, further toward the red than the light of the yellow flaming arc, and yet the enhanced acuity under the latter was almost as conspicuous as with the mercury lamp. The increased sharpness under monochromatic illumination has been long known and made use of by microscopists, although they have the advantage over the eye of working with pretty well achromatized objectives. They have also taken advantage of Rayleigh's work by using the very short wave-lengths for photomicrography and have even utilized monochromatic illumination at the same time by using unachromatized quartz objectives with monochromatic illumination in the far ultra violet.

The explanation of the increased pupillary contraction noted for the mercury lamp both by Mr. Ashe, and by Broca and LaPorte appears to be rather simple. It is now pretty well established by the researches of Sachs and of Abelsdorff that the contraction of the pupil in lights of different colors depends essentially on the luminosity value of the particular color used. Hence the mercury lamp, which concentrates its light almost exactly at the peak of the luminosity curve, as is well shown by Ives (*Transactions*, Illuminating Engineering Society, Vol. VI, page 261), ought to exhibit the enhanced pupillary reaction which has been found. The long and short of the matter is that the eye seems in the course of its evolution to have adjusted its pupillary mechanism to the luminosity value of the stimulus, while in respect to defining power it behaves like any other unachromatized optical system, gaining greatly by monochromatic illumination and to a minor extent, inversely as the wave-lengths of the lights concerned, by a change in the effective color of the stimulus.

Boston, Mass. Louis Bell.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Automatic Pressure Regulator for Alternating-Current and Direct-Current Circuits.—An illustrated description of a new pressure regulator of the Brown Boveri Company. The variations in the pressure of the machine to which the regulator is connected are utilized to disturb the equilibrium of a light pivoted armature, which is acted upon by an electromagnet connected across the machine circuit, and the strength of whose field is consequently dependent upon the pressure of this circuit. The torque exerted by the armature with a certain definite field strength is counterbalanced by a spring, so that the armature turns in one or the other direction immediately the pressure, and the field strength corresponding to it, varies from a certain predetermined value. This movement is utilized to vary the resistance of a resistor having frictionless contacts in the field circuit of the exciter or (for the case of a direct-current machine) in the exciting circuit of the generator, thus regulating the pressure up or down to the required constant value. A damping arrangement is provided, but in order that the retarding effect of the electromagnetic inertia of the field circuit may be as far as possible eliminated the moving parts of the regulator (which are made as light as possible) are not connected rigidly to the damping system, but are coupled to the latter by a spring. This permits the armature to carry the sectors ahead of the required new position at the moment the generator pressure changes, after which it quickly adjusts itself in such a manner that the field current is brought to the correct value corresponding to the load. These regulators are built in two different patterns, namely, for alternating current (single or polyphase) and for direct current. The regulator for alternating current consists of a "shaded pole" electromagnet (Fig. 1) which acts upon a cylindrical armature. The electromagnet is wound with a fine wire coil, which is connected in series with an external resistance to a pressure transformer. This transformer is placed across the mains. The magnetic field produced by the electromagnet is dependent upon the pressure on the circuit, and for a definite value of pressure a certain definite torque is, in consequence, produced on the moving system, due to the electromagnetic action between the magnetic field and the armature. The torque is opposed by a flat spiral spring, and as the tension of the latter is dependent upon the extent to which it is wound up, an additional spring is provided, so adjusted that the resisting torque has a constant value for any position of the armature. The cylindrical armature is made of aluminum. The movements of the armature brought about by the pressure variations in

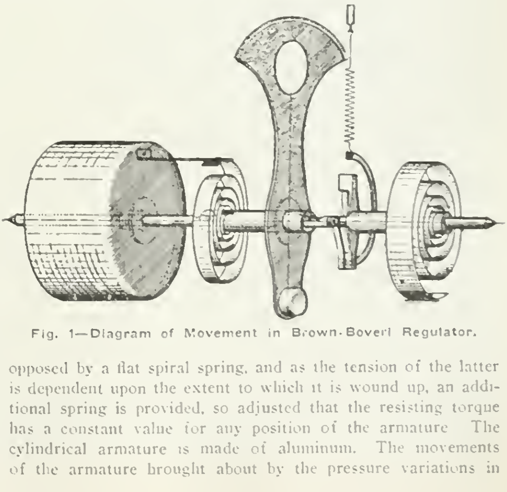


Fig. 1—Diagram of Movement in Brown-Boveri Regulator.

the circuit are communicated to a frictionless contact system consisting of the sectors which roll over the contacts, thereby inserting more or less resistance into the field circuit of the exciter. With alterations of pressure the spring-controlled armature naturally possesses a tendency to oscillate about the required new position, and in order to prevent these oscillations and yet to allow the armature to carry the sectors momentarily ahead of the required new position a special system of damping is provided, consisting of an aluminum disk, arranged to rotate between the poles of permanent magnets. This disk is driven from the armature by means of a pinion and sector, and the connection between the armature and the sector is a flexible one—that is, the sector is mounted upon a sleeve which is coupled to the armature by a flat spiral spring. When the moving parts are in a condition of equilibrium this spring is not in tension, but as soon as the pressure on the circuits alters then, according to the magnitude and direction of the alteration, the spring pulls in one or the other direction according to the direction of movement of the armature, and in this way carries the sector with it. It follows that just at the moment the pressure variation takes place the damping is not operative, thus allowing the armature to carry the regulation farther than is actually required, but almost immediately afterward the sector follows up the movement of the armature, thus causing the suppression of the oscillatory movements which would otherwise take place. Fig. 2 represents diagrammatically the excitation circuit of the alternator and exciter. Suppose that at no-load the regulator is at the position marked I corresponding to an exciter field current of, say, 6 amp at 60 volts at the full load and normal pressure of the alternator, the exciter field current must be increased to 11 amp at 100 volts, and for this purpose the regulator must be at position II. When the entire load is suddenly thrown on the generator the exciter field current is brought by the regulator to a higher value than that corresponding to full-load by the quick short-circuiting of the resistor, the regulator momentarily taking up the position III. It is necessary for the regulator to take up this latter position at the first moment, because, owing to the self-induction of the exciting circuit and the inertia of the turbine or engine governor, it is necessary to increase the exciter pressure (by cutting out the whole of the resistance) by an amount which more than corresponds to the actual requirements when the steady state has been reached. But immediately afterward, as the pressure of the generator increases, resistance is automatically and successively inserted into the exciter field circuit until the regulator takes up the correct position II, at which point the period of regulation is at an end.—Lond. *Electrician*, May 12.

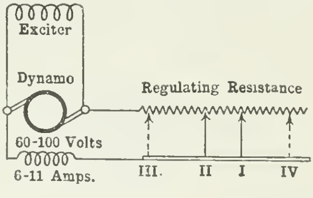


Fig. 2—Diagram Illustrating Action of the Regulator Upon Change of Load.

Repulsion Motors Operating as Generators.—A note on a recent British patent (25,473, May 11) of the Brown, Boveri Company. When repulsion motors are driven in a direction oposite to their torque they act as generators and large currents at a low periodicity are generated which are liable to damage the windings of the stator and rotor. The object of the invention is to prevent this by connecting, in series with either or both the circuits, a non-inductive resistance, with which is supplied a switch for short-circuiting it. The resistance need only be put into circuit at high speeds, when dangerous currents are likely to flow, and then can be thrown in automatically at a certain speed.—Lond. *Elec. Eng'ing*, May 18.

Lamps and Lighting.

Reflecting Power of Metals.—W. W. COBLENTZ.—An account of an experimental investigation of the optical properties of the metals used in incandescent lamps. The author investigated tungsten, molybdenum, graphite, tantalum, antimony, rhodium, iridium, iron, magnesium, chromium, vanadium, tellurium and silicon. It is shown that in common with all the other pure metals previously examined the present series has a low reflectivity in the visible spectrum which increases rapidly to high values in the infra-red. The reflectivity curves of tungsten and molybdenum are so nearly alike that from a consideration of their optical properties there is no great choice in the use of these two metals in incandescent lamps. Since molybdenum is tough and tungsten is brittle (that is, becomes brittle after being operated at high temperatures) it remains to be seen whether other physical difficulties can be overcome in the former metal to enable its introduction as an illuminant. The reflectivity curves show that the high efficiencies of the metallic-filament lamps are due to their low reflectivity (true absorption, and not diffuse reflection, is meant) in the visible spectrum and to a high reflectivity in the infra-red. A high operating temperature is also necessary for a high luminous efficiency in metallic-filament lamps. This is exemplified in the difference in the efficiencies of platinum and tungsten lamps. In tungsten the low reflectivity in the visible spectrum results in an emissivity of almost 50 per cent, while in the infra-red the emissivity is less than 10 per cent of an ideal radiator. The ideal solid illuminant giving a high luminous efficiency must fulfil the condition of a high operating temperature, a high reflectivity (hence low emissivity) in the infra-red and a low reflectivity (high emissivity) in the visible spectrum. The pure metals tungsten and molybdenum fulfil these conditions more exactly than any other known metals, excepting tantalum, which as a lamp filament, however, does not have the optical properties of the samples described in this paper. There are some additional notes on the thermoelectric properties of molybdenum, on the preservation of silver mirrors and on the radiation laws of metals.—*Bull. Bur. of Standards*, May 15.

Storage Batteries and Portable Photometers.—Two letters by Mr. C. H. Sharp and Mr. A. P. Trotter. Mr. Sharp has formerly condemned the practice of trusting to the constancy of the voltage of a storage battery in making measurements with a portable photometer. Mr. Trotter, on the other hand, has defended this practice and thinks that electrical measuring instruments are superfluous in street photometry. In reply Mr. Sharp now points out again in detail that the use of electrical measuring instruments in photometrical work tends toward an increased and not a superfluous accuracy. The importance is due to the fact that the portable photometer is now being used as a most important means of obtaining data bearing on the problems of illuminating engineering. It is important that the photometers should be standardized against nothing but reliable standards and that any systematic error in their use should be eliminated. Mr. Trotter replies that he is in agreement with Mr. Sharp that the practice of photometry has been raised in precision and that an accuracy of 0.5 per cent is possible under laboratory conditions. He agrees, too, that high accuracy is possible under such conditions with portable photometers. But he does not consider that for street work and other applications of portable photometers for industrial purposes a higher accuracy is necessary than a variation of 3 per cent from the mean of a number of measurements. One reason is that the quantity to be measured, whether illumination due to electricity, gas or daylight, is liable to vary, and another reason is that it is better in street work, etc., to obtain a number of readings of tolerable accuracy than a few readings of high precision.—Lond. *Electrician*, May 12.

Generation, Transmission and Distribution.

Electricity in Mining.—Almost the complete issue is devoted to the applications of electricity in minng and metallurgy. N.

Taylor deals with electricity in Cornish mines, giving an account of the very special conditions which exist in the metalliferous mines of Cornwall and of the points to which particular attention must be given. Stress is laid on the importance of securing good results in pumping. Owing to the extreme conservatism of those connected with this isolated branch of mining there has been considerable difficulty in introducing electric plant, but much headway is now being made. Mr. C. F. Mackness discusses the position of electricity in mining in South Africa and sketches the enormous progress made there in the application of electricity to mining. This is particularly noticeable in electric winding, the progress of which has quite eclipsed anything in this direction in Europe. Brief particulars are given of the public energy supply systems, which have received an impetus through the advent of the Victoria Falls & Transvaal Power Company. The minor applications of electric motors are also described, including locomotives, haulages, stamp and pulp mills, pumps and other uses. Mr. W. M. Thornton deals with the elimination of risk in the use of electricity in mines. The risks that are particularly considered are those from explosion and from shock. Risk of explosion from switch boxes and fuse boxes can be eliminated by adopting a simple flame-proof method of construction. Danger would be eliminated if the supply of electrical energy were cut off whenever gas is present, and automatic apparatus for this purpose has been devised but this has to stand the test of practical working before it is generally adopted. There does not seem to be much risk from electric oscillations giving rise to sparks (from armored cables) of sufficient energy to cause ignition. Danger arises from coal dust as much as from gas, but risk from the former may be eliminated by certain precautions. Risk of shock can be overcome by effective earthing. It is suggested that a certain number of mining electrical engineers should be appointed among the new sub-inspectors. Mr. H. J. Heather discusses special risks in the application of electricity to mining work under South African conditions. The subject is discussed from the points of view of safety as regards life, safety as regards plant and safety as regards continuity of service. Each of these points of view is liable to have extreme importance given it, depending upon the position of the individual. In South Africa ignorance, curiosity and wilful tampering are important factors. A table is given showing the conditions under which shocks may be received, and the question of protection by earthing is considered, the conclusion being reached that the neutral of a three-phase system should not be earthen. Mr. T. Duckitt discusses the gas-tight and flame-proof motor problem. Attempts have been made to produce motors which are gas-tight and also those which are explosion-proof and flame-tight. The author commences with a description of the totally inclosed type of motor and the development of the flame-tight machine. He then passes on to discuss water-cooled and pipe-ventilated motors. Details of totally inclosed motors, armatures, brush gear and commutators, slip rings and also of explosion-proof motors are given.

Mr. W. B. Woodhouse deals with public electric supply collieries. He shows that a source of public supply has several advantages over a private generating station, among which are the ease with which large motors can be switched on (even winding engines), owing to the large reserve of power, without affecting other plant; the colliery avoids obsolescence of station plant; the capital cost per kilowatt of plant installed in a large station is much less than in a small one, and a larger demand can be supplied per kilowatt installed than is possible in a private station, owing to diversity factor. Consequently the capital charges per unit are reduced. In regard to generating plant, the author does not look upon exhaust-steam turbines with much favor. Finally he points out that there are three ways in which advantage may be taken of a public supply—as the sole source of energy, as a user of surplus energy and as a standby. Mr. W. B. Shaw deals with the supply of energy from a private plant. After considering in a general way the advantages of a private supply as compared with supply from a central source, the author discusses the various types of plant available. Steam plant is generally preferred, and if the installation is above a certain size the steam turbine has distinct advantages. The size of units to be adopted requires careful consideration. Curves are given showing the increase of use at a particular colliery and the relation the consumption bears to the kilowatts of plant installed. Finally, figures of running costs based on actual results are given and the general working of the plant is considered from the point of view of reliability. Mr. W. E. Chappell discusses the centralization of power in collieries. He shows that the generation of energy for collieries is now being concentrated in large stations which can serve a group of pits in contradistinction to each pit having its own plant. The difference in the problems that have to be faced when direct or alternating currents, or a combination of both, are used are discussed, while in this connection the various classes of load met with in colliery working are described. To obtain satisfactory results the various requirements must be accurately judged and balanced one against the other. Mr. H. W. Clothier gives notes on switch gear for underground use in mines. After referring to the events of the last two or three years and their bearing on the design of electrical plant for mines, the author deals with "explosion-proof" gear and points out its limitations. The proper provision of cable connections is then emphasized and the combination of plant, such as switch gear and transformers, is discussed. A pit-lighting system is introduced. Continuous-current automatic switches present difficulties if of the air-break type, owing to their bulk when inclosed; on the other hand, if oil is used it carbonizes, but this seems the better solution of the two. The problem of automatic protection, a "balance system," meets many cases, and warrants the special consideration of mining engineers, particularly as applied to leakage devices. Finally, a general layout is briefly described. Mr. G. Hooghwinkel discusses the progress of electric winding in England. The points which are usually taken into account in considering the advantages of the steam, as compared with the electric winder, are low capital cost, simplicity and low cost of winding. As to capital cost, no general rule can be stated. If electric driving is being used for other purposes there is not much difference in the cost of the two systems, even with a private installation; and with a public supply, the electric system is the cheaper. The exhaust steam turbine is now a factor in the case, but must not be pushed too far. Experience has shown that the less directness of the electric winder is not a disadvantage. The question of the cost of winding is one on which reliable information is not easily obtained, because the figures for steam are not readily separated. Costs are given for the electric-winding plant of the Maritime Pit of the Great Western Collieries. In conclusion, the author describes briefly the different electric systems now available and gives details of electric winding plants in Great Britain. Coal cutting is dealt with by Mr. H. J. Fisher, who discusses the conditions under which electric coal cutting should be carried on to show success, and refers to some of the various types of machines that are at present available. Some references are also made to the accessory apparatus connected with coal cutting. Finally, a brief account is given of the chief electrical coal cutters at present on the market. Underground colliery wiring is dealt with by Mr. A. B. Mallinson. The author discusses the various points to which attention must be given to insure a satisfactory system of colliery wiring, and he deals particularly with the selection of the cable, its handling, its erection in the shaft, the erection of "in-bye" cables, earthing, wiring for lighting and finally the maintenance of the system. Electric hand lamps for collieries are discussed by Mr. W. Maurice, who first considers the use of electric lamps, as now compulsory, for rescue purposes, and then discusses the desirable qualities in a lamp for ordinary mining use. Figures of cost are given and it is pointed out that a fire-damp detector is not an essential adjunct of such a lamp. The profitable use of waste heat in collieries is taken up in a special article. The principal sources of waste heat are referred to and the most profitable methods of utilizing waste heat are described. While the waste heat can be utilized in an independent installation the fact that the load curves of the motor demand and the waste heat output do not coincide makes profitable use of the waste heat impossible without the co-operation of some independent user of the waste heat. Some of the chief waste-heat stations in the north of England are described, and the success of the movement generally is indicated. Mr. E. Garside describes controllers and resistors for use in mines. There are further articles on the new electric-mining rules, on electrically driven belt conveyors, on recent extensions in the Yorkshire Electric Power Company's supply to collieries, on recent electric developments in North Staffordshire collieries, on the transmission of energy in mines, on electric winding for collieries, with statistical tables on electric-winding engines, on the motor and telephone equipment of the Llanharran colliery, on cable makers' problems in mining work, on the switchboard of the new Kleinfontein Consolidated Gold Mining Company, etc.—Lond. *Electrician*, May 12.

Driving of Winding Engines by Induction Motors.—H. J. S. Heather.—A paper read before the (British) Institution of Electrical Engineers. The author discusses the use of induction motors for driving winding engines and thinks that, although not so efficient in energy consumption, his suggested arrangement is superior to the Ward-Leonard system as regards simplicity and safety. Emergency braking in case of failure of supply is obtained by exciting the stator from a source of continuous current.—Lond. *Electrician*, May 12.

Traction.

Protection of Water Pipes Against Stray Currents from Tramways.—Geppert and Liese.—An account of the methods which have been adopted in the city of Karlsruhe in Germany, where considerable damage has been done in the past to gas and water pipes by the stray currents from the tramways. The method of protection is based on the fact that a gas pipe or a water pipe will be corroded only at places where it is an anode—that is, where an electric current leaves the water pipe into the earth. On the other hand, at places where it is a cathode, so that an electric current enters the water pipe from the earth, no damage is done, but on the contrary the pipe is protected. The system employed in Karlsruhe is, therefore, to make the water pipes cathodes at dangerous places. For this purpose auxiliary plates are placed in the earth in the neighborhood of the water pipes and connected to the positive pole of a low-voltage generator or storage battery, while the water pipes or gas pipes to be protected are connected with the negative pole. The electric power required for this purpose is very small. The system is said to prove very satisfactory.—*Elek. Kraftbetr. u. Bahnen*, Feb. 14, and *L'Industrie Elec.*, April 25.

Installations, Systems and Appliances.

Electrodynamical Couplings.—A note on a recent British patent (28,940, May 11) of Siemens Brothers Dynamo Works, Ltd. (Siemens-Schuckertwerke). This invention describes a simplified form of coupling and covers in particular that part of the power which is transmitted indirectly from one shaft to the other. An armature made up of two separate concentric iron cores, wound with a series of short-circuited conductors common to both cores, is mechanically coupled to one of the shafts. There is also provided a rotating field produced by supplying a stationary polyphase winding with energy from an outside source of such a phase that a motoring action is set up between the armature and the rotating field and the inner conductors on the armature generate current for the outer motoring conductors. The other shaft is mechanically coupled to a direct-current field system. When the speeds of the two shafts are equal and in the same direction there is no torque transmitted from one shaft to the other, but when the speed of the armature is less than that of the shaft coupled to the direct-current field a torque is transmitted directly and partly indirectly. The armature need not have two separate iron cores; one common core will often prove satisfactory.—Lond. *Elec. Eng'ing*, May 18.

Protective Reactance.—E. D. Eby.—An article on protective reactance for current and potential. The author discusses the following two principal types of reactances, first, current-limiting reactances, for use on moderate-voltage systems subject to enormous current rushes due to short-circuits, grounds, phase displacement in multiple circuits, etc., and, secondly, voltage-limiting reactances used on high-potential systems for protection against almost unlimited voltages arising from lightning, grounds, switches and similar disturbances which develop or contribute to high-frequency surges with their attendant dangers.—*Jour. of Eng'ing*, Univ. of Colo., No. 7.

Wires, Wiring and Conduits.

British Wiring Rules.—An account of the sixth edition of the wiring rules of the (British) Institution of Electrical Engineers, which has been revised in various respects. In calculating the size of conductors it is no longer necessary to assume that at least 60 watts may be consumed at any point. The permissible drop in pressure for lighting circuits must now not exceed 2 per cent plus a constant allowance of 1 volt, subject to currents given in a table not being exceeded. This determines the minimum size of conductors, while for motor and heater circuits the rise of temperature (20 deg. Fahr.) is the determining factor. The table giving the maximum permissible currents for the various sizes of conductors has been considerably altered. In general, a very large increase has been made in the permissible current carried by small conductors, but, on the other hand, the maximum allowable current of large rubber-insulated conductors has been reduced. Thus, while a 1/18 S. W. G. conductor has now a minimum carrying capacity of 7.2 amp, instead of 4.2 amp in the case of both rubber-insulated and paper or fiber-insulated cables, a conductor having a nominal sectional area of 1 sq. in. has now a maximum permissible capacity of 595 amp in the case of rubber-insulated cables and 932 amp in the case of paper of fiber-insulated cables, as against 750 amp for both types of cable in the previous edition of the rules. The minimum insulation resistance per mile has been reduced, in the case of small rubber cables for 250 volts pressure, from 2000 megohms to 1250 megohms, but for 1/16 S. W. G. and larger conductors the minimum insulation resistance remains unchanged. The pressure test on insulated conductors has been reduced from 2000 volts to 1000 volts, while no mention is made of alternating current or frequency. The test for flexible cables is unaltered. Details are given of methods of inclosed wiring, metallic conduits, earthed concentric systems, rules on switches, fuses, etc.—Lond. *Electrician*, May 12.

Insulators.—An article on comparative tests of suspension insulators and of pin insulators with reference to a recent German paper of Benischke.—*L'Industrie Elec.*, April 25.

Electrophysics and Magnetism.

Electric Discharges from Hot Bodies.—W. Wilson.—An account of an experimental investigation of the discharge of positive electricity from hot bodies. The activity of platinum is not reduced by continued heating merely, but only under conditions which admit of a positive discharge from the metal. The loss of activity is, therefore, due to the diminution of the quantity of matter—carbon, carbon monoxide or whatever it may be—which emerges from the platinum in the form of positive ions at sufficiently high temperatures. The activity is greatly increased by heating the platinum in the presence of water. This effect is possibly due to the production of carbon monoxide and hydrogen in the platinum or at its surface, and can be observed even when the platinum is heated in a dry atmosphere, provided it has been previously heated and allowed to cool in an atmosphere saturated with aqueous vapor.—*Phil. Mag.*, May.

Scattered Roentgen Radiation.—C. G. Barkla.—A note on the energy of scattered Roentgen radiation with special reference to a recent investigation of Crowther, whose results the present author thinks to be erroneous.—*Phil Mag.*, May.

Heusler Alloys.—D. Owen.—The author gives a review of the various physical researches made in recent years on magnetic bodies composed of non-magnetic elements.—Lond. *Electrician*, May 5.

Electrochemistry and Batteries.

Primary Battery. W. R. Cooper.—A paper read before the (British) Institution of Electrical Engineers on the Benkö primary cell, which has a zinc anode and uses a bichromate solution. The special feature is the method of preventing polarization and depends essentially on the idea that if the layer of electrolyte on the cathode is removed as fast as polarization sets in the emf will be maintained constant. The remedy adopted by Mr. Benkö is to use a carbon electrode sufficiently porous to allow the electrolyte to flow through it, thus continually providing a fresh supply to the surface that is tending to polarize. By so doing not only is very effective depolarization obtained (depending, of course, upon the depolarizing qualities of the solution and its rate of flow), but for a given current the polarization remains quite constant provided the cell is not overloaded.—Lond. *Electrician*, May 19.

Measuring the Phase Difference Between Voltage at the Terminals and Induced Voltage of Synchronous Generators.—J. Liska and O. Szilas.—Goerges and Weidig, as well as Van Dyke, have described optical methods for measuring the angle of displacement between the rotors of two synchronous machines connected in parallel. When one of these machines is loaded and the other unloaded and both are two-pole machines, the measured angle in space equals the phase difference in time between the voltage P at terminals and the emf E induced by the magnet system. The present authors have developed a method of measuring this phase difference directly. This can best be done by means of the dynamometer, the two systems of which are acted upon by the two vectors of known intensity the phase difference between which is to be determined. Since in this case when the machine is loaded the induced emf is not directly available, a substitution method is necessary. For this purpose a small auxiliary two-pole generator is employed, the rating of which needs not be more than 10 watts. This auxiliary generator is coupled by means of a rack-and-pinion gear to the generator under test so that the two generators have the same frequency. The phase difference between the voltage of the auxiliary generator and the no-load voltage E of the generator under test is first determined. The latter generator is then loaded and the phase difference is again measured between the two voltages, which are now P and the same voltage E as before of the auxiliary machine. The difference of the two angles thus determined gives the desired phase difference between P and E. Since the dynamometer reading always gives the cosine of the angle the readings are most exact when the angle is near 90 deg. The two vectors should, therefore, be arranged to be nearly perpendicular to each other. This may be accomplished by a displacement of the coupling of the two machines or with polyphase machines by using another phase. The arrangement can be simplified if the auxiliary two-pole machine has a stator which can be displaced and for which the angle of displacement can be measured. At no-load the stator is displaced until the dynamometer reading is zero so that the two voltage vectors are perpendicular to each other and the position of the stator is noted on the scale. The generator under test is then loaded and the deflection of the dynamometer is again brought to zero by displacing the stator of the auxiliary machine. The scale difference of the two positions of the stator then gives directly the desired angle. Results of tests using this method are given.—*Elek. u. Masch.* (Vienna), April 16.

Photometric Attachment for Spectroscopes.—P. G. Nutting.—The attachment consists of two reflecting prisms P_1 and P_2, two Glan-Thompson nicol prisms N_1 and N_2 and a lens arranged as shown in Fig. 3. The whole is attached to the slit of any spectroscope, for example, one of the Hilger "wave-length" type. The essential feature is that a real image of the photometric surface (the common surface of two reflecting prisms) is thrown on the slit by an achromatic lens and may thus be brought into the plane of the slit. The two beams of light to be compared, one passing through and the other reflecting from the photometric surface, are brought to equality by rotating the nicol prism N_1. The photometric surface is alternately silvered and clear, the silver strips being 0.25 mm wide and separated by clear strips equal in width to the silver strips.—*Bull, Bur. of Standards,* May 15.

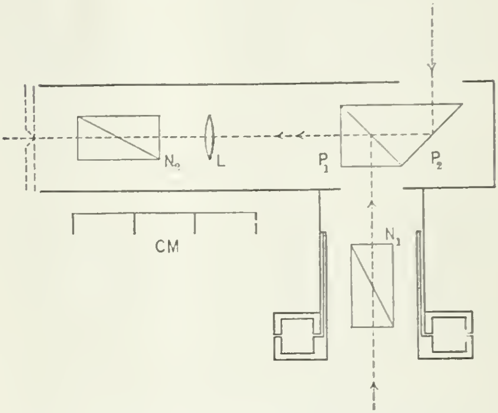


Fig. 3—Diagram of Spectrophotometric Instrument.

High-Tension Electrostatic Wattmeter.—E. Wilson.—An abstract of a (British) Physical Society paper. When using the electrometer as a wattmeter it is necessary (in order to secure accuracy) that the voltage impressed upon the quadrants shall not be less than a certain minimum depending upon the voltage to be impressed upon the moving system. When the latter voltage is of the order 10,000 the quadrants require a voltage larger than can economically be provided by a shunt. One is led, therefore, to consider intensifying devices. The "series" or "current" transformer, whose secondary winding is closed on a non-inductive resistance, can be used to give fairly good results, but it is not accurate at all frequencies and is dependent upon the wave-form. The author's quadrature transformer is a very simple piece of apparatus which can be relied upon to give for electrostatic wattmeters an emf that is strictly the differential of the current in the primary winding. When so used it is necessary, for accuracy, at all frequencies and on all wave-forms that the integral of the line voltage shall be impressed upon the moving system, although for sine curves only the differential need be impressed instead of the integral. The best device to impress on the quadrants a suitable voltage in phase with the currents is a generator with an air-cored magnetic circuit. The line current, which is passed through the field coil of the generator, produces a magnetic field proportional to the current. The armature is driven at known speed in this field, and is provided with a commutator and brushes. The brushes when set accurately have a voltage between them proportional to and having the same wave-form as the line current. Another device depending upon the charging of condensers is parallel and the placing of them in series has also been used for multiplying a small voltage produced by the passage of the line current through a low-resistance shunt.—Lond. *Electrician*, May 19.

Photometric Units.—A. P. Trotter.—A discussion of the nomenclature of primary and secondary sources of light with reference to the recent paper of Harrison.—Lond. *Electrician*, May 19.

Telegraphy, Telephony and Signals.

Automatic Telephony.—W. Aitken.—The first part of an illustrated paper read before the (British) Institution of Electrical Engineers. A description is first given of a switchboard designed by the author, in which the connection is made manually, but disconnection is automatic. The full-automatic telephone system of the Automatic Electric Company is next described in detail. A comparison is finally made between the features of automatic and manual systems, and an estimate is made of the comparative cost of working.—Lond. *Electrician,* May 19.

Printing Telegraphy.—D. Murray.—A paper read before the (British) Institution of Electrical Engineers. The author first discusses the field for printing telegraphs. Their use is chiefly in connection with land lines between centers of population and they will assist materially the co-operation between the telegraph and the telephone. He next gives a detailed account of the difficulties encountered in connection with the development and practical application of printing telegraph, and finally describes the Murray automatic system and the new Murray multiplex system.—Lond. *Electrician,* May 5.

Miscellaneous.

Freight Transport in London.—A. W. Gattie.—A paper read before the Royal Society of Arts in London with special reference to the proposed establishment of a clearing house for sorting and distributing all kinds of freight and packages in London.—Lond. *Electrician,* May 5.

Book Reviews.

Elektromotorische Antriebe. By B. Jacobi. Munich and Berlin: R. Oldenbourg. 341 pages, 172 illus. Price, 8 marks.

A textbook for the use of the engineer and non-motor-specialist, describing the construction, installation, utilization and maintenance of various types of electric motor. The book lends itself especially to the use of engineers who desire to install electric motors, but who are not sufficiently acquainted with their technics to know what types or what sizes to employ.

The main sections of the book are on the following subjects: The choice of the type of supply; the choice of voltage; the properties and capabilities of motors; the construction of motors; starting methods and apparatus; reversal of rotation; the braking of motors; the regulation of motor speeds; the maintenance of constant motor speeds; double motor installations; the delivery of power from motor to driven machinery; examples for computation.

The book is written clearly and in simple technical language by an engineer for the help of assistants or of other engineers.

Das Elektrische Kabel. By Dr. C. Baur. Second edition. Berlin: Julius Springer. 398 pages, 91 illus.

A carefully prepared textbook on cables for direct and alternating currents as used in power transmission, distribution and telephony. It is prepared for electrical engineers and advanced students of electrotechnics. The book is divided into seven main sections, relating respectively to fundamental principles, cable construction, installation, operation, materials used in manufacture, design and costs, and machinery for making cables. The treatment is thoroughly practical and at the same time the engineering mathematics of the subject is clearly developed. The work will be valued by all operating and designing engineers connected with land cables.

New Apparatus and Appliances

SATISFACTORY OPERATION OF CONEY ISLAND GAS-ENGINE FIRE PUMPS.

Misled by inaccurate information, the *Convention Daily* of the National Electric Light Association of May 30, published by courtesy of the *Electrical World,* did an unintentional injustice to the gas-engine-driven fire pumps at Coney Island by stating that they failed to work at the Dreamland fire of May 27. The facts are set forth in the following correspondence between Mr. W. E. Dickey, vice-president of the Goulds Manufacturing Company and manager of the New York office of that company, and the Department of Water Supply, Gas and Electricity of the City of New York. Under date of May 29 Mr. Dickey wrote as follows to Commissioner Henry S. Thompson:

"We take the liberty of writing you on the subject of the operation of the power pumps in the Coney Island high-pressure fire-service pumping station during the fire at Dreamland early Saturday morning last. Almost every paper published in New York yesterday morning reported a conversation with Fire Chief Lally of Brooklyn to the effect that the fire could have been confined to closer limits if it had not been for the utter failure of the pumps in the high-pressure station to operate. Will you kindly state if at any time before, during or since the fire any trouble was experienced in the operation of any of the pumps installed at the plant, and if, in your opinion, the cause of the inability of the pumps to keep up the pressure was caused by the large number of hose connections attached to the mains requiring a great deal more water than the station was capable of pumping? By answering these questions you will confer a great favor upon us, for on account of the criticism of Chief Lally a reflection is thrown upon the pumps, which are of our make and which have been in constant operation for nearly seven years without the necessity of the city being put to the expense of one cent for repairs in all that time.

"We would also like to have an expression from you on the condition of the pumps at this time, after the heavy test under which they have been operating for the past forty-eight hours. Would it not appear that the Fire Department was not aware of the limited capacity of this station, viz., 4500 gal. per minute, and in allowing the large number of hose connections to be attached to the high-pressure hydrants was in itself the chief cause for complaint on the part of Chief Lally for lack of pressure? Taking it for granted that a 3-in. fire hose having a 1¼-in. nozzle can handle 300 gal. of water per minute, the station can only, at its utmost, provide for fifteen fire streams; and is it not a fact that the department had more than thirty hose connections attached to the system?

"By answering these questions you will set at rest any doubt that may have arisen on the part of the public in general on the ability of our pumps to stand up under the most severe conditions, and will materially assist us in maintaining our reputation as the largest manufacturers of the highest type of pumping machinery on the American market, which fact might be questioned from the interviews with Fire Chief Lally, who is apparently not acquainted with the maximum duty that the high-pressure fire-service pumping station at Coney Island is capable of maintaining. We respectfully ask for a prompt reply."

To this letter Mr. J. W. F. Bennett, deputy commissioner of the Department of Water Supply, Gas and Electricity, sent the following answer under date of June 6:

"In reply to your communication to Commissioner Henry S. Thompson under date of May 29, 1911, I have pleasure in stating that the three high-pressure fire-service gas-engine-driven pumps at the Coney Island station worked satisfactorily during the Dreamland fire. The overdraft on the pump necessarily resulted in the reduction in pressure shown on the charts and mentioned in the press."

To this may be added the statement of the National Meter Company, maker of the Nash gas engines, which are the ones used in the Coney Island fire service, that "Coney Island, with its high-pressure water system especially designed for fire protection, is better guarded against a disaster of this kind than any other similar resort in the world." The *Electrical World* regrets that the *Convention Daily* was led into unintentional error of statement by what now appears to be overloading of the plant rather than any defect in the plant itself.

AUTOMATIC SECTION INSULATOR.

Automatic section insulators are inserted at points where it is desirable to energize a section of trolley wire when the trolley passes onto it and to de-energize it when the trolley passes off. They are widely used in mining installations and are so constructed that a mining locomotive in entering a section will throw the switch of the insulator and energize the section. In returning, the trolley of the locomotive throws the switch in the opposite direction and renders dead the section controlled.

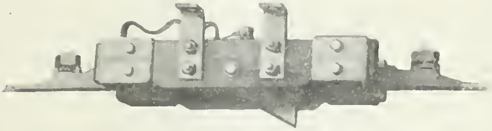


Fig. 1—Side View of Insulator.

In construction the Westinghouse automatic section insulator, shown herewith, is similar to that company's ordinary section insulator except that a circuit opening-and-closing arrangement is incorporated in the automatic type. Side bars of impregnated hickory take the tensile stress due to the trolley wires. All metal parts are either of sherardized malleable iron or of a bronze composition. A wedge of the type that has given excellent service on standard trolley frogs is used to secure the trolley wire in each approach. Supplementing the wedge an internally threaded chuck is provided. This, when tapped into its tapered hole, firmly grips the wire.

Opening and closing of the circuit is effected by a switch blade mounted on a rocker. In one position of the rocker the blade makes connection with spring contactors and in the other position contact is not made, while the action of the spring prevents the rocker from remaining in an intermediate position.

Electricity is fed to the rocker switch-blade through a heavy, flexible, woven-copper bond which is securely connected at each of its ends. When the trolley wheel is inbound no arc can be drawn across the knife switch and contact because their connection is completed before the trolley wheel leaves the rocker, which is always energized. In returning the trolley does not open the branch line until the wheel has passed onto the rocker.

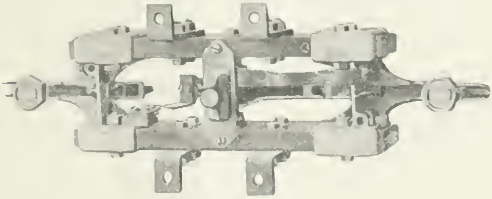


Fig. 2—Top View of Insulator.

As the automatic section insulator is used most frequently in mines, it is arranged for suspension from roof timbers. Four suspension angles are provided on the insulator, each of which is drilled for a lag screw. Any size of trolley wire can be used, but its size and section must be specified when the insulator is ordered.

SOLDER IN PASTE FORM.

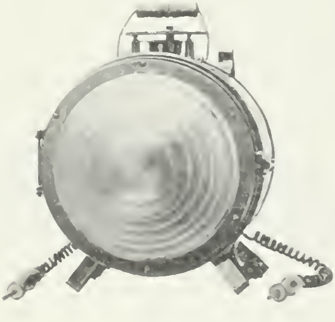
A solder arranged in such a form and having such characteristics as to render it particularly well adapted for use by electric wiremen has been placed on the market by the H. W. Johns-Manville Company, 100 William Street, New York. The solder is in the form of paste in a collapsible tube and can be applied by placing the desired amount on any clean metallic surface and heating it with a match, candle or torch.

LUMINOUS MAGNETITE-ARC HEAD-LAMPS.

The new arc head-lamps developed by the General Electric Company employ to advantage the characteristics of the luminous magnetite arc for electric railway service demanding high speeds and heavy cars for maintaining satisfactory schedules over long suburban and interurban electric railroads.

The head-lamps are made in eight styles—six for suburban and interurban cars and two for mine service. All of these operate on the same principle and differ only in details of construction and in the equipment for adapting them to the different classes of service.

The mechanism is of the non-regulating type, the arrangement and characteristics of the electrodes maintaining an arc of fixed length at the focus of the reflector. The positive electrode consists of a stationary copper forging sheathed with a non-oxidizable metal. It has a life of from 2000 hours to 3000 hours. The negative electrode consists of a tube of welded steel filled with the mixture of iron oxide and other suitable ingredients for forming the luminous arc. The negative electrode has a life of from sixty hours to eighty hours. The slow rate of electrode consumption renders it unnecessary for the motorman to make any adjustments during regular working intervals. Furthermore, one of the most advantageous characteristics of the magnetite arc is its low luminosity when operating under reversed polarity, and this feature has been utilized for dimming or modifying the glare of the head-lamps when operating within the limits of cities, towns and other populous districts. Its application enables the motorman to obtain either full or reduced illumination at will by the simple operation of throwing a switch.



Magnetite-Arc Head-Lamp.

The head-lamps suitable for suburban cars, which usually operate on tracks having numerous curves and many intersecting roadways, are designed to give wide-angle illumination. They are equipped with parabolic metal reflectors and furnish a broad fan of light extending directly from the head of the car to a distance of from 1200 ft. to 1500 ft. up the track. The lateral illumination extends to about 50 ft. on each side, thereby enabling the motorman to see, to some extent, around curves and to detect the presence of persons or vehicles approaching at right angles to the track. These head-lamps are arranged for in-town dimming either by reversed polarity or by means of auxiliary incandescent lamps, the latter method being preferred by some companies.

The styles suitable for rapid suburban and interurban cars are equipped with mangin mirrors or with semaphore lenses and spherical mirrors which serve to project a beam of parallel rays to a distance of about 2000 ft. ahead of the car. Since an interurban train traveling at 60 miles an hour can be stopped with good braking within a distance of 1750 ft. these head-lamps afford an ample factor of safety.

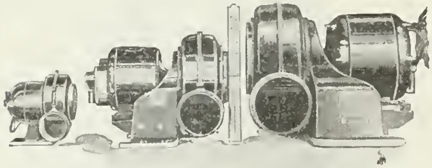
For the usual service the lamps are designed to operate on a nominal 550-volt railway circuit, with 80 volts at the arc and a current of 4 amp. The difference between the line and arc potentials may be controlled by suitable resistances or by incandescent lamps, the latter being utilized to light the interior of the cars. Different combinations of incandescent lamps can be used to build up the necessary resistance. A very satisfactory combination is a group of sixteen 32-cp, 110-volt lamps of four series of four lamps each, connected in multiple. If necessary the number of lamps can be readily increased by using eight series of four lamps each. If it is desirable to keep these incandescent lamps lighted whenever the head-lamp is not being used or when it is being transferred from one end of the car to the other, a substitutional resistance connected to a pair of two-way switches, one at each end of the car, can be employed, thus permitting the head-lamp to be turned on or off without interfering with the interior lighting of the car.

ELECTRIC FORGE BLOWER.

In comparison with the hand blower or bellows the electric blower saves space; it is started and stopped by a switch, which can be located wherever it will be handy to reach from the forge or anvil; the blast produced is strong and positive, and the fire builds up more rapidly than with a bellows or hand blower. More can be done in the same time, as it requires no attention; while the iron is heating other work can be prepared or finished.

A later development in electric forge blowers is illustrated herewith. The blower is built in three sizes, 6.5 in., 9.5 in. and 12.5 in. in diameter, the largest one being capable of caring for five fires. The smaller size, suitable for a single-light fire, uses less than half the power consumed by an ordinary 16-cp electric lamp. The larger sizes are relatively of equal efficiency.

Comparing these blowers with a hand blower or bellows, it will be noted that there are no belts, no levers, no gears, no pulleys, no cranks, no springs. The 'Sirocco" patented wheel being set-screwed to the motor shaft, there are only two bearings on the entire machine.

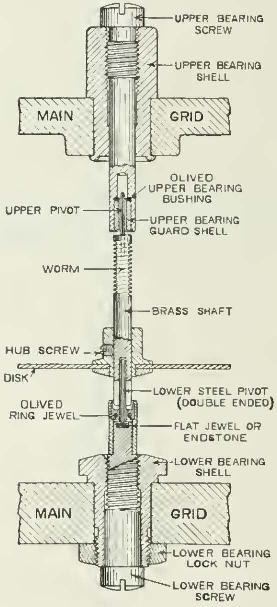


Figs. 1, 2 and 3—Three Sizes of Elowers for Lamp-Socket Attachment.

Among the advantages claimed for these blowers are high mechanical efficiency, hence small power consumption; quiet running; large volume of air at ample pressure to overcome resistance of tuyere and fire; hot fires because of perfect combustion of fuel in fire bed; smooth operation due to extremely small diameter of runner. These blowers are manufactured by the American Blower Company, of Detroit, Mich.

RING-STONE METER BEARING.

In the watt-hour meter bearing shown herewith use is made of a type of construction long used in high-grade watches, but only recently introduced in meters. The steel pivot of the meter slips friction tight into the lower end of a split-brass shaft. When one end of the steel pivot has become worn or injured it can easily be withdrawn and reversed, and when pushed in there is an entirely new pivot on the other end. This pivot centers in a sapphire ring stone and end stone of the same construction as used in watch bearings. Any dust or foreign material collecting near the pivot by the rotative action of the pivot is carried to the side and away from the center of the flat jewel.



Ring-Stone Bearing Construction.

It has long been known that in induction-meter operation there is a continual vibration of the moving element caused by the shunt field. This vibration tends to pull the armature sidewise and lift the pivot up against the curved surface of the jewel cup at each vibration. In the instant following this lifting the pivot tends to drop back to the center of the cup, thus setting up a continuous pounding or drilling on the lower jewel, which eventually impairs or destroys its bearing surface. With the ring and end-stone bearing it is impossible for the entire moving system to be lifted bodily off the end stone, so that, while side play exists in the moving systems, the ring jewel and end stone prevent the pounding or drilling effect. A feature inherent to the ring and end-stone bearing is that the slight and necessary clearance between the shaft and ring jewel allows some play of the lower pivot on the end stone. This distributes the wear instead of concentrating and intensifying it at one point.

When combined with an electrical measuring system having a high ratio of torque to weight, the bearing system here described permits the construction of a meter having a high ratio of torque to friction and a great life with accuracy. This means minimum maintenance charges against the meter department. This type of bearing is used in meters built by the Sangamo Electric Company, Springfield, Ill.

Industrial and Commercial News

The Week in Trade.

Business continues to advance gradually in volume, accompanied by an improvement in tone. The prevalence of summer weather and reduction in prices are stimulating sales in retail lines, while a similar awakening is reported in other branches of trade. Increases of 8 per cent in bank clearings during the week and larger loans made by the banks throughout the country are signs of the better feeling reported at the various centers. The iron and steel trades showed a minor improvement during the week, with fresh buying of merchant steel and a gain in the sales of pig iron, but these industries are, on the whole, in a quiet condition with little response given to the reductions in prices made a few weeks ago and little expected until after the steel and coke hearings in Washington are closed. A few fair orders for rails have been received, with the roads purchasing rolling stock only in small lots. Building lines are moderately active, but May figures are some 4 per cent under those for April. The crop situation is most favorable, and the monthly crop report issued by the Department of Agriculture was one of the most encouraging features of the week. In spite of curtailment of the winter-wheat crop, amounting to 10,000,000 bu., due to the long period of dryness during the month of May, the government report estimates that the ultimate figures for this season will be close to 479,900,000 bu., a total surpassed only by the crop in 1906. With the probability that the estimates of the early part of the year will be fulfilled the result upon the business of the country has been of a most helpful nature, both in domestic and foreign trade, in assisting the extension of credit abroad and in curtailing the tendency to withhold action for the present in domestic trade. Collections are reported slightly better in some sections of the country. Business failures for the week ended June 8, as reported by *Bradstreet's*, were 232, as compared with 168 for last week, 189 for the same week in 1910, 197 in 1909, 253 in 1908 and 161 in 1907.

The Copper Market.

Production for the month of May, as given by the report of the Copper Producers' Association, was 126,962,544 lb. and deliveries were nearly 126,522,520 lb., the largest reported for any month this year. Domestic deliveries were given as 64,543,936 lb., and exports as 61,978,557 lb., the latter being slightly under the showing for the month of April. While production increased 8,977,000 lb., the deliveries show the remarkable increase of 12,100,000 lb. over the April figures, making the net addition to stocks on hand only 440,024 lb. The wide difference in the deliveries of April and May is a matter of extensive comment throughout the trade, and is thought by many to be due possibly to the including of deliveries on contracts made a few months ago for May shipment. The report shows little net improvement in the situation, and the fact is still evident that production continues greatly in excess of consumption. There have been but few price changes during the week and the market has exhibited a firm tone throughout. Inquiries are reported in fair volume, but selling has not been active, due largely to the majority of producers holding out for 12½ cents. Some small sales of electrolytic are said to have been made at 12⅜ cents, while lake copper has been offered at the same price as electrolytic, finding few purchasers. Stocks in consuming quarters are thought to be in need of replenishment, but there is only a small amount of copper being taken at this time. Foreign demand, while moderate, continues to be the sustaining element of the present market. Exports for the month, including June 12, total 10,273 tons. With the report that a major proportion of sales call for June delivery, and with exports at the rate of 60,000,000 lb. for the month, many in the trade are inclined to believe that the June statement will show a larger reduction in surplus stocks than was reported for May. The daily call on the Metal Exchange, June 12, quoted copper as per the accompanying table

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	11.90	12.10	.....
June	11.90	12.10	12.00
July	11.90	12.10	12.00
August	11.90	12.10	12.00
September	11.90	12.10	12.00

The London market, June 12, was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	55	17	6	56	8	9
Standard copper, futures	56	0	0	56	11	3

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.30c			11.57½c		
London, spot	£56	15	0	£53	7	6
London, futures	57	12	6	54	0	0
Best selected	60	5	0	57	5	0

Industrial and Commercial Notes.

Foreign Trade Notes and Opportunities.—A report by the Bureau of Manufactures, Washington, D. C., discussing industrial activity in Japan, states that the following orders for power-station equipment have been secured in that country by American companies during a period covering approximately ninety days: Tokyo Railway Company, two 800-kw Curtis turbo-generator units; Kobe Electric Light Company, two 3000-kw Curtis turbo-generator units; this company has approximately 4000 kw in operation; Hakata Electric Light Company, of the city of Hakata, in Kiushiu, one 1500-kw Curtis turbo-generator unit, which will complete a generating station of approximately 4000 kw; Matsumoto Electric Light Company, of the city of Matsumoto, one 625-kw waterwheel type generator as an addition to its existing plant; the Kyoto Electric Traction Company has placed some very substantial orders for railway motor equipments as an extension to its existing lines in the city of Kyoto; the Nikkau Gas & Electric Company, which owns the electric-light and railway companies of Seoul, Korea, has placed orders for a 1000-kw Curtis turbo-generator plant; the Osaka Municipal Railway Company has placed an order for sixty standard railway motors. A British concern representing the Parsons type of turbine has received an order from the Keihau Electric Company for a 3000-kw plant. The equipment for electrifying the government railway between Yokohama and Tokyo for passenger service and a 500-kw turbine plant for the Asashi Electric Railway Company will be furnished by British interests. The report states further that the American, German, British and other manufacturers are represented throughout Japan by high-class business agents. Experts are utilized and every possible prospect for new business is thoroughly investigated. The field is fully covered by expert salesmen, so that those who are desirous of obtaining business through ordinary mail channels find little encouragement. Among opportunities for sales of electrical equipment the bureau mentions, under Schedule No. 6856, "Electric Locomotives and Supplies": A report from an American consular officer in the Far East states that the contract for electric locomotives to be used on the main line of a government electric railway between points in that region will be placed during the next few months. This will be the first move toward a more extended utilization of electricity on the general railway service in the country in question. Some of the preliminary orders in connection with this important improvement have been placed, according to the reports of Americans concerned, with British concerns, and in one instance without competitive bidding." Schedule No. 6850 outlines the prospects for the sale of small electrical appliances, such as heaters for table use, irons, bed warmers, transformers for electric-bell service, etc. A business house abroad has issued a number of circular letters describing the above appliances and has received a number of inquiries for further information. A vacuum cleaner of American make is being sold, but the price is said to be too high for the general public, and it would be well for firms manufacturing a machine to cost about $65 to correspond with this house. Details can be obtained by applying for the schedules named.

Railway Motors for Kansas City.—The Metropolitan Street Railway Company of Kansas City, Mo., has just placed an order with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., for twenty-five quadruple equipments of No. 306 motors, with K-35 control. The nominal rating of the No. 306 motor is 50 hp at 500 volts and 60 hp at 600 volts, corresponding to currents of 89 and 87 amp respectively.

The Allied Machinery Company of America.—The Allied Machinery Company of America, the formation of which was recently noted in these columns, has been incorporated with a capital of $200,000, and the following officers have been elected: President, Samuel McRoberts, vice-president of the National City Bank; vice-president and general manager, Captain Godfrey L. Carden; treasurer, Thomas A. Reynolds, assistant cashier National City Bank; secretary, H. C. Newland. The directors of the company are: F. A. Vanderlip, president of the National City Bank; J. E. Gardin, Samuel McRoberts and J. T. Talbert, vice-presidents of the National City Bank; Thomas A. Reynolds, assistant cashier of the National City Bank; Captain Godfrey L. Carden and H. C. Newland. Mr. Newland has been associated in a secretarial capacity with President Vanderlip. Mr. C. N. Thorn, appointed assistant manager, was for twelve years assistant manager of the machinery department of Manning, Maxwell & Moore.

The home office of the company has been established at 55 Wall Street, New York City, under direction of Mr. Thorn, and will handle the placing of orders and general work. The sale of machine tools, contractors' supplies and agricultural implements will be promoted at the outset, and the development of other lines will be instituted in the future. It is understood that the function of the National City Bank of New York in the affairs of the company is to investigate the standing of prospective customers and finance such loans to foreign purchasers as may be necessary in order for the American concerns to secure their business. Many foreign banks are closely associated with machinery houses abroad, and extend credit to purchasers to a degree not yet granted by American concerns. Interests associated with the Allied Machinery Company state that American houses can secure a large share of machinery business abroad by giving liberal terms of payment, and that the Allied company will endeavor to do this with the aid of the National City Bank. As previously stated in these columns, Captain Godfrey L. Carden and Mr. Samuel McRoberts, of the Allied company, are now abroad arranging for representation in the large cities on the other side. Agencies, when established there, will co-operate with branches of the National City Bank in arranging terms of payment with purchasers of machinery sold through the Allied Machinery Company.

Among the machinery concerns that will be represented abroad by the Allied Machinery Company are the following: Bullard Machine Tool Company, Bridgeport, Conn., boring machines; Woodward-Powell Planer Company, Worcester, Mass.: F. E. Reed Company, Worcester, Mass., lathes; Kearney & Trecker, Milwaukee, milling machines; J. E. Snyder & Son, Worcester, Mass., drills; Henry & Wright, Hartford, Conn., high-speed drills; Foote, Bert & Company, Cleveland, Ohio, multiple-spindle drills; Gleason Works, Rochester, N. Y., gear planers; Robertson Manufacturing Company, Buffalo, N. Y., hacksaws; E. D. Flather Manufacturing Company, Nashua, N. H., automatic gear-cutting machinery; Whitcomb, Blaisdell Machine Tool Company, Worcester, Mass., planers, lathes; Becker Milling Machine Company, Hyde Park, Mass., vertical milling machines; and Flather & Company, Inc., Nashua, N. H., shapers and planers.

Fort Wayne Electric Works.—A brief note in these columns in the issue of June 8 relating to the merging of the Fort Wayne Electric Works with the General Electric Company failed to represent fully the principal details of the merger. According to its terms the business will be conducted under the name of Fort Wayne Electric Works of General Electric Company. The same lines of apparatus and supplies will continue to be manufactured and sold under the immediate direction of the same individuals as heretofore, with Mr. F. S. Hunting in responsible charge as general manager. All correspondence will be with the Fort Wayne Electric Works at the same addresses as in the past; bills and statements will be rendered from Ft. Wayne, Ind., and all remittances made to Fort Wayne Electric Works, Ft. Wayne, Ind. All outstanding contracts and other obligations of the Fort Wayne Electric Works will be carried out by the new organization, and all offices will be continued as heretofore.

Goulds Company's Factory Additions.—The Goulds Manufacturing Company, of Seneca Falls, N. Y., is about to build four large additions to the No. 2 Plant, in which will be housed the part of the works known as the No. 1 Plant. A one-story storage building, for rough castings, is completed. This building is 240 ft. x 60 ft. and of mill construction. Two machine shops, 300 x 100 ft., will parallel the storage building. They will be of steel-frame and brick construction and about 70 per cent of the wall surfaces will be glass. South of the two machine shops a four-story warehouse, 240 x 60 ft., will be built. These will be of reinforced concrete, and on the south side there will be a loading platform. All new buildings will be lighted with tungsten clusters and will be heated and ventilated by the hot-blast system. All the equipment of the machine shops will be motor-driven. The buildings will be ready for use by Nov. 1.

Washington Engineering & Securities Company.—The Portland Power & Light Company, which owns and operates about 90 public utilities in the Pacific Northwest, is extending its system toward Portland. Through the Electric Bond & Share Company, of New York, it has recently organized and incorporated the Washington Engineering & Securities Company, with headquarters at Vancouver, Wash. The latter company is capitalized at $3,500,000, and its charter permits it to operate all forms of industrial plants, to engage in the distribution of energy for light and motor service, and operate transportation lines. This is the first move that this syndicate has made toward obtaining a foothold in the immediate vicinity of Portland. E. M. Scanlon, James P. Stapleton, of Portland, and E. M. Summerson, L. W. Osborne, G. J. Anderson and O. R. McMahon, New York City, are mentioned as directors in this new enterprise.

Pennsylvania Electrification.—The special committee which has been working on the rearrangement of the passenger service facilities of the Broad Street station of the Pennsylvania Railroad and the immediate vicinity, as mentioned in the *Electrical World,* May 25, has come to an agreement. It is understood that an expenditure of from $20,000,000 to $25,000,000 will be made in this connection. One of the main features of the plan is the electrification of all the suburban lines of the Pennsylvania service, and of the Broad Street station, the cost of which is estimated at $14,000,000. The plan also provides for the complete separation of local and through passenger traffic. The suburban business will be handled at the Broad Street station, while the through trains will be taken care of at West Philadelphia, where it is proposed to erect a new passenger station.

General Electric Sales.—The Delaware & Hudson Railroad Company has ordered the following equipment from the General Electric Company for use in its Mechanicsville substation: One 8000-kw, 2300-volt turbo-generator, one 100-kw, 125-volt turbo-exciter, and four 2500-kva step-up transformers. Among recent orders for traction equipment received by the General Electric Company is that of the Syracuse Rapid Transit Railway Company, calling for twelve quadruple equipments; also that of the Erie & Suburban Railway, Electric Light & Power Company for twenty double equipments. The New York & North Shore Railway Company has purchased four quadruple equipments with air brakes.

Orders for Taylor Stokers.—The following electric light and railway companies have just purchased an aggregate of 22,700 hp in Taylor stokers from the manufacturer, the American Ship Windlass Company, Providence, R. I.: Havana Electric Railway Company, Havana, Cuba, 2000 hp; Dayton Citizens' Electric Light Company, Dayton, Ohio, two stokers, 2400 hp; New York, New Haven & Hartford Railroad Company, Cos Cob power station, 7500 hp; Northern Ohio Traction Company, Akron, Ohio, 6000 hp, and Philadelphia Electric Company, Christian Street station, 4800 hp.

Lehigh Valley Telephone Yard Dispatching Circuits.—To expedite the work of handling trains in and about its Jersey City yards, the Lehigh Valley railroad has applied to terminal operation the methods already employed in dispatching scheduled trains. Western Electric selectors and telephones, with which the rest of the Lehigh Valley's dispatching system has been equipped, are being used. It is believed that the Lehigh Valley is the first railroad in the East to apply telephone train dispatching methods to direct car movement in a local yard.

Otis Elevator Company to Move Plant.—In keeping with its policy to centralize its work in a few large plants instead of operating a comparatively large number of small plants throughout the country, the Otis Elevator Company plans to discontinue its Springfield (Mass.) plant and transfer the manufacturing of elevators, motors and controllers to its larger plants near New York City.

Financial.

THE WEEK IN WALL STREET.

MUCH interest has been attracted in financial circles during the week to the hearings in Washington on the history of the United States Steel Corporation, the methods used by the corporation in the development of the iron and steel trades, and the public-spirited manner in which the information has been advanced by its officials. While investigations of this nature are productive of much ultimate good, both to the concern and to the country as a whole, there is a pronounced feeling in Wall Street that probings at this time are not to be welcomed owing to the tendency to prolong the absence of public participation in the stock markets. The transactions of the past week have been due largely to the results of professional activity rather than to any speculative interest on the part of the public. Sales for the week were 2,502,428 shares, as compared with 2,946,879 for the week preceding, with a few price changes of importance at the close. Several railroad issues have been in good demand, with their prices reaching new levels for the year. The bond market continues to be firm and active, and many new offerings have had easy disposal. A substantial increase in bank clearings over the figures of the previous week and the large amount of foreign exchange have been of a favorable nature, accompanied by the excellent crop reports and a firmer tone in the money market. Rates have not been advanced to any notable extent, but loans are not offered as eagerly at this time as heretofore at existing rates, as a result of the amount of borrowing attendant on the bond sales of the month and the financing of new business. This growing firmness is of a most encouraging nature, indicating improvement in the condition of trade throughout the country. Rates June 12 were: Call, *2@2½* per cent; ninety days, *2¾@2⅞* per cent. The quotations in the table are those of the close June 12.

NEW YORK.

	June 5.	June 12.	Shares Sold.		June 5.	June 12.	Shares Sold.
All. Ch.	9	8⅞*	600	Int. Met., pf.	53½	52¼	17,910
All. Ch., pf.	33	33	300	Mackay Cos.	90⅛	91	700
Amal. Cop.	67¼	69¼	63,130	Mackay C., pf.	75¼*	74½	100
Am. D. T.	20½*	20½*	———	Man. Elev.	138	139⅞*	660
Am. Loco.	41½	42	1,050	Met. St. Ry.	15*	15*	———
Am. Loco., pf.	108¾*	109*	300	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	82*	83	———	Steel, com.	77¾	78	338,900
Am. T. & T.	149¾	151⅞	49,550	Steel, pfd.	119	118¼	9,545
B. R. T.	85⅝	81¼	39,911	W. U. T.	81½	81⅝	10,915
Gen. Elec.	165	164⅛	8,400	West'h, com.	77	76½	8,300
Int Met.	19½	19	8,700	West'h, pfd.	118	118⅛*	100

PHILADELPHIA.

	June 5.	June 12.		June 5.	June 12.
Am. Rys.	44*	44*	Phila. R. T.	19⅛	19
El. Co. of A.	11⅞*	11⅞*	Phila. Elec.	16½	16⅞
Elec. St. Bt'y.	54	55½	Phila. Trac.	83¼	86¼
Elec. St. B'ty., pfd.	30*	30*	Union Trac.	48½	48

CHICAGO.

	June 5.	June 12.		June 5.	June 12.
Chi. City Ry.	186*	186*	Chi. Tel. Co.	14*	123
Chi. Rs., Ser. 1.	80*	80*	Met. El. Co.	25*	25
Chi. Rs., Ser. 2.	22½*	22*	Met. El., pfd.	72½	72½*
Com. Edison	129½*	128½	Nat'l Car.	120*	120*
Chi. Subways.	4¼*	4⅛	Nat'l Car, pfd.	119*	119*

BOSTON.

	June 5.	June 12.		June 5.	June 12.
Am. T. & T.	149¾	151¾	Mex. Tel.	4*	4*
Cum. Tel.	157½*	157½*	Mex. Tel., pfd.	6*	6*
Edison E. Ill.	287*	286½*	N. E. Tel.	146¾	150
Gen. Elec.	165½	164¼	W. T. & T.	19	20
Mass. E. Ry.	23¼	23¼*	W. T. & T., pfd.	97*	96*
Mass. E. Ry., pf.	90⅞	90¼			

*Last price quoted.
Shares sold for week, June 5 to June 10.

FINANCIAL NOTES.

Annual Report of Westinghouse Company.—The report of the Westinghouse Electric & Manufacturing Company and subsidiaries for the year ended March 31, 1911, has been issued and shows the business for the year to be the largest in the history of the company. Gross earnings were $38,110,312, an increase of $8,870,630 over those of the preceding year, and were $5,093,072 larger than those of the best previous year in the company's existence. Total costs amounted to $32,510,547, leaving net manufacturing profits of $5,608,765, as compared with $3,552,078 for this item in the report of the previous year. Other income was $1,515,531, making a total income of $7,124,206. Deductions from this for interest, depreciation on plant, etc., amounted to $2,243,100, leaving a surplus for the year amounting to $4,881,105, which compares with $3,660,664 for last year's report. Profit and loss credits were $6,349,255, making a gross surplus of $11,230,361, and profit and loss charges were $5,266,137, leaving a surplus of $5,964,224, as against $5,668,948 for the previous year. The report states that the satisfactory results of the past year, attained in a period of somewhat less than normal activity in other lines of industry, afford a sound basis for a good future for the electrical manufacturing industry, but that the results of last year are no certain indication of the future, inasmuch as the present volume of business is on a diminishing scale. The volume of unfilled orders as of March 31, 1910, was $11,256,106, and as of March 31, 1911, this value stood at $7,616,058. Commenting on the surplus, the report states that the surplus as of March 31, 1910, of $5,668,948 has been increased during the year by various items detailed in the statement of profit and loss to $6,349,255, which with the addition of the net income of $4,881,105, as above, made a surplus at the end of the fiscal year of $11,230,361. Against this have been charged dividends on the preferred stock for the year at the rate of 7 per cent per annum and a balance of 8¾ per cent accumulated but unpaid in previous years, together aggregating $629,795. In the adjustment of the account property and plant, and in establishing a direct liability for bonds to the Walker company, guaranteed by the parent company, there resulted charges against surplus aggregating $1,193,297. Charges against surplus in connection with reserves for notes and accounts receivable were made during the year aggregating $589,774. The total of the charges enumerated was $2,413,322, and there was also written off as depreciations of investments $2,852,914, on account of stocks in the Westinghouse Electric Company, Ltd., London, the Société Anonyme Westinghouse, and the Westinghouse Machine Company, bonds of the Lackawanna & Wyoming Valley Rapid Transit Company and in miscellaneous stocks and bonds.

Manhattan Bridge Three Cent Fare Line.—The Manhattan Bridge Three Cent Fare Line, which has received a certificate of public convenience and necessity for the construction of a trolley line over Manhattan Bridge and through certain streets in Brooklyn and New York, has applied to the Public Service Commission of the First District of New York for permission to issue its common capital stock to the amount of $50,000. The petition states that the company has authorized capital stock of $50,000, of which none has been issued, that the company has no bonded or mortgage indebtedness, no road, plant, system or equipment, and none of its stock is held by other corporations. The commission will take up the petition on June 22. The company proposes to build a line of some 5 miles in length between the Long Island Railroad terminal at Flatbush Avenue, Brooklyn, across the Manhattan Bridge, through Canal Street, New York City, to the Hudson River. Among the directors are the following: Mr. John C Brackenridge, of New York; Mr. Walter Hammitt, Mr Edward Norwill, Mr. Almet R. Latson, Mr. Charles Jerome Edwards, Mr. Charles E Perkins, Mr. Thomas P. Peters, Mr. Norton B. Smith, Mr Simon J. Harding, Mr. John H Mowler, Mr. William F. Neu, Mr. Frank H. Tyler and Mr. Frederick W. Wurster, all of Brooklyn.

Mexican Telephone & Telegraph Company.—The annual report of the Mexican Telephone & Telegraph Company for the year ended Feb. 28, 1911, gives its figures in Mexican currency. Gross earnings were $574,420, as compared with $480,600 in 1910. The operating expenses were $200,431, and the net earnings $306,146, an increase of $55,120 in this item over that for the preceding year During the year, $320,520 was expended for construction work, and $67,843 charged off to maintenance. The telephones in service March 1 1911, were 10,277, showing a gain of 1416 for the year. President W. F. Smith said that the increase in subscribers would have been much greater in Mexico City had it not been for the lack of facilities, and that 920 applications for service during the year were rejected owing to the congested conditions These will be overcome by the installation of the Juarez office. Vice-president Menzies, in the report, states that a very large percentage of the work of construction and repairs has been done in the federal district, which comprises the cities of Mexico, Tacubaya, Tacuba, Guadalupe and San Angel

Rumored Sale of Northern California Power Company.—It is reported that an option has been obtained for the sale of the stock of the Northern California Power Company, of San Francisco, to a purchaser said to represent the Smith-Tever interests

Southern California Edison Company.—The report of the Southern California Edison Company for the twelve months ended Dec. 31, 1910, shows extremely favorable results for this period. The gross earnings were $3,364,933, representing an increase of more than $489,000, or 16¾ per cent, as compared with gross earnings for the previous year. The operating expenses and taxes were $1,717,857, an increase of $231,704, leaving net earnings of $1,667,076, which is an increase of 18.29 per cent over the returns of the preceding year. During the year the company earned a surplus over fixed charges sufficient to pay the regular 5 per cent cumulative dividend on the preferred stock, and still leave a balance of 11.32 per cent on the common stock, as against 8.48 per cent earned on the $7,200,000 outstanding common stock in 1909. The fixed charges were $651,482, and the depreciation item $545,000, leaving a surplus of $470,584, which was 51.53 per cent greater than the surplus of the year preceding. The company operates in Los Angeles, Pasadena, Riverside, Redlands, and other cities in southern California, and owns and operates the properties formerly controlled by the Edison Electric Illuminating Company of Los Angeles. These include water power and steam plants with a total generating rating of some 60,000 hp, to which is being added the 15,000-hp hydroelectric plant described in these columns under date of May 11. The common stock is paying dividends at the rate of 5 per cent per annum and is earning a substantial surplus. The preferred stock is cumulative and pays dividends at the rate of 5 per cent.

McCrum Howell Company.—The report of the McCrum Howell Company for the fiscal period ended March 31, 1911, covers the operations of eleven months owing to the change of the fiscal year from April 30 to March 31. Net earnings were $529,240, an increase of $138,140, and preferred dividends were $138,538, an increase of $77,794. Common dividends were $11,273, leaving $379,429, from which $100,000 was deducted for depreciation. The balance to surplus amounted to $279,429, an increase of $24,074, making a total surplus of $612,615. The report states, in part: "During the period from May 1, 1910, to April 1, 1911, the capital stock of the company was increased from $3,000,000 to $7,000,000 for the purpose of providing funds with which to engage more extensively in the vacuum-cleaning industry, . . . and we are now well started upon the present fiscal year splendidly equipped to serve the interests of the public in the wares we manufacture. Your company has taken its position as the largest maker of vacuum-cleaning systems in the world, and is now equipped to produce a complete line of cleaning machinery from a forty-sweeper plant, such as is installed in the store of the Marshall Field Company, Chicago, down to a hand-operated portable cleaner."

Jacksonville Traction Company.—Stone & Webster are offering $750,000 first consolidated mortgage, 5 per cent gold bonds of the Jacksonville Traction Company, of Jacksonville, Fla. The bonds are a first mortgage on a power plant now under construction, and the Ortega extension, 3¾ miles in length, also on property to be acquired hereafter; direct mortgage on all property acquired from the Jacksonville Electric Company, subject only to $1,250,000 first mortgage bonds. The bonds are followed by $500,000 6 per cent preferred stock and $800,000 common stock, paying dividends at the rate of 7 per cent per annum. The value at present market prices is more than $1,500,000. The proceeds from the sale of this issue of bonds will be applied to the retirement of the company's floating indebtedness and to further extensions and improvements, including the modern central station mentioned above.

Tri-State Telephone & Telegraph Company.—The record of the Tri-State Telephone & Telegraph Company, which operates in North and South Dakota and Minnesota, for the year ended Dec. 31 was one of the most satisfactory in the history of the company. Both gross and net earnings were the largest on record and the operating expenses the lowest the company has ever had. The company has declared its thirty-second quarterly dividend of 1½ per cent on the preferred stock, and dividends of 6 per cent per year are now being paid on the common stock. The business of the company in the past six years has increased rapidly, and in this time the gross earnings have practically doubled, while the net returns have been at even a greater ratio than the above.

New Directors for Philadelphia Rapid Transit.—Five new directors, representing the Stotesbury interests in the organization which has succeeded the Widener-Elkins control, have been elected to the board of the Philadelphia Rapid Transit Company. The new members are E. T. Stotesbury and H. G. Lloyd, of Drexel & Company; C. S. W. Packard, of Philadelphia; E. Ingersoll, a director of the Pennsylvania Railroad Company, and T. E. Mitten, of Chicago. The retiring directors include P. A. B. Widener, George D. Widener and J. B. Parsons, former president of the company.

York Manufacturing Company Bond Issue.—The York Manufacturing Company, of York, Pa., maker of refrigerating machinery, has authorized a bond issue of $750,000 to increase its working capital. It is reported that the entire issue was subscribed for within a few days after authorization through the Girard Trust Company of Philadelphia. The company has doubled its working capital within the past few years, the capitalization now being $2,000,000.

Mexican Power Company to Issue Bonds.—Bond and stock holders of the Mexican Northern Power Company, Limited, will meet in Montreal on June 29 to approve an issue of $200,000 bonds and to give the bondholders one vote for each $100 par value of the bonds in place of one vote for each $500 of such bonds, as under the present system.

Ontario Power Bonds Sold.—The $2,300,000 6 per cent debentures of the Ontario Power Company recently purchased by William Salomon & Company have been sold at par and interest with a 10 per cent bonus in stock.

DIVIDENDS.

Buffalo General Electric Company, quarterly, 1¼ per cent, payable July 1.

Phelps-Dodge & Company, Inc., quarterly, 2½ per cent, payable June 29.

United Traction & Electric Company, quarterly, 1¼ per cent, payable July 1.

Manila Electric Railroad & Lighting Corporation, quarterly, 1¼ per cent, payable July 1.

Virginia Railway & Power Company, semi-annual, preferred, 2½ per cent, payable July 10.

National Gas, Electric Light & Power Company, quarterly, preferred, 1½ per cent, payable July 1.

St. Joseph Railway, Light, Heat & Power Company, quarterly, preferred, 1¼ per cent, payable July 1.

REPORTS OF EARNINGS.

Period.		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus.
BLACKSTONE VALLEY GAS & ELECTRIC COMPANY.						
April	1911	$82,468	$40,654	$41,814	$29,862	$11,952
"	1910	78,016	36,317	41,699	29,316	12,383
BUFFALO GENERAL ELECTRIC COMPANY.						
3m., March,	'11	$318,276	$181,869	$148,042	$35,139	$112,903
3 " "	'10	264,023	155,236	119,524	33,135	86,388
COLUMBUS ELECTRIC COMPANY.						
April,	1911	$41,303	$17,158	$24,145	$10,648	$13,497
"	1910	40,695	15,943	24,752	19,980	4,772
DALLAS ELECTRIC CORPORATION.						
April,	1911	$125,387	$73,118	$42,269	$27,787	$14,472
"	1910	113,406	74,510	38,896	26,600	12,296
DETROIT UNITED RAILWAY COMPANY.						
April,	1911	$802,163	$518,596	$296,453	$176,380	$120,074
"	1910	724,812	486,898	250,711	161,490	89,221
EL PASO ELECTRIC COMPANY.						
April,	1911	$53,695	$30,797	$22,898	$8,221	$14,677
"	1910	49,490	28,874	20,616	8,306	12,310
GALVESTON-HOUSTON ELECTRIC COMPANY.						
April,	1911	$121,146	$69,393	$51,753	$24,586	$26,897
"	1910	104,550	66,059	38,491	23,540	14,951
MINNEAPOLIS GENERAL ELECTRIC COMPANY.						
April,	1911	$119,174	$44,489	$74,685	$41,879	$32,906
"	1910	101,141	43,254	57,887	30,634	27,253
NORTHERN TEXAS ELECTRIC COMPANY.						
April,	1911	$126,681	$67,123	$59,558	$25,354	$34,204
"	1910	111,280	61,002	50,278	19,090	31,198
SAVANNAH ELECTRIC COMPANY.						
April,	1911	$55,395	$36,928	$18,467	$18,449	$18
"	1910	50,650	32,740	17,910	17,901	9
SEATTLE ELECTRIC COMPANY.						
April,	1911	$452,178	$257,695	$194,483	$115,501	$78,982
"	1910	460,490	273,266	187,224	108,708	78,516
UNITED RAILWAYS OF ST. LOUIS.						
April,	1911	$973,939	$668,876	$308,463	$229,436	$79,027
"	1910	938,648	675,659	265,932	233,539	32,393

General News

Construction News.

FLORENCE, ALA.—Plans are being considered for the installation of a cotton gin at the Ashcraft Cotton Mill, which will be operated by electricity.

HEADLAND, ALA.—It is reported that bonds to the amount of $7,500 have been voted, the proceeds to be used for extension sand improvements to the municipal electric light plant and waterwork system.

DERMOTT, ARK.—Plans are being considered for extensions to the municipal electric-light plant, which will include the installation of a direct-connected generating unit.

JACKSON, CAL.—Preparations are being made to use electrical power instead of water power for hoisting at the Argonaut Mine.

LAKEPORT, CAL.—The Clear Lake Railroad Company, recently incorporated with a capital stock of $500,000, proposes to build an electric railway from Hopeland to Lakeport, with branches to Upper Lake and Kelseyville, 44 miles in length. Among the directors are: L. H. Boggs, M .M. Gopcevic, of Kelseyville, Z. T. Spencer, of Lakeport, and S. E. Brooks, of Hopeland.

LODI, CAL.—Arrangements have been completed by the City Trustees for the installation of an electrolier lighting system in Lodi.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has awarded the contract for the construction of its proposed extension from Glendale to Burbank, a distance of 4½ miles, to Robert Sherer & Company, of Los Angeles.

LOS ANGELES, CAL.—The Southern California Edison Company has filed application with the War Department for permission to erect transmission lines across Gerritas Slough, west of Long Beach Harbor. The company agrees to maintain cables on towers at least 140 ft. above the water.

LOS ANGELES, CAL.—In a decision handed down by the Supreme Court the city of Los Angeles was given permission to issue bonds to the amount of $3,500,000, authorized by the voters at an election held April 19, 1910, for the purpose of constructing and maintaining a municipal, light, heat and power plant. An injunction was obtained by Percy H. Clark, which had been decided in favor of the city and then appealed to the Supreme Court.

LOS ANGELES, CAL.—Plans are being prepared by E. F. Scattergood, electrical engineer for the aqueduct, and the Public Service Commission, for the construction of at least one large power plant capable of transmitting 30,000 hp to Los Angeles, work on construction of which will begin as soon as funds from the $3,500,000 in bonds can be obtained. At present two power plants are furnishing power in connection with the construction of the aqueduct, and will form part of the general power system. The present plans call for the erection of plant known as the San Fernando plant, to be located about 24 miles from Los Angeles and 3 miles north of San Fernando, where about 9500 hp will be developed. Plant No. 2 will be located about 40 miles from Los Angeles, 9 miles above Saugus, in the San Francisquita Canyon, and have an output of about 17,500. No. 3 will be located further north with an output of 30,000 hp. The fourth will be the Haiwee plant on the aqueduct, 162 miles from Los Angeles, located just below the Haiwee reservoir, with an output of 6000 hp.

LOS BANOS, CAL.—Arrangements are being made by the San Joaquin Light & Power Company, of Fresno, Cal., for the construction of a substation in Los Banos.

RICHMOND, CAL.—The City Trustees have awarded the contract for street lighting to the Western States Gas & Electric Company. The contract calls for ninety arc lamps at the rate of $72 each per year.

RIVERSIDE, CAL.—The Board of County Supervisors has awarded the franchise to erect and operate electric transmission lines along the public roads in Riverside County to the Pacific Light & Power Corporation, of Los Angeles, Cal. The price paid for the franchise was $150.

SAN FRANCISCO, CAL.—Preliminary plans are being prepared by H. E. Stone, engineer, Pacific Building, San Francisco, Cal., for the construction of a large hydroelectric plant for the Kern County Water Power Company.

SAN FRANCISCO, CAL.—The San Francisco Gas & Electric Company has submitted bids to the Board of Supervisors for supplying gas and electricity for lighting the streets and buildings of the city for the next fiscal year. The company agrees to supply arc lamps with an all-night service at $69.35 each per year; under the present contract the charge is $72 each per year. The price for gas lamps has been reduced from $23.90 to $21.90 each per year. Under the new contract a total saving of $23,000 for the year is estimated.

SAN JOSE, CAL.—The San José Railroad is preparing to begin work on the construction of its new electric railway to Alum Rock Park, via Berryessa, a distance of 7 miles. At present the company is only operating its cars as far as the power house, near the mouth of the canyon.

SANTA BARBARA CAL.—A meeting of the stockholders of the Santa Barbara Gas & Electric Company has been called for June 20 to vote on the proposition to increase the bonded indebtedness from $1,000,000 to $2,000,000, the proceeds to be used for extensive improvements to its system.

TUSTIN, CAL.—The town officials have awarded a contract to the Southern California Edison Electric Company for the installation of 110 incandescent lamps for street lighting in Tustin, to cost $1.15 each per month, to burn until 1 o'clock.

VALLEJO, CAL.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 8 for auxiliary power plant equipment at the Navy Yard, Mare Island, Cal. Plans and specifications can be obtained upon application to the bureau or to the commandant of the navy yard named. A deposit of $25 will be required, which will be refunded upon return of the plans. R. C Hollyday is chief of bureau.

GUNNISON, COL.—Bonds to the amount of $70,000 will be sold by the town of Gunnison about July 1 at private sale, the proceeds to be used for improvements to the municipal electric-light plant and water works system.

BRIDGEPORT, CONN.—The City Council is considering the question of establishing a municipal electric-light plant in Bridgeport.

BRISTOL, CONN.—The Bristol & Plainville Tramway Company has recently placed orders for two 750-kw Curtiss turbines, with condensers and three 300-kw rotary converters, pumps, etc., to be installed within four months. G. E. Cockings is manager.

MERIDEN, CONN.—The Meriden Industrial Building Corporation is erecting a new building which will be occupied by small industrial companies. A power plant will be installed in another building.

WINDSOR LOCKS, CONN.—The Supreme Court of Errors has handed down a decision refusing a permanent injunction against the acceptance of the right of the Connecticut River Power Company to construct a dam across the Connecticut River at Windsor Locks and Endfield and the erection of a power plant and transmission system, applied for by the minority of the stockholders. It is understood that the company will begin work to carry out its plans.

HAVANA, CUBA.—President Gomez has signed a concession granting Hugh Reilly permission to build an electric railway. The proposed railway will be known as the Cienfugos, Palmira & Cruces Railway. Electricity for operating the road will be secured from the large reservoir in the Trinidad Mountains.

NEW CASTLE, DEL.—The City Council, it is stated, is considering the question of installing a municipal electric-light plant.

WASHINGTON, D. C.—The contract for the construction of the powerhouse in connection with the Providence Hospital, located at D Street. corner Second Street, S. E., Washington, D. C., has been awarded to S. H. Gaskins, at a cost of $24,000.

WASHINGTON, D. C.—The District Commissioners are reported to have abandoned the scheme of lighting Pennsylvania Avenue by erecting ornamental lamp standards on the center of the avenue and have authorized Walter C. Allen, District electrical engineer, to submit another plan.

WASHINGTON, D. C.—The contract for dry dock pumping equipment has been awarded to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for $20,802. The General Electric Company has secured the contract for furnishing all meters, except water meters, for the various navy yards, for $37,550.

WASHINGTON, D. C.—Sealed bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 1 for eight 5000-pound and four 10,000-pound electric motor trucks for navy yards and naval stations, specifications for which may be obtained on application to the bureau. R. C. Hollyday is chief of bureau.

WASHINGTON, D. C.—Sealed bids will be received at the Bureau of Yard and Docks, Navy Department, Washington, D. C., until July 1, for sixteen electrically driven capstans, complete; seven for the navy yard at New York, N. Y., and nine for the naval station at Pearl Harbor, Hawaii. Plans and specifications can be obtained on application to the bureau or to the commandant of the navy yard, New York. The estimated cost of the work is $44,500. R. C. Hollyday is chief of bureau.

WASHINGTON, D. C.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until June 30 for supplying and installing lighting fixtures in the Unitedl States buildings at Austin, Minn.; Beloit, Wis.; Clintoo, Mo.; Decorah, Ia.; Fremoot, Neb.; Kokomo, Ind.; Litchfield, Ill.; Plattsmouth, Neb., and Great Falls, Mont., in accordance with plans and specifications, copies of which may be obtained at the above office. James Knox Taylor is supervising Architect.

WASHINGTON, D. C —Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 20 to furnish at the navy yard, Brooklyn, N. Y., a quantity of naval supplies as follows. Schedule 3634, turrent tracks, etc.: Schedule 3635, wireless telegraph sets. Applications for proposals should designate the schedule desired by number. Blank proposals will be furnished upon application to the navy pay office, New York, N. Y., or to the bureau. T. J. Cowie is paymaster general.

PLANT CITY, FLA.—The City Council is reported to be considering the installation of an electric-light plant and sewer system.

COLUMBUS, GA.—The Swift Manufacturing Company has awarded contract for construction of two additions to its plant, to cost about $20,000. The plant is operated by electricity.

COLUMBUS, GA.—It is reported that the towns of LaGrange and Newnan are negotiating with the Columbus Power Company for electrical service from its power plant at Goat Rock, on the Chattanooga River, 14 miles above Columbus, when completed. It is said that the initial installation will develop about 40,000 hp.

CUTHBERT, GA.—Bonds to the amount of $20,000 have been authorized for improvements to the municipal electric-light and water plant. It is proposed to sink one or more artesian wells, and to move the water and light power stations into the city and to extend and improve both the water and light distributing systems.

LEARY, GA.—The Leary Gin & Light Company is preparing plans for the erection of an electric light plant and ginnery and grist mill, to cost approximately $5,000.

PEARL HARBOR, HAWAII.—The contract for furnishing turbo-alternators, etc., at the naval station, Pearl Harbor, Hawaii, has been awarded to the General Electric Company, Schenectady, N. Y., at $29,600.

PEARL HARBOR, HAWAII.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 8 for furnishing boilers and auxiliary power plant equipment at the United States Naval Station, Pearl Harbor, Hawaii. Plans and specifications can be obtained on application to the bureau. A deposit of $25 will be required, which will be refunded upon return of the plans. The cost of the work is estimated at $135,000. R. C. Holiday is chief of bureau.

WALLACE, IDAHO.—Plans have been prepared by the North Idaho Telephone Company for the construction of a telephone line between Murray and Nelson, 14 miles in length.

ALTON, ILL.—The Alton, Jacksonville & Peoria Railway Company has awarded the contract for the erection of its power house to be located on Pisa Creek, about 9 miles from Alton, to J. J. Wullner & Son, of Alton. The building will be of brick and concrete construction and will cost about $15,000. The plant will have a generating capacity of 1200-hp.

CHESTER, ILL.—The Southern Illinois Traction Company has purchased the Wabash, Chester & Western Railroad, extending from Chester, Ill., to Mount Vernon, 64.4 miles in length, which, it is said, it will equip for electrical operation, to be used as a part of an extensive interurban system in southern Illinois. The traction company proposes to build a railway from the east end of the East Side free bridge approach to Pinckneyville, Ill., to connect with the Wabash, Chester & Warren Railroad. The Southern Illinois Traction Company recently secured a franchise to use the upper deck of the free bridge and several streets in the business section of St. Louis.

CHICAGO, ILL.—Bids will be received by the board of inspectors of the House of Correction of the City of Chicago, at the office of the superintendent of the House of Correction, Twenty-sixth Street and California Avenue, Chicago, Ill., until June 21 for furnishing two 250-hp water-tube boilers, with all accessories, for the power plant of the House of Correction.

GALENA, ILL.—Preparations are being made by H. M. Byllesby & Company, of Chicago, Ill., for extensive improvements to the electric plant of the Interstate Light & Power Company in Galena. The work will include the erection of an addition to the power house, the installation of four new boilers with a rating of 5000 hp, of which two will be installed immediately and the others later: new electric generating units and a 3000-kw General Electric steam turbine will be installed immediately. An addition will be built to the coal bunkers and the storage capacity doubled. Lincoln Nissley, constructing engineer, will have charge of the work. F. H. Rickeman, of Galena, Ill., is general manager of the Interstate Light & Power Company.

QUINCY, ILL.—The Quincy & Terre Haute Railroad Company will award contracts for grading its proposed railway to connect Quincy and Baylis and intervening towns, a distance of 56 miles, as soon as it secures a new charter. The motive power will be either electricity or gasoline. The company is capitalized at $1,680,000. William C. Tick, of Quincy, is president.

WAUKEGAN, ILL.—The Northern Illinois Industrial Company, recently incorporated, proposes to construct and operate an electric railway from North Chicago to Waukegan. The company is capitalized at $50,000. Among the directors are: C. E. Saylor and M. H. Hussey, of Waukegan; John Sherwin and L. B. Joley, of North Chicago.

BRAZIL, IND.—The Terre Haute, Indianapolis & Eastern Traction Company has submitted a bid to the City Council for street lighting in which it offers to supply electric arc lamps at $67 each per year with all-night schedule, under a five-year contract, and the same equipment under a ten-year contract at $65 per lamp per year; three-lamp tungsten clusters at $80 each per year under a five-year contract, and $77.50 each per year under a ten-year contract. The bids submitted by the Brazil Electric Company offers to supply arc lamps with all-night schedule at the rate of $72 per lamp per year under a five-year contract and $64 each per year under a ten-year contract; five-lamp tungsten clusters at $124 each per year for five years and $115 each per year for ten-year contract.

CRAWFORDSVILLE, IND.—The annual report of the trustees of the municipal electric-light plant for the year ending May shows a profit of $20,464. The total receipts were $63,194 and the expenditures $42,730. Improvements involving an expenditure of $38,553 have been made to the plant during the past year.

GARY, IND.—Application has been made by the Gary Connecting Railways Company for a charter to build an interurban railway from Goodrum to Gary and Hammond, and also to a point on the State line between Illinois and Indiana south to Hobart. The capital stock of the company is placed at $500,000. V. O. Ward, I. A. Wheeler, Richard D. Green and others are interested in the company.

GREENCASTLE, IND.—The City Council has voted to install an ornamental street-lighting system. Cluster lamps placed on ornamental standards will be used. It is understood that bids will soon be asked for installation of the new system.

HARTFORD CITY, IND.—Preparations are being made by the United Telephone Company for extensive improvements to the local telephone system, which will involve an expenditure of about $10,000 and include the installation of new lead cable and the erection of five rural lines out from the local exchange, the longest of which will be 13 miles.

INDIANAPOLIS, IND.—The Indianapolis, Chicago & Meridian Railway Company has applied for a charter to build an interurban railway to connect Indianapolis, Gary, Hammond, Columbia and Fort Wayne. The proposed railway will connect with interurban lines near Hammond, Ill. John A. Shafer, M. J. Moreland, M. B. Killer and others are interested in the project.

OSSIAN, IND.—Arrangements have been made for the installation of an electric-lighting system in Ossian by Reidel-Gray Milling Company. Electricity for operating the system will be supplied by the Ft. Wayne & Northern Indiana Traction Company.

SOUTH BEND, IND.—The Board of Public Improvements has awarded a contract to the Westinghouse Electric & Manufacturing Company for a large amount of electrical supplies.

BLANCHARD, IA.—The installation of an electric-light plant in Blanchard is reported to be under consideration. Frank Walkinshaw is interested in the project.

FAIRFIELD, IA.—The Fairfield Gas & Electric Company has applied for a franchise to erect a transmission line on the Fairfield-Birmingham road.

POCAHONTAS, IA.—Bids will be received by George Schneiders, city clerk, until June 27, for the construction of an electric-light plant, which will include erection of power house, installation of steam plant or gas-producer outfit, a 40-kw generator, pole line and wiring and all accessories. Plans and specifications are on file at the office of the city clerk, Pocahontas, Ia., and at the office of the Oscar Claussen Engineering Company, National German-American Bank Building, St. Paul, Minn.

STANWOOD, IA.—It is reported that W. S. Taskey has submitted a proposition to supply electricity to operate an electric-light system in Stanwood, Lisbon and other towns in this vicinity. Mr. Taskey proposes to develop the water-power of the Wapsipinicon River to generate electricity for transmission to the above-named towns to be deliverd at substations for distribution.

CHERRYVALE, KAN.—Bids will be received until June 19 by E. E. Bellamy, city clerk, for furnishing and erecting complete one 75-kw generator, engine, switchboard, etc. Plans and specifications are on file at the office of the city clerk and at the office of the J. S. Worley Company, Reliance Building, Kansas City, Mo.

GALENA, KAN.—The Murphy Mining Company, operating on the Murphy and Haughey mining properties, it is reported, is contemplating equipping its machinery for electrical operation.

SYLVAN GROVE, KAN.—The proposition to issue bonds to the amount of $35,000, the proceeds to be used for the construction of an electric-light plant and water-works system, will be submitted to a vote of the people on June 26.

OWENSBORO, KY.—The Western Kentucky Electric Railways Company is preparing plans for the construction of an electric railway to connect Owensboro, Calhoun, Central City, Madisonville, Earlington, Nortonville, Dawson Springs, Bowling Green, Niagara, Sturgis, Ky., and Rockport, Ind., 230 miles in length. Preliminary arrangements are being made and application will soon be made for a charter. The company will supply electricity for lamps and motors. Capital stock to the amount of $2,000,000 has been authorized. H. U. Wallace & Company, Marquette Building, Chicago, Ill., are the engineers. E. F. Wheaton, of Owensboro, Ky., is fiscal agent.

LAFAYETTE, LA.—The City Council has authorized plans and specifications prepared for rebuilding the municipal electric light plant. It is proposed to change the system from direct-current to alternating-current. Bids are being asked for machinery and equipment for the plant. The cost of the work is estimated at about $40,000.

ROSELAND, LA.—The installation of a municipal electric light plant is reported to be under consideration.

BIDDEFORD, MAINE.—It is reported that negotiations have been closed between the York Light & Heat Company, of Biddeford, Maine, and the Biddeford & Saco Street Railway Company, whereby the former will supply electricity to the street railway company. The York Light & Heat Company will furnish the service as soon as the necessary equipment can be installed. The power plant of the Biddeford & Saco Street Railway Company will be kept intact for use in emergencies.

HARTLAND, MAINE.—The Hartland & St. Albans Electric Company, of Hartland, Maine, is reported to have decided to advertise for bids for the construction of an overhead distributing system in the towns where the company proposes to furnish electrical service. At the annual meeting held recently the following officers were elected: A. W. Miller, president; R. C. Hamilton, secretary and treasurer.

LUBEC, MAINE.—It is reported that arrangements are being made to open up the electric-light plant in Lubec. The town has been without electrical service since the old plant was closed down several years ago.

BALTIMORE, MD.—Proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until June 16 for furnishing two new engines and generators for the United States post office and court house at Baltimore, Md., plans and specifications for which may be obtained at the above office. James Knox Taylor is Supervising Architect.

LONACONING, MD.—The Georges Creek Coal Company is reported to be contemplating the installation of an electrical car-haulage system. It is also proposed to extend its tracks and erect a coal tipple.

BROCKTON, MASS.—The special committee of the City Council appointed to investigate the matter of installing a municipal electric-light plant will ask the Council for an appropriation to pay expenses of investigation and if granted will visit several cities where municipal plants are operated.

CLINTON, MASS.—Work is progressing rapidly on the installation of the new power plant at the Wachusett dam. Preparations are being made by the Connecticut River Transmission Company for the erection of the feed line which is to transmit energy from the plant at the dam to the Lancaster Mills and to Berlin and Marlboro.

EASTHAMPTON, MASS.—The Easthampton Gas Company has applied to the State Board of Gas and Electric Light Commissioners for permission to issue $125,000 in additional capital stock, the proceeds to be used to take up $19,000 in outstanding notes and the balance for improvements to its plant.

FALL RIVER, MASS.—The stockholders of the Fall River Electric Light Company have voted to increase the capital stock of the company from $800,000 to $1,000,000, the proceeds to be used to reduce the existing indebtedness and to meet the cost of extensions to the plant already contracted for. Application will be made to the State Board of Gas and Electric Light Commissioners for permission to issue additional stock.

ROCKLAND, MASS.—The Electric Light & Power Company of Abington and Rockland has applied to the Selectmen of Pembroke for permission to extend its service from Rockland to West's Mill in North Pembroke.

ROWLEY, MASS.—At a town meeting held recently it was voted to extend the street lighting system in several directons. It was also decided to light the town hall by electricity, the cost not to exceed $350.

SPRINGFIELD, MASS.—Mayor Lathrop has appointed a committee, consisting of Aldermen Frank E. Stacy and Ralph W. Wight, Councilmen Everett E. Belding, J. R. Albee and Joseph P. Cannon, to investigate the question of municipal ownership of lighting plants.

WEST NEWBURY, MASS.—The question of installing a municipal electric-light plant in West Newbury is under consideration. If a municipal plant is built, electricity will be secured from Newburyport to operate the system.

WORCESTER, MASS.—The committee on street lighting has voted to authorize Superintendent Henry A. Knight to make arrangements for the installation of twenty-four ornamental street lamps for experimental purposes in the vicinity of the City Hall. Various styles will be erected temporarily.

DIMONDALE, MICH.—Preparations are being made by the Dimondale Mutual Telephone Company for the installation of a new telephone system and exchange in Dimondale. It is proposed to extend the system to all parts of the county.

MARENGO, MICH.—The Commonwealth Power Company, of Jackson, Mich., is reported to have offered W. W. Cleveland, of Marengo, $12,000 for his mill and water rights on the Kalamazoo River. It is said that the company proposes to build a large dam across the Kalamazoo River, similar to those at Ceresco, Plainwell and Allegan.

MUSKEGON, MICH.—The Muskegon Traction & Lighting Company has submitted bids to the City Council offering to furnish street arc lamps at the rate of $55 each per year. Under the contract which has expired the city paid $76 per arc lamp per year. If given a new contract for street lighting the company agrees to reduce the price of electricity for residential lighting from 12½ cents per kw-hour to 10 cents per kw-hour. The reduction was made voluntarily by the company.

BROWNS VALLEY, MINN.—Bids will be received by the village of Browns Valley until June 21 for the installation of a municipal light plant. It is proposed to install a gas-producer power development. Plans and specifications are on file at the Builders' Exchanges in Minneapolis and St. Paul, Minn. L. P. Bigelow is village clerk.

NORTH BRANCH, MINN.—The Village Council has granted the Eastern Minnesota Power Company, of Pine City, a franchise to operate an electric-light system in North Branch, Minn.

NORTH MANKATO, MINN.—Bids will be received by D. Donohue, city clerk, until June 24 for furnishing and installing pumping equipment for the village water-works system. Bids will be received on centrifugal pumps with electrical power, centrifugal pumps with gasoline power and also triplex pumps and gasoline power. Specifications may be seen at the Builders' Exchange, St. Paul, Minn.; at the office of John Wilson, 208 Board of Trade Building, Duluth, Minn., or at the office of the village clerk, North Mankato, Minn.

ST. CLOUD, MINN.—The Granite City Railway Company, it is reported, is contemplating extending its railway to the Sauk River.

KANSAS CITY, MO.—The Public Utilities Commission has recommended that the ornamental electric lamps in the downtown business section be discontinued, unless the merchants and property owners on the streets lighted by the system agree to share the cost of maintaining the same.

HOLDREGE, NEB.—The City Council has passed an ordinance authorizing the Nebraska Telephone Company to place its wires underground in certain sections of the city.

NEW MARKET, N. H.—The New Market Electric Light, Power & Heat Company, which has been in the hands of a receiver for the past five years, has been reorganized and the receivership terminated. The control of the company has been taken over by the New Market Electric Company, of which Edwin G. Eastman is president and William H. C. Follansby treasurer.

STONE HARBOR, N. J.—The Stone Harbor Electric Light & Power Company, recently incorporated, it is reported, is installing an electric plant to supply electricity for lamps and motors to the cottages in Stone Harbor.

COHOES, N. Y.—Work has commenced on the construction of the new electric power plant of the Harmony Mills, of Cohoes, N. Y. The plant will have an output of 2000 hp and will be used as an auxiliary plant for operating and lighting the mills.

INDUSTRY, N. Y.—Sealed proposals will be received by John F. White, acting president of the Board of Managers of the New York State Agricultural and Industrial School, Industry, N. Y., until June 20 for inside wiring and fixtures in connection with electric power wiring and cables at the New York Agricultural and Industrial School. Drawings and specifications may be seen and blank forms of proposal obtained at the New York Agricultural and Industrial School, Industry, N. Y., and at the office of Franklin B. Ware, State architect, Albany, N. Y. Complete set of plans will be furnished on application to the State architect.

ONEONTA, N. Y.—Sealed proposals will be received by Dr. Andrew S. Draper, Commissioner of Education, State Normal College, Albany, N. Y., until June 19 for direct-connected engines and generators and switchboard; also for feeder cables and interior electric-light wiring for the State Normal School at Oneonta, N. Y. Plans and specifications may be seen and blank proposal forms obtained at the State Normal School, Oneonta, and at the office of Franklin B. Ware, State architect, Albany, N. Y. Copies of drawings and specifications may be obtained on application to the architect.

SMITHTOWN, N. Y.—The Town Board has granted the Long Island Lighting Company a franchise to construct and operate an electric-light system in Smithtown for a term of thirty years. Work will begin immediately on the erection of transmission lines to Smithtown. Electricity for operating the system will be supplied from plants already in operation.

TROY, N. Y.—Extensive improvements will be made by the New York Telephone Company to its system in Troy, which will involve an expenditure of about $140,000. The work includes the installation of underground conduits and practically rebuilding the system.

DURHAM, N. C.—The Durham Traction Company is reported to be contemplating extending its railway beyond West Durham, a distance of three miles, in connection with the development of the section and plans for a country club.

HENDERSON, N. C.—It is reported that H. H. Thomas, promoter of the new local electric railway company, is contemplating the use of the Edison storage battery cars.

RALEIGH, N. C.—The North State Hydro-Electric Company is reported to have purchased a tract of about eleven acres near Raleigh upon which, it is said, a manufacturing plant will be erected.

RUTHERFORD, N. C.—The capital stock of the Rutherford Telephone Company has been increased from $1,000 to $10,000. John C. Mills is president of the company.

LISBON, N. D.—The Commercial Club is considering the question of establishing an electric-light plant at Lisbon, N. D.

NEW SALEM, N. D.—The Council has granted the Dakota Coal Products Company a twenty-year franchise to supply electricity for lamps and motors in New Salem. It is understood that the company has purchased electrical and mining machinery.

CLEVELAND, OHIO.—Ordinances authorizing an expenditure of $10,500 for additional equipment for the two municipal electric plants were introduced by the City Council at a recent meeting. The apparatus to be purchased includes copper wire, to cost $3,000; electric meters, at $3,000; $1,500 for poles, and transformers at a cost of $3,000. The equipment will be paid for out of earnings of the plants.

COLUMBUS, OHIO.—Announcement has been made by J. J. Henry, of Denver, that the Central Ohio Power Company will be incorporated in a short time. The company, it is said, will be financed by the British Electric Traction Company, of England. The company proposes to build a large power plant at Beaumont, in the Hocking Valley coal field, where a site of twenty acres has been secured and 3000 acres of coal land purchased. Part of this land has been developed and it is proposed to use slack coal, which will be produced on the property, for fuel for the plant. Plans have been prepared for the construction of the plant by C. W. Humphreys, engineer, of Chicago, Ill., and bids for construction received. The initial installation will consist of three 3000-kw steam turbines to generate electricity at 6600 volts for distribution to mines and local manufacturing plants. For long-distance lines energy will be transmitted at 66,000 volts. It is said that contracts have been placed for the initial capacity of the plant. The British Electric Traction Company, it is reported, has agreed to take the bonds of the Hocking-Sunday Creek Traction Company that will enable it to build an electric railway from Nelsonville to Lancaster. It is expected that the new company will supply electricity for operating the railway. The cost of the initial installation is estimated at $3,500,000. Later it is expected to enlarge the plant.

DAYTON, OHIO.—The committee on law of the City Council has submitted a report to the effect that the Dayton Lighting Company has no right under its franchise to make a minimum charge of 90 cents per month, whether the customers uses energy or not. It recommends that the Director of Public Service order the company to make a change in its policy and charge only for the amount of electricity consumed, in accordance with its franchise.

ELMORE, OHIO.—At an election held June 5 the citizens voted to issue bonds to the amount of $5,000 to install an electric-light system. It is proposed to erect a distributing system and purchase current to operate the plant, bids for which have been asked. Either the Lake Shore Electric Railway Company, of Cleveland, Ohio, or the Toledo, Port Clinton & Lakeside Railway Company, of Toledo, Ohio, will probably supply the service.

GENEVA, OHIO.—The plant and holdings of the Madison Telephone Company have been purchased by the People's Telephone Company for a consideration of about $30,000.

NAPOLEON, OHIO.—The plant and holdings of the Napoleon Home Telephone Company, including subsidiary plants, will be sold at receiver's sale on June 30. The value of the property is estimated at about $38,500.

TOLEDO, OHIO.—Service Director Cowell has been authorized to prepare and submit plans to the City Council for a power station for the new high-pressure water system for fire service.

TOLEDO, OHIO.—City Solicitor Schrieber has recommended that the City Council repeal all electric-lighting grants, inasmuch as the Toledo Railways & Light Company has absolutely refused to accept one made to it recently, when the price was fixed at 8 cents per kw-hour with a discount of one cent if bills are paid within ten days.

VINITA, OKLA.—It is reported that the committee appointed to investigate the relative cost of purchasing electrical energy for the State Insane Asylum or installing an electric plant to furnish electrical service has decided that it would be cheaper to install a plant.

PORTLAND, ORE.—It is reported that arrangements are being made by the Mount Hood Railway & Power Company to extend its transmission line to South Mount Tabor to supply electricity for lamps in that locality.

BLOOMSBURG, PA.—Papers have been filed with the Secretary of State recording the merger of twenty-two electric and gas companies in Columbia, Montour and adjoining counties, under the name of the Columbia Gas & Electric Company. The company is to be capitalized at $525,000 and the officers are: Edward R. Sponsler, of Harrisburg, president; M. I. Low, of Bloomsburg, Pa., vice-president; Albert W. Duy, of Bloomsburg, secretary, and M. Milleisen, of Bloomsburg, treasurer.

CLARION, PA.—The Clarion River Power Company, if granted a charter, is planning extensive water-power developments on the Clarion River, which will involve an expenditure of about $10,000,000. The present plans call for the construction of a dam near the mouth of Tionesta Creek, which will form a reservoir extending back to within a few miles of Sheffield, and will back up Coon Creek to a point near Valley Run. From that point a tunnel 15,000 ft. in length will be bored to the headwaters of Toms run, which empties into Clarion River. The upper 40 ft. of the Tionesta River will be taken to the Clarion through the proposed tunnel. Dams will be erected at the mouth of the Clarion River, near Clarion. H. L. Benedum and J. C. Trees, of Pittsburgh, Pa., are interested in the project.

LOCK HAVEN, PA.—The Schofield Engineering Company, of Philadelphia, Pa., has been engaged to take charge of the construction of the Scootac power plant, which is being promoted by Luther M. Patterson, of Lock Haven.

NANTY GLO, PA.—T. Stanton Davis and Walter Jones are reported to have secured the controlling interest in the Jackson Light Company, which operates in Nanty Glo. T. P. Burns is president of the Jackson Light Company and Walter Jones is secretary.

PHILADELPHIA, PA.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until July 15 for installing a conduit and wiring system, lighting fixtures, etc., in the United States appraisers' stores at Philadelphia, Pa. Plans and specifications may be obtained at the above office or at the office of the custodian at Philadelphia, Pa. James Knox Taylor is Supervising Architect.

GREENVILLE, S. C.—The Kattim Manufacturing Company, recently incorporated with a capital stock of $50,000, proposes to do a general cotton-manufacturing business and acquire and develop water-powers to generate electricity. William G. Goldsmith, F. Hammond, H. Briggs, J. A. and B. E. Greer are interested in the company.

GREENWOOD, S. C.—The Southern Power Company has applied to the City Council for a franchise to erect transmission lines in Greenwood to supply electricity to manufacturing plants where 100 hp or more will be required. Surveys are now being made by the company for the extension of its line from Newberry to Greenwood.

CUSTER, S. D.—The installation of an electric-light plant in Custer is reported to be under consideration.

FAIRVIEW, S. D.—The Fairview Milling Company is reported to be interested in a project to build a 16-ft. dam and develop 500 hp.

PLANKINGTON, S. D.—A proposition to install an electric-lighting system in Plankington has been submitted to the Council by W. A. Kuntz, of Woolsey, S. D. He asks for a twenty-five-year franchise, and if this be granted he agrees to have the plant ready for operation by Nov. 1. If sufficient patronage is guaranteed Mr. Kuntz will establish a day service for power purposes.

CHATTANOOGA, TENN.—It is reported that the officials of the Durham Coal Company and the Chattanooga Estates Company are contemplating the construction of an electric railway to extend from Chattanooga through the lands of the estates company to the foot of Walden Ridge, where it will either connect with an incline or take an easy grade for a line up the ridge. Electricity for operating the railway will be secured from Hale's Bar lock and dam plant.

GALLATIN, TENN.—It is reported that the City Council is contemplating changing the location of the municipal electric light plant and moving it to another part of the town.

FT. WORTH, TEX.—The committee appointed by the directors to take charge of the installation of an electric-light and heating plant for the Masonic Home is reported to have awarded the contract for same, to cost complete about $30,000.

GALVESTON, TEX.—Plans have been completed by Dr. F. S. Pearson for an irrigation system for the reclamation of 1,000,000 acres of arid lands in Southwestern Texas. The plans include the construction of a dam, 160 ft. high and 1360 ft. long, in Medina River, 34 miles south of San Antonio. The company proposes to irrigate large tracts of land in Bexar, Medina and adjoining counties. Other irrigation schemes are also under consideration by the company. The pumping plant will be operated by electricity. The cost of the entire project is estimated at about $6,000,000.

TERRELL, TEX.—The contract for the construction of power-house for the municipal water and light plants has been awarded to Sherwood & Casgrain, of Terrell. H. Galbraith is chairman of Water Commission.

OGDEN, UTAH.—The Davis & Weber Counties Canal Company has commenced condemnation proceedings against Joshua Goodale in the district court for a tract of land desired as a power site. The company proposes to build an electric power plant near Riverdale, 1½ miles east of its canal terminus, and has been unable to secure the land desired for its power house. The proposed plant will have an output of about 5000 hp.

SALT LAKE CITY, UTAH.—The plant and holdings of the Utah Independent Telephone Company have been purchased by the Rocky Mountain Bell Telephone Company. It is understood that the consideration was $1,200,000.

CLIFTON FORGE, VA.—The capital stock of the Jackson River Company has been increased from $5,000 to $250,000.

GREAT GATE, VA.—Preparations are being made by Walter Graham, manager of the New River Terraces Land Company, which is planning the development of an industrial city to be called Gate City, to organize a company under the name of the Gap Falls Power & Electric Company to develop the water power of the New River falls to generate electricity for transmission to Gate City to operate limestone quarrying plant, kilns and iron-mining plant. Post Office address, Narrows, Va.

RICHMOND, VA.—The contract for erecting poles for the municipal lighting system in Washington Ward has been awarded to W. H. Jenks, to cost about $1,200. The plans call for the installation of 142 lamps. The annual appropriation ordinance for this year provides $9,000 for extending the Broad Street ornamental lighting system westward to Pine Street. It is also proposed to erect ornamental lamps on Jefferson Avenue.

RICHMOND, VA.—The City Council has authorized E. W. Trafford, engineer, to proceed with the installation of electric incandescent lamps to replace gas lamps in streets and alleys in the city. The sub-committee has recommended that the contract for equipment, including a new generator, 200 lamps and cut-outs and other equipment, be awarded to the Gordon Supply Company, at $14,040. The contract for ornamental hangers for the center lamps on Broad Street, to carry two arc lamps each, has been awarded to the Boyd Iron Works. These lamps will replace the center lamps now in use in the business section of Broad Street.

LEAVENWORTH, WASH.—Application has been made to the Commissioners of Chehalis County for a franchise to operate an electric railway across and on the streets of Leavenworth.

ORIENT, WASH.—Walter Bryant is reported to be contemplating the development of Boulder Falls, 3 miles below Orient. An electric plant will be installed to supply electricity for lighting the town.

WENATCHEE, WASH.—The Great Northern Railway Company is reported to have applied for franchises to construct and operate electric railways to Pateros, Leavenworth and other cities in the Wenatchee Valley.

SUTTON, W. VA.—The contract for the construction of the electric plant which is to supply electrical service to the towns of Sutton and Gassaway, W. Va., is reported to have been awarded to George H. Smith & Company, of Baltimore, Md. The contract includes all buildings, boilers, engines, generators, transmission lines and wiring for public building. The cost of the work is estimated at about $35,000.

MILWAUKEE, WIS.—The finance committee of the City Council has recommended that $6,000 be appropriated immediately for preliminary engineering work on the proposed municipal electric plant.

MINOCQUA, WIS.—Sealed proposals will be received by the Town Board of Minocqua, Wis., until June 23 for installation of an electric-light system. The work will include the erection of an addition to the building for water-works system for power station, a 25 to 30-hp crude-oil or fuel-oil engine, one 20-kw, 220-volt direct-current generator with switchboard, a 3-kw balancer set complete with switchboard, instruments and accessories, pole line and wiring system, and one storage battery having a capacity for 100 lamps of 16 cp for a period of eight hours. Plans and specifications are on file at the office of W. H. Fisher, town chairman.

CARMANGAY, ALTA., CAN.—Plans are being considered by the town officials for the installation of an electric-light plant and water-works system to cost about $20,000. It is proposed to erect a pumping station on the bank of the river near the present electric plant.

VANCOUVER, B. C., CAN.—The local power plant of the Portland Railway Light & Power Company was destroyed by fire on June 4, causing a loss of about $65,000. Electricity is now being supplied in Vancouver from the Portland plant through an emergency cable.

HAMILTON, ONT., CAN.—E. I. Sifton, consulting engineer, of London, Ont., engaged by the City Council to prepare a report on the cost of the installation of a municipal electric-light and power plant in Hamilton, has submitted his report to the City Council. For a complete plant supplying electricity for street lighting, commercial and residential lighting and power requirements he estimates an expenditure of $502,878, as follows: Underground conduits, $95,375; estimated cost of service for same, $3,200; cables, drawings and splicing, $48,980; primary wood pole distribution, $29,994; substation and equipment, $54,450; line transformers, $14,500; meters, $15,750; high-tension interswitching station, $5,300; concrete distribution poles and lamps, $99,540; iron five-lamp ornamental tungsten standards, $30,000; iron one-lamp ornamental tungsten standards, $6,220; establishment expenses, $62,350; secondary wiring, residence lamps, $8,000, and secondary power service lines, $3,675. The street lighting system provides for 1789 arc lamps. The classification of capital costs are approximately as follows: Street lighting, $240,906; commercial lighting, $66,041; residential lighting, $67,732; power, $55,725, and prospective investment, $72,474. At present the city is paying $75,180 for street lighting and for operating pumping stations.

TORONTO, ONT., CAN.—The Electrical Department of the city of Toronto has announced rates for electricity for lamps and motors furnished by the municipal electric plant, energy for which is supplied by the Toronto hydroelectric system. The new schedule is as follows: Residence service—A monthly service charge of 4 cents per hundred square feet of floor area, plus 3 cents per kw-hour for all energy consumed, with a discount of 10 per cent for prompt payment, under a one-year agreement. Commercial lighting, alternating current, 115-230 volts—8 cents per kw-hour for the first thirty hours used per month and 3 cents per kw-hour for all used in excess per month, with a discount of 10 per cent for prompt payment under a one-year agreement, 15 per cent discount under a three-year agreement, and 20 per cent discount under a five-year agreement; minimum monthly bill $1 net for each kw-hour of maximum demand. Commercial power service, three-phase, 25 cycles, 550 volts—A service charge of $1.35 per month per hp of maximum demand for the first 10 hp; all excess at $1 per hp of maximum demand, plus 1½ cents per kw-hour for all energy consumed for the first fifty hours' monthly use of the maximum demand, 1 cent per kw-hour for the next succeeding fifty hours' use and ½ cent per kw-hour for all in excess, with the same discounts as above. The present rates charged by the Toronto Electric Light Company are as follows: Residence lighting, 8 cents per kw-hour (20 cents per kw-hour, subject to a discount of 60 per cent for prompt payment). Commercial lighting, net rate of 8 cents per kw-hour on five-year contract; 12 cents per kw-hour on one-year contract. Power rates—For alternating current, 8 cents per kw-hour, with a minimum charge of $1 per month, with discounts as follows: To consumers whose bills amount to $25 per month, 6 cents per kw-hour, and for bills of $50 per month the rate is 4 cents per kw-hour. Special rates are made to large consumers. It is understood that the Toronto Electric Light Company is considering a reduction in its rate to meet the prices made by the municipal electric system.

MELVILLE, SASK, CAN.—Contracts for equipment for the proposed municipal electric-light plant have been awarded as follows: To Kilmer, Pullen & Burnham, of Toronto, Ont., agents for the General Electric Company, of Sweden, for generators, switchboard exciters, pumps, motors and compressors, for $7,438; street lighting system to the Northern Electrical & Manufacturing Company, Ltd., of Winnipeg, Man., Can., for $832, and for poles and line materials at $2,947, and to William Bross & Sons for compression tanks, for $2,018.

SASKATOON, SASK., CAN.—At an election held May 25 the ratepayers voted in favor of the by-law appropriating $25,000 for extensions to the municipal electric-light plant.

New Industrial Companies.

THE AUTOMATIC ELECTRIC PIANO COMPANY, of Everett, Mass., has been incorporated with a capital stock of $25,000. A. E. Vinal is president of the company and W. M. Ferguson, of Everett, Mass., treasurer.

THE BLAKE ELECTRIC MANUFACTURING COMPANY, of Boston, Mass., has been chartered with a capital stock of $50,000 for the purpose of manufacturing electrical goods. H. A. Quinn, of Woburn, Mass., is president, and E. M. Heustis, of Charleston, Mass., is treasurer.

THE B. A. B. MODEL & MANUFACTURING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000 to do an electrical and mechanical engineering business, etc. The incorporators are Arthur J. Brown and Anthony J. Brown, both of 1544 Minford Place, New York, N. Y., and Thomas R. Atkinson, Fifth Avenue, corner of Forty-first Street, Brooklyn, N. Y.

THE CLEVELAND ELECTRIC & MACHINE MANUFACTURING COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $25,000 by A. F. Klein, A. H. Bender, Alonzo Manhard and S. J. Schwenger.

THE DULUTH BOILER WORKS, of Augusta, Maine, has filed articles of incorporation with the Secretary of State with a capital stock of $250,000. The company proposes to manufacture boilers, do a machinists' and metalworkers' business. R. S. Buzzell is president and L. J. Coleman, treasurer, both of Augusta, Maine.

THE ELECTRIC WELDER COMPANY, of Kokomo, Ind., has been organized to manufacture machines for the purpose of electric welding of all kinds of metals. The directors are Jesse Jackson, Fred M. Ruddell and Conrad Wolf.

THE GREENFIELD CONDUIT MANUFACTURING COMPANY, of Jersey City, N. J., has filed articles of incorporation with a capital stock of $200,000. The incorporators are E. T. Greenfield, W. T. Ruette and S. Cochrane, of Jersey City, N. J. The company proposes to manufacture conduits, pipes, etc.

THE ILLUMINATING PRODUCTS COMPANY, of Newark, N. J., has been chartered by M. B. Allen, of Honesdale, Pa.; G. M. Jost, of Brooklyn, N. Y.; J. J. Steinbart, of Newark, N. J., and T. M. Sewards, of New York, N. Y. The company is capitalized at $250,000 and proposes to manufacture illuminating articles and electric appliances.

THE MID-WESTERN CAR SUPPLY COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $25,000 by G. A. Chritton, J. G. Anderson and R. A. Raymond, all of Chicago, Ill. The company proposes to manufacture railway material and supplies.

THE PERPETUAL GERM-PROOF TELEPHONE MOUTHPIECE COMPANY, of San Francisco, Cal., has been granted a charter with a capital stock of $75,000. The incorporators are E. J. Leiter, F. Rittigstein, J. L. Janet, M. F. Rapp and W. M. English.

THE REQUA MOTOR COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $500,000 to manufacture motors, machinery, etc. The incorporators are W. B. Wait, Jr., H. Sammatt, of New York, N. Y., and J. A. McCort, of Brooklyn, N. Y.

THE SIEMUND WENZELL ELECTRIC WELDING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $125,000 for the purpose of doing a business of electric welding, etc. The incorporators are T Rumney, of Bayside, N. Y.; L. M. Smith, of Hoboken, N. J., and H. L. J. Siemund, of New York, N. Y.

THE SUPERIOR STORAGE BATTERY COMPANY, of Brooklyn, N. Y., has been granted a charter with a capital stock of $25,000 to manufacture and deal in storage batteries. The incorporators are R. Drambourg, H. Bonawitz and J. E. Reid, of Brooklyn, N. Y.

W. C. COVINGTON & COMPANY, of Gary, Ind., have been incorporated for the purpose of doing a general contracting business, including the construction of gas and electric plants, railroads, water systems, etc. The incorporators are William C. Covington, D. E. Baxter and O. L. Wildemuth.

New Incorporations.

BAKERSFIELD, CAL.—The Bakersfield & Kern Electric Railway Company has been chartered with a capital stock of $250,000 to build an electric railway in Bakersfield. The incorporators are C. R Eazer, S. B. Cushing, H. A. Blodgett, F. T. Whorff and C N. Beal.

ANDERSON, MO.—Articles of incorporation have been filed for the Anderson Water, Light, Heat & Power Company with a capital stock of $30,000 by B. S. Dunn, W. J. Chamblis and R. A. Bates.

TULSA, OKLA.—The Dodge Electric Company has been incorporated with a capital stock of $2,000 by C. A. Veale, J. W. Dodge and G. P. Dodge.

HERMISTON, ORE.—The Hermiston Farmers' Telephone Company has been incorporated with a capital stock of $10,000 by W. H. Skinner, president; Henry Sommers, P. P. Sullivan and Charles E. Percy.

STRAHL, R. F. D., PERSIA, TENN.—The Tennessee River Telephone Company has been chartered with a capital stock of $5,000 by C. M. Smith, R. D. Keller, J. R. Roark and J. R. Sanders. The company proposes to erect a telephone line from Strahl to Romeo and from Strahl to Rogersville.

ATHENS, TEX.—Articles of incorporation have been filed for the Athens Telephone Company with a capital stock of $25,000 by J. A. Jones, J. W. Murchison, E. A. Carroll and others.

BUDA, TEX.—The Buda Telephone Company has been organized with a capital stock of $5,000. It is understood that the new company will make extensive improvements to the local system which it has recently purchased. The directors are W. S. Birdwell, L. L. Carter, C. C. Huddleston, J. J. Blanton and J. W. Adair.

HONDO, TEX.—The Hondo Light, Power & Ice Company has been organized with a capital stock of $24,000 by J. H. Horn, Louis Schlentz and Jacob Fohn.

PORTLAND, TEX.—Articles of incorporation have been filed for the Portland Development Company with a capital stock of $60,000 by John G. Willacy, J. M. Eskridge and E. C. Wessnedor. The company proposes to install public utilities and other improvements in the town.

HEBER, UTAH—The Duchesne Telephone Company has been chartered with a capital stock of $20,000 to operate a telephone and telegraph system. The officers of the company are J. W. Buckley, president and manager; Virgil Fraughton, vice-president; George M. Gorjensen, secretary and treasurer.

NARROWS, VA.—The Narrows Electric Light & Power Company has been granted a charter with a capital stock of $5,000. The officers of the company are: H. W. Hale, president; George L. Bane, vice-president; H. C. Johnson, secretary, and B. T. Johnson, Jr., treasurer.

RICHMOND, VA.—The Federal Electrical Utilities Corporation has been granted a charter by the Virginia Corporation Commission with a capital stock of $6,000,000. The officers of the company are: M. Gregg Latimer, president; D. K. Keller, vice-president, and John B. Marsh, secretary, all of New York, N. Y. The headquarters of the company will be located in Richmond, Va.

RICHMOND, VA.—The Appalachian Power Company has been chartered, with an authorized capital stock of $25,000,000. The company will confine its operations to the counties of southwest Virginia, with rights to enter any city and furnish power. Among the towns which the company's lines will reach are Pocahontas, Graham, Bluefield, Princeton and Bramwell. The officers of the company are: H. M. Byllesby, of Chicago, Ill., president; M. A. Wells, of New York, N. Y., vice-president; Elmer Dover, of Chicago, Ill., secretary, and R. J. Graff, of Chicago, Ill., treasurer.

RICHMOND, VA.—Articles of incorporation have been filed for the Henrico & Chesterfield Railroad Company with a capital stock of $50,000 to build an electric railway from Ridge Church to Bon Air and across the Southampton bridge at the Country Club, a distance of 6 miles. The officers of the company are: Thomas S. Winston, president; W. O. Burton, vice-president, and William C. Schmidt, secretary and treasurer.

Personal.

MR. HUGO REISINGER, of New York, the well-known importer of arc-lamp electrodes, received the honorary degree of master of arts from Columbia University on June 7.

MR. F. B. BRIGGS has resigned his position as chief engineer of the electrical plant of the North Adams (Mass.) Gas Light Company, which he has held for the past eighteen years.

MR. WILLIAM UNDERWOOD, a graduate of the Forestry School, University of Minnesota, has been appointed by Page & Hill Company to take charge of its pole-preserving plant at Minnesota Transfer, Minn.

MR. RONALD CRAWFORD has resigned his position as general manager of the Stamford (Conn.) Gas & Electric Company, to devote his entire time to the management of the Oven Equipment Company, New Haven, Conn.

MR. CARL HERING presented, by invitation, a description of his new type of electric furnace at a meeting last week of the Philadelphia Foundrymen's Association. The meeting was held at the Manufacturers' Club, with a large attendance from out of town.

MR. C. A. REED, general superintendent of the Ohio Division of the Central Union Telephone Company, has been appointed general superintendent of the company's property in Ohio, Indiana, Illinois, Wisconsin and Michigan. He was the guest of honor at a testimonial banquet given by officials of the company at the Southern Hotel, Columbus.

DR. LOUIS BELL, consulting engineer of the Edison Electric Illuminating Company of Boston, was the speaker at the regular May meeting of the New England Section of the Illuminating Engineering Society, which was held at the Edison Building, Boston. Dr. Bell gave an informal talk on "Chromatic Aberration of the Eye in Relation to Vision."

MR. E. G. SCHMEISSER, from the electrical engineering course of the Massachusetts Institute of Technology and formerly assistant engineer in the department of electric traction of the Pennsylvania Railroad Company, has been elected second vice-president of the Wiener Machinery Company, of New York. The capital of the Wiener Machinery Company has been increased recently to $25,000 and branch offices have been opened in Pittsburgh and Boston.

MR. HARRY R. STOKES has resigned as motor-service engineer and acting general agent of the New York & Queens Electric Light & Power Company to become associated with the Packard Motor Car Company, of New York, where the greater part of his time will be devoted to development of increased production and efficiency methods. Prior to his connection with the New York & Queens Company Mr. Stokes was with the Edison Electric Illuminating Company of Brooklyn for a year as assistant motor-service engineer, for five years with the Stone & Webster Corporation in Minneapolis and Savannah as a special agent in the commercial departments, and was for two years in a similar position with the Georgia Railway & Electric Company.

Obituary.

MR. OTIS E. PUTNAM, for many years a prominent merchant and a director of the Worcester (Mass.) Electric Light Company from 1904 to 1910, died at his home on June 9. At one time he was a prominent director of the Worcester & Holden Street Railway Company.

MR. JAMES B. DOUGLAS, manager for the Dayton (Ohio) territory of the Bell Telephone Company, died on June 3 after a lingering illness of two years. He was born in Shiloh, Ohio, in 1875 and entered the employ of the Bell Telephone Company in 1895, having been manager for the company successively in Tiffin, Gallipolis, Circleville, Alliance and Dayton, Ohio. He is survived by his wife and one son.

MR. CHARLES A. BODWELL, a prominent figure in the Maine electrical field, died at Sanford, Maine, June 6 at the age of fifty-four. Mr. Bodwell was president of the Sanford Light & Power Company, Bridgton Water & Electric Company and Ossipee Valley Power Company. He became connected with the Sanford company in 1892, and two years later took charge of an electric railway three miles long between Sanford and Springvale, which developed into the Atlantic Shore Line System.

Trade Publications.

IGNITION APPARATUS AND ACCESSORIES.—A folder published by the Manhattan Electrical Supply Company, New York, describes the line of automobile specialties manufactured by it. The list includes horns, push buttons, spark coils, switches, lamps and attachments, connectors, spark plugs, batteries and meters.

ELECTRICALLY HEATED APPARATUS.—The Manhattan Electrical Supply Company, New York, has issued a booklet devoted to its line of "Mesco" heating devices, including toasters, stoves, chafing dishes, percolators, cookers, pads, soldering coppers, etc. The "Mesco" toaster has adjustable doors, enabling the bread to be placed near to or far from the heating element.

SCREW GLASS INSULATORS.—Catalog No. 50 of the Brookfield Glass Company, New York, dated May 1, includes, in addition to lines of standard telegraph and telephone glass insulators, several recent types for ordinary pole lines and a number of forms for heavy high-tension work. The advance in the use of glass insulators for the latter service is illustrated by the weights, one type weighing 12 lb.

BOILER TUBE CLEANERS.—In a 28-page publication, designated as Catalog No. 36, the Roto Company, Hartford, Conn., describes and illustrates tube cleaners of the rotary type driven by either air, steam or motor. The driving motor operates by the direct pressure of steam or air upon a balanced rotary piston which revolves in a special cylinder and carries the shaft to which the cutting tools are attached.

FIXTURES FOR STREET AND PARK LIGHTING.—The Morris Iron Company, Frederick, Md., has just issued Catalog No. 20, devoted to posts and poles for ornamental street-lighting projects. Ornamental standards, combination light and trolley poles, combination light and transmission poles, arc-lamp posts, bases and brackets are listed and described, and a number of tables on wrought-iron tubular poles given.

MULTIPHASE INDUCTION MOTORS.—The induction motors built by the Ft. Wayne Electric Works, Ft. Wayne, Ind., have two types of frame—riveted and skeleton. A description and general idea of the important features in the construction and design of these two types of frame, the different forms of rotors, and such accessories as rheostats, controllers, etc., are contained in Bulletin No. 1128, just issued.

BRILLIANT LAMPS.—The Brilliant Electric Company, Electric Building, Cleveland, is distributing a 12-page price-list of vest-pocket size, covering the principal types of Brilliant incandescent lamps, including the new drawn-wire "Mazda." A commendable feature of the booklet is its stiff cover, which is calculated to preserve the contents until the owner has thoroughly familiarized himself therewith, or until such time as a later edition may be issued.

INDUCTION-TYPE WATT-HOUR METER.—The Ft. Wayne Electric Works' type K3 polyphase watt-hour meter is described in Bulletin

No. 1129. Two single-phase motor elements act on separate cups, both of which are mounted on a single shaft so that the registration is due to the resultant torque of the two elements. The meter is said to be dust and tamper-proof and to be free from the effects of external and internal fields. It has a bronze shaft, removable pivot and diamond jewel, with spring-top bearing.

MOTOR-DRIVEN GRINDERS AND BUFFERS.—Bulletin No. 1127, issued by the Ft. Wayne Electric Works, Ft. Wayne, Ind., gives details, dimensions and general descriptions of Northern grinders and buffers for direct-current circuits. The machines embody the motor, speed contoller and grinder or buffer in a single unit. The controller is located in the pedestal and wired to the motor, so that when the machine is fastened to the floor the only wiring necessary is the connection between the starter and the mains.

CENTRAL-STATION HEATING.—The American District Steam Company, Lockport, N. Y., has issued a pamphlet dealing in a general way with central-station heating. Throughout the pamphlet are illustrations of residences, business blocks, public buildings, etc., in various parts of the country which are heated by live and exhaust steam from central-station systems installed by the company. Mechanical points of interest, views of work under construction, and information on the materials and devices used in the construction of the system are also incorporated in the 56-page pamphlet.

OPERATION OF ARC LAMPS.—The National Carbon Company, Cleveland, Ohio, has published a 76-page book entitled "Practical Operation of Arc Lamps," which it will send gratis to any one connected with the construction, operation or maintenance of arc lamps of any form. The book contains practical and helpful notes on almost every phase of arc-lamp construction and operation. A number of practical tables are incorporated, and by means of an index the various articles are readily found. The work was compiled by the company's illuminating engineers and embodies besides their experiences those of its salesmen.

FEED-WATER HEATER.—Leaflet No. 9, isued by the Harrison Safety Boiler Works Philadelphia, Pa., is devoted to a description of the Cochrane heater for two different water supplies. The combination heater has two separate water inlets, two sets of trays, a dividing wall or partition in the water space so that there are two sedimentation and filter chambers and two pump supply openings. The apparatus is designed for use where water from one source is required for one purpose and water from another source for another purpose, and besides requiring less area than two separate heaters dispenses with duplication of valves and piping.

CHARGING THE "ELECTRIC" AT HOME.—"Don't forget the 'little' charging set when you buy her that 'little electric' " is the title of an attractive, full-color poster just issued by the General Electric Company for display by central-station operators and dealers in electric automobile supplies. The "little" charging set refers to the company's "Runabout Type" mercury-arc rectifier battery-charging set, so popular with women and other owners of "electrics," who wish to do their charging at home and find that the "little" charging set overcomes all difficulties usually attending the operation. The lady, the electric runabout, and the "little" charging set make a happy combination, which tells an important story in a very pleasing way.

BUSINESS NOTES.

BOSTON SONS OF JOVE.—A "rejuvenation" of the Sons of Jove will take place on the evening of June 23 at Boston, Mass.

THE EASTERN ELECTRIC LAMP COMPANY, Boston, has transferred its executive offices to more commodious quarters in the Oliver Building, 141 Milk Street.

ELECTRICAL CLAMBAKE.—The ninth annual clambake of the New England Electrical Fraternity will be held at the Pomham Club at Providence, R. I., on Saturday, June 24.

ALL-NIGHT WORK IN POLE YARD.—To enable work to be carried on night and day at its Minnesota Transfer yard, the Page & Hill Company has installed an electric-lighting system, and put on a night shift.

THE EYNON-EVANS MANUFACTURING COMPANY, engineers, brass-founders and machinists, Fifteenth and Clearfield Streets, Philadelphia, has purchased the entire plant of the H. P. White Company, of the same city.

MR. F. G. HALDY, formerly superintendent of the door check and hoist departments of the Yale & Towne Manufacturing Company, Stamford, Conn., has accepted the position of superintendent of the Whitlock Coil Pipe Company, of Hartford, Conn.

CATALOGS WANTED.—Wright & Company, 105 Reade Street, New York City, who are purchasing agents for electrical supply houses, electric-light companies and independent telephone companies, would be pleased to receive catalogs and prices from manufacturers.

THE ELECTRIC CONTROLLER & MANUFACTURING COMPANY has moved its Chicago office from the Merchants' Loan & Trust Building to 1417 Monadnock Block, and has added to its sales force Mr. T. H. Pitber, formerly of the Western Electric Company.

THE FITZGERALD AND BENNIE LABORATORIES, Niagara Falls, were removed June 15 to new and more commodious quarters at Highland and Whirlpool Avenues. The new location affords greatly enlarged and improved facilities for the work of these laboratories.

SWITCHES AND FUSES.—The Detroit Fuse & Manufacturing Company, Detroit, Mich., is distributing Bulletin No. 21, on "Detroit" switches, and Bulletin No. 22, on "Arkless" fuses. These bulletins give complete information on these appliances, and should be found of great interest to fuse and switch buyers.

McCASLIN CONVEYOR FOR HANDLING RAW SUGAR.—The Mead-Morrison Manufacturing Company, Cambridge, Mass., has just closed a contract with the Canada Sugar Refining Company, of Montreal, Canada, for apparatus to handle raw sugar at their refinery. The capacity of the conveyor will be seventy tons per hour. The installation will be particularly interesting because of an ingenious device for preventing the accumulation of sugar in the buckets.

ELECTRIC STORAGE BATTERY COMPANY'S ATLANTA STOREROOM.—The Electric Storage Battery Company, of Philadelphia, has opened a new storeroom at Atlanta, Ga., owing to the development of the electric vehicle business in the South and the constantly increasing shipments of "Exide" batteries to that section. A supply of "Exide" material will now be kept in stock at Atlanta for the purpose of supplying promptly the requirements of agents and owners of "Electrics" in this territory. The storeroom is located at 113 Marietta Street.

4000 KW GENERATOR MADE IN SIXTY DAYS.—The Crocker-Wheeler Company is putting through a rush job on a 4000-kw generator for the Sanitary District of Chicago, this making the sixth generator of this installation which that company has furnished. The time ordinarily required to build such a generator is four to six months, but this machine has been put through the shop within sixty days. The frame measures 27 ft. outside diameter, and when laid out on the floor plate shop it had five great machine tools working on it at one time, boring, drilling, planing, etc.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 6, 1911.

994,125. RAILWAY SIGNAL; J. P. Coleman, New York, N. Y. App. filed May 2, 1910. Constructive details relating to motor-operated railway signals.

994,145. AUTOMATIC ELECTRIC-LIGHTING SYSTEM; John W. Frees and Louis Winter, Reading, Pa. App. filed May 2, 1910. Arrangements are made for charging a storage battery whenever the voltage is reduced below a predetermined value and disconnecting the charging circuit when the voltage reaches a predetermined value.

994,146. AUTOMATIC ELECTRIC-LIGHTING SYSTEM; John W. Frees and Louis Winter, Reading, Pa. App. filed May 2, 1910. A modification of patent 994,145.

994,159. MOTOR-CONTROLLER; Clark T. Henderson, Milwaukee, Wis. App. filed Oct. 17, 1908. Arrangements are made for employing a series-wound motor as a generator during braking by exciting the field coils from an external source.

994,170. AUTOMATIC CIRCUIT-CLOSER; L. A. Laplant, Plattsburg, N. Y. App. filed April 8, 1910. The switch is provided with a toggle mechanism operated electromagnetically.

994,188. ELECTRIC HEATING UNIT; E. J. Ovington, Los Angeles, Cal. App. filed Jan. 25, 1909. Details of an immersion heater intended for heating liquids in an open vessel.

994,205. ELECTRIC INCUBATOR; E. H. Schorer, Columbia, Mo. App. filed Sept. 13, 1909. Arrangements are made for regulating the heat electrically developed in the incubator.

994,[illegible]. UNIFORM-MOVEMENT DEVICE; A. S[illegible], Yonkers, N. Y. App. filed Oct. 2, 1907. A mechanical movement [illegible] device so arranged that the load upon an electromagnet is varied in proportion to the pull of the magnet.

994,217. ELECTRIC FURNACE; I. Thomson, New York, N. Y. App. filed Sept. 1, 1909. The furnace is of the carbon resistor type, the resistor being adapted to be immersed in the molten bath and formed of a plurality of interlocking members.

994,218. ELECTRIC SIGNAL APPARATUS; S. P. Thrasher, Hartford, Conn. App. filed Jun. 3, [illegible]. In an electrical signaling system provision is made for returning a signal in order that the sender may know that the signal which he sent has been received.

994,251. COMBINED FUSE-BOX AND SWITCH FOR ELECTRIC CIRCUITS; P. Druseidt, Remscheid, Germany. App. filed Sept. 7, 1910. The contact caps of a cartridge fuse are formed as switches, so that an existing fuse box can be converted into a combined safety fuse and switch by screwing on the contact caps.

994,261. ARC LAMP; M. Korting, Leutzsch, near Leipzig, Germany. App. filed Jan. 26, 1911. In order to prevent a deposit on the globes of an arc lamp, the gases produced by the arc are led past bodies maintained at a difference of electrical potential.

994,294. OZONE-GENERATOR; E. P. Willard, Los Angeles, Cal. App. filed Oct. 17, 1910. Relates to a process for the generation of ozone without deleterious gases, use being made of a terminal plate comprising a metallic base and a coating of porcelain substance deposited upon the base.

994,300. ELECTRICAL VIBRATOR; H. I. Blattle and P. Newman, Providence, R. I. App. filed Oct. 3, 1910. Means are provided for producing a secondary current in the skin, in addition to the vibratory motion upon the skin.

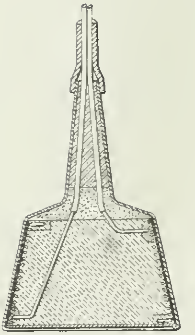
994,302. TELEPHONE SYSTEM; H. P. Clausen, Chicago, Ill. App. filed April 26, 1901. Relates to systems employing a common calling generator at the central station and a grounded bell at the subscriber's station, with provision for connecting the lines of this system with lines of other systems.

994,303. ARMATURE; S. A. Duvall, San Francisco, Cal. App. filed March 14, 1910. The armature is of the magneto type, arrangements being made to protect it against moisture.

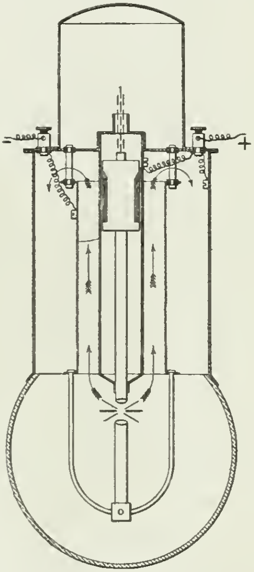
994,345. CURRENT-CONTROLLING APPARATUS; A. Sundh, Yonkers, N. Y. App. filed June 12, 1905. Details of an automatic motor starter, depending for its operation upon the counter voltage produced by the motor.

994,351. SAFETY DEVICE FOR IMMERSION HEATERS; C. S. Walton, Los Angeles, Cal. App. filed Feb. 25, 1911. Mechanical means are employed for opening the switch of a heater when removed from the vessel containing the liquid to be heated.

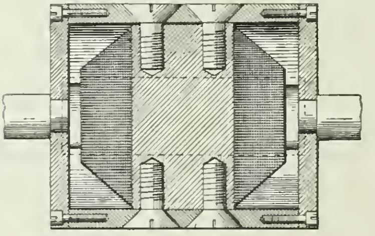
994,355. RESISTANCE UNIT AND METHOD OF MAKING THE SAME; C. Wirt, Philadelphia, Pa. App. filed June 27, 1906. The unit comprises a helical resistance coil, a cylindrical body of insulating material in which the coil and its ends are entirely embedded, and terminals secured to the ends of the coil and partially embedded in the ends of the surrounding body of insulating material.



994,188.—Electric Heating Unit.



994,261.—Arc Lamp.



994,303.—Armature.

994,361. METHOD OF PROPAGATING TELEPHONIC CURRENTS; C. G. Ashley, Chicago, Ill. App. filed July 24, 1909. A telephone relay of the electric generator type. The current in the inductor on the generator is subjected to a normally uniform field, the value of which is modified by the telephone current, so that the voltage produced in the generator varies with the current in the telephone circuit.

994,371. INDIVIDUAL SELECTIVE LOCK-OUT DEVICE FOR PARTY-LINE TELEPHONE SYSTEMS; W. M. Bruce, Jr., Springfield, Ohio. App. filed Sept. 1, 1904. The energy for operating the selective device is obtained wholly electrically, and is under the direct control of the central operator.

994,375. AUTOMATIC CIRCUIT-CLOSING DEVICE; W. A. Collins, Mount Vernon, N. Y. App. filed June 11, 1909. A thermally operated contacting device, the switch arm of which is held in the open position against gravity by fusible supports.

994,381. ALTERNATING-CURRENT MOTOR; V. A. Fynn, London, England. App. filed Nov. 19, 1909. Arrangements are made for allowing a current to be produced in a circuit surrounding a magnetic bridge separating two windings upon an induced member of the motor.

994,382. ALTERNATING-CURRENT MOTOR; V. A. Fynn, London, England. App. filed Nov. 29, 1909. The motor starts as an induction machine having series characteristics, and operates as a compensated induction machine having shunt characteristics.

994,405. ELECTRICAL ARRANGEMENT FOR PROTECTING SHIPS' BOTTOMS FROM BARNACLES OR AQUATIC LIFE AND SUCH LIKE; J. E. James, Bolton, England. App. filed May 3, 1910. High voltage is produced between numerous discharge points placed along the external surface of the ship.

994,413. REFILLABLE CARTRIDGE FUSE; E. B. Mallory, Wilkinsburg, Pa. App. filed April 3, 1911. The fuse is provided with screw caps at each end, which enable good electrical and mechanical contact to be obtained with the renewed fuse wire.

994,425. METHOD OF ANCHORING FILAMENTS; H. Remane, Berlin, Germany. App. filed June 27, 1906. At the side of the filament is placed a flexible looped holder with the loop parallel to the filament. After the filament is passed through the loop, the holder is twisted so that it will stand transversely to the filament and inclose it.

994,426. RECEIVER FOR WIRELESS TELEGRAPHY; R. H. Rendahl, Berlin, Germany. App. filed Nov. 1, 1906. Comprises an oscillating circuit containing a self-induction coil and an aperiodic circuit branched off from the coil, a detector responding to current intensities and a condenser included in the aperiodic circuit.

994,447. ELECTRIC RADIATORY STOVE; G. Egly, Treptow, near Berlin, Germany. App. filed Oct. 27, 1910. Arrangements are made to prevent the heating rod in the radiator from changing its shape owing to the heat, and to prevent air entering into the tube surrounding the heating rod, so that the latter cannot burn away too rapidly.

994,451. PROCESS OF MAKING SECONDARY BATTERY PLATES; J. E. Frederickson, Revere, Mass. App. filed Jan. 21, 1909. Oxide of lead is mixed with a solution of sodium carbonate into a paste, which is applied to the electrodes, which are then placed in the sodium carbonate solution, through which a current of electricity is passed until the electrodes are formed.

994,474. MEANS FOR INSULATING CANOPIES FOR SYSTEMS OF ELECTRICAL DISTRIBUTION; G. A. Lutz, Plainfield, N. J. App. filed Feb. 20, 1909. Blocks of insulating material are fitted upon the conduits for conductors, so that the canopies may bear upon them and be insulated thereby from the conduits and outlet boxes.

994,480. COMMUTATOR; F. W. Reeves, Pittsburgh, Pa. App. filed Dec. 4, 1909. The commutator is provided with a plurality of insulated segments, each having a plurality of transversely disposed alternate ribs and grooves in its face.

994,493. PUSH-BUTTON; F. E. Altemus, Philadelphia, Pa. App. filed Feb. 26, 1909. Details of a push-button arranged to prevent arcing when the contacts are separated.

994,500. SELECTIVE SYSTEM FOR PARTY-LINE TELEPHONES; W. M. Bruce, Jr., Springfield, Ohio. App. filed June 9, 1905. Electromagnetic devices are placed at each subscriber's branch, in order to open the circuit when other subscribers on the line are to be called.

994,510. ELECTRIC-CAR-LIGHTING SYSTEM; H. Groh, Zurich, Switzerland. App. filed April 29, 1907. Use is made of a continuous-current generator having two pairs of terminals, one of which is of lower voltage than the other. An extraneous source of constant voltage is connected in parallel with the low-tension terminals, in order to set the voltage of the generator which supplies energy to the storage battery connected in parallel with the high-tension terminals.

994,516. REVERSE ATTACHMENT PLUG; H. Hubbell, Bridgeport, Conn. App. filed Feb. 25, 1910. The attachment plug is so arranged that when the plug is removed there are no protruding members on the stationary part.

994,517. SEPARABLE ATTACHMENT PLUG; H. Hubbell, Bridgeport, Conn. App. filed April 23, 1910. At the forward end of a screw shell is placed an insulating head carrying a contact plate, connected to which is a contact spring having on its inner side a circular groove in which there are bosses.

994,518. PULL SOCKET; H. Hubbell, Bridgeport, Conn. App. filed July 21, 1910. Details relating to sockets of the chain-pull type.

994,542. ALARM LOCK; M. Sheinman, New York, N. Y. App. filed Sept. 29, 1908. Relates to a lock which will automatically sound an alarm when it is being tampered with.

994,566. FUSE; R. P. Bernardini; Providence, R. I. App. filed March 25, 1911. The fuse is of the cartridge type, provided with a removable binding plug having a bayonet joint.

994,588. PULL SOCKET; H. Hubbell, Bridgeport, Conn. App. filed July 21, 1910. The pull socket consists of an insulating block, a metallic cup socketed in the block, a spring in the cup, an insulating block resting on the spring and a center post seated in the insulating block.

994,605. ELECTRIC IRONING DEVICE; G. A. Ricks, Lafayette, Ind. App. filed Nov. 2, 1910. A flexible cord connected to the iron is surrounded by a helical spring fastened between the iron and the bracket, and mounted at the edge of the ironing table.

994,623. COMBINED MULTIPLE FUSE-BLOCK AND SWITCH; P. E. Westerdahl, Seattle, Wash. App. filed Dec. 1, 1910. Arrangements are made for a quick and easy renewing of fuses when any of them have burned out.

994,652. RAIL BOND; W. E. Noble and D. K. Dabaghian, Oakland, Cal. App. filed Aug. 24, 1910. The rail bond consists of a head of relatively hard material of high conductivity, and an attaching plug of relatively soft material of high conductivity, which is screwed into the head, the plug used for connecting the bond to the rail being renewable.

994,670. MEANS FOR CONTROLLING THE SUPPLY OF GAS TO GAS BURNERS AND FOR IGNITING THE SAME; A. Giorgi, Florence, Italy. An electromagnetic device for controlling the supply of gas to gas burners, and also for igniting them.

994,690. ELECTRIC INCANDESCENT LAMP; H. Remane, Berlin, Germany. App. filed June 27, 1906. The material for the filament consists of a book-shaped guide piece of refractory oxide flexibly connected with the carrier.

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INTERNATIONAL NOTATION IN ELECTRICAL ENGINEERING.

In the symbolic language of mathematics, or even of mathematical physics, it is undesirable to fetter the meaning of the symbols employed. It is far better to encourage freedom and originality of thought by allowing each writer to assign the meanings of the algebraic symbols he selects. In technology, however, when the mathematical concepts are stereotyped and the formulas are simplified into mental apparatus for dealing with specific structural and economic problems, there is an enormous advantage in retaining the same symbols for the same perpetually recurring quantities. In order that the ordinary notation of electrotechnical literature should be consistent and orderly in any one country, it is essential that it shall be standardized systematically in all the civilized countries of the world, because the tendency to follow the notation of foreign writers is constantly being experienced by writers in each land. Moreover, aside from the national viewpoint, it is of great international importance that all the fundamental electrotechnical literature should be couched in the same symbolic terms. Such unification in practice is not only more civilized and becoming to the inhabitants of one and the same planet, but also leads to clearer mutual understanding and appreciation of all the electrical engineers of the world.

It will be remembered that last year the conference of the International Electrotechnical Commission, at Brussels, unanimously recommended the international adoption of eight symbols in electrotechnics, representing respectively emf, quantity, inductance, magnetic force, magnetic flux-density, length, mass and time. No attempt was made to reach a decision upon symbols for the two important quantities, resistance and current, which enter into Ohm's law, because the usage of writers in different countries differed to some extent on these symbols. In Germany, W, the initial letter of *widerstand*, has been much used for resistance; while, in regard to current, writers in Great Britain have very generally used C, those in Germany J as well as I, and those in other countries I simply. The use of C for current in Great Britain has likewise prevented the use in that country of C for capacity, as generally employed in other countries of the world.

We learn that at a recent conference held in Europe, between delegates of the International Electrotechnical Commission from Belgium, France, Germany and Great Britain, a mutual understanding was reached that Great Britain would accept I for current and C for capacity, if Germany would accept R for resistance and I for current, to the exclusion of W and J. This paves the way for complete international agreement on the symbology of Ohm's law, as well as on the eight symbols already agreed upon at Brussels. This agreement, if ratified at Turin this year, will prove not only a great achievement for the International Electrotechnical Commission, but also a great international asset. Hitherto we have all had one and the same international ohm, volt and ampere, but now we shall hope to have international symbols for their embodiment in electrotechnical literature.

THE BOOM IN ELECTRIC VEHICLES.

The last year has seen a very notable increase in the number of electric vehicles in service and their more general distribution. In several cities vigorous efforts are being made to exploit this particular phase of electric service with, on the whole, rather promising results. Of late some of the runabouts have been making remarkable records for distance covered between charges, but at the present time the electric vehicle, whether truck or touring car, is particularly recognized as a vehicle of convenience, not ordinarily adapted to covering very long distances or running at very high speed, but immensely handy and workable within its limitations. This recommendation is enough to insure steadily increasing use even if no material improvements on the present equipment are made; but that which we here want to point out is tthat the essential thing for the successful operation of electric vehicles of every kind is the existence of frequent and convenient charging stations.

So far as pleasure vehicles are concerned one of the chief advantages of the electric type is that it can be operated by anybody and the services of a chauffeur are not required. This means that the majority of such cars will find their way into the hands of persons who are themselves operators, and it is the arrangements made for their convenience that will very largely determine the success of the present boom. Now, when one brings home a car at, let us say, 10:30 p. m., with the battery pretty well exhausted, he does not want to take it three-quarters of a mile to a garage where charging energy is available and ride home on the street cars. He either should be able to run the car into his own little garage and charge it there, or take it a block or two to a convenient charging point. The number and convenient location of public and private charging points will determine the fate of the electric pleasure vehicle. If a suitable automatic equipment can be installed in each private garage much will have been accomplished toward success. At present the high cost of most charging outfits stands in the way of their general use.

Even an electric vehicle requires occasional overhauling, and the class in the community most likely to buy electric vehicles is the very one least likely to wish to undertake the personal care of them; hence the necessity for more numerous and conveniently placed charging stations where minor overhauling can be quickly and readily done. To a less degree the same condition holds for business vehicles. If the electric central stations desire to promote a large use of energy for this class of transportation, they must be prepared, either directly or indirectly, to see to it that charging points are installed at numerous convenient points and that preparations are made to recharge systematically and take care of the vehicles in the vicinity. If charging stations could readily be found in every town where there is electric service, the use of electric pleasure cars on fairly long runs would become very much more common than it now is. In the absence of such conveniences long runs are out of the question and the whole proposition becomes essentially confined pretty strictly to city limits. It is not enough to boom the sale of electric vehicles and acquaint the public with their indubitable advantages. One must go further and make the use of such vehicles as easy in practice as it is in theory, and this requirement implies singularly good facilities for charging and care, frequent enough to relieve the owners of any considerable burden in the matter.

INDUCTANCE OF THREE-PHASE TRANSMISSION LINES.

When a circuit is composed of two parallel wires at a uniform distance apart, with terminal generator and motor apparatus as in the simplest form of direct-current circuit, the emf of self-induction, when the current in the circuit varies, is the rate of change of magnetic flux threading and linked with the circuit loop. In the case of a direct-current circuit in the steady state, this emf of self-induction disappears, and only makes its appearance when the current in the circuit is started or stopped. This was one of Faraday's brilliant experimental discoveries. In the case of a single-phase alternating-current circuit, the current is, of course, perpetually changing, and consequently the emf of self-induction due to change of flux linkage with the loop is always being cyclically developed. The emf of self-induction, as is well known, lags behind the current one-quarter cycle in phase, if magnetic hysteresis in iron is eliminated from consideration. The vector emf of self-induction may therefore be added in proper phase to the vector impressed emf in order to obtain the resultant emf in the single-phase circuit, which, in turn, sends current through the resistance of the circuit by Ohm's law. We may, however, ignore the emf of self-induction explicitly, as is a common practice among engineers, and introduce in its place a certain imaginary resistance called reactance into the circuit, compounded of the angular velocity and the inductance, in such a manner as virtually to alter the ohmic resistance into an impedance, and such that the impressed emf acting on this vector impedance produces the actual current strength calculated according to Ohm's law when two-dimensionally interpreted.

It is a known proposition in electric-circuit technology that the self-induction of a single-wire line, constituting the outgoing conductor of a circuit, is not altered by splitting up the return conductor into a plurality of parallel elements, provided that the said elements all lie at the same distance from the axis of the outgoing conductor as the original return conductor. Consequently, when we take three wires and suspend them at equal distances apart, or at the edges of an equilateral prism, the self-induction of one of them, taken as outgoing conductor, will be the same, whether the current returns on either or on both of the two other wires. Thus, in a three-phase line system, when the three wires are symmetrically separated equilaterally, the self-induction of all three wires is the same, although at different portions of the current cycle the current divides in varying shares between the two return conductors. This means that the emf of self-induction bears the same symmetrical relation to the impressed emf on each side of the three-phase system, both as to magnitude and relative phase. But when the three wires of a three-phase system are not symmetrically separated equilaterally the three-line self-inductors will differ, and the three emfs of self-induction, on the three sides of the system, will differ. This dissymmetry of induced emf constitutes in itself an unbalancing element in the system, so that the resulting system tends to become unbalanced in currents as well as emf, thereby introducing secondary dissymmetry and further complicating the relations.

In his interesting article on page 1607, Mr. Alfred Still discusses the frequently recurring practical case of a three-phase line comprising three equidistant wires in one place. This is the condition when the three wires are suspended from three insulators, which are equally spaced along one and the same cross-arm at each pole of an aerial line. In such a case the middle wire has clearly less self-induction, reactance and induced emf than the two outers. The article clearly shows that a certain relatively simple form of dissymmetry in emf is thus set up in the three induced emfs of the system. Moreover, when the three conductors are symmetrically transposed, so that each becomes the middle wire, at regular intervals along the line, the dissymmetry in inductance, reactance and induced emf disappears, and the line becomes once more balanced. For short lines, with moderate spacing, this is the simplest disposition to follow. When, however, two or more separate three-phase lines occupy different cross-arms on the same pole, then the transpositions must be effected so as not only to symmetrize the emfs induced within each three-phase system, considered alone, but also the emfs that are induced mutually between the separate systems.

A STUDY OF LIGHTNING.

The coming season, which brings worry to the mind of the central station operator, also brings opportunities for the investigator which ought not to be neglected. Considering the familiarity of lightning, its frequent occurrence, and its power for mischief, it is rather remarkable that so little is known of its real characteristics, and that so much of what is supposed to be known is not so. Only a few years ago there was a general impression that lightning flashes were oscillatory discharges of high frequency, and that protective measures to be effective must be planned accordingly. It is now well established that the magnitudes involved in lightning flashes are not such as correspond to high-frequency oscillations, although the steepness of the current wave may lead to secondary phenomena of vastly greater frequency than would be indicated by the character of the discharge as a whole. Some recent experiments by Dr. Walter, a German investigator, throw a new light upon the multiple flashes, which seem to be the nearest approach to the character of oscillatory discharge of which lightning is ordinarily capable.

Dr. Walter investigated the subject by means of two cameras, one fixed and the other shifting at a known rate. When a lighning flash was trapped by this device, both cameras, of course, gave the same form; but in the case of a multiple flash the moving camera registered a series of images from which the time constants of the discharge can be computed. The exact nature of these multiple flashes is somewhat mysterious, yet it is perfectly clear that they take place in virtue of the ionized lane of air established by the first discharge. At all events the phenomenon is a somewhat deliberate one. One of Dr. Walter's photographs showed five flashes with an average, somewhat irregular, interval of about one-tenth second. One occasionally sees similar phenomena, sometimes between clouds, showing a sheaf of discharges reminding one strongly of a photograph of a sheaf of electric sparks from an induction coil. When seen these generally give clearly the impression of being consecutive phenomena, taking place within perhaps a small fraction of a second, but being enormously deliberate compared with anything to which one could fairly call high frequency. Both such discharges and those more common ones presenting the characteristics of a single flash deserve more study than they have yet received. While a lightning flash has the general nature of a condenser discharge, the capacities concerned appear to be of terrific dimensions, and the electrical characteristics of the clouds which serve as the condenser plates are very slightly known. It would be a very interesting and important study to determine as well as may be the general magnitude of the capacities and resistances involved. Dr. Walter's method applied at two stations, from which not only the periods of the discharges, but their actual lengths, could be determined, would put in our hands a very large amount of valuable information. Further than this, observations on the induced discharges along lines bearing an ascertainable relation to the path of the flash and automatically recorded should give a far more definite idea of the magnitudes involved than would be yielded by any ordinary process of estimate or calculation. Such data might in addition give useful information about the strength of the air as a dielectric when great potentials are involved. Our present experimental region is so far removed from the magnitudes involved in lightning that extrapolation from laboratory results is extremely hazardous. From a practical standpoint, too, it is certainly most desirable to know the approximate magnitudes of the various quantities which must be dealt with in planning lightning protection.

What, for example, are the magnitudes involved in the ordinary lightning stroke as observed on overhead lines, which is usually not a direct lightning stroke at all, but a phenomenon of induction? What are the electrical characteristics of these discharges, and are they within the region in which preventive measures are possible? The subject has a direct commercial value, for one avertible bad shutdown may involve loss which would pay for a deal of experimenting to find the conditions of prevention. With all the infinite variety of societies and committees whose energies are directed toward investigating natural phenomena, we think there is room for more active efforts than have yet been displayed regarding the systematized study of lightning. There are some committees charged with looking into the matter, but nothing yet like a general co-ordination of the efforts of investigators, such as might yield results of the highest theoretical and practical importance. The world knows little yet about even the simplest form of the terrific phenomena of lightning and still less about the more strange and unusual forms of which the theoretical bearings are of extraordinary interest. How about globular lightning, for example, a rare but well-attested phenomenon, of which the movements appear to be as deliberate as those of the ordinary flash are instantaneous? And how about that first cousin of the lightning, the corposant, known since the times of the Romans, and other freaks of atmospheric electricity, indicating forces in action far beyond the usual, and in action, too, under conditions practically unknown? The whole subject is one fraught with interest for the scientific investigator, and of direct value to the electrical industries. It is time for united effort for the solution of the curious and intricate problems involved in the thunderstorm.

A. I. E. E. Convention in Chicago.

Preparations are now practically complete for the annual convention of the American Institute of Electrical Engineers to be held at the Hotel Sherman, Chicago, June 26-30. The complete technical program was given in these columns in the issue of June 1, and announcement may now be made of the final arrangements for the entertainment features. During the week there will be ten business sessions, as follows: Tuesday morning, power stations; Tuesday evening, electric lighting; Wednesday morning, railways; Wednesday afternoon, industrial power and telephone and telegraph (parallel sessions): Thursday morning, high-tension transmission; Thursday evening, conference of officers and section delegates; Friday morning, general and high-tension transmission (parallel sessions); Friday afternoon, educational.

On the evening of Monday, June 26, there will be a general reception at the Hotel Sherman, followed by dancing. Light refreshments will be served. On Tuesday afternoon there will be a circular tour by train, including the Hawthorne works of the Western Electric Company and the Fisk and Quarry Street stations of the Commonwealth Edison Company. A train will leave the Union Station in time to take the party to the Hawthorne Works for luncheon, afterward conveying the party to the generating stations, returning by train to the Union Station.

On Wednesday at 1 p. m. there will be a complimentary luncheon to the members of the American Institute of Electrical Engineers by the Electric Club of Chicago. This luncheon will be served in the Hotel Sherman, and there will be four or five five-minute addresses and a musical program. At 2 p. m. on Wednesday the ladies are invited to visit the Art Institute, where there will be a reception, gallery tour and tea. All visitors and ladies in the families of local members are invited to attend.

A third event on Wednesday will be the boat trip on Lake Michigan for both ladies and gentlemen. The fine steamer *United States* has been chartered and will leave its dock not far from the Hotel Sherman at 8:15 p. m. There will be music and dancing on board, as well as a special entertainment. If the weather is unfavorable the party will be entertained on the boat at the dock.

A luncheon for the visiting ladies at the South Shore Country Club has been arranged for Thursday. The party will leave the hotel in automobiles at 11 a. m., going through the South Side boulevards and parks to the South Shore Country Club, which is pleasantly located on the shore of Lake Michigan, south of Jackson Park. Luncheon will be served here and there will be a special entertainment for those in attendance. Returning, the automobiles will take the ladies to their respective hotels.

On Thursday afternoon members of the Institute are invited to go as guests of the General Electric Company to Gary, Ind., by special train. The great electrically operated rolling mills of the Indiana Steel Company here, driven by electric motors which are perhaps the largest to be found in the world, will be inspected.

Several golf clubs having links in or near Chicago have extended the privileges of their grounds to visitors during the convention. There is every indication that there will be an exceptionally large attendance at the Chicago convention, and with the carefully arranged programs of business sessions and entertainment it is expected that this year's convention will be one of the most profitable and enjoyable in the history of the Institute. Mr. H. M. Byllesby is chairman of the entertainment committee.

Chicago has been honored with only one previous convention of the Institute, and that as far back as 1892. The members in that city have made elaborate and careful preparation for this meeting, and they assure all their fellow members in other localities that they will have no occasion to regret attendance at this Western convention, for which the arrangements are unusually complete.

New York Electrical Exposition.

Arrangements have been completed for holding the New York Electrical Exposition of 1911, from Oct. 11 to 21, at the New Grand Central Palace, Lexington Avenue and Forty-sixth Street, as noted in our issue for March 23. The exposition has received the indorsement of the Edison Electric Illuminating Company of Brooklyn, the New York & Queens Electric Light & Power Company, the Northern Westchester Lighting Company, the Peekskill Lighting & Railroad Company, the Public Service Electric Company, the Richmond Light & Railroad Company, the Bronx Gas & Electric Company, the Electric Vehicle Association of America, the New York Edison Company, the United Electric Light & Power Company, the Yonkers Electric Light & Power Company and the Westchester Lighting Company.

The exposition building, which has recently been completed, is of such a size as to accommodate 200,000 people daily. The entire first floor will be devoted to a variety of exhibits similar to those given in the Madison Square Garden during the past four years. On the second floor articles will be shown in the process of actual manufacture, with electricity as a basis of operation. The third floor will be devoted almost exclusively to the electric automobile industry.

The president of the exposition is Mr. Arthur Williams, and the vice-president and general manager is Mr. George F. Parker, who now maintains headquarters at 124 West Forty-second Street, New York.

Long-Distance Wireless Telegraphy.

In a recent lecture on radiotelegraphy before the Royal Institution, London, Mr. Marconi gave an insight into the present state of the art of long-distance wireless telegraphy. Air condensers have been adopted at Clifden and Glace Bay and have effected economies in working and in energy losses. It was found to be neither economical nor efficient to attempt to obtain continuous waves. Much better results are obtained when groups of waves are emitted at regular intervals in such manner that their cumulative effect produces a clear musical note in the receiver, which is tuned not only to the periodicity of the electric waves transmitted, but also to their group frequency. Persistency of oscillations is obtained by employing an apparatus consisting of a metal disk having metal studs firmly fixed at regular intervals in its periphery and placed transversely to its plane. This disk is caused to rotate rapidly between two other disks by means of a motor or turbine and the side disks revolve in a plane at right angles to that of the middle disk. The studs are of such length as just to touch the side disks in passing. The frequency employed at Clifden is 45,000, and when a potential of 15,000 volts is used on the condenser, the spark-gap is practically short-circuited during the time in which one complete oscillation only is taking place, when the peripheral speed of the disk is about 600 ft. per second. The primary circuit, therefore, continues oscillating without material loss by resistance in the spark-gap.

An interesting feature of the Clifden plant is the regular employment of high-tension direct current for charging the condenser. Direct current at a potential capable of being raised to 20,000 volts is obtained by means of special direct-current generators. These machines charge a storage battery of 6000 cells, all connected in series. Each cell has a rating of 40 amp-hours. When the cells are used alone the working voltage varies from 11,000 volts to 12,000 volts, and when the generators and battery are employed together the potential might be raised to 15,000 volts by using the gassing voltage of the battery. The potential at which the condenser is charged reaches 18,000 volts, due to the presence of choke coils between the battery or generator and the condenser. Satisfactory insulation is obtained by dividing the battery into small sets of cells placed on separate stands suspended on insulators attached to girders fixed to the ceiling of the battery-room.

A curious result noticed in long-distance work is the effect produced by daylight on the propagation of electric waves over great distances. According to Professor Fleming, the effect should be more marked on long than on short waves, but Mr. Marconi has found the reverse to be true. In some transatlantic experiments in which waves about 8000 m long were used the energy received by day at the distant receiving station was usually greater than that obtained at night. Recent observations tend to show that the effects vary greatly with the direction in which transmission is taking place, the results obtained when transmitting in a northerly or southerly direction differing from those obtained when transmitting east or west. With wave-lengths of 7000 m and 5000 m the strength of the received wave remains steady, as a rule, during the day. Shortly after sunset at Clifden they become gradually weaker and about two hours later are weakest. They then begin to strengthen again and reach a very high maximum about the time of sunset at Glace Bay. They then gradually return to normal, but through the night remain very variable. Shortly before sunrise at Clifden they begin to strengthen and reach another high maximum shortly after sunrise at Clifden. The received energy then steadily decreases until it reaches a marked minimum a short time before sunrise at Glace Bay. After that the signals gradually come back to normal day strength.

Mr. Marconi is of the opinion that there is no foundation for the statement to the effect that the earth connection is detrimental to good tuning. A bad earth connection damps out the oscillations due to its resistance, and in that way makes tuning difficult, but no such effect is noticed when an efficient earth connection is employed. The earth wire may have a condenser or its equivalent in series with it.

Waterway and Water-Power Issue in Illinois.

Governor Deneen called a special session of the Illinois Legislature, which met on June 14. The object of the session is the consideration of legislation necessary to carry out the provisions of the constitutional amendment authorizing the issuing of $20,000,000 of State bonds to provide funds for the construction of a deep waterway along the Illinois River, between Lockport and Utica, Ill., and the development of water-power incident thereto. This is a subject which is very near to the Governor's heart. After a stormy session the State Senate passed the Johnson deep-waterway bill at an all-night session extending into the morning of June 16. The bill had not passed the lower house at this writing, however, that chamber having adjourned until June 21. The proposed deep waterway would be about 61 miles long, with a depth of 14 ft. The work of construction would be vested in five commissioners, and water-power leases are to be made by these commissioners only after the water-power plants shall have been completed substantially by the State. Then ninety days' public notice shall be given by public advertising for bids for such water-power. No water-power lease shall be made for a period exceeding ten years.

Ohio Telephone Situation.

Mr. Rollo R. Stevens, of Columbus, Ohio, has been appointed by the American Telephone & Telegraph Company as agent for the connecting companies in Ohio. For several years Mr. Stevens has been division sub-license agent of the Central Union Telephone Company and has been concerned in all the agreements made in that time for connecting the toll lines of the Central Union and American Telephone & Telegraph Companies with Independent exchanges. Since the administrative offices of the Bell and associated companies have been moved to Chicago Mr. Stevens will probably be the principal Bell representative in Ohio and as such will have charge of all consolidations of Bell and Independent exchanges and toll-line connections. He will also be the representative of the Bell companies before the Public Service Commission and will aid it in making preparations for the many consolidations that, it is believed, will be made within the near future.

It is said to be the policy of the Bell interests to secure and place before the commission all the data that can possibly be secured in cases of consolidation. Plenty of time will be taken for this work in order that the commission may have the fullest knowledge of every such transaction. While these data are being prepared the commission will have time to complete its organization for its new duties and will get down to a practical working basis. Nothing will be offered it for consideration by the telephone people until it is fully equipped for handling it. While it is said that some of the Independents are in a hurry to present propositions of this kind, they will not be entertained by the Bell interests until everything is in proper shape.

The annual meetings of the stockholders of the United States and Cuyahoga telephone companies will be held on July 10. The voting trust agreements expire on July 1 and, as most of the legal entanglements have been arranged, it is believed that the interests controlled by J. P. Morgan & Company will come into actual power and that plans for the future will be decided upon. No annual meetings have been held for two years, because of the suits pending against the new owners, but the public utilities bill recently enacted will make it possible to effect consolidations under proper conditions and no further trouble is anticipated.

Electrical Equipment of the Largest Vessel in the World.

The steamship *Olympic*, of the White Star Line, which sailed on her maiden trip from Southampton to New York on June 14, is the largest vessel in the world, having a gross tonnage of about 45,000. She is 882.75 ft. long, 92 ft. wide and 64.5 ft. deep. Her speed is 21 knots and she has three screws, two driven by two sets of triple-expansion, reciprocating engines and a center screw driven by a Parsons exhaust-steam turbine. The total horse-power is 46,000. The exhaust-steam turbine, which is placed in a separate engine-room abaft of the reciprocating engine-room and separated from it by a watertight bulkhead, receives steam at 9 lb. absolute and expands it down to 1 lb. absolute. The rotor, built up of steel forgings, weighs about 130 tons and has a diameter of 12 ft. The blades, ranging in length between 18 in. and 25.5 in., are built on the segmental principle, laced on wire through the blades and distance pieces at the roots and with binding soldered on the edge. The length between the extreme edges of the first and last rings of blades is 13 ft. 8 in. The speed is 165 r.p.m. when 16,000 hp is developed.

For generating electrical energy there are four 400-kw dynamos arranged at tank-top level in a separate watertight compartment aft of the turbine-room between the central and wing propeller shaft. Each is directly coupled to a 580-hp vertical, three-crank, compound engine running at 325 r.p.m. In addition there are two emergency 30-kw dynamos placed in a recess off the turbine-room at saloon-deck level well above the water line. The energy at 100 volts is distributed over a single-wire system and is controlled from a main switchboard in the electric engine-room. Electricity is employed not only for lighting and heating, but also for driving no fewer than seventy-five fans for ventilation, in addition to numerous electric cranes and winches for cargo purposes.

Electric Vehicle Club Meeting.

At the regular weekly meeting of the Boston Electric Vehicle Club on June 14 Mr. W. C. Wallace, Jr., of the Lansden Motor Car Company, presided. The usual luncheon was held in the Edison building, and at its close a free discussion took place upon present commercial developments in the Boston situation.

Attention was called to the increasing magnitude of the display of enlarged electric commercial and pleasure-vehicle photographs in the Boston Edison company's appliance exchange. About twenty views are now on exhibition, and arrangements are being made to provide for their special show-window display in rotation. A protracted discussion took place regarding the location of charging sets in the general Boston territory. It was pointed out that by installing a 40-amp tube on a 30-amp rectifier outfit Edison batteries can be successfully charged, and garages equipped with 30-amp outfits can thus render their service more inclusive. Mr. L. R. Wallis, Boston Edison company, stated that the company was most anxious to install charging equipment wherever anything like a reasonable use of its facilities could be anticipated. He briefly discussed the company's policy regarding the location of such stations, and said that it has been decided to remove all such apparatus from the substations, although in no case will facilities in a given town for electric-vehicle charging be diminished. On a system as large as that of the Boston company the interruption of substation operators' duties to charge vehicles is simply out of the question.

Mr. W. E. Eldredge, Boston, distributed blanks to the members providing for the tabulation of data of actual operating costs and fixed charges of vehicles of from 1000 lb. to 10,000 lb. capacity, running on one or two batteries in a daily service of from 25 miles to 40 miles. From the replies collected it is hoped to assemble average data which will be of great service in confuting the extravagant claims of gasoline-truck dealers regarding the operating and fixed costs of their service. Before the meeting closed it was announced that the Boston & Albany Railroad, the New York, New Haven & Hartford Railroad, the Boston & Maine Railroad and the Metropolitan Steamship Company have given consent to owners of electric trucks to drive their vehicles upon their wharves and terminal properties, gasoline vehicles being debarred on account of fire risk. Negotiations are in progress on behalf of the electric truck with several of the transatlantic steamship companies having docking facilities in Boston. Mr. Day Baker announced that a company has been organized in Boston by Mr. DeForest Smith, Tremont Building, to investigate the actual cost of vehicular transportation by the use of a speed-recording instrument which will deliver to the owner daily tape records of the exact performance of any vehicle in service.

Railway Electrical Engineers' Convention.

The third semi-annual convention of the Association of Railway Electrical Engineers was held on June 16 and 17 at the Union Terminal Station at Washington, D. C. Both the active and associate membership from all over the country were well represented, and a lively discussion on matters pertaining to standardization of electrical equipment on the railways was entered into. As all recommendations for standards are decided upon at the annual meeting held in Chicago each fall, no definite action was taken, but the various points were considered and discussed.

At the Friday morning session the sub-committee on lamps submitted a very comprehensive set of specifications for the purchase of lamps. Some objection was made to these by the representatives of the lamp manufacturers, but the general consensus of opinion was that the specifications as submitted were remarkably fair to all parties. The specifications proposed the inspection and testing of sample lamps by the purchaser's agent at the factory. Ten per cent of the lamps are to be examined, of which not more than 15 per cent shall fail to meet all requirements set forth in the contract. Of this 10 per cent, 2 per cent are to be used for a life test in the laboratory of the purchaser. The life of the lamp is the hours until the candle-power has fallen to 80 per cent of the initial value. The average candle-power shall be not less than 91 per cent of the initial candle-power. In event of failure of lamps to meet the required life test, the lot shall be returned to the manufacturer at his expense.

The Friday afternoon session opened with a discussion of the standards recommended by the committee on train lighting practice of the Master Car Builders' Association at the meeting of June, 1910. This report was reconsidered at the 1911 meeting of that association in Atlantic City, June 19-21.

Mr D. J. Cartwright, electrical engineer of the Lehigh Valley Railroad, was instructed to submit certain suggestions and criticisms of the report at the Atlantic City meeting, the principal change being that a 150-amp fuse should be placed at each pole of the battery. Mr. C. R. Gilman, chief electrician of the Chicago, Milwaukee & St. Paul Railway, outlined the report of the committee on illumination, which will be presented in full at the annual meeting of the association in November. Mr. F. R. Frost, electrical engineer, Atchison, Topeka & Santa Fé Railway, presented the report of the committee on accounts and reports, outlining a report which would give a comprehensive detailed statement of the costs of the electric lighting of cars by various methods. The question of how much depreciation to allow on storage batteries—a large item in the maintenance charge—was discussed at length. The figure of 20 per cent per annum was suggested, but no final decision was reached. For the accurate comparison of car lighting costs on different roads it is essential that a standard form be adopted.

Saturday morning was devoted to a tour of the United States navy and gun shop, especial attention being paid to the electrical equipment used. Seventy-five members were in attendance at this meeting, which was one of the most successful in the history of the organization.

The Automatic Telephone System at San Francisco.

At the joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers, May 24, Mr. S. G. McMeen, of the firm of McMeen & Miller, consulting telephone engineers, Chicago, presented a paper entitled "Notes on a Telephone System Recently Built in San Francisco and Its Neighborhood." Mr. McMeen has just returned from San Francisco, where under his direction there has been completed what is probably the most extensive automatic-telephone system in the world, serving a population of 600,000 in San Francisco and its suburbs, Oakland and Berkeley, across the bay. The switchboard features of this plant were described in a paper by Mr. Arthur Bessey Smith, read before the American Institute of Electrical Engineers' (Jefferson, N. H.) meeting, June 29, 1910, and abstracted in the *Electrical World* of July 7, 1910. Mr. McMeen's paper covered briefly the switchboard equipment features of the work, but related more particularly to matters of construction and to some of the difficulties encountered in installing a comprehensive telephone system following the almost complete destruction of a large business section by fire and seismic disturbances. The entire system comprises ten groups of automatic switching equipment, properly assembled under two exchanges. All underground construction in San Francisco is laid in bituminized-fiber and vitrified-clay conduit, using iron-pipe laterals and insulated drop wires. The conduits are laid four high, with the required width of ducts, regardless of the number. On account of the sandy character of the soil the conduits have been inclosed in concreted sheaths, which were found especially serviceable following washouts due to sewers and water pipes opening up. Under such conditions large holes were washed in the ground, but in every instance the conduit in its concreted sheath spanned the opening like a beam and suffered no damage. Over 2,500,000 duct-ft. of conduit are installed in San Francisco, leading into more than 1000 manholes, the latter being of the molded concrete type. In these manholes the cables are supported on grooved wooden blocks, carried by rods inserted in holes drilled in the concrete.

On account of the destruction of all underground records by fire the task of placing conduit in the streets of San Francisco was made especially difficult. Even where records existed, reference to them had to be given up and the streets themselves used for determining line locations by excavation and trial. In one instance, for example, after making a number of efforts to place conduit under one of the important street crossings, it was necessary to sink shafts 20 ft. deep at either curb and drive a tunnel between these. Even then, the constructors suffered their own troubles with the sewers and other underground lines.

The main trunk cables to Oakland and Berkeley from the city of San Francisco have a total length of 8 miles, 3 miles of which is submarine. On account of the use of comparatively large conductor in the land sections, however, where No. 13 B. & S. copper was employed, the transmission distance has been reduced to the equivalent of 6½ miles of standard cable construction, so that transmission of the best quality is maintained between the parts of the system. Mr. McMeen described a manual private branch exchange switchboard installed in some of the local business houses in which, to be consistent with the secrecy secured by the automatic system, the operator's listening key is arranged to be cut off while conversation is taking place.

During the discussion of the paper, Mr. Lee Campbell, engineer of the Automatic Electric Company, Chicago, referred to the difficulties met in an engineering way in arranging for the interconnection for the two-wire San Francisco automatic exchanges with the three-wire Oakland and Berkeley exchanges. Special provision had also to be made for securing the rapid two-number service across the bay. Mr. Franklin H. Reed referred to the advantages of the automatic apartment-house switchboard which obviates the presence of an attendant to receive incoming and outgoing calls at odd hours. Mr. Arthur Bessey Smith spoke of the flexibility and adaptation with which the automatic telephone meets all traffic conditions. Others taking part in the discussion were Messrs. D. C. Tanner, E. H. Smythe, Albert Scheible and J. G. Wray.

At the next meeting of the Chicago Electrical Section, to be held Sept. 28, Mr. Samuel G. Neiler, of the firm of Pierce, Richardson & Neiler, Chicago, will present a paper on "The Electrical Equipment of the New Northwestern Railway Station at Chicago."

Automatic Telephony.

The Chicago Electric Club June 7 listened to Mr. W. Lee Campbell, general superintendent of the Automatic Electric Company, on the subject "Automatic Telephony."

In introduction he spoke at some length on the long years of development and adversity and adverse criticisms which automatic telephony went through before it became a commercial success. The first patents on automatic telephone apparatus were taken out twenty-five years ago, which is a very long time for the present age, when other inventions like the trolley car, the tungsten lamp, etc., have come into commercial success so rapidly from the time of their first announcement.

In 1891 Mr. Joseph Harris, a traveling salesman looking for novelties to show at the World's Fair in Chicago, discovered the Strowger Automatic Telephone Exchange and secured the patents. A company by that name was organized which led a precarious existence for ten years and finally was enlarged into the Automatic Electric Company. Mr. Campbell recalled some of the earlier automatic exchanges, including those at LaPorte, Ind., and Michigan City, Ind. The real turning point in the history of automatic telephony seemed to come in 1903, when about 20,000 automatic telephones were installed in different exchanges. So doubtful were investors that the contract for the equipment of the Grand Rapids exchange provided for a seven-year guarantee, under which the Automatic Electric Company was to pay the cost of all labor and material needed for the alterations and repairs made necessary to render the system and service acceptable to 90 per cent of the subscribers. This contract, he said, had cost the company less than $1,000 for the supply of repair parts, etc. The first common-battery automatic telephone exchange was installed in 1905 at South Bend, Ind. At Pontiac, Ill., three and one-half years ago, the first two-wire system was installed. All previous systems had employed two wires running to the telephone and a third ground wire at each subscriber's instrument. The largest automatic telephone exchange at the present time is in Los Angeles, Cal., where there are 41,000 subscribers. The next largest is at San Francisco, Oakland and Berkeley, where there are 25,000 subscribers. The exchange now being installed in Chicago has 20,000 subscribers divided among eight offices. Patent rights in most of the foreign countries have been disposed of.

Automatic telephony, he said, has been a success because it is popular with subscribers and investors. Subscribers like the automatic calling features, while investors like the operating features. Among the operating advantages in a city like Chicago are the absence of operators and the shortening of subscribers' lines from subscribers' instruments to the nearest exchange, due to the trunking features. In answer to a question as to private branch exchanges Mr. Campbell explained that these could either be semi-automatic with a private branch exchange operator, or the automatic feature could be carried clear through to each telephone on a private branch exchange.

Lightning Phenomena.

In a paper recently presented before the Franklin Institute Dr. C. P. Steinmetz said that lightning is one of the most important uninvestigated phenomena of electricity. In the early days, he said, lightning was explained as a discharge from the clouds. The clouds being positively and the ground negatively charged, a spark jumps from the clouds to the ground.

Speculations were made as to how the clouds became charged, and as then the only method of producing electricity was by friction, it was said it might be the friction of the vapor through the air, or the rain-drops through the air, or some other form of friction. That explanation used to appear satisfactory, but Dr. Steinmetz said that with our present knowledge of dielectric phenomena, it is not now satisfactory.

It was thought that lightning was the discharge from the cloud to the ground. That means that the electric field between the cloud and the ground must be beyond the breakdown strength of air. In a uniform field the breakdown strength of air is about 75,000 volts per inch, or nearly 1,000,000 volts per foot. Even if the cloud is only 1000 ft. above ground, this would require 1,000,000,000 volts. If there were an electrostatic field between the cloud and the ground of 1,000,000,000 volts extending over the whole area of the thunder cloud, this would represent such an immense amount of electric energy that it is inconceivable how any reasonable source of energy can produce it; how it can exist without having a destructive effect far beyond anything known of lightning. Furthermore, a uniform field cannot well exist between clouds and ground on account of the unevenness of the ground surface.

Another conception is of, not a uniform electrostatic field, but an ununiform field, like that of the discharge between points. With long striking distances between points the average gradient is about 170,000 volts per foot. This would require only 170,000,000 volts between a cloud 1000 ft. high and the ground. This would be more reasonable It would not require such an unreasonably vast amount of stored electric energy. But we know that in such an ununiform field the spark is preceded by a brush discharge covering more than half the distance. Thus, lightning should be preceded by a brush reaching down from the cloud and up from the ground for several hundred feet. Now, such an enormous brush has never been observed, and is inconceivable; the brush discharges occasionally observed at points during storms are only a few inches long. Furthermore, a 300-ft. brush is inconceivable, because the resistance of the ground is not low enough to conduct the energy necessary to maintain such a brush discharge.

Furthermore, most of the lightning discharges are not between the cloud and the ground, but are internally in the clouds, frequently reaching the length of several miles. So one sees that the explanation of the lightning as a spark discharge similar to the discharge of the friction machine appeared plausible in the early days, but with our present knowledge it is not tenable any more.

The lightning discharge cannot be considered as a simple electric rupture, in the same way that an overloaded beam may break mechanically, but as an equalization of internal stresses, about as a piece of hot glass that is rapidly chilled, and thereby full of internal compression and tension strains, may suddenly break all over, by the internal stresses. So, with our present knowledge, we must consider as the most probable explanation —although not certain by any means—that the lightning discharge is the phenomenon of the equalization of internal electric stresses in the cloud, and is analogous to the splintering or breaking of an unevenly stressed brittle material like glass.

The question then is, how do those uneven electrostatic stresses originate in the cloud, and how do they reach such values as to cause internal equalization by rupture? If there has been produced a very highly unequal distribution of voltage in the electrostatic field of the cloud, it is easy to see how a discharge can pass along miles of cloud, without such unreasonably great potential differences as would be required for a direct discharge across space, just as from a scratch in a poorly annealed glass plate cracks may run all over the plate, splintering it in all directions. Assume that the potential distribution in the cloud becomes very uneven. If then at some point the potential gradient becomes higher than the disruptive strength of air, at this point a local disruptive discharge occurs, perhaps only a few inches in length. This discharge equalizes the potential gradient within its path, and thereby increases the gradient at the end of the discharge. If this gradient is already fairly high, it rises beyond the disruptive strength of air, and thereby the discharge extends farther along the discharge path, but by the voltage equalization resulting therefrom, still further increases the potential gradient ahead of the discharge, and in this manner the equalizing discharge extends farther and farther, possibly for miles, side discharges issue from it or run into it, until finally cloud regions are reached where the initial potential gradient is very low and the discharge gradually tapers down.

But where does the initial voltage come from, and how does it become uneven?

It is not so difficult at least to make a preliminary estimate of the building up to very high and uneven voltage distribution in the clouds as soon as you have assumed some initial voltage. We do not know where the initial voltage comes from, but we must accept the fact that there is normally a voltage gradient in the air, a potential difference between different altitudes which may amount to 100 volts or more per foot. In the air 100 ft. above the ground there may be a potential difference against ground amounting to thousands of volts. If you bring a wire up to there you do not carry a current down, you merely carry the ground potential up, but by a carefully insulated electrostatic voltmeter you can measure these potential differences. Possibly this potential gradient in the atmosphere may even be of cosmic origin, the earth having a high negative potential against our solar system, against the universe, which would mean that there must be a positive voltage gradient from the surface of the ground into space.

If condensation takes place in the higher regions of the atmosphere, rain-drops form, minute drops at first, which necessarily must be at the potential of the air in which they form. That means they have a potential difference against the ground, and therefore an electrostatic charge against the ground corresponding to this potential difference. Assuming now that many of these minute rain-drops conglomerate to larger drops, it means, that many small condensers conglomerate to one condenser, which is somewhat larger in capacity than each component, but very much smaller in capacity than the sum of the capacities of its components. But it contains all the electrostatic charges of the rain-drops, and at the much smaller capacity the same charge gives a higher potential difference. Suppose 1000 small rain-drops conglomerate into one large one. This has ten times the capacity but 1000 times the charge, hence 100 times the voltage. Conglomeration of minute drops into larger ones thus must give a great increase of potential difference against ground.

The clouds are by no means uniform in density, and where the density is greatest conglomeration of condensed drops takes place to a much greater extent, building up to a much higher voltage, and thereby between the parts of the cloud of different density, the light and the dark portions, potential differences must appear and increase with increasing condensation, until somewhere the disruptive gradient is passed, equalization occurs by a lightning discharge, and then the same play repeats again and again.

Lightning discharges then are the result of the voltage unequalities produced in the clouds by the unequal rate of conglomeration of rain particles due to the unequal cloud density.

In agreement with this is the fact that heavy lightning strokes are usually followed by a heavy downpour of rain; in reality they are preceded and caused by it, but it takes time for the rain-drops to come down.

Let us assume now that the process is reversed, and after conglomerating to high voltages the rain-drops evaporate again. Since gases apparently do not carry electrostatic charges the rapidly dwindling rain-drop retains its entire charge, hence must rise in potential, and finally must discharge, and this progressive evaporation of the rain-drops must also result in the building up of potential differences and therefore the formation of lightning, and this may explain the two forms of lightning, that accompanying rainstorms and thunderstorms, and the so-called "heat" lightning.

The former is the result of condensation and conglomeration, the latter the result of evaporation of rain-drops.

One sees then that in this field, which is not merely of theoretical interest, but of high industrial and general importance, our knowledge is still very limited; it is a fairly unexplored field of electrical engineering and electrical science. It is a branch of electrostatics, of the phenomena of the dielectric field. The phenomena of the dielectric field we cannot very well call unexplored, because there has been a great deal of investigation in the early days, and volumes have been written on it. Many of us may still remember the early days when the textbooks of electrical engineering started with the theory of the distribution of the electric charge, investigated the electric density on an ellipsoid and all that sort of thing. All this has now pretty well vanished from electrical engineering textbooks. With the development of electrical engineering, electrostatics became of less interest and were thus neglected. Only in recent years, when we have in transformers and transmission lines reached voltages higher than in almost any electrostatic machine, and those not of a negligible power, but of a very large power, the field of electrostatics has become a very important one and has to be studied again.

It is seen that in the study of electrostatics the conceptions of the work of former days are untenable, from our present point of view; we cannot conceive of the dielectric phenomena as a charge on the conductor surface, we know there is not an electric charge on the conductor, the dielectric energy resides not on the conductor surface, but is in the space around the conductor, in the dielectric field, and the so-called "charge" is nothing but the termination at the conductor surface of the electrostatic field in space. It is the electrostatic or dielectric field which we must consider as representing the phenomena of electrostatics, in the same way as Faraday has shown us with the magnetic field.

The old conception of the electrostatic charge on the conductor has been the cause of the far greater difficulty which we find in dealing with even simple phenomena of electrostatics, compared with the simplicity with which even apparently complex phenomena are treated by the conception of the lines of magnetic force.

One must then abandon the conception of the theory of electrostatics of the early days—which still largely is used in theoretical textbooks—as incorrect and useless. Capacity then is not the capability of the conductor to store electric quantity, but is the ratio of the number of lines of dielectric force to the emf which produces them, just as permanence is the ratio of the number of lines of magnetic force to the mmf which produces them, the "charging current" is no more a current charging the conductor with electricity than the "inductance voltage" is a voltage charging the conductor with magnetism; the former as "capacity current" supplies the energy stored in the dielectric field, just as the inductance voltage supplies the energy stored in the magnetic field, and dielectric and magnetic phenomena are very largely analogous and treated in the same manner and with the same simplicity.

This was not possible with the conception of electrostatic charges, and even simple problems, as the calculation of the capacity and the mutual capacity of parallel conductors, become so complicated that the most satisfactory method of their calculation was not to calculate the capacity at all, but calculate the corresponding inductance and derive the capacity by the relation, that capacity times inductance equals the square of the velocity of propagation, which in space is the velocity of light (3×10^{10}).

In conclusion Dr. Steinmetz said it will thus be seen that in this field, which is of the highest industrial importance now, where we have in transmission lines reached voltages which approach those of lightning, we are only just in the beginning of an intelligent understanding, an insight into the phenomena.

In reply to a question Dr. Steinmetz said that the lightning rod is a great protection, and that he would not like to be in an exposed place without such protection. But one must not expect that one rod on one end of the building will completely protect the other end a hundred or more feet away. There must be sufficient rods to extend their protective zone over the entire area; the apex of the roof, and other projecting edges, must be protected by connecting wires, etc. That is, like any other apparatus, the lightning rod protection must be installed intelligently and properly to be effective. The general principle is correct, but it must be rationally applied.

Engineering Instruction Coincident with Cultural Studies.

In a recent address in Chicago, Prof. William C. Bauer, who is in charge of the course in electrical engineering at Northwestern University, Evanston, Ill., detailed the aims of the new engineering school at that university. The Swift College of Engineering at Evanston is a handsome building on the shore of Lake Michigan, and the engineering department has been installed there for two years. Two courses are offered, one leading to the degree of C. E. at the end of the fifth year, the other in mechanical and electrical engineering and leading to the degree of E. E. at the end of the same period. For the first three years the courses are identical, specialization in more advanced subjects being introduced during the last two years.

The main idea at the university seems to be to carry on engineering instruction at the same time that cultural studies are also being given. Thus, for the first three years of the course the study of physics, languages and literature is the same both for the liberal arts students and the engineering students. Prof. Bauer emphasized the fact that talent, training and tact are necessary for the embryo engineer. He spoke of these qualifications as the three T's, and declared that the good engineer should be a man of liberal education as well as of technical education. The relation of pure and applied science may be expressed by an angle of lag, and it is the duty both of educators and practising engineers to make this angle as small as possible. The aim in college should be to teach the students the "why" of things as well as the "how."

One interesting feature of the work at the university is that engineering students are required to spend six weeks of each of the four summer vacations in some practical engineering work. The student makes a report of this work on his return to college in the fall, and is given credit for it. A practical insight into actual engineering performances may be obtained in this manner, and at the same time the experience helps the young man to acquire the desired tact. As yet the equipment at the Swift College of Engineering is not elaborate, but nearly all kinds of engineering plants are to be found in and near Chicago. The speaker made particular reference to the courtesy of Vice-president Baker, of the North Shore Electric Company, in permitting students to inspect the plants of that company.

In concluding, Professor Bauer made use of an analogy comparing men to various types of electric motors, and said that it was the hope of the engineering department of the university to turn out a few over-excited synchronous motors. Prof. J. F. Hayford, dean of the engineering school, and Prof. E. H. Freeman, of the Armour Institute of Technology, spoke briefly.

Corporation Tax Return Affected by Depreciation.

The Washington correspondent of the Chicago *Daily Tribune* says that the United States Treasury Department will probably make an inquiry to determine why the depreciation account of the Chicago Telephone Company was so much larger in 1910 than in 1909, reducing the apparent net income more than $800,000, and, therefore, making the corporation tax to be paid the government about $8,000 less than in the preceding year. In 1909 the Chicago Telephone Company reported a net income of $2,101,665. For the year 1910 the net income reported is $1,366,557. The falling off in net profit is, therefore, $825,108, although the company did about $1,300,000 more business in 1910 than in 1909. The difference is caused by the jump in the depreciation account, which in 1910 is placed at $2,347,068. This compares with $1,051,197 for depreciation in 1909, the increase being $1,296,871, which is considered remarkable by the Washington authorities. Mr. B. E. Sunny, president of the company, is reported as ready to welcome an investigation. He says that the increase in the depreciation charge is due to the company's efforts to comply with the recommendations made by official experts representing the city of Chicago. If the company's efforts to conform to these suggestions fail to satisfy the federal government, the company contends that it is not to blame.

Massachusetts Legislative News.

The question of extending the leases of the Boston Elevated Railway Company has raised a storm of discussion in the present legislative session, following the introduction of a bill in the Senate providing for the continued dominance of the company in local transportation affairs for the next fifty years. As introduced the bill provides for the construction of a tunnel to Dorchester from Park Street to Andrew Square by way of the South Station; for a Boylston Street subway in place of the Riverbank tube authorized a few years ago, and for extension of the East Boston tunnel into the outer West End district of Boston. A second part of the bill provides for the extension of the lease of the West End Street Railway Company to the Boston Elevated for fifty years from date at a rental of 7.5 per cent on the common stock of the West End company and at a rate of 8 per cent on the preferred stock. A third section of the bill provides for the expiration of the present and prospective subway leases in 1930, provision being made for their extension at the option of either the company or the city after 1930 for a maximum period of twenty-five years or a minimum period of such length that the rentals shall have paid the cost of the subways at the end of the period. Parts one and three, to become operative, require the consent of the Mayor and City Council, while part two needs the approval of a majority of the stockholders of the Elevated and West End companies. The West End interests own practically the entire surface-line system of Boston, although for about fourteen years the management of this branch of the service has been carried on by the Boston Elevated Railway Company under a lease. The railway company contends that it cannot afford to become responsible for many millions of dollars to be invested in additional subways unless it can be assured of a control sufficiently long to remove the hazards naturally incurred by such large investments. Public sentiment in Boston appears somewhat disinclined to favor a fifty-year lease, although the demand for additional rapid-transit lines to be operated electrically is insistent. In a statement issued a few days ago the company points out that the essentials of its plans have been approved in the reports of the joint commission on Boston rapid transit, consisting of the Massachusetts Railroad and Boston Transit Commissions sitting together, in answering inquiries of the Legislature of 1909. An effort is being made to secure a comprehensive solution of the entire Boston rapid-transit problem by the present bill. The Boston Elevated Railway Company has assumed in recent years burdens in the way of rentals and charges on subway, elevated and tunnel lines amounting to over $100,000,000, and its management feels that in the face of the rising costs of operation and the limitations of the 5-cent fare unit as expressed in the company's charter, enormous additional expenditures cannot be shouldered unless a more permanent foothold is given to the interests now performing a service which is reputed to be the best of its kind in the world.

The outlook for the passage of a bill providing for steam-railroad electrification at Boston continues to grow more promising. The House has passed the bill without debate to be engrossed. The measure provides that all railroads of standard gage entering Boston shall be equipped for electrical operation within the limits of the metropolitan park district within such time and in such part and order as the Railroad Commission shall determine. Plans and specifications covering some substantial portion of the work are to be submitted to the commission for approval by September, 1912, after which the board is required to order in its discretion electrification with due regard to the resources of the company, proper economy in operation, public safety and convenience.

The bill providing that if the consumption of electricity exceeds $7 worth of energy in a year, no charge shall be made for the use of electric meters has been passed to be engrossed. The opposition to the bill arose chiefly from municipal plants, which contend that it is liable to injure their business to a serious degree. An effort to amend the bill to exempt municipal plants failed.

President C. S. Mellen, of the New York, New Haven & Hartford Railroad, appeared before the committee on railroads recently and stated that if the bill giving the New Haven interests authority to purchase the Boston, Revere Beach & Lynn narrow-gage railroad is passed, including the right to build a tunnel under Boston Harbor, electrification will take place at the earliest possible date.

New York Commission News.

The Public Service Commission, Second District, has closed on its records a complaint of certain residents of Hudson Street, South Glens Falls, against the United Gas, Electric Light & Fuel Company, which asked that a gas main be extended 1000 ft. to supply gas to complainants. At the hearing the commission directed that the extension be made provided eight residents would become customers and would guarantee the use of 1000 cu. ft. per month. The company agreed at that time to make the extension if eight customers were secured, but complainants have been unable to secure pledges from that number of people and the commission has directed a dismissal of the complaint.

The Orange & Rockland Electric Company has been authorized to execute a mortgage covering its rights, franchises and properties to secure the sum of $500,000 twenty-year 5 per cent bonds. The company is authorized to issue presently bonds to the amount of $183,500, $37,000 to be used to refund outstanding bonds, $97,000 to pay off and discharge obligations of the company incurred for capital purposes, $5,000 to discharge accounts payable incurred for capital purposes, $44,500 for improvements and extensions to the company's plant and system, which is located in Monroe. The company operates in Monroe, Chester, Blooming Grove, Woodbury Falls, Florida, Washingtonville, Central Valley, Highland Mills, Turner and Oxford Depot.

This week adjourned meetings will be held at New York on the complaints of various municipalities in Westchester County against the Westchester Lighting Company for prices charged for gas and electricity in those communities; also on the application of the Northern Westchester Lighting Company at Ossining for permission to exercise franchises for the service of gas and electricity in the village of Pleasantville, Westchester County.

Ohio Public Service Commission.

The Ohio public utilities bill became a law last Wednesday night without Governor Harmon's signature. It is said that he was unwilling to affix his approval to the section allowing the consolidation of telephone companies with such capitalization and rates as the Public Service Commission may fix and at the same time he did not wish to take the responsibility of vetoing the section, so he allowed it to become a law by the expiration of the period fixed by law.

The law will become operative on June 30, after which all public service corporations will be subject to the regulation of the State Railroad Commission, under the name of the Public Service Commission of Ohio, with the exception of local utilities, over which the commission can exercise no power unless an appeal is taken to it.

The provisions of the bill were given in a recent issue. The commission will employ inspectors, examiners and such other help as is necessary to do the work required by the new law, and a complete organization will be effected as soon as possible. Members of the commission and chiefs of departments are now studying the systems used in other states and will endeavor to profit by them rather than work out a system of their own by experience.

New Hampshire Commission News.

Governor Bass has nominated and his council has unanimously confirmed as members of the Public Service Commission Messrs. Edward C. Niles, of Concord; John E. Benton, of Keene, and Prof. Thomas W. D. Worthen, of Hanover. The new commission law provided that it should become effective June 1, replacing the Railroad Commission, which was abolished on that date; but a deadlock occurred between the Governor and Council, the latter refusing to confirm the names of the men nominated by the Governor.

Governor Bass was desirous of having on the commission Mr. R. B. Stevens, who, as a representative in the last Legislature, took an active part in passing the law creating the commission, but the Council would not confirm any list of nominations containing the name of Mr. Stevens, so that the Governor was forced to offer another name, that of Professor Worthen. The law, which has been in nominal effect since June 1, thus now goes into actual operation.

Mr. Niles and Mr. Benton are prominent lawyers, and Professor Worthen is head of the department of mathematics at Dartmouth College.

Maryland Commission News.

The Maryland Public Service Commission last week heard argument on the petition of the Chesapeake & Potomac Telephone Company for permission to purchase the stock of the Western Maryland Telephone Company, which operates in Allegany County, which action is opposed by the independent telephone interests on the ground that it will cripple the service of the companies that now compete with the Chesapeake &

Potomac and which exchange business with the Western Maryland. The latter company has its headquarters in Cumberland and has been paying small dividends. The Chesapeake & Potomac proposes to buy all the stock at a price in advance of what it has been bringing on the market and to assume the bonded indebtedness, part of the payment to be made in stock of the American Telephone & Telegraph Company.

The city authorities have announced that unless the Consolidated Gas, Electric Light & Power Company, of Baltimore, decides to reduce its rates for gas and electricity by July 15, the city will make application to the Public Service Commission for a thorough investigation of the company's business. It is understood that the city officials have in mind a reduction in gas rates from 90 cents per thousand cu. ft. to at least 85 and perhaps 80 cents, and a general revision of electrical rates for industrial use. Under the law the commission could initiate proceedings, but it is thought that a formal application from the city would be more appropriate. For more than a year past the city, though employing experts for the purpose, has accomplished nothing in the way of bringing the case to a head.

That the Public Service Commission has power to force the Brooklyn & Curtis Bay Light & Water Company to extend its service to Brooklyn, in satisfaction of a complaint from the Brooklyn Improvement Association, is the opinion of Mr. W. Cabell Bruce, counsel for the commission. Mr. Bruce declares that the justice of exercising such power will depend entirely upon the evidence presented at the hearing before the commission. The Brooklyn Improvement Association appealed to the commission through J. Oliver Johnson to force the light and water company to extend its service to its town, and presented evidence to show that the stipulations laid down by the company as necessary to the extension had been complied with. In a communication from the chief engineer of the company the association was promised the service provided that it could furnish 200 subscribers. The reply was that 212 could be furnished at once, but the company's lines were not extended and no intimation was given that they were to be. The association requested the commission to take the matter up and force the company to furnish the service as required under its charter.

Wisconsin Commission News.

The commission has refused the application of the Red Cedar Valley Electric Company for authority to increase rates, but has ordered or suggested amendments to the present schedule which will eliminate certain of its objectionable features. The company owns and operates a hydroelectric plant at Rice Lake, Wis. It alleged in its complaint that the present rate schedule is not adjusted to the costs for the different classes of service; also, that the revenue derived from the business does not provide for a depreciation fund and a fair return upon the investment. A detailed investigation of the company's financial affairs showed that the present rate of return amounts to between 6 per cent and 7 per cent on the investment, after allowing for depreciation. Furthermore, the company has ample power and generating capacity for a considerable increase in station load, which means that additional business could be taken on without increasing the fixed charges materially. These facts led the commission to the conclusion that an increase in rates would not be justifiable. The investigation did show, however, that the present rates were not adjusted to the costs. The table of unit costs deduced by the commission is as follows:

Use of Active Connected Load. Hours.	Capacity Charge. Cents.	Output Charge. Cents.	Total Cents.
1	11.03	2.19	13.22
2	5.52	2.19	7.71
3	3.68	2.19	5.87
5	2.21	2.19	4.39

An analysis of the consumer data showed that about 50 per cent of the lighting consumers had small installations of from five to ten lamps each. The small-residence consumer used his active connected load on an average 2.3 hours daily, while the business consumer used his active load on an average 3.1 hours daily. These consumers, therefore, are entitled to a lower rate than 8 cents, which is the present rate for all consumers, irrespective of size. On the other hand, consumers whose installations exceeded twenty lamps seldom used their active load more than a fraction of an hour daily. These consumers cost the company in the neighborhood of 18 cents per kw-hour. With a view of eliminating these inequalities the commission suggested the following schedule for commercial lighting: First thirty hours' use per month of the active connected load, 13 cents per kw-hour; next sixty hours, 7 cents; excess, 4 cents. For residence consumers, 40 per cent of the connected load can be considered active; for business consumers, 65 per cent.

At the time of the hearing the company had in effect a uniform power rate of 5 cents per kw-hour, with a discount of 5 per cent for prompt payment. The commission ordered the company to amend this rate schedule and to substitute a fixed charge of $1 per month per horse-power for motors of from 1 hp to 5 hp capacity and 80 cents per month per horse-power for motors of over 5 hp. plus a meter rate of 2 cents per kw-hour for energy used. A minimum bill of $1 per month is allowed.

In the petition of Otto Schicker, of Janesville, against the Rockford & Interurban Electric Railway Company, the commission has ordered that the company discontinue its present rate of 10 cents for passenger fare from points within the city limits of Janesville to points about the yards of the Chicago & Northwestern Company in South Janesville, and substitute a 5-cent fare. South Janesville is about 80 rods outside the city limits. The present arrangement of fare zones, the petitioner alleges, works a hardship on the 200 or more railroad men whose business takes them to South Janesville. Outside of an early morning train on the Northwestern Railroad the Interurban offers the only means of transportation. An analysis of the fare zones showed that if the zone in controversy was extended so as to include South Janesville it would be no longer than the average of the company's present fare zones. An analysis of the company's earnings in Wisconsin revealed the fact that the present earnings amount to 10 per cent or more on the investment after deducting taxes and depreciation. The loss in revenue occasioned by the 5-cent fare will result in a decrease in total earnings of about one-tenth of 1 per cent.

The commission has authorized the Badger Railway & Lighting Company to issue 2550 shares of common stock of the par value of $100 each. Stock of par value $216,000 is to be issued and exchanged for the right-of-way and the grading on which the company proposes to construct its line of electric railway between the city of Whitewater and the city of Lake Geneva, a distance of about 22 miles. The order describes and put a value upon each piece of property which it will be necessary for the company to obtain. Stock of par value $39,000 is to be sold for money only and for not less than par. This money is to be used in paying the expenses of construction. All details relating to the exchange of property for stock must be filed with the commission within thirty days after the exchange.

The commission has served notice upon the Madison Gas & Electric Company that it is about to investigate the reasonableness of the company's rates, rules and regulations. This action follows an investigation which the commission has caused to be made and which indicates that the company's present rates may be reduced. This question was investigated by the commission about a year ago and a new rate schedule ordered which decreased very materially the rates in effect at that time. As this was the first large rate case to be decided by the commission, the action taken at that time was very conservative and the rates were not reduced to the extent which circumstances seemed to warrant. The increase in business during the past year, brought about largely by the reduction in rates, together with the liberality of the commission in fixing the present rate schedule, is enabling the company to earn 10 per cent or more upon its investment, according to the investigation just completed. The time for the hearing has not been set.

The commission is in receipt of a petition, signed by certain residents of the city of Milwaukee, requesting an investigation of the charges and rates of the Milwaukee Gas Light Company, with a view to fixing more reasonable rates. The petition alleged that the rates, rules and regulations of the respondent company are excessive, unreasonable and discriminatory.

CURRENT NEWS AND NOTES.

California Electrical Contractors.—The electrical contractors of California have arranged to charter a steamer for thirty days to cover their convention at Santa Catalina Island during July. Mr. John Rendler, Los Angeles, is in charge of the entertainment features.

Meeting of Electric Vehicle Association of America.—At the next meeting of the Electric Vehicle Association of America in the Engineering Societies Building, New York, June 27, Mr. W. P. Kennedy will present a paper entitled "Administrative Engineering and Salesmanship in the Commercial Car Field."

No Connecticut Public Utility Legislation.—The Connecticut Legislature has failed to pass any of the several public utility bills before it. The Senate passed one bill and the House another, but one would not accept the bill of the other. The bill passed by the House is less strong than the Senate bill, though the latter is not as rigorous as measures adopted in other states.

Heat Transmission Data.—While the laws governing the transmission of heat through various surfaces are not well determined and much experimental work is required to enable the engineer to make exact computations, Prof. J. R. Allen, of the University of Michigan, pointed out in a paper before the National District Heating Association at Pittsburgh June 7 that some reliable German data on the subject are published in an English translation, "Formulas and Tables for Heating," by Mr. J. H. Kinealy.

Institute of Operating Engineers Incorporated.—The Institute of Operating Engineers, with headquarters in the Engineering Societies Building, New York, has been incorporated under the laws of New York. The institute has a charter membership of 326, and the following branches: First district, New York branch; second district, Isherwood branch; fifth district, T. J. Waters branch; ninth district, Col. Goethals branch. There are branches yet unnamed in Providence, R. I., and Binghamton, N. Y., and fifteen others are in process of formation.

Diversion of Niagara Water.—An extension for two years, or until June 29, 1913, of the present regulations under the Burton law governing the diversion of water from Niagara River for commercial power has been recommended by the United States Senate committee on foreign relations, which reported favorably a resolution having this effect on June 16. Senator Burton explained that the existing treaty with Canada, under which the diversion of water on both the United States and Canadian sides is limited, would expire in another ten years, and it is proposed to continue the present status quo for that time.

Extension of German Transatlantic Cables.—The laying of the cable between Germany and Vigo, in Spain, in 1896, was Germany's first step to become independent of English cables. At its opening the intention was announced of extending the cable to the Azores and America. This was not fulfilled, as it was found that the Vigo cable was too overcrowded to serve as part of the American cable. An additional cable was therefore laid between Germany and America, touching only the Azores. The company recently made the statement that this American cable is so occupied that it has been decided to lay a second line. In all probability the Vigo cable will also be doubled in the next few months.

New Officers of Chicago Section, I. E. S.—At the meeting of the Chicago Section of the Illuminating Engineering Society on June 15 the following officers were elected for the ensuing year: Chairman, Mr. R. F. Schuchardt, electrical engineer, Commonwealth Edison Company; secretary, Mr. A. L. Eustice, illuminating engineer, Nernst Lamp Company; managers, Mr. Charles A. Luther, illuminating engineer, People's Gas Light & Coke Company, and Mr. A. J. Morgan, secretary National X-Ray Reflector Company. In the absence of the other elected officers brief speeches of acceptance were made by Messrs. Eustice and Morgan, and Mr. F. J. Pearson, the retiring chairman, thanked the section for the co-operation accorded the administration whose term was just closing.

Electricity in St. Louis Public Library.—New York is not the only city with a new and monumental public library building, for in St. Louis the Central Building of the St. Louis Public Library, which is a handsome and dignified structure costing about $1,000,000, is approaching completion. A liberal use of electricity will be made in this building. There will be thirty-one electric motors used to operate passenger elevators, dumb-waiters, book lifts, fans, vacuum cleaners, air-washing equipment, air compressors, boiler stokers and ash hoists. The lighting arrangements have been carefully designed and about 3800 incandescent electric lamps will be installed. The vestibule of the building will be illuminated by indirect lighting, the sources of light being concealed by marble cornices. The indirect system will be used almost exclusively also on the ground floor and the second story. Fourteen handsome lamp standards of bronze will be placed on the terraces surrounding the building. These and the interior lighting fixtures will be of special design, harmonizing with the general scheme of architectural treatment.

Edison Giant Roll Patents Sustained.—Two patents of Mr. Thomas A. Edison on crushing machinery have been strongly sustained in a recent decision by Judge Hazel in the United States Circuit Court of the Western District of New York. These rolls are referred to as follows in the recent book "Edison: His Life and Inventions," by Messrs. Frank L. Dyer and T. Commerford Martin: "No such departure was as radical as that of the method of crushing the ore. Existing machinery for this purpose had been designed on the basis of mining methods then in vogue, by which the rock was thoroughly shattered by means of high explosives and reduced to pieces of 100 lb. or less. These pieces were then crushed by power directly applied. If a concentrating mill, planned to treat 5000 tons or 6000 tons per day, were to be operated on this basis the investment in crushers and the supply of power would be enormous, to say nothing of the risk of frequent breakdowns by reason of multiplicity of machinery and parts. From a consideration of these facts, and with his usual tendency to upset traditional observations, Mr. Edison conceived the bold idea of constructing gigantic rolls which, by the force of momentum, would be capable of crushing individual rocks of vastly greater size than ever before attempted. He proposed to eliminate the slow and expensive method of breaking large boulders manually and to substitute therefor momentum and kinetic energy applied through the medium of massive machinery which in a few seconds would break into small pieces a rock as big as an ordinary cottage piano and weighing as much as 6 tons. Engineers to whom Mr. Edison communicated his ideas were unanimous in declaring the thing an impossibility: that it was like driving two express trains into each other at full speed to crack a great rock placed between them; that no practical machinery could be built to stand the terrific impact and strains. Edison's convictions were strong, however, and he persisted."

Electric Club of Chicago.—Mr. Sidney A. Teller, in charge of West Side Park No. 2, addressed the Electric Club of Chicago on June 14 on the subject of "Chicago's Small Parks and What They Are Doing for the City." Mr. Teller's remarks were most interesting and instructive and gave his hearers a new idea of what modern "social engineers" are doing for the welfare of the inhabitants of crowded cities.

Chicago Has 250,000 Telephones.—The Chicago Telephone Company has passed the quarter-million mark in the number of telephones in service in the city of Chicago. This is about one telephone for every nine inhabitants. Chicago has more telephones than any other city in the world except New York, and more in proportion to population than New York. It has twice as many as London and five times as many as Paris.

Long Electric Railway for Cuba.—It is reported from Havana that the President of the Cuban Republic has signed a bill granting a concession to Mr. Hugh Reilly to build and operate an electric railway to be known as the Cienfuegos, Palmira & Cruces. The project is said to provide for a line about 300 miles long, paralleling other roads at various points. Water-power for the operation of the railway is to be developed at a point about 30 miles from Cienfuegos, according to the account.

Rates for Electricity in Los Angeles.—The City Council of Los Angeles has been asked by the Vermont Square Improvement Association to take the first step toward the abolition of the Board of Public Utilities and restoration to the City Council of the power to fix rates for electricity. The association asks that the existing rates be continued for another year. In similar vein the Arlington Home Improvement Association has asked the City Council to "abolish all 'bureaus,' 'scientific expert' heads and 'commissions' having legislative power, and place the same back in the Council, where it belongs."

Larger Appropriation for University of Illinois.—Governor Deneen of Illinois has signed bills appropriating $3,500,000 by the State for the University of Illinois to cover a period of two years. The Governor also approved the Hamilton "one-mill" bill, which in the future will provide an annual revenue of about $2,000,000 for the university. The generous attitude of the State authorities will establish the State university upon an entirely new financial basis and will relieve the president and trustees from the constantly recurring necessity of begging money from the Legislature. Part of the recent appropriation will be expended for a new engineering building at Urbana.

Gas Controversy in Chicago.—The People's Gas Light & Coke Company, of Chicago, still refuses to turn over to the city of Chicago the papers by which Mr. W. J. Hagenah, the city's expert under the preceding administration, arrived at the conclusion that the price of gas could be reduced from 85 cents to 77 cents. The documents are wanted for the use of Mr. E. W. Bemis, the expert of the present administration, who has been retained to see if a 70-cent rate cannot be figured out. The company dislikes the prospect of 70-cent gas even more than the proposed 77-cent rate, against which it made a protest. Therefore, it refuses to give up the papers which it placed at Mr. Hagenah's disposal. In reprisal the city threatens to withhold permits for street openings for gas-pipe extensions.

New Power-Transmission Project in Southern California.—It is reported in San Bernardino, Cal., that a new power-transmission company with ample financial backing is to enter the Southern California field in competition with the Southern California Edison Company and the Pacific Light & Power Company. Application has been made on behalf of the new company for a franchise to erect pole lines along highways in San Bernardino County. The supervisors of that county will advertise for bids on the application, and the bids will be opened on July 24. It is said that electrical energy will be obtained from water-power utilized on Bishop Creek, Inyo County, Cal., and also from the Los Angeles aqueduct now in course of construction. The new company intends to push its lines into new territory, including the San Jacinto Valley, where electricity is not available now.

Meeting New York Companies' Section, N. E. L. A.—The regular monthly meeting of the New York Companies' Section of the N. E. L. A. was held in the Edison Auditorium, New York City, June 19. Four papers were presented, two of which were read in abstract. The subjects were as follows: *Securing Business on the Instalment Plan: Its Advantages and Disadvantages*, by Mr. A. A. Pope; *Value of the Electric Sign as a Business Getter*, by Mr. Jesse Richards, *Value of the Show Window as an Advertising Factor*, by Mr. Joseph F. Becker, and *How Best to School Our Commercial Men*, by Mr. F. C. Henderschott. Mr. Pope's paper was read in his absence by Mr. E. A. Mills. Vice-chairman J. F. Becker presided and at the business meeting preceding the reading of the papers it was decided to hold an outing during the summer either on the Hudson or Long Island Sound. The membership of the New York Companies' Section is now 1539. The usual vaudeville entertainment was given at the end of the meeting.

Mexico A. I. E. E. Dinner.—On Friday evening, June 9, about thirty members of the Mexico Section of the American Institute of Electrical Engineers met at dinner in the famous Hotel Iturbide, City of Mexico. The chairman for the occasion, Mr. W. B. Hale, in opening the meeting at the conclusion of the repast, referred in a humorous vein to the prevailing political conditions in Mexico, with its "provisional" President and cabinet, and said that it appeared to be in keeping with the general order of things that the Mexico Section should have a provisional chairman—the one who had the honor of presiding at that meeting. An interesting paper by Mr. E. Loenarz, the chairman of the section, who was unavoidably absent, was then read. It was entitled "Tariffs for Electric Energy," and compared in an able manner the various systems of charging for electric light and power, such as flat rate, meter rate, combined "readiness-to-serve" and meter rate, etc., pointing out the proper application of each to conditions encountered in Mexico. An extended discussion, participated in by many of those present, followed the reading of the paper. It was announced that Mr. Leonarz would be the section delegate to the annual convention at Chicago, and that a meeting would be called in July for the election of officers.

Robinson Plan for Chicago Subways.—Before the local transportation committee of the Chicago City Council, on June 14, Mr. A. S. Robinson, at present chief engineer of the Mountain, Valley & Plains Railroad Company, of Dalhart, Tex., presented suggestions for a plan of Chicago subways involving a number of through routes between the North, South and West Sides of the city, besides several loops entering the downtown district from the West Side. Intersecting all of these subways, along the lines of Monroe Street and Jackson Boulevard, Mr. Robinson has provided a low-level transfer-belt subway by changing to which passengers may cross over to any other main line and continue their journeys, with universal transfers if desired. The subway tracks for the surface cars would be carried at a level of 10 ft. below the street surface and the elevated cars 14 ft. below the surface, requiring excavation averaging 20 ft. deep, or about 6 ft below the Lake Michigan datum line. Automatic electric pumps would provide for removing any seepage coming through the waterproofed concrete walls. At the side of the tracks Mr. Robinson allows space for gas, water, electric-service and telephone wires, while in the 5-ft. earthen back-fill above the roof of the tunnel would be space for various small service laterals. The cost of four-track construction is estimated at $3,141,000 a mile.

Tests of Meters.—Of 7558 tests of electric meters reported to the New York Public Service Commission, Second District, in April, 1911, 412, or 5.45 per cent, were fast; 6046, or 79.99 per cent, were accurate, and 1100, or 14.56 per cent, were slow.

Marine Wireless Service Mandatory.—According to a bill passed by Congress, after July 1 ocean-going vessels carrying more than fifty passengers will be liable to a fine of $5,000 unless they are equipped with wireless-telegraph apparatus capable of transmitting messages not less than 100 miles and manned by an operator carrying a certificate issued by this or another government.

Susquehanna Power at Baltimore.—The United Railways & Electric Company, of Baltimore, expects the company's cars to be operated by Susquehanna power sometime before Sept. 1. The high-tension current brought from the power plant will be transformed or reduced at the transformer station of the Pennsylvania Water & Power Company, Eighth Street and Philadelphia Road, whence it will be brought to the Pratt Street power house of the United Railways for distribution over the system. The power house of the United will be run every afternoon from 1 o'clock until 7 o'clock, so as to take care of the rush-hour service and period of heavy traffic.

Some Federal Tax Figures.—A Chicago newspaper publishes the returns of a number of large Chicago corporations for 1910 under the federal corporation-tax law. The Commonwealth Edison Company reports a net income for the calendar year 1910 of $2,849,712, compared with $2,303,786 in 1909. The federal tax for 1910 to be paid by this company is $28,447. The increase in net income for 1910 was $545,926. It is interesting to note that, although the People's Gas Light & Coke Company of Chicago reports a larger net income for 1910 than the Commonwealth Edison Company, the increase is much less. The gas company's net income for 1910 was $3,332,465, an increase of but $114,562 compared with the preceding year.

Progress on Keokuk Dam.—Bulletin No. 2, just issued by the Mississippi River Power Company, which is constructing the 200,000-hp water-power dam and power house in the Mississippi River opposite Keokuk, Ia., shows the progress of the work for May. Cofferdams have been constructed bearing the site of the power house and dam in the riverbed, and the construction buildings, crushers, mixers, power house, etc., are completed. Footings for the dam have been prepared and traveler cranes are already in position placing concrete. Work is being carried on simultaneously on both sides of the river, which is nearly a mile wide at this point, and all parts of the work are interconnected for communication by a private telephone system having seventy instruments.

Electric Roses for the Coronation.—One of the features of the night spectacles during the medieval coronation function in London this week is the extensive use of shades for incandescent lamps having the appearance of "Tudor" roses, the botanical name of this species of rose not being divulged. It is reported that one firm alone has done 1,000,000 ft. of wiring to supply 750,000 Tudor make-believe roses. A large number of clubs, banks and commercial houses have placed orders for electric roses and a group of clubs in the West End have combined in one order for 10,000 roses to be arranged in one scheme of decoration. The Bank of England will have 5000 electric lamps placed so as to outline the structure at night and 2000 lamps will decorate the American Embassy.

Report on Philadelphia Street Railway Service.—The report of Messrs. Ford, Bacon & Davis, of New York, in reference to the service and equipment of the Philadelphia Rapid Transit Company, rendered to the Pennsylvania State Railroad Commission, has been issued in book form. It is an analytical engineering study of the conditions affecting the physical operation and rolling stock of the Philadelphia system. Chapter I contains a brief summary of the report and the many detailed studies of different features of operation. The detailed report is divided into the following general subjects: Physical property as of June 30, 1910, surface cars, sub-elevated cars, recommendations as to cars, operating statistics 1907-10, comparative operating statistics of large American street railway systems, car maintenance, accidents, traffic and service, rush-hour problem and routing. Volume II contains tabulated statements, maps and diagrams relating to the general subjects of the report.

Another Selden Patent?—The text of a decision rendered several months ago by the Court of Appeals of the District of Columbia indicates that there is another Selden patent on the stocks. In the present case the regular application was filed in 1879, that in issue being a division made in 1895. After various routine proceedings the claims of the application were rejected, whereupon twenty-one other claims were submitted in lieu of those passed upon. In 1902 the applicant filed a substitute specification containing thirty claims, including the above-mentioned twenty-one claims in amended form. In July, 1904, an amendment was presented erasing certain claims and changing certain others, and in September of the same year a further amendment was filed canceling all of the claims and presenting twenty-four others. In 1907 three other amendments were filed, whereupon certain suggestions were made by the examiner which were not complied with until 1909, or thirty years after the date of the original application. After consideration of a communication received soon after from the examiner, the commissioner of patents decided that owing to the lack of action in 1902 and 1904 the application must be held as abandoned for lack of sufficient prosecution. The court reversed this decision of the commissioner and ordered the application to be reinstated. The opinion of the court gives no clew to the subject matter of the specification and claims.

The Gyro-Compass.—An interesting application of the gyroscope to the construction of a compass is being shown in London. The apparatus, which is known as the Anschütz gyrocompass, possesses the advantage that it points to the true north, thereby greatly simplifying the use of charts in navigation, and it is also unaffected by the presence of steel. It depends on the principle enunciated by Foucault, that a gyrostat with only two degrees of freedom will at any point on the earth's surface, except the poles, tend to set itself with its axis of rotation parallel to the axis of the earth by reason of the relative rotations of the two bodies. As applied to the ship's compass the gyrostat is suspended below the card with its axle fixed directly under the north and south line, from a circular hollow ring floating in a bowl of mercury, which is carried on gimbals in the usual way. It is driven by a small three-phase motor whose rotor is rigidly fixed in the inside of the gyrostat flywheel. The speed of rotation is approximately 20,000 r.p.m., and the driving energy furnished by a small motor-generator set has a frequency of 333 cycles. The oscillations of the gyrostat's axle and therefore of the compass card are damped by means of the air blast from the flywheel. An electrical transmitting arrangement can be fitted by which the movements of the needle in relation to the ship can be reproduced on receivers in any part of the vessel. The master gyrocompass can thus be placed in any desirable and well-protected position low down within the hull. An inner card in the receivers makes a complete revolution for 10 deg. alteration of course, and by rendering small variations readily perceptible tends to increase closeness in steering. It is calculated that the directive force of the gyro-compass is approximately fifteen times greater than that of a good magnetic liquid compass placed in a position where it is free from disturbances by surrounding iron.

WATERPOWER FROM CANNON FALLS.

Second Hydroelectric Development of the Consumers' Power Company in Southern Minnesota.

As outlined in an article on the Blue Earth water-power development near Mankato, Minn., in the *Electrical World* of April 13, 1911, energy for the transmission and distribution system of the Consumers' Power Company in the southern portion of the State is obtained by water-power plants at the Cannon Falls and Blue Earth sites. These plants, 80 miles apart, serve the rich intermediate region, including the cities of Mankato, Northfield, Faribault and Cannon Falls, the first three having auxiliary steam-power plants in connection with their transforming substations. The transmission line from Cannon Falls through Northfield has now been completed to Faribault.

The Cannon Falls plant develops a maximum hydraulic head of 59 ft. in the Cannon River, 2 miles west of the village of Cannon Falls. The dam is of the Ambursen hollow reinforced-concrete type, and comprises forty-three 18-ft. bays, making in all a length of nearly 800 ft. of concrete construction. The plan of the structure is roughly that of an expanded Z, comprising a central north-and-south section 400 ft. in length, including the 100-ft. power house; a southern wing wall 350 ft. in length, making an angle of 40 deg. with the power-house section, and a 100-ft. north wall roughly parallel with the south wing wall.

The buttresses supporting the sloping upstream deck of the dam are 28 in. thick at the bottom, where the largest central ones have up and down stream bases 90 ft. in length, and taper to 12 in. in thickness at their tops. The 45-deg. sloping deck is 36 in. thick at its lower edge, tapering to a thickness of 14 in. at the top. The weight of the impounded water over this sloping upstream deck presses downward on its surface and increases the stability of the dam, thereby equalizing any tendency to overturning or horizontal sliding due to the horizontal pressure of the water.

The ordinary 58-ft. operating head created by the dam impounds a pond of about 1800 acres extending five miles upstream. About 18,000 acre-ft. of water can thus be drawn upon by lowering the pond level within 10 ft. below the full reservoir level. The turbine units installed are designed to operate efficiently throughout this range, with a minimum head of 49 ft.

The spillway section of the dam extends from the power-house wall southward 414 ft. and along the south wing section of the dam. The spillway crest is at an elevation 55.5 ft. above tailwater, and to this head 30 in. additional can be added by the erection of flashboards supported on pins in sockets provided for them along the spillway crest. The side walls, which lock into the earth embankment, are 62 ft. above tailwater level, and all embankments are 2 ft. higher than this level. Beneath the reverse-curved apron of the spillway section nearest the power house are the four 7 x 5-ft. sluice gates for controlling the flow of water through the dam. With these gates and with its 414-ft. spillway the dam is capable of passing extreme floods of 15,000 cu. ft. per second.

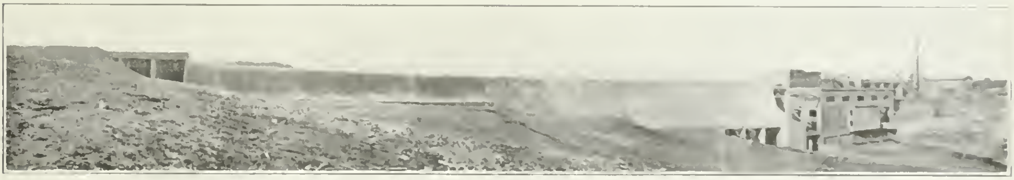
Fig. 1—Panoramic View of Cannon Falls Dam and Power House Under Construction.

Altogether the completed dam contains 16,500 cu. yd. of reinforced concrete, using 23,500 barrels of cement and 350 tons of steel reinforcing. In preparing the site for the dam 21,500 cu. yd. of rock were excavated, besides 17,000 cu. yd. of earth. The total embankments and fill aggregate 17,000 cu. yd. Along the north side of the impounding basin and about 3500 ft. from the dam it was necessary to erect a dike 2000 ft. long, with a concrete core wall carried 10 ft. below the level of the ground. This dike required 12,000 cu. yd. of earth. Its water slope is paved with 3000 cu. yd. of quarry waste and 2500 cu. yd. of hand-laid riprap.

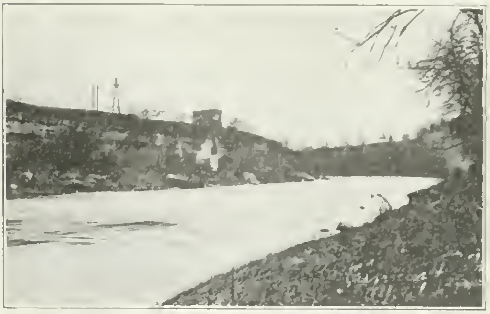
Fig. 2—View of Cannon Falls Dam Site Before the Beginning of Construction Work.

An incident in the early construction of the Cannon Falls dam was the change in location to a point about 100 ft. upstream from the original site which had been partially prepared for the structure. This summary action was taken as a refusal to submit to what were felt to be extortionate demands after the arrangements for the original site in question were thought to be fully agreed upon with the owner. Such annoying incidents frequently beset those engaged in developing public enterprises, but in this case the rebuke was administered promptly by moving the dam and redesigning the plans for the new site. Work at this position was begun in April, 1910, and by March 1, 19[illegible], the waterwheels were ready to operate.

The power house is a poured-concrete structure, measuring 54 by 92 ft. in plan and 33 ft. from the generator-room floor to the roof. Rising 16 ft. above the main roof level is the high tension gallery. The completed plans call for a head-gate house 12 ft. above the bulkhead level from which the gate wheels are manipulated.

Entering through the inclined trash racks and head-gates the water for the main turbine units is led through 60-in. steel penstocks to the twin Pelton-Francis spiral-case center-discharge waterwheels, each having a rating of 750 hp. Each pair of wheels drives a 550-kw, 2300-volt, 60-cycle, three-phase General Electric alternator at 300 r.p.m. To assist regulation of the machines a 12,000-lb. flywheel is mounted on the shaft between each pair of water turbines and the generator it drives. Directly connected on the shaft of each machine is also a 14 kw direct-current exciter-generator.

Two main waterwheel sets have already been installed, but provision is made for two additional similar units. The present separate waterwheel-driven 35-kw exciter set will also be duplicated. The water to operate the 60-hp waterwheel of this exciter is conducted to the runner through a 20-in pipe slung from the floor of the power house. A 15-ton hand-operated Whiting crane runs on overhead tracks the entire length of the power-house interior. For the switchboard gallery a bay window overhanging the power-house wall proper has been provided as in the case of the Blue Earth structure. From the 12-panel black-slate switchboard on the main generator floor level the 2300-volt oil switches on the floor above are operated through pull rods and bell cranks, no high-tension wiring appearing on the main switchboard.

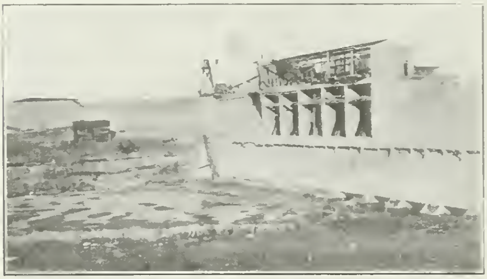
Fig. 3—View of Upstream Side of Cannon Falls Dam and Power House Before Completion.

The transformers which raise the emf to the line potential of 33,000 volts are inclosed in concrete compartments along the bulkhead wall of the power house. These compartments are closed by self-releasing steel doors; in case of fire or undue temperature rise a fusible link in the detent mechanism allows the door to roll shut. Two 1250-kw. three-phase, oil-insulated, water-cooled transformers are installed, the circulating water for cooling the units being taken from the upper level impounded by the dam.

From the transformers the high-tension buses are led upward through oil switches in the overhead high-tension gallery to the line entries and lightning arrester taps in the tower structure.

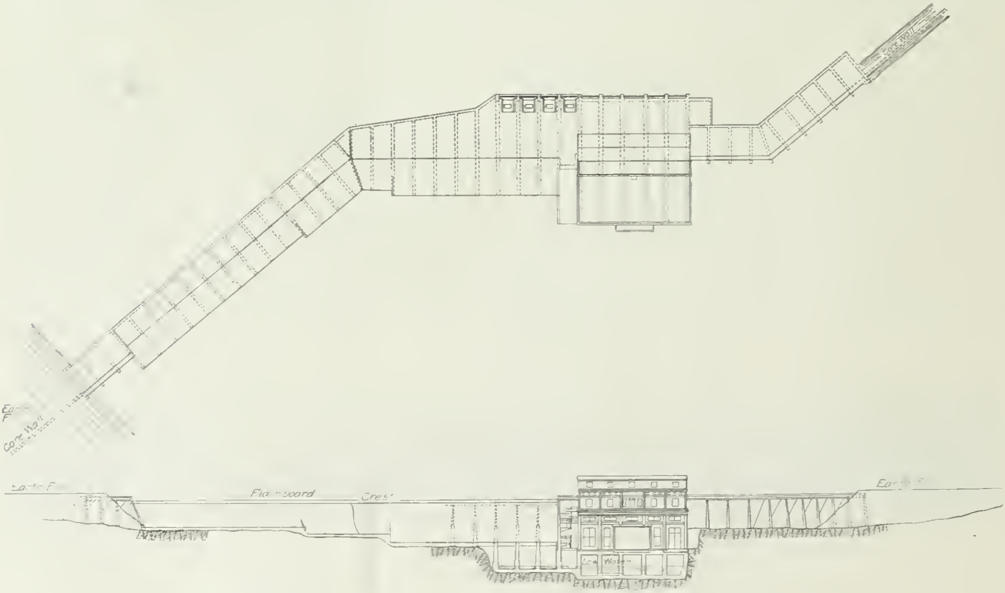

Fig. 4—Plan and Section Showing General Scheme of Cannon Falls Development.

The transmission line from Cannon Falls to Faribault is of the same unique "wishbone" type of construction developed by the Byllesby company and employed in the Mankato-Blue Earth line described in the *Electrical World*, Dec. 1, 1910, and April 13, 1911. A 2300-volt tap from the generator buses also is taken to Cannon Falls, two miles distant, energy for the city and commercial lighting of the town being supplied from the new dam. While the present equipment of the Cannon Falls development comprises two 750-hp units, making 1500 hp in present installed generator rating, the equipment will be doubled as already provided for, increasing the rating 3000 hp.

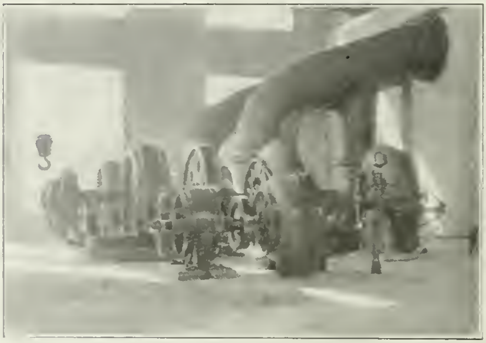
Fig. 5—Waterwheels and Generators in Cannon Falls Hydroelectric Plant.

The construction of the dams and power house at Cannon Falls and the substations at Northfield, Faribault and Mankato, together with the reconstruction of the steam reserve stations at the latter points, was done by the engineering department of H. M. Byllesby & Company, Chicago, of which Mr. Otto E. Osthoff is vice-president and chief engineer; Mr. W. R. Thompson, assistant chief engineer; Mr. J. W. Link, hydraulic engineer. Mr. E. C. Bacot was the designing engineer of the electrical equipment.

The contract for the dam was carried out by the Ambursen Hydraulic Construction Company, Boston. The Pelton Water

Wheel Company furnished the wheels and governors, and the General Electric Company the electrical apparatus.

Acting for H. M. Byllesby & Company in the field were Mr. D. M. Bunn, construction superintendent in charge of power house, substations and transmission lines, and Mr. J. W. Gilbert, resident engineer at the Cannon Falls dam. The operating department of the Byllesby company is represented by Messrs. B. W. Cowperthwaite and J. E. Hanson, managers respectively of the Faribault and Northfield divisions of the Consumers' Power Company.

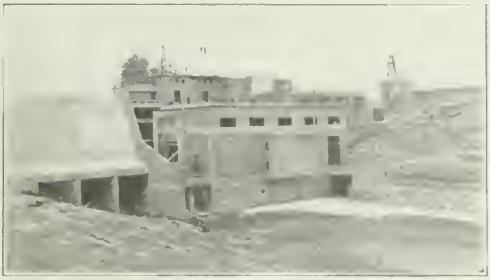

Fig. 6—View of Power House and a Portion of the Dam.

ELECTRIC MOTOR SERVICE IN LARGE TEXTILE MILLS.

A Description of the 17,500-kw Motor Installation in the Plants of the Amoskeag Manufacturing Company at Manchester, N. H.

ELECTRIC motor driving plays an important part in the operation of the largest cotton and worsted mills in the world, which are grouped in the plant of the Amoskeag Manufacturing Company, at Manchester, N. H. Nearly a mile of cloth is produced per minute in this establishment, which employs 19,500 persons, has an annual payroll of about $7,000,000 and a total power-producing capacity in water-wheels, steam engines and steam turbines of about 40,000 hp. The annual coal consumption of the mills approximates 200,000 tons. The buildings occupy nearly 6,000,000 sq. ft. of floor space and are supplied with telephone service from a private exchange having over 400 instruments connected and needing the services of five operators. The mills occupy land on both sides of the Merrimac River in Manchester, and the distance from the northern to the southern end of the plant is about two miles, the width of the property being about one mile. Through the courtesy of Capt. Charles H. Manning, superintendent of motive power, the following particulars of the electric motor drive are given.

The mills are divided into northern, central and southern sections, and electricity for lighting and power service is supplied from two large steam-turbine plants located near the northern and southern centers of production and also from generators located at a number of scattered points on the east side of the river. The largest power plant for electrical supply is the turbine station in the northern division, which at present contains two 4000-kw horizontal Curtis General Electric units delivering three-phase current at 2250 volts. Sixty-four 150-hp Manning vertical boilers are installed in a single row in the boiler house of this station, the coal being fired by Jones underfeed stokers after being wheeled to the boiler-room from a great storage yard immediately outside. The fuel is unloaded by electricity from the railroad which ships it to the plant. Ample room for expansion of power producing capacity is available in this station. The southern turbine station at present contains a 2000-kw vertical Curtis-General Electric unit, with space for additional equipment as needed.

The generator leads in the basement of the northern turbine station are carried to the switchboard section in Orangeburg fiber conduits with solid concrete envelopment. All wiring in the station, including instrumental and auxiliary transformer connections, is run in iron conduit. Other electric generating plants are a 1000-kw, 600-volt Westinghouse three-phase alternator in the southern division arranged for driving by water-wheel and reciprocating engine together, a 500-kw synchronous generator in the central division arranged for alternative driving by water-wheel or engine connections, a 2500-kw, 600 volt unit in the central division, steam-driven, a 200 kw, 600-volt unit in the same division, steam driven; a 1000 kw steam-driven unit in the central division, and in the northern division a 500-kw, 600-volt unit driven by water wheels and a 200 kw, 2250 volt water driven generator. An interesting feature of the power situation is the use of synchronous generators on water wheel shafts. When the water supply is ample these are driven by hydraulic turbines, but when the river is low these generators are operated as synchronous motors with current from the steam turbine installation, and by driving a portion of the load carried by the water-wheel shafts enable continuous service to be maintained in portions of the plant which might otherwise have to be shut down. The northern division will shortly be equipped with three synchronous generators rated at 2000 kva, 1000 kva and 375 kva and wound for 2250-volt service. These machines will materially raise the power-factor of the system, which is at present about 85 per cent. The lighting and power loads of the mills are supplied from common busbars in the generating stations, Tirrill regulators being installed to maintain steady voltage.

The company began to install electric motors about nine years ago, using 600 volt, three-phase induction outfits. About 4500 kw connected load in 600-volt motors is in service to-day. For the past six years the practice of installing 2250 volt motors has been considered standard by the motive-power department and the result has obviously been a great saving in copper over the cost of extending the original system operated on moderately low-potential service. There are now 13,000 kw of 2250-volt motors in service in the mills, so that the total connected motor load figures 17,500 kw at the present time, or nearly one-half as much as the total connected motor load of the Boston Edison company's system. All the motors are wound for 60-cycle service and the larger sizes are provided with external starting equipment applying power to the windings in steps. There are about 275 motors in the plant, ranging in average size from 200 hp to 25 hp. The motors are largely of General Electric manufacture, although a few Westinghouse and other makes are in service. On account of the care with which the motors are wired and maintained the company has so far not had a single accident to its employees resulting from the electric drive and, as is generally the case in textile work, the introduction of electricity into loom driving has resulted in increased production and a better quality of cloth on account of the great steadiness of electric as compared with other motive powers. The curve of voltage regulation at the power station busbar is a clean circle on the recording voltmeter and the results at the textile machinery follow as a matter of course. Hundreds of quarter-turn belts, line shafts, pulleys and other obstructions have been eliminated by the electric drive and it is now the standard method of machine operation in all parts of the plant where water power is not available, only excepting a few instances where the steam-engine drive has not as yet been superseded. In addition to the foregoing improvements the motor drive has effected a gain in the operating spaces available in different departments, has decreased the chances of accident to operatives and has enabled the company to check its power consumption with a convenience and accuracy entirely out of the question with the older forms of mechanical driving. The saving in frictional losses, while not available in figures, has been very large.

Motors are selected on the basis of careful tests of the power requirements of the machines to be driven, with due regard to the elimination of all possible mechanical driving fixtures which can be cut off without sacrificing the flexibility of the installation. In general, the mills are equipped with the group drive, the motors being centrally located and accessible for inspection and repairs. Usually, too, the power required to operate spinning frames is determined by running a group of frames temporarily by a 10-hp motor, testing the power consumption of the frames when running empty, with the spindle half loaded and with the bobbin ready to empty. In the new Coolidge mill, completed early last year, ninety-six motors of 25-hp rating each drive approximately 380 frames of 272 spindles each on a single floor, or 43.5 spindles per horse-power.

The power requirements of loom work are tested by temporary use of larger motors, sometimes as high as 50 hp or 75 hp each. The motors are run with the shafting only to get the friction load, and then a test is made with 75 or 100 looms connected. The power required varies from ⅓ hp to ¼ hp per loom in cotton work, depending upon the width and design of the loom, the style of cloth, etc. Power requirements in miscellaneous service are tested by temporary motor installations in the same general way. Every motor in the mills is provided with an index card, 5 in. x 8 in. in size, upon which are kept the date of installation, the kind of motor, voltage of the supply circuit, rated horse-power and horse-power developed by test in service, together with the location of the motor, list of machinery driven by it, direction of rotation, number of poles, synchronous and full-load speeds, and the diameter, face and bore of the driving pulley. Typical data taken from a few representative cards are shown abridged in the following tabulation:

Motor No.	Rating Hp	Volts.	Hp Delpd.	Speed r.p.m.	Pulley Data.			Machines Driven.
					Dia.	Face.	Bore.	
69	200	2,250	216	575	29	24	25	17 wool-twisting frames.
64	125	2,250	128	585	32	20	4.5	12 272-spindle wool spinners.
19	150	600	150	580	30	18	4.875	192 60 in. looms 64 54 in. looms 126 two-box l'ms. 92 four-box l'ms.
5	75	2,250	65	700	20	12	3	French draw'g and mule spinners.
66	50	2,250	43	885	13	13	3	18 fly, 4 intmdte. f'mes. 7 slubbers.
73	25	2,250	18	1,728	8.5	15.25	2.375	Four 272-spindle spinning frames
122	60	2,250	58	700	18.75	15	3.5	Three blowers, one pump.
127	270	2,250	——	200	syn.	direct conn.		One air compressor

The practice of maintaining such data for all motors installed in the mills has proved to be most useful in reducing idle investment in motor capacity; in determining the power requirements of various divisions of departments, and in facilitating the transfer of motors from one location in the mills to another. In so large a plant there are constant changes in motor locations. The number of each motor remains with it during its life, regardless of where it may be operating, and it is painted on the end shield in yellow, an arrow showing the direction of proper rotation also being painted on the shield in the same color. If a motor is transferred from one grand division to another a letter corresponding to it is placed upon the frame, so that motor No. 100, for instance, originally in service in the southern division and later transferred to the central division, becomes No. "100-C," to distinguish it from motor "100," of the central division, which may already be in service there. Motor numbers and record cards begin in each division at unity and work upward seriatim. Motor tests are made in service either by the use of an indicating meter reading in kilowatts directly, or by the reading of ammeters in the phases and the determination of the power output at a given measured speed from characteristic curves in the possession of the motive-power department. The company maintains such a curve for every motor in its service. In case new or additional machinery is installed on a given motor drive, or in case any machines are withdrawn, a new power test is at once made by the electrical engineering department, and the developed power recorded on the motor index card.

Motors are inspected four times daily, with temperature readings, in the summer season by regular maintainers. The temperatures of the frames are recorded on blanks furnished for the purpose, and each maintainer is provided with a pocket thermometer for this work. Outside the spinning departments about thirty motors are assigned per maintainer, and in the spinning-rooms fifty motors per man are apportioned. The bearings are felt at each inspection in addition to the temperature readings on the stator. Spare coils are carried in stock by the company, and ordinary repairs are made locally. All 2250-volt motors in the mills are provided with slate controlling panels carrying permanently connected ammeters, and an automatic oil switch with no-voltage release coil for each motor. The larger motors, particularly those in loom work, are usually separated by partitions of glass and wood from the operating rooms. Forced ventilation is provided in cases where such motors are housed in the center of a working-room and away from any windows or natural air currents. Cool air is introduced to the motor frames by galvanized-iron duct connections, and the air supply is forced into the compartments by 14-in. fans driven from the line shafts which the motors operate. A few direct-current, variable-speed motors are in service in the operation of cotton and wool tenters. These motors are usually rated at 25 hp each, and ordinarily drive two tenters each. The regular mill hours are from 6:30 a. m. until noon, and from 1 p. m. to 6 p. m., except Saturdays, when the mills close at noon. The starting and stopping of motors is under the direction of department foremen, the work usually being done by so-called "second hands," or foremen's assistants. The electrical department is responsible for the care, inspection and cleaning of the motors, including their maintenance.

All motor frames, switch boxes and conduits are grounded, including both sides of junction boxes. No fuses are employed on motor circuits, and every motor is equipped with an automatic circuit-breaker. Each power circuit at the generating station switchboard is equipped with an indicating wattmeter and an automatic overload oil circuit-breaker, with time-limit relay, and connections are made to frequency and power-factor indicators. Miscellaneous motor applications in the mills are the driving of machine-shop tools, rotary pumps for condensing apparatus, air compressors for general motor and machine cleaning, toilet and lavatory ventilation, operation of large fans on heating service, running of elevators, and the operation of seven electric trucks used in hauling material about the yards. The company maintains a large and well-equipped garage, which has already been described in this paper. Motors are usually installed as near their normal ratings as possible. Numerous clutch connections are provided in the shafting arrangements, so that the temporary shutdown of a motor will not halt production for any length of time. Quite a few motors are also in service driving arc-lighting generators in various portions of the plant, the total capacity of this equipment being about 2000 kw. On account of the reduction in heavy shafting effected by the motor drive it has been unnecessary to strengthen the flooring and ceiling in the older mills where mechanical drives have been replaced by motors. At the main switchboards in the generating stations emergency connections are made with the lines of the Manchester Traction, Light & Power Company, double busbars being provided, with double-throw, remote-control switches. All conduit in the plant is painted pea-green. Oil switches are usually set at 125 per cent load for motors driving machines that start easily, and at 150 per cent of normal load for machinery which starts with difficulty. In the case of eight sets of Brush arc machines, which are driven in pairs by a direct-connected 200-hp induction motor in each case, flexible rubber couplings are provided for insulating purposes between the motor and the generators.

The latest installation of motor-driven machinery is in the new Coolidge mill, which is located on the west bank of the Merrimac River about 2500 ft. from the turbine station of the northern division. In this mill are 127 motors of the induction type, with a total rating of about 5000 kw. Power is transmitted across the river by way of an island in its channel, the porcelain insulators supported on steel towers. There are nine 300,000-circ. mil copper cables, which are carried on spans, and the cables are paralleled electrically to form one three-phase circuit of 900,000-circ. mil capacity per leg. The Coolidge mill is four stories in height, 704 ft. long, 103 ft. wide, and has two wings, each 204 ft. long and 103 ft. in width. The electrical service for the mill is received at the top of a central brick tower and brought to a general supply busbar set in a fireproof compartment on the upper floor level, the tower being anchored into the building proper by steel rods and turnbuckles, on account of the diagonal approach of the electric feeders. The entire wiring of this mill is carried in conduit, with condulet outlets, and the standard cable used is of the triple-conductor varnished-cambric type, with an insulation test of 7500 volts and a working guarantee of 3000 volts.

The distribution arrangement at this mill is of a novel character. Vertical copper busbars are carried downward through the central tower past each floor, and at each level where power is required in the mill a center of distribution has been established. The busbars are 2.5 in. wide x ¼ in. thick, and are hung 24 in. apart on centers from strain insulators attached to two steel channel irons carried horizontally across the tower at the top. The bars are held in place by guide insulators attached to hard pine vertical base strips, kiln-dried, paraffined and shellacked with five coats. The busbars and bases are each surrounded on three sides by solid concrete barriers from 8 in. to 14 in. thick and 14 in. deep, and the total length of the bars is about 90 ft. Each floor is built of concrete with an insulating cork matting on top. A main supply panel is located at the top of the tower, with automatic oil circuit-breaker, the latter being wired for emergency tripping from the different mill floors in case of trouble by the simple method of opening a small knife switch on a low-voltage auxiliary circuit. The line from the power plant to the Coolidge tower is built with insulators arranged in series of four at each attachment, in order to preserve the continuity of service in case of one or two broken insulators. The tops of the steel towers are connected by a grounded line, and the mill tower is equipped with a set of electrolytic lightning arresters. Every group of sixteen 25-hp motors in the mill is provided with a separate feeder panel with automatic oil switch and time-limit relay in the busbar tower, and also an indicating wattmeter. The time-limit relays in the tower are set for operation at from twenty to twenty-five seconds overload. Each feeder circuit is carried from the tower in conduit to its two groups of eight motors, taps being made at each motor to the controlling oil switch at the latter. The size of the tap is equivalent to the carrying capacity of the switch in the tower on the motor panel, so that no fuses are necessary at the motor. Platforms are carried across the manufacturing rooms past the motors, so that each is quite accessible for accurate inspection. The time-limit relays on the motor oil switches are in general set for operation after eight seconds' overload. The vertical busbars are not carried below the first floor, but the concrete recesses in which they are set are carried to the basement, permitting extension in the future if necessary.

INDUCTANCE OF THREE-PHASE TRANSMISSION LINES WHEN THE CONDUCTORS LIE IN THE SAME PLANE.

By Alfred Still.

In an article by the present writer in the *Electrical World*, May 23, 1908, certain formulas were evolved by the aid of which the total induced emf can be calculated in any one of the conductors of an alternating-current transmission system whatever may be the arrangement of the conductors.

In the present article it is proposed to consider the special case, which frequently arises in practice, of the conductors of a three-phase transmission being arranged as indicated in Fig. 1—that is, with the centers of the three conductors lying in the same plane, the minimum distance, *D*, between any two of the wires being approximately equal to the side of the equilateral triangle which would have been adopted had the triangular arrangement been decided upon. The formulas used, if not identical in all respects with those used in the article previously referred to, will be such as can readily be derived therefrom.

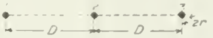

Fig. 1—Three Conductors in One Plane.

In the subsequent calculations of the magnetic flux and the induced emfs resulting therefrom no account has been taken of the magnetic lines of induction *within* the material of the conductors. The error is usually negligible, and some simplification is thereby introduced.

In a three-phase transmission system the current flowing out through any one wire may be considered as returning along the two remaining wires, and when the three conductors occupy the vertices of an equilateral triangle the whole of the return current is at a distance *D* from the outgoing current. This condition also applies to the middle conductor (No. 2) in the arrangement, shown in Fig. 1; but it does not apply to either of the outside conductors, Nos. 1 and 3. In the case of conductor No. 1 a part of the outgoing current returns along conductor No. 2 at a distance *D*, while the remainder returns along conductor No. 3 at a distance 2 *D*; so that the total flux of induction surrounding conductor No. 1 must necessarily be greater than that surrounding conductor No. 2. The same argument applies to conductor No. 3.

In the earlier article, to which reference was made at the outset, the formula which gives the induced volts per mile of single conductor, on the assumption of the sine wave form, is:

$$E = 0.004655 \times f \times \Big[-I_1 \log \frac{D_1}{r} - I_2 \log \frac{D_2}{r} \; . \; . \; . \; - I_n \log \frac{D_n}{r} \Big] \qquad (1)$$

where f = the frequency, r = the radius of the conductor and I_1, I_2, etc., are the currents in the several conductors carrying the return currents at the respective distances D_1, D_2, etc., from the center of the conductor for which the calculation is to be made.

Applying this formula to the arrangement of conductors, as shown in Fig. 1, the quantity between brackets in the case of conductor No. 1 becomes:

$$- I_2 \log \frac{D}{r} - I_3 \log \frac{2\,D}{r}$$

$$= -(I_2 + I_3) \log \frac{D}{r} - I_3 \log 2$$

$$= I_1 \log \frac{D}{r} - I_3 \log 2$$

The total induced emf per mile of conductor No. 1 will therefore be:

$$E_1 = 0.004655 \times f \times \Big[I_1 \log \frac{D}{r} - I_3 \log 2 \Big] \qquad (2)$$

Similarly, for conductor No. 3:

$$E_3 = 0.004655 \times f \times \Big[I_3 \log \frac{D}{r} - I_1 \log 2 \Big] \qquad (3)$$

while the volts induced in the middle conductor (No. 2) will be simply:

$$E_2 = 0.004655 \times f \times I_2 \log \frac{D}{r} \qquad (4)$$

It is interesting to note that what may be referred to as the disturbing element in the case of the two outside wires (the quantities $I_3 \log 2$ and $I_1 \log 2$ respectively) is not dependent upon the actual diameter or distance apart of the conductors. It consists of an emf component either 30 time-degrees or 150 time-degrees behind the phase of the line current, depending upon the order of the phase rotation; and the magnitude of this emf component relatively to the total emf of self-induction will depend upon the value of the ratio $\frac{D}{r}$. If D is large and r relatively small, as in the case of a high-pressure overhead transmission system, then the first quantity between brackets, in equations (2) and (3), is relatively large, and the disturbing element ($I_3 \log 2$ or $I_1 \log 2$) is usually negligible. On the other hand, if the conductors consist of three separate single cables, laid side by side in a trench, with the distance, D, between them small in comparison with the diameter, $2r$, of the cables, then the "disturbing element" becomes of greater importance relatively to the total self-induction or induced emf.

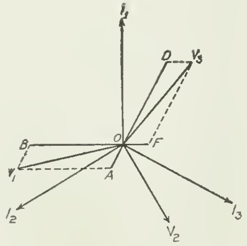

Fig. 2—Vector Diagram of Current and Voltage Relations.

In order to form some idea as to the magnitude of this out-of-balance component of the induction it will be well to work out two numerical examples, one for a high-tension overhead scheme and the other for a low-tension transmission system with the three conductors in comparatively close proximity.

Example 1.—Assumed data: Three-phase power transmitted = 20,000 kw; emf = 110,000 volts; power-factor = 0.8; frequency (f) = 25 cycles per second; length of line = 200 miles. Conductors of aluminum; diameter, $2r = 0.6$ in. Minimum distance between wires, $D = 10$ ft. = 120 in. On the above data the current per conductor is about 130 amp. With the aid of formulas (2), (3) and (4) it is an easy matter to determine the induced emfs in the several conductors, and since the quantity, $\log \frac{D}{r} = \log \frac{120}{0.3} = 2.6021$, while $\log 2 = 0.3010$, it will at once be seen that the "disturbing element" is relatively small.

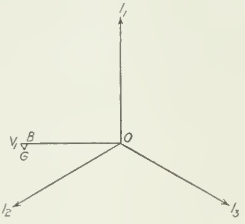

Fig. 3—Vector Relations When Conductors Are Transposed.

The emfs induced in each conductor 200 miles long in round figures are as follows: In the middle conductor (No. 2), 800 volts, the time-phase of which is exactly one-quarter cycle behind the time-phase of the current I_2.

In conductor No. 1, an emf component of 800 volts, exactly a quarter cycle behind the current I_1 less another component (referred to as the disturbing element) equal to about 90 volts, the phase of which is exactly one-quarter cycle behind the current I_3. The resultant is the difference between two *vector* quantities separated by a time-phase angle of 120 deg., so that this resultant is actually *greater* than either of the two components, as will be shown hereafter.

In conductor No. 3 there will be an emf component of 800 volts, one-quarter cycle behind the current I_3, and a component of 90 volts, one-quarter cycle behind I_1.

Example 2.—Assumed data: Three-phase power transmitted = 20 kw; emf = 110 volts; power-factor = 0.8; frequency (f) = 60 cycles per second; current per wire = 130 amp; distance of transmission = ½ mile; three single cables in trench, lying in the same plane with a distance between centers $D = 3$ in.; diameter over copper $= 2r = 0.5$ in.

In this example the quantity $\log \frac{D}{r}$

$$= \log \frac{3}{0.25}$$

$$= 1.0792.$$

The ratio between log 2 and this number is $\frac{0.3010}{1.0792} = 0.28$. That is to say, the component of the total induced emf, which appears only in the two outside conductors, as indicated by formulas (2) and (3) in this example, is numerically equal to more than a quarter of the more important component; while in the previous example of a high-tension overhead transmission system the ratio was $\frac{0.3010}{2.6021} = 0.115$, being considerably smaller because of the greater distance between the wires.

Vector Diagram Illustrating Example 2.—The vectors I_1, I_2 and I_3 in Fig. 2 represent the currents in the three conductors, the time-phase angle between them being 120 deg. The rotation of the phases is assumed to be in the order I_1, I_2, I_3; in other words, I_2 lags behind I_1 by one-third of a cycle, and I_3 lags behind I_2 also by one-third of a cycle. The lengths of these vectors are such as to represent the line current of 130 amp; as the diagram has been drawn to illustrate the phase angles and magnitudes of the various components of the induced emfs the magnitude of the current vectors need not be considered. If the numerical values of the induced volts are determined with the aid of formulas (2), (3) and (4) it will be found that the component common to all three conductors amounts to approximately 19.5 volts, while the "disturbing element"—that is, the component appearing in the two outer conductors only—amounts to 5.5 volts.

The vectors OB, OV_2 and OD must, therefore, be drawn of such a length as to represent 19.5 volts in a direction exactly 90 time-degrees behind the corresponding current vectors; and, so far as the middle conductor is concerned, the vector OV_2 will represent the whole of the induced emf; but in the case of conductor No. 1 (carrying current I_1), OA must be drawn exactly 90 time-degrees *in advance* of OI_3—that is, exactly *opposite* to OD, because of the negative sign in equation (2)—and of such a length as to represent 5.5 volts. By combining OA with OB in the usual way OV_1 is obtained as representing the total emf induced in conductor No. 1. In a similar manner OV_3 is obtained for the total induced emf in conductor No. 3. It is interesting to note that OV_1 lags behind the current I_1 by a time interval *greater* than a quarter period, while the lag of the induced volts V_3 behind the current I_3 is less than a quarter period.

In the particular example under consideration the numerical value of V_1 or V_3 as scaled off from the diagram is 22.75 volts, V_2 being 19.5 volts.

Effect of Transposing the Conductors.—If each conductor in turn is made to occupy the position midway between the remaining two conductors for a distance equal to one-third of the total distance of transmission it is obvious that the out-of-balance effect will be corrected. It will, however, be of interest to ascertain what will be the numerical value of the (equal) voltages induced in the three conductors if transposed in the manner suggested. It is not necessary to consider more than one of the conductors, and, in Fig. 3, *OB* represents (as in Fig. 2) that portion of the emf induced in conductor No. 1 which remains unaltered whether the conductor be midway between the other two or be itself one of the outer conductors. The length of this vector will, therefore, be such as to represent 19.5 volts. Now, when the arrangement of the conductors is in the order 1, 2, 3 (as in Fig. 1), the "disturbing element" will be *BG*, drawn 90 deg. *in advance* of OI_3, exactly as *OA* (or BV_1) in Fig. 2; but the *length* of this vector, instead of being equivalent to 5.5 volts, will be only one-third of this value, or 1.83 volts, because conductor No. 1 occupies this position over only one-third of the total distance of transmission. When the arrangement of the conductors is 1, 3, 2, the "disturbing element" will be GV_1 (Fig. 3), drawn 90 deg. in advance of OI_2. Clearly BGV_1 is an equilateral triangle, and the resultant of the induced emf in conductor No. 1 is OV_1, drawn 90 time-degrees behind the current vector OI_1 and equal in magnitude to the algebraic sum of $OB = 19.5$ volts and $BV_1 =$ one-third of 5.5 volts.

If, therefore, the wires of a transmission line are disposed in one plane, as indicated in Fig. 1, but transposed at intervals so that each wire shall occupy the middle position over a space equal to one-third of the distance of transmission, then the resultant induced emf per conductor will, so far as phase is concerned, lag behind the current by a quarter period, exactly as if the wires occupied the vertices of an equilateral triangle; but the amount of the induced volts will be somewhat greater than in the latter case under otherwise similar conditions.

The numerical value of the induced volts per conductor—that is, the length of the vector OV_1 in Fig. 3—can be calculated by the formula:

$$E = 0.004655 \times f \cdot \left(I \log \frac{D}{r} + \frac{I \log 2}{3} \right) \qquad (5)$$

where I is the current in any one conductor and the two quantities between brackets are merely to be added algebraically

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INDICATING ALTERNATING-CURRENT METERS.

By J. H. Morecroft.

It is the purpose of this brief article to give a suggestion of the precautions necessary, especially in accurate work, when using indicating meters for measuring emf, current and power in an alternating-current circuit.

The fundamental unit in alternating-current work is the ampere and is defined as that value of alternating current which, when flowing through a circuit containing a certain ohmic resistance, will generate heat in that resistance at the same rate as it is generated by the direct-current ampere flowing through the same resistance. The term "ohmic" is used to make the definition complete. If a coil of wire is wound upon an iron core, heat will be generated in the circuit much faster when an ampere of alternating current is flowing through it than when an ampere of direct current is flowing in the circuit. It is only the heat set free by the current flowing against the ohmic resistance reaction which is used to define the ampere of alternating current.

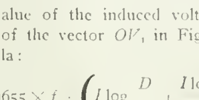

Fig. 1—Square-Top and Pointed Waves.

As the heat generated in a circuit at any instant varies as the (current)² we have the following relation:

If a = instantaneous value of alternating current,
A = maximum value of alternating current,
I = value of direct current to generate same amount of heat per second as is generated by alternating current,
R = ohmic resistance of circuit (no iron in circuit).

$$\int_0^{\pi} a^2 R dt = [I^2 R]_0^{\pi} \text{ or}$$

$$I = \left(\frac{1}{\pi} \int^{\pi} a^2 dt \right)^{1/2}$$

As the quantity in the parenthesis is the average value of a^2, we have the fundamental definition that the effective value of any alternating current, no matter whether the current is a sine wave or not, is equal to (average value of (instantaneous value)²)^{1/2}. When the alternating current is a sine wave $I = \frac{A}{\sqrt{2}}$. It is noticed that this differs from the average value of the alternating current, which is $\frac{2A}{\pi}$ for a sine wave. The ratio of the effective value to the average value is called the form factor and is 1.11 for a sine wave. If the wave is of a square form (*a*, Fig. 1) the form factor is equal to one, while if the wave is triangular in shape (b) the form factor is

$$\frac{a\pi}{\sqrt{3}} \quad \frac{a\pi}{2} = \frac{2}{1.73} = 1.16.$$

From these values it is readily seen that the ratio of the average value of the current to the effective value varies greatly with the shape of the current wave.

When a current is passed through a measuring instrument designed for alternating current the moving element moves away from its zero position and takes up some position where the average value of the impelling force (due to the current) is just equal to the value of the resisting force (spring, force of gravity, etc.).

Now, according to the construction of the meter, the impelling force may vary directly with the first power of the current flowing through the instrument or with the second power, etc.

It is evident from the definition of the ampere of alternating current that if the meter is to record accurately on various wave forms the impelling force must vary with the (current)². As the ampere is defined as the (average value of (current)²)^{1/2}, and the reading of the meter is proportional to the average value of the impelling force, the impelling force must vary as the square of the current. In the case of the hot-wire and dynamometer types of instruments this is strictly true; in the case of instruments employing a moving iron vane (Weston and Thomson) it is approximately true. The force acting on the iron vane is proportional to the strength of the magnet (the iron vane becomes a magnet by induction) times the strength of magnetic field in which it is situated. The field strength varies directly as the current, and so long as the permeability of the iron vane remains constant its pole strength varies directly as the current, so that the impelling force varies with the (current)²

A meter whose impelling force varies directly with the current, if calibrated with sine-wave current, will not read accurately when used with a wave form differing from sine form. The magnitude of its error will be measured by the ratio of the wave-form factor to the form factor of a sine wave.

Now if the current being measured is a distorted wave it may be represented by a fundamental sine wave and a series of harmonics of various amplitudes. If the impelling force of the meter is proportional to the square of the current the reading of the meter will be equal to $\sqrt{A_1^2 + A_2^2 + A_3^2 + \ldots}$, where A_1, A_2, A_3, etc., represent the amplitudes of the fundamental and the various harmonics.

Consider the case of an alternating-current ammeter recording the exciting current of a transformer. This wave is much distorted, but may be fairly represented by the equation

$$x = A_1 \cos pt + A_3 \cos (3\,pt + \Theta)$$

where

A_1 = amplitude of fundamental,

$p = 2\,\pi \times$ fundamental frequency,

A_3 = amplitude of third harmonic.

Θ = distance on X axis between the zero value of the two waves, as in Fig. 2.

Now the meter reading with such a current will be proportional to the average value of the impelling force or average value of x^2.

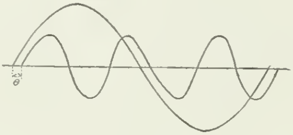

Fig. 2—Waves of Different Frequencies.

$$\text{Average force} = \frac{1}{\pi}\int_0^\pi \{A_1 \cos pt + A_3 \cos (3\,pt - \Theta)\}^2\,dt$$

$$= \frac{1}{\pi}\int_0^\pi A_1^2 \cos^2 pt\,dt + \frac{1}{\pi}\int_0^\pi A_3^2 \cos^2 (3\,pt + \Theta)\,dt$$

$$= \frac{1}{\pi}\int_0^\pi 2\,A_1A_3 \cos pt \cos (3\,pt + \Theta)\,dt$$

The values of the first two integrals are quite evidently

$$\frac{A_1^2}{2} \text{ and } \frac{A_3^2}{2} \text{ respectively.}$$

The third integral can be obtained by expanding the term $\cos\ (3\,pt + \Theta)$.

$$\text{The third integral} = \frac{2\,A_1A_3}{\pi}\int_0^\pi \cos pt \cos (3\,pt + \Theta)\,dt$$

$$= \frac{2\,A_1A_3}{\pi}\int_0^\pi \cos pt\,(\cos 3\,pt \cos \Theta - \sin 3\,pt \sin \Theta)$$

$$= K\int_0^\pi \cos 3\,pt \cos pt\,dt - K_1\int_0^\pi \sin 3\,pt \cos pt\,dt$$

Put $\cos 3\,pt = \cos 2\,pt \cos pt - \sin 2\,pt \sin pt.$

$= (\cos^2 pt - \sin^2 pt) \cos pt - 2 \sin^2 pt \cos pt;$

therefore,

$$K_1\int_0^\pi \cos 3\,pt \cos pt\,dt = K_1\left[\int_0^\pi \cos^4 pt\,dt - 3\int_0^\pi \sin^2 pt \cos^2 pt\,dt\right] = [\cos^3 pt \sin pt]_0^\pi = 0$$

In the same way

$$\int_0^\pi \sin 3\,pt \cos pt\,dt = \int_0^\pi 3 \sin pt \cos^3 pt\,dt - \int_0^\pi \sin^3 pt \cos pt\,dt$$

$$= -\,[\tfrac{3}{4} \cos^4 pt]^\pi{}_0 - \tfrac{1}{4}\,[\sin^4 pt]^\pi{}_0 = 0$$

Therefore the force acting on the moving element of the instrument $= K\left(\frac{A_1^2}{2} + \frac{A_3^3}{2}\right)$; and as the meter scale is graduated in terms of the square root of the impelling force, the reading of the meter will be

$$\sqrt{\frac{A_1^2}{2} + \frac{A_3^2}{2}}.$$

But $\frac{A_1^3}{2} = \left(\frac{A_1}{\sqrt{2}}\right)^2$ = (effective value)^2 of fundamental, and

$\frac{A_3^2}{2}$ = (effective value)^2 of the third harmonic current.

The current indicated by the ammeter will thus be

$$I = \sqrt{I_1^2 + I_3^2},$$

where I_1 and I_3 are the effective values of the fundamental and harmonic.

This demonstration may be easily generalized, and it is found that the meter indication for any complex wave is

$$I = \sqrt{I_1^2 + I_3^2 + I_6^2 +}$$

As the alternating-current voltmeter is an essentially non-inductive resistance, the current flowing through its moving element will be of exactly the same shape as the emf wave. Therefore, when acted upon by a complex wave the meter indication will be $E = \sqrt{E_1^2 \times E_3^2 + E_5^2 +}$, where E_1 = amplitude of fundamental, etc.

The validity of these two formulas may be readily tested. Connect two alternators of different frequencies in series with one another. Read the voltage of each alternator and of the line and results will be obtained as in Fig. 3. Or two currents of different frequencies, the amplitude of each of which can be measured, may be used to check the current formula. Send both currents through the same ammeter and it will be found that the meter reading will be the square root of the sum of the squares of the individual currents.

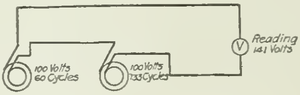

Fig. 3—Superposition of Voltages.

In electrical quantities the different frequencies are all simply related—that is, there are the third, fifth or seventh harmonics, etc. In case the two frequencies are very nearly alike the integral of the cross product will have different values depending upon the interval over which the integral is taken. The force acting on the moving element of the meter will vary with a comparatively slow period, and if the frequencies are close enough together, the reading of the meter will be a fluctuating one, the amount of fluctuation depending upon the relative magnitudes of the two frequencies. In Fig. 3, if the frequencies were 60 and 60.1 respectively and the voltages each 100 volts, the voltage of the line would oscillate between 0 and 200.

When the question of power measurement in a circuit having either the current or emf, or both, complex quantities is considered the action of the wattmeter must be analyzed.

The field in such an instrument is produced by the current in the circuit, and the current in the moving coil is of the same shape as and proportional to the voltage of the circuit being tested. The impelling force will then vary as the product of these two quantities.

Suppose the emf is simple harmonic

$e = E \cos pt;$ and the current complex, as

$x = A_1 \cos (pt + \phi) + A_3 \cos (3\,pt + \Theta)$

what will the wattmeter read when connected to such a circuit?

$$\text{Average force} = \frac{1}{\pi}\int_0^\pi E \cos pt \left[A_1 \cos (pt + \phi) + A_2 \cos (3\,pt + \Theta)\right] dt = \int_0^\pi EA_1 \cos pt \cos (pt + \phi)\,dt + \frac{1}{\pi}\int_0^\pi EA_3 \cos pt \cos (3\,pt + \Theta)\,dt.$$

Now it has previously been shown that an integral of the form of the second term is equal to zero, therefore,

$$\text{average force} = \frac{1}{\pi}\int_0^\pi EA_1 \cos pt \cos (pt + \phi)\,dt$$

$$= \frac{E\ \ A_1}{\sqrt{2}\ \sqrt{2}} \cos \phi.$$

This analysis may be carried out for a current containing any number of harmonics, but it will be found that the wattmeter reading is equal to the product of the effective values of the emf, and the fundamental current and the cosine of their phase difference. So long as one of the quantities, emf or current, is a simple harmonic the wattmeter reading is entirely independent of any upper harmonics which may exist in the other quantity.

If, however, there is a third harmonic in both emf and current, then the wattmeter reading will be proportional to

$$\frac{1}{\pi}\int_0^\pi (E_1 \cos pt + E_3 \cos (3\,pt+\gamma))$$
$$(A_1 \cos (pt+\phi) + A_3 \cos (3pt+\theta))\, dt.$$

Upon evaluation this integral yields two terms, or the

$$\text{wattmeter reading} = \frac{E_1}{\sqrt{2}}\,\frac{A_1}{\sqrt{2}} \cos \phi + \frac{E_3}{\sqrt{2}}\,\frac{A_3}{\sqrt{2}} \cos (\gamma - \theta).$$

That is, the wattmeter reading is the sum of the watts obtained by multiplying the effective value of each voltage by the effective value of the current of the same frequency by the cosine of their phase difference.

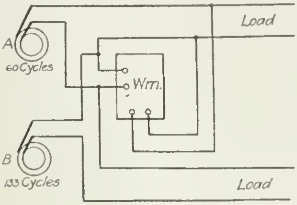

Fig. 4—Superposition of Currents.

That the conclusions reached in this analysis are correct may be readily proved experimentally. Make connection as in Fig. 4, and arrange the wattmeter to measure the load of alternator A, furnishing power at some convenient frequency, say 60 cycles. Arrange a load on the alternator B of a frequency different from that of A. Pass the current delivered by machine B through the current-coil of the wattmeter. It will be found that the current furnished by machine B has no effect whatsoever on the reading of the wattmeter, it merely indicating the power delivered by machine A. Of course, it will readily be appreciated that the currents and emfs of each machine must be pure sine waves. If the current delivered by machine B has in it some harmonic of the same frequency as some upper harmonic of machine A, then some effect will be produced on the wattmeter when machine B is loaded.

From this simple discussion it is evident why the power-factor of a circuit in which there is flowing a complex current is more or less a fictitious quantity. The ratio of watts to volts × amperes gives a certain number, but the significance of such number is not at once apparent. The wattmeter takes no account of the upper harmonics, but the product, volts × amperes, does involve them indirectly, because the ammeter reads the (root mean square) of the amplitudes of the fundamental and all upper harmonics which may be present. The value of ϕ so obtained does not signify the phase difference of the zero points of the emf and current waves of the circuit. Neither does it signify the phase difference of the emf and the fundamental current wave. The real significance of ϕ so obtained is the phase displacement of the emf and a fictitious simple harmonic current, the effective value of which is the same as that of the complex wave, the frequency of which is the same as that of the fundamental current, and the phase of which is such that it would produce on the wattmeter the same effect as is produced by the actual complex wave.

Questions which involve the points brought out in the above analysis may, and undoubtedly will, arise when specifications of power consumption in circuits involving complex currents are more rigidly enforced. A case to illustrate this point is the magnetite arc fed from the mercury-arc rectifier. This lamp is a direct-current lamp, and one would naturally use a direct-current voltmeter and ammeter to measure the power consumption of such a lamp. But the current delivered by the mercury-arc rectifier is a pulsating one. It may be roughly approximated by the equation

$$x = A + B \sin pt.$$

A direct-current ammeter cannot accurately record such a current. The current supplied to the lamp is really the (root mean square) of the pulsating current, and it is necessary to use an alternating ammeter to get this value. But stray fields, such as the earth's field, may affect the reading of the latter meter in measuring such a pulsating current, and it will therefore be necessary to take reversed readings with the meter and average the two. Shall the power used by such a lamp at the arc be measured by a wattmeter or by volts × amperes?

It has been noted that if a complex emf and current are supplied to a wattmeter its indication will be

$$E_1 I_1 \cos \phi_1 + E_2 I_2 \cos \phi_2 + E_3 I_3 \cos \phi_3 +$$

Suppose that a complex current of the form

$$x = I_1 \cos p_1 t + I_2 \cos (p_2 t + \theta_1) + I_3 (\cos p_3 t + \theta_2)$$

is passed through the current coil of a wattmeter and on the potential coil of the wattmeter there is impressed a sine emf of frequency $= p_2$ and amplitude $= E_2$ the reading of the wattmeter will be $E_2 I_2 \cos (p_2 t + \phi)$.

Suppose now there is some method of gradually changing the phase of E_2, with respect to the current passing through the wattmeter; then as ϕ is varied the indication of the wattmeter will vary and will become a maximum when $\phi = 0$. Then the reading of the wattmeter will be $= E_2\ I_2$.

As E_2 can be measured, the value of I_2 is readily computed; and if the phase of E_2 is known with regard to the emf causing the complex current to flow, both the magnitude and phase of the upper harmonic I_2 are known. In the same way by impressing on the wattmeter a voltage E_3 of frequency p_3, the third harmonic of the complex current can be measured in phase and magnitude. Here, then, is a very easy method for analyzing complex waves. For high frequencies perhaps the inductance of the wattmeter may introduce difficulties in properly determining phase, etc. But for a rapid and fairly accurate analysis of waves for the upper harmonics, not exceeding perhaps 500 cycles, this method is probably as good as can be obtained.

DIRECT-CURRENT VERSUS ALTERNATING-CURRENT ELECTRICAL EQUIPMENT FOR CRANES.

THE induction motor was early welcomed by engineers in general as a very opportune medium for the direct application of power from alternating-current circuits for general industrial purposes. In comparison with its more mature competitor, the direct-current motor, it was considered to possess desirable simplicity and ruggedness to withstand the abuses of service, as well as good speed regulation, at rated speed, and fair efficiency.

It was, however, recognized as having less desirable torque characteristics and very poor regulation at intermediate speeds, which latter practically eliminated it from the field of adjustable-speed motors.

Between zero and full speed the polar-wound induction motor, with adjustable secondary resistance, has speed-torque characteristics quite similar to a series-wound direct-current motor. The former, however, will not exceed its rated (synchronous) speed, even at no load, and it possesses a certain maximum torque, which, if exceeded, will cause the motor to "break down" and come to rest.

The last-mentioned limitations have not prevented the increasing application of induction motors to cranes, hoists and for other industrial purposes to which the series-wound direct-current motor is generally applicable.

The question of the selection of motors arises in connection with almost every installation of the latter character in an establishment the power for which is primarily generated and distributed in alternating-current form. The power-plant engineer will naturally champion the alternating-current equipment wherever applicable, because it does not require additional capacity in rotaries or motor-generators to convert alternating current into direct current. The shop manager, to whom the apparatus in question is only a part or adjunct to the general manufacturing process, may have had long and satisfactory service from direct-current equipments on the same kind of apparatus, and, having in mind only the continuation of the manufacturing process without embarrassment or interruption, he will insist upon the direct-current equipment.

A good illustration of the foregoing is found in the United States navy yards, in which the use of motor-driven machinery has kept well abreast of the best practice from the beginning. Until about 1905 the navy yards were with few exceptions equipped with direct-current power plants. Subsequent to 1905 the yards at Boston, New York, Philadelphia (partially), Norfolk, Charleston, S. C.; Mare Island, Cal., and Puget Sound, Wash., have been or are being equipped with central stations in which power is generated at 2300 volts, 60 cycles, three-phase, and distributed at 220 volts for power purposes. The yards at Portsmouth, N. H.; Washington, D. C.; Pensacola, Fla., and the naval stations at New Orleans, La., and Cavite, P. I., continue to use the existing direct-current plants.

The introduction of the alternating-current motor in the first-mentioned navy yards, to supersede the direct-current motor for all constant-speed service, has been continued as fast as alternating current has become available.

Naturally the tendency of the alternating-current motor, for reasons above stated, is to encroach farther and farther into the field of the direct-current motor. This movement met with decided opposition when it advanced upon the field of cranes, especially jib and traveling cranes in shops and foundries. In order to obtain a more comprehensive understanding of the relative advantages of direct-current and alternating-current equipments for cranes the Bureau of Construction and Repair, Navy Department, communicated with twelve of the principal American crane manufacturers, and their opinions were solicited upon this subject, having in mind the existing conditions at navy yards. Opinions were invited under the following headings: Reliability, first cost, cost of upkeep and maintenance, power efficiency, and speed and accuracy of control. The different crane builders are designated anonymously by capitals "A" to "L" inclusive. Quotations under "M" are from the opinion of one of the principal users of cranes in this country. To avoid duplication of evidence only those opinions are given which appear to present a different argument from the others.

By permission of the Navy Department and the different crane builders the following are quotations from the replies received. Crane builder "A" preferred not to be quoted on this subject:

RELIABILITY.

Crane Builder "B": "In this respect one motor we consider just as good as the other. The alternating-current motor has a slight disadvantage in that the air-gap is smaller than in the direct-current motor."

Crane Builder "C": "The ——— standard crane design and construction is the same in all mechanical parts, whether equipped with direct-current or alternating-current motors. The use of alternating-current motors eliminates the possibility of overloading the crane to a dangerous extent by careless handling, the maximum torque which these motors will develop being predetermined and proportioned to the work the motor will be called upon to perform under maximum safe conditions; whereas, under similar conditions, in the case of a crane equipped with direct-current motors the current will increase and the torque increases in proportion, resulting either in the motor being burned out or in the crane being damaged by the straining of the parts." (Note:—Such a contingency is guarded against by the installation of overload devices in the electric circuit.)

Crane Builder "D": "As applied to cranes, there may be a slight advantage in favor of alternating current, but such figures as we have at hand do not show any material advantage in this respect. Formerly, probably not over 10 per cent of our electric cranes were equipped with alternating-current motors. More recently we think probably 25 per cent or more have been thus equipped. We have never had any difficulty in applying alternating current to our cranes, for we have so designed them that the mechanical portion of the cranes is interchangeable with either direct-current or alternating-current equipment."

Crane Builder "E": "The alternating-current motor has the advantage due to the fact that it is practically impossible to burn it out owing to overloading, as when the motor is overloaded very greatly it will stall and refuse to operate. This we consider a decided advantage, and it prevents the operator from overloading the crane to a dangerous point."

Crane Builder "F": "The reliability of induction motors for crane service is now beyond question and their use for this service is being continually increased."

Crane Builder "G": "The direct-current apparatus has practical advantages which, in our judgment, serve to offset the superior reliability and the reduced maintenance cost of the alternating-current apparatus. If we had both kinds of current in our establishment we should undoubtedly use direct current for our cranes and for all other cases where a variable speed of motor is desirable."

Crane Builder "H": Less insulation strain on the windings of direct-current motors and no trouble from transformer action caused by small defects in stator or rotor circuits; otherwise, we consider reliability about equal."

Crane Builder "I": "Either type of motor will prove reliable, provided motors of proper size are used on properly designed cranes. When cranes are equipped with alternating-current motors that are required to do hard and continuous service motors of higher horse-power should be selected than when direct-current motors are used."

Crane Builder "J": "Equally reliable."

Crane Builder "K": "So far as we know we made the first alternating-current crane built in this country. It was installed in 1899 and has been in continuous service ever since. But our conclusion is as follows: Alternating-current motors are just as reliable in every way as the direct-current motors."

Crane Builder "L": "Both equipments are successful in performing the functions regularly required of a crane, and it appears more a question of the power plant and the source of energy than one of merely the selection of crane equipment. In large industrial plants it would appear to be a pretty even stand-off whether the alternating-current cranes should be used, with possibly higher cost of crane equipment, or whether converting apparatus should be introduced between the cranes and the power station and direct current used."

FIRST COST.

Crane Builder "B": "An alternating-current crane must necessarily cost considerably more than a direct-current crane. Alternating-current motors usually cost about 35 per cent more than direct-current motors of the same horse-power capacity. Furthermore, it is usually necessary to select an alternating-current motor of larger capacity in order to obtain the requisite starting torque. The capacity of a direct-current motor is limited by its temperature rise only, while in the case of the alternating-current motor the starting torque is the limiting factor, and the motor very often cannot be loaded up to its full temperature capacity. Alternating-current motors, as a general rule, require more space than direct-current motors, which is reflected in the size and weight of the trolley. The wiring is more expensive for an alternating-current crane. On the other hand, if only alternating current is available a motor-generator set is required to transform alternating current into direct-current. We find usually that in cases where alternating current only is available alternating-current equipment is cheaper in first cost if there are only one or two cranes; if, however, there are four or more cranes the total price of all the direct-current cranes, plus the motor-generator, will be less than the total price of all the alternating-current cranes. A generator capacity in kilowatts equal to 20 per cent of the total horse-power rating of all the motors will usually be found ample. In cases where lifting magnets must be used a direct-current supply must be available. Also, for bucket cranes we consider the direct current very much superior."

Crane Builder "C": "The first cost is in favor of the direct-current equipment, this being about 15 per cent to 20 per cent less than in the case of the alternating current. The first cost of alternating-current-equipped cranes more closely approaches the cost of direct current, as the manufacturers of electrical equipment are commercializing and standardizing the alternating-current equipment. The slight difference in cost is practically offset by the reduced cost of maintenance."

Crane Builder "D": "Alternating-current motors increase the cost of electric traveling cranes, first, because the initial purchase cost of such electrical equipment is higher; second, because the auxiliary electrical devices, like electric brakes, limit stops, etc., are more expensive to make; third, there is a small additional labor cost in the crane itself. The usual additional first cost of a 60-cycle crane over a direct-current, 220-volt crane will run from 15 per cent to 18 per cent."

Crane Builder "E": "The selling price of an alternating-current crane is about 15 per cent to 20 per cent higher than a direct-current crane. This is accounted for by several things. There are only two concerns furnishing alternating-current[1] equipments complete. Alternating-current wiring is more expensive, requiring more wires and wires of larger capacity, due to the wattless current that is flowing at the time of starting the motors."

Crane Builder "F": "The first cost of induction motors is greater than direct-current motors, because it is necessary to use alternating-current motors of larger horse-power on account of the limited overload capacity of such motors."

Crane Builder "G": "The first cost is in favor of the direct-current motors."

Crane Builder "H": "Alternating-current equipment costs more than direct current, ranging, roughly, from 10 per cent to 20 per cent. It is also heavier than direct current for same power requirements."

Crane Builder "I": "The cost of cranes equipped with alternating-current motors are usually considerably more than those equipped with direct-current motors. No proportion can be laid down owing to the fact that cranes are special and the proportion of cost of the electrical apparatus varies greatly."

Crane Builder "J": "About the same first cost."

Crane Builder "K": "The first cost would probably run from 1 per cent to 2 per cent greater for the alternating-current equipment."

Crane Builder "L": "If the customer is compelled to transform alternating current into direct current for the operation of direct-current cranes we should have to add to the cost of the direct-current equipment its proportionate share of the motor-generator or rotary-converter installation, which would doubtless bring the cost of the direct-current crane up very close to the alternating-current crane. There would, therefore, not appear to be a very wide question regarding the cost of crane equipment.

COST OF UPKEEP AND MAINTENANCE.

Crane Builder "B": "There is very little difference to be expected between the two. The motor bearings of alternating-current equipment have to be renewed from time to time on account of the small air-gap. On the other hand, the direct-current motor will require more frequent brush renewals. The commutator will last as long as the slip-rings of the induction motor."

Crane Builder "C": "The cost of upkeep and maintenance on all mechanical parts is equal; on the electrical parts the alternating current has the advantage for reasons explained under the heading of 'Reliability,' although the direct-current motor cannot be considered an expensive machine to maintain."

Crane Builder "D": "Considering the higher cost of repair parts we doubt if there is anything in favor of alternating current under this heading."

Crane Builder "E": "The cost of maintaining an alternating-current crane will be much less than a direct-current crane."

Crane Builder "F": ""The cost of maintenance for induction motors we believe is slightly less than for direct current, since the former has no commutator."

Crane Builder "G": "The use of alternating current apparatus will result in reduced maintenance cost."

Crane Builder "H": "Direct-current motors are easier and cheaper to repair, otherwise maintenance appears about equal."

Crane Builder "I": "With properly designed cranes having motors of the proper size the upkeep and maintenance of cranes equipped with alternating-current apparatus should be considerably less than that of those equipped with direct-current apparatus."

Crane Builder "J": ""It is our opinion that this would be about the same, if not less, with the alternating-current equipment."

Crane Builder "K": "The cost of maintenance is somewhat less with alternating-current equipment."

Crane Builder "L": "With the recent mill-type design in alternating-current motors there would be little choice in the quality of installation. The direct-current motors, on account of their commutators and brushes, would be probably somewhat more expensive to maintain, but this would be partially counterbalanced by the somewhat increased control maintenance of the alternating-current equipment."

POWER EFFICIENCY.

Crane Builder "B": "Considering a straight alternating-current crane installation, on the one hand, and a direct-current crane installation with a motor-generator set, on the other hand, the former will invariably show a higher power consumption and a lower power factor at the switchboard of the power house than the latter."

Crane Builder "C": "The average electrical efficiency of cranes is about 86 per cent with either direct-current or alternating-current motors, increasing or decreasing according to the horse-power of the motors used."

Crane Builder "D": "We do not consider that the mechanical or electrical efficiency of the alternating-current machines is higher than that of the direct-current."

Crane Builder "E": "We do not believe there is any advantage in either alternating current or direct current."

Crane Builder "F": "In starting, the induction motor consumes a proportionately heavier current than the direct-current and, as crane service requires frequent starting, alternating-current equipment will use more power than direct-current."

Crane Builder "G": "The power efficiency of direct-current motors is considerably greater than the variable-speed induction motors."

Crane Builder "H": "Direct-current motors are superior to alternating-current in that there is no loss due to low power-factor. The average day efficiency is, therefore, greater unless constant loads are handled and a constant line voltage is maintained."

Crane Builder "I": This should be somewhat in favor of the alternating-current equipment"

Crane Builder "J": "In calculating the size of an induction motor for any specific duty, it is very essential to select a motor which will have sufficient maximum torque to meet any demands which it will be called upon to supply in the particular service. The comparative efficiencies of the two types of motors can best be obtained from the motor manufacturers."

Crane Builder "K": No comments.

Crane Builder "L": "With regard to efficiencies there would be no very wide difference in the efficiency of either crane equipment."

SPEED AND ACCURACY OF CONTROL.

Crane Builder "B": "On this subject we consider that there is really no comparison and feel that the direct-current crane is very much superior to the alternating-current. When you have in mind that the average load on the crane hook is only a fraction of the full capacity of the crane it must be evident that the direct-current crane can handle almost twice the work in a given time and for the same horse-power capacity of motor. The characteristics of the direct-current series-wound motor permit of a much closer speed regulation than the alternating-current motor, which will be appreciated whenever accuracy in handling the material is demanded.

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[1] Attention is invited to the fact that Crane Builder "E" considers the market for alternating-current equipments unfavorable, from a commercial standpoint, for the development and adoption of this form of equipment in competition with the direct-current equipment. Note the comment of Crane Builder "C" under "First Cost" upon this point.

"We have given you this information in the shape we understand you desire it, but we cannot let go of the subject without laying some emphasis on the advantages which we feel obtain in the direct-current over the alternating-current motor for crane work generally."

Crane Builder "C": "The maximum speed with full load on a properly designed crane is the same with alternating-current or direct-current motors. This speed increases with the decrease of load on direct-current cranes; on alternating-current cranes this speed is constant. It is possible to handle light loads more expeditiously with direct-current motors. All things being equal, it is generally agreed that 220 volts direct current is most satisfactory."

Crane Builder "D": "In our standard specifications we usually figure that the empty hook or a very light load can be hoisted by a direct-current motor at two and one-half to three times the speed of the full load. With alternating current the maximum speed under any load is practically the same as the full-load speed. This makes the direct-current series-wound motor an especially efficient and valuable adjunct to the modern electric traveling crane."

Crane Builder "E": "We have in this question the real important point that must be considered in deciding whether to use alternating current or direct current. Alternating-current motors do not accelerate nearly as fast as a series direct-current motor. For this reason it is impossible for an alternating-current crane to compete with a direct-current crane in a plant where it is essential that a crane act promptly. We have found that one of the greatest disappointments to the user of alternating-current cranes is the fact that the speed of the hoist is practically the same at light loads as at full loads. We have recently closed a contract[2] with the ——— Company covering several cranes in capacities from 20 tons to 50 tons, all of which are alternating current. This would seem to indicate that this company on account of the advantages in the use of alternating-current equipment is going to give up some speed in handling."

Crane Builder "F": An advantage of the direct-current motor is its increased speed with reduced loads. This characteristic you will note results in a considerable saving in time with direct-current equipment, making it possible to accomplish much more work since most crane movements are with comparatively small loads. Another advantage in favor of the direct-current motor is that if the voltage drops below normal it results in a corresponding drop in speed, but does not reduce its torque, whereas with the induction motor the torque varies with the square of the voltage."

Crane Builder "G": "In the alternating-current apparatus the entire working range of motor speed is not large. With the resistance cut out—that is, with the controller in the last notch —the speed of the heaviest load will be the same as the speed of the lightest; in other words, you cannot lift a light load any faster than you can lift the heaviest for which the crane is designed. With direct-current apparatus you have the great advantage that with light loads the motor will run at an accelerated speed, and you will be able to handle such loads two or three times as fast as your heaviest loads."

Crane Builder "H": "With variable speeds the direct-current motor is more efficient. This is also true with variable loads. Having a larger relative starting torque the direct-current motor will accelerate loads faster than alternating current. On heavy loads that are to be lifted slowly and but a short distance at a time, for example, picking up the cope of a mold in the foundry, the direct-current motor will start and run slowly without speeding up in a way not ordinarily obtainable with the alternating-current motor. Where loads are uniform and where speeds are required which correspond to full load on the motors we believe there is little difference."

Crane Builder "I": "With equal horse-power of motors this should be in favor of the direct-current apparatus, owing to the greater flexibility and greater ease of control."

Crane Builder "J": "With the class of apparatus which we manufacture we find the induction motor meets every condition quite as well as the direct-current motor."

Crane Builder "K": "You have the advantage of the series-wound crane motor speeding up on direct current which you do not have on alternating current. That is, with a full-load speed of 20 ft. per minute the low-load speed would be about 45 ft. per minute. If you were using alternating current the full and low-load speed would be the same."

Crane Builder "L": "It has been proposed by some users of alternating-current cranes to install permanent resistance in series with the secondaries of the motors, so that the speed would drop off materially under load and speed up under light load. This, however, involves considerably increased motor capacities at increased price and much lower operating efficiencies, and represents merely the case of desperation to approximate direct-current crane operating conditions. Other plans have been suggested to accomplish the same result, but the fact remains that the inherent characteristics of the motors in this particular regard are less favorable in alternating-current than in direct-current installations."

"M": "There is a general impression throughout the trade that cranes, especially for foundry service, cannot be operated as well with alternating-current motors as with direct current. This impression was prevalent among some of the engineers when the time came for a decision for the type of crane to be installed in our new works. As a result a committee was appointed, of which I was a member, which conducted very extensive tests on cranes in our works and demonstrated beyond the question of a doubt that just as delicate control could be obtained by the alternating-current crane as by the direct-current. As an example of this, we took a 5-ton load on an overhead traveling crane and were able to hoist and lower by increments of 1/16 in. and travel and trolley about ⅛ in. The load was then changed to 50 lb. with practically the same results.

"The policy of our company as regards the choice of alternating current versus direct current depends on the original supply of current. If the original supply of current which you are to use in the foundry is alternating current, do not change to direct current for your cranes. If it is direct current, do not change to alternating current for your cranes.

"There is, however, one inherent advantage in the alternating-current motor for crane work which cannot be obtained from direct current, and we have had cause many times in our works to notice this. Where the cranes in our foundry are direct current if the craneman is trying to pull a very heavy casting from the sand and it is not properly loosened up he will invariably plug or hold his breaker if he is not able to pull the casting from the sand with the ordinary setting of the breaker. This in several instances has caused serious breakages of chains and gearing on the cranes. This, of course, would be impossible with an alternating-current motor of the proper size. Regardless of whether he had his breakers plugged or there were none, the alternating-current motor would fail after a certain torque was reached and more current sent through it. This, however, is not true in machine shops in general, as no piece goes into the machine shop which cannot be handled."

CONCLUSIONS.

By consulting the table on the following page it will be seen that under the headings "Reliability" and "Efficiency" favor appears to be about equally divided. First cost, maintenance, and speed and accuracy of control are the more important considerations involved in the selection of crane equipment, and, from the standpoint of the crane builders, favor is decidedly on the side of the direct-current equipment, especially as regards the most important feature, speed and accuracy of control.

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[2] The extracts under "M" are quoted from the opinion of the manufacturer referred to, in reply to an inquiry as to the considerations which led to the adoption of alternating-current equipments.

It is fair to assume that a slight prejudice against alternating-current equipment exists among crane builders for the reason expressed by builder "E" under "First Cost"—that is, there are only two American firms which regularly furnish alternating-current crane equipments. Several crane builders manufacture their own direct-current crane equipments.

RÉSUMÉ OF OPINIONS.

Crane Builder.	Reliability	Lowest First Cost	Lowest Upkeep and Maintenance	Efficiency	Speed and Accuracy of Control
A		D C		A C	D C
B		D.C.		D C	D C
C	A C	D C	A C		D C
D	A C.	D C			D C
E	A C.	D.C.	A C.		D.C
F	A.C.	D C.	A.C	D C.	D C
G	D C	D C	A C	D.C	D C
H	D C	D C.	D C	D C.	D C
I		D C.	A.C.	A C	D C
J			A.C.		
K		D C	A C.		D C
L					D.C
	2 D C.	10 D C.	1 D C.	4 D C	11 D C
	4 A C		7 A.C.	2 A C	
	6 no choice	2 no choice	4 no choice	6 no choice	1 no choice

Total: 28 for direct current; 13 for alternating current; 19 no choice.

Having in mind the foregoing, the following conclusions appear logical:

(a) Where the current supply to a shop is direct current the crane equipments of that shop will naturally be direct current.

(b) Where the current supply is alternating current and additional motor-generator or converter capacity would be required for direct-current cranes judgment should be guided by the considerations set forth by crane builder "B" under "First Cost."

(c) Where speed is of importance and the loads to be handled vary widely in weight, the majority being small compared with the crane capacity, direct-current equipment should be selected.

(d) Where delicacy is of importance direct-current cranes have established their effectiveness. Manufacturer "M" produces evidence of satisfactory delicacy and control having been obtained with alternating-current cranes. This is a matter of controlling appliances more than anything else, and although direct-current crane-controlling appliances are undoubtely more fully developed than alternating-current appliances, if the desirable degree of control is guaranteed by the manufacturers of alternating-current controlling appliances, the alternating-current equipment should receive equally favorable consideration as regards delicacy.

(e) If the source of current supply to the shop is alternating current and the loads are intermittent and relatively heavy, there appears no reason why alternating-current cranes should not be installed. The motors, however, should be carefully selected as regards capacity, so that their maximum torque will be ample for handling the heaviest loads.

Central Station
Management, Policies and Commercial Methods

COMBINATION ELECTRIC-LIGHT PLANT AND CREAMERY.

A plant recently started at O'Neill, Neb., by the O'Neill Light & Power Company carries on the unique combination of an electric light and motor and a creamery business. The combination of these two industries made it possible to install an electric-light plant where otherwise the enterprise would be of a doubtful financial character. The motive power is a Murray 45-hp Corliss engine belted to a line shaft. From this line shaft is driven a 50-kw, three-phase, 2300-volt alternator at 900 r.p.m. For the creamery business there is belted to the line shaft a 10-ton DeKalb refrigerating machine, made by the Creamery Package Company. The other machinery for the butter and ice-cream making is also driven by the line shaft. The establishment has a capacity of one car of butter per week and 300 gal. of ice cream per day. Provision is made for adding another unit as the business grows. The engineering features were worked out by Mr. B. C. Adams, general manager of the Lincoln Gas & Electric Company, of Lincoln, Neb. The officers of the O'Neill Light & Power Company are Mr. R. W. McGinnis, president, and Mr. A. A. Driggs, secretary and treasurer, both of Lincoln, Neb. Mr. H. R. Holdeman is superintendent of the electrical plant.

WOOD MILL USING CENTRAL-STATION DRIVE SELLS REFUSE AT PROFIT.

A large stave mill at Galveston, Tex., which formerly burned its refuse in its own 100-hp isolated steam plant, is now operated by 40 hp in electric motors using central-station service. This motor drive costs the mill $60 to $65 a month at 4 cents per kw-hour, while it sells the refuse formerly burned to the local gas company for $1.15 per ton delivered, or about $150 per month. The gas company utilizes the oak shavings and refuse for fuel in its water-gas plant, replacing oil that formerly cost $400 to $500 a month. A ton of the oak fuel, reports Mr. F. M. Lege, manager of the local company, is equivalent to about 4 bbl. of oil. Special furnace settings had to be designed to burn the wood to the best advantage, but the existing boiler equipment was converted for the purpose at very slight cost. The wood mill finds the new arrangement very satisfactory as it saves both cost and labor, and the gas company has been able to cut its fuel cost considerably. The figures above given for the stave mill's saving do not adequately represent the entire economy gained by the customer, for he has since added several machines.

Several other wood-mill customers of the Brush Electric Light & Power Company, of Galveston, also report substantial savings in replacing steam by electric power One such mill, which formerly burned all its refuse besides $100 worth of coal per month, now pays $80 a month for electric service to its 100 hp in motors, sells its by-products for $100 and saves the entire cost of its coal, netting an economy of about $120 a month.

DEMONSTRATION BY MODEL OF ELECTRIC SERVICE IN DENVER.

At a recent meeting of the N. E. L. A. company section of the Denver Gas & Electric Company Mr. H. S. Russell, one of the electrical engineers of the company, gave a demonstration, by the aid of a model, to illustrate the salient features of the generation and distribution of electrical energy as exemplified by the Denver company's system.

Simple forms of apparatus were used. The hydroelectric system of the Central Colorado Power Company was represented by a water motor driving a small alternating-current generator, the energy from which, by three transformations, was delivered to the buses of the West Side station of the Denver company. To represent one of the three steam generating stations of the company a small steam engine driving an alternating-current generator was used, the output of this unit being also delivered to the buses. Direct current was generated by means of motor-generator sets, a belt-driven combination being used to represent this type. A sectional model of the modern steam boiler was employed to illustrate the construction and operation of steam-raising apparatus.

From the alternating-current and direct-current buses circuits were run out to represent the distribution of the following classes of service: Single-phase current for lighting, three-phase current for motors, direct current for motors, and a transmission line to neighboring towns for lighting and motor purposes.

The idea of demonstrating by this ocular means the manner in which the company serves its customers proved very attractive to the members of the section, and the demonstration was viewed with much interest. At further meetings the distribution of gas and electricity will be taken up in greater detail, using miniature apparatus for the purpose.

SALE OF ELECTRICITY BY ELECTRIC RAILWAYS.

In the discussion following the presentation of a paper on "Development of the Auxiliary Load for Railway Power Plants," by Mr. J. C. Young, Cedar Rapids & Iowa City Railway & Light Company, read at the recent Iowa street-railway convention, Mr. Mathes, of Dubuque, noted that the general trend nowadays is for electric railways to increase their revenue in any possible way and for this reason many roads had undertaken to sell energy from the trolley wires or transmission line.

Mr. Crafts, of Clinton, said that the Iowa & Illinois Railway a few years ago undertook the sale of energy. The tendency then was to sell 500-volt energy from the trolley wire and to have the purchaser build his line to the right-of-way fence, where protective devices were installed. Mr. Crafts criticised this plan because the expense for fuses, burned meters and upkeep overbalanced the profits from the sale of the energy. He now has two direct-current motor customers, one with a 5-hp motor and the other with a 50-hp motor. The former installation is located near a carhouse and the latter near a substation, so that the cost for attendance to the customer's service line and connection is not unduly large.

At Princeton Mr. Crafts' company is furnishing energy for a circuit of 40-watt series-tungsten street lamps. In addition another installation has been made recently at a large country residence. Energy here is furnished for motors having a total rating of 40 hp and 500 lamps, all operated by alternating current transmitted at 2200 volts. The supply is taken from the secondary side of the substation transformers at 360 volts and stepped up for transmission. Energy is sold at the rates established by the lighting company in Davenport. Mr. Crafts doubted the advisability of connecting a large number of motor customers directly to the trolley line because railroad service might thus be hampered. On the other hand, however, if the motor load were large enough a maintenance man might be employed and thus the possibility of interference greatly reduced.

Mr. Frank McDonald, of Waterloo, said that the Waterloo, Cedar Falls & Northern when first started had some direct-current motor customers. The business was not found profitable, however, and so it was turned over to the local electrical company. To-day, however, the road is considering the sale of energy along its interurban line to those towns in which substations are located.

Mr. Charles Munson, electrical engineer of the Cedar Rapids & Iowa City Railway & Light Company, said that his motor customers receiving direct-current service had not caused any line trouble. Heavy fuses are put at the line connection close to the lightning arresters, and lighter fuses, which can be replaced by the customer, are placed at the motors.

Mr. Mathes told of some motor-service supply furnished from a suburban trolley line extending to his company's railway park. One customer is a dairy establishment using a 10-hp motor to operate a machine for milking cows. The revenue from this customer averages from $35 to $40 a month. Other customers on the trolley line have installed 5-hp motors for sawing wood. The gross revenue from the sale of energy along this suburban trolley line is about $900 a year, and regular city rates are charged.

COMMONWEALTH EDISON COMPANY SECTION N. E. L. A.

At the meeting of the Commonwealth Edison Section of the National Electric Light Association in Chicago on June 13 Chairman E. F. Smith announced that the membership had now reached a total of 1188, which is the largest of any individual company section in the association. Mr. John F. Gilchrist, the new president of the N. E. L. A., gave an interesting address on the mercantile business of the company. He also described in a few words the benefits of the employees' savings fund. Employees of the company may invest in this fund. By allowing their savings to accumulate for a term of five years the principal and accrued interest compounded at 6 per cent may be invested in the company's stock at par. Inasmuch as this stock is now selling on the market at about 128 and 129 the result for the five-year period is a very fine investment for the employees, and will net approximately 16 per cent to 20 per cent a year provided the stock is selling at the end of the period at about the present market price.

Mr. Gilchrist made an earnest plea for the support by the section during the coming year of the association's activity. The Commonwealth Section has been honored by the promotion of one of its members to the presidency of the national association, and, therefore, has an added responsibility. The greatest value of the N. E. L. A. perhaps is its influence on the individuals comprising the association. It engenders enthusiasm which is of incalculable benefit both to the N. E. L. A. and to the member companies which control it. Mr. Gilchrist's appearance on the platform and his address were received with enthusiastic applause.

Brief reports from the recent New York convention were presented by Messrs. E. W. Goedjen, G. A. Freeman, Joseph H. Perry, John C. Johnson, E. A. Edkins, R. F. Schuchardt and E. W. Lloyd. The last-named speaker called particular attention to the great value of the papers and reports read at the New York convention, and the fact that only a few members of the section had obtained opportunity to read and assimilate them as yet. In order that greater benefit may be obtained from these papers, Mr. Lloyd announced that several of the departments of the company would hold meetings in the future at which convention papers pertaining to the work of that department would be abstracted and discussed.

A pleasant feature of the evening was the presentation by Mr. Peter Junkersfeld of gold-button badges to Messrs. George H. Jones, J. C. Manley and Ernest F. Smith, who have served as chairmen of the section. Resolutions of condolence on the death of Mr. Robert D. Ferguson were adopted. The meeting was concluded by some excellent music given by the N. E. L. A. orchestra of the section.

EFFECT OF BRONZE AND PAINT ON RADIATOR EFFICIENCY.

Without doubt the worst kinds of coatings that can be applied to radiators are the familiar aluminum and copper bronzes so generally used, according to the results of tests made at the University of Michigan and reported by Prof. J. R. Allen, of that institution, to the National District Steam Association at its Pittsburgh convention, June 6.

In these investigations use was made of two radiators exactly alike, which in their unpainted condition fresh from the factory showed practically the same condensation. One radiator was then painted with two coats of copper bronze and was found to have its heat radiation diminished by 24 per cent below that of the original cast iron. Another pair of copper bronze coats decreased the radiation by 25 per cent. Two coats of terra-cotta enamel were then brushed over the existing four coats of bronze, with the result that the heat transmission became even 3 per cent better than with the original unpainted cast iron. The results of applying fourteen other coats are shown in the accompanying table, the procedure being terminated by adding two final coats of aluminum bronze, when the radiation again promptly fell to 73 per cent of its former value. Other tests with enamels, japans, and lead and zinc paints are shown in the last six lines of the table.

Surface.		Room Temperature.	Temperature of Steam.	Condensation in Pounds.	Radiation in B.T.U.	Efficacy.
Plain cast iron		74.4	222	.413	2.82	.997
Plain cast iron		76.0	220	.418	2.94	1.005
Copper bronze. . . .		63.1	224	.353	2.16	.761
Copper bronze . . .	Two Coats	72.3	220	.325	2.08	.752
Terra-cotta enamel .		74.5	220	.436	2.86	1.038
Copper bronze . . .		66.3	218	.351	2.24	.735
Light-brown varnish.		74.1	224	.421	2.67	.977
Oak-brown varnish. .		72.9	226	.431	2.67	.977
Aluminum bronze. .		71.8	225	.318	1.97	.730
Aluminum bronze.		70.5	224	.324	2.005	.724
Silver-gray enamel.		66.7	223	.442	2.68	.970
Snow-white enamel.		67.6	224	.452	2.75	1.01
Bronze-green enamel.		64.2	224	.446	2.66	.997
No-luster green enamel.		64.0	224	.429	2.545	.956
Maroon gloss Japan.		70.6	224	.423	2.62	.997
Shellac and copper bronze. . .		68.5	224	.364	2.22	.850
Linseed and copper bronze. .		67.0	224	.347	2.02	.760
White paint		86.9	224	.379	2.62	.987
Terra-cotta paint.		83.4	224	.389	2.65	1.00
Light-green paint.		86.8	224	.374	2.59	.989
Light-green paint, zinc.		77.2	224	.423	2.72	1.00
Terra-cotta paint, zinc		77.7	224	.408	2.66	.964
White paint, zinc.		76.0	224	.418	2.70	1.01

The condensation and b.t.u. radiation in the above table are expressed in terms of hours and square feet of actual surface.

In general the table shows that aluminum, copper and metal pigments in the bronzes reduce the heat radiation. This is probably largely due to the composition of the bronze and partly to the vehicle which contains this pigment. Enamel, lead paints and zinc paints show almost no loss in heat radiation. The experiments demonstrate that the effect is largely surface effect and not conduction effect. The results show that the loss of heat from radiators depends largely upon the surface effect and to only a small extent upon the conduction of heat through the metals.

Experiments conducted with radiators of the same shape made of different materials, cast iron, wrought iron and copper, do not show a material difference in the heat radiation when painted with similar coatings of paint. This is due to the fact that the total heat radiation is determined by the region of greatest resistance to the transmission of heat. This point is at the surface, so that the material of which the radiator is made (which is always a good conductor) has very little effect. For the same reason the thickness of the metal composing the radiator has very little effect.

INDUSTRIAL ELECTRIC HEATING.

In a paper on industrial heating loads before the Iowa Electrical Association at Davenport, Mr. J. D. A. Cross, of the General Electric Company, Chicago, predicted that, encouraged by favorable rates, industrial applications of electric heat will eventually form a large factor in "off-peak" loads. There are many commercial processes requiring an even, accurately controlled temperature, together with safety. All hotels should take up the electric percolator, chafing dish and table toaster for the dining-room and the six-slice toaster for the kitchen. The proprietor of a hotel in Pittsfield, Mass., writes that it cost him from 30 cents to 35 cents per day to run his gas toaster. It costs only 10 cents to run the electric. The latter is cleaner, handier and 60 per cent faster than the gas. The above figures were based on $1.50 gas and electricity at 4 cents. The six-slice toaster takes 3500 watts a minute or 10 watts per slice. In view of its economy to the consumer on the one hand and its income to the central station on the other, an electric toaster should be placed in every hotel and restaurant. An electric broiler of the overhead radiant type has been brought out in different sizes, in which open coils of "calorite" are supported in channels of white enamel steel. The broiler pan rests upon a vertically adjustable shelf. It is worth much to have a broiler available which can be heated up instantly. Electric ranges are now available in large sectional units to displace the hotel coal or gas range. Tests on these in the United States Navy showed that electricity is somewhat cheaper than coal and the output of food with a given size of electric range is greater. This electric range has been standardized in the navy for use in ships' galleys.

Bake ovens of sixty-four-loaf and ninety-six-loaf capacity are now available and have also been standardized by the United States Navy. The electric baking can be done at the rate of fifteen 1-lb. loaves per kw-hour, or 0.2 cent per loaf at a 3-cent rate.

A laundry flatiron uses three or four kw-hours per day. In the laundry high temperature devices using steam and gas may be displaced by electricity, but low-pressure steam will usually be able to maintain its ground for drying and mangling. The following data relate to a Sikeston (Mo.) electric laundry.

The bill for this laundry amounts to $35 per month at a 3-cent rate, the energy consumption being about 1160 kw-hours. This laundry has ten employees and an income of about $780 per month. The electric-heating equipment consists of one combination bosom and body ironer, one neckband and wrist ironer, one collar shaper and several flatirons. A 5-hp motor drives the ironer and shaper and in addition three washing machines, one starcher, one wringer and one steam mangle. The mangle and the dryroom are supplied with low-pressure steam. The power consumption of the laundry rolls used in the ironers is designed on the basis of 5 watts or 6 watts per square inch surface of the rolls. The introduction of electricity in this laundry has resulted in a notable improvement in appearance and sanitary conditions, increased output and quality of work and in lessened fire risk and greater contentment of the employees. In the printing trade the author called attention to possible load from electric glue pots, embossing machines, stereotype melting kettles and matrix dryers. Glue pots are also used in the wood-working trade. In the metal trade there are saddling irons, oil tempering baths and ovens.

DISCUSSION.

Mr. George S. Carson, of Iowa City, said he had found but a limited number of places where industrial electric-heating appliances were needed, but where he had placed them on trial they usually remained in service.

Mr. Young, of Cedar Rapids, reported 150 disk stoves on his lines for various purposes.

Mr. H. C. Blackwell, of Davenport, had been introducing electric flatirons, but said that other devices moved very slowly. After trying to sell them from the company's salesrooms he then tried department and jewelry stores, but without success. He felt the devices were all right, but he had not discovered the way to place them. Nevertheless his customers would go to the electrical shop in Chicago and make such purchases. About 15 per cent of the consumers have electric flatirons.

Mr. P. B. Sawyer, of Des Moines, said his company had adopted the practice of repairing irons free for consumers in order to keep them in regular service. Mr. Young, of Cedar Rapids, reported having 120 electric irons among 180 residence customers. Mr. Cross told of a plan worked by the Milwaukee Electric Railway & Light Company of sending out 1000 electric irons by telegraph messengers. These irons were delivered without note or comment and a day later a letter was sent by the company saying that the iron was sent for trial.

GENERAL-UTILITY MOTOR IN THE HOUSEHOLD.

At the Nebraska Electrical Association convention recently held at Lincoln, Neb., Mr. S. G. Peticolas gave a paper dealing especially with small motors for general household uses. He showed a small portable motor provided with several attachments and intended for many different uses. There has been a great demand for this motor on account of the various uses to which it can be put. It is made in both alternating-current and direct-current types. The Westinghouse company has given the motor wide publicity through popular advertisements and the distribution of literature. Its particular field is to create in the mind of the user a desire for small units for a variety of service. The blower attachment suggests the desirable possibility of ventilation, obtaining fresh air and getting rid of foul air. The buffing and grinding attachment shows how desirable a motor would be for that service alone. The use of the general-utility motor demonstrates the usefulness of a little larger motor to operate the washing machine. The general-utility motor is, therefore, intended as an entering wedge by which to demonstrate to the user the advantages and possibilities of electric drive in the various household arrangements.

DISCUSSION.

The discussion centered mainly on the question of how such devices should be handled, whether by the central-station company or supply dealers exclusively. Mr. J. E. Schuff, of Lincoln, said that the various vacuum-cleaner companies and washing-machine companies had agents in Lincoln, and hence his company, the Lincoln Gas & Electric Company, did not attempt to handle these machines.

Mr. E. V. Capps, of Beatrice, said that at Beatrice this business had been turned over to the supply men. Imperfectly developed devices are likely to make trouble if introduced by the central-station company. Mr. Schuff reported that fifty or sixty vacuum cleaners had been put out in Lincoln by one company.

Mr. J. G. Boyd said that the central-station company should not divide the responsibility of putting these devices out. If a supply dealer puts out a piece of apparatus with which the consumer has trouble and the consumer comes to the central station, it is little comfort to the consumer to be told that he must go to the company which sold the device.

Mr. S. F. Dibble thought it a mistake for the central-station company to evade the responsibility of handling new appliances. The dealer cannot afford to follow up and spend much time on the prospects which are the most difficult to get, but which may be the most desirable for the central station. The central station, on the other hand, can afford to follow these up. The central stations which are pushing the various devices are doing the most business, but co-operation between the central station and the dealer is the best policy. In many communities the motors which are the easiest to sell, such as those used on very intermittent service, have already been sold, leaving the factory installation to be worked up by the central-station company.

Mr. A. L. Pond told of a test on the value of wood refuse obtained from a wood-working plant for fuel. The net result was that between 5 tons and 6 tons of shavings were required to equal 1 ton of coal when the shavings were hand-fired and from 4.5 tons to 5 tons of shavings when the shavings were blown in. In regard to placing motor installations on free trial in order to secure business, he warned managers that when so placed the motors were likely to be used rather wastefully in order to determine the maximum bill that could be run up with the new method of driving. The result was an excessive bill the first month. He admitted, however, that the plan frequently worked well.

Mr. T. O. Kennedy, of Lincoln, said that the central-station man had better watch the trial installation the first month to see that it is being used in the ordinary manner.

Mr. F. H. Brooks, of Lincoln, thought that large power propositions should be handled mainly by the company rather than the dealer. However, small devices are in another field, which he thought best to let remain with the supply dealer, but it is necessary for the central station to do considerable pioneer work to create demand. Once the sales are started the dealers can take care of the business.

Mr. C. C. Smith, of Exeter, said that his town was so small that no reliable supply man could live. As a result if supply business was not done by the central station it would be done by hardware stores, which would handle devices as a side issue.

A CENTRAL-STATION'S EXHIBIT-ROOM IN A DEPARTMENT STORE.

The Kentucky Electric Company maintains only a business office at its building at 219 Washington Street, Louisville, but has recently arranged an appliance display window in a new department store on the principal shopping street of the city. The central-station company obtains this window space as well as a demonstration counter within the store rent free from the store owner, who gets his return from the presence of persons attracted into his establishment by the electrical demonstrations, and has willingly given up the largest part of one of his two show windows for this purpose. Electric heating and cooking appliances, fans, etc., are shown in the street window, and practical demonstrations of their use are given at the counter inside. The central-station company has its own service lines for its exhibit, but makes no payment to the department store for the space occupied. Invitations to visit the demonstration are run in the display-advertising columns of the local newspapers and have already done much to popularize the new store.

The Kentucky company has the services of a capable demonstrator who is qualified to discuss electric-appliance advantages with the class of people who make use of such conveniences. From her own experience and that of friends who have used certain devices this demonstrator is able to discuss the practical possibilities of the apparatus, explaining, for example, how an entire chicken dinner can be cooked on a 500-watt toaster stove, and give other points that instil confidence in the use of the apparatus into her women customers. The experience of the Louisville company has shown that a professional demonstrator is not so much needed as one combining tact with a knowledge of the community in which she works. Good results have also been obtained from a telephone invitational campaign carried out by this demonstrator. A selected list of probable appliance users is compiled, and the demonstrator, who is familiar with local people, calls up these persons, inviting them in the name of the company to visit the demonstration booth and to try certain appliances in which she thinks they may be interested. Knowing something about the individual called, she is able without disclosing her own identity to add personal touches that invariably bring a pleasant acknowledgment of the invitation and "Thank you" from the other end of the wire and leave a definite impression which no other kind of advertising could create.

AN ALL-ELECTRIC BAKESHOP IN MUSKOGEE.

The use of electric motors in bakeshops is no longer unusual in the case of the drive of individual machines, such as dough-mixers, cake-mixers, ovens or the like. By installing such motor-driven machines even conservative practical bakers admit that they can often replace the wages of a high-priced man by the nominal monthly bill of the electric company. Bakery-machine manufacturers, however, have already applied the electric motor to every conceivable power-consuming operation in the production of breadstuffs, so that the food need not be touched from the time it is unbarreled into the flour bins until it comes fresh and crisp from the ovens.

One of these all-electrically operated bakeries is at Muskogee, Okla., where a total of 13 hp in motors is installed, with an average consumption of from 1500 kw-hours to 2000 kw-hours per month. This bakery has a maximum productive capacity of 40,000 loaves of bread per day, although, being new in the community, it has never yet been put to its full rated output.

The flour is lifted from a hopper in the basement of the building by means of the inclosed-bucket conveyor seen in the background of the picture, Fig. 1. From this it is discharged into a screw conveyor dumping into the funnel-shaped hopper shown. This hopper is mounted on a scale beam so that its contents can be weighed from the floor. The hopper discharges the flour into the three-barrel dough mixer beneath, which is driven by the same 5-hp electric motor as the flour lifter and conveyor above mentioned. A graduated tank is mounted over the hopper, from which measured quantities of water can be drawn for making up the dough batches in the motor-driven mixer. After the ingredients of the dough are thoroughly incorporated in the mixer, the latter is turned over and its contents emptied into the roller-mounted rising pans. After the dough has risen properly in these it is fed into the hopper of the loaf molder, operated by a 2-hp motor. This molder comprises a cylinder in the surface of which are cut two pairs of depressions, each the size of a dough loaf. By means of a scale and handwheel the depth of these loaf molds can be set to produce any desired weight of loaf. After the dough has been pressed into the molds on the hopper side, the cylinder is given a rapid half-rotation and the dough loaves are discharged onto a slowly moving belt, being meanwhile sprinkled with a little parting flour. The travel on the conveyor belt gives the dough loaves time to recover from their compression in the molder and by the time they have reached the far end of the long table they are ready for the 2-hp motor-driven rolling machine, where they are rolled by a large wheel around an outer casing emerging ready for the oven pans. The 700-loaf revolving oven, Fig. 2, is operated by a 2-hp motor, but, of course, is heated by gas.

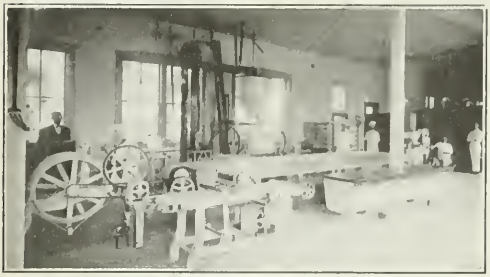


Fig. 1.—Motor-Driven Flour Conveyors, Dough-Mixers, Loaf-Molder, Dough-Breaker, etc.

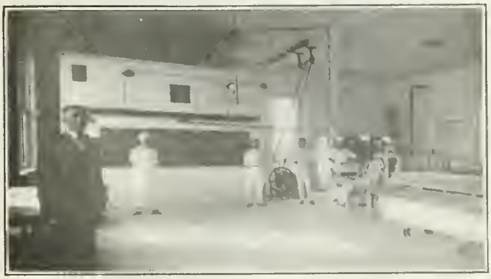


Fig. 2.—Motor-Operated Bread Oven in Muskogee Bake Shop.

In addition to the apparatus above mentioned there is also a 1-hp motor-driven egg-beater and a 1-hp motor-driven cake machine used in the production of other bakery goods. The electricity for light and motor service in this modern bakeshop is supplied by the Muskogee Gas & Electric Company

Wiring and Illumination

PHOTOMETRY AND PHOTOGRAPHY.

By JAMES L. PARTON.

It is interesting to notice how closely allied are many of the researches conducted by photographers and illuminating engineers. The same problems are constantly being studied, often from a somewhat different point of view, it is true, but with similar results, by workers in both fields. Many of the early photographic experimenters, for example, were interested in the variations of daylight under different climatic conditions and during various times of the day, and they made actual measurements of the intensity of daylight in order to determine the probable exposure required under different conditions. Their results are surprisingly similar in some instances to those obtained by illuminating engineers who were interested in the same problem, but mainly from the standpoint of the daylight illumination of schoolrooms and other places of a similar nature.

Especially in the early stages of experience in photometrical processes, photography has often suggested itself as a means of measuring light. To some people the blackening of a piece of sensitive paper has seemed a more tangible method of studying light variations than a purely comparative method. For example, before convenient illumination photometers were available efforts were sometimes made to ascertain the distribution of illumination in a room by exposing sheets of sensitive paper in different portions and subsequently developing the whole series under identical conditions. Even recently the method has seemed to have advantages for special researches. For example, Messrs. Ives and Coblentz have used it with effect in their researches on firefly radiation. In a recent number of the *Physical Review* Mr. Charles F. Brush described a method of ascertaining small changes of illumination by photographic means. It appears to have proved, with care, a comparatively delicate means of measurement since a change in intensity of under 1 per cent is stated to have been discernible. One interesting feature was the effect of temperature, a change of only 2 deg. C. being apparently influential in affecting the final photograph.

Theoretically it is conceivable that it might be possible to exhibit on a photograph a change in tone which the eye could not detect. It is known that the sharpness of contrast in light and shade is very much affected by slight alterations in the conditions of development. By selecting the ideal conditions to make such contrasts appear well marked who can say what degrees of sensitiveness might not be attained? In short, for very refined researches photography might be a useful weapon in enabling one to detect small changes which would be allowed to pass unperceived on any photometric instrument. Against this is to be set the fact that the process is necessarily tedious and complicated compared with a measurement by means of a photometer, the subsequent development of plates, etc., taking a good deal of time.

There is, however, another quite different aspect of the subject to be borne in mind, namely, the assistance of photometry to photographers. This is the converse of the problem referred to above. Granted that photography may be of only limited service to an expert in photometry, may not measurements with photometric apparatus be of great value to the photographer?

This question was discussed in a recent paper read before the Royal Photographical Society of London by Messrs. J. S. Dow and V. H. Mackinney in which the value of photometric measurements of the actual surface-brightness of surrounding objects was touched upon. The experiments described were carried out with the holophane lumeter, a small photometrical instrument devised by the authors for measuring illumination and surface brightness.

The photographer, in judging exposure, is guided very largely by past experience, and a skilled expert learns in time to allow for variations in climatic conditions with great accuracy. This judgment, however, is attained only slowly by the novice, who has sometimes recourse to exposure tables in which the presumed variation in intensity of daylight at different hours in the day and at various times in the year is calculated. But actual measurements of daylight illumination show that the course of affairs during any day taken at random may be utterly different from what such tables, based on the average of a large number of days, would suggest. Moreover, they take no account of the variations in light and shade in the picture, the reflecting power of the object, etc. The variations in light and shade are often enormous, amounting to several thousand per cent. Yet the final print cannot represent a degree of light and shade greater than 30:1. This was demonstrated by the authors by measuring in turn the surface-brightness of pure ground white celluloid and a dead-black painted card, placed side by side and exposed to the same illumination. The consequence is that it is not possible to adjust the exposure so as to show all the relative tones correctly, but it is very essential to select that time of exposure which gives, on the whole, the best result and brings out correctly those portions of the field which are most important.

Another difficulty in photography often arises from the fluctuating character of daylight. Actinometer readings, for example, take some time (in a darkish interior and by artificial light often too long to be of practical service) and the conditions may have changed radically while the test is in progress.

All these difficulties are avoided by basing the exposure on measurements of the actual surface-brightness of the objects in the field of view. Such a measurement can be taken in an instant, and one can gain information as to the comparative lightness and darkness of distant objects, in which actinometer readings would naturally not be of assistance.

However, there is one special field in which photometer readings are specially serviceable as a guide in taking photographs, namely, views of interiors lighted by artificial means. This is a matter of increasing interest to illuminating engineers. Companies concerned with the sale of lighting appliances are coming to recognize that nothing is so influential in enabling them to arouse interest as excellent photographs of well-lighted interiors. Illuminating engineers, too, know the value of good photographs as a record of good and bad installations, especially for demonstrations and in lecturing.

Yet, curiously enough, it is not often that one sees really successful views of interiors taken exclusively by the light of the actual illuminants in use and without retouching of any sort. The requirements of the illuminating engineer in this matter are not often realized by the professional photographer. For his purpose it is the nature of the lights themselves and the distribution of illumination that is important. For scientific purposes it is also often essential that the photographs should not be retouched in any way, so that they may show an absolutely faithful record of the actual conditions as seen by the eye. The exposure in such cases must, therefore, be judged with great accuracy, and this is specially important in the case of interiors in which it is desired to bring out the play of shadows and the gradation of tone by artificial light. As an illustration of this point the authors showed three photographs of a white screen illuminated respectively by a bare lamp and a lamp with a prismatic reflector, the times of exposure being different but the development and all other conditions identical. It was shown at once how easily the contrast in distribution of light was spoiled by a small error in exposure.

The painstaking illuminating engineer interested in photography of this kind usually finds that he must study the subject for himself. An outside photographer, however expert in ordinary work, rarely understands his exact requirements. During the discussion of the paper referred to Mr. T. E. Ritchie, of the Union Electric Company, exhibited a series of excellent photographs of various interiors lighted by arc lamps and taken by the aid of the holophane lumeter. A feature of these views, in addition to the wonderful clearness of detail and the gradation of tone, was the perfect definition of the arc lamps themselves, the globes of which appeared without any sign of "flare;" although the photographs were not retouched in any way. The use of a surface-brightness photometer for this purpose naturally fits in with the work of the illuminating engineer, as in visiting installations he would be using it for the measurement of illumination in any case.

There is, of course, one point that must be borne in mind in this work, namely, the varying actinic value of different artificial lights. Two objects having the same surface-brightness, but illuminated respectively by an arc lamp and an incandescent lamp may naturally not require the same exposure By the aid of a few preliminary experiments with the most common illuminants it is, however, quite easy to allow for this fact. An interesting experiment described by Messrs. Dow and Mackinney consisted in the photography of a white test-type card (under identical conditions as regards development and exposure, etc.) when illuminated successively by nine illuminants ranging from the carbon-filament lamp to daylight and the mercury-vapor quartz-tube lamp. The surface-brightnesses were identical in all cases, but yet the results were very different. The lamps studied fell into three chief groups, and it was evident that a correction factor would be needed when results obtained with widely different illuminants were being compared.

A more difficult problem, which, however, is encountered in all ordinary photography, is the fact that the sensitiveness of the photographic plate of different colors is very distinct from that of the eye. Even this, however, it was suggested, might be overcome by using a special light filter and a Wratten panchromatic plate, the sensitiveness of which throughout the spectrum resembles that of the eye quite closely. In conclusion the authors pointed out the scope for improved photometrical appliances in connection with such processes as the testing of photographic plates, the density of negatives, etc., for which somewhat crude methods are at present sometimes used.

NEW ORLEANS' STREET-SURFACE JUNCTION BOXES.

On account of the water conditions to which New Orleans is subject, all of the junction boxes in the underground section of the city are placed above the street level, as shown in the accompanying illustrations. Simple and ornamental cast-iron circular boxes 44 in. high and 20 in. in diameter are employed, in many instances these boxes forming the bases of arc-lamp

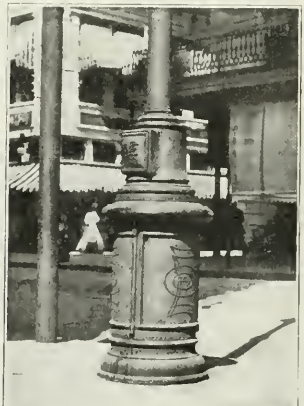


Fig. 1—Surface Junction Box Used as Arc-Lamp Pole Base.

poles at the street intersections. In other places where simply the turret-shaped box is installed on the curb its presence is not even noticed by the majority of the people passing. When first designed it was feared that these boxes might prove objectionable in appearance, but experience has shown that they are practically unnoticed.

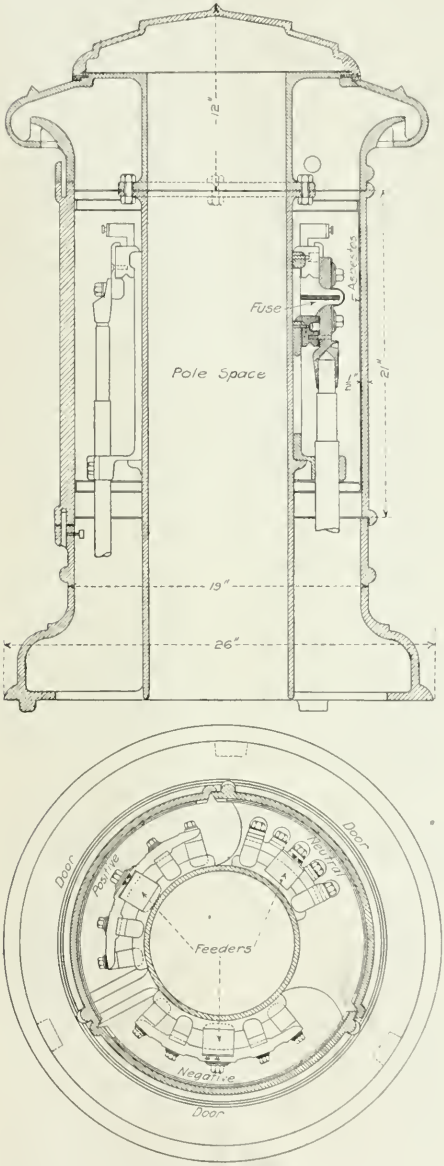


Fig. 2—Sections of Surface Junction Box.

The boxes are constructed with three 60-deg. hinged doors, which can be opened, leaving a bare skeleton framework with the electrical connections exposed. The buses are formed in arcs of circles and each has connecting lugs for the four mains and for a feeder to the middle contacts. The positive and negative sides are fused, while the neutral, recognizable by its shorter bus, is not protected.

The boxes have 26-in bases and at their principal section are 20 in. in diameter. Where not used to inclose a pole the central space is covered by a circular cap. For use with arc-lamp poles the junction box is surmounted by an extra cut-out box for the arc-lamp circuit, as shown in the illustration. At present 136 of these surface-type junction boxes are in use in New Orleans. Several of the underground type are also employed, but the difficulty of getting at these, together with the heavy cost of replacing the rubber gaskets each time a box is opened, makes the surface type of box much more satisfactory. These street junction boxes have been used in New Orleans for a number of years, and, besides fully satisfying the requirements of local conditions, have been declared by competent distribution engineers to be admirable standard construction for use elsewhere.

Letters to the Editor.

Test of Gasoline Street Lamps.

To the Editor of Electrical World:

Sir:—Inasmuch as the candle-power measurements on gasoline mantel street lamps which I made in May and June, 1910, for the information of the Merriam commission (the Chicago Commission on City Expenditures) have been quoted and discussed recently at certain technical meetings, and as there appears to have been some misunderstanding, or at least a possibility of misunderstanding, as to the real significance of these tests, I wish to make a statement of certain facts in connection with them.

An account of these tests and the circumstances connected with them is given in the *Electrical World* of Aug. 18, 1910, pages 368 and 369. Rough preliminary tests were made on twenty gasoline lamps in service inclosed in the regular glass lantern or head. The average horizontal candle-power of these twenty lamps was 19.4; the minimum candle-power observed was 2 and the maximum 33. The foregoing averages do not include one lamp which was too low to read on the photometer. After these tests the company which supplies these gasoline lamps to the city of Chicago under yearly contract was notified and twelve tests were made later in the presence and with the approval of the company's expert, Mr. F. V. Westermaier. The twelve lamps so tested averaged 26.4 cp. measured horizontally with the lamp in the regular lantern, the maximum being 58.4 and the minimum 14. On this second set of tests one lamp not included in the foregoing averages was too low to read on the photometer.

As there seems to have been some controversy as to whether the candle-power measurements which were taken represented lamps that were picked out as being apparently of low candle-power or whether they represented averages as near as it was possible to obtain them, I wish to state that the lamps were not in any case selected because of apparently low candle-power, but were taken consecutively. The method employed in selecting lamps for tests was as follows. The day before each test the engineers in charge of the investigation consulted a map of the city showing the location of gasoline lamps, and selected at random without any knowledge of local conditions a locality in which a number of gasoline lamps were being operated. The locality selected was not announced until all concerned were ready to start for the place of testing that evening. Upon arriving at the locality where the testing was to be done the test was begun at a place selected at random, and from then on the lamps were tested consecutively along a street or route until the work in that locality was finished. In other words, the tests represent as near a true average as is possible from testing such a limited number. No tests have been made by the writer on the candle-power of gasoline lamps in the city of Chicago since June 23, 1910, when the last set of tests before mentioned was completed.

As a result of these candle-power investigations a new form of contract was drafted for the supply of these gasoline lamps for the year beginning Sept. 1, 1910. This contract provides for a rebate to the city if the average of 150 or more lamps tested by it each month shall fall below 45 cp. The table of rebates is as follows:

	Per Cent Rebate.
60 to 45	0
45 to 40	5
40 to 35	10
35 to 30	20
30 to 25	35
25 to 20	55
20 to 15	75
15 or below	100

It should be further explained that candle-power measurements on which rebates are based are made with the lantern door open so as to eliminate the loss of light in passing through the glass of the lantern and whatever dirt there may be on that glass. The tests on which I have quoted figures were all made with the lantern door closed. In two cases where tests were also made with the lantern door open there was an increase of about 10 per cent in light caused by opening the door. The new contract providing for 45 cp with lantern door open was drawn with the idea that 60 cp minimum with lantern closed would be a commercial impossibility with the present equipment, a point which was virtually agreed upon both by all the engineers connected with this investigation and by the gasoline-lighting contractors.

Since the present contract has been in force under which provisions are made for testing and rebates, I am informed by Mr. E. M. Tompkins, chief electrical engineer of the electrical department of the city of Chicago (under which department all street lighting comes) that the lamps tested each month average from 58 cp to 60 cp. Readings are occasionally obtained as high as 80 cp. The difference from previous results was brought about by more intelligent maintenance, and those living in gasoline-lighted districts do not need any photometric results to tell them that there has been great improvement.

Chicago, Ill. J. R. Cravath.

The Tungsten vs. the Flaming-Arc Lamp.

To the Editor of Electrical World:

Sir:—Permit me to refer briefly to the letter of Mr. J. Gustav V. Lang in your issue of May 25. The purpose of my letter in the May 11 issue was primarily to point out the great difference which the inclusion of fixed charges and maintenance costs makes in the relative operating expense of illumination with different units. Of the light sources considered in Mr. Ladoff's article this difference was most apparent in the case of the flaming-arc and the tungsten-filament lamp, hence these units were chosen as an illustration.

The two conditions of operation given were taken as typical of industrial lighting on the one hand and lighting on commercial circuits with relatively short hours of burning on the other, and did not indicate the field of either type of lamp. Mr. Lang points out that with energy at 4 cents per kw-hour there is a saving in favor of the flaming arc. This, of course, is true if the lamps are burned 4000 hours per year, but it is rather unusual to find an energy cost of 4 cents in an industrial plant which is run all night, as 4000 hours' of lighting indicates. It will be noted that a 1000-hour year was used with the 10-cent rate. With this period of operation and a 4-cent energy rate the saving will be in favor of the tungsten-filament lamps.

Since the cost table was included merely as an illustration, it seems scarcely necessary to discuss items, such as cleaning, about which there may be some difference of opinion, but which at most would make but a minor change in the final cost ratio. However, in regard to the life of tungsten-filament lamps which I assumed, I would again call attention to the fact that this was based upon operation at low efficiency, which is most economical with energy at 2 cents per kw-hour. The manufacturers rate lamps at high, medium and low efficiencies, corresponding respectively to a life of 1000 hours, 1300 hours and 1700 hours. Most lamps are, of course, operated at high efficiency, and in giving a service figure Mr. Lang no doubt based his value of 1200 hours upon experience with such lamps. At low efficiency the life would be increased by approximately 70 per cent.

The 150-hour flaming-arc lamp was not included in Mr. Ladoff's table and was, therefore, not discussed in my letter. At the time the 1000-watt cluster was placed upon the market it was undoubtedly one of the most economical units available for the illumination of certain areas, and in many cases replaced flaming arcs with highly satisfactory results. The inclosed-flame lamp is a comparatively new unit, but if it is found that inclosing the arc does not materially reduce its candle-power and does not result in excessive depreciation in intensity between trims, this lamp will be of great value in the illumination of large areas.

Cleveland, Ohio. H. H. Magdsick.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Transformer Oil.—A. Duckham.—After introductory notes on the requirements of transformer oils the author discusses the causes of deposits or sludges and of the thickening of the oil. The causes are enumerated as follows: (a) The deposition of atmospheric dust. (b) The thickening of oil due to evaporation. (c) The action of the oil on the insulating materials and varnishes of the transformer. (d) Chemical changes in the oil. It is in the chemical changes that the author finds the explanation of the formation of the greater part of the sludges and deposits that have in the past been the cause of so much trouble. In spite of the fact that mineral oils have been looked upon as stable articles and non-saponifiable and non-oxidable, yet in view of the results of his research work he considers this to be a merely comparative statement, and that under the conditions appertaining to a transformer oxidation and consequent formation of saponifiable products and of the other oxygen compounds undoubtedly does occur. In the first place there is a constant and fairly high temperature; secondly, there is usually a space above the oil where the cables are attached to the terminals and where air can circulate, and it is well known that the presence of ozone and oxides of nitrogen is often detected here. Now, from experiments he has found that mineral oils in varying degrees, when exposed to heat and in contact with oxygen, not only rapidly darken and thicken, but do actually throw out a solid deposit in the form of an amorphous brown powder, and the action is more rapid with oxygen than it is with air and still more rapid with ozone. These are the agents which are to be combated in a transformer, and more especially as the electrostatic attraction insures any solid matter depositing on the windings. This discovery is of importance to transformer users and would at once suggest tests to which their oil should be submitted before selection. There are some oils that are affected to a very much less extent than others, and by the careful selection of the crude oil from which the transformer oils are to be distilled, and by their subsequent suitable refining, one can guarantee practical immunity from this sludge.—Lond. *Electrician*, May 19.

Induction Motors.—H. L. Smith.—A paper presented before the Rugby Engineering Society on the mechanical design of induction motors. The author deals with the various parts of induction motors individually and discusses the points that have to be borne in mind in the mechanical design of these machines. Slot dies, punchings, base plates, shafts, end shields, bearings, belt pulleys and binding bands are all considered.—Lond. *Electrician*, May 26.

Cooling of Rotors.—A note on a recent British patent (5247, May 18, 1911) of the Siemens-Schuckert Company. In providing for the cooling of cylindrical slotted rotors the conditions for effective cooling require that the air shall be brought into as intimate contact as possible with the windings to be cooled and also that the amount of cooling air passing shall bear some relation to the heat generated at that point. Now, the heat generated in this kind of rotor is a minimum about the magnetic axis and a maximum about the axis at right angles to this, and the inventor provides ventilating ducts in close proximity to the slots, which are near the axis at right angles to the magnetic axis.—Lond. *Elec. Eng'ing*, May 25.

Single-Phase Repulsion Motor.—O. Stern.—An abstract of a thesis in which the author first subjects to harmonic analysis the fluxes produced by single-phase windings. The second part deals with the calculation of the winding-factor and the third part with the experimental determination of the field of the single-phase repulsion motor of the Deri type during operation.—*Elek. Zeit.*, May 4.

Lamps and Lighting.

Series Connection of Arc Lamps and Incandescent Lamps.—W. Schaeffer.—The conclusion of his paper presented before the Berlin Electrical Society, the first part of which was recently abstracted in the Digest. With the arrangements described in the first part it was not possible to have the incandescent lamps lighted alone without the arc lamps. To make this possible use may be made of the principle shown in Fig. 1, in which the incandescent lamps are arranged in two groups, G_1 and G_2. These two groups are in parallel with each other and are in series with the variators *v* (ballast resistors of Nernst lamps) and with the arc lamps *B*. If it is desired to use the incandescent lamps alone the two groups G_1 and G_2 are connected in series with each other by means of the switch *u*. If it is desired to use three arc lamps on a 220-volt supply it is also possible to use the incandescent lamps alone before the arc lamps are lighted. The three arc lamps consume about 130 volts. Use is made of incandescent lamps of 80 volts, again divided in two groups in parallel. As shown in Fig. 2, a three-pole switch *a* is used. In the position I the incandescent lamps *e* are lighted alone. In the position II the arc lamps *b* are started. In position III the battery *d* is connected in parallel with the arc lamp resistor *c*. In position IV the two groups of incandescent lamps *e* are connected in parallel and are connected in series with the variators *f* and arc lamps *b*, while the resistor *c* is disconnected. The author finally discusses the arrangement for alternating current. In this case autotransformers are employed, and the principle is clearly shown in Fig. 3 where *d* is the autotransformer, *B* the arc lamps, *G* the incandescent lamps and *V* the variators.—*Elec. Zeit.*, May 4.

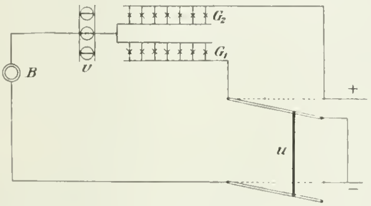


Fig. 1.—Diagram Showing Incandescent Lamps Lighted Alone.

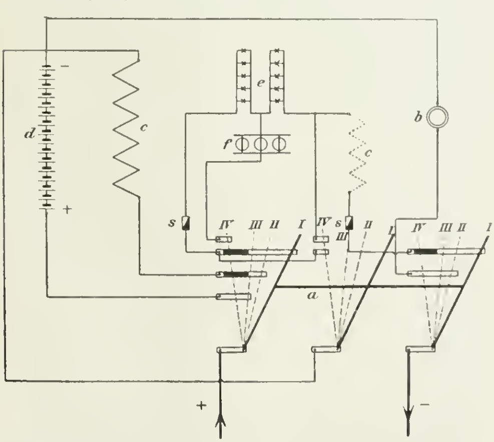


Fig. 2.—Series Connection of Arc Lamps and Incandescent Lamps.

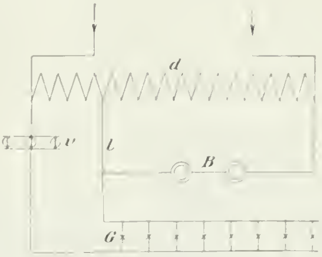


Fig. 3.—Series Connection of Arc Lamps and Incandescent Lamps on Alternating-Current Circuit.

Series Connection of Incandescent and Arc Lamps.—In the forty installations which have been equipped with the new system of series connection of incandescent lamps and arc lamps (see abstract above of the paper of Schaeffer) the following results have been obtained:

	For Forty Plants	Average Per Plant
Number of arc lamps	102	2.5
Number of incandescent lamps lighted without cost	554	14
Aggregate candle-power of incandescent lamps lighted without cost	26,710	668
Hours of burning per year	69,305	1,733
Cost of energy for the kw-hours taken from the supply lines in dollars	9,665.10	241.63
Savings against the former system in dollars	4,255.49	106.39
Percentage of savings due to incandescent lamps operated without cost		44

The saving is 44 per cent of the amount paid by the plants at present for lighting.—*Elek. Zeit.*, May 18.

Electric Lighting of Motor Cars.—An illustrated description of the "Carleon" system of lighting for motor cars, the special feature of which is a generator the voltage of which is maintained constant over a wide range of speed by varying the air-gap between the armature and the field magnets. As will be seen from Fig. 4, the armature is cone-shaped and its position relative to the field magnets is adjusted by a centrifugal governor. The total travel of the armature is $1\frac{1}{2}$ in. and in its limiting position each air-gap is $\frac{3}{8}$ in. The position, however, is not likely to be reached, since at 4000 r.p.m. the armature is displaced only 1 in. The lower limit at which the armature supplies energy to the lamps or battery is 1400 r.p.m. The generator is a four-pole shunt machine, and four brushes are used to collect the current from the commutator. Two additional brushes are attached to the end of the spindle and are displaced radially by centrifugal force when the armature is rotating, their position being controlled by two springs. Each of these brushes, which are not indicated in the diagram and which are insulated from one another, comes into contact at speeds above 1400 r.p.m. and short-circuits two insulated brass rings fixed inside the generator casing. This serves to connect the armature to the main terminals of the machine when the normal voltage is reached, so that a switch is unnecessary. The battery is connected permanently to the terminals of the machine, so that charging takes place whenever the generator runs at a speed higher than 1400 r.p.m., the pressure being from 14 volts to 15 volts. One set of plates consists of zinc and the other of a star-shaped carbon rod embedded in a block containing manganese peroxide, graphite, zinc chloride and sal ammoniac. These ingredients in certain proportions are made into a paste with distilled water and pressed into a block containing the star-shaped carbon at the center. The electrolyte comprises crushed oats, crushed rice, zinc chloride and sal ammoniac. The cell is therefore of the dry Leclanché type.—Lond. *Electrician*, May 26.

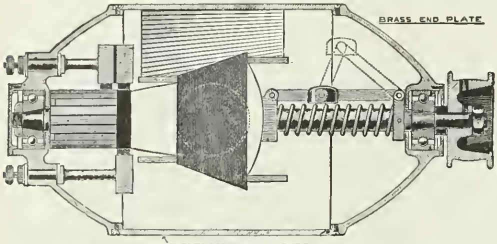


Fig. 4.—Diagram Showing Principle of Carleon Generator.

Photometry of Linear Sources of Light.—J. Pole.—A mathematical paper dealing with the same subject as his recent paper before the (American) Illuminating Engineering Society. The subject is discussed in the following four chapters: First, illumination produced by a linear source of light; second, photometry of linear sources of light; third, the total flux from linear sources of light, and fourth, the total flux for a concentric sphere. The paper still contains the statement that the problem of calculating the total flux from a linear source of light (in contradistinction to a point source of light) is indefinite if at the same time the surface inclosing the linear source of light and for which the flux is to be calculated is not exactly defined.—*Elek. Zeit.*, May 4.

Electric Equipment of a Theater.—D. C. M. Hume.—An article in which the author first discusses the use of electricity in a modern theater in connection with the revolving stage, panoramas, lifting stage, sliding stage, special scenic gear, mechanical flies, fireproof curtains, etc. In the second installment the author deals with theater lighting and especially the arrangement of the switchboard and dimmers.—Lond. *Electrician*, May 19 and 26.

Generation, Transmission and Distribution.

Induction Motors for Winding Engines.—An account of the extended discussion which followed the reading of the recent paper of Mr. J. H. Heather on the driving of winding engines by induction motors.—Lond. *Electrician*, May 19.

Traction.

Electric Railways.—G. W. Kupka.—An article on the new electric railways connecting Tyrol with Bavaria Ten thousand-volt, 15-period, single-phase current is to be used with electric locomotives. The maximum speed will be from 40 km to 45 km per hour (24 miles to 27 miles per hour); average speed, 30 km per hour (18 miles). Energy will be supplied from a hydroelectric station near Innsbruck.—*Elec. Zeit.*, May 18.

Installations, Systems and Appliances.

Electromagnetic Relays.—A note on a recent British patent (2249, May 18, 1911) of the Adams Manufacturing Company, Limited (Cutler-Hammer Manufacturing Company of this country). In alternating-current relays the windings which attract a number of cores in a longitudinal direction to actuate a pivoted switch member are by this invention made to actuate a pivoted member which carries a switch and also a number of cores. The windings are arranged on a frame of conducting material to which one terminal is connected, the other end being taken to the supply line so that each winding is connected in a different phase of the polyphase supply which energizes the relay. When an abnormal current flows in the circuit the pivoted arm is actuated to open or close the switch to control the required apparatus. The pivoted member may be abnormally held in this position, so that its contact switch engages with the stationary contacts by a tension device adjustable to vary the conditions under which the pivoted arm is actuated by the windings.—Lond. *Elec. Eng'ing*, May 25

Rates.—K. Gajczak.—The author discusses a tariff system which he formerly recommended and in which he emphasizes that central stations should arrange their charges according to the cost at which a consumer can generate energy for himself in an isolated plant. A certain fixed price is charged according to the maximum power which the consumer is permitted to take from the supply mains and another charge is made for the kw-hours consumed. The maximum power taken from the supply mains is not controlled by a maximum demand indicator, but is fixed by some limiting device which makes lamps flicker and stops the motors when the maximum permissible power is exceeded. Some figures are given on the cost of generation in stations of different sizes on which the rates should be based. He thinks that such a rate would greatly aid the development of electric cooking and heating.—*Elec. Zeit.*, May 18.

Wires, Wiring and Conduits.

Heating of Cables with Current.—S. W. Melsom and H. C. Booth.—A paper presented before the (British) Institution of Electrical Engineers. Investigations on the rise in temperature of various sizes of conductors carrying current are discussed, the effect of stranding, of installing in tubes, wood casing, etc., and of various methods of insulating and covering being described. The results of this research are incorporated in the recently issued sixth edition of the "Wiring Rules" of the (British) institution. The conditions under which the tests were made and the temperature rise was measured are described. The increase of temperature of the cables was determined by measuring the increase of conductor resistance. Fig. 5 is typical of the results obtained with different types of covering for a 7/16 cable. In general, the current-carrying capacity of rubber cables for a temperature rise of 20 deg. Fahr is about 10 per cent less when they are run in casing than when they are laid out along the floor—that is, in air (the latter, of course, approximates to the conditions of the cables cleated to a wall or in a wood chase). There is also very little difference between the rubber-insulated and paper-insulated cables when laid under similar conditions. The difference between rubber cable in casing and in iron tube in air (that is, laid along the floor) is very small. When, however, the iron tube is embedded in plaster the cooling is distinctly better, the curve being nearly the same as that obtained with the lead-covered single cable. Other diagrams are given in which the current density is given as a function of the cross-section of the conductor for various temperature rises. In certain cases (that is, single rubber-covered cables in air and in wood casing and paper-insulated lead-covered cables, both single and concentric) the connection between cross-section and current-density could be fairly represented by a formula of the type $i = K\,(D/S)^n$, where n is a constant and K depends on the system of units adopted and the amount of the temperature rise. If i is the current-density in amperes per square inch, S the cross-section of the copper in square inches and D the diameter of the outside covering of the cables in inches, then, for a rubber-covered cable in air, $i = 364\,(D/S)^{0.661}$; for a similar conductor in casing, $i = 309\,(D/S)^{0.66}$, and for a lead-covered cable, $i = 429\,(D/S)^{0.5}$, the temperature rise assumed in each case being 20 deg. Fahr. For a 30 deg. Fahr. rise K is 457, 358 and 536 respectively for the above three types, n being unchanged.

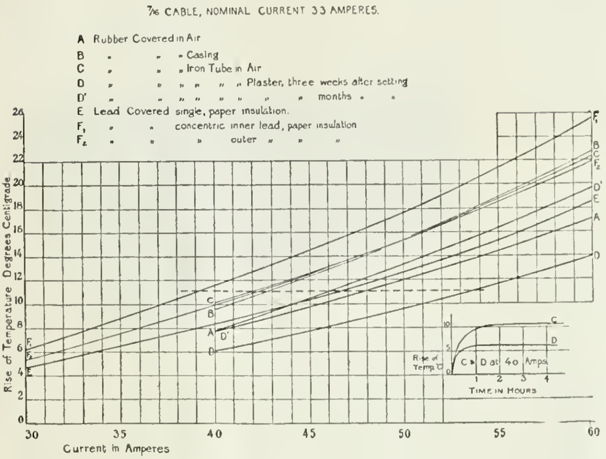


Fig. 5.—Temperature Rise in Various Cables.

For a 50 deg. Fahr. rise $K = 688$ for a lead-covered cable.—Lond. *Electrician*, May 26.

Electrophysics and Magnetism.

Positive Atomic Charges.—So far as our knowledge extends at the present time an atom consists of a positive part (sub-atom) combined with some unknown number of electrons. The positive sub-atom is generally regarded as the strictly material part of the atom, since the atomic mass seems to be associated with it. The positive charges are generally assumed to be equal and opposite to the negative charges, but the author suggests that different sub-atoms may have different electric charges and that the electrical charge of an atom is as characteristic a physical constant as its atomic weight. He offers the hypothesis that the positive sub-atoms of the elements have characteristic charges which vary as the square roots of their atomic weights. In a second paper in the same issue he suggests that both the viscosity of gases and their solubility in water depend upon the characteristic charges carried by their molecules.—*Phys. Review*, May.

Electrified Sphere.—G. H. Livens.—A paper of a mathematical nature on the initial accelerated motion of a perfectly conducting electrified sphere.—*Phil. Mag.*, May.

Uranium and Radium in Minerals.—Miss R. Pirret and F. Soddy.—An account of further experimental investigations on the ratio between uranium and radium in different minerals.—*Phil. Mag.*, May.

Units, Measurements and Instruments.

Measuring Insulation Resistance in Networks—L. Verain.—An article in which the author first shows the futility of some proposed methods of measuring the insulation resistance of direct-current three-wire networks during operation. The author then describes two methods which permit one to measure the insulation resistance of the three conductors of a three-wire network where access can be had to the generators. It is not possible to determine by this method the insulation of a three-wire network at any point, as is possible in two-wire plants.—*La Lumière Elec.*, May 6.

Meters.—An official communication by the Reichsanstalt by which a modification of the single-phase induction meter of the Siemens-Schuckert Company is admitted for calibration. The adjustment of the phase displacement is obtained no longer by branch circuits, but by a short-circuit coil which is closed by a loop of constantan wire, the resistance of the loop being variable by a sliding contact. The cores of the current coils have shoes of thin sheet iron for the purpose of mixing the current flux and the voltage flux more intimately and thereby increasing the torque.—*Elek. Zeit.*, May 4.

Exhibition of Apparatus.—J. Reyval.—An illustrated description of the exhibits at the recent exhibition of the French Physical Society in Paris.—*La Lumière Elec.*, May 6.

Reducing Screens for Photometric Use.—H. E. Ives and M. Luckiesh.—A description of a new form of neutral-tint absorbing screen suitable for reducing intensities with the photometer. It is an opaque-line grating on glass, of the type used by photoengravers.—*Phys. Review*, May.

Telegraphy, Telephony and Signals.

Automatic Telephony.—A. Raps.—A fully illustrated lecture held before the Berlin Electrical Society on automatic and semi-automatic telephony with connections up to 100,000, with special reference to the Sprowger system as modified by the Siemens & Halske Company for German conditions. The author shows that automatic telephony has many advantages in operation and permits great savings with respect to first cost as well as operation.—*Elek. Zeit.*, May 4, 11 and 18.

Printing Telegraphy.—D. Murray.—The conclusion of his recent paper presented before the (British) Institution of Electrical Engineers. In the present instalment illustrated descriptions are given of the Murray printing telegraphy system, especially the Murray multiplex page-printing telegraph. An account of the discussion which followed is also given.—Lond. *Electrician*, May 12.

Shock Excitation.—M. Wien.—An illustrated review of his experiments on a new form of shock excitation using longer spark-gaps. For the purpose of obtaining a better quenching effect there are inserted in the exciting circuit Geissler tubes in addition to the spark-gap proper.—Lond. *Electrician*, May 19.

Miscellaneous.

Higher Technical Instruction—J. H. Reynolds.—A paper read before the British Imperial Educational Conference. The author discusses the reasons why Great Britain is behind other countries in regard to education. In spite of the fact that facilities for higher technical instruction have been considerably increased the number of students studying science as applied to manufacturing industry is small. The author pleads especially for a keener appreciation of the value of knowledge and the subordination of the passion for games.—Lond. *Electrician*, May 19.

BOOK REVIEW.

Elektrotechnische Winke für Architekten und Hausbesitzer. By L. Bloch and R. Zaudy. Berlin: Julius Springer. 151 pages, 60 illus. Price, 2.80 marks.

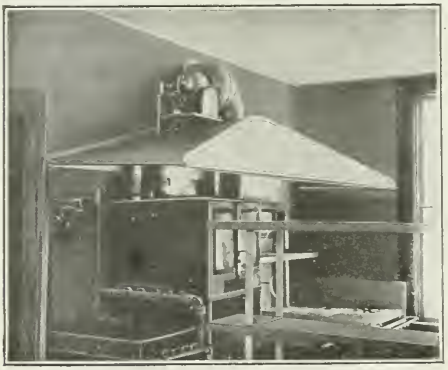
A handy elementary textbook for the use of architects and of others interested in its subject-matter on the use of electricity in buildings, how installed and how applied. The ordinary electric household appliances, such as lamps, heaters and motors, are described in non-technical language, so as to be readily understood by the uninitiated. The methods of running wires in buildings, both old and in course of erection, are explained. A final chapter is devoted to the applications of electricity in building construction. The book will be useful to architects as illustrating German practice in the use of electricity both in building and for buildings

New Apparatus and Appliances

ELECTRIC BLOWER FAN FOR THE KITCHEN.

For carrying off the fumes from kitchens in hotels, apartment houses and institutions of various characters the method frequently adopted consists of simply placing hoods over the ranges and connecting same to the chimney (in case the flue area is large enough) or into a separate pipe up through the roof with a ventilator on top. Such a system works fairly well when there is a good circulation of air outside, but fails on a close, muggy day when kitchen ventilation and cooling are most desirable.

An outfit overcoming this difficulty is shown in the accompanying illustration. It has recently been installed in the kitchen of the Lewis School for Stammerers, Detroit, Mich. It was installed primarily to carry off the fumes from over the range, as the window next to the range is but a few feet away from a window in another building where the Lewis School holds some of its classes. The arrangement, which consists of a "Sirocco" electric utility blower, made by the American Blower Company, Detroit, is, however, handling about 400 cu. ft. of air per minute and in doing this effects an air change in the kitchen once every six or seven minutes, which provides good ventilation in addition to carrying away the odors.


Electric Blower Fan for the Kitchen.

The hood is about 6 ft. 2 in. from the floor with a rise of about 2 ft. and a flattened area on the top which is connected with the inlet pipe leading to the blower. The blower has an elbow on the outlet which is shoved up into a flue which carries off the discharge.

DIMMERS FOR REALISTIC STAGE EFFECTS.

Recognizing the growing necessity for improved apparatus for controlling the lighting of theaters, the General Electric Company has developed a form of dimmers which, while possessing reliable operating characteristics, are also capable of ready adaptation to widely varying requirements.

These dimmers consist of resistance units or plates of circular form, which may be used singly or in banks composed of several plates for controlling any number of lights and for producing any dimming or intermingled color effect desirable.

In order to obtain fine gradations of light intensity each plate is provided with a large number of contact buttons, and any objectionable flickering effects are eliminated by making the resistance divisions or steps at the first or working position of the plate finer than those at the opposite position when the reduced efficiency of the lamps renders such effects inappreciable.

For convenience of operation and for facilitating adaptation to any desired arrangement of lamps each resistance plate is provided with its own switch arm, and when several plates are combined into a bank the switch arms are moved over the contact buttons by means of levers working on a common rod or shaft. In the interlocking form of dimmers the individual levers may be readily and quickly locked to the shaft and the whole bank controlled by a master lever.

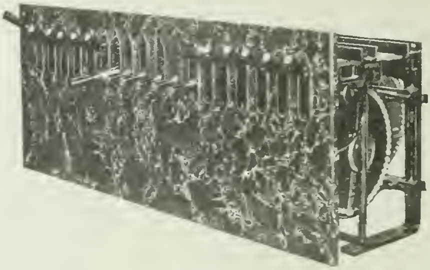


Fig. 1—Twenty-Three-Plate Interlocking Type Theater Dimmer.

The possibility of burn-outs is reduced to a minimum by the use of liberal values in the design of the resistance plates, thus avoiding troubles the least of which would be sufficiently disastrous to the scenic effects to cause the entire failure of an otherwise successful production.

A quality absolutely essential in dimmers is noiselessness. A noisily operating dimmer offers an intolerable interference in the case of scenes requiring intense silence. This shortcoming has been entirely eliminated by carefully grinding down the contact buttons so as to bring their surfaces on an exact level with each other, thus enabling the contact piece on the switch arm to pass over the buttons without rattling. Furthermore, continued perfect contact is insured by providing means for maintaining the permanent elasticity of the switching device. This is accomplished by the addition of a phosphor-bronze spring to the steel spring attached to the switch arm for holding the contact pieces against the surfaces of the contact buttons.

The long life or service of the apparatus is greatly enhanced by the unit resistance type of construction, since it enables the removal and replacement of any plate which happens to get out of order without interfering with the continuous operation of the other plates. This feature is particularly important where the stage lighting is laid out on a four-color scheme with separate banks of dimmers controlling the red, white, blue and amber lights, the pocket-lights on the stage and the general illumination of the auditorium.

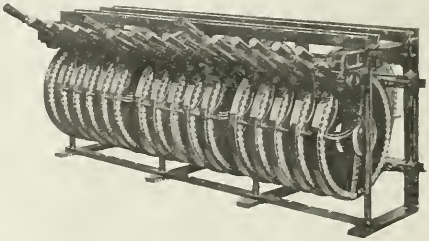


Fig. 2—Theater Dimmer with Board Removed.

INDICATING BOILER FLOW METER.

The boiler meter developed by the General Electric Company is designed to indicate the amount of steam generated at any instant by a boiler or a battery of boilers. The meter apparatus complete consists of a nozzle plug, the meter proper and the necessary pipes for connecting the nozzle plug to the meter. The nozzle plug consists of a screw plug provided with a stem having two sets of orifices—a leading set arranged longitudinally and a trailing set comprising three holes located at the middle of the stem and at right angles to the leading set. The interior of the stem is divided longitudinally into two separate compartments, the leading set of orifices opening into one and the trailing set opening into the other. For operation the nozzle plug is screwed into a small hole drilled and tapped in the steam pipe, with the stem extending across the pipe and the leading set of orifices facing the direction of steam flow. When thus arranged the velocity of the steam causes a certain difference of pressure to exist in the two sets of orifices, and this difference of pressure is communicated through suitable pipes connecting the compartments in the nozzle-plug stem with the U-tube of the meter. The body of the meter consists of an iron casting cored out to form one leg and the well of the U-tube, the other leg being formed by one of the nozzle-plug connecting pipes entering the well at the opposite end. The well is filled with mercury, and the rest of the apparatus, including the connecting pipes and the compartments in the nozzle plug, is filled with water. The movable mechanism of the meter comprises a small float resting on top of the mercury in one of the legs of the U-tube and attached to a waterproof silken cord passing over a pulley and held taut by means of a counterbalance weight acting on the pulley in the opposite direction and a pair of horseshoe magnets—one inside the meter, attached to the pulley shaft, the other outside the meter, fixed to the pivoted end of the indicating needle. The axes of rotation of the two magnets are in line, and their mutual attraction exerted through a copper plug screwed into the side of the meter body casting compels them to move in unison. When the difference of pressure caused in the nozzle plug by the velocity of the steam flowing in the steam pipe is communicated to the two legs of the U-tube the mercury in the well rises or falls in the leg containing the float to a height proportional to the difference of pressure. The resulting motion of the float rotates the pulley, and the motion of the latter is transmitted through the pair of magnets to the indicating needle. The meter is easily installed, without interfering in any way with existing steam-pipe arrangements The dial scale is 8 in. in diameter, marked with heavy flow lines and large figures on a white surface for easy reading. A target of conspicuous size is provided for designating a certain flow on the scale. The meter can be calibrated to read in pounds per hour or in boiler horse-power (30 lb. of steam per hour being taken as equivalent to one boiler horse-power), for pressures ranging from 0 lb. to 250 lb. gage; for quality ranging from 4 per cent moisture to 260 deg. Fahr. superheat, and for pipe diameters of 2 in., 3 in., 4 in., 6 in., 8 in., 10 in., 12 in. and 14 in. Meters calibrated for pipes larger than 14 in. in diameter are also built. It will be noted in this connection that for any given case a meter of this type is calibrated for a certain pressure, quality and pipe diameter, and cannot be used for any other condition.

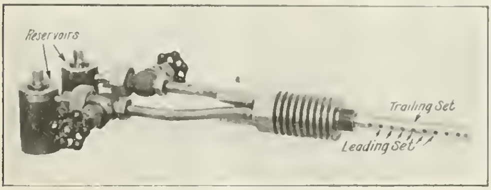


Fig. 1—Nozzle Plug and Piping for Steam-Flow Meter.

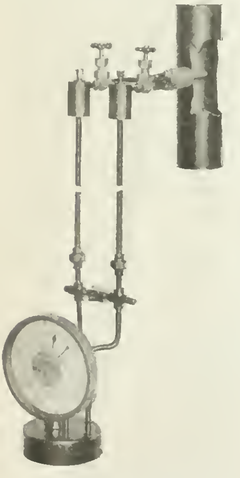
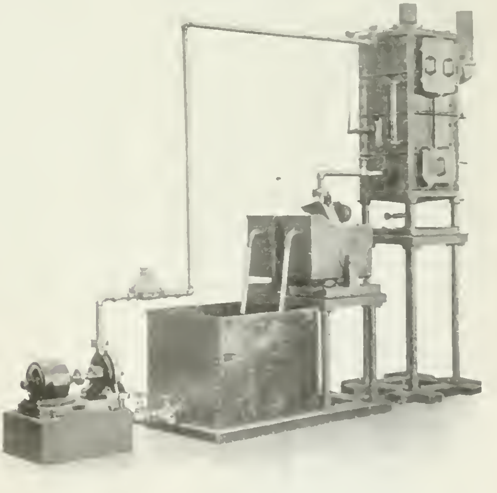


Fig. 2—Indicating Steam-Flow Meter Connected to Pipe.

APPARATUS FOR WEIGHING LIQUIDS.

The International Steam Pump Company, New York, has recently brought out an open-pattern liquid weigher particularly developed for accurately measuring and recording by weight the flow of hot water, chemicals, oils, etc., that cannot be measured satisfactorily by meters. The weigher is independent of the density of the liquid and of its temperature, its action being governed entirely by weight and not by volume. It possesses no valves or other feature, it is claimed, which through wear or friction would afford an opportunity for any falling off in original efficiency. As may be seen from the illustration, the weigher consists of two tanks pivoted at a point in their height which is above the center of gravity when the tank is empty. As the tanks alternately fill the center of gravity is raised until it comes above and to one side of the center of support, which causes the tank to tip on its knife edge bearings and start the discharge of the liquid through the bent-pipe outlet. This pipe is continued within the tank as the short leg of the siphon so that the flow being once established continues until the tank is drained. After the center of gravity has been lowered the tank tilts back to its normal position. As each tank tips it automatically turns the rocking inlet spout so as to deflect the water into the other tank and that one is filled while the first is discharging Each movement of this spout actuates a mechanical counter which is calibrated to read either the number of load of the tanks, or directly in pounds, gallons, or whatever other unit of measure may be desired. Since the record is by weight, the counter reading is final The weigher is shown in connection with an elevated open feed-water heater serving merely as a tank and a centrifugal pump. The group formed part of a recent exhibit in New York City.



Liquid Weigner.

SINGLE-PHASE AND POLYPHASE POWER-FACTOR METERS.

Every effort is made to keep the power-factor of a system high in value because to a certain extent it is a measure of the degree to which the circuits and apparatus are being utilized. In large systems the economic importance of the power-factor assumes such proportions that special means are often employed for adjusting it to unity and thus attaining maximum utilization of the electrical equipment. Wherever the power-factor is adjusted it is necessary to have actual knowledge of its correct value at all times, and this is most conveniently obtained by means of a suitable power-factor meter.

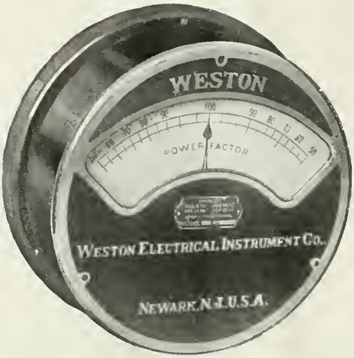


Fig. 1—Power-Factor Meter.

One type of power-factor meter operates on the electrodynamometer principle. It depends for its action upon the time and space-phase relations of currents in a system of coils. The system consists essentially of one fixed field coil in series with the load and two movable coils mounted on the same staff and in space quadrature to each other. One movable coil is connected across a load circuit, and the other is connected across a circuit that differs considerably in time-phase from the load circuit. When there is current in all coils the movable system will take up a position such that the resultant field due to the two coils which is in time-phase with the field produced by the current in the fixed coil will be in space-phase coincidence with the fixed field.

From a consideration of the above it may be seen that for uniformity and permanency of calibration it is absolutely essential that all working parts be definitely and permanently located with reference to each other. In the olden types of meter the movable coils are wound separately and then one is forced inside of the other and fastened by a coating of shellac. This construction has the following disadvantages: 1. The coils are irregularly distorted from the true circular form, and, therefore, cannot be made interchangeable, as each one requires special calibration. 2. The coils are not permanently located at right angles to each other and are apt to become displaced under service conditions, thus requiring the recalibration of the instrument.

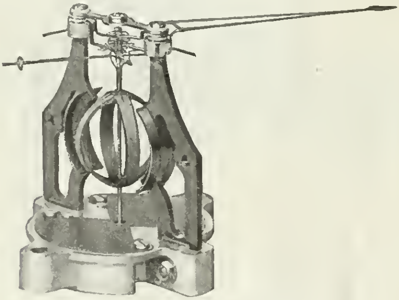


Fig. 2—Power-Factor Movement.

The Weston Electrical Instrument Company, of Newark, N. J., has brought out a form of electrodynamometer power-factor meter in which it has been attempted to produce an instrument having all parts interchangeable and one which will permanently hold its calibration under the usual service conditions. These results are attained by making every part accurate to dimensions and located absolutely in position with reference to every other part. The general construction of these instruments is similar to that employed in the Weston single-phase switchboard wattmeters and possesses the same general construction and interchangeability of all parts.

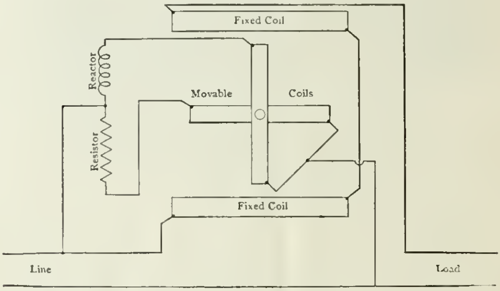


Fig. 3—Circuit Diagram of Single-Phase Power-Factor Meter.

In order that the movable-coil system might be made interchangeable a new type of construction had to be evolved. By this method the coils are wound simultaneously on a special machine and interlaced layer by layer at crossing points. The completed coil system is then treated with a special cement that binds the turns together and gives it the strength of a solid mass of metal, thus assuring the absolute retention of its original form.

These coil systems are pinned to the staff just as is the movable coil of the Weston switchboard wattmeter, and thus its position is definitely fixed.

All electrodynamometer power-factor meters operate theoretically without spring control, but since current-carrying filaments must be used to connect the movable coils to the external circuit some torque is always produced by the torsional moment of these filaments. In fact, it usually requires from 3 amp to 5 amp in the series coil to produce any usable deflection of the pointer.

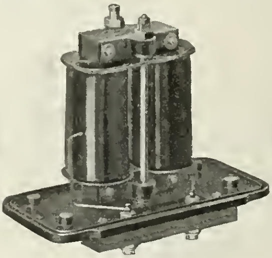


Fig. 4—Reactor.

In the present form of power-factor meter these current-carrying filaments have been reduced almost to the vanishing point. The whole movable system weighs less than 2 grams, and, therefore, very little current is needed in order to produce the torque, and consequently the filaments have been reduced until they have just sufficient strength to be self-supporting. It takes 16,000 of them to weigh 1 oz., and the error produced by them is only 1 per cent at one-fifth full-load current through the series coils.

These power-factor meters are equipped with the same type of air damper as is used in the Weston switchboard wattmeters and are sensitive to sudden changes and perfectly dead-beat. The meters can be used on single-phase circuits without sacrifice of accuracy. This is partly due to the method of construction and partly to the reactor used in the phase-splitting device. The reactor, which is shown in Fig. 4, resembles in general construction a core-type transformer. The core is made of extremely thin laminations and is provided with two air-gaps, one in each leg, placed in the middle of each coil. The laminations are held firmly in place by insulated bolts and the gaps are made readily adjustable. By locating the gaps in this manner instead of outside, they are shielded from stray field by the conductor turns and variations in reactance with voltage are avoided.

RECTIFIER FOR ALTERNATING CURRENTS.

The Murphy Electricity Rectifier Company, Rochester, N. Y., has brought out a 10-amp rectifier which differs materially from that shown some years ago at the New York Electrical Show. Work on larger rectifiers is also in progress, it being the purpose of the company to build a complete line to fill any requirement within the range of the commercial field. The rectifier herein described has a range of operation for any current value from a fraction of an ampere up to 10 amp, and is furnished to operate at any voltage up to 500 and for any commercial frequency from 15 cycles to 150 cycles. It is especially adapted for charging small batteries for ignition, automobile and other work, and also for supplying small direct-current motors.

The Murphy rectifier as at present designed is in effect a graphite-arc valve having an infinite resistance for current in one direction and a negligible resistance for current in the other direction. A high-tension disruptive discharge closes the graphite-arc valve, which is in series with the alternating-current supply and the direct-current load, and the load current (alternating supply current) follows the low-resistance path established by the high-tension discharge and forms an arc which maintains itself until extinguished by the dropping of the impressed voltage near the end of the half cycle. The disruptive discharge is furnished by an auxiliary circuit containing a small high-tension transformer, a condenser and an auxiliary spark-gap. One terminal of the auxiliary spark-gap is a nickeled disk and the other a loop of platinum-iridium wire heated to a dull-red heat by an auxiliary secondary winding on the transformer. This loop under this condition tends to throw off negative ions, which action lessens the resistance to current flowing in their direction and increases the resistance to current flowing in the opposite direction. The auxiliary spark-gap is adjusted so that the emf of the high-tension transformer alone will not quite establish the arc across the air-gap, but with the assistance of the stream of negative ions, the arc is established and the current flows in the same direction at every other half cycle. To aid further the valve action at the spark-gap, the transformer is excited by both alternating current and direct current, which results in a higher voltage during every other half cycle. When the current flows in the opposite direction during the other half cycle the voltage in the auxiliary circuit is not sufficient to establish the arc and no current will pass the graphite electrodes. The result is an intermittent flow of current in one direction only.

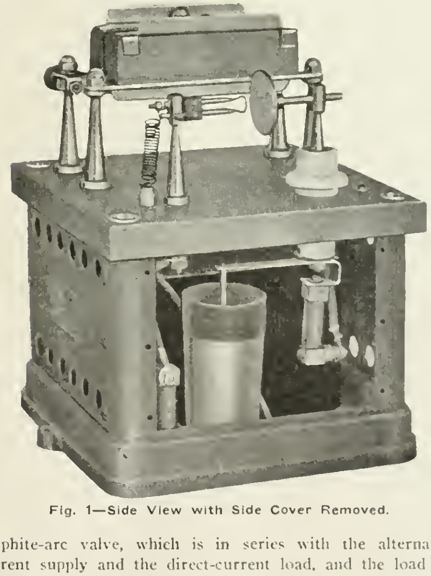


Fig. 1—Side View with Side Cover Removed.

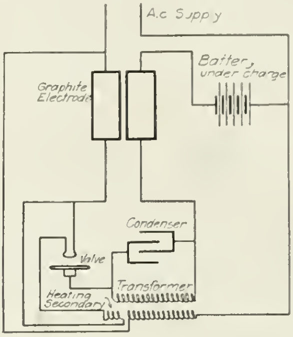


Fig. 2—Diagram of Connections.

Oscillograph records show that when adjusted for normal operation no reversed current passes through the rectifier. The rectifier is self-starting and the graphite electrodes, which have a life equivalent to from 8000 kw-hours' to 10,000 kw-hours' use, are given a slight adjustment once after every 1000 kw-hours' use. The loop terminal of the auxiliary spark-gap has a life equivalent to about 2000 kw-hours' use. The accompanying curves show the efficiency of the apparatus as determined by tests at Cornell University. As the rectified current is unidirectional the power-factor of the load will be unity for all cases in which the counter emf is always positive, as in hand-operated arc lamps, storage cells, electrolytic and resistance loads of all kinds. When reactive loads are being carried the efficiency will naturally drop with a decrease in the power-factor of the load. The rectifier occupies a space 10 in. x 10 in. x 13 in. and weighs 48 lb.

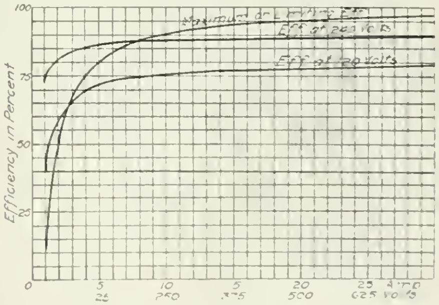


Fig. 3—Efficiency Curves.

Industrial and Commercial News

The Week in Trade.

ALTHOUGH no marked changes have taken place during the week in any particular line, confidence in early improvement is reported from nearly every section of the country. Iron and steel trades have made a better showing as a result of the price reductions of the past few weeks, and prospects for new business in this field are said to be good, modified to some extent by the views of a few manufacturers that railroad purchases will be irregular during the summer months. A most favorable report on the foreign trade of the country for the month of May was issued during the week and showed new records for both exports and imports. The former aggregated $153,261,278 for the month and the latter $130,677,753, while the excess of exports over imports, $22,583,525, is nearly double this item for the corresponding month in 1910. The situation is further strengthened by the smaller number of cars reported idle in the past two weeks, the decrease, though small, being indicative of the advance in trade. Interest at this time is centered chiefly in the crop reports. There has been a lack of sufficient moisture in the Southwestern wheat area, but should the totals not reach the estimates of the earlier part of the season on this account, the harvests are expected to be satisfactory, and the prospects are regarded by many as fully equal to those of any former year, unless absence of rain is unduly extended. Conditions in the West are considered much better than in recent weeks. Railroads have done a larger business in consequence of increased shipments of live stock to the packing houses. Dry goods throughout the country are said to be maintaining their position, and demand in retail lines, though slightly under the recent scale, is mildly active.

Buyers, while withholding large commitments until more settled times, are less hesitant in purchasing for future requirements. Collections, while better in some sections of the country, continue from slow to fair. Business failures for the week, as reported by *Bradstreet's*, were 212, as compared with 232 for last week, 178 for the same week in 1910, 213 in 1909, 254 in 1908, and 165 in 1907.

The Copper Market.

AS a result of the manipulative prices which have dominated the copper market for a considerable length of time, prices were advanced during the past week, electrolytic reaching 12¾ cents per pound, the highest figure thus far for the year. Sales were in larger volume, with domestic consumers buying for July, August and September shipment up to midweek, until discouraged by the maintenance of high prices. After that time the purchasing was confined largely to foreign interests. The domestic demand came chiefly from wire-drawers, the brass interests having been more prominent in the market during the previous week. In spite of the larger saies for the week, there are no signs of general increase in consumption, nor of marked decrease in production. The larger interests are now asking 12⅝ cents to 12¾ cents for electrolytic delivered thirty days, and 13-cent copper is predicted in a short time by many in the trade. The outlook for the next few months is considered to be far brighter than it has been at any time in the present year. This is attributed to changes in selling methods, and in a measure to the gradual revival of trade throughout the country, requiring consumers to replenish stocks, although there is little doubt that the recent buying movement was only for present needs, and was induced by the advance in the electrolytic market. The prospects for continuation of foreign demand are also regarded as favorable for briskness in the trade, foreign business in finished copper having been one of the saving elements in the trade during the year. Exports for the month, including June 10, amount to 19,527 tons. The daily call on the Metal Exchange June 19 quoted copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling Price.
Spot	12.25	12.35	.....
June	12.25	12.35	12.30
July	12.25	12.35	12.30
August	12.25	12.35	12.30
September	12.25	12.35	12.30

The London market, June 19, was as follows:

	Noon.			Closing.		
	£	s	d	£	s	d
Standard copper, spot	57	0	0	57	11	3
Standard copper, futures	56	18	9	57	10	0

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	12.30c			11.57½c		
London, spot	£56	15	0	£53	7	6
London, futures	57	12	6	54	0	0
Best selected	60	5	0	57	5	0

Industrial and Commercial Notes.

Assignment of American Electric Fuse Company.—Dated Muskegon, Mich., June 9, 1911, Paul S. Moon, of that city, assignee of the American Electric Fuse Company, makes the following official announcement to the customers of that company: "The American Electric Fuse Company has met with certain reverses and has made an assignment to me for the benefit of all of the creditors. I have taken charge of the business and affairs of the company and am operating under the orders of the court. Customers' orders are being taken care of in the usual way. I have not yet had an opportunity to make definite plans for the permanent operation of the plant, but think there will be no change in that regard. Any orders received from you will have prompt attention the same as in the past." One estimate places the liabilities of the company at $720,000, with assets supposed to be worth from $250,000 to $500,000. After the assignment Frank G. Jones, formerly of Chicago, and for several years president of the American Electric Fuse Company, of Muskegon, was arrested on a warrant sworn out by the Old National Bank of Grand Rapids. He was charged with violating the federal banking laws, and, according to the daily newspapers, Jones admitted that in his capacity as president he had forged notes and drafts, and made false acknowledgments of accounts sufficient to develop a capital of $720,000. From Jones' confession, if the newspaper accounts are correct, he had been carrying on a losing business for a period of nearly eight years. He had no accomplices, apparently, but by a chain of forged notes and accounts he appears to have met his obligations, expecting each year to be able to repay the money he had floated in forged paper through the increased earnings of the business. This hope, however, was not realized. Many of the largest creditors are banks and note brokers. It is said that the final dénouement was almost an accident. On June 8 the Continental and Commercial National Bank of Chicago received a note for collection amounting to $3,000. The address given was the American Electric Fuse Company's Chicago branch. Owing to the recent change in street numbering in Chicago there was some difficulty in locating the Chicago branch of the company, and in consequence the alleged maker of the note was appealed to. This man declared immediately that the note was a forgery, and the Chicago bank in turn notified the bank in Muskegon from which the note had been forwarded. Jones was confronted with the evidence of his guilt and is said to have admitted with scarcely a tremor that the note was a forgery. He appeared to be glad that the matter had come to an end, and not only confessed to the forgery of a $3,000 note, but outlined in brief a series of other fraudulent acts. Creditors were notified, and it was ascertained that the company was apparently a going concern with a plant worth, perhaps, $250,000, and accounts receivable worth perhaps $50,000. It is said that the factory employed about 700 men and did a business amounting to $30,000 to $35,000 a month. The bankruptcy proceedings and the arrest of President Jones followed the investigation of the creditors. Jones contended that all the money he received was turned into the business, leaving nothing whatever for himself but his home in Muskegon, Mich.

Georgia Power Company Equipment.—Contracts for the alternators, motors, transformers and controlling apparatus for the initial instalment of the Georgia Power Company's development at Tallulah Falls have been awarded to the General Electric Company. The specifications for this equipment and the ultimate requirements at the station were given in the *Electrical World*, May 4, 1911.

Organization of Federal Utilities, Incorporated.—A company known as Federal Utilities, Incorporated, to deal in public utility securities, has been organized under the laws of the State of Virginia, with an authorized issue of $3,000,000 6 per cent cumulative preferred stock and $3,000,000 common stock, $1,000,000 of the former and $2,000,000 of the latter having been issued. De Forest Candee, formerly of Lee, Higginson & Company, Boston, is president of the new company, and the other members of the executive committee are as follows: Anson W. Burchard, assistant to the president of the General Electric Company; Samuel McRoberts, vice-president National City Bank; Thomas A. Reynolds, assistant cashier National City Bank, and Harrison Williams, who is prominent in the affairs of the American Gas & Electric Company, the Federal Light & Traction Company, and is president of the Springfield Railway & Light Company, of Springfield, Mo. The company has established large offices at 60 Broadway, New York City, and will begin operations at once, and $1,000,000 has been paid into the treasury. The policy of the company involves the acquisition and sale of properties and of the securities of public utilities and other corporations having established earnings. The capital of the company will be invested in various dividend-paying securities, chiefly public utilities which have demonstrated their earning power. The investments of the company will, at all times, be diversified and sufficiently well known to be salable. The preferred stock has preference both as to principal and dividends, the company reserving the right to redeem this stock at 110 per share at any time after the date of issue. The company expects that its investments will furnish revenue sufficient to pay the 6 per cent dividend in 1911 on the outstanding $1,000,000 preferred stock, and that in addition to the income and profits which will result from the ownership of securities it will derive its largest profit from the sale of bonds, stocks, notes and other securities to bankers and other brokers. Under its charter the company may issue its own collateral trust bonds, secured by the bonds of other companies as collateral.

National Electrical Credit Association.—On June 8, at the King Edward Hotel, Toronto, the National Electrical Credit Association held its twelfth annual meeting. This is the second time in the history of the association that it has held its meeting in a large Canadian city, the former occasion being on June 23, 1905, when the delegates were entertained by the manufacturers and jobbers of Montreal. Delegates and representatives from the Boston, New York, Philadelphia, Chicago and San Francisco associations were in attendance, as well as invited guests from Montreal and Toronto. The total membership of the several associations reporting at the meeting was 478, comprising the largest and most representative manufacturers and jobbers in the electrical trade throughout the United States and Canada. This is an increase in membership of over 10 per cent in the past year. The several associations have handled 59,020 credit items, and the total number of adjustments effected has been 37,252, involving $3,073,820.15. While the association is in no sense a collection agency, yet, by its operation, it effected the adjustment of fifteen claims per member on an average, last year, and secured for each an average of $985.73. The chief value of the service, however, is the promotion of mutual confidence among its members, the securing of uniformity and certainty in the customs and usages of the electical trade and the distribution among members of credit information to save them from making unsatisfactory sales. The officers-elect for the ensuing year are: President, Mr. A. L. Miller, of John A. Roebling's Sons Company, New York; vice-president, Mr. George J. Murphy, of Pettingell-Andrews Company, Boston; general secretary-treasurer, Mr. Frederic P. Vose, Marquette Building, Chicago.

Westinghouse Railway Equipment Orders.—The following orders for electric railway equipment have recently been received by the Westinghouse Electric & Manufacturing Company: Two quadruple equipments of No. 306 split-frame interpole motors with type K-55 control, from the Parkersburg, Marietta & Interurban Railway Company, of Parkersburg, W. Va.; from the North Jersey Construction Company, Paterson, N. J., two quadruple equipments of No. 306 interpole railway motors with type HL (non-automatic) unit-switch control; from the Great Falls & Old Dominion Railroad Company, of Washington, D. C., four quadruple equipments of No. 03-A railway motors with type HL (non-automatic) unit-switch control; from the Cincinnati Traction Company, a quadruple equipment of No. 303 railway motors with type HL (non-automatic) unit-switch control; from the Boise Railway Company, of Boise, Idaho, and the Union Street Railway Company, New Bedford, Mass., each for two double equipments of No. 101-B motors, with K-36 and K-35 control, respectively; from the Lehigh Valley Traction Company, Allentown, Pa., for four quadruple equipments of No. 304 interpole railway motors, with type HL (non-automatic) unit-switch control; from the Alton, Jacksonville & Peoria Railroad Company, of Alton, Ill., five quadruple equipments of No. 304 interpole railway motors with type HL (non-automatic) unit-switch control; from the Boston Elevated Railroad Company, twenty equipments of No. 301 interpole railway motors with multiple-unit control.

Contracts Awarded for Wireless Towers.—The Baltimore Bridge Company has received the contract for the three large towers for the wireless system to be used by the Navy Department, near Washington, D. C. The plans of the Navy Department include the erection of towers at Ft. Myer, Va., on the opposite side of the Potomac from Washington, with a main tower 600 ft. in height and two others of 450 ft. About 900 tons of steel will be required for building these towers. When completed the wireless system is to be capable of sending messages between 2000 miles and 3000 miles, and by relays, to cover the North Atlantic, so that it will be possible to communicate with vessels on the coast of Europe and Africa. The instruments to be used in this system have been building and under trial at Brant Rock, Mass., for over two years, final decision to erect the system being withheld until satisfactory performance of these instruments was made. The Baltimore Bridge Company submitted alternative bids for the towers as follows: For one 600-ft. steel tower, $105,541; for two 450-ft. towers, $63,440; for two of the foregoing with complete auxiliaries, $122,954; one 600-ft. tower built on different specifications from the foregoing, $42,101; two 600-ft. towers, $82,368.

Crocker-Wheeler Sales.—Among recent sales of the Crocker-Wheeler Company are the following: A shipment of apparatus to the Franciscan Sugar Company, of Manzanillo, Cuba, including one 350-hp generator; several repeat orders for transformers from the Hartford Electric Light Company, Hartford, Conn., this making in excess of 100 Crocker-Wheeler transformers now in use by the Hartford company; a lot of twenty-two motors for the Salem Elevator Works, Salem, Mass.; complete generating equipment for the Itasca Paper Company, Grand Rapids, Minn., including one 625-kva engine-type alternator; several motor generators for the Mackay Telegraph & Cable Company; generating plant for the Alamo Cement Company, San Antonio, Tex., including one 450-kva engine-type alternator. One 4000-kw alternator is being completed for the Sanitary District of Chicago.

Aichiken Commercial Museum, Nagoya, Japan.—A handsome commercial museum, known as the Aichiken, was opened on Jan. 15, 1911, in the city of Nagoya, prefecture of Aichi, Japan. The city of Nagoya, with its 400,000 inhabitants, is yet a virgin market for foreign goods, it is said, and the purpose of the institution is to foster local trade and to build up foreign business. There are three exhibition buildings, one being devoted to machinery. The museum will gladly furnish information on business matters and act as a medium between business houses of Japan and those of other countries. It is suggested that descriptions of machinery be made very clear and in abundant detail. Mr. T. Yamaguchi is director of the museum.

Mexican Northern Power Company.—Following some interference with its work on the hydroelectric development on the Conchas River, eighteen miles from Santa Rosalia, Mexico, due to revolutionary troubles, the Mexican Northern Power Company has increased its force of workmen, to make up for lost time. The company is composed of Canadian capitalists, and it is said that the initial cost of the enterprise will be $5,000,000, gold.

Receivers for United Wireless Telegraph Company.—Receivers have been appointed for the New York, New Jersey and Maine assets of the United Wireless Telegraph Company, certain officials of which were recently convicted in the federal court of using the mails to obtain money by false pretences. The company was organized under the laws of Maine, with $10,000,000 common stock and $3,000,000 preferred.

Financial.

The Week in Wall Street.

Trading on the New York Stock Exchange last week was irregular, and sales were slightly under those of the week preceding, amounting to 2,494,178 shares, as compared with 2,502,428 for last report. While activity is only moderate, there is an excellent tone throughout the Street, and conditions are approaching those of more stable times. The bond market, in addition to its well-maintained briskness, has been characterized by the successful sale of the Chinese government 5 per cent bonds and the oversubscription of the Panama Canal issues. Subscription for the former was closed two days before scheduled time, owing to the large subscriptions received on the day of opening, and the latter offering was, as had been expected, oversubscribed about three times. The larger bids came from bond and banking houses, and there was, no doubt, considerable duplication of funds in connection with the heavy subscription. It is likely that the government will net close to 102½ on the issue, with the sale reflecting favorably upon its credit. It is a question whether the activity of the bond market will continue throughout the summer, in view of the scale of its operations in the past few months, following the long period of depression. The stock market was influenced more acutely by the fact that Steel bookings for May were in larger volume than had been expected, and by crop conditions, than by the sale of the large issues cited above, and the dealings of the week were concerned more with the industrial issues than with the railroad shares that have been prominent in recent markets. Important price changes during the week were few in number. The absence of heavy demand for time money leaves the money market in its former state of quietness, with quotations practically unchanged. Rates June 19 were: Call, 2¼@2½ per cent; ninety days, 3@3¼ per cent. The quotations in the table are those of the close, June 19.

NEW YORK.

	June 12.	June 19.	Shares Sold.		June 12.	June 19.	Shares Sold.
All. Ch.....	8⅞*	9	325	Int. Met., pf.	52¼	51¾	4,800
All. Ch., pf..	33	31*	700	Mackay Cos..	91	90*	300
Amal. Cop...	69¼	71¼	133,200	Mackay C.,pf.	74½	74⅞	784
Am. D. T...	20½*	20½*	———	Man. Elev...	139⅞*	139*	225
Am. Loco....	42	42¾	2,100	Met. St. Ry..	15*	15*	———
Am. Loco.,pf.	109*	110*	217	N.Y.&N.J.Tel.	139½*	139½*	———
Am. Tel. & C.	83	83*	10	Steel, com...	78	79	447,260
Am. T. & T..	151⅞	151½	15,081	Steel, pfd....	118¼	119	2,650
B. R. T.....	81¼	80⅛	14,710	W. U. T.....	81⅝	80¼	7,410
Gen. Elec...	164⅛	164¼	6,700	West'h, com..	76½	77⅛	10,877
Int. Met.....	19	18⅜	3,700	West'h, pfd..	118⅛*	118⅛*	———

PHILADELPHIA.

	June 12.	June 19.		June 12.	June 19.
Am. Rys............	44*	44	Phila. R. T........	19	19¾
El. Co. of A........	11⅞*	12*	Phila. Elec.........	16⅞	17
Elec. St. Bt'y........	55½	56	Phila. Trac.........	86¼	87½*
Elec. St. Bt'y., pfd..	30*	30*	Union Trac........	48	49½*

CHICAGO.

	June 12.	June 19.		June 12.	June 19.
Chi. City Ry........	186*	186*	Chi. Tel. Co........	123	123*
Chi. Rs., Ser. 1.....	80*	80*	Met. El. Co........	25	26*
Chi. Rs., Ser. 2....	22*	22*	Met. El., pfd........	72½*	72¼*
Com. Edison........	128½	129	Nat'l Car..........	120*	120*
Chi. Subways........	4⅛	4	Nat'l Car, pfd......	119*	118½*

BOSTON.

	June 12.	June 19.		June 12.	June 19.
Am. T. & T........	151¾	151¾*	Mex. Tel...........	4*	4*
Cum. Tel...........	157½*	159½*	Mex. Tel., pfd......	6*	6¾*
Edison E. Ill.......	286½*	285*	N. E. Tel..........	150	150¼*
Gen .Elec...........	164¼	164¾*	W. T. & T.........	20	20*
Mass. E. Ry........	23¼*	23⅛*	W. T. & T., pfd....	96*	96*
Mass. E. Ry., pf....	90¼	92⅝*			

*Last price quoted.

Shares sold for the week, June 12 to June 19.

Financial Notes.

Chicago Elevated Railway Merger.—Responding to the offer of Henry A. Blair, the stockholders of the South Side Elevated Railroad Company, the Metropolitan West Side Elevated Railway Company and the Northwestern Elevated Railroad Company are depositing their stock quite freely with the Illinois Trust & Savings Bank, of Chicago, and the National City Bank, of New York. As heretofore mentioned, Mr. Blair offers the following prices for the stocks, payable in cash; South Side, $75; Metropolitan preferred, $75; Metropolitan common, $27.50; Northwestern preferred, $70; Northwestern common, $30. Each depositor of stock may elect to apply 30 per cent of the cash payable to him to the purchase of preferred and common participation shares of a voluntary association formed for the purpose of acquiring the deposited stocks at the rate of one preferred share and four-fifths of a common share for each $100. The new preferred stock is to be 6 per cent cumulative. For example, a person depositing 100 shares of Metropolitan preferred is entitled to receive $7,500 in cash, or, if he wishes, $5,250 in cash, new preferred shares having a par value of $2,250 and new common shares having a par value of $1,800, making $9,300 in all at the par valuation of the new stock. One estimate of the saving to be effected by consolidation of the elevated roads places the amount at $1,000,000 a year. This will be due to economy in operation, rearrangement of routing, reduction in cost of power, saving in office expenses and other causes.

Springfield Railway & Light Company.—Lee, Higginson & Company are offering $2,000,000 first lien fifteen-year 5 per cent sinking fund gold bonds of the Springfield Railway & Light Company, of Springfield, Mo., at 96 and interest, yielding 5.40 per cent. The total authorized issues of which these bonds are a part is $7,000,000, of which $5,000,000 is reserved for additions and improvements. The bonds will be dated May 1, 1911, and will mature May 1, 1926, interest being payable May 1 and Nov. 1 in New York, Boston and Chicago. They will be callable as a whole (but not in part except for the sinking fund) at 102 per cent and accrued interest on any interest day. The Springfield Railway & Light Company was incorporated in January, 1906, under the laws of the State of Maine, owns the entire capital stocks of the Springfield Traction Company and the Springfield Gas & Electric Company and is in turn controlled by the Federal Light & Traction Company. The bonds will be secured by a first mortgage on all the capital stock, mortgage bonds and notes of the two subsidiary companies (except certain non-callable bonds), making them substantially a first lien on the entire property of the system. The proceeds of these bonds will be applied toward the retirement of all present outstanding funded debt of the Springfield Railway & Light Company and of its two subsidiary companies, either by calling the outstanding bonds or by the deposit of sufficient funds in trust. A portion of the proceeds, to the amount of $300,000, will be applied to additions and improvements to the properties. It is planned to install a new turbine unit and to make extensions to the gas and electric distribution systems which are expected to produce increases in gross and net earnings.

Edison Electric Illuminating Company of Boston.—The earning statement of the Edison Electric Illuminating Company of Boston for the month of May and eleven months ended May 31 showed a gain in gross for the month of $35,272, or 9.73 per cent, as compared with the same month in the preceding year. There was an increase of $27,889 in operating expenses, which, deducted from gross earnings, left an increase in net earnings of $7,383. In the eleven months, as above, the gross revenue was $4,859,292, which compares favorably with $4,352,759 for this item in the same period of the previous year, and is equivalent to an increase of 11.64 per cent. This gain was made with an increase of only 5.68 per cent in operating expenses. The operating ratio for May, 50.74, was the highest thus far in the fiscal year, excepting the ratio in August last of 51.94.

Ottawa Traction Merger Expected.—Plans for effecting the merger of the Ottawa Electric Railway Company, the Ottawa Light, Heat & Power Company (which controls the Ottawa Gas Company) and the Ottawa Car Company are said to be nearly completed. A holding company, with a capital of $10,000,000 5 per cent bonds and $10,000,000 stock, is a part of the plan. The present capitalization of the merging companies is as follows: Ottawa Electric Railway Company, $1,247,000 stock and $50,000 bonds; the Ottawa Light, Heat & Power Company, $2,000,000 stock, and the Ottawa Car Company, $200,000 stock.

H. M. Byllesby & Company Acquire Colorado Property.—It is understood that controlling interest in the Pueblo & Suburban Traction & Lighting Company has been purchased by H. M. Byllesby & Company, of Chicago, the consideration being $3,000,000. The deal includes the traction and electric service properties of Pueblo, power plant and distribution systems of Skaguay and Victor, together with a generating station at La Junta and other utilities controlled by the Pueblo interests.

Baltimore Consolidated Securities Placed Abroad.—President J. E. Aldred of the Consolidated Gas, Electric Light & Power Company, while recently in Europe, placed a large block of the company's 4½ per cent bonds with Messrs. Kitcat & Aiken, the London brokers.

Rumored Consolidation of Dayton (Ohio) Electrical Properties.—A conference was held at the Dayton Club, Dayton, Ohio, Friday evening by men interested in the Dayton Lighting Company, the Citizens' Electric Company and the Dayton Light & Power Company, as a result of which it is said that arrangements have been completed for the consolidation of the three companies. It was further reported that A. M Young and Anthony Brady, both of New York, were admitted to be the controlling owners of the first two companies named, as well as the backers of the Dayton Light & Power Company, which was organized some months ago to build an electric line in the Hills and Dales, a large park near Dayton. The Citizens' Electric Company was organized in 1906 and holds a twenty-five-year franchise to operate in the city. The Dayton Lighting Company, incorporated in 1905, is a consolidation of the Dayton Electric Light Company, with plants in Dayton, Ohio, and Covington, Newport and Dayton, Ky., and the Montgomery County Electric Light Company, of Dayton, Ohio. According to a report made last year it has outstanding $1,875,000 common stock and $500,000 cumulative 5 per cent preferred stock. The authorized capital is $3,000,000 common and $500,000 preferred. The bonded debt amounts to $2,080,000, it is said. The Dayton Light & Power Company was originally the Hills and Dales Electric Company, and was incorporated with a capital stock of $25,000. The officers of the Dayton Lighting Company will be in temporary control of the consolidated companies.. They are as follows: President, E. P. Matthews; vice-president, F. M. Taft; treasurer, H. E. Talbott; secretary and general manager, F. M. Tait.

Western Union Telegraph Earnings.—The preliminary statement of earnings of the Western Union Telegraph Company for the year ended June 30, 1911, with the returns of the last quarter estimated, indicates a decrease of some $537,000 in net earnings and a decrease of over $580,000 in surplus applicable to dividends. Net earnings for the year ended June 30, 1910, were $7,274,900, while for the present fiscal year, ending June 30, 1911, the estimated earnings are $6,738,000. After payment of a 3 per cent dividend last year the surplus was $2,597,373, while the approximation for this year is $2,050,000. Following the recent directors' meeting, at which the regular quarterly dividend of three-quarters of 1 per cent was declared, this being done just before the end of the quarter, contrary to general practice, President Vail said that the business of the company has been largely increased in the last year, that there has been a gratifying increase in gross revenue, but that there has also been a large increase in expenditures, and that the results of the betterments will be reaped in the future.

United Railways & Electric Company.—An announcement is expected by July 1 of the plan by which the United Railways & Electric Company of Baltimore will raise the $2,500,000 needed to retire $2,000,000 first mortgage 5 per cent bonds and $500,000 4½ per cent certificates of indebtedness of the former Baltimore City Passenger Railway. The details are being arranged by Alexander Brown, founder of the United Railways, who still takes an active part in the affairs of the company. No details of the plan are known as yet, but it is believed that the members of the board have decided to issue three-year notes bearing interest at the rate of 5 per cent.

Sierra & San Francisco Power Company.—Arrangements have been completed by Patrick Calhoun, Ernest Thalmann and their associates for the sale of $1,000,000 of the bonds of the Sierra & San Francisco Power Company. The proceeds will be used to complete the generating station now building on the Stanislaus River and the distribution system. This company was acquired some time ago by the foregoing for the purpose of giving the United Railroads of San Francisco an independent source of power for the operations of its system in San Francisco. The surplus power will be sold in that city and neighboring localities.

New Stock to Be Issued by American Telephone & Telegraph Company.—President Vail, of the American Telephone & Telegraph Company, has stated that costs of new construction in the current year will be financed by a new stock issue, the amount and date of which has not been determined. Between one-half and three-quarters of the cost of new construction for the year, which is estimated at close to $60,000,000, will be furnished by surplus earnings, leaving between $30,000,000 and $15,000,000 to be provided for by the new issue.

South Side Street-Railway Amalgamation in Chicago.—It is said that an agreement has been reached by which the Chicago City Railway Company will take over the Chicago lines of the Chicago & Southern Traction Company, the latter an interurban company, operating from Halsted and Seventy-ninth Streets, Chicago, to Kankakee If the plan receives the approval of the city authorities, patrons of the road between Seventy-ninth Street and the city limits will be carried down town for a single 5-cent fare.

Orange & Rockland Electric Company.—The Public Service Commission of the Second District of New York has authorized the Orange & Rockland Electric Company to execute a mortgage on its properties, franchises, etc., to secure $500,000 twenty-year 5 per cent bonds. The proceeds from the sale of this issue will be used to refund outstanding bonds, for improvements and betterments to the power station and to pay off other obligations.

Virginia Traction Companies.—William Northrop, president of the Virginia Railway & Power Company, has been inspecting traction properties at Newport News, Hampton and Old Point Comfort, with a view to their acquisition by Gould interests.

DIVIDENDS.

American Cities Railway & Light Company, quarterly, preferred, 1½ per cent; semi-annual, common, 2½ per cent; both payable July 1.

American Gas & Electric Company, quarterly, preferred, 1½ per cent, payable Aug. 1; common, 1½ per cent, payable July 1.

Columbus Electric Company, semi-annual, preferred, $3 per share, payable July 1.

Cumberland Telephone & Telegraph Company, quarterly, 2 per cent, payable July 1.

Duluth Edison Electric Company, quarterly, preferred, 1½ per cent, payable July 1.

McCrum-Howell Company, quarterly, three-fourths of 1 per cent, payable July 1.

Otis Elevator Company, quarterly, preferred, 1½ per cent; common, 1 per cent; both payable July 15.

Philadelphia Company, quarterly, 1½ per cent, payable Aug. 1.

Reading Traction Company, semi-annual, 1½ per cent, payable July 1.

Susquehanna Railway, Light & Power Company, initial, 1 per cent, payable July 1.

Tri-City Railway & Light Company, quarterly, preferred, 1½ per cent, payable July 1.

United Gas & Electric Company, quarterly, preferred, 2½ per cent, payable July 15.

United Gas Improvement Company, quarterly, 2 per cent, payable July 15.

REPORTS OF EARNINGS.

EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON.

Period.		Gross Earnings.	Operating Expenses.	Net Earnings.	Fixed Charges.	Net Surplus
May,	1911	$397,684	$195,863	$201,821	......	......
"	1910	362,412	167,974	194,438	......	......
11m., May,	'11	$4,859,291	$2,058,130	$2,801,161	......	......
" "	'10	4,352,759	1,947,431	2,405,328	......	......

EDISON ELECTRIC ILLUMINATING COMPANY OF BROCKTON MASS

April,	1911	$27,532	$16,456	$11,076	$4,358	$6,718
"	1910	22,829	12,978	9,851	3,308	6,542

HOUGHTON COUNTY (MICH.) ELECTRIC LIGHT COMPANY

April,	1911	$20,775	$9,977	$10,176	$3,888	$6,287
"	1910	21,135	10,865	9,624	3,708	5,916

KEYSTONE (PA.) TELEPHONE COMPANY.

May,	1911	$98,839	$48,303	$50,536	$24,265	$26,271
"	1910	96,688	45,791	50,897	24,840	26,057
11m., May,	'11	$1,056,743	$525,730	$531,013	$268,937	$262,076
" "	'10	1,028,040	512,772	515,772	277,819	237,459

KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY

May,	1911	$377,123	$201,108	$176,015	[illegible]	[illegible]
"	1910	340,101	169,380	170,721	[illegible]	[illegible]

LOWELL (MASS.) ELECTRIC CORPORATION

April,	1911	$36,637	$20,010	$16,627	$4,113	$12,513
"	1910	35,489	18,406	17,083	4,108	12,975

*MEXICAN TELEPHONE & TELEGRAPH COMPANY.

Yr., Feb.,	'11	$564,419	$258,274	$306,145	..	..
Yr., Feb.,	'10	480,609	229,592	251,017	.....	.....

SIERRA PACIFIC ELECTRIC COMPANY (NEVADA.)

April,	1911	$46,040	$16,012	$30,028	$5,170	$24,858
"	1910	44,797	13,991	30,805	5,052	25,753

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*Mexican currency.

General News

Construction News.

FT. SMITH, ARK.—The Ft. Smith Light & Traction Company, it is reported, is contemplating extensive improvements to its system, involving an expenditure of $200,000. About $65,000 will be expended on the Garrison Avenue line and $40,000 in the Little Rock system. The remainder, it is understood, will be used to enlarge and rebuild the company's car barn for the purpose of manufacturing its own cars. J. Walter Gillette is general manager.

HELENA, ARK.—Plans and specifications have been completed by the Scofield Engineering Company, of Philadelphia, Pa., consulting engineers, for power house and equipment for the Helena Gas & Electric Company, of Helena, Ark., for which bids are now being asked.

AUBURN, CAL.—The Board of Supervisors has granted the Great Western Power Company a franchise to erect overhead transmission lines along the highways of Placer County, for which the company paid the sum of $105.

BAKERSFIELD, CAL.—The transmission line which the San Joaquin Light & Power Company is building from Bakersfield through Maricopa and McKittrick northward to join with the Coalinga line and the northern lines of the system lacks only about 40 miles of being completed. The new line will carry 60,000 volts. The Coalinga branch will be supplied with electricity generated at the steam plant in Bakersfield and the hydroelectric plants on the San Joaquin River. When the new line is completed it will be possible to use the output of the Bakersfield plant in Fresno and northward.

DUNSMUIR, CAL.—Preparations are being made by the Dunsmuir Water, Power and Light Company for extensive additions and improvements to its system, which will involve an expenditure of about $75,000.

FAIRMONT, CAL.—The proposition to issue bonds to the amount of $200,000, the proceeds to be used for municipal improvements, including the construction of a dam, tunnels and hydraulic work, in San Transquito Canyon, with power house and service lines to substations, is reported to be under consideration by the council.

FILLMORE, CAL.—Preparations are being made by the Ventura County Power Company, of Oxnard, Cal., to rebuild all of its local transmission lines to provide for the increasing demands and to improve the service.

FRESNO, CAL.—Plans have been prepared by the Fresno, Hanford & Summit Lake Interurban Railway Company for the construction of a power house at the Matteiwinery, in Fresno.

FRESNO, CAL.—It is reported that the San Joaquin Light & Power Company will reduce the price of electricity for lamps in all the larger cities and town from Merced on the north to Bakersfield and towns on the south and including Fresno to 8 cents per kw-hour after Nov. 1, 1911. The company recently established a rate of 9 cents per kw-hour in all of the towns and cities which it serves but Bakersfield, where a maximum of 12 cents per kw-hour has been maintained, pending the installation of a more modern plant. A reduction of 25 per cent is to go into effect July 1 in Bakersfield.

HEROULT, CAL.—Work has commenced on the construction of the large steel building for the Noble Electric Steel Smelter Company, in which five new smelters will be installed. The Northern California Power Company is building a large substation at Heroult for the purpose of supplying electricity to operate the plant.

LIVE OAK, CAL.—The Board of County Supervisors has granted Messrs. Metz & Berg a franchise to erect transmission lines for the distribution of electricity in Live Oak and vicinity.

LOS ANGELES, CAL.—The Pacific Electric Railway Company is making extensive improvements and extensions to its system, which will involve an expenditure of about $550,000, of which $400,000 will be expended for additional cars. The company has recently placed orders for new motor-generator sets for substations at Pasadena, Redondo, Del Rey, Vineyards and other points, to cost about $150,000.

SACRAMENTO, CAL.—Application has been made by F. V. Keesling, of San Francisco, president of the Sacramento-Folsom Electric Railway Company, for a franchise over certain streets in Sacramento. The proposed railway is to extend from Sacramento to Folsom with a branch to Fair Oakes. The road will provide both passenger and freight service.

SAN FRANCISCO, CAL.—Arrangements have been completed for the sale of $1,000,000 in bonds of the Sierra & San Francisco Power Company to provide funds to complete its electric generating plant on the Stanislaus River, together with its distributing system. The plant, when completed, will supply electricity for the street-car lines of the United Railroads of San Francisco.

SUSANVILLE, CAL.—The Town Trustees have granted the Lassen Electric Company a franchise to erect electric transmission lines for the distribution of electricity within the corporate limits of the town. The Northern California Telephone Company has also been granted a franchise.

TULARE, CAL.—The City Trustees have granted the Tulare Power Company a franchise to erect electric transmission line for the distribution of electricity for lamps and motors within the city limits.

LA JUNTA, COL.—The Pueblo Light, Power & Traction Company has applied to the Commissioners of Otero County for a franchise to erect a transmission line down the valley from the western edge of the county of La Junta.

LA JUNTA, COL.—Application has been made to the Otero County Commissioners by John F. Vail, general manager of the Pueblo & Suburban Traction & Lighting Company, for a franchise to erect electric transmission lines across the country roads. The company is said to be contemplating the construction of a large electric generating plant in La Junta to supply electricity for industrial and manufacturing plants in La Junta and vicinity. The company already operates an electric-light station, which it proposes to replace with a larger plant.

PUEBLO, COL.—H. M. Byllesby & Company, of Chicago, Ill., it is reported, have purchased the controlling interest in the Pueblo & Suburban Traction & Lighting Company, of Pueblo. The property includes the street railway and lighting systems of Pueblo, the power plant and lighting systems in Skaguay and Victor, the electric light plant at La Junta and several other plants owned or controlled by the Pueblo company. The consideration is said to be about $3,000,000.

DANIELSON, CONN.—The Connecticut Mills Company is now operating its factory by electricity supplied by the People's Light & Power Company, from its plant on Mechanic Street. At present one 75-hp motor is used, but it is expected that another motor of the same size will be installed as soon as the new machinery is in place. Several other factories, it is said, will use electricity for motive power.

MANCHESTER, CONN.—Arrangements have been made between the North End Light & Power Company and the South Manchester Light & Power Company, whereby the management of the North End system is to be taken over by the South Manchester company on July 1.

WILMINGTON, DEL.—Work will soon begin on the construction of an addition to the No. 1 Brandywine power plant of the Wilmington & Philadelphia Traction Company, which will be erected on the north side of the Brandywine, near Buena Vista Street. The building will be 100 ft. long and 80 ft. wide, one story high. The addition, when completed, will increase the output of the plant by about 4000 kw.

TAKOMA PARK, D. C.—Plans are being considered by the Town Council for the installation of an electric-light system in Takoma Park. The Mayor has been instructed to enter into negotiations with the Potomac Electric Power Company, of Washington, D. C., to install and maintain the service. The streets are now lighted by oil lamps.

WASHINGTON, D. C.—The Secretary of the Interior has awarded the contract for furnishing copper wire for use in connection with the Boise irrigation project, Idaho, to the Standard Underground Cable Company, of Perth Amboy, N. J., for $6,197.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the chief signal officer, War Department, Washington, D. C., until July 19 for furnishing one carload of bituminized fiber conduit, Orangeburg, 3-in. socket joint, approximately 25,000 ft. per carload, including 20 gallons of coupling mixture. Captain A. S. Cowan is disbursing officer.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 26 for the construction of wireless-station buildings at the United States Reservation, Arlington, Va. Plans and specifications may be obtained upon application to the bureau. The cost of the work is estimated at about $60,000. R. C. Hollyday is chief of bureau.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 27 for furnishing to the various navy yards and naval stations supplies as follows: Puget Sound, Wash.: Schedule 3655—3000 ft. single-conductor wire. Norfolk, Va.; 3568—One 7-hp electric motor, one milling machine and tool-grinding machine. Philadelphia, Pa.: Schedule 3680—One electric trolley car. Annapolis, Md.: Schedule 5—850 ft. lead-covered cable, miscellaneous enameled conduit, etc., 12 mine-type telephones. Newport, R. I.: Schedule 3688—Electric soldering irons, unmagnetic electricians' levels. Philadelphia, Pa.: Schedule 3692—1200 lb. copper tubing. Applications for proposals should designate the schedule desired by number.

FORT MEADE, FLA.—The Fort Meade Electric Light Company, recently incorporated, is reported to have awarded contracts for equipment for its plant. J. G. Fancy is president.

ATLANTA, GA.—The Cotton Belt Telephone & Telegraph Company has filed application with the State Railroad Commission for permission to issue $50,000 in bonds, the proceeds to be used for extensions and improvements to its system.

COLQUITT, GA.—It is reported that plans are being prepared by J.

B. McCrary Company, of Atlanta, Ga., for the construction of an electric-light plant in Colquitt. P. E. Wilkins is Mayor.

DALLAS, GA.—Arrangements have been completed by the Paulding County Cotton Manufacturing Company to operate its mill by electricity, which will be obtained from the power plant of the Paulding County Power Company, located 3 miles from Dallas, Ga.

DALTON, GA.—The East Tennessee Power Company has applied to the City Council for a franchise to supply electricity in Dalton. If granted a franchise the company, it is said, will have its system in operation by Sept. 1. Charles Mayfield, of Cleveland, Tenn., is interested in the company.

LEWISTON, IDAHO.—The Lewiston-Clarkston Improvement Company is reported to be preparing plans for the development of its power site on the Grande Ronde River. It is also said that the company proposes to erect a substation east of the city and rebuild the high-tension transmission line serving the city in about a year. The Lewiston-Clarkston Improvement Company has been awarded the contract to supply the city with electricity for operating the pumping station and for street lighting.

CHICAGO, ILL.—The contract for suppying 25,000 ft. No. 6 B. & S. gage, rubber-covered, lead-incased electric-light cable has been awarded to the Simplex Electrical Company, 1144 Monadnock Block, Chicago, Ill., at $3,287.

HAMPSHIRE, ILL.—Plans are being considered for the construction of an electric railway in Hampshire. T. E. Getzelman, Hiram Gilkerson, J. F. Reid, A. A. Baker and others are interested in the project.

SYCAMORE, ILL.—The Woodstock & Sycamore Traction Company has completed its extension to Marengo, and is now making surveys for a route from Marengo to Woodstock.

ELKHART, IND.—The Indiana & Michigan Electric Company is reported to be preparing plans for the construction of a concrete dam across the St. Joseph River, just below the present dam, and the erection of large power house equipped with hydroelectric and steam equipment, capable of developing 7500 hp. J. P. Ohmer is superintendent.

FT. WAYNE, IND.—The Board of Public Works is contemplating the installation of a new coal conveyor in the municipal electric-light plant.

INDIANAPOLIS, IND.—Preparations are being made by the Indianapolis, Nashville & Southern Traction for the construction of an electric railway to connect Indianapolis, Trafalgar, Nashville, Bloomington, Bedford, Mitchell, Orleans and French Lick, bids for which will soon be asked for. Thomas F. Wakeland is secretary.

VINCENNES, IND.—The Vincennes North and South Traction Company is contemplating building an electric railway from Decker to Sullivan. B. M. Willoughby, of Vincennes, Ind., is president.

WARREN, IND.—The Town Board has made arrangements with the Marion Bluffton & Eastern Traction Company to furnish electrical energy for a day service in Warren in connection with the municipal electric system. It is proposed to supply electricity to operate manufacturing and industrial plants. The town officials would like to communicate with parties contemplating the establishment of new plants or making a change in location of their plants with a view to offering them inducements to locate in Warren. For further information address W. H. Hickerson, superintendent of municipal water and light plant.

BOONE, IA.—It is reported that the property and holdings of the Boone Electric Company, consisting of electric-light, power and street railway systems, have been purchased by Colonel W. C. Dows, Isaac B. Smith and John A. Reed, of Cedar Rapids, Ia. It is understood that extensive improvements are contemplated during this year and next.

DAVENPORT, IA.—Preparations are being made by the Iowa Telephone Company for the construction of a new telephone exchange in Davenport.

DAVENPORT, IA.—Preliminary arrangements have been completed by the Davenport-Muscatine Railway Company for the construction of its proposed railway from Blue Grass to Muscatine, contracts for which will soon be awarded. Later contracts will be awarded for building the railway from Blue Grass to Davenport. J. F. Porter is president and K. C. Weedin is chief engineer.

NEW LONDON, IA.—The contract for the construction of the power house for the municipal electric-light plant has been awarded and work on it will soon begin.

PELLA, IA.—The new municipal electric-light and water systems have been completed and will soon be put into commission. The electric plant has sufficient output to supply 8400 lamps of 16 cp. The street-lighting system includes 104 40-watt tungsten lamps. Electricity for pumping the water supply is supplied by the electric plant. The cost of both systems is estimated at about $90,000.

WEBSTER CITY, IA.—The City Council has awarded the contract for equipment for the municipal electric-light plant, bids for which were opened June 7, as follows: For engines, boilers, piping and heaters, to the Murray Iron Works, of Burlington, Ia., at $12,000, and to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for electric generators, switchboard, etc., for $9,998.

McLOUTH, KAN.—The City Council, it is reported, is considering a proposition submitted by Oskaloosa capitalists to install an electric-light system in McLouth. It is said that a franchise will soon be granted.

MELVERN, KAN.—The City Council, it is reported, is contemplating the installation of an electric-light system in Melvern. It is proposed to secure electricity for operating the system from the [illegible] electric plant at Lyndon, about 10 miles distant.

BOWLING GREEN, KY.—The construction of an electric railway between Bowling Green and Franklin, Ky., is under consideration.

LEXINGTON, KY.—The Kentucky Traction & Terminal Company is reported to be contemplating extensive improvements to its system which will involve an expenditure of about $800,000 and include the erection of a power plant with an output of 4750 kw, substation and the installation of new equipment.

SHREVEPORT, LA.—The Caddo Window Glass Company, of Shreveport, La., is reported to be in the market for equipment for its plant, including a boiler, engine and generator.

MONSON, MAINE.—It is reported that a large hydroelectric development is under way on what is known as Big Wilson Stream, in Elliottsville, Maine. The project will include a dam 30 ft. in height to provide power to operate a large electric generating plant. Electricity generated at the plant will be used in the slate mills, quarries and sawmills in Monson, Maine.

BALTIMORE, MD.—The Consolidated Gas and Electric Light and Power Company has awarded the contract for construction of its storage battery station to be erected on McClellan Alley, near Baltimore Street, to the J. Henry Miller Company. The building with equipment will cost approximately $300,000.

BROOKLYN, MD.—The Brooklyn Improvement Association has applied to the Public Service Commission to compel the Brooklyn and Curtis Bay Light & Water Company to extend its service to Brooklyn. The association states that the company promised the service provided 200 customers was guaranteed. The company was informed that 212 parties would take the service to begin with, but as yet the lines have not been extended to this town.

CUMBERLAND, MD.—Preliminary arrangements have been made by the Cumberland and Westernport Electric Railway Company for the construction of an extension from Westernport to Piedmont and Keyser, W. Va., a distance of about 6 miles.

ATHOL, MASS.—Preliminary surveys are being made by the Athol and Orange Street Railway Company for building an extension of its railway from Athol to Winchendon, via Baldwinville.

BOSTON, MASS.—Contracts have been awarded for material and equipment for the power plant at the City Hospital as follows: To the Lord Electric Company, of New York, N. Y., for furnishing generator, switchboard and electric wiring, at $10,750; steam fittings in power house and tunnels to Bradlee & Chatman, for $12,543; to the Ames Iron Works, of Oswego, N. Y., for engine for direct connection, at $2,600, and to John A. Rooney for fireproofing work in power house and changes in the tunnels at City Hospital, including flooring for engine rooms, at $13,370.

CLINTON, MASS.—The Clinton Gas Light Company has submitted a new schedule to the Board of Selectmen showing a reduction in the rates for both electricity and gas, to take effect Oct. 1, 1911. Under the new schedule the price of electricity will be as follows: For the first 50 kw used 18 cents per kw-hour with a discount of 2 cents per kilowatt and a discount of 6 cents per kilowatt for all used in addition to 50 kw per month. The price of gas will be reduced from $1.60 to $1.50 for the first 1000 cu. ft., and for all used above that amount the price will be $1.40.

MANSFIELD, MASS.—At a special town meeting held June 14 the citizens voted to issue bonds to the amount of $22,500, the proceeds to be used for extensions and improvements to the municipal electric-light plant.

PITTSFIELD, MASS.—The Berkshire Street Railway Company has awarded the contract for the construction of the addition to its power house on East Street to Fred T. Ley & Company, of Springfield, Mass. The addition will be 80 ft. x 35 ft. A transformer station 40 ft. x 50 ft. will be erected on the opposite side of the street.

WESTFIELD, MASS.—The contract for additional equipment for the municipal electric-light plant has been awarded to the General Electric Company, of Schenectady, N. Y., for $3,377. The new apparatus will provide for the additional arc lamps on Elm Street and will include lamps, rectifiers. The new circuit will provide for thirty-three lamps.

DETROIT, MICH.—Arrangements are being made by the Detroit United Railway Company to begin work on the extension of the Third Avenue line out Hamilton Boulevard

LANSING, MICH.—The Michigan United Railways Company, which has recently completed an extension to Owosso, is contemplating building another extension to Durand and to Flint.

MIDLAND, MICH.—Application has been made to the County Supervisors of Midland County by William A. Markey, of Midland, for permission to build a steel and concrete dam across Pine River in connection with a hydroelectric power plant.

NEWBERRY, MICH.—At an election held recently the citizens voted against the proposition to issue $11,500 in bonds for the construction of a new power house for the municipal electric-light plant.

BROWNS VALLEY, MINN.—The date for receiving bids for the installation of a municipal electric-light plant in Browns Valley has been extended from June 21 to June 28. Plans and specifications are on file at the Builders' Exchange in Minneapolis and St. Paul. L. P. Bigelow is village clerk.

LINDSTROM, MINN.—The Minneapolis General Electric Company, it is reported, is contemplating extending its transmission lines to Lindstrom, Center City and Chisago City to supply electricity for lighting those towns.

MINNEAPOLIS, MINN.—The Twentieth Avenue Publicity Club has awarded the contract for lamp-posts and standards to the Flour City Iron Works and to Mr. Hartig for installation of curb lamps on Twentieth Avenue North, Minneapolis.

MINNEAPOLIS, MINN.—The Minneapolis Northern Suburban Railway Company has awarded the contract for the construction of its proposed electric railway to connect Minneapolis, Amoka, Onaway and Little. W. J. Whitcomb, of Minneapolis, Minn., is president of the company.

KANSAS CITY, MO.—The McLaughlin Engineering Company, of Kansas City, Mo., has been engaged to take charge of the engineering work in connection with the construction of the municipal electric-light plant and distributing system in Kansas City, for which $350,000 has been appropriated. Plans and specifications for the plant will be ready in about thirty days.

KING CITY, MO.—We are informed that the city of King City is anxious to have an electric-light system installed in that place, and a liberal franchise will be granted to responsible parties to establish and maintain a central station there. For further information address J. W. Sullinger, city attorney.

MEXICO, MO.—The North Missouri Central Railway Company is reported to be preparing plans for the construction of an electric railway from Jefferson City to Mexico, via Columbia, 63 miles in length. A branch will also be built from Columbia to Moberly, a distance of 39 miles. M. M. Stephens, of East St. Louis, Mo., is president of the company.

SPRINGFIELD, MO.—Bonds to the amount of $300,000 have been issued by the Springfield Railway & Light Company. The proceeds will be used for extensions and improvements to its system, including the installation of a turbine generating unit, additional gas-producing apparatus, which will double the generating capacity of the electric-lighting system, and extensions to the electric-light and gas-distributing systems.

CLYDE PARK, MONT.—The question of installing an electric-light plant in Clyde Park is under consideration. W. B. Calhoun is reported to be interested in the project.

POLSON, MONT.—Plans are being considered for the installation of an electric power plant at Hell Roaring Creek. Mayor Dawson and others are reported to be interested in the project.

DEETH, NEV.—The Board of Commissioners has granted the Deeth Mercantile Company a franchise to construct and operate an electric-light plant in Deeth.

DERRY, N. H.—Announcement has been made that the Derry Electric Light Company has been reorganized under the name of the Derry Electric Company. The officers of the new company are: Greenleaf K. Bartlett, president; Fred J. Shepard, treasurer, and Joseph B. Bartlett, manager.

FLORHAM PARK, N. J.—It is reported that the Morris & Somerset Electric Light Company, of Morristown, N. J., will accept the contract for lighting the borough and twenty-five-year franchise to supply electricity in Floral Park. The company applied for a forty-year franchise. Under the terms of the contract for street lighting the company will furnish sixty-five incandescent street lamps at the rate of $20 per lamp per year. The company agrees to have the system completed by September 1, 1911.

SANTA FE, N. M.—Charles D. Miller, Territorial engineer, has approved the application of L. A. Hughes and G. W. Prichard for water rights on the Rio Grande River at Cochiti, N. M., to be used to operate a large hydroelectric power plant. The application of Andrieus A. Jones for water rights for a proposed irrigation system in Guadalupe County, N. M., has also been granted.

BUFFALO, N. Y.—The Buffalo Southern Railway Company is considering plans for the construction of an extension to East Aurora.

BUFFALO, N. Y.—The Buffalo and Lake Erie Traction Company is reported to have decided to equip the Jamestown, Chautauqua and Lake Erie Railroad, which extends from Westfield to James, for electrical operation.

FREEPORT, N. Y.—The Village Board has awarded contracts for four mercury rectifiers, to take the place of the arc machines now in use, and for fifty lamps, to cost $2,732.

LIBERTY, N. Y.—Contracts will be awarded in the near future by the Liberty and Jeffersonville Electric Railway Company for the construction of 12 miles of new track. William Craig, of East Orange, N. J., is president.

MONROE, N. Y.—The Public Service Commission, Second District, has authorized the Orange & Rockland Electric Company, of Monroe, N. Y., to execute a mortgage, to secure an issue of $500,000 in bonds. The company has received authority to issue bonds to the amount of $134,000, of which the proceeds of $37,000 are to be used to refund outstanding bonds, $97,000 to discharge obligations of the company incurred for capital purposes, $5,000 to discharge accounts incurred for capital purposes and $44,000 for improvements and extensions to its plant and system located in Monroe. The company operates in Monroe, Chester, Blooming Grove, Woodbury Falls, Florida, Washingtonville, Central Valley, Highland Mills, Turner and Oxford Depot.

NEWBURGH, N. Y.—The Central Hudson Light, Heat & Power Company, recently formed, to take over the control of the Poughkeepsie Light, Heat & Power Company, of Poughkeepsie; the Newburgh Light, Heat & Power Company, of Newburgh, and the Hudson Counties Gas & Electric Company, of Cornwall-on-Hudson, has asked the Public Service Commission, Second District, for permission to issue $600,000 in bonds.

NEW HARTFORD, N. Y.—The Village Board has entered into a contract with the Utica Gas & Electric Company for lighting the streets of the city for a term of five years. Under the terms of the contract the company is to furnish thirty-one arc lamps at $51 each per year on an all-night schedule.

NORTHPORT, N. Y.—Negotiations have been completed whereby the Long Island Lighting Company has purchased the property of the Northport Electric Light Company. This is a step toward the consolidation of the lighting plants at Northport, Amityville, Islip, Sayville, and Port Jefferson, permission for which was recently granted by the Public Service Commission. Plans are being made for improvements to the local plant, which will include an addition to the power house and the installation of additional machinery and involve an expenditure of about $70,000. It is proposed to supply electricity from the Northport plant to Commack, Elwood, Kings Park, Smithtown and other places. Several substations will probably be erected.

PERRYSBURG, N. Y.—Sealed proposals will be received at the office of the Department of Public Works, Room 5, Municipal Building, Buffalo, N. Y., until July 1, for furnishing and erecting power-plant equipment for a tuberculosis hospital to be known as the J. N. Adam Memorial Hospital, and located at Perrysburg, N. Y., as follows: For placing concrete foundations for boilers, engines, pumps and tanks, including excavation and placing anchor bolts, etc.; for furnishing and erecting three 80-hp boilers complete, one 80-hp engine with one 50-kw generator, one 40-hp engine with one 25-kw generator; wiring to main building, power house and laundry, switchboards, etc.; for furnishing and erecting water-supply system for fire and tank service, including duplex pump, two deep-well pumps, pressure tanks, air pumps and feed-water heater, water purifier and pump, high-pressure hot-water heater, piping for water and heating system and accessories, etc.; for furnishing and erecting laundry equipment, including all machinery, apparatus, etc.; for furnishing and erecting ice machinery, refrigerating plant, etc.; for furnishing and installing electric-light fixtures, etc., and supplying and installing fire service mains. Plans and specifications can be seen and forms of proposals obtained on application at the Bureau of Building, Room 6, Municipal Building, Buffalo, N. Y. A separate proposal must be submitted for the work and supplies furnished. Francis G. Ward is Commissioner of Public Works.

ROCHESTER, N. Y.—Plans have been approved by the Public Service Commission, Second District, whereby the eastern end of Wayne County, including the villages of Wallington, Alton, North Rose, Rose, Wolcott and Red Creek will be supplied with electricity for lamps and motors from the Niagara Falls power transmission lines. The service will be supplied by the Northern Wayne Electric Light & Power Company, which will secure energy from the Rochester Railway & Light Company for distribution.

SCHENECTADY, N. Y.—Bids will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until July 25 for the construction of United States post office building at Schenectady, N. Y., including pumping, gas piping, heating apparatus, electric conduits and wiring, and conduits, in accordance with plans and specifications, copies of which may be obtained from the above office or from the custodian of site, Schenectady, N. Y.

CHARLOTTE, N. C.—Paul Chatham, promoter of the local rapid transit company, has awarded the contract for grading the railway east of Charlotte. It is expected that the company will use the storage battery car on the line.

CHARLOTTE, N. C.—The Charlotte Rapid Transit Company has awarded the contract for construction of an extension of its railway from the present terminus in Elizabeth Heights, in Charlotte, to the Mecklenburg Country Club, to W. J. Oliver & Company, of Knoxville, Tenn.

RIDGEWAY, N. C.—The North Carolina-Virginia Railway Company has been granted supplemental articles of incorporation from the State Corporation Commission to build an electric railway from the North Carolina border to Ridgeway, a distance of 6 miles. The company has been authorized to increase its capital stock from $5,000 to $100,000, as the minimum, and $500,000 as the maximum amount. The headquarters of the company have been moved from Ridgeway to Roanoke, Va.

SHELBY, N. C.—Municipal ownership of the electric-light plant is under consideration. The Board of Aldermen has engaged Lamar Gidney, electrical engineer, to make an appraisal of the local plant and also to submit an estimate of erecting a new plant of sufficient capacity to supply electricity for lamps and motors in the town to be operated in connection with the water-works system.

WINSTON-SALEM, N. C.—Plans have been completed by the Mengel Box Company, of Louisville, Ky., for the erection of a new factory to be built by the company in Winston-Salem, N. C. The plant will cost complete about $100,000 and will be equipped for electric motor drive. Electricity for operating the plant will be secured from the local company.

MANDAN, N. D.—Bids will be received by Lee Nichols, city auditor. until June 29 for furnishing materials and construction of water-works system for the city of Mandan as follows: 1. General contract. To consist of hauling and laying cast-iron water mains and appurtenances, furnishing materials and constructing power house, intake, intake well, settling basins, clear-water well, etc. 2. Machinery contract. To include furnishing and erecting boilers, heater, feed pumps, engine, generator and motors, steam piping, etc. 3. For furnishing hydrants and valves. 4. For furnishing cast-iron pipe and special castings. Plans and specifications are on file at the office of the city engineer, Mandan, N. D., and at the office of Burns & McDonnell, Scarritt Building, Kansas City, Mo., consulting engineers.

VALLEY CITY, N. D.—Bids will be received by the City Council of Valley City, N. D., until July 3 for electric lamps, wire, carbons, cylinder and other oils and such other materials as are needed in connection with the operation of an electric-light plant. Bids will also be received at the same date for sufficient coal to operate the plant for the ensuing year.

AKRON, OHIO.—The Northern Ohio Traction & Light Company has awarded contract for electrical equipment for its proposed new plant at Cuyahoga Falls and six substations to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., at $275,000.

CINCINNATI, OHIO.—The contract for furnishing and installing two turbine water wheels in head-house filtration plant has been awarded by the Water Department to the Trump Manufacturing Company, of Springfield, Ohio, for $4,249.

COLUMBUS, OHIO.—It is reported that the Department of Public Service has adopted the plans of cluster lamps for street lighting submitted by J. William Thomas, of the firm of Howell & Thomas, architects, Broad and Fourth Streets, Columbus, Ohio. The city, it is said, will soon advertise for proposals for furnishing and erecting 900 cluster lights on the principal streets of the city, similar to the design adopted. The cost of the installation complete is estimated at $100,000, including lamp standards, to cost $40,000.

ZANESVILLE, OHIO.—The contract for electrical work at the Children's Home, near Zanesville, has been awarded to the Furges Electric Company, of Zanesville.

COMANCHE, OKLA.—Arrangements are being made for the installation of a municipal electric-light plant in Comanche, to cost about $8,000. It is understood that equipment for the plant has been purchased.

EUGENE, ORE.—The Lane County Asset Company has received authority to begin work at once on the construction of its proposed electric railway between Eugene and Elmira, a distance of 12 miles. S. P. Ness, F. A. Anderson and John Baird are interested in the project.

HOOD RIVER, ORE.—The Hydro-Electric Company, recently incorporated with a capital stock of $250,000, proposes to develop two dam sites in Hood River. One site is located on the Evans property, about 1½ miles from the city and the other a short distance above Tucker's Bridge on the county road. Mr. Evans, Dr. J. A. Watt, of Hood River, and H. J. Jackson, of Portland, Ore., are interested in the enterprise.

MYRTLE CREEK, ORE.—At an election to be held June 29 the proposition to issue $18,000 in bonds, the proceeds to be used to purchase and enlarge and improve the local electric-light and water plant, owned and operated by the Myrtle Creek Water, Light & Milling Company, will be submitted to a vote.

NEWPORT, ORE.—The contract for the survey of a hydroelectric power site and canal at the Siletz Agency has been awarded by the General Land Office, Washington, D. C., to Morris Wygant. The cost of the proposed plant is estimated at $250,000.

PANAMA.—Sealed proposals will be received at the office of the General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until June 26 for furnishing locomotive cranes, reinforcement steel bars, valves, pipe fittings and copper wire as per circular (No 636-A). Blanks and general information to the above circular may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Captain F. C. Boggs is general purchasing officer.

ALLENTOWN, PA.—The Lehigh Valley Transit Company is installing a new 6000-hp turbine in its power house at Allentown, which will increase the output of the plant to 23,000 kw.

ALLENTOWN, PA.—Preliminary arrangements are being made for the organization of a company to build an electric railway from Schnecksville in a northerly course through North Whitehall, Heidelberg and Lynn, to the valley of the Ontalaunce, where connection will be made with the Slatington line of the Lehigh Valley Transit Company for Reading.

ASPINWALL, PA.—Plans are being made for improvements for the municipal electric-light plant in Aspinwall. Bids for additional equipment have already been received. S. R. Chase is borough clerk.

BRADFORD, PA.—The capital stock of the Bradford Electric Light & Power Company has been increased from $85,000 to $130,000.

HARRISBURG, PA.—The Central Pennsylvania Traction Company is contemplating the installation of generating units having a rating of 1600 kw by next November.

JOHNSTOWN, PA.—The Johnstown Traction Company has secured the right-of-way for extending its system from Walnut Grove to Gie[illegible]town. Work will soon begin on construction of same.

MEADVILLE, PA.—The Northwestern Pennsylvania Railway Company will purchase one 300-kw rotary converter for its substation and one 300-kw motor-generator set for its main generating station in the near future. C. L. Murray is general manager.

NEW BRIGHTON, PA.—The Beaver County Electric Light & Power Company is reported to have purchased the municipal electric plant at College Hill. It is understood that the plant will be dismantled and electrical service will be supplied in that place from the power house at Fallston.

NEW CASTLE, PA.—Plans are being considered by the Mahoning and Shenango Railway and Light Company and the City Council for the construction of an extension of the railway out Washington Street to Cascade Park in New Castle.

PHILADELPHIA, PA.—The Fifty-second Street and Lancaster Avenue Business Men's Association has indorsed Councilman Mackey's proposal for lighting the business thoroughfares of West Philadelphia.

SCRANTON, PA.—The Scranton Electric Company has awarded the contract for the enlargement and extensions to its plant to the New England Engineering Company, of New York, N. Y. The work will cost approximately $1,000,000, and will include the installation of one 5000-kw turbine and one 2500-kw turbine at the suburban plant of the Scranton Electric Company, the installation of a complete condenser system in the main power station, rebuilding the plant and making it fireproof and laying railroad tracks for transportation of fuel from culm piles to the plant.

TITUSVILLE, PA.—The Titusville Electric Traction Company has purchased from the Erie and Central Pennsylvania Railroad Company the right-of-way, trackage, etc., between Erie and Punxsutawney.

WASHINGTON, PA.—It is reported that the West Penn Electric Company will soon apply for a franchise in Washington and other towns in this vicinity to supply electric light and power service. Electricity, it is expected, will be supplied from the company's large plant at New Haven. W. S. Kuhn, of Pittsburgh, Pa., is president of the company.

WAYNESBURG, PA.—The Waynesburg and Blacksville Street Railway Company is asking for bids for the construction of its proposed electric railway from Waynesburg to Blacksville, a distance of 15 miles.

WEST CHESTER, PA.—Surveys have been completed and most of the right-of-way secured by the West Chester Street Railway Company for its proposed electric railway from Pequea to Mt. Nebo, which will connect with present line at Rawlinsville. It is understood that work will soon begin on construction of the road.

PROVIDENCE, R. I.—Work has commenced on the laying of the cable for the Narragansett Electric Lighting Company, which is to connect Nayatt Point with Conimicutt Point, a distance of about 2 miles.

BLACKSBURG, S. C.—The Council is reported to be considering the question of installing a municipal electric-light plant in Blacksburg.

EDGEFIELD, S. C.—Plans have been prepared by J. B. McCrary & Company, of Atlanta, Ga., for the municipal electric-light plant, for which bonds to the amount of $15,000 were recently issued.

MURDO, S. D.—The Interior Telephone Company is reported to be considering several propositions to erect several extensions out of Murdo

DYER, TENN.—Bids will be received by the Mayor and Board of Aldermen of Dyer, Tenn., until June 27, for materials and construction of water-works system as follows: One 60-hp gasoline engine, directly connected to underwriters' fire pump; deep-well pumping outfit, operated by an electric motor; 150,000-gal. reservoir, 40,000-gal. steel tank on 50-ft. tower, brick or concrete pumping station, 2600 ft. 8-in., 5200 6-in. and 15,100 ft. 4-in. pipe; 41 hydrants, 21 valves and boxes. R. C. Houston is consulting engineer. R. B. Daniel is Mayor.

GREENVILLE, TENN.—At an election held recently the proposition to issue bonds to the amount of $65,000, the proceeds to be used for the purpose of acquiring or constructing an electric-light plant and water works, was carried.

MEMPHIS, TENN.—Preparations are being made by the Tennessee Traction Company for the construction of an electric railway from Memphis to Brownsville. Later the road will be extended to Jackson, Tenn.

ALVIN, TEX.—The Alvin Water, Light & Ice Company, recently organized with a capital stock of $20,000, will take over the property of the Alvin Ice, Light & Refrigerating Company. It is understood that the new company will install a new electric-light and water plant.

AMARILLO, TEX.—The City Council has authorized the installation of 100 additional electric street lamps to be erected as soon as possible. The Amarillo Water, Light & Power Company supplies electrical service in Amarillo.

AUSTIN, TEX.—Two bids were submitted to the City Council for the reconstruction of the dam across the Colorado River at Austin. The J. F. Cogan Company and the Hydraulic Properties Company, both of New York, N. Y., were the bidders. The proposition offered by the J. F. Cogan Company agrees to rebuild the dam and install a hydroelectric plant in Austin for $1[illegible]50,000 and provides for terms of payment as follows: For $100,000 when the dam has reached low-water mark; another $100,000 when the dam is completed and machinery installed; $300,000 in semi-annual payments of $30,000 each for a period f the next five years, and $750,000 in semi-annual payments of $25,000 each for the next ensuing fifteen years. The proposal submitted by the Hydraulic Properties Company provides for the construction of a patent dam and installation of a hydroelectric plant at a cost of $1,400,000, of which $100,000 is to be paid upon completion and acceptance of the dam and the remainder in twenty-six semi-annual instalments of $50,000 each.

BONHAM, TEX.—Plans are being considered by the Bonham Electric & Gas Company for the construction of a new electric plant within the city limits to take the place of the present plant in Russell Heights, work on which will soon begin. It is understood that the company has placed a contract with Deering & Son to bore a deep well for the electric plant.

BROWNSVILLE, TEX.—The City Council has authorized a reduction in the rates in electricity for lamps supplied by the municipal electric plant to take effect from July 1. Under the new schedule the prices will be reduced from 25 to 50 per cent.

BROWNSVILLE, TEX.—It is reported that the City Council has ordered the Brownsville & Gulf Railway Company to remove its track which extends for a mile through the heart of the town. The company recently applied for a franchise to operate a motor service over the track, which was refused. The City Council is inviting applications for a franchise for an electric-railway system to cover the principal streets of the city.

EBENEZER, TEX.—Plans are being considered by the Alamo Land & Sugar Company for the construction of an interurban railway system, 16 miles in length, to run from Ebenezer to various points upon its tract of 32,000 acres, located near here, work on construction of which will soon begin. Gasoline cars will be used at first, but later on electricity will be substituted for motive power. The Alamo Land & Sugar Company owns one-half interest in the Louisiana-Rio Grande Sugar Company, which has just finished the construction of an extensive irrigation system for a 32,000-acre tract. C. D. Hellen, of Des Moines, Ia., is interested in the project. Ebenezer has not a post office.

LORAINE, TEX.—The installation of an electric-light plant in Loraine is reported to be under consideration. For further information address W. T. Mullin, of Loraine.

McKINNEY, TEX.—The Commercial Club of McKinney is reported to be promoting the construction of an electric railway between this city and Bonham, a distance of 36 miles.

SAN ANGELO, TEX.—The power plant of the San Angelo Street Railway Company was destroyed by fire on June 8, causing a loss of about $25,000. The property was recently purchased by J. D. Sugg at a foreclosure sale.

WAXAHACHIE, TEX.—The City Council has granted the Stone & Webster Management Association, of Boston, Mass., a fifty-year franchise to construct and operate an electric railway and build a power plant in Waxahachie.

LAWRENCEVILLE, VA.—The proposition to issue bonds to the amount of $50,000, the proceeds to be used for the installation of water-works, sewerage and electric lighting, is reported to be under consideration.

CENTRALIA, WASH.—Arrangements are being made by the Washington-Oregon Corporation for the installation of a hydroelectric power plant on the Kalama River, to cost about $750,000. A pipe connection covering a distance of 60 miles will be laid to carry the power to the cities of Centralia and Chehalis. The company owns and operates the local electric-light and power plant, street-car system and waterworks. Isaac Anderson, of Tacoma, Wash., is president, and A. Welch general manager of the company.

CONCONULLY, WASH.—J. C. Morton is reported to have been granted a franchise to construct and operate an electric-light plant and water-works system in Conconully, work on which will begin at once. The electric plant will at first be operated by steam power, but later water power will be used.

COULEE CITY, WASH.—The City Council is reported to have granted the Pacific Power & Light Company a franchise to erect electric transmission lines in Coulee City.

DAYTON, WASH.—The County Commissioners have granted the Pacific Light & Power Company a franchise to extend its transmission line along the old Lewiston road from the Walla Walla County line, passing through Dayton to Garfield County.

KLAMATH FALLS, WASH.—Preparations are being made by the Klamath Falls Light & Water Company for increasing the output of its plant to meet the increasing demands for electrical service. Orders have been placed for a 1000-hp Pelton-Francis turbine, which will replace the 500-hp turbine now in use.

LACROSSE, WASH.—It is reported that Harry C. Wilson, lessee of the local water-works system, is contemplating the installation of an electric-light plant with sufficient output to supply 150 lamps of 16 cp.

SEATTLE, WASH.—The Commissioners have granted George W. H. White a franchise to construct and operate a railway over the Seattle-Tacoma boulevard for a term of fifty years, with permission to use trolley, electric-storage or gasoline motor-driven cars.

VANCOUVER, WASH.—The local power plant of the Portland Railway, Light & Power Company was destroyed by fire on June 4, causing a loss of about $65,000. Electricity is now being supplied in Vancouver from the Portland plant through an emergency cable. Through error this item appeared under Vancouver, B. C., Can., in the issue of June 15.

BEAVER DAM, WIS.—The installation of an ornamental street-lighting system in Beaver Dam is under consideration.

MINOCQUA, WIS.—The Town Board has extended the date for receiving bids for the installation of an electric-light plant from June 23 until July 6. W. H. Fisher is town chairman.

BASIN, WYO.—The Katz-Craig Contracting Company, of Omaha, Neb., was awarded the contract for the entire work for improvements in connection with the water-works and electric-light plant at Basin, Wyo., for $58,582. The contract includes cast-iron pipe, at $11,948; hydrants, pumping and electrical machinery, at $12,250.

STETTLER, ALTA., CAN.—Sealed tenders will be received until July 3 for the following equipment: One 125-kva generator, exciter and switchboard, one tandem, compound steam engine, one 72-in. x 16 ft. boiler and stack, cedar poles and line material and erection of pole line. Specifications and further information may be obtained at the office of the John Galt Engineering Company, 317 Portage Avenue, Winnipeg, Man. David Mitchell is town commissioner.

VANCOUVER, B. C., CAN.—Preparations are being made by the British Columbia Corporation Company, of Vancouver, B. C., for the construction of a new sawmill on Lulu Island, New Westminster, B. C., with a daily capacity of 200,000 ft. A shingle mill, planing mill and box factory will also be built. The entire plant will be equipped for electrical operation. Arthur Pracna, of Seattle, Wash., will have charge of the engineering work.

VICTORIA, B. C., CAN.—Proposals will be received by the Canadian Collieries (Dunsmuir) Ltd., until June 26 for construction necessary in the development of hydroelectric power on the Puntledge River, Comax, B. C., the work to include clearing, construction of dams, flume, pipe line and power house, plans and specifications for which may be obtained at the office of the company, Pemberton Block, Victoria, B. C. W. L. Coulson is general manager. H. K. Ownes, Central Building, Seattle, Wash., is consulting engineer.

BRANTFORD, ONT., CAN.—The Brantford and Port Dover Railway Company will receive bids until August 1 for the construction and equipment for its proposed 30-mile electric railway. The 6600-volt, single-phase line will be carried on steel towers and five large bridges will be built.

HAMILTON, ONT., CAN.—The Dominion Power & Transmission Company has engaged F. E. Frothingham, engineer, of Boston, Mass., to make investigations and submit a report in connection with the proposed extensive additions which the company proposes to make to meet the demands of the rapid expansion in the population and area of the city.

NIAGARA FALLS, ONT., CAN.—Tenders will be received by J. Robinson & Sons, Niagara Falls, Ont., Can., until Aug. 1 for electrical equipment as follows: Electric rectifier, lathe, drill press and shaper.

SOUTH LORRAINE, ONT., CAN.—The South Lorraine substation of the Mines Power Company is reported to have been destroyed by fire recently, causing a loss of about $10,000. Arrangements have been made to restore the service at once.

MONTREAL, QUE., CAN.—The Montreal Light, Heat & Power Company has announced a reduction in its rates for electricity for lamps to take effect from July 1. Under the new schedule the price will be reduced from 9 cents per kw-hour for commercial service and 8 cents per kw-hour for residential lighting to 7½ cents per kw-hour on five-year contracts.

PRINCE ALBERT, SASK., CAN.—Sealed tenders will be received by the Corporation of the city of Prince Albert, Sask., until June 26 for the construction of power station superstructure and transmission line, being portions of the proposed hydroelectric power development on the North Saskatchewan River at La Colle Falls, 25 miles distant from the city. Plans and specifications are on file at the City Hall, Prince Albert, Sask., and at the office of C. H. & P. H. Mitchell, Traders' Bank Building, Toronto, Ont., Can. C. O. Davidson is secretary and treasurer.

New Industrial Companies.

THE ELECTRIC MACHINERY & WIRING COMPANY, of Kansas City, Mo. has been chartered with a capital stock of $9,000 by T. B. Stuszer, John H. Shaw and Theodore Remley, all of Kansas City, Mo.

THE E-Z TELEPHONE RECEIVER COMPANY, of Camden, N. J., has been chartered by J. B. Fellheimer, D. C. Reed and S. R. Leap, Jr., all of Camden, N. J. The company is capitalized at $125,000 and proposes to manufacture telephone receivers.

THE INDUCTION SIGNAL & SAFETY STOP COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $25,000 to manufacture signaling devices, etc. The incorporators are: M. L. Sindeband, C. B. Woticky, both of New York, N. Y., and W. Bishop, of Yonkers.

THE JUSTRITE VACUUM CLEANER COMPANY, of Bloomington, Ill., has been incorporated by Lewis C. Walter, Burdette C. Gilmore and A. W. Rigby. The company is capitalized at $25,000 and proposes to manufacture vacuum cleaners.

THE KANSAS CITY ENGINE WORKS, of Kansas City, Mo., has filed articles of incorporation with a capital stock of $100,000 by A. W. Calkins, J. E. Elliott and A. D. Elliott. The company is planning to establish a plant to manufacture engines and also for repair work.

THE METAL POLE POST COMPANY, of Kansas City, Mo., has been incorporated by C. A. Thompson, E. S. Winston and S. J. Mead. The company is capitalized at $50,000 and proposes to manufacture a patent device to be used as a substitute for wooden poles, posts, etc.

THE MULTIPLE SIGN COMPANY, of Louisville, Ky., has been incorporated by A. C. Bowen, John C. Hughes, George T. Wood, William C. Kentrick and J. J. Roberts. The company is capitalized at $10,000 and proposes to manufacture changeable electric signs.

THE PORSTH ELECTRIC COMPANY, of New York, N. Y., has been incorporated by Robert E. Denike, 214 Park Avenue, Brooklyn, N. Y.; Emmile Pincus, 7 Beekman Street, and Arthur L. Semel, 220 Audubon Avenue, both of New York, N. Y. The company is capitalized at $25,000 and proposes to do general contracting and electrical work of all kinds.

THE RHODE ISLAND GLASS COMPANY, of Central Falls, R. I., has filed articles of incorporation under the laws of the State of Rhode Island. It is understood that the company will locate in Central Falls. The company is capitalized at $100,000 and proposes to manufacture glass to be used in making globes for electric lamps. The incorporators are: Francis B. Keeley, Herbert K. Humphrey and Thomas F. Sexton.

THE SUPERIOR MANUFACTURING & MILL COMPANY, of Springfield, Ohio., has been chartered with a capital stock of $50,000 for the purpose of manufacturing gas and gasoline engines, pumps and feed mills. The company proposes to establish a plant on East Street in Springfield. George C. Lynch, temporary president of the company, has purchased the property of the O. S. Kelly Manufacturing Company, of Iowa City, Ia., and will remove the machinery to the Springfield plant.

THE WATERSON POWER SAVING COMPANY, of Bristol, Tenn., has been chartered with a capital stock of $150,000 and proposes to manufacture a mechanical device. The officers are: J. A. Dickey, president; B. K. Vance, secretary, and G. M. Turner, treasurer.

New Incorporations.

CENTERVILLE, ALA.—The Centerville Light & Power Company has been chartered with a capital stock of $15,000 by John P. Kennedy, H. E. Reynolds, J. N. Lightsey and O. C. Oakley.

GADSDEN, ALA.—Articles of incorporation have been filed for the Alabama Power & Light Company by R. A. Mitchell, E. T. Hollinsworth, T. S. Kyle, O. R. Goldman and G. C. Allen. The company proposes to develop water-power on Little River, near the town of Blanche, about 30 miles north of Gadsden, and on other streams in this section of the State. The company's charter gives it the right to do business in Cherokee, DeKalb, Marshall, St. Clair, Morgan, Madison, Etowah, Calhoun and Talladega counties. The company is capitalized at $1,000.

MOSS BEACH, CAL.—The Half Moon Bay Light & Power Company has been chartered with a capital stock of $25,000 by J. J. Gomes, M. Codivo, Benjamin Cunha, Joseph Fernandez and F. N. Staley.

STOCKTON, CAL.—Articles of incorporation have been filed for the Joaquin Delta Railway Company with a capital stock of $500,000 by E. W. and L. H. Woods, Frank West and E. L. Wilhoit, of Stockton; W. P. Plumer, I. L. Borden and M. E. Cerp, of San Francisco, Cal.

DRY BRANCH, GA.—The Dry Branch Telephone Company has been incorporated with a capital stock of $10,000. T. S. Tharpe is interested in the company.

COUNCIL, IDAHO.—The Boise-Council-Ladrone Railroad Company has been incorporated by E. W. Rowman, C. M. Hail, D. S. Manville, Henry C. Wyman and George H. Bener. The company is capitalized at $2,000,000 and proposes to build an electric railway from Council through the fruit belt of Adams County and the mining and timber regions of the Seven Devils sections.

CHICAGO, ILL.—The Cicero & Southwestern Railways Company has been incorporated with a capital stock of $1,000 to build electric railways in Illinois. The incorporators are Emil R. Rosenthal, Louis Cohern and Augustus J. C. Timm.

CHICAGO, ILL.—The Central Terminal Railway Company has filed articles of incorporation with a capital stock of $2,000,000 for the purpose of building a railway from Forest Park to Chicago. The incorporators are Donald R. McLennan, Charles E. Vroman, Joseph W. Hiner, Fayette S. Munroe and John C. Vroman, all of Chicago, Ill.

PIKEVILLE, KY.—The Sandy Valley Telephone Company has been incorporated with a capital stock of $10,000 by W. E. Johnston, R. M. Deskins and John W. Kerr.

HERMISTON, ORE.—The Hermiston Farmers' Telephone Company has been incorporated with a capital stock of $10,000 by W. H. Skinner, president; Henry Sommers, P. P. Sullivan and Charles E. Percy.

CRESSONA, PA.—The Eastern Pennsylvania Light, Heat & Power Company has been incorporated with a capital stock of $5,000. The directors are C. E. Calder, of Pottsville, Pa., treasurer, W. B. Rockwell, Van Dusen Rickert, all of Pottsville, Pa.

POTTSTOWN, PA.—The Pottstown & Phoenixville Railway Company has been chartered with a capital stock of $6,000. The directors are George N. Malsberger, of Pottstown, Pa., president, C. Taylor Lean[illegible], Harry C. Case, of Newton, Pa., Charles W. Rambo, of Spring City, Pa., and Harry F. S[illegible]nehart, of Pottstown, Pa.

RICHLAND, PA.—The Richland Township Light, Heat & Power Company has filed articles of incorporation with a capital stock of $5[illegible]. The directors are Eugene A. Delany, of Windber, Pa., treasurer; John R. Caldwell and W. R. Calverly, both of Windber, Pa.

WINDBER, PA.—Articles of incorporation have been filed for the Adams Township Light, Heat & Power Company with a capital stock of $5,000. The directors are Eugene A. Delaney, of Windber, treasurer; John R. Caldwell and W. R. Calverly, both of Windber, Pa.

SEATTLE, WASH.—Articles of incorporation have been filed for the United Power, Irrigation & Development Company with a capital stock of $500,000 by J. P. Smith, J. E. Wright, A. J. Nichols, G. E. Langerfe[illegible] and E. J. Flateboe.

VANCOUVER, WASH.—The Washington Engineering & Securities Company has been incorporated with a capital stock of $3,5[illegible],000 to operate light and power plants. The incorporators are E. M. Scanlon, James P. Stapleton, of Vancouver, Wash.; E. P. Summerson, L. W. Osborne, D. J. Anderson and O. R. McMahon, of New York, N. Y.

FAIRMONT, W. VA.—The East Side Telephone Company has been granted a charter with a capital stock of $10,000. The incorporators are A. A. Hamilton, D. S. Huffman, George A. Nuzum, Paul Hamilton and others.

OTTAWA, ONT., CAN.—The Imperial Traction Company has been chartered to construct and operate an electric railway from Hamilton to Stratford and London, with extensions to Sarnia and Niagara Falls.

Personal.

MR. H. J. FREYN, formerly with the Illinois Steel Company, South Works, South Chicago, Ill., has accepted a position with the Allis-Chalmers Company of Milwaukee, Wis.

MR. RALPH MODJESKI, of Chicago, received the degree of doctor of engineering from the University of Illinois during the commencement exercises at Urbana, June 14.

MR. F. E. FROTHINGHAM, consulting engineer, Boston, has been engaged by the Dominion Power & Transmission Company to report upon extensions to be made to its system in Hamilton, Ont.

MR. JAMES R. CRAVATH, of Chicago, has been appointed a director of the Illuminating Engineering Society, succeeding Mr. E. W. Lloyd, of the Commonwealth Edison Company, Chicago, resigned.

PROF. ALBERT A. MICHELSON, head of the department of physics of the University of Chicago, has received the honorary degree of doctor of philosophy from the University of Göttingen, Germany. Dr. Michelson is exchange professor at Göttingen this year.

MR. J. E. POWELL, chief mechanical and electrical engineer, office of the Supervising Architect, Treasury Department, Washington, has resigned on account of ill health. Mr. Nelson S. Thompson, who was assistant chief engineer, has succeeded to the position.

MR. WYNN MEREDITH, San Francisco, has been appointed consulting engineer in charge of the work to be undertaken by the city of Victoria, B. C., in developing the Sooke Lake scheme of water supply. Mr. Meredith has been a full member of the American Institute of Electrical Engineers since 1903.

MR. E. C. NEWMAN has resigned his position as manager of the appliance department of the Concord Electric Company, of Concord, N. H., to accept a position as head of the new-business department of the Kennebec Light & Power Company, Augusta, Maine. Mr. W. F. Stevens has been appointed to fill the position left vacant by Mr. Newman.

MR. ALTEN S. MILLER, at present president of the Union Electric Light & Power Company, St. Louis, was the guest of honor and principal speaker at a recent meeting of the League of Electrical Interests of that city. Mr. Miller claimed that the rapid development of the South and West renders St. Louis a natural center for consulting engineers and said that the work to be done is sufficient to keep busy many more engineers than are now located at that place.

MR. G. F. STRADTMI[illegible]R, manager of the Erie (Pa.) office of the Western Union Telegraph Company, has been promoted to be district commercial manager, with headquarters in Jamestown, N. Y. Jamestown is now the headquarters of a subdistrict, including a number of [illegible] in the southwestern part of New York State and the northwestern part of Pennsylvania. Mr. J. [illegible] McGraw, who has been manager of the Jamestown office of the Western Union Company, has been [illegible] to be local manager for the company in Erie.

MR. ALFRED STILL, of Eccles, Lancashire, England, who recently accepted a position with the Lake Superior Power Company, Sault Ste. Marie, Ont., is the author of two books entitled "Polyphase Currents" and "Alternating Currents of Electricity and the Theory of Transformers." He has contributed frequently to the technical press, among his articles being the following that have appeared in these columns: "Armature Losses in Double-Current Generators," Aug. 12, 1905; "The Single-Phase Induction Motor," Dec. 8, 15 and 22, [illegible]6; "Inductance of Electric Transmission Lines with Unsymmetrically Disposed Conductors," [illegible] 23, 1908; "Transmission Line Calculations," Sept. 15, 1910.

and "Unusual Current Relations in Condensive and Inductive Circuits," Jan. 26, 1911. The present issue contains an article by him entitled "Inductance of Three-Phase Transmission Lines When the Conductors Lie in the Same Plane." Mr. Still is a member of the (British) Institution of Electrical Engineers and an associate member of the (British) Institution of Civil Engineers.

MR. S. W. GREENLAND has been appointed assistant general manager in charge of the lighting and motor service department of the Fort Wayne & Northern Indiana Traction Company to succeed Mr. M. J Kehoe, who has resigned to become connected with the Fort Wayne Oil & Supply Company. Mr. Greenland, who was secretary-treasurer and general manager of the Columbus (Miss.) Railway, Light & Power Company prior to becoming purchasing agent for the Fort Wayne company, has recently had charge of operation since the resignation of general manager C. D. Emmons, to become general manager of the Chicago, South Bend & Northern Indiana Railway and the Southern Michigan Railway, South Bend, Ind.

Trade Publications.

THE SUNRAY ELECTRIC LAMP MANUFACTURING COMPANY has moved its offices from 109 West Forty-second Street to 311 West Fifty-ninth Street, New York.

RAILROAD TELEPHONE AND SELECTIVE APPARATUS.—Bulletin No. 1080 issued by the Western Electric Company is replete with information of value to contemplating purchasers of railroad telephone and selective apparatus. It lists only standard apparatus for this class of work, showing the apparatus, describing it, pointing out its use and giving prices.

TRANSFORMER FOR BELL-RINGING CIRCUITS.—Bulletin No. 1152 of the Pittsburgh Transformer Company, Pittsburgh, Pa., is devoted to small bell-ringing transformers built in two sizes and suitable for connection to 60-cycle or 25-cycle, 100-volt to 125-volt circuits. Three low voltages are available, the smaller size giving 4, 8 and 12 volts and the larger size 6, 10 and 16 volts.

SMALL LOW-VOLTAGE TRANSFORMERS.—"Pittsburgh Mazda Transformers" is the title of Bulletin No. 1151 issued by the Pittsburgh Transformer Company and covering a new line of small low-voltage transformers. The wide use of electric signs using low-voltage lamps and interior low-voltage lighting has become so important that the Pittsburgh Transformer Company has developed a special line of transformers with very low core and copper loses.

ELEVATING AND CONVEYING MACHINERY.—General catalogue No. 40 issued by the Chain Belt Company, Milwaukee, Wis., contains complete information on the company's line of elevating, conveying and concrete machinery. Every part of the system is illustrated as well as the system as a whole, and the work is replete with tables of sizes, weights, etc., of the materials used in their make-up. The catalogue is bound in cloth and contains 278 pages.

ELECTRIC FITTINGS.—The H. T. Paiste Company, Philadelphia, Pa., has issued Paistery No. 81, pipe-taplet bulletin. Pipe taplets bear the same relation to conduit wiring that fielding and molding taplets bear to wooden molding wiring, and not only are the pipe taplets standardized but the wiring material as well. The pipe taplets are a series of nine types of iron fittings with uniform openings, on the ½-in., ¾-in. and 1-in. sizes of which can be used all standard sockets, receptacles, snap switches, etc.

ELECTROMEDICAL APPARATUS.—A pamphlet describing electromedical apparatus has been published by Dr. Richard Heilbrun, Berlin, Germany. The first two sections treat of transforming apparatus and auxiliary instruments, and the other sections of material of importance to doctors and hospitals, such as massage motors and fittings, electrically driven surgical instruments, lamps for operating and consulting rooms, heating pads, hot-air fans, electric sterilizers, portable stoves, fans, ozone generators, light baths, etc.

ORNAMENTAL LAMP STANDARDS.—One of the most potent factors in the rapid introduction of ornamental street lighting in downtown business sections, next to the use of the tungsten lamp itself, is the design of the post. The latter offers such a marked contrast to the old wooden poles and arc lamps that it is its own best advertisement. The Flour City Ornamental Iron Works, Minneapolis, Minn., manufactures a line of ornamental standards of pleasing proportions which are illustrated and described in a brochure just off the press.

INTERNAL-COMBUSTION ENGINES.—The Foos Gas Engine Company, Springfield, Ohio, has issued Catalogue No. 23 and Circular No. 82, the first describing the single-cylinder horizontal type of gas engine built in sizes ranging from 3 hp to 90 hp, and the second devoted to the vertical multiple-cylinder gas engine. The engines are designed to operate on all liquid fuels, including kerosene, naphtha, distillate and alcohol, and on natural, artificial and producer gas. A number of stationary and portable gas-engine-driven electric generator sets are shown in the catalogue.

POLYPHASE INDUCTION MOTORS.—Induction motors of large size are described in a pamphlet recently issued by Bruce, Peebles & Company, Ltd., Edinburgh, Scotland. Two separate types of machines are dealt with in the pamphlet, open-bedplate type machines arranged with two or three bearings, and end-hood pedestal type machines, which, having pedestal bearings carried on the end hoods, are suited for direct coupling to pumps, fans, etc. The machines are listed for circuits of from 110 to 6600 volts, and the approximate weights and dimensions of both types are given.

ELECTROMAGNETIC PRESSING EQUIPMENT.—Booklet No. 201 issued by the Electro-Magnetic Appliance Company,* Cleveland, Ohio, describes the cloth-pressing machine built by the company. The machine is operated from an ordinary incandescent lamp socket, the iron itself, however, being equipped for other than electric heat. A counterbalanced foot lever connects the magnet control so that the arm to which the iron is attached automatically produces a momentary, slight uniform pressure before greater pressure can be applied. Pressures as high as 4000 lb. may be secured.

TALKING SIGNS.—The Wall-Win Company, Jersey City, N. J., has issued Bulletin No. 208, describing the talking sign, or, as it is sometimes called, the Mason monogram. As is well known the sign is made up on a unit system so designed that a sign with any number of monograms can be erected. The commutators which control the changes are made in three sizes, and the monogram itself comprises a collection of metal compartments each of which holds an incandescent lamp. It is possible to form any letter in the alphabet by means of the twenty-one compartments and lamps.

BALL BEARINGS.—Two interesting publications have been issued by the Hess-Bright Manufacturing Company, Philadelphia, Pa., on the subject of ball bearings as applied to industrial work. One shows the application of such bearings to woodworking machinery and the other to flour and feed-milling machinery. Ball bearings are, of course, applicable to all kinds of machinery and do not differ in their construction with different tools or machines, since a shaft is a shaft no matter where placed. Friction losses, however, while they cannot be avoided can be materially reduced by the use of anti-friction bearings, and those manufactured by the Hess Bright company are said to have a coefficient of friction of one-sixth of 1 per cent. This saving coupled with that made possible by the use of electric motors is an achievement worthy of any industry.

CREOSOTED CONDUIT AND TIMBER.—The Wyckoff Pipe & Creosoting Company, New York, manufacturer of creosoted conduit for underground wires, creosoted poles, cross-arms, anchor blocks and signal posts, poles, cross ties, fence posts, piles, wharf and bridge timbers, paving blocks, plank and all kinds of creosoted lumber, describes these various products in a catalogue just issued. The Wyckoff conduit is made of creosoted yellow pine, 4½ in. square on the outside, 8 ft. long and has a 3-in. hole through it. The sections are held together by mortise-and-tension joint. A creosoted top board 1 in. or 1½ in. thick and 4½ or 9 in. wide is placed on top of the run to protect it from workmen's picks. Concrete is not employed in laying the ducts, which are said to hold together like a bridge truss. The duct weighs about 5 lb. per linear foot.

BUSINESS NOTES.

MR. M. A. JOHNSON has been appointed by the Otto Gas Engine Works as representative in the Chicago territory, with offices at 537 South Dearborn Street.

GARWOOD ELECTRIC COMPANY.—Sales of small two and three-wire generators by the Garwood Electric Company in the last month aggregate 1500 kw.

THE WALPOLE RUBBER COMPANY and the Massachusetts Chemical Company are now located in the Brooks Building, at West Jackson Boulevard and South Franklin Street, Chicago.

COLONIAL ELECTRICAL AGENCY COMPANY, of San Francisco, Cal., agents for the Colonial Electric Company and the Economy Electric Company, both of Warren, Ohio, has moved from 576 Mission Street to the Board of Trade Building, 444 Market Street, San Francisco, Cal.

THE SCOTT ENGINEERING COMPANY, of 632 Wilson Building, Dallas, Texas, announces that it is prepared to do electrical or other engineering work after July 1. Dr. A. C. Scott, who is a member of the American Institute of Electrical Engineers and of the American Society of Mechanical Engineers, is president of the company.

IDEAL ELECTRIC NEW YORK OFFICE.—The Ideal Electric & Manufacturing Company, of Mansfield, Ohio, has opened a New York office at 50 Church Street, which is in the charge of H. J. Brewer. The new line of Ideal apparatus comprises standard frames, alternating-current and direct-current motors and generators, high-torque squirrel-cage motors, interpole motors and a new design of electroplating dynamos. Applications and specifications for apparatus may be submitted to the New York office by prospective purchasers.

MORRIS STREET-LIGHT STANDARDS.—The Morris Iron Company, 88 West Street, New York City, reports a large increase over the same period of last year in the sale of street-light standards. During the past two weeks orders have been received from Battle Creek, Mich., for fifty five-light standards; from Richmond, Va., for thirty-five five-light standards, and from Canajoharie, N. Y., for ten five-light standards. As an indication of the type in greatest demand, it may be noted that all of these poles have four pendent and one upright globe.

BRILLIANT LAMP PITTSBURGH OFFICE.—The Brilliant Electric Company, of Cleveland, Ohio, has opened a branch office at 15 Terminal Office Building, Pittsburgh, Pa. A large and well-assorted warehouse stock of lamps will be carried in connection with this office. Mr. Ralph O. Sperry, formerly with Jones, Beach & Company, electrical supply dealers of Philadelphia, will be district manager of the Brilliant Electric Company's Pittsburgh branch.

COAL-MINE ELECTRICAL PLANT.—The Ellsworth Collieries Company, which operates a large mining property at Ellsworth, Pa., will install a central plant for generating and distributing electric energy to its various mines. To this end it has ordered of the General Electric Company one 750-kw, 60-cycle, 2300-volt generator, driven by a mixed pressure Curtis turbine; one 360-kw, 60-cycle, 2300-volt belt-driven generator, one motor-generator exciter, one belted exciter and switchboard. The mixed-pressure turbine will operate as a low-pressure turbine most of the time it is in service, taking steam from the mine-hoist engine, fan engine and engine driving the 360-kw generator in the power station.

MEXICAN GOLD MILL MOTOR INSTALLATION.—The Santa Rosa Mining Company, a subsidiary of the Exploration Company, of England and Mexico, located in the State of Zacatecas, Mexico, near Concepcion del Oro, is erecting a mill that will be electrically operated. Light and power is supplied from a gas-producer plant in which anthracite coal or charcoal is used as fuel. The gas engine will be connected by a belt to a 150-kw Westinghouse alternator. Switchboards, transformers, etc., and twenty motors have been installed. The tube mill is driven by a 60-hp motor; there are seven motor-driven direct-connected pumps for supplying water to the cyanide plant, and nine other motors are located at various places around the plant. A transmission line about 2 miles long supplies the energy for three motor-driven pumps, which control the water supply. All of the equipment has been purchased from the Cia. Ingeniera, Importadora y Contratista, S. A., of Mexico City, which has furnished Westinghouse equipment throughout. The motors are of a new type which the Westinghouse company has brought out for especially heavy-duty service. When completed, this property will have one of the most modern equipments in Mexico.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 13, 1911.

994,712. ELECTRICAL INDICATOR; E. W. Bishop, Bakersfield, Cal. App. filed April 26, 1910. The indicator is intended for use with walking beams of pumps, and is so arranged that when in motion the walking beam opens and closes a circuit, thereby oscillating the indicator in synchronism with itself.

994,713. MECHANICAL MOVEMENT; T. A. C. Both, New York, N. Y. App. filed Jan. 5, 1911. Details relating to a quick-make and quick-break mechanism of an incandescent lamp socket.

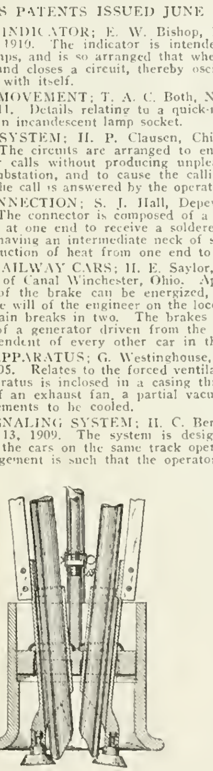
994,719. TELEPHONE SYSTEM; H. P. Clausen, Chicago, Ill. App. filed Oct. 25, 1901. The circuits are arranged to enable the central operator to make her calls without producing unpleasant sounds in the receiver at the substation, and to cause the calling signal to remain displayed until the call is answered by the operator.

994,744. BATTERY CONNECTION; S. J. Hall, Depew, N. Y. App. filed Feb. 28, 1908. The connector is composed of a short section of metal having a socket at one end to receive a soldered connector for a cell, the connector having an intermediate neck of such limited size as to retard the conduction of heat from one end to the other.

994,791. BRAKE FOR RAILWAY CARS; H. E. Saylor, H. S. Hedrock and F. P. Gladfelter, of Canal Winchester, Ohio. App. filed Aug. 2. 1910. The magnets of the brake can be energized, and the brakes can be set either at the will of the engineer on the locomotive or automatically when the train breaks in two. The brakes on each car are energized by means of a generator driven from the axle of the car, each car being independent of every other car in the train.

994,810. ELECTRICAL APPARATUS; G. Westinghouse, Pittsburgh, Pa, App. filed Dec. 29, 1905. Relates to the forced ventilation of rotating machinery. The apparatus is inclosed in a casing through which air is drawn by means of an exhaust fan, a partial vacuum being maintained around the elements to be cooled.

994,814. RAILWAY SIGNALING SYSTEM; H. C. Bennecke, Chicago, Ill. App. filed May 13, 1909. The system is designed for use on railways in which all the cars on the same track operate in the same direction. The arrangement is such that the operator of each car is notified when the line ahead of him is not clear, either by reason of a misplaced switch, the presence of another car, or other cause.



994,833.—Electric Arc Lamp.

994,818. RAIL BOND; W. B. Cleveland, Cleveland, O. App. filed June 23, 1909. The bond is made up of a flexible cable portion connected to two terminals consisting of sleeves fitted over the ends of the body portion and cold pressed so as to compact the ends of the cable strands together and present in effect a solid body.

994,826. METHOD OF TREATING MOLDS USED IN THE ART OF ELECTROTYPING; G. E. Dunton, New York, N. Y. In order to insulate a wax mold from its molding pan, a continuous coating is formed on the edges of the wax mold, the molding pan, and the outer marginal portions of the mold and the molding pan.

994,833. ELECTRIC ARC LAMP; J. H. Hallberg, New York, N. Y. App. filed March 9, 1907. The electrodes are provided with ribs arranged to be in contact with conducting supports which form the terminal contacts for the lamp. The electrodes are so proportioned that the parts farthest from the arc, and by which they are supported, are consumed at a linear rate equal to the consumption of the main portion of the electrodes.

994,834. ELECTRIC ARC LAMP; J. H. Hallberg, New York, N. Y. App. filed June 13, 1908. One of the electrodes is arranged similar to patent 994,833, while the other is movable with relation to the former.

994,835. ELECTRIC ARC LAMP; J. H. Hallberg, New York N. Y. App. filed June 22, 1908. A modification of 994,834.

994,836. ELECTRIC ARC LAMP; J. H. Hallberg, New York, N. Y. App. filed June 23, 1908. The electrode support is provided with a rod and means for conducting current thereto, comprising a sleeve which incloses and carries the rod, means upon which the sleeve is pivotally mounted and a cut-out arm connected to the sleeve and partaking of the movement thereof.

994,837. ELECTRIC ARC LAMP; J. H. Hallberg, New York, N. Y. App. filed May 1, 1909. Modification of No. 994,834.

994,846. THERMALLY OPERATED ELECTRIC TIME LIGHT. J. L. Kiser, St. Charles, Mo. App. filed May 6, 1910. The heat from the lamp filament expands a fluid contained within a tube, and thereby operates a switch to cut out the lamp after a predetermined time limit.

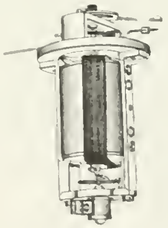
994,853. ELECTRIC SWITCH; J. K. Lux, St. Louis, Mo. App. filed May 26, 1900. Constructive details of a snap switch of the knife-blade type.

994,867. ELECTRICAL ADVERTISING DEVICE; B. A. Neagle, Durham, N. C. App. filed Nov. 17, 1910. Within a glass inclosure is placed an incandescent lamp, in the circuit of which is placed a switch automatically operated by the second-hand pinion of a clock.

994,871. METHOD OF MAGNETICALLY SEPARATING ORES C. Q. Payne, New York, N. Y. App. filed March 15, 1911. The ore mixture to be separated is divided into separate groups by sizing it so that the particles in each group will be as nearly uniform in size as possible, each group being independently treated upon a separating surface, so formed that the particles acted upon by magnetic attraction are permitted independent positions, instead of massed positions of attachment.

994,908. PROCESS OF BONDING RAILS; W. B. Cleveland, Cleveland. O. App. filed June 12, 1909. The bond is of the stud-terminal type, and is attached to the rail by welding with electrical heat.

994,923. MEASURING INSTRUMENT; C. E. Holmes, Lynn, Mass. App. filed July 18, 1908. The combination with a cylindrical core forming part of a magnetic system of a moving coil having the form of a section included between parallel planes at different distances from and on opposite sides of the axis of a hollow cylinder larger than the core.



994,923.—Measuring Instrument.

994,952. ELECTRIC SWITCH; I. T. Rhoades Mont Clare, Pa. App. filed Jan. 3, 1911. The switch is designed for use on automobiles, and is so constructed as to connect the battery and the magneto-generator in and out of circuit with the spark plugs of the engine.

994,957. MAGNETIC VIBRATOR; F. V. Smith, Floriston, Cal App. filed Dec. 20, 1910. Details of a massage vibrator of the electro-magnetic plunger type.

994,976. CONTROLLING ELECTRICAL CIRCUITS; E. T. Childs, Rosemont, Pa. App filed Dec. 21, 1907. Arrangements are made for shifting mercury vapor lamps from parallel to series connection without interrupting the current to any one lamp.

994,993. ELECTRIC MOTOR CONTROL; R Fuller, Detroit, Mich. App. filed Sept. 9, 1908. The control mechanism is designed for use with electric trucks, and involves the use of a special generator driven at constant speed by a gas engine, and adapted to operate the propelling motors at various outputs.

995,000. OIL SWITCH; C. D. Haskins, Schenectady, N. Y. App. filed Nov. 19, 1906. Co-operating contact blades are so mounted beneath the oil and the containing vessel as to separate along their edges, and are of a sufficient length to extend the whole length of the vessel, and are arranged to form a diffuse arc when the circuit is opened.

995,025. MECHANICAL JOINT FOR VACUUM TUBES; D. McF. Moore, Newark, N. J. App. filed April 16, 1908. In order to prevent the heating of the joint made in glass tubes, a separate connecting tube is located at the joint so as practically to fill the bore of the tube, and thereby contract the electric discharge at the joint.

995,036. ELECTRICAL MEANS FOR AUTOMATICALLY CONTROLLING THE FLOW OF GASES OR LIQUIDS; A. F. Shepherd, Dayton, O. App. filed March 3, 1910. The flow of gas is regulated through a large number of valves, in order to relieve the switches of the strain due to breaking heavy currents.

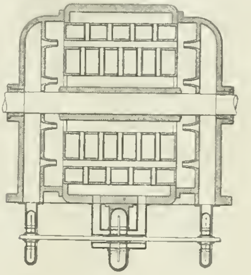
995,051. HELICAL HEATERS FOR TUBES; J. I. Ayer, Cambridge, Mass. App. filed Nov. 25, 1910. The heater member comprises a resistance coil and insulating plates having a series of lobes projected therethrough, the coil engaging opposite sides of the alternate lobes on each successive plate.

995,077. INCANDESCENT LAMP; M. M. Merritt, Middleton, Mass. App. filed March 23, 1906. The lamp is so constructed that it may not be refilled. A downward opening pocket is formed in the walls of the bulb, and in this pocket is placed a substance which will rupture the bulb by expansion when heated.

995,091. CONTROLLER REGULATOR; J. Y. Porter, Detroit, Mich. App. filed March 18, 1911. The regulator is provided with a mechanical device so that it cannot be advanced at too rapid a rate.

995,123. INSULATOR PIN; C. G. Ette, St. Louis, Mo. App. filed Aug. 31, 1910. The body portion is adapted to be connected to a support, and a removable head is adapted to be permanently connected to an insulator, and a separate screw-threaded device is permanently embedded in one of the parts and detachably connected to the other part.

995,126. SYSTEM FOR AMPLIFYING FEEBLE ELECTRIC CURRENTS; L. De Forest, New York, N. Y. App. filed June 20, 1907. Between the currents to be amplified and the signal-indicating device there is interposed a source of high-frequency electrical oscillations, and a circuit including an oscillating responsive device.



994,810.—Electrical Apparatus.

995,132. ELECTRIC STEAM GENERATOR; C. E. Griffing, Salt Lake City, Utah. App. filed Nov. 9, 1910. An electric heater is placed within a tank, and a spray of water is forced upon the electric heater by means of compressed air.

995,133. SECTION INSULATOR FOR ELECTRIC CONDUCTORS; W. G. Hamilton, Twickenham, England. App. filed May 6, 1910. The two end members are insulated from each other and from a central member, upon which a blade support is rotatably mounted, the flexible element being fastened to the blade support for operating it from a distance.

995,145. CURRENT-COLLECTING DEVICE; R. P. Jackson, Wilkinsburg, Pa. App. filed April 12, 1906. A third rail shoe having a pivotally mounted contact arm comprising two pivotally connected members, with resilient means for opposing pivotal movement between the members in either direction, and operating means connected to the joint between the members.

995,162. STORAGE BATTERY; A. E. Lawrence, San Marcos, Texas. App. filed Jan. 10, 1911. The plate is composed of one part graphite and nine parts of red lead, and has a metallic coating.

995,171. CONTROL OF SYNCHRONOUS MACHINES; H. W. Peck, Wilkinsburg, Pa. App. filed Oct. 3, 1905. The combination with a plurality of electric transmission circuits, a supply circuit and auxiliary apparatus for the transmission circuits of means for selecting one of the transmission circuits for connection with the supply circuit and for rendering operative only the auxiliary apparatus connected to the circuit selected.

995,184. TIME-LIMIT RELAY; A. B. Reynders, Wilkinsburg, Pa. App. filed Oct. 20, 1904. One side of a bellows connected to the movable core is provided with an air inlet valve, and the other side is provided with an escape valve, each of the valves being automatically opened and closed.

995,191. SAFETY TROLLEY; G. Sitka, Chicago, Ill. App. filed May 24, 1909. Grooved wheels are mounted on either side of the wire, in order to prevent the main running trolley wheel from losing contact with the wire.

995,203. ADJUSTABLE OUTLET FOR ELECTRICAL APPARATUS; W. T. Thomas, Glenside, Pa., and H. T. Paiste, Philadelphia, Pa. App. filed March 9, 1910. A reversible plate is mounted adjacent to an opening in the wall, and is provided with a laterally projected portion capable of entering the opening in the wall, there being an opening in the plate capable of being brought into registry with the opening of the wall.

995,204. THIRD RAIL FOR ELECTRIC RAILWAYS; J. N. Tomlinson, Vineland, N. J. App. filed Dec. 15, 1909. Supporting blocks formed of insulating materials are provided for the reception of the third rails, a trough surrounding three sides of the rails, roof strips being hinged to one side of the trough, with brackets secured to the blocks, and strips secured to the roof strips and hinged to the brackets.

995,213. ELECTRIC FOOT WARMER; S. Ballard, Temple, Texas. App. filed March 28, 1910. The foot warmer consists of an electric lamp, which may be used not only in the heating device, but also for supplying light for treating certain diseases.

995,221. AUTOMATIC FIRE ALARM; W. P. Britain and G. J. Packman, Westplains, Mo. App. filed May 7, 1910. Between outer and inner casings is placed a fusible contacting material, which forms a contact between the two cases when the temperature outside becomes higher than normal.

995,238. INCANDESCENT LAMP SOCKET; H. E. Evans, London, England. App. filed Dec. 29, 1910. A cord terminal electric connector constructed with separate individual insulating grips for the respective positive and negative cord conductors.

995,244. ELECTRIC PULL SOCKETS; E. H. Freeman, Trenton, N. J. App. filed Jan. 28, 1911. The pull socket comprises a body having a lateral segmental guide slot, a switch and switch-operating means, including a pull lever extending through the slot.

995,255. ELECTROMAGNET; W. Kaisling, Chicago, Ill. App. filed Aug. 1, 1908. The armature of the electromagnet is provided with a transverse groove, opposed bearings, a pin lying in the groove and extending beyond it into the bearings, and a clamped piece overlying the groove and pressing against the pin to hold it frictionally in place.

995,292. ELECTRICAL MEASURING INSTRUMENT; F. W. Roller, East Orange, N. J. App. filed July 3, 1909. The combination with the movable element of a threaded extension, and an eccentrically-mounted nut on the extension, the nut being slotted from the opening to one side.

995,294. SUBSTATION SELECTOR; H. O. Rugh, Sandwich, Ill. App. filed Nov. 13, 1909. Mechanical details of a selector used in connection with electric circuits when one station unites a number of substations with a central station.

995,328. COMBINED CIGAR CUTTER, LIGHTER AND ADVERTISING DEVICE; J. F. Davis and P. Lestrade, New Orleans, La. App. filed Dec. 12, 1910. The device consists of a cigar cutter, lighter and illuminated advertising sign, the means for lighting the cigars and illuminating, the sign being ignited through the medium of the action of the cigar cutter.

995,339. SPACE TELEGRAPHY; L. De Forest, New York, N. Y. App. filed June 20, 1907. In a system for developing a practically continuous train of electromagnetic waves of uniform amplitude, arc electrodes, a source of current connected in circuit with the electrodes, capacity and inductance, shunt electrodes and means for automatically moving the electrodes relatively to each other.

995,421. APPARATUS FOR AND PROCESS OF MIXING METALS; F. E. Canda, New York, N. Y. App. filed Dec. 29, 1906. A receptacle for molten metals is provided with a floor, and has projecting downward from the floor a crucible pit equipped with an electrode and an electric welding device.

The Following Patents of Earlier Dates Have Just Been Received from the Patent Office:

990,418. CURRENT TAP; R. B. Benjamin, Chicago, Ill. Issued April 25, 1911. App. filed June 24, 1907. The tap comprises an insulating base having an opening to accommodate conductors, a lamp-receiving socket carried thereby, a plug extending from the base and a threaded outer contact rotatable with respect to the plug.

990,419. CURRENT TAP; R. B. Benjamin, Chicago, Ill. Issued April 25, 1911. App. filed June 24, 1907. The outer contact member of the plug is rotatable thereon, and means are provided for conveniently grasping it so that when the device is applied to a stationary socket the outer contact may be screwed into the socket without rotating the device as a whole.

990,420. CURRENT TAP; R. B. Benjamin, Chicago, Ill. Issued April 25, 1911. App. filed June 28, 1909. The tap is arranged so that the plug may be withdrawn with very little strain upon any part of the device, so that the danger of loosening the socket into which the device is screwed is minimized.

991,289. MULTIPLE PLUG SOCKET; L. H. Figgs, Los Angeles, Cal. Issued May 2, 1911. App. filed Oct. 30, 1909. The socket is so arranged that several lamps may receive energy through a single plug connection, each socket being removable from the main body independently of any other socket.

991,309. PORCH RECEPTACLE FOR ELECTRIC CONDUIT OUTLET BOXES; C. S. Homsher, Denver, Col. Issued May 2, 1911. App. filed Oct. 4, 1910. The receptacle comprises a body having chambers at opposite ends, an attaching device disposed in one chamber, and a screw passing through the wall between the chambers and connected with the device for holding it in position.

992,084. INCANDESCENT LAMP LOCK; C. W. Trulock, Los Angeles, Cal. Issued May 9, 1911. App. filed June 30, 1909. The plug socket member comprises a hollow screw-threaded plug member having a central terminal and a screw-threaded socket member rotatably carried within the plug member having a central terminal adapted to receive the screw-threaded base of an incandescent lamp.

992,306. CLUSTER LAMP SOCKET; N. Weeks, Richmond Hill, N. Y. Issued May 16, 1911. App. filed May 17, 1904. The socket consists of a finishing cap and a block of insulating material located centrally therein, and having lamp contacts attached thereto for a plurality of lamps, the block being supported wholly by the cap, and a suitable support with which the cap is movably connected.

992,636. INCANDESCENT ELECTRIC LAMP OR LIKE HOLDER; H. O. Beige, Halle-on-the-Saale, Germany. Issued May 16, 1911. App. filed Aug. 11, 1910. The holder is a lamp socket consisting chiefly of insulating material with the minimum of separate metallic parts.

992,971. MEANS FOR ATTACHING ELECTRIC WALL SOCKETS TO WALLS; C. T. McDonald, Oak Park, Ill. Issued May 23, 1911. App. filed June 30, 1910. The socket, which is adapted to be inserted through the aperture of the cap of an outlet box, is provided with a shoulder which abuts against the outer face of the cap, and which co-acts with a locking member projecting laterally from the socket body at the rear of the shoulder, and is adapted to engage against the inner face of the cap after the socket is in place so as to lock the socket within the aperture.

993,340. MECHANICAL MOVEMENT; T. A. C. Both, New York, N. Y. Issued May 30, 1911. App. filed July 2, 1910. Relates to details of the quick-make and quick-break switch of an incandescent lamp socket.

993,762. CLUSTER SOCKET; J. H. Dale, New York, N. Y. Issued May 30, 1911. App. filed May 11, 1910. The socket is of the ceiling type so arranged that the lamps inserted are connected in series, the object being to minimize the number of separate parts employed in building up the socket.

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